Draft Feasibility Study

Solvents Recovery Service of New England, Inc.
Superfund Site
Southington, Connecticut

May 2005

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

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1. Introduction

1.1 Purpose and Organization of Report

This Feasibility Study (FS) identifies and evaluates potential remedial alternatives for soil and groundwater that contain chemical constituents at concentrations exceeding acceptable risk levels or regulatory limits at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site (Site) in Southington, Connecticut. The FS evaluates the remedial technologies identified and retained from the preliminary screening process presented in the "Development and Initial Screening of Alternatives Report," Appendix V of the Remedial Investigation (RI) Report [Blasland, Bouck & Lee, Inc. (BBL), June, 1998]. The FS also evaluates a number of additional technologies that have been further developed since the completion of the RI Report. As required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the FS concludes with a comparative analysis of technically feasible and cost-effective remedial alternatives to address constituents related to the SRSNE Operations Area that are present in environmental media at the Site.

This FS has been prepared in accordance with an Administrative Order on Consent (AOC) and Scope of Work (SOW) for the second non-time critical removal action (NTCRA 2) and RI/FS between the United States Environmental Protection Agency (EPA) and a group of potentially responsible parties (the Group), which became effective on February 12, 1997 (EPA Region I CERCLA Docket No. I-97-1000). This report has been prepared based on EPA guidance, directives, and other publications including, but not limited to the following.

- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, 42 U.S.C. 9601, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA);

- National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, March 8, 1990;

- Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final, October 1988;

This FS addresses the following areas of the Site:

- *"Operations Area/Railroad Soils"* that contain contaminant concentrations exceeding acceptable risk levels or regulatory criteria;

- *"Cianci Property Soil"* that contain contaminant concentrations that present potential ecological risks or exceed regulatory criteria;

- groundwater and saturated glacial deposits (gravel, sand, silt and clay) in the *"Overburden Groundwater"* aquifer that contain contaminant concentrations exceeding acceptable risk levels or regulatory criteria; and

- groundwater and fractured rock in the "*Bedrock Groundwater"* aquifer that contain contaminant concentrations exceeding acceptable risk levels or regulatory criteria.

As discussed in the RI Work Plan (BBL, November 1995) and detailed in the RI Report (BBL, June 1998), and the NAPL Delineation Pilot Study Report (BBL, December 2003), non-aqueous phase liquids (NAPLs) have been found in the overburden and bedrock aquifers at the SRSNE Site. NAPL is the primary long-term source of contaminants that affects water quality at this site. As such, this FS also considers remedial technologies for portions of the overburden and bedrock where NAPL has been observed. These areas are referred to throughout this document as the "Overburden NAPL Area" or "ONOGU", and, "Bedrock NAPL Area" or "NBGU", respectively.

In accordance with applicable EPA guidance, this report is organized into the following sections:

Section	Purpose
Section 1 – Introduction	This section presents a summary of information from the RI report and subsequent investigations regarding the site's history, the nature and extent of contamination, contaminant fate and transport, and the assessment of human health and ecological risk.
Section 2 – Identification and Screening of Technologies	Section 2 presents applicable or relevant and appropriate requirements; remedial action objectives; preliminary remediation goals and general response actions; and estimates of the volumes of each medium of interest for which remedial action may be required. In addition, this section identifies and screens representative remedial technologies and process options for each medium of interest, and selects potentially appropriate remedial technologies for further evaluation in the FS.
Section 3 – Development and Screening of Alternatives	This section provides a rationale for combining individual technologies into applicable remedial alternatives for each medium of interest, and screens each alternative on the basis of effectiveness, implementability, and relative cost.
Section 4 – Detailed Analysis of Alternatives	Section 4 presents an analysis of each surviving remedial alternative based on a set of evaluation criteria defined in the NCP.
Section 5 – Comparative Analysis	Section 5 provides a comparative analysis of remedial alternatives for each medium of interest.
Section 6 – References	This section provides a list of supporting documents referenced in the FS.
Section 7 – Acronyms	This section lists and defines the acronyms used in the FS.
Section 8 – Glossary	This section provides definitions for technical and regulatory terms commonly used in this report.

In addition, appendices which present detailed technical information in support of the FS analyses are included in this report. These include the following:

- Appendix A – Overburden Investigation Field Results and Data Evaluation
- Appendix B – Deleted
- Appendix C – NAPL Delineation Pilot Study
- Appendix D – NAPL Mass Estimate Calculation for the ONOGU
- Appendix E – Calculation of DNAPL Pool Volume
- Appendix F – Simulation of Plume Migration in Fractured Bedrock Subject to Aqueous Phase Decay and Source Zone Decay
- Appendix G – Site Specific Assessment and Evaluation of Enhanced In Situ Bioremediation as a Remedial Technology
- Appendix H – Evaluation of Biodegradation Mechanisms for Site Chemicals
- Appendix I – Hydraulic Displacement of DNAPL for Application at the SRSNE Site, Southington, CT
- Appendix J – Human Health Risk Assessment Update
- Appendix K – Supplemental Sediment Sampling
- Appendix L – Interim Monitoring and Sampling Report No. 13
- Appendix M – Supplemental Soil Sampling

- Appendix N – Soil and Groundwater Database Regulatory Screening Results
- Appendix O – Deleted
- Appendix P – Application of Cosolvent Extraction for DNAPL Removal at the SRSNE Site, Southington, CT
- Appendix Q – SRSNE Feasibility Study Water Treatment System Alternatives Evaluation
- Appendix R – Quantitative Assessment of Groundwater Remedial Alternatives
- Appendix S – Evaluation of Potential Biological Impacts of Enhanced In Situ Bioremediation Following Hydraulic Displacement
- Appendix T – White Paper for In Situ Chemical Oxidation
- Appendix U – Evaluation of Enhanced In Situ Bioremediation After In Situ Chemical Oxidation
- Appendix V – White Paper for Thermal Technologies
- Appendix W – Risks of Vertical Mobilization of DNAPL During Thermal Remediation
- Appendix X – Evaluation of Enhanced In Situ Bioremediation Following Steam Treatment

1.2 Background Information

1.2.1 General Site Description

The SRSNE Site is located on approximately 14 acres of land along Lazy Lane in Southington, Hartford County, Connecticut, approximately 15 miles southwest of the city of Hartford (see Site Location Map, **Figure 1-1**). The key areas discussed in the FS (see Study Area, **Figure 1-2**), include the following:

- the SRSNE facility Operations Area;
- the adjoining former Cianci Property;
- the Town of Southington Well Field Property; and
- The adjacent areas to the north, south, east, and west.

In this document, the term "site" refers to the SRSNE Operations Area and the Containment Area on the former Cianci Property. "Offsite" refers to areas within the study area that are hydraulically downgradient of the Containment Area, including the Town Well Field Property.

1.2.2 Area Descriptions

Each of the areas impacted by past SRSNE operations is briefly described below. A comprehensive description of the study area background and physical setting for each area is included in the RI Report, Sections 1 and 3 (HNUS, May 1994). Two of the areas, the Operations Area and the former Cianci Property, are still owned by the Estate of Carlton Boll, the former owner of SRSNE, Inc. The Group performs required investigative and remediation activities on the properties under an access agreement with the Estate.

SRSNE Operations Area

The SRSNE Operations Area comprises approximately 2.5 paved acres on a 3.7-acre lot in the Quinnipiac River basin approximately 600 feet west of the Quinnipiac River channel (see **Figure 1-3**). The Operations Area is bordered on the east (downhill) by the Boston and Maine (B&M) railroad right-of-way and the former Cianci Property, to the north by Mickey's Garage automotive repair shop, to the west (uphill) by the S. Yorski property, and to the south by the Delahunty property, the Connecticut Light and Power (CL&P) electrical transmission line easement, and the Town of Southington Well Field.

Much of the Operations Area is paved with asphalt and/or concrete and is completely enclosed with security fencing. In July 1999, all above ground structures and miscellaneous equipment and debris were decontaminated, demolished and disposed of offsite. Additionally, underground facilities including septic tanks, underground storage tanks, and underground utilities were abandoned through excavation and removal or by pumping contents, cleaning and backfilling (septic and piping). Prior to the demolition activities, features of the Operations Area included an office trailer, former operations building, former groundwater treatment system control building, multiple above ground storage tanks, and two former concrete-surfaced drum storage areas. The former structures and buildings are further described below.

Building 1
Building 1 was a single-story, 800 square foot modular building, reportedly used as the SRSNE office building. It contained office equipment and miscellaneous supplies and documents associated with SRSNE operations.

Building 2
Building 2 covered an area of approximately 750 square feet and was constructed of a concrete slab-on-grade floor, framed wooden walls, and a wood-framed asphalt shingle roof. Building 2 was constructed in the early 1990s by Connecticut Department of Environmental Protection (CTDEP) to house a groundwater treatment system, and was burned to the ground by vandals in October 1998. The remaining building debris has been removed for offsite disposal.

Building 3
Building 3 was approximately 2,500 square feet and was constructed of a concrete slab-on-grade floor, concrete block walls, and a wood-framed asphalt roof. The building was used as an onsite laboratory and as office space.

Aboveground Storage Tanks (ASTs)
Seven ASTs were identified on the property. Six of the seven were formerly associated with the solvent recovery operations, and the seventh held fuel oil.

Former Process Equipment
Former process equipment, including a distillation column, pumps, and piping, was located immediately south of Building 3. Miscellaneous process piping remained throughout the western half of the property between the process equipment, ASTs, and Building 3.

Former Truck Unloading Area
The former truck unloading area is located south of the former process equipment area, and at one time was the location of an unlined concrete slab-on-grade containment area approximately 60 feet long and 50 feet wide. Product transfer piping and pumps were present along the western wall of the area.

Former Drum Storage Area
The former drum storage area is located directly southeast of the former truck unloading area and consists of an uncoated concrete slab-on-grade containment area approximately 120 feet long and 40 feet wide. The containment area was enclosed by a berm approximately 1 foot high, and had one sump (1.5 feet by 1.5 feet by 1 foot deep). From approximately 1955 to 1991, day-to-day operations in this area included drum and bulk storage solvent distillation and fuel blending.

Vandalism at the site had resulted in the destruction of the former treatment system building and damage to other structures. Therefore, the existing buildings and above ground tanks were demolished and removed for offsite disposal in July 1999.

Former Cianci Property

The former Cianci Property is the 10-acre parcel immediately east of the Operations Area, across the B&M Railroad right-of-way (see **Figure 1-3**). CTDEP purchased the B&M right-of-way in this area in support of extending the Farmington Canal Heritage Trail, a rails-to-trails greenway, from New Haven to the Massachusetts border (Draft Final Preliminary Reuse Assessment, EPA, 2003a). The Quinnipiac River borders the eastern edge of the former Cianci Property. Lazy Lane is to the north, and the Town of Southington Well Field borders the property to the south.

The former Cianci Property lot was occupied by the Cianci Construction Company from approximately 1969 through 1988 and was used for the storage of construction equipment and as a truck washing station. The property was sold to SRSNE in June 1988. SRSNE did not use the Cianci property in their operations.

Southington Town Police Building

The Town of Southington police headquarters building, constructed in 2002, is located across Lazy Lane, immediately north of the Cianci property.

Southington Well Field

The Town of Southington Well Field property consists of approximately 28.2 acres of undeveloped land south of the former Cianci Property and southeast of the Operations Area (see **Figure 1-2**). The well field is bounded to the east by the Quinnipiac River and to the south by the Quinnipiac River and Curtiss Street. The B&M Railroad right-of-way and the Delahunty property border the western perimeter of the well field. The CL&P easement runs northwest-southeast through the northern portion of the well field.

Town Production Wells No. 4 and 6 are approximately 2,000 and 1,400 feet south of the SRSNE property, respectively. The Quinnipiac River divides the area between Wells No. 4 and 6. Production Well No. 6 is accessible using dirt roads originating from Lazy Lane or Curtiss Street, while Well No. 4 is only accessible from Curtiss Street. Production Well No. 4 was installed in August 1965 and provided drinking water to the Town of Southington from July 1966 to December 1977. Production Well No. 6 was installed in April 1976 and was pumped from May through October 1978, May through July 1979, and March 1980. The actual usage rates of Wells No. 4 and 6 were considerably less than their design sustainable rates of approximately 700 and 1,400 gpm, respectively, which were determined based on pumping tests (Geraghty & Miller, September 1965; Amory, November 1975). Except for the brief period of pumping at Well No. 6 in March 1980, Wells No. 4 and 6 have not been used for water supply since approximately 1979 due to the detection of volatile organic compounds (VOCs) in their discharge water (HNUS, May 1994).

1.2.3 SRSNE Site History

1.2.3.1 Facility Operations

The SRSNE facility began operations in Southington in 1955 (ATSDR, 1992). From approximately 1955 until the facility's closure in 1991, spent solvents were received from customers and distilled to remove impurities, and the recovered solvents were returned to the customer or sold to others for reuse. Aerial photographs of the site from 1965 and 1980 are included as **Figures 1-4 and 1-5**, respectively. Site features visible in the aerial photographs are also depicted on **Figure 1-3**. Based on a partial record of materials processed at the SRSNE facility (excluding pre-1967 operations files, which were destroyed in a fire), SRSNE handled in excess of 41 million gallons of waste solvents, fuels, paints, etc. Approximately three to five million gallons of liquid wastes and 100,000 pounds of solid wastes were processed annually at the SRSNE facility during this period of operations (ATSDR, 1992).

The liquid wastes processed at the SRSNE facility included unrecoverable or spent solvent-based fuels, spent chlorinated solvents, spent non-chlorinated solvents, and waste oils generated from fuel-blending operations. The spent solvents were brought to the facility in drums and in tank trucks and were typically distilled in a batch process, so that clean solvents could be returned to individual customers. The facility processed approximately 170,000 gallons of other state-regulated wastes annually; including spent lubricating and hydraulic oils and antifreeze. Waste liquids generated onsite included still-bottom sludge, contact and non-contact steam from the distillation process, non-contact cooling water from the fuel-blending operations, water generated from an onsite groundwater recovery system, boiler blow down generated from boiler steam condensate, and storm water runoff (ATSDR, 1992). The facility also generated solid and hazardous wastes, including used gloves, rubber, cloth, rags, plastics, and spent asphalt.

From 1957 to about 1967, the non-recoverable portion of distilled solvents, consisting of distillation or still-bottom sludge, was discharged from the distillation columns into two unlined lagoons in the Operations Area. The larger, primary lagoon was about 90 feet long, 40 feet wide, and 10 feet deep (270,000-gallon capacity) (CTDEP, October 1978). The exact quantity of waste material placed in the onsite lagoons is unknown. The sludge was periodically removed from the lagoons; however, the lagoons sometimes were filled beyond their capacity with solvent sludge, and overflowed to the ditch along the west side of the B&M Railroad tracks (CTDEP, October 1978). The secondary lagoon was reportedly used for skimming of free oils for use in SRSNE's fuel blending program. In 1967, sludge disposal in the lagoons was discontinued, the sludge was excavated and removed, and the lagoons were filled.

After the closure of the lagoons in 1967, wastes including still-bottom sludge and flammable liquids were incinerated in an open onsite pit or were disposed of offsite. The open pit incinerator burned as much as 1,000 gallons of solvent sludge per day between 1966 and 1974, when it was decommissioned (ATSDR, 1992). Ash from the open pit incinerator was used as fill material within the Operations Area. By about 1976, most of the solvent sludges were incorporated into SRSNE's fuel blending program. The solvent-burning and fuel-blending operations involved handling, storage, and transfer activities that resulted in leaks and spills to bare ground within the Operations Area. In 1989 and 1990, site paving and control measures were installed in accordance with a Resource Conservation and Recovery Act (RCRA) Corrective Measures Plan.

In 1983, EPA and SRSNE signed a Consent Decree, which required the installation of an onsite interceptor system (OIS) along the downgradient property line of the Operations Area to capture contaminated groundwater. The OIS was installed in 1985 and reportedly consisted of 25 combination overburden/bedrock groundwater extraction wells spaced every 24 feet along a generally north-south line, perpendicular to the east-southeastward direction of groundwater flow and parallel to the railroad easement. The Consent Decree also required modification to SRSNE's solvent handling practices and the performance of subsurface investigation activities to assess impacts associated with the site. Concurrent with the issuance of the Consent Decree, EPA placed the site on the National Priority List (NPL), making it eligible for federal assistance with the site study and cleanup expenses. Between 1983 and the facility's closure in 1991, SRSNE made some improvements as required under the Consent Decree, including spill control measures, paving of the Operations Area, fire protection measures, and installation of the onsite groundwater treatment system.

Between 1986 and 1991, the onsite groundwater treatment system utilized a cooling tower on the roof of the operations building that was converted to an air stripper, with discharge via a subsurface pipe to the ditch along the railroad tracks east of the Operations Area. In addition to groundwater from the OIS, the converted air stripper also received liquid containing high concentrations of solvent compounds from the solvent distillation process. Thus, during system operation, VOC concentrations in the tens of parts per million (ppm), potentially including NAPL, may have been discharged to the ditch along the railroad tracks.

An EPA RCRA inspection in February 1989 documented 75 cases of solvent releases from drums, tank trucks, hoses, and other solvent containers and transfer equipment during 1988, and, noted that the OIS was not operating as a continuous hydraulic barrier to downgradient groundwater flow (EPA, February 1989). Subsequently, three extraction wells were replaced in 1989 in an attempt to improve the groundwater extraction rate of the OIS. The cooling tower/air stripper treatment system was replaced by CTDEP with an enhanced oxidation treatment system in July 1992. CTDEP operated the OIS until 1995.

In 1988, the three batch stills were removed, and spent solvents received by SRSNE were transferred to other facilities for the remainder of SRSNE's operations period. Additional EPA and CTDEP enforcement orders subsequently were issued to compel SRSNE to perform further site cleanup work at the facility. The facility ceased operation in March 1991 and was closed down in May 1991.

SRSNE performed site cleanup activities between January and March 1991. As part of those activities, onsite tanks were emptied of free liquids and sludge, and were then scraped and pressure washed. The wash waters were collected using a vacuum truck and disposed of off site. A total of 70,284 gallons of bulk liquid, 178 55-gallon drums, and various other materials were removed from the site during the cleanup activities.

In 1992, EPA conducted field studies to determine the extent of contamination in soils and sediments in the vicinity of the Operations Area. As a result of the investigation, EPA implemented a removal action in September 1992 to mitigate potential health threats associated with polychlorinated biphenyl (PCB) contamination in soils and sediments. The removal action included excavating contaminated sediments from the drainage ditch area along the railroad tracks east of the Operations Area, installing a French drain, and backfilling the excavation with clean sediments. During that effort, approximately 19 drums of soil and ditch sediment containing up to 100 ppm total VOCs and 350 ppm PCBs were removed.

1.2.3.2 Groundwater Containment and Treatment under NTCRA 1 and 2

In 1992, EPA notified the PRPs of their potential liability at the site and its intent to perform additional investigations and pilot studies. The purpose of this work was to fill existing data gaps and support the design and implementation of a non-time critical removal action (NTCRA) to contain overburden groundwater (characterized by high concentrations of solvent-related VOCs in both dissolved and non-aqueous phases) within a zone designated by EPA at and immediately downgradient of the Operations Area. After this demand, the parties negotiated and entered into an Administrative Order on Consent (AOC) to perform this work.

System Design and Installation

BBL performed a pre-design investigation for this NTCRA (termed "NTCRA 1") in September and October 1994 to further characterize the overburden geology and hydrogeology for design of the NTCRA 1 Groundwater Containment and Treatment System (December 1994). The pre-design investigation included two geotechnical soil borings in the proposed area of the treatment system building, four initial NTCRA 1 overburden groundwater extraction wells (RW-1 through RW-4), four overburden piezometers (PZO-1 through PZO-4), and four bedrock piezometers (PZR-1 through PZR-4). Brief pumping evaluations were performed during the development of the extraction wells, and a 48-hour pumping test was completed at RW-2. The results of the NTCRA 1 pre-design investigation and the previous investigations by HNUS and ENSR were used to develop a three-dimensional, numerical groundwater flow model in support of the design of the NTCRA 1 System.

The NTCRA 1 groundwater containment system was constructed between February and July 1995, and began operating in July 1995. It consists of a 700-foot long, 30-foot deep (average) sheet-pile wall installed from the ground surface to the top of bedrock, with twelve overburden groundwater recovery wells on the up gradient (west) side of the wall (**Figure 1-3**).

During the construction of NTCRA 1, BBL removed, through over-drilling and tremie grouting from the bottom up, the 25 interceptor wells associated with the OIS, and monitoring wells TW-7B, DN-1, DN-2, MW-502, and

WE-4 (BBL, October 1995). These overburden/bedrock interface wells in the vicinity of the NTCRA 1 extraction system were abandoned prior to system start-up to reduce the potential for downward NAPL mobilization under the modified hydraulic gradient conditions associated with NTCRA 1 pumping. During the well removal process, DNAPL (dense NAPL, or NAPL denser than water) presence was inferred or confirmed at several locations, indicating that the OIS had probably served as one of the conduits for DNAPL migration to bedrock beneath the former Cianci Property.

During the first nine and one-half years (July 1995 to February 2005) that NTCRA 1 has operated, the total two-week average pumping rate has ranged from approximately 9 to 38 gallons per minute (gpm), with a long-term steady-state average of 16.7 gpm. The total volume of contaminated groundwater extracted by the NTCRA 1 containment system during that time was 84,330,000 gallons.

In July 1996, the SRSNE Group entered into an AOC for a second NTCRA ("NTCRA 2"), which required the design and installation of a bedrock groundwater containment system. To satisfy the requirements of the NTCRA 2 AOC, a bedrock groundwater recovery well (RW-1R) was installed in the northern portion of the Town Well Field Property between December 1997 and January 1998 (see **Figure 2-4**). In July of that year, an overburden groundwater extraction well (RW-13) installed in the same area to help support the development of this FS was found to not only induce a substantial containment area in the overburden, but also appeared to meet the NTCRA 2 requirements for bedrock groundwater containment as well. Overburden well RW-13 was connected to the NTCRA 1 treatment system in June 1999. Later tests showed that pumping bedrock extraction well RW-1R in addition to RW-13 further enhanced the hydraulic containment effectiveness in the deep bedrock, and RW-1R was connected to the NTCRA 1 system in September 2001.

Containment System Effectiveness

The overburden groundwater containment system has generally achieved compliance with the Reversal of Gradient Test described in the Demonstration of Compliance Plan (BBL, June 1995). The operating data, which are reported to EPA on a regular basis, indicates a limited number of short term "losses of compliance" (> 0.3 feet head difference between inner and outer piezometers), typically associated with heavy rains, power outages and/or equipment malfunctions. The groundwater extraction and treatment system has maintained compliance approximately 99 percent of the time to date due to an effective preventive maintenance program. Recovery wells are surged and redeveloped annually, to mitigate biological fouling of the well screens. The recovery well pumps are also pulled as part of the maintenance procedure, cleaned and/or replaced. Most recovery well level controls need cleaning on a weekly basis to remove biological fouling. Routine preventive maintenance (redevelopment) has minimized operational issues with the wells.

The total volume of groundwater pumped by the twelve NTCRA 1 overburden groundwater extraction wells between July 1995 and February 2005 is 84,330,000 gallons. This corresponds to approximately 26.4 pore volumes of flushing through the area contained by the NTCRA 1 sheet-pile wall. Hydraulic responses have been observed in the overburden as well as the bedrock in the vicinity of the NTCRA 1 overburden groundwater extraction system, confirming a hydraulic connection between the two formations as suggested by the results of previous pumping evaluations (ENSR, June 1994; BBL, December 1994). These results indicated that the NTCRA 1 overburden groundwater containment system is also capturing some bedrock groundwater. Based on bedrock head measurements, the bedrock groundwater capture zone from NTCRA 1 is interpreted to extend approximately 150 feet east of the NTCRA 1 sheet-pile wall.

The bedrock containment system has effectively captured overburden and bedrock groundwater migrating into the Town Well Field Property from the former Cianci Property, and may "pull back" overburden and bedrock groundwater from the southern edge of the power line right-of-way in the Town Well Field property (BBL, November 1999). Based on the results of pumping tests performed in August 1998 and July 1999, and confirmed during routine compliance monitoring (Weston, 2003), continued pumping from wells RW-13 and

RW-1R provides effective hydraulic containment of the entire zone where NAPL is interpreted to be present in the overburden groundwater area.

Treatment System Effectiveness

The groundwater treatment process consists of flow equalization, pH adjustment, polymer addition, flocculation and clarification, sand filtration, pH adjustment, peroxide addition, UV/oxidation and primary and secondary GAC filtration. Samples of effluent from the groundwater treatment system are collected twice a month and analyzed for metals, VOCs, alcohols and total suspended solids. The first round each month is also analyzed for total PCBs. Once every quarter, additional samples are collected and tested for dioxins/furans. Treatment system effluent samples have, with only three exceptions, met the discharge requirements established by CTDEP for discharge to the Quinnipiac River. The exceptions are: a hydrogen peroxide discharge limit exceedence on May 1, 1996 an iron discharge limit exceedence on September 25, 1998, and a copper discharge limit exceedence on June 14, 2004. Effluent samples have passed the quarterly acute and chronic toxicity testing requirements established by CTDEP, with the exception of samples collected in June 1998 and March 2001. Resampling and analysis were performed immediately following the June 1998 and March 2001 events, with the results indicating acceptable effluent concentrations.

Influent Concentrations and Mass Removal

Samples of the combined influent from the twelve NCTRA 1 overburden extraction wells and two NTCRA 2 bedrock extraction wells are collected on the same schedule and analyzed for the same contaminants as the groundwater treatment system effluent (described above), except that the combined influent is not sampled for TSS, PCBs, and toxicity. Influent concentrations average 16.1 ppm (range of <1 to 77.9 ppm) of total combined VOCs, including primarily 1,2-DCE, toluene, 1,1,1-TCA, ethylbenzene, xylenes, and vinyl chloride. Alcohols, ketones, and tetrahydrofuran have also been detected in the influent during operation of only the NTCRA 1 wells. However, since the NTCRA 2 wells have been placed into service, these compounds have been historically below detectable levels. Recent 1,4 dioxane influent sampling (2004 and 2005) reveals that this compound is also present at concentrations below 0.5 ppm.

These results suggest that the influent concentrations may have reached a steady state level, approximately three orders of magnitude above regulatory criteria. The average has been much lower since July 1999, when the relatively low VOC concentration (~25 ppb) flow from the NTCRA 2 wells (RW-13 and RW-1R) were added. The temporal trend of VOCs in the influent from the groundwater extraction wells (July 1995 to February 2005) appears to be generally downward.

The incremental dissolved VOC removal rate for NTCRA 1 was steady, but low, throughout the first five years of operation, with an average of 4.5 lbs/day (2.1 kg/day). Over the first two years, approximately 15 liters (approximately 16.5 kg) of NAPL were also removed from wells in the NTCRA 1 Containment Area, including extraction well RW-5 and DNAPL monitoring well MWD-601. No measurable NAPL was recovered during the third year of NTCRA 1 system operation. The mass of NAPL removed to date is negligible in comparison to the mass of dissolved VOCs removed by the NTCRA system.

The cumulative mass of dissolved VOCs removed by the NTCRA 1 and 2 Groundwater Containment and Treatment System during the period from July 26, 1995 to February 28, 2005 is approximately 12,128 lbs (5,512 kg), an average VOC mass removal rate of approximately 580 kg/year.

Evaluation of Hydraulic Influence on Wetlands and Private Water Supply Wells

Hydraulic responses have been observed in the overburden and the bedrock in the vicinity of the NTCRA 1 overburden groundwater extraction wells, confirming a hydraulic connection between the two formations as suggested by the results of previous pumping evaluations (ENSR, June 1994; BBL, December 1994). These results indicate that the NTCRA 1 system is also capturing some bedrock groundwater. Based on bedrock head measurements, the bedrock groundwater capture zone from NTCRA 1 is interpreted as extending approximately 150 feet east of the NTCRA 1 sheet-pile wall.

To assess the hydraulic influence of the NTCRA 1 system on wetlands in the vicinity of the site, eight shallow overburden drive point piezometers (DP series) were installed in the wetland area along the Quinnipiac River, where the hydraulic impact of NTCRA 1 was considered uncertain. Groundwater elevation data recorded at these drive points prior to and during NTCRA 1 groundwater extraction indicated slightly declining water table elevations throughout the monitoring period, including the pre-pumping period. These results were expected due to the anomalously dry summer months during which the data were collected. The monitoring results, which were presented in a Detailed Wetlands Mitigation Design (BBL, September 1995), indicated little or no hydraulic impact due to NTCRA 1 pumping at the drive points installed along the Quinnipiac River. Other wetlands in or adjacent to the NTCRA 1 Containment Area were expected to be dewatered due to the extraction of groundwater for the NTCRA 1 system, although no impacts were observed. A half-acre constructed wetland in the shape of an oxbow was built along the west side of the Quinnipiac River immediately south of Lazy Lane to compensate for the expected loss of wetlands, as shown on **Figure 1-6** (Area G).

To assess the hydraulic influence of the NTCA 1 system on private water-supply wells in the vicinity of the site, three pairs of overburden and bedrock piezometers were installed in the areas west and northwest of the site, where the nearest residences using private water-supply wells are located. Groundwater elevation data were recorded at these three locations and at five pre-existing overburden and/or bedrock monitoring well locations prior to and during NTCRA 1 groundwater extraction. The data obtained at these monitoring locations indicated generally declining groundwater elevations throughout the monitoring period, including the pre-pumping period. These results were expected due to the anomalously dry summer months during which most of the data were collected. The groundwater elevations rose in September and early October 1995, apparently in response to precipitation events following the dry summer months. The monitoring results, which were presented in a Private Well Monitoring Report (BBL, October 1995), suggested that there is little or no hydraulic impact at the private wells around the site due to NTCRA 1 pumping.

In summary, the above information indicates that the NTCRA 1 Containment and Treatment System has been effective at containing and treating VOC-impacted groundwater with little to no adverse affect on area wetlands and private water supply wells. Continued operation of the NTCRA 1 and/or NTCRA 2 groundwater extraction systems will be incorporated into groundwater remedial alternatives for the site. The NTCRA 1 treatment system will be evaluated and screened along with other alternatives for the treatment of impacted groundwater.

1.2.3.3 Other NTCRA 1 and Related Activities

Until the construction of the NTCRA 1 Groundwater Containment and Treatment System, the former Cianci Property contained no permanent structures, but had been altered by past earthmoving and leveling activities. Some of the wetland areas that formerly occupied a portion of this property had been filled. As discussed above, the impact of the NTCRA 1 system on the remaining wetland areas along the floodplain of the Quinnipiac River was evaluated and a plan was developed to mitigate potential impacts to small, isolated wetlands within and immediately adjacent to the Containment Area during implementation of NTCRA 1. The wetland mitigation activities included the construction and planting of a new wetland in the shape of an oxbow in the northeast corner of the Cianci Property in June 1996. No impacts were observed at the wetlands adjacent to the Quinnipiac River (BBL, September 1995).

In 1998, a full-scale phytoremediation pilot study was implemented within the NTCRA 1 Containment Area. This pilot study consisted of planting approximately 1,000 poplar trees, which were predicted to remove and naturally treat groundwater at approximately the same rate as the NTCRA 1 pumping system. The study included a greenhouse toxicity evaluation in which poplar poles were grown in water with VOC concentrations similar to those found in the NTCRA 1 containment area (up to 175 ppm). No toxicity effects were observed in the greenhouse during this study (see Ferro et al, in: International Journal of Phytoremediation, Vol. 1, No. 1, pp. 9-17 (1999)).

By the spring of 1999 some of the poplar trees had failed to survive and were replaced with poplar poles and rooted white willow cuttings. In addition, a small stand of native trees was planted to assess their viability in the phytoremediation system. In May of 2002, all of the poplars within the stand were removed due to a canker fungus that infected most of the trees. Currently, there are 340 willows and 36 native trees in the 0.8-acre phytoremediation area. Annual monitoring of the phytoremediation pilot study has indicated that the trees remove on the order of five gpm from within the NTCRA 1 Containment Area during seasonal peak growing periods.

Also in 1998, the University of Connecticut started a bench-scale treatability study of Fenton's reagent for the treatment of groundwater from the site. Preliminary results of this study suggested that Fenton's reagent shows promise to be effective in treating groundwater from the NTCRA 1 system as well as from any downgradient pumping system that may be implemented as part of the final remedy for the site.

An overburden aquifer pump test was performed in 1998 to provide data on groundwater hydraulics in the north-central portion of the Southington Well Field, where a groundwater remedy may be considered (**Appendix A**).

In 1999, preliminary feasibility analysis and bench-scale column studies were performed in support of a conceptual design for a constructed wetland to treat VOCs in groundwater extracted with the NTCRA system, with the goal of providing treatment for the extracted groundwater. The use of wetlands for cost-effective treatment of municipal wastewater and landfill leachate is widely recognized. Studies were performed showing degradation of the VOCs and identifying the bacteria responsible for degradation of the VOCs.

1.2.3.4 History of Public Involvement

Over the years EPA and the PRP Group have held numerous public meetings with concerned citizens and local officials to update them on ongoing activities as well as activities planned in the future and to receive their feedback on these activities.

Southington Association for the Environment (SAFE)

The Southington Association for the Environment (SAFE) was formed in 1992 in response to local citizens concerns about past and potential future emissions from the SRSNE Site. SAFE has been the recipient of two $50,000 Technical Assistance Grants (TAG) from EPA. The purpose of the TAG program is to fund appropriate local organizations, so that they can retain their own experts to assist in evaluating complex site information and alternatives. SAFE has been an active participant in the site evaluation and remediation process, with members attending each of the site meetings and open houses, and providing written and verbal comments on the alternatives presented at those meetings. Site information and reports are routinely shared with SAFE, and their comments and concerns have been considered throughout the site investigation and remediation process.

Reuse Assessment

EPA's draft Preliminary Reuse Assessment of September 2003 reported that the only reuse scenario for the site that is currently being discussed by town officials, the PRP Group, neighboring residents, and CTDEP (which owns the rail corridor) is an extension to an existing rails-to-trails bike path along the railroad right-of-way, with supporting infrastructure, such as parking for the bike path, in the northern portion of the Cianci Property, between the NTCRA treatment building and Lazy Lane. Local officials and residents stated that they would like the rails-to-trails conversion to be completed as soon as possible, and would advocate an appropriate remedy design that provides flexibility in completing construction of the rails-to-trails project prior to completion of the overall site remedy. The timing of the availability of the site for reuse will depend quite heavily on the remedy that is selected.

1.3 Physical Setting of the Site

1.3.1 Regional Geology

The SRSNE Site is located within the Connecticut Valley Lowland section of the New England physiographic province. The Connecticut Valley Lowland occupies a regional, structural rift basin, which is characterized by block-faulted and tilted bedrock strata. The geology of the region, in general, consists of glacially-derived unconsolidated deposits overlying the Upper Triassic New Haven Arkose bedrock (Rogers, 1985). Bedrock fractures in the region dip moderately eastward, parallel to the eastward-dipping bedding (Hubert et al., 1978; Rogers, 1985; BBL, 1997). Steeply dipping fractures, however, have also been observed in outcrops near the site, and in core samples and down hole fracture-logging results obtained within the study area. While normal faults have been mapped approximately 2.5 miles west and 2.0 miles east of the site (Rogers, 1985), no bedrock faults have been reported within the RI Study Area. The published bedrock geologic maps do not provide a sufficient basis to evaluate the presence or locations of faults, if any, beneath the thick sequence of unconsolidated materials within the Quinnipiac River Valley in the vicinity of the site (Rogers, 1997). The depth to bedrock varies throughout the study area, from approximately 15 to 40 feet below grade at the SRSNE Operations Area, to approximately 25 to 45 feet below grade, on the former Cianci Property, to approximately 80 to 100 feet below grade at the Town Well Field Property.

A generalized regional geologic cross section is presented in **Figure 1-7**. The regional and study area bedrock and overburden geology are described in detail in Section 3 of the RI Report.

1.3.2 Study Area Overburden Geology

Wisconsin-age glaciation partly eroded and smoothed the bedrock hills and deposited the principal unconsolidated overburden units throughout the region (La Sala, 1961). The overburden geology beneath the Operations Area and former Cianci Property consists of two main unconsolidated layers. The shallow, upper layer, called outwash, extends from ground surface to approximately 10 to 25 feet below grade at the site and consists of reddish-brown silty sand and gravel deposits, interbedded with discontinuous layers of silt and relatively well sorted sand and gravel. The lower layer consists of glacial till, a generally unstratified unit consisting of reddish-brown clay, silt, sand, gravel, cobbles, and boulders, but also including isolated, discontinuous sandy seams. Fill materials are present above the outwash in portions of the Operations Area and former Cianci Property, where grading operations have reworked the upper few feet of soil and filled low areas. Fill materials are also observed along the B&M Railroad grade that separates the Operations Area from the former Cianci Property, and appear to have been placed along the east bank of the Quinnipiac River in the area east-southeast of the SRSNE Operations Area (CTDEP, April 1978). In the area south of the site (i.e., the Town Well Field Property), the entire overburden grades to a coarser overall grain size distribution, and resembles classic stratified drift (Mazzaferro et al., 1979) throughout the overburden thickness. The deeper portion of the overburden south and southeast of the site generally lacks fines, and is described as “gravelly drift.”

1.3.3 Study Area Bedrock Geology

The depth to bedrock varies throughout the study area, from approximately 15 to 40 feet below grade at the SRSNE Operations Area, to approximately 25 to 45 feet below grade on the former Cianci Property, and to approximately 80 to 100 feet below grade at the Southington Well Field. Top-of-bedrock elevation contours are consistent with top-of-bedrock elevation data published by the USGS (Mazzaferro, 1975), and indicate that the bedrock surface dips toward the east in the vicinity of the site. While generally smooth, the interpretation of the top of bedrock during drilling in some areas is complicated due to the presence of boulders in the till, particularly near the base of the till. However, the drilling methods used during the RI were appropriate to help distinguish between boulders and bedrock.

Core samples and drilling observations at the SRSNE Site indicate that the upper 5 feet of bedrock ("weathered bedrock") is severely weathered and partially decomposed. The degree of weathering generally decreases with depth. The bedrock in the depth interval between five and 30 feet below the top of bedrock ("shallow bedrock") is more competent than the weathered bedrock, but is still highly fractured and permeable. The fracture spacing generally increases with depth. At depths of 30 feet or more below the top of bedrock ("deep bedrock"), the rock is characterized by relatively few fractures and may exhibit slightly lower hydraulic conductivity. The deep bedrock can transmit groundwater flow, however, and is the primary zone tapped by private water supply wells north and east of the site. Thus, local, transmissive fractured zones are also likely to be present in the deep bedrock.

1.3.4 Study Area Hydrogeology

Essentially all overburden and bedrock groundwater within the monitored geologic zones ultimately discharges to the Quinnipiac River. The overburden and bedrock units are recharged primarily via precipitation, although groundwater underflow also occurs from the north within the saturated zone in the vicinity of the river (Mazzaferro et al., 1979). Where the till layer is relatively thick, it may limit the rate of groundwater flow between the two aquifers. In areas where till is anomalously thin or absent ("till windows"), or lacks fine-grained material, more groundwater flow may occur between the overburden and bedrock aquifers.

Five groundwater monitoring zones (shallow, middle, and deep overburden and shallow and deep bedrock) were designated based on geology and on the desire to add vertical resolution to the presentation of groundwater data. These five monitored zones are hydraulically connected and comprise a hydrogeologic continuum from the water table downward through the deepest monitored bedrock interval. Deeper sections of bedrock, below the deepest monitoring well in the study area, are also interpreted as part of the regional groundwater flow system.

<u>Overburden</u>

Depth to the water table generally ranges from 0 to 10 feet throughout the site. Overburden wells are designated as shallow, middle, or deep overburden depending on the vertical position of the well-screen midpoint with respect to the saturated overburden thickness. This screening procedure also provides a means to differentiate between groundwater quality and hydraulic conditions in different vertical zones within the overburden. The procedure was maintained during the evaluation of the new hydraulic head (i.e., groundwater elevation, or potentiometric elevation) and groundwater quality data in the RI.

The hydraulic properties of the overburden units vary considerably from location to location due to varying grain size distribution and density of the soil deposits. On a regional scale, the overburden is viewed as heterogeneous and anisotropic. The saturated overburden units, including the outwash and underlying "gravelly drift," are considerably thicker and more permeable south of the site in the Town of Southington Well Field Property.

<u>Bedrock</u>

Bedrock wells are designated as shallow or deep depending on the well screen location. Shallow wells are screened in shallow (upper 30 feet) bedrock. Deep wells are installed to depths of approximately 60 to 90 feet below the top of the bedrock. The designations facilitate further characterization of the three-dimensional VOC distribution and groundwater flow directions.

The hydraulic properties of the fractured New Haven Arkose bedrock are interpreted as highly heterogeneous on a small scale (meters to tens of meters) due to the variable spacing and connectedness of bedrock fractures; however, on a regional scale, the bedrock is believed to be relatively homogeneous and anisotropic.

1.3.5 Groundwater Classification

Groundwater within the RI Study Area is currently classified by CTDEP as GA, GA-Degraded, and GAA (**Figure 1-8**).

Much of the study area is Class GA. Per the CTDEP Groundwater Quality Standards (CTDEP, April 1996), Class GA is "Groundwater within the area of existing private water supply wells or in an area with the potential to provide water to public or private water supply wells. The Department presumes that groundwater in [a Class GA] area is, at a minimum, suitable for drinking or other domestic uses without treatment." The GA classification means that the State's goal is to maintain or restore groundwater to its natural quality.

Two portions of the study area are Class GA-Degraded, formerly designated GB/GA. These are 1) the Operations Area, former Cianci Property, and northern Town Well Field, and, 2) an area south of Curtiss Street. Groundwater quality in these areas is not currently suitable for drinking, but the State's goal is to restore the groundwater to its natural quality (CTDEP, August 1997).

A small area surrounding Town of Southington Production Wells No. 4 and 6 is currently classified as GAA. Class GAA groundwater is "… used or which may be used for public supplies of water suitable for drinking without treatment; groundwater within the area that contributes to a public drinking water supply well; and groundwater in areas that have been designated as a future water supply in an individual water utility supply plan." CTDEP notes, however, in its Preliminary Groundwater Use and Value Determination that the portion of the GAA area south of the Quinnipiac River, near the eastern end of Curtiss Street, does not currently meet Class GA/GAA Groundwater Protection Criteria (CTDEP, May 2005).

1.3.6 Groundwater Use

Within the RI Study Area, the only known current domestic use of ground water occurs in homes along Lazy Lane to the west of and hydraulically up gradient of the SRSNE Site (HNUS, July 1994; Southington Water Department, January 1997). The private wells historically situated nearest the SRSNE Site were at the Maiellaro (Mickey's Garage) Property, situated approximately 400 feet north of the Operations Area, and the former Onofrio Residence (now the location of the new Southington Police Department building), located north of Lazy Lane opposite the location of the former Cianci water supply well. The Onofrio and Maiellaro wells have since been abandoned and the properties have been connected to the municipal water supply. Approximately 85 homes on Melcon Street, Curtiss Street, Juniper Road, Little Fawn Road, and Carrier Court on the hill west of the SRSNE Site also use domestic wells for their water supply, but these wells are located approximately 1,000 to 2,500 feet up gradient (west) of the western boundary of the RI Study Area (HNUS, July 1994; Southington Water Department, January 1997). Based on information compiled during the first round of private well sampling in the vicinity of the SRSNE Site in 1990 by the CTDEP, the majority of the private wells near the site are drilled, open-bedrock wells ranging from 90 to more than 200 feet deep. The CTDPH Public

Health Code prohibits the drilling of new water supply wells on the properties within 200 feet of a municipal water supply (CTDPH Public Health Code 2000, 19-13-B51m).

The remainder of the study area is supplied with municipal water (Southington Water Department, January 1997; August 1997). The Town of Southington Water Department currently has nine municipal water supply wells in their inventory as well as three surface water reservoirs. The only potential source of municipal water in the RI Study Area is Wells No. 4 and 6, which have been out of service since 1979-1980 due to the presence of VOC contamination in their discharge water.

Outside the RI Study Area, the two currently operating production wells that are closest to the SRSNE Site are Well No. 3, which is approximately 0.8 miles southeast of the site, and Well No. 1A, which is 1.1 miles south of the site. These wells are not currently affected by contaminants related to SRSNE. Both of these wells are south of the Quinnipiac River and all of the available hydraulic gradient data indicates that groundwater in the overburden and bedrock, even when these two wells are operating, flows northward, presumably due to the hydraulic influence of the Quinnipiac River as a groundwater discharge location. Thus, under current pumping conditions (Wells No. 1A and 3 active, Wells No. 4 and 6 inactive), even if the plumes related to the SRSNE Site were to continue to migrate southward (they actually dissipate due to natural attenuation processes including degradation, dilution, dispersion and sorption) they would be intercepted by the Quinnipiac River, and would not reach Production Wells No. 1A and 3. However, if Town Well No. 4 was reactivated at its maximum historical pumping rate (Wells No. 1A, 3 and 4 active, 6 inactive), some of the groundwater migrating southward within the main portion of the Town of Southington Well Field property could potentially flow under the Quinnipiac River, rather than being intercepted by the river.

Although Town Production Wells No. 4 and 6, the production wells nearest to the SRSNE Site, have not been used since approximately 1979, the Town believes it has the right to reactivate the wells at any time. However, the Town has no current plans to reactivate these wells. As stated in the Town of Southington's 50-year water supply plan, additional sources of water are not expected to be needed until the year 2020 or later (Lenard, April 1996). In anticipation of the need for a future water source, a Water Supply Alternative Analysis report has been prepared for the Town of Southington Water Department (SWD) by Metcalf & Eddy (M&E) (Metcalf & Eddy, October 1999). In this document, M&E presented technical and cost information on three alternatives to the reactivation of Town Wells No. 4 and 6 under current conditions. The three alternatives included wellhead treatment, interconnection to the New Britain Water Department (NBWD), and interconnection to the South Central Region Water Authority (SCRWA).

1.3.7 Study Area Drainage

The Operations Area generally drains to the east, with surface runoff collected in a ditch on the west side of the existing B&M railroad right-of-way. This ditch also collects runoff from areas to the north of the Operations area, including areas north of Lazy Lane. An existing 30-inch culvert conveys water from this ditch easterly to the Quinnipiac River (**Figure 1-3**).

The former Cianci Property currently drains by overland flow to the east towards the Quinnipiac River and adjoining wetland and low-lying areas. The Town Well Field property also drains by overland flow towards the east, although an intermittent stream collects some runoff in the eastern and central portions of the property (**Figure 1-2**).

1.3.8 Surface Water Classification

The primary surface water within the RI Study Area is the Quinnipiac River. Surface water along the Quinnipiac River within the RI Study Area is currently classified by CTDEP as Class C/B (CTDEP, May 1992). This classification signifies that the goal for surface water quality is Class B, but the current surface-water quality is Class C. Thus, certain water quality criteria for one or more designated uses assigned to Class B are not currently met. Class B surface waters are designated for recreational use, fish and wildlife habitat, agricultural and industrial supply, and other legitimate uses including navigation. Class C waters may be suitable for certain fish and wildlife habitat, certain recreational activities, industrial use, and other uses including navigation. Class C waters have good aesthetic value. Surface-water quality conditions that result in a Class C designation are usually correctable, and commonly relate to combined sewer overflows, urban runoff, inadequate municipal or industrial waste-water treatment, and community-wide septic system failures (CTDEP, May 1992).

1.3.9 Surface-Water Use

The Quinnipiac River is not used as a drinking water supply; however, nearby drinking water wells could be affected by the river. For example, public supply wells and large-capacity cooling water wells situated near the river could induce infiltration of river water. Urban runoff resulting from extensive paving of the river basin is likely the source of contaminant presence within the river (HNUS, May 1994). Adjacent and south of the SRSNE Site there is limited access to the Quinnipiac River, as it is a narrow, shallow meander bordered by steep banks along Queen Street to the east and the Town Well field property to the west. Seasonally low water and lack of access leads to little to no recreational use of the river in the vicinity of the site. Downstream of the site, the Quinnipiac River is used for recreation from Southington to its mouth in New Haven Harbor. Two recreational areas within the Town of Southington, but at least two miles downriver of the SRSNE Site, provide public access to the river, including canoe access points. A fish consumption advisory was placed on the Eight Mile River and the stretch of the Quinnipiac River north of the Cheshire Gorge after the discovery of a PCB release site in Plantsville. It was advised that all species of fish not be eaten due to unacceptably high levels of PCB's in the fish tissue (CTDEP, 1998).

1.4 Summary of Remedial Investigation Activities

EPA initiated a remedial investigation (RI) to characterize the geology, hydrogeology, and soil and groundwater quality at the Site and surrounding area. These investigations are detailed in the HNUS RI Report, dated May 1994. The Group conducted additional RI activities to complete the characterization of the site. The significant RI findings are summarized below and are detailed in the RI Report (BBL, June 1998). Following completion of the RI, a number of additional investigations and assessments were completed in support of the development of this FS; these are discussed in Section 1.6 below.

1.4.1 Nature and Extent of Contamination

During the completion of the RI, the hydrogeologic and groundwater quality conditions at the site were characterized using an extensive network of monitoring wells, extraction wells, wetland drive points, and piezometers. Contaminant plumes with dissolved VOC concentrations in excess of drinking water standards ("regulatory VOC plumes") in groundwater were delineated based on fundamental groundwater hydraulics and solute-transport principles, as well as exceedences of regulatory criteria such as Federal Maximum Contaminant Levels (MCLs) and State of Connecticut Class GA/GAA Groundwater Protection Criteria. "Probable" and "potential" NAPL zones were also identified. . The NAPL-containing zone in the overburden (see **Figure 2-3**) was more precisely delineated in November 2003 (see **Appendices C, D and E**).

The total VOC mass at the site is estimated to be 546,700 kg and is thought to be distributed approximately as follows:

- *Unsaturated Soil*: 2,200 kg sorbed and dissolved, and 1,300 kg as NAPL; for a total of 3,500 kg, or 0.64% of the estimated total VOC mass;
- *Overburden NAPL Area*: 460,000 kg as NAPL, or 84% of the estimated total VOC mass;

- *Overburden Groundwater*: 1,900 kg dissolved, 9,300 kg sorbed; for a total of 11,200 kg, or 2.1% of the estimated total VOC mass;
- *Bedrock*: 39,000 kg dissolved and sorbed (combined), 33,000 kg NAPL, or 7.1% and 6.0% of the estimated total VOC mass, respectively; and
- *Bedrock NAPL Area*: NAPL is known to be present in the bedrock, but its extent has not been defined.

In summary, the majority of the VOC mass is in the form of NAPL in the Overburden NAPL Area.

1.4.1.1 Soil

The distribution of VOCs in soil covers much of the Operations Area, suggesting that solvent VOCs likely entered the subsurface in varying quantities at many locations within the Operations Area. Likely known entry points include the two unlined lagoons, drum storage areas, and truck loading/unloading areas.

1.4.1.2 Overburden and Bedrock Groundwater

Overburden Groundwater Aquifer

The shallow overburden groundwater VOC plume associated with the SRSNE Site extends approximately 300 feet of the Operations Area and the NTCRA 1 Containment Area (see **Figure 1-10**). The middle overburden groundwater VOC plume associated with the SRSNE Site extends into the center of the Town Well Field (see **Figure 1-11**). The southern extension of the middle overburden VOC plume attenuated to below regulatory standards following the startup of the NTCRA 2 groundwater containment system. The deep overburden groundwater VOC plume associated with the SRSNE Site extends into the northern portion of the Town Well Field (see **Figure 1-12**). A second unrelated VOC source is interpreted near the southwestern portion of the Town Well Field.

The mass of sorbed and dissolved phase VOCs in the saturated overburden was estimated in the RI Report. The total dissolved VOC mass in the overburden groundwater was estimated as 1,900 kg. The total sorbed VOC mass in the saturated overburden was estimated as 9,300 kg. The evaluation of VOC mass in the RI Report indicated that the middle overburden contains the majority of the VOC contaminants.

Bedrock Groundwater Aquifer

The shallow and deep bedrock groundwater VOC plumes associated with the SRSNE Site extend into the central portion of the Town Well Field (see **Figures 1-13 and 1-14**). In the RI Report, the estimated dissolved and sorbed phase VOC mass in the bedrock was approximately 39,000 kg.

1.4.1.3 NAPL Zones

NAPL thickness measurements at wells and piezometers indicated dense NAPL (DNAPL) at four overburden and three bedrock wells and piezometers in the Operations Area and the (downgradient) former Cianci Property. Measurable light NAPL (LNAPL) was observed at one overburden well, indicating a limited distribution of potentially recoverable LNAPL. As part of the RI, “probable” and “potential” NAPL zone boundaries in both overburden and bedrock were delineated. A subsequent field-based NAPL delineation study further refined the area in the overburden where most of the NAPL appears to be located.

Overburden Probable and Potential NAPL Zones

The overburden probable NAPL zone defined in the RI Report covers an area of approximately 214,000 square feet (4.9 acres), and extends east from the Operations Area to the vicinity of the Quinnipiac River, and southeast to the northern edge of the Town Well Field. The overburden potential NAPL zone defined in the RI Report covers an area of approximately 540,000 square feet (12.4 acres).

As discussed in Section 1.6, additional studies were performed subsequent to the completion of the RI to further refine the area and volume of overburden within which the majority of NAPL is located. The resulting 1.5-acre NAPL source area is targeted for the evaluation of mass reduction remedial alternatives in this FS. As a result, the “probable” and “potential” overburden NAPL zone designations are not discussed further in this document.

Bedrock Probable and Potential NAPL Zones

As defined in the RI Report, the bedrock probable NAPL zone covers an area of approximately 260,000 square feet (6.0 acres), and extends from the Operations Area eastward to the vicinity of the Quinnipiac River, and north (up gradient based on non-pumping head data) to the location of the former Cianci Water Supply Well. The bedrock potential NAPL zone defined in the RI Report covers an area of approximately 618,000 square feet (14.2 acres). The depth of the bedrock potential NAPL zone was not investigated directly during the RI. The depth of the NAPL zone may be inferred indirectly, based on the three-dimensional distribution of dissolved VOCs and groundwater flow directions. Based on the interpreted depth of the VOC plume in bedrock and the vertical hydraulic gradients, it appears that the NAPL zone may potentially extend to a depth on the order of 200 feet below grade within the footprint of the bedrock probable NAPL zone.

1.4.1.4 Surface Water and Sediment

Previous investigations at the site indicated that the drainage culvert that conveys Operations Area runoff from the ditch east of the Operations Area across the former Cianci Property to the Quinnipiac River had historically collected contaminated surface water and groundwater. Supplemental surface water sampling performed during the RI confirmed that contaminated groundwater drains into the culvert and impacts surface water at the culvert discharge. Although EPA removed the surficial VOC- and PCB-impacted soil/sediment from the Operations Area catch basin outfall and railroad grade ditches upstream of the culvert in 1992, some VOC- and PCB-contaminated wetland soil likely remains at depth, in the culvert, and/or in the area where the culvert discharges at the Quinnipiac River.

1.4.2 Contaminant Fate and Transport

VOC mass estimates presented in the RI Report and **Appendix D** concluded that the majority of the VOC mass is within the NAPL phase within the Overburden NAPL Area. Relatively minor components of the overall VOC mass are in the soil, the portion of the overburden aquifer that is outside the NAPL source area, and the bedrock (BBL, 1998).

1.4.2.1 Soil

To provide an understanding of the relative VOC contribution from soil to the overburden aquifer in the Operations Area, BBL used a model to estimate chemical mobility in soil. The model results suggest that VOCs in the soil contribute very little to contamination in the overburden aquifer beneath the Operations Area (BBL, 1997).

1.4.2.2 Overburden and Bedrock Groundwater

VOC mass transport is controlled mainly by the direction in which groundwater flows. Groundwater from the site generally flows east to southeast, where it discharges to the Quinnipiac River and associated wetlands. Factors that limit the movement of contaminated groundwater include the interaction between the dissolved constituents and the geologic media, including the effects of dispersion, retardation, biogenic degradation/transformation, and diffusion into low-permeability zones.

Matrix Diffusion

Calculations were performed in the RI using site-derived physical parameters for the soil and bedrock and literature-reported degradation half-lives and site-specific retardation factors for the groundwater constituents of concern. Calculated retardation factors imply that molecular diffusion into the unfractured bedrock matrix is particularly important to plume migration and the evaluation of groundwater restoration practicability in bedrock. The steady-state retardation of a constituent plume due to matrix diffusion was approximated by the ratio of the bedrock matrix porosity to the bedrock fracture porosity, both of which were quantified during the completion of the RI (Kueper, August 1995). The influence of retardation due to matrix diffusion in fractured porous media can be even greater than in granular aquifers (Pankow and Cherry, 1996). Similarly, diffusion from the higher permeability zones to low-permeability lenses and strata also occurs in the overburden, contributing to the overall retardation of the plume (Gorelick et al., 1993).

The arkoses that underlie the SRSNE Site are a relatively porous rock type. This bedrock matrix porosity represents a significant storage capacity for VOCs that diffuse out of contaminated groundwater or NAPL in the fractures in the bedrock into the rock matrix from the fractures, as confirmed by bedrock matrix VOC analysis performed during the RI. The contaminants move slowly out of the rock pores in the presence of groundwater with relatively lower concentrations of contaminants.

Appendix F presents the results of a modeling effort that looks at the impact of the slow movement of contaminants out of the bedrock matrix on cleanup times. The modeling results indicated that, with a modest amount of aqueous phase degradation in the plume and source zone concentration degradation, the bedrock plume should begin to decay within a period of approximately 125 years and all bedrock groundwater should reach regulatory standards within approximately 225 years. This model incorporates the process of diffusion only, and does not consider advection, which could lead to more rapid cleanup times than predicted.

Natural Attenuation

During sampling performed as part of the RI, BBL measured biologic and geochemical parameters at several wells located along the general groundwater flow path from up gradient of the Operations Area at the P-8 well cluster, eastward through the probable NAPL zones in the overburden and bedrock, and southward into the Town Well Field Property. These data were then evaluated to determine the effects of biodegradation in reducing VOC concentrations within the offsite plumes. An evaluation of natural attenuation processes, indicator parameters, and products was performed and is presented in detail in the RI Report (BBL, 1997), and is summarized below.

The results indicate that natural attenuation processes are robust within the plume associated with the SRSNE Site, and particularly in and immediately downgradient of the NAPL zones. Groundwater analytical data obtained at the site indicate that dissolved VOCs are being degraded to carbon dioxide (CO_2) and methane (CH_4) due to the presence of naturally occurring, biologically mediated oxidation reduction reactions, and that dissolved chlorinated VOCs are being dechlorinated in-situ due to the anaerobic conditions resulting from biodegradation of the aromatic VOCs. The data show that dissolved solvent compounds, such as tetrachloroethene (PCE), trichloroethylene (TCE), and trichloroethane (TCA), are undergoing complete dechlorination with byproducts consisting of ethene, ethane, and chloride. It is likely that, in addition to dechlorination, the more highly chlorinated VOCs are also cometabolically degraded during biodegradation of the ketones, alcohols, semi-volatile organic compounds (SVOCs), and aromatic VOCs. Furthermore, lesser chlorinated VOCs, such as dichloroethylene (DCE) (combined 11,-DCE and 1,2-DCE isomers) and vinyl chloride, are also likely being metabolically degraded

In summary, there is strong evidence for natural attenuation of chlorinated VOCs in groundwater at the site due to in-situ biodegradation processes.

Further information regarding the VOC degradation mechanisms at the site are presented in **Appendices G and H**. Appendix G provides the detailed discussion of site-specific degradation mechanisms and data analysis; and Appendix H provides a detailed discussion of the known degradation mechanisms and rates for the suite of site-specific VOCs.

1.4.2.3 NAPL Zones

The physical properties of DNAPL and LNAPL from the SRSNE Site were quantified based on samples obtained from three monitoring wells during the RI and two wells during the June 2003 groundwater sampling event. At the approximate groundwater temperature, the subsurface physical characteristics and the total VOCs detected can be summarized as follows:

Sample Location	Density (g/cm^3)	Viscosity (cS)	Interfacial Tension (dynes/cm)	VOC Concentration (mg/l)
MWD-601 (DNAPL)	1.12	1.3	7.8	282,000
RW-5 (DNAPL)	1.11	1.23	3.1	99,800
MW-705DR (DNAPL)	1.23	0.993	9.0	899,000
CPZ-8R (DNAPL)	1.068	5.59	8.67	596,200

Detailed analytical results for Site NAPLs are provided in Appendix Q, Table 2-1. The physical testing results suggest that the DNAPL sampled at these locations is relatively easy to mobilize, where present in pools.

Natural Attenuation

The available data demonstrate that robust degradation processes are currently occurring within the NAPL zone. The rate of contaminant removal is influenced by the total effective surface area over which biodegradation can occur; the biodegradation rate; and, the partitioning behavior of the degradation products (into the remaining DNAPL and into water). Other factors include groundwater flow rate, nutrient availability, concentrations of alternate electron acceptors, and biofilms if formed near the water:DNAPL interface. The rate of biologically-assisted NAPL dissolution has been found to be 3 to 6.5 times higher than the rate of abiotic dissolution (Carr *et al.,* 2000; Yang and McCarty, 2000). The surface area over which NAPL can dissolve increases substantially when pools are depleted to residual distribution. Additional details supporting this site-specific interpretation are presented in **Appendices G, H and I**.

1.5 1994 Baseline Risk Assessment and 1999 Risk Assessment Update

1.5.1 Human Health Risk

In 1994, HNUS performed a baseline human health risk assessment (RA) which evaluated both current and future risks from exposure to contamination under a variety of different exposure scenarios. The HNUS (1994) Baseline RA identified several contaminants of potential concern (COPCs) in the study area groundwater, shallow soil, surface water, and sediment, and then evaluated the possible adverse health effects to human receptors posed by these contaminants to determine the total cancer risks and total non-cancer hazards present. In 1999, BBL performed a human health risk assessment update (RA Update) to incorporate data collected subsequent to the HNUS (1994) Baseline RA and to apply current risk assessment guidance (i.e., RAGS Part D guidance). In addition, the RA Update evaluated a non-residential land use scenario that was not included in the HNUS (1994) Baseline RA. The RA Update is presented in **Appendix J,** and is a companion piece to the HNUS (1994) Baseline RA, as it re-evaluates only those exposure pathways identified as posing potential risks in the HNUS Baseline RA. The COPCs identified for each media as part of either the 1994 assessment or the 1999 update are presented in **Table 1-1a**.

The HNUS (1994) Baseline RA assumed a residential land use scenario for groundwater. In addition to direct ingestion, it considered dermal contact through bathing and inhalation of VOCs and SVOCs emitted from showers, toilets, dishwashers, washing machines and other turbulent water-use sources. Residential, recreational and trespasser exposure scenarios were considered for soil, surface water and sediment. Exposure pathways included direct contact with soil, surface water and sediment, as well as inhalation of soil particulates and vapors. The 1999 RA Update (**Appendix J**) re-evaluated risk from those media identified as posing the highest potential risks in the HNUS (1994) Baseline RA (i.e., groundwater and soil). Briefly, the RA Update evaluated the potential risks/hazards associated with incidental ingestion and dermal contact with surface and subsurface soils for both residential and commercial/industrial land use scenarios. The RA Update also re-evaluated potential risks/hazards associated with hypothetical future ingestion of groundwater.

A reasonable maximum exposure to soils was characterized in the RA Update using the 95% upper confidence limit (UCL) on the arithmetic mean contaminant concentration or the maximum detected concentration, whichever was less. This approach is consistent with EPA (1989) and EPA (1992) guidance. For groundwater, the RA Update calculated groundwater exposure point concentrations as the average concentration across several rounds for a given well, consistent with EPA (1994) Region 1 Guidance (Risk Update 2). For exposures to sediment and surface water, the findings of the HNUS (1994) Baseline RA are summarized below.

The human health RA process consists of the following four steps: 1) data evaluation to identify site-related chemicals of interest; 2) exposure assessment to determine potential exposure pathways and quantify the magnitude of potential exposure; 3) toxicity assessment to determine what types of effects are associated with exposures in general; and 4) risk characterization to quantify cancer and non-cancer hazards associated with the specific exposure at this site. Only step 4 - Risk Characterization is summarized here. The complete RA process, including tabulated information and results of the risk evaluation in EPA (1998) RAGS Part D format, is presented in **Appendix J** and the HNUS (1994) Baseline RA.

Exposure Assumptions

The following human health exposure scenarios were evaluated in one or both of the risk assessments conducted for the Site.

The potential human-health risk/hazard posed by exposures to groundwater was evaluated based upon the following assumptions:

- no one currently uses the contaminated groundwater at the site; and
- in the future, groundwater could hypothetically be used for drinking water (potable use). This is consistent with the State’s classification of the groundwater at the site.

The potential human health risk posed by exposures to soil was as follows:

- risks were calculated for incidental soil ingestion and dermal contact with soil in the RA Update;
- inhalation was considered as a potential route of exposure in the HNUS (1994) Baseline RA;

- the RA Update only considered potential exposures to subsurface soil at the Operations Area/Railroad Property because asphalt and railroad bedding make surface soils in these areas inaccessible;
- the RA Update only considered potential exposures to surface soil on the Cianci Property because institutional controls prohibiting excavation on the Cianci Property will be an element of any remedy selected for this Site;
- potential exposure to soils at the Town Well Field Property were not considered in the RA Update because the human-health risk were previously found in the HNUS (1994) Baseline RA to be below levels of concern; and
- both residential and industrial/commercial future land use scenarios were evaluated.

The potential human-health risk posed by exposures to surface water was evaluated based upon the following assumptions:

- incidental ingestion and dermal contact with surface water while swimming in the Quinnipiac River or wading in its associated wetlands.

The potential human-health risk posed by exposures to sediment was evaluated based upon the following assumptions:

- incidental ingestion and dermal contact with sediments while swimming in the Quinnipiac River or wading in its associated wetlands, and
- ingestion of fish.

Risk Characterization

Risk characterization integrates the results of data evaluation, toxicity assessment, and exposure assessment to evaluate potential risks associated with estimated exposures. Consistent with EPA (1989) guidance, the potential for carcinogenic and non-carcinogenic hazards are evaluated separately. The RA Update used the same area designations as were used in the Baseline RA. For groundwater, these areas are the Operations Area Plume, Queen Street Plume and the Up gradient Area. The areas that presented an unacceptable risk or exceeded regulatory criteria are referred to later in this document as “overburden groundwater”, “overburden NAPL area”, “bedrock groundwater”, and “bedrock NAPL area” for purposes of identifying and evaluating cleanup alternatives in Chapters 3 - 5. For surface and subsurface soil, these areas are referred to in the HNUS (1994) Baseline RA and RA Update as the North Cianci property, South Cianci property, and the Operations Area/Railroad property (see **Figure 2-1**). The areas that presented an unacceptable risk or exceeded regulatory criteria are referred to later in this document as “Operations Area/Railroad soil” or “Cianci Property soil” for purposes of identifying and evaluating cleanup alternatives in Chapters 3 - 5.

Non-Carcinogenic Hazard

The hazard index approach is used to characterize the overall potential for non-carcinogenic effects associated with exposure to multiple chemicals. This approach assumes that sub-threshold chronic exposures to multiple chemicals are additive. A hazard quotient (HQ) value greater than 1 indicates that a calculated exposure is greater than the reference dose (RfD) for a given constituent, and that there may be some potential for health concerns. Similarly, a hazard index (HI) greater than 1 indicates that overall exposure to all chemicals of interest may pose a threat to human health.

Groundwater

Overburden and bedrock groundwater may present a significant non-cancer hazard should groundwater from the Operations Area Plume be used in the future for potable use. HQ values for most contaminants in groundwater exceeded 1 for a reasonable maximum exposure with an overall HI of 1000 for both overburden and bedrock groundwater. The highest target-organ specific HIs for overburden and bedrock groundwater for this area are 600 and 700, respectively. These potential hazards are due predominantly to contamination within the NAPL zone.

Another area of groundwater evaluated in the risk assessment assuming the bedrock aquifer was used for potable purposes, the Queen Street Plume, is unlikely to present a significant hazard assuming reasonable maximum exposure conditions. HQ values and the HI are below 1 for chemicals in bedrock groundwater for the Queen Street Area. There were no COPC for overburden groundwater for Queen Street. HQ values for groundwater constituents of the Up gradient Area were above and below 1, ranging from 0.01 to 7 for overburden groundwater, and from 0.003 to 10 for bedrock groundwater. A HI greater than 1 was determined for both overburden (HI of 10) and bedrock groundwater (HI of 20) from this location. However, because the Up gradient Area is in the direction opposite of groundwater flow, this area will not be addressed by the remedy for this site.

Soil

Potential exposure to subsurface soil in the Operations Area/Railroad Property area may present a potentially unacceptable future non-cancer hazard for future residential receptors assuming reasonable maximum exposure. The calculated HI for children is 20, with the primary diver being cadmium. The non-cancer hazard for future adult residents and workers is 2. Future potential exposures to lead in the Operations Area may also pose a significant threat of harm to young children should the area be used for residential purposes as maximum concentrations of lead exceed the USEPA Region 9 residential preliminary remediation goal (PRG) of 400 mg/kg.

The other areas of soil contamination at the Site do not present a current or future unacceptable non-cancer hazard under a residential, recreational/trespassing, or industrial use scenario, assuming reasonable maximum exposure conditions. At the North and South Cianci Properties, all non-cancer HQs and HIs are much less than 1. As previously stated, the Town Well Field Property was not found during the HNUS (1994) Baseline RA to present a current or future unacceptable non-cancer risk.

Sediment

Sediment in the Quinnipiac River and associated wetlands did not present current or a potential future unacceptable non-cancer hazard assuming reasonable maximum exposure conditions. Exposure from incidental ingestion and dermal contact with sediment for adults and older children in a recreational and/or trespasser scenario, as well as exposure from ingestion of fish were evaluated in reaching this conclusion.

Surface Water

The surface waters of the Quinnipiac River and associated wetlands also did not present current or a potential future unacceptable non-cancer hazard assuming reasonable maximum exposure conditions. Exposure from incidental ingestion and dermal contact with surface water for adults and older children swimming in the Quinnipiac River or wading in the associated wetlands were evaluated in reaching this conclusion.

Carcinogenic Risk

Carcinogenic risk is expressed as a probability of developing cancer over the course of a lifetime as a result of a given level of exposure. For exposure to multiple carcinogens, EPA assumes that the total risk is equivalent to the sum of individual chemical risks, and thus individual-chemical risks can be added together to calculate a total risk for a given receptor.

Regulatory agencies have policies and guidelines to determine the significance of these calculated risk levels. EPA (1991) considers a risk of one in ten thousand (1×10^{-4}) to one in one million (1×10^{-6}) to be an acceptable upper limit of risk that is sufficient to protect public health. Specifically, EPA (1991) states that “where the cumulative carcinogenic site risk to an individual based on reasonable and maximum exposure for both current and future land use is less than 10^{-4}, ...action is generally not warranted.” “EPA uses the general 10^{-4} to 10^{-6} risk range as a target range within which EPA strives to manage risks as part of a Superfund cleanup.”

Groundwater

Overburden and bedrock groundwater may present a significant excess cancer risk should groundwater from the Operations Area Plume be used in the future for potable use. Cumulative cancer risks that could result if overburden or bedrock groundwater were used for residential purposes (drinking water) were estimated at 1×10^0, 2×10^0, respectively. As with the non-carcinogenic risks, the calculated carcinogenic risks are due predominantly to constituents present in groundwater within the NAPL zone. Regulatory requirements under the Safe Drinking Water Act (MCLs and non-zero MCLGs) and Connecticut Remediation Standard Regulations (RSRs) were also exceeded in groundwater in this area of the Site.

Bedrock and overburden groundwater of the Queen Street Plume evaluated in the risk assessment assuming the aquifer were used for potable purposes did not present a significant current or future cancer risk. Individual constituent risks and total risk for groundwater are within or below EPA’s acceptable cancer risk range of 10^{-4} to 10^{-6}. A potentially significant cancer risk, however, is associated with exposure to overburden groundwater of the Up gradient Area (6×10^{-4}). Cumulative cancer risk for the bedrock groundwater of this area is equal to EPA’s low end target risk of 1×10^{-4}.

Soil

Potential exposure to subsurface soil in the Operations Area/Railroad Property area also may present an unacceptable cancer risk to potential future adult residents and children. Reasonable maximum exposure and resulting risk associated with exposure to soil in this area was calculated at 1×10^{-3} for a child living in this area of the site (residential) and 5×10^{-4} for an adult, for a cumulative residential cancer risk of 2×10^{-3}. Risks to future workers evaluated for the Operations Area/Railroad Property are 3×10^{-4}. Levels of contaminants in soil in the Operations Area/Railroad Property area also exceeded regulatory requirements established by Connecticut under the Connecticut RSRs for pollutant mobility criteria and for direct exposure criteria.

Potential reasonable maximum exposure to surface soil located at other areas of the Site are not likely to present a current or future unacceptable cancer risk under either a residential or industrial use scenario. Risks projected for the North and South Cianci property are less than 1×10^{-6} under the recreational/trespasser scenario. Total residential risks are within the USEPA target risk range of 1×10^{-6} to 1×10^{-4} (1×10^{-5} for North Cianci and 2×10^{-5} for South Cianci). Cumulative cancer risks for workers at the North and South Cianci properties are also within this range (2×10^{-6} for North Cianci and 4×10^{-6} for South Cianci). Although soil outside the Operations Area/Railroad Area is not likely to present an unacceptable cancer risk when compared with EPA’s target risk range, contaminant levels did exceed regulatory requirements established under the Connecticut RSRs pollutant mobility criteria and/or direct exposure criteria in isolated areas on the Cianci properties, including the culvert outfall and the drainage ditch north of the culvert.

Sediment

Contamination in the sediment from the Quinnipiac River and associated wetlands is not likely to present a current or a potential future unacceptable cancer risk under reasonable maximum exposure conditions. Exposure from incidental ingestion and dermal contact with sediment for adults or older children in a recreational and/or trespasser scenario, as well as exposure from ingestion of fish were evaluated in reaching this conclusion.

Surface Water

Contamination in the surface waters of the Quinnipiac River and associated wetlands also is not likely to present a current or a potential future unacceptable cancer risk under reasonable maximum exposure conditions. Exposure from incidental ingestion and dermal contact with surface water for adults or older children swimming in the Quinnipiac River or wading in the associated wetlands were evaluated in reaching this conclusion.

A summary of potential human health risks for exposures to soil assuming reasonable maximum exposure conditions, based on the findings from the RA Update, is presented below:

	Surface Soils		**Subsurface Soils**	
Location **Receptor**	**Total Excess Lifetime Cancer Risk**	**Total Noncancer Hazard Index**	**Total Excess Lifetime Cancer Risk**	**Total Noncancer Hazard Index**
North Cianci				
Adult Resident	3×10^{-6}	0.01	-	-
Child Resident	7×10^{-6}	0.1	-	-
Total Residential Risk (30 year)	1×10^{-5}	0.1		
Recreational/Trespasser	3×10^{-7}	0.002	-	-
Worker	2×10^{-6}	0.009	-	-
South Cianci				
Adult Resident	5×10^{-6}	0.08	-	-
Child Resident	1×10^{-5}	0.8	-	-
Total Residential Risk (30 year)	2×10^{-5}	0.9		
Recreational/Trespasser	5×10^{-7}	0.02	-	-
Worker	4×10^{-6}	0.06	-	-
Operations Area/Railroad Property				
Adult Resident	-	-	5×10^{-4}	2.0
Child Resident	-	-	1×10^{-3}	20
Total Residential Risk (30 year)	-	-	2×10^{-3}	20
Worker	-	-	3×10^{-4}	2.0

A summary of potential human health risks for groundwater based on the RA update is presented below:

Location	Bedrock Groundwater: Total Excess Lifetime Cancer Risk	Bedrock Groundwater: Total Noncancer Hazard Index	Overburden Groundwater: Total Excess Lifetime Cancer Risk	Overburden Groundwater: Total Noncancer Hazard Index
Operations Area Plume	2×10^{0}	1000	1×10^{0}	1000
Queen Street Plume	7×10^{-5}	0.08	NO COPC	NO COPC
Up gradient Area	1×10^{-4}	20	6×10^{-4}	10

Note: the numbers in the above tables are expressed using scientific notation. For example, "3×10^{-6}" is scientific notation for 3 times 10 to the -6 power, or 0.000003.

1.5.2 Ecological Risk

The HNUS (1994) baseline RA also included an evaluation of the risks posed to ecological receptors at the site. The ecological RA (ERA) compared sediment, surface water, and soil concentrations to generic benchmarks to calculate hazard quotients. A summary of the ERA is presented below.

Summary of the HNUS (1994) Ecological Risk Assessment

According to the ERA, ecological risks were considered "possible" if the maximum detected concentration exceeded the benchmark and "probable" if the mean concentration exceeded the benchmark. The benchmarks used in the ERA included Long and Morgan (1991) Effects Range-Low (ER-L) sediment criteria and USEPA Chronic Ambient Water Quality Criteria (CAWQC). No site-specific ecological data (e.g., biological surveys, tissue residue monitoring) were presented in the ERA.

The ERA identified potential ecological risks for most portions of the site, including risks due to background concentrations detected at upstream areas of the Quinnipiac River. The ERA did not differentiate between potential site-related and non-site-related risks.

The areas evaluated in the ERA for potential ecological risks from surface water and sediment were:

- upstream (Quinnipiac River in the vicinity north of Lazy Lane);
- downstream (Quinnipiac River in the vicinity of the southern half of the Cianci Property and northern half of Town Well Field);
- floodplain (Quinnipiac River, southern half of Town Well Field to Curtiss Street, including associated wetland habitats);
- culvert outfall area (underground culvert area and area near monitoring well TW-7A); and
- seasonal ponds (intermittent shallow ponds at the southwestern corner of the Cianci Property and the northwestern corner of the Town Well Field).

The ERA evaluated four areas for potential ecological risks from soils:

- Cianci Property/SRSNE Facility;
- Southington Well Field;
- upslope area; and
- Queen Street

A summary of the results of the ERA and the identification of potentially actionable ecological risks for specific contaminants for surface water, sediment, and soil are discussed in the following sections.

Surface Water

Potential ecological risks from surface water were evaluated in the ERA based on comparison to CAWQC. According to the risk estimates presented in the ERA, the area that appeared to pose the greatest cumulative risk from surface water is the culvert area on the former Cianci Property, followed by the seasonal ponds and downstream areas of the Quinnipiac River.

According to the ERA, potential surface water risks associated with the culvert area are from bis(2-ethylhexyl)phthalate and PCBs, and to a lesser extent lead. Of these constituents, bis(2-ethylhexyl)phthalate and lead were detected at similar concentrations upstream of the site, and the concentrations are not considered site related. The maximum detected PCB concentration (0.85 ug/L exceeded the CAWQC of 0.014 ug/L).

The ERA identified potential surface water risks associated with the seasonal ponds from cadmium and lead, and to a lesser extent copper. Of these constituents, only cadmium was detected at concentrations greater than upstream samples. However, there is currently no standing water in the seasonal pond area, thus there is limited potential for ecological exposure from surface water.

The ERA identified potential ecological risks for the downstream section of the Quinnipiac River attributed to lead, copper, and bis(2-ethylhexyl) phthalate. Each of these constituents (except copper) was detected at similar concentrations in upstream surface water samples. For copper, there was only one sample (SW1-11) with a detected concentration greater than upstream samples and greater than the criterion used in the ERA. Subsequent surface water samples collected from the Quinnipiac River had very low concentrations of copper. The more recent sample concentrations were similar to upstream concentrations and below the criterion. For the floodplain section, the ERA identified “probable” ecological risks only for lead. Lead was also detected at similar concentrations in upstream samples.

In summary, for surface water, the only potential actionable ecological risk that should be addressed is from PCBs in the area of the culvert outfall.

Sediment

The ERA evaluated potential ecological risks associated with exposure to river sediment based on comparison of concentrations to either USEPA CAWQC (by applying equilibrium partitioning equations), Long and Morgan (1991) ER-L values, or (for inorganics) Wisconsin’s interim criteria for sediments from Great Lakes harbors. All areas evaluated in the ERA, including areas up gradient of the site, exhibited potential ecological risks from sediment. With respect to sediment-related risks, the agencies expressed concern that the existing RI database may have been too limited to fully evaluate potential ecological risks posed by site-related chemicals in sediments. To address this concern, BBL performed a supplemental sediment investigation, which is described in **Appendix K**. The sediment investigation involved sampling and analysis of sediment from upstream, adjacent to, and downstream of the Site. The sediment investigation evaluated these data, along with additional sediment data from the RI and data from CTDEP/USEPA, to evaluate the significance of potential ecological risks posed by sediment constituents.

Risks in sediment were due primarily to the presence of PAHs and metals (notably arsenic, cadmium, copper, lead and mercury). According to the ERA, the greatest cumulative ecological risk due to sediment constituents appears to be associated with the floodplain sector, followed by the culvert area, the downstream sector, the upstream sector, and the seasonal ponds sector.

The potential ecological risks from sediment in the floodplain were due primarily from PAHs and cadmium, followed by copper, lead, mercury, and zinc. However, of these contaminants, only lead was detected at concentrations greater than upstream locations. The highest risks from lead were from sediment sample SD1-13. This sample was collected from a tributary to the Quinnipiac River, on the other side of the river and more than ½-mile south of the site. Similarly, samples SD3-37 and SD3-38 are located immediately downstream of the confluence with the tributary and the Quinnipiac River, on the other side of the river. As such, contaminants detected in these samples may not be attributable to the site. The other three samples used to evaluate potential ecological risks in the floodplain (SD1-12, SD1-14, SD1-15) were from the Quinnipiac River adjacent or immediately downstream of the site. Concentrations detected in these samples were generally similar to concentrations detected in upstream samples.

The potential ecological risks in the culvert outfall area were due to PAHs, PCBs, and metals (cadmium, lead, and mercury). Of the constituents identified as having a probability for adverse effects, only bis(2-ethylhexyl)phthalate, 2-methylnaphthalene, and Aroclor 1254 exceed background levels. The highest concentrations were detected directly at the culvert outfall. Although the contaminated material at the outfall is referred to as sediment in the ERA, it meets the definition of "soil" under the CT RSRs. Henceforth, the material at the culvert outfall will be referred to in this document as "wetland soil."

The potential ecological risks from sediment in downstream areas of the Quinnipiac River were primarily due to PAHs and metals (cadmium, lead, and mercury). However, concentrations and distribution of PAHs and metals detected at these locations were generally similar to upstream areas.

For the seasonal ponds, ecological risks were attributed to alpha- and gamma-chlordane, cadmium, and mercury. The maximum detected chlordane concentration (associated calculated pore water concentration of 0.0046 ug/L) exceeds the CAWQC of 0.0043 ug/L. Again, concentrations of cadmium and mercury were not greater than those in upstream locations.

In summary, for sediment, the only potential ecological risks that are actionable are those associated with PCBs and PAHs (bis(2-ethylhexyl)phthalate, 2-methylnaphthalene, and Aroclor 1254) in the wetland soils at the culvert outfall. Potential ecological risks for other areas are not actionable because most constituents were also detected at similar concentrations in upstream samples.

Soil

The HNUS ERA evaluated potential ecological risks for soil by comparing detected concentrations to Ontario's soil contamination values. These values depict "concentrations which represent moderate soil contamination and may or may not require cleanup." Because these criteria are not ecological risk-based, a large degree of uncertainty is associated with their use to identify potential ecological risks.

The ERA identified potential ecological risks from soils for the Cianci Property/SRSNE Facility only. The potential ecological risks were associated with specific areas of the site, including within the Operations Area in the vicinity of the former primary lagoon and the operations building (soil borings B-1, B-2, B-5 and B-7), the eastern perimeter of the SRSNE operations building (soil borings B-8, P-2A, B-14, and P-1A), the drainage ditch east of the SRSNE Operations Area (surficial soil sample SS3-C1 and soil boring B-15), and the culvert outfall area (soil boring P-11A, and surficial soil samples SS3-B1, SS3-B2, SS3-B3 and SS3-B4). The potential ecological risks for soils from these areas were primarily due to xylenes, PCBs, cadmium, lead and selenium. However, as stated in the ERA, these areas provide only marginal habitat for ecological receptors and thus the exposure pathways may, in most cases, be incomplete. Potential ecological risks from soil were not considered significant for the Southington Well Field, upslope area, and Queen Street.

In summary, because elevated soil levels are located in areas that provide only marginal habitat for ecological receptors, soil does not appear to present an actionable ecological risk, aside from PCBs and PAHs (as described under "Sediment" above).

1.6 Summary of Post-RI Investigations and Activities

The Group has continued to conduct various studies and perform further evaluations of site conditions in the period since the completion of the RI in 1998. These include the following:

Supplemental Overburden Hydrogeologic Investigation

To further understand the groundwater hydraulics in the north-central portion of the Town of Southington Well Field Property, a post-RI overburden hydrogeologic investigation was conducted by BBL during August 1998. The additional hydrogeologic investigation activities were specifically conducted to provide data to support the evaluation of remedial alternatives for overburden groundwater in this FS. The overburden investigation included:

- pumping well and piezometer installation;
- pumping well and piezometer development;
- step drawdown and constant-rate pumping tests;
- groundwater elevation and flow modeling; and
- reporting.

The findings and evaluation of the overburden investigation is presented in the Overburden Investigation Field Results and Data Evaluation (**Appendix A**).

Interim Monitoring and Sampling (IMS)

The Group has conducted 13 biannual groundwater and surface water sampling and analysis events since 1998. As defined in the final IMS Plan (IMSP; BBL, November 1998), each sampling event has involved the collection of samples from 25 monitoring wells and 3 surface water points along the Quinnipiac River. The most recent Interim Monitoring and Sampling Report dated January 2005 is included as **Appendix L**.

Among the IMS findings, it is noteworthy that the highest total VOC concentration in each IMS data set (approximately 41,000 ug/L as of October 2003) has consistently been detected at deep overburden monitoring well MW-502. This well is situated between the NTCRA 1 sheet-pile wall and the Quinnipiac River. During the completion of the RI, this well was interpreted as being situated in close proximity to non-aqueous phase liquids (NAPLs) in the saturated overburden. Another possible explanation for the persistent, elevated VOC concentrations at well MW-502, however, could be the upward discharge of groundwater containing VOCs from the shallow bedrock; an upward hydraulic gradient generally exists between the shallow bedrock and the deep overburden in that area. In addition, similar constituents have been reported at nearby shallow bedrock monitoring wells.

Another noteworthy IMS finding is that, as predicted in the June 2000 draft FS, groundwater VOC concentrations downgradient of the NTCRA 2 capture zone decreased through natural attenuation to less than regulatory limits, and have been consistently below MCLs since 2001-2002.

Supplemental Sediment Investigation

In response to comments on the first draft of this FS, BBL conducted a supplemental sediment investigation in the Quinnipiac River to support the interpretation of the 1994 Ecological Risk Assessment (ERA). Results from that effort are presented in **Appendix K**.

Supplemental Soil Sampling

Also in response to comments on the first draft of this FS, BBL conducted a supplemental soil sampling program. The program had three primary purposes, as summarized below:

- provide additional soil data to support the ongoing Risk Assessment (RA) Update for the former Cianci Property;
- obtain leaching-based inorganics analytical data for soil to compare to CT DEP's Remediation Standard Regulations (RSRs), specifically the pollutant mobility criteria standards (PMCs); and
- further characterize background soil quality to identify naturally occurring inorganic constituents to which the CTDEP RSRs would not apply.

The findings from the supplemental soil sampling program are presented in **Appendix M**.

Supplemental FS Groundwater Sampling Event

In June 2003, 31 monitoring wells at the Site were sampled for a range of bioremediation assessment parameters (e.g., dissolved hydrocarbon gases, volatile fatty acids, anions, dissolved metals, alkalinity and other key natural attenuation parameters). The results from this comprehensive sampling event and previous Site data were used to evaluate the status of natural bioremediation processes inside the NTCRA 1 and NTCRA 2 containment areas (GeoSyntec, 2004; see **Appendix G**). The results from this sampling event are also summarized above in Section 1.4.3.2.

NAPL Delineation Pilot Study

In response to EPA and CTDEP comments on the second draft of this FS, the Group performed a NAPL delineation pilot study to identify areas within the overburden groundwater with potentially mobile (pooled) and residual NAPL based on visual observations of NAPL in soil samples. The purpose of this work was to provide a basis for calculating an area and volume of greatest NAPL concentration in the overburden to consider for treatment.

The NAPL delineation pilot study involved the installation of soil borings in and around the zone where NAPL had already been visually observed in previous soil samples or monitoring wells, and the assessment of soil samples for the presence of visible NAPL. The results of the study were summarized in a December 2003 memorandum to the USEPA (BBL, 2003; **Appendix C**). The results of the study were used to define the overburden NAPL area.

1,4-Dioxane Evaluation

During the sampling in 2004, groundwater and surface water samples were analyzed for 1,4-dioxane using SW-846 Method 8720C. In addition, NTCRA 1 influent and effluent samples were analyzed for 1,4-dioxane. The results of the NTCRA 1 system and IMS sampling results for 1,4-dioxane are summarized in **Appendix L**.

2. Identification and Screening of Technologies

The identification of potentially applicable remedial technologies in the FS begins with the identification of applicable or relevant and appropriate requirements (ARARs), remedial action objectives (RAOs), preliminary remediation goals (PRGs), and general response actions (GRAs). The areas or volumes of media of concern to which remedial action might be applied are identified based on these criteria, and specific remedial technologies to address those media are listed and screened in a two-step process. Initially, the universe of potentially applicable technologies are identified and screened solely on the basis of technical implementability. Following this initial screening, the options for the remaining technologies are evaluated with respect to relative effectiveness, implementability and cost to select one or more representative options for each technology.

Throughout this section of the FS, the terms “technology” or “technology type” refer to general categories of technologies. The term “process option” refers to specific cleanup processes within each technology type. For example, “physical treatment” would represent a technology type, while “air stripping,” a type of physical treatment, would be a process option under this technology.

2.1 Potential Applicable or Relevant and Appropriate Requirements (ARARs)

ARARs are promulgated, enforceable federal and state environmental, or public health requirements, which fit into either of two categories: "applicable requirements” or "relevant and appropriate requirements." Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not legally applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site or actions at the site.

EPA and the states have also identified certain guidance as "to be considered" criteria (TBCs). TBCs are non-promulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARS. Along with ARARS, TBCs may be used to develop the remedial action limits necessary to protect human health and the environment.

EPA categorizes ARARs and TBCs as chemical-specific, location-specific, or action-specific. These ARAR categories are described below.

2.1.1 Potential Chemical-Specific ARARs and TBCs

Chemical-specific ARARs and TBCs are usually health- or risk-based values that may define acceptable exposure levels and, therefore, may be used in establishing remediation goals. In general, chemical-specific ARARs are set for a single chemical or a closely related group of chemicals. A listing of potential chemical-specific ARARs and TBCs is presented in **Table 2-1**.

2.1.2 Potential Location-Specific ARARs and TBCs

Location-specific ARARs and TBCs are restrictions placed on the concentrations of hazardous substances or the conduct of activities solely because they are in specific areas. The general types of potential location-specific ARARs and TBCs that may be applied to the SRSNE Site are briefly described below.

Several potential federal and state ARARs and TBCs address wetlands and floodplains. Because the study area includes wetlands and portions of the area are located in the 100-year floodplain of the Quinnipiac River, these would be location-specific ARARs or TBCs if the remedial alternatives to be evaluated during the FS would result in impacts to these resources. Section 404 of the Clean Water Act and State Water and Wetlands requirements restrict activities that adversely affect wetlands and waterways. RCRA Location Standards outline the requirements for the construction of a RCRA facility located in a 100-year floodplain. The Wetlands and Floodplains Executive Order, incorporated into 40 CFR Part 6, Appendix A, requires that wetlands and floodplains be protected and preserved and that adverse impacts be minimized.

Additional potential location-specific ARARs include the Fish and Wildlife Coordination Act, which requires that any federal agency proposing to modify a body of water must consult with the U.S. Fish and Wildlife Service. Again, these requirements would be ARARs for the SRSNE Site if the remedial alternatives evaluated in the FS impact the Quinnipiac River.

A listing of potential location-specific ARARs and TBCs is presented in **Table 2-2**.

2.1.3 Potential Action-Specific ARARs and TBCs

Action-specific ARARs and TBCs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements generally focus on actions taken to remediate, handle, treat, or dispose of hazardous wastes. These action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. The general types of potential action-specific ARARs that may be applied to the SRSNE Site are briefly described below.

The Clean Water Act (CWA) requires that any point source discharge to waters of the U.S. meet all applicable requirements under the National Pollutant Discharge Elimination System (NPDES) program. These requirements would apply if the remedial alternatives evaluated during the FS involve point source discharges to the Quinnipiac River. The state regulates the discharge of process wastewater and does not permit the discharge of toxic pollutants for which "Health Advisories" are unavailable and for which there is insufficient data for the establishment of a Health Advisory. This discharge restriction is potentially applicable to several contaminants detected in the study area. In addition, Ambient Water Quality Criteria (AWQC) have been developed under the CWA as guidelines for the protection of freshwater aquatic life and human health, based on ingestion of water and fish consumption. These standards would be used to develop effluent discharge limits for those alternatives that require discharges to the Quinnipiac River.

Various requirements of the Clean Air Act, including requirements implemented under State regulations, would be potential ARARs, if the remedial alternatives to be evaluated as part of the FS involve air emissions.

Disposal actions may be regulated by the state hazardous waste regulations, state waterways regulations, and the groundwater injection program. In addition, the RCRA facility standards address the design, facility operations, manifesting and record keeping, treatment, disposal, groundwater monitoring, and closure for certain types of waste management facilities. These regulations may also be potential ARARs.

The Toxic Substances Control Act (TSCA) includes requirements for the treatment and disposal of PCBs This ARAR would apply to alternatives involving treatment or disposal of waste material containing PCBs.

A listing of potential action-specific ARARs and TBCs is presented in **Table 2-3**.

The final ARARs and TBCs will be used in the detailed analysis of the effectiveness of remedial alternatives, and will be factored into the development of performance standards to be included in the Record of Decision (ROD) for the site.

2.1.4 ARAR Waivers

Under certain circumstances, a remedial alternative that does not meet an ARAR may be selected, and a waiver may be granted. There are six sets of circumstances described in Section 300.430(f)(1)(ii)(c) of the NCP under which waivers are granted:

- if the alternative is an interim measure and will become part of a total remedial action that will attain the ARAR;
- if compliance with the ARAR will result in greater risk to human health and the environment than other alternatives;
- if compliance with the requirement is technically impracticable from an engineering perspective;
- if the alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach;
- if the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state; or
- for fund-financed actions (i.e., remedial actions financed by the federal Superfund), an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of Fund monies to respond to other sites that may present a threat to human health and the environment.

All ARARs listed above will be evaluated with regard to the applicability of the waiver mechanisms in the NCP as part of the FS.

2.1.5 Superfund Program Expectations

EPA expects to select a remedy for a site considering the Superfund program's "goal and expectations" which are stated in the NCP as follows:

Program Goal (40 CFR 300.430(a)(1)(I))

The national goal of the remedy selection process is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste.

Program Expectations (40 CFR 300.430(a)(1)(iii)

A. EPA expects to use treatment to address the principal threats posed by a site, wherever practicable. Principal threats for which treatment is most likely to be appropriate include liquids, areas contaminated with high concentrations of toxic compounds, and highly mobile materials.

B. EPA expects to use engineering controls, such as containment, for waste that poses a relatively low long-term threat or where treatment is impracticable.

C. EPA expects to use a combination of methods, as appropriate, to achieve protection of human health and the environment.

D. EPA expects to use institutional controls, such as water use and deed restrictions, to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous substances, pollutants, or contaminants.

E. EPA expects to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies.

F. EPA expects to return usable ground waters to their beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of groundwater to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to contaminated groundwater and evaluate further risk reduction.

2.2 Remedial Action Objectives

Remedial Action Objectives (RAOs) or “clean up objectives” consist of media-specific goals for protecting human health and the environment. As defined in EPA’s RI/FS guidance (USEPA, October 1988), RAOs should specify the contaminants of concern, exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route. The baseline human health risk assessment identified several COCs with respect to human health risk in the study area groundwater, soil, wetland soil, surface water, and sediment.

2.2.1 Groundwater Risk

Contaminants in groundwater exceed both cancer and non-cancer EPA target risk requirements and state and federal regulatory requirements assuming that the groundwater is used for potable use in the future. The highest calculated groundwater ingestion risks are related to the Operations Area, the former Cianci property, and the northern portion of the Southington well field. Groundwater in this area is not currently used for drinking water or other domestic purposes.

2.2.2 Soil and Wetland Soil Risk

The Baseline RA and RA Update evaluated potential soil exposure risks based on both residential and industrial land use scenarios. Soil in the Operations Area/Railroad Property presented unacceptable cancer and/or non-cancer risks to adults and children who might live on the property in the future (residential scenario) and workers (industrial scenario). Connecticut believes that the most reasonable future use for the Site is a recreational use. Under Connecticut law, areas used for recreational purposes are required to meet cleanup standards for residential use. As a result, cleanup actions will focus on soil that presents unacceptable cancer and/or non-cancer risks to adults and children who might live on the property in the future. In addition, soil at the Operations/Railroad Area, isolated areas on the Cianci properties, and the drainage ditch north of the culvert exceed Connecticut RSRs for pollutant mobility criteria and/or direct exposure criteria. Wetland soil at the culvert outfall also exceeds RSRs for direct exposure criteria and presents an unacceptable ecological risk.

2.2.3 Sediment and Surface Water Risk

The total cancer risk and non-cancer risk calculated as part of the Baseline Risk Assessment for accidental ingestion and dermal contact with surface waters and sediment indicate that surface water and sediment do not present an unacceptable risk to human health.

Surface water at the discharge of the 30-inch concrete culvert poses an unacceptable risk to ecological receptors.

2.2.4 Remedial Action Objectives

Remedial Action Objectives (RAOs) have been developed in consultation with EPA and CTDEP for Operations Area/Railroad soil; overburden and bedrock groundwater; overburden and bedrock NAPL areas; and Cianci Property soil (including wetland soil). Although surface water at the culvert outfall also presented an unacceptable ecological risk due to PCBs, that risk will be addressed by the action taken to address PCBs in wetland soil at the same location. As a result, no cleanup objectives were developed for surface water.

The RAOs were developed based upon potential human health or ecological risks associated with exposure to these areas of the site. A summary of each area of the site and the threats each present is included in **Table 2-4**.

The clean up objectives for each area of the Site are presented below.

Operations Area/Railroad Soil – Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to soil contaminants that may exceed an excess carcinogenic risk of 1×10^{-4} to 1×10^{-6}, that may pose a non-carcinogenic Hazard Index greater than 1, or that exceed ARARs (regulatory criteria). Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARS or which might otherwise present an unacceptable risk.

Operations Area/Railroad Soil – Protection of the Environment

Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARs or present an unacceptable risk in groundwater.

Cianci Property Soil – Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to soil with contaminants that exceed ARARs (regulatory criteria). Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARs or which might otherwise present an unacceptable risk in groundwater.

Cianci Property Soil – Protection of the Environment

Prevent potential ecological risks associated with SRSNE-related contaminants.

Overburden NAPL Area – Human Health

Reduce or stabilize the NAPL mass that would otherwise result in groundwater concentrations that may pose a carcinogenic risk in excess of 1×10^{-4} to 1×10^{-6}, non-carcinogenic Hazard Index greater than 1, or that may exceed ARARs.

Overburden NAPL Area – Protection of the Environment

Reduce NAPL mass in this area to achieve one or more of the following:

- Shorten the time frame that groundwater standards are exceeded;

- Shrink the size of the groundwater contaminant plume;
- Reduce groundwater contaminant concentrations; and
- Prevent the migration of NAPL.

Overburden Groundwater – Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to overburden groundwater with contaminants that may pose an excess carcinogenic risk in excess of 1×10^{-4} to 1×10^{-6}, non-carcinogenic Hazard Index greater than 1, or that may exceed ARARs.

Overburden Groundwater – Protection of the Environment

Restore groundwater quality to meet ARARs.

Bedrock NAPL Area – Human Health

Minimize expansion of the extent of contaminated bedrock groundwater due to further NAPL migration.

Bedrock NAPL Area – Protection of the Environment

Minimize expansion of the extent of contaminated bedrock groundwater due to further NAPL migration.

Bedrock Groundwater – Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to bedrock groundwater with contaminants that may pose a carcinogenic risk in excess of 1×10^{-4} to 1×10^{-6}, that may pose a non-carcinogenic Hazard Index of 1, or that may exceed ARARs.

Bedrock Groundwater – Protection of the Environment

Prevent continuing migration of contaminants that exceed ARARs or that present an unacceptable risk; and restore bedrock groundwater to meet ARARs once VOC residuals are depleted.

2.3 Preliminary Remediation Goals

Preliminary remediation goals (PRGs) provide the basis for development and comparison of remedial alternatives and the framework to evaluate the relative effectiveness of each respective alternative. PRGs are based on remedial goals for the CERCLA program including chemical-specific ARAR levels. PRGs were developed for soil, wetland soil, groundwater and riverine sediment. No PRG was proposed for surface water, based on the assumption that remediating wetland soils in the culvert outfall area will also address PCBs in surface water in that area. Separate remedial goals will be established for the overburden and bedrock NAPL areas, where risk-based PRGs are not expected to be achieved in the short-term.

Tables 2-5a to 2-5d present potential PRG values for COPCs in soil and groundwater. PRGs were derived for those constituents identified in soil and groundwater as having a cancer risk level of 1×10^{-6} and/or significantly contributing to a non-cancer hazard of 1 [In some instances COPCs with a hazard quotient (HQ) less than 1 are included if they significantly contribute to a HI greater than 1 or exceed an ARAR.]

Table 1-1b shows those substances which are known to exceed CT RSRs at this time.

PRGs are also derived for PCBs and PAHs in wetland soil at the culvert outfall area that are protective of ecological risk. Finally, site-specific PRGs were calculated for riverine sediment. The following discussion presents the rationale behind the selected PRGs.

Soil PRGs

The soil PRGs are the lesser of the Connecticut Remediation Standard Regulations (RSRs) residential direct exposure criteria (DEC), the RSR pollutant mobility criteria (PMC), and risk-based concentrations [based on a cancer risk of 1 x 10^{-6} and/or a HQ of 1 and exposure assumptions for a resident used in the RA update (Appendix J)]. Because the RA update evaluated potential exposure to unsaturated soils only (soils to a depth of 10 feet or groundwater, whichever was shallower), DEC and PMC are used in the PRG selection process. **Table 2-5a** lists the potential PRGs that were identified using the stated sources as described above. The lowest of these values is the selected PRG (**Table 2-5b**). **Table 2-5b** also provides the cancer risk level and non-cancer hazards associated with residential exposure to the selected PRG.

Groundwater PRGs

PRGs for groundwater are the lower of the CTDEP RSR criteria [i.e., background levels for the SRSNE site (which are the analytical detection limits for organics)], USEPA maximum contaminant levels (MCLs), and in the absence of a federal or state standard, risk-based concentrations [based on a cancer risk of 1 x 10^{-6} and a non-cancer HQ of 1 and groundwater exposure assumptions consistent with potable use of the groundwater]. These values are presented in **Table 2-5c** and the selected PRGs are presented in **Table 2-5d**. PRGs for inorganics are currently the lower of the available MCLs and CTDEP RSRs, and in their absence, a risk-based concentration. The PRGs for inorganics are subject to change based on an ongoing (2005) background groundwater investigation for inorganics. When this data becomes available, background concentrations will be considered in the PRG selection process. These background levels for inorganics for the SRSNE Site should be representative of regional background values and therefore may be appropriate as remediation goals.

Wetland Soil PRGs

Per USEPA's *A Guide on Remedial Actions at Superfund Sites with PCB Contamination* (OSWER Directive 9355.4-01FS. August 1990), a cleanup level of close to 1 ppm is to be considered where the organic carbon concentrations are 5%. Total organic carbon measured at this Site during the 1991 Remedial Investigation ranges from 4.3% to 4.6%. Therefore, the PRG of 1 ppm set for total PCBs in soil (Table 2-5b) is also protective of ecological health in the area of the culvert outfall.

There are no established benchmarks to use as PRGs for PAHs in wetland soil to address potential ecological risks. However, conservative screening levels are available from a variety of sources. These values were compared to the RSR DECs for PAHs, and the human-health based DEC values were found to be lower. Therefore, clean up to meet the DEC levels will also be protective of ecological health.

Riverine Sediment

The sediment in the Quinnipiac River does not pose an excess carcinogenic risk in excess of 1 x 10^{-4} to 1 x 10^{-6} or a non-carcinogenic Hazard Index of 1. The CTDEP RSRs establish DEC for soil; however these values are not directly applicable to riverine sediment. Therefore, human-health based PRGs for sediment were calculated by modifying the CTDEP soil RSR DEC concentrations to account for differences in exposure. The following describes the adjustment in the exposure frequency used to develop the modified DEC values for sediment.

The default exposure factors used in calculating a risk-based direct exposure concentration for residential soils are listed in the table below and consider both the child and adult exposures.

Parameter	Default Exposure Factor
Target Cancer Risk Level	1 x 10^{-6} (unitless)
Hazard Index	1 (unitless)
Ingestion Rate (child)	200 mg/day
Ingestion Rate (adult)	100 mg/day
Exposure Frequency	365 days/year
Exposure Duration (child)	6 years
Exposure Duration (adult)	24 years
Body Weight (child)	15 kg
Body Weight (adult)	70 kg
Averaging Time (for carcinogens)	25,550 days
Averaging Time (non-carcinogens-child)	2,910 days
Averaging Time (non-carcinogens-adult)	8,760 days

Because the exposure frequency to river sediment is expected to be much lower than exposure to the residential soil (365 days per year), this parameter was adjusted to reflect a scenario where exposure to sediment is 10-times lower than that of residential soils (36.5 days per year). Exposure to sediments of the Quinnipiac River will be at least 10-times lower than residential soil exposure because of limited public access and public use. Adjusting the exposure frequency results in calculated PRGs for sediment that are 10-fold higher than the residential soil DECs. No sediment in the Quinnipiac River exceeded the calculated sediment PRGs.

Another riverine sediment screening value for PCBs of 0.1 mg/kg using the sediment-to-fish pathway for human exposure was derived by the Connecticut Department of Public Health (CDPH) (See **Appendix N**). CTDEP recommended that the most recent sediment data for the Quinnipiac River be compared to this value. Only one sample [SD-10-99-4 (0.5-2.0 feet) = 0.11 mg/kg PCB] exceeded this screening value of 0.1 mg/kg, but only by a very small margin. The potential human food chain pathway for fish, assuming the fish spent their entire lives within the 1,800 foot reach of the river adjacent to and immediately downstream of SRSNE, does not pose a significant risk based on the new sediment data.

2.4 General Response Actions

General Response Actions (GRAs) are potential cleanup technologies identified for the site. GRAs may include treatment, containment, excavation, extraction, disposal, institutional actions, or a combination of these. Like RAOs, these technologies are identified for each area of the Site that presents an unacceptable risk. A listing of the GRAs for each area of the Site is presented below.

Operations Area/Railroad Soil

- No Action
- Institutional Controls/Limited Actions
- Containment
- Ex-Situ Treatment or Disposal
- In -Situ Treatment

Cianci Property Soil

- No Action

- Containment
- Removal and Disposal

Overburden NAPL Area

- No Action
- Institutional Controls/Limited Actions
- Containment
- Removal and Offsite Disposal
- In-Situ Treatment

Overburden Groundwater

- No Action
- Institutional Controls/Limited Actions
- Containment
- Diversion
- Containment/Removal with Ex-Situ Treatment
- In-Situ Treatment

Bedrock NAPL Area

- No Action
- Institutional Controls/Limited Actions
- Containment

Bedrock Groundwater

- No Action
- Institutional Controls/Limited Actions
- Containment
- Diversion
- Containment/Removal with Ex-Situ Treatment
- In-Situ Treatment

2.5 Areas and Volumes of Media to Which Remedial Action May Apply

In accordance with applicable guidance, the development of remedial alternatives during the FS process includes an initial determination of the areas or volumes at each part of the Site that would potentially be addressed by each cleanup technology. This determination is based on the results of the investigations completed as part of and subsequent to the RI, considering the preliminary cleanup levels developed for the site. A description of the areas or volumes is presented in this section.

2.5.1 Operations Area/Railroad Soil

The soil database for the site was screened to evaluate each soil sample with respect to the cleanup levels developed for soil (**Appendix M**). The results indicated that CTDEP Direct Exposure Criteria (DEC) exceedences were primarily within the Operations Area/Railroad (**Appendix M, Figure M-1**). Another cluster of exceedences (sampling locations SB-915, SS3-B3, SD1-05, SD3-34, SD3-35 and SD3-36) was identified near the outfall of an underground culvert that crosses the Southern Cianci Property and discharges to the western floodplain of the Quinnipiac River. Other isolated exceedences (SS3-B2, SS3-B4, and SB-907) were also noted on the Southern Cianci Property**.** The exceedences observed at the culvert outfall, and on the Cianci Property are addressed with the Cianci Property Soil discussed below**.**

The CTDEP Pollutant Mobility Criteria (PMC) screening similarly identified the majority of exceedences within the Operations Area or the railroad (**Appendix M, Figure M-2**). Other isolated exceedences (SB3-B4, SB-905 and SB-914) were also noted in the southern Cianci Property, although these are minor exceedences within a factor of one to three times the listed PMC.

Based on the analysis of contaminants presented in the RI Report, the cleanup levels developed for soil, depth to seasonal high water table (to avoid recontamination from contact with contaminated groundwater in the overburden), and data presented in **Appendix N**, the volume of contaminated soil is approximately 17,000 cubic yards. The approximate area that will be addressed is shown on **Figure 2-1**.

2.5.2 Cianci Property Soil

The areas potentially requiring remedial action are as follows:

- the 30-inch diameter culvert crossing the former Cianci property that conveys site runoff to the Quinnipiac River;
- isolated surficial soil locations on the former Cianci property; and
- wetland soil within, at the entrance to, and at the discharge of the 30-inch diameter culvert.

Clean up actions would be taken in these areas based upon cleanup levels developed, (**Appendix M**) and actionable ecological risk. Impacted soil in the wetlands at the culvert discharge (near sampling locations SB-915, SS3-B3, SD1-05, SD3-34, SD3-35 and SD3-36) presents an unacceptable risk to ecological receptors. The total volume where cleanup is necessary to address Cianci Property soil is approximately 900 cubic yards.

2.5.3 Overburden NAPL Area

The area and volume (**Figure 2-3**) is based on the results of the NAPL delineation pilot study performed at the site in November, 2003.

The results of the NAPL Delineation Pilot Study indicate the following:

- while the potential existence of NAPL in the subsurface at the former Cianci Property cannot be absolutely ruled out, it appears that NAPL is much more prevalent in the former Operations Area of the site;

- pooled NAPL was interpreted as present below the approximate water table at several locations in the former Operations Area;

- residual NAPL was interpreted as present above and below the water table at several locations in the former Operations Area; and

- pooled and residual NAPL were both encountered near the base of the overburden at several locations in the Operations Area.

Based on the results of the pilot study, an area of approximately 1.5 acres, predominantly within the Operations Area of the Site extending from the water table to the top of bedrock will be addressed. The volume of this area is approximately 47,000 cubic yards, with 32,000 cubic yards below the water table, containing an estimated 460,000 kg (1,000,000 pounds) of NAPL. The actual mass in this area could range from 500,000 pounds to 2,000,000 pounds.

2.5.4 Overburden Groundwater

The areal extent of impacted groundwater is estimated as approximately 29 acres. The plume has been defined on the basis of background as required by CTDEP (as well as on the basis of USEPA MCLs/MCLGs). VOC mass estimates presented in the RI indicate that most of the contamination is present in the overburden, and only a minor fraction is in the bedrock. The total dissolved and sorbed VOC mass in the overburden were estimated as 1,900 and 9,300 kg, respectively. A significant portion of the area included in this portion of the Site overlaps the Overburden NAPL Area discussed above.

2.5.5 Bedrock NAPL Area

This area was identified based on groundwater quality data from the RI and subsequent Interim Monitoring and Sampling results. The delineation of this zone takes into account locations where NAPL was actually observed in monitoring wells or during drilling activities, as well as groundwater analytical results that suggest there was NAPL in the vicinity of a well. The estimated area is shown on Figure 2-5, and covers approximately 6.0 to 14.6 acres

The depth of the bedrock NAPL area was not investigated directly during the RI. However, assuming the bedrock probable NAPL zone extends an average of 60 feet below the top of bedrock, the total volume of the bedrock NAPL area is estimated as a minimum of 580,000 cubic yards. Based on the distribution of dissolved VOCs and the hydraulic gradient, it appears that the NAPL could extend to a depth on the order of 200 feet below grade, or 160 feet below the top of bedrock within portions of the probable NAPL zone. Assuming the bedrock potential NAPL zone extends an average of 100 feet below the top of bedrock, the total volume of the bedrock potential NAPL zone could be as much as 2.3 million cubic yards.

2.5.6 Bedrock Groundwater

Figure 2-6 presents the 31-acre area where groundwater in bedrock exceeds regulatory criteria. As with groundwater occurring in overburden, this area was defined on the basis of background as required by CTDEP (as well as on the basis of USEPA MCLs/MCLGs). A portion of the SRSNE groundwater plume in the bedrock extends downgradient of the existing NTCRA 2 containment area. This part of the plume is in the southern portion of the Town Well Field property. The constituents in this area are primarily VOCs at low concentrations (less than drinking water limits).

2.6 Identification and Screening of Technology Types and Process Options

The methodology used to identify potential technologies and process options is discussed below. This is a two-step process; in the first step the universe of potentially applicable technology types and process options is identified and reduced by eliminating those options that are not technical implementable. In the second step, each option is evaluated based on effectiveness, implementability and cost relative to the other options for the same technology type. The goal of this second step is, if possible, to identify one representative process option for each technology type. Technologies and process options that are retained through this process will be used in the assembly of remedial alternatives in Section 3.

Remedial technologies and process options were identified based on a review of available literature, including the following USEPA documents:

- "Remedial Action at Waste Disposal Sites Handbook," USEPA, October 1985;
- "Treatment Technologies," August 1991;

- USEPA Superfund Innovative Technology Evaluation (SITE) program literature (various dates);
- "Innovative Treatment Technologies," USEPA, October 1991;
- "Remediation Technologies Screening Matrix and Reference Guide," USEPA, July 1993;
- Evaluation of Technologies for In-Situ Cleanup of DNAPL Contaminated Sites, USEPA, 1994;
- Presumptive Response Strategy and Ex-Situ Treatment Technologies for Contaminated Groundwater at CERCLA Sites, October 1996;
- "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites", USEPA, December 1997; and
- “A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents,” USEPA, July 1999.

In addition, select technology/process option vendor information was consulted to identify additional candidate technologies that are potentially applicable for addressing the contaminants in the media of concern at the site.

2.6.1 Identification and Initial Screening of Technologies

In this section, a list of potentially applicable technologies and technology processes is compiled and then reduced by evaluating the process options with respect to technical implementability. A summary is presented in **Table 2-6**.

2.6.1.1 Technologies for Operations Area/Railroad Soil

The potentially applicable technology types and process options associated with soil in the Operations Area and along the railroad are discussed below. A summary of the technical implementability screening of the technologies can be found in **Table 2-7**.

No Action

Under this option, no additional actions would be taken in the Operations Area or the along the railroad to address exposure to soils. The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained throughout the detailed evaluation of alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for soils.

Institutional/Access Controls

Access controls and deed restrictions are actions that could be implemented to limit potential exposure to contaminated soil in the Operations Area and along the railroad.

Access Controls

Access controls such as site fencing and posting are intended to limit unauthorized access to the site. These options are technically implementable and will be retained for further evaluation.

Institutional Controls
Institutional controls are aimed at preventing unauthorized access to or use of the site by the public through legal restrictions on the future use of the property. This option would include the placement of deed restrictions and Environmental Land Use Restrictions (ELURs) on the property to limit future use of the site. Institutional measures are technically implementable and, therefore, will be retained for further evaluation.

Containment

Containment technologies for Operations Area/Railroad soil include hydraulic containment and the use of physical barriers.

Hydraulic Containment

Hydraulic containment involves pumping and treating groundwater to limit the migration of contaminants from the area of concern. The hydraulic containment option is not technically implementable for soil and will not be retained for further evaluation.

Physical Barriers

Physical Barriers include horizontal barriers such as caps, and vertical barriers such as underground walls. Capping technologies limit exposure by preventing contact with soil and reduce migration of contaminants from soil to groundwater. Capping would involve upgrading the existing asphalt cap or installing a new low permeability asphalt, geocomposite, or multilayer clay and geosynthetic material cap. The cap would be designed to minimize infiltration and promote surface water runoff, and would be installed in a manner that minimizes disturbance of soil. Because capping is technically implementable, this technology will be retained for further evaluation.

Vertical barriers are subsurface structures that physically limit the horizontal migration of contaminants. Typical vertical barriers include slurry walls, sheet piling, and grout curtains. Vertical barriers are not applicable to soil, and will not be retained for further evaluation.

Ex-Situ Treatment or Disposal

The following ex-situ technologies have been identified for addressing the soil in these areas. Ex-situ technologies require contaminated material be removed for treatment as opposed to in-situ treatment where the contaminated material is treated in place.

- Excavation
- Offsite Disposal
- Thermal Treatment
- Chemical Treatment
- Physical Treatment
- Biological Treatment

Excavation

This technology consists of excavating soil to remove contaminated material. Soil is present only at shallow depths and can be excavated using standard construction equipment (e.g., backhoe and excavator). Because this technology is technically implementable and the use of any ex-situ treatment technology would require excavation of contaminated soil, this technology will be retained for further evaluation.

Offsite Disposal

This technology would involve transporting excavated soil to an existing, offsite commercial landfill facility for disposal. This technology is technically implementable and will be retained for further evaluation.

Thermal Treatment

Thermal treatment includes low temperature thermal desorption (LTTD) and incineration. LTTD involves heating excavated soil containing constituents with boiling points less than 800° F using a mobile treatment unit, the contaminants in the soil are transferred to the air, captured and treated prior to being discharged to the atmosphere. Incineration would be implemented in a manner similar to LTTD, although instead of thermally desorbing contaminants at relatively low temperatures, incineration provides high temperature thermal destruction of contaminants. The treated soils from either treatment technique could be used as backfill material within the excavation. Both LTTD and incineration are technically implementable, and will be retained for further evaluation.

Chemical Treatment

Chemical treatment includes stabilization and solidification. These options involve mixing excavated soil in a vessel (tank or container) with stabilization agents to alter the physical or chemical state of the constituents present in the soil matrix. The end product is a stabilized mass in which the constituents are less toxic and/or leachable than the original soil. Because stabilization/solidification is technically implementable, it will be retained for further evaluation.

Physical Treatment

Physical treatment includes soil washing and solvent extraction. Soil washing is an aqueous-based technology that, in general, uses mechanical processes to separate fine- and coarse-grained particles in soil. This technology is based on the principle that contaminants adhere mostly to the fine particles in soil. Separating these fine particles effectively separates and concentrates the contaminants into a smaller volume of soil that can be further treated or disposed of. Washing separates the fine- and coarse-grained particles that are then separated in a gravity separator. Attrition scrubbing may then be used to remove contaminant films that are adhered to coarser particles.

Solvent extraction uses a cosolvent to strip and remove contaminants from affected soil. Solvent extraction does not destroy contaminants but is a means of separating hazardous contaminants from soil, thereby reducing the volume of the hazardous waste that must be treated. The treated material would be disposed of off site after having met the required standards.

Because both soil washing and solvent extraction are technically implementable, these options will be retained for further evaluation.

Biological Treatment

Biological treatment involves using microorganisms to change the nature of contaminants in soil. A variety of biological treatment techniques are available for the treatment of soils. These techniques can be performed either anaerobically (in the absence of oxygen) or aerobically (in the presence of oxygen), although biological treatment under aerobic conditions is not applicable to chlorinated contaminants which are present at this Site.

Biological treatment is technically implementable and will be retained for further evaluation.

<u>*In-Situ Treatment*</u>

The following in situ treatment (treatment in place) technologies have been identified for addressing the soil in these areas.

- Thermal Treatment
- Chemical Treatment
- Biological Treatment
- Physical Treatment

Thermal Treatment

Thermal includes steam stripping, vitrification and electrical resistance heating. Steam stripping involves the subsurface application of a heat source (i.e., steam) to increase desorption and volatilization of VOCs from the soil. The volatilized VOCs are entrained in the steam and carried to the surface where they can be captured for treatment. Steam stripping typically involves the use of drill augers modified to allow the injection of steam while drilling in the treatment area. The area being actively treated is covered with a shroud placed under negative pressure, which is designed to collect VOC-containing vapors as they rise to the surface. The collected vapors are typically condensed to remove water and treated as needed prior to discharge.

Vitrification involves inducing an electrical current (producing temperatures up to 3,600 C) across the impacted area. Large electrodes are inserted into contaminated soil containing significant levels of silicate. Because dry soils not electrically conductive, a layer of conductive material (e.g., graphite) is placed between the electrodes. At the induced temperatures, any soil or rock components of the waste material will melt, organic compounds will be pyrolyzed in the glass matrix, and many metallic materials will either fuse or vaporize. Any gases and vapors produced can be collected for treatment at the surface with a shroud under negative pressure. After the process is terminated and the soil cooled, the fused waste material is dispersed into a chemically inert and stable crystalline form that has a very low leachability.

Electrical resistance heating uses an electrical current to heat less permeable soils such as clays and fine-grained sediments so that water and contaminants are vaporized and ready for vacuum extraction. Electrodes are placed directly into the less permeable soil. Electrical current passes through the soil, creating a resistance which then heats the soil. The heat dries out the soil causing it to fracture. These fractures allow the use of soil vapor extraction (SVE) to remove the contaminants. The heat created by electrical resistance heating also forces trapped liquids to vaporize and move to the steam zone for removal by SVE. With this technology, the temperature of the contaminated soil is increased, thereby increasing the contaminant's vapor pressure and its removal rate.

Steam stripping, vitrification, and electrical resistance heating are technically implementable, and will be retained for further evaluation.

Chemical Treatment

Chemical treatment includes in-situ oxidation and stabilization/solidification. In-situ oxidation involves injection of a chemical to oxidize organic contaminants. The chemical oxidants most commonly employed include peroxide, ozone, and permanganate. These oxidants are able to cause the rapid chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation.

Stabilization/solidification involves mixing the soils with stabilizing agents to alter the physical and/or chemical state of the constituents present in the soil. The end product is a stabilized mass in which the constituents are less toxic and/or less leachable than the original material. In-situ stabilization/solidification involves mixing soil with stabilizing agents typically including cement-, pozzolonic-, asphalt-, or organic polymer-based agents. The process is designed to result in a low-permeability monolith of stabilized soil.

In-situ oxidation requires saturated soils to aid in dispersing the oxidant, and therefore would not be technically implementable for the unsaturated soil being addressed here. This option will not be retained for further evaluation. Stabilization/solidification would be technically implementable and will be retained for further evaluation.

Biological Treatment

Biological treatment involves the use of natural biological processes to reduce the concentrations of contaminants. Biological treatment includes bioventing and soil mixing/nutrient addition. Bioventing involves the use of air circulation to stimulate and support aerobic degradation of soil contaminants. Because chlorinated compounds do not readily biodegrade in aerobic conditions, this option is not technically implementable. Soil mixing/nutrient addition involves the addition of nutrients to stimulate biodegradation of soil contaminants. This process option is technically implementable, and will be retained for further evaluation.

Physical Treatment

Soil vapor extraction (SVE) is a potential physical treatment option for remediation of soil. This option involves separation of VOCs from the soil matrix by inducing a high-flow vacuum within the contaminated zone. This process option is technically implementable and will be retained for further evaluation.

2.6.1.2 Technologies for Cianci Property Soil

The potentially applicable technology types and process options associated with surficial and wetland soils on the former Cianci Property are discussed below. A summary of the technical implementability screening of the technologies is presented in **Table 2-8**.

No Action

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation through the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for the soil and sediment on the former Cianci Property.

Containment

Containment involves the use of a physical barrier to limit exposure to contaminated soil. Several options could be employed including a soil cap, asphalt cap, synthetic (i.e., geomembrane) cap, and a multilayer cap comprising low permeability soil and geomembrane. This technology is technically implementable and will be retained for further analysis.

Removal and Disposal

The following technologies have been identified to address the drainage pathway soil.

- Excavation
- Culvert Removal/Drainage System Rerouting
- Onsite Disposal

- Offsite Disposal

Excavation

Excavation and removal of contaminated soil will address the potential ecological risks associated with contaminants on the former Cianci property. Because this technology is technically implementable and will be required for options involving disposal it will be retained for further evaluation.

Culvert Removal/Drainage System Rerouting

Culvert removal with relocation/rerouting of the drainage system would prevent groundwater, which is an ongoing source of contamination, from infiltrating the culvert and impacting downgradient surface water and wetland soil. This technology is technically implementable and will be retained for further evaluation.

Onsite Disposal

This technology would be implemented in conjunction with the capping option discussed under *Technologies for Operations Area/Railroad Soil,* and would consist of placing the excavated soil under the proposed cap for the site. Based on the concentration levels identified in the RI/FS (HNUS, 1994), it is not anticipated that soil will require treatment prior to placement beneath the cap (this would be confirmed by additional testing during predesign). This technology is technically implementable and will be retained for further analysis.

Offsite Disposal

This technology would consist of excavation and offsite disposal of contaminated soil in a permitted landfill. Based on the concentration levels identified in the RI/FS (HNUS, 1994), which indicates that constituent concentrations in soil are below land disposal restriction levels, it is not anticipated that soil will require treatment prior to disposal (this would be confirmed by additional testing during predesign). This technology is technically implementable and will be retained for further analysis.

2.6.1.3 Technologies for Overburden NAPL Area

The potentially applicable technology types and options for treating NAPL in the overburden are discussed below. A summary of the technical implementability screening of the technologies can be found in **Table 2-9**.

No Action

Under the no action alternative, no additional actions would be taken to address exposure to the saturated soil and groundwater present in this area.

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained throughout the detailed evaluation of alternatives. The no-action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for the overburden NAPL area.

Institutional Controls/Limited Actions

Institutional and/or limited control actions include institutional controls such as deed restrictions, and limited activities such as monitored natural attenuation.

Institutional Controls
Institutional controls include the use of deed restrictions to restrict or prohibit excavation in contaminated areas or restrictions on the use of groundwater. This option is technically implementable and will be retained for further evaluation.

Natural Attenuation

Natural attenuation involves allowing natural processes to address contaminates in the overburden (biodegradation, dilution, diffusion, dispersion, etc.). These natural processes are typically monitored over time. This process option is technically implementable and will be retained for further evaluation.

Containment

Containment includes the use of hydraulic containment and physical barriers. These technologies would focus on containing the migration of contaminants in groundwater from the NAPL area but would not directly enhance or accelerate the reduction in contaminant concentration.

Hydraulic Containment

Hydraulic containment includes the continued operation of the NTCRA 1 groundwater extraction system, which is currently providing effective hydraulic containment of the overburden NAPL area. Additional extraction wells or extraction trenches could be added to this extraction system. This is technically implementable at the site, and will be retained for further evaluation.

Physical Barrier

A physical barrier involves subsurface vertical walls put in place to physically limit further migration of the contaminated groundwater from the overburden NAPL area. Options under this technology include slurry walls, sheet pile walls, and grout curtains. All of these options are technically implementable and will be retained for further evaluation.

Removal and Offsite Disposal

Removal and offsite disposal involves the physical removal of contaminants from the overburden NAPL area through excavation or pumping, and the disposal of the materials at offsite licensed commercial disposal facilities.

Excavation

This technology consists of excavating material from the overburden NAPL area to remove contamination. This technology is technically implementable and will be retained for further evaluation.

Pumping

Pumping would involve the removal of contamination from the subsurface using extraction wells or trenches installed into the overburden. Both of these options are technically implementable at the site, and will be retained for further evaluation.

Commercial Disposal Facilities

Contaminated material that is excavated would be sent offsite for treatment, if necessary, and disposal at an existing commercial treatment facility. There are a number of facilities in the United States with the capability to treat VOC- and PCB-contaminated material, at the levels found in this area of the Site. This technology is technically implementable and will be retained for further evaluation.

In-Situ Treatment

The following in-situ treatment technologies have been identified for the overburden NAPL area:

- Thermal Treatment
- Physical Treatment
- Chemical Oxidation
- Biological Treatment

Thermal Treatment

Thermal treatment involves heating the overburden NAPL area to enhance desorption, volatilization, and/or destruction of contaminants. Thermal treatment must be combined with a vapor extraction system to capture contaminants in the vapor phase so they can be treated. Options for thermal treatment include steam injection/vapor extraction, hot water flooding, electrical resistance heating/vapor extraction, radio frequency heating/vapor extraction, and thermal conductive heating/vapor extraction.

Steam injection/vapor extraction requires the injection of steam or a steam-hot air mixture into wells drilled into the overburden. The steam heats the subsurface and collects mobile and residual contamination from this material. VOC-laden steam is captured at the surface through the use of vapor extraction wells, and treated to remove contaminants for offsite disposal. This option is technically implementable and will be retained for further evaluation.

Hot water flooding involves the injection of moderately hot water to increase contaminant solubility and flow for removal by pumping. This option requires treatment of the material that is removed by pumping. It is technically implementable and will be retained for further evaluation.

Electrical resistance heating uses an electrical current to heat soils such as clays and fine-grained sediments so that water and contaminants are vaporized and ready for vacuum extraction. With this option, the temperature of the material being treated increases, thereby increasing the contaminants' vapor pressure and its removal rate. As with steam injection, contaminants are captured at the surface through the use of vapor extraction wells, and treated to remove contaminants for offsite disposal. This process option is technically implementable and will be retained for further evaluation.

Radio frequency heating uses electromagnetic energy in the radio frequency band to heat soil, resulting in the increased volatilization of VOC contaminants. This option would also be combined with a soil vapor extraction system. However, radio frequency heating is generally not technically implementable in saturated soil, and the volume of material requiring treatment at the SRSNE site is too large for the available radio frequency heating equipment. This process option will not be retained for further analysis.

Thermal conductive heating involves the application of heat using a heating element. Heat is transferred from the heating element to the subsurface via thermal conduction and radiant heat transport. As with steam injection and electrical resistance heating, contaminants are captured at the surface through the use of vapor extraction wells, and treated to remove contaminants for offsite disposal (some contaminants may also be destroyed in place depending on the temperatures reached in the subsurface). This process is technically implementable and will be retained for further evaluation.

Physical Treatment

Physical treatment includes hydraulic displacement, cosolvent extraction/alcohol flushing, air sparging/vapor extraction, foam, and surfactant flushing.

Hydraulic displacement involves the use of water injection and pumping using either wells or trenches to increase hydraulic gradients to mobilize and displace contaminants in the overburden. The contaminants would be pumped along with the extracted groundwater for treatment. Residual amounts of contamination would remain. However, this residual contamination would now have an increased surface area thereby allowing other treatment options such as chemical or biological treatment to more effectively address this residual contamination. This process option is technically implementable and will be retained for further evaluation.

The cosolvent extraction/alcohol flushing requires the addition of alcohol to the overburden NAPL area, resulting in a liquid mixture of water and high concentrations of dissolved contaminants that can be removed by pumping. The extracted material would require treatment. This process option is technically implementable and will be retained for further evaluation.

Air sparging with vapor extraction involves the injection of air into the overburden groundwater unit to change VOCs from the aqueous phase into the vapor phase, so it can be removed through vapor extraction. This option is not expected to be technically implementable at the SRSNE site due to the complex geology in this portion of the Site. This process option will not be retained for further analysis.

The injection of complex sugars, such as cyclodextrin, into the overburden NAPL area would increase the solubility of contaminants. The contaminants would be removed by pumping from extraction wells, where they would be treated. This process option is technically implementable and will be retained for further analysis.

Foam injected into the overburden NAPL area could enhance the removal of mobile contaminants through physical scouring, reduction of interfacial tension, and increasing solubility. These contaminants would be pumped along with the extracted groundwater and then treated prior to disposal. As with hydraulic displacement, residual amounts of contamination would remain. However, this residual contamination would now have an increased surface area thereby allowing other treatment processes such as chemical or biological to more effectively address this residual contamination. This process option is technically implementable and will be retained for further evaluation.

The surfactant flushing involves the injection of surface agents to increase contaminant solubility. Contaminants would be removed from the subsurface by pumping from extraction wells, and the recovered contaminants would be treated prior to disposal. This process option is technically implementable and will be retained for further evaluation.

Chemical Oxidation

Chemical oxidation relies on an oxidant to chemically break down NAPL constituents. The oxidant would be delivered to the subsurface using injections wells or trenches, and would migrate with groundwater into the target treatment zone. Potentially applicable process options for this technology include the use of permanganate, persulfate, and hydrogen peroxide (Fenton’s Reagent).

Two common forms of permanganate are potassium permanganate and sodium permanganate. Both of these are technically implementable and will be retained for further evaluation.

Persulfate salts are available in three forms: ammonium persulfate, sodium persulfate and potassium persulfate. The use of persulfate salts in an in-situ chemical oxidation technology is technically implementable, and will be retained for further evaluation.

Hydrogen peroxide by itself is a strong oxidant, but is very unstable in the environment. It is typically used in chemical oxidation applications with an iron catalyst as “Fenton’s Reagent.” This process option is technically implementable and will be retained for further evaluation.

A reactive permeable barrier would involve the use of a passive treatment wall, similar to that discussed below for overburden groundwater. This process option is technically implementable and will be retained for further evaluation.

Biological Treatment

Biological treatment would include the use of injection wells for the addition of nutrients (biostimulation) or bacteriological cultures (bioaugmentation) to accelerate biodegradation of contaminants. These options are considered to be technically implementable at the site, and will be retained for further evaluation.

Phytoremediation would use plants to enhance VOC degradation in the plant rhizosphere, enhance phytodegradation, promote hydraulic control and increase phytovolatilization. This process option would only address dissolved phase contaminants, and therefore is not considered technically implementable for the pools of NAPL in the overburden. It will not be retained for further evaluation.

2.6.1.4 Technologies for Overburden Groundwater

The potentially applicable technology types and options associated with groundwater in the overburden aquifer are discussed below. A summary of the technical implementability screening of the technologies is presented in **Table 2-10**.

<u>*No Action*</u>

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation through the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for overburden groundwater.

<u>*Institutional Controls/Limited Actions*</u>

Institutional and/or limited control actions include institutional controls such as deed restrictions, and limited activities such as monitored natural attenuation.

Institutional Controls
Institutional controls include the use of deed restrictions to restrict or prohibit the use of groundwater as a potable supply. This option is technically implementable and will be retained for further evaluation.

Natural Attenuation

Natural attenuation involves allowing natural processes (biodegradation, dilution, diffusion, dispersion, etc.) to reduce levels of contamination over time. These natural activities are typically monitored overtime so that the results can be taken into account when accessing the effectiveness of this option. This process option is technically implementable and will be retained for further evaluation.

<u>*Containment*</u>

Containment includes hydraulic containment and physical barriers.

Hydraulic Containment

This technology uses strategically-placed extraction wells to intercept the groundwater plume. Hydraulic containment of overburden groundwater would include the continued operation of the NTCRA 2 groundwater extraction system, which currently provides hydraulic containment of the majority of the contamination in groundwater. The extracted groundwater would be treated using an appropriate treatment technology, as discussed below. Another option under hydraulic containment includes the installation of horizontal drains in trenches. All of these process options are technically implementable at the site, and will be retained for further evaluation.

Physical Barrier

Physical barriers would involve construction of subsurface vertical walls to physically limit further migration of contaminants. Options include slurry walls, sheet pile walls, and grout curtains.

Slurry walls are constructed by filling a trench with a soil-bentonite or cement-bentonite slurry that acts as a low permeability barrier to horizontal groundwater migration. Similarly, sheet pile walls involve driving interlocking metal sheets into the subsurface to provide a vertical barrier to groundwater flow (a sheet pile wall is currently in place as part of the NTCRA 1 containment system). Grout curtains use injected grout as a physical barrier. All of these options are technically implementable and will be retained for further evaluation.

<u>*Diversion*</u>

Groundwater diversion technologies involve the installation of a physical or hydraulic barrier up gradient of the site to divert flow and prevent the influx of clean groundwater into a contaminated area.

Groundwater diversion includes trenches, sheet pile walls, grout curtains, and wells. Trenches collect up gradient groundwater and divert it away from the contaminated source. Sheet pile walls would be driven to the top of bedrock to act as a physical barrier to redirect up gradient groundwater. A grout curtain uses injected grout to fill pore spaces in overburden soil thus diverting groundwater. Vertical extraction wells collect up gradient groundwater and discharge it downgradient of the contaminated area. These options are technically implementable and will be retained for further evaluation.

<u>*Containment/Removal with Ex-Situ Treatment*</u>

Containment/removal with ex-situ treatment would be used in combination with groundwater extraction under the hydraulic containment discussed above, in conjunction with one or more of the following ex-situ treatment technologies.

- Biological Treatment
- Chemical Treatment
- Physical Treatment

Biological Treatment

Biological treatment would be provided by a constructed wetland that would essentially provide treatment through natural biological processes. Contaminated water extracted from wells is discharged into the wetland where the levels of contamination are reduced by natural processes. Because constructed wetland technology is implementable, it will be retained for further evaluation.

Chemical Treatment

Ultraviolet (UV) oxidation, Fenton's Reagent, and zero valent iron are potentially applicable forms of chemical treatment. UV oxidation uses ultraviolet light in conjunction with standard oxidants such as hydrogen peroxide and ozone to achieve greatly increased treatment performance over that obtained by hydrogen peroxide or ozone alone (The existing NTCRA 1 treatment system at the SRSNE Site utilizes this option). Fenton's Reagent is a chemical oxidation technology, similar to UV oxidation, with the difference being that the Fenton's technology generates hydroxyl radicals through the catalysis of hydrogen peroxide by iron. As with UV oxidation, the hydroxyl radicals quickly react with organic contaminants in the water to mineralize the organics into carbon dioxide and water. The zero valent iron process option involves pumping groundwater through a treatment bed that uses reductive dehalogenation triggered by a metal catalyst (i.e., zero valent iron). The result is a non-toxic chloride and simple hydrocarbons, such as methane, ethane and ethene, which are further reduced naturally through biodegradation.

All three of these process options are technically implementable, and will be retained for further evaluation.

Physical Treatment

Physical treatment includes conventional treatment techniques such as flow equalization, metals pretreatment, sedimentation/filtration, oil/water separation, air stripping, and carbon adsorption. These process options are common water treatment techniques that would be combined as needed to provide an effective treatment train. Consequently, conventional treatment is technically implementable and will be retained for further evaluation.

In-Situ Treatment

In-situ treatment involves treating contaminated groundwater in place, rather than removing it for treatment in an aboveground treatment facility. The in-situ treatment technologies that are potentially applicable to the SRSNE site include biological, chemical, and thermal treatment.

Biological Treatment

Biological treatment technology would include the use of injection wells or trenches that add nutrients (biostimulation) or bacteriological cultures (bioaugmentation) to accelerate biodegradation of contaminants. These process options are technically implementable at the site, and will be retained for further evaluation.

Phytoremediation involves the use of plants to naturally remediate contaminated soil and groundwater through a variety of natural mechanisms. Special planting techniques are utilized to develop deep root zones. A phytoremediation pilot study has been underway at the SRSNE Site since 1998, and this process option is considered technically implementable. It will be retained for further evaluation.

Chemical Treatment

Three potential chemical treatment process options include chemical oxidation, installation of a passive treatment wall, and solvent extraction/alcohol flooding.

Chemical oxidation would involve the addition of chemical oxidants to facilitate destruction of contaminants in place. Oxidation chemically converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used include peroxide, ozone, and permanganate.

Passive treatment walls involve directing groundwater flow through a permeable subsurface treatment zone that uses reductive dehalogenation triggered by a metal catalyst (i.e., zero valent iron). The in-situ application of this technology can use a "funnel and gate" system, which includes a low permeability wall (the "funnel") to passively direct flow toward a high permeability zone (the "gate") that contains zero valent iron. As water flows through the iron wall, contaminants are degraded, sorbed, or precipitated. The result is a non-toxic chloride and simple hydrocarbons, such as methane, ethane, and ethene that are further reduced naturally through biodegradation.

Solvent extraction/alcohol flooding uses a cosolvent or alcohol to strip and remove contaminants. Cosolvent flushing involves injecting a solvent mixture (e.g., water plus a miscible organic solvent such as alcohol) into the saturated overburden to extract organic contaminants. Cosolvent flushing can be applied to soils to dissolve either the source of contamination or the contaminant plume emanating from it. The cosolvent mixture is normally injected up gradient of the contaminated area, and the solvent with dissolved contaminants is extracted downgradient and treated above ground. Recovered groundwater and flushing fluids with the desorbed contaminants would be treated prior to disposal. Treatment of the recovered fluids results in process sludges and residual solids.

These options would be technically implementable at the site, and will be retained for further evaluation.

Thermal Treatment

Thermal treatment includes steam injection. Under this process option, steam is forced into groundwater through injection wells to vaporize contaminants. Vaporized components rise to the surface where they are removed by vacuum extraction and then treated. The area being actively treated is covered with a shroud placed under negative pressure, which is designed to collect VOC-containing vapors as they rise to the surface. The collected vapors are typically condensed to remove water and treated as needed prior to discharge. This technology is technically implementable, and will be retained for further evaluation.

2.6.1.5 Technologies for Bedrock NAPL Area

The potentially applicable technologies for NAPL in the bedrock are discussed below. A summary of the technical implementability screening of the technologies can be found in **Table 2-11**.

No Action

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained throughout the detailed evaluation of alternatives. The no-action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for the bedrock NAPL area.

Institutional Controls/Limited Actions

Institutional and/or limited control actions include institutional controls such as deed restrictions, and limited activities such as monitored natural attenuation.

Institutional Controls
Institutional controls include the use of deed restrictions to restrict or prohibit excavation in contaminated areas or restrict the use of groundwater. This option is technically implementable and will be retained for further evaluation.

Natural Attenuation

Natural attenuation involves allowing natural processes (biodegradation, dilution, diffusion, dispersion, etc.) to reduce levels of contamination over time. These natural activities are typically monitored overtime so that the results can be taken into account when accessing the effectiveness of this option. This option is technically implementable and will be retained for further evaluation.

Containment

Containment includes hydraulic containment and physical barriers. These technologies would focus on preventing the migration of contaminants in overburden groundwater by containing the groundwater, but would not directly enhance or accelerate the reduction in contaminant concentration.

Hydraulic Containment

Hydraulic containment of the bedrock NAPL area would include the continued operation of the NTCRA 2 groundwater extraction system, which currently provides effective hydraulic containment of this portion of the site through the use of vertical extraction wells. Extracted groundwater would be treated prior to disposal as discussed below. The hydraulic containment system currently in place could be enhanced by the installation of additional extraction wells or extraction trenches. All of these options are technically implementable at the site, and will be retained for further evaluation.

Physical Barrier

Physical barriers would involve construction of subsurface vertical walls used to physically limit further migration of the contaminated groundwater. Options under this technology include slurry walls, sheet pile walls, and grout curtains. The slurry wall and sheet piling options are not technically implementable in bedrock, and will not be retained for further evaluation. The grout curtain process option is technically implementable, and will be retained.

2.6.1.6 Technologies for Bedrock Groundwater

The potentially applicable technology types and options associated with contaminated groundwater in the bedrock aquifer are discussed below. A summary of the technical implementability screening of the technologies is presented in **Table 2-12**.

No Action

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation through the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for bedrock groundwater.

Institutional Controls/Limited Actions

Institutional and/or limited control actions include institutional controls such as deed restrictions, and limited activities, such as monitored natural attenuation.

Institutional Controls
Institutional controls include the use of deed restrictions to restrict or prohibit the use of groundwater as a potable supply. This option is technically implementable and will be retained for further evaluation.

Natural Attenuation

Natural attenuation involves allowing natural processes (biodegradation, dilution, diffusion, dispersion, etc.) to reduce levels of contamination over time. These natural activities are typically monitored overtime so that the results can be taken into account when accessing the effectiveness of this option. This process option is technically implementable and will be retained for further evaluation.

Containment

Containment includes hydraulic containment and physical barriers.

Hydraulic Containment

Hydraulic containment would include the continued operation of the NTCRA 2 groundwater extraction system, which currently uses vertical extraction wells to provide hydraulic containment of the dissolved phase contaminant plumes in bedrock groundwater. The extracted groundwater would be treated prior to discharge. Other options to enhance this system include the installation of additional extraction wells or extraction trenches. Both the continued operation of the NTCRA 2 extraction systems and the use of additional extraction wells are technically implementable at the site, and will be retained for further evaluation. The use of trenches for hydraulic containment in bedrock is not technically implementable, and will not be retained.

Physical Barrier

A physical barrier would involve construction of subsurface vertical walls to physically limit further migration of contaminated groundwater. Options under this technology include slurry walls, sheet pile walls, and grout curtains.

Slurry walls are constructed by filling a trench with a soil-bentonite or cement-bentonite slurry that acts as a low permeability barrier to horizontal groundwater migration. Similarly, sheet pile walls involve driving interlocking metal sheets into the subsurface to provide a vertical barrier to groundwater flow. Both the slurry wall and sheet pile process options are not technically implementable in bedrock, and will not be retained. Grout curtains use injected grout as a physical barrier, which can be applied to fractured rock matrices. This process option is technically implementable and will be retained for further evaluation.

Diversion

Groundwater diversion involves the installation of a physical or hydraulic barrier up gradient of the site to divert flow and prevent the influx of clean groundwater into a contaminated area.

Groundwater Diversion Barrier

Groundwater diversion includes trenches, sheet pile walls, grout curtains, and wells. Trenches serve as a horizontal drain to collect up gradient groundwater for diversion, and sheet pile walls serve as a physical barrier to groundwater flow. Both of these options would not be technically implementable in bedrock, and will be eliminated from further evaluation. Grout curtains use injected grout to create a barrier to flow in fractured rock. Vertical extraction wells collect up gradient groundwater for discharge downgradient of the contaminated area. These options are technically implementable and will be retained for further evaluation.

Containment/Removal with Ex-Situ Treatment

The containment/removal with treatment combine groundwater extraction under hydraulic containment discussed above with one or more of the following ex-situ treatment technologies.

- Biological Treatment
- Chemical Treatment
- Physical Treatment

The application of these treatment technologies (and their associated process options) is identical to that for the overburden groundwater discussed above.

In-Situ Treatment

In-situ treatment involves treating contaminated groundwater in place, rather than removing it for treatment in an aboveground treatment facility. The in-situ treatment technologies that are potentially applicable to the SRSNE site include biological, chemical, and thermal treatment.

Biological Treatment

Biological treatment would include the use of injection wells or trenches to add nutrients (biostimulation) or bacteriological cultures (bioaugmentation) to accelerate biodegradation of contaminants. These options are considered to be technically implementable at the site.

The biological treatment will be retained for further evaluation.

Chemical Treatment

Three potential in-situ chemical treatment process options include chemical oxidation, installation of a passive treatment wall, and solvent extraction/alcohol flooding.

Chemical oxidation involves the addition of oxidants to facilitate destruction of contaminants in place. Oxidation converts hazardous contaminants to non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. The oxidizing agents most commonly used include peroxide, ozone, and permanganate. These oxidants have been able to cause the rapid and complete chemical destruction of many toxic organic chemicals; other organics are amenable to partial degradation as an aid to subsequent bioremediation. This option would be technically implementable, and will be retained for further evaluation.

Passive treatment walls involve directing groundwater flow through a permeable subsurface that uses reductive dehalogenation triggered by a metal catalyst (i.e., zero valent iron). This process option would not be technically implementable in bedrock, due to the need to install a trench through the treatment zone, and therefore will not be retained.

Solvent extraction/alcohol flooding uses a cosolvent or alcohol to strip and remove contaminants. Cosolvent flushing involves injecting a mixture into the saturated zone to extract organic contaminants. Cosolvent flushing can be applied to soils to dissolve either the source of contamination or the contaminant plume emanating from it. The cosolvent mixture is normally injected up gradient of the contaminated area, and the solvent with dissolved contaminants is extracted downgradient and treated above ground. Recovered contaminated groundwater would be treated prior to discharge. This process option would be technically implementable, and will be retained for further evaluation.

Thermal Treatment

Thermal treatment potentially applicable to bedrock groundwater is steam injection. Under this option, steam is forced into groundwater through injection wells to vaporize volatile and semivolatile contaminants. Vaporized components rise to the surface where they are removed by vacuum extraction and then treated. The area being actively treated is covered with a shroud placed under negative pressure, which is designed to collect VOC-containing vapors as they rise to the surface. The collected vapors are typically condensed to remove water and treated as needed prior to discharge. This technology may be technically implementable in conjunction with a thermal technology applied to the overburden groundwater unit, and will be retained for further evaluation.

2.6.1.7 Technologies Retained for Further Evaluation

The following technologies (and their associated process options) have been retained based solely on their potential technical implementability.

Operations Area/Railroad Soil
No Action
- No Action

Institutional/Access Controls
- Access Controls (fencing, posting)
- Institutional Measures (deed restrictions)

Containment
- Physical Barriers (soil cap, asphalt cap, synthetic cap, multi-layer cap)

Ex-Situ Treatment or Disposal
- Excavation
- Offsite Disposal (landfilling)
- Thermal Treatment (LTTD, incineration)
- Chemical Treatment (stabilization/solidification)
- Physical Treatment (soil washing, solvent extraction)
- Biological Treatment (soil pile treatment, batch reactor)

In-Situ Treatment
- Thermal Treatment (steam stripping, vitrification, electrical resistance heating)
- Chemical Treatment (stabilization/solidification)
- Biological Treatment (soil mixing/nutrient addition)
- Physical Treatment (soil vapor extraction)

Cianci Property Soil
No Action
- No Action

Containment
- Physical Barrier (soil cap, asphalt cap, synthetic cap, multilayer cap)

Removal and Disposal

- Excavation
- Culvert Removal/Drainage System Rerouting
- Onsite Disposal (consolidation with Operations Area/Railroad soils)
- Offsite Disposal (permitted landfill)

Overburden NAPL Area

No Action

- No Action

Institutional and/or Limited Control Actions

- Institutional Measures (deed restrictions)
- Natural Attenuation (long-term monitoring, natural attenuation)

Containment

- Hydraulic Containment (extraction wells, collection trench)
- Physical Barrier (sheet pile wall, slurry wall, grout curtain)

Removal and Offsite Disposal

- Excavation
- Pumping (extraction using wells or trenches)
- Commercial Disposal Facilities (commercial TSDF)

In-Situ Treatment

- Thermal Treatment (steam flooding/vapor extraction, hot water flood, electrical resistance heating, thermal conductive heating)
- Physical Treatment (hydraulic displacement, cosolvent extraction/alcohol flushing, complex sugar, foam, surfactant flushing)
- Chemical Oxidation (hydrogen peroxide, permanganate, persulfate, reactive permeable barrier)
- Biological Treatment (biostimulation, bioaugmentation)

Overburden Groundwater

No Action

- No Action

Institutional and/or Limited Control Actions

- Institutional Measures (deed restrictions)
- Natural Attenuation (long-term monitoring, natural attenuation)

Containment

- Hydraulic Containment (extraction wells, collection trench)
- Physical Barrier (slurry wall, sheet piling, grout curtain)

Diversion

- Groundwater Diversion Barrier (trench, sheet pile wall, grout curtain, wells)

Containment/Removal with Ex Situ Treatment

- Biological Treatment (constructed wetland)
- Chemical Treatment (ultraviolet oxidation, Fenton's reagent, zero valent iron)
- Physical Treatment (conventional treatment)

In-Situ Treatment

- Biological Treatment (injection wells, nutrient/culture addition, phytoremediation)
- Chemical Treatment (reagent addition, passive treatment wall, solvent extraction/alcohol flood)
- Thermal Treatment (steam injection)

Bedrock NAPL Area

No Action
- No Action

Institutional and/or Limited Control Actions
- Institutional Measures (deed restrictions)
- Natural Attenuation (long-term monitoring, natural attenuation)

Containment
- Hydraulic Containment (traction wells)
- Physical Barrier (grout curtain)

Bedrock Groundwater

No Action
- No Action

Institutional and/or Limited Control Actions
- Institutional Measures (deed restrictions)
- Natural Attenuation (long-term monitoring, natural attenuation)

Containment
- Hydraulic Containment (extraction wells)
- Physical Barrier (grout curtain)

Diversion
- Groundwater Diversion Barrier (grout curtain, wells)

Containment /Removal with Ex-Situ Treatment
- Biological Treatment (constructed wetland)
- Chemical Treatment (UV oxidation, Fenton’s Reagent, zero valent iron)
- Physical Treatment (conventional treatment)

In-Situ Treatment
- Biological Treatment (injection wells, biostimulation, bioaugmentation)
- Chemical Treatment (reagent addition, solvent extraction/alcohol flood)
- Thermal Treatment (steam injection)

2.6.2 Evaluation of Process Options

In the following sections, the process options associated with each retained technology type are screened based on their relative effectiveness, implementability and cost. The goal of this screening step is to simplify the development and evaluation of alternatives by selecting, if possible, one process option for each remaining technology type.

The effectiveness evaluation focuses on: 1) the potential effectiveness of options in handling the estimated areas or volumes of media and meeting the cleanup objectives for the site; 2) the potential impacts to human health and the environment during the construction and implementation phase; and 3) how proven and reliable the process is with respect to the contaminants and conditions at the site. The implementability evaluation takes into account both the technical and administrative feasibility of implementing the process. The cost evaluation judges the capital and O&M costs for each process option relative to the others within the same technology type.

2.6.2.1 Operations Area/Railroad Soil

The effectiveness, implementability and cost evaluation of the options for soil in the Operations Area/Railroad are discussed below. A summary of the process option evaluation for this medium of concern is presented in **Table 2-13**.

No Action

As previously stated, the NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained throughout the detailed evaluation of alternatives. The no-action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for these soils.

Institutional/Access Controls

Institutional controls include access restrictions (fencing) and institutional measures such as postings and deed restrictions. Although technically and administratively feasible, fencing is not effective in the long term to prevent exposure to contaminated soil. Institutional controls such as deed restrictions can be effective as long as they are adequately enforced and are technically and administratively feasible and low in cost. This option will be retained for further evaluation.

Containment

Capping was the only containment technology technically implementable for contaminated soil in the Operations Area/Railroad at the site. Capping includes installing a new low permeability soil, asphalt, synthetic, or multilayer clay cap. The cap would be designed to minimize infiltration and promote surface water runoff, and would be installed in a manner that minimizes disturbance of soil.

A cap is technically and administratively feasible, and would be low or moderate in cost. However, both the soil and asphalt caps do not meet applicable or relevant and appropriate requirements (ARARs) at this site and, as such, would not be effective. A synthetic cap may initially be effective in meeting ARARs; however, long-term maintenance and durability are of concern and may reduce the long-term effectiveness of this alternative. Therefore these three process options will not be retained for further evaluation.

A multilayer cap could be designed to effectively meet ARARs. This process option will be retained for further evaluation.

Ex-Situ Treatment or Disposal

The following removal and ex-situ treatment technologies have been identified for addressing Operations Area/Railroad soil.

- Excavation
- Offsite Disposal
- Thermal Treatment
- Chemical Treatment
- Physical Treatment
- Biological Treatment

Excavation

This technology consists of excavating soil that presents an unacceptable risk or exceeds ARARs. Contaminated soil is present only at shallow depths and can be excavated using standard construction equipment (e.g., backhoe and excavator). It is expected that soil excavation would be conducted during seasonal low groundwater conditions. However, because of the shallow depth to groundwater and significant fluctuations in groundwater elevations, a localized groundwater control (i.e., dewatering) system such as a well point system may be needed near the excavation area to limit groundwater accumulation and slope failures within the excavation. Any collected groundwater would presumably be treated and discharged in accordance with legal requirements. Excavated materials would be temporarily stored in a constructed stockpile area prior to treatment and/or disposal. The excavated area would be backfilled with clean fill material. The excavation technology would be combined with another technology process option that would address final disposition of the excavated materials.

Excavation is an effective technology. It may present some short-term risks that would need to be addressed. It is both technically and administratively feasible and could be implemented at moderate capital and low O&M costs. In addition, excavation would be a necessary component of all alternatives that require the soil to be picked up prior to treatment (ex-situ treatment). This process option will be retained for further evaluation.

Offsite Disposal

This process would involve transporting excavated soil to an offsite permitted landfill facility for disposal. The contaminated soil may require treatment prior to disposal to meet Land Disposal Restrictions. Offsite disposal would be an effective technology. It may present some short-term risks that would need to be addressed. It is both technically and administratively feasible and could be implemented at very high capital and low O&M costs. Offsite disposal will be retained for further evaluation.

Thermal Treatment

Thermal treatment would include LTTD and incineration. In general, both of these options would be effective in treating site soils and would be technically feasible. They may present some short-term risks that would need to be addressed. The administrative feasibility of LTTD would be superior to incineration, since significant preliminary testing (e.g., trial burn) would extend the time required to implement incineration and hence reduce its overall implementability. The capital and O&M cost of implementing both options are high.

Based on its superior administrative feasibility, thermal treatment using LTTD will be retained.

Chemical Treatment

Chemical treatment of soil would involve stabilization/solidification. Stabilization/solidification would be technically and administratively feasible and could be implemented at moderate capital and low O&M cost. However, it would not be effective in addressing soil with high concentrations of organic constituents. This technology will not be retained for further evaluation.

Physical Treatment

Physical treatment of soil would involve soil washing and solvent extraction. Both options would be technically and administratively feasible and both would require additional treatment and/or disposal measures for the waste stream. Solvent extraction would have higher short-term risks during implementation when compared to soil washing, and would not be effective on all site contaminants. In addition, solvent extraction would have higher capital and moderate O&M costs. Soil washing would be effective in removing organic constituents from soil, with the overall effectiveness dependent on soil grain size distribution and contaminant adsorption characteristics. Soil washing will be retained for treatment of soil.

Biological Treatment

The ex-situ biological treatment for soil involves soil pile treatment and batch reactor treatment. In terms of implementability, both options would be technically and administratively feasible. Both options would have relatively high capital costs, although the batch reactor treatment has somewhat higher O&M costs. However, biological treatment is not effective on PCBs, and will not be retained for further evaluation.

In-Situ Treatment

The following in-situ treatment options were retained during the technically implementability screening.

- Thermal Treatment (Steam Stripping, Vitrification, Electrical Resistance Heating)
- Chemical Treatment (Stabilization/Solidification)
- Biological Treatment (Mixing/Nutrient Addition)
- Physical Treatment (Soil Vapor Extraction)

Thermal Treatment

Steam stripping, vitrification, and electrical resistance heating are effective in reducing VOC concentrations in soil under certain conditions. The steam stripping and electrical resistance heating options would not be technically feasible for treatment of contaminants in shallow soils, and the vitrification option would not be technically feasible for the volume of soils requiring remedial action. All three options would require high capital and O&M costs to implement. The in-situ thermal treatment will not be retained for further evaluation for the soil in the Operations Area/Railroad Area.

Chemical Treatment

Chemical treatment of soil would involve stabilization/solidification. This process option would be technically and administratively feasible at moderate capital cost. However, it is not effective on soils with high concentrations of organic constituents), and would have relatively high short-term risks during implementation. Therefore, this technology is not retained for further evaluation.

Biological Treatment

The option remaining under this technology consists of mixing soils in place to improve the mass transfer of oxygen and nutrients, which, in turn, enhances the growth and activity of aerobic bacteria. Implementation of this technology may be achieved using commercially available equipment and services and would be moderate in capital and O&M costs. However, this process option would not be effective on treating the PCBs present in the soil, and would carry a relatively high short-term risk during implementation due to the volatilization of contaminants during the mixing process. Thus, this technology will not be retained for further evaluation.

Physical Treatment

Physical treatment for soil involves soil vapor extraction (SVE). This technology would be both technically and administratively implementable and could be implemented using commercially available equipment and construction techniques. The capital and O&M costs to implement SVE are moderate. However, this technology may not be effective given existing site conditions. Previous vapor extraction pilot tests conducted at the facility have concluded that due to the shallow depth to groundwater and the heterogeneity of the soil (which promotes preferential flow pathways and lateral contaminant migration), SVE as a stand-alone would not be an effective remedial technology to treat the soil at this site. Thus, the physical treatment technology will not be retained for further evaluation.

2.6.2.2 Cianci Property Soil

The effectiveness, implementability and cost evaluation for the Cianci Property Soil are discussed below. A summary of this evaluation is presented in **Table 2-14**.

No Action

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation during the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives developed for the surficial and wetland soil on the former Cianci property.

Containment

Containment includes the use of soil, asphalt, synthetic materials, and multilayer soil and geosynthetic materials) in a cap. While all of these options would be equally effective in meeting the cleanup objectives for this area of the site, and all would be technically and administratively feasible, they may not meet ARARs for wetlands/floodplains. Because the majority of this contamination falls within wetlands and/or floodplains, this technology will not be retained.

Removal and Disposal

The following technologies have been identified to address soil on the former Cianci property.

- Excavation
- Culvert Removal/Drainage System Rerouting
- Onsite Disposal
- Offsite Disposal

Excavation

Under this technology, contaminated soil would be excavated from those areas being addressed. Excavation would be combined with another technology to address final disposition of the excavated material. Excavation and removal of soil would be technically and administratively implementable and would effectively address exceedences of regulatory criteria and the potential ecological risks associated with site-related contaminants within the site's drainage pathways. The capital cost to implement this technology would be moderate with low O&M costs. This option will be retained for further evaluation.

Culvert Removal/Drainage System Rerouting

Culvert Removal with Drainage System Rerouting would prevent an ongoing source of contaminants from entering the drainage pathways and impacting downgradient soil. This technology would involve excavating and removing the existing 30-inch concrete culvert, and backfilling the resulting trench with clean fill. Drainage will be rerouted to the Quinnipiac River via a new non-permeable drainage pipe.

This technology would effectively eliminate the infiltration of contaminated groundwater into the existing culvert and the conveyance of contaminated groundwater to downgradient surface water and wetland soil; and prevent human health and ecological risks associated with site contaminants. This technology would be both technically and administratively implementable at moderate capital and O&M costs, and will be retained for further evaluation.

Onsite Disposal

This technology would be implemented in conjunction with the soil capping alternative for Operations Area/Railroad soil discussed above, and would consist of placing the excavated soil under the proposed cap. Based on the concentration levels identified in the RI/FS (HNUS, 1994), it is not anticipated that soil will require treatment prior to disposal (this would be confirmed by additional testing during predesign). This technology would be technically and administratively implementable and effective in eliminating potential future exposure to contaminants and preventing human health and ecological risks associated with site contaminants. The capital and O&M costs to implement this technology would be low. This technology process option will be retained for further evaluation.

Offsite Disposal

This technology would consist of disposal of the excavated soil at an offsite location. Based on the concentration levels identified in the RI/FS (HNUS, 1994), it is not anticipated that this waste material will require treatment prior to disposal (this would be confirmed by additional testing during predesign). This technology would be technically and administratively implementable; and effective in eliminating potential future exposure to contaminants and preventing ecological risks associated with site contaminants. The capital and O&M costs to implement this technology would be high. This technology will be retained for further analysis.

2.6.2.3 Overburden NAPL Area

The effectiveness, implementability and cost evaluation of the options to address the NAPL in the overburden is discussed below. A summary of the process option evaluation for this medium of concern is presented in **Table 2-15**.

No Action

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation during the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives developed for this area of the site.

Institutional Controls/Limited Actions

Institutional controls/limited actions include institutional measures such as deed restrictions (e.g., ELURs), and natural attenuation (including long-term monitoring).

Institutional Controls

Deed restrictions are currently in place prohibiting construction or use of groundwater wells. Additional deed restrictions (i.e., State of Connecticut Environmental Land Use Restrictions) could be implemented to ensure that groundwater would not be used in the future. Deed restrictions would not be effective in reducing the levels of contamination. This option would be technically and administratively feasible at low cost, and will be retained for further evaluation.

Natural Attenuation

Natural attenuation relies on the natural degradation of contaminants through physical, chemical, and biological processes to reduce the concentration of contaminants. This option would be technically and administratively feasible, and could be implemented at a low capital and O&M cost. Natural attenuation will be retained for further evaluation.

Containment

Containment includes hydraulic containment and physical barriers.

Hydraulic Containment

The remaining options available to provide hydraulic containment include vertical extraction wells and collection trenches. Vertical extraction well(s) are currently used at the site (NTCRAs 1 and 2) and are technically and administratively feasible, effective, and relatively low in cost. Collection trenches would consist of excavating a trench to a specified depth, installing a perforated collection pipe at the base of the trench, and backfilling the trench with a permeable fill (e.g., stone) to provide a preferential subsurface discharge zone. This option would be administratively feasible, but would have lower technical feasibility compared to wells due to the difficulty to construct to the required depth and the need to manage a large volume of contaminated soils resulting from the excavation activities. Implementation of this process option would require high capital cost and moderate O&M cost. Vertical wells will be retained for further evaluation.

Physical Barrier

Physical barriers include sheet pile walls, slurry walls, and grout curtains. All three options would be technically and administratively feasible. The sheet pile option would have superior technical feasibility when compared to the others. Each option would also be effective, although the effectiveness of grout curtains in an overburden application would be less certain than the other options. The sheet piling and slurry wall process options would also have lower capital costs when compared to the grout curtain option. Based on this, the sheet pile wall will be retained for further evaluation.

Removal and Offsite Disposal

Removal and offsite disposal include excavation, pumping, and the use of offsite disposal facilities.

Excavation

Excavation could be accomplished using standard construction equipment, and would be an effective means of removing the NAPL in the overburden. Because of the saturated nature of this area of the site, contaminated groundwater entering the excavation would need to be removed and treated in order for this option to be technically feasible. In addition, the potential for significant VOC and particulate emissions during excavation would require that excavation activities be performed within a structure or with other, similar emission controls. The relative capital and O&M costs for excavation are expected to be high.

This option would need to be combined with an ex-situ treatment or offsite disposal technology. It will be retained for further evaluation.

Pumping

This technology would involve the removal of pooled NAPL using either extraction wells or an extraction trench. Extraction wells have been successfully employed at the site, and continue to be employed as necessary when pooled NAPL is detected in wells located in this area of the site. However, its effectiveness would be limited to the immediate vicinity of each extraction well. It is technically and administratively feasible, and has relatively low capital and O&M costs. Extraction of NAPL using trenches may also be effective in shallow overburden, although it too would have limited effectiveness solely as a localized removal technique. Trenches are less technically feasibility compared to wells due to the need to manage substantial volumes of contaminated soils resulting from the trench excavation. The trench option would have relatively high capital and moderate O&M costs. Contamination collected using either of these techniques would require additional treatment prior to disposal.

Extraction wells and trenches are limited as to their effectiveness in addressing the overburden NAPL area and will not be retained for evaluation. However, extraction wells may be combined with a number of technologies where waste is treated in place that require manipulation of hydraulic gradients or the introduction of agents to enhance the mobility of contaminants in the overburden NAPL area.

Commercial Disposal Facilities

This technology would involve the shipment of excavated contaminated waste to an offsite commercially operated, licensed treatment and/or disposal facility. It is currently employed for the disposal of NTCRA 1 treatment residuals. It is technically and administratively feasible, and would have relatively high capital and low O&M costs. This technology will be retained for further evaluation.

In-Situ Treatment

Based on the results of the technical implementability screening, the following technologies involving treatment in place (and associated options) have been identified for the overburden NAPL area of the site.

- Thermal Treatment (steam flooding/vapor extraction, hot water flood, electrical resistance heating, thermal conductive heating)

- Physical Treatment (hydraulic displacement, alcohol flooding, cosolvent extraction, complex sugar, foam, surfactant flushing)

- Chemical Oxidation (Fenton’s reagent, permanganate, reactive permeable barrier)

- Biological Treatment (biostimulation, bioaugmentation)

Thermal Treatment

Thermal treatment involves heating of the overburden groundwater to enhance the desorption, volatilization, and/or destruction of contaminants. Thermal treatment options may be coupled with a vapor extraction system to capture contaminants in the vapor phase for further treatment. The options identified for this area of the site include steam injection, hot water flooding, electrical resistance heating, and thermal conductive heating.

Steam injection involves the injection of steam into the target treatment zone to dissolve, vaporize, mobilize and displace contaminants for recovery with standard vapor and liquid extraction equipment. After extraction, vapors and liquids would be treated using conventional aboveground treatment technologies, such as condensation, air stripping, carbon adsorption and thermal oxidation. While technically and administratively feasible, the complex geology at the site reduces the effectiveness of this thermal option when compared to the others. Steam injection will not be retained for further evaluation.

Hot water flooding involves the injection of moderately hot water to increase solubility and flow of contaminants in the overburden hot spot area for subsequent removal by pumping. While technically and administratively feasible, this process option would be less effective than the other thermal treatment choices. Hot water flooding will not be retained for further evaluation.

Electrical resistance heating involves using electrical current in area being treated to generate heat. As the subsurface temperature increases, steam is generated. The steam dissolves, vaporizes, mobilizes and displaces contaminants that are then recovered by standard vapor and liquid extraction equipment. Conventional aboveground treatment technologies similar to those used with steam injection are usually required. This option would be effective in treating NAPL in the overburden. It is complex but technically and administratively feasible with a moderate to high capital and O&M cost.

Thermal conductive heating involves the application of heat and vacuum to the overburden NAPL area using vertical heater/vacuum wells. Heat is transferred from the heating element to the subsurface via thermal conduction and radiant heat transport. Contaminants are volatilized and removed for treatment using a soil vapor extraction system (some contaminants may also be destroyed in place, depending on the temperature reached). This process option would potentially be effective in addressing the overburden hot spot area. It is complex but technically and administratively feasible option with a moderate to high capital and O&M cost.

There are similarities in the effectiveness, implementability and cost between electrical resistance heating and thermal conductive heating. This suggests that one should not be eliminated from further evaluation at this stage; rather that the representative thermal treatment process option(s) should be identified during the more detailed development of those alternatives that include an in-situ thermal treatment component. In addition, certain site conditions might dictate that a combination of options might be more effective and elimination of one specific option at this point would be premature. Based on these considerations, both of the remaining options will be carried forward.

Physical Treatment

Physical treatment includes hydraulic displacement, cosolvent extraction/alcohol flushing, complex sugars, foam, and surfactant flushing.

Hydraulic displacement involves the use of water injection and pumping using wells and/or trenches to increase hydraulic gradients to mobilize and displace pooled contaminants. Mobilized contamination would be pumped along with the extracted groundwater for treatment. Residual contamination would remain in the target area. This residual contamination has a significantly increased surface area which would enhance dissolution and allow other cleanup processes to further reduce contamination (e.g., enhanced bioremediation, chemical oxidation). This option would be effective at reducing the mobility of NAPL. It could be used in combination with other treatment technologies as part of an overall effective treatment train. It is technically and administratively feasible, and would have a relatively moderate capital and O&M cost. This process option will be retained for further evaluation.

Cosolvent extraction/alcohol flushing requires the addition of alcohol to the overburden NAPL area using wells and/or trenches to reduce the NAPL-water interfacial tension, resulting in a liquid phase extraction of the NAPL from the subsurface. This mixture is then removed by pumping at extraction wells or trenches where it is then treated prior to disposal. Although a relatively innovative application at this scale, this option would potentially be effective at removing significant contamination in the target area, particularly in combination with (following) hydraulic displacement. This option would be technically and administratively feasible, and would have a relatively moderate capital and O&M cost. It will be retained for further evaluation.

The injection of complex sugars, such as cyclodextrin, into the overburden hot spot area would increase the solubility of contaminants. While potentially feasible from a technical and administrative standpoint, this process option would have a lower effectiveness than cosolvent extraction/alcohol flushing at a similar cost. Complex sugar will not be retained for further analysis.

Injected foam to remove contaminants has limited effectiveness due to the heterogeneity of the overburden materials. It would be administratively feasible, but would have a lower technical feasibility compared to other physical treatment process options. It will not be retained for further evaluation.

Surfactant flushing involves the injection of surface active agents to increase contaminant solubility. Contaminants would be removed from the subsurface by pumping from extraction wells, and the recovered contaminants would be treated prior to disposal. This process option would have similar technical and administrative feasibility and cost as cosolvent extraction/alcohol flushing, but would have a lower overall effectiveness. It will not be retained for further evaluation.

Chemical Oxidation

Chemical oxidation for the overburden NAPL area includes injection of hydrogen peroxide (Fenton's Reagent), permanganate, and persulfate; and a reactive permeable barrier. The options requiring the addition of oxidants would also rely on the use of wells and/or trenches for the introduction of the reagents.

Permanganate or persulfate would be technically and administratively feasible. Both would be effective at oxidizing the predominant constituents (PCE, TCE, toluene, benzene, xylenes), although persulfate may require the addition of a catalyst for more complete effectiveness on the contaminants being addressed. Both would require high capital and O&M costs. By comparison, the use of hydrogen peroxide with a catalyst (Fenton's Reagent) would have a lower effectiveness due to the hazards associated with large volumes of this highly unstable and strong oxidizing liquid. Also, because hydrogen peroxide cannot persist in the environment for more than a relatively short period (hours to days), its application at the site would require significantly more injection points than persulfate or permanganate.

All of these options could be enhanced using them in combination with (following) hydraulic displacement. Based on the above considerations, the use of permanganate and/or persulfate alone or in sequence will be the retained for further evaluation.

Biological Treatment

Biological treatment includes the use of injection wells to add appropriate degrading bacteria populations ("bioaugmentation") and/or adding electron donor and other materials to optimize biodegradation ("biostimulation"). Together, these treatments are known as enhanced in-situ biodegradation (Enhanced Biodegradation or EISB). Both are technically and administratively feasible, and would potentially be effective in reducing contaminant mass. Capital and O&M costs for each of these options would be moderate. Although each option could be used by itself, these cleanup options have greater effectiveness and technical feasibility if used in combination with (following) other mass removal cleanup technologies. As a result, EISB will be retained for further evaluation in conjunction with other overburden NAPL cleanup methods.

2.6.2.4 Overburden Groundwater

The effectiveness, implementability and cost evaluation for overburden groundwater is discussed below. A summary of the options evaluated is presented in **Table 2-16**.

No Action

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation during the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for overburden groundwater.

<u>*Institutional Controls/Limited Actions*</u>

Institutional controls/limited actions for the overburden groundwater include institutional measures such as deed restrictions (e.g., ELURs), and natural attenuation (including long-term monitoring).

Institutional Measures

Deed restrictions are currently in place prohibiting construction or use of groundwater. Additional deed restrictions (i.e., State of Connecticut Environmental Land Use Restrictions) could be implemented to ensure that groundwater would not be used in the future. Deed restrictions would not be effective in reducing the levels of contamination. This option would be technically and administratively feasible at low cost, and will be retained for further evaluation.

Natural Attenuation

Natural attenuation relies on the natural degradation of contaminants through physical, chemical, and biological processes to reduce the concentration of contaminants. This process option would be technically and administratively feasible, and could be implemented at a low capital and O&M cost. Natural attenuation will be retained for further evaluation.

<u>*Containment*</u>

Containment for the overburden groundwater includes hydraulic containment and physical barriers.

Hydraulic Containment

The remaining options available to provide hydraulic containment include vertical extraction wells and collection trenches. Vertical extraction well(s) are technically and administratively feasible, effective, and relatively low in cost. NTCRA 2, which is the hydraulic containment system that is currently in place at the site, uses vertical extraction wells. Collection trenches would consist of excavating a trench to a specified depth, installing a perforated collection pipe at the base of the trench, and backfilling the trench with a permeable fill (e.g., stone) to provide a discharge zone. This process option would be administratively feasible, but would have lower technical feasibility compared to extraction wells due to the difficulty to construct to the required depth and the need to manage a large volume of contaminated soils resulting from the excavation activities. However, extraction wells may have higher long-term O&M costs due to the need for annual redevelopment. Implementation of this option would require high capital cost and moderate O&M cost.

Vertical wells and/or collection trenches will be retained for further evaluation.

Physical Barrier

Physical barriers include sheet pile walls, slurry walls, and grout curtains. All three options would potentially be effective if used in combination with a hydraulic containment option. In addition, all three options would be administratively feasible. However, based on the volume and area of the overburden groundwater, none of the physical barrier process options would be technically feasible. A physical barrier will not be retained for further analysis as a stand-alone containment technology; although it will be considered in combination with hydraulic containment.

Diversion

Groundwater diversion/barrier options considered for the control of up gradient groundwater include trenches, sheet pile walls, grout curtains and wells. These physical barrier options would be designed to divert up gradient groundwater around the contaminated area of the site. Two of these options would offer superior technical feasibility in overburden materials at the depths required in the overburden groundwater unit, sheet pile walls and vertical extraction wells. Although both process options have been used for hydraulic containment purposes at the site, they would not be effective in a groundwater diversion application because a substantial area of contamination is not addressed. Therefore, this technology will not be retained for further evaluation.

Containment/Removal with Ex-Situ Treatment

Several options were retained to address treatment of extracted groundwater that is generated under a number of containment treatment technologies. Potential treatment for extracted groundwater includes the following: biological treatment (constructed wetland); chemical treatment (UV oxidation, Fenton's Reagent, zero valent iron); and conventional treatment. The relative effectiveness, implementability and cost are described in more detail below.

Biological Treatment

Biological treatment would require construction of a wetland essentially to provide biological treatment. This option would be effective in reducing contaminant toxicity, mobility and volume. This option would be technically feasible and administratively feasible as long as it is located in an area unaffected by the Wetland and Floodplains Executive Orders, and associated regulatory requirements. This option could be implemented at a moderate capital and low O&M cost, and will be retained for further evaluation.

Chemical Treatment

Chemical treatment for the overburden groundwater includes UV oxidation, Fenton’s Reagent, and zero valent iron. UV oxidation is currently being used to treat effectively groundwater that is extracted by the NTCRA containment systems. This technology would be both technically and administratively feasible. The capital cost to implement this technology would be moderate because the existing NTCRA treatment system could be used, and O&M costs would be moderate compared to other process options.

Fenton's Reagent may also be applicable to the SRSNE Site. However there is some question as to its effectiveness given that only a limited number of treatment scenarios have been explored to date. This technology would be both technically and administratively implementable. The capital and O&M costs to implement this technology would be moderate.

Zero valent iron may have a lower effectiveness relative to UV oxidation or Fenton’s Reagent. This option would be both technically and administratively implementable, and the capital and O&M cost to implement it would be moderate.

Based on the above, UV oxidation and Fenton’s Reagent have been retained for further evaluation.

Physical Treatment

Physical treatment for overburden groundwater includes flow equalization, metals pretreatment, sedimentation/filtration, oil/water separation, air stripping, and carbon adsorption. Conventional treatment includes common water treatment technologies that would be combined as needed to provide an effective treatment train. These options are all technically and administratively feasible, and have relatively moderate capital and O&M costs. Therefore, conventional treatment will be retained for further evaluation.

<u>*In-Situ Treatment*</u>

In-situ treatment technologies retained during the initial screening of technical implementability include biological treatment, chemical treatment, and thermal treatment. Each of these technologies is discussed further below.

Biological Treatment

Biological treatment includes the use of injection wells for nutrient or biological culture addition ("enhanced in-situ bioremediation" or EISB), and phytoremediation. All of these options would be administratively feasible, and all are potentially effective in reducing contaminant concentrations in overburden groundwater (the use of injection wells or trenches would be required in order to implement EISB). Capital and O&M costs for each of these options would be low to moderate. However, given the volume, area and depth of the overburden groundwater unit, phytoremediation would be less technically feasible than EISB. Therefore, the use of injection wells with EISB will be retained.

Chemical Treatment

Chemical treatment to treat overburden groundwater in place includes chemical oxidation, passive treatment walls and solvent extraction/alcohol flooding. Chemical oxidation would be technically and administratively feasible, but it has a low effectiveness on the type of contaminants that are dissolved in the overburden groundwater. Its capital and O&M costs would be relatively high due to the need for large volume of commercially-available oxidizing agents, such as peroxide, ozone, and permanganate.

A passive treatment wall would also be technically and administratively feasible, but it would not be effective on all site contaminants present in the overburden groundwater. The capital cost of this option would be high relative to other in-situ treatment technologies.

Solvent extraction/alcohol flooding would potentially be effective on site contaminants in groundwater, but it would not be technically implementable because the size overburden groundwater would require many millions of gallons of reagent to achieve treatment. The capital and O&M costs of this option would be high.

Because of the limitations of this technology as it applies to the contaminants at this site and the size of the area that must be addressed, chemical treatment will not be retained for further evaluation.

Thermal Treatment

Thermal treatment for treating overburden groundwater in place includes steam injection. While potentially effective in addressing the contaminants present at the site, it has significant short-term risks associated with its implementation. In addition, this process option is not technically feasible for the size of the area that must be addressed in overburden groundwater. This technology will not be retained for further evaluation.

2.6.2.5 Bedrock NAPL Area

The effectiveness, implementability and cost evaluation for NAPL in the bedrock are discussed below. A summary is presented in **Table 2-17**.

<u>*No Action*</u>

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation during the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives.

<u>*Institutional Controls/Limited Actions*</u>

Institutional controls/limited actions for the bedrock NAPL area includes institutional controls such as deed restrictions (e.g., ELURs), and natural attenuation (including long-term monitoring). The implementability, effectiveness and cost of these technologies would be identical to that for the overburden NAPL area discussed above.

<u>*Containment*</u>

Containment technologies for the bedrock NAPL area include hydraulic containment and physical barriers.

Hydraulic Containment

Hydraulic containment includes the use of vertical extraction wells. Vertical extraction well(s) are currently used at the site in the NTCRA 1 and 2 systems, and are technically and administratively feasible, effective, and relatively low in cost. This option will also be retained for further evaluation.

Physical Barrier

Physical barriers would involve grout curtains to fill fractures and create an impermeable zone within the bedrock. Although a grout curtain may be effective, its application at the depths required to contain bedrock NAPL limits its technical feasibility. This technology will not be retained for further consideration.

2.6.2.6 Bedrock Groundwater

The effectiveness, implementability and cost evaluation for the bedrock groundwater are discussed below. A summary of the evaluation is presented in **Table 2-18**.

<u>*No Action*</u>

The NCP requires that the no action alternative be considered during the FS process. Therefore, the no action alternative will be retained for further evaluation during the detailed analysis of remedial alternatives. The no action alternative will serve as a baseline for comparing the effectiveness of other remedial alternatives to be developed for bedrock groundwater.

<u>*Institutional Controls/Limited Actions*</u>

The institutional controls/limited actions for bedrock groundwater are identical to those considered above for overburden groundwater.

<u>*Containment Technologies*</u>

The containment technologies that could be implemented in bedrock groundwater include hydraulic containment and physical barriers.

Hydraulic Containment

Vertical extraction wells, as are currently in use for the NTCRA 2 hydraulic containment system, are technically and administratively feasible, effective, and relatively low in cost. This option will be retained for further evaluation.

Physical Barrier

A physical barrier to address bedrock groundwater involves use of a grout curtain. While potentially effective in providing a physical barrier to groundwater flow in rock, this option would not be technically feasible at the depths required (up to 200 feet below the bedrock surface). It would have very high capital and O&M costs. The physical barrier technology will not be retained for further evaluation.

Diversion

Groundwater diversion for bedrock groundwater includes grout curtains and wells. These physical barrier options would be designed to divert up gradient groundwater around the contaminated area of the site. While potentially effective, the grout curtain process option would not be technically feasible at the depths required (up to 200 feet below the bedrock surface). This technology will not be retained for further evaluation.

Containment/Removal with Ex-Situ Treatment

The application of this technology to bedrock groundwater is identical to that discussed for the overburden groundwater. Biological, chemical and physical treatment technologies will be retained.

In-Situ Treatment

In-situ treatment technologies include biological treatment, chemical treatment, and thermal treatment. Each of these technologies is discussed further below.

Biological Treatment

Biological treatment includes the use of injection wells for nutrient or biological culture addition, enhanced bioremediation, and phytoremediation to treat bedrock groundwater in place. All of these options would be administratively feasible, and all are potentially effective in reducing contaminant concentrations in bedrock groundwater, but their application to the SRSNE site is not technically feasible due to the volume and area of bedrock groundwater. Biological treatment will not be retained for further evaluation.

Chemical Treatment

Chemical treatment would involve chemical oxidation and solvent extraction/alcohol flooding to treat bedrock groundwater in place. Neither option would be technically feasible given the area and volume of the bedrock groundwater. Although they would be administratively feasible and potentially effective, the limitation on technical feasibility precludes chemical treatment from being retained for further evaluation.

Thermal Treatment

As with chemical treatment, steam injection would not be technically feasible at the scale necessary to address bedrock groundwater. This technology will not be retained for further evaluation.

2.6.3 Technologies and Process Options Retained for Further Evaluation

Based on the effectiveness, implementability and cost, the following technologies (and their associated options) remain. These will be use to assemble potential remedial alternatives in the next step of the FS process.

Operations Area/Railroad Soil

No Action
- No Action

Institutional/Access Controls
- Institutional Measures (Posting, Deed Restrictions)

Containment
- Physical Barriers (multi-layer cap)

Ex-Situ Treatment or Disposal
- Excavation
- Offsite Disposal
- Thermal Treatment (LTTD)
- Physical Treatment (soil washing)

Cianci Property Soil

No Action
- No Action

Removal and Disposal
- Excavation
- Culvert Removal/Drainage System Rerouting
- Onsite Disposal (consolidation with Operations Area/Railroad soil)
- Offsite Disposal (permitted landfill)

Overburden NAPL Area

No Action
- No Action

Institutional Controls and/or Limited Actions
- Institutional Controls (deed restrictions)
- Natural Attenuation (long-term monitoring, natural attenuation)

Containment
- Hydraulic Containment (vertical extraction wells)
- Physical Barrier (sheet pile wall)

Removal and Offsite Disposal

- Excavation
- Commercial Disposal Facilities

In-Situ Treatment
- Thermal Treatment (electrical resistance heating, thermal conductive heating)
- Physical Treatment (hydraulic displacement, cosolvent extraction/alcohol flushing)
- Chemical Oxidation (permanganate, persulfate)
- Biological Treatment (EISB)

Overburden Groundwater

No Action
- No Action

Institutional Controls and/or Limited Actions
- Institutional Measures (deed restrictions)

- Natural Attenuation (long-term monitoring, natural attenuation)

Containment
- Hydraulic Containment (vertical extraction wells)

Containment/Removal with Ex-Situ Treatment
- Biological Treatment (wetland treatment)
- Chemical Treatment (ultraviolet oxidation, Fenton's reagent)
- Physical Treatment (conventional treatment)

In-Situ Treatment
- Biological Treatment (injection wells with EISB)

Bedrock NAPL Area

No Action
- No Action

Institutional Controls and/or Limited Actions
- Institutional Controls (deed restrictions)
- Natural Attenuation (long-term monitoring)

Containment
- Hydraulic Containment (vertical extraction wells)

Bedrock Groundwater

No Action
- No Action

Institutional Controls and/or Limited Actions
- Institutional Controls (deed restrictions)
- Natural Attenuation (long-term monitoring, natural attenuation)

Containment
- Hydraulic Containment (vertical extraction wells)

Containment /Removal with Ex-Situ Treatment
- Biological Treatment (wetland treatment)
- Chemical Treatment (ultraviolet oxidation, Fenton’s Reagent)
- Physical Treatment (conventional treatment)

3. Development and Screening of Remedial Alternatives

In this section of the FS, technologies listed at the end of the last chapter are combined into remedial alternatives to address site cleanup objectives. The assembled remedial alternatives are then screened based on effectiveness, implementability, and cost to determine which will be carried forward to detailed analysis in Section 4.

The effectiveness screening of each assembled alternative considers its short- and long-term effectiveness and the reductions achieved in the toxicity, mobility, or volume of contaminants. The implementability screening considers both the technical and administrative feasibility of construction, operation, and maintenance of the alternative relative to site-specific conditions. Technical feasibility includes the ability to successfully construct and reliably operate the remedial action to meet the objectives until the remedial action is completed. Administrative feasibility includes the ability to successfully obtain approvals from other agencies and offices to perform the remedial action, the availability of treatment and/or disposal services and capacities, and the need for and availability of special equipment and technical specialists. The cost evaluation considers capital and annual operation and maintenance costs, although this preliminary evaluation presents only relative costs so that alternatives with grossly disproportionate costs for the protectiveness they provide can be eliminated from further consideration in the detailed analysis of alternatives in Section 4.

Alternatives with the most favorable composite evaluation of all screening factors will be retained for further consideration during the detailed analysis of alternatives. In addition, innovative technologies may be carried through the screening process if a reasonable belief exists that the technologies will offer advantages over conventional technologies.

3.1 Assembly of Remedial Alternatives

Potentially applicable remedial alternatives for each area of the site being addressed have been assembled from the technologies and options that survived the “identification and screening of technologies” in Section 2. In assembling the alternatives, an attempt has been made to preserve the range of treatment and containment technologies.

3.1.1 Operations Area/Railroad Soil

The following remedial alternatives have been assembled for the soil in the Operations Area and along the railroad and will be evaluated in this section based on effectiveness, implementability and cost:

- No Action
- Capping and Institutional Controls (Posting, Deed Restrictions)
- Excavation, Thermal Treatment (LTTD), Onsite Disposal and Institutional Controls
- Excavation, Physical Treatment (Soil Washing), Onsite Disposal and Institutional Controls
- Excavation, Offsite Disposal and Institutional Controls

3.1.2 Cianci Property Soil

The following alternatives have been developed to address the Cianci Property Soil:

- No Action
- Culvert Removal/Drainage System Rerouting and Excavation with Onsite Disposal

- Culvert Removal/Drainage System Rerouting and Excavation with Offsite Disposal (Permitted Landfill)

3.1.3 Overburden NAPL Area

The following alternatives have been assembled for the Overburden NAPL Area:

- No Action
- Institutional Controls (Deed Restrictions) and Monitored Natural Attenuation
- Institutional Controls, Monitored Natural Attenuation and Hydraulic Containment
- In-Situ Physical Treatment (Hydraulic Displacement) and Monitored Natural Attenuation
- In-Situ Physical Treatment (Hydraulic Displacement) and Enhanced Bioremediation
- In-Situ Physical Treatment (Hydraulic Displacement and Cosolvent Extraction) and Monitored Natural Attenuation
- In-Situ Physical Treatment (Hydraulic Displacement), Chemical Oxidation and Monitored Natural Attenuation
- In-Situ Thermal Treatment (Electrical Resistance Heating, and/or Thermal Conductive Heating) and Monitored Natural Attenuation
- Excavation and Offsite Disposal (Commercial Disposal Facilities)

All of the in-situ treatment alternatives include a monitored natural attenuation or an enhanced bioremediation component as the final step in a treatment train because biodegradation is most effective when combined with other in-situ treatment technologies. In addition, all of the potential alternatives for the overburden NAPL area that include in-situ treatment technologies would also include the continued operation of the NTCRA 1 groundwater extraction and treatment system, at least through implementation of the first component of the overburden NAPL remedy (i.e., hydraulic displacement, cosolvent extraction, chemical oxidation, and/or thermal treatment). The need for continued hydraulic containment by the NTCRA 1 containment system during the monitored natural attenuation or enhanced bioremediation components of the overburden NAPL remedy will be evaluated. This evaluation will include an assessment of the impacts to the Quinnipiac River. Should it be determined that the NTCRA 1 system is no longer needed, the NTCRA 1 extraction wells may be deactivated and/or portions of the sheet pile wall will be removed to allow groundwater flow patterns in the NTCRA 1 Containment Area to return to their natural condition.

3.1.4 Overburden Groundwater

The groundwater alternatives presented below address the groundwater in the overburden aquifer at the site:

- No Action
- Institutional Controls (Deed Restrictions) and Monitored Natural Attenuation
- Hydraulic Containment, Ex-Situ Treatment [Physical Treatment (Conventional), Chemical (UV Oxidation or Fenton’s), or Biological Treatment (Constructed Wetland)], Institutional Controls and Monitored Natural Attenuation of the Severed VOC Plume
- In Situ Biological Treatment (Injection Wells and Enhanced Bioremediation) and Institutional Controls

The overburden groundwater alternatives are evaluated assuming Town Wells 4 and 6 are not active. As discussed previously, because the town has the option to reactivate these wells, a contingent alternative (Supplemental Containment under Pumping Conditions) is included in each one of these alternatives that would require additional hydraulic containment of Site-related contaminants in the event the Town Wells are reactivated.

An underlying assumption in the screening of Overburden Groundwater alternatives is that the NAPL, which is the primary long-term source of contaminants that affects water quality in the overburden, will be eliminated, significantly reduced or controlled by the alternative selected for the Overburden NAPL Area.

3.1.5 Bedrock NAPL Area

The following alternatives have been assembled for the bedrock NAPL area:

- No Action
- Institutional Controls (Deed Restrictions) and Monitored Natural Attenuation
- Institutional Controls (Deed Restrictions), Monitored Natural Attenuation, and Hydraulic Containment

3.1.6 Bedrock Groundwater

The following alternatives have been assembled for groundwater in the bedrock aquifer:

- No Action
- Institutional Controls (Deed Restrictions) and Monitored Natural Attenuation
- Hydraulic Containment, Ex-Situ Treatment [Physical (Conventional), Chemical (UV Oxidation or Fenton's), or Biological (Constructed Wetland) Treatment], Institutional Controls and Monitored Natural Attenuation of the Severed VOC Plume

3.2 Screening of Alternatives for Operations Area/Railroad Soil

3.2.1 No Action

Technical Description

Under this alternative, no active remediation would be conducted to address contaminated soil. Exposure to site soil would continue to be limited by asphalt pavement and fencing, and the contaminant concentrations would diminish very slowly through natural attenuation processes. The asphalt pavement and fence would not be maintained in the long term. In accordance with Section 121(c) of CERCLA, periodic reviews would be conducted at five year intervals to assess this alternative.

Effectiveness

This alternative will not actively reduce the mobility, toxicity, or volume of the contaminants present in the soil, although natural attenuation processes are expected to reduce the toxicity and volume of contaminants in the soil over a very long time. The No Action alternative would not be effective in the long term in preventing unacceptable risk from soil.

Implementability

This alternative could be implemented without technical or administrative limitations.

Costs

There is no capital cost associated with this alternative. Costs associated with the five-year reviews required under CERCLA are low.

Screening Summary

This alternative is not effective in the long term in preventing exposure to soil that presents an unacceptable risk. This alternative is easily implementable. The NCP requires that the no action alternative be carried through the entire FS process as a baseline for comparison to other alternatives. Therefore, this alternative will be retained for detailed evaluation as "**Alternative OAR-1: No Action**."

3.2.2 Capping and Institutional Controls

Technical Description

Under this alternative, the existing asphalt cap would be upgraded to further reduce potential exposure to contaminated soil in the Operations Area, and the railroad easement would be capped. As discussed earlier, an "engineered control" consisting of a low-permeability composite cover would be installed in these areas, in accordance with the requirements of the Connecticut RSRs and RCRA standards. In conjunction with the cap, deed restrictions and/or an ELUR would be put in place to ensure that the property would not be used in a manner that could disturb the cap and to limit future use of the property.

Effectiveness

This alternative would effectively reduce the potential exposure to soil and limit the mobility of contaminants by reducing infiltration (although not by treatment). The toxicity and volume of the contaminants would be reduced over a very long time through natural attenuation processes. The Capping and Institutional Control alternative would include a long-term maintenance and monitoring component, and would achieve the cleanup objectives for soil.

Implementability

This alternative would require obtaining a variance from the Connecticut RSR soil cleanup requirements in favor of an "engineered control." It is considered administratively feasible. Cap systems are commonly used for containment of contaminated materials making this alternative technically feasible as well.

Cost

The capital and operation and maintenance costs associated with this alternative are low to moderate.

Screening Summary

This alternative is effective and technically and administratively feasible for Operations Area/Railroad soil. It will be retained for detailed evaluation as "**Alternative OAR-2: Capping and Institutional Controls**."

3.2.3 Excavation, Thermal Treatment (LTTD), Onsite Disposal, and Institutional Controls

Technical Description

Under this alternative, soil would be excavated, stockpiled onsite, and thermally treated onsite using low temperature thermal desorption (LTTD) with vapor phase treatment. The treated soil would be redeposited on site. Excavation would require the removal of the existing asphalt cap in the Operations Area. Due to the presence of shallow groundwater, excavation would be conducted during seasonal low groundwater and a groundwater dewatering system may be needed; any collected groundwater would be treated in the NTCRA 1 treatment system, modified as needed to remove particulates and/or to treat a higher concentration influent waste stream. Deed restrictions and/or an ELUR would be put in place to ensure that the property would not be used in a manner that could disturb soil below the seasonal high groundwater level, which is the lower limit of the excavation, and to limit future use of the property.

Effectiveness

Excavation, Thermal Treatment and Onsite Disposal would effectively address the risks posed by contaminated soil. Excavation and thermal treatment are proven technologies for addressing VOC-impacted soils. This alternative would be expected to reduce the toxicity, mobility, and volume of contaminants in soil. Dust and emissions that occur during excavation, and untreated off-gases, if any, from thermal treatment would present some short-term risks to the community and onsite workers that would have to be addressed by using proper construction techniques and acceptable health and safety practices.

Implementability

Excavation, thermal treatment, and onsite disposal are proven remedial technologies that are considered technically implementable. Compliance with substantive requirements of treatment and disposal permits would be required**.** There would be significant administrative implementability concerns with regard to onsite thermal treatment of excavated soils. This is because high levels of PCBs are present and the applicability of TSCA requirements would have to be determined. Soil must also be treated to comply with Connecticut RSRs (Section 22a-133k-2(h)).

Implementing this alternative could require dewatering to facilitate excavation of soils. Dewatering activities would take place within the overburden NAPL zone where contamination is greatest and would create potential additional exposure risk to onsite workers from air emissions that would need to be addressed. The extracted groundwater would require handling and treatment prior to disposal. The existing NTCRA 1 treatment system, modified as necessary to accept the additional flow, would be used to treat the extracted groundwater.

Cost

The capital cost of this alternative is expected to be high compared to a capping alternative. There are no operation and maintenance costs associated with this alternative.

Screening Summary

This alternative would permanently reduce the mobility, toxicity and volume of contaminated soil through treatment. It also effectively reduces contaminants to safe levels. It has high costs. Short-term risks to workers and nearby residents would have to be addressed during excavation activities. There would be significant administrative implementability concerns associated with onsite thermal treatment of excavated soils. Therefore, this alternative will not be retained for further evaluation.

3.2.4 Excavation, Physical Treatment (Soil Washing), Onsite Disposal and Institutional Controls

Technical Description

Under this alternative, impacted soil would be excavated, stockpiled onsite, treated onsite using soil washing, and disposed of within the excavation. Excavation of site soil would require the removal of the existing asphalt cap in the Operations Area. Soil would be excavated to the seasonal high groundwater elevation to avoid recontamination of soils due to the fluctuation of impacted groundwater. Due to the presence of shallow groundwater, excavation would be conducted during seasonal low groundwater and a groundwater dewatering system may be needed; any collected groundwater would be treated in the NTCRA 1 treatment system.

The soil washing component of this alternative would segregate highly organic and fine-grained soil that will contain higher VOC concentrations. The segregated high concentration soil would be collected for treatment and/or disposal. The segregated low concentration soil would be backfilled within the excavation, provided it meets appropriate regulatory levels.

Deed restrictions and/or an ELUR would be put in place to ensure that the property would not be used in a manner that could disturb soil below the seasonal high groundwater level, which is the lower limit of the excavation, and to limit future use of the property.

Effectiveness

Excavation and soil washing are proven technologies for permanently reducing the levels of contaminants in soil to safe levels. Dust and emissions that occur during excavation would present some short term risks to the community and on-site workers that would have to be addressed by using proper construction techniques and acceptable health and safety practices.

Implementability

Excavation, soil washing, and onsite disposal are proven volume reduction technologies that are considered both technically and administratively feasible. This alternative would need to be coupled with an additional step of onsite or offsite treatment and disposal of the segregated high concentration fines as well as liquid residuals. Compliance with the substantive requirements of treatment and disposal permits would be required. However, this is not expected to preclude the use of these technologies. Additionally, management and reuse (after treatment) of soil would have to comply with Connecticut RSRs (Section 22a-133k-2(h)) including direct exposure criteria.

Cost

The capital cost of this alternative is expected to be moderate, although the overall cost would be high when the onsite or offsite treatment or disposal step is included. There are no operation and maintenance costs associated with this alternative.

Screening Summary

This alternative is expected to be effective in reducing contaminants in soil to acceptable levels. Short term risks to workers and nearby residents would have to be addressed during excavation activities. While it is effective and technically feasible, it has the added administrative complexity of generating both solid and liquid residuals that would require offsite treatment and/or disposal. Therefore, this alternative will not be retained for further evaluation.

3.2.5 Excavation, Offsite Disposal and Institutional Controls

Technical Description

Under this alternative, contaminated soil would be excavated and transported offsite for thermal treatment (incineration) and disposal at an existing commercial treatment facility. The excavated area would be backfilled with clean soil from an offsite source. Excavation of site soil would require the removal of the existing asphalt cap in the Operations Area Due to the presence of shallow groundwater, excavation would be conducted during seasonal low groundwater and a groundwater dewatering system may be needed; any collected groundwater would be treated in the NTCRA 1 treatment system modified to accept construction dewatering flows. Deed restrictions and/or an ELUR would be put in place to ensure that the property would not be used in a manner that could disturb soil below the seasonal high groundwater level, which is the lower limit of the excavation, and to limit future use of the property.

Effectiveness

Excavation and offsite thermal treatment and disposal are proven technologies for addressing VOC-impacted soil. This alternative is expected to reduce the mobility, toxicity and volume of contaminants present in the onsite soil through treatment. Excavation of contaminated soils would present the same short-term risks as those discussed in previous excavation alternatives. In addition, this alternative would present additional potential short-term risks associated with the transportation of untreated and highly-contaminated soil through a residential area that would need to be addressed.

Implementability

Excavation and offsite thermal treatment and disposal are proven remedial technologies that are considered both technically and administratively feasible.

Cost

The capital cost of this alternative, including the need for treatment by incineration to meet RCRA land disposal restrictions (LDR) and/or TSCA requirements, is expected to be high. There are no operation and maintenance costs associated with this alternative.

Screening Summary

This alternative would permanently reduce the mobility, toxicity and volume of contaminated soils through treatment. Implementation issues, such as short-term risks to workers and nearby residents during excavation, and during transportation of untreated soil can be addressed through proper engineering controls and health and safety practices. Compared to the other excavation alternatives, this one is the easiest administratively to implement since it would not require design of an onsite treatment system. This alternative will be retained for detailed evaluation as "**Alternative OAR-3: Excavation, Offsite Disposal and Institutional Controls.**"

3.3 Screening of Alternatives for Cianci Property Soil

3.3.1 No Action

Technical Description

Under this alternative, no active remediation would be conducted for contaminated soil on the former Cianci property, and contaminants would continue to migrate within the drainage pathways and may continue to impact surface water and sediment.

Effectiveness

This alternative will not actively reduce the mobility, toxicity, or volume of the contaminants present in these areas of the site.

Implementability

Because this alternative does not require any action be taken, there are no implementation issues

Cost

There is no capital cost associated with this alternative. Costs associated with the five-year reviews required under CERCLA are low.

Screening Summary

Migration of constituents to surface water would continue under this alternative and unacceptable ecological risk would remain. Exceedences of Connecticut RSRs in the drainage ditch soils and Cianci property would remain. This alternative is easily implementable. The NCP requires that the no action alternative be carried through the entire FS process as a baseline for comparison to other alternatives; thus, this alternative will be retained for detailed evaluation as "**Alternative CP-1: No Action**."

3.3.2 Culvert Removal/Drainage System Rerouting, and Excavation with Onsite Disposal

Technical Description

Under this alternative, surface water impacts would be eliminated by removing the existing 30-inch diameter concrete culvert that collects surface runoff as well as contaminated groundwater. This technology would involve excavating and removing the existing 30-inch concrete culvert, and backfilling the resulting trench. Drainage will be rerouted to the Quinnipiac River via a new non-permeable drainage pipe.

Contaminated isolated hotspots of surficial soil on the Cianci property, and contaminated wetland soil at the culvert outfall, would be excavated. This alternative includes onsite disposal of the materials excavated and, therefore, would need to be implemented in conjunction with the soil capping alternative discussed above for the Operations Area/Railroad. Should the soil capping alternative not be implemented, excavated and soil would be disposed of offsite.

Effectiveness

Culvert removal and relocation would be effective in eliminating and/or preventing ecological risks associated with contaminated groundwater and surface water discharging via the culvert to the Quinnipiac River. Potential short-term impacts to workers and nearby residents from cleanup activities would have to be addressed by appropriate construction practices and health and safety practices.

This alternative would not reduce the toxicity, mobility and volume of contaminants in soil. Excavation of the soil at the culvert outfall would be effective in eliminating the risk to human health and to ecological receptors in the Quinnipiac River and would also address exceedences of regulatory criteria.

Implementability

Culvert removal and soil excavation are all proven technologies that are considered technically and administratively feasible. This alternative would meet the Connecticut RSR soil cleanup requirements by use of an "engineered control" and an Environmental Land Use Restriction (ELUR) as an alternative method of compliance.

Cost

The capital cost of this alternative is expected to be moderate. The operation and maintenance costs associated with this alternative are expected to be low.

Screening Summary

This alternative is expected to be effective in eliminating potential ecological risks associated with surficial and wetland soil on the former Cianci property. It would meet the Connecticut RSR soil cleanup requirements by use of an "engineered control" and an ELUR as an alternative method of compliance. The alternative would need to be implemented in conjunction with the soil capping alternative discussed above, and will be retained for detailed evaluation as "**Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal**."

3.3.3 Culvert Removal/Drainage System Rerouting, and Excavation with Offsite Disposal

Technical Description

This alternative for the surficial and wetland soil on the former Cianci property is identical to the previous alternative, with the exception that contaminated soil would be disposed of by transporting them to an offsite commercial disposal facility.

Effectiveness

The effectiveness of this alternative would be similar to the previous alternative. The need to transport materials offsite for disposal would result in an increase in truck traffic from the site that would need to be addressed.

Implementability

This alternative is technically and administratively feasible. Because the excavated materials would not be expected to have contaminant concentrations in excess of RCRA LDRs, no pretreatment prior to disposal would be required.

Cost

The capital cost of this alternative is expected to be moderate to high, compared to the previous alternative. The operation and maintenance costs associated with this alternative are expected to be low.

Screening Summary

This alternative is expected to be effective in eliminating potential ecological risks associated with the culvert. It would meet the Connecticut RSR soil cleanup requirements through excavation and offsite disposal. This alternative will be retained for detailed evaluation as **"Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal**."

3.4 Screening of Alternatives for the Overburden NAPL Area

Five of the nine alternatives assembled for the Overburden NAPL Area have as a first step some form of in-situ physical treatment. Four of those five employ the same technology as the first step; they differ by what follows in the treatment train. Some further mobilization of NAPL into bedrock may be unavoidable with the in-situ treatment alternatives as well as the excavation alternative. However, one of the key objectives for this alternative is to eliminate the mobility of overburden NAPL, which will make other components of the Site remedy (e.g., the overburden and bedrock groundwater alternatives) more reliable and effective. Proper engineering controls will be used to minimize the potential for inadvertent mobilization of NAPL into the bedrock. A key uncertainty is the actual amount of contaminant mass present in the subsurface, which is estimated to be at least 1,000,000 pounds of NAPL. The cost is more sensitive for some alternatives than for others should the mass of contaminants differ significantly from the amount estimated in this FS. All of the technologies where waste is treated in place are expected to achieve the reduction in mobility objective. However, each will leave behind some amount of VOC mass that will degrade over time. The effectiveness of each technology will determine how much residual VOC mass remains after treatment.

3.4.1 No Action

Technical Description

The No Action alternative would not involve any additional remedial activities to address NAPL in the overburden. Although contaminant levels will continue to decline over time as a result of ongoing natural attenuation processes, the time required to meet cleanup objectives for the site is estimated to be in the hundreds of years. In accordance with Section 121(c) of CERCLA, periodic reviews would be conducted at five-year intervals to assess the long-term protectiveness of this alternative.

Effectiveness

This alternative will not actively reduce the mobility, toxicity or volume of the contaminants present in this area of the site.

Implementability

Because this alternative does not require any action be taken, there are no implementation issues.

Cost

There is no capital cost associated with this alternative. Costs associated with the five-year reviews required under CERCLA are low.

Screening Summary

This alternative will be retained for purposes of comparison in accordance with the requirements of the NCP as "**Alternative ONOGU-1: No Action**."

3.4.2 Institutional Controls and Monitored Natural Attenuation

Technical Description

This alternative would involve putting institutional controls in place to limit future exposure to contaminated material in this area of the site. Because NAPL is the primary long-term source of contaminants that affects water quality at the site, institutional controls may include placing deed restrictions and/or ELURs on affected properties to restrict groundwater usage at the site.

Natural attenuation relies on the natural degradation of contaminants through physical, chemical, and biological processes to reduce the concentration of contaminants. Long-term monitoring of the ongoing natural attenuation processes ("monitored natural attenuation" or MNA) would be conducted to assess the effectiveness of this alternative over time. As with the No Action alternative discussed above, the contaminant levels in this area of the site will continue to decline over time as a result of ongoing natural processes. However, the time required to meet cleanup objectives is estimated to be many hundreds of years.

Effectiveness

Although contaminants will eventually be reduced to acceptable levels through natural processes, an MNA alternative would not achieve the cleanup objectives for this area of the site. It would not shorten the time frame that groundwater standards are exceeded, shrink the size of the groundwater contaminant plume, reduce groundwater contaminant concentrations, or prevent the migration of NAPL in a reasonable timeframe.

Implementability

There are no technical or administrative limitations associated with this alternative.

Cost

The capital and O&M costs of this alternative would be associated with securing the institutional controls and performing periodic monitoring respectively, and would be low compared to all other alternatives except the No Action alternative.

Screening Summary

This alternative would not be effective in achieving the cleanup objectives for this area of the site although it is technically and administratively feasible. This alternative will not be retained for detailed analysis.

3.4.3 Hydraulic Containment, Institutional Controls and Monitored Natural Attenuation

Technical Description

This alternative would be similar to the previous alternative, with the addition of the continued operation of the NTCRA 1 extraction and treatment systems.

Effectiveness

The existing system is effective at hydraulically containing the contaminants in this area of the site through the use of vertical extraction wells and a sheet-pile wall. However, as with the MNA alternative discussed above, it would not achieve the cleanup objectives established for this portion of the site. Because this alternative focuses on containing the contamination, rather than reducing contaminant mobility or reducing the mass of contaminants present at the site, this alternative would not result in a permanent reduction of the mobility, toxicity or volume of contaminants. Mobile NAPL in the overburden would make other aspects of the remedy for the site less reliable over time.

Implementability

Because it is essentially a continuation of ongoing NTCRA 1 operation, this alternative would be both technically and administratively feasible.

Cost

The capital costs of this alternative would be associated with securing the requisite institutional controls, which would be low. Operation and maintenance activities would include continued operation of the NTCRA 1 pumping and treatment systems, including replacement of equipment and long-term monitoring. These costs would be low to moderate relative to other alternatives for this area of the site.

Screening Summary

This alternative would not be fully effective in meeting the cleanup objectives established for this portion of the site although it is technically and administratively feasible. This alternative will not be retained for detailed analysis.

3.4.4 In-Situ Physical Treatment (Hydraulic Displacement) and Monitored Natural Attenuation

Technical Description

This is the first of four in-place treatment alternatives that would begin with hydraulic displacement. Hydraulic displacement uses injection and extraction of water at locations within the treatment zone to increase the horizontal hydraulic gradient. Increasing the hydraulic gradient will cause the “pooled” or potentially mobile NAPL to move towards extraction wells or trenches where up to 44% can be recovered for treatment. Contamination will remain behind in the subsurface as “residual” or in small pools of NAPL. The treatment process significantly increases the surface area of the residual NAPL, enhancing the effectiveness of the follow on treatment. See **Appendix I** for a more detailed discussion of hydraulic displacement.

The NTCRA 1 treatment system would need to be supplemented with a temporary system to address the higher flows and greater influent constituent concentrations that would be generated during the hydraulic displacement period. Collected NAPL liquids will be transported off-site for safe disposal. Pooled NAPL that is not recovered is generally converted to the residual form of NAPL, resulting in the permanent reduction of NAPL mobility after a relatively short period of pumping, and a significant increase in the surface area of immobile, residual NAPL, making it more available for subsequent natural degradation processes.

In this alternative, hydraulic displacement would be followed by monitored natural attenuation (MNA). MNA is long-term monitoring of the ongoing natural attenuation processes to assess the effectiveness of this alternative over time. Hydraulic displacement of pooled NAPL and the increase in surface area of the NAPL that remains will greatly enhance the rate at which contaminant levels in the Overburden NAPL Area will decline as a result of ongoing natural processes. An evaluation (presented in **Appendix G) of** current (through June 2003) site conditions suggests that biological degradation has destroyed some of the VOC mass, a trend that is expected to continue.

Effectiveness

The combination of hydraulic displacement and MNA will achieve all cleanup objectives for this area of the site. This alternative would result in the permanent reduction in the toxicity, mobility and volume of contaminants in the subsurface through natural processes, following hydraulic displacement. The time required to meet final cleanup objectives with this alternative, while less than the No Action alternative, will likely be on the order of three hundred to four hundred years.

Implementability

This technology would be both technically and administratively feasible. Changes to the existing NTCRA 1 treatment system may require changes to the existing discharge requirements, which are not expected to be problematic.

Cost

The capital cost of this alternative would include the installation of extraction and injection wells or trenches and associated piping, and modifications to the NTCRA 1 treatment system to treat the extracted groundwater/contaminant mixture. These costs would be moderate compared to the other alternatives for this area of the site. Operation and maintenance costs would include periodic monitoring to gauge the effectiveness of the MNA component, and would be considered low compared to other alternatives.

Screening Summary

This alternative would be effective at achieving the cleanup objectives for this portion of the site and would be technically and administratively feasible. It will be retained for detailed analysis as "**Alternative ONOGU-2: Hydraulic Displacement and MNA**."

3.4.5 In-Situ Physical Treatment (Hydraulic Displacement) and Enhanced Bioremediation

Technical Description

This alternative also would begin with hydraulic displacement to recover pooled contaminants and increase the surface area of the NAPL that remains. This component would be identical to the alternative discussed above. Following the completion of the hydraulic displacement step, Enhanced Bioremediation would be used to further treat contamination in this area of the site to substantially reduce the total remediation time. Enhanced Bioremediation uses enhancements (adding nutrients and/or bacteriological cultures) to natural biodegradation processes to more rapidly reduce the mass of contaminants in the subsurface than is possible with natural processes. See Appendix S for a conceptual approach to an enhanced bioremediation polishing step following hydraulic displacement.

Effectiveness

The combination of hydraulic displacement and Enhanced Bioremediation will achieve cleanup objectives for this area of the site. This alternative would result in the permanent reduction of the mobility of NAPL contaminants and up to a 44% reduction in the volume of NAPL at the completion of the hydraulic displacement step. Further reductions of toxicity and volume of contaminants in the subsurface would occur over time with enhanced bioremediation, which would be faster than the MNA process. The time required to meet final cleanup objectives with this alternative is on the order of forty to one hundred thirty years, depending on the degradation rate that can be achieved.

Implementability

This alternative would be both technically and administratively feasible. Changes to the existing NTCRA 1 treatment system may require changes to the existing discharge requirements, which are not expected to be problematic.

Cost

The capital cost of this alternative would include the installation of extraction and injection wells or trenches and associated piping, and the modifications to the NTCRA 1 treatment system for the treatment of the extracted groundwater/contaminant mixture. These costs would be moderate compared to the other alternatives for this area of the site and should not fluctuate significantly if the actual amount of contamination varies. Operation and maintenance costs would include cost to the implement Enhanced Bioremediation (i.e., periodic injections of emulsified food grade vegetable oil), and would also be moderate compared to other alternatives. Variations in contaminant mass would affect the duration of oil injections (currently estimated to be 20 years) and amount of vegetable oil that would need to be used per injection.

Screening Summary

This alternative would be effective at achieving the cleanup objectives for this area of the site and would be technically and administratively feasible. It will be retained for detailed analysis as "**Alternative ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation.**"

3.4.6 In-Situ Physical Treatment (Hydraulic Displacement and Cosolvent Extraction) and Monitored Natural Attenuation

Technical Description

This alternative would be similar to the Hydraulic Displacement and Monitored Natural Attenuation alternative described above, with the addition of a cosolvent extraction component following hydraulic displacement. Because the cosolvent extraction step would result in additional contaminant removal, monitored natural attenuation would be used to achieve final clean up objectives. In addition, this design would take into account the changes resulting from the use of alcohols in the cosolvent extraction step.

Cosolvent extraction would entail the injection and extraction of an alcohol solution that would flow through the Overburden NAPL Area removing contaminants by complete miscible extraction through elimination of NAPL interfacial tension. The alcohol/water/contaminant mixture would be extracted using the same wells/trenches installed for hydraulic displacement. The extracted water/alcohol/contaminant mixture would be treated on site using the NTCRA 1 treatment system, or shipped off site for treatment and disposal. See Appendix P for an evaluation of cosolvent extraction (Kueper, 2004).

Effectiveness

The effectiveness of hydraulic displacement with cosolvent flooding would be identical to the previous alternative in terms of its ability to recover pools of NAPL, but would remove a more significant (more than 99%) portion of the contaminant mass after a relatively short period, and increase the surface area of the remaining residual NAPL. This phase of treatment would be followed by MNA. Based upon evaluations conducted regarding the use of this technology at this site, while cosolvent extraction shows promise in laboratory and pilot-scale field studies, it has no track record of application at full scale. There are significant uncertainties regarding how the large volumes of cosolvent mixture of VOCs, ethanol and water would be treated, once it is recovered from the subsurface.

In aggregate, this alternative could potentially achieve the cleanup objectives for this area of the site, and would result in permanent reduction in the toxicity, mobility and volume of NAPL contaminants

Implementability

The implementability of the hydraulic displacement and biological treatment components of this alternative would be similar to the previous alternative. However, cosolvent extraction presents technical implementation issues because it depends in large part on the logistics of delivering large quantities of alcohol to the site and disposing of the extracted alcohol/water/NAPL mixture at an offsite location. This alternative is expected to be administratively feasible.

Cost

The capital cost of this alternative would include performing the hydraulic displacement and cosolvent extraction steps, including the delivery, mixing, injection, extraction and disposal of the alcohol solution. The capital cost is estimated to be moderate to high. Operation and maintenance costs would include the MNA component of the alternative, and are expected to be moderate.

Screening Summary

The cosolvent extraction component of this alternative is considered an innovative and emerging technology, and is not proven in a full-scale application. USEPA guidance (USEPA, 1988) suggests that innovative technologies may be carried through the alternative screening process if there is reason to believe that they would offer significant advantages in the form of better treatment performance or implementability, fewer impacts than other available approaches, or lower costs for similar levels of performance. In this case, however, the cosolvent extraction component would not offer any significant advantages, and would present additional implementability issues when compared to other, more conventional alternatives. This alternative will not be retained for detailed analysis.

3.4.7 In-Situ Physical Treatment (Hydraulic Displacement), Chemical Oxidation and Monitored Natural Attenuation

Technical Description

This alternative would be similar to the previous alternative, with use of a chemical oxidation component in place of cosolvent extraction following the hydraulic displacement step. The chemical oxidation component of this alternative would involve the injection of a permanganate or persulfate solution to oxidize the contaminants following the completion of the hydraulic displacement step. As with the previous alternative, MNA would be used to achieve final clean up objectives. Chemical oxidation would significantly further reduce the mass of residual contamination remaining after hydraulic displacement. The application of chemical oxidation to the ONOGU media following the completion of the hydraulic displacement step is evaluated in **Appendix T**.

Unlike the cosolvent extraction component included as part of the previous alternative, implementation of the chemical oxidation component would not require the extraction of groundwater. Therefore, no additional ex-situ treatment system O&M costs would be incurred during implementation.

Effectiveness

The effectiveness of hydraulic displacement would be identical to the previous alternative in terms of its ability to eliminate up to 44% of the VOC mass and eliminate further mobility within a relatively short period of time. Chemical oxidation would then remove a substantial amount (more than 90%) of the contaminants remaining after hydraulic displacement, resulting in a net removal of more than 95% of the VOC mass after two to three years of oxidant injection. The remaining VOC contamination would degrade over time through MNA.

Chemical oxidation is a commonly applied and effective technology for treating contaminants in place. It would temporarily delay the progress of MNA while favorable conditions and bacteriological populations are re-established following oxidant injection.

This alternative would achieve the cleanup objectives for this area of the site and would result in permanent reduction in the toxicity, mobility and volume of contaminants. Compared to hydraulic displacement and biological treatment only, there would be additional short-term risks associated with chemical oxidation due to the need to transport, handle and inject large quantities of oxidants. The time required to meet final cleanup objectives with this alternative is fifty to one hundred fifty years.

Implementability

The implementability of the hydraulic displacement and MNA components of this alternative would be similar to the previous alternative. The chemical oxidation component would also be technically and administratively feasible, as its implementation would rely on the use of readily available services, equipment and materials.

Cost

The capital cost of this alternative would include performing the hydraulic displacement and chemical oxidation steps, including the delivery, mixing, and injection of the permanganate and/or persulfate solution. The capital cost is estimated to be moderate to high. The high cost of oxidants makes this approach the most sensitive to variation in the amount of NAPL mass to be treated. Operation and maintenance costs would include the MNA component of the alternative, and are expected to be moderate.

Screening Summary

This alternative would be effective at achieving cleanup objectives, and would be technically and administratively feasible. It will be retained for detailed analysis as "**Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation and MNA**."

3.4.8 In-Situ Thermal Treatment (Electrical Resistance Heating, and/or Thermal Conductive Heating) and Monitored Natural Attenuation

Technical Description

This alternative would utilize in-situ thermal treatment to achieve target cleanup objectives. The most likely thermal technologies are electrical resistance heating and/or thermal conductive heating. These thermal technologies would heat the subsurface with electrodes and/or thermal wells. A network of aboveground piping and/or electrical distribution lines would be required to connect all of the wells/electrodes. Perimeter pumping wells and/or sheet-piling or a slurry wall would be necessary to provide a hydraulic barrier around the perimeter of the treatment area to control the cooling effects of groundwater migrating into the treatment zone. Significant electrical power and/or power transformation would be required onsite to provide sufficient power. A major component of this alternative is a vapor extraction and treatment system to remove and treat contaminants recovered in the vapor phase. The vapor extraction system would likely require the construction of a surface cap, or plenum, to capture gases containing high concentrations of contaminants. A vapor treatment system consisting of condensation and recovery as liquids, and thermal oxidation and scrubbing of vapors, likely with carbon polishing, will be needed to manage the large amounts of contaminants that are expected to be removed from the subsurface. A discussion of the applicability of a thermal treatment alternative to this site is presented in Appendices V and W.

Effectiveness

This alternative would be expected to achieve cleanup objectives for this area of the site, and would result in the permanent reduction of contaminant toxicity, mobility and volume by removing 95% to 99% percent of the VOC contamination over a relatively short period of time. Short-term risks associated with thermal treatment would need to be addressed due to the complex nature of the infrastructure required, the amount of electrical and thermal energy that must be managed, and the need to manage the vapor extraction system. The system would be designed to meet state air standards. The time required to meet cleanup objectives with this alternative ranges from seven to one hundred fifty years, depending on the removal efficiency of thermal treatment.

Implementability

Thermal treatment would require the construction and operation of a highly complex and complicated system of wells, electrodes, power generation, and aboveground treatment facilities. The volume and type of contamination at SRSNE, in addition to the complex geology, will present an engineering challenge; however, it is technically and administratively feasible for this area of the Site. A pilot study would be appropriate to confirm that treatment to target levels is possible, to evaluate methods to control groundwater migration into the treatment zone, to confirm vapor treatment equipment sizing, and to evaluate the potential for significant corrosion of equipment.

Cost

The capital cost of this alternative would include constructing and operating the thermal treatment system, including the thermal wells and/or electrodes, vapor extraction system, vapor control plenum, power generation system, aboveground treatment system, and offsite disposal of liquid wastes, and MNA to achieve final clean up objectives. The capital cost is estimated to be moderate to high.

Screening Summary

This alternative would be effective at achieving the cleanup objectives for this area of the site, and would be technically and administratively feasible. It will be retained for detailed analysis as "**Alternative ONOGU-5: Thermal Treatment and MNA**."

3.4.9 Excavation and Offsite Disposal

Technical Description

This technology consists of excavating NAPL contaminated soil in this area of the site. Excavation (including the volume of overlying soil) would require the removal of approximately 60,000 cubic yards of materials at depths up to about 20 feet below the water table. Implementation of this alternative would require dewatering activities with collected groundwater being treated prior to disposal. Treatment of water generated during excavation dewatering could be accomplished in the NTCRA 1 treatment system, modified to handle significant suspended solid loads and the increased flows associated with dewatering activities. The excavated material would then be transported offsite for treatment and disposal at a licensed RCRA and/or TSCA hazardous waste treatment and disposal facility. Following completion of the excavation activities, the excavation would be backfilled with clean soil from an offsite source.

If this alternative were to be selected, it would eliminate the potential need to implement an alternative for the Operations Area soil because the soil overlying this area of the site would also be removed and disposed of off site, however, railroad grade soils would not be addressed.

Effectiveness

Excavation and off-site disposal are proven technologies for addressing the contaminated gravels, sand, silt and clay found beneath the soil cover in the Operations Area. This alternative would be expected to permanently reduce the toxicity, mobility, and volume of contaminants in this area of the site, however, some degree of recontamination would be expected as contaminated groundwater from the bedrock moves upwards towards the surface.

Potential short-term risks from volatile and particulate emissions and increased truck traffic would be associated with this alternative and would need to be addressed by using proper construction techniques and appropriate health and safety practices.

Implementability

Offsite treatment and disposal are proven remedial technologies that are considered technically feasible. Excavation would be technically feasible, provided excavation dewatering is incorporated into the remedial design. This waste material would be able to be treated prior to offsite disposal in compliance with regulatory requirements.

Cost

The capital cost of this alternative is very high. There would be no operation and maintenance costs associated with this alternative.

Screening Summary

This alternative is technically and administratively feasible. Although it potentially could have short-term risks associated with the excavation, handling and transportation of highly contaminated soils and liquids that would have to be addressed, it would achieve the cleanup objectives for this area of the site. Therefore, this alternative will be retained for detailed analysis as "**Alternative ONOGU-6: Excavation and Offsite Disposal**."

3.5 Screening of Alternatives for the Overburden Groundwater

3.5.1 No Action

Technical Description

Under this alternative no actions would be taken to address the contamination in this area of the site. In accordance with Section 121(c) of CERCLA, periodic reviews would be conducted at five-year intervals to assess the long-term effectiveness of continued No Action.

Effectiveness

Under the current exposure scenario there are no risks associated with human exposure to groundwater. However, overburden groundwater presents a future unacceptable risk should it be used in the future for drinking water. The no action alternative would not effectively address this risk and would not actively reduce the toxicity, mobility or volume of contaminants in groundwater.

Implementability

There are no technical or administrative limitations associated with this alternative.

Cost

There is no capital cost associated with this alternative. Operation and maintenance costs associated with the five-year reviews required under CERCLA are low.

Screening Summary

This alternative will be retained for purposes of comparison in accordance with the requirements of the NCP as "**Alternative OGW-1: No Action**."

3.5.2 Institutional Controls and Monitored Natural Attenuation

Technical Description

Under this alternative a series of institutional controls would be put in place to limit potential future exposure to groundwater. These institutional controls may include imposing deed restrictions/ ELUR on affected properties, to restrict groundwater usage at the site. While mentioned specifically here, these institutional controls would be included as a component of every alternative for Overburden Groundwater (except the No Action alternative).

Natural attenuation relies on the natural degradation of contaminants through physical, chemical, and biological processes to reduce the concentration of contaminants. Long-term monitoring of the ongoing natural attenuation processes ("monitored natural attenuation" or MNA) would be conducted to assess the effectiveness of this alternative overtime. Contaminant levels in this area of the site will continue to decline over time as a result of ongoing natural processes. However, the time required to meet cleanup objectives for this and all the overburden groundwater alternatives is estimated to be two hundred years due to upwelling of contaminated bedrock groundwater into the overburden aquifer.[1]

Effectiveness

This alternative is expected to be effective in limiting potential human health risks associated with groundwater consumption under current and reasonably foreseeable exposure scenarios as long as the institutional controls are adequately monitored and enforced. Assuming that a remedial alternative that achieves the cleanup objectives is selected for the Overburden NAPL Area, this alternative would restore groundwater quality to acceptable levels within a reasonable time frame.

Implementability

There are no technical limitations associated with this alternative. As with all of the Overburden Groundwater alternatives, a contingent remedy (see Supplemental Containment) would be required if the Town of Southington were to reactivate pumping from Town Wells 4 and 6.

Cost

The capital and operation and maintenance costs associated with this alternative are expected to be low to moderate.

Screening Summary

This alternative would be technically and administratively feasible, and achieve the cleanup objectives for this area of the site provided that a protective remedy for the overburden NAPL area is selected. This alternative will be retained for further evaluation as "**Alternative OGW-2: Institutional Controls and MNA**."

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[1] As mentioned previously, this groundwater alternative is evaluated assuming Town Wells 4 and 6 are not active. Although modeling suggests that it is unlikely that the current SRSNE plume would adversely affect the use and value of groundwater pumped from these wells (see "Quantitative Assessment of Groundwater Remedial Alternatives," **Appendix R**), a system to isolate any groundwater alternative from the hydraulic influence of the Town Wells, in the event they are reactivated is included as a contingent component of all groundwater alternatives. This component is discussed in detail in Section 3.5.5 of the FS report.

3.5.3 Hydraulic Containment, Institutional Controls and Monitored Natural Attenuation of the Severed VOC Plume

Technical Description

This alternative would involve extraction of groundwater using the existing NTCRA 2 extraction and treatment system, or a suitable treatment alternative, and monitored natural attenuation. This alternative would also require institutional controls be put in place as discussed in the previous alternative. This alternative would hydraulically contain the entire area where drinking water regulatory levels are exceeded. The area outside the containment area, called the "severed VOC plume", in the overburden groundwater has contaminant concentrations that do not exceed drinking water standards, but which are above background levels (a State of CT ARAR). Under this alternative, the severed VOC plume would be addressed through MNA**.**

As stated previously, this groundwater alternative is evaluated assuming Town Wells 4 and 6 are not active. A contingent alternative addressing the potential future reactivation of these wells is discussed in Section 3.5.5.

Effectiveness

Groundwater extraction using the NTCRA 2 extraction system has been shown to be effective in containing the area where there are exceedences of drinking water standards in overburden groundwater. In addition, natural attenuation processes have resulted in a marked reduction in contaminant concentrations outside the containment area in overburden groundwater to less than MCLs.

Implementability

This alternative could be implemented using standard techniques and readily available equipment. Treated water that is discharged would require compliance with the substantive requirements of an NPDES permit. This alternative is considered technically and administratively feasible.

Cost

The estimated capital cost of this alternative is low. Annual operation and maintenance costs are considered high relative to passive alternatives (i.e., no action, institutional controls).

Screening Summary

This technology would be expected to provide hydraulic containment of the entire portion of Overburden Groundwater that currently exceeds drinking water standards, with MNA to monitor the severed VOC plume. Institutional controls would provide exposure control. This alternative will be retained for further evaluation as "**Alternative OGW-3: Hydraulic Containment and MNA**."

3.5.4 In-Situ Biological Treatment and Institutional Controls

Technical Description

Under this alternative the natural subsurface biological processes would be enhanced by the addition of nutrients or bacteriological cultures through a series of injection wells. This alternative would include the institutional controls described above. A long-term groundwater monitoring program would be instituted using the existing monitoring wells.

As stated previously, this groundwater alternative is evaluated assuming Town Wells 4 and 6 are not active. A contingent alternative addressing the potential future reactivation of these wells is discussed in Section 3.5.5.

Effectiveness

Existing groundwater data indicates that natural subsurface biological processes are dramatically reducing the toxicity and volume of contaminants in overburden groundwater. Assuming that the alternative for the NAPL area in overburden achieves cleanup objectives, enhancing natural degradation processes would not be expected to significantly increase the rate of contaminant reduction within the Overburden Groundwater.

Implementability

The technical feasibility of this alternative would be limited by the size of the Overburden Groundwater that must be addressed and the ability to provide complete contact between added nutrients and contaminated groundwater within it. However, this alternative would utilize equipment and materials that are readily available. This alternative would be expected to be administratively feasible.

Cost

Capital and operation and maintenance costs associated with this alternative are high given the need to install a large number of injection wells or trenches to ensure adequate nutrient delivery.

Screening Summary

Although this alternative could potentially increase the performance of the natural bioremediation processes, it would not be expected provide a significant incremental increase in effectiveness. It will not be retained for detailed evaluation.

3.5.5 Supplemental Containment under Pumping Conditions

Technical Description

This alternative is a component of all overburden groundwater alternatives in the event that the Town Wells No. 4 and 6 are reactivated. As with the other Overburden Groundwater alternatives, this contingent alternative assumes that the alternative for the Overburden NAPL Area achieves cleanup objectives for that portion of the site.

This alternative involves the installation and operation of additional groundwater extraction wells at a location designed to intercept contaminants in the overburden groundwater that could migrate to Town Wells 4 and/or 6 under pumping conditions. Groundwater from the new extraction wells would be treated in the existing NTCRA treatment system (or alternative system, depending on the Overburden Groundwater alternative chosen) prior to discharge. Long-term monitoring of groundwater conditions would also be a component of this alternative.

Effectiveness

This alternative would effectively cut off migration of contaminants from the Site to the Town Wells in the event that they were restarted. This alternative would ensure that the selected primary Overburden Groundwater alternative would continue to meet cleanup objectives.

Implementability

This contingent alternative would be technically and administratively feasible. It would use existing or readily available equipment, and could be implemented rapidly upon notification by the Town of Southington that the town wells would be reactivated.

Cost

The capital cost of this contingent alternative would be associated with the installation of up to five new extraction wells, pumps, and ancillary equipment. Capital costs would be moderate to low, depending on the actual number of wells required. Operation and maintenance costs would be associated with the operation of the NTCRA treatment system at higher flow rates, and would be moderate.

Screening Summary

This contingent component would effectively ensure that contamination from overburden groundwater does not adversely impact Town Wells No. 4 and 6 under pumping conditions. Implementation of this component would be deferred until such time that the Town of Southington provides notification of intent to reactivate the wells. It is technically and administratively feasible, and could be implemented using existing or readily available infrastructure. This alternative will be retained for further evaluation as "**Alternative OGW-4: Supplemental Containment (Contingent)**."

3.6 Screening of Alternatives for Bedrock NAPL Area

3.6.1 No Action

Technical Description

The No Action alternative would not involve any action take place to address contaminants in this area of the site. Although contaminant levels will continue to decline over time as a result of ongoing natural processes, the time required to reduce contaminant mass, absent any other mass reduction activities, is estimated to be in the low hundreds of years. In accordance with Section 121(c) of CERCLA, periodic reviews would be conducted at five-year intervals to assess the long-term effectiveness and protectiveness of this alternative.

Effectiveness

This alternative will not actively reduce the mobility, toxicity or volume of the contaminants present in this area of the site.

Implementability

The No Action alternative would be readily implementable, and would not have any technical or administrative limitations.

Cost

There is no capital cost associated with this alternative. Operation and maintenance costs associated with the five-year reviews required under CERCLA are considered low, and are included in the cost for the Overburden Groundwater alternatives.

<u>*Screening Summary*</u>

This alternative will be retained for purposes of comparison in accordance with the requirements of the NCP as "**Alternative NBGU-1: No Action**."

3.6.2 Institutional Controls and Monitored Natural Attenuation

Technical Description

This alternative would require institutional controls be put in place to limit potential future exposure to contaminants in this area of the site. These institutional controls may include deed restrictions/ELUR on affected properties to restrict groundwater usage at the site.

Natural attenuation relies on the natural degradation of contaminants through physical, chemical, and biological processes to reduce the concentration of contaminants. Long-term monitoring of the ongoing natural attenuation processes ("monitored natural attenuation" or MNA) would be conducted to assess the effectiveness of this alternative overtime. As with the No Action alternative discussed above, the contaminant levels in this area of the site will continue to decline over time as a result of ongoing natural processes. However, the time required to meet cleanup objectives is estimated to be in the low hundreds of years.

<u>*Effectiveness*</u>

This alternative would achieve cleanup objectives for this area of the site, provided that downward migration of NAPL during implementation of the overburden NAPL alternative is minimized. This alternative would permanently reduce the mobility, toxicity or volume of contaminants in the long-term through natural degradation processes over a very long time frame.

<u>*Implementability*</u>

There are no technical limitations associated with this alternative.

<u>*Cost*</u>

The capital and operation and maintenance costs of this alternative would be associated with securing the institutional controls and performing periodic monitoring, respectively and would be low.

<u>*Screening Summary*</u>

This alternative would be effective in meeting the cleanup objectives for this area of the site. It is technically and administratively feasible, and will be retained for detailed analysis as "**Alternative NBGU-2: Institutional Measures and MNA**."

3.6.3 Hydraulic Containment, Institutional Controls and Monitored Natural Attenuation

<u>*Technical Description*</u>

This alternative would be identical to the previous alternative, with the addition of a hydraulic containment component consisting of vertical extraction wells.

Effectiveness

As with the previous alternative, this alternative would achieve the cleanup objectives for this area of the site. This alternative would ultimately result in a permanent reduction of the mobility, toxicity or volume of contaminants in the long-term through natural degradation processes. Hydraulic containment would not reduce contaminant mass beyond what is occurring naturally, however, it would effectively limit migration of contamination beyond the containment area.

Implementability

Institutional controls and monitored natural attenuation are easily implementable. The NTCRA containment and treatment system is currently operational and is technically and administratively feasible.

Cost

The capital cost of this alternative would be associated with securing the institutional controls and would be low. Operation and maintenance costs would be required for performing periodic monitoring, vertical extraction wells, and the continued operation of the NTCRA treatment system. Operation and maintenance costs would be moderate to low.

Screening Summary

This alternative would be effective in achieving cleanup objectives for this area of the site and is administratively feasible. It would not significantly reduce the time to achieve clean up objectives. This alternative will not be retained for detailed analysis. It has a higher cost and does not provide any additional effectiveness when compare to institutional controls and MNA alone because hydraulic containment will not reliably prevent migration of NAPL, and it will not reduce the amount of time necessary for restoration. Screening of Alternatives for the Bedrock Groundwater

3.6.4 No Action

Technical Description

Under this alternative no actions would be taken to address the bedrock groundwater. However, natural subsurface processes would continue to take place to reduce the levels of contaminants in this area of the site.

Effectiveness

The no action alternative will not actively reduce the risk associated with the future exposure to contaminated groundwater and would not actively reduce the toxicity, mobility or volume of contaminants. Ongoing natural processes are expected to continue to reduce the toxicity and volume of contaminants in the leading edge of the groundwater plume (i.e., areas farthest from the source). However, cleanup objectives for this area of the site will not be met for a very long time.

Implementability

There are no technical or administrative limitations associated with this alternative.

Cost

There is no capital cost associated with this alternative. Operation and maintenance costs associated with the five-year reviews required under CERCLA are low.

Screening Summary

This alternative will be retained for purposes of comparison in accordance with the requirements of the NCP as "**Alternative BGW-1: No Action**."

3.6.5 Institutional Controls and Monitored Natural Attenuation

Technical Description

This alternative would require putting in place institutional controls to limit potential future exposure to contaminants in this area of the site. These institutional controls may include deed restrictions on affected properties and/or implementing an ELUR to restrict groundwater usage at the site.

Natural attenuation relies on the natural degradation of contaminants through physical, chemical, and biological processes to reduce the concentration of contaminants. Long-term monitoring of the ongoing natural attenuation processes ("monitored natural attenuation" or MNA) would be conducted to assess the effectiveness of this alternative over time. As with the No Action alternative discussed above, the contaminant levels in this area of the site will continue to decline over time as a result of ongoing natural processes. However the time required to meet cleanup objectives is estimated to be at least two hundred years. This component would be identical to the MNA component of the Overburden Groundwater alternatives discussed earlier.

Effectiveness

This alternative is expected to be effective in limiting potential human health risks associated with groundwater consumption under current and future exposure scenarios. It would meet the cleanup objectives for this area of the site.

Implementability

There are no technical limitations associated with this alternative.

Cost

The capital and operation and maintenance costs associated with this alternative are expected to be low to moderate.

Screening Summary

This alternative would be technically and administratively feasible, and achieve the cleanup objectives for Bedrock Groundwater. It will be retained for further evaluation as "**Alternative BGW-2: Institutional Controls and MNA**."

3.6.6 Hydraulic Containment, Institutional Controls and Monitored Natural Attenuation of the Severed VOC Plume

Technical Description

This alternative would involve extraction of groundwater from the existing NTCRA 2 extraction and treatment system, or a suitable treatment alternative, treatment using the existing NTCRA treatment system or a suitable alternative, and monitored natural attenuation. This alternative would also include the implementation of institutional controls discussed in the previous alternative. This alternative would hydraulically contain the entire area where drinking water regulatory levels are exceeded. The area outside the containment area, called the "severed VOC plume", in the bedrock groundwater has contaminant concentrations that do not exceed drinking water standards, but which are above background levels (a State of CT ARAR). Under this alternative, the severed VOC plume would be addressed through MNA**.**

Effectiveness

Groundwater extraction using the NTCRA 2 extraction system has been shown to be effective in containing the entire zone of drinking water regulatory exceedences in bedrock groundwater. In addition, natural attenuation processes have reduced contaminant concentrations outside the containment area, in the severed VOC plume, to below drinking water standards. The existing NTCRA treatment system has effectively treated extracted groundwater through many years of continued operation, and would provide a suitable treatment under this alternative.

Implementability

This alternative could be implemented using standard techniques and readily available equipment. Treated water discharged would require compliance with the substantive requirements of a NPDES permit. This alternative is considered technically and administratively feasible.

Cost

The estimated capital cost of this alternative is low. Annual operation maintenance costs are high.

Screening Summary

This technology is expected to provide hydraulic containment of the bedrock groundwater. The contamination within the containment area would eventually by reduced to acceptable levels through natural attenuation processes. Institutional controls would provide exposure control. This alternative will be retained for further evaluation as "**Alternative BGW-3: Hydraulic Containment and MNA**."

3.7 Screening Results

Several potentially applicable remedial alternatives to address the various media of concern at the site were assembled and screened to identify those that warrant a more detailed analysis. The alternatives were screened based on the anticipated effectiveness, implementability and relative cost with respect to site conditions. Based on the results of the preliminary screening process the remedial alternatives listed below have been retained for detailed evaluations.

Operations Area/Railroad Soil

- Alternative OAR-1: No Action
- Alternative OAR-2: Capping and Institutional Controls
- Alternative OAR-3: Excavation, Offsite Disposal and Institutional Controls

Cianci Property Soil

- Alternative CP-1: No Action
- Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal
- Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

Overburden NAPL Area

- Alternative ONOGU-1: No Action
- Alternative ONOGU-2: Hydraulic Displacement and MNA
- Alternative ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation
- Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation and MNA
- Alternative ONOGU-5: Thermal Treatment and MNA
- Alternative ONOGU-6: Excavation and Offsite Disposal

Overburden Groundwater

- Alternative OGW-1: No Action
- Alternative OGW-2: Institutional Controls and MNA
- Alternative OGW-3: Hydraulic Containment and MNA
- Alternative OGW-4: Supplemental Containment (Contingent)

Bedrock NAPL Area

- Alternative NBGU-1: No Action
- Alternative NBGU-2: Institutional Controls and MNA

Bedrock Groundwater

- Alternative BGW-1: No Action
- Alternative BGW-2: Institutional Controls and MNA
- Alternative BGW-3: Hydraulic Containment and MNA

4. Detailed Analysis of Alternatives

This section of the FS presents a detailed analysis of those remedial alternatives that survived the preliminary screening presented in Section 3. The purpose of this detailed analysis is to assess each alternative relative to the evaluation criteria prescribed in the NCP, so that a comparison of each alternative's performance can be made to support the selection of a preferred alternative for the site.

As detailed in USEPA's RI/FS guidance (USEPA, October, 1988), remedial actions must:

- be protective of human health and the environment;
- attain ARARs (or attain through obtaining a waiver);
- be cost-effective;
- utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
- satisfy the preference for treatment that reduces toxicity, mobility, or volume as a principal element or provide an explanation in the Record of Decision (ROD) as to why it does not.

The remedy for the SRSNE site will have six components which are evaluated separately in this section of the FS:

- an Operations Area/Railroad Soil (OAR) component which includes alternatives for no action, engineered and institutional controls, and excavation for unsaturated soils located within the Operations Area of the site and adjoining railroad easement;
- a Cianci Property Soil (CP) component which includes alternatives for no action and for excavation of impacted soil within the Cianci Property;
- an Overburden NAPL Area (ONOGU) component which includes alternatives for no action, in-situ treatment or excavation to remove contaminant mass in the ONOGU;
- an Overburden Groundwater (OGW) component which includes alternatives for no action, monitored natural attenuation and hydraulic containment;
- a Bedrock NAPL Area (NBGU) component which includes alternatives for no action, institutional controls and monitored natural attenuation; and
- a Bedrock Groundwater (BGW) component which includes alternatives for no action, monitored natural attenuation and hydraulic containment.

Although evaluated separately in this detailed analysis, the final remedy for the site will be comprised of one alternative for each of the preceding components. Alternatives for separate areas of the site may be combined if they are similar in scope and intent (e.g., the ex-situ treatment components of potential overburden groundwater and bedrock groundwater alternatives) or are logically linked based on consistent objectives (e.g., the MNA alternatives for overburden groundwater and the NAPL mass reduction/stabilization alternatives for the ONOGU media). In addition, the selection of a particular alternative for one area of the site may preclude the selection of one or more alternatives for other areas; where appropriate this is noted in the Technical Description sections of the detailed analysis.

The remedial alternatives that are subject to detailed analysis in this section are as follows:

Operations Area/Railroad Soil

- Alternative OAR-1: No Action
- Alternative OAR-2: Capping and Institutional Controls
- Alternative OAR-3: Excavation, Offsite Disposal and Institutional Controls

<u>*Cianci Property Soil*</u>

- Alternative CP-1: No Action
- Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal
- Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

<u>*Overburden NAPL Area*</u>

- Alternative ONOGU-1: No Action
- Alternative ONOGU-2: Hydraulic Displacement and MNA
- Alternative ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation
- Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation and MNA
- Alternative ONOGU-5: Thermal Treatment and MNA
- Alternative ONOGU-6: Excavation and Offsite Disposal

<u>*Overburden Groundwater*</u>

- Alternative OGW-1: No Action
- Alternative OGW-2: Institutional Controls and MNA
- Alternative OGW-3: Hydraulic Containment and MNA
- Alternative OGW-4: Supplemental Containment (Contingent)

<u>*Bedrock NAPL Area*</u>

- Alternative NBGU-1: No Action
- Alternative NBGU-2: Institutional Controls and MNA

<u>*Bedrock Groundwater*</u>

- Alternative BGW-1: No Action
- Alternative BGW-2: Institutional Controls and MNA
- Alternative BGW-3: Hydraulic Containment and MNA

The detailed analysis consists of a technical description of each alternative, followed by an assessment of each of the remedial alternatives against the following seven NCP evaluation criteria as described in 40 CFR 300.43(e)(9)(iii):

- Overall Protection of Human Health and the Environment;
- Compliance with ARARs;
- Long-Term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, or Volume Through Treatment;
- Short-Term Effectiveness;
- Implementability; and
- Cost.

The results of the detailed analysis provide the basis for identifying a preferred alternative and preparing the proposed plan for the site. Upon completion of the detailed analysis, the FS Report, the RI Report, and the proposed plan are subject to public review and comment. Two additional NCP evaluation criteria, State Acceptance and Community Acceptance, are considered “balancing criteria” and will be fully factored into the analysis of alternatives by the USEPA following the public comment period.

For ease of comparison between the various evaluation criteria and the anticipated performance of each alternative, the detailed analysis is presented in tabular form. Following the technical description of each alternative below, a number of tables are referenced that provide the appropriate components of the detailed analysis of the alternative.

4.1 Description of Evaluation Criteria

The detailed analysis of each alternative is preceded by a technical description. The technical description presents a discussion of the characteristics of the remedial alternative, including any unique engineering aspects of the physical components associated with the alternative. For alternatives to be evaluated in the detailed analysis, they must meet two "threshold" criteria:

Overall Protection of Human Health and the Environment

This evaluation criterion assesses how the alternative, as a whole, achieves and maintains adequate protection of human health and the environment. The overall evaluation relies on the assessments conducted under other evaluation criteria including long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs

This evaluation focuses on the ability of the remedial alternative to comply with applicable or relevant and appropriate requirements (ARARs) or to provide grounds for invoking one of the ARAR waivers. The following items are considered during the evaluation of the remedial alternative.

- Compliance with chemical-specific ARARs;
- Compliance with location-specific ARARs; and
- Compliance with action-specific ARARs.

This evaluation also considers other appropriate criteria, advisories, and guidance.

The remaining five criteria are grouped together because they represent the "primary" criteria upon which the detailed analysis is based.

Long-Term Effectiveness and Permanence

This evaluation focuses on an alternative's long-term effectiveness and permanence based on the following factors:

- Magnitude of residual risk remaining from untreated waste or treatment residuals at the completion of the remedial alternative, and
- Adequacy and long-term reliability of controls (if any) that will be used to manage treatment residuals and untreated wastes, and the potential need to replace components of the remedy over time.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

This evaluation focuses on the degree to which an alternative will permanently and significantly reduce contaminant toxicity, mobility, and/or volume through removal and/or treatment of the chemical constituents in site media. The evaluation addresses the following factors and specific related considerations:

- The treatment process and materials to be treated;
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated;
- The degree of expected reduction in toxicity, mobility, and/or volume of waste due to treatment;
- The degree to which the treatment is irreversible;
- The type and quantity of residuals that will remain after treatment, and
- The degree to which treatment reduces inherent hazards posed by principal threats at the site.

Short-Term Effectiveness

The short-term effectiveness of each remedial alternative is evaluated relative to its effect on human health and the environment during implementation. The evaluation of the alternative with respect to short-term effectiveness considers the following:

- Protection of the community during remedial action;
- Protection of onsite workers during remedial action;
- Potential environmental impacts; and
- The time until protection is achieved.

Implementability

This evaluation focuses on the ease or difficulty of implementing the remedial alternatives. The following factors are addressed during the implementability evaluation.

- Technical Feasibility
    - ability to construct and operate technology;
    - reliability of technology;
    - ease of undertaking additional remedial action if necessary; and
    - ability to monitor effectiveness.

- Administrative Feasibility
    - coordination with other agencies; and
    - ability and time required to obtain approvals/permits for offsite actions.

- Availability of Services and Materials
    - availability of treatment, storage capacity, and disposal services;
    - availability of necessary equipment and specialists; and
    - availability of prospective technologies.

Cost

This criterion refers to the total cost to implement the remedial alternative. The total cost of each alternative represents the sum of direct capital costs (materials, equipment, and labor), indirect capital costs (engineering, licenses or permits, and contingency allowances), and operation and maintenance (O&M) costs. O&M may include operating labor, energy, chemicals, and sampling and analysis. These costs are estimated with expected accuracies of -30 to +50 percent in accordance with USEPA guidance, and allow the comparison of the remedial alternatives against each other. Present worth costs are calculated for alternatives expected to last more than two years. A 30-year discount rate of seven percent was used in accordance with USEPA guidance.

State and community acceptance, the final two criteria, will be evaluated by USEPA following comment on the RI/FS and the proposed plan, and will be addressed once a final decision is being made and the ROD is being prepared. The evaluation of state acceptance will reflect the state's apparent preferences among or concerns about alternatives. Community acceptance will take into account the community's apparent preferences among and concerns about alternatives.

4.2 Detailed Analysis of Alternatives for Operations Area/Railroad Soil

As discussed earlier, contaminants present in soil within the Operations Area and railroad grade present an unacceptable future risk to human health. In addition, contaminants in soil contribute to exceedences of ARARs in groundwater beneath the Operations Area. The soil alternatives are intended to achieve the following cleanup objectives for this area of the site:

Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to soil contaminants that may exceed an excess carcinogenic risk of 1×10^{-4} to 1×10^{-6}, that may pose a non-carcinogenic Hazard Index greater than 1, or that exceed ARARs (regulatory criteria). Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARS or which might otherwise present an unacceptable risk.

Operations Area/Railroad Soil – Protection of the Environment

Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARs or present an unacceptable risk in groundwater.

4.2.1 Alternative OAR-1: No Action

Technical Description

This alternative was developed as a baseline for comparison with other remedial alternatives. Under the no action alternative no direct actions would be implemented to address the potential human and ecological risks associated with soil.

Detailed Analysis of Alternative

The detailed analysis of this alternative is presented in Tables 4-1 through 4-3.

4.2.2 Alternative OAR-2: Capping and Institutional Controls

Technical Description

Under this alternative, the existing asphalt cover within the 2.5 acre Operations Area as well as the railroad grade area would be covered with a cap and institutional controls put in place to prevent the cap from being disturbed in the future.

An “engineered control” consisting of a low-permeability composite cover would be installed in the Operations Area and along the railroad grade in accordance with the requirements of the Connecticut RSRs and federal requirements, to further limit exposure through direct contact, inhalation, or ingestion and to reduce infiltration of precipitation through the soil. This alternative requires the upgrade of existing asphalt pavement with installation of a cap designed to be consistent the state requirement of a permeability less than 1×10^{-6} cm/sec and to physically isolate the impacted soil, minimize migration of liquids through the soil, function with a minimum of maintenance, promote drainage and minimize damage to such control, and accommodate settling and subsidence of the underlying soil so as to maintain the control’s structural integrity. Given the nature of the materials at the site, a vapor control (collection and removal) system would not be required.

It is assumed that approximately 25% of the Operations Area (particularly the area surrounding the concrete pads) would be filled with sub-base material and graded for proper drainage prior to liner installation. Conceptually, the composite cover would include a geotextile and 40-mil geomembrane installed over the grading layer, existing asphalt cap and non-paved areas of the site. The geomembrane would be covered with a protection layer for cushioning during the construction of the overlying materials, as well as for protection from frost. The cover would be completed with the installation of a new 4-inch thick asphalt surface. This cover system would be designed to meet both RCRA and RSR cover system requirements. The capping design for the railroad grade would be intended to be consistent with the planned use as a "Rails to Trails" path and would include a granular sub-base and asphalt capping.

In addition to the cap, institutional controls would be put in place to ensure that the property would not be used in a manner that could disturb the cap and would limit future use of the property to commercial, industrial or limited recreational activity. The condition of the cover system and fencing would be inspected quarterly to verify that they are functioning properly, and to identify the need for repairs, if necessary.

Detailed Analysis of Alternative

The detailed analysis of this alternative is presented in Tables 4-4 through 4-6.

4.2.3 Alternative OAR-3: Excavation, Offsite Disposal and Institutional Controls

Technical Description

Under this alternative, contaminated soil from the Operations Area and along the railroad grade would be excavated and transported offsite for thermal treatment (incineration) and disposal at an existing commercial treatment facility. Excavation would extend from the ground surface to the "seasonally high water table," resulting in the removal of approximately 17,000 cubic yards of soil. The excavated area would be backfilled with clean soil from an offsite source. In addition, institutional controls would be put in place to ensure that the property would not be used in a manner that could disturb the soil below the lower limit of the excavation.

A significant factor that would need to be taken into account in the design of this alternative is the potential for the release of volatile and particulate emissions during excavation of highly contaminated soil. The risk to onsite workers would be managed through the use of personal protective equipment. The risk to the offsite community would be managed through the use of a temporary enclosure over the excavation and perimeter monitoring.

This alternative includes the transportation of the excavated soil for offsite treatment and disposal at a licensed RCRA and/or TSCA hazardous waste treatment and disposal facility. Because of the high concentrations of organic contaminants that would be present in the excavated materials, treatment and disposal at Waste Management's Model City hazardous waste management facility in Porter, New York was assumed. Given the volume of material requiring treatment and disposal, approximately 1,200 truckloads of excavated material would be sent to Model City over existing public roads and highways. A similar number of truckloads of clean backfill materials would be imported to the site at the completion of the excavation process.

Detailed Analysis of Alternative

The detailed analysis of this alternative is presented in Tables 4-7 through 4-9.

4.3 Detailed Analysis of Alternatives for Cianci Property Soil

The remedial alternatives discussed below address Connecticut RSR exceedences and potential ecological risk associated with contaminated surficial and wetland soil on the former Cianci property and at the entrance to and outfall of the existing 30-inch diameter concrete culvert. The culvert presently conveys surface runoff from the east side of the Operations Area across the Cianci Property, to the Quinnipiac River. The soil alternatives are intended to achieve the following cleanup objectives for this area of the site:

Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to soil with contaminants that exceed ARARs (regulatory criteria). Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARs or which might otherwise present an unacceptable risk in groundwater.

Protection of the Environment

Prevent potential ecological risks associated with SRSNE-related contaminants.

4.3.1 Alternative CP-1: No Action

Technical Description

This alternative was developed as a baseline for comparison with other remedial alternatives. Under the No Action alternative, no actions would be implemented to address the potential ecological risks associated with the Cianci Property soil.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-10 through 4-12.

4.3.2 Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

Technical Description

This alternative consists of removing the existing 30-inch diameter concrete drainage culvert, and replacing it with an impermeable, continuous butt-fusion welded 36-inch HDPE pipe. In addition, contaminated surficial soil on the former Cianci property (approximately 400 CY) and wetland soil in the vicinity of the culvert outfall (approximately 500 CY) would be excavated to a depth of 1 foot. This activity would take place within the 100-year floodplain of the Quinnipiac River, and partially wetlands. As such, this work would have to be conducted consistent with federal and state wetland and floodplain requirements, including habitat restoration. Erosion control devices would be used during excavation and restoration to prevent contaminated sediment from migrating to the Quinnipiac River.

This alternative would be implemented in conjunction with the soil cap alternative (OAR-2). Excavated materials would be temporarily stored prior to placement beneath the cap on the Operations Area. Should the soil capping alternative not be selected, excavated soil would be disposed of offsite as described in Alternative CP-3 below.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-13 through 4-15.

4.3.3 Alternative CP-3: Culvert Removal, Capping, and Excavation with Offsite Removal

Technical Description

This alternative is identical to Alternative CP-2, with the exception that excavated soils from the Cianci Property and the culvert outfall would be disposed of at a commercially licensed, offsite disposal facility instead of under the Operations Area cap. This would require trucking excavated material from the site via existing public roads. Approximately 50 truck trips would be required to ship this material off site.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-16 through 4-18.

4.4 Detailed Analysis of Alternatives for Overburden NAPL Area

The alternatives discussed in this section address the presence of observed pooled and residual NAPL in the Overburden NAPL, or ONOGU, Area. Generally, the ONOGU alternatives (other than the No Action alternative) attempt to eliminate, significantly reduce or control the potentially mobile, principal threat contaminants to achieve the following ONOGU RAOs:

Human Health

Reduce or stabilize the NAPL mass that would otherwise result in groundwater concentrations that may pose a carcinogenic risk in excess of 1×10^{-4} to 1×10^{-6}, non-carcinogenic Hazard Index greater than 1, or that may exceed ARARs.

Protection of the Environment

Reduce NAPL mass to achieve one or more of the following:

- shorten the time frame that groundwater standards are exceeded;
- shrink the size of the groundwater contaminant plume;
- reduce groundwater contaminant concentration; and
- prevent the migration of NAPL.

As stated earlier (Section 1.4.1), an estimated 84% of the NAPL mass at the SRSNE Site is believed to be in the overburden aquifer, the greatest concentration of which is confined to a relatively small area (1.5 acres), to average depths of 25 to 40 feet. NAPL is the primary long-term source of contaminants that affects water quality at this site. A key objective on which these alternatives will be evaluated is their ability to eliminate the mobility of overburden NAPL, and, by doing so, greatly enhance the long-term reliability and protectiveness of the overburden and bedrock groundwater components of the remedy. Also critical to the evaluation of the ONOGU alternatives is their relative effectiveness at reducing groundwater concentrations and the size of the overburden plume, and, the length of time that groundwater standards are exceeded. Downward mobilization of NAPL into bedrock may be unavoidable with all of the in-situ treatment alternatives, as well as with the excavation alternative. However, with proper engineering controls, this risk can be minimized.

No remedial technology can achieve ARARs for all contaminants of concern immediately following implementation, although other remedial measures, such as containment and institutional controls will provide protection of human health and the environment in the interim. In addition, contaminated bedrock groundwater discharges upward into areas of the overburden NAPL zone, which may prevent attainment of groundwater ARARs in this area until bedrock ground water quality is restored.

4.4.1 Alternative ONOGU-1: No Action

Technical Description

The No Action alternative would not utilize any remedial technologies. The site would be allowed to remain in its current condition, and no actions would be taken to address the contaminants in this portion of the site. The natural subsurface processes that reduce the concentrations of chemical constituents would continue to take place under this alternative, although over a very long time period. In the absence of monitoring or other activities to assess the progress of these processes, this reduction could not be assessed or documented. However, it would take an estimated 400 to 500 years to remove virtually all (99%) of the NAPL at current degradation rates. Additional time would be needed to reach cleanup levels.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-19 through 4-21.

4.4.2 Alternative ONOGU-2: Hydraulic Displacement and MNA

Technical Description

This is the first of three in-place treatment alternatives that would begin with hydraulic displacement as an initial step to eliminate mobile NAPL. Hydraulic displacement involves two steps: injection and extraction of groundwater through wells and/or trenches to manipulate the hydraulic gradient, and, treatment of the extracted groundwater/NAPL mixture. The NAPL that remains in the subsurface after hydraulic displacement will either be in small pools, or as “residual” NAPL. Residual NAPL has significantly more surface area than pooled NAPL. The increase in surface area is particularly important to help the dissolution of the remaining residual contamination. Once hydraulic displacement has been completed, other technologies can be used to further reduce the levels of contamination. Examples of technologies that benefit from increased contaminant surface area include MNA, enhanced bioremediation, oxidant flushing, and pump-and-treat. See Appendix I for a more thorough description of hydraulic displacement, including pool mobilization; rate of NAPL recovery; increase in NAPL-water surface area; benefits and risks of implementation; shut-down criteria, performance evaluation, and predictive modeling results regarding potential NAPL removal rates and volumes that may be expected in the ONOGU (Kueper, 2004).

During implementation of hydraulic displacement, the existing NTCRA 1 extraction well and treatment system would continue to operate, providing overall hydraulic control of the groundwater at the site. A separate, temporary treatment system would be needed to treat the highly-contaminated groundwater/NAPL mixture collected during hydraulic displacement. This treated groundwater may be recirculated into the injections wells for hydraulic displacement. Further details regarding the hydraulic displacement treatment system are in Appendix Q.

In Alternative ONOGU-2, the hydraulic displacement phase would be followed by MNA. This alternative would result in the permanent reduction of the mobility of NAPL and up to a 44% reduction in the volume of NAPL at the completion of the hydraulic displacement step. Further reductions of toxicity and volume of contaminants in the subsurface would occur over time with the MNA process. An evaluation of data collected from the Site demonstrates that biological degradation of NAPL is occurring at a robust rate (Appendices G and H). Monitoring of the natural attenuation processes would be conducted periodically and evaluated as part of the five-year review process required under the Superfund law when waste is left in place at a site.

In addition, this alternative (and all of the remaining alternatives considered for the Overburden NAPL Area) would require institutional controls be put in place to prohibit the use of groundwater for drinking or other domestic purposes, and, to comply with Connecticut RSRs, including newly-proposed revisions to the volatilization criteria.

The time required to remove virtually all (99%) of the NAPL at current assumed degradation rates is estimated to be 300 to 400 years. Additional time would be needed to reach cleanup levels.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-22 through 4-24.

4.4.3 Alternative ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation

Technical Description

This alternative would also employ two components: hydraulic displacement (in a fashion identical to that described in Alternative ONOGU-2), followed by enhanced bioremediation.

Site-specific data confirms that biological degradation of NAPL is already occurring in the subsurface at SRSNE at a robust rate (see Appendices G and H). Enhanced bioremediation increases the rate at which these processes are occurring either by adding more of the microbes that already exist in the overburden aquifer, supplying the microbes with more food (in this case, emulsified soybean oil), or both.

A conceptual approach to an enhanced bioremediation polishing step following hydraulic displacement is detailed in **Appendix S (**GeoSyntec 2004). The infrastructure installed as part of the hydraulic displacement phase would be used for enhanced bioremediation. Additional wells may need to be added to optimize the distribution of electron donor (soybean oil) and microbial cultures. The electron donor and/or microbial culture would be diluted and dispersed into the treatment area through the extraction and re-injection of groundwater via the extraction and injection trench/well networks.

As discussed above, it is estimated that hydraulic displacement would reduce the mass of NAPL in the portion of the site by up to 44% by mobilizing and extracting NAPL. Further reductions of toxicity and volume of contaminants in the subsurface would occur over time through the implementation of enhanced bioremediation. The period of time required to achieve these further reductions cannot be reliably estimated, although it would be expected to be significantly shorter than would be achieved by MNA alone. It would take an estimated 130 years with enhanced bioremediation achieving three times the current rate of degradation to remove virtually all (99%) of the NAPL in this area, and an estimated 40 years if enhanced bioremediation can achieve ten times the current degradation rate. With either scenario, additional time would be needed to reach cleanup levels.

As with the preceding ONOGU alternative, institutional controls and five-year reviews would be needed.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-25 through 4-27.

4.4.4 Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation and MNA

Technical Description

This alternative is similar to Alternative ONOGU-2, with the addition an in-situ chemical oxidation step following hydraulic displacement and before MNA. For this alternative, the hydraulic displacement component and the MNA component would be identical to that described for Alternative ONOGU-2.

With this alternative, after the hydraulic displacement operational period is completed, the in-situ chemical oxidation application would be initiated. The chemical oxidation approach would be designed to integrate with the injection/extraction system and manifold network used for the hydraulic displacement system. Potassium permanganate would be injected into the subsurface to treat the predominant contaminants, during several injection events, over a period of approximately 12 to 15 months. During the injection period no extraction or recirculation of groundwater would be implemented; therefore there would be no need for additional above-ground water treatment or disposal. A more thorough description of how this technology would be implemented at the SRSNE Site, see **Appendix T** (XDD, 2004).

As discussed above, it is estimated that hydraulic displacement would reduce the mass of NAPL in the portion of the site by up to 44% by mobilizing and extracting NAPL. Additional reductions of toxicity and volume of contaminants in the subsurface would occur over time through the implementation of the chemical oxidation phase. To achieve an additional 90% reduction in NAPL mass after the hydraulic displacement phase, for a total NAPL removal rate of at least 95%, approximately 1,450,000 kg or 3,190,000 pounds of potassium permanganate at a concentration of 40 g/L would be injected into the target treatment zone. This equates to approximately 9,580,000 gallons (approximately five times the pore volume of the target treatment zone) of permanganate solution. Projected chemical use is based on the estimate of 1,000,000 pounds of NAPL at the site. If the actual mass is greater, then additional permanganate solution would be required. The toxicity and volume of the remaining NAPL mass would be subject to dissolution and destruction through MNA.

The time to remove virtually all (99%) of the NAPL in this area using this alternative is estimated to be 50 to 150 years, assuming current degradation rates. Additional time would be needed to reach cleanup levels. As with the preceding ONOGU alternatives, institutional controls and five-year reviews would be needed.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-28 through 4-30.

4.4.5 Alternative ONOGU-5: Thermal Treatment and MNA

Technical Description

This alternative comprises the construction of an in-situ thermal treatment system for the Overburden NAPL Area; utilizing electrical resistance or thermal conductive heating; and vapor extraction to remove NAPL mass. Following completion of the thermal treatment step, MNA would be used as a “polishing” step to achieve additional reductions in toxicity and volume of contaminants, similar to the approach discussed under the previous ONOGU alternatives.

Based on the site-specific geology, hydrogeology, NAPL distribution and the potential for downward DNAPL migration into the fractured bedrock underlying the site, thermal conductive heating has been selected as the representative thermal treatment approach for this alternative. With this approach, heat delivered to the subsurface would convert the liquid contaminants to a vapor phase which would be collected and treated on site.

Thermal heater wells would be placed in the treatment zone at approximately 15-foot spacing in a hexagonal pattern. These wells would consist of solid “heater cans,” installed through the full depth of the overburden, and cemented three to four feet into the upper bedrock layer. The combination of solid heater casing, simultaneous heating of the overburden and bedrock, and bedrock grouting would minimize the chance for downward migration of NAPL. Vapors would be vacuumed out of extraction wells installed several feet below grade, into the unsaturated zone. A network of aboveground piping and/or electrical distribution lines would be required to connect all of the wells. A vapor treatment system consisting of condensation and recovery as liquids, and thermal oxidation and acid gas scrubbing of vapors, likely with carbon polishing, will be needed to manage the large amounts of contaminants that are expected to be removed from the subsurface**.** The entire treatment area would be covered with a high-temperature resistant, low permeability cap to control vapors developed in the subsurface.

A more complete discussion of the thermal treatment alternative is presented in **Appendix V**. In addition, the potential risks associated with downward contaminant mobilization during implementation of an in-situ thermal remedy are evaluated in Appendix W.

Bench-scale testing would be necessary to evaluate vapor treatment needs and options; a pilot study would be appropriate to confirm design specifications to achieve target levels, to evaluate methods to control groundwater migration into the treatment zone, to confirm vapor treatment equipment sizing, and to evaluate the potential for significant corrosion of equipment. The total estimated duration of field operations, including initial heating and pressure cycling phases is estimated to be approximately 200 to 250 days. If maximum removal rates are attained, virtually all (99%) of the NAPL mass would be removed at the end of thermal treatment. If the technology attains a 95% removal rate, it will take an estimated 50 to 100 years to remove virtually all NAPL mass, and 40 to 100 years if a 97% removal rate is attained. Additional reductions in NAPL mobility, volume and toxicity to achieve cleanup levels would be accomplished through MNA over time. As with the preceding ONOGU alternatives, institutional controls and five-year reviews would be needed.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-31 through 4-33.

4.4.6 Alternative ONOGU-6: Excavation and Offsite Disposal

Technical Description

This alternative involves the excavation and offsite disposal of overburden soil and pooled contaminants in this area of the site. All material from the ground surface to bedrock would be removed, staged, and transported offsite for treatment and disposal at a commercial facility. Excavation of the entire Overburden NAPL Area volume (including the volume of overlying soil) would require the removal of approximately 50,000 cubic yards of materials at depths up to about 20 feet below the water table. In addition, approximately 10,000 cubic yards of soil excavation would be required to maintain stable side slopes during the excavation activities (because the excavation would extend vertically to the top of bedrock, the use of sheet piling or other excavation sidewall retention system would not be feasible). The excavation would be backfilled with clean soils from an offsite source. Upward flow of impacted bedrock groundwater would be expected to recontaminate the backfilled, saturated soils, although likely at levels far lower than pre-excavation results. Implementation of this alternative would reduce the need to implement an alternative for the soil in the Operations Area as they would be part of the excavation, however, the railroad grade soils would still need to be addressed.

Two significant factors would need to be taken into account in the design of this alternative: controlling volatile and particulate emissions that would result from the disturbance and exposure of pooled contaminants and highly-contaminated soil, and treatment and disposal of large volumes of contaminated groundwater that would enter the excavation during construction. The control of emissions during excavation would be accomplished through the use of a temporary enclosure over the excavated area. Respiratory protection (i.e., Level B, comprising self-contained breathing apparatus) would likely be required to ensure the protection of workers.

The requirements for treating water pumped from the excavation would be similar to that for the hydraulic displacement alternative described in **Appendix Q**, with the addition of a pre-treatment step to remove NAPL and silt from the extracted fluid. Settling tanks would likely be necessary to allow initial settling of incoming silts. Because DNAPL is also present, these settling tanks would also inherently trap DNAPL, which would also require periodic removal.

This alternative includes the transportation of the excavated soil and NAPL for offsite treatment and disposal at a licensed RCRA and/or TSCA hazardous waste treatment and disposal facility. Because of the high concentrations of organic contaminants that would be present in the excavated materials, it would be likely that the material would not comply with federal Land Disposal Restriction criteria without treatment. For purposes of the implementability, short-term effectiveness and cost evaluations in this detailed analysis, treatment and disposal at Waste Management's Model City hazardous waste management facility in Porter, New York was assumed. Given the volume of material requiring treatment and disposal, approximately 2,400 truckloads of excavated material would be sent to Model City over existing public roads and highways. A similar number of truckloads of clean backfill materials would be imported to the site at the completion of the excavation process.

Long-term protection would be achieved at the completion of the excavation activities which are expected to take three to four years to design and implement.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-34 through 4-36.

4.5 Detailed Analysis of Alternatives for the Overburden Groundwater

The alternatives subject to detailed analysis below address contaminated groundwater and saturated soil in the areas outside of the Overburden NAPL Area addressed by the ONOGU alternatives. There are two underlying assumptions to the detailed analysis of the Overburden Groundwater alternatives: 1) that the source of potentially mobile, principal threat contaminants in the Overburden NAPL Area will be eliminated, reduced or controlled through the implementation of an alternative that meets the cleanup objectives for that area of the site; and 2) that Town Wells 4 and 6 are inactive. As discussed in Section 3, a contingent alternative (OGW-4) has been identified that would become a component of the selected alternative if the Town of Southington elects to reactivate the wells.

The costs associated with long-term groundwater monitoring and conducting five-year reviews for the entire Site have been incorporated into the Overburden Groundwater (OGW) alternatives. The OGW alternatives (except for the No Action alternative) also incorporate the costs of closing the existing NTCRA 1 containment system (demobilizing equipment, removing sections of the sheet-pile wall, and abandoning over 300 monitoring wells).

The alternatives evaluated in this section are intended to address the following Overburden Groundwater cleanup objectives:

Overburden Groundwater – Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to overburden groundwater with contaminants that may pose an excess carcinogenic risk in excess of 1×10^{-4} to 1×10^{-6}, non-carcinogenic Hazard Index greater than 1, or that may exceed ARARs.

Overburden Groundwater – Protection of the Environment

Restore groundwater quality to meet ARARs.

4.5.1 Alternative OGW-1: No Action

Technical Description

The No Action alternative would not utilize any remedial technologies. The site would be allowed to remain in its current condition, and no actions would be taken to address the contaminants in the Overburden Groundwater. The natural subsurface processes that reduce the concentrations of chemical constituents would continue to take place under this alternative, but because no monitoring is being done to evaluate the degradation, time to achieve protection is unknown. However, it is estimated to take on the order of 200 years based on the upwelling of contaminated groundwater from the bedrock aquifer, if virtually all (99%) of the NAPL has been removed from the Overburden NAPL Area with an ONOGU alternative.

In accordance with the requirements of the NCP, performance of the No Action alternative would be evaluated on a regular basis (e.g., every five years) to determine its effectiveness and protectiveness in the long term.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-37 through 4-39.

4.5.2 Alternative OGW-2: Institutional Controls and MNA

Technical Description

The first component of this alternative would require placing institutional controls on a number of properties that could be affected by contaminants in the overburden groundwater, to prevent the usage of or exposure to contaminated groundwater. This would include restrictions for the Cianci Property and a portion of the Town Well Field property. This component of the alternative would be common to all of the alternatives for the Overburden Groundwater except for the No Action alternative.

Natural attenuation relies on the natural degradation of contaminants through physical, chemical, and biological processes to reduce the concentration of contaminants. The second component of this alternative would be the long-term monitoring to assess the effectiveness of the natural attenuation processes (MNA) in overburden groundwater over time. This component would require the removal of sections of the NTCRA 1 containment area sheet pile wall (following “construction completion” of the ONOGU remedy, which would include the continued operation of the NTCRA 1 extraction system) to allow the natural groundwater gradients to be reestablished at the site.

In the short term, protection will be achieved when institutional controls are put in place. In the long term, MNA will result in long-term protection in an estimated 200 years, due to the upwelling of contaminated groundwater from the bedrock into the overburden aquifer. This estimate is based on the assumption that virtually all (99%) of the NAPL has been removed from the Overburden NAPL Area with an ONOGU alternative.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-40 through 4-42.

4.5.3 Alternative OGW-3: Hydraulic Containment and MNA

Technical Description

This alternative would involve extracting groundwater from the existing NTCRA 2 extraction wells, treating the extracted groundwater using the NTCRA 1 treatment system (modified as necessary following the completion of the selected ONOGU alternative to account for changes in contaminants, concentrations, and/or flow), and monitored natural attenuation of the severed, downgradient dissolved phase plume. As with the previous alternative, the MNA component includes the removal of sections of the NTCRA 1 sheet-pile wall to allow the natural groundwater gradients to be reestablished at the site. In addition to groundwater extraction and treatment, this alternative includes institutional controls to prohibit the use of groundwater for drinking or other domestic purposes.

The MNA component of this alternative would be identical to Alternative OGW-2. The groundwater extraction component of this alternative would entail the continued pumping of groundwater from NTCRA 2 extraction well RSW-13. One additional extraction well may be required. Once extracted, groundwater would ~~initially~~ be pumped to the NTCRA 1 treatment building for treatment in the existing system although some modifications may be necessary for the effective treatment of lower flows and concentrations from this alternative.

In the short term, protection will be achieved when institutional controls are put in place. In the long term, MNA will result in long-term protection in an estimated 200 years, due to the upwelling of contaminated groundwater from the bedrock into the overburden aquifer. This estimate is based on the assumption that virtually all (99%) of the NAPL has been removed from the Overburden NAPL Area with an ONOGU alternative. Hydraulic containment does not significantly reduce the time to achieve protection, but it does protect against the spread of the groundwater plume.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-43 through 4-45.

4.5.4 Alternative OGW-4: Supplemental Containment (Contingent)

Technical Description

This alternative would be instituted in conjunction with the alternative selected for the overburden groundwater if ~~the~~ Town Wells No. 4 and 6 were to be reactivated. As stated in the Town of Southington's 50-year water supply plan, additional water is not expected to be needed until the year 2020 or later (Lenard, April 1996). Modeling indicates that a series of five additional extraction wells pumping at a combined rate of approximately 56 gpm would cut off the migration of dissolved phase contaminants from the SRSNE Site to off-set the regional hydraulic influence that is expected to occur should Town Wells No. 4 and 6 were operated at their registered capacities of 740 gpm and 1,150 gpm, respectively. This contingent alternative would ensure that the cleanup objectives for overburden groundwater continue to be met.

If activated, this alternative would require the extraction and treatment of groundwater utilizing the modified NTCRA 1 treatment system. If the primary Overburden Groundwater alternative selected is OGW-2 (Institutional Measures and MNA), then provisions would have to be made to restart the modified NTCRA 1 treatment system as part of this contingent alternative.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-46 through 4-48.

4.6 Detailed Analysis of Alternatives for the Bedrock NAPL Area

This area of the site includes NAPL present in bedrock fractures and the associated contaminated bedrock matrix. This area covers approximately 260,000 square feet (6.0 acres), and extends from the Operations Area eastward to the vicinity of the Quinnipiac River, and north (up gradient based on non-pumping head data) to the location of the former Cianci Water Supply Well. The depth of the Bedrock NAPL Area is inferred to extend to a depth on the order of 200 feet below grade.

The alternatives subject to detailed analysis in this section are intended to achieve the following cleanup objectives for the Bedrock NAPL Area:

Bedrock NAPL Area – Human Health

Minimize expansion of the extent of contaminated bedrock groundwater due to further NAPL migration.

Bedrock NAPL Area – Protection of the Environment

Minimize expansion of the extent of contaminated bedrock groundwater due to further NAPL migration.

4.6.1 Alternative NBGU-1: No Action

Technical Description

The No Action alternative would not utilize any remedial technologies. The site would remain in its current condition, and no actions would be taken to address the contaminants in this area of the site. The natural subsurface processes that reduce the concentrations of chemical constituents would continue to take place under this alternative, over a very long time period. In the absence of monitoring or other activities to assess the progress of these processes, this reduction could not be assessed or documented. However, it would take an estimated 200 years to reach cleanup levels.

In accordance with the requirements of the NCP, performance of the No Action alternative would be evaluated on a regular basis (e.g., every five years) to determine the effectiveness and protectiveness of this alternative in the long term.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-49 through 4-51.

4.6.2 Alternative NBGU-2: Institutional Controls and MNA

Technical Description

This alternative would require placing institutional controls on a number of properties that could be affected by contaminants in this area of the site to prevent exposure to this contamination. This would include institutional controls that prohibit the use of groundwater for drinking or other domestic purposes for the Cianci Property and a portion of the Town Well Field property, as well as a number of properties adjacent to the Quinnipiac River on Queen Street.

The second component of this alternative would be the long-term monitoring of the natural attenuation processes in this area of the site. This component would be similar to the MNA component of Alternative OGW-2: Institutional Measures and Monitored Natural Attenuation of the Overburden Groundwater.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-52 through 4-54.

4.7 Detailed Analysis of Alternatives for Bedrock Groundwater

The Bedrock Groundwater alternatives subject to detailed analysis in this section are intended to achieve the following cleanup objectives for this area of the site:

Bedrock Groundwater – Human Health

Prevent potential human exposure (dermal contact, ingestion, and inhalation) to bedrock groundwater with contaminants that may pose a carcinogenic risk in excess of 1 x 10^{-4} to 1 x 10^{-6}, that may pose a non-carcinogenic Hazard Index of 1, or that may exceed ARARs.

Bedrock Groundwater – Protection of the Environment

Prevent continuing migration of contaminants that exceed ARARs or that present an unacceptable risk; and restore bedrock groundwater to meet ARARs once VOC residuals are depleted.

4.7.1 Alternative BGW-1: No Action

Technical Description

The No Action alternative would not utilize any remedial technologies. The site would remain in its current condition, and no actions would be taken to address the contaminants in the Bedrock Groundwater. The natural subsurface processes that reduce the concentrations of chemical constituents would continue to take place under this alternative, over a very long time period. In the absence of monitoring or other activities to assess the progress of these processes, this reduction could not be assessed or documented. However, it would take an estimated 200 years to reach cleanup levels.

In accordance with the requirements of the NCP, performance of the No Action alternative would be evaluated on a regular basis (e.g., every five years) to determine the effectiveness and protectiveness of this alternative in the long term.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-55 through 4-57.

4.7.2 Alternative BGW-2: Institutional Measures and MNA

Technical Description

This alternative would require institutional controls be put in place on a number of properties that could be affected by contaminants in this area of the site to prevent exposure to this contamination. This would include institutional controls that prohibit the use of groundwater for drinking or other domestic purposes for the Cianci Property and a portion of the Town Well Field property, as well as a number of properties adjacent to the Quinnipiac River on Queen Street.

The second component of this alternative would be the long-term monitoring of the natural attenuation processes in bedrock groundwater. This component would be similar to the MNA component of Alternative OGW-2: Institutional Measures and Monitored Natural Attenuation of the Overburden Groundwater. In the short term, protection will be achieved when institutional controls have been put in place. In the long term, protection will be achieved when groundwater cleanup levels are achieved which modeling suggests will happen in 200 years.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-58 through 4-60.

4.7.3 Alternative BGW-3: Hydraulic Containment and MNA

Technical Description

This alternative would involve extracting groundwater from the existing NTCRA 2 extraction wells, treating the extracted groundwater using the NTCRA 1 treatment system (modified as necessary following the completion of the selected ONOGU alternative), and monitored natural attenuation of the severed, downgradient dissolved phase plume (as described in OGW-3). In addition to groundwater extraction and treatment, this alternative includes institutional controls to prohibit the use of groundwater for drinking or other domestic purposes.

In the short term, protection will be achieved when institutional controls have been put in place. In the long term, protection will be achieved when groundwater cleanup levels are achieved which modeling suggests will be in 200 years. Hydraulic containment does not significantly reduce the time to achieve protection, but it does protect against the spread of the groundwater plume.

Detailed Analysis of Alternative

The detailed analysis of the alternative is presented in Tables 4-61 through 4-63.

5. Comparative Analysis of Alternatives

This section presents a comparative analysis of each remedial alternative, using the seven evaluation criteria identified in Section 4. Comparative analyses have been performed separately for the alternatives addressing each medium of concern. The analyses identify the advantages and disadvantages of each alternative relative to the other alternatives that address the medium of concern to highlight the differences. The results will be used by USEPA as the basis for selecting a remedial alternative for soil; NAPL in the overburden and bedrock groundwater units; and overburden and bedrock groundwater.

5.1 Remedial Alternatives for Operations Area/Railroad Soil

Overall Protection of Human Health and the Environment

Alternative OAR-3: Excavation and Offsite Disposal ranks highest among the soil remedial alternatives in terms of overall protectiveness in that all contaminated soil is excavated and permanently removed from the site. However, this alternative has higher short-term risks associated with potential exposures to workers and the community during excavation. Alternative OAR-2 Capping and Institutional Measures would achieve the human health and protection of the environment cleanup objectives by preventing human exposure through the construction of an engineered control (i.e., the composite cap) and the implementation of institutional controls; and the prevention of contaminant migration to groundwater.

Although Alternative OAR-1: No Action would not provide for overall protection for human health in the long term as no action would be taken to eliminate, reduced or control exposures to levels in the soil that present an unacceptable risk or exceed ARARs.

Compliance with ARARs

Alternative OAR-2 would comply with ARARs through the engineered control provisions of the Connecticut RSRs. Alternative OAR-3 would also comply with ARARs. Alternative OAR-1 would not comply with ARARs.

Long-Term Effectiveness and Permanence

Alternative OAR-2 would not result in the removal of contaminated soils, but would provide long-term effectiveness by isolating the soils from preventing human exposure through the construction of an engineered control, and using institutional controls to ensure that the cap remains effective in the long term. In order for the cap to remain effective in the long term, the condition and integrity of the cap would be inspected and maintained periodically. Alternative OAR-3 provides long-term effectiveness and permanence by permanently removing all soil that presents an unacceptable risk from the site. Alternative OAR-1 would not limit potential exposures to contaminated soil. Alternative OAR-1 ranks lowest in terms of long-term effectiveness.

Reduction of Toxicity, Mobility, or Volume through Treatment

Neither Alternative OAR-2 nor OAR-3 would use active treatment or recycling processes to reduce the toxicity, mobility or volume of contaminants in the Operations Area/Railroad soils. However, OAR-2 would reduce mobility by containing the contaminants and preventing the infiltration of surface water through the soil. OAR-3 would reduce contaminant mobility, toxicity and volume of contaminants through their removal from the site and offsite disposal. There is no reduction in toxicity, mobility, or volume with Alternative OAR-1.

<u>*Short-Term Effectiveness*</u>

Alternative OAR-1 ranks highest in terms of short-term effectiveness, since there would be no short-term risks posed to the community or onsite workers during implementation of the alternative, nor impacts to the environment. OAR-1 would not achieve protection at any time. The cap in Alternative OAR-2 would be installed in a manner that minimizes disturbance of Operations Area/Railroad soil, and potential short-term exposures to onsite workers would be further mitigated through standard construction techniques and personal safety equipment. Alternative OAR-3 presents the greatest potential short term risks due to the magnitude of potential risk posed to workers and the community associated with excavation of highly-contaminated soil within an enclosure system and transportation of approximately 2,250 truckloads of materials over public roadways. As with Alternative OAR-2, these potential short term risks would be minimized and/or prevented by use of standard construction techniques, personal safety equipment and perimeter monitoring. After implementation, both OAR-2 and OAR-3 would be protective.

<u>*Implementability*</u>

Alternatives OAR-1, OAR-2 and OAR-3 are technically and administratively feasible. Alternative OAR-2 would require coordination for the implementation of institutional controls. This is not expected to limit the implementability of this alternative.

<u>*Cost*</u>

A summary of the present worth cost for each soil remedial alternative follows. Detailed cost estimates are in **Tables 4-3, 4-6 and 4-9**.

Alternative	Estimated Present Worth Cost
OAR-1: No Action	$0
OAR-2: Capping and Institutional Controls	$1,060,000
OAR-3: Excavation and Offsite Disposal	$13,230,000

5.2 Remedial Alternatives for Cianci Property Soil

<u>*Overall Protection of Human Health and the Environment*</u>

Both Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal and Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal provide overall protection of human health and the environment for Cianci property soil by eliminating potential ecological risks associated with site-related contaminants. Alternative CP-3 would offer slightly greater overall protectiveness than Alternative CP-2 in that it permanently removes the soil from the site, but it would have slightly higher short-term impacts as CP-3 requires contaminated soil to be taken off site by truck through the community.

Because no action would be taken with Alternative CP-1, it would not provide any overall protection of human health or the environment.

<u>*Compliance with ARARs*</u>

Alternatives CP-2 and CP-3 would meet all ARARs. Alternative OAR-1 would not comply with ARARs.

Long-Term Effectiveness and Permanence

Alternative CP-3 would rank highest in terms of long-term effectiveness by permanently removing contaminated soil from the site. Alternative CP-2 would also provide long-term effectiveness but would require the long-term management of excavated materials onsite in conjunction with the Operations Area cap (OAR-2).

Alternative CP-1 would not limit potential exposures to contaminated soil. Alternative CP-1 ranks lowest in terms of long-term effectiveness.

Reduction of Toxicity, Mobility, or Volume through Treatment

Neither Alternatives CP-2 nor CP-3 would reduce contaminant toxicity, mobility, and volume through treatment. Alternative CP-2 would reduce surface-water infiltration, thus reducing the mobility of contaminants in the soil. Alternative CP-3 will reduce toxicity, mobility and volume by permanently removing contaminated soils from the site for disposal off site. By replacing the existing culvert, both Alternatives CP-2 and CP-3 will eliminate it as a conduit for contaminated groundwater to reach surface water. There is no reduction in toxicity, mobility, or volume with Alternative CP-1.

Short-Term Effectiveness

Alternative CP-1 ranks highest in terms of short-term effectiveness, since there would be no short-term risks posed to the community or onsite workers during implementation of the alternative, nor impacts to the environment. CP-1 would not achieve protection at any time. The soil excavation, handling, and transportation activities of Alternatives CP-2 and CP-3 may pose some potential risks to workers and nearby residents due to uncontrolled emissions of VOCs and fugitive dust to the atmosphere. However, these potential risks would be addressed through the use of standard construction techniques and personal safety equipment. Alternative CP-3 would pose slightly higher potential short-term risks to the community as a result of the need to truck contaminated soil over public roadways to an offsite disposal location. Because some of the contaminated soil is located in a wetland, actions would need to be taken with both CP-2 and CP-3 to minimize the temporary impacts to this resource, followed by restoration. Long-term protection would be achieved by CP-2 and CP-3 after construction.

Implementability

Alternatives CP-1, CP-2 and CP-3 are all technically and administratively feasible. The no-action alternative (CP-1) is the most implementable of the remedial alternatives for Cianci Property soil since it requires no activities. Alternatives CP-2 and CP-3 would also require compliance state and federal wetland and floodplain requirements. This is not expected to limit the implementability of this alternative.

Cost

A summary of the present worth cost for each Cianci Property soil remedial alternative follows. Detailed cost estimates are in **Tables 4-12, 4-15 and 4-18**.

Alternative	Estimated Present Worth Cost
CP-1: No Action	$0
CP-2: Culvert Removal, Capping, and Excavation with Onsite Disposal	$310,000
CP-3: Culvert Removal, Capping, and Excavation with Offsite Disposal	$730,000

5.3 Remedial Alternatives for Overburden NAPL Area

Overall Protection of Human Health and the Environment

All six ONOGU alternatives subject to detailed analysis, Alternative ONOGU-2: Hydraulic Displacement and MNA; Alternative ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation; Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation and MNA; Alternative ONOGU-5: Thermal Treatment and MNA; and Alternative ONOGU-6: Excavation and Off-site Disposal, would achieve cleanup objectives and would provide overall protection of human health and the environment in the long term. They differ from each other in the amount of NAPL mass that remains after implementation of the initial step(s) of the treatment train, and what is left for degradation through natural processes. ONOGU-6 would result in the most complete removal of the contaminated material in this portion of the site, but excavation poses potential significant risk to onsite workers and the community which would have to be addressed. ONOGU-5 would reduce NAPL mass by an estimated 95%, and ONOGU-4 by 95% to 99%. But ONOGU-4 would require managing a very large volume of highly-reactive material on site, and ONOGU-5 is a highly-complex system that would require the capture and treatment of contaminated vapors. The hydraulic displacement component of ONOGU-3 and ONOGU-2 would result in the reduction of NAPL mass by up to 44%, leaving more than half of the NAPL mass to be addressed by enhanced bioremediation or MNA, which both require much longer durations of time to achieve further reductions in contamination. Downward mobilization of NAPL during implementation of any of the ONOGU alternatives would likely increase the amount of time to achieve cleanup objectives. Of these alternatives, the risk for downward mobilization is greatest for ONOGU-5 and ONOGU-6. Alternative ONOGU-1: No Action would not be protective of human health and the environment.

Compliance with ARARs

All of the ONOGU alternatives except the No Action alternative would comply with ARARs.

Long-Term Effectiveness and Permanence

Alternative ONOGU-6 would have the highest long-term effectiveness and permanence, in that it would result in the permanent removal of the entire ONOGU media (NAPL and contaminated soil) from the site. Alternatives ONOGU-2 through ONOGU-5 would have comparable long-term permanence. However the magnitude of the residual risk that remains in the short term after active treatment takes places varies considerably among the alternatives. Alternatives ONOGU-4 and ONOGU-5 would have comparatively the greatest long-term effectiveness and permanence in the short term, as it is expected that they would remove at least 95% of the NAPL mass during treatment. Impurities in the injected oxidant in ONOGU-4 could add metals contamination to the subsurface that could exceed regulatory criteria, and that could become more mobile under the reducing conditions associated with natural attenuation. Alternatives ONOGU-2 through ONOGU-5 would also include post-treatment groundwater monitoring (in support of either the MNA or enhanced bioremediation components) and would require five-year reviews to determine protectiveness and effectiveness. The No Action alternative, ONOGU-1, would not provide long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume through Treatment

All of the ONOGU alternatives except No Action (ONOGU-1) would ultimately achieve a similar level of reduction of toxicity, mobility and volume through treatment. The mobility of contaminants in the Overburden NAPL Area would be eliminated and the volume would be reduced at the completion of the hydraulic displacement component of alternatives ONOGU-2 through ONOGU-4, and at the completion of the thermal treatment component of alternative ONOGU-5. However, among the alternatives that rely on treatment, the volume of contaminants addressed during the active treatment component of each alternative varies considerably from up to 44% for ONOGU-2 to up to 99% for ONOGU-5 and ONOGU-6. The toxicity and volume would be further reduced upon completion of the follow-on treatment steps (i.e., MNA, chemical oxidation or enhanced bioremediation). In the short term, PCBs and/or metals may remain at concentrations above cleanup levels after treatment with alternatives ONOGU-2 through ONOGU-5. However, their concentrations are expected to meet cleanup levels in the long term as the solubility of PCBs (which are co-located with the NAPL) decreases, and, metals stabilize with the removal of solvents from the subsurface. Alternative ONOGU-6 would have the greatest reduction in contaminant toxicity, mobility and volume, through excavation of contaminants and trucking to another location for disposal.

Short-Term Effectiveness

Alternative ONOGU-1 ranks highest in terms of short-term effectiveness, since there would be no short-term risks posed to the community or onsite workers during implementation of the alternative, nor impacts to the environment. Of the remaining ONOGU alternatives, all present potential risks to workers and the community which would have to be addressed. Alternatives ONOGU-2 and ONOGU-3 present the smallest number of issues which would have to be addressed. Alternative ONOGU-4 would present additional issues associated with the transportation, handling and injection of large volumes of oxidant chemicals which would have to be addressed. Alternatives ONOGU-5 and ONOGU-6 are both relatively complex alternatives. The potential for escape of emissions during construction and operation, and/or the need to transport large quantities of contaminated materials over public roadways through the community would need to be addressed under these two remaining alternatives.

In terms of time until protection is achieved, ONOGU-6 achieves protection in the shortest period of time -- in three to four years, after design and excavation. It is the only technology that does not rely on natural or enhanced degradation processes to achieve protection. Because the remaining ONOGU alternatives do rely on natural or enhanced degradation processes to achieve cleanup levels in the long term, they will be discussed in terms of their relative abilities to remove virtually all (99%) of the NAPL mass. With no action taken to reduce risk under ONOGU-1, natural degradation processes would reduce virtually all NAPL mass in 400 to 500 years. The hydraulic displacement component of ONOGU-2 through ONOGU-4 is expected to remove up to 44% of NAPL mass. With MNA added, ONOGU-2 would take an estimated 300 to 400 years to remove virtually all NAPL mass. With enhanced biodegradation, ONOGU-3 would remove virtually all NAPL in 130 years if the technology is able to reach degradation rates three times the current assumed rate, and 40 years if it can achieve ten times the current assumed degradation rate. After chemical oxidation and MNA, ONOGU-4 would remove virtually all NAPL mass in 50 to 150 years. ONOGU-5 will remove virtually all mass in 50 to 150 years if the technology is able to remove 95% of the mass initially, 40 to 100 years if it removes 97%, and seven years if the technology is able to attain a removal efficiency of 99%.

Implementability

Other than the No Action alternative, alternatives ONOGU-2 and ONOGU-3 would be the simplest to construct and operate. However, the rate of recovery of pooled contaminants with hydraulic displacement, and, the ability of enhanced biodegradation to significantly increase the current naturally-occurring degradation rate have a greater uncertainty than the estimated rates of contaminant removal with the other ONOGU alternatives. The initial construction requirements for alternative ONOGU-4 would be similar, although the chemical oxidation component would require the installation of additional wells and facilities for handling, mixing and injecting oxidant into the subsurface. The application outlined in ONOGU-4 would be the largest use of oxidant to date in an environmental remedial project. Alternative ONOGU-6 would be significantly more complex because of the need to provide particulate and volatile emissions control, and it's technical feasibility would depend on the ability to coordinate and manage the transportation of a large volume of contaminated materials to the offsite treatment and disposal facility. Finally, although thermal remedies have been successfully implemented at other sites, ONOGU-5 would present some implementation issues because of the complex infrastructure and engineering that would be needed to ensure the successful control of groundwater migration and the capture and on-site treatment of recovered solvent vapors.

Cost

A summary of the present worth cost for each ONOGU remedial alternative follows. Detailed cost estimates are in **Tables 4-21, 4-24, 4-27, 4-30, 4-33 and 4-36**.

Alternative	Estimated Present Worth Cost
ONOGU-1: No Action	$0
ONOGU-2: Hydraulic Displacement and MNA	$6,190,000
ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation	$9,640,000
ONOGU-4: Hydraulic Displacement, Chemical Oxidation, and MNA	$20,130,000
ONOGU-5: Thermal Treatment and MNA	$17,660,000
ONOGU-6: Excavation and Offsite Disposal	$39,970,000

5.4 Remedial Alternatives for the Overburden Groundwater

Overall Protection of Human Health and the Environment

Alternative OGW-2: Institutional Measures and MNA and Alternative OGW-3: Hydraulic Containment and MNA provide overall protection of human health and the environment through the use of institutional controls to prevent domestic use of groundwater, and, MNA to achieve cleanup objectives within a reasonable time frame if an alternative other than No Action is selected for the Overburden NAPL Area. Alternative OGW-3 affords greater overall protectiveness because the hydraulic containment component prevents the groundwater plume from spreading. Alternative OGW-1: No Action would not be protective.

Compliance with ARARs

Both alternatives OGW-2 and OGW-3 would comply with ARARs. Alternative OGW-1, No Action, would not comply with ARARs.

Long-Term Effectiveness and Permanence

Provided an alternative for the Overburden NAPL Area that will achieve the cleanup objectives is selected, the long-term effectiveness and permanence of alternatives OGW-2 and OGW-3 would be equivalent. Both would restrict the use of groundwater through institutional controls, and use treatment (i.e., monitored in-situ natural degradation processes) to destroy contaminants in groundwater to safe levels. Alternative OGW-3 would also employ ex-situ treatment technologies to the contaminated groundwater extracted from the overburden aquifer, Alternative OGW-1, No Action, provides neither long-term effectiveness nor permanence.

If no action is taken in the Overburden NAPL Area, or, if the contingent overburden groundwater remedy, OGW-4, is implemented, then alternative OGW-3 would provide a higher level of long-term effectiveness and permanence when compared to the other OGW alternatives.

Reduction of Toxicity, Mobility, or Volume through Treatment

The MNA component of alternatives OGW-2 and OGW-3 would result in the permanent and irreversible reduction of contaminant toxicity, mobility and volume through treatment, by the natural degradation processes that occur in the subsurface. The hydraulic containment component in Alternative OGW-3 would provide additional reduction in mobility of contaminants, and the NTCRA treatment system would be effective in permanently reducing the toxicity and volume of contaminants in the extracted dissolved phase groundwater. Alternative OGW-1 would not provide treatment for the reduction of the toxicity, mobility and volume of contaminants in this area of the site above that which happens through natural degradation processes. However, absent any monitoring or other activities to assess the progress of these processes, this reduction could not be documented.

Short-Term Effectiveness

Alternative OGW-1 ranks highest in terms of short-term effectiveness, since there would be no short-term risks posed to the community or onsite workers during implementation of the alternative, nor impacts to the environment. Alternative OGW-2 and Alternative OGW-3 present few issues related to short-term risk to workers, the community, and the environment. These issues can be addressed by standard construction techniques and personal safety equipment.

In the short term, both OGW-2 and OGW-3 would provide protectiveness with the implementation of institutional controls, which OGW-1 would not do. In the long term, all the OGW alternatives except Alternative OGW-1 would likely achieve protection in an estimated 200 years. This could not be determined under OGW-1 since there would be no monitoring. This estimate is based on the assumption that virtually all (99%) of the NAPL has been removed from the Overburden NAPL Area.

Implementability

Alternatives OGW-1, OGW-2 and OGW-3 (as well as the contingent alternative OGW-4) would be readily implementable. In all cases, the alternatives would be technically and administratively feasible.

Cost

A summary of the present worth cost for each overburden groundwater remedial alternative follows. The cost of five-year reviews is included in the OGW alternatives. Detailed cost estimates are in **Tables 4-39, 4-42 and 4-45**.

Alternative	Estimated Present Worth Cost
OGW-1: No Action	$80,000
OGW-2: Institutional Measures and MNA	$2,590,000
OGW-3: Hydraulic Containment and MNA	$9,570,000

In addition, contingent Alternative OGW-4: Supplemental Containment has an estimated cost of $~~1,910,000~~ 1,380,000 (see **Table 4-48**).

5.5 Remedial Alternatives for NAPL in the Bedrock Groundwater Unit

Overall Protection of Human Health and the Environment

Alternative NBGU-2: Institutional Measures and MNA would provide the greatest protection of human health and the environment when compared to Alternative NBGU-1: No Action which would not provide any protection as waste material are neither eliminated, reduced nor controlled. Alternative NBGU-2 provides overall protection through the use of institutional controls to prevent exposure to NAPL in the bedrock fractures and in the bedrock matrix, and, uses MNA to restore groundwater quality to cleanup levels within a reasonable time frame.

Compliance with ARARs

Alternative NBGU-1would not meet ARARs. Alternative NBGU-2 would comply with all ARARs.

Long-Term Effectiveness and Permanence

Because the No Action alternative (NBGU-1) would not involve any monitoring of the ongoing natural attenuation processes within the Bedrock NAPL Area, the degree to which long-term effectiveness and permanence of this alternative is achieved cannot be assessed. Alternative NBGU-2 would provide long-term effectiveness by restricting the use of groundwater through institutional controls, and MNA to permanently reduce contaminant concentrations.

Reduction of Toxicity, Mobility, or Volume through Treatment

Both alternatives NBGU-1 and NBGU-2 would result in the permanent reduction of contaminant toxicity, mobility and volume through treatment, by the natural degradation processes that occur. However, alternative NBGU-2 would allow for the continued monitoring of conditions to assess the progress of these mechanisms, while the No Action alternative would not.

Short-Term Effectiveness

Implementation of either alternative NBGU-1 or NBGU-2 would not result in any significant short-term exposure of onsite workers or the community to the chemical constituents present in the Bedrock NAPL Area. Similarly, no short-term environmental impacts would be anticipated. Based on modeling of the rates of NAPL dissolution, matrix diffusion and natural attenuation occurring within the Bedrock NAPL Area, the bedrock plume should begin to decay within a period of 125 years and all bedrock groundwater should reach regulatory standards within 225 years. Only Alternative NBGU-2 would provide for the ongoing monitoring of the natural attenuation processes.

Implementability

Both alternatives NBGU-1 and NBGU-2 would be technically and administratively feasible. While alternative NBGU-2 would require coordination for the implementation of the institutional controls component, this should not prevent the implementation of this alternative.

Cost

As shown in **Tables 4-51 and 4-54**, there would be no cost associated with the No Action alternative. Additionally, all costs of alternative NBGU-2 would be included with the costs of the remedial alternatives for the Overburden Groundwater and/or the Bedrock Groundwater

5.6 Remedial Alternatives for the Bedrock Groundwater Unit

Overall Protection of Human Health and the Environment

Alternative BGW-2: Institutional Measures and MNA and Alternative BGW-3: Hydraulic Containment and MNA would provide overall protection of human health and the environment through the use of institutional controls to prevent domestic use of groundwater, and MNA to achieve cleanup objectives within a reasonable time frame if an alternative other than No Action is selected for the Overburden NAPL Area and Bedrock NAPL Area. Alternative BGW-3 affords greater overall protectiveness because the hydraulic containment component prevents the groundwater plume from spreading. Alternative BGW-1 would not be protective.

Compliance with ARARs

Both alternatives BGW-2 and BGW-3 would be comply with ARARs. Alternative BGW-1 would not comply with ARARs.

Long-Term Effectiveness and Permanence

Provided alternatives for the Overburden NAPL Area and Bedrock NAPL Area that will achieve the cleanup objectives are selected, Alternatives BGW-2 and BGW-3 would provide long term effectiveness by restricting the use of groundwater through institutional controls and treatment (i.e., monitored in-situ natural degradation processes) to destroy contaminants in groundwater to safe levels. Alternative BGW-3 would also employ ex-situ treatment technologies to the contaminated groundwater extracted from the bedrock aquifer, Alternative BGW-1, No Action, provides neither long-term effectiveness nor permanence.

If a combination of alternatives that do not achieve the cleanup objectives for the Bedrock NAPL Area is selected, then alternative BGW-3 would provide a higher level of long-term effectiveness and permanence when compared to the other BGW alternatives.

Reduction of Toxicity, Mobility, or Volume through Treatment

The MNA component of alternatives BGW-2 and BGW-3 would result in the permanent and irreversible reduction of contaminant toxicity, mobility and volume through treatment, by the natural degradation processes that occur in the subsurface. The hydraulic containment component in Alternative BGW-3 would provide additional reduction in mobility of contaminants, and the NTCRA treatment system would be effective in permanently reducing the toxicity and volume of contaminants in the extracted dissolved phase groundwater. Alternative BGW-1 would not provide treatment for the reduction of the toxicity, mobility and volume of contaminants in this area of the site above that which happens through natural degradation processes. However, absent any monitoring or other activities to assess the progress of these processes, this reduction could not be documented.

Short-Term Effectiveness

Alternative BGW-1 ranks highest in terms of short-term effectiveness, since there would be no short-term risks posed to the community or onsite workers during implementation of the alternative, nor impacts to the environment. Alternative BGW-2 and Alternative BGW-3 present few issues regarding risks to workers and the community. These issues would be addressed by standard construction techniques and personal safety equipment.

In the short term, both BGW-2 and BGW-3 would provide protectiveness with the implementation of institutional controls, which BGW-1 would not do. In the long term, all the BGW alternatives except BGW-1, would likely achieve protection in an estimated 200 years. This could not be determined under BGW-1 since there would be no monitoring.

Implementability

Alternatives BGW-1, BGW-2 and BGW-3 would be readily implementable. In all cases, the alternatives would be technically and administratively feasible.

Cost

A summary of the present worth cost for each bedrock groundwater remedial alternative follows. Detailed cost estimates are in **Tables 4-57, 4-60 and 4-63**.

Alternative	Estimated Present Worth Cost
BGW-1: No Action	$0
BGW-2: Institutional Measures and MNA	$660,000
BGW-3: Hydraulic Containment and MNA	$660,000

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7. List of Acronyms

ACL	alternate concentration limit
AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
AWQC	Ambient Water Quality Criteria
BGW	bedrock groundwater unit
B&M	Boston & Maine
BBL	Blasland, Bouck and Lee, Inc.
BEHP	bis (2-ethylhexyl) phthalate
BTEX	benzene, toluene, ethylbenzene, xylenes
CAA	Clean Air Act
CAWQC	chronic ambient water quality criteria
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CH_4	methane
CL&P	Connecticut Light & Power
CO_2	carbon dioxide
COC	chemical of concern
COPC	chemical of potential concern
CT DEP	Connecticut Department of Environmental Protection
CVOC	chlorinated volatile organic compound
CWA	Clean Water Act
DCE	dichloroethylene
DEC	risk-based Direct Exposure Criteria (CT DEP)
DHC	dehalococcoides
DNAPL	dense non-aqueous phase liquid
EE/CA	engineering evaluation/cost analysis
EISB	enhanced in situ biological treatment
ELUR	Environmental Land Use Restrictions
ERA	ecological risk assessment
ER-L	effects range - low
FS	feasibility study
GRA	general response action
GWPC	ground water protection criteria
GWUVD	Ground Water Use & Value Determination
HASP	Health and Safety Plan
HI	hazard index
HNUS	Halliburton NUS Environmental Corporation
HQ	hazard quotient
IMS	interim monitoring and sampling
LDR	RCRA Land Disposal Restrictions
LNAPL	light non-aqueous phase liquid
LTTD	low temperature thermal desorption
MCL	RCRA Maximum Contaminant Level
MCLG	RCRA Maximum Contaminant Level Goal
MNA	monitored natural attenuation
NAAQS	National Ambient Air Quality Standards
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan

NBGU	NAPL in the Bedrock Groundwater Unit
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NTCRA	non-time critical removal action
OGW	overburden groundwater unit
O&M	operation and maintenance
OIS	on-site ground-water interceptor system
ONOGU	observed NAPL in the Overburden Groundwater Unit
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCR	polymerase chain reaction
PLFA	phospholipid fatty acid
PMC	pollutant mobility criteria
POTW	publicly owned treatment work
PMC	Pollutant Mobility Criteria (CT DEP)
ppb	part per billion
PPE	personal protective equipment
ppm	parts per million
PRG	preliminary remediation goal
PRP	potentially responsible party
QA/QC	quality assurance/quality control
RA	risk assessment
RAGs	risk assessment guidance (USEPA)
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
ROD	record of decision
RSR	Remediation Standard Regulations (CTDEP)
SAFE	Southington Association for the Environment
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SIP	state implementation plan
SITE	Superfund Innovative Technology Evaluation program
SOW	scope of work
SRSNE	Solvents Recovery Service of New England, Inc.
SVE	soil vapor extraction
SVOC	semi-volatile organic compound
TAG	Technical Assistance Grant
TBC	“to be considered” criteria
TCA	trichloroethane
TCE	trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TI	technical impracticability
TSCA	Toxic Substances Control Act
TSDF	treatment storage and disposal facility
TEX	toluene, ethyl benzene, and xylenes
UCL	upper confidence limit
UCONN	University of Connecticut
USAF	United States Air Force Center for Environmental Excellence

USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UvOx	ultraviolet oxidation
VC	vinyl chloride
VOC	volatile organic compound

8. Glossary

Administrative Order On Consent (AOC): A legal agreement signed by EPA and an individual, business, or other entity through which the violator agrees to pay for correction of violations, take the required corrective or cleanup actions, or refrain from an activity. It describes the actions to be taken, may be subject to a comment period, applies to civil actions, and can be enforced in court.

Applicable or Relevant and Appropriate Requirements (ARAR): Any state or federal statute that pertains to protection of human life and the environment in addressing specific conditions or use of a particular cleanup technology at a Superfund site.

Activated Carbon: A highly adsorbent form of carbon used to remove odors and toxic substances from liquid or gaseous emissions. In waste treatment it is used to remove dissolved organic matter from waste water.

Aerobic Treatment: Process by which microbes decompose complex organic compounds in the presence of oxygen and use the liberated energy for reproduction and growth.

Aerobic: Life or processes that require, or are not destroyed by, the presence of oxygen.

Air Pollutant: Any substance in air that could, in high enough concentration, harm man, other animals, vegetation, or material. Pollutants may include almost any natural or artificial composition of airborne matter capable of being airborne. They may be in the form of solid particulates, liquid droplets, gases, or in combination thereof. Generally they fall into two main groups: (1) those emitted directly from identifiable sources and (2) those produced in the air by interaction between two or more primary pollutants, or by reaction with normal atmospheric constituents, with or without photoactivation.

Air Pollution Control Device: Mechanism or equipment that cleans emissions generated by an incinerator by removing pollutants that would otherwise be released to the atmosphere.

Air Stripper: A treatment system that removes volatile organic compounds (VOCs) from contaminated ground water or surface water by forcing an air stream through the water and causing the compounds to evaporate.

Ambient Air: Any unconfined portion of the atmosphere: open air, surrounding air.

Anaerobic: A life or process that occurs in, or is not destroyed by, the absence of oxygen.

Aquifer: An underground geologic formation, or group of formations, containing usable amounts of ground water that can supply wells and springs.

Attenuation: The process by which a compound is reduced in concentration over time, through absorption, adsorption, degradation, dilution, and/or transformation.

Bacteria: Microscopic living organisms that can aid in pollution control by metabolizing organic matter in media such as ground water, soil, oil spills, and sewage.

Bedrock: Any solid rock exposed at the surface of the earth or overlain by unconsolidated overburden soil.

Bedrock Groundwater (BGW): Groundwater and the fractured consolidated rock matrix that contain contaminant concentrations exceeding acceptable risk levels or regulatory criteria.

Biodegradable: Capable of decomposing rapidly under natural conditions.

Biological Treatment: A treatment technology that uses bacteria to consume organic waste.

Bioremediation: Use of living organisms to clean up oil spills or remove other pollutants from soil, water or wastewater; use of organisms such as non-harmful insects to remove agricultural pests or counteract diseases of trees, plants, and garden soil.

Cap: A layer of clay, or other impermeable material installed over the top of a landfill or contaminated area of soil to prevent entry of rainwater and minimize leaching of pollutants into ground water.

Carbon Adsorption: A treatment system that removes contaminants from ground water or surface water by forcing it through tanks containing activated carbon treated to attract the contaminants.

Chlorinated Solvents: An organic solvent containing chlorine atoms, e.g., methylene chloride and 1,1,1-trichloromethane, often used in aerosol spray containers and paint.

Chronic Toxicity: The capacity of a substance to cause long-term poisonous human health effects.

Cleanup: Actions taken to deal with a release or threat of release of a hazardous substance that could affect humans and/or the environment. The term “cleanup” is sometimes used interchangeably with the terms remedial action, removal action, response action, or corrective action.

CFR: Code of Federal Regulations

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): (Commonly known as Superfund) This law, enacted by Congress on December 11, 1980, created the Superfund program. Specifically, CERCLA established prohibitions and requirements concerning closed and abandoned hazardous waste sites; provided for liability of persons responsible for releases of hazardous waste at these sites; and established a trust fund to provide for cleanup when no responsible party could be identified.

Consent Decree: A legal document, approved by a judge, that formalizes an agreement reached between EPA and potentially responsible parties (PRPs) through which PRPs will conduct all or part of a cleanup action at a Superfund site; cease or correct actions or processes that are polluting the environment; or otherwise comply with EPA initiated regulatory enforcement actions to resolve the contamination at the Superfund site involved.

Contaminant: Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.
Dechlorination: Removal of chlorine from a substance by chemically replacing it with hydrogen or hydroxide ions in order to detoxify a substance.

Dense Non-Aqueous Phase Liquid (DNAPL): A non-aqueous phase liquid (NAPL) that is more dense than water and would tend to migrate below the water table.

Ecological Impact: The effect that a man-made or natural activity has on living organisms and the non-living (abiotic) environment.

Ecological Risk Assessment: The application of a formal framework, analytical process, or model to estimate the effects of human action(s) on a natural resource and to interpret the significance of those effects in light of the uncertainties identified in each component of the assessment process. Such analysis includes initial hazard identification, exposure and dose-response assessments, and risk characterization.

Effluent: Wastewater, treated or untreated, that flows out of a treatment facility, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

Effluent Limitations: Restrictions established by a State or EPA on quantities, rates, and concentrations in wastewater discharges.

Emission: Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, or aircraft exhausts.

Exceedence: Concentration that is greater than the pollutant levels permitted by environmental protection standards.

Ex-Situ: Moved from its original place; excavated; removed or recovered from the subsurface.

Feasibility Study: Analysis of the practicability of a proposal; e.g., a description and analysis of potential cleanup alternatives for a site. The feasibility study usually recommends selection of a cost-effective alternative. It usually starts as soon as the remedial investigation is underway; together, they are commonly referred to as the “RI/FS”.

General Response Action (GRA): Actions identified/taken for each media of interest that will contain, treat or remove potential health-threatening environmental events such as spills, sudden releases. GRAs are developed to satisfy the remedial action objectives for the site.

Generator: A facility or mobile source that emits pollutants into the air or releases hazardous waste into water or soil.

Ground Water: Water found beneath the earth=s surface that fills pores between materials such as sand, soil, or gravel. In aquifers, ground water occurs in sufficient quantities that it can be used for drinking water, irrigation, and other purposes.

Hazard Quotient (HQ): A value calculated during risk assessment of non-carcinogens that is equal to the average intake (based on ingestion rate and exposure duration) divided by the reference dose. A HQ value greater than 1 indicates that a calculated exposure is greater than the reference dose for a given constituent, and that there may be some potential for health concerns.

Hazardous Waste: By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity or toxicity), or appears on special EPA lists.

Hydraulic Gradient: In general, the direction of ground water flow due to changes in the depth of the water table.

Infiltration: The penetration of water through the ground surface into sub-surface soil.

In-Situ: Remaining in original place.

Leachate: Water that collects contaminants as it trickles through waste (e.g. landfills), and may result in hazardous substances entering surface water, ground water or soil.

Leaching: The process by which soluble constituents are dissolved and filtered through the soil by a percolating fluid (e.g. rain water).

Light Non-Aqueous Phase Liquid (LNAPL): A non-aqueous phase liquid (NAPL) that is less dense than water and would tend to remain above the water table.

Maximum Contaminant Level (MCL): The maximum permissible level of a contaminant in water delivered to any user of a public system. MCLs are enforceable standards.

Maximum Contaminant Level Goal (MCLG): Under the Safe Drinking Water Act (SDWA), a non-enforceable concentration of a drinking water contaminant, set at the level at which no known or anticipated adverse effects on human health occur and which allows an adequate safety margin. The MCLG is usually the starting point for determining the regulated MCL.

Media: Specific environments- air, water, soil - which are the subject of regulatory concern and activities.

Mitigation: Measures taken to reduce adverse impacts on the environment.

Monitoring Wells: Wells drilled at specific locations on or off a hazardous waste site where ground water can be sampled at selected depths and studied to determine the direction of ground water flow and the types and amounts of contaminants present.

National Ambient Air Quality Standards (NAAQS): Standards established by EPA that apply to outside air throughout the country.

National Oil and Hazardous Substances Contingency Plan (NCP): The federal regulation that guides determination of the sites to be corrected under both the Superfund program and the program to prevent or control spills into surface waters or elsewhere.

National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the United States unless a permit is issued by EPA, a state, or, where delegated, a tribal government on an Indian reservation.

National Priority List (NPL): EPA=s list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action under Superfund. The list is based primarily on the score a site receives from the Hazard Ranking System. EPA is required to update the NPL at least once per year. A site must be on the NPL to receive money from the Superfund trust fund for remedial action.

Non-Aqueous Phase Liquid (NAPL): Contaminants that remain as the original bulk liquid in the subsurface (also referred to as “free product”).

Non-Time Critical Removal Action (NTCRA): Non-emergency removal action that is conducted prior to completion of the remedial investigation in an effort to expedite cleanup or containment of contaminated sites. NTCRAs are often implemented where the complexity of the remedial investigation may require an extended period of time to evaluate and determine the appropriate final remedial action.

Organic Compound: Animal or plant-produced substances containing mainly carbon, hydrogen, nitrogen, and oxygen.

Outfall: The place where effluent is discharged into receiving waters.

Overburden: Unconsolidated rock and soil comprising the uppermost geologic formation above bedrock.

Overburden Groundwater: Groundwater and saturated soil that contain contaminant concentrations exceeding acceptable risk levels or regulatory criteria.

Oxidation: The addition of oxygen that breaks down organic waste or chemicals such as cyanides, and phenols by bacterial and chemical means.

Particulates: Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog, found in air or emissions.

Parts Per Billion (ppb)/Parts Per Million (ppm): Units commonly used to express contaminant ratios or concentration, especially when defining the maximum permissible amount of a contaminant in water, land or air.

Permeability: The rate at which liquids pass through soil or other materials in a specified direction.

Personal Protective Equipment (PPE): Any equipment or clothing designed to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous waste site. PPE should appropriately protect the respiratory system, skin, eyes, face, hands, feet, head, body, and hearing.

Phytoremediation: An in-situ remediation technique that uses plants to remove, stabilize, and destroy contaminants in soil and sediment.

Plume: A visible or measurable discharge of a contaminant from a given point of origin (e.g., dissolved phase contamination in groundwater, downgradient from the initial release or spill).

Potentially Responsible Party (PRP): Any individual or company-including owners, operators, transporters or generators-potentially responsible for, or contributing to a spill or other contamination at a Superfund site. Whenever possible, through administrative and legal actions, EPA requires PRPs to clean up hazardous sites they have contaminated.

Preliminary Remediation Goals (PRGs): Chemical-specific, numeric cleanup criteria for each environmental media that provide the basis for development and comparison of remedial alternatives and the framework to evaluate the relative effectiveness of each respective alternative.

Publicly Owned Treatment Works (POTW): A waste-treatment works owned by a state, unit of local government, or Indian tribe, usually designed to treat domestic wastewater.

Quality Assurance/Quality Control (QA/QC): A system of procedures, checks, audits, and corrective actions to ensure that all work is of the highest achievable quality.

Record of Decision (ROD): A public document that explains which cleanup alternative(s) will be used at National Priority List sites.

Reference Dose (RfD): The concentration of a chemical known to cause health problems; also referred to as the ADD, or acceptable daily intake.

Release: Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous or toxic chemical or extremely hazardous substance.

Remedial Action (RA): The actual construction or implementation phase of a Superfund site cleanup that follows remedial design.

Remedial Action Objective (RAO): Remedial action objectives specify media-specific or site-specific goals for the protection of human health and the environment.

Remedial Design: The phase of remedial action that follows the remedial investigation/feasibility study and includes development of engineering drawings and specifications for a site cleanup.

Remedial Investigation (RI): An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site; establish site cleanup criteria; identify preliminary alternatives for remedial action; and support technical and cost analyses of alternatives. The remedial investigation is usually done with the feasibility study. Together they are usually referred to as the “RI/FS”.

Remediation: Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a Superfund site.

Removal Action: Short-term immediate actions taken to address releases of hazardous substances that require expedited response.

Residual: Amount of a pollutant remaining in the environment after a natural or technological process has taken place, e.g., the particulates remaining in air after it passes through a scrubbing or other process.

Resource Conservation and Recovery Act (RCRA): A law enacted in 1976 to protect the quality of ground water, surface water, air and land from contamination by solid waste. It established the first comprehensive federal regulatory program for controlling hazardous waste and provided grants and technical assistance to States to help improve their waste management techniques.

Risk: A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.

Risk Assessment: Qualitative and quantitative evaluation of the risk posed to human health and/or the environment by the actual or potential presence and/or use of specific pollutants.

State Implementation Plans (SIP): EPA-approved state plans for the establishment, regulation, and enforcement of air pollution standards.

Superfund: The program operated under the legislative authority of CERCLA and SARA that funds and carries out EPA solid waste emergency and long-term removal and remedial activities. These activities include establishing the National Priorities List, investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions.

Superfund Amendments and Reauthorization Act (SARA): Legislation that amended the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on October 17, 1986. SARA reflected EPA’s experience in administering the complex Superfund program during its first six years and made several important changes and additions to the program. SARA stressed the importance of permanent remedies and innovative treatment technologies; required Superfund actions to consider the standards and requirements found in other State and Federal environmental laws and regulations; provided new enforcement authorities and settlement tools; increased State involvement; increased the focus on human health problems; encouraged greater citizen participation; and increased the size of the Trust Fund to $8.5 billion.

Surface Water: All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water.

Technical Assistance Grant (TAG): As part of the Superfund program, Technical Assistance Grants of up to $50,000 are provided to citizens’ groups to obtain assistance in interpreting information related to cleanups at Superfund sites or those proposed for the National Priorities List. Grants are used by such groups to hire technical advisors to help them understand the site-related technical information for the duration of response activities.

Toxic Pollutants: Materials that cause death, disease, or birth defects in organisms that ingest or absorb them. The quantities and exposures necessary to cause these effects can vary widely.

Toxic Substance: A chemical or mixture that may present an unreasonable risk of injury to health or the environment.

Treatability Studies: Tests of potential cleanup technologies conducted in a laboratory.

Treatment, Storage, and Disposal Facility (TSDF): Site where a hazardous substance is treated, stored, or disposed of. TSDFs are regulated by EPA and states under RCRA.

Trial Burn: An incinerator test in which emissions are monitored for the presence of specific organic compounds, particulates, and hydrogen chloride.

Unsaturated Zone: The area below ground surface and above the water table where soil pores are not fully saturated, although some water may be present.

Vadose Zone: The unsaturated zone.

Variance: Government permission for a delay or exception in the application of a given law, ordinance, or regulation.

Volatile: Any substance that evaporates readily.

Volatile Organic Compound (VOC): Any organic compound that is characterized by being highly mobile in ground water and tends to readily volatilize or evaporate into the atmosphere.

Wastewater: The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

Water Quality Criteria: Levels of water quality expected for its designated use. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water Table: The level of ground water.

Wetlands: An area that is saturated by surface or ground water with vegetation adapted for life under those soil conditions, as swamps, bogs, fens, marshes, and estuaries.

Table 1-1a
SRSNE Superfund Site
Feasibility Study

Summary of Chemicals of Potential Concern in Ground Water, Soil and Sediment

Chemical Constituent
Overburdern and Bedrock Groundwater (a)
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethane (b)
1,2-Dichlorethene,total
2-Butanone
4-Methyl-2-pentanone
4-Methylphenol
Acetone
Aroclor 1254 (b)
Aroclor 1260 (c)
Arsenic
Barium
Benzene
Cadmium
Carbon tetrachloride (b)
Chlorobenzene
Chloroethane
Chromium
cis-1,2-Dichloroethene
Copper (b)
Ethylbenzene
Lead
Manganese
Methylene chloride
Nickel (b)
Tetrachloroethene
Tetrahydrofuran
Thallium (b)
Toluene
trans-1,2-Dichloroethene
Trichloroethene
Vanadium
Vinyl chloride
Xylenes, total

Table 1-1a
SRSNE Superfund Site
Feasibility Study

Summary of Chemicals of Potential Concern in Ground Water, Soil and Sediment

Chemical Constituent
Soil (d)
Aroclor 1254
Aroclor-1016
Aroclor-1260
Arsenic
Benzo(a)pyrene
bis(2-Ethylhexyl)phthalate
Cadmium
Lead
2,3,7,8-TCDD (e)
2,3,7,8-TCDF (e)
Tetrachloroethene
Trichloroethene
Vinyl chloride
Wetland Soil (f)
Total PCB

Notes:

(a) Chemicals of potential concern in overburden and bedrock groundwater from the Operations Area contributing to a cancer risk level greater than 1 x 10^{-6} and/or a hazard quotient of 1 (SRSNE Risk Assessment Update, April 2005).

(b) Chemicals of potential concern in bedrock groundwater only.

(c) Chemicals of potential concern in overburden groundwater only.

(d) Chemicals of potential concern in soils of the North and/or South Cianci Properties, and/or the Operations Area/Railroad Gradient contributing to a cancer risk level greater than 1 x 10^{-6} and/or a hazard quotient of 1 (SRSNE Risk Assessment Update, April 2005).

(e) Although individual dioxin and furan congeners are present in soils of the Operations Area/Railroad Gradient at cancer risk levels greater than 1 x 10^{-6}, not all dioxin and furan congeners are listed in this table. As described in Table 2-5, remediation goals will be derived for 2,3,7,8-TCDD on a TEQ-basis and not for individual dioxin and furan congeners.

(f) PCBs are the only COPC for wetland soil (based on potential ecological risk) (See Section 2.3 of the FS).

Table 1-1b
SRSNE Superfund Site
Feasibility Study

Summary of Substances in Groundwater and Soil that Exceed Connecticut Remediation Standards (CT RSRs)

Chemical Constituent[1]	Background (ug/L)	Groundwater Protection Criteria for GA and GAA Areas (ug/L)	USEPA MCLs and Non-Zero MCLGs (ug/L)
Groundwater			
VOCs			
1,1,1,2-Tetrachloroethane	1	1	NA
1,1,1-Trichloroethane	1	200	200
1,1,2-Trichloroethane	1	5	5
1,1-Dichloroethane	1	70	NA
1,1-Dichloroethene	1	7	7
1,2-Dibromo-3-chloropropane	NA	NA	0.2
1,2-Dichlorobenzene	1	600	600
1,2-Dichloroethane	1	1	5
1,2-Dichloroethene, Total	2	NA	NA
1,4-Dichlorobenzene	1	75	75
2-Butanone	5	400	NA
2-Hexanone	5	NA	NA
4-Methyl-2-pentanone	5	350	NA
Acetone	5	700	NA
Benzene	1	1	5
Bromomethane	1	9.8	NA
Carbon disulfide	1	700	NA
Carbon tetrachloride	1	5	5
Chlorobenzene	1	100	100
Chloroethane	1	NA	NA
Chloroform	1	6	100
Chloromethane	1	2.7	NA
cis-1,2-Dichloroethene	1	70	70
Ethylbenzene	1	700	700
Methylene chloride	2	5	5
Styrene	1	100	100
Tetrachloroethene	1	5	5
Tetrahydrofuran	1	NA	NA
Toluene	1	1000	1000
trans-1,2-Dichloroethene	1	100	100
trans-1,3-Dichloropropene	NA	0.5	NA
Trichloroethene	1	5	5
Vinyl chloride	1	2	2
Xylenes, Total	2	530	10000
SVOCs			
1,2,4-Trichlorobenzene	2	70	70
2,4-Dimethylphenol	10	140	NA
2-Methylphenol	10	350	NA
4-Methylphenol	10	35	NA
Benzoic Acid	10	50000	NA
bis(2-Ethylhexyl)phthalate	10	2	6
Di-n-butyl phthalate	10	700	NA
Di-n-octyl phthalate	10	100	NA
Hexachlorobutadiene	NA	0.45	NA
Isophorone	10	37	NA
Naphthalene	1	280	NA
Phenol	10	4000	NA
PCBs			
Aroclor-1254	1	NA	0.5
Aroclor-1260	1	NA	0.5
Inorganics			
Aluminum	NA	NA	50
Antimony	NA	6	6
Arsenic	NA	50	50
Barium	NA	1000	2000
Beryllium	NA	4	4
Cadmium	NA	5	5
Chromium	NA	50	100
Cobalt	NA	10	NA
Copper	NA	1300	1300
Iron	NA	NA	300
Lead	NA	15	15
Manganese	NA	NA	50
Nickel	NA	100	100
Silver	NA	36	100
Thallium	NA	5	2
Vanadium	NA	50	NA
Zinc	NA	5000	5000
Misc.			
4,4'-DDD	0.1	0.15	NA
Aldrin	0.05	NA	NA
Ethanol	1000	NA	NA
Isopropanol	1000	NA	NA
Methanol	1000	NA	NA
Sec-Butanol	1000	NA	NA

Table 1-1b
SRSNE Superfund Site
Feasibility Study

Summary of Substances in Groundwater and Soil that Exceed Connecticut Remediation Standards (CT RSRs)

Chemical Constituent[2]	Background (mg/kg)	Residential Direct Exposure Criteria (mg/kg)	GA, GAA Pollutant Mobility Criteria (mg/kg)
Soil			
VOCs			
1,1,1-Trichloroethane	NA	500	4
1,1,2,2-Tetrachloroethane	NA	3.1	0.01
1,1,2-Trichloroethane	NA	11	0.1
1,1-Dichloroethane	NA	500	1.4
1,1-Dichloroethene	NA	1	0.14
1,2-Dichloroethene, Total	NA	500	1.4
1,2-Dichloropropane	NA	9	0.1
2-Butanone	NA	500	8
4-Methyl-2-pentanone	NA	500	7
Acetone	NA	500	14
Benzene	NA	21	0.02
Carbon tetrachloride	NA	4.7	0.1
Chlorobenzene	NA	500	2
Chlorodibromomethane	NA	7.3	0.01
Chloroform	NA	100	0.12
Ethylbenzene	NA	500	10.1
Methylene chloride	NA	82	0.1
Styrene	NA	500	2
Tetrachloroethene	NA	12	0.1
Toluene	NA	500	20
Trichloroethene	NA	56	0.1
Vinyl chloride	NA	0.32	0.04
Xylenes, Total	NA	500	19.5
SVOCs			
2-Methylnaphthalene	NA	474	0.98
4-Chloroaniline	NA	270	1
4-Methylphenol	NA	340	0.7
Benzo(a)anthracene	NA	1	1
Benzo(a)pyrene	NA	1	1
Benzo(b)fluoranthene	NA	1	1
Benzo(k)fluoranthene	NA	8.4	1
bis(2-Ethylhexyl)phthalate	NA	44	1
Chrysene	NA	84	1
Dibenzofuran	NA	270	1
Di-n-butyl phthalate	NA	1000	14
Di-n-octyl phthalate	NA	1000	2
Fluoranthene	NA	1000	5.6
Indeno(1,2,3-cd)pyrene	NA	1	1
Phenanthrene	NA	1000	4
Pyrene	NA	1000	4
PCBs			
PCBs, Total	NA	1	0.0005*
Inorganics			
Antimony	TBD	27	0.006*
Arsenic	TBD	10	0.05*
Beryllium	TBD	2	0.004*
Cadmium	TBD	34	0.005*
Chromium	TBD	100	0.05*
Lead	TBD	500	0.015*
Manganese	TBD	1600	NA
Inorganics (TCLP) (mg/L)			
Barium	NA	NA	1
Lead	NA	NA	0.015

Table 1-1b
SRSNE Superfund Site
Feasibility Study

Summary of Substances in Groundwater and Soil that Exceed Connecticut Remediation Standards (CT RSRs)

Notes:

1. CT Remediation Standards Regulation requires that "Remediation of groundwater in a GA area shall result in reduction of each substance therein to a concentration equal to or less than the background concentration for groundwater of such substance …" (RCSA 22a-133k-3(a)(2)). At the SRSNE site, VOCs have not been detected in the background groundwater. In that case, CT DEP's cleanup goal for VOCs defaults to the method detection level. Metals, however, are present in the background groundwater. Background levels for metals will be established based on ongoing field sampling and laboratory analyses.
2. CT Remediation Standards Regulation requires, for any substance that does not have a DEC or PMC listed in Appendices A and B of the CT RSRs, or in subsequent lists of DEC and PMC approved for use at all sites in CT (lists dated April 30, 1999, March 29, 2001 and November 15, 2004), an application with proposed DEC and PMC for such unlisted substance must be presented to the Commissioner of the CT DEP for Approval according to the procedures required in RCSA 22a-133k-2(b)(4) and -2(c)(5). The approved criteria, which may be more stringent than federal cleanup levels established for this site, become CT DEP's cleanup criteria for those substances at the SRSNE site.

* For inorganics and PCBs, the Pollutant Mobility Criteria is reported in units of mg/L leachate. Inorganics listed above (and measured in soil in units of mg/kg) are identified as exceeding CT RSRs if the maximum concentration is greater than the CT DEC Direct Contact Exposure Criteria.

NA = not applicable TBD = to be determined

Table 2-1
SRSNE Superfund Site
Feasibility Study

Potential Chemical-Specific ARARs and TBCs

Regulatory Level	Requirement	Status	Requirement Synopsis	RI Work Plan Considerations
Federal	Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) and Non-zero Maximum Contaminant Level Goals (MCLGs)	Relevant and Appropriate	Establishes primary drinking water regulations, goals and contaminant concentration standards for public drinking water systems.	The SDWA MCLs, along with Connecticut standards and guidance values, will be used during the evaluation of target cleanup levels.
State of Connecticut	Remediation Standard Regulations	Applicable	Provides soil, surface water, and groundwater concentration standards for remedial activities in the state of Connecticut.	This ARAR would be considered during the development of target cleanup levels for soil and groundwater at the Site.

Table 2-2
SRSNE Superfund Site
Feasibility Study

Potential Location-Specific ARARs and TBCs

Regulatory Level	Requirement	Status	Requirement Synopsis	FS Considerations
Federal	Fish and Wildlife Coordination Act (16 U.S.C. 661)	Relevant and Appropriate	This regulation requires that any federal agency that proposes to modify a body of water must consult with the U.S. Fish and Wildlife Service.	During the identification, screening, and evaluation of remedial alternatives in the FS, the effects of potential remedial actions on streams and wetlands will be evaluated. If an alternative modifies a body of water or potentially affects fish or wildlife, the U.S. Fish and Wildlife Service will be consulted.
	RCRA Location Standards (40 CFR 264.18)	Applicable	This regulation outlines the requirements for constructing a RCRA facility on a 100-year floodplain.	A facility located on a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by a 100-year flood, unless waste may be safely removed before floodwater can reach the facility or no adverse effects on human health and the environment would result if washout occurred.
	Clean Water Act (CWA) - Discharge to waters of the United States, Section 404 (40 CFR 230; 33 CFR 320-323)	Applicable	These rules regulate the discharge of dredge and fill materials in wetlands and navigable waters. Such discharges are not allowed if practicable alternatives are available.	During the evaluation of remedial alternatives in the FS, consideration will be given to minimizing potential discharge to wetlands. Alternatives would meet substantive requirements for dredging/filling into U.S. waters, including wetlands.
	Protection of Wetlands Executive Order (E.O. 11990)	To Be Considered	Federal agencies are required to avoid construction in wetlands if there is a practicable alternative.	Potential actions in wetland areas must be evaluated to determine if there is a practicable alternative that is protective.
	Floodplain Management Executive Order (E.O. 11988)	To Be Considered	Federal agencies are required to avoid any action in a floodplain if there is a practicable alternative.	Potential actions in floodplains must be evaluated to determine if there is a practicable alternative that is protective.
State of Connecticut	Surface Water and Wetlands - Inland Wetlands and Watercourses Regulation (CGS 22a-36 through 45)	Applicable	This regulation regulates activities within or affecting inland wetlands involving removal or deposition of material or any obstruction, construction, alteration or pollution of such wetlands.	During evaluation of remedial alternatives in the FS, the potential to removes of deposit material, obstruct, construct, alter or pollute wetlands would require compliance with the requirements of this rule.

Table 2-3
SRSNE Superfund Site
Feasibility Study

Potential Action-Specific ARARs and TBCs

Regulatory Level	Requirement	Status	Requirement Synopsis	FS Plan Considerations
Federal	Federal Statues administered through state regulations			
State of Connecticut	Hazardous Waste Management: Generator and Handler Requirements, Listing and Identification (RSCA §22a-449(c)-100 to 101)	Relevant and Appropriate		Remedial alternatives requiring disposal of solid waste would comply with the listing and identification requirements of this potential ARAR.
	Hazardous Waste Management: Generator Standards (RSCA §22a-449(c)-102)	Relevant and Appropriate	This section of the rule establishes standards for various classes of generators. The standards of 40CFR 262 are incorporated by reference.	Remedial alternatives generating treatment residues (spent filtration residue and activated carbon) that fail hazardous characteristic tests, would meet the substantive requirements of this potential ARAR.
	Hazardous Waste Management: Treatment, Storage and Disposal Facility Standards (RCSA §22a-449(c)-102)	Applicable	This section of the rule establishes standards for treatment, storage, and disposal facilities, including requirements for general waste analysis, security measures, inspections, and training; safety equipment and spill control; emergency procedures to be used following explosions, fires, etc; and specific requirements for closure and post-closure of hazardous waste facilities. The standards of 40 CFR 264-are incorporated by reference.	Remedial alternatives requiring treatment, storage or disposal of soil or groundwater would comply with this potential ARAR.
	Hazardous Waste Management: Interim Status Standards for TSDF (RCSA §22a-449(c)-105)	Relevant and Appropriate	This regulation outlines the requirements for TSD Facilities during interim status. It establishes the requirements for storing hazardous waste in piles on-site during remedy implementation activities. The standards of 40 CFR 265 are incorporated by reference.	Remedial alternatives that require stockpiling of excavated soil/sediment would comply with the requirement of this potential ARAR, including protection from wind, containment, response action plan, monitoring and inspection, etc.
	Hazardous Waste Management: Land Disposal Restrictions (RCSA §22a-449(c)-108)	Relevant and Appropriate	This regulation identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may continue to be land disposed. The standards of 40 CFR 268 are incorporated by reference.	Remedial alternatives that require on-site disposal of soil or sediment would comply with the requirements of this potential ARAR.
	Disposition of PCBs (CGS 22a-467)	Relevant and Appropriate	This regulation establishes prohibitions of, and requirements for the disposal, storage, and marking of PCBs and PCB waste. The standard requires the handling of OCB waste to be consistent with the Toxic Substances Control Act (TSCA) listed at 40 CFR 761.	Remedial Alternatives requiring on-site disposal of PCB contaminated soil would comply with this potential ARAR.

Table 2-3 (Continued)
SRSNE Superfund Site
Feasibility Study

Potential Action-Specific ARARs and TBCs

Regulatory Level	Requirement	Status	Requirement Synopsis	FS Plan Considerations
State of Connecticut (cont.)	Air Pollution Control: Control of Particulate Matter (RCSA §22a-174-1 to 33)	Applicable	This regulation details the permit requirements to construct and to operate specified types of emission sources and contain emission standards that must be met. Pollutant abatement controls maybe required. Specific standards pertain to fugitive dust (18b).	Remedial alternatives requiring excavation activities would comply with emission standards of this potential ARAR to control fugitive dust from excavation activities and waste piles with dust control measures.
	Water Quality Standards (CGS 22a-426)	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria, designated uses, and anti-degradation policies fro groundwater and surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Remedial alternatives involving extraction of surface and groundwater would be treated in a manner that is consistent with the anti-degradation policy that would meet the requirements of this ARAR.
	Water Pollution Control: Connecticut Discharge Permit Regulations (RSCA §22a-430-1 to 8)	Applicable	This rule prohibits discharge to waters of the state without a permit; and establishes the permitting requirements and criteria for water discharge to surface water, groundwater and POTW.	Remedial alternatives resulting in point source discharge(s) would be permitted in accordance with this potential ARAR.
	Control of Noise (RCSA §22a-69-1)	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	Remedial alternatives involving construction activities would comply with noise restrictions specified by this potential ARAR.
	Control of Particulate Matter (RCSA §22a-174-18)	Applicable	This regulation governs visible emissions and fugitive dusts from stationary sources.	This potential ARAR would apply to remedial alternatives requiring on-site treatment of soil or groundwater.
	Control of Organic Compound Emissions (RCSA §22a-174-20)	Relevant and Appropriate	This requirement regulates the storage of VOCs and specifies the air emission controls required if a storage tank of 250 gallons or greater is used, or the VOC has a vapor pressure of 1.5 psi or greater.	This potential ARAR would apply to remedial alternatives requiring on-site treatment of groundwater.
	Connecticut Water Quality Standards (CGS 22a-426)	Relevant and Appropriate	These standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best managed practices (BMP).	Groundwater treated on-site and discharged to surface water would be required to comply with these standards.
	Connecticut Discharge Permit Regulations (22a-430-1 to 8)	Applicable	These regulations provide specific effluent limitations for a given discharge.	Groundwater treated on-site and discharged to a surface water will need to comply with the substantive requirements of these regulations.
Criteria, Advisories, Guidance	OSWER Directive 9355.8-28, Air Stripper Control Guidance	To be Considered	Guidance regarding use of air emission controls at CERCLA sites.	This guidance will be used to develop air emission controls if an alternative requiring emissions is selected.

TABLE 2-4
SRSNE Superfund Site
Feasibility Study

Summary of Principal Threats

Medium of Concern	Contaminants of Concern	Threat/Pathway
Operations Area/ Railroad Soil	VOCs, PCBs, TCDD, PCDF, metals	Human Health Threat Direct exposure (contact, ingestion – risks in 1 to 3 E-04 range, HI of 2E+00 to 2E+01), concentrations exceed CT RSRs. ***Principal Threat*** *– highly toxic, poses risks > 1E-03.* Leaching of VOCs to groundwater will result in contaminant concentrations exceeding MCLs and CT groundwater RSRs, posing potential human health risks. ***Principal Threat*** *– source material, soil contaminants are mobile.*
		Threat to the Environment VOCs leaching to groundwater will degrade groundwater quality and will migrate in the aquifer, and VOCs in groundwater pose potential human health risks. ***Principal Threat*** *– highly mobile contaminants in source material that will result in highly toxic groundwater.*
Cianci Property Soil	AS, Cd, Mn, Benzo(a)pyrene	Human Health Threat Direct exposure (contact, ingestion, inhalation – risks in 1.5E-05 to 1E-07 range, HI of 2E-03 to 1E+00), SVOC concentrations exceed CT RSRs. ***Not a Principal Threat.***
		Threat to the Environment None Noted. ***Not a Principal Threat.***
	PCBs and phthalates	Human Health Threat No excess risk associated with potential exposure to contaminated soil and sediments. ***Not a Principal Threat.***
		Threat to the Environment Residual PCBs and phthalates in sediments exceed ecological risk screening levels. ***Not a Principal Threat.***
Overburden NAPL Area	Separate-phase VOCs and other organic compounds dissolved in NAPL (e.g., PCBs)	Human Health Threat No direct exposure, but NAPLs are a continuing source of groundwater contamination that could result in potential human health exposures. ***Principal Threat*** *– source material, highly mobile contaminants that will result in highly toxic groundwater.*
		Threat to the Environment NAPLs are contaminant sources that continue to degrade groundwater quality and could migrate and expand the plume size and extent, resulting in excess human health threat. ***Principal Threat*** *– source material, highly mobile constituents that will result in highly toxic groundwater.*

TABLE 2-4
SRSNE Superfund Site
Feasibility Study

Summary of Principal Threats

Medium of Concern	Contaminants of Concern	Threat/Pathway
Overburden Groundwater	Aqueous-phase and adsorbed VOCs and metals	Human Health Threat Direct exposure (contact, ingestion, inhalation – risks in 3E-01 range), concentrations exceed MCLs and CT RSRs. Although causes excess risk and is mobile, by definition ***Not a Principal Threat.***
		Threat to the Environment Contaminated groundwater could continue to migrate downgradient of source area. By definition ***Not a Principal Threat.***
Bedrock NAPL Area	Separate-phase VOCs and other organic compounds sorbed in NAPL (e.g., PCBs).	Human Health Threat No direct exposure, but NAPLs are a continuing source of groundwater contamination that could result in potential human health exposures. NAPL that becomes mobilized could result in increased contamination of the bedrock aquifer unit. ***Principal Threat*** *– source material, highly mobile contaminants that will result in highly toxic groundwater.*
		Threat to the Environment NAPLs are contaminant sources that continue to degrade groundwater quality and could migrate and expand the plume size and extent, resulting in excess human health threat. ***Principal Threat*** *– source material, highly mobile constituents that will result in highly toxic groundwater.*
Bedrock Groundwater	Aqueous-phase and adsorbed VOCs, PCBs and metals	Human Health Threat Direct exposure (contact, ingestion, inhalation – risks in 3E-01 range), concentrations exceed MCLs and CT RSRs. Although causes excess risk and is mobile, by definition ***Not a Principal Threat.***
		Threat to the Environment Contaminated groundwater could continue to migrate downgradient of source area. By definition ***Not a Principal Threat.***

Table 2-5a
Potential Soil Preliminary Remediation Goals
Solvents Recovery System of New England, Inc.

Soil Contaminants of Potential Concern [1]		Risk Information [2]				Potential Preliminary Remediation Goals (PRGs)			
						CT RSRs		Risk-Based Value [9]	
CAS Registry Number	Chemical Name	Cancer Class [3]	RME Risk [4]	Target Endpoint [5]	Non-cancer Hazard [6]	DEC [7]	CT PMC [8]	Cancer	Non-Cancer
11097691	Aroclor 1254[13]	B2	5.00E-05	immune system	1.00E+01	1.0	(0.0005)	0.22	1.1
12674112	Aroclor 1260[13]	B2	2.E-05	-	NA			0.22	--
7440382	Arsenic	A	1.E-05	skin	2.2E-01	10	(0.05)	0.39	22
50328	Benzo(a)pyrene	B2	6.E-06	-	NA	1.0	1.00	0.062	--
117817	bis(2-Ethylhexyl)phthalate	B2	3.E-06	liver	8.0E-02	44	1.00	35	1200
7440439	Cadmium [10]	B1	NA	kidney	8.0E+00	34	(0.005)	--	69
7439-92-1	Lead	B2	NA	neuro/developmental	NA	500	(0.015)	--	400 [15]
1746016	2,3,7,8-TCDD-TEQ[14]	B2	0.000077 [14]	-	NA	NA	NA	0.0000039 [14]	--
127184	Tetrachloroethene	-	1.E-03	liver	2.0E+00	12	0.10	0.48	38
79016	Trichloroethene[11]	-	3.E-04	-	NA	56	0.10	0.053	16
75014	Vinyl chloride[12]	A	4.E-06	liver	2.3E-03	0.32	0.04	0.090	39

Notes:

Units for potential PRGs are in mg/kg with the exception of CT PMC value for PCBs, arsenic, lead and cadmium which are reported as mg/L leachate.

1. COPCs are those constituents having a cancer risk greater than 1×10^{-6} and contributing to a hazard index greater than 1 (as presented in RAGS Part D Risk Assessment Summary Tables 10.7 to 10.17) (Appendix J).
2. Information from the Human Health Risk Assessment Update (BBL, 2005) (Appendix J).
3. Cancer Class based on information provided in the Integrated Risk Information System (IRIS) on-line database.
4. RME Risk = greatest child and adult cancer risk calculated in the risk assessment update (Appendix J) for all soil areas.
5 Target Endpoint based on information provided in the Integrated Risk Information System (IRIS) on-line database.
6. Non-cancer Hazard = greatest non-cancer hazard calculated for a child in the risk assessment update (Appendix J) for all soil areas.
7. Connecticut Department of Environmental Protection (CT DEP) Soil Remediation Standard Regulations (RSR) Residential Direct Exposure Criteria (RES. DEC). DEC values apply from the soil surface to fifteen feet below grade.
8. CT DEP Soil RSR Residential Pollutant Mobility Criteria (RES. PMC). CT PMC values apply from the soil surface to the seasonal high water table. PMC for PCBs and metals (in paratheses above) are maximum allowable leachate concentrations, in unit of mg/L). Leachate must be obtained using either SPLP or TCLP methods.
9. Region 9 PRGs for residential soil [based on a 1×10^{-6} excess lifetime cancer risk and/or a hazard quotient of 1]. [Region 9 PRG assumptions for incidental ingestion and dermal contact are similar to those used in the Risk Assessment Update (Appendix J)]. Region 9 values for trichloroethene, tetrachloroethene and vinyl chloride include the inhalation pathway, in addition to ingestion.
10. Risk-based value for cadmium is based on an RfD for dietary exposure (Region 9 PRG for cadmium is based on the RfD developed for water exposure).
11. Risk-based values for trichloroethene are based on the USEPA-proposed cancer slope factor of 0.4 (mg/kg-day)$^{-1}$.
12. RME cancer risk and cancer risk-based PRG for vinyl chloride are derived from methods outlined in USEPA (2000) Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on IRIS).
13. CT DEC and PMC values for PCB congeners are cumulative criteria, i.e., the sum of all PCB congeners must be equal to, or less than, the DEC or PMC.
14. The RME risk estimate and the risk-based PRG for 2.3.7.8 TCDD TEQs are based on a cancer slope factor of 1.5×10^{5} mg/kg/day (EPA 1987 Health Assessment document for Polychlorinated Dibenzo-p-dioxin) which is under review and subject to change.

Table 2-5b
Selection of Soil Preliminary Remediation Goals
Solvents Recovery System of New England, Inc.

Soil Contaminants of Potential Concern [1]		Risk Information		PRG Information			
CAS Registry Number	Chemical Name	Cancer Class [2]	Target Endpoint [3]	Selected PRG [4]	Basis [4]	Carcinogenic Risk [6]	Non-Cancer Hazard [6]
1336363	Total PCB	B2	immune	0.0005 mg/L and 1.0 mg/kg	CT PMC; CERCLA Policy [5]	4.E-06	0.89
7440382	Arsenic	A	skin	0.05 mg/L and 0.39 mg/kg	CT PMC; Risk-Based	1.E-06	0.018
50328	Benzo(a)pyrene	B2	-	0.062	Risk-based	1.E-06	--
117817	bis(2-Ethylhexyl)phthalate	B2	liver	1.0	CT PMC	2.E-08	0.00062
7440439	Cadmium [7]	B1	kidney	0.005 mg/L and 34 mg/kg	CT PMC; CT DEC	--	1.0
7439-92-1	Lead	B2	neuro/developmental	0.015 mg/L and 400 mg/kg	CT PMC; Risk-Based	NA	NA
1746016	2,3,7,8-TCDD-TEQ [8]	B2	-	0.001	CERCLA Policy [8]	3.E-04	--
127184	Tetrachloroethene	-	liver	0.10	CT PMC	1.E-06	0.00014
79016	Trichloroethene [9]	-	-	0.053	Risk-based	4.E-08	--
75014	Vinyl chloride [10]	A	liver	0.040	CT PMC	4.E-07	0.00022
					Total Cancer Risk =	3.E-04	

Sum of HI - Target Endpoint	
Immune	0.89
Skin	0.018
Liver	0.00098
Kidney	1.0
Neuro/Developmental	NA

Notes:

1. COPCs are those constituents having a cancer risk greater than 1 x 10^{-6} and contributing to a hazard index greater than 1 (as presented in RAGS Part D Risk Assessment Summary Tables 10.7 to 10.17) (Appendix J).
2. Cancer Class based on information provided in the Integrated Risk Information System (IRIS) on-line database.
3. Target Endpoint based on information provided in the Integrated Risk Information System (IRIS) on-line database.
4. Selected PRG is generally the CT RSR PMC and/or risk-based concentrations as reported on Table 2.5A. Units for PRGs are in mg/kg with the exception of CT PMC value for PCBs, arsenic, lead and cadmium which are reported as mg/L leachate.
5. Selected PRG for Total PCBs of 1.0 mg/kg is based on CERCLA Policy (*A Guide on Remedial Actions at Superfund Sites with PCB Contamination* . OSWER Directive #9355.4-01FS. August 1990).
6. Carcinogenic risk and/or non-carcinogenic hazard associated with the selected PRG [based on adult and child resident, using exposure assumptions/equations presented in the human health risk assessment update (Appendix J). Carcinogenic risks are the sum of adult and child incidental ingestion and dermal contact risks. Non-carcinogenic hazards are the sum of incidential ingestion and dermal contact hazards for children]. When both CT PMC and risk-based PRGs are selected, the risk/hazard corresponds to the risk-based PRG (or CERCLA Policy for PCBs).
7. Non-cancer hazard for cadmium is based on the cadmium RfD for dietary exposure.
8. PRG for dioxin is based on CERCLA Policy (Approach for Addressing Dioxin in Soil at CERCLA and RCRA Sites. OSWER Directive #9200.4-26, April 1998). Cancer risk attributed to 2,3,7,8 TCDD-TEQs is based on a cancer slope factor of 1.5 x 10^{5} mg/kg/day which is under review and subject to change. The PRPs can derive a more stringent number to satisfy CT DEP residential cleanup criteria, if necessary.
9. Risk-based values for trichloroethene are based on the USEPA-proposed cancer slope factor of 0.04 (mg/kg-day)$^{-1}$.
10. RME cancer risk and cancer risk-based PRG for vinyl chloride are derived from methods outlined in USEPA (2000) Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on IRIS).

Table 2-5c
Potential Groundwater Preliminary Remediation Goals
Solvents Recovery System of New England, Inc.

Groundwater Contaminants of Potential Concern[1]			Risk Information [2]				Potential Preliminary Remediation Goals (PRGs)			
									Risk-Based Concentrations [9]	
CAS Registry Number	Chemical Name	Units	Cancer Class [3]	RME Risk [4]	Target Endpoint [5]	Non-cancer Hazard [6]	MCLs and Non-Zero MCLGs [7]	CT RSRs [8, 10]	Cancer	Non-Cancer
71-55-6	1,1,1-Trichloroethane	mg/L	--	--	--	2.0E+01	0.2	0.001	--	10.2
75-34-3	1,1-Dichloroethane	mg/L	C	--	--	3.9E+00	NA	0.001	--	3.7
75-35-4	1,1-Dichloroethene	mg/L	--	--	liver	3.8E+00	0.007	0.001	--	1.8
107-06-2	1,2-Dichloroethane	mg/L	B2	5.E-03	--	--	0.005	0.001	0.00094	--
540-59-0	1,2-Dichloroethene, Total	mg/L	--	--	liver	3.7E+02	0.07	0.002	--	0.37
78-93-3	2-Butanone	mg/L	--	--	fetal weight	2.2E+01	NA	0.005	--	21.9
108-10-1	4-Methyl-2-pentanone	mg/L	--	--	liver,kidney	2.0E+01	NA	0.005	--	2.9
67-64-1	Acetone	mg/L	--	--	liver,kidney	9.7E+00	NA	0.005	--	32.9
71-43-2	Benzene	mg/L	A	3.E-03	lymphocyte	3.4E+01	0.005	0.001	0.0015	0.146
56-23-5	Carbon tetrachloride	mg/L	B2	8.E-03	liver	2.0E+02	0.005	0.001	0.00066	0.026
108-90-7	Chlorobenzene	mg/L	--	--	liver	6.9E+00	0.1	0.001	--	0.73
75-00-3	Chloroethane	mg/L	--	2.E-04	--	3.4E-01	NA	0.001	0.029	14.6
156-59-2	cis-1,2-Dichloroethene	mg/L	--	--	blood	6.1E+02	0.07	0.001	--	0.4
100-41-4	Ethylbenzene	mg/L	--	--	liver,kidney	2.3E+01	0.7	0.001	--	3.7
75-09-2	Methylene chloride	mg/L	B2	1.E-03	liver	5.0E+00	NA	0.002	0.011	2.2
127-18-4	Tetrachloroethene	mg/L	--	3.E-01	liver	1.4E+02	0.005	0.001	0.00016	0.37
109-99-9	Tetrahydrofuran	mg/L	--	5.E-03	--	6.8E+00	NA	0.001	0.011	7.7
108-88-3	Toluene	mg/L	--		liver,kidney	1.8E+01	1	0.001	--	7.3
156-60-5	trans-1,2-Dichloroethene	mg/L	--	--	blood	9.5E+00	0.1	0.001	--	0.73
79-01-6	Trichloroethene	mg/L	--	1.E+00	--	--	0.005	0.001	0.00021	--
75-01-4	Vinyl chloride[11]	mg/L	A	7.E-01	liver	1.2E+02	0.002	0.001	0.00002	0.11
1330-20-7	Xylenes, Total	mg/L	--	--	body weight	3.0E+00	10	0.002	--	7.3
106-44-5	4-Methylphenol	mg/L	--	--	neurotoxicity	6.0E+00	NA	0.01	--	0.18
11097-69-1	Aroclor-1254 [12]	mg/L	B2	4.E-04	immune	1.0E+02	0.0005	0.001	b	0.00073
11096-82-5	Aroclor-1260 [12]	mg/L	B2	4.E-04	--	--			0.000043	--
7440-38-2	Arsenic	mg/L	A	9.E-04	skin	4.0E+00	0.01	TBD	0.000057	0.011
7440-39-3	Barium	mg/L	--	--	kidney	8.0E+00	2	TBD	--	2.6
7440-43-9	Cadmium	mg/L	--	--	kidney	3.0E+00	0.005	TBD	--	0.037
7440-47-3	Chromium (Total)	mg/L	--	--	--	7.0E+00	0.1	TBD	--	0.11
7440-50-8	Copper	mg/L	--	--	--	1.0E+00	1.3*	TBD	--	1.5
7439-92-1	Lead	mg/L	--	--	neuro/developmental	--	0.015*	TBD	--	--
7439-96-5	Manganese	mg/L	--	--	CNS	5.0E+01	0.3**	TBD	--	0.87
7440-02-0	Nickel	mg/L	--	--	body and organ weight	1.0E+00	0.1**	TBD	--	0.73
7440-28-0	Thallium	mg/L	--	--	blood	2.0E+00	0.002	TBD	--	0.0024
7440-62-2	Vanadium	mg/L	--	--	--	5.0E+00	na	TBD	--	0.26

Notes:

1. COPCs are those constituents having a cancer risk greater than 1×10^6 and contributing to a hazard index greater than 1 (as presented in RAGS Part D Risk Assessment Summary Tables 10.1 to 10.6) (Appendix J).
2. Information from the Human Health Risk Assessment Update (BBL, 2005) (Appendix J).
3. Cancer Class based on information provided in the Integrated Risk Information System (IRIS) on-line database.
4. RME Risk = greatest cancer risk calculated in the risk assessment update (Appendix J) for all groundwater areas.
5 Target Endpoint based on information provided in the Integrated Risk Information System (IRIS) on-line database.
6. Non-cancer Hazard = greatest non-cancer hazard calculated in the risk assessment update (Appendix J) for all groundwater areas.
7. MCL = maximum contaminant levels and Non-Zero MCLG = non-zero maximum contaminant level goals (Safe Drinking Water Act).
8. Connecticut Remediation Standard Regulations [(for organics is equal to the detection limit reported in the CT-approved background monitoring well (TW-12)].
9. Groundwater concentrations corresponding to a 1×10^6 excess lifetime cancer risk and/or a non-cancer hazard of 1, based on exposure assumptions presented in the risk assessment update (Appendix J).
10. TBD = to be determined based on results of the 2005 background investigation for inorganics.
11. Vinyl chloride cancer risk value is derived from methods outlined in USEPA (2000) *Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on the Integrated Risk Information System).*

12. PCB congeners are cumulative criteria, i.e., the sum of all PCB congeners must be equal to, or less than, the values given.

* Values for copper and lead are based on treatment technologies or the action level.

** Values are based on the USEPA Health Advisory for these constituents (www.epa.gov/waterscience/criteria/drinking/standards/dwstandards.pdf).

Table 2-5d
Selection of Groundwater Preliminary Remediation Goals
Solvents Recovery System of New England, Inc.

Groundwater Contaminants of Potential Concern [1]								
CAS Registry Number	Chemical Name	Units	Cancer Class [2]	Target Endpoint [3]	Selected PRG [4, 5]	Basis of PRG [4, 5]	Carcinogenic Risk [6]	Non-Cancer HI [6]
71-55-6	1,1,1-Trichloroethane	mg/L	--	--	0.001	CT RSR	--	0.00010
75-34-3	1,1-Dichloroethane	mg/L	C	--	0.001	CT RSR	--	0.00027
75-35-4	1,1-Dichloroethene	mg/L	--	liver	0.001	CT RSR	--	0.00055
107-06-2	1,2-Dichloroethane	mg/L	B2	--	0.001	CT RSR	1.00E-06	--
540-59-0	1,2-Dichloroethene, Total	mg/L	--	liver	0.002	CT RSR	--	0.0055
78-93-3	2-Butanone	mg/L	--	fetal weight	0.005	CT RSR	--	0.00023
108-10-1	4-Methyl-2-pentanone	mg/L	--	liver,kidney	0.005	CT RSR	--	0.0017
67-64-1	Acetone	mg/L	--	liver,kidney	0.005	CT RSR	--	0.00015
71-43-2	Benzene	mg/L	A	lymphocyte	0.001	CT RSR	6.46E-07	0.0069
56-23-5	Carbon tetrachloride	mg/L	B2	liver	0.001	CT RSR	1.50E-06	0.039
108-90-7	Chlorobenzene	mg/L	--	liver	0.001	CT RSR	--	0.0014
75-00-3	Chloroethane	mg/L	--	--	0.001	CT RSR	3.41E-08	0.000069
156-59-2	cis-1,2-Dichloroethene	mg/L	--	blood	0.001	CT RSR	--	0.0027
100-41-4	Ethylbenzene	mg/L	--	liver,kidney	0.001	CT RSR	--	0.00027
75-09-2	Methylene chloride	mg/L	B2	liver	0.002	CT RSR	1.76E-07	0.00091
127-18-4	Tetrachloroethene	mg/L	--	liver	0.001	CT RSR	6.30E-06	0.00270
109-99-9	Tetrahydrofuran	mg/L		--	0.001	CT RSR	8.29E-08	0.00013
108-88-3	Toluene	mg/L	--	liver,kidney	0.001	CT RSR	--	0.00014
156-60-5	trans-1,2-Dichloroethene	mg/L	--	blood	0.001	CT RSR	--	0.0014
79-01-6	Trichloroethene	mg/L	--	--	0.001	CT RSR	4.70E-06	--
75-01-4	Vinyl chloride	mg/L	A	liver	0.001	CT RSR	6.00E-05	0.00910
1330-20-7	Xylenes, Total	mg/L	--	body weight	0.002	CT RSR	--	0.00027
106-44-5	4-Methylphenol	mg/L	--	neurotoxicity	0.01	CT RSR	--	0.055
1336363	Total PCBs	mg/L	B2	immune	0.0005	MCL	1.20E-05	0.680
7440-38-2	Arsenic	mg/L	A	skin	0.01	MCL	1.70E-04	0.9100
7440-39-3	Barium	mg/L	--	kidney	2	MCL	--	0.78
7440-43-9	Cadmium	mg/L	--	kidney	0.005	MCL	--	0.14
7440-47-3	Chromium (Total)	mg/L	--	--	0.1	MCL	--	0.91
7440-50-8	Copper	mg/L	--	--	1.3*	MCL*	--	0.89
7439-92-1	Lead	mg/L	--	neuro/developmental	0.015*	MCL*	--	--
7439-96-5	Manganese	mg/L	--	CNS	0.3**	Health Advisory**	--	0.34
7440-02-0	Nickel	mg/L	--	body and organ weight	0.1**	Health Advisory**	--	0.14
7440-28-0	Thallium	mg/L	--	blood	0.002	MCL	--	0.83
7440-62-2	Vanadium	mg/L	--	--	0.26	Risk-based	--	1.0
						Total Cancer Risk =	3.E-04	

Sum of HI - Target Endpoint	
Blood	0.8
CNS	0.39
Kidney	0.9
Liver	0.014
Skin	0.91
Body weight	0.1

Notes:

1. COPCs are those constituents having a cancer risk greater than 1×10^{6} and contributing to a hazard index greater than 1 (as presented in RAGS Part D Risk Assessment Summary Tables 10.1 to 10.6) (Appendix J).
2. Cancer Class based on information provided in the Integrated Risk Information System (IRIS) on-line database.
3. Target Endpoint based on information provided in the Integrated Risk Information System (IRIS) on-line database.
4. PRGs are the lowest of the MCLs and CT RSRs on Table 2.5C (PRGs are the risk-based concentrations if MCLs and CT RSRs are not available) .
5. PRGs for inorganics are subject to change based on the proposed 2005 background evaluation for inorganics in groundwater.
6. Carcinogenic risk and/or non-carcinogenic hazard (HI) associated with the selected PRG (based on hypothetical groundwater ingestion - adult resident, using exposure assumptions/equations presented in the human health risk assessment update (Appendix J).
7. Vinyl chloride cancer risk value is derived from methods outlined in USEPA (2000) *Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on the Integrated Risk Information System).*

* Values for copper and lead are based on treatment technologies or the action level.

** Values are based on the USEPA Health Advisory for these constituents (www.epa.gov/waterscience/criteria/drinking/standards/dwstandards.pdf).

Table 2-6
SRSNE Superfund Site
Feasibility Study

Remedial Action Objectives, General Response Actions, Technology Types, and Process Options

Environmental Media	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options
Operations Area/Railroad Soil	For Human Health: Prevent potential human exposure (dermal contact, ingestion, and inhalation) to soil contaminants that may exceed an excess carcinogenic risk of 1 x 10^{-4} to 1 x 10^{-6}, that may pose a non-carcinogenic Hazard Index greater than 1, or that exceed ARARs (regulatory criteria).	No Action	No Action	None
		Institutional Controls/Limited Actions	Institutional Actions: • Access Controls • Institutional Measures	Fencing, Posting, Deed Restrictions.
		Containment	Containment Technologies • Hydraulic Containment • Physical Barriers	Pump and Treat, Cap with Soil, Asphalt, Synthetic or Multilayers; Slurry Walls, Sheet Pile Wall, Grout Curtain.
	Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARs or which might otherwise present an unacceptable risk in groundwater.	Ex-Situ Treatment or Disposal	Excavation and Ex-Situ Treatment or Disposal Technologies • Excavation • Off-Site Disposal • Thermal • Chemical • Physical • Biological	Excavation, Landfilling, LTTD, Incineration Stabilization/Solidification, Soil Washing, Solvent Extraction, Soil Pile Treatment, Batch Reactor
	For Environmental Protection: Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations that exceed ARARs or present an unacceptable risk in groundwater.	In-Situ Treatment	In-Situ Treatment Technologies • Thermal • Chemical • Biological • Physical	Steam Stripping, Vitrification, Electrical Resistance Heating, In-Situ Oxidation, Stabilization/Solidification, Bioventing, Mixing/Nutrient Addition, Soil Vapor Extraction

Note: After Table 4-1 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-6
SRSNE Superfund Site
Feasibility Study

Remedial Action Objectives, General Response Actions, Technology Types, and Process Options

Environmental Media	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options
Cianci Property Soil	For Human Health: Prevent potential human exposure (dermal contact, ingestion, and inhalation) to soil contaminants that exceed ARARs (regulatory criteria). Prevent migration of contaminants from soils to groundwater that would result in groundwater concentrations in excess of ARARs or which might otherwise present an unacceptable risk in groundwater. For Environmental Protection: Prevent potential ecological risks associated with SRSNE-related contaminants.	No Action Containment Removal and Disposal	No Action Containment Technologies • Physical Barrier Removal and Disposal Technologies • Excavation • Culvert Removal/Drainage System Rerouting • On-Site Disposal • Off-Site Disposal	None Soil Cap, Asphalt Cap, Synthetic Multilayer Cap Excavation, Culvert Removal with Drainage System Rerouting, Consolidation with Vadose Zone Soils, Off-Site Landfill Disposal

Note: After Table 4-1 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-6
SRSNE Superfund Site
Feasibility Study

Remedial Action Objectives, General Response Actions, Technology Types, and Process Options

Environmental Media	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options
Overburden NAPL Area	<u>For Human Health</u>: Reduce or stabilize the NAPL mass that would otherwise result in groundwater concentrations that may pose an excess carcinogenic risk in excess of 1×10^{-4} to 1×10^{-6}, non-carcinogenic Hazard Index greater than 1, or that may exceed ARARs. <u>For Environmental Protection</u>: Reduce NAPL mass to achieve one or more of the following: 1) Shorten the time frame that groundwater standards are exceeded; 2) Shrink the size of the groundwater contaminant plume; 3) Reduce groundwater contaminant concentrations; 4) Prevent the migration of NAPL.	No Action	No Action	None
		Institutional Controls/Limited Actions	Institutional Controls/Limited Actions • Institutional Measures • Natural Attenuation	Deed Restrictions, Long-Term Monitoring, Natural Attenuation
		Containment	Containment Technologies • Hydraulic Containment • Physical Barrier	Continued NTCRA 1 and 2 Operation, Wells, Trenches, Sheet Pile Wall, Slurry Wall, Grout Curtain
		Extraction and Off-Site Disposal	Extraction and Off-Site Disposal Technologies • Excavation • Pumping • Commercial Disposal	Excavation, Extraction using Wells, Extraction using Trenches, Trucking to Commercial Disposal Facilities
		Stabilization	Stabilization Technologies • Hydraulic Gradient Management	Groundwater Removal and Injection using Wells, Groundwater Removal and Injection using Trenches
		In-Situ Treatment	In-Situ Treatment Technologies • Thermal Treatment • Physical Treatment • Chemical Oxidation • Biological Treatment	Steam Flooding/Vapor Extraction, Hot Water Flood, Electrical Resistance Heating, RF Heating, Thermal Conductive Heating, Hydraulic Displacement, Alcohol Flooding, Air Sparging/SVE, Cosolvent Extraction, Complex Sugar, Foam, Surfactant Flushing, Fenton’s, H2O2, Permanganate, Reactive Permeable Barrier, Biostimulation, Bioaugmentation, Phytoremediation

Note: After Table 4-1 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-6
SRSNE Superfund Site
Feasibility Study

Remedial Action Objectives, General Response Actions, Technology Types, and Process Options

Environmental Media	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options
Overburden Groundwater	For Human Health: Prevent potential human exposure (dermal contact, ingestion, and inhalation) to overburden groundwater with contaminants that may pose an excess carcinogenic risk in excess of 1 x 10^{-4} to 1 x 10^{-6}, that may pose a non-carcinogenic Hazard Index greater than 1, or that may exceed ARARs. For Environmental Protection: Restore groundwater quality to meet ARARs.	No Action	No Action	None
		Institutional Controls/Limited Actions	Institutional/Limited Control Options • Institutional Measures • Natural Attenuation	Deed Restrictions, Long-Term Monitoring, Natural Attenuation
		Containment	Containment Technologies • Hydraulic Containment • Physical Barrier	Continued NTCRA 1 and 2 Operation, Wells, Trenches, Sheet Pile Wall, Slurry Wall, Grout Curtain.
		Diversion	Diversion Technologies • Groundwater Diversion Barrier	Trench, Sheet Pile Wall, Grout Curtain, Wells
		Containment/Removal with Ex-Situ Treatment	Ex-Situ Treatment Technologies • Biological Treatment • Chemical Treatment • Physical Treatment	Wetland Treatment, UV Oxidation, Fenton's Reagent, Zero Valent Iron, Conventional Treatment,
		In-Situ Treatment	In-Situ Treatment Technologies • Thermal Treatment • Chemical Treatment • Biological Treatment	Injection Wells and/or Trenches, Biostimulation, Bioaugmentation, Phytoremediation, Reagent Addition, Passive Treatment Wall, Solvent Extraction, Steam Injection

Note: After Table 4-1 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-6
SRSNE Superfund Site
Feasibility Study

Remedial Action Objectives, General Response Actions, Technology Types, and Process Options

Environmental Media	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options
Bedrock NAPL Area	For Human Health: Avoid expansion of the contaminated bedrock groundwater unit through NAPL migration. For Environmental Protection: Avoid expansion of the contaminated bedrock groundwater unit through NAPL migration.	No Action	No Action	None
		Institutional Controls/Limited Actions	Institutional Controls/Limited Actions • Institutional Measures • Natural Attenuation	Deed Restrictions, Long-Term Monitoring, Natural Attenuation
		Containment	Containment Technologies • Hydraulic Containment • Physical Barrier	Continued NTCRA 1 and 2 Operation, Wells, Trenches, Sheet Pile Wall, Slurry Wall, Grout Curtain

Note: After Table 4-1 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-6
SRSNE Superfund Site
Feasibility Study

Remedial Action Objectives, General Response Actions, Technology Types, and Process Options

Environmental Media	Remedial Action Objectives	General Response Actions	Remedial Technology Types	Process Options
Bedrock Groundwater	For Human Health: Prevent potential human exposure (dermal contact, ingestion, and inhalation) to bedrock groundwater with contaminants that may pose an excess carcinogenic risk in excess of 1 x 10^{-4} to 1 x 10^{-6}, that may pose a non-carcinogenic Hazard Index of 1, or that may exceed ARARs. For Environmental Protection: Prevent continuing migration of contaminants exceeding ARARs or that present an unacceptable risk from the bedrock groundwater; and restore bedrock groundwater to meet ARARs once VOC residuals are depleted.	No Action	No Action	None
		Institutional Controls/Limited Actions	Institutional Controls/Limited Actions • Institutional Measures • Natural Attenuation	Deed Restrictions, Long-Term Monitoring, Natural Attenuation
		Containment	Containment Technologies • Hydraulic Containment • Physical Barrier	Continued NTCRA 1 and 2 Operation, Wells, Trenches, Sheet Pile Wall, Slurry Wall, Grout Curtain.
		Diversion	Diversion Technologies • Groundwater Diversion Barrier	Trench, Sheet Pile Wall, Grout Curtain, Wells
		Containment/Removal with Ex-Situ Treatment	Ex-Situ Treatment Technologies • Biological Treatment • Chemical Treatment • Physical Treatment	Wetland Treatment UV Oxidation, Fenton's Reagent, Zero Valent Iron, Conventional Treatment,
		In-Situ Treatment	In-Situ Treatment Technologies • Thermal Treatment • Chemical Treatment • Biological Treatment	Injection Wells and/or Trenches Biostimulation, Bioaugmentation, Passive Treatment Wall Reagent Addition, Solvent Extraction, Steam Injection

Note: After Table 4-1 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-7
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Operations Area/Railroad Soil

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
No Action	No Action	None	Used as a baseline to which other technology types/process options may be compared.	Required for consideration by the NCP.	None	Retain
Institutional Controls/Limited Actions	Access Controls	Fencing	Perimeter fencing to restrict human access to site.	Potentially applicable	None	Retain
		Posting	Use of signage to restrict access by trespassers	Potentially applicable	None	Retain
	Institutional Measures	Deed Restrictions	Use of deeds to restrict or prohibit future disruption of site soils	Potentially applicable	None	Retain
Containment	Hydraulic Containment	~~Pump and Treat~~	Removal and treatment of groundwater to hydraulically contain affected media	Not applicable to soil	N/A	Eliminate
	Physical Barriers	Soil Cap	Use of compacted soil cap to contain affected media	Potentially applicable	None	Retain
		Asphalt Cap	Use of asphalt cap to contain affected media	Potentially applicable	None	Retain
		Synthetic Cap	Use of synthetic material (e.g., geomembrane) cap to contain affected media	Potentially applicable	None	Retain
		Multilayer Cap	Use of multilayer capping materials (e.g., compacted soil and geosynthetic materials) to contain affected media	Potentially applicable	None	Retain
		~~Slurry Wall~~	Use of soil-bentonite or cement-bentonite slurry wall as a physical barrier to prevent horizontal migration	Not applicable to soil	N/A	Eliminate
		~~Sheet Pile Wall~~	Use of steel sheet piling as a physical barrier to prevent horizontal migration	Not applicable to soil	N/A	Eliminate
		~~Grout Curtain~~	Use of injected grout as a physical barrier to prevent migration of contaminants	Not applicable to soil	N/A	Eliminate

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-7
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Operations Area/Railroad Soil

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
Ex-Situ Treatment or Disposal	Excavation	Excavation	Excavation of affected soils	Potentially applicable	Requires treatment and/or disposal of excavated soils.	Retain
	Off-Site Disposal	Landfilling	Off-site disposal of excavated soils in commercial landfill facility	Potentially applicable	None	Retain
	Thermal Treatment	LTTD	On-site thermal desorption of excavated soils	Potentially applicable	Requires treatment and discharge of vapor phase contaminant stream and disposal of treated soils	Retain
		Incineration	On-site incineration of excavated soils	Potentially applicable	Requires treatment and discharge of vapor phase contaminant stream and disposal of treated soils	Retain
	Chemical Treatment	Stabilization/ Solidification	Mixing of stabilization/solidification agents with affected soils to reduce contaminant mobility	Potentially applicable	Requires disposal of solidified soil	Retain
	Physical Treatment	Soil Washing	Size separation of soils to remove less contaminated course fragment	Potentially applicable	Requires treatment or disposal of separated soil fractions	Retain
		Solvent Extraction	Use of cosolvent to strip and remove contaminants from affected soil	Potentially applicable	Requires treatment of cosolvent stream and disposal of treated soil	Retain
	Biological Treatment	Soil Pile Treatment	Biological augmentation/stimulation of contaminated soils in solid phase	Potentially applicable	Requires disposal of treated soil	Retain
		Batch Reactor	Biological augmentation/stimulation of contaminated soils in liquid slurry	Potentially applicable	Requires disposal of treated soil	Retain

Note: After Figure 4-4 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-7
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Operations Area/Railroad Soil

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
In-Situ Treatment	Thermal Treatment	Steam Stripping	Injection of steam to volatilize contaminants from the soil matrix	Potentially applicable	Requires treatment and discharge of vapor phase contaminant stream	Retain
		Vitrification	Use of large electrical current to melt soils	Potentially applicable	Requires treatment and discharge of vapor phase contaminant stream	Retain
		Electrical Resistance Heating	Use of heating elements to volatilize contaminants from the soil matrix	Potentially applicable	Requires treatment and discharge of vapor phase contaminant stream	Retain
	Chemical Treatment	~~In-Situ Oxidation~~	Injection of oxidant to oxidize organic contaminants	Not applicable to soil	N/A	Eliminate
		Stabilization/ Solidification	Mixing of stabilization/solidification agents with affected soils to reduce contaminant mobility	Potentially applicable	None	Retain
	Biological Treatment	~~Bioventing~~	Use of air circulation to stimulate and support aerobic degradation of soil contaminants	Not applicable to chlorinated organic compounds	N/A	Eliminate
		Mixing/Nutrient Addition	Addition of nutrients to stimulate biodegradation of soil contaminants	Potentially applicable	None	Retain
	Physical Treatment	Soil Vapor Extraction	Removal of contaminants in vapor phase through vacuum extraction	Potentially applicable	Requires treatment and discharge of vapor phase contaminant stream	Retain

Note: After Figure 4-4 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-8
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Cianci Property Soil

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
No Action	No Action	None	Used as a baseline to which other technology types/process options may be compared.	Required for consideration by the NCP.	None	Retain
Containment	Physical Barrier	Soil Cap	Use of compacted soil cap to contain affected media	Potentially applicable	None	Retain
		Asphalt Cap	Use of asphalt cap to contain affected media	Potentially applicable	None	Retain
		Synthetic Cap	Use of synthetic material (e.g., geomembrane) cap to contain affected media	Potentially applicable	None	Retain
		Multilayer Cap	Use of multilayer capping materials (e.g., compacted soil and geosynthetic materials) to contain affected media	Potentially applicable	None	Retain
Removal and Disposal	Excavation	Excavation	Excavation of contaminated soil and sediment	Potentially applicable	Requires disposal of excavated soil and sediment	Retain
	Culvert Removal/ Drainage System Rerouting	Culvert Removal/Drainage System Rerouting	Removal of culvert across Cianci Property and rerouting of RR ditch drainage along Lazy Lane	Potentially applicable	Requires disposal of culvert materials and associated excavated soils	Retain
	On-Site Disposal	Consolidation with Vadose Zone Soils	Consolidation of excavated materials with Operations Area soils under cap	Potentially applicable	None	Retain
	Off-Site Disposal	Off-Site Landfill Disposal	Transportation of excavated materials off-site for commercial landfill disposal	Potentially applicable	None	Retain

Note: After Figure 4-4 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-9
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
No Action	No Action	None	Used as a baseline to which other technology types/process options may be compared.	Required for consideration by the NCP.	None	Retain
Institutional Controls/Limited Actions	Institutional Measures	Deed Restrictions	Use of deed restrictions to restrict or prohibit use of groundwater as a potable supply	Deed restriction completed. CTDEP ELUR potentially applicable.	None	Retain
	Natural Attenuation	Long-Term Monitoring	Continued monitoring of existing well network	In progress, potentially applicable for long term.	None	Retain
		Natural Attenuation	Continued natural attenuation of contaminants in groundwater	Potentially applicable	None	Retain
Containment	Hydraulic Containment	Continued NTCRA 1 and 2 Operation	Continued operation of overburden and bedrock groundwater removal and treatment in existing treatment facility	Potentially applicable	Requires treatment of extracted groundwater in NTCRA 1 treatment facility	Retain
		Wells	Use of extraction wells to manipulate hydraulic gradients and prevent migration of NAPL	Potentially applicable	Requires treatment of extracted groundwater	Retain
		Trenches	Use of horizontal drains to manipulate hydraulic gradients and prevent migration of NAPL	Potentially applicable	Requires treatment of extracted groundwater	Retain
	Physical Barrier	Sheet Pile Wall	Use of soil-bentonite or cement-bentonite slurry wall as a physical barrier to prevent horizontal NAPL migration	Potentially applicable	None	Retain

Note: After Figure 4-4 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-9
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
Containment (cont'd)	Physical Barrier (cont'd)	Slurry Wall	Use of steel sheet piling as a physical barrier to prevent horizontal NAPL migration	Potentially applicable	None	Retain
		Grout Curtain	Use of injected grout as a physical barrier to prevent NAPL migration	Potentially applicable	None	Retain
Removal and Off-Site Disposal	Excavation	Excavation	Excavation to remove saturated soil and NAPL	Potentially applicable	Requires treatment and/or off-site disposal of removed materials	Retain
	Pumping	Extraction using Wells	Use of extraction wells with sumps to collect NAPL	Potentially applicable	Requires treatment and/or off-site disposal of removed materials	Retain
		Extraction using Trenches	Use of horizontal drains to collect NAPL	Potentially applicable	Requires treatment and/or off-site disposal of removed materials	Retain
	Commercial Disposal Facilities	Commercial Disposal Facilities	Disposal of recovered NAPLs at off-site TSDF	Potentially applicable	None	Retain
Stabilization	Hydraulic Gradient Management	Removal/Injection with Wells	Pumping from wells to maintain stable hydraulic gradients within NAPL zones	Potentially applicable	May require treatment of extracted groundwater	Retain
		Removal/Injection with Trenches	Pumping form horizontal drains to maintain stable hydraulic gradients within NAPL	Potentially applicable	May require treatment of extracted groundwater	Retain
In-Situ Treatment	Thermal Treatment	Steam Injection/Vapor Extraction	Injection of steam to volatilize and displace VOCs and NAPL for recovery through vapor extraction	Potentially applicable	Requires treatment of vapor phase and condensate streams	Retain
		Hot Water Flood	Injection of moderately hot water to increase NAPL solubility and reduce NAPL viscosity for subsequent removal by pumping	Potentially applicable	Requires treatment of removed water/NAPL mixture	Retain

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-9
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
In-Situ Treatment (cont.)	Thermal Treatment (cont’d)	Electric Resistance Heating/Vapor Extraction	Use of electrodes to pass electrical current through the soil to heat and volatilize NAPLs for removal by vapor extraction	Potentially applicable	Requires treatment of vapor phase contaminants	Retain
		Thermal Conductive Heating/Vapor Extraction	Use of thermal wells to conductively heat soils and volatilize and/or destroy contaminants	Potentially applicable	Requires treatment of vapor phase contaminants	Retain
		~~Radio Frequency Heating/Vapor Extraction~~	Use of electromagnetic energy in the radio frequency band to heat soil resulting in increased volatility of VOCs, for subsequent removal by vapor extraction	Not applicable to saturated soil	N/A	Eliminate
	Physical Treatment	Hydraulic Displacement	Use of water pumping to increase hydraulic gradients to mobilize and displace pooled NAPLs, increasing potential NAPL recovery and increasing surface area for increased dissolution	Potentially applicable	Requires treatment of extracted groundwater/NAPL mixture	Retain
		Cosolvent Extraction/Alcohol Flushing	Addition of alcohol to reduce NAPL-water interfacial tension, resulting in one liquid phase that can be removed by pumping	Potentially applicable	Requires treatment of extracted groundwater/NAPL mixture	Retain
		~~Air Sparging/Vapor Extraction~~	Injection of air into overburden groundwater to partition VOCs from aqueous phase into the vapor phase, with subsequent removal by vacuum extraction	Potentially applicable, but stratigraphy may limit air injection or vapor recovery	Requires treatment of vapor phase stream	Eliminate
		Complex sugar	Use of cyclodextrin to increase the solubility of NAPL to enhance its removal from the subsurface	Potentially applicable	Requires treatment of extracted groundwater/NAPL mixture	Retain

Note: After Figure 4-4 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-9
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
In-Situ Treatment (cont.)	Physical Treatment (cont'd)	Foam	Use of injected foam to enhance NAPL removal through physical scouring, reduction of interfacial tension, and increasing solubility, and increasing surface area for increased dissolution	Potentially applicable	Requires treatment of extracted groundwater/NAPL mixture	Retain
		Surfactant flushing	Use of surface active agents to decrease NAPL-water interfacial tension, thus increasing NAPL solubility and mobility for subsequent removal by pumping	Potentially applicable	Requires treatment of extracted groundwater/NAPL mixture	Retain
	Chemical Oxidation	Permanganate	Injection and distribution of potassium or sodium permanganate to oxidize VOCs	Potentially applicable	None	Retain
		Hydrogen Peroxide (Fenton's Reagent)	Injection and distribution of hydrogen peroxide with iron catalyst to oxidize VOCs	Potentially applicable	None	Retain
		Persulfate	Injection and distribution of ammonium, sodium or potassium persulfate salts to oxidize VOCs	Potentially applicable	None	Retain
		Reactive Permeable Barrier	Use of zero valent iron walls installed in trenches to passively dechlorinate VOCs	Potentially applicable	None	Retain
	Biological Treatment	Biostimulation	Addition of nutrients or other amendments to increase microbial metabolic processes to enhance reductive dechlorination of VOCs	Potentially applicable	None	Retain
		Bioaugmentation	Addition of appropriate microbes to enhance reductive dechlorination of VOCs	Potentially applicable	None	Retain
		~~Phytoremediation~~	Use of plants to enhance VOC degradation in plant rhizosphere	Not applicable to subsurface NAPLs	None	Eliminate

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-10
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
No Action	No Action	None	Used as a baseline to which other technology types/process options may be compared.	Required for consideration by the NCP.	None	Retain
Institutional Controls/Limited Actions	Institutional Measures	Deed Restrictions	Use of deed restrictions to restrict or prohibit use of groundwater as a potable supply	Potentially applicable	None	Retain
	Natural Attenuation	Long-Term Monitoring	Continued monitoring of existing well network	Potentially applicable	None	Retain
		Natural Attenuation	Continued natural attenuation of contaminants in groundwater	Potentially applicable	None	Retain
Containment	Hydraulic Containment	Continued NTCRA 1 and 2 Operation	Continued operation of overburden and bedrock groundwater removal and treatment in existing treatment facility	Potentially applicable	Requires treatment of extracted groundwater in NTCRA 1 treatment facility	Retain
		Wells	Use of extraction wells to manipulate hydraulic gradients and eliminate migration of contaminated groundwater	Potentially applicable	May require treatment of extracted groundwater	Retain
		Trenches	Use of horizontal drains to manipulate hydraulic gradients and eliminate migration of contaminated groundwater	Potentially applicable	May require treatment of extracted groundwater	Retain
	Physical Barrier	Slurry Wall	Use of soil-bentonite or cement-bentonite slurry wall as a physical barrier to prevent horizontal migration of contaminants	Potentially applicable	May require removal and treatment of groundwater to maintain static hydraulic conditions	Retain

Note: After Figure 4-4 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-10
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
Containment (cont.)	Physical Barrier (cont'd)	Sheet Pile Wall	Use of steel sheet piling as a physical barrier to prevent horizontal migration of contaminants	Potentially applicable	May require removal and treatment of groundwater to maintain static hydraulic conditions	Retain
		Grout Curtain	Use of injected grout as a physical barrier to prevent migration of contaminants	Potentially applicable	May require removal and treatment of groundwater to maintain static hydraulic conditions	Retain
Diversion	Groundwater Diversion Barrier	Trench	Use of horizontal drain to collect upgradient groundwater for diversion around contaminated area	Potentially applicable	Requires discharge of diverted groundwater	Retain
		Sheet Pile Wall	Use of a sheet pile barrier to divert up gradient groundwater around contaminated area	Potentially applicable	None	Retain
		Grout Curtain	Use of injected grout as a vertical barrier to divert up gradient groundwater around contaminated area	Potentially applicable	None	Retain
		Wells	Use of extraction wells to collect up gradient groundwater for diversion around contaminated area	Potentially applicable	Requires discharge of diverted groundwater	Retain
Containment /Removal with Ex-Situ Treatment	Biological Treatment	Wetland Treatment	Use of constructed wetland as self-maintaining bioreactor	Potentially applicable	Requires discharge of treated groundwater	Retain
	Chemical Treatment	UV Oxidation	Use of ultraviolet light and oxidants to destroy organic contaminants	Potentially applicable	Requires discharge of treated groundwater	Retain
		Fenton's Reagent	Use of chemical oxidant and iron to mineralize organic contaminants	Potentially applicable	Requires discharge of treated groundwater	Retain

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-10
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
Containment /Removal with Ex-Situ Treatment (cont'd)		Zero Valent Iron	Use of zero valent iron as a catalyst for reductive dehalogenation of chlorinated organic compounds	Potentially applicable	Requires discharge of treated groundwater	Retain
	Physical Treatment	Conventional Treatment	Use of flow equalization, metals pretreatment, sedimentation, filtration, air stripping, carbon adsorption in conventional treatment system	Potentially applicable	Requires discharge of treated groundwater, and treatment and discharge of vapor phase contaminants	Retain
In-Situ Treatment	Biological Treatment	Injection Wells/Trenches	Use of wells for injection of nutrients and/or bacterial cultures	Potentially applicable	None	Retain
		Biostimulation	Addition of nutrients or other amendments to increase microbial metabolic processes to enhance reductive dechlorination of VOCs	Potentially applicable	None	Retain
		Bioaugmentation	Addition of appropriate microbes to enhance reductive dechlorination of VOCs	Potentially applicable	None	Retain
		Phytoremediation	Use of plants to enhance VOC degradation in plant rhizosphere, enhance phytodegradation, promote hydraulic control, and increase phyto-volatilization	Potentially applicable	None	Retain
	Chemical Treatment	Chemical Oxidation	Addition of chemical reagents (e.g., oxidants) to facilitate in-situ destruction of contaminants	Potentially applicable	None	Retain

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-10
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Overburden Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
In-Situ Treatment (cont'd)	Chemical Treatment (cont'd)	Passive Treatment Wall	Installation of subsurface vertical reactive wall (e.g., zero valent iron) for passive flow-through of contaminated groundwater	Potentially applicable	None	Retain
		Solvent Extraction/Alcohol Flood	Use of cosolvent or alcohol to strip and remove contaminants	Potentially applicable	Requires treatment of extracted groundwater	Retain
	Thermal Treatment	Steam Injection	Injection of steam to volatilize contaminants	Potentially applicable	Requires treatment of vapor and condensate	Retain

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-11
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Bedrock NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
No Action	No Action	None	Used as a baseline to which other technology types/process options may be compared.	Required for consideration by the NCP.	None	Retain
Institutional Controls/Limited Actions	Institutional Measures	Deed Restrictions	Use of deed restrictions to restrict or prohibit use of groundwater as a potable supply	Potentially applicable	None	Retain
	Natural Attenuation	Long-Term Monitoring	Continued monitoring of existing well network	Potentially applicable	None	Retain
		Natural Attenuation	Continued natural attenuation of contaminants in groundwater	Potentially applicable	None	Retain
Containment	Hydraulic Containment	Continued NTCRA 1 and 2 Operation	Continued operation of overburden and bedrock groundwater removal and treatment in existing treatment facility	Potentially applicable	Requires treatment of extracted groundwater in NTCRA 1 treatment facility	Retain
		Wells	Use of extraction wells to manipulate hydraulic gradients an prevent migration of NAPL	Potentially applicable	May require treatment of extracted groundwater	Retain
		~~Trenches~~	Use of horizontal drains to manipulate hydraulic gradients and prevent migration of NAPL	Not applicable in bedrock	May require treatment of extracted groundwater	Eliminate
	Physical Barrier	~~Sheet Pile Wall~~	Use of soil-bentonite or cement-bentonite slurry wall as a physical barrier to prevent horizontal NAPL migration	Not applicable in bedrock	None	Eliminate
		~~Slurry Wall~~	Use of steel sheet piling as a physical barrier to prevent horizontal NAPL migration	Not applicable in bedrock	None	Eliminate
		Grout Curtain	Use of injected grout as a physical barrier to prevent NAPL migration	Potentially applicable	None	Retain

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-12
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Bedrock Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
No Action	No Action	None	Used as a baseline to which other technology types/process options may be compared.	Required for consideration by the NCP.	None	Retain
Institutional Controls/Limited Actions	Institutional Measures	Deed Restrictions	Use of deed restrictions to restrict or prohibit use of groundwater as a potable supply	Potentially applicable	None	Retain
	Natural Attenuation	Long-Term Monitoring	Continued monitoring of existing well network	Potentially applicable	None	Retain
		Natural Attenuation	Continued natural attenuation of contaminants in groundwater	Potentially applicable	None	Retain
Containment	Hydraulic Containment	Continued NTCRA 1 and 2 Operation	Continued operation of overburden and bedrock groundwater removal and treatment in existing treatment facility	Potentially applicable	Requires treatment of extracted groundwater in NTCRA 1 treatment facility	Retain
		Wells	Use of extraction wells to manipulate hydraulic gradients and eliminate migration of contaminated groundwater	Potentially applicable	May require treatment of extracted groundwater	Retain
		Trenches	Use of horizontal drains to manipulate hydraulic gradients and eliminate migration of contaminated groundwater	Not applicable in bedrock	N/A	Eliminate
	Physical Barrier	Slurry Wall	Use of soil-bentonite or cement-bentonite slurry wall as a physical barrier to prevent horizontal migration of contaminants	Not applicable in bedrock	N/A	Eliminate

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-12
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Bedrock Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
Containment (cont'd)	Physical Barrier (cont'd)	Sheet Pile Wall	Use of steel sheet piling as a physical barrier to prevent horizontal migration of contaminants	Not applicable in bedrock	N/A	Eliminate
		Grout Curtain	Use of injected grout as a physical barrier to prevent migration of contaminants	Potentially applicable	None	Retain
Diversion	Groundwater Diversion Barrier	Trench	Use of horizontal drain to collect upgradient groundwater for diversion around contaminated area	Not applicable in bedrock	N/A	Eliminate
		Sheet Pile Wall	Use of a sheet pile barrier to divert up gradient groundwater around contaminated area	Not applicable in bedrock	N/A	Eliminate
		Grout Curtain	Use of injected grout as a vertical barrier to divert up gradient groundwater around contaminated area	Potentially applicable	None	Retain
		Wells	Use of extraction wells to collect up gradient groundwater for diversion around contaminated area	Potentially applicable	Requires discharge of diverted groundwater	Retain
Containment /Removal with Ex-Situ Treatment	Biological Treatment	Wetland Treatment	Use of constructed wetland as self-maintaining bioreactor	Potentially applicable	Requires discharge of treated groundwater	Retain
	Chemical Treatment	UV Oxidation	Use of ultraviolet light and oxidants to destroy organic contaminants	Potentially applicable	Requires discharge of treated groundwater	Retain
		Fenton's Reagent	Use of chemical oxidant and iron to mineralize organic contaminants	Potentially applicable	Requires discharge of treated groundwater	Retain

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-12
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Bedrock Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
Containment/Removal with Ex-situ Treatment (con’d)	Chemical Treatment (cont’d)	Zero Valent Iron	Use of zero valent iron as a catalyst for reductive dehalogenation of chlorinated organic compounds	Potentially applicable	Requires discharge of treated groundwater	Retain
	Physical Treatment	Conventional Treatment	Use of flow equalization, metals pretreatment, sedimentation, filtration, air stripping, carbon adsorption in conventional treatment system	Potentially applicable	Requires discharge of treated groundwater, treatment and discharge of vapor phase contaminants	Retain
In-Situ Treatment	Biological Treatment	Injection Wells	Use of wells for injection of nutrients and/or bacterial cultures	Potentially applicable	None	Retain
		~~Injection Trenches~~	Addition of nutrients and/or bacterial cultures to stimulate biodegradation of contaminants	Not applicable in bedrock	N/A	Eliminate
		Biostimulation	Addition of nutrients or other amendments to increase microbial metabolic processes to enhance reductive dechlorination of VOCs	Potentially applicable	None	Retain
		Bioaugmentation	Addition of appropriate microbes to enhance reductive dechlorination of VOCs	Potentially applicable	None	Retain
	Chemical Treatment	Chemical Oxidation	Addition of chemical reagents (e.g., oxidants) to facilitate in-situ destruction of contaminants	Potentially applicable	None	Retain
		~~Passive Treatment Wall~~	Installation of subsurface vertical reactive wall (e.g., zero valent iron) for passive flow-through of contaminated groundwater	Not applicable in bedrock	N/A	Eliminate

Note: After Figure 4-4 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-12
SRSNE Superfund Site
Feasibility Study

Initial Screening of Remedial Technologies and Process Options
Bedrock Groundwater

General Response Actions	Remedial Technology Types	Process Options	Description	Screening Comments	Waste Stream Treatment Considerations	Screening Outcome
In-Situ Treatment (cont'd)	Chemical Treatment (cont'd)	Solvent Extraction/Alcohol Flood	Use of cosolvent or alcohol to strip and remove contaminants	Potentially applicable	Requires treatment and discharge of extracted groundwater.	Retain
	Thermal Treatment	Steam Injection	Injection of steam to volatilize contaminants	Potentially applicable	Requires treatment of removed vapor and condensate streams	Retain

Note: After Figure 4-4 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-13
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Operations Area/Railroad Soil

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
No Action	No Action	None	Does not achieve RAO, required for consideration by NCP.	Technically and administratively feasible.	None	Retain
Institutional Controls/ Limited Actions	Access Controls	~~Fencing~~	May be effective in restricting access. Does not meet RAOs by itself.	Technically and administratively feasible.	Very low capital and O&M costs	Eliminate
	Institutional Measures	Posting	Effectiveness depends on future enforcement. Does not reduce contamination.	Technically and administratively feasible.	Very low capital and O&M costs	Retain
		Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Implementable. Requires legal action by state for ELUR	Very low capital and O&M costs	Retain
Containment	Physical Barriers	~~Soil Cap~~	Effective method to reduce potential future exposure. Would not meet ARARs.	Technically and administratively feasible.	Moderate capital and O&M costs	Eliminate
		~~Asphalt Cap~~	Effective method to reduce potential future exposure. Would not meet ARARs.	Technically and administratively feasible.	Moderate capital and O&M costs	Eliminate
		~~Synthetic Cap~~	Effective method to reduce potential future exposure, but long-term maintenance and durability are issues. Would not meet ARARs.	Technically and administratively feasible.	Moderate capital and relatively high O&M costs	Eliminate
		Multilayer Cap	Effective method to reduce potential future exposure. Can be designed to meet ARARs.	Technically and administratively feasible.	Relatively high capital and moderate O&M costs	Retain

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-13
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Operations Area/Railroad Soil

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
Ex-Situ Treatment or Disposal	Excavation	Excavation	Effective, proven and reliable when coupled with ex-situ treatment or off-site disposal. Would have relatively high short-term risks during construction that would have to be addressed.	Technically and administratively feasible.	Moderate capital, low O&M costs	Retain
	Landfilling	Landfilling	Effective, proven and reliable. Would have relatively high short-term risks associated with loading and transportation of contaminated materials that would have to be addressed.	Technically and administratively feasible. May require treatment prior to disposal to meet Land Disposal Restrictions.	Very high capital, low O&M costs	Retain
	Thermal Treatment	LTTD	Effective in reducing VOC concentrations in soils. Requires vapor treatment. Would have moderate short-term risks during implementation that would have to be addressed.	Technically and administratively feasible.	Very high capital and O&M costs	Retain
		~~Incineration~~	Similar effectiveness and risks as LTTD treatment.	May not be administratively feasible.	Very high capital and O&M costs	Eliminate
	Chemical Treatment	~~Stabilization/ Solidification~~	Not effective on all site contaminants	Technically feasible, but would require additional treatment and/or disposal measures.	Moderate capital, low O&M costs	Eliminate
	Physical Treatment	Soil Washing	Effectiveness depends on soil grain size distribution and contaminant adsorption characteristics.	Technically feasible, but would require additional treatment and/or disposal measures.	Moderate capital, high O&M costs	Retain
		~~Solvent Extraction~~	Not effective on all site contaminants. Would have moderate short-term risks during implementation.	Implementable, but would require additional treatment and/or disposal measures.	High capital, moderate O&M costs.	Eliminate

Note: After Figure 4-5 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-13
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Operations Area/Railroad Soil

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
	Biological Treatment	~~Soil Pile~~	Not effective on all site contaminants (e.g., PCBs in soil).	Technically and administratively feasible.	High capital, moderate O&M costs	Eliminate
		~~Batch Reactor~~	Not effective on all site contaminants (e.g., PCBs in soil).	Technically and administratively feasible.	High capital and O&M costs	Eliminate
In-Situ Treatment	Thermal Treatment	~~Steam Stripping~~	Effective in reducing VOC concentrations in soils. Would have moderate short-term risks during implementation that would have to be addressed.	Not technically feasible for treatment of shallow soils.	Very high capital and O&M costs	Eliminate
		~~Vitrification~~	Effective in reducing VOC concentrations in soils.	Not technically feasible	Very high capital and O&M costs	Eliminate
		~~Electrical Resistance Heating~~	Effective in reducing VOC concentrations in soils.	Not technically feasible for treatment of shallow soils.	Very high capital and O&M costs	Eliminate
	Chemical Treatment	~~Stabilization/ Solidification~~	Not effective on all site contaminants. Would have relatively high short-term risks during implementation.	Technically and administratively feasible.	Moderate capital costs	Eliminate
	Biological Treatment	~~Mixing/Nutrient Addition~~	Would have relatively high short-term risks during implementation.	Technically and administratively feasible.	Moderate capital and O&M costs.	Eliminate
	Physical Treatment	~~Soil Vapor Extraction~~	Not effective due to shallow depth to groundwater and heterogeneity of soil.	Implementable, would require treatment and discharge of vapors	Moderate capital and O&M costs	Eliminate

Note: After Figure 4-5 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-14
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Cianci Property Soil

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
No Action	No Action	None	Does not achieve RAO, required for consideration by NCP.	Technically and administratively feasible.	None	Retain
Containment	Physical Barrier	Soil Cap	Effective in preventing risks associated with site contaminants.	Technically and administratively feasible.	Low capital and O&M costs.	Retain
		~~Asphalt Cap~~	Similar effectiveness to soil cap process option.	Technically and administratively feasible.	Moderate capital, Low O&M costs.	Eliminate
		~~Synthetic Cap~~	Similar effectiveness to soil cap process option.	Technically and administratively feasible.	Moderate capital, Low O&M costs.	Eliminate
		~~Multilayer Cap~~	Similar effectiveness to soil cap process option.	Technically and administratively feasible.	Moderate capital, Low O&M costs.	Eliminate
Removal and Disposal	Excavation	Excavation	When used in combination with disposal technology, effective in preventing risks associated with site contaminants.	Technically and administratively feasible.	Moderate capital, low O&M costs.	Retain
	Culvert Removal/ Drainage System Rerouting	Culvert Removal/Drainage System Rerouting	When used in combination with disposal technology, effective in preventing risks associated with site contaminants.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
	On-Site Disposal	Consolidation with Vadose Zone Soils	Effective in preventing risks associated with site contaminants.	Technically and administratively feasible.	Low capital and O&M costs.	Retain
	Off-Site Disposal	Off-Site Landfill Disposal	Effective in preventing risks associated with site contaminants.	Technically and administratively feasible.	High capital and O&M costs.	Retain

Note: After Figure 4-5 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-15
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
No Action	No Action	None	Does not achieve RAO, required for consideration by NCP.	Technically and administratively feasible.	None	Retain
Institutional/ Limited Control Actions	Institutional Measures	Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Implementable.	Very low capital and O&M costs	Retain
	Natural Attenuation	Long-Term Monitoring	Does not achieve RAO, but may be used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital and O&M costs	Retain
		Natural Attenuation	Does not achieve RAO for this medium by itself, but may be used in combination with other alternatives.	Technically and administratively feasible.	None	Retain
Containment	Hydraulic Containment	Continued NTCRA 1 and 2 Operation	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
		Wells	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
		~~Trenches~~	Potentially effective in shallow overburden.	Low technical feasibility compared to wells.	High capital, moderate O&M costs.	Eliminate
	Physical Barrier	Sheet Pile Wall	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Moderate capital, low O&M costs	Retain
		~~Slurry Wall~~	Potentially effective in shallow overburden.	Low technical feasibility compared to sheet pile wall	High capital, low O&M costs.	Eliminate

Note: After Figure 4-5 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-15
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
Containment (cont'd)	Physical Barrier (cont'd)	~~Grout Curtain~~	Potentially effective.	Low technical feasibility compared to sheet pile wall.	High capital, low O&M costs.	Eliminate
Removal and Off-Site Disposal	Excavation	Excavation	Effective for NAPL in shallow overburden. Must be implemented in combination with a treatment or off-site disposal component.	Technically feasible with adequate controls for volatile and particulate emissions. May have low administrative feasibility.	High capital, low O&M costs.	Retain
	Pumping	~~Extraction using Wells~~	Has been previously implemented at the site. Limited effectiveness as an extraction technique.	Technically and administratively feasible.	Low capital and O&M costs.	Eliminate
		~~Extraction using Trenches~~	Limited effectiveness as a removal technique.	Low technical feasibility.	High capital, moderate O&M costs.	Eliminate
	Commercial Disposal Facilities	Commercial Disposal Facilities	Currently being used for NTCRA 1 treatment residuals.	Technically and administratively feasible.	High capital, low O&M costs.	Retain
Stabilization	Hydraulic Gradient Management	~~Removal/Injection with Wells~~	Does not achieve RAOs.	Technically and administratively feasible.	Moderate capital and O&M costs.	Eliminate
		~~Removal/Injection with Trenches~~	Does not achieve RAOs.	Technically and administratively feasible.	High capital, moderate O&M costs.	Eliminate
In-Situ Treatment	Thermal Treatment	Steam Injection	Potentially effective. Would require treatment of condensate and vapor phase contaminant streams.	Technically feasible, although a very complex technology. Administratively feasible.	Very high capital and O&M costs.	Retain
		~~Hot Water Flood~~	Less effective than steam flooding among thermal treatment process options.	Technically and administratively feasible.	High capital and O&M costs.	Eliminate
		Thermal Conductive Heating	Potentially effective when used in combination with soil vapor extraction. Would require treatment of vapor phase contaminant stream.	Technically feasible, although a very complex technology. Administratively feasible.	Very high capital and O&M costs.	Retain

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-15
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
In-Situ Treatment (cont'd)	Thermal Treatment (cont'd)	Electrical Resistive Heating	Potentially effective when used in combination with soil vapor extraction. Would require treatment of vapor phase contaminant stream.	Technically feasible, although a very complex technology. Administratively feasible.	Very high capital and O&M costs.	Retain
	Physical Treatment	Hydraulic Displacement	Effective at reducing occurrence of potentially mobile NAPL in the overburden groundwater unit. Could utilize existing NTCRA 1 treatment system for treatment of extracted groundwater.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
		Cosolvent Extraction/Alcohol Flushing	Potentially effective at increasing NAPL mobility to facilitate pumping.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
		~~Complex sugar~~	Potentially effective at increasing NAPL mobility to facilitate pumping, but less effective than cosolvent extraction at similar cost.	Technically and administratively feasible.	Moderate capital and O&M costs.	Eliminate
		~~Foam~~	Limited effectiveness due to heterogeneity of overburden groundwater unit.	Low technical feasibility.	Moderate capital and O&M costs.	Eliminate
		~~Surfactant flushing~~	Potentially effective at increasing NAPL mobility to facilitate pumping, but less effective than cosolvent extraction at similar cost.	Technically and administratively feasible.	Moderate capital and O&M costs.	Eliminate
	Chemical Oxidation	Permanganate	Effective at reducing contaminant mass.	Technically and administratively feasible.	High capital and O&M costs.	Retain
		Persulfate	Effective at reducing contaminant mass.	Technically and administratively feasible.	High capital and O&M costs.	Retain

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-15
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Overburden NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
	Chemical Oxidation (cont'd)	~~Hydrogen Peroxide (Fenton's Reagent)~~	Effective at reducing contaminant mass, but greater short-term risks than other process options.	Technically and administratively feasible	High capital and O&M costs.	Eliminate
		~~Reactive Permeable Barrier~~	Potentially effective for mobile contaminants.	Limited technical feasibility due to NAPL immobility.	High capital, low O&M costs.	Eliminate
	Biological Treatment	Biostimulation	Potentially effective in conjunction with other mass removal technologies.	Technically and administratively feasible	Moderate capital and O&M costs.	Retain
		Bioaugmentation	Potentially effective in conjunction with other mass removal technologies.	Technically and administratively feasible	Moderate capital and O&M costs.	Retain

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-16
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Overburden Groundwater

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
No Action	No Action	None	Does not achieve RAO, required for consideration by NCP.	Technically and administratively feasible.	None	Retain
Institutional Controls/ Limited Actions	Institutional Measures	Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Technically and administratively feasible.	Very low capital and O&M costs	Retain
	Natural Attenuation	Long-Term Monitoring	Does not achieve RAOs by itself, but may be used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital and moderate O&M costs	Retain
		Natural Attenuation	Effective in reducing contaminant concentrations, alone or in conjunction with other technologies.	Technically and administratively feasible.	None	Retain
Containment	Hydraulic Containment	Continued NTCRA 1 and 2 Operation	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
		Wells	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
		~~Trenches~~	Potentially effective in shallow overburden.	Low technical feasibility compared to wells.	High capital, moderate O&M costs.	Eliminate
	Physical Barrier	~~Slurry Wall~~	Potentially effective in shallow overburden in combination with hydraulic containment.	Not technically feasible for volume and area required.	Moderate capital, low O&M costs.	Eliminate
		~~Sheet Piling~~	Currently in process in NTCRA 1, would be effective in long term when used in combination with hydraulic containment.	Not technically feasible for volume and area required.	Moderate capital, low O&M costs	Eliminate

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-16
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Overburden Groundwater

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
Containment (cont'd)	Physical Barrier (cont'd)	~~Grout Curtain~~	Potentially effective in combination with hydraulic containment.	Not technically feasible for volume and area required.	High capital, low O&M costs.	Eliminate
Diversion	Groundwater Diversion Barrier	~~Trench~~	Does not meet RAO.	Low technical feasibility compared to wells.	High capital, moderate O&M costs.	Eliminate
		~~Sheet Pile Wall~~	Does not meet RAO.	Technically and administratively feasible.	Moderate capital, low O&M costs	Eliminate
		~~Grout Curtain~~	Does not meet RAO.	Low technical feasibility compared to sheet pile wall.	High capital, low O&M costs.	Eliminate
		~~Wells~~	Does not meet RAO.	Technically and administratively feasible.	Low capital, moderate O&M costs	Eliminate
Containment /Removal with Ex-Situ Treatment	Biological	Wetland Treatment	Potentially effective. Treatability testing required to define system design parameters.	Technically feasible. Administrative feasibility subject to compliance with Wetland Executive Order.	Moderate capital, low O&M costs.	Retain
	Chemical	UV Oxidation	Currently in process as part of NTCRA 1 treatment system.	Technically and administratively feasible.	Moderate capital, high O&M costs.	Retain
		Fenton's Reagent	May be effective on site contaminants, pending treatability study results.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
		~~Zero Valent Iron~~	May not be effective on all site contaminants.	Technically and administratively feasible.	Moderate capital and O&M costs.	Eliminate
	Physical	Conventional Treatment	Effective, air stripping would require additional treatment of vapor phase contaminant stream.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
In-Situ Treatment	Biological Treatment	Injection Wells/Trenches	Potentially effective, however effectiveness may be limited in shallow water table areas.	Technically and administratively feasible.	Moderate capital, low O&M costs.	Retain
		Biostimulation	Effective in reducing contaminant concentrations in groundwater.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-16
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Overburden Groundwater

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
In-Situ Treatment (cont'd)	Biological Treatment (cont'd)	Bioaugmentation	Effective in reducing contaminant concentrations in groundwater.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
		Phytoremediation	Pilot study of this process option is currently in process at the site. Potentially effective.	Technically and administratively feasible.	Low capital and O&M costs.	Retain
	Chemical Treatment	~~Chemical Oxidation~~	Low effectiveness on dissolved phase contaminants in groundwater.	Technically and administratively feasible.	High capital and O&M costs.	Eliminate
		~~Passive Treatment Wall~~	Not effective on all site contaminants.	Technically feasible in shallow overburden. Administratively feasible.	High capital, low O&M costs.	Eliminate
		~~Solvent Extraction/Alcohol Flood~~	Potentially effective.	Not technically feasible for volume and area required	High capital and O&M costs.	Eliminate
	Thermal Treatment	~~Steam Injection~~	Potentially significant short-term risks during implementation.	Not technically feasible for volume and area required	Very high capital and O&M costs.	Eliminate

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 2-17
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Bedrock NAPL Area

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
No Action	No Action	None	Does not achieve RAO, required for consideration by NCP.	Technically and administratively feasible.	None	Retain
Institutional Controls/ Limited Actions	Institutional Measures	Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Implementable.	Very low capital and O&M costs	Retain
	Natural Attenuation	Long-Term Monitoring	Does not achieve RAO, but may be used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital and O&M costs	Retain
		~~Natural Attenuation~~	Does not achieve RAO for this medium.	Technically and administratively feasible.	None	Eliminate
Containment	Hydraulic Containment	Continued NTCRA 1 and 2 Operation	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
		Wells	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
	Physical Barrier	~~Grout Curtain~~	Potentially effective.	Not technically feasible at depths required (up to 200 feet).	High capital, low O&M costs.	Eliminate

Note: After Figure 4-5 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-18
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Bedrock Groundwater

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
No Action	No Action	None	Does not achieve RAO, required for consideration by NCP.	Technically and administratively feasible.	None	Retain
Institutional Controls/ Limited Actions	Institutional Measures	Deed Restrictions	Effectiveness depends on future enforcement. Does not reduce contamination.	Technically and administratively feasible.	Very low capital and O&M costs	Retain
	Natural Attenuation	Long-Term Monitoring	Does not achieve RAOs by itself, but may be used in combination with other remedial alternatives.	Technically and administratively feasible.	Very low capital and low O&M costs	Retain
		Natural Attenuation	Effective in reducing contaminant concentrations, alone or in conjunction with other technologies.	Technically and administratively feasible.	None	Retain
Containment	Hydraulic Containment	Continued NTCRA 2 Operation	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
		Wells	Currently in process, would be effective in long term when used in combination with other remedial alternatives.	Technically and administratively feasible.	Low capital, moderate O&M costs	Retain
	Physical Barrier	~~Grout Curtain~~	Potentially effective.	Not technically feasible at depths required (up to 200 feet).	Very high capital, moderate O&M costs.	Eliminate
Diversion	Groundwater Diversion Barrier	~~Grout Curtain~~	Potentially effective.	Not technically feasible at depths required (up to 200 feet).	Very high capital, moderate O&M costs.	Eliminate
		~~Wells~~	Marginally effective based on expected groundwater extraction rates available from site bedrock formation.	Technically and administratively feasible.	High capital and O&M costs.	Eliminate

Note: After Figure 4-5 in “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,” OSWER Directive 9355.3-01, October 1988

Table 2-18
SRSNE Superfund Site
Feasibility Study

Evaluation of Process Options
Bedrock Groundwater

General Response Actions	Remedial Technology Types	Process Options	Effectiveness	Implementability	Cost	Screening Outcome
Containment /Removal with Ex-Situ Treatment	Biological	Wetland Treatment	Potentially effective. Treatability testing required to define system design parameters.	Technically feasible. Administrative feasibility subject to compliance with Wetland Executive Order and regulatory requirements.	Moderate capital, low O&M costs.	Retain
	Chemical	UV Oxidation	Currently in process as part of NTCRA 1 treatment system.	Technically and administratively feasible.	Moderate capital, high O&M costs.	Retain
		Fenton's Reagent	May be effective on site contaminants, pending treatability study results.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
		~~Zero Valent Iron~~	May not be effective on all site contaminants.	Technically and administratively feasible.	Moderate capital and O&M costs.	Eliminate
	Physical	Conventional Treatment	Effective, air stripping would require additional treatment of vapor phase contaminant stream.	Technically and administratively feasible.	Moderate capital and O&M costs.	Retain
In-Situ Treatment	Biological Treatment	~~Injection Wells~~	Potentially effective in combination with nutrient or reagent addition.	Not technically feasible for volume and area required.	Moderate capital, low O&M costs.	Eliminate
		~~Nutrient/Culture Addition~~	Effective in reducing contaminant concentrations in groundwater.	Not technically feasible for volume and area required.	Moderate capital and O&M costs.	Eliminate
	Chemical Treatment	~~Reagent Addition~~	Potentially effective.	Not technically feasible for volume and area required.	Moderate capital and O&M costs.	Eliminate
		~~Solvent Extraction/Alcohol Flood~~	Potentially effective.	Not technically feasible for volume and area required	Moderate capital, high O&M costs.	Eliminate
	Thermal Treatment	~~Steam Injection~~	May not be effective on bedrock matrix. Potentially significant short-term risks during implementation.	Not technically feasible for volume and area required	Very high capital and O&M costs.	Eliminate

Note: After Figure 4-5 in "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA," OSWER Directive 9355.3-01, October 1988

Table 4-1
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with §300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Currently, exposure to Operations Area soils at the site is controlled by existing asphalt pavement and fencing, and there are no unacceptable exposure scenarios. Railroad soils are not covered by pavement and are potentially accessible. The baseline risk assessment concluded that unacceptable potential human health risk related to Operations Area/Railroad soil may occur under hypothetical future exposure scenarios (i.e., trespassing and residential development). In addition, some soil in the railroad area exceeds CT RSR values for DEC. The no action alternative would not provide for overall protection for human health in the long term as no action has been taken to eliminate, reduce or control exposures to levels in soil that present an unacceptable risk or exceed ARARs.

Table 4-1
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-2**.

Table 4-1
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative would not actively address the potential risks associated with the contaminants present in the Operations Area/Railroad soils and as such is neither effective in the long term nor permanent. The no action alternative would provide no exposure controls or management measures, and therefore the magnitude of the residual risk is high. As no controls have been put in place to manage residual waste left under this alternative, the adequacy and reliability of controls is very low because the exposure pathways have not been addressed. Because this alternative allows contaminants to remain on site above acceptable levels, a periodic review (i.e., every five years) would be conducted review the protectiveness of the remedy.

Table 4-1
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	Under the No Action alternative, no actions would be taken to treat, recycle, or destroy contaminants in Operations Area/Railroad soil therefore there is no reduction of toxicity, mobility or volume through treatment under this alternative. As a result, no treatment processes will be employed; hazardous materials will not be destroyed, treated or recycled; the type and quantity of residuals that remain does not change; and there is no reduction in risk.

Table 4-1
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	No remedial actions would be initiated under this alternative; therefore, there would be no short-term risks posed to the community or onsite workers during implementation. No short-term environmental impacts would be associated with this alternative. Because no action is being taken, protection will not be achieved at any time.

Table 4-1
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	The No Action alternative would be technically and administratively feasible and would not require the use of services or materials to be implemented.

Table 4-1
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	No capital costs would be associated with the No Action alternative (**Table 4-3**). The present worth costs of conducting five-year reviews are included in the estimates of the annual operation and maintenance costs for the Overburden Groundwater alternatives (OGW).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-2
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Operations Area/Railroad Soil
Alternative OAR-1: No Action

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	State of Connecticut	Remediation Standard Regulations for soil	CGS 22a-133k; RCSA 22a-133k-2	Applicable	These regulations establish direct exposure and pollutant mobility criteria for contaminated soils based on either industrial or residential use of the Site.	No action would be taken for soils that exceed levels in these regulations; therefore alternative would not meet ARAR.	N
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-3
SRSNE Superfund Site
Feasibility Study

Operations Area and Railroad Remedial Alternatives Cost Estimate
Alternative OAR-1: No Action

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
	No Initial Capital Costs				$0
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30 year Present Worth)					
1	No O&M Costs				$0
				Annual O&M Cost Subtotal:	$0
				Project Administration/Management Cost	$0
				Annual O&M Cost Contingency	$0
				Total Annual O&M Cost:	$0
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost:	**$0**
				Aggregate Present Worth of Total Cost:	**$0**
				Rounded To:	**$0**

Note:

1. No action, five-year review costs included under Overburden Groundwater options.

Table 4-4
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-2: Capping and Institutional Controls

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Currently, exposure to Operations Area soils at the site is controlled by existing asphalt pavement and fencing, and there are no unacceptable exposure scenarios. Railroad soils are not covered by pavement and are potentially accessible. The baseline risk assessment concluded that unacceptable potential human health risk related to Operations Area/Railroad soil may occur under hypothetical future exposure scenarios (i.e., trespassing and residential development). In addition, some soil in the railroad area exceeds CT RSR requirements. This alternative would provide overall protection of human health and the environment by eliminating exposure to contaminated soils that present an unacceptable risk or exceed ARARs in the long term by covering them with a cap that would be maintained and operated over time. The cap would be designed to minimize infiltration and promote surface water runoff, and would achieve the cleanup objectives for the Operations Area/Railroad soils. Institutional controls would be put in place to ensure that the cap is not disturbed and the integrity of the cap is not jeopardized in the long term. No significant short-term impacts to human health or the environment would be anticipated, other than minimal short-term worker exposures during cap construction and demolition of remaining structures (tank cradles and concrete walls). Exposures would be kept to a minimum by limiting disturbance of the soil. This alternative would comply with ARARs.

Table 4-4
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-2: Capping and Institutional Controls

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-5**.

Table 4-4
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-2: Capping and Institutional Controls

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long term effectiveness by placing contaminated material beneath a cap and using institutional controls to ensure the cap remains effective in the long term. An analysis of the factors to be considered as part of this criterion follows: 1. This alternative leaves all untreated soil on site. This alternative would reduce residual risk presented by this untreated soil by limiting potential future exposure to the Operations Area/Railroad soil. In order for it to remain effective in the long-term, the condition and integrity of the cap would be inspected and maintained periodically. Any erosional damage or reduction in cap impermeability would need to be identified and addressed to ensure the long-term effectiveness of this alternative. 2. This alternative can reliably and adequately control exposure to contaminated soil as long as the cap is properly maintained and operated. A cap is a proven technology that has been used at a number of sites to prevent exposure to contaminated waste in the long term. Institutional controls would also be used to prevent disturbance of the cap. These controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining onsite above acceptable levels, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-4
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-2: Capping and Institutional Controls

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:	This alternative would not utilize active treatment or recycling processes to reduce the toxicity, mobility or volume of contaminants in the Operations Area/Railroad soils. However, it would reduce surface-water infiltration, thus reducing the mobility of contaminants in the soil. The toxicity and volume of the contaminants would not be directly addressed by this alternative, although ongoing natural degradation processes would continue to reduce contaminant concentrations over time. An analysis of the factors to be considered as part of this criterion follows:
1. The treatment or recycling process the alternatives will employ and materials they will treat.	1. This alternative will not use active treatment or recycling processes. Mobility of contaminants will be reduced by the installation of the engineered control (i.e., low permeability cap). Natural degradation processes will continue to reduce contaminant concentrations over time.
2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.	2. No hazardous substances, pollutants or contaminants will be destroyed, treated, or recycled under this alternative; however natural degradation processes will continue to reduce contaminant concentrations over time.
3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment or recycling and the specification of which reduction(s) are occurring.	3. The engineered control would not achieve concentration-based cleanup goals but would meet relevant state mandated design criteria by complying with the requirements of an engineered control. Contaminant mobility would be significantly reduced through the elimination of surface water infiltration through the Operations Area/Railroad soils.
4. The degree to which treatment is irreversible.	4. This alternative will not use active treatment processes. Natural degradation processes will continue to reduce contaminant concentrations over time; the destruction of contaminants through the natural degradation processes would be irreversible.
5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents.	5. This alternative will not use active treatment and as a result, all material remains on site untreated.
6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	6. This alternative will not use active treatment or recycling processes, although natural degradation processes will continue to reduce soil contaminant concentrations over time.

Table 4-4
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-2: Capping and Institutional Controls

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. The cap would be installed in a manner which minimizes disturbance of Operations Area/Railroad soil. The potential exists for a temporary increase of risk to the community due to particulate and VOC emissions during construction. Particulate emissions would be addressed by dust control technologies, such as water or foam sprays. 2. The potential exists for a temporary increased risk to onsite workers due to particulate and VOC emissions during construction. Potential exposure for onsite workers would be mitigated through the use of dust control technologies, PPE and through compliance with a site-specific HASP. 3. This alternative would not be expected to create any short-term environmental impacts. 4. Long-term protection would be achieved once construction was completed and institutional controls were put in place. Design and construction is expected to take 3-4 years during which time institutional controls would be put in place.

Table 4-4
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-2: Capping and Institutional Controls

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of the engineered controls (capping) component of this alternative would be technically feasible. An existing fiber optic cable that runs in the vicinity of the railroad grade would need to be relocated if this alternative were to be selected, but this would not be expected to affect the overall implementability of this alternative. 2. This alternative would be administratively feasible; the institutional controls may require coordination with the state and town. 3. Implementation of this alternative would rely on the use of readily available contractors, materials, and equipment.

Table 4-4
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-2: Capping and Institutional Controls

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	Capital costs associated with this alternative include the design and construction of the engineered control and implementation of institutional controls for the site. O&M costs for this alternative include the quarterly inspections of the cover system and fencing, and periodic repairs, if necessary. The estimated present worth cost of this alternative is $1,060,000 (**Table 4-6**) based on a 30-year operation and maintenance period.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-5
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs -Operations Area/Railroad Soil
Alternative OAR-2: Capping and Institutional Controls

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	State of Connecticut	Remediation Standard Regulations for soil	CGS 22a-133k; RCSA 2a-133k-2	Applicable	These regulations establish direct exposure and pollutant mobility criteria for contaminated soils based on either industrial or residential use of the Site.	Contaminated soil exceeding these values would be managed according to these standards (through a variance), including land use restrictions, and construction of an engineered control to prevent exposure to soil.	Y
Location Specific		None apply.					
Action-Specific	State of Connecticut	Hazardous Waste Regulations	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Relevant and Appropriate	These regulations establish standards for treatment, storage and disposal of hazardous waste and remediation waste, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities.	All treatment, storage and disposal standards. Emergency requirements, groundwater monitoring requirements and landfill closure and post closure requirements would be met by this alternative.	Y
		Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures are required.	Would comply with emission standards to control fugitive dust from excavation activities.	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y
To Be Considered	Federal	EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments	EPA/530-SW-89-047	TBC	Presents technical specifications for the design of multi-barrier covers at landfills at which hazardous wastes were disposed.	Will be considered during the design of the cap.	Y

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
		Technical Memorandum: Revised Landfill Cap Design Guidance Proposed for Unlined Hazardous Waste Landfills in EPA Region 1	Dated February 5, 2001	TBC	Provides guidance for landfill cap design for unlined hazardous waste landfills at Superfund site in EPA Region 1.	Will be considered during the design of the cap.	Y

Table 4-6
SRSNE Superfund Site
Feasibility Study

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Operations Area and Railroad Remedial Alternatives Cost Estimate
<u>Alternative OAR-2: Capping and Access Control</u>

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	Institutional Controls	100	man hours	$250	$25,000
2	Mobilization/Demobilization	1	LS	$20,000	$20,000
3	Site Preparation/Erosion Control Measures	1	LS	$20,000	$20,000
4	Clean Fill, including backfill and compaction	500	CY	$30	$15,000
5	Granular Subbase (Operations Area)	2,300	SY	$14	$32,200
6	Subbase Leveling	2,300	SY	$14	$32,200
7	Non-woven Geotextile	10,100	SY	$3	$30,300
8	HDPE Geomembrane	10,100	SY	$12	$121,200
9	Granular Cushion Layer	2,300	SY	$14	$32,200
10	Asphalt Cap	10,100	SY	$11	$111,100
11	Restoration/Revegetation of Access Areas	1	LS	$10,000	$10,000
13	Well abandon/conversion	10	Well	$500	$5,000
14	RR Grade Remediation (cap)				
14a	Clean Fill, Backfill & Compaction	1,000	CY	$30	$30,000
14b	Rough Grading	2,950	SY	$0.98	$2,891
14c	Non-woven Geotextile	2,950	SY	$5	$14,750
14d	HDPE Geomembrane	2,950	SY	$12	$35,400
14e	Asphalt Cap	2,950	SY	$11	$32,450
				Initial Capital Cost Subtotal:	$569,691
				Rounded To:	$570,000

Table 4-6
SRSNE Superfund Site
Feasibility Study

Operations Area and Railroad Remedial Alternatives Cost Estimate
Alternative OAR-2: Capping and Access Control

Item No.	Description	Quantity	Unit	Unit Cost	Cost
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30 year Present Worth)					
1	**Inspection & Maint. of cover**	150	man hours	$75	$11,250
2	**Verification of Institutional Controls**	20	man hours	$115	$2,300
3	**Annual Report**	20	man hours	$115	$2,300
	Annual O&M Cost Subtotal:				$13,550
	Total Annual O&M Cost:				$10,000
	Present Worth Factor (30-year, 7%):				12.41
	Total Present Worth of Annual O&M Cost (rounded):				$120,000

Description	Cost
Aggregate Present Worth of Total Cost:	$690,000
Remedial Design (15%)	$103,500
Project Administration/Management Cost (8%)	$55,200
Construction Management (10%)	$69,000
Scope Contingency (10%)	$69,000
Bid or Construction Contingency (10%):	$69,000
Subtotal	$1,055,700
Rounded To:	**$1,060,000**

Table 4-6
SRSNE Superfund Site
Feasibility Study

Operations Area and Railroad Remedial Alternatives Cost Estimate
Alternative OAR-2: Capping and Access Control

Notes:

1. Institutional controls includes implementing a ELUR to limit future usage of the Site and prevent disturbance of the cap.
2. Mobilization/demobilization includes site preparation and staging/handling area for equipment and materials.
3. Costs include materials and installation and are based on past project experience, published references and vendor estimates. Costs do not include costs associated with sales tax, bonding, financial costs insurance, etc.
4. Clean fill, including backfill and compaction, is assumed necessary to regrade the railroad grade for proper surface runoff to the relocated drainage culvert (along Lazy Lane).
5. Subbase leveling assumes that approximately 25% of the Operations Area (particularly area surrounding concrete pads) will need to be filled with gravel subbase material prior to liner installation.
6. Geotextile Liner will be Type 2, Non-Woven (16 oz/sq.yd).
7. Geomembrane will be 40 mil HDPE.
8. Granular Subbase will be 8" thick.
9. Asphalt cap will consist of a 2-1/2" bituminous concrete base course with a 1-1/2" bituminous concrete wearing surface.
10. Contingency includes unforeseen legal and administrative fees.
11. LS - lump sum.
12. Costs rounded to the nearest $10,000.
13. Inspection and maintenance of the asphalt cap includes cost for surface sealing

Table 4-7
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-3 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Currently, exposure to Operations Area soils at the site is controlled by existing asphalt pavement and fencing, and there are no unacceptable exposure scenarios. Railroad soils are not covered by pavement and are potentially accessible. The baseline risk assessment concluded that unacceptable potential human health risk related to Operations Area/Railroad soil may occur under hypothetical future exposure scenarios (i.e., trespassing and residential development). In addition, some soil in the railroad area exceeds CT RSR requirements. This alternative would provide overall protection of human health and the environment by eliminating exposure to contaminated soils that present an unacceptable risk or exceed ARARs in the long term by permanently removing contaminants from the site, thus eliminating long term risks associated with exposure to the soil or migration of contaminants. There would be increased short-term impacts to human health or the environment during the implementation of this alternative. The potential for the release of volatile and particulate emissions during excavation could be significant, and although many of these risks could potentially be addressed by employing personal protective equipment and excavation enclosure systems, the potential short-term risks for this alternative would be greater than those of Alternatives OAR-1 and OAR-2. This alternative would comply with ARARs. This alternative would achieve the cleanup objectives for the Operations Area/Railroad soil within a reasonable time frame. .

Table 4-7
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-3 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-8**.

Table 4-7
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-3 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness and permanence by removing all soil that presents an unacceptable risk from the site. An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would eliminate residual risk by removing the Operations Area/Railroad soil for offsite disposal. The magnitude of residual risk would therefore be quite small. 2. This alternative would result in the removal of all Operations Area/Railroad soil for offsite disposal; as such, future controls would not be necessary to manage treatment residuals and/or untreated waste at the site.

Table 4-7
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-3 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	This alternative would not utilize active treatment or recycling processes to reduce the toxicity, mobility or volume of contaminants in the Operations Area/Railroad soils. The mobility, volume and toxicity of contaminants would be reduced through their removal from the site and disposal at an offsite facility. An analysis of the factors to be considered as part of this criterion follows: 1. This alternative will not use active treatment or recycling processes. Mobility, toxicity and volume of contaminants will be reduced by their removal and placement in an offsite disposal facility. 2. No hazardous substances, pollutants or contaminants will be destroyed, treated, or recycled under this alternative. 3. This alternative would achieve concentration-based cleanup goals onsite. Contaminant mobility, volume and toxicity would be significantly reduced through the removal and placement of Operations Area/Railroad soil in an offsite disposal facility. 4. This alternative will not use active treatment processes. 5. Because all waste is removed from the site and no treatment activities have been conducted, there is no residual which must be addressed. 6. This alternative will not use active treatment or recycling processes, although the removal and offsite disposal of Operations Area soils will eliminate the principal threat posed by that portion of the area.

Table 4-7
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-3 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. The short-term risks to the community during implementation of this alternative would be managed through the use of an enclosure within which excavation activities would take place. However, the failure of the enclosure could result in unacceptable levels of exposure for the offsite community. As a result, perimeter monitoring would be required as well as limits placed on the size of the excavation at one time. In addition, this alternative would require the movement of approximately 2,250 trucks of contaminated soil and clean backfill over public roads in the vicinity of the site, which has additional short term impacts on the community that would have to be addressed. 2. High levels of respiratory protection would likely be required to protect workers involved with excavation and soil handling. Although such protective measures would reduce the potential for unacceptable worker exposures, measures would need to be taken to ensure that such protective measures were safely used by workers. 3. There are no potential environmental impacts from this action. 4. Long term protection will be achieved after construction of this alternative. It is expected to take 4-5 years to design and implement this alternative.

Table 4-7
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-3 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	This alternative provides long term effectiveness and permanence by permanently removing contamination from the site. An analysis of the factors to be considered as part of this criterion follows: 1. Excavation and offsite transportation and disposal are proven technologies that would be technically feasible. An existing fiber optic cable that runs in the vicinity of the railroad grade would need to be relocated if this alternative were to be selected, but this would not be expected to affect the overall implementability of this alternative. The potential need for excavation area enclosures and associated air handling and treatment systems would add to the complexity of this alternative. 2. This alternative would be administratively feasible. It would rely on the use of an existing, licensed offsite disposal facility that is in compliance with applicable laws and regulations. 3. Implementation of this alternative would rely on the use of readily available contractors, materials, and equipment. The offsite disposal capacity for approximately 21,250 tons of contaminated soil is available at a number of existing licensed hazardous waste disposal facilities.

Table 4-7
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Operations Area/Railroad Soil

Alternative OAR-3 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The costs associated with this alternative include the remedial design and construction costs for the excavation and off-site disposal of the Operations Area/Railroad soils, including the provisions for volatile and particulate emissions control, and restoration of the area with the placement of clean backfill materials. The estimated present worth costs of this alternative is $13,230,000 (**Table 4-9**), which is relatively high compared to Alternatives OAR-1 and OAR-2. .
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-8
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs -Operations Area/Railroad Soil
Alternative OAR-3: Excavation, Offsite Disposal and Institutional Controls

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These requirements establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through excavation and offsite disposal of contaminated NAPL material.	Y
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through excavation and offsite disposal of contaminated NAPL material. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y
Location-Specific		None apply.					

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific	State of Connecticut	Hazardous Waste Regulations	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Relevant and Appropriate	These regulations establish standards for treatment, storage and disposal of hazardous waste and remediation waste, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities.	All treatment, storage and disposal standards. Emergency requirements, groundwater monitoring requirements and landfill closure and post closure requirements would be met by this alternative.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
		Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards to control VOCs and fugitive dust emissions from construction/excavation activities with control measures.	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-9
SRSNE Superfund Site
Feasibility Study

Operations Area and Railroad Remedial Alternative Cost Estimate
Alternative OAR-3: Excavation and Off-Site Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Excavation Activities**				
1a	Mobilization/Demobilization	700	LS	$75	$52,500
1b	Site Preparation/Erosion Control Measures	1	LS	$25,000	$25,000
1c	Temporary Sprung Structure	1	LS	$500,000	$500,000
1d	Air Handling System	1	LS	$500,000	$500,000
1e	Excavation of Contaminated Soil	17,000	CY	$5	$85,000
1f	Staging and Loading Contaminated Soil	17,000	CY	$2	$34,000
1g	Transportation and Off-Site Disposal	21,250	TN	$290	$6,162,500
1h	Clean Fill, Backfill & Compaction	21,250	CY	$30	$637,500
1i	Well Abandonment	10	Well	$500	$5,000
1j	Well Abandonment IDW	7	CY	$75	$555
1k	Air Monitoring Program	1	LS	$250,000	$250,000
				Initial Capital Cost Subtotal:	$8,252,055
				Total Initial Capital Cost (rounded):	**$8,250,000**
B. Annual Operation and Maintenance Costs (30 year Present Worth)					
1	**Verification of Institutional Controls**	20	man hours	$115	$2,300
2	**Annual Report**	20	man hours	$115	$2,300
				Annual O&M Cost Subtotal:	$4,600
				Total Annual O&M Cost:	$5,000
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost (rounded):	**$60,000**

Table 4-9
SRSNE Superfund Site
Feasibility Study

Operations Area and Railroad Remedial Alternative Cost Estimate
Alternative OAR-3: Excavation and Off-Site Disposal

Description	Cost
Aggregate Present Worth of Total Cost:	$8,320,000
Remedial Design (8%)	$665,600
Project Administration/Management Cost (5%)	$416,000
Construction Management (6%)	$499,200
Scope Contingency (25%)	$2,080,000
Bid or Construction Contingency (15%):	$1,248,000
Subtotal	$13,228,800
Rounded To:	**$13,230,000**

Notes:

1. Excavation assumes 30% and Final Design, 2 acres avg 6' depth to mean high water table across Ops Area + 7,500 cu yds associated with the former railroad grade
2. IDW Volumes: .74 cubic yard per well
3. Site work cost include Clearing and Grubbing, and Site Prep, and erosion control measures.
4. Mobilization & Demobilization includes cost for equipment and field offices.
5. Staging & Loading of material includes on-site preparation for shipment of soils.
6. Transportation and Off-Site Disposal Costs assume transportation to Model City, NY, S/S pretreatment, and TSCA disposal.
7. Well Abandonment- 10 wells within the Operations Area will be abandoned prior to excavation.

8 LS - lump sum.

Table 4-10
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The baseline risk assessment concluded that unacceptable potential ecological risk related to material in the culvert outfall exists under the current scenario. Additionally, soil samples taken at isolated locations on the former Cianci property exceed CT RSR values for DEC and PMC. Because this alternative does not take any action to address these risks, this alternative would not provide any overall protection of human health or the environment. Furthermore, it would not comply with ARARs or achieve the cleanup objectives.

Table 4-10
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil and Sediment

Alternative CP-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-11**.

Table 4-10
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative would not actively address the potential human exposure and ecological risks associated with the contaminants present in the Cianci Property surficial and wetland soil. The No Action alternative would provide no exposure controls or management measures, and therefore, would not address future hypothetical risks. Because contaminants remain on site unaddressed under this alternative, the magnitude of the residual risk is very high. There are no controls in place to adequately and reliably address this contamination. Because this alternative results in contaminants remaining onsite above safe levels, a periodic review (i.e., every five years) would need to be conducted.

Table 4-10
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil and Sediment

Alternative CP-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	Under the No Action alternative, no actions would be taken to treat, recycle or destroy contaminants in the Cianci Property soil. Therefore, the alternative would not cause a reduction in contaminant toxicity, mobility, or volume, and would not actively reduce inherent hazards at the site.

Table 4-10
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	No remedial actions would be initiated under this alternative; therefore, there would be no short-term risks posed to the community or onsite workers during implementation. Short-term environmental impacts would be anticipated to be essentially the same risk currently identified in the ecological risk assessment. Because no action is being taken, protection will not be achieved at any time.

Table 4-10
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil and Sediment

Alternative CP-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	Because the No Action alternative does not require any activities to be taken, it is technically and administratively feasible and could be implemented at the site. This alternative would not require any specific permits to implement.

Table 4-10
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	No capital costs would be associated with the No Action alternative (**Table 4-12**). The present worth costs of conducting five-year reviews are included in the estimates of the annual operation and maintenance costs for the Overburden Groundwater alternatives (OGW).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-11
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Cianci Property Soil
Alternative CP-1: No Action

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	State of Connecticut	Remediation Standard Regulations for soil	CGS 22a-133k; RCSA 22a-133k-2	Applicable	These regulations establish direct exposure and pollutant mobility criteria for contaminated soils based on either industrial or residential use of the Site.	No action would be taken for soils/sediment that exceeds the levels set in these regulations; therefore alternative would fail to meet ARAR.	N
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-12
SRSNE Superfund Site
Feasibility Study

Cianci Property Remedial Alternatives Cost Estimate
Alternative CP-1: No Action

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
	No Initial Capital Costs				$0
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30 year Present Worth)					
	No O&M Costs				$0
				Annual O&M Cost Subtotal:	$0
				Project Administration/Management Cost	$0
				Annual O&M Cost Contingency	$0
				Total Annual O&M Cost:	$0
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost:	**$0**
				Aggregate Present Worth of Total Cost:	**$0**
				Rounded To:	**$0**

Note:

1. No action, five-year review costs included under Overburden Groundwater options.

Table 4-13
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The baseline risk assessment concluded that unacceptable potential ecological risk related to material in the culvert outfall exists under the current scenario. Additionally, soil samples taken at isolated locations on the former Cianci property exceed CT RSR values for DEC and PMC. This alternative would provide overall protection for the Cianci Property soil by eliminating the potential ecological risk associated with contaminated wetland soil at the culvert outfall by excavating this soil, replacing the existing culvert (a continuing source of contamination), and disposing of this material beneath a cap located on a different part of the property. The cap would need to be operated and maintained in order for this alternative to be protective in the long term. In addition, soil that exceed Connecticut RSRs would also be removed and isolated under a cap. This alternative would be designed and implemented to comply with ARARs.

Table 4-13
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-14**.

Table 4-13
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness by placing contaminated soil beneath a cap and putting institutional controls in place to prevent disruption of the cap. An analysis of the factors to be considered as part of this criterion follows: 1. This alternative leaves all untreated soil on site. This alternative would reduce the residual risk presented by this untreated soil by limiting potential future exposure to the soil on this portion of the property. In order for it to remain effective in the long-term, the condition and integrity of the cap would be inspected and maintained periodically. Any erosional damage or reduction in cap impermeability would need to be identified and addressed to ensure the long-term effectiveness of this alternative. 2. This alternative can reliably and adequately control exposure to contaminated soil as long as the cap is properly maintained and operated. A cap is a proven technology that has been used at a number of sites to prevent exposure to contaminated waste in the long term. Institutional controls would also be used to prevent disturbance of the cap. These controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in the contamination remaining onsite above acceptable levels, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-13
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	This alternative would not utilize active treatment or recycling processes to reduce the toxicity or volume of contaminants from a site wide prospective. However, it would reduce surface-water infiltration, thus reducing the mobility of contaminants in the soil and sediment. Replacing the existing culvert will eliminate it as a conduit for contaminated groundwater to reach surface water. The toxicity and volume of the contaminants would not be directly addressed by this alternative, although ongoing natural degradation processes would continue to reduce contaminant concentrations over time. An analysis of the factors to be considered as part of this criterion follows: 1. This alternative will not use active treatment or recycling processes. Mobility of contaminants will be reduced by the installation of the engineered control (i.e., low permeability cap). Natural degradation processes will continue to reduce contaminant concentrations over time. 2. No hazardous substances, pollutants or contaminants will be destroyed, treated, or recycled under this alternative; however natural degradation processes will continue to reduce contaminant concentrations over time. 3. The engineered control would not achieve concentration-based cleanup goals but would meet relevant state mandated design criteria by complying with the requirements of an engineered control. Contaminant mobility would be significantly reduced through the elimination of surface-water infiltration through the Cianci property soil. 4. This alternative will not use active treatment processes. Natural degradation processes will continue to reduce contaminant concentrations over time; the destruction of contaminants through the natural degradation processes would be irreversible. 5. This alternative will not use active treatment processes; treatment residuals would not remain at the site. 6. This alternative will not use active treatment to address contaminated soil at the site. This alternative does however control exposure to contamination that presents a risk.

Table 4-13
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Culvert removal and replacement, as well as soil excavation would be conducted in a manner which minimizes disturbance to the area. Potential short-term risks to the community would include the emissions of VOCs and fugitive dust to the atmosphere during removal of the culvert and surface. However, this potential exposure would be addressed by the use of various construction techniques such as dust suppression and reducing the size of the excavation area and perimeter air monitoring. 2. Potential short-term impacts to workers may be associated with the emissions of VOCs and fugitive dust to the atmosphere during removal of the culvert and surface soil. However, this potential exposure would be addressed by the use of PPE and compliance with a site-specific HASP. 3. Because the culvert outfall is located in a wetland area, action needs to be taken to minimize impacts to this resource in accordance with federal and state law. These impacts would be temporary in nature (probably less than one to two months in duration) and would be mitigated by the restoration of the areas upon completion. 4. Long-term protection would be achieved after this alternative has been constructed. Design and construction is expected to take 3-4 years during which time institutional controls would be put in place.

Table 4-13
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Excavation and capping are proven and reliable technologies that would be technically feasible. This alternative will need to be implemented in accordance with both state and federal wetlands requirements but this does not affect the technical implementability of this alternative. 2. There are no administrative impediments to constructing this alternative. 3. Services, equipment and materials required to conduct an excavation and capping alternative are expected to be readily available.

Table 4-13
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The capital costs associated with this alternative include the remedial design and construction costs for removal and replacement of the existing culvert, capping, excavation of soil, onsite disposal of soil and sediment and site restoration. The estimated present worth costs of this alternative is $310,000 (**Table 4-15**), based on a 30-year operation and maintenance period.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-14
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Cianci Property Soil
Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal[1]

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	State of Connecticut	Remediation Standard Regulations for soil	CGS 22a-133k; RCSA 22a-133k-2	Applicable	These regulations establish direct exposure and pollutant mobility criteria for contaminated soils based on either industrial or residential use of the Site.	These regulations would be used to determine the cleanup levels for soil/sediment. Contaminated soil/sediment exceeding PMC or DEC values would be excavated.	Y
Location-Specific	Federal	Fish and Wildlife Coordination Act	16 U.S.C. 661	Applicable	This order protects fish and wildlife when federal actions result in control or structural modification of a natural stream or body of water.	Appropriate agencies would be consulted should remedial action involve modification to a waterway.	Y
		Clean Water Act (CWA)-Discharge to Waters of the United States, Section 404	33 USC 1344; 40 CFR Part 230 and 33 CFR Parts 320-323	Applicable	These rules regulate the discharge of dredge and fill materials in wetlands and navigable waters. Such discharges are not allowed if practicable alternatives are available.	There is no practical alternative to address contaminated sediment and relocation of the culvert in the wetlands. Measures will be taken to minimize impacts.	Y
	State of Connecticut	Surface Water and Wetlands, Inland Wetlands and Watercourses Act	CGS 22a-36 through 45	Applicable	This rule regulates any activities within or affecting inland wetlands involving removal or deposition of material or any obstruction, construction, alteration or pollution of such wetlands.	Would meet requirements for removal or deposition of material or any obstruction, construction, alteration or pollution of wetlands.	Y
Action-Specific	Federal	Toxic Substances Control Act	15 USC 2601, 40 CFR 761	Applicable	Soil containing PCBs>50 ppm is regulated under this Act.	Should PCBs be encountered during excavation/consolidation they will be addressed in accordance with these requirements.	Y

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[1] ARARs associated with placing contaminated soil and sediment under Operations Area cap are included in Table 4-3

Table 4-14 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Cianci Property Soil
Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific (cont)	State of Connecticut	Hazardous Waste Management: Land Disposal Restrictions and Corrective Action Management Units	CGS 22a ch 445 RCSA §22a-449(c) – 108, -104	Relevant and Appropriate	These regulations establish treatment standards for placement/disposal of hazardous waste.	Contaminated soil/sediment would be excavated and disposed of on-site by placing it in the Operations Area beneath the cap. All excavated soil/sediment would be evaluated prior to placement beneath the cap to ensure compliance with LDR. Soil/sediment requiring further treatment would be managed in accordance with requirements of these regulations.	Y
		Hazardous Waste Management	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Relevant and Appropriate	These regulations establish standards for treatment, storage and disposal of hazardous waste, remediation waste treatment, storage and disposal, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities.	Soil and sediment would be handled in accordance with these requirements.	Y
		Disposition of PCBs	CGS 22a-467	Relevant and Appropriate	This regulation establishes prohibitions of, and requirements for the disposal, storage, and marking of PCBs and PCB waste. The standard requires the handling of PCB waste to be consistent with the Toxic Substances Control Act (TSCA) listed at 40 CFR 761.	Sampling data indicates that levels of PCBs are low and would not trigger these requirements. Should these levels be exceeded during the cleanup, PCBs will be managed in accordance with these requirements.	Y
		Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures are required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards to control fugitive dust from excavation/construction activities with dust control measures.	Y

Table 4-14 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Cianci Property Soil
Alternative CP-2: Culvert Removal and Excavation with Onsite Disposal

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific (cont)	State of Connecticut (cont)	Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted NAPL/groundwater that may be collected during dewatering that is discharged to surface water would be treated to meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
To Be Considered	Federal	Floodplain Management Executive Order	E.O. 11988	Relevant and Appropriate	Federal agencies are required to avoid any action in floodplains if there is a practicable alternative.	There is no practical alternative to address contaminated sediment and the location of the culvert in the floodplain. Measures will be taken to minimize impacts.	Y
		Protection of Wetlands Executive Order	E.O. 11990	Relevant and Appropriate	Federal agencies are required to avoid construction in wetlands if there is a practicable alternative.	There is no practical alternative to address contaminated sediment and the location of the culvert in the wetlands. Measures will be taken to minimize impacts.	Y
	Connecticut Guidance	Connecticut Guidance for Soil Erosion and Sediment Control	CT Council on Soil and Water Conservation	TBC	This document includes guidance for development, adoption and implementation of erosion and sediment control program.	These guidelines would be considered during excavation activities to protect wetland and aquatic resources.	Y

Table 4-15
SRSNE Superfund Site
Feasibility Study

Cianci Property Remedial Alternatives
Alternative CP-2 - Culvert Removal and Excavation with On-Site Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Mobilization/Demobilization**	1	LS	$10,000	$10,000
2	**Access Area Development**	1	LS	$20,000	$20,000
3	**Site Preparation/Erosion Control Measures**	1	LS	$5,000	$5,000
4	**Pipe Removal/Drainage Swale Construction**				
4a	Flowable Fill (RR Culvert)	6	CY	$50	$275
4b	Pipe Excavation	300	LF	$15	$4,500
4c	Soil Removal	20	CY	$12	$240
4d	General Backfill	150	CY	$30	$4,500
4e	Pipe Installation Underneath RR Tracks	30	LF	$100	$3,000
4f	Drainage Swale Excavation	293	CY	$12	$3,516
5	**Culvert Outfall Remediation**				
5a	Sediment Excavation	500	CY	$12	$6,000
5b	Stabilization Agent	167	TN	$60	$10,020
5c	Material Handling	500	CY	$6	$3,000
5d	Special Fill	278	CY	$20	$5,560
5e	On-site Disposal	500	CY	$10	$5,000
5f	Replacement Culvert Installation (36" HDPE)	350	LF	$75	$26,250
6	**Cianci Property Soils**				
6a	Soil Excavation	400	CY	$12	$4,800
6b	General Backfill	400	CY	$15	$6,000
6c	On-site Disposal	400	CY	$10	$4,000
7	**Restoration/Revegetation of Access Areas**	1	LS	$15,000	$15,000
8	**Revegetation of Excavated Areas**	1	LS	$25,000	$25,000
				Initial Capital Cost Subtotal:	$161,661
				Rounded To:	**$160,000**

Table 4-15
SRSNE Superfund Site
Feasibility Study

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Cianci Property Remedial Alternatives
Alternative CP-2 - Culvert Removal and Excavation with On-Site Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30 year Present Worth)					
1	No O&M Costs	1	LS	$0	$0
				Annual O&M Cost Subtotal:	$0
				Total Annual O&M Cost:	$0
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost:	**$0**

Description	Cost
Aggregate Present Worth of Total Cost:	$180,000
Remedial Design (15%)	$27,000
Project Administration/Management Cost (8%)	$14,400
Construction Management (10%)	$18,000
Scope Contingency (25%)	$45,000
Bid or Construction Contingency (15%):	$27,000
Subtotal	$311,400
Rounded To:	**$310,000**

Table 4-15
SRSNE Superfund Site
Feasibility Study

Cianci Property Remedial Alternatives
Alternative CP-2 - Culvert Removal and Excavation with On-Site Disposal

Notes:

1. Remedial design includes engineering of replacement pipe to handle additional run-off from capped area
2. Mobilization/demobilization is taken as a lump sum based on project size.
3. Access area development includes clearing and preparation of an equipment staging/handling area and the construction of temporary gravel access roads.
4. Site preparation/erosion control costs include the installation and maintenance of silt fences and/or straw bales around the perimeter of the site, and the installation of silt containment systems downstream of active remediation areas.
5. Pipe removal and drainage swale construction costs include: (a) excavation of the existing 30" diameter drainage pipe, plugging of RR culvert; (b) the installation of a new section of 30" pipe to transmit storm water underneath the existing railroad tracks.
6. Culvert outfall remediation costs are based on the removal of the top foot of sediment over a 140 by 100 foot area centered around sediment sample SD3-36. Costs assume materials would be handled and stabilized to pass the paint filter test for disposal. Approximately 6 inches of special fill material, indicative of wetlands soils, would be placed over the excavated area prior to restoration.
7. Excavation of Cianci soils assumes the removal of soil in 4 isolated areas to a depth of one foot (and to a depth of 2 ft at SB-905). Following excavation, clean fill materials will be placed to match the existing grade.
8. Restoration and revegetation of access areas includes removal and disposal of gravel, replacement of excavated stockpiled fill, followed by topsoil and vegetation.
9. Revegetation of excavated areas includes hydro seeding, and the placement of revegetation matting (i.e., jute mat) at the culvert outfall, the drainage ditch, and in the newly constructed drainage swale.

Table 4-16
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	This alternative would provide overall protection of human health and the environment by removing contaminated soil from the site. Alternative CP-3 would offer slightly greater overall protectiveness than CP-2 in that it permanently removes the soil from the site. It would have slightly higher short-term impacts as this alternative requires contaminated soil be taken off site by truck through the community. The additional impact would be slight because this would be a relatively small excavation and disposal project. This alternative would be expected to achieve the cleanup objectives for the Cianci Property soil and sediment and would be conducted in accordance with ARARs.

Table 4-16
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	This alternative would comply with ARARs in the same manner as that described for Alternative CP-2. These are summarized on **Table 4-17**.

Table 4-16
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative would provide long term effectiveness and permanence by permanently removing contaminated soil from the site. An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would be an effective and permanent means to address potential risks associated with Cianci Property soil. No residual risk would remain from untreated waste or treatment residuals. 2. No untreated waste or treatment residuals would remain under this alternative. As all waste that exceeds unacceptable levels is removed from the site, there are no additional controls put in place to manage treatment residuals or untreated waste.

Table 4-16
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	This alternative would reduce toxicity, mobility or volume although not by treatment. Rather than onsite disposal of excavated soil (Alternative CP-2), all materials would be disposed of offsite in a licensed commercial landfill facility. No residuals remain on site under this alternative.

Table 4-16
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would have short-term effectiveness similar to that of Alternative CP-2, although slightly higher short-term risk to the community may occur due to the need to transport approximately 50 truck loads of contaminated materials to an offsite disposal facility via existing public roadways. This risk would be minor when compared to the total number of trucks that routinely utilize the roadway system in the town, and would be of limited duration (less than approximately 10 days). 2. Potential short-term impacts to workers may be associated with the emissions of VOCs and fugitive dust to the atmosphere during removal of the culvert and surface soil. However, this potential exposure would be addressed by the use of PPE and compliance with a site-specific HASP. 3. Because the culvert outfall is located in a wetland area, action needs to be taken to minimize impacts to this resource in accordance with federal and state law. These impacts would be temporary in nature (probably less than one to two months in duration) and would be mitigated by the restoration of the areas upon completion. 4. Long term protection will be achieved after design and construction of this alternative which is expected to take 3-4 years.

Table 4-16
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Excavation and off-site disposal are proven and reliable technologies that would be technically feasible. This alternative will need to be implemented in accordance with both state and federal wetlands requirements but this does not affect the technical implementability of this alternative. 2. There are no administrative impediments to constructing this alternative. 3. Services, equipment and materials required to conduct an excavation and off-site disposal alternative are expected to be readily available.

Table 4-16
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Cianci Property Soil

Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The capital costs associated with this alternative include the remedial design and construction costs for removal and replacement of the existing culvert, excavation of surficial and wetland soil, offsite disposal of soil and site restoration. The estimated present worth costs of this alternative is $730,000 (**Table 4-18**), based on a 30-year operation and maintenance period. The cost of this alternative is approximately twice that of CP-2.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state's comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-17
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Cianci Property Soil
Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	State of Connecticut	Remediation Standard Regulations for soil	CGS 22a-133k; RCSA 22a-133k-2	Applicable	These regulations establish direct exposure and pollutant mobility criteria for contaminated soils based on either industrial or residential use of the Site.	These regulations would be used to determine the cleanup levels for soil/sediment. Contaminated soil/sediment exceeding PMC and /or DEC values would be excavated.	Y
Location-Specific	Federal	Fish and Wildlife Coordination Act	16 U.S.C. 661	Applicable	This order protects fish and wildlife when federal actions result in control or structural modification of a natural stream or body of water.	Appropriate agencies would be consulted should remedial action involve modification to a waterway.	Y
		Clean Water Act (CWA)-Discharge to Waters of the United States, Section 404	33 USC 1344; 40 CFR Part 230 and 33 CFR Parts 320-323	Applicable	These rules regulate the discharge of dredge and fill materials in wetlands and navigable waters. Such discharges are not allowed if practicable alternatives are available.	There is no practical alternative to address contaminated sediment and location of the culvert in the wetlands. Measures will be taken to minimize impacts	Y
	State of Connecticut	Surface Water and Wetlands, Inland Wetlands and Watercourses Act	CGS 22a-36 through 45	Relevant and Appropriate	This rule regulates any activities within or affecting inland wetlands involving removal or deposition of material or any obstruction, construction, alteration or pollution of such wetlands.	Would meet requirements for removal or deposition of material or any obstruction, construction, alteration or pollution of wetlands.	Y
Action-Specific	State of Connecticut	Hazardous Waste Management Regulations	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Relevant and Appropriate	These regulations include general facility standards, requirements for emergency procedures and temporary storage requirements for hazardous waste facilities.	Soil and sediment which is excavated and/or temporarily stored on-site as part of this alternative would be managed in accordance with these requirements.	Y
		Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures are required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards to control fugitive dust from excavation activities.	Y

Table 4-17 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Cianci Property Soil
Alternative CP-3: Culvert Removal and Excavation with Offsite Disposal

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific (cont)	State of Connecticut (cont)	Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted NAPL/groundwater that may be collected during dewatering that is discharged to surface water would be treated to meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
To Be Considered	Federal	Floodplain Management Executive Order	E.O. 11988	Relevant and Appropriate	Federal agencies are required to avoid any action in floodplains if there is a practicable alternative.	There is no practical alternative to address contaminated sediment and the location of the culvert in. the floodplain. Measures will be taken to minimize impacts	Y
		Protection of Wetlands Executive Order	E.O. 11990	Relevant and Appropriate	Federal agencies are required to avoid construction in wetlands if there is a practicable alternative.	There is no practical alternative to address contaminated sediment and the location of the culvert in the wetlands. Measures will be taken to minimize impacts	Y
	Connecticut Guidance	Connecticut Guidance for Soil Erosion and Sediment Control	CT Council on Soil and Water Conservation	TBC	This document includes guidance for development, adoption and implementation of erosion and sediment control program.	These guidelines will be considered during excavation activities to protect wetland and aquatic resources.	Y

Table 4-18
SRSNE Superfund Site
Feasibility Study

Cianci Property Remedial Alternatives Costs Estimate
Alternative CP-3: Culvert Removal and Excavation with Off-Site Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Mobilization/Demobilization**	1	LS	$10,000	$10,000
2	**Access Area Development**	1	LS	$20,000	$20,000
3	**Site Preparation/Erosion Control Measures**	1	LS	$5,000	$5,000
4	**Pipe Removal/Drainage Swale Construction**				
4a	Flowable Fill (RR Culvert)	6	CY	$50	$275
4b	Pipe Excavation	300	LF	$15	$4,500
4c	Soil Removal	20	CY	$12	$240
4d	General Backfill	150	CY	$30	$4,500
4e	Pipe Installation Underneath RR Tracks	30	LF	$100	$3,000
4f	Drainage Swale Excavation	293	CY	$12	$3,516
5	**Culvert Outfall Remediation**				
5a	Sediment Excavation	500	CY	$12	$6,000
5b	Stabilization Agent	167	TN	$60	$10,020
5c	Material Handling	500	CY	$6	$3,000
5d	Special Fill	278	CY	$20	$5,560
5e	Off-site Disposal	1,183	TN	$140	$165,655
5f	Replacement Culvert Installation (36" HDPE)	350	LF	$75	$26,250
6	**Cianci Property Soils**				
6a	Soil Excavation	400	CY	$12	$4,800
6b	General Backfill	400	CY	$15	$6,000
6c	Off-site Disposal	600	TN	$140	$84,000
7	**Restoration/Revegetation of Access Areas**	1	LS	$15,000	$15,000
8	**Revegetation of Excavated Areas**	1	LS	$25,000	$25,000
				Initial Capital Cost Subtotal:	$402,316
				Total Initial Capital Cost (rounded):	**$400,000**

Table 4-18
SRSNE Superfund Site
Feasibility Study

Cianci Property Remedial Alternatives Costs Estimate
Alternative CP-3: Culvert Removal and Excavation with Off-Site Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30 year Present Worth)					
1	No O&M Costs	1	LS	$0	$0
				Annual O&M Cost Subtotal:	$0
				Total Annual O&M Cost:	$0
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost:	**$0**

Description	Cost
Aggregate Present Worth of Total Cost:	$420,000
Remedial Design (15%)	$63,000
Project Administration/Management Cost (8%)	$33,600
Construction Management (10%)	$42,000
Scope Contingency (25%)	$105,000
Bid or Construction Contingency (15%):	$63,000
Subtotal	$726,600
Rounded To:	**$730,000**

Table 4-18
SRSNE Superfund Site
Feasibility Study

Cianci Property Remedial Alternatives Costs Estimate
Alternative CP-3: Culvert Removal and Excavation with Off-Site Disposal

Notes:

1. Remedial design includes engineering of replacement pipe to handle additional run-off from capped area
2. Mobilization/demobilization is taken as a lump sum based on project size.
3. Access area development includes clearing and preparation of an equipment staging/handling area and the construction of temporary gravel access roads.
4. Site preparation/erosion control costs include the installation and maintenance of silt fences and/or straw bales around the perimeter of the site, and the installation of silt containment systems downstream of active remediation areas.
5. Pipe removal and drainage swale construction costs include: (a) excavation of the existing 30" diameter drainage pipe, plugging of RR culvert; (b) the installation of a new section of 30" pipe to transmit storm water underneath the existing railroad tracks.
6. Culvert outfall remediation costs are based on the removal of the top foot of sediment over a 140 by 100 foot area centered around sediment sample SD3-36. Costs assume materials would be handled and stabilized to pass the paint filter test for disposal. Approximately 6 inches of special fill material, indicative of wetlands soils, would be placed over the excavated area prior to restoration.
7. Excavation of Cianci soils assumes the removal of soil in 4 isolated areas to a depth of one foot (and to a depth of 2 ft at SB-905). Following excavation, clean fill materials will be placed to match the existing grade.
8. Restoration and revegetation of access areas includes removal and disposal of gravel, replacement of excavated stockpiled fill, followed by topsoil and vegetation.
9. Revegetation of excavated areas includes hydroseeding, and the placement of revegetation matting (i.e., jute mat) at the culvert outfall, the drainage ditch, and in the newly constructed drainage swale.

Table 4-19
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The overburden NAPL area does not present a risk in the short term as there is no current exposure to NAPL or groundwater in this area of the site. Because this alternative does not require any action to be taken to address the risks from the Overburden NAPL Area, it does not provide overall protection of human health and the environment in the long term as waste material is neither eliminated, reduced nor controlled. This alternative does not meet ARARs or cleanup objectives established for this area of the site.

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-20**.

Table 4-19
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	Because the No Action alternative would not require any action to be taken, this alternative neither provides long term effectiveness nor permanence. The magnitude of the residual risk is high as previous estimates have suggested that the Overburden NAPL Area would act as an ongoing source of groundwater contaminants for hundreds of years. Because there are no actions taken under this alternative, there are no controls in place to assess their adequacy or reliability.

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	This alternative does not provide treatment for the reduction of the toxicity, mobility, and volume of contaminants in this area of the site. However, over time natural attenuation processes will very very slowly reduce the toxicity and volume of contaminants. However, absent any monitoring or other activities to assess the progress of these processes, this reduction could not be documented.

Table 4-19
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	No remedial actions would be required under this alternative; therefore no short-term risks would be posed to the community or onsite workers during implementation. There would also be no short-term environmental impacts associated with this alternative. Because no action is being taken to address the risk this area of the site presents, and no monitoring is being done to evaluate naturally-occurring degradation, time to achieve protection is unknown. However, it would take an estimated 400 to 500 years to remove virtually all (99%) of the NAPL at current assumed degradation rates. Additional time would be needed to reach cleanup levels.

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	The No action alternative would be technically and administratively feasible.

Table 4-19
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	No capital costs would be associated with the No Action alternative (**Table 4-21**). The present worth costs of conducting five-year reviews are included in the estimates of the annual operation and maintenance costs for the Overburden Groundwater alternatives (OGW).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state's comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-20
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-1: No Action

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Since no action is being taken, this alternative does not meet these federal requirements.	N
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Relevant and Appropriate	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Since no action is being taken, this alternative does not meet these state requirements.	N
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-21
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-1: No Action

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	No Initial Capital Costs				$0
B. Recurring Capital Costs					
1	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30 year Present Worth)					
1	No O&M Costs				$0
				Annual O&M Cost Subtotal:	$0
				Project Administration/Management Cost	$0
				Annual O&M Cost Contingency	$0
				Total Annual O&M Cost:	$0
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost:	**$0**
				Aggregate Present Worth of Total Cost:	**$0**
				Rounded To:	**$0**

Notes:

1. No action, five-year review costs included under Overburden Groundwater options.

Table 4-22
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-2 – Hydraulic Displacement and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The overburden NAPL area does not present a risk in the short term as there is no current exposure to this area of the site. This alternative provides overall protection of human health and the environment in the long term by permanently reducing the mass of NAPL by up to 44% through treatment. NAPL will remain in small pools and as residual. However, this material will not be mobile under foreseeable site conditions. Through monitored natural attenuation (MNA), this residual would degrade over time through natural processes, resulting in removal of the remaining VOCs. MNA would shorten the time frame that groundwater standards are exceeded, and in doing so would shrink the size of the overburden groundwater contaminant plume and reduce groundwater contaminant concentrations. Downward migration of NAPL into bedrock during implementation would be minimized by phasing implementation. Groundwater MNA analysis would be used to evaluate long-term performance. NAPL production rates and pre- and post-treatment soil sampling would be used to evaluate performance of the hydraulic placement portion of the remedy. Moderate short-term risks and potential impacts on workers and the community would be addressed by employing typical construction, transportation, and treatment system operation safety measures. In addition, the alternative would be designed to comply with ARARs.

Table 4-22
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-2 – Hydraulic Displacement and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C)	A detailed evaluation of ARARs for this alternative is provided in **Table 4-23**.

Table 4-22
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-2 – Hydraulic Displacement and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness and permanence by treating contaminants in this area of the site with hydraulic displacement and MNA. An analysis of the factors to be considered as part of this criterion follows: 1. Upon completion of the hydraulic displacement component of this alternative, up to 44% of contaminate mass in this area of the site will have been permanently removed through treatment. The remaining contamination will be converted to the more readily treated residual phase. The MNA component would complete the destruction of the residual NAPL over time. The magnitude of remaining risks would be reduced by up to 44% in the short term, with the remaining risk being addressed through MNA of the remaining residual. 2. Because it will be some time before safe levels are achieved, institutional controls would be required under this alternative to prevent exposure to untreated wastes. This alternative can reliably and adequately control exposure to contamination in the overburden NAPL area by use of institutional controls. These controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminant remaining on-site for some period of time above safe levels, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-22
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-2 – Hydraulic Displacement and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in the permanent reduction of toxicity, mobility and volume through treatment in this area of the site. The hydraulic displacement phase would remove pooled contaminants from this area of the site with MNA addressing the remaining contamination over time. 2. The hydraulic displacement component of this alternative would result in the removal and treatment of an estimated 44% of the initial NAPL mass within this area of the site. The MNA component of this alternative would address the remaining contaminants through naturally-occurring processes. In the short term, PCBs and metals may remain at levels above ARARs after treatment. However, their concentrations are expected to meet cleanup levels in the long term as the solubility of PCBs (which are co-located with the NAPL) decreases, and, metals stabilize with the removal of solvents from the subsurface. 3. The removal of pooled NAPL during the hydraulic displacement phase will reduce the mobility of contaminants under foreseeable changes to future site conditions, and the treatment of the removed NAPL and NAPL-water mixture will result in the reduction of toxicity and volume of contaminants. In addition, the MNA component of this alternative would result in eventual further removal through degradation of NAPL contaminants over time. 4. The treatment or degradation of NAPL constituents would be permanent and irreversible. 5. The removal of pooled NAPL will eliminate its potential for mobilization. Following the hydraulic displacement component of this alternative, the remaining treatment residuals within the Overburden NAPL Area will comprise NAPL in residual form with some small pools. The MNA component of this alternative would result in the in-situ destruction of the remaining contaminants through naturally-occurring processes over time. 6. The hydraulic displacement component of this alternative would eliminate the principal threat associated with NAPL by removing up to 44% of the contamination which exists in this area in pools and converting most of the remaining NAPL to residual form for further treatment through MNA.

Table 4-22
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-2 – Hydraulic Displacement and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in modest potential short-term risks to the community during implementation of the hydraulic displacement component that would have to be addressed. Above-ground treatment of the extracted NAPL and NAPL-water mixture could potentially result in the emission of VOCs to the atmosphere. This potential risk would be addressed through the use of appropriate vapor phase controls during treatment. 2. Potential exposure of onsite workers to NAPL and the groundwater/NAPL mixture could occur during implementation of this alternative, and hazards inherent in well installation and treatment system construction would be present. These potential risks would be addressed by the use of PPE and compliance with a site-specific HASP, and by employing typical construction and treatment system operation safety measures. 3. There are no environmental impacts on-site from this alternative. 4. Significant reduction of NAPL mobility would be achieved at the completion of the hydraulic displacement component of this alternative. Up to 44% of the mass will be removed at the completion of the hydraulic displacement component of this alternative. Further reductions in NAPL mass would be accomplished over the longer term through the implementation of the MNA component. It would take an estimated 300 to 400 years to remove virtually all (99%) of the NAPL at current assumed degradation rates. Additional time would be needed to reach cleanup levels.

Table 4-22
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-2 – Hydraulic Displacement and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Hydraulic displacement is a reliable and feasible technology that can be viewed as a form of enhanced pump-and-treat. It would require subsurface drilling and installation of extraction and injection wells or trenches and associated piping, modifications to the existing treatment system, and transport of untreated NAPL to an off-site disposal facility. There is considerable experience at the SRSNE site regarding the installation and use of groundwater extraction wells and operation of pumping and treatment systems. There is little experience, however, using hydraulic displacement to address a NAPL site of this magnitude. The risk of mobilizing NAPL pools downward can be minimized by phasing implementation. MNA has been applied at full scale, and is a proven and reliable technology for the in-situ destruction of organic contaminants. Based on studies previously completed at the site, it has been shown to be a viable and technically feasible technology. 2. This alternative would be administratively feasible. A modification to the existing NPDES discharge requirements for NTCRA 1 may be needed although this would not be expected to be problematic. Substantive requirements for injecting treated water into the subsurface would also have to be met. 3. This alternative could be implemented using available services, materials and equipment. There are a large number of potential contractors from which to obtain competitive pricing.

Table 4-22
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-2 – Hydraulic Displacement and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The costs associated with this alternative include the remedial design and construction costs for installation and operation of the hydraulic displacement well network and the temporary treatment system, and ongoing operation of the NTCRA containment and treatment system during the period of design, construction and operation of the ONOGU remedy. The estimated present worth costs of this alternative is $6,190,000 (**Table 4-24**).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-23
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-2: Hydraulic Displacement and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through treatment of groundwater/NAPL followed by natural attenuation.	Y
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through treatment of groundwater/NAPL followed by natural attenuation. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	TBC, Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	To be complied with through OAR alternative and institutional controls in the interim.	Y
Location-Specific		None apply.					

Table 4-23 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-2: Hydraulic Displacement and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific	State of Connecticut	Hazardous Waste Management Regulations	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Applicable	These regulations establish standards for treatment, storage and disposal of hazardous waste and remediation waste, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities.	Treatment residues (spent filtration residue and activated carbon) could contain high concentrations of regulated constituents. If determined to be hazardous waste, will be stored on site consistent with these requirements before being shipped offsite for disposal. Extracted NAPL will be stored in accordance with these requirements before being shipped offsite for disposal. Groundwater will be monitored.	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted NAPL/groundwater that is discharged to surface water would be treated to meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water and groundwater.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
		Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures are required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards, requirements for pollution abatement, and requirements to control fugitive dust from construction activities with dust control measures.	Y

Table 4-23 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-2: Hydraulic Displacement and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-24
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-2: Hydraulic Displacement and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
A. Initial Capital Costs							
1	**Hydraulic Displacement Design and Construction**						
1a	Mobilization and Demobilization	325	man hours	$75	$24,375	$24,375	$24,375
1b	Temporary Treatment Structure	1	LS	$310,000	$310,000	$310,000	$310,000
1c	Fencing/Temporary Access Restrictions	1	LS	$8,600	$8,600	$8,600	$8,600
1d	Site Work	1	LS	$21,500	$21,500	$21,500	$21,500
1e	Groundwater Injection/Extraction Trench System	1	LS	$750,000	$750,000	$750,000	$750,000
1f	IDW Disposal	3,300	CY	$75	$247,500	$247,500	$247,500
1g	Groundwater Injection/Extraction System Equipment	1	LS	$250,000	$250,000	$250,000	$250,000
1h	DNAPL Pretreatment	1	LS	$260,000	$260,000	$260,000	$260,000
1i	Metals Treatment	1	LS	$255,000	$255,000	$255,000	$255,000
1j	Primary VOC Treatment	1	LS	$260,000	$260,000	$260,000	$260,000
1k	Polishing	1	LS	$210,000	$210,000	$210,000	$210,000
1l	Effluent	1	LS	$70,000	$70,000	$70,000	$70,000
1m	IDW Disposal	215	CY	$75	$16,125	$16,125	$16,125
1n	NTCRA 1/2 Integration	1	LS	$60,000	$60,000	$60,000	$60,000
1o	O&M Plan	1	LS	$25,000	$25,000	$25,000	$25,000
1p	Pre- and Post-Treatment Sampling and Analysis	1	LS	$250,000	$250,000	$250,000	$250,000
2	**Decomissioning**						
2a	Well Abandonment	10	well	$500	$5,000	$5,000	$5,000
2b	IDW Disposal	7	CY	$75	$555	$555	$555
2c	Deconstruction and Demobilization of Equipment	1	LS	$100,000	$100,000	$100,000	$100,000
	Initial Capital Cost Subtotal:				$3,123,655	$3,123,655	$3,123,655
	Total Initial Capital Cost (rounded):				**$3,120,000**	**$3,120,000**	**$3,120,000**

Table 4-24
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-2: Hydraulic Displacement and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
B. Hydraulic Displacement Operating Cost - 180 days							
1	**System Operation and Maintenance**	2,160	man hours	$75	$162,000	$162,000	$162,000
2	**System utilities**						
2a	Electric	500,000	KW hours	$0.11	$55,000	$55,000	$55,000
2b	Gas	45,000	Therm (100	$0.60	$27,000	$27,000	$27,000
2c	Potable Water	175,000	gallons	$0.03	$5,250	$5,250	$5,250
3	**System Chemicals**						
3a	Caustic Soda	120,000	kg	$0.44	$52,800	$52,800	$52,800
3b	Polymer	30	gal	$60	$1,800	$1,800	$1,800
3c	Sulfuric Acid	2,300	kg	$0.45	$1,035	$1,035	$1,035
3d	Coagulant Aid (Aluminum Chlorhydrate)	900	gal	$10	$9,000	$9,000	$9,000
4	**Disposal Costs**						
4a	DNAPL - Bulk Disposal	101,200	kg	$2.10	$212,520	$425,040	$850,080
4b	PCB - Sludge Disposal - Drums	75	ea	$600	$45,000	$45,000	$45,000
4c	Non-PCB Sludge Disposal - Drums	50	ea	$200	$10,000	$10,000	$10,000
4d	PPE Disposal - Drums PCB Contaminated	25	ea	$350	$8,750	$8,750	$8,750
5	**Laboratory Analysis**	132	ea	$470	$62,040	$62,040	$62,040
				Water TreatmentO&M Cost Subtotal:	$435,195	$647,715	$1,072,755
				Total Operating Capital Cost (rounded):	**$440,000**	**$650,000**	**$1,070,000**

Table 4-24
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-2: Hydraulic Displacement and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
C. Monitoring Costs (5 Years of Monitoring, 10 wells, twice per year, VOCs + MNA parameters)							
1	**Compliance Monitoring**	100	man hours	$95	$9,500	$9,500	$9,500
2	**Analytical**	24	analysis	$500	$12,000	$12,000	$12,000
3	**Equipment**	20	each	$125	$2,500	$2,500	$2,500
				Subtotal Annual O&M Cost:	$24,000	$24,000	$24,000
				Total Annual O&M Cost:	$24,000	$24,000	$24,000
				Present Worth Factor (5 years, no discount):	5	5	5
				Total Present Worth of Annual O&M Cost (rounded):	**$120,000**	**$120,000**	**$120,000**

Description	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
Aggregate Present Worth of Total Cost:	**$3,680,000**	**$3,890,000**	**$4,310,000**
Remedial Design (8%)	$294,400	$311,200	$344,800
Project Administration/Management Cost (5%)	$184,000	$194,500	$215,500
Construction Management (6%)	$220,800	$233,400	$258,600
Scope Contingency (25%)	$920,000	$972,500	$1,077,500
Bid or Construction Contingency (15%):	$552,000	$583,500	$646,500
Subtotal	$5,851,200	$6,185,100	$6,852,900
Rounded To:	**$5,850,000**	**$6,190,000**	**$6,850,000**

Table 4-24
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-2: Hydraulic Displacement and MNA

Notes:

1 Hydraulic Displacement assumes 100% design only.

2. Cost for HD Treatment building assume a temporary structure, utility installation, plant control system, and building foundation

3. Site work cost include Clearing and Grubbing, and Site Prep, and Well Access Roads

4. Groundwater Injection & Extraction System costs include trench installation, Well Equipment, instrumentation, process controls, mechanical & electrical installation, heat trace, and development

5. Hydraulic Displacement DNAPL Pretreatment consist of NAPL Phase Separation Tanks

6. Hydraulic Displacement Primary VOC treatment consist of Air Stripping, Catalytic Oxidation, and HCL

7. Hydraulic Displacement Polishing Treatment consist of Photo Catalytic Oxidation

8. Well Abandonment- 10 wells within the Operations Area will be abandoned prior to the installation of the HD wells.

9. Costs for NTCRA O&M are based on past project experience

10. IDW Volumes: .74 cubic yard per well

11. LS - lump sum

12. Long-term monitoring includes labor and materials for semi-annual monitoring of ONOGU ground-water quality utilizing a subset of the existing on-site ground-water monitoring well network. This assumes that 10 wells will sampled semi-annually for VOCs and MNA parameters.

Table 4-25
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-3 – Hydraulic Displacement and Enhanced Bioremediation

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The overburden NAPL area does not present a risk in the short term as there is no current exposure to this area of the site. This alternative provides overall protection of human health and the environment in the long term by permanently reducing the mass of NAPL by up to 44% through treatment. NAPL will remain in small pools and as residual, this material will not be mobile under foreseeable site conditions. This residual would degrade over time, resulting in removal of the remaining VOCs. Enhanced bioremediation (EISB) would shorten the time frame that groundwater standards are exceeded when compared to the MNA component described in the previous alternative, and in doing so would shrink the size of the overburden groundwater contaminant plume and reduce groundwater contaminant concentrations. Downward migration of NAPL into bedrock would be minimized by phasing implementation. EISB performance would be monitored though review of vegetable oil usage and monitoring MNA parameters. NAPL production rates and pre- and post-treatment soil sampling would be used to evaluate performance of the hydraulic displacement portion of the remedy. Moderate short-term risks and potential impacts on workers and the community would be addressed by employing typical construction, transportation, and treatment system operation safety measures. In addition, the alternative would be designed to comply with ARARs.

Table 4-25
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-3 – Hydraulic Displacement and Enhanced Bioremediation

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-26**.

Table 4-25
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-3 – Hydraulic Displacement and Enhanced Bioremediation

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness and permanence by treating contaminants in this area of the site with hydraulic displacement and enhanced bioremediation. An analysis of the factors to be considered as part of this criterion follows: 1. Upon completion of the hydraulic displacement component of this alternative, up to 44% of contaminant mass in this area of the site will have been permanently removed through treatment. The remaining contamination will be converted to the more readily treated residual phase. The enhanced bioremediation component would complete the destruction of the remaining contamination within a shorter time frame than that required under the previous alternative. The magnitude of remaining risk would be reduced by up to 44% in the short term, with the remaining risk being addressed through enhanced bioremediation of the remaining residual. 2. Because it will be some time before safe levels are achieved, institutional controls would be required under this alternative to prevent exposure to untreated wastes. This alternative can reliably and adequately control exposure to contamination in the overburden NAPL area by use of institutional controls. These controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining on-site for some period of time above safe levels, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-25
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-3 – Hydraulic Displacement and Enhanced Bioremediation

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in the permanent reduction of toxicity, mobility and volume through treatment in this area of the site. The hydraulic displacement phase would remove pooled contaminants from this area of the site with enhanced bioremediation addressing the remaining contamination over time. 2. The hydraulic displacement component of this alternative would result in the removal and treatment of an estimated 44% of the initial NAPL mass within this area of the site. The enhanced bioremediation component of this alternative would result in the in-situ destruction of the remaining NAPL contaminants through enhanced naturally-occurring processes. In the short term, PCBs and metals may remain at levels above ARARs after treatment. However, their concentrations are expected to meet cleanup levels in the long term as the solubility of PCBs (which are co-located with the NAPL) decreases, and, metals stabilize with the removal of solvents from the subsurface. 3. The removal of pooled NAPL during the hydraulic displacement phase will reduce the mobility of contaminants under foreseeable changes to future site conditions, and the treatment of the removed NAPL and NAPL-water mixture will result in the reduction of toxicity and volume of contaminants. In addition, the enhanced bioremediation component of this alternative would result in the complete degradation of NAPL contaminants over time. 4. The treatment or degradation of NAPL constituents would be permanent and irreversible. 5. The removal of pooled NAPL will eliminate its potential for mobilization. Following the hydraulic displacement component of this alternative, the remaining treatment residuals within this area comprise NAPL in residual form with some small pools. The enhanced bioremediation component of this alternative would result in the in-situ destruction of the remaining NAPL contaminants through enhanced naturally-occurring processes over time. 6. The hydraulic displacement component of this alternative would eliminate the principal threat associated with NAPL by removing up to 44% of the contamination which exists in this area in pools and converting most of the remaining NAPL to residual form for further treatment by enhanced bioremediation.

Table 4-25
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-3 – Hydraulic Displacement and Enhanced Bioremediation

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in potential modest short-term risks to the community during implementation of the hydraulic displacement component that would have to be addressed. Above-ground treatment of the extracted NAPL and NAPL-water mixture could potentially result in unacceptable emissions of VOCs to the atmosphere. This potential risk would be addressed through the use of appropriate vapor phase controls during treatment. 2. Potential exposure of onsite workers to NAPL and the groundwater/NAPL mixture could occur during implementation of this alternative, and hazards inherent in well installation and treatment system construction would be present. These potential risks would be addressed by the use of PPE and compliance with a site-specific HASP, and by employing typical construction and treatment system operation safety measures. 3. There are no environmental impacts on-site from this alternative. 4. Significant reduction of NAPL mobility would be achieved at the completion of the hydraulic displacement component of this alternative. Up to 44% of the mass will be removed at the completion of the hydraulic displacement component of this alternative. Further reductions in NAPL mass would be accomplished over the longer term through the implementation of the enhanced bioremediation component. The period of time required to achieve these further reductions and the overall benefit resulting from the implementation of the enhanced bioremediation component cannot be reliably estimated, although it would be expected to be significantly shorter (i.e., three to ten times shorter) than would be achieved by natural degradation alone. It would take an estimated 130 years with EISB achieving three times the current rate of degradation to remove virtually all (99%) of the NAPL in this area, and an estimated 40 years if EISB can achieve ten times the current degradation rate. With either scenario, additional time would be needed to reach cleanup levels.

Table 4-25
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-3 – Hydraulic Displacement and Enhanced Bioremediation

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Hydraulic displacement is a reliable and feasible technology that can be viewed as a form of enhanced pump-and-treat. It would require subsurface drilling and the installation of extraction and injection wells or trenches and associated piping, modifications to the existing system and transport of untreated NAPL to an off-site disposal facility. There is considerable experience at the SRSNE site regarding the installation and use of groundwater extraction wells and operation of pumping and treatment systems. There is little experience, however, using hydraulic displacement to address a NAPL site of this magnitude. The risk of mobilizing NAPL into bedrock can be minimized by strategic placement of recovery wells and phased implementation. Enhanced bioremediation has been applied at full scale, and is a proven and reliable technology for the in-situ destruction of organic contaminants. Based on studies previously completed at the site, it has been shown to be a viable and technically feasible technology. It is difficult to predict, however, what increase over natural degradation rates, if any, can be achieved with EISB. 2. This alternative would be administratively feasible. A modification to the existing NPDES discharge requirements for NTCRA 1 may be needed although this would not be expected to be problematic. 3. This alternative could be implemented using available services, materials and equipment. There are a large number of potential contractors from which to obtain competitive pricing.

Table 4-25
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-3 – Hydraulic Displacement and Enhanced Bioremediation

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The costs associated with this alternative include the remedial design and construction costs for installation and operation of the hydraulic displacement trench network and the temporary treatment system, an initial bioaugmentation treatment, twenty years of delivery and injection of electron donor as part of the enhanced bioremediation component, and five years of post-hydraulic displacement monitoring. The estimated present worth costs of this alternative is $9,640,000 (**Table 4-27**).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-26
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through treatment of groundwater/NAPL followed by Enhanced Bioremediation.	Y
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Relevant and Appropriate	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through treatment of groundwater/NAPL followed by Enhanced Bioremediation. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	TBC, Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	To be complied with through OAR alternative and institutional controls in the interim.	Y
Location-Specific		None apply.					

Table 4-26 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-3: Hydraulic Displacement and Enhanced Bioremediation

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific	State of Connecticut	Hazardous Waste Management Regulations	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Applicable	These regulations include requirements for temporary storage of hazardous waste on site and groundwater monitoring requirements.	Treatment residues (spent filtration residue and activated carbon) could contain high concentrations of regulated constituents. If determined to be hazardous waste, will be stored on site consistent with these requirements before being shipped offsite for disposal. Extracted NAPL will be stored in accordance with these requirements before being shipped offsite for disposal. Groundwater will be monitored	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted NAPL/groundwater that is discharged to surface water would be treated to meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water and groundwater.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
		Air Pollution Control: Control of Particulate Matter	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards, requirements for pollution abatement, and requirements for control of fugitive dust from construction activities.	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-27
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-3: Hydraulic Displacement and EISB

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
A. Initial Capital Costs							
1	**Hydraulic Displacement Design and Construction**						
1a	Mobilization and Demobilization	325	man hours	$75	$24,375	$24,375	$24,375
1b	Temporary Treatment Structure	1	LS	$310,000	$310,000	$310,000	$310,000
1c	Fencing/Temporary Access Restrictions	1	LS	$8,600	$8,600	$8,600	$8,600
1d	Site Work	1	LS	$21,500	$21,500	$21,500	$21,500
1e	Groundwater Injection/Extraction Trench System	1	LS	$750,000	$750,000	$750,000	$750,000
1f	IDW Disposal	3,300	CY	$75	$247,500	$247,500	$247,500
1g	Groundwater Injection/Extraction Equipment	1	LS	$150,000	$150,000	$150,000	$150,000
1h	DNAPL Pretreatment	1	LS	$260,000	$260,000	$260,000	$260,000
1i	Metals Treatment	1	LS	$255,000	$255,000	$255,000	$255,000
1j	Primary VOC Treatment	1	LS	$260,000	$260,000	$260,000	$260,000
1k	Polishing	1	LS	$210,000	$210,000	$210,000	$210,000
1l	Effluent	1	LS	$70,000	$70,000	$70,000	$70,000
1m	IDW Disposal	215	CY	$75	$16,125	$16,125	$16,125
1n	NTCRA 1/2 Integration	1	LS	$60,000	$60,000	$60,000	$60,000
1o	O&M Plan	1	LS	$25,000	$25,000	$25,000	$25,000
1p	Pre- and Post-Treatment Sampling and Analysis	1	LS	$250,000	$250,000	$250,000	$250,000

Table 4-27
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-3: Hydraulic Displacement and EISB

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
2	**Enhanced In-Situ Bioremediation Design**						
2a	Microcosm Studies	800	LS	$125	$100,000	$100,000	$100,000
2b	Column Studies	1,200	LS	$125	$150,000	$150,000	$150,000
2c	System Infrastructure Installation	1	LS	$75,000	$75,000	$75,000	$75,000
2d	System Infrastructure shake down	100	man hours	$75	$7,500	$7,500	$7,500
2e	Bioaugmentation W/ DHC	1	LS	$250,000	$250,000	$250,000	$250,000
3	**Decommisioning**						
3a	Well Abandonment	10	well	$500	$5,000	$5,000	$5,000
3b	IDW Disposal	7	CY	$75	$555	$555	$555
3c	Deconstruction and Demobilization of Equipment	1	LS	$100,000	$100,000	$100,000	$100,000
4	**Remedial Action Report**	500	man-hours	$115	$57,500	$57,500	$57,500
				Initial Capital Cost Subtotal:	$3,663,655	$3,663,655	$3,663,655
				Total Initial Capital Cost (rounded):	**$ 3,660,000**	**$ 3,660,000**	**$ 3,660,000**

Table 4-27
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-3: Hydraulic Displacement and EISB

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
B. Hydraulic Displacement Operating Cost - 180 days							
1	**System Operation and Maintenance**	2,160	man hours	$75	$162,000	$162,000	$162,000
2	**System utilities**						
2a	Electric	500,000	KW hours	$0.11	$55,000	$55,000	$55,000
2b	Gas	45,000	Therm (100 ft^3)	$0.60	$27,000	$27,000	$27,000
2c	Potable Water	175,000	gallons	$0.03	$5,250	$5,250	$5,250
3	**System Chemicals**						
3a	Caustic Soda	120,000	kg	$0.44	$52,800	$52,800	$52,800
3b	Polymer	30	gal	$60	$1,800	$1,800	$1,800
3c	Sulfuric Acid	2,300	kg	$0.45	$1,035	$1,035	$1,035
3d	Coagulant Aid (Aluminum Chlorhydrate)	900	gal	$10	$9,000	$9,000	$9,000
4	**Disposal Costs**						
4a	DNAPL - Bulk Disposal	101,200	kg	$2.10	$212,520	$425,040	$850,080
4b	PCB - Sludge Disposal - Drums	75	ea	$600	$45,000	$45,000	$45,000
4c	Non-PCB Sludge Disposal - Drums	50	ea	$200	$10,000	$10,000	$10,000
4d	PPE Disposal - Drums PCB Contaminated	25	ea	$350	$8,750	$8,750	$8,750
5	**Laboratory Analysis**	132	ea	$470	$62,040	$62,040	$62,040
	Water TreatmentO&M Cost Subtotal:				$435,195	$647,715	$1,072,755
	Total Operating Capital Cost (rounded):				**$440,000**	**$650,000**	**$1,070,000**

Table 4-27
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-3: Hydraulic Displacement and EISB

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
C. Monitoring Costs (5 Years of Monitoring, 10 wells, twice per year, VOCs + MNA parameters)							
1	**Compliance Monitoring**	100	man hours	$95	$9,500	$9,500	$9,500
2	**Analytical**	24	analysis	$500	$12,000	$12,000	$12,000
3	**Equipment**	20	each	$125	$2,500	$2,500	$2,500
				Subtotal Annual O&M Cost:	$24,000	$24,000	$24,000
				Total Annual O&M Cost:	$24,000	$24,000	$24,000
				Present Worth Factor (5 years, no discount):	5	5	5
				Total Present Worth of Annual O&M Cost (rounded):	**$120,000**	**$120,000**	**$120,000**

Table 4-27
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-3: Hydraulic Displacement and EISB

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
D. EISB O&M Costs					10 years O&M	20 years O&M	30 years O&M
1	**EISB Injection O&M (first ten years)**						
1a	Oil for injection	27,500	KG	$2.5	$68,750	$68,750	$68,750
1b	Labor for injection	200	man hours	$75	$15,000	$15,000	$15,000
1c	EISB Trench Maintenance O&M	200	man hours	$75	$15,000	$15,000	$15,000
1d	EISB Analytical	20	analysis	$1,000	$20,000	$20,000	$20,000
1e	EISB Sampling	80	man hours	$75	$6,000	$6,000	$6,000
				Subtotal Annual O&M Cost:	$124,750	$124,750	$124,750
				Subtotal PW O&M Cost:	$1,091,812	$1,091,812	$1,091,812
				Present Worth Factor (10 years, 2.5%):	8.752	8.752	8.752
2	**EISB Injection O&M (next 10 or 20 years)**						
2a	Oil for injection	7,000	KG	$2.5	$0	$17,500	$17,500
2b	Labor for injection	200	man hours	$75	$0	$15,000	$15,000
2c	EISB Trench Maintenance O&M	200	man hours	$75	$0	$7,500	$15,000
2d	EISB Analytical	20	analysis	$1,000	$0	$15,000	$20,000
2e	EISB Sampling	80	man hours	$75	$0	$6,000	$6,000
				Subtotal Annual O&M Cost:	$0	$61,000	$73,500
				Subtotal PW O&M Cost:	$0	$533,872	$1,103,970
				Present Worth Factor (10 years, 2.5%, 20 years, 2.8%):		8.752	15.02
				Total Present Worth of Annual O&M Cost (rounded):	**$1,090,000**	**$1,630,000**	**$2,200,000**

Table 4-27
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-3: Hydraulic Displacement and EISB

Description	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
Aggregate Present Worth of Total Cost:	**$5,310,000**	**$6,060,000**	**$7,050,000**
Remedial Design (8%)	$424,800	$484,800	$564,000
Project Administration/Management Cost (5%)	$265,500	$303,000	$352,500
Construction Management (6%)	$318,600	$363,600	$423,000
Scope Contingency (25%)	$1,327,500	$1,515,000	$1,762,500
Bid or Construction Contingency (15%):	$796,500	$909,000	$1,057,500
Subtotal	$8,442,900	$9,635,400	$11,209,500
Rounded To:	**$8,440,000**	**$9,640,000**	**$11,210,000**

Notes:

1. Hydraulic Displacement assumes 100% design only
2. Cost for HD Treatment building assume a temporary structure
3. Site work cost include Clearing and Grubbing, and Site Prep, and Well Access Roads
4. Groundwater Injection & Extraction System costs include trench installation, Well Equipment, instrumentation, process controls, mechanical & electrical installation, heat trace, and development
5. Hydraulic Displacement DNAPL Pretreatment consist of NAPL Phase Separation Tanks
6. Hydraulic Displacement Primary VOC treatment consist of Air Stripping, Catalytic Oxidation, and HCL Scrubber
7. Hydraulic Displacement Polishing Treatment consist of Photo Catalytic Oxidation
9. Well Abandonment- 10 wells within the Operations Area will be abandoned prior to the installation of the HD wells
10. Costs for NTCRA O&M are based on past project experience
11. IDW Volumes: .74 cubic yard per well
12. EISB assumes 30%, 60%, 90% and Final Design
13. EISB (low) assumes injections for 10 years, EISB (high) assumes 30 years of injection
14. LS - lump sum
15. Long-term monitoring includes labor and materials for semi-annual monitoring of ONOGU ground-water quality utilizing a subset of the existing on-site ground-water monitoring well network. This assumes that 10 wells will sampled semi-annually for VOCs and MNA parameters.

Table 4-28
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-4 – Hydraulic Displacement, Chemical Oxidation and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The Overburden NAPL Area does not present a risk in the short term as there is no current exposure to this area of the site. This alternative provides overall protection of human health and the environment in the long term by permanently reducing the mass of NAPL by up to 44% through treatment. NAPL will remain in small pools and as residual. However, this material will not be mobile under foreseeable site conditions. The chemical oxidation component would reduce the remaining NAPL mass by an additional 90% resulting is a significantly shorter time frame that groundwater standards are exceeded, and in doing so would shrink the size of the overburden groundwater contaminant plume and reduce groundwater contaminant concentrations. In addition to the performance standards previously discussed for hydraulic displacement and MNA, completion of the chemical oxidant phase would be demonstrated by breakthrough of oxidant in downgradient monitoring locations. Downward migration of NAPL into bedrock during implementation of this alternative would be minimized by phasing implementation of the hydraulic displacement component. Moderate short-term risks and potential impacts on workers and the community could be mitigated by employing typical construction, transportation, and treatment system operation safety measures, although the short-term risks for this alternative would be somewhat greater than Alternatives ONOGU-2 and ONOGU-3 due to the need to transport, deliver, mix and inject approximately 3,190,000 pounds of oxidant. In addition, the alternative would comply with ARARs.

Table 4-28
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-4 – Hydraulic Displacement, Chemical Oxidation and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-29**.

Table 4-28
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-4 – Hydraulic Displacement, Chemical Oxidation and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness and permanence by treating contaminants in this area of the site with hydraulic displacement, chemical oxidation and MNA. An analysis of the factors to be considered as part of this criterion follows: 1. Upon completion of the hydraulic displacement and chemical oxidation components of this alternative, up to 95% of the mass of the contamination in this area of the site will be permanently removed. The deposition of manganese oxides during the chemical oxidation step could affect its efficiency. Chemical oxidation may also alter the subsurface geochemistry resulting in a spike in the concentrations of metals in groundwater within the treatment zone, thereby temporarily increasing its toxicity. These effects would diminish over a relatively short time as conditions return to pre-treatment levels. The magnitude of remaining risks would be reduced by up to 95% in the short term, with the remaining risk being addressed through MNA of the remaining residual. This alternative would complete destruction of the remaining contamination within a time frame somewhat shorter than that required under the previous two alternatives. 2. Because it will be some time before safe levels are achieved, institutional controls would be required under this alternative to prevent exposure to untreated wastes. This alternative can reliably and adequately control exposure to contamination in the Overburden NAPL Area by use of institutional controls. These controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining on site for some period of time above safe levels, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-28
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-4 – Hydraulic Displacement, Chemical Oxidation and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in the permanent reduction of NAPL toxicity, mobility and volume through treatment. During the hydraulic displacement phase, pooled NAPL will be removed from the Overburden NAPL Area and will be treated above ground in a treatment system to reduce the material's toxicity. 2. The hydraulic displacement component of this alternative would result in the removal and treatment of an estimated 44% of the initial NAPL mass within this area of the site. An additional 90% of the NAPL mass that remains would be destroyed during the chemical oxidation phase, for a total reduction in NAPL mass of approximately 95%. Natural degradation processes would complete destruction of the remaining NAPL contaminants. In the short term, PCBs and metals may remain at levels above ARARs after treatment. However, their concentrations are expected to meet cleanup levels in the long term as the solubility of PCBs (which are co-located with the NAPL) decreases, and, metals stabilize with the removal of solvents from the subsurface. 3. The removal of pooled NAPL during hydraulic displacement and the subsequent destruction of contaminants by chemical oxidation would result in the permanent reduction of toxicity, mobility and volume of 95% of the contaminants through treatment. 4. The removal and treatment of NAPL constituents would be permanent and irreversible. 5. The removal of pooled NAPL during hydraulic displacement will eliminate its potential for mobilization. Following the hydraulic displacement component of this alternative, the chemical oxidation step will destroy almost all additional contaminant mass, leaving treatment residuals within the Overburden NAPL Area in residual form only. Natural degradation processes would result in complete destruction of remaining contaminants over time. 6. Together, the hydraulic displacement and chemical oxidation components of this alternative would eliminate the principal threat associated with NAPL by removing 95% of the contamination in this area and/or converting it to residual form for additional treatment by MNA.

Table 4-28
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-4 – Hydraulic Displacement, Chemical Oxidation and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in the same moderate short-term risks to the community during implementation of the hydraulic displacement component as those discussed for Alternative ONOGU-2. Additionally, potential short-term risks to the community could occur during the implementation of the chemical oxidation component of this alternative. The delivery, mixing, and injection of approximately three million pounds of chemical oxidant would result in an increase in truck traffic over local roadways as well as the potential exposure to potentially unstable, highly oxidative materials. These potential risks would be addressed by a carefully-planned and executed site-specific health and safety plan and by employing typical transportation safety measures. 2. Potential short-term risks to workers during implementation of the hydraulic displacement component would be the same as those discussed for Alternative ONOGU-2. In addition, workers could be exposed to potentially unstable, highly oxidative materials during the delivery, mixing and injection of approximately three million pounds of chemical oxidant during the chemical oxidation step. These potential risks would be addressed by the use of PPE and compliance with a site-specific HASP, and by employing typical construction, transportation, and treatment system operation safety measures. 3. There are no environmental impacts on-site from this alternative. 4. Significant reduction of NAPL mobility would be achieved at the completion of the hydraulic displacement component of this alternative. Up to 44% of the mass will be removed at the completion of the hydraulic displacement component of this alternative, with an additional 90% (for a total of 95%) mass removed after the chemical oxidation phase. Further reductions in NAPL mass would be accomplished over the longer term through the implementation of the MNA component. It would take an estimated 50 to 150 years to remove virtually all (99%) of the NAPL in this area, assuming current degradation rates. Additional time would be needed to reach cleanup levels.

Table 4-28
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-4 – Hydraulic Displacement, Chemical Oxidation and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. The implementability of the hydraulic displacement component of this alternative would be identical to that of Alternatives ONOGU-2 and ONOGU-3. Chemical oxidation would be technically feasible; it has been used in numerous full-scale applications as an in-situ treatment technique at sites with similar contaminants as the SRSNE Site. The risk of downward NAPL pool mobilization can be minimized by strategic placement of recovery wells and phased implementation. 2. This alternative would be administratively feasible. A modification to the existing NPDES discharge authorization for NTCRA 1 may be required, although this would not be expected to be problematic. Similarly, the substantive requirements of the Connecticut Water Pollution Control regulations would need to be met for the injection of the oxidant solution and treated water to ground waters of the state; this would also be expected to be feasible. 3. Based on information from chemical oxidant suppliers, the approach proposed for the Site would use about five times more oxidant than used at any previous environmental chemical oxidation site. The availability of this quantity of oxidant may present challenges to the project. This alternative would require the installation of a number of additional injection wells, which would utilize readily available materials and equipment. The delivery, mixing and injection of a large quantity of oxidant would present logistical and health and safety challenges, although it could be accomplished using standard process, pumping, mixing and chemical handling equipment and materials.

Table 4-28
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-4 – Hydraulic Displacement, Chemical Oxidation and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The costs associated with this alternative include the remedial design and construction costs for installation and operation of the hydraulic displacement well network and the temporary treatment system; the chemical mixing/delivery system for the in-situ chemical oxidation system, and the chemical oxidant. The estimated present worth costs of this alternative is $20,130,000 (**Table 4-30**). This alternative has the greatest degree of cost sensitivity with respect to the actual mass of NAPL. At the high end of potential NAPL mass, the cost for this alternative would exceed the +50% / -30% range of acceptable variation in projected costs.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-29
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation, and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These requirements establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through treatment of groundwater/NAPL followed by MNA	Y
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through treatment of groundwater/NAPL followed by MNA. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	To be complied with through OAR alternative and institutional controls in the interim.	Y
Location-Specific		None apply.					

Table 4-29 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific	State of Connecticut	Hazardous Waste Management: Storage Requirements, Groundwater Monitoring, : General Facility Standards, Preparedness and Prevention, Contingency Plan and Emergency Procedures	CGS 22a ch 445 RCSA §22a-449(c)	Applicable	These requirements establish standards for temporary storage of hazardous waste and groundwater monitoring.	Treatment residues (spent filtration residue and activated carbon) could contain high concentrations of regulated constituents. If determined to be hazardous waste, will be stored on site consistent with these requirements before being shipped offsite for disposal. Materials used in the chemical oxidation process will be handled in accordance with these requirements. Extracted NAPL will be stored in accordance with these requirements before being shipped offsite for disposal. Groundwater will be monitored.	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted NAPL/groundwater that is discharged to surface water would be treated in a manner that would meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water and groundwater.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y

Table 4-29 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-4: Hydraulic Displacement, Chemical Oxidation and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific (cont.)	State of Connecticut (cont.)	Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards, requirements for pollution abatement, and requirements for control of fugitive dust from construction activities with dust control measures.	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-30
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-4: Hydraulic Displacement and Chemical Oxidation and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
A. Initial Capital Costs							
1	**Hydraulic Displacement Design and Construction**						
1a	Mobilization and Demobilization	325	man hours	$75	$24,375	$24,375	$24,375
1b	Temporary Treatment Structure	1	LS	$310,000	$310,000	$310,000	$310,000
1c	Fencing/Temporary Access Restrictions	1	LS	$8,600	$8,600	$8,600	$8,600
1d	Site Work	1	LS	$21,500	$21,500	$21,500	$21,500
1e	Groundwater Injection/Extraction Trench System	1	LS	$750,000	$750,000	$750,000	$750,000
1f	IDW Disposal	3,300	CY	$150	$495,000	$495,000	$495,000
1g	DNAPL Disposal - System Installation Dewatering	10,000	kg	$1.25	$12,500	$12,500	$12,500
1h	Groundwater Injection/Extraction System Equipment	1	LS	$250,000	$250,000	$250,000	$250,000
1i	DNAPL Pretreatment	1	LS	$260,000	$260,000	$260,000	$260,000
1j	Metals Treatment	1	LS	$255,000	$255,000	$255,000	$255,000
1k	Primary VOC Treatment	1	LS	$260,000	$260,000	$260,000	$260,000
1l	Polishing	1	LS	$210,000	$210,000	$210,000	$210,000
1m	Effluent	1	LS	$70,000	$70,000	$70,000	$70,000
1n	IDW Disposal	215	CY	$75	$16,125	$16,125	$16,125
1o	NTCRA 1/2 Integration	1	LS	$60,000	$60,000	$60,000	$60,000
1p	O&M Plan	1	LS	$25,000	$25,000	$25,000	$25,000
1q	Pre- and Post-Treatment Sampling and Analysis	1	LS	$250,000	$250,000	$250,000	$250,000

Table 4-30
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-4: Hydraulic Displacement and Chemical Oxidation and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
2	**Chemical Oxidation Design and Construction**						
2a	System Infrastructure Installation	1000	man hours	$75	$75,000	$75,000	$75,000
2b	IDW Disposal	34	CY	$75	$2,550	$2,550	$2,550
2c	Chemical Storage Tanks/Pumps/Infrastructure	1	LS	150,000	$150,000	$150,000	$150,000
2d	Chem-Ox Bench Scale Treatability Study	200	man hours	$115	$23,000	$23,000	$23,000
2e	Materials	1	LS	$50,000	$50,000	$50,000	$50,000
2f	Lab support	200	analysis	$250	$50,000	$50,000	$50,000
2g	Mobilization and Demobilization	500	man hours	$75	$37,500	$37,500	$37,500
2h	Chem-Ox Pilot Study (Full Scale)	1000	man hours	$115	$115,000	$115,000	$115,000
2i	Chem-Ox pilot study materials	1	LS	$50,000	$50,000	$50,000	$50,000
2j	Chem-Ox pilot study lab support	200	analysis	$250	$50,000	$50,000	$50,000
3	**Decommisioning**						
3a	Well Abandonment	10	well	$500	$5,000	$5,000	$5,000
3b	IDW Disposal	7	CY	$75	$555	$555	$555
3c	Deconstruction and Demobilization of Equipment	1	LS	$150,000	$150,000	$150,000	$150,000
				Initial Capital Cost Subtotal:	$4,036,705	$4,036,705	$4,036,705
				Total Initial Capital Cost (rounded):	**$4,040,000**	**$4,040,000**	**$4,040,000**

Table 4-30
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-4: Hydraulic Displacement and Chemical Oxidation and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
B. Hydraulic Displacement Operating Cost - 180 days							
1	**System Operation and Maintenance**	2,160	man hours	$75	$162,000	$162,000	$162,000
2	**System utilities**						
2a	Electric	500,000	KW hours	$0.11	$55,000	$55,000	$55,000
2b	Gas	45,000	herm (100 ft	$0.60	$27,000	$27,000	$27,000
2c	Potable Water	175,000	gallons	$0.03	$5,250	$5,250	$5,250
3	**System Chemicals**						
3a	Caustic Soda	120,000	kg	$0.44	$52,800	$52,800	$52,800
3b	Polymer	30	gal	$60	$1,800	$1,800	$1,800
3c	Sulfuric Acid	2,300	kg	$0.45	$1,035	$1,035	$1,035
3d	Coagulant Aid (Aluminum Chlorhydrate)	900	gal	$10	$9,000	$9,000	$9,000
4	**Disposal Costs**						
4a	DNAPL - Bulk Disposal	101,200	kg	$2.10	$212,520	$425,040	$850,080
4b	PCB - Sludge Disposal - Drums	75	ea	$600	$45,000	$45,000	$45,000
4c	Non-PCB Sludge Disposal - Drums	50	ea	$200	$10,000	$10,000	$10,000
4d	PPE Disposal - Drums PCB Contaminated	25	ea	$350	$8,750	$8,750	$8,750
5	**Laboratory Analysis**	132	ea	$470	$62,040	$62,040	$62,040
				Water TreatmentO&M Cost Subtotal:	$435,195	$647,715	$1,072,755
				Total Operating Capital Cost (rounded):	**$440,000**	**$650,000**	**$1,070,000**

Table 4-30
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-4: Hydraulic Displacement and Chemical Oxidation and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
C. Chemical Oxidation Operations Cost - 180 to 720 days of oxidant injection							
1	**System Operation and Maintenance**	3,500	man hours	$95	$332,500	$665,000	$1,330,000
1a	System utilities						
1b	Electric	32,000	KW hours	$0.13	$4,160	$8,320	$16,640
1c	Potable Water	5,000,000	gallons	$0.03	$150,000	$300,000	$600,000
2	**Oxidant Cost**	725,000	kg	$3.76	$2,726,000	$5,452,000	$10,904,000
3	**Laboratory Analysis**	400	ea	$250	$100,000	$200,000	$400,000
4	**Demobilization of Chem-Ox Equipment**	1,000	man hours	$95	$95,000	$95,000	$95,000
5	**Disposal/Salvage of Chem-Ox Equipment**	1	LS	$100,000	$100,000	$100,000	$100,000
	Water TreatmentO&M Cost Subtotal:				$4,444,895	$8,180,075	$15,650,435
	Total Operating Capital Cost (rounded):				**$4,440,000**	**$8,180,000**	**$15,650,000**

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
C. Monitoring Costs (5 Years of Monitoring, 10 wells, twice per year, VOCs + MNA parameters)							
1	**Compliance Monitoring**	100	man hours	$95	$9,500	$9,500	$9,500
2	**Analytical**	24	analysis	$500	$12,000	$12,000	$12,000
3	**Equipment**	20	each	$125	$2,500	$2,500	$2,500
	Subtotal Annual O&M Cost:				$24,000	$24,000	$24,000
	Total Annual O&M Cost:				$24,000	$24,000	$24,000
	Present Worth Factor (5 years, no discount):				5	5	5
	Total Present Worth of Annual O&M Cost (rounded):				**$120,000**	**$120,000**	**$120,000**

Description	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
Aggregate Present Worth of Total Cost:	**$9,040,000**	**$12,990,000**	**$20,880,000**
Remedial Design (4%)	$361,600	$519,600	$835,200
Project Administration/Management Cost (5%)	$452,000	$649,500	$1,044,000
Construction Management (6%)	$542,400	$779,400	$1,252,800
Scope Contingency (25%)	$2,260,000	$3,247,500	$5,220,000
Bid or Construction Contingency (15%):	$1,356,000	$1,948,500	$3,132,000
Subtotal	$14,012,000	$20,134,500	$32,364,000
Rounded To:	**$14,010,000**	**$20,130,000**	**$32,360,000**

Table 4-30
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-4: Hydraulic Displacement and Chemical Oxidation and MNA

Notes:

1. Hydraulic Displacement assumes 100% design only.
2. Cost for HD Treatment building assume a temporary structure
3. Site work cost include Clearing and Grubbing, and Site Prep, and Well Access Roads
4. Groundwater Injection & Extraction System costs include trench installation, Well Equipment, instrumentation, process controls, mechanical & electrical installation, heat trace, and development
5. Hydraulic Displacement DNAPL Pretreatment consist of NAPL Phase Separation Tanks
6. Hydraulic Displacement Primary VOC treatment consist of Air Stripping, Catalytic Oxidation, and HCL Scrubber
7. Hydraulic Displacement Polishing Treatment consist of Photo Catalytic Oxidation
8. Well Abandonment- 10 wells within the Operations Area will be abandoned prior to the installation of the HD wells.
9. Costs for NTCRA O&M are based on past project experience.
10. IDW Volumes: .74 cubic yard per well
11. EISB assumes 30%, 60%, 90% and Final Design.
12. EISB assumes three injections over the course of five years.
13. LS - lump sum.
14. Long-term monitoring includes labor and materials for semi-annual monitoring of ONOGU ground-water quality utilizing a subset of the existing on-site ground-water monitoring well network. This assumes that 10 wells will sampled semi-annually for VOCs and MNA parameters.
15. Chemical Oxidation Infrastructure includes KMnO4 Batching Skid, Water Supply Skid, Dosing Skid, and Injection Skid
16. Chemical Oxidation will follow Hydraulic Displacement
17. Chemical Oxidation - Potassium Permanganate will be injected over a period of 12 to 15 months

Table 4-31
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-5 – Thermal Treatment

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The overburden NAPL area does not present a risk in the short term as there is no current exposure to this area of the site. This alternative provides overall protection of human health and the environment in the long term by permanently reducing the mass of NAPL in a range of 95-99% through treatment with the final performance standard in this range determined in consultation with EPA based on actual system performance**.** This degree of performance can be equated to the near complete removal of NAPL from the treatment zone. It is anticipated that the performance of thermal treatment in removing NAPL would be evaluated based on soil samples collected after treatment to establish average soil VOC concentrations across the treatment zone. Such treatment ranging from 95-99% mass reduction results in a significantly shorter time frame that groundwater standards are exceeded, and in doing so would shrink the size of the overburden groundwater contaminant plume and reduce groundwater contaminant concentrations. Due to the need to construct and operate an extensive well-field and robust treatment system, short-term risks and potential impacts on workers and the community during the implementation of this alternative would need to be managed. Vapor treatment systems will need to be sized to manage the large mass of contaminants expected to be removed. The infrastructure that would have to be constructed to support the thermal treatment component has been safely installed and operated at other sites, where the associated risks have been mitigated by employing typical construction, transportation, and treatment system operation safety measures. This alternative would be designed to meet ARARs, including State of CT air regulations.

Table 4-31
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-5 – Thermal Treatment

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-32**.

Table 4-31
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-5 – Thermal Treatment

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness and permanence by treating contaminants in this area of the site with thermal treatment and MNA. An analysis of the factors to be considered as part of this criterion follows: 1. Upon completion of thermal treatment, 95-99% of contamination in this area of the site will have been permanently removed. The magnitude of remaining risks would be reduced by a range of 95-99% in the short term, with the remaining risk being addressed through MNA of the remaining residual. Because more contaminant mass is removed during the first phase of treatment, this alternative would complete destruction of the remaining contamination within a time frame somewhat shorter than that required under the previous alternatives. 2. Because it will be some time before safe levels are achieved, institutional controls would be required under this alternative to prevent exposure to untreated wastes. This alternative can reliably and adequately control exposure to contamination in the overburden NAPL area by use of institutional controls. These controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminant remaining on-site for some period of time above safe levels, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-31
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-5 – Thermal Treatment

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in the permanent reduction of NAPL toxicity, mobility and volume through treatment. 2. In the range of 95% to 99% (depending on pilot test results and actual field conditions), on average, of the VOC mass would be removed from this area of the site. This mass of contaminants will be destroyed using thermal treatment resulting in the permanent reduction of toxicity, mobility and volume of VOC contaminants through treatment. Residual VOCs remaining in the Overburden NAPL Area after treatment will degrade through MNA. In the short term, PCBs and metals may remain at levels above ARARs after treatment. However, their concentrations are expected to meet cleanup levels in the long term as the solubility of PCBs (which are co-located with the NAPL) decreases, and, metals stabilize with the removal of solvents from the subsurface. 3. The removal and destruction of contaminants by thermal treatment would result in the permanent reduction of toxicity, mobility and volume in the range of 95-99% of the mass of contaminants in this area of the site. 4. The removal and ex-situ treatment of NAPL constituents would be permanent and irreversible. 5.Thermal treatment removes in the range of 95% to 99% (depending on pilot test results and actual field conditions), on average, of the VOC mass in this area of the site leaving only relatively small quantities of the less mobile residual contamination. The potential for downward mobilization of NAPL during treatment will be minimized by strategic placement of heater wells and preventing the formation of condensate banks during implementation. Natural degradation processes would result in the in-situ destruction of the remaining contaminants through naturally-occurring processes. 6. This alternative would eliminate the principal threat associated with potentially mobile NAPL by removing pooled NAPL and in the range of 95% to 99% (depending on pilot test results and actual field conditions), on average, of the total NAPL mass.

Table 4-31
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-5 – Thermal Treatment

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Potential short-term risks to the community associated with the possibility of contaminated vapor escape in the event of extraction system failure or short-circuiting of steam in the subsurface, cap failure, or vapor treatment system problems would need to be addressed. A site-specific HASP will include redundant safe-guards and perimeter monitoring. However, the effluents will be treated using a system similar to that utilized in past projects (both with respect to process units, size, and operational duration), where no significant impacts were seen. The vapor treatment equipment for this project is anticipated to be larger than many previous applications, due to the large amount of VOCs expected to be removed and treated. 2. This alternative would present limited short-term risks to workers due to the elaborate infrastructure required for implementation. These risks will be addressed through the use of PPE and compliance with a site-specific HASP, and by employing typical construction, transportation, and treatment system operation safety measures (as documented by the safe implementation at more than ten sites since 2000). 3. There are no environmental impacts on-site from this alternative. 4. Significant reductions of NAPL mobility, volume and toxicity would be achieved at the completion of this alternative. Between 95% and 99% of the mass will be removed. Further reductions in NAPL mass would be accomplished over the long term though the implementation of an MNA component. If the technology removes 95% initially, it will take 50 to 150 years before virtually all (99%) is removed. If 97% is removed initially, it will take 40 to 100 years before virtually all is removed. With either scenario, additional time would be needed to reach cleanup levels. If maximum removal rates are attained, virtually all the NAPL mass would be removed in seven years, which is the time it would take to design and implement this alternative.

Table 4-31
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-5 – Thermal Treatment

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative is technically feasible although it is complex in nature requiring subsurface drilling and installation of heater and extraction wells, a network of heating and vapor collection piping, a heat resistant vapor cap a slurry wall or sheet piling around the treatment area, electrical power transformation and distribution networks, and an above ground fluid and vapor treatment system (see **Appendix V**). Implementation at several similar sites has documented that thermal treatment can reliably remove large amounts of VOC mass. Specially-designed heater borings will minimize the risk of downward NAPL migration during implementation. Key issues for successful implementation include overcoming the cooling effects of groundwater migration into the treatment zone, adequate capture and treatment of produced vapors, and to assessing the potential for extracted vapors to corrode piping and equipment, in order to select appropriate materials during the design process. 2. This alternative is administratively feasible. A modification to the existing NPDES discharge requirements for NTCRA 1 would be required. Additionally, this alternative must meet state requirements for treated vapor phase emissions. 3. The complexity of this alternative requires significant infrastructure, and the services, equipment and materials required for its implementation are expected to be limited, but available. There is currently only one vendor of thermal conductive heating in the United States. Several firms provide electrical resistive heating, which may be an applicable technology.

Table 4-31
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-5 – Thermal Treatment

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The costs associated with this alternative include the remedial design, pilot study and construction costs for installation and operation of the thermal conduction wells, slurry or sheet pile wall, thermal monitoring points, vapor extraction wells, containment cap, above-ground vapor headers, electrical supply, vapor treatment systems, liquid pre-treatment, off-site disposal of residuals, monitoring, etc. The estimated present worth cost of this alternative, which assumes 95% removal of VOCs, is $17,660,000 (**Table 4-33**). The added cost to achieve 99% removal of VOCs is within a +50%/-30% range of these costs. As this is within the acceptable range for FS cost accuracy, those costs are not estimated separately.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-32
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-5: Thermal Treatment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	This Part establishes primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through thermal treatment of groundwater/NAPL followed by Monitored Natural Attenuation.	Y
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through thermal treatment of groundwater/NAPL followed by Monitored Natural Attenuation. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	TBC, Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	To be complied with through OAR alternative and institutional controls in the interim.	Y
Location-Specific		None apply.					

Table 4-32 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-5: Thermal Treatment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific	Federal	RCRA Air Emission Standards for Equipment Leaks	40 CFR 264 Subpart BB	Relevant and Appropriate if treatment involves groundwater with organic concentrations of at least 10% by weight.	Standards for air emissions for equipment that contains or contacts hazardous substances with organic concentrations of at least 10% by weight.	If these requirements are determined to be relevant and appropriate, then the substantive requirements of these regulations will be met in addressing emissions from thermal treatment.	Y
		RCRA Air Emission Standards for Process Vents	40 CFR 264 Subpart AA	Relevant and Appropriate if threshold concentrations are met.	Standards for air emissions from process vents associated with treatment of hazardous substances and have total organic concentrations of 10 ppm or greater.	If these requirements are determined to be relevant and appropriate, then the substantive requirements of these regulations will be met in addressing emissions from thermal treatment.	Y
	State of Connecticut	Hazardous Waste Management Regulations	CGS 22a ch 445 RCSA §22a-449(c)	Applicable	These regulations establish standards for treatment, storage and disposal of hazardous waste and remediation waste, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities	Treatment residues (spent filtration residue and activated carbon) could contain high concentrations of regulated constituents. If determined to be hazardous waste, will be stored on site consistent with these requirements before being shipped offsite for disposal. NAPL collected from the thermal treatment process will be stored on site consistent with these requirements before being shipped off site for disposal. Groundwater will be monitored. General facility, preparedness and prevention, contingency plan and emergency procedures will also be met.	Y

Table 4-32 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-5: Thermal Treatment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific (cont.)	State of Connecticut (cont.)	Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust and control of air toxics.	Would comply with emission standards, requirements for pollution abatement, and requirements for control of fugitive dust from construction activities with dust control measures. Will take appropriate measures to address state air toxics requirements.	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-33
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-5: Thermal Treatment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
A. Initial Capital Costs							
1	**Thermal Treatment Design and Construction**						
1a	PreMobilization and Procurement	1	LS	$350,000	$350,000	$350,000	$350,000
1b	Mobilization	900	man hours	$75	$67,500	$67,500	$67,500
1c	Install Well Field and Electrodes	1	LS	$ 2,500,000	$2,500,000	$2,500,000	$2,500,000
1d	Construct Cover	1	LS	$500,000	$500,000	$500,000	$500,000
1e	Piping and Electrical	1	LS	$450,000	$450,000	$450,000	$450,000
1f	Utility Installation	1	LS	$80,000	$80,000	$80,000	$80,000
1g	Treatment System (Vapor & Condensate)	1	LS	$1,300,000	$1,300,000	$1,300,000	$1,800,000
1h	Condensate Pumping and Separation	1	LS	$162,000	$162,000	$162,000	$162,000
1i	Final Post-Installation Modifications	1	LS	$45,000	$45,000	$45,000	$45,000
1j	Decommission cap and equipment	1	LS	$390,000	$390,000	$390,000	$390,000
1k	Site Clearance & demobilization	1	LS	$69,000	$69,000	$69,000	$69,000
1l	Contractor Internal Management/Coordination	1	LS	$200,000	$200,000	$200,000	$200,000
1m	Pre- and Post-Treatment Sampling and Analysis	1	LS	$250,000	$250,000	$250,000	$250,000
1n	Perimeter barrier (1,300' linear, 20' avg. depth)	26,000	SQ FT	$16	$416,000	$416,000	$416,000
1o	Earthwork and grading	7,260	SQ YD	$5	$36,300	$36,300	$36,300
1p	Fiber optic relocation	1	LS	$75,000	$75,000	$75,000	$75,000
1q	NTCRA Infrastructure Modifications (Abandon RW-5, MWD-601, realign HDPE forcemain, etc.)	1	LS	$50,000	$50,000	$50,000	$50,000
1r	Pilot Study (assumes 50' by 50' by 20' deep target zone)	1	LS	$1,500,000	$1,500,000	$1,500,000	$1,500,000
2	**Well Abandonment**						
2a	Monitoring Well Abandonment	10	well	$500	$5,000	$5,000	$5,000
2b	System Well Abandonment	525	well	$500	$262,500	$262,500	$262,500
				Initial Capital Cost Subtotal:	$8,708,300	$8,708,300	$9,208,300
				Total Initial Capital Cost (rounded):	**$8,710,000**	**$8,710,000**	**$9,210,000**

Table 4-33
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-5: Thermal Treatment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
B. Thermal Treatment Operating Cost (2 people, 24 hrs/day, 200 days for 95% removal)							
1	**Operating ISTD System**	9,600	man hours	$95	$912,000	$912,000	$912,000
2	**Air Monitoring (~ 2 RCRA perf tests)**	2	LS	$50,000	$100,000	$100,000	$100,000
3	**Utilities**						
3a	Electricity	7,700,000	KW-Hr	$0.11	$847,000	$847,000	$847,000
3b	Natural Gas	80,000	Therm (100 ft^3)	$0.60	$24,000	$48,000	$96,000
3c	Potable Water	1,000,000	gallons	$0.03	$30,000	$30,000	$30,000
4	**Field Supplies**	1	LS	$170,000	$170,000	$170,000	$170,000
5	**Contractor Management/Reporting**	1	LS	$250,000	$250,000	$250,000	$250,000
6	**Interim Soil Sampling**	1	LS	$75,000	$75,000	$75,000	$75,000
7	**Condensed NAPL Disposal**	23,000	kg	$2.10	$48,300	$96,600	$193,200
8	**Caustic 25%NaOH HCL neutralization**	120,000	Gal	$1.25	$75,000	$150,000	$300,000
9	**Brine Disposal**	64,800	gal	$0.50	$16,200	$32,400	$64,800
				Thermal O&M Cost Subtotal:	$2,547,500	$2,711,000	$3,038,000
				Total Operating Capital Cost (rounded):	**$2,550,000**	**$2,710,000**	**$3,040,000**

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
C. Monitoring Costs (5 Years of Monitoring, 10 wells, twice per year, VOCs + MNA parameters)							
1	**Compliance Monitoring**	100	man hours	$95	$9,500	$9,500	$9,500
2	**Analytical**	24	analysis	$500	$12,000	$12,000	$12,000
3	**Equipment**	20	each	$125	$2,500	$2,500	$2,500
				Subtotal Annual O&M Cost:	$24,000	$24,000	$24,000
				Total Annual O&M Cost:	$24,000	$24,000	$24,000
				Present Worth Factor (5 years, no discount):	5	5	5
				Total Present Worth of Annual O&M Cost (rounded):	**$120,000**	**$120,000**	**$120,000**

Table 4-33
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-5: Thermal Treatment and MNA

Description	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
Aggregate Present Worth of Total Cost:	**$11,380,000**	**$11,540,000**	**$12,370,000**
Remedial Design (6%)	$682,800	$692,400	$742,200
Project Administration/Management Cost (5%)	$569,000	$577,000	$618,500
Construction Management (6%)	$682,800	$692,400	$742,200
Scope Contingency (25%)	$2,845,000	$2,885,000	$3,092,500
Bid or Construction Contingency (15%):	$1,707,000	$1,731,000	$1,855,500
Total Cost	$17,866,600	$18,117,800	$19,420,900
Rounded To:	**$17,870,000**	**$18,120,000**	**$19,420,000**
Remedial Cost Reduction Associated with Successful Pilot Study			
Pilot Study = 3.9% of ONOGU Volume, Assumed Cost Reduction = 3.9% of Capital + O&M Costs)	**($460,000)**		
Total Cost - 95% Removal (Rounded):	**$17,660,000**		

Table 4-33
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-5: Thermal Treatment and MNA

Notes:

1. Thermal Treatment assumes 30% and Final Design.
2. System Instrumentation and Equipment includes additional cost for a back-up power supply
3. IDW Volumes: .74 cubic yard per well
4. Mobilization & Demobilization includes cost for shipment of equipment and decontamination
5. Install Well Field- includes cost for drillers time and materials to install well field consisting of 450 20' deep Heater Wells and conductors/elements, 450 4' deep vapor Extraction Wells, and 75 20' pressure/temperature monitoring locations
6. Construct Cover- Cover will consist of a asphalt or concrete cover to minimize heat loss, contain vapors, and to ensure adequate heating
7. Utility Installation includes cost for electrical and natural gas installations and upgrades
8. Well Abandonment- 10 wells within the Operations Area will be abandoned prior to the installation of the well field.
9. Vapor treatment assumes capture and treatment of up to 850,000 pounds of VOCs during thermal remediation, and treatment using condensation, thermal oxidation, acid-gas scrubbing and other measures as needed to comply with ARARs.
10. Operations and maintenance costs assume 200 days of operation, and use of NTCRA system for final treatment of groundwater. Additional NTCRA O&M costs are not included.
11. LS - lump sum.
12. Long-term monitoring includes labor and materials for semi-annual monitoring of ONOGU ground-water quality utilizing a subset of the existing on-site ground-water monitoring well network. This assumes that 10 wells will sampled semi-annually for VOCs and MNA parameters.

13 Pilot Study necessary to determine implementability and ability to achieve target clean up goals, to confirm ability to control grounwater migration, and to confirm selection of materials of construction. Scope assumed to be similar to Silresim Site.

Table 4-34
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-6 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	The Overburden NAPL Area does not present a risk in the short term as there is no current exposure to this area of the site. This alternative would achieve the cleanup objectives for the Overburden NAPL Area by permanently removing the mass of NAPL so that the potential for NAPL migration would be eliminated. In doing so, it would shrink the size of the overburden groundwater contaminant plume and reduce groundwater contaminant concentrations. Significant potential short-term risks and impacts on workers and the community would need to be addressed during the implementation of this alternative. The potential for the release of volatile and particulate emissions during excavation could be significant, and although many of these risks could potentially be mitigated by employing personal protective equipment and excavation enclosure systems, the short-term risks for this alternative would be significantly greater than those of Alternatives ONOGU-1 through ONOGU-5. This alternative could potentially be designed, constructed and operated in accordance with the requirements of ARARs.

Table 4-34
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-6 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-35**.

Table 4-34
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-6 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness and permanence by treating contaminants in this area of the site by excavating them and permanently removing them from the site. An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of the excavation and offsite disposal alternative would result in the permanent removal of NAPL from the overburden in this portion of the site. Backfill placed below the water table would likely become recontaminated through upward migration of contaminated bedrock groundwater, however the degree of recontamination would be much significantly than the pre-excavation impacts. 2. Because this alternative would result in the complete removal of NAPL constituents, no containment systems or institutional controls would be required specifically for this area of the site. Such controls would still be required for other areas of the site (i.e., Overburden Groundwater, Bedrock Groundwater, Bedrock NAPL area, etc.)

Table 4-34
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-6 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would result in the permanent and irreversible reduction of NAPL toxicity, mobility and volume through treatment at the offsite disposal facility. 2. Excavation and offsite disposal of the overburden materials media would be expected to remove all of the existing NAPL within the Overburden NAPL Area, although there would be a potential that excavation activities could inadvertently result in release of NAPL to the bottom of the excavation and/or bedrock surface. 3. The degree of reduction would be very high as all materials above cleanup levels would be removed from the site. The potential exists for a degree of contamination of the clean backfill soils from contaminants in bedrock groundwater once the excavation dewatering system is shut off, although in time natural attenuation processes would be expected to address these contaminants. 4. The removal and treatment of NAPL constituents would be permanent and irreversible. 5. Excavation and offsite disposal of the overburden materials media would be expected to remove all of the existing NAPL within the Overburden NAPL Area. No contaminant residuals would be expected to remain following excavation. 6. Excavation and offsite disposal would eliminate the principal threat associated with potentially mobile NAPL by removing pooled NAPL.

Table 4-34
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-6 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. The potential risks associated with volatilization of NAPL contaminants and release of fugitive dust during excavation would necessitate the use of an enclosure and air treatment system to control emissions. The failure of the enclosure could result in unacceptable levels of exposure for the offsite community. To address this risk, perimeter air monitoring would be required as well as limits placed on the size of the excavation at one time. Given the large number of truckloads of materials requiring movement (approximately 4,800 truckloads), the potential risk of off-site transportation accidents, injuries and fatalities would also be relatively high for this alternative. This potential risk would be addressed by employing typical transportation safety measures. This alternative would also result in additional potential modest short-term risks to the community during treatment of groundwater extracted during the excavation dewatering process – the above-ground treatment of the extracted NAPL and NAPL-water mixture could result in the emission of VOCs to the atmosphere. This potential risk would be addressed through the use of appropriate vapor phase controls during treatment. 2. The short-term risks to workers during implementation of this alternative would require high levels of respiratory protection to protect workers involved with excavation and soil handling. Such protective measures would reduce the potential for unacceptable worker exposures. 3. There are no environmental impacts on-site from this alternative 4. Long-term protection would be achieved at the completion of the excavation activities which are expected to take three to four years to design and implement.

Table 4-34
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-6 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Offsite treatment and disposal are proven remedial technologies which are considered technically feasible. Excavation would be technically feasible, provided excavation dewatering is incorporated into the remedial design. The excavation and dewatering activities would utilize standard construction equipment and methods, although the potential need for emissions control in the form of an enclosure system would reduce the overall reliability of the alternative. 2. Compliance with the substantive requirements of treatment and disposal permits would be required; however, this is not expected to preclude the use of these technologies. In addition, a modification to the existing NPDES discharge requirements for NTCRA 1 would be required for the treatment and discharge of the flows from the excavation dewatering treatment system, and substantive air emissions requirements would also need to be met. 3. The services, equipment and materials required for the implementation of this alternative are expected to be available.

Table 4-34
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden NAPL Area

Alternative ONOGU-6 – Excavation and Offsite Disposal

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	The costs associated with this alternative include the remedial design and construction costs for the excavation and off-site disposal of the ONOGU media, including the provisions for volatile and particulate emissions control and the treatment of water from the excavation dewatering system, restoration of the ONOGU area with the placement of clean backfill materials, and ongoing operation of the NTCRA containment and treatment system during the period of design, construction and operation of the ONOGU remedy. The estimated present worth costs of this alternative is $39,970,000 (**Table 4-36**).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns 2. state’s comments on ARARs and the proposed use of waivers	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received	

Table 4-35
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden NAPL Zone
Alternative ONOGU-6: Excavation and Offsite Disposal

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These requirements establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through excavation and offsite disposal of contaminated NAPL material.	Y
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through excavation and offsite disposal of contaminated NAPL material. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	TBC Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	Will achieve compliance through excavation and off-site disposal of contaminated soils.	
Location-Specific		None apply.					

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific	State of Connecticut	Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted NAPL/groundwater and water from dewatering processes that is discharged to surface water would be treated in a manner would meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
		Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards to control emissions from construction/excavation activities with dust control measures.	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-36
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
<u>Alternative ONOGU-6: Excavation and Offsite Disposal</u>

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
A. Initial Capital Costs							
1	**Excavation Activities**						
1a	Mobilization/Demobilization	700	LS	$75	$52,500	$52,500	$52,500
1b	Site Preparation/Erosion Control Measures	1	LS	$25,000	$25,000	$25,000	$25,000
1c	Temporary Sprung Structure	1	LS	$500,000	$500,000	$500,000	$500,000
1d	Air Handling System	1	LS	$500,000	$500,000	$500,000	$500,000
1e	Excavation of Contaminated Soil	59,125	CY	$5	$295,625	$295,625	$295,625
1f	Staging and Loading Contaminated Soil	59,125	CY	$2	$118,250	$118,250	$118,250
1g	Transportation and Off-Site Disposal	73,906	TN	$290	$21,432,813	$21,432,813	$21,432,813
1h	Clean Fill, Backfill & Compaction	73,906	CY	$30	$2,217,188	$2,217,188	$2,217,188
1i	Well Abandonment	10	Well	$500	$5,000	$5,000	$5,000
1j	Well Abandonment IDW	7	CY	$75	$555	$555	$555

Table 4-36
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-6: Excavation and Offsite Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
2	**Ex-Situ Water Treatment Design and Construction**						
2a	Temporary Treatment Structure	1	LS	$310,000	$310,000	$310,000	$310,000
2b	Fencing/Temporary Access Restrictions	1	LS	$8,600	$8,600	$8,600	$8,600
2c	Site Work	1	LS	$25,000	$25,000	$25,000	$25,000
2d	Groundwater Extraction System	1	LS	$250,000	$250,000	$250,000	$250,000
2e	DNAPL Pretreatment	1	LS	$260,000	$260,000	$260,000	$260,000
2g	Metals Treatment	1	LS	$255,000	$255,000	$255,000	$255,000
2h	Primary VOC Treatment	1	LS	$260,000	$260,000	$260,000	$260,000
2i	Polishing	1	LS	$210,000	$210,000	$210,000	$210,000
2j	IDW Disposal	215	CY	$75	$16,125	$16,125	$16,125
2k	NTCRA 1/2 Integration	1	LS	$60,000	$60,000	$60,000	$60,000
				Initial Capital Cost Subtotal:	$26,801,655	$26,801,655	$26,801,655
				Total Initial Capital Cost (rounded):	**$26,800,000**	**$26,800,000**	**$26,800,000**

Table 4-36
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-6: Excavation and Offsite Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
B. O&M Costs for Ex-Situ Water Treatment (90 days)							
1	**System Operation and Maintenance**	720	man hours	$75	$54,000	$54,000	$54,000
2	**System utilities**						
2a	Electric	100,000	KW hours	$0.11	$11,000	$11,000	$11,000
2b	Gas	30,000	Therm (100 ft^3)	$0.60	$18,000	$18,000	$18,000
3	**System Chemicals**						
3a	Caustic Soda	100,000	kg	$0.44	$44,000	$44,000	$44,000
3b	Polymer	1,350	gal	$60	$81,000	$81,000	$81,000
3c	Sulfuric Acid	1,150	kg	$0.45	$518	$518	$518
3d	Coagulant Aid (Aluminum Chlorhydrate)	450	gal	$10	$4,500	$4,500	$4,500
4	**Disposal Costs**						
4a.	DNAPL - Bulk Disposal	45,455	kg	$2.10	$95,455	$190,909	$381,818
4b	Non-PCB Sludge Disposal - Drums	50	ea	$100	$5,000	$5,000	$5,000
5	**Laboratory Analysis**	60	ea	$470	$28,200	$28,200	$28,200
6	**Well Redevelopment, Tooling, Health & Safety Mea**	1	LS	$25,000	$25,000	$25,000	$25,000
				Water Treatment O&M Cost Subtotal:	$366,672	$462,127	$653,036
				Total Operating Capital Cost (rounded):	**$370,000**	**$460,000**	**$650,000**

Table 4-36
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-6: Excavation and Offsite Disposal

Item No.	Description	Quantity	Unit	Unit Cost	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
C. Monitoring Costs (5 Years of Monitoring, 10 wells, twice per year, VOCs + MNA parameters)							
1	**Compliance Monitoring**	100	man hours	$95	$9,500	$9,500	$9,500
2	**Analytical**	24	analysis	$500	$12,000	$12,000	$12,000
3	**Equipment**	20	each	$125	$2,500	$2,500	$2,500
Subtotal Annual O&M Cost:					$24,000	$24,000	$24,000
Total Annual O&M Cost:					$24,000	$24,000	$24,000
Present Worth Factor (5 years, no discount):					5	5	5
Total Present Worth of Annual O&M Cost (rounded):					**$120,000**	**$120,000**	**$120,000**

Description	Cost (500,000 pounds VOCs)	Cost (1,000,000 pounds VOCs)	Cost (2,000,000 pounds VOCs)
Aggregate Present Worth of Total Cost:	**$27,290,000**	**$27,380,000**	**$27,570,000**
Remedial Design (2%)	$545,800	$547,600	$551,400
Project Administration/Management Cost (2%)	$545,800	$547,600	$551,400
Construction Management (2%)	$545,800	$547,600	$551,400
Scope Contingency (25%)	$6,822,500	$6,845,000	$6,892,500
Bid or Construction Contingency (15%):	$4,093,500	$4,107,000	$4,135,500
Subtotal	$39,843,400	$39,974,800	$40,252,200
Rounded To:	**$39,840,000**	**$39,970,000**	**$40,250,000**

Table 4-36
SRSNE Superfund Site
Feasibility Study

Overburden NAPL Area Remedial Alternatives Cost Estimate
Alternative ONOGU-6: Excavation and Offsite Disposal

1. Excavation assumes 30% and Final Design.
2. IDW Volumes: .74 cubic yard per well
3. Site work cost include Clearing and Grubbing, and Site Prep, and erosion control measures.
4. Mobilization & Demobilization includes cost for equipment and field offices.
5. Excavation Dewatering System- includes cost for drillers time and materials to install dewatering well field
6. Staging & Loading of material includes on-site preparation for shipment of soils.
7. DNAPL Pretreatment consist of NAPL Phase Separation Tanks
8. VOC treatment consist of Air Stripping, Catalytic Oxidation, and HCL Scrubber
9. Polishing Treatment consist of Photo Catalytic Oxidation
10. Well Abandonment- 10 wells within the Operations Area will be abandoned prior to excavation.
11. Transportation and Off-Site Disposal Costs assume transportation to Model City, NY, S/S pretreatment, and TSCA disposal.
12. LS - lump sum.
13. Long-term monitoring includes labor and materials for semi-annual monitoring of ONOGU ground-water quality utilizing a subset of the existing on-site ground-water monitoring well network. This assumes that 10 wells will sampled semi-annually for VOCs and MNA parameters.

Table 4-37
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Overburden Groundwater does not present a risk in the short term as there is no current exposure to this area of the site. Because this alternative does not require any action to be taken to address the risks from the Overburden NAPL Area, it does not provide overall protection of human health and the environment in the long term as waste material is neither eliminated, reduced nor controlled. This alternative does not meet ARARs or cleanup objectives established for this area of the site.

NCP Analysis Criteria	SRSNE FS Analysis
Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-38**.

Table 4-37
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	Because the No Action alternative would not require any action to be taken, this alternative neither provides long term effectiveness nor permanence. The magnitude of the residual risk is high as significant contamination remains unaddressed in this area of the site. Because there are no actions taken under this alternative, there are no controls in place to assess their adequacy or reliability.

NCP Analysis Criteria	SRSNE FS Analysis
Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	This alternative does not provide treatment for the reduction of the toxicity, mobility, and volume of contaminants in this area of the site. However, over time natural attenuation processes will very very slowly reduce the toxicity and volume of contaminants. Absent any monitoring or other activities to assess the progress of these processes, this reduction could not be documented.

Table 4-37
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	No remedial actions would be required under this alternative; therefore no short-term risks would be posed to the community or onsite workers during implementation. There would also be no short-term environmental impacts associated with this alternative. Because no action is being taken to address the risk this area of the site presents, and no monitoring is being done to evaluate naturally-occurring degradation, time to achieve protection is unknown. However, it is estimated to take on the order of 200 years until protection is achieved due to the upwelling of contaminated groundwater from the bedrock into the overburden aquifer. This estimate is based on the assumption that virtually all (99%) of the NAPL has been removed from the Overburden NAPL Area.

NCP Analysis Criteria	SRSNE FS Analysis
Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	The No Action treatment alternative would be technically and administratively feasible and would not require the use of services or materials to be implemented.

Table 4-37
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M cost.	No capital costs would be associated with the No Action alternative. The present worth costs of conducting five-year reviews are estimated to be $60,000 assuming a duration of 30 years. The total cost for this alternative is $80,000, as summarized on **Table 4-39**.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State’s comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-38
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater
Alternative OGW-1: No Action

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	No action would be taken to address overburden groundwater that exceeds these requirements. Therefore, alternative would not meet ARARs.	N
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	No action would be taken to address overburden groundwater that exceeds these requirements. .Therefore, alternative would not meet ARARs.	N
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-39
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-1: No Action

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
	No Initial Capital Costs				$0
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (Perpetuity)					
1	Five Year Reviews	1	LS	$5,000	$5,000
				Annual O&M Cost Subtotal:	$5,000
				Total Annual O&M Cost:	$5,000
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost (rounded):	**$60,000**

Description	Cost
Aggregate Present Worth of Total Cost:	**$60,000**
Remedial Design (0%)	$0
Project Administration/Management Cost (0%)	$0
Construction Management (N/A - 0%)	$0
Scope Contingency (15%)	$9,000
Bid or Construction Contingency (15%):	$9,000
Subtotal	$78,000
Rounded To:	**$80,000**

Notes:

1. Assumes spreading five year review cost over time as annual cost.
2. LS - lump sum.

Table 4-40
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-2 – Institutional Controls and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Overburden groundwater does not present a risk in the short term as there is no current exposure to this area of the site. This alternative provides overall protection of human health and the environment through the use of institutional controls to prevent exposure to contaminated groundwater. Monitored natural attenuation would eventually restore groundwater quality to meet ARARS.

Table 4-40
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-2 – Institutional Controls and MNA

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-41**.

Table 4-40
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-2 – Institutional Controls and MNA

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would provide long term effectiveness by restricting the use of groundwater through institutional controls. MNA would eventually reduce contaminant concentrations to safe levels but only in a very long time frame. Because contaminant concentrations will eventually reach safe levels, the magnitude of residual risk in the long term is low. 2. This alternative relies on institutional controls to prevent exposure to groundwater in this area of the site. Institutional controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining onsite above safe levels for a very long period of time, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Alternative OGW-2 – Institutional Controls and MNA

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative provides treatment for the reduction of the toxicity, mobility, and volume of contaminants in this area of the site through MNA. Over time natural attenuation processes will very very slowly reduce the toxicity and volume of contaminants in this area of the site. 2. When coupled with an effective source control (i.e., Overburden NAPL Area) alternative, the MNA component of this alternative would eventually result in the complete destruction of contaminants in the Overburden Groundwater. 3. The MNA component of this alternative would result in complete removal through degradation of Overburden Groundwater contaminants over time. 4. Treatment of contaminants in the Overburden Groundwater through MNA would be permanent and irreversible. 5. Based on previous monitoring of the Overburden Groundwater, analytical data indicate that dissolved VOCs are being degraded to carbon dioxide (CO_2) and methane (CH_4) due to the presence of naturally occurring, biologically mediated oxidation reduction reactions, and that dissolved chlorinated VOCs are being dechlorinated in-situ due to the anaerobic conditions resulting from biodegradation of the aromatic VOCs. 6. Although groundwater cannot be identified as a principal threat, this alternative eventually reduces the levels of contamination which present an unacceptable risk.

Table 4-40
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-2 – Institutional Controls and MNA

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of this alternative would not result in any significant short-term exposure of the community to the chemical constituents present in the Overburden Groundwater. 2. Potential exposure of onsite workers to contaminants in Overburden Groundwater could occur during periodic groundwater sampling activities. These potential risks would be addressed by the use of PPE and compliance with a site-specific HASP. 3. No potential environmental impacts would be anticipated as a result of the implementation of this alternative. 4. In the short term, protection will be achieved when institutional controls are put in place. In the long term, protection will be achieved in an estimated 200 years due to the upwelling of contaminated groundwater from the bedrock into the overburden aquifer. This estimate is based on the assumption that virtually all (99%) of the NAPL has been removed from the Overburden NAPL Area.

Table 4-40
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-2 – Institutional Controls and MNA

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. MNA has been applied at full scale at many sites, and is a proven and reliable technology for the in-situ destruction of organic contaminants. Based on studies previously completed at the site, it has been shown to be a viable and technically feasible technology. 2. This alternative would be administratively feasible. Although the institutional measures component would require coordination with the state and town, these controls should be easily implemented. 3. This alternative could be implemented using available services, materials and equipment.

Table 4-40
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-2 – Institutional Controls and MNA

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M cost.	Capital costs associated with this alternative include the implementation of the institutional measures, and removal of the NTCRA 1 containment area sheet pile wall. Operation and maintenance costs would include semiannual monitoring for the MNA component of the alternative. Future site closure capital costs for the abandonment of the site's monitoring wells would also be incurred at the time of remedy completion. The estimated cost of this alternative is $2,590,000 (**Table 4-42**), assuming a 30-year operation period.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State's comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-41
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater
Alternative OGW-2: Institutional Controls

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance with regulation through monitored natural attenuation, therefore, alternative would meet ARAR.	Y
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance with regulation through monitored natural attenuation, therefore, alternative would meet ARAR.	Y
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	TBC Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	Would eventually achieve compliance though natural attenuation	

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Location-Specific Action-Specific		None apply.					

Table 4-42
SRSNE Superfund Site
Feasibility Study

Ground-Water Remedial Alternatives Cost Estimate
Alternative OGW-2: Institutional Measures and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Institutional Controls**	200	man hours	$250	$50,000
2	**Sheet Pile Removal (Create Gaps)**	1	LS	$100,000	$100,000
3	**Initial Groundwater Sampling**				
3a	**Sampling**	800	man hours	$95	$76,000
3b	**Analytical**	240	analysis	$500	$120,000
3c	**Equipment**	200	each	$125	$25,000
				Initial Capital Cost Subtotal:	$371,000
				Total Initial Capital Cost (rounded):	**$370,000**
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30+ years)					
1	**Verify Institutional Controls**	20	man hours	$125	$2,500
2	**Annual MNA Sampling and Analysis**				
2a	**MNA Sampling**	200	man hours	$95	$19,000
2b	**MNA Analytical**	60	analysis	$600	$36,000
2c	**MNA Equipment**	60	each	$125	$7,500
3	**Complete Round of TCL/TAL every five years - annualized costs for 200 wells**				
3a	**Sampling**	160	man hours	$95	$15,200
3b	**Analytical**	48	analysis	$500	$24,000
3c	**Equipment**	40	each	$125	$5,000
4	**Five Year Reviews**	1	LS	$5,000	$5,000
				Annual O&M Cost Subtotal:	$114,200
				Total Annual O&M Cost (rounded):	**$110,000**
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost (rounded):	**$1,370,000**

Table 4-42
SRSNE Superfund Site
Feasibility Study

Ground-Water Remedial Alternatives Cost Estimate
Alternative OGW-2: Institutional Measures and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost
D. Site Closure Capital Costs					
1	**Monitoring Well Abandonment**	300	Wells	$1,000	$300,000
2	**Well Abandonment IDW**	555	CY	$75	$41,625
3	**Demobe of equipment**	1,000	man hours	$115	$115,000
4	**Dismantling NTCRA GW Treat. Bldg.**	1,000	man hours	$75	$75,000
5	**Demo & Disposal**	22,000	kg	$5	$99,000
	Subtotal Site Closure Cost:				$630,625
	Total Site Closure Cost (rounded):				**$630,000**
	Single Future Payment Factor				**0.356**
	Total Present Worth of Site Closure Cost (rounded):				**$220,000**

Description	Cost
Aggregate Present Worth of Total Cost:	**$1,960,000**
Remedial Design (4%)	$78,400
Project Administration/Management Cost (5%)	$98,000
Construction Management (3%)	$58,800
Scope Contingency (10%)	$196,000
Bid or Construction Contingency (10%):	$196,000
Subtotal	$2,587,200
Rounded To:	**$2,590,000**

Table 4-42
SRSNE Superfund Site
Feasibility Study

Ground-Water Remedial Alternatives Cost Estimate
Alternative OGW-2: Institutional Measures and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost

Notes:

1. Long-term monitoring includes labor and materials for semi-annual monitoring of ground-water quality utilizing the existing on-site ground-water monitoring wells.
2. Institutional controls includes implementing an ELUR to limit future usage of the Site and use of Site ground water. Because these institutional controls would be in addition to those employed as part of the vadose zone soil remedy, the costs included for this alternative would be additive to those costs included in the vadose soil alternatives.
3. LS - lump sum.
4. Contingency includes unforeseen legal and administrative fees and insurance.
5. Initial sampling assumes one round of 200 wells for TCL/TAL parameters.
6. Assumes sampling 25 wells for VOCs and MNA parameters twice per year
7. Assumes sampling 200 wells for TCL/TAL parameters once every five years
8. Assumes the Groundwater Treatment System and Equipment will be removed at Site Closure
9. Assumes all Groundwater monitoring wells will be abandoned at Site Closure.

Table 4-43
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-3 – Hydraulic Containment and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Overburden groundwater does not present a risk in the short term as there is no current exposure to this area of the site. This alternative provides overall protection of human health and the environment through the use of institutional controls to prevent exposure to all contaminated groundwater, hydraulic containment to contain and treat the most contaminated portion of the plume, and MNA of the severed portion of the plume. Natural attenuation is expected to restore groundwater quality in the severed portion of the Overburden Groundwater plume within a reasonable time frame (in fact, this area of the Overburden Groundwater area was restored to drinking water quality within a few years after the startup of the NTCRA 2 extraction system). Additionally, once an effective Overburden NAPL remedy has been implemented, this alternative would be expected to achieve cleanup levels inside the hydraulic containment area within a reasonable time frame.

Table 4-43
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-3 – Hydraulic Containment and MNA

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-44**.

Table 4-43
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-3 – Hydraulic Containment and MNA

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative provides long-term effectiveness and permanence by permanently reducing contaminant concentrations to safe levels through natural processes, preventing exposure until safe levels are reached through the use of institutional controls, and through the use of hydraulic containment to capture and treat the highly-contaminated portion of the groundwater plume. Under this alternative, contaminants in this area of the site would eventually be reduced to safe levels. As a result, in the long term, the residual risk will be low. This alternative would be expected to provide hydraulic containment of the entire Overburden Groundwater area having contaminant concentrations above drinking water regulatory standards. Low levels of contaminants (above laboratory detection limits but below regulatory standards) downgradient of the hydraulic containment system would be restored through natural attenuation. 2. The hydraulic containment component of this alternative has been reliably operated for many years at the site (as part of the NTCRA1 and NTCRA 2 containment systems). This alternative would require continued monitoring to ensure that the system continues to effectively contain contaminated groundwater. This alternative also relies on institutional controls to prevent exposure to groundwater in this area of the site until safe levels are reached. Institutional controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining onsite above safe levels for a very long period of time, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-43
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-3 – Hydraulic Containment and MNA

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative reduces toxicity, mobility, and volume of contaminants in this area of the site through hydraulic containment of the highly-contaminated portion of the plume, and MNA for the rest of the plume. In addition, contaminants in groundwater removed by the hydraulic containment system would be treated using a modified NTCRA 1 treatment system. The hydraulic containment system will greatly reduce mobility of contaminants while also reducing volume and toxicity. Over time, natural attenuation processes will reduce the toxicity and volume of contaminants in this area of the site. 2. When coupled with an effective source control (i.e., Overburden NAPL Area) alternative, this alternative would result in the complete destruction of contaminants in the Overburden Groundwater. 3. This alternative would be effective in permanently reducing the toxicity and volume of contaminants in the treated groundwater as a result of the hydraulic containment system. Data collected from the site confirms that active pumping can be used to provide hydraulic containment, thus this alternative would also reduce the mobility of contamination within the containment area. The MNA component would result in complete removal through degradation of Overburden Groundwater contaminants over time. 4. Treatment of contaminants using a modified NTCRA 1 treatment system and through natural attenuation processes would be permanent and irreversible. 5. Within a reasonable time period following the completion of an effective remedy in the Overburden NAPL Area, MNA would be expected to reduce contaminant toxicity, mobility and volume in the Overburden Groundwater. 6. Although groundwater cannot be identified as a principal threat, this alternative eventually reduces the levels of contamination which present an unacceptable risk to an acceptable level.

Table 4-43
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-3 – Hydraulic Containment and MNA

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of this alternative would not result in any significant short-term exposure of the community to the chemical constituents present in the Overburden Groundwater. 2. Implementation of this alternative may potentially result in short-term exposure of onsite workers to the chemical constituents present in the impacted groundwater by ingestion or dermal contact with groundwater. Additional potential exposure through inhalation of volatilized chemicals may also occur. These potential exposures would be addressed by the use of PPE and compliance with a site-specific HASP. 3. No short-term environmental impacts would be anticipated. 4. In the short term, protection will be achieved when institutional controls are put in place. In the long term, protection will be achieved in an estimated 200 years due to the upwelling of contaminated groundwater from the bedrock into the overburden aquifer. This estimate is based on the assumption that virtually all (99%) of the NAPL has been removed from the Overburden NAPL Area. Hydraulic containment does not significantly reduce the time to achieve protection, but it protects against the spread of the groundwater plume.

Alternative OGW-3 – Hydraulic Containment and MNA

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Hydraulic containment and active treatment using the NTCRA 1 treatment system and the NTCRA 1 and 2 extraction wells have been ongoing at the site for many years. In addition, MNA has been applied at full scale at many sites, and is a proven and reliable technology for the in-situ destruction of organic contaminants. This alternative would be technically feasible. 2. This alternative would also be administratively feasible. Discharge of treated water would require compliance with NPDES discharge requirements. Although the institutional measures component would require coordination with the state and town, these controls should be easily implemented. 3. This alternative could be implemented using available services, materials and equipment.

Table 4-43
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-3 – Hydraulic Containment and MNA

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	Capital costs associated with this alternative would include the installation of a second NTCRA 2 groundwater extraction well, pump, controls, piping, etc.; and the modification of the groundwater treatment system to reflect groundwater conditions following ONOGU treatment. Operation and maintenance costs are calculated assuming operation of the system for 30 years. The MNA component of this alternative will continue for 30 years. Future site closure capital costs for the abandonment of the site's monitoring wells would also be incurred at the time of remedy completion. The estimated cost of this alternative is $9,570,000 (see **Table 4-45**), assuming a 30-year operation period.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State's comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-44
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater Unit
Alternative OGW-3: Hydraulic Containment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through natural attenuation.	Y
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance though natural attenuation. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	TBC Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	Would eventually achieve compliance though natural attenuation.	

Table 4-44 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater Unit
Alternative OGW-3: Hydraulic Containment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Location-Specific		None apply.					
Action-Specific	State of Connecticut	Hazardous Waste Management	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Applicable	These regulations establish standards for treatment, storage and disposal of hazardous waste and remediation waste, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities	Treatment residues (spent filtration residue and activated carbon) could contain high concentrations of regulated constituents. If determined to be hazardous waste, will be stored on site consistent with these requirements before being shipped offsite for disposal. Groundwater will be monitored in accordance with these requirements.	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted groundwater that is discharged to surface water would be treated in a manner would meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
		Air Pollution Control	CGS 22a ch 446c RCSA §22a-174-1 to 33	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards, requirements for pollutant abatement and requirements for control of fugitive dust from construction/excavation activities with dust control measures	Y

Table 4-44 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater Unit
Alternative OGW-3: Hydraulic Containment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-45
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-3: Hydraulic Containment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Institutional Controls**	200	man hours	$250	$50,000
2	**Sheet Pile Removal (Create Gaps)**	1	LS	$100,000	$100,000
3	**Initial Groundwater Sampling**				
3a	**Sampling**	800	man hours	$95	$76,000
3b	**Analytical**	240	analysis	$500	$120,000
3c	**Equipment**	200	each	$125	$25,000
4	**Final Post-HD System Modification**	1,000	man hours	$115	$115,000
5	**New Equipment**	1	LS	$500,000	$500,000
				Initial Capital Cost Subtotal:	$986,000
				Total Initial Capital Cost (rounded):	**$990,000**
B. Recurring Capital Costs					
1	Equipment Replacement	1	LS	$500,000	$500,000
				Recurring Capital Cost Subtotal:	$500,000
				Total Recurring Capital Cost	$500,000
				Annualization Factor (15 years, 7%)	0.040
				Total Annualized Recurring Capital Cost	$19,900
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Recurring Capital Cost (rounded):	**$250,000**

Table 4-45
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-3: Hydraulic Containment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost
C. Annual Operation and Maintenance Costs (Extraction and Treatment for 30 years)					
1	**System Operation and Maintenance**	3,000	man hours	$75	$225,000
1a	System Utilities	100000	KW hours	$0.15	$15,000
1b	Well redevelopment	200	man-hours	$75	$15,000
1c	Development Chemicals	550	gallons	$5	$2,750
1d	Replacement Equipment Cost	12	days	$1,000	$12,000
1e	Spare Parts	1	LS	$30,000	$30,000
1f	System Chemicals	2000	gallons	$5	$10,000
1g	Laboratory Analysis	50	each	$500	$25,000
1h	Filter Cake Disposal Costs	30	CY	$500	$15,000
2	**Compliance Monitoring**	208	man hours	$75	$15,600
3	**Annual MNA Sampling and Analysis**				
3a	MNA Sampling	200	man hours	$95	$19,000
3b	MNA Analytical	60	analysis	$600	$36,000
3c	MNA Equipment	60	each	$125	$7,500
4	**Complete Round of TCL/TAL every five years**	200	wells		
4a	Sampling	160	man hours	$95	$15,200
4b	Analytical	48	analysis	$500	$24,000
4c	Equipment	40	each	$125	$5,000
5	**Five Year Reviews**	1	LS	$5,000	$5,000
				Annual O&M Cost Subtotal:	$477,050
				Total Annual O&M Cost (rounded):	$480,000
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost (rounded):	**$5,960,000**

Table 4-45
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-3: Hydraulic Containment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost
D. Site Closure Capital Costs					
1	**Monitoring Well Abandonment**	300	Wells	$1,000	$300,000
2	**Well Abandonment IDW**	555	CY	$75	$41,625
3	**Demobe of equipment**	1,000	man hours	$115	$115,000
4	**Dismantling NTCRA GW Treat. Bldg.**	1,000	man hours	$75	$75,000
5	**Demo & Disposal**	22,000	kg	5	$99,000
	Subtotal Site Closure Cost:				$630,625
	Total Site Closure Cost:				**$630,000**
	Single Future Payment Factor				**0.356**
	Total Present Worth of Site Closure Cost (rounded):				**$220,000**

Description	Cost
Aggregate Present Worth of Total Cost:	**$7,420,000**
Remedial Design (3%)	$222,600
Project Administration/Management Cost (5%)	$371,000
Construction Management (1%)	$74,200
Scope Contingency (10%)	$742,000
Bid or Construction Contingency (10%):	$742,000
Subtotal	$9,571,800
Rounded To:	**$9,570,000**

Table 4-45
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-3: Hydraulic Containment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost

Notes:

1. Long-term monitoring includes labor and materials for semi-annual monitoring of ground-water quality utilizing the existing on-site ground-water monitoring wells. This assumes that a subset of approximately 25 wells would be sampled for MNA parameters (including VOCs) semi-annually.
2. Institutional controls includes implementing an ELUR to limit future usage of the Site and use of Site ground water. Because these institutional controls would be in addition to those employed as part of the vadose zone soil remedy, the costs included for this alternative would be additive to those costs included in the vadose soil alternatives.
3. It is assumed that hydraulic containment would be achieved by pumping existing well RW-13 and one new downgradient extraction well. For the purpose of cost estimation, the additional downgradient well is assumed to pump at the same rate as the existing well at the TI Boundary for a total influent flow rate of 45 gpm to the remedial treatment system from NTCRA2.

Table 4-45
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-3: Hydraulic Containment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost

4. Installation of extraction wells includes one backup overburden pumping well and one downgradient pumping well.
5. Equipment replacement cost assumes 50% of the initial capital construction cost will be required within 15 years of commencing operation to replace mechanical components (e.g. pumps, valves, well rehabilitation), including the equipment installed as part of the NTCRA 1 system.
6. Long-term operation and maintenance costs include all costs necessary to operate and maintain the pumping wells and the remedial treatment system including: equipment repair, energy costs, carbon regeneration and off-gas treatment.
7. LS - lump sum.
8. Contingency includes unforeseen legal and administrative fees and insurance.
9. Initial sampling assumes one round of 200 wells for TCL/TAL parameters.
10. Assumes sampling 25 wells for VOCs and MNA parameters twice per year
11. Assumes sampling 200 wells for TCL/TAL parameters once every five years
12. Assumes the Groundwater Treatment System and Equipment will be removed at Site Closure
13. Assumes all Groundwater monitoring wells will be abandoned at Site Closure.

14 Costs for NTCRA O&M are based on past project experience.

Table 4-46
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-4 – Supplemental Containment (Contingent)

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Overburden Groundwater does not present a risk in the short term as there Is no current exposure to this area of the site. This alternative would provide overall protection of human health and the environment by using hydraulic isolation to prevent migration of site related contamination in the event that Town Wells No. 4 and/or No. 6 were to be operated in the future. This is a contingent action that would supplement the selected groundwater remedy.

Table 4-46
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-4 – Supplemental Containment (Contingent)

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-47**.

Table 4-46
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-4 – Supplemental Containment (Contingent)

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This contingent alternative provides long-term effectiveness by providing hydraulic isolation from the effects of town well pumping to prevent site-related contaminants from reaching the Town Wells. The magnitude of the residual risk will be determined by the selected remedy. This alternative relies on hydraulic isolation to prevent contamination from reaching town wells.

Table 4-46
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-4 – Supplemental Containment (Contingent)

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	The reduction of toxicity, and volume would be addressed through the selected Overburden Groundwater alternative. Alternative GW-4 would slightly increase the rate of reduction of toxicity, or volume of constituents in groundwater through an increased withdrawal rate. This alternative would limit the dissolved phase mobility of SRSNE-related contaminants in the presence of pumping of Town Wells No. 4 and 6 by providing hydraulic isolation from the effects of well pumping, but would not address non-SRSNE VOC sources that would be expected to affect the Town Wells.

Table 4-46
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-4 – Supplemental Containment (Contingent)

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of this alternative would not result in any significant short-term exposure of the community to the chemical constituents present in the Overburden Groundwater Unit. 2. Implementation of this alternative may result in the short-term exposure of onsite workers to the chemical constituents present in the impacted groundwater by ingestion or dermal contact with groundwater. Additional exposure through inhalation of volatilized chemicals may also occur. These potential exposures would be mitigated by the use of PPE and compliance with a site-specific HASP. 3. No short-term environmental impacts would be anticipated. 4. In the short term, protection will be achieved in six months, the time it would take to design and implement this contingent alternative. In the long term, the time required to achieve protection would depend on the selected groundwater alternative.

Table 4-46
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-4 – Supplemental Containment (Contingent)

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Hydraulic containment and active treatment using the NTCRA 1 treatment system and the NTCRA 1 and 2 extraction wells has been ongoing at the site for many years. In addition, MNA has been applied at full scale at many sites, and is a proven and reliable technology for the in-situ destruction of organic contaminants. This alternative would be technically feasible. 2. This alternative would also be administratively feasible. Discharge of treated water would require compliance with NPDES permit equivalency requirements. Although the institutional measures component would require approval of the state and town, it is expected that such approval would be granted. 3. This alternative could be implemented using available services, materials and equipment.

Table 4-46
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Overburden Groundwater

Alternative OGW-4 – Supplemental Containment (Contingent)

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	Costs associated with this alternative, which would be in addition to the estimated cost for the selected groundwater alternative, include capital costs for the construction of the additional extraction wells and connection of the wells to the existing NTCRA 1 treatment system. Operation and maintenance costs would be related to operation of the wells and the treatment of the extracted groundwater. The estimated cost of this alternative is $1,380,000 (see **Table 4-48**).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. state's position and key concerns. 2. state’s comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-47
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater
Alternative OGW-4: Supplemental Containment (Contingent)

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through natural attenuation.	Y
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through natural attenuation. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has met GWPS and other ARAR/risk based cleanup levels.	Y

Table 4-47 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater Unit
Alternative OGW-4: Supplemental Containment (Contingent)

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
		Proposed Revisions – Connecticut's Remediation Standard Regulations Volatilization Criteria, March 2003	Proposed Revisions to portions of RCSA §§22a-133k-1 through 3	Will be applicable (as part of the RSRs) when adopted	Revises how volatilization criteria are calculated, incorporated revised transport models and updated risk information, and volatilization criteria are applied.	Would eventually achieve compliance through natural attenuation.	
Location-Specific		None apply.					
Action-Specific	State of Connecticut	Hazardous Waste Management Regulations	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Applicable	These regulations establish standards for treatment, storage and disposal of hazardous waste and remediation waste, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities	Treatment residues (spent filtration residue and activated carbon) could contain high concentrations of regulated constituents. If determined to be hazardous waste, will be stored on site consistent with these requirements before being shipped offsite for disposal. Groundwater will be monitored in accordance with these requirements.	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted groundwater that is discharged to surface water would be treated in a manner would meet the requirements of these regulations.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y

Table 4-47 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Overburden Groundwater Unit
Alternative OGW-4: Supplemental Containment (Contingent)

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
		Air Pollution Control: Control of Particulate Matter	CGS 22a ch 446c RCSA §22a-174-1 to 20	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards to control fugitive dust from construction/excavation activities with dust control measures	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-48
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-4: Supplemental Containment (Contingent)

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Installation of Additional Wells**	3	EA	$85,000	$255,000
2	**Tie-in to Existing System**	1	LS	$25,000	$25,000
				Initial Capital Cost Subtotal:	$280,000
				Total Initial Capital Cost (rounded):	**$280,000**
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30+ years)					
1	Additional O&M Costs	1	LS	$50,000	$50,000
				Annual O&M Cost Subtotal:	$50,000
				Total Annual O&M Cost:	**$50,000**
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost (rounded):	**$620,000**

Table 4-48
SRSNE Superfund Site
Feasibility Study

Groundwater Remedial Alternatives Cost Estimate
Alternative OGW-4: Supplemental Containment (Contingent)

Item No.	Description	Quantity	Unit	Unit Cost	Cost
D. Site Closure Capital Costs					
1	**Well Abandonment**				
1a	Well Abandonment	5	Wells	$1,000	$5,000
1b	Well Abandonment IDW	9	CY	$75	$694
2	**Infrastructure Abandonment**	5	LS	$1,000	$5,000
				Subtotal Site Closure Cost:	$10,694
				Total Site Closure Cost:	**$11,000**
				Single Future Payment Factor	**0.356**
				Total Present Worth of Annual O&M Cost (rounded):	**$4,000**

Description	Cost
Aggregate Present Worth of Total Cost:	**$900,000**
Remedial Design (6%)	$54,000
Project Administration/Management Cost (3%)	$27,000
Construction Management (4%)	$36,000
Scope Contingency (25%)	$225,000
Bid or Construction Contingency (15%):	$135,000
Subtotal	$1,377,000
Rounded To:	**$1,380,000**

Notes:

1. The cost for this alternative would be in addition to the cost for the OGW-3 ground-water remedial alternative.
2. LS - lump sum.
3. Assumes extraction wells will be abandoned at site closure.

Table 4-49
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Under the current exposure scenario, no risks are associated with human exposure to NAPL or groundwater in the bedrock aquifer. Because this alternative does not require any action to be taken to address the risks from the Bedrock NAPL Area, it does not provide any overall protection of human health and the environment in the long term as waste material is neither eliminated, reduced nor controlled. This alternative does not meet ARARs or cleanup objectives established for this area of the site.

Table 4-49
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-1 – No Action

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-50**.

Table 4-49
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-1 – No Action

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative does not provide any long-term effectiveness or permanence. Because the No Action alternative would not involve any monitoring of the ongoing natural attenuation processes within the Bedrock NAPL Area, the degree to which long-term effectiveness and permanence is achieved cannot be assessed.

Table 4-49
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-1 – No Action

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	Although not an active remedy, the No Action alternative would allow the continued reduction of the toxicity, mobility, and volume of contaminants in the Bedrock NAPL Area over time through natural attenuation processes. However, absent any monitoring or other activities to assess the progress of these processes, this reduction could not be documented.

Table 4-49
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-1 – No Action

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	No remedial actions would be initiated under this alternative; therefore no short-term risks would be posed to the community or onsite workers during implementation. There would also be no short-term environmental impacts associated with this alternative. Because no action is being taken to address the risk this area of the site presents, and no monitoring is being done to evaluate naturally-occurring degradation, time to achieve protection is unknown. However, it is estimated to be on the order of 200 years until protection is achieved.

Table 4-49
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-1 – No Action

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	The No action alternative would be technically and administratively feasible

Table 4-49
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-1 – No Action

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	No capital costs would be associated with the No Action alternative (**Table 4-51**). The present worth costs of conducting five-year reviews are included in the estimates of the annual operation and maintenance costs for the Overburden Groundwater alternatives (OGW).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State’s comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-50
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Bedrock NAPL Zone
Alternative NBGU-1: No Action

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	No action would be taken to address overburden groundwater that exceeds these requirements; therefore, this alternative would fail to meet this ARAR	N
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	No action would be taken to address overburden groundwater that exceeds these requirements; therefore, this alternative would fail to meet this ARAR.	N
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-51
SRSNE Superfund Site
Feasibility Study

NAPL in Bedrock Groundwater Unit Remedial Alternatives Cost Estimate
Alternative NBGU-1: No Action

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	No Initial Capital Costs				$0
B. Recurring Capital Costs					
1	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (Perpetuity)					
1	No O&M				$0
				Annual O&M Cost Subtotal:	$0
				Project Administration/Management Cost (10%)	$0
				Initial Capital Cost Contingency (20%):	$0
				Total Annual O&M Cost:	$0
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost:	**$0**
				Aggregate Present Worth of Total Cost:	**$0**
				Rounded To:	**$0**

Note:

1. No action, five-year review costs included under Overburden Groundwater

Table 4-52
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-2 – Institutional Controls and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Under the current exposure scenario, no risks are associated with human exposure to NAPL or groundwater in the bedrock aquifer. This alternative provides overall protection of human health and the environment through the use of institutional controls to prevent exposure to contaminated groundwater. Monitored natural attenuation would eventually restore groundwater quality to meet ARARS.

Table 4-52
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-2 – Institutional Controls and MNA

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-53**.

Table 4-52
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-2 – Institutional Controls and MNA

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would provide long-term effectiveness by restricting the use of groundwater through institutional controls. MNA would eventually reduce contaminant concentrations to safe levels but only in a very long time frame. Because contaminant concentrations will eventually reach safe levels, the magnitude of residual risk in the long term is low. 2. This alternative relies on institutional controls to prevent exposure to groundwater in this area of the site. Institutional controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining onsite above safe levels for a very long period of time, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-52
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-2 – Institutional Controls and MNA

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. The MNA component of this alternative would result in the permanent reduction of contaminant toxicity, mobility and volume through treatment, by the natural mineralization of contaminants in the subsurface. 2. The MNA component of this alternative would result in the in-situ destruction of the NAPL contaminants through naturally-occurring processes; the complete removal through degradation of NAPL contaminants would occur over time. 3. The MNA component of this alternative would result in the permanent reduction of contaminant toxicity, mobility and volume through treatment, by the natural mineralization of contaminants in the subsurface. Based on previous monitoring of the Overburden Groundwater Unit, analytical data indicate that dissolved VOCs are being degraded to carbon dioxide (CO_2) and methane (CH_4) due to the presence of naturally occurring, biologically mediated oxidation reduction reactions, and that dissolved chlorinated VOCs are being dechlorinated in-situ due to the anaerobic conditions resulting from biodegradation of the aromatic VOCs. It is believed that these same processes are occurring in the bedrock. 4. The destruction of contaminants in the NBGU through MNA would be permanent and irreversible. 5. The MNA component of this alternative would result in the in-situ destruction of the NAPL contaminants through naturally-occurring processes; the complete removal through degradation of NAPL contaminants would occur over time. 6. The principal threat associated with potentially mobile NAPL in the Bedrock NAPL Area would eventually be eliminated through the MNA component of this alternative.

Table 4-52
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-2 – Institutional Controls and MNA

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of this alternative would not result in any significant short-term exposure of the community to the chemical constituents present in the Bedrock NAPL Area. 2. Potential exposure of onsite workers to contaminants in the Bedrock NAPL Area could occur during periodic groundwater sampling activities. These potential risks would be mitigated by the use of PPE and compliance with a site-specific HASP. 3. No potential environmental impacts would be anticipated as a result of the implementation of this alternative. 4. In the short term, protection will be achieved when institutional controls have been put in place. Assuming modest future rates of ongoing natural processes at the site, modeling suggests that the bedrock plume should reach cleanup levels in 200 years (**Appendix F**).

Table 4-52
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-2 – Institutional Controls and MNA

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. MNA has been applied at full scale at many sites, and is a proven and reliable technology for the in-situ destruction of organic contaminants. Based on studies previously completed at the site, it has been shown to be a viable and technically feasible technology. 2. This alternative would be administratively feasible. Although the institutional measures component would require coordination with the state and town, these controls should be easily implemented. 3. This alternative could be implemented using available services, materials and equipment.

Table 4-52
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock NAPL Area

Alternative NBGU-2 – Institutional Controls and MNA

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	Costs associated with the implementation of the institutional control measures are included with the Overburden Groundwater (OGW) alternatives. Operation and maintenance costs including semiannual monitoring for the MNA component of the alternative are included with the BGW-2 and BGW-3 alternatives. Therefore, there are no additional costs associated with this alternative (**Table 4-54**).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State's comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-53
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Bedrock NAPL Zone
Alternative NBGU-2: Institutional Controls and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Would achieve compliance eventually through monitored natural attenuation, therefore, alternative would meet ARAR	Y
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Relevant and Appropriate	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded	Would achieve compliance eventually through monitored natural attenuation, therefore, alternative would meet ARAR	Y
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-54
SRSNE Superfund Site
Feasibility Study

NAPL in Bedrock Groundwater Unit Remedial Alternatives Cost Estimate
Alternative NBGU-2: Institutional Measures and MNA

Item No.	Description	Cost
A. Initial Capital Costs		
1	No Initial Capital Costs	$0
B. Recurring Capital Costs		
1	No Recurring Capital Costs	$0
C. Annual Operation and Maintenance Costs (30 year Present Worth)		
1	MNA costs included with BGW-2 and BGW-3	$0
	Annual O&M Cost Subtotal:	$0
	Total Annual O&M Cost:	$0
	Present Worth Factor (30-year, 7%):	12.41
	Total Present Worth of Annual O&M Cost:	**$0**
	Aggregate Present Worth of Total Cost:	**$0**
	Rounded To:	**$0**

Notes:

1. Institutional controls costs included with OGW-2 and OGW-3 costs
2. LS - lump sum

Table 4-55
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-1 – No Action

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Under the current exposure scenario, no risks are associated with human exposure to NAPL or groundwater in the Bedrock Groundwater. Because this alternative does not require any action to be taken to address the risks from Bedrock Groundwater, it does not provide any overall protection of human health and the environment in the long term as waste material is neither eliminated, reduced nor controlled. This alternative does not meet ARARs or cleanup objectives established for this area of the site.

Table 4-55
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-1 – No Action

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-56**.

Table 4-55
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-1 – No Action

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative does not provide any long-term effectiveness or permanence. This alternative would not actively address the potential human health risks associated with future hypothetical exposure to contaminated groundwater. The no action alternative would not achieve the cleanup objectives for the Bedrock Groundwater, and therefore would not provide significant long-term effectiveness Because this alternative results in contaminants remaining on site above safe levels, a periodic review (i.e., every five years) would need to be conducted to review the protectiveness of this alternative.

Table 4-55
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-1 – No Action

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	Although not an active remedy, the No Action alternative would allow the continued reduction of the toxicity and volume of contaminants in the Bedrock Groundwater Unit over time through natural attenuation processes over a very long time frame. However, absent any monitoring or other activities to assess the progress of these processes, this reduction could not be documented.

Table 4-55
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-1 – No Action

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	No remedial actions would be initiated under this alternative; therefore no short-term risks would be posed to the community or onsite workers during implementation. There would also be no short-term environmental impacts associated with this alternative. Because no action is being taken to address the risk this area of the site presents, and no monitoring is being done to evaluate naturally-occurring degradation, time to achieve protection is unknown. However, it is estimated it will take on the order of 200 years until protection is achieved.

Table 4-55
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-1 – No Action

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	The No Action treatment alternative would be technically and administratively feasible and would not require the use of services or materials to be implemented.

Table 4-55
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-1 – No Action

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	No capital costs would be associated with the No Action alternative (**Table 4-57**) . The present worth costs of conducting five-year reviews are included in the estimates of the annual operation and maintenance costs for the Overburden Groundwater alternatives (OGW).
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State’s comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-56
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Bedrock Groundwater
Alternative BGW-1: No Action

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	No action would be taken to address bedrock groundwater that exceeds these requirements; therefore, this alternative would not meet this ARAR	N
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	No action would be taken to address bedrock groundwater that exceeds these requirements; therefore, this alternative would not meet this ARAR	N
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-57
SRSNE Superfund Site
Feasibility Study

Bedrock Groundwater Unit Remedial Alternatives Cost Estimate
Alternative BGW-1: No Action

Item No.	Description	Cost
A. Initial Capital Costs		
	No Initial Capital Costs	$0
B. Recurring Capital Costs		
	No Recurring Capital Costs	$0
C. Annual Operation and Maintenance Costs (30 Year Present Worth)		
1	No O&M Costs	$0
	Annual O&M Cost Subtotal:	$0
	Total Annual O&M Cost:	$0
	Present Worth Factor (30-year, 7%):	12.41
	Total Present Worth of Annual O&M Cost:	**$0**
	Aggregate Present Worth of Total Cost:	**$0**
	Rounded To:	**$0**

Note:

1. No action, five-year review costs included under Overburden Groundwater options.

Table 4-58
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-2 – Institutional Controls and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Under the current exposure scenario, no risks are associated with human exposure to NAPL or groundwater in the bedrock aquifer. This alternative provides overall protection of human health and the environment though the use of institutional controls to prevent exposure to contaminated groundwater. MNA would eventually restore groundwater quality to meet ARARs.

Table 4-58
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-2 – Institutional Controls and MNA

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-59**.

Table 4-58
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-2 – Institutional Controls and MNA

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative would provide long-term effectiveness by restricting the use of groundwater through institutional controls. MNA would eventually reduce contaminant concentrations to safe levels but only in a very long time frame. Because contaminant concentrations will eventually reach safe levels, the magnitude of residual risk in the long term is low. 2. This alternative relies on institutional controls to prevent exposure to groundwater in this area of the site. Institutional controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining onsite above safe levels for a very long period of time, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-58
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-2 – Institutional Controls and MNA

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. The MNA component of this alternative would result in the permanent reduction of contaminant toxicity, mobility and volume through treatment, by the natural mineralization of contaminants in the subsurface. 2. When coupled with an effective source control (i.e., ONOGU) alternative, the MNA component of this alternative would eventually result in the complete destruction of contaminants in the Bedrock Groundwater. 3. The MNA component of this alternative would result in the permanent reduction of contaminant toxicity, mobility and volume through treatment, by the natural mineralization of contaminants in the subsurface. 4. Treatment of contaminants in the Bedrock Groundwater through MNA would be permanent and irreversible. 5. Based on previous monitoring of the Bedrock Groundwater, analytical data indicate that dissolved VOCs are being degraded relatively rapidly at a distance from the NBGU zones. For example, the area of the Bedrock Groundwater downgradient of the NTCRA 2 containment area has gone from having groundwater contaminant concentrations above drinking water regulatory standards to non-detectable and/or below regulatory levels in a few years following startup of the system; this implies that dissolved VOCs are being destroyed in-situ due to the various natural degradation mechanisms. 6. Although groundwater cannot be identified as a principal threat, this alternative eventually reduces the levels of contamination which present an unacceptable risk to acceptable levels.

Table 4-58
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-2 – Institutional Controls and MNA

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of this alternative would not result in any significant short-term exposure of the community to the chemical constituents present in the Bedrock Groundwater. 2. Potential exposure of onsite workers to contaminants in Bedrock Groundwater could occur during periodic groundwater sampling activities. These potential risks would be mitigated by the use of PPE and compliance with a site-specific HASP. 3. No potential environmental impacts would be anticipated as a result of the implementation of this alternative. 4. In the short term, protection will be achieved when institutional controls have been put in place. In the long term, protection will be achieved when groundwater cleanup levels are achieved which modeling suggests will happen in 200 years.

Table 4-58
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-2 – Institutional Controls and MNA

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. MNA has been applied at full scale at many sites, and is a proven and reliable technology for the in-situ destruction of organic contaminants. Based on studies previously completed at the site, it has been shown to be a viable and technically feasible technology. 2. This alternative would be administratively feasible. Although the institutional measures component would require coordination with the state and town, these controls should be easily implemented. 3. This alternative could be implemented using available services, materials and equipment.

Table 4-58
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-2 – Institutional Controls and MNA

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	Costs associated with the implementation of the institutional controls are included with the OGW-2 and OGW-3 alternatives. Operation and maintenance costs would include semiannual monitoring for the MNA component of the alternative. The estimated cost of this alternative is $660,000 (**Table 4-60**), assuming a 30-year operation period.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State's comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-59
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Bedrock Groundwater
Alternative BGW-2: Institutional Controls

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance with regulation through monitored natural attenuation, therefore, alternative would meet ARAR.	Y
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance with regulation through monitored natural attenuation, therefore, alternative would meet ARAR. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has proceeded to meet GWPS.	Y
Location-Specific		None apply.					
Action-Specific		None apply.					

Table 4-60
SRSNE Superfund Site
Feasibility Study

Bedrock Groundwater Unit Remedial Alternatives Cost Estimate
Alternative BGW-2: Institutional Measures and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Remedial Design (incl below)**	0	man hours	$0	$0
				Annual Capital Cost Subtotal:	$0
				Total Initial Capital Cost (rounded):	**$0**
B. Recurring Capital Costs					
	No Recurring Capital Costs				$0
C. Annual Operation and Maintenance Costs (30 years)					
1	Monitored Natural Attenuation Sampling	120	man hours	$95	$11,400
2	Analytical	36	analysis	$750	$27,000
				Annual O&M Cost Subtotal:	$38,400
				Total Annual O&M Cost:	$40,000
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost (rounded):	**$500,000**

Description	Cost
Aggregate Present Worth of Total Cost:	**$500,000**
Remedial Design (6%)	$30,000
Project Administration/Management Cost (6%)	$30,000
Construction Management (0%)	$0
Scope Contingency (10%)	$50,000
Bid or Construction Contingency (10%):	$50,000
Subtotal	$660,000
Rounded To:	**$660,000**

Notes:

1. Bedrock ELUR costs included in OGW options
2. LS - lump sum
3. Assumes sampling 15 wells for VOCs and MNA parameters twice per year

Table 4-61
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-3 – Hydraulic Containment and MNA

NCP Analysis Criteria	SRSNE FS Analysis
Overall protection of human health and the environment Alternatives shall be assessed to determine whether they adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site by eliminating, reducing, or controlling exposures to levels established during development of remedial goals consistent with § 300.430(e)(2)(i). Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.	Under the current exposure scenario, no risks are associated with human exposure to NAPL or groundwater in the Bedrock Groundwater. This alternative provides overall protection of human health and the environment by controlling the spread of highly contaminated groundwater in the bedrock through hydraulic containment. Institutional controls would also provide overall protection by controlling exposure to contaminated ground water. This alternative would provide further protection of human health and the environment through MNA of the severed portion of the plume. Natural attenuation is expected to restore groundwater quality in the severed bedrock groundwater plume within a reasonable time frame. Additionally, once the source of contaminants in bedrock (NAPL present in the NBGU) has been depleted, this alternative would be expected to meet protective levels inside the hydraulic containment area within a reasonable time frame.

Table 4-61
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-3 – Hydraulic Containment and MNA

Compliance with ARARs Alternatives shall be assessed to determine whether they shall attain applicable or relevant and appropriate requirements under federal environmental laws, state environmental or facility siting laws or provide grounds for invoking one of the waivers under § 300.430 (f)(1)(ii)(C).	A detailed evaluation of ARARs for this alternative is provided in **Table 4-62**.

Table 4-61
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-3 – Hydraulic Containment and MNA

Long-term effectiveness and permanence Alternatives shall be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered, as appropriate, include the following: 1. Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of remedial activities. The characteristics of the residuals should be considered to the degree they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bio-accumulate. 2. Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risk posed should the remedial action need replacement.	This alternative provides long-term effectiveness by preventing the spread of highly contaminated groundwater in the bedrock, permanently reducing contaminant concentrations to safe levels through natural processes, and preventing exposure until safe levels are reached through the use of institutional controls. An analysis of the factors to be considered as part of this criterion follows: 1. Under this alternative, contaminants in this area of the site would eventually be reduced to safe levels. As a result, in the long term, the residual risk will be low. This alternative would be expected to provide hydraulic containment of the entire Bedrock Groundwater area having contaminant concentrations above drinking water regulatory standards. Low levels of contaminants (above laboratory detection limits but below regulatory standards) downgradient of the hydraulic containment system would be restored through natural attenuation. 2. The hydraulic containment component of this alternative has been effectively and reliably operated for many years at the site (as part of the NTCRA1 and NTCRA 2 containment systems). This alternative would require continued monitoring to ensure that the system continues to effectively contain contaminated groundwater. This alternative also relies on institutional controls to prevent exposure to groundwater in this area of the site until safe levels are reached. Institutional controls are only reliable and effective if they are monitored and enforced in the long term. Because this alternative results in contaminants remaining onsite above safe levels for a very long period of time, periodic reviews (every five years) would be conducted to comply with NCP requirements.

Table 4-61
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-3 – Hydraulic Containment and MNA

Reduction of toxicity, mobility or volume through treatment The degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following: 1. The treatment or recycling process the alternatives will employ and materials they will treat. 2. The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled. 3. The degree of expected reduction in toxicity, mobility or volume of waste due to treatment recycling and the specification of which reduction(s) are occurring. 4. The degree to which treatment is irreversible. 5. The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bio-accumulate of such hazardous substances and their constituents. 6. The degree to which treatment reduces the inherent hazards posed by principal threats at the site.	An analysis of the factors to be considered as part of this criterion follows: 1. This alternative reduces the mobility of highly contaminated groundwater in the bedrock through hydraulic containment. In addition, contaminants in groundwater removed by the hydraulic containment system would be treated using a modified NTCRA 1 treatment system thereby reducing volume and toxicity by treatment. Over time natural attenuation processes will reduce the toxicity and volume of contaminants in this area of the site. Contaminants remaining in the severed portion of the Bedrock Groundwater plume would be destroyed over time through natural attenuation processes. 2. This alternative would result in the eventual complete destruction of contaminants in the Bedrock Groundwater. 3. This alternative would be effective in permanently reducing the toxicity and volume of contaminants in the treated groundwater as a result of the hydraulic containment system. Data collected from the site confirms that active pumping can be used to provide hydraulic containment, thus this alternative would also reduce the mobility of contamination within the containment area. The MNA component would result in complete removal through degradation of Bedrock Groundwater contaminants over time. 4. Treatment of contaminants using a modified NTCRA 1 treatment system and through natural attenuation processes would be permanent and irreversible. 5. Within a reasonable time period following the depletion of the source of contaminants in the NBGU, MNA would be expected to reduce contaminant toxicity, mobility and volume in the Bedrock Groundwater area to safe levels. 6. Although groundwater cannot be identified as a principal threat, this alternative eventually reduces the levels of contamination which present an unacceptable risk to an acceptable.

Table 4-61
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-3 – Hydraulic Containment and MNA

Short-term Effectiveness The short-term impacts of alternatives shall be assessed considering the following: 1. Short-term risks that might be posed to the community during implementation of an alternative. 2. Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures. 3. Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation. 4. Time until protection is achieved.	An analysis of the factors to be considered as part of this criterion follows: 1. Implementation of this alternative would not result in any significant short-term exposure of the community to the chemical constituents present in the Bedrock Groundwater. 2. Implementation of this alternative may result in the short-term exposure of onsite workers to the chemical constituents present in the impacted groundwater by ingestion or dermal contact with groundwater. Additional exposure through inhalation of volatilized chemicals may also occur. These potential exposures would be addressed by the use of PPE and compliance with a site-specific HASP. 3. No short-term environmental impacts on site would be anticipated. 4. In the short term, protection will be achieved when institutional controls are put in place. In the long term, protection will be achieved when groundwater cleanup levels are met which modeling predicts will happen in 200 years.

Table 4-61
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-3 – Hydraulic Containment and MNA

Implementability The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors as appropriate: 1. Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy. 2. Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions). 3. Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies. .	An analysis of the factors to be considered as part of this criterion follows: 1. Hydraulic containment and active treatment using the NTCRA 1 treatment system and the NTCRA 2 extraction wells has been ongoing at the site for many years. In addition, MNA has been applied at full scale at many sites, and is a proven and reliable technology for the in-situ destruction of organic contaminants. This alternative would be technically feasible. 2. This alternative would also be administratively feasible. Discharge of treated water would require compliance with NPDES discharge requirements. Although the institutional measures component would coordination with the state and town, these controls should be easily implemented. 3. This alternative could be implemented using available services, materials and equipment.

Table 4-61
SRSNE Superfund Site – Feasibility Study
Detailed Evaluation
Bedrock Groundwater

Alternative BGW-3 – Hydraulic Containment and MNA

Cost The types of costs that shall be assessed include the following: 1. Capital costs, including both direct and indirect costs, 2. Annual Operation & Maintenance costs, and 3. Net present value of capital and O&M costs.	Capital costs of this alternative would be included in the costs for Overburden Groundwater Unit Alternative OGW-3. Operation and maintenance costs would include semiannual monitoring for the MNA component of the alternative. The estimated cost of this alternative is $660,000 (**Table 4-63**), assuming a 30-year operation period.
State Acceptance TBD in ROD after RI/FS and PRAP comments received 1. State's position and key concerns. 2. State’s comments on ARARs and the proposed use of waivers.	
Community Acceptance TBD in ROD after RI/FS and PRAP comments received.	

Table 4-62
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Bedrock Groundwater Unit
Alternative BGW-3: Hydraulic Containment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Chemical-Specific	Federal	Safe Drinking Water Act (SDWA): Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs)	Pub. L. 93-523; 40 CFR 141	Relevant and Appropriate	These regulations establish primary drinking water regulations and goals pursuant the SDWA.	Would eventually achieve compliance through monitored natural attenuation.	Y
		EPA Reference Doses (RfDs) and EPA Carcinogen Assessment Group Potency Factors		To Be Considered	RfD is an estimate of human daily oral exposure that is likely to be without an appreciable risk of non-cancer effects. The potency factors are used as qualitative weight-of-evidence judgment as to the likelihood of a chemical being a carcinogen.	Will be considered in developing groundwater clean up levels.	
		EPA Health Advisories		To Be Considered	A health advisory is an estimate of acceptable drinking water levels for a chemical based upon health effects.	Will be considered in developing groundwater clean up levels.	
	State of Connecticut	Remediation Standard Regulations for groundwater	CGS 22a-133k; RCSA §22a-133k-3	Applicable	These regulations establish groundwater cleanup standards. Requirements are based on groundwater in the area being classified by the state as GA-degraded.	Would eventually achieve compliance through monitored natural attenuation. May apply the provision in regulation for exemption from restoring groundwater to background once remediation has proceeded to meet GWPS.	Y
Location-Specific		None apply.					

Table 4-62 (Continued)
SRSNE Superfund Site
Feasibility Study

Evaluation of ARARs - Bedrock Groundwater Unit
Alternative BGW-3: Hydraulic Containment and MNA

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ARAR
Action-Specific	State of Connecticut	Hazardous Waste Management: Storage Requirements	CGS 22a ch 445 RCSA §22a-449(c) 100 through 119	Applicable	These regulations establish standards for treatment, storage and disposal of hazardous waste and remediation waste, groundwater monitoring and requirements for closure and post-closure of hazardous waste facilities.	Treatment residues (spent filtration residue and activated carbon) could contain high concentrations of regulated constituents. If determined to be hazardous waste, will be stored on site consistent with these requirements before being shipped offsite for disposal. .	Y
		Water Quality Standards	CGS 22a-426	Applicable	The Connecticut Water Quality Standards establish specific numeric criteria for surface water. The standards provide criteria for maintaining the quality of surface waters through limitations on point source discharges and implementation of reasonable controls or best management practices.	Extracted groundwater that is discharged to surface waters would be treated in a manner that is consistent with the requirements of this rule.	Y
		Water Pollution Control: Connecticut Discharge Permit Regulations	CGS 22a ch 446k RCSA §22a-430-1 to 8	Applicable	These regulations establish the requirements for discharge to surface water.	The effluent discharge from the treatment facility would meet the substantive requirements of these regulations.	Y
		Air Pollution Control: Control of Particulate Matter	CGS 22a ch 446c RCSA §22a-174-1 to 20	Applicable	These regulations include requirements to control emissions. Pollutant abatement controls/measures may be required. Specific standards pertain to fugitive dust (18b).	Would comply with emission standards to control fugitive dust from construction activities with dust control measures	Y
		Control of Noise	RCSA §22a-69- 1 to 7.4	Applicable	These regulations establish allowable noise levels; and would apply to construction activities at the site.	All construction activities on-site would comply with these noise level requirements.	Y

Table 4-63
SRSNE Superfund Site
Feasibility Study

Bedrock Groundwater Unit Remedial Alternatives Cost Estimate
Alternative BGW-3: Hydraulic Containment and MNA

Item No.	Description	Quantity	Unit	Unit Cost	Cost
A. Initial Capital Costs					
1	**Remedial Design (incl below)**	0	man hours	$0	$0
				Annual Capitol Cost Subtotal:	$0
				Total Initial Capital Cost (rounded):	**$0**
B. O&M Costs (NTCRA Extraction and Treatment)					
1	**O&M Costs included with OGW-3**				$0
				Annual O&M Cost Subtotal:	$0
				Total Annual O&M Cost:	$0
				Present Worth Factor (30-year, 7%):	12.41
				Total Annual O&M Cost:	**$0**

Table 4-63
SRSNE Superfund Site
Feasibility Study

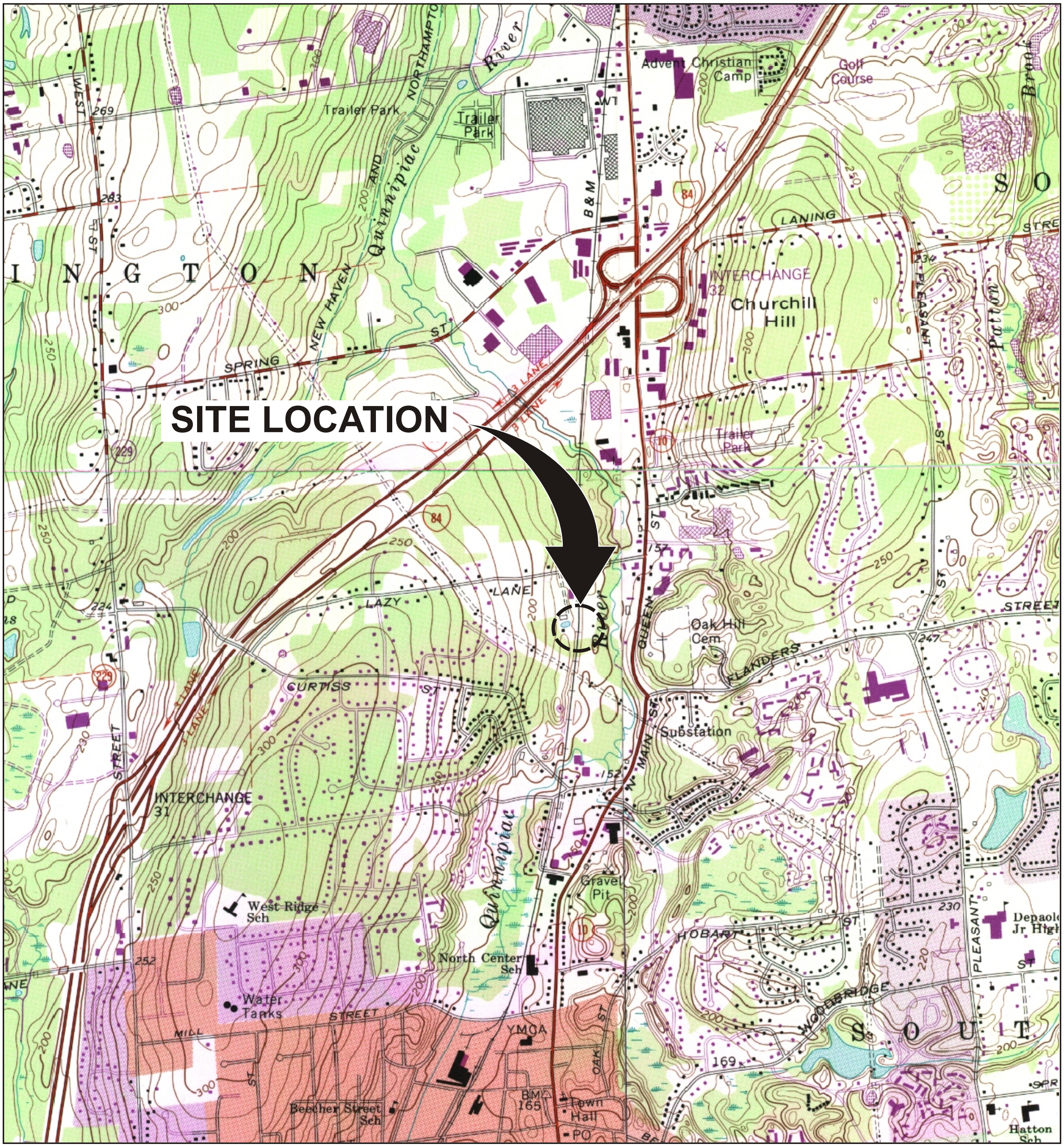
Bedrock Groundwater Unit Remedial Alternatives Cost Estimate
Alternative BGW-3: Hydraulic Containment and MNA

C. Annual Operation and Maintenance Costs (30 years)					
1	Monitored Natural Attenuation Sampling	120	man hours	$95	$11,400
2	Analytical	36	analysis	$750	$27,000
				Annual O&M Cost Subtotal:	$38,400
				Total Annual O&M Cost:	$40,000
				Present Worth Factor (30-year, 7%):	12.41
				Total Present Worth of Annual O&M Cost (rounded):	**$500,000**

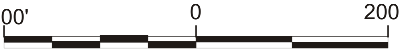
Description	**Cost**
Aggregate Present Worth of Total Cost:	**$500,000**
Remedial Design (6%)	$30,000
Project Administration/Management Cost (6%)	$30,000
Construction Management (0%)	$0
Scope Contingency (10%)	$50,000
Bid or Construction Contingency (10%):	$50,000
Subtotal	$660,000
Rounded To:	**$660,000**

Notes:

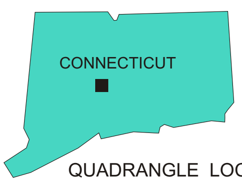
1. Bedrock Hydraulic Containment and ELUR Costs covered in OGW options
2. LS - lump sum
3. Assumes sampling 15 wells for VOCs and MNA parameters twice per year



REFERENCE: SOUTHINGTON, CONN. USGS QUAD. 1968 PR 1992, MERIIDAN, CONN. USGS QUAD. 1966 PR 1984, NEW BRITIAN, CONN. USGS QUAD. 1966 PR 1984, & BRISTOL, CONN. USGS QUAD 1967 PR 1984



APPROX. SCALE: 1" = 2000'



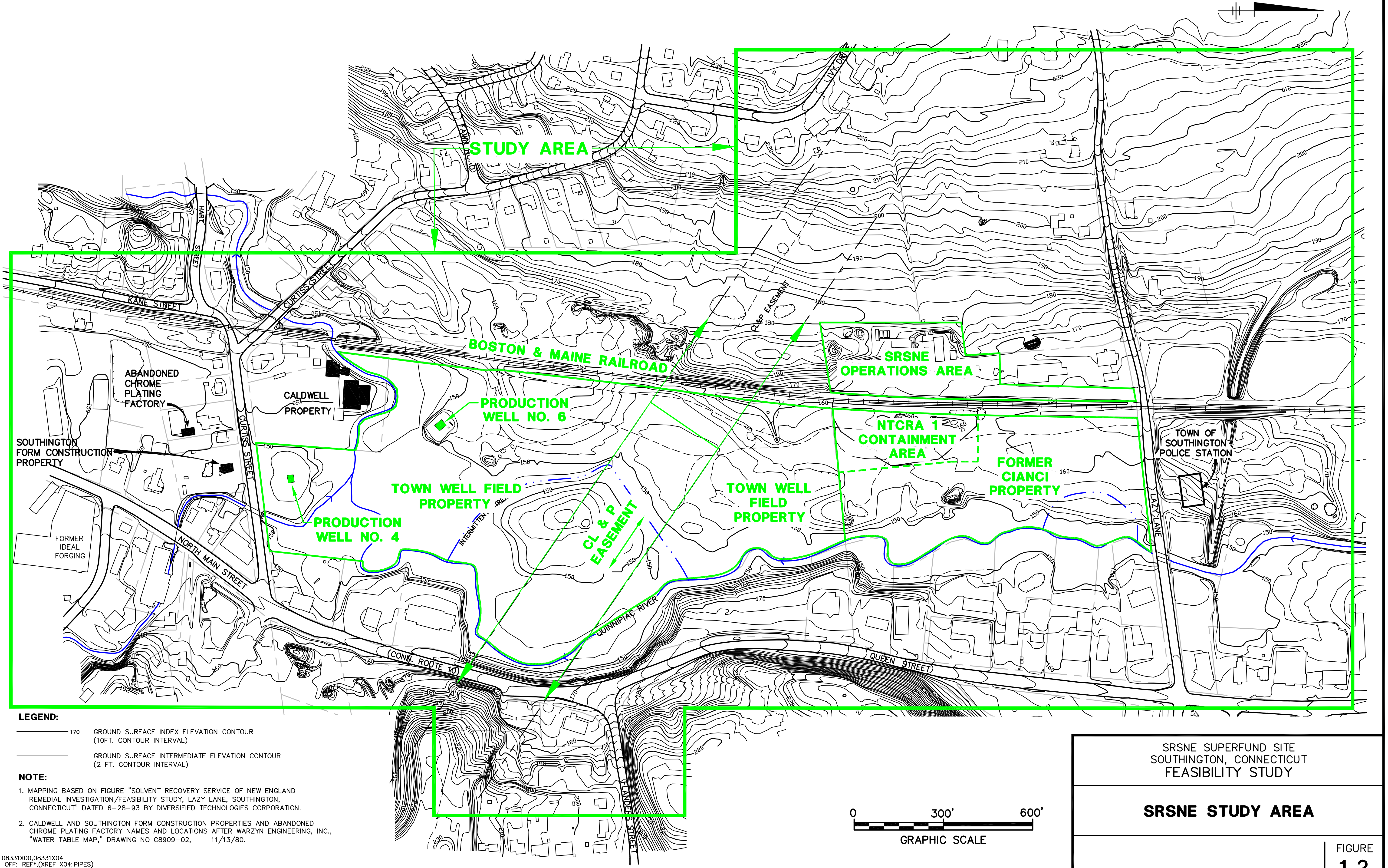
QUADRANGLE LOCATION

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SITE LOCATION MAP

FIGURE
1-1

05/24/05 SYR D85-DJH
08331009/08331n01.cdr



LEGEND:

170	GROUND SURFACE INDEX ELEVATION CONTOUR (10FT. CONTOUR INTERVAL)
	GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

NOTE:

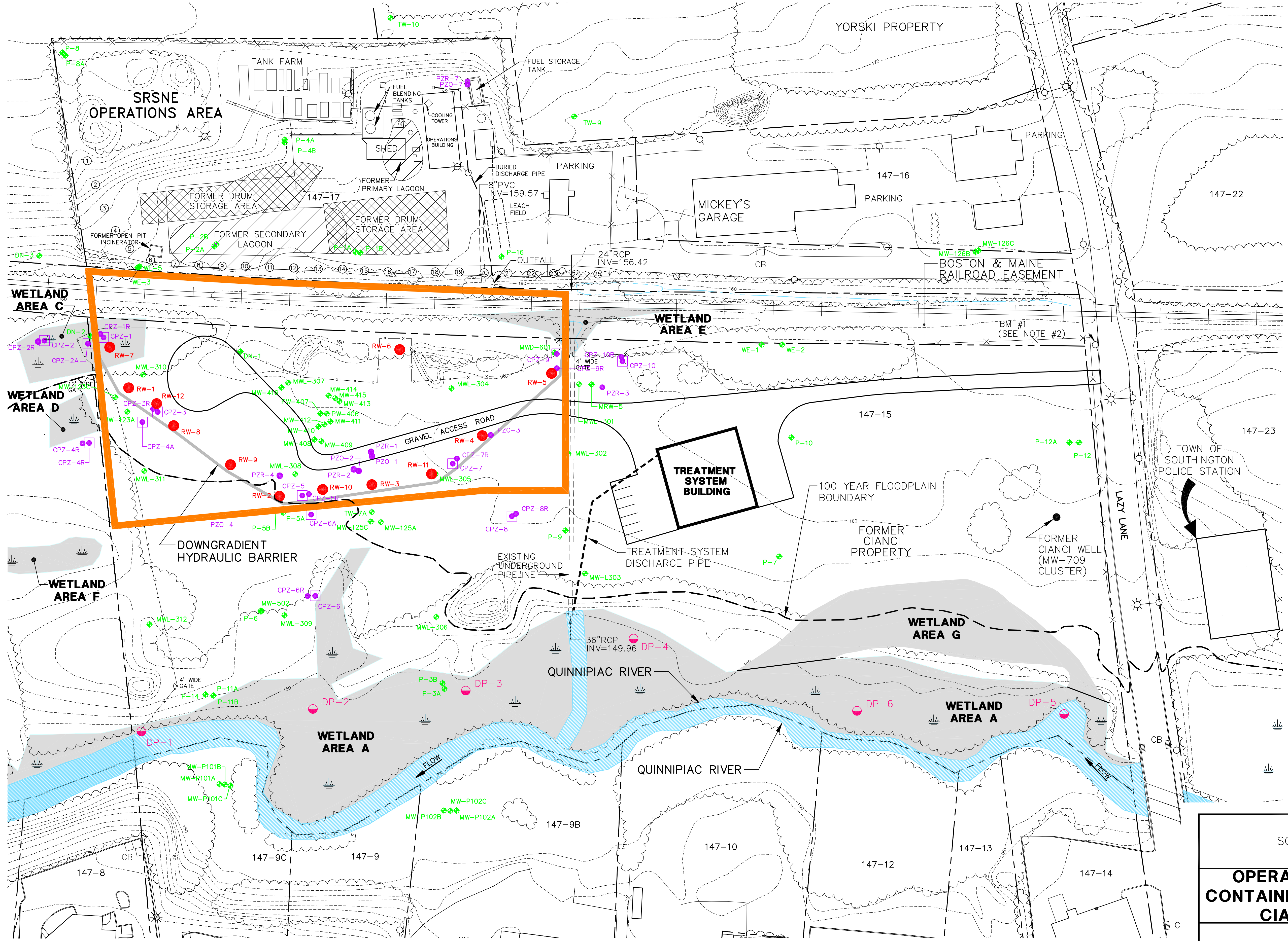
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6–28–93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. CALDWELL AND SOUTHINGTON FORM CONSTRUCTION PROPERTIES AND ABANDONED CHROME PLATING FACTORY NAMES AND LOCATIONS AFTER WARZYN ENGINEERING, INC., "WATER TABLE MAP," DRAWING NO C8909–02, 11/13/80.

X: 08331X00,08331X04
L: OFF: REF*,(XREF X04:PIPES)
P: PAGESET/SYR–BL1
5/24/05 SYR–85–DMW NJR GJD
08331009/FEASIBILITY/08331B05.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SRSNE STUDY AREA

FIGURE
1-2



LEGEND

— — —	PROPERTY LINE
— — —	100-YEAR FLOOD LIMIT
——	WATER
▨	RIVER
▨	WETLAND
▭	NTCRA 1 CONTAINMENT AREA
▭	EXISTING STRUCTURE
⌒⌒⌒	VEGETATION
- - -	EXISTING CONTOUR
—x—x—	FENCE
● P-10	PREVIOUSLY INSTALLED MONITORING WELL
● PZR-3	NTCRA 1 PIEZOMETER
▣ CPZ-10	NTCRA 1 COMPLIANCE PIEZOMETER
● RW-1	NTCRA 1 OVERBURDEN EXTRACTION WELL
◒ DP-5	WETLAND DRIVE POINT
147-12	LOT NUMBER
□ ○	ABOVE-GROUND TANK
⑫	FORMER ON-SITE INTERCEPTOR SYSTEM EXTRACTION WELL
⏀	UTILITY POLE
	LIGHTING
	PROPOSED COMPLIANCE PIEZOMETER

NOTES

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY SIDE; POLE #9049.
3. THE 100-YEAR FLOOD LIMIT AND WETLAND AREAS WERE TAKEN FROM THE FINAL REMEDIAL INVESTIGATION REPORT (HNUS, MAY 1994). THE 100-YEAR FLOOD LIMIT WAS REVISED TO FOLLOW THE ELEVATION 156 CONTOUR BASED ON INFORMATION PROVIDED BY THE SOUTHINGTON TOWN ENGINEER.
4. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

0 50' 100'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

OPERATIONS AREA, NTCRA 1 CONTAINMENT AREA, AND FORMER CIANCI PROPERTY MAP

FIGURE
1-3

X: 08331X01, 08331X05
L: ON=*., OFF=1,REF VIEW: 50
P: PAGESET/SYR-DL2B1
5/24/05 SYR-85-PGL DMJ GJD
08331009/FEASIBILITY/08331B01.DWG

NOTES:

1. Base map was scanned from an aerial photograph taken April 3, 1965.
2. All site location information and property boundaries are approximate.

APPROX. SCALE: 1" = 100 FEET

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

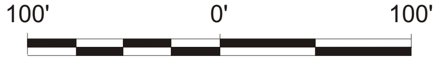
AERIAL PHOTOGRAPH - 1965

FIGURE
1-4

05/25/05 SYR-D85-DJH
08331009/08331g02.CDR

NOTES:

1. Base map was scanned from an aerial photograph taken April 3, 1980.
2. All site location information and property boundaries are approximate.



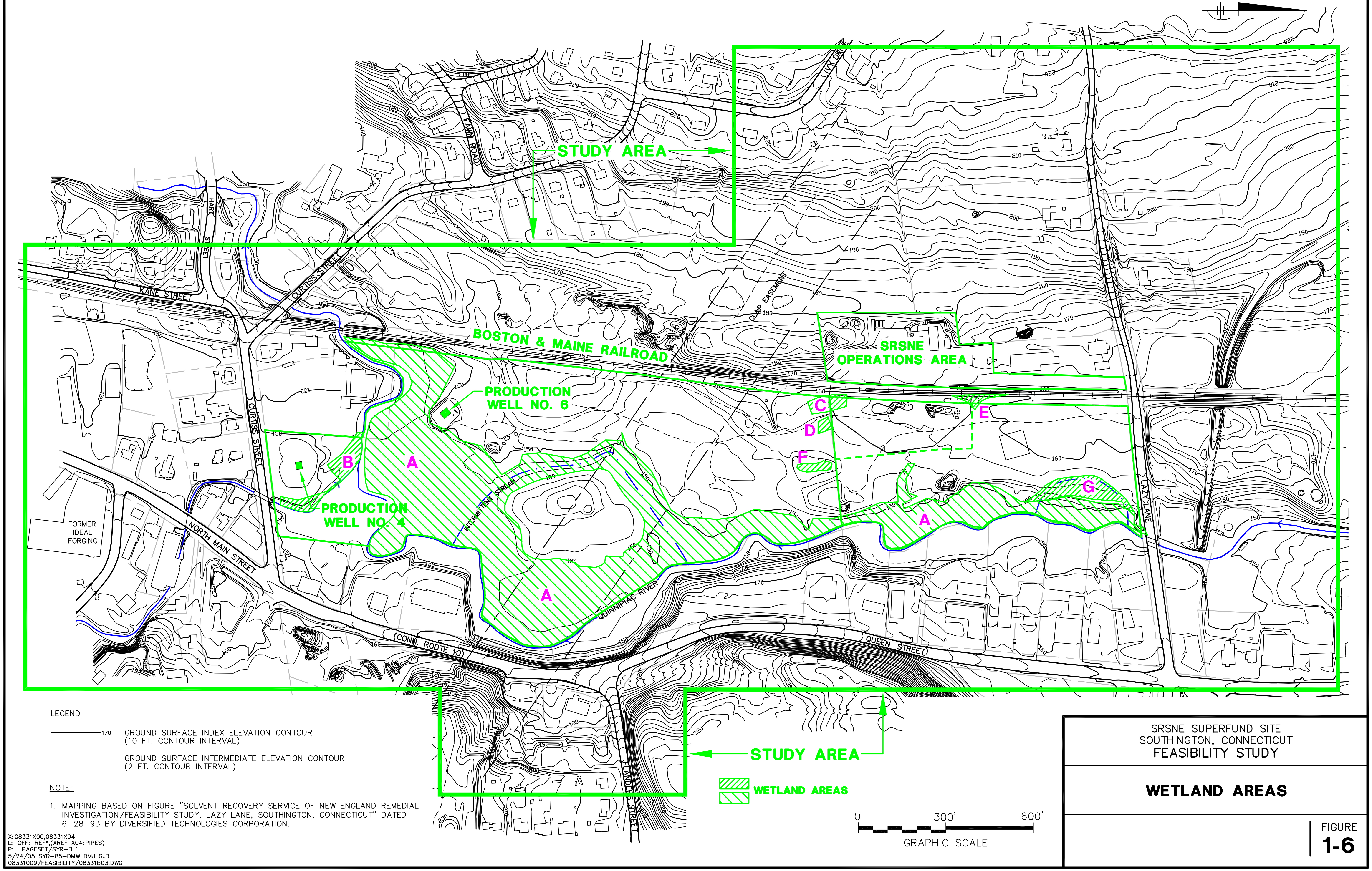
APPROX. SCALE: 1" = 100 FEET

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

AERIAL PHOTOGRAPH - 1980

FIGURE
1-5

05/25/05 SYR-D85-DJH
08331009/08331g01.CDR



LEGEND

GROUND SURFACE INDEX ELEVATION CONTOUR (10 FT. CONTOUR INTERVAL)

GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

NOTE:

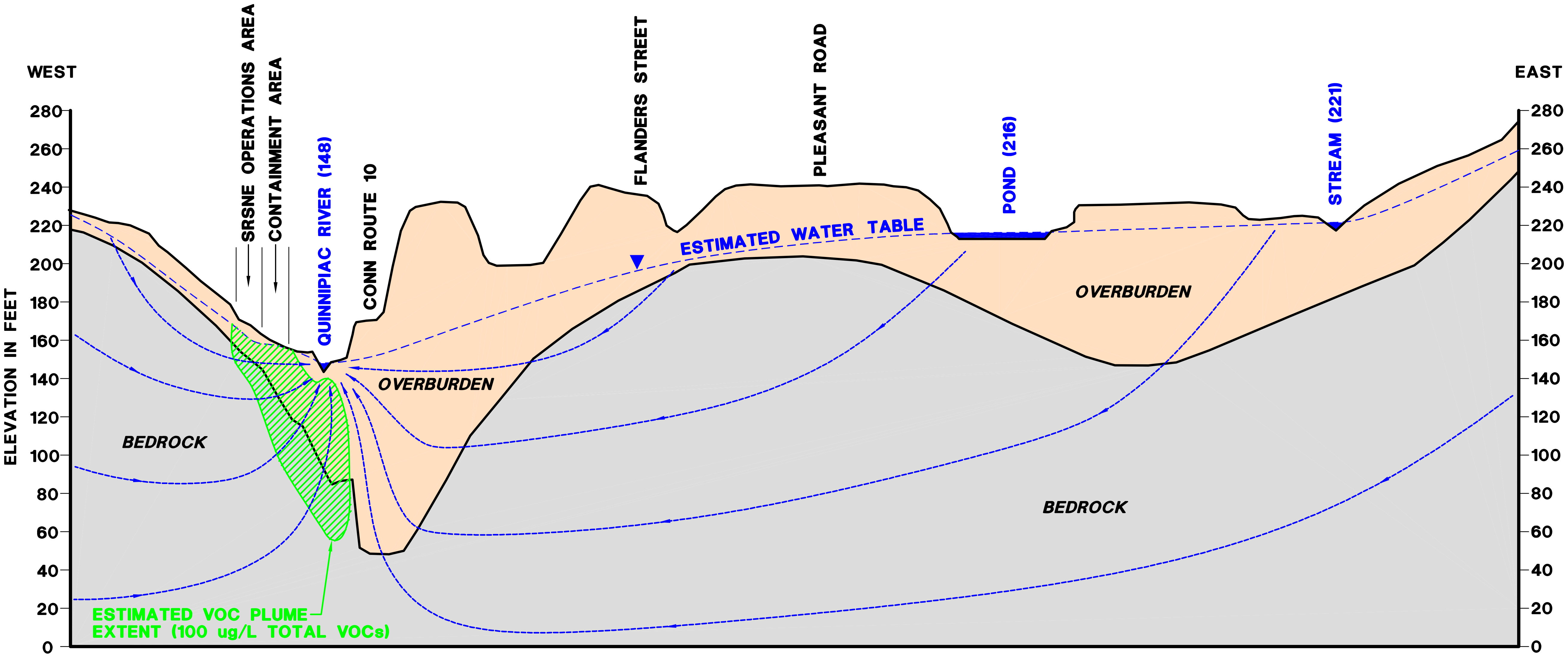
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

X: 08331X00,08331X04
L: OFF: REF*,(XREF X04:PIPES)
P: PAGESET/SYR-BL1
5/24/05 SYR-85-DMW DMJ GJD
08331009/FEASIBILITY/08331B03.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

WETLAND AREAS

FIGURE
1-6



NOTES:

1. GROUND SURFACE AND WATER TABLE CONTINUE TO RISE TO THE EAST OF THIS CROSS SECTION.
2. APPROXIMATELY 17,000 FT TO THE EAST IS HATCHERY BROOK, WHICH IS AT THE SAME ELEVATION AS QUINNIPIAC RIVER.
3. WATER TABLE DIVIDE APPROXIMATELY 6,000 FT EAST OF THIS CROSS SECTION.
4. TOP OF BEDROCK AND GROUND SURFACE DATA FROM USGS MAPS MF–660A (1975) AND MF–661A (1976).

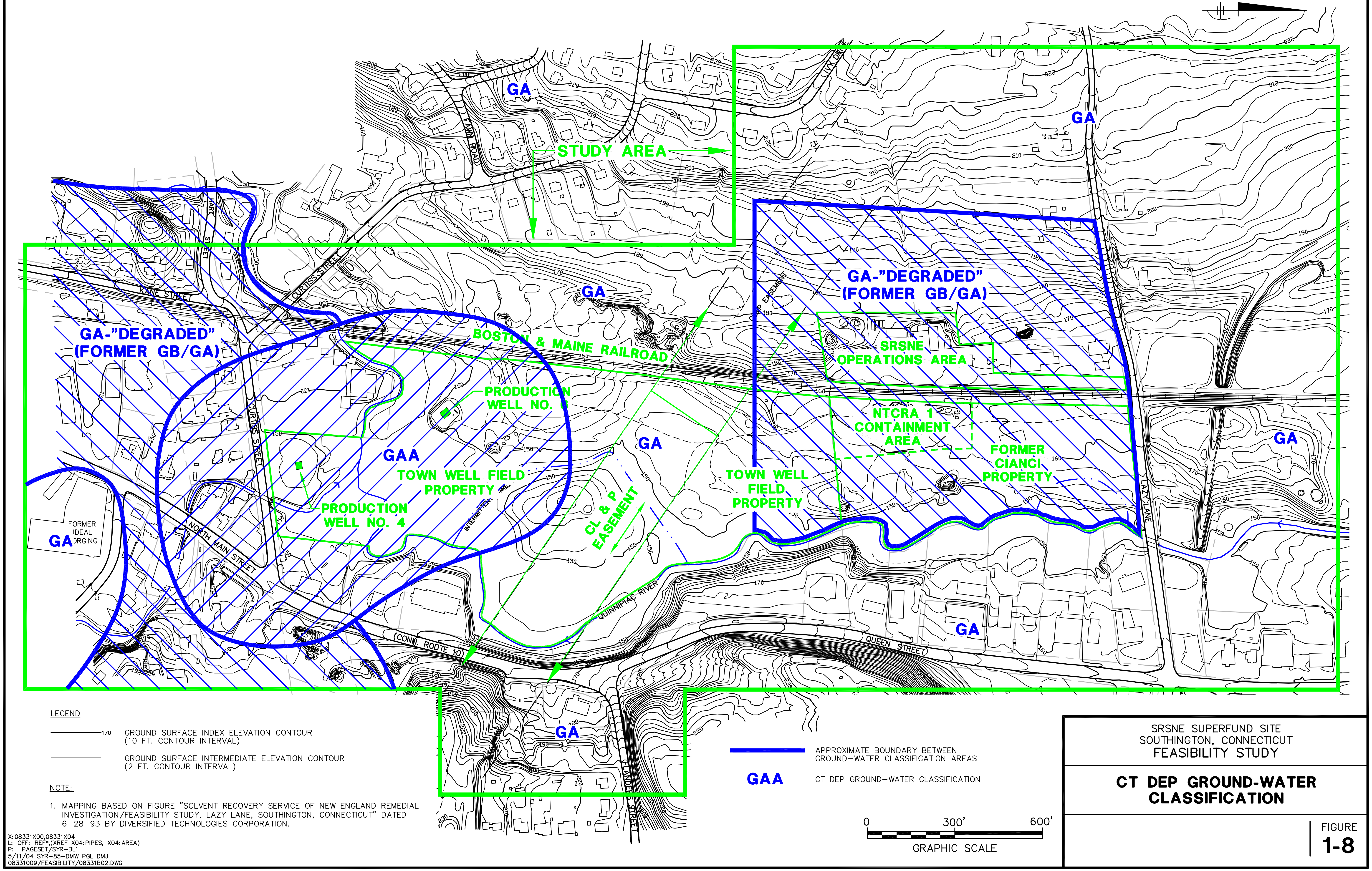
HORIZONTAL SCALE:
1000' 0 1000'

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

GENERALIZED REGIONAL GEOLOGIC CROSS SECTION

FIGURE
1-7

X: 08331X00
L: OFF: REF*
P: PAGESET/SYR–BL1
5/25/05 SYR–85–DMW DMJ GJD
08331009/FEASIBILITY/08331V01.DWG



LEGEND

170 GROUND SURFACE INDEX ELEVATION CONTOUR (10 FT. CONTOUR INTERVAL)

GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

APPROXIMATE BOUNDARY BETWEEN GROUND-WATER CLASSIFICATION AREAS

GAA CT DEP GROUND-WATER CLASSIFICATION

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

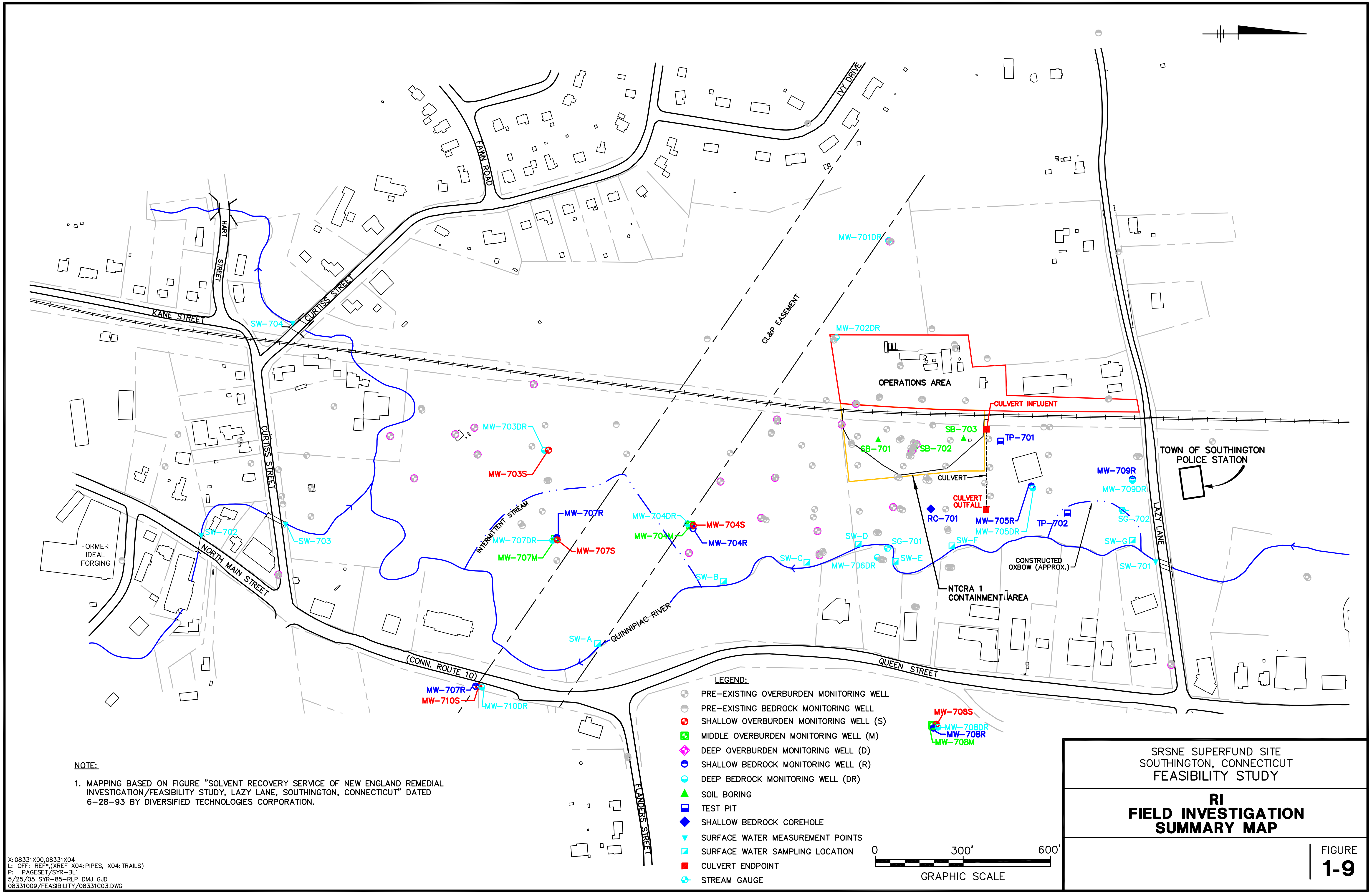
0 300' 600'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

CT DEP GROUND-WATER CLASSIFICATION

FIGURE
1-8

X: 08331X00,08331X04
L: OFF: REF*(XREF X04:PIPES, X04:AREA)
P: PAGESET/SYR-BL1
5/11/04 SYR-85-DMW PGL DMJ
08331009/FEASIBILITY/08331B02.DWG



LEGEND:

- PRE-EXISTING OVERBURDEN MONITORING WELL
- PRE-EXISTING BEDROCK MONITORING WELL
- SHALLOW OVERBURDEN MONITORING WELL (S)
- MIDDLE OVERBURDEN MONITORING WELL (M)
- DEEP OVERBURDEN MONITORING WELL (D)
- SHALLOW BEDROCK MONITORING WELL (R)
- DEEP BEDROCK MONITORING WELL (DR)
- ▲ SOIL BORING
- TEST PIT
- ◆ SHALLOW BEDROCK COREHOLE
- ▼ SURFACE WATER MEASUREMENT POINTS
- ◪ SURFACE WATER SAMPLING LOCATION
- ■ CULVERT ENDPOINT
- STREAM GAUGE

0 300' 600'

GRAPHIC SCALE

NOTE:

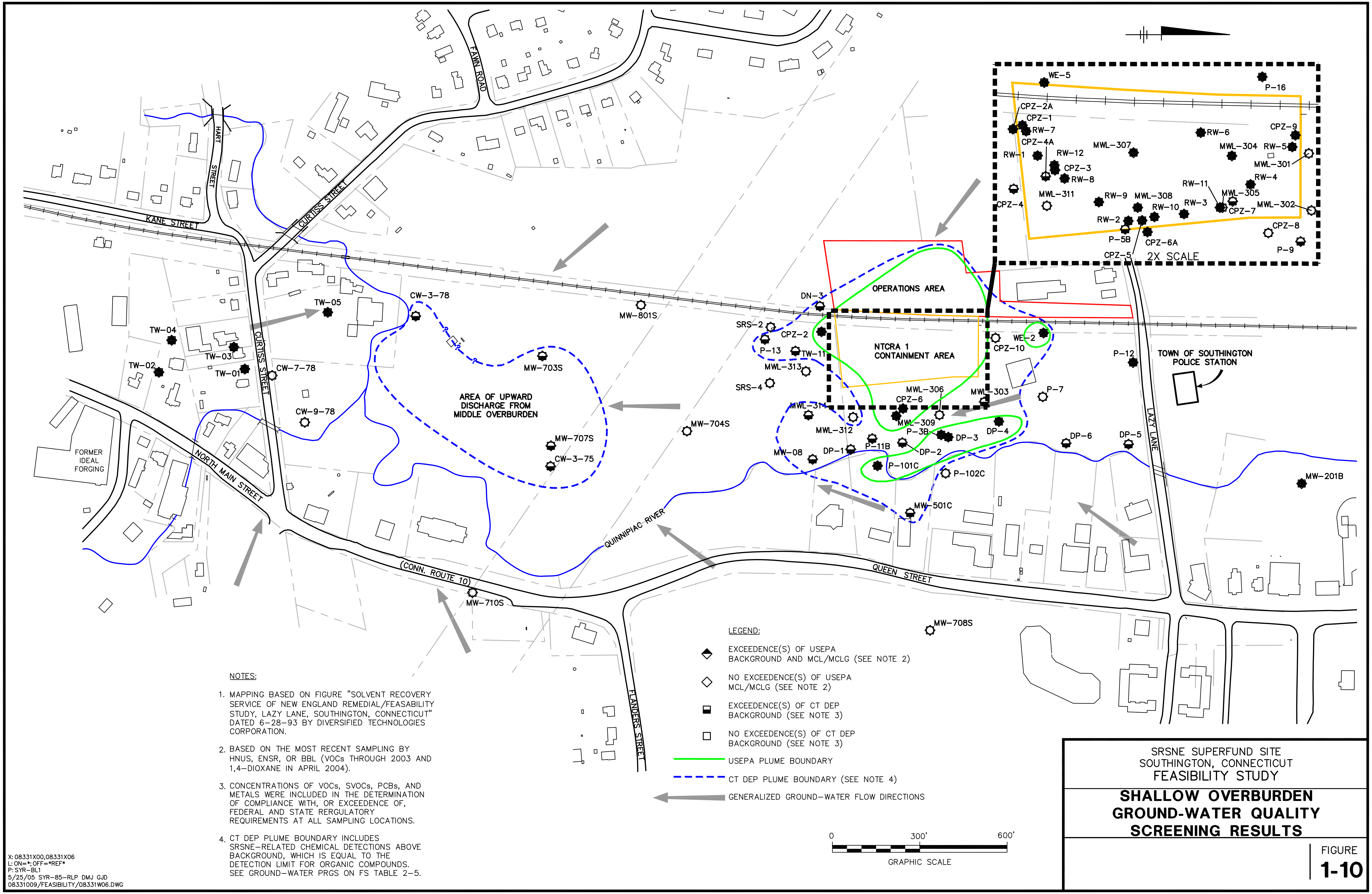
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

X: 08331X00,08331X04
L: OFF: REF*,(XREF X04: PIPES, X04: TRAILS)
P: PAGESET/SYR-BL1
5/25/05 SYR-85-RLP DMJ GJD
08331009/FEASIBILITY/08331C03.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

RI
FIELD INVESTIGATION SUMMARY MAP

FIGURE
1-9



LEGEND:

◈	EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
⬓	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
□	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
—	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
⟵	GENERALIZED GROUND-WATER FLOW DIRECTIONS

NOTES:

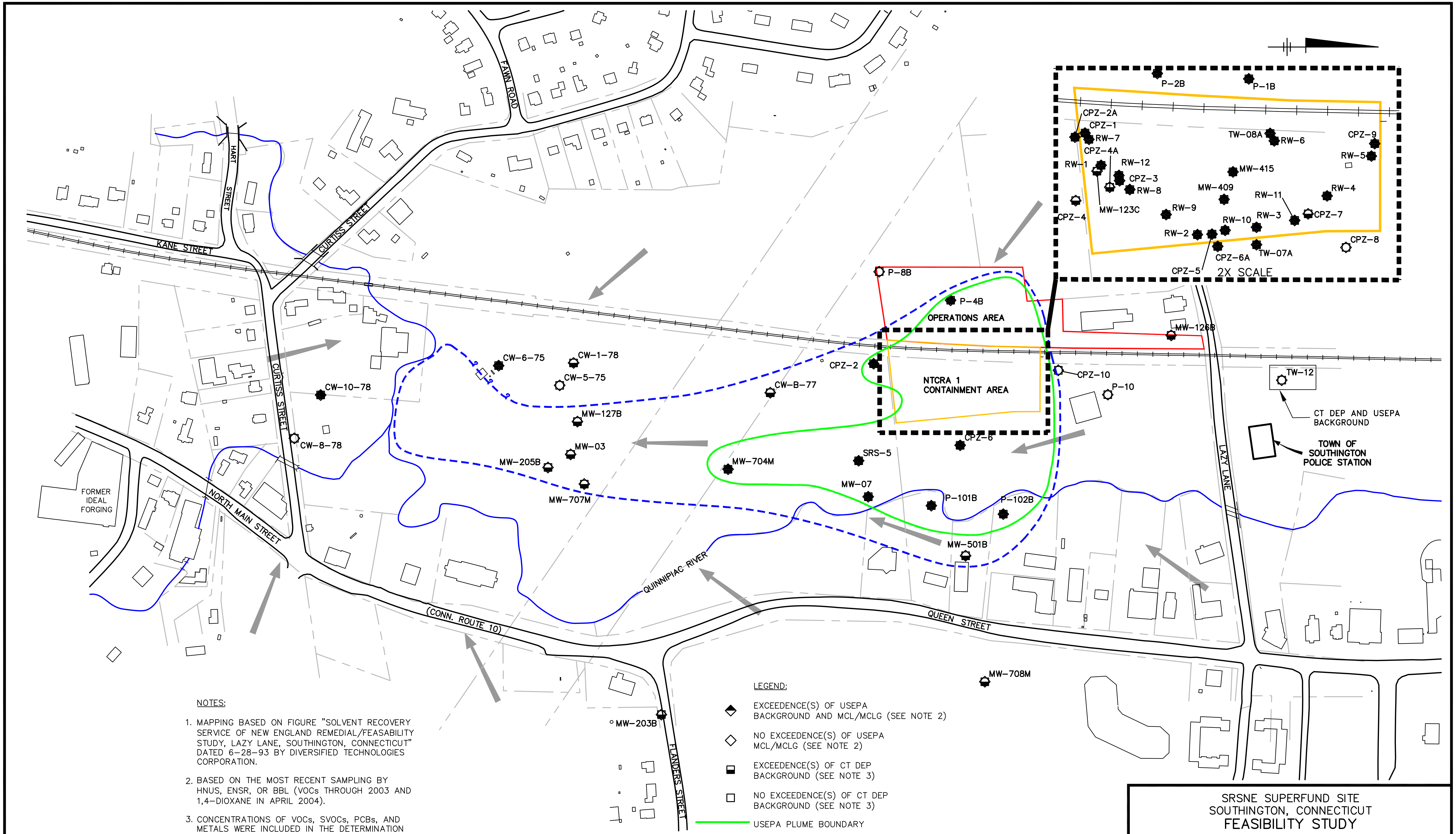
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BASED ON THE MOST RECENT SAMPLING BY HNUS, ENSR, OR BBL (VOCs THROUGH 2003 AND 1,4-DIOXANE IN APRIL 2004).
3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

X: 08331X00,08331X06
L: ON=*;OFF=*REF*
P: SYR-BL1
5/25/05 SYR-85-RLP DMJ GJD
08331009/FEASIBILITY/08331W06.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW OVERBURDEN
GROUND-WATER QUALITY
SCREENING RESULTS

FIGURE
1-10



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BASED ON THE MOST RECENT SAMPLING BY HNUS, ENSR, OR BBL (VOCs THROUGH 2003 AND 1,4-DIOXANE IN APRIL 2004).
3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

◆	EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
■	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
☐	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
—	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
←	GENERALIZED GROUND-WATER FLOW DIRECTIONS

0 300' 600'

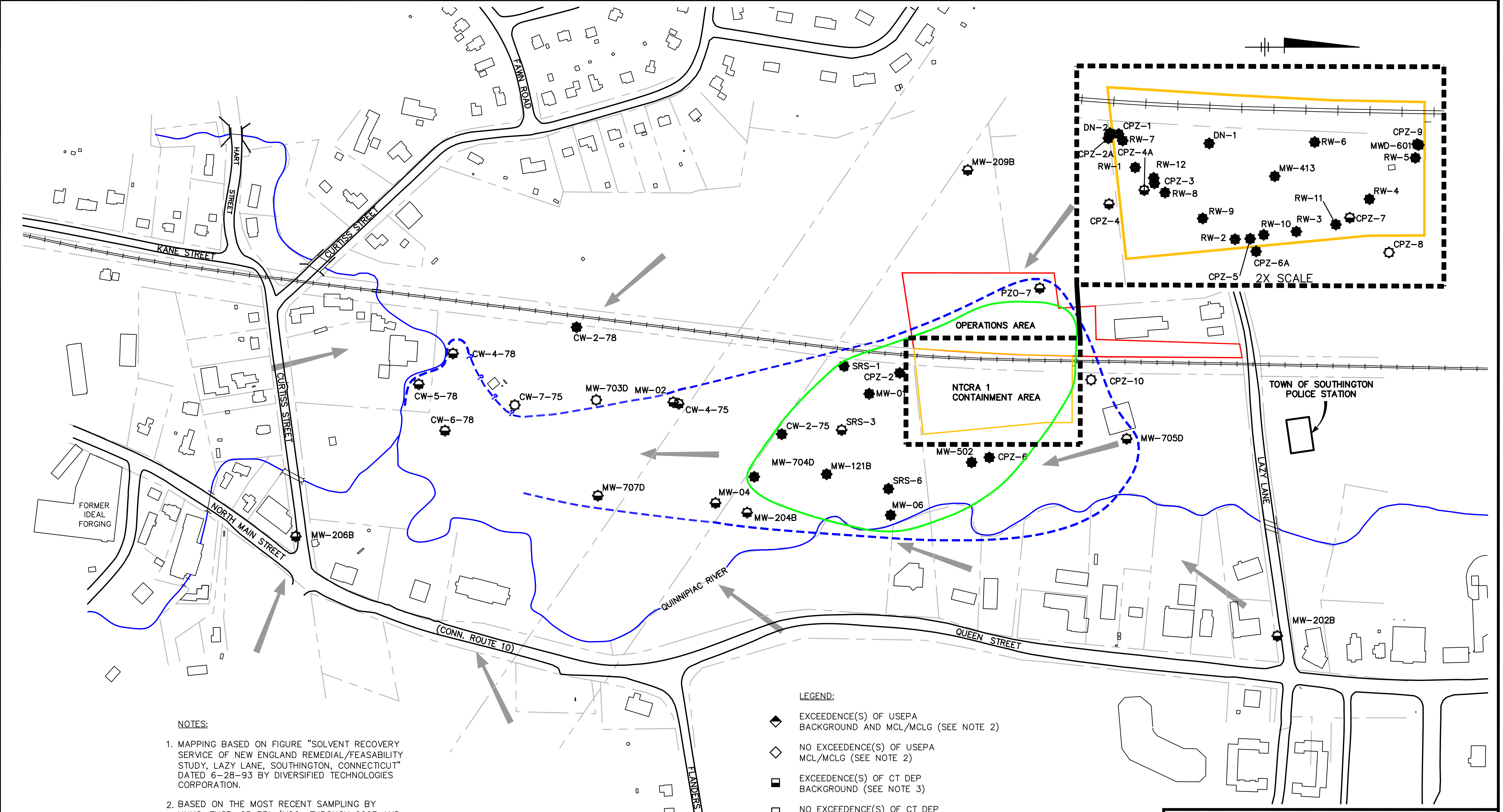
GRAPHIC SCALE

X: 08331X00,08331X06
L: ON=*;OFF=*REF*
P: SYR-BL1
5/25/05 SYR-85-RLP DMJ GJD
08331009/FEASIBILITY/08331W07.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

MIDDLE OVERBURDEN
GROUND-WATER QUALITY
SCREENING RESULTS

FIGURE
1-11



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BASED ON THE MOST RECENT SAMPLING BY HNUS, ENSR, OR BBL (VOCs THROUGH 2003 AND 1,4-DIOXANE IN APRIL 2004).
3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

◆	EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
▣	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
□	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
🟩	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
←	GENERALIZED GROUND-WATER FLOW DIRECTIONS

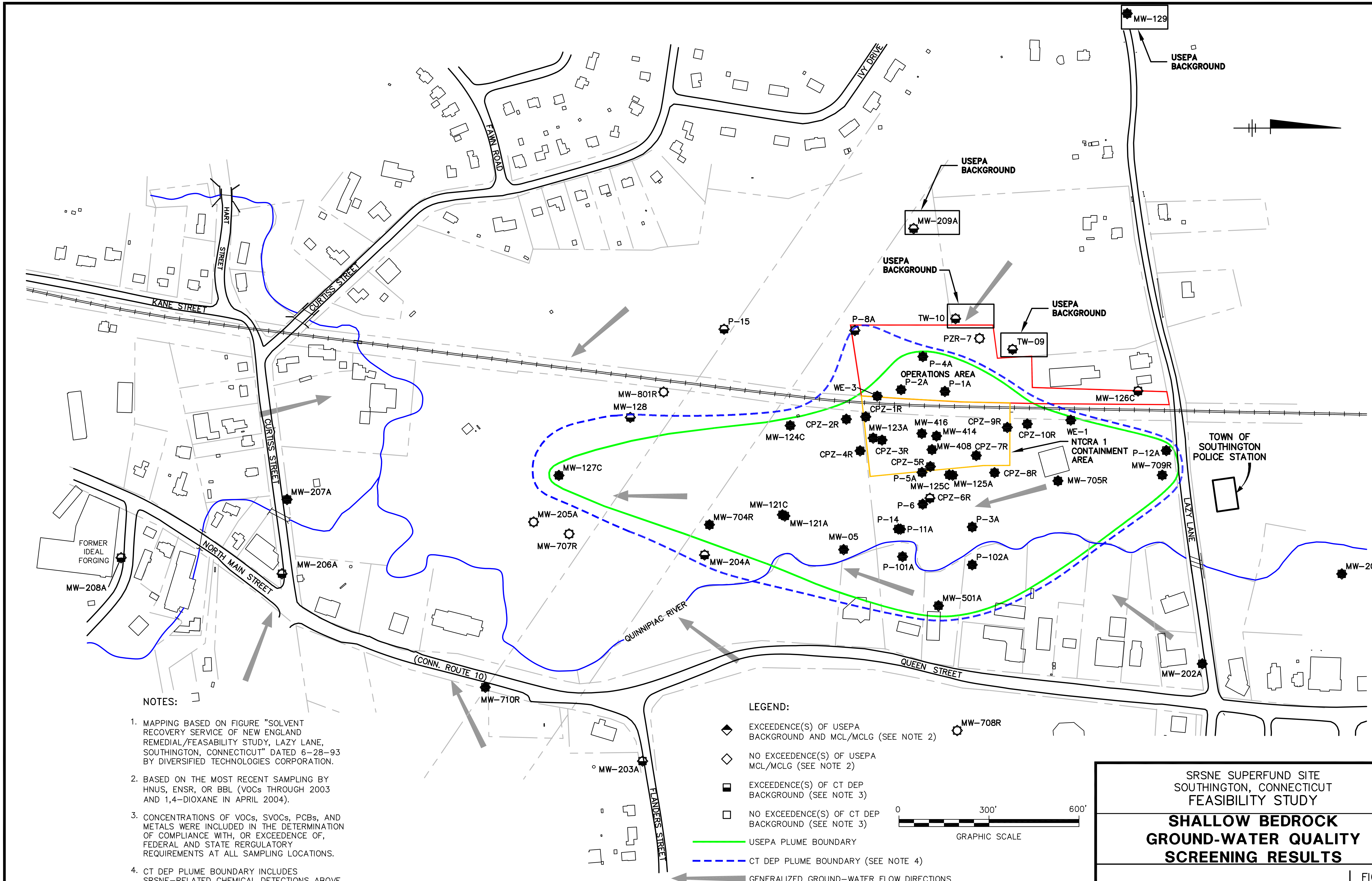
0 300' 600'
GRAPHIC SCALE

X: 08331X00,08331X06
L: ON=*;OFF=*REF*
P: SYR-BL1
5/25/05 SYR-85-RLP DMJ GJD
08331009/FEASIBILITY/08331W08.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

DEEP OVERBURDEN GROUND-WATER QUALITY SCREENING RESULTS

FIGURE
1-12



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BASED ON THE MOST RECENT SAMPLING BY HNUS, ENSR, OR BBL (VOCs THROUGH 2003 AND 1,4-DIOXANE IN APRIL 2004).
3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

⬘	EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
⬓	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
□	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
━━━	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
⟵	GENERALIZED GROUND-WATER FLOW DIRECTIONS

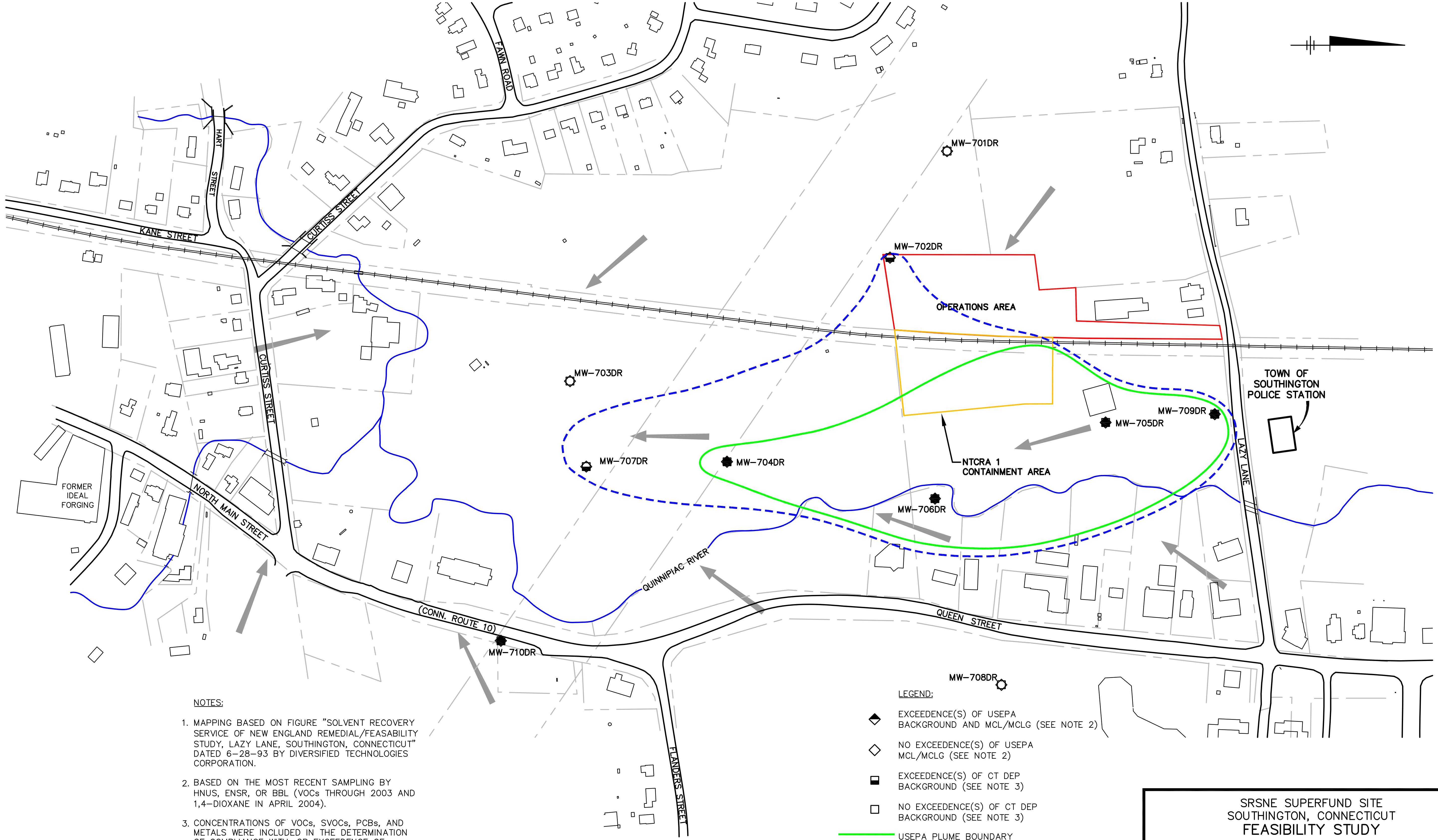
0 300' 600'
GRAPHIC SCALE

X: 08331X00, 08331X06
L: ON=*; OFF=*REF*
P: SYR-BL1
5/25/05 SYR-85-RLP DMJ GJD
08331009/FEASIBILITY/08331W09.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW BEDROCK GROUND-WATER QUALITY SCREENING RESULTS

FIGURE
1-13



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BASED ON THE MOST RECENT SAMPLING BY HNUS, ENSR, OR BBL (VOCs THROUGH 2003 AND 1,4-DIOXANE IN APRIL 2004).
3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

◆ EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)

◇ NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)

■ EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)

□ NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)

— USEPA PLUME BOUNDARY

- - - CT DEP PLUME BOUNDARY (SEE NOTE 4)

← GENERALIZED GROUND-WATER FLOW DIRECTIONS

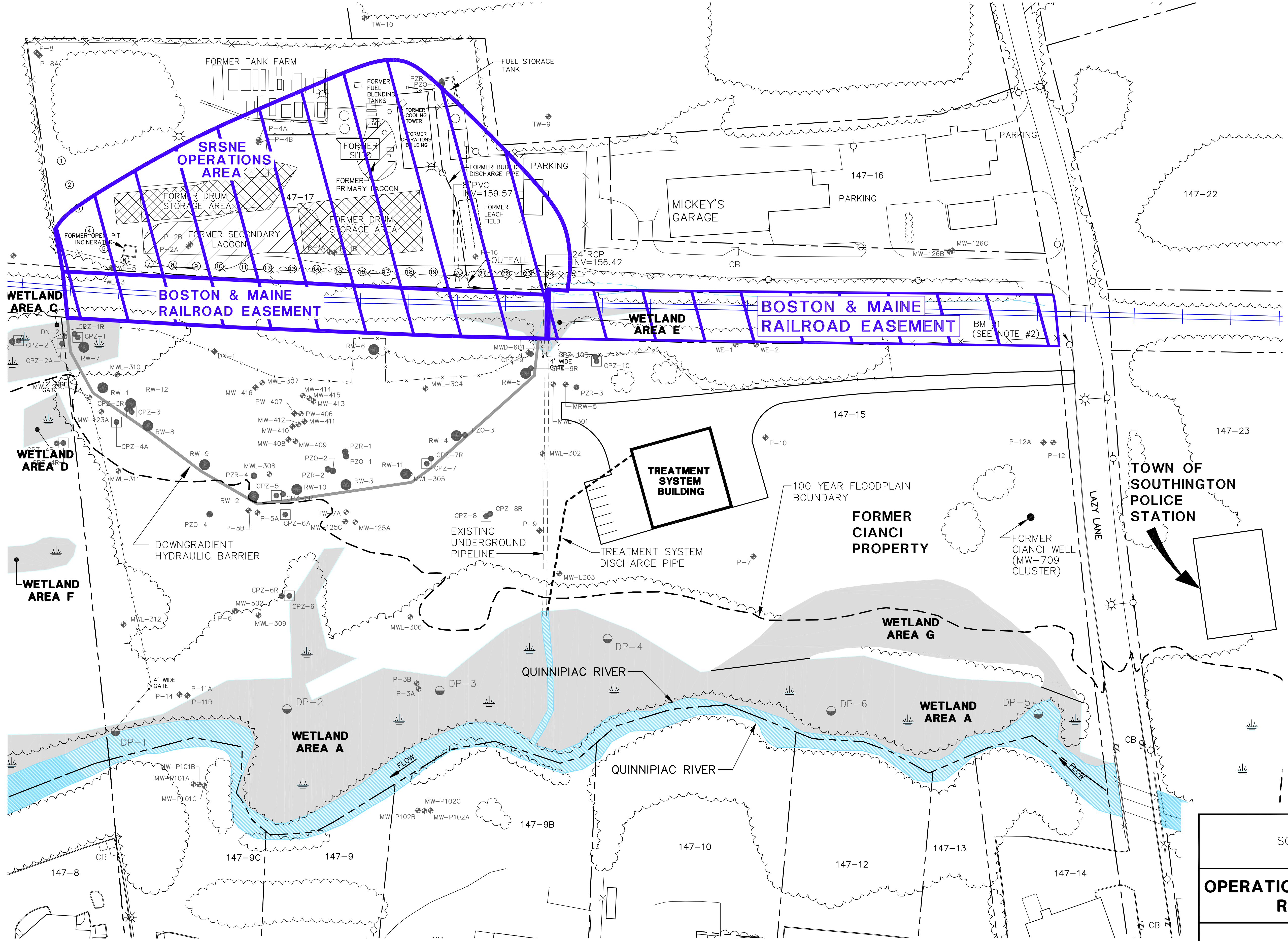
0 300' 600'
GRAPHIC SCALE

X: 08331X00,08331X06
L: ON=*;OFF=*REF*
P: SYR-BL1
5/25/05 SYR-85-RLP DMJ GJD
08331009/FEASIBILITY/08331W10.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

DEEP BEDROCK GROUND-WATER QUALITY SCREENING RESULTS

FIGURE
1-14



LEGEND

— — — —	PROPERTY LINE
— — — —	100-YEAR FLOOD LIMIT
- - - -	WATER
▨	RIVER
▨	WETLAND
	NTCRA 1 CONTAINMENT AREA
	EXISTING STRUCTURE
	VEGETATION
—x—x—	FENCE
P-10	PREVIOUSLY INSTALLED MONITORING WELL
PZR-3	NTCRA 1 PIEZOMETER
CPZ-10	NTCRA 1 COMPLIANCE PIEZOMETER
RW-1	NTRCA 1 OVERBURDEN EXTRACTION WELL
DP-5	WETLAND DRIVE POINT
147-15 147-12	LOT NUMBER
	ABOVE-GROUND TANK
⑫	FORMER ON-SITE INTERCEPTOR SYSTEM EXTRACTION WELL

NOTES

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY SIDE; POLE #9049.
3. THE 100-YEAR FLOOD LIMIT AND WETLAND AREAS WERE TAKEN FROM THE FINAL REMEDIAL INVESTIGATION REPORT (HNUS, MAY 1994). THE 100-YEAR FLOOD LIMIT WAS REVISED TO FOLLOW THE ELEVATION 156 CONTOUR BASED ON INFORMATION PROVIDED BY THE SOUTHINGTON TOWN ENGINEER.
4. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

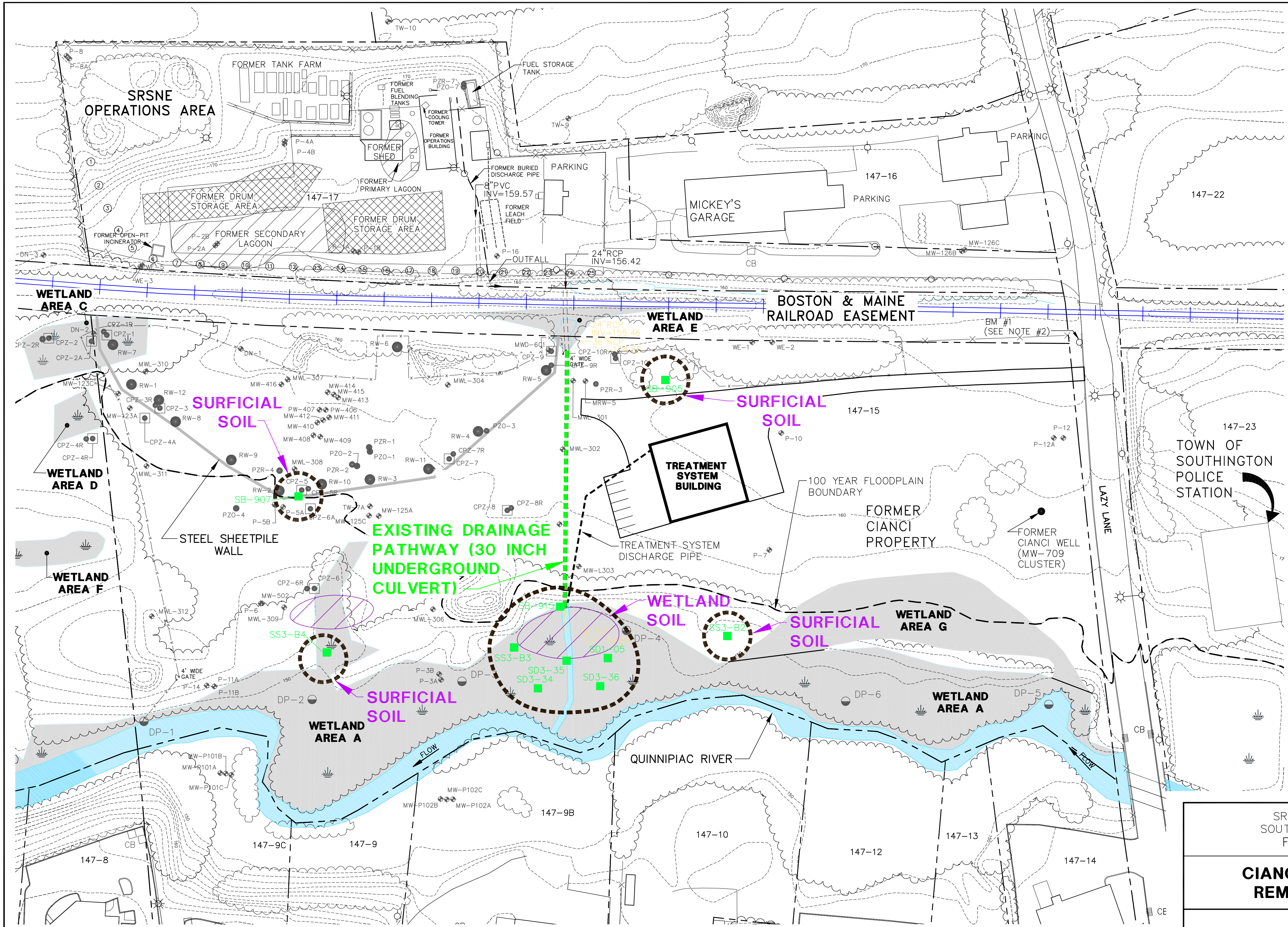
0 50' 100'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

OPERATIONS AREA/RAILROAD SOIL REMEDIATION AREA

FIGURE
2-1

X: 081131X00.DWG, 08331X02.DWG
L: ON=*, OFF=*REF*
P: PAGESET/SYR-DL2B1
5/25/05 SYR-85-PGL NJR GJD
08331009/FEASIBILITY/08331B07.DWG



LEGEND:

— · — · —	PROPERTY LINE
— — — —	100-YEAR FLOOD LIMIT
······	WATER
🟦	RIVER
▨	WETLAND
⌂	EXISTING STRUCTURE
⌒⌒⌒	VEGETATION
—x—x—	FENCE
🟩 SB-915	SOIL SAMPLING LOCATION
● P-10	MONITORING WELL
● PZR-3	NTCRA 1 PIEZOMETER
☐ CPZ-10	NTCRA 1 COMPLIANCE PIEZOMETER
● RW-1	NTCRA 1 OVERBURDEN EXTRACTION WELL
◒ DP-5	WETLAND DRIVE POINT
147-15	LOT NUMBER
☐ ○	ABOVE-GROUND TANK
⑫	FORMER ON-SITE INTERCEPTOR SYSTEM EXTRACTION WELL

NOTE:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY SIDE; POLE #9049.
3. THE 100-YEAR FLOOD LIMIT AND WETLAND AREAS WERE TAKEN FROM THE FINAL REMEDIAL INVESTIGATION REPORT (HNUS, MAY 1994). THE 100-YEAR FLOOD LIMIT WAS REVISED TO FOLLOW THE ELEVATION 156 CONTOUR BASED ON INFORMATION PROVIDED BY THE SOUTHINGTON TOWN ENGINEER.
4. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

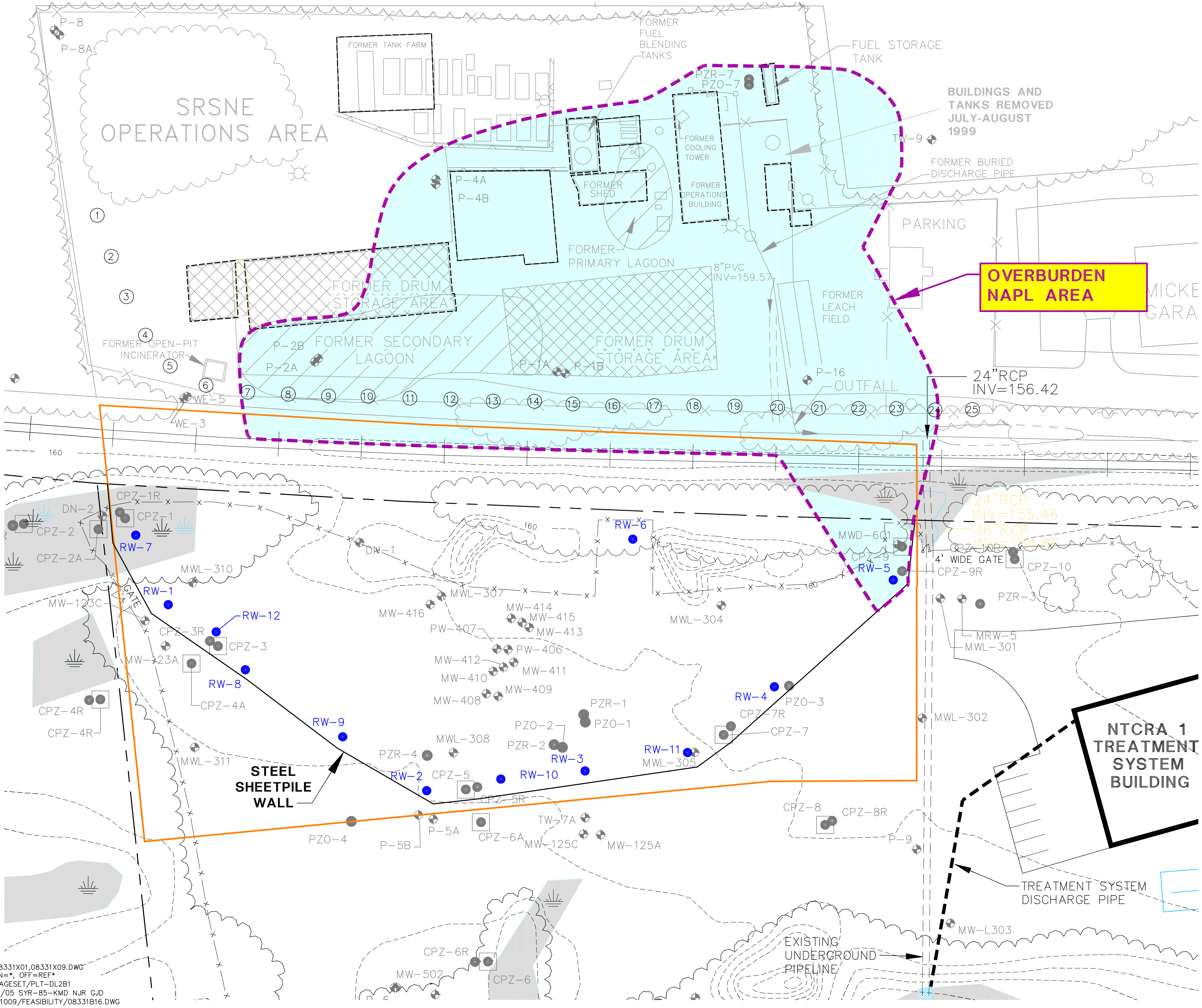
0 50' 100'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

CIANCI PROPERTY SOIL REMEDIATION AREAS

FIGURE
2-2

X: 081131X00.DWG, 08331X02.DWG
L: ON=*, OFF=*REF*
P: PAGESET/SYR-DL2B1
5/24/05 SYR-85-PGL RCA NJR GJD
08331009/FEASIBILITY/08331B15.DWG



X: 08331X01,08331X09.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-DL2B1
5/24/05 SYR-85-KMD NJR GJD
08331009/FEASIBILITY/08331B16.DWG

LEGEND:

— — — —	PROPERTY LINE
	EXISTING CONCRETE PAD
▨	WETLAND
🟧	NTCRA 1 CONTAINMENT AREA
	EXISTING STRUCTURE
—X——X—	FENCE
⊕ P-10	MONITORING WELL
● PZR-1	NTCRA 1 PIEZOMETER
◙ CPZ-10	NTCRA 1 COMPLIANCE PIEZOMETER
● RW-1	NTCRA 1 OVERBURDEN EXTRACTION WELL
⑫	FORMER ON-SITE INTERCEPTOR INTERCEPTOR SYSTEM EXTRACTION WELL

NOTE:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978. SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.

2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY SIDE; POLE #9049.

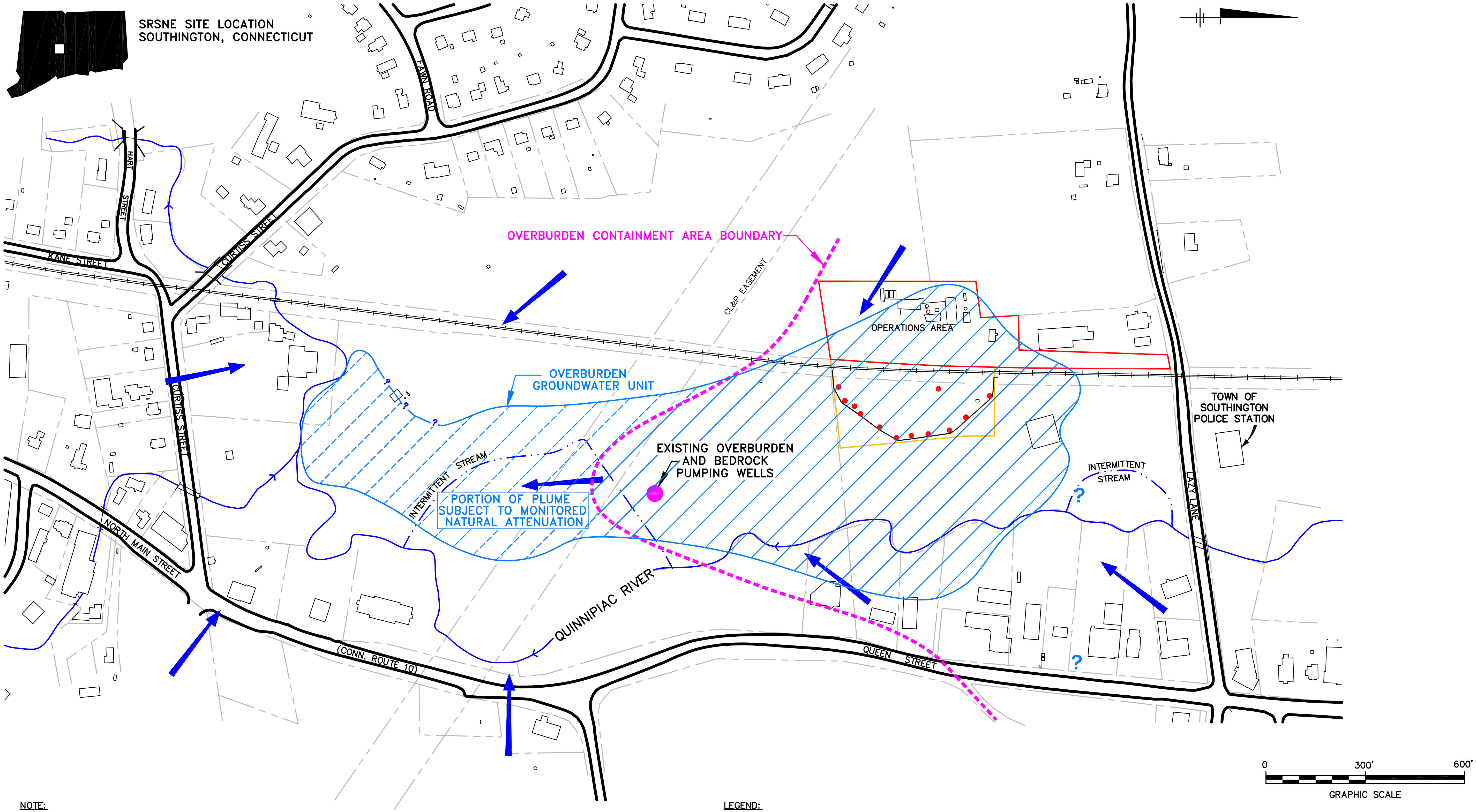
3. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

0 30' 60'
GRAPHIC SCALE

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

OVERBURDEN NAPL AREA

FIGURE
2-3



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

LEGEND:

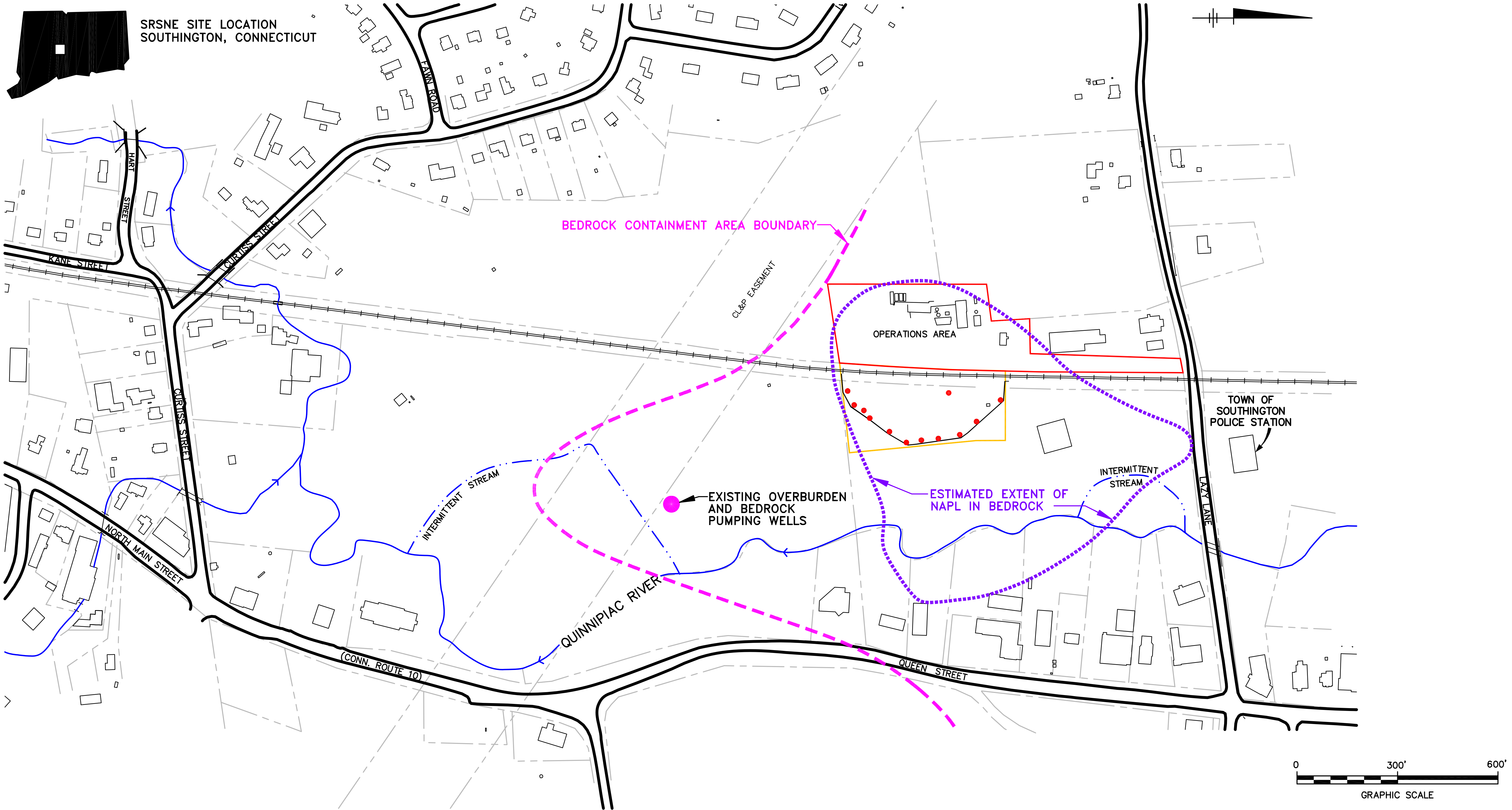
—	OVERBURDEN SHEET PILE WALL
●	OVERBURDEN EXTRACTION WELL (12)
←	GENERALIZED GROUND-WATER FLOW DIRECTIONS

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

OVERBURDEN GROUNDWATER AREA

FIGURE
2-4

X: 08331X00
L: OFF: REF*
P: PAGESET/SYR-BL1
5/24/05 SYR-85-PGL NJR GJD
08331009/FEASIBILITY/08331T03.DWG



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

LEGEND:

— OVERBURDEN SHEET PILE WALL

● OVERBURDEN EXTRACTION WELL (12)

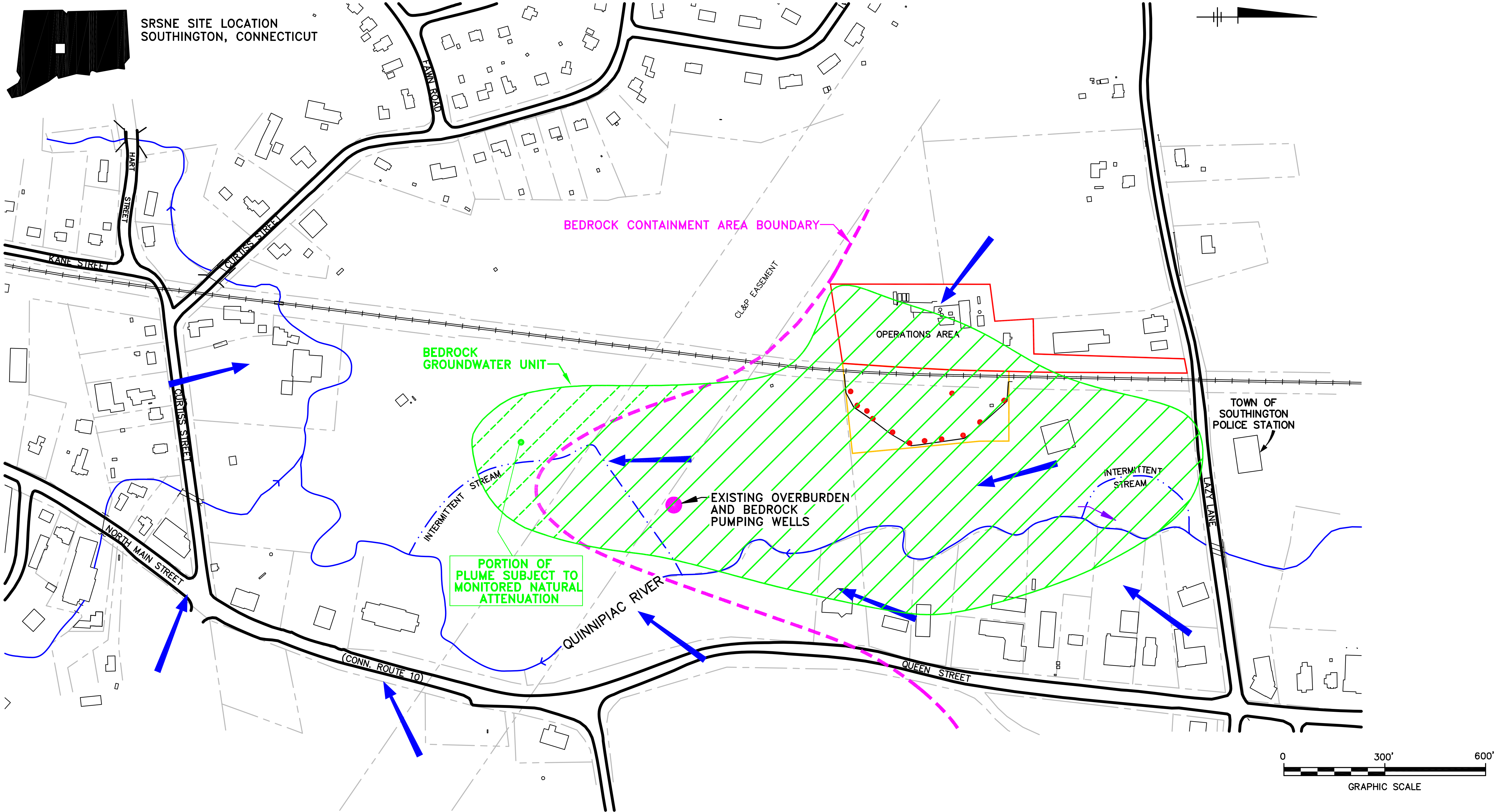
← GENERALIZED GROUND-WATER FLOW DIRECTIONS

X: 08331X00
L: ON= *; OFF= *REF*
P: PAGESET/SYR-BL1
5/24/05 SYR-85 PGL NJR GJD
08331009/FEASIBILITY/08331T05.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

BEDROCK NAPL AREA

FIGURE
2-5



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

LEGEND:

— OVERBURDEN SHEET PILE WALL

● OVERBURDEN EXTRACTION WELL (12)

← GENERALIZED GROUND-WATER FLOW DIRECTIONS

X: 08331X00
L: ON= *; OFF= *REF* P:
PAGESET/SYR-BL1
5/24/05 SYR-85 PGL NJR GJD
08331009/FEASIBILITY/08331T04.DWG

SRSNE SUPERFUND SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

BEDROCK GROUNDWATER AREA

FIGURE
2-6

Appendices

Appendix A

Overburden Investigation Field Results and Data Evaluation

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Appendix A - Overburden Investigation Field Results and Data Evaluation

A.1 General

This appendix presents the results of hydrogeologic investigation activities performed by Blasland, Bouck & Lee, Inc. (BBL) to help support the evaluation of potential groundwater remedial alternatives in the Feasibility Study (FS) for the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. The investigation activities described herein were proposed in the Overburden Investigation Plan (BBL, March 1998), including field activities, data evaluation, and modeling to support the FS for the site. Appendix A to this FS Report presents the Overburden Investigation Plan, which describes background information and the technical approach for the investigation. This Appendix A presents the field investigation results and associated data evaluation. The groundwater flow modeling component of the overburden investigation is presented in Appendix R to this FS Report.

The fundamental purpose for the additional overburden investigation was to refine our understanding of groundwater hydraulics in the north-central portion of the Town of Southington Well Field Property, where a groundwater containment remedy may be required. The saturated overburden within the north-central portion of the Town Well Field is approximately 75 feet thick, and consists predominantly of glaciofluvial sand and gravel with some strata containing silt, cobbles and/or boulders. This area was investigated through the performance and analysis of an extensive pumping test, as described below.

The overburden investigation included the following elements:

- Pumping Well and Piezometer Installation;
- Pumping Well and Piezometer Development;
- Step Drawdown and Constant-Rate Pumping Tests;
- Data Evaluation;
- Groundwater Flow Modeling (see Appendix F); and
- Reporting (this appendix).

The results for the four tasks indicated by the first four bullets are reported below.

A.2 Pumping Well and Piezometer Installation

To provide a pumping and head-monitoring system for use during the step-drawdown and constant-rate pumping tests, one overburden pumping well and eight overburden piezometers were installed by East-Coast Thomas Environmental between May 28 and July 16, 1998. Overburden pumping well RW-13 was installed adjacent to the MW-704 monitoring well cluster in the north-central portion of the Town Well Field Property, as shown on Figures A-1 through A-5. The new overburden piezometers fill data gaps in the pre-existing overburden groundwater elevation monitoring array. Shallow overburden piezometers PZO-6S, PZO-121S, and PZO-204S are located as shown on Figure A-1. Middle overburden piezometers PZO-2M, PZO-3M, and PZO-204M are situated as shown on Figure A-2. Deep overburden piezometers PZO-2D and PZO-3D were installed at the locations shown on Figure A-3.

Pumping well and piezometer as-built specifications are listed in Attachment A-1. Depths to till ranged from approximately 40 feet at PZO-6S and RW-13 to 84 feet at the PZO-3 cluster. Depths to bedrock ranged from approximately 75 feet at the PZO-6S and RW-13 locations to 114 at the PZO-3 cluster.

A.2.1 Pumping Well RW-13 Installation

The RW-13 pumping well borehole was advanced to the top of bedrock at approximately 78 feet below grade using 16-inch-diameter dual-rotary (Barber rig) drilling. Air was used during the drilling of the pumping well borehole to lift the drill cuttings to ground surface. The pumping well was constructed using a 40-foot length of 8-inch-diameter, continuous-wound, 0.030-inch slot, #304 stainless steel screen placed within the middle and deep overburden zones (depth interval of 35 to 75 feet below grade), and an 8-inch-diameter, Schedule 80 PVC riser pipe. The annulus between the pumping well and the borehole wall was backfilled with Morie No. 1 sand filter pack material from the bottom of the borehole to 5 feet above the top of the well screen. The pumping well screen slot size and sandpack grain size were selected following the procedure outlined by Driscoll (1986) for production well design. A 3-foot-thick, hydrated bentonite pellet seal was placed above the sand pack, and a cement grout seal was placed from the top of the bentonite seal to ground surface.

A.2.2 Piezometer Installation

To fill key data gaps in the overburden potentiometric monitoring network and provide hydraulic response data during the pumping test activities, eight overburden piezometers (three shallow, three middle, and two deep overburden) were also installed. The nomenclature of the new piezometers follows the designation of pre-existing wells and piezometers, to the extent possible. For example, shallow overburden piezometer PZO-121S was installed at the general location of the MW-121 cluster. Similarly, middle and deep overburden piezometers PZO-2M and PZO-2D, respectively, were installed next to existing NTCRA 2 bedrock piezometers PZR-2R and PZR-2DR, which were described in the NTCRA 2 Interim Technical Memorandum (BBL, September 1997). The new overburden piezometers installed as part of the additional overburden investigation, and the bedrock piezometers installed to support NTCRA 2 activities, are listed in Attachment A-1.

The new overburden piezometer boreholes were advanced through the overburden using 8.25-inch-outside-diameter (OD) hollow-stem augers. In addition, rotary (4-inch roller bit) drilling was used to help advance the borehole through cobbles and boulders in the deep overburden at the PZO-2D and PZO-3D locations. Split-spoon samples were obtained at 5-foot intervals to characterize the overburden geology and identify appropriate screen intervals for the overburden piezometers. Each new overburden piezometer was installed with a 10-foot-long, 2-inch-diameter, 0.010-inch slot, Schedule 40 PVC screen centered within the coarsest zone identified within either the shallow, middle, or deep overburden (each zone is approximately 20 to 35 feet thick). A Morie No. 0 filter pack was placed in the well/borehole annulus from the bottom of the piezometer screen to approximately 2 feet above the top of the screen, and the remainder of the annulus was be filled with bentonite to ground surface. Each new piezometer was completed above ground surface with a lockable protective casing set in concrete.

A.2.3 Survey Control

Horizontal and vertical survey control were established for each new well and piezometer by Conklin and Soroka, Inc., of Cheshire, Connecticut, including the top of the PVC riser, the top of the protective casing, and the ground surface adjacent the well, using the existing baseline for the SRSNE Site and the National Geodetic

Vertical Datum (NGVD) of 1929. Survey coordinates for the new pumping well and piezometers are also listed in Attachment A-1.

A.3 Pumping Well and Piezometer Development and Specific Capacity Testing

The new overburden pumping well and piezometers were developed to enhance their hydraulic connection to the surrounding overburden formation. In addition, specific capacity tests were performed at each new overburden piezometer to estimate the hydraulic conductivity of the overburden formation surrounding each piezometer.

A.3.1 Pumping Well and Piezometer Development

The objectives of well development were to remove fine sediment from the well/piezometer, produce sediment-free discharge water, and increase the yield of the overburden pumping well to the degree practicable. Between August 6 and 10, 1998, pumping well RW-13 was developed by surging using an approximately 8-inch-diameter surge block, pumping with a submersible pump, and jetting using air. During the development process, approximately 17,000 gallons of water were removed from the well and pumped to a frac tank located at the NTCRA 1 Area for later treatment at the NTCRA 1 treatment system. The sustainable yield of pumping well RW-13 increased from approximately 8 to 25 gallons per minute (gpm) during development.

After approximately 8,000 gallons had been removed from well RW-13, a sample of the discharge water was obtained from well RW-13 using a bailer, and submitted to Galson Laboratories of East Syracuse, New York for analysis of volatile organic compounds (VOCs) by USEPA Method 601/602. The analytical results indicated no individual constituent VOC concentration above groundwater regulatory criteria, as presented in Attachment A-2.

The new overburden piezometers were developed by pumping with a submersible pump until a minimum of five casing volumes was removed and clarity of the pumped water improved to the extent practicable. The final turbidity values ranged from 2 to 10 nephelometric turbidity units (NTUs) at all the new piezometers except PZO-3M (178 NTUs) and PZO-3D (295 NTUs), which were installed in a qualitatively siltier area than the other piezometers.

A.3.2 Specific Capacity Testing

Specific capacity test data were also obtained at each new overburden piezometer. Specific capacity test data acquisition entailed pumping each new piezometer at relatively constant rate for up to four hours and measuring the drawdown inside the tested piezometer. Specific capacity test data were used to estimate the hydraulic conductivity of the formation surrounding the screened interval of each new piezometer, as presented in Attachment A-3.

A.4 Step Drawdown and Constant-Rate Pumping Tests

Following the development and specific-capacity testing activities, a step-drawdown test and a comprehensive, constant-rate pumping test were performed to empirically test the hydraulic effectiveness of the overburden groundwater pumping well and obtain hydraulic response data from the formation for parameter estimation purposes. The overburden groundwater generated during these activities was pumped to the NTCRA 1 treatment system. A discharge line was set up from overburden well RW-13 to a frac tank in the vicinity of the NTCRA 1 Containment Area, with a sampling valve situated on the discharge line. The frac tank served as a preliminary settling tank to help improve the clarity of the water prior to pumping to the NTCRA 1 treatment system.

A.4.1 Overburden NAPL Zone Gradient Monitoring

During the pumping test activities, the horizontal hydraulic gradient was monitored within the potential overburden non-aqueous phase liquid (NAPL) zone identified in the RI Report (BBL, June 1998). The potential overburden NAPL zone extends from the Operations Area through the NTCRA 1 Containment Area, and eastward to the vicinity of the Quinnipiac River. The available horizontal hydraulic gradient data within the potential overburden NAPL zone were evaluated to assess the historical range of gradients that have been observed within the overburden NAPL zone. The range of pre-existing horizontal gradients was considered the acceptable range of gradients that would be allowed during the pumping test activities without risking NAPL remobilization due to overburden pumping from well RW-13 in the Town Well Field Property.

During overburden pumping from well RW-13, the horizontal component of the hydraulic gradient was monitored frequently at the following pairs of piezometers within the overburden potential NAPL zone to reduce the possibility that NAPL would be mobilized due to pumping:

- CPZ-4 and CPZ-4A; and
- CPZ-6 and TW-7A.

These locations have been monitored weekly since July 1995 as part of NTCRA 1 activities. The extensive, frequent monitoring history at these locations provides a sound basis to determine the range of hydraulic gradients at specific locations within the overburden NAPL zone, assess whether any hydraulic gradient changes occurred during the pumping tests, and deduce whether the changes are within the range of conditions that have already occurred. Overburden NAPL zone hydraulic gradient monitoring data measured during the 1-week-long constant-rate pumping test are presented in Attachment A-4.

A.4.2 Step Drawdown Test -- August 12, 1998

The primary purpose for conducting the step-drawdown test was to identify an appropriate discharge rate for the 2-week pumping test. The step-drawdown test involved pumping from overburden pumping well for 90 minutes at four successive, increasing pumping rates, and monitoring the drawdown in the pumping well. In addition, to provide an initial assessment of the hydraulic influence produced in the formation during pumping, water-levels will were monitored at nearby overburden monitoring wells and/or piezometers.

On August 12, 1998, middle/deep overburden pumping well RW-13 was pumped for 90 minutes at each of the following successive rates: 7.5 gpm; 15 gpm; 22 gpm; and 30 gpm. Attachment A-5 presents the step-drawdown data measured in pumping well RW-13 in tabular and graphical form.

A.4.3 Constant-Rate Pumping Test -- August 17 to 24, 1998

Following the completion of the step-drawdown test, a constant-rate pumping test was performed in accordance with the Overburden Investigation Plan (BBL, March 1998) to empirically assess the steady-state hydraulic influence produced by the overburden pumping well and estimate hydraulic parameters pertinent to the evaluation of potential groundwater remedial alternatives. The constant-rate pumping test objectives were to pump well RW-13 for a sufficient duration to establish approximately steady-state head and flow conditions, and measure the transient and steady-state hydraulic response in the surrounding formation during pumping. Based on the hydraulic responses observed the constant-rate test, steady-state conditions were identified within approximately 3 days of pumping, and the test was terminated after 1 week.

Immediately prior to beginning the constant-rate pumping test on August 17, 1998, an initial, comprehensive round of groundwater elevation measurements was obtained at essentially all accessible wells, piezometers, and surface-water measurement locations within the vicinity of the SRSNE Site, including the newly-installed pumping well and piezometers. This data set: 1) established the initial pre-pumping head distribution which was used to assess the hydraulic changes induced by pumping; and 2) provided a basis to evaluate the total hydraulic influence produced by the overburden pumping well. The comprehensive, pre-pumping groundwater and surface-water elevation measurement data set is presented in Attachment A-6.

Pumping was initiated at middle/deep overburden pumping well RW-13 at 8:00 p.m. on Monday, August 17, 1998. The pump was operated at a relatively constant rate of approximately 22.5 gpm, as measured using an in-line-totalizing flow meter situated at the well-head. Pumping rate data recorded during the 1-week, constant-rate test are summarized in Attachment A-7.

Manual groundwater elevation measurements were made relatively frequently (as rapidly as possible for the first three hours of pumping, several times during the remainder of the first day of pumping, and three times daily thereafter) throughout the constant-rate pumping test at the following locations: RW-13; CW-2-75; CW-B-77; MW-704S; MW-704M; MW-704D; PZO-6S; PZO-121S; MW-121B; PZO-204S; PZO-204M; and MW-204B. These data, in conjunction with the data obtained from transducers (discussed below) provided temporal data to estimate the hydraulic parameters of the sand-and-gravel outwash deposit. In addition, as requested by USEPA, groundwater elevations were measured daily at the MW-710 well cluster, which is situated along North Main Street, east of the Quinnipiac River. Transient, manual groundwater elevation measurements are presented in Attachment A-8.

Automatic pressure transducers were installed at overburden pumping well RW-13 and six additional overburden monitoring wells or piezometers located at various distances and directions from the pumping well to record the transient hydraulic response during pumping. Pressure transducers were installed at the following locations: pumping well RW-13; piezometers PZO-2M, PZO-2D, and PZO-121S; and monitoring wells MW-704S, MW-202B and MW-203B.

Groundwater elevation changes were reviewed periodically throughout the constant-rate pumping test to determine whether steady-state conditions are evident. Steady-state conditions were considered achieved after approximately 3 days of pumping, when the net head changes recorded within a given 24-hour period were similar at all the locations monitored using transducers. The data used to identify steady-state conditions are presented in Attachment A-9. BBL transmitted these data to the United States Environmental Protection Agency's (USEPA's) hydrogeologic consultant, TetraTech NUS, on August 21, 1998. Based on BBL's telephone discussion with TetraTech NUS on August 21, 1998, the parties agreed it would be appropriate to terminate the test after 1 week of pumping.

As barometric pressure and precipitation can also influence water levels in wells and piezometers, these data were also recorded on site (Attachment A-10). Minor precipitation events occurred during the first 2 days of pumping. Minor barometric pressure changes also occurred throughout the test. These influences are considered negligible, and do not appear to have adversely impacted the results of the pumping test.

On Monday, August 24, 1998, after approximately 1 week of pumping, a final, comprehensive groundwater elevation measurement round was obtained at all accessible monitoring wells, piezometers, and surface-water measurement locations within the vicinity of the SRSNE Site. This final, comprehensive data measurement round was used to empirically demonstrate the steady-state hydraulic influence of the overburden pumping well, as discussed below. Following the completion of the final measurement round, pumping was terminated at 8:00 p.m. on Monday, August 24, 1998. Transient recovery data were obtained at the locations monitored using transducers and data loggers until the recovery of the water level in the pumping well was within 90% of the maximum drawdown observed during pumping.

During the constant-rate pumping test, three groundwater discharge samples were collected on the second, sixth, and seventh days of pumping for laboratory analysis for the same organic and inorganic parameters required for the influent to the NTCRA 1 treatment system in the Substantive Requirements for Discharge required by the CT DEP. The purpose for these samples was to provide a basis to assess treatment alternatives in the event that a groundwater containment remedy is implemented in the north-central portion of the Town Well Field Property. Well RW-13 discharge sampling results are presented in Attachment A-11.

A.5 Data Evaluation

This subsection describes in detail the key findings from the extensive volume of groundwater hydraulic data obtained during the overburden investigation.

A.5.1 Specific Capacity Tests

Specific capacity test data obtained from each new piezometer are presented in Attachment A-3. The test duration (t), pumping rate (Q), drawdown (s), and piezometer screen and borehole geometry were used to estimate the hydraulic conductivity of the overburden formation surrounding the well intake section based on the method of Walton (1962). (Similar data were also obtained during the development of the NTCRA 2 bedrock piezometers, as summarized in Attachment A-3.)

The specific capacity test results from the overburden piezometers are summarized below.

Piezometer	Q (gpm)	t (min)	s (ft)	K (cm/sec)	K (ft/day)
PZO-2M	5	240	1.02	3.4E-2	96
PZO-2D	3.4	250	1.17	1.9E-2	54
PZO-3M	0.17	90	46.51	5.8E-6	0.016
PZO-3D	0.82	265	45.55	7.9E-5	0.22
PZO-6S	3	195	13.59	1.1E-3	3.1
PZO-121S	5	240	2.03	1.6E-2	45
PZO-204S	0.75	240	3.07	1.2E-3	3.4
PZO-204M	0.47	240	48.65	2.9E-5	0.082

These results, in combination with previous specific capacity test results presented in the final Remedial Investigation Report (BBL, June 1998), indicate a zone of relatively high hydraulic conductivity within the overburden along an approximately north-south transect in the vicinity of the MW-121, MW-704 and PZO-2 clusters, and continuing to the location of middle overburden monitoring well MW-3. Well MW-3 is the furthest overburden monitoring well within the interpreted groundwater regulatory plumes associated with the SRSNE Site. The new specific capacity test results from piezometers PZO-2M, PZO-2D, and PZO-121S are consistent with the previous data, and indicate an apparently continuous, permeable overburden zone extending approximately from the MW-121 well cluster to well MW-3. In contrast, at the locations slightly further to the east (PZO-3 and MW-204/PZO-204 clusters), significantly lower hydraulic conductivities were measured, suggesting that the interpreted permeable zone may bounded on the east side by relatively lower-permeability materials.

A.5.2 Overburden NAPL Zone Gradient Monitoring

The maximum historical horizontal hydraulic gradient within the overburden NAPL zone was assessed in terms of the head differential at the following pairs of wells/piezometers located southeast and east of the NTCRA 1 Containment Area: 1) CPZ-4 and CPZ-4A; and 2) CPZ-6 and TW-7A. The locations of these piezometers and the NTCRA 1 Containment Area are shown on Figure A-2. The maximum historical head differentials at these two pairs of wells/piezometers were:

- CPZ-4 and CPZ-4A -- 3.46 feet; and
- CPZ-6 and TW-7A -- 4.68 feet.

During the step-drawdown test on August 12, 1998, the maximum head differentials measured at these two clusters were 0.90 feet (CPZ-4 and CPZ-4A) and 3.07 feet (CPZ-6 and TW-7A). These data indicate that the horizontal component of the hydraulic gradient within the overburden NAPL zone was within the acceptable (historical) range during the step drawdown test.

Overburden NAPL zone hydraulic gradient monitoring data measured during the 1-week-long constant-rate pumping test are presented in Attachment A-4. During the constant-rate test pumping test activities (August 17 to 24, 1998), the maximum head differentials measured at these two clusters were 0.94 feet (CPZ-4 and CPZ-4A) and 3.29 feet (CPZ-6 and TW-7A). These data indicate that the horizontal component of the hydraulic gradient within the overburden NAPL zone during the constant-rate pumping test was also within the acceptable (historical) range.

A.5.3 Step-Drawdown Test

On August 12, 1998, middle/deep overburden pumping well RW-13 was pumped for 90 minutes at each of the following successive rates: 7.5 gpm; 15 gpm; 22 gpm; and 30 gpm. Attachment A-5 presents the step-drawdown data measured in pumping well RW-13 in tabular and graphical form.

The drawdown measured in RW-13 was approximately 1.0, 2.4, 5.7, and 21.1 feet, respectively, at the end of each step. These data indicate specific capacity values of approximately 7.5, 6.3, 3.9, and 1.4 gallons per minute per foot (gpm/ft). The reduction in specific capacity with increasing pumping rate indicates decreasing efficiency ("well loss"). This affect is commonly seen in pumping wells (Driscoll, 1986), and is usually related to smearing of the geologic formation or siltation at the borehole wall. Based on the relatively steep slope of the drawdown curve for the final pumping step, it appears that well RW-13 is not capable of maintaining a rate of 30 gpm during long-term pumping. The straight-line trend at the end of the curve for the 22 gpm rate (Step No. 3), however, indicated that a similar rate could likely be maintained during the constant-rate test.

Total drawdown data during the step drawdown test were also quantified at the following wells:

- Shallow Overburden Wells/Piezometers -- MW-704S and PZO-121S, 0.12 and 0.02 feet, respectively;
- Middle Overburden Wells -- MW-704M, 1.70 feet; and
- Deep Overburden Wells -- MW-704D and MW-121B, 1.66 and 0.65 feet, respectively.

These data indicated that the rate of 22.5 would provide a sufficient hydraulic stress to characterize overburden hydraulic responses and parameters with a constant-rate pumping test of one to 2 weeks' duration.

A.5.4 Constant-Rate Pumping Test

Groundwater hydraulic data obtained during the constant-rate pumping test of well RW-13 included two comprehensive rounds of groundwater elevations and transient drawdown data measured at select wells and piezometers. The comprehensive head measurement rounds, obtained prior to pumping and during the final (seventh) day of pumping, were used to prepare maps showing the drawdown distribution and capture zones achieved by pumping 22.5 gpm from well RW-13 for 7 days (Figures A-1 through A-12). The transient drawdown data were used to perform standard curve matching analyses and provide additional hydraulic parameter estimates pertinent to groundwater remedial design (Attachment A-12). Finally, the actual pumping test capture zones effected in the middle and deep overburden and the shallow bedrock were compared to a simulation of the pumping test using the existing regional MODFLOW groundwater flow model for the site.

BBL compiled the two rounds of comprehensive groundwater elevation measurements, obtained immediately prior to pumping and prior to the termination of pumping, within the comprehensive groundwater database. These data were used to develop drawdown maps (Figures A-1 through A-5) and a cross section (Figure A-6) to depict the three-dimensional extent of the hydraulic influence produced by the pumping well. In addition, the heads measured during pumping were used to prepare groundwater elevation contour maps (Figures A-7 through A-11) for the overburden and bedrock formations, and a cross section (Figure A-12) showing the RW-13 steady-state capture zone in three dimensions.

The steady-state drawdown and groundwater elevation data measured on the final day of the constant rate pumping test were evaluated in the following five hydrostratigraphic zones:

- Shallow, middle and deep overburden, which represent the upper, middle, and lower thirds of the saturated overburden deposits, respectively; and

- Shallow and deep bedrock, which represent approximately the upper 30 feet of bedrock and a zone between 60 and 90 feet below the top of bedrock, respectively.

These five zones were designated during the development of the RI Work Plan (BBL, November 1995) based on geology (overburden versus bedrock) and on the desire to add vertical resolution to the presentation of hydrogeologic data. As the thickness of the saturated overburden ranges from approximately zero to 100 feet in the study area, the thickness and depth of the three overburden zones are variable. These five monitored zones are hydraulically connected and comprise a hydrogeologic continuum from the water table downward through the deepest monitored bedrock interval. Deeper sections of bedrock, below the deepest monitoring well in the study area, are also interpreted as part of the regional groundwater flow system.

A.5.4.1 Drawdown Contour Maps and Cross Section

The drawdown contour maps presented as Figures A-1 through A-5 provide an empirical demonstration of the areal extent and magnitude of the steady state pumping influence effected by middle/deep overburden pumping well RW-13. Figure A-6 shows the drawdown response in cross section. In general, the wells situated furthest from pumping well RW-13 had net drawdown values of approximately 0.0 to 0.1 feet. These data indicate that the overall, regional, background potentiometric change was approximately 0.0 to 0.1 feet. In contrast, higher drawdown values were generally seen in the immediate vicinity of middle/deep overburden pumping well RW-13, with a systematic decrease in drawdown in each of the five monitored hydrogeologic zones with increasing lateral distance from the pumping well. The key deductions from the five drawdown contour maps are summarized below.

- Shallow Overburden Drawdown (Figure A-1) – Relatively little response, with maximum drawdown values of approximately 0.4 feet at monitoring wells MW-704S and PZO-6S. Elliptical cone of depression extends approximately 600 feet to south, and 400 feet west, and 200 feet east. Water-table drawdown limited toward east due to Quinnipiac River. The extent of the hydraulic influence toward the north is interpreted as approximately 750 feet.

- Middle Overburden Drawdown (Figure A-2) – Substantial response, with maximum drawdown value of approximately 1.5 feet at monitoring well MW-704M. Elliptical cone of depression extends approximately 500 feet to south and west. Extent of hydraulic influence toward north at least 1,000 feet, based on consistent drawdown data at wells P-101B, P-102B, and MW-501B in the area immediately east of the Quinnipiac River. Extent of influence toward east may be as far as 800 feet ("background" well MW-203B indicated an apparent drawdown of 0.3 feet). Eastward extent of drawdown in middle overburden not limited by Quinnipiac River, which penetrates only approximately 2 feet of the shallow overburden.

- Deep Overburden Drawdown (Figure A-3) – Substantial response, with maximum drawdown value of approximately 1.5 feet at monitoring well MW-704D. Elliptical cone of depression extends approximately 500 feet to south and west. Extent of the hydraulic influence toward the north and east estimated as at least 800 feet and 500 to 600 feet based on responses observed in middle overburden. Pumping well RW-13 is screened in the middle and deep overburden.

- Shallow Bedrock Drawdown (Figure A-4) – Largest response of the five monitored zones, with maximum drawdown value of approximately 3.2 feet at monitoring well MW-704R. Irregular cone of depression extends approximately 600 feet to south and 500 feet west. Extent of hydraulic influence toward north at least 1,100 feet, based on consistent drawdown data at wells P-101A, P-102A, and MW-501A. Extent of influence toward east estimated as at least 400 feet.

- Deep Bedrock Drawdown (Figure A-5) – Substantial response, with maximum drawdown value of approximately 1.5 feet at monitoring well MW-704DR and bedrock pumping well RW-1. Irregular cone of depression extends approximately 700 feet to south and 400 feet west. Extent of hydraulic influence toward north likely at least 900 feet. Extent of influence toward east estimated as 500 feet.

The drawdown produced by pumping well RW-13 is also shown on a north-south oriented cross section presented as Figure A-6. The biggest hydraulic response was observed in the shallow bedrock in the area beneath the pumping well. Furthermore, Figure A-6 shows that the hydraulic influence produced by pumping well RW-13 extended vertically beyond the deepest monitored bedrock zone. The drawdown at deep bedrock monitoring well MW-704DR was 1.5 feet, which was the same drawdown observed in the middle and deep overburden at wells MW-704M and MW-704D. Thus, in spite of the fact that well RW-13 is screened in the middle and deep overburden, this well has a substantial hydraulic influence within the bedrock.

The extent of the hydraulic influence north of pumping well RW-13 in the shallow bedrock and all overburden zones is obscured by irregular potentiometric responses in the area east of the NTCRA 1 Containment System, which may be attributed to cycling of the twelve NTCRA 1 overburden pumping wells. These extraction wells have a substantial influence on overburden and shallow bedrock heads inside the NTCRA 1 overburden sheet pile wall. Since the NTCRA 1 well influence would obscure any interpretation of RW-13 pumping response, this area is not contoured on Figures A-1 through A-5. Also, as these wells have a significant influence on shallow bedrock potentiometric heads, their cycling may influence overburden heads outside the sheet pile wall. This hypothesis may account for relatively random, non-systematic drawdown data (including some negative values) measured near the NTCRA 1 Containment Area in all three overburden zones and the shallow bedrock.

A.5.4.2 Steady-State Groundwater Elevations and Estimated Capture Zones during Pumping

The groundwater elevation data measured during the seventh and final day of pumping (August 24, 1998) were contoured as shown on Figures A-7 through A-12. Superimposed on these maps are the interpreted groundwater captures zones, which were estimated based on the results of numerical simulations (see Attachment A-13) and calculation of the stagnation point location defining the limits of the capture zone downgradient from pumping well RW-13 (see Attachment A-14). As a group, these figures illustrate the approximate, three-dimensional steady-state capture zone achieved after 1 week of pumping 22.5 gpm from middle/deep overburden pumping well RW-13. The key deductions from these five groundwater elevation contours and estimated capture zones are summarized below

- Shallow Overburden Groundwater Elevations (Figure A-7) -- Relatively little response, with no apparent capture zone.

- Middle Overburden Groundwater Elevations and Estimated Capture Zone (Figure A-8) -- Substantial response, with potentiometric cone of depression centered about middle/deep overburden pumping well RW-13. Approximately parabolic capture zone extends south to stagnation point located approximately 220 feet south of pumping well. Estimated capture zone includes Operations Area, Cianci Property, and extends beneath the Quinnipiac River to the vicinity of Queen Street.

- Deep Overburden Groundwater Elevations and Estimated Capture Zone (Figure A-9) -- Substantial response, with potentiometric cone of depression centered about middle/deep overburden pumping well RW-13. Approximately parabolic capture zone extends south to stagnation point located approximately 210 feet south of pumping well. Estimated capture zone includes Operations Area, Cianci Property, and extends beneath the Quinnipiac River to the vicinity of Queen Street.

- Shallow Bedrock Groundwater Elevations and Estimated Capture Zone (Figure A-10) -- Largest response of the five monitored zones, with potentiometric cone of depression centered about middle/deep overburden pumping well RW-13. Approximately parabolic capture zone extends south to stagnation point located approximately 310 feet south of pumping well. Estimated capture zone includes the majority of the Operations Area and the entire Cianci Property, and extends beneath the

Quinnipiac River to the vicinity of Queen Street. A shallow bedrock second capture zone evident in vicinity of NTCRA 1 overburden pumping system, with stagnation point located near well P-6.

- Deep Bedrock Groundwater Elevations and Estimated Capture Zone (Figure A-11) -- Significant response, with potentiometric cone of depression centered about middle/deep overburden pumping well RW-13. Approximately parabolic capture zone extends south to stagnation point located approximately 185 feet south of pumping well. Estimated capture zone includes the majority of the Operations Area and Cianci Property, and extends beneath the Quinnipiac River to the vicinity of Queen Street.

These groundwater elevation contours and estimated capture zones indicate that, during steady-state pumping of 22.5 gpm from middle/deep overburden pumping well RW-13, mappable groundwater capture zones were established in all monitored zones except the shallow overburden. While a reversal of gradient was not demonstrated in the shallow overburden, it is reasonable to assume that, due to vertical flow components, shallow overburden groundwater was also within the RW-13 capture zone. This interpretation is illustrated in a north-south-oriented cross section on Figure A-12. As depicted on Figure A-12, the hydraulic head data measured during the seventh day of pumping indicate that the RW-13 capture zone extended approximately 185 to 270 feet south of pumping well. In addition, the capture zone achieved by pumping well RW-13 extended deeper than the interpreted bottom of groundwater regulatory VOC plume within the deep bedrock.

A.5.4.3 Comparison between Empirical and Simulated Capture Zones

The estimated capture zones presented on Figures A-8 through A-12, which are consistent with the empirical groundwater elevation data, are also consistent with output from the NTCRA 2 numerical groundwater flow (MODFLOW) model.

BBL performed a simulation of the steady-state influence of well RW-13 operating at a steady-state rate of 22.5 gpm. Attachment A-13 presents two model output figures used to draw the estimated middle overburden, deep overburden, and shallow bedrock capture zones, respectively, shown on Figures A-8, A-9, and A-10. The deep bedrock capture zone shown on Figure A-11 was estimated based on the shape of the shallow bedrock capture zone, and the calculated location of the deep bedrock stagnation point, as discussed below.

To provide an independent check of the estimated capture zones shown on these figures, which are based on MODFLOW model output. BBL calculated the theoretical location of the stagnation point along a line extending south from pumping well RW-13, as presented in Attachment A-14. The stagnation point is the location of the hydraulic divide that defines the downgradient extent of the capture zone created by a pumping well. To calculate the stagnation point location, BBL used the pre-pumping groundwater elevations and steady-state drawdown values measured at three points along a line south of well RW-13 in each of the following zones: middle overburden; deep overburden; shallow bedrock; and deep bedrock. In each hydrostratigraphic zone, data measured at the three observation points (“upgradient”, “middle”, and “downgradient”) were used to interpolate the pre-pumping groundwater elevation and drawdown along the line extending south from the pumping well. The pre-pumping elevations were linearly interpolated between adjacent pairs of observation points. Drawdown values were interpolated with respect to the logarithm of distance from pumping well RW-13. This is the same principle as used in developing semi-logarithmic distance-drawdown plots according to the Jacob method (Kruseman and de Ridder, 1990). The resulting drawdown estimates were subtracted from the pre-pumping groundwater elevation estimates to obtain the estimated pumping groundwater elevations, as shown in Attachment A-14. These calculations suggest that relatively broad “stagnation zones” may exist in the middle overburden (190-250 feet south of well RW-13), deep overburden (180-240 feet south of RW-13), and deep bedrock (150-220 feet south of RW-13) during pumping from well RW-13.

The results of the stagnation point calculation analysis detailed in Attachment A-14 were compared with the MODFLOW model output, as summarized in the following table.

Stratigraphic Zone	Calculated Stagnation Point Distance South of RW-13 (Feet, Attachment A-14)	Simulated Stagnation Point Distance South of RW-13 (Feed, Attachment A-13)	Summary Figure
Middle Overburden	220	220*	A-8
Deep Overburden	210	220*	A-9
Shallow Bedrock	270	310	A-10
Deep Bedrock	185	**	A-11**

* Middle and deep overburden are within the same overburden layer in the NTCRA 2 MODFLOW model.

* * Deep bedrock capture zone estimated based on simulated bedrock capture zone shape and calculated stagnation point distance from RW-13.

These results indicate that the MODFLOW model and the stagnation point analysis provide a consistent results regarding the stagnation point location within the monitored hydrogeologic zones. These results are also consistent with the general distribution of hydraulic head values measured in each stratigraphic zone during pumping from well RW-13. However, the model results may be conservative with respect to the actual capture zone width achieved in the field, because the MODFLOW model underestimated the drawdown observed in the field.

Attachment A-13 presents contours of the middle/deep overburden drawdown predicted by the model. The model predicted elliptical drawdown contours with a similar general shape as seen in the field data, except the model underestimated the magnitude of drawdown observed in the field. The model predicted very similar drawdown contours in the shallow bedrock as in the middle/deep overburden. The simulated shallow bedrock drawdown contours were elongate in the north-south direction. However, the model underestimated the actual magnitude of drawdown observed in the shallow bedrock, which was the largest drawdown response observed in the field. The model also underestimated the drawdown observed in the deep bedrock.

In summary, the modeling results indicate that the existing MODFLOW model provides a reasonable, yet likely conservative mechanism to assess the hydraulic effectiveness of various remedial alternatives as part of this FS (see Appendix R).

A.5.4.4 RW-13 Pumping Impact on NTCRA 1 Demonstration of Compliance

Pumping 22.5 gpm from middle/deep overburden pumping well RW-13 appears to have had some hydraulic influence on overburden groundwater elevations outside the NTCRA 1 sheet pile wall and slightly reduced the compliance head differentials, but did not cause a lapse in compliance as described in the NTCRA 1 Demonstration of Compliance Plan (BBL, June 1995). The Demonstration of Compliance Plan requires that the hydraulic gradient at the sheet-pile wall be maintained inward, with a minimum head differential of 0.3 feet as measured at each of five pairs of overburden compliance piezometers. The inward gradient is maintained by the operation of twelve overburden groundwater extraction wells located within (west of) the NTCRA 1 sheet pile wall.

The NTCRA 1 overburden head differentials at the five pairs of compliance piezometers before and after approximately 1 week of pumping 22.5 gpm from well RW-13 are presented in Attachment A-6 and summarized below.

Compliance Piezometer Pair	Piezometer Outside Wall	Piezometer Inside Wall	Pre-Pumping, Head Differential, 08/17/98 (ft)	Pumping, Head Differential, 8/24/98 (ft)	Change in Head Differential (ft)
1	CPZ-2	CPZ-1	1.18	0.96	-0.22
2	CPZ-4	CPZ-3	0.70	0.44	-0.26
3	CPZ-6	CPZ-5	7.59	7.26	-0.33
4	CPZ-8	CPZ-7	1.41	1.34	-0.07
5	CPZ-10	CPZ-9	1.29	1.27	-0.02

These results indicate that the RW-13 pumping influence was approximately 0.2 to 0.3 feet in the overburden formation outside of the central to southern portions of the NTCRA 1 sheetpile wall, consistent with the drawdown contours shown on Figures A-1 through A-3. Thus, steady-state pumping from well RW-13 could influence the NTCRA 1 Demonstration of Compliance. For example, the inward head difference at compliance piezometer pair CPZ-3/CPZ-4 decreased from 0.70 to 0.44 during the constant-rate pumping test and, therefore, approached the minimum allowed head differential of 0.3 feet. However, these data demonstrate that during the RW-13 constant-rate pumping test, NTCRA 1 compliance was maintained.

A.5.4.5 RW-13 Pumping Impact on Wetlands Areas

Within the central portion of the Quinnipiac River valley, the Quinnipiac River is bordered by a floodplain. HNUS identified the area within approximately 50 to 150 feet west of the Quinnipiac River, and the intermittent stream that crosses the Town Well Field Property, as wetlands. Wetlands are defined as areas of permanent or periodic inundation of prolonged soil saturation sufficient to create anaerobic conditions in the soil (USFWS, 1989). These areas constitute riparian wetlands habitat, canopied by a deciduous forest community interspersed with an understory of scrub-shrub and herbaceous communities. Additional smaller wetlands are situated near the south edge of the NTCRA 1 Containment Area.

Pumping 22.5 gpm from middle/deep overburden pumping well RW-13 appears to have had relatively little influence on overburden groundwater elevations in these wetland areas. As discussed above, and shown on the shallow overburden drawdown contour map (Figure A-1), the hydraulic influence in the shallow overburden was limited during pumping from RW-13. For example, the shallow overburden drawdown within 100 feet east of pumping well RW-13, at piezometer PZO-204S, was only 0.2 feet. A localized area with drawdown up to 0.8 feet, at well MW-08, was also observed within approximately 40 feet of the Quinnipiac River. Given the closer proximity of this well to the NTCRA 1 Containment Area, however, the response observed at well MW-08 may also relate, in part, to cycling of NTCRA 1 pumps.

A.5.4.6 RW-13 Pumping Impact on Private Wells

The private residential wells nearest the SRSNE Site are along Lazy Lane, approximately 1,600 feet northwest of pumping well RW-13. Approximately 85 homes on Melcon Street, Curtiss Street, Juniper Road, Little Fawn Road, and Carrier Court on the hill west of the SRSNE Site also use domestic wells for their water supply; these wells are located at least a half-mile upgradient (west) of the pumping well RW-13 location (HNUS, July 1994;

Southington Water Department, January 1997). Based on information compiled during the first round of private well sampling in the vicinity of the SRSNE Site in 1990 by the CT DEP, the majority of the private wells in the area of the site are drilled, open-bedrock wells ranging from 90 to more than 200 feet deep.

Pumping 22.5 gpm from middle/deep overburden pumping well RW-13 had a substantial influence on bedrock potentiometric heads as shown on the shallow and deep bedrock drawdown contour maps (Figures A-4 and A-5), and depicted in cross section (Figure A-6). However, the bedrock data measured at the extensive network of bedrock wells and piezometers indicates little or no hydraulic influence at the distance of the nearest private wells along Lazy Lane. Also, given the closer proximity of these private wells to the NTCRA 1 Containment Area, any responses inferred along Lazy Lane could relate to cycling of NTCRA 1 pumps.

A.5.4.7 Drawdown Data Analysis and Parameter Estimates

Drawdown data were used to estimate the hydraulic parameters for the saturated overburden in the vicinity of middle/deep overburden pumping well RW-13 based on transient responses (log-log plots of drawdown versus time) and steady-state drawdown data (a semi-log distance-drawdown plot).

A.5.4.7.1 Transient Curve Matching Analysis and Parameter Estimates

Transient groundwater elevation measurements recorded manually and using transducers in the vicinity of middle/deep overburden pumping well RW-13 were converted to drawdown data to estimate the hydraulic parameters of the glaciofluvial sand-and-gravel formation. Frequent manual measurements were recorded at the following locations: RW-13; CW-2-75; CW-B-77; MW-704S; MW-704M; MW-704D; PZO-6S; PZO-121S; MW-121B; PZO-204S; PZO-204M; and MW-204B. Transient, manual groundwater elevation measurements are tabulated in Attachment A-8. Also, automatic pressure transducers were used to record data at overburden pumping well RW-13 and the following observation locations: PZO-2M; PZO-2D; MW-704S; PZO-121S; MW-202B; and MW-203B.

The transient drawdown data were evaluated using the Neuman (1975) method for anisotropic unconfined aquifers with delayed gravity drainage and the Theis (1935) method for confined aquifers. These methods are described in detail by Kruseman and de Ridder (1990). BBL used AQTESOLVTM pumping-test analysis software (Duffield, 1995) to facilitate Neuman and Theis type-curve matching and automatically compute the overburden transmissivity (T), storativity (S), specific yield (Sy), and delayed drainage term (ß). In Neuman's method, the term ß is defined as:

ß = (r2/H2)(Kv/Kh),

where r is the radial distance from the pumping well to the observation point where transient drawdown was measured, Kv is the vertical hydraulic conductivity, and Kh is the effective horizontal hydraulic conductivity. Thus, based on the estimated values of ß, the Neuman method was also used to estimate the ratio of the horizontal to vertical hydraulic conductivities, i.e., the magnitude of horizontal to vertical anisotropy. Based on the T values and the estimated average saturated thickness (H) of the overburden in the vicinity of pumping well RW-13, the effective horizontal hydraulic conductivity (K) was also estimated.

Attachment A-12 presents a tabulated summary of the transient drawdown curve analyses, and graphical depictions of the plotted data and curve-matching results. Ideally, a log-log graph of transient drawdown data versus time measured in an unconfined aquifer has three distinct segments: 1) an early segment where the data follow a Theis type curve related to the instantaneous storativity, S; 2) a middle segment where the increase in drawdown slows down due to a contribution of water via gravity drainage of the water table; and 3) a late segment where the data again follow a Theis type curve related to the effect of specific yield, Sy. Theoretically, the two Theis curves indicate the same T value, but different storage coefficients (S or Sy). Therefore, BBL attempted to select early and late Theis curves with similar vertical positions on the log-log plots, and took the average of the T values. The Neuman type curves take into account the entire data set, including all three segments of the drawdown versus time curve.

The results of the Theis and Neuman analyses are tabulated in Attachment A-12, and can be summarized as follows:

- Geometric Mean T: 0.67 ft^2/min, or 970 ft^2/day;
- Overall Geometric Mean Kh: 13 ft/day;
- Arithmetic Mean Kh at MW-704 Cluster: 25 ft/day;
- Arithmetic Mean S: 0.0041 (dimensionless);
- Arithmetic Mean Sy: 0.18 (dimensionless);
- Geometric Mean Anisotropy Ratio, Kh/Kv: 5.2; and
- Arithmetic Mean Anisotropy Ratio Kh/Kv: 7.6.

It is important to note that the overall geometric mean Kh value derived from the transient analyses of drawdown curves, 13 ft/day, is likely influenced by heterogeneity within the overburden formation. Wells in relatively permeable zones connected to the pumping well exhibit relatively high drawdown. In contrast, wells in low-permeability zones exhibit relatively low drawdown. These results are the opposite of what one would expect in a homogeneous formation. Thus, the hydraulic conductivity estimate deduced from a given data set should not be taken as an accurate estimate of the hydraulic conductivity at that location, nor as a representative estimate of the formation as a whole.

Heterogeneity results in an increase in the scatter of estimated hydraulic conductivity values with increasing distance from the pumping well, as shown on the graph of Kh versus distance from RW-13 in Attachment A-12. The conditions in the immediate vicinity of overburden pumping well RW-13, however, are probably best estimated using the data from the wells nearest to the pumping well, namely monitoring wells MW-704S, MW-704M, and MW-704D. The data from these wells indicated relatively consistent K values between 17 and 35 ft/day, with an arithmetic mean of 25 ft/day. This number is very similar to the arithmetic mean hydraulic conductivity of 27 ft/day calculated based on specific capacity tests performed at wells MW-704S, MW-704M, and MW-704D during the completion of the RI (BBL, June 1998), an is considered a reliable estimate of the effective horizontal hydraulic conductivity in the vicinity of pumping well RW-13.

The arithmetic and geometric mean anisotropy ratios (Kh/Kv) were approximately 5.2 and 7.6, respectively. These numbers are very consistent with anisotropy data reported for glaciofluvial sand and gravel aquifers by Bair and Lahm (1996) and indicate a significant degree of vertical connection across the overburden formation. Bair and Lahm (1996) reported geometric and arithmetic mean Kh/Kv ratios of 5.5 and 7.3 for nine glaciofluvial sand and gravel aquifer pumping tests analyzed using the Neuman method. A graph of Kh/Kv versus distance from well RW-13 is also presented in Attachment A-12. This plot indicates no obvious relationship between estimated anisotropy ratio and distance of data collection points from well RW-13.

The drawdown data obtained during the well RW-13 constant-rate pumping test also suggest horizontal anisotropy, as evidenced by the drawdown contour maps for the middle and deep overburden (Figures A-2 and A-13). These maps show elliptical cones of depression around middle/deep overburden pumping well RW-13, with the longer axis oriented roughly north-south and the shorter axis oriented approximately east-west. Based on the aspect ratios of these ellipses, which are approximately 2:1, it appears that the horizontal hydraulic conductivity may be four times higher in the north-south direction than in the east-west direction (Kruseman and de Ridder, 1990). This finding is consistent with the conclusions of the RI (BBL, June 1998) and the NTCRA 2 model calibration (BBL, September 1997), and may be related to the orientation of braided stream channels associated with deposition of the outwash materials.

A.5.4.7.2 Distance-Drawdown Data Analysis and Parameter Estimates

The interpretation of horizontal anisotropy in the overburden is also supported by middle and deep overburden distance-drawdown data, as plotted in Attachment A-12. To prepare the distance-drawdown plot, BBL used the database to sort the available middle and deep overburden monitoring wells and piezometers based on their directional locations with respect to well RW-13. The wells/piezometers within the NTCRA 1 sheet pile wall were removed from the data set. The remaining wells/piezometers were split into one of four 90-degree quadrants, each of which is centered about the directions due north, south, east, or west from pumping well RW-13. Thus, the map was digitally split along diagonal lines through the location of pumping well RW-13. The wells and piezometers in the north and south quadrants were combined and their distance-drawdown data were plotted using solid square symbols, as shown on the plot in Attachment A-12. The wells and piezometers in the east and west quadrants were combined and their distance drawdown data were plotted using open circle symbols on the plot in Attachment A-12. Finally, regression lines were drawn for either data set. As shown on the distance-drawdown plot, the regression line for the north-south oriented quadrants generally indicates more drawdown than the regression line for the east-west quadrants. This plot confirms greater hydraulic response and, therefore, higher hydraulic conductivity in the north-south direction than the east-west direction.

The slope of each regression line (delta s) is approximately 0.77 feet per cycle. Based on this slope, the mean transmissivity for the middle and deep overburden can be estimated as T (gpd/ft) = 528 Q (gpm) / delta s (ft/cycle) (Driscoll, 1986). The estimated T value, 2,100 ft^2/day, leads to an estimated effective K value of approximately 41 ft/day for the (combined) middle and deep overburden near pumping well RW-13. This result is consistent with the effective K estimates obtained from the MW-704M and MW-704D specific capacity tests results, which yielded effective horizontal K estimates of 27 ft/day and 52 ft/day, respectively, with an arithmetic mean of 40 ft/day. This combined middle/deep overburden hydraulic conductivity is higher than the average for the entire overburden at the same location, 25 ft/day, indicating that the hydraulic conductivity increases with depth in the overburden in the vicinity of pumping well RW-13 and the MW-704 well cluster.

In summary, the results from the drawdown data analysis are consistent with the previous findings from specific capacity tests performed during the RI (BBL, June 1998), and published hydraulic parameters for glaciofluvial aquifers (Bair and Lahm, 1996). The pumping test results satisfied the objectives stated in the Overburden Investigation Plan (BBL, March 1998), and indicate that the overburden in the north-central portion of the Town Well Field Property is sufficiently characterized for the purposes of evaluating potential groundwater remedial alternatives as part of this FS.

A.5.4.8 Treatability Assessment

The analytical data for the three discharge samples obtained on the second, sixth, and seventh days of pumping from well RW-13 are presented in Attachment A-11.

The purpose of the overburden groundwater treatability assessment was to use the overburden groundwater analytical and pumping-rate data collected during the constant-rate pumping test to assess treatability alternatives. The long-term, overburden groundwater influent concentrations and flow rate were estimated and compared to the existing NTCRA 1 treatment system basis of design to assess the treatability of the overburden discharge with the existing treatment system. The objectives of the treatability assessment will be to:

- Determine if the existing NTCRA 1 treatment system can effectively treat the constituents in the overburden groundwater that may be pumped during remedial implementation involving groundwater pumping wells; and

- Determine if the existing NTCRA 1 treatment system has the hydraulic capacity to accept the additional overburden groundwater flow.

These results will be discussed in the evaluation of remedial alternatives in the FS Report.

In summary, the analytical results from samples collected during the constant-rate pumping test that included concentrations above the analytical detection level are summarized below. Also presented is the influent basis of design for the existing NTCRA 1 treatment system.

Parameter	**Pumping Test Results (µg/l)**			**Existing NTCRA 1 Treatment System Influent Basis of Design (µg/l)**
	Day 2	**Day 6**	**Day 7**	
Trichloroethene	3	4	4	1,300
Benzene	3	6	6	580
Tetrahydrofuran	7	46	62	5,500
cis-1,2-Dichloroethene	8	8	8	8,400

The concentration of these parameters are approximately two to three orders of magnitude below the influent basis of design for the existing NTCRA 1 treatment system. The total groundwater flow from the NTCRA 1 containment system (20 gpm) and from the overburden in the Town of Southington Well Field Property (approximately 22.5 gpm, as presented above and in Appendix R of this FS Report) is approximately half of the NTCRA 1 treatment system design flow rate of 100 gpm. Therefore, the existing NTCRA 1 treatment system has the hydraulic capacity to effectively treat the constituents in groundwater both from the existing NTCRA 1 containment system and the overburden in the Town of Southington Well Field Property.

A.6 References

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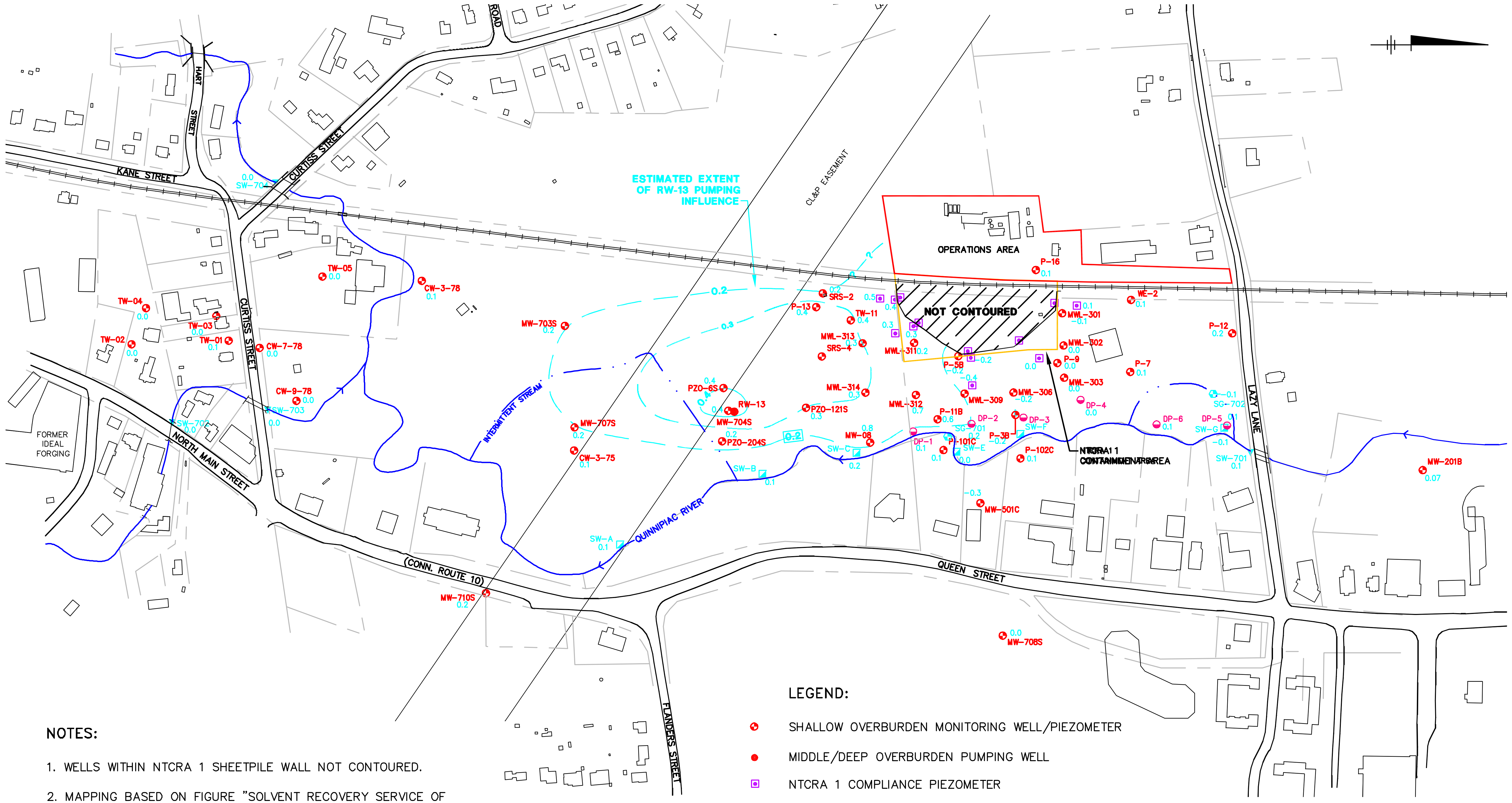
FIGURES



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LEGEND:

⊗	SHALLOW OVERBURDEN MONITORING WELL/PIEZOMETER
●	MIDDLE/DEEP OVERBURDEN PUMPING WELL
▣	NTCRA 1 COMPLIANCE PIEZOMETER
◒	NTCRA 1 WETLAND DRIVEPOINT
▼	SURFACE WATER MEASUREMENT PONTS
◪	SURFACE WATER SAMPLING LOCATION
⊕	STREAM GAUGE
0.2	DRAWDOWN (FT)
0.2 ——	DRAWDOWN CONTOUR (FT), DASHED WHERE INFERRED

0 300' 600'
GRAPHIC SCALE

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W01.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW OVERBURDEN DRAWDOWN CONTOURS 8/24/98 (PUMPING)

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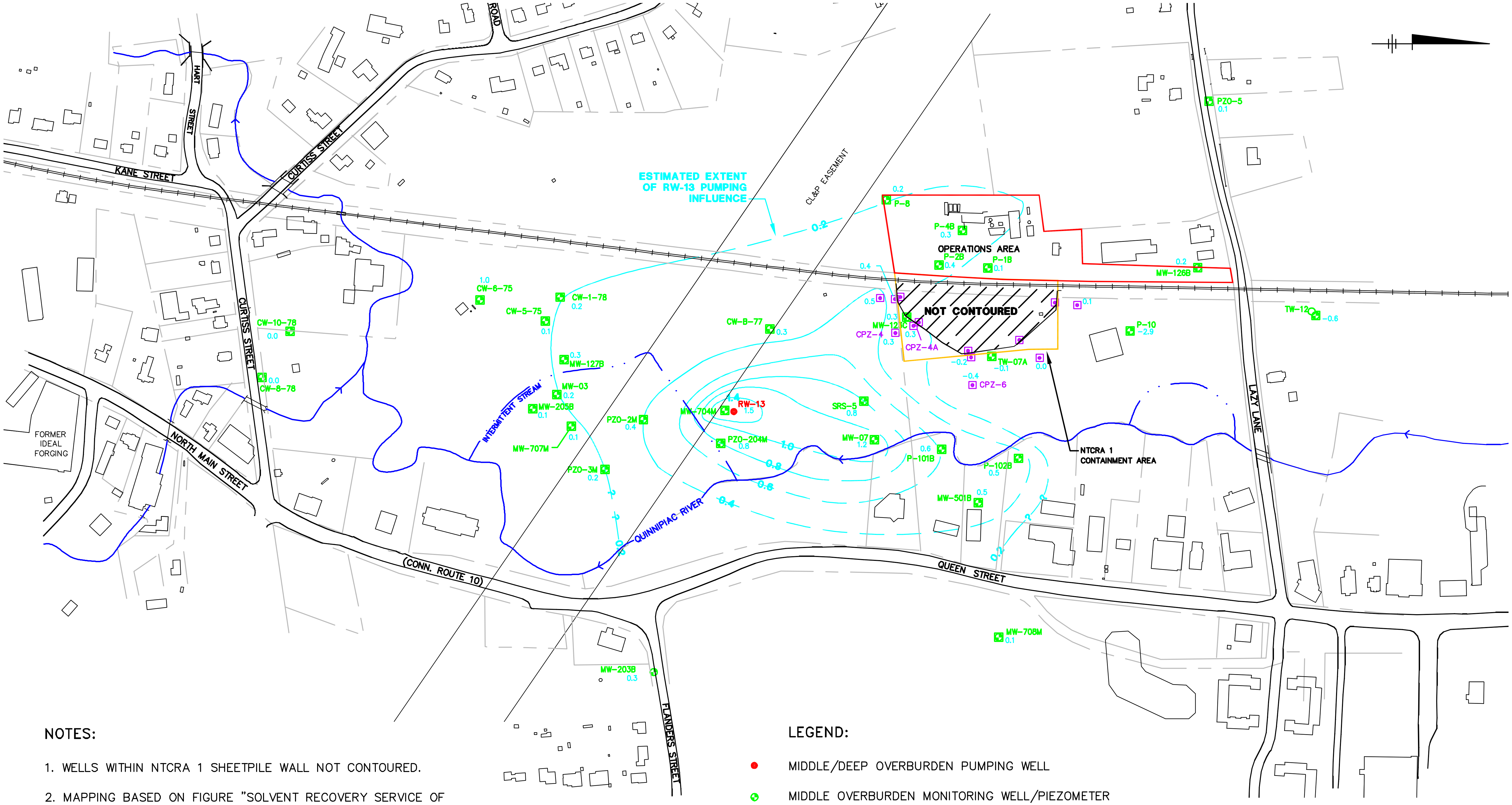
FIGURE
A-1



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LEGEND:

● MIDDLE/DEEP OVERBURDEN PUMPING WELL

● MIDDLE OVERBURDEN MONITORING WELL/PIEZOMETER

▣ NTCRA 1 COMPLIANCE PIEZOMETER

0.2 DRAWDOWN (FT)

0.2 —— DRAWDOWN CONTOUR (FT), DASHED WHERE INFERRED

0 300' 600'
GRAPHIC SCALE

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W02.DWG

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MIDDLE OVERBURDEN DRAWDOWN CONTOURS 8/24/98 (PUMPING)

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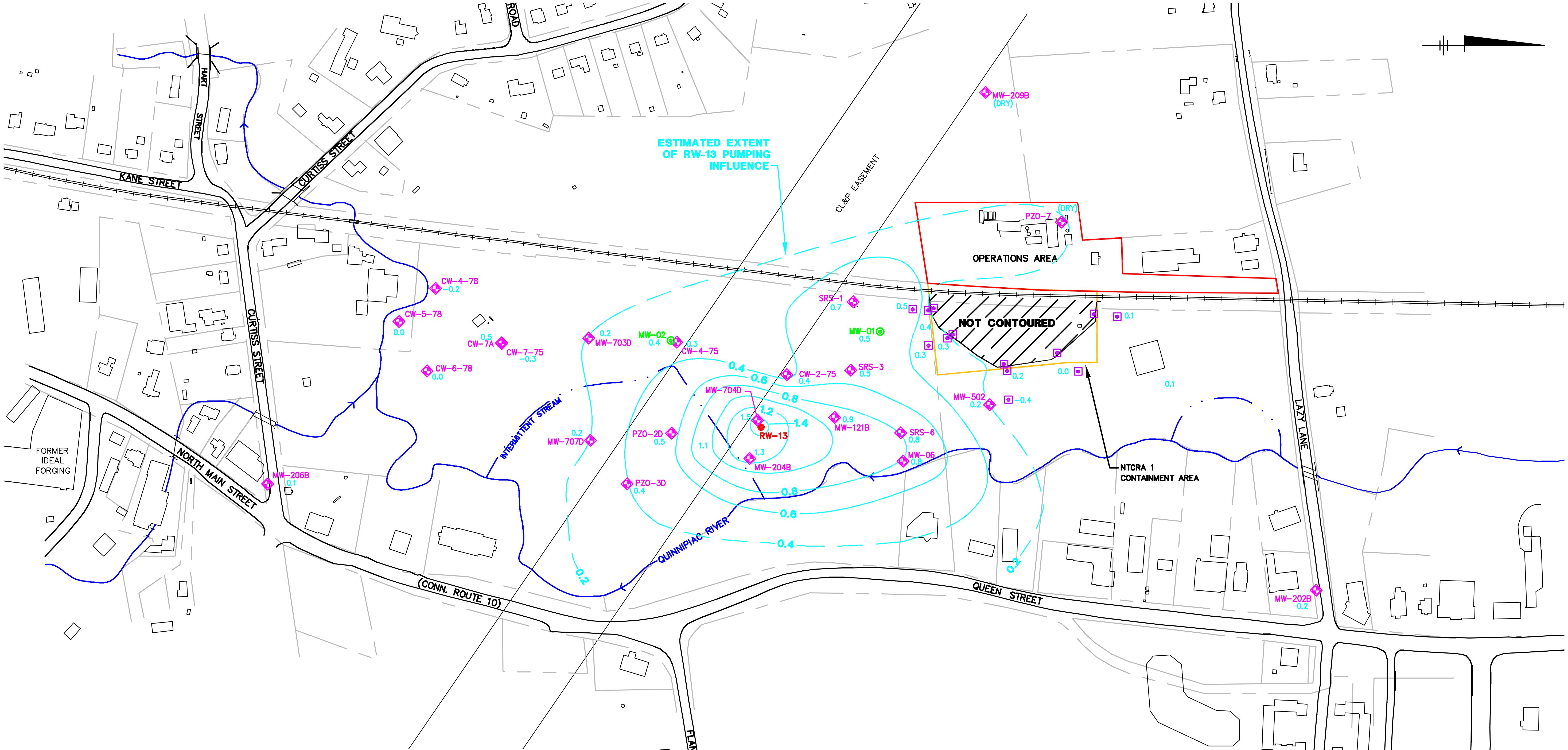
FIGURE
A-2



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

0 300' 600'
GRAPHIC SCALE

LEGEND:

● MIDDLE/DEEP OVERBURDEN PUMPING WELL
◈ DEEP OVERBURDEN MONITORING WELL/PIEZOMETER
▣ NTCRA 1 COMPLIANCE PIEZOMETER
◎ OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
0.2 DRAWDOWN (FT)
0.2 —— DRAWDOWN CONTOUR (FT), DASHED WHERE INFERRED

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W03.DWG

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FEASIBILITY STUDY

DEEP OVERBURDEN DRAWDOWN CONTOURS, 8/24/98 (PUMPING)

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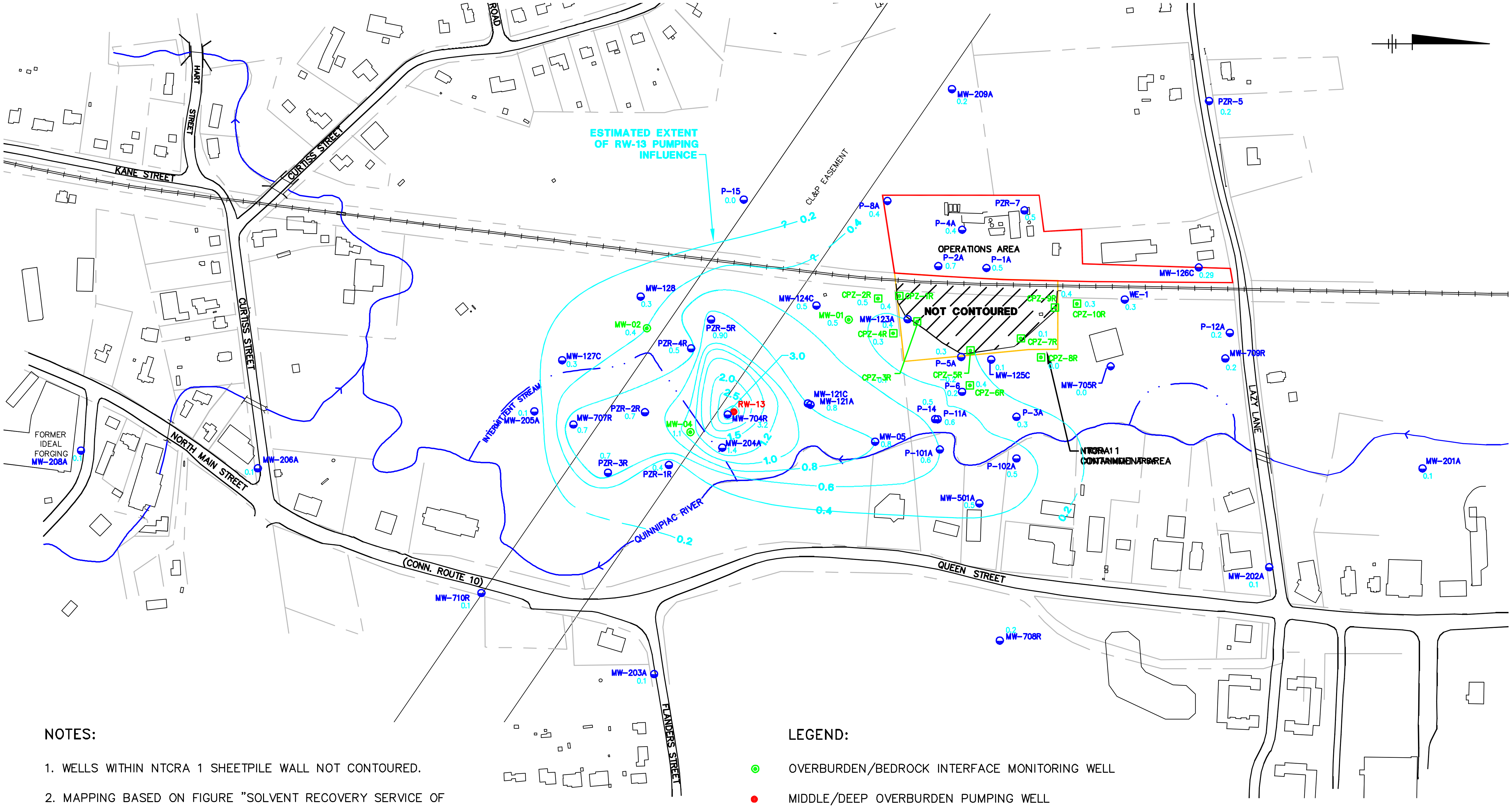
FIGURE
A-3



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

0 300' 600'

GRAPHIC SCALE

LEGEND:

◎	OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
●	MIDDLE/DEEP OVERBURDEN PUMPING WELL
◒	SHALLOW BEDROCK MONITORING WELL/PIEZOMETER
⊡	SHALLOW BEDROCK PIEZOMETER (NTCRA 1)
0.2	DRAWDOWN (FT)
0.2 ——	DRAWDOWN CONTOUR (FT), DASHED WHERE INFERRED

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W04.DWG

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FEASIBILITY STUDY

SHALLOW BEDROCK DRAWDOWN CONTOURS 8/24/98 (PUMPING)

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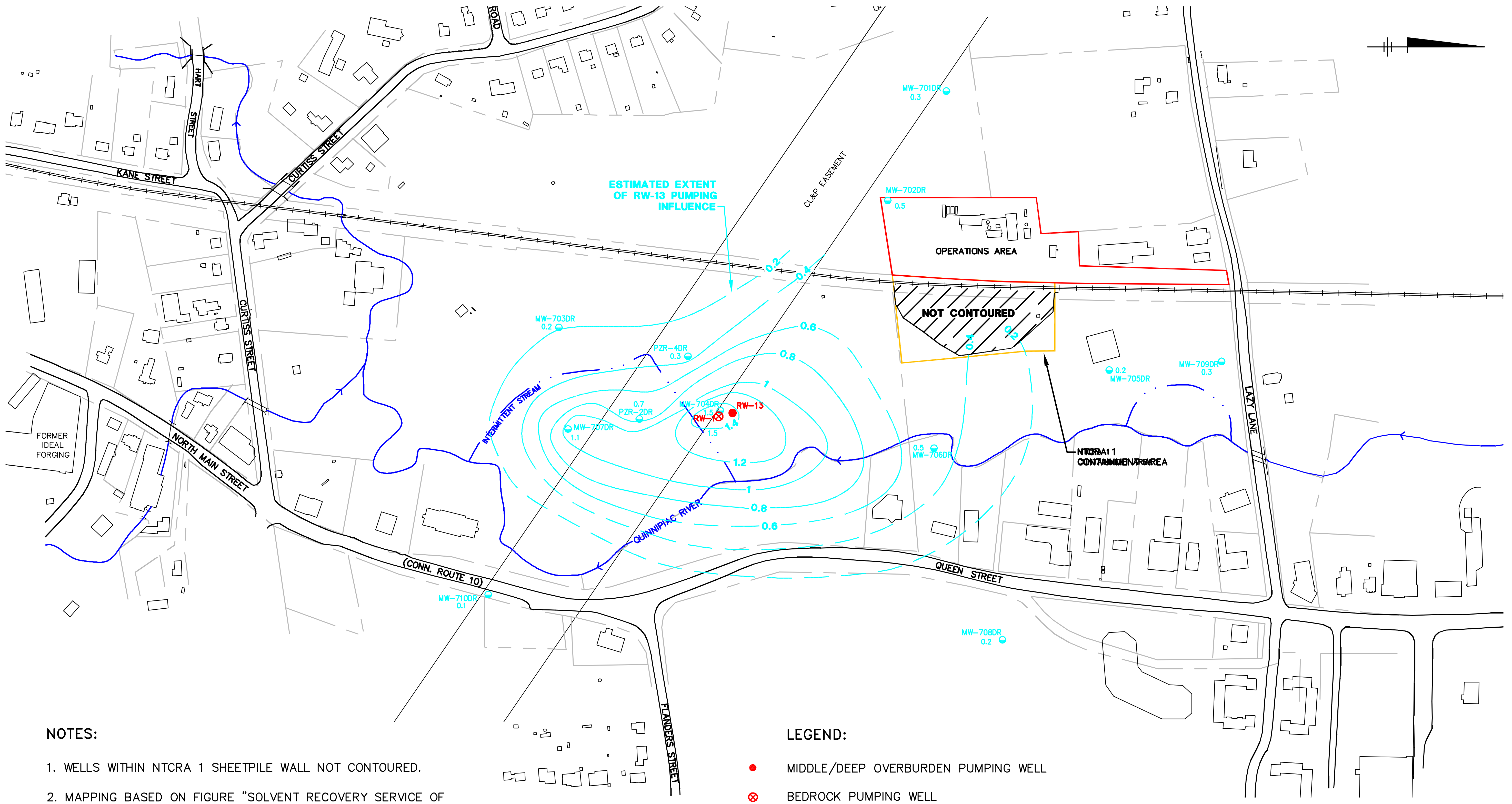
FIGURE
A-4



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

0 300' 600'
GRAPHIC SCALE

LEGEND:

●	MIDDLE/DEEP OVERBURDEN PUMPING WELL
⊗	BEDROCK PUMPING WELL
◒	DEEP BEDROCK MONITORING WELL/PIEZOMETER
0.2	DRAWDOWN (FT)
0.2 ——	DRAWDOWN CONTOUR (FT), DASHED WHERE INFERRED

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W05.DWG

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SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

DEEP BEDROCK DRAWDOWN CONTOURS, 8/24/98 (PUMPING)

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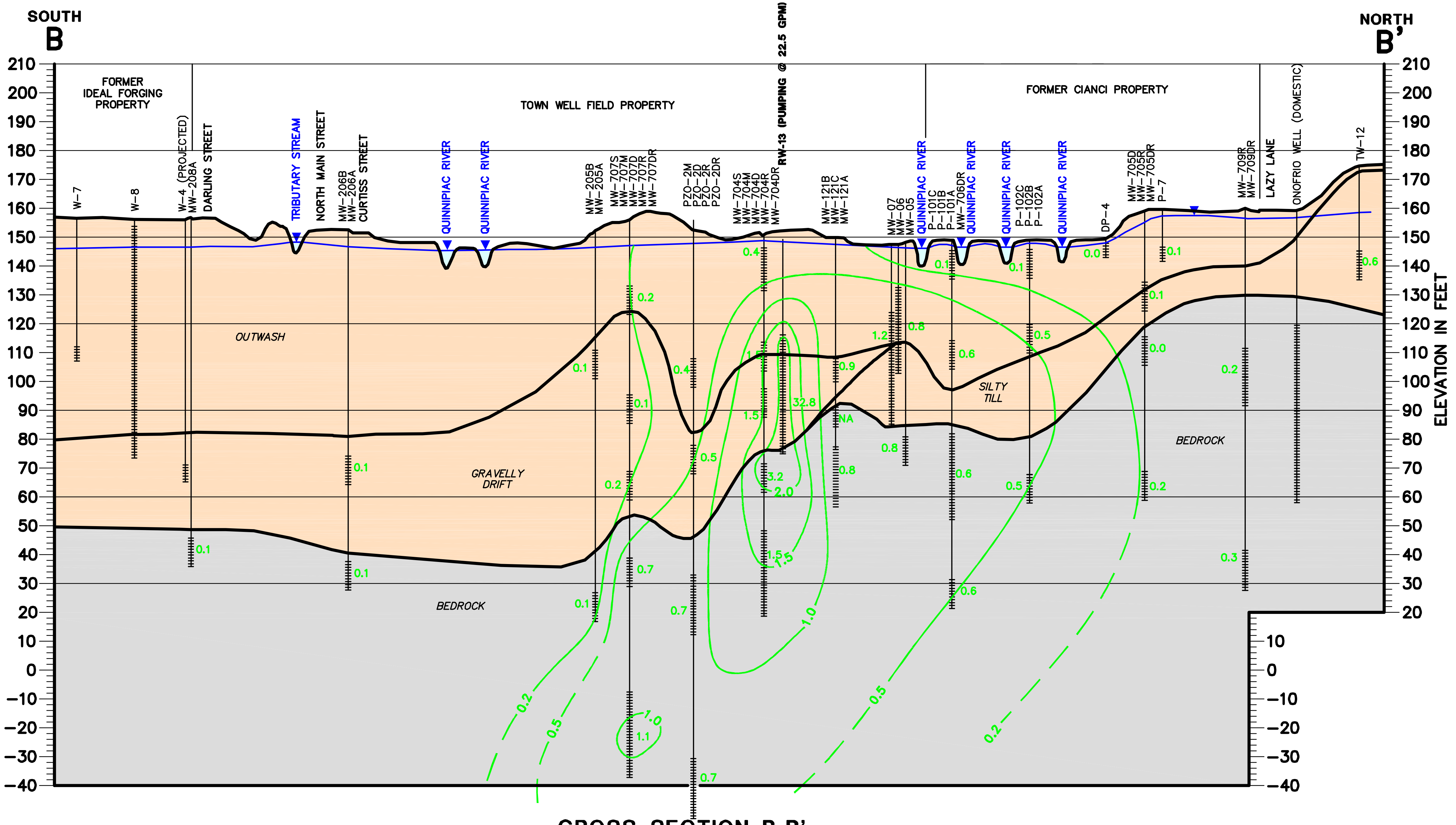
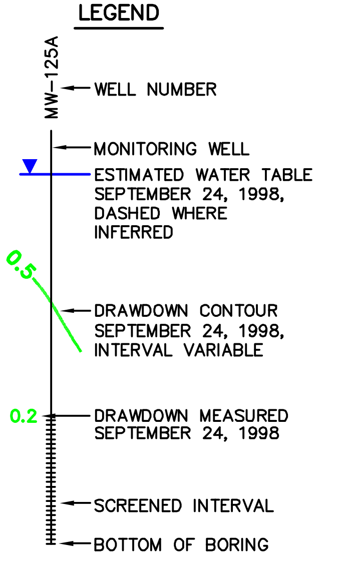
FIGURE
A-5



CROSS SECTION B-B'

HORIZONTAL SCALE:
400' 0 400'



NOTE:

THESE DATA MEASURED SEPT. 24, 1998, AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LOCATION MAP

1000' 0 1000'

CROSS SECTION B-B' WITH NO VERTICAL EXAGGERATION

HORIZONTAL SCALE:
400' 0 400'

X: 08331X00.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331V01.DWG

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GEOLOGIC CROSS SECTION B-B' WITH DRAWDOWN CONTOURS (PUMPING) AND REGULATORY PLUME

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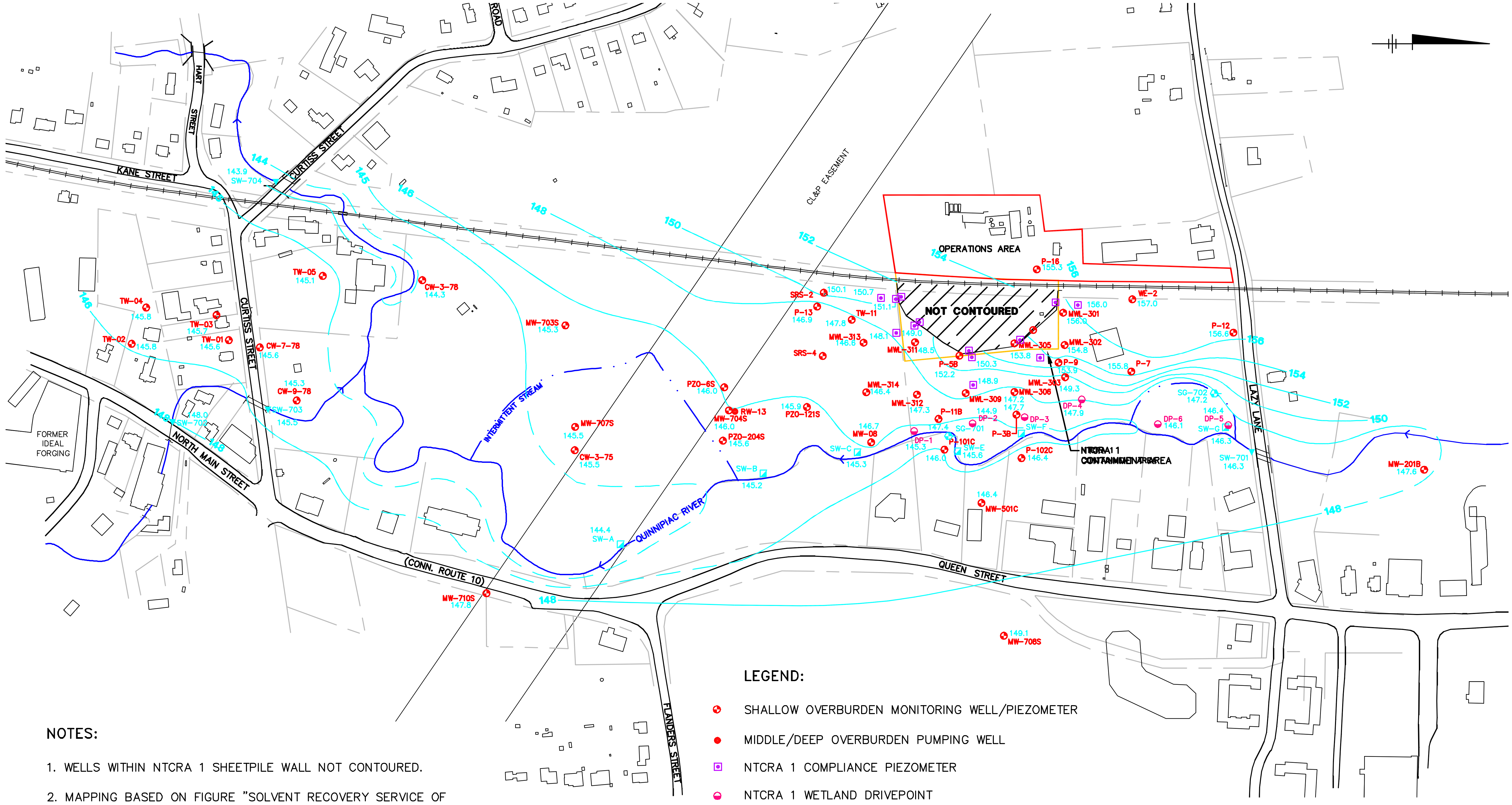
FIGURE
A-6



LEGEND:

●	SHALLOW OVERBURDEN MONITORING WELL/PIEZOMETER
●	MIDDLE/DEEP OVERBURDEN PUMPING WELL
▣	NTCRA 1 COMPLIANCE PIEZOMETER
◒	NTCRA 1 WETLAND DRIVEPOINT
▼	SURFACE WATER MEASUREMENT PONTS
◪	SURFACE WATER SAMPLING LOCATION
⊕	STREAM GAUGE
144.4	GROUNDWATER (POTENTIOMETRIC) ELEVATION (FT AMSL)
148 ——	GROUNDWATER (POTENTIOMETRIC) ELEVATION CONTOUR (FT AMSL), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

0 300' 600'
GRAPHIC SCALE

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W06.DWG

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SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW OVERBURDEN
GROUNWATER ELEVATION
CONTOURS 8/24/98 (PUMPING)

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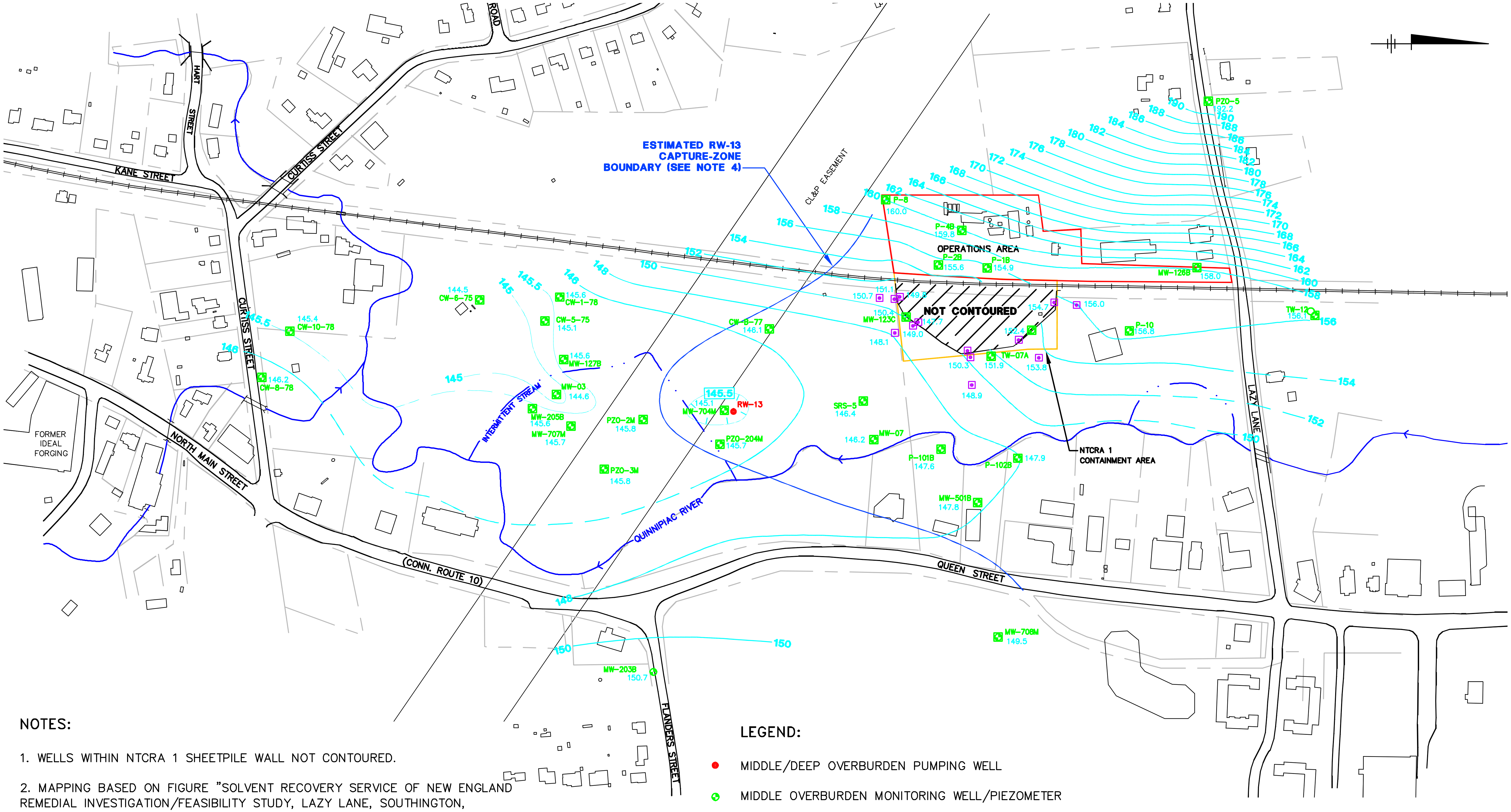
FIGURE
A-7



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. GROUNDWATER ELEVATION DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

4. ESTIMATED RW-13 CAPTURE ZONE BASED ON SIMULATION RESULTS (ATTACHMENT B-13) AND STAGNATION POINT CALCULATION (ATTACHMENT B-14).

LEGEND:

●	MIDDLE/DEEP OVERBURDEN PUMPING WELL
⊙	MIDDLE OVERBURDEN MONITORING WELL/PIEZOMETER
▣	NTCRA 1 COMPLIANCE PIEZOMETER
0.2	GROUNDWATER (POTENTIOMETRIC) ELEVATION (FT AMSL)
0.2 ―	GROUNDWATER (POTENTIOMETRIC) ELEVATION CONTOUR (FT AMSL), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

0 300' 600'

GRAPHIC SCALE

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
/2708331009/SRSNE04/APPENDIX/APPEND_A/08331W07.DWG

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FEASIBILITY STUDY

MIDDLE OVERBURDEN GROUNDWATER ELEVATION CONTOURS 8/24/98 (PUMPING)

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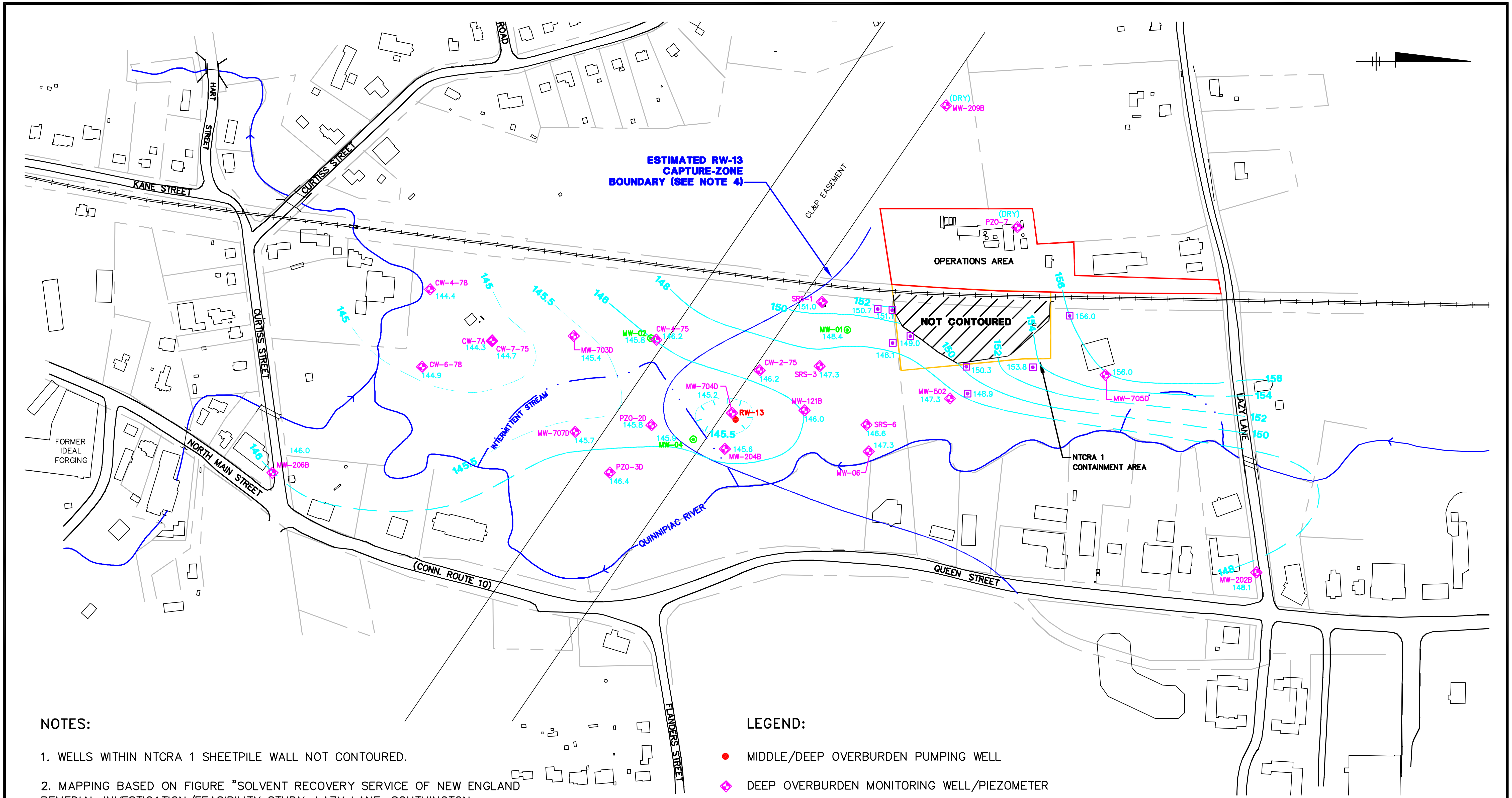
FIGURE
A-8



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. GROUNDWATER ELEVATION DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

4. ESTIMATED RW-13 CAPTURE ZONE BASED ON SIMULATION RESULTS (ATTACHMENT B-13) AND STAGNATION POINT CALCULATION (ATTACHMENT B-14).

LEGEND:

● MIDDLE/DEEP OVERBURDEN PUMPING WELL

◈ DEEP OVERBURDEN MONITORING WELL/PIEZOMETER

▣ NTCRA 1 COMPLIANCE PIEZOMETER

◎ OVERBURDEN/BEDROCK INTERFACE MONITORING WELL

144.85 GROUNDWATER (POTENTIOMETRIC) ELEVATION (FT AMSL)

160 —— GROUNDWATER (POTENTIOMETRIC) ELEVATION CONTOUR (FT AMSL), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

0 300' 600'

GRAPHIC SCALE

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W08.DWG

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SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

DEEP OVERBURDEN GROUNDWATER ELEVATION CONTOURS, 8/24/98 (PUMPING)

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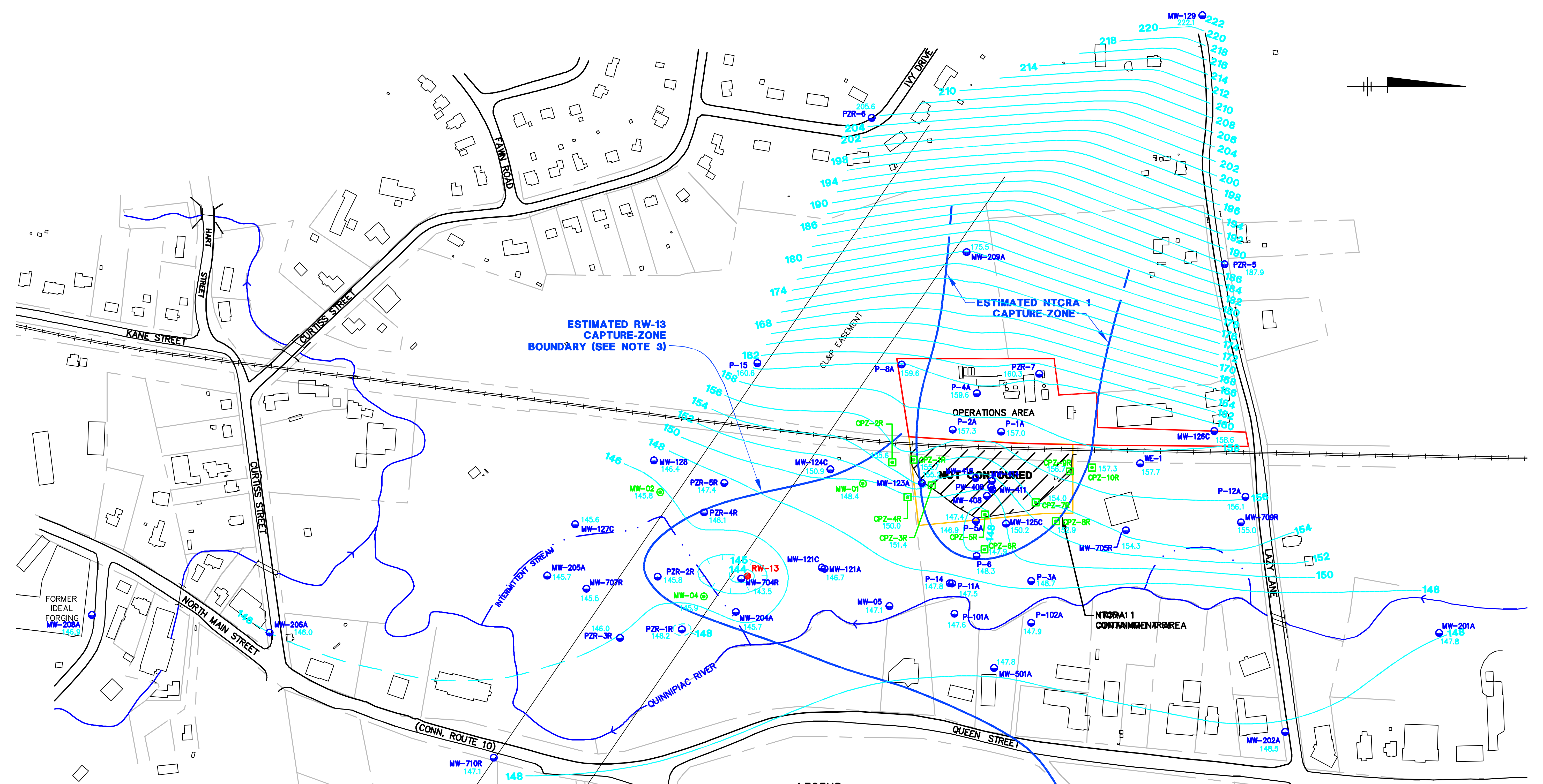
FIGURE
A-9



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

2. GROUNDWATER ELEVATION DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

3. ESTIMATED RW-13 CAPTURE ZONE BASED ON SIMULATION RESULTS (ATTACHMENT B-13) AND STAGNATION POINT CALCULATION (ATTACHMENT B-14).

0 300' 600'
GRAPHIC SCALE

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W09.DWG

LEGEND:

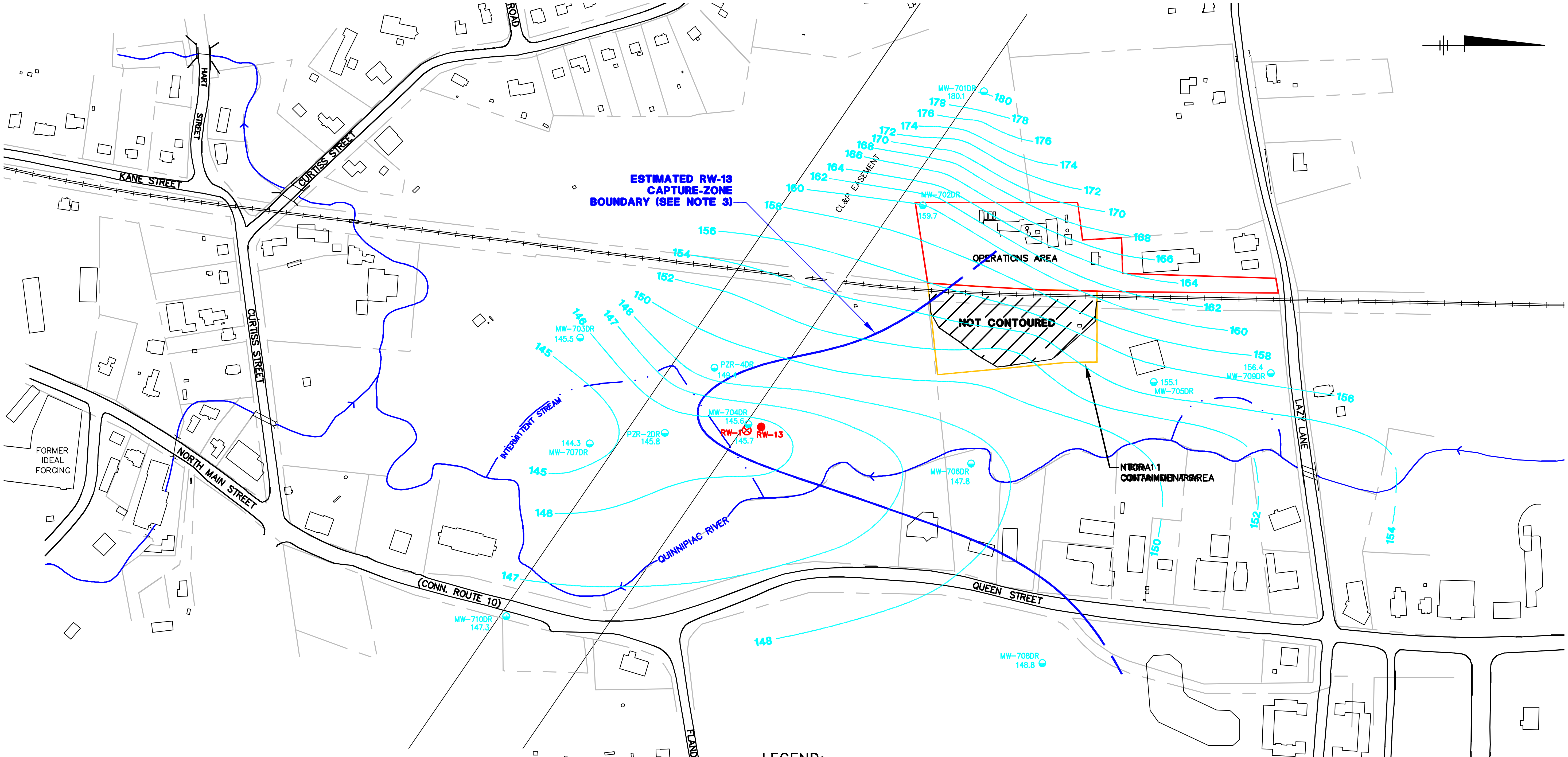
◎	OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
●	MIDDLE/DEEP OVERBURDEN PUMPING WELL
◓	SHALLOW BEDROCK MONITORING WELL/PIEZOMETER
▣	SHALLOW BEDROCK PIEZOMETER (NTCRA 1)
147.2	GROUNDWATER (POTENTIOMETRIC) ELEVATION (FT AMSL)
148 ——	GROUNDWATER (POTENTIOMETRIC) ELEVATION CONTOUR (FT AMSL), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW BEDROCK GROUNDWATER ELEVATION CONTOURS 8/24/98 (PUMPING)

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
A-10



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

2. GROUNDWATER ELEVATION DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

3. ESTIMATED RW-13 CAPTURE ZONE BASED ON SIMULATION RESULTS (ATTACHMENT B-13) AND STAGNATION POINT CALCULATION (ATTACHMENT B-14).

0 300' 600'

GRAPHIC SCALE

LEGEND:

● MIDDLE/DEEP OVERBURDEN PUMPING WELL

⊗ BEDROCK PUMPING WELL

◒ DEEP BEDROCK MONITORING WELL/PIEZOMETER

148.8 GROUND-WATER (POTENTIOMETRIC) ELEVATION (FT AMSL)

148 —— GROUND-WATER (POTENTIOMETRIC) ELEVATION CONTOUR (FT AMSL), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

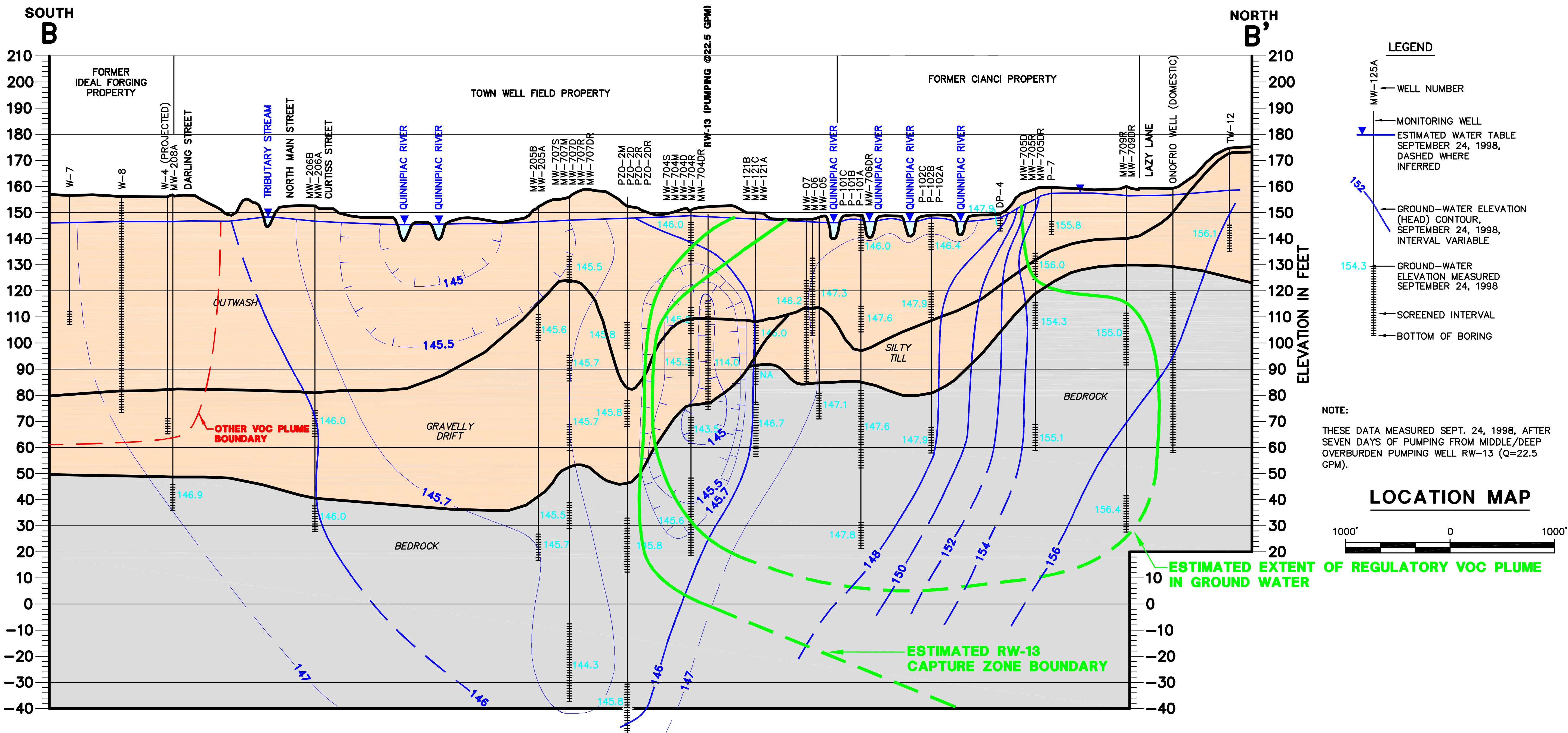
X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331W10.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

DEEP BEDROCK GROUNDWATER ELEVATION CONTOURS, 8/24/98 (PUMPING)

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
A-11



NOTE:

THESE DATA MEASURED SEPT. 24, 1998, AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LOCATION MAP

1000' 0 1000'

CROSS SECTION B-B'

HORIZONTAL SCALE:
400' 0 400'

CROSS SECTION B-B' WITH NO VERTICAL EXAGGERATION

HORIZONTAL SCALE:
400' 0 400'

X: 08331X00.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_A/08331V02.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

GEOLOGIC CROSS SECTION B-B'
WITH HEAD CONTOURS (PUMPING)
AND REGULATORY PLUME

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
A-12

ATTACHMENTS

ATTACHMENT A – 1

SRSNE SITE
RI/FS OVERBURDEN INVESTIGATION AND NTCRA 2 DESIGN INVESTIGATION

Well and Piezometer Specifications

Location	Easting (X)	Northing (Y)	Ground Surf. Elev. (1929 NGVD)	Meas. Pt. (Top of Well) Elevation	Meas. Pt. Stickup	Depth to Top of Till	Depth to Top of Bedrock	Borehole Diameter (Inches) *	Total Well Depth from Stickup	Depth to Bottom of Borehole	Depth to Top of Bentonite	Depth to Bottom of Bentonite	Type of Sandpack Material	Depth to Top of Sandpack	Depth to Bottom of Sandpack	Screen/ Sump Material	Screen Length	Screen Diameter (Inches)	Screen Slot Size (Inches)	Depth to Top of Screen	Depth to Bottom of Screen	Sump Length	Depth to Top of Sump	Depth to Bottom of Sump	Riser Material	Riser Diameter (Inches)	Well Formation
PZR-1R	565721.5	285403.8	148.72	151.07	2.35	NA	98	8.25 & 4.0	125.7	125.5	2	101.5	Morie #0	101.5	125.5	Sch40 PVC	20.0	2	0.010	103.0	123.0	0.3	123.0	123.3	Sch40 PVC	2	Shallow Bedrock
PZR-2R	565562.5	285330.5	152.10	153.77	1.67	70	113	8.25 & 4.0	142.5	141.5	2	118.7	Morie #0	118.7	141.5	Sch40 PVC	20.0	2	0.010	120.5	140.5	0.3	140.5	140.8	Sch40 PVC	2	Shallow Bedrock
PZR-2DR	565579.3	285318.7	153.41	154.92	1.51	70	113	8.25 & 4.0	205.8	205.0	2	181.5	Morie #0	181.5	205.0	Sch40 PVC	20.0	2	0.010	184.0	204.0	0.3	204.0	204.3	Sch40 PVC	2	Deep Bedrock
PZR-3R	565745.3	285219.9	149.92	152.39	2.47	84	114	8.25 & 3.0	143.1	141.0	2	119.5	Morie #0	119.5	141.0	Sch40 PVC	20.0	2	0.010	120.3	140.3	0.3	140.3	140.6	Sch40 PVC	2	Shallow Bedrock
PZR-4R	565368.6	285470.6	152.36	153.95	1.59	NA	64	8.25 & 4.0	91.6	95.0	2	68.5	Morie #0	68.5	95.0	Sch40 PVC	20.0	2	0.010	69.7	89.7	0.3	89.7	90.0	Sch40 PVC	2	Shallow Bedrock
PZR-4DR	565388.3	285463.6	151.15	153.25	2.10	NA	64	8.25 & 4.0	157.4	156.0	2	132.7	Morie #0	132.7	156.0	Sch40 PVC	20.0	2	0.010	135.0	155.0	0.3	155.0	155.3	Sch40 PVC	2	Deep Bedrock
PZR-5R	565279.8	285532.2	152.12	154.84	2.72	NA	47	8.25 & 4.0	76.0	75.2	2	52	Morie #0	52.0	75.2	Sch40 PVC	20.0	2	0.010	53.0	73.0	0.3	73.0	73.3	Sch40 PVC	2	Shallow Bedrock
RW-1R	565570.6	285561.2	149.80	152.18	2.38	40	75	16 & 12	174.4	172.0	NA	NA	NA	NA	NA	Open Hole	90.0	12	NA	82.0	172.0	0.0	172.0	172.0	Black Steel	12	Shallow and Deep Bedrock
PZO-2M	565586.0	285328.1	152.70	154.81	2.11	70	113	8.25	58.4	70.0	2	44.0	Morie #0	44.0	58.0	Sch40 PVC	10.0	2	0.010	46.0	56.0	0.3	56.0	56.3	Sch40 PVC	2	Middle Overburden
PZO-2D	565578.2	285339.8	152.48	154.29	1.81	70	113	8.25 & 4.0	87.1	119.0	2	70.0	Morie #0	70.0	86.0	Sch40 PVC	10.0	2	0.010	75.0	85.0	0.3	85.0	85.3	Sch40 PVC	2	Deep Overburden
PZO-3M	565736.4	285211.5	150.59	152.58	1.99	84	114	8.25	58.3	58.0	2	44.0	Morie #0	44.0	58.0	Sch40 PVC	10.0	2	0.010	46.0	56.0	0.3	56.0	56.3	Sch40 PVC	2	Middle Overburden
PZO-3D	565726.3	285209.5	150.85	153.13	2.28	84	114	8.25 & 4.0	100.6	102.0	2	83.0	Morie #0	83.0	102.0	Sch40 PVC	10.0	2	0.010	88.0	98.0	0.3	98.0	98.3	Sch40 PVC	2	Deep Overburden
PZO-6S	565487.1	285569.1	151.28	153.07	1.79	40	75	8.25	24.1	23.0	2	10.0	Morie #0	10.0	23.0	Sch40 PVC	10.0	2	0.010	12.0	22.0	0.3	22.0	22.3	Sch40 PVC	2	Shallow Overburden
PZO-121S	565547.3	285819.6	150.14	152.14	2.00	54	58	8.25	14.0	12.0	1	1.5	Morie #0	1.5	12.0	Sch40 PVC	10.0	2	0.010	1.7	11.7	0.3	11.7	12.0	Sch40 PVC	2	Shallow Overburden
PZO-204S	565649.2	285564.9	149.06	151.16	2.10	79	82	8.25	15.1	13.0	1	2.0	Morie #0	2.0	13.0	Sch40 PVC	10.0	2	0.010	2.7	12.7	0.3	12.7	13.0	Sch40 PVC	2	Shallow Overburden
PZO-204M	565658.0	285561.9	149.18	151.16	1.98	79	82	8.25	58.0	58.0	2	44.0	Morie #0	44.0	56.0	Sch40 PVC	10.0	2	0.010	45.7	55.7	0.3	55.7	56.0	Sch40 PVC	2	Middle Overburden
RW-13	565560.2	285601.7	150.12	152.40	2.28	40	75	16	77.3	77.8	27	30.0	Morie #1	30.0	77.8	Sch80 SS	40.0	8	0.030	35.0	75.0	0.0	75.0	75.0	Sch80 PVC	8	Middle and Deep Overburden

1) NA - Not Available or Not Applicable
2) Measurements in feet except where noted otherwise. Elevations are in terms of feet above mean sea level (AMSL); the datum is the NGVD of 1929.
3) Wells/piezometers finished with neat cement grout above upper bentonite seal.
4) SS = Stainless steel; PVC = polyvinyl chloride

* Larger number indicates overburden borehole diameter; smaller number indicates bedrock borehole diameter or roller-bit diameter used in cobbly section of overburden.

ATTACHMENT A – 2

GC VOLATILE ANALYTICAL REPORT

Galson
Laboratories

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 08-AUG-98
Date Sampled : 07-AUG-98

Matrix : Water
Method : EPA 601/602
Units : UG/L

Galson ID: Client ID:	L44779-1 W-G-RW13-01-S		QC8080898-1 Method Blank
Benzene	1.0		<0.2
Bromodichloromethane	<0.2		<0.2
Bromoform	<0.2		<0.2
Bromomethane	<0.2		<0.2
Carbon tetrachloride	<0.3		<0.3
Chlorobenzene	0.6		<0.1
Chloroethane	4.6		<0.3
2-Chloroethylvinylether	<0.3		<0.3
Chloroform	<0.2		<0.2
Chloromethane	<0.3		<0.3
Dibromochloromethane	<0.1		<0.1
1,2-Dichlorobenzene	<0.1		<0.1
1,3-Dichlorobenzene	<0.1		<0.1
1,4-Dichlorobenzene	<0.2		<0.2
Dichlorodifluoromethane	<0.06		<0.06
1,1 Dichloroethane	1.9		<0.2
1,2-Dichloroethane	<0.2		<0.2
1,1-Dichloroethene	<0.4		<0.4
trans-1,2-Dichloroethene	<0.4		<0.4
1,2-Dichloropropane	<0.2		<0.2
cis-1,3-Dichloropropene	<0.3		<0.3
trans-1,3-Dichloropropene	<0.2		<0.2
Ethylbenzene	<0.2		<0.2
Methylene chloride	1.1	B	2.3
1,1,2,2-Tetrachloroethane	<0.1		<0.1
Tetrachloroethene	<0.3		<0.3
Toluene	<0.1		<0.1
1,1,1-Trichloroethane	0.4		<0.3
1,1,2-Trichloroethane	<0.1		<0.1
Trichloroethene	4.4		<0.2
Trichlorofluoromethane	<0.3		<0.3
Vinyl chloride	<0.4		<0.4
m,p-Xylene	<0.3		<0.3
o-Xylene	<0.2		<0.2
Dilution Factor	1		1
Analysis Date	08/08/98		08/08/98
Method Blank	QC8080898-1		QC8080898-1

Approved by : JMT
Date : 10-AUG-98
QC by :
Date : 8/11/98
NYS DOH # : 11626
Footnotes:
B : This compound was also detected in the method blank.

2A
WATER GC VOLATILE SURROGATE RECOVERY

Lab Name: GALSON LABORATORIES Contract:

Lab Code: Case No.: 1 SAS No.: SDG No.: L44779

SAMPLE NO.	SMC1 (FBZ)#	SMC2 (CFB)#	SMC3 ( )#	OTHER	TOT OUT
Method Blank-QC8080898-1	102			PID	0
Method Blank-QC8080898-1		91		ELCD	0
W-G-RW13-01-S	102			PID	0
W-G-RW13-01-S		97		ELCD	0

		QC LIMITS
SMC1 (FBZ)	= Fluorobenzene	(72-126)
SMC2 (CFB)	= 1-Chloro-2-fluorobenzene	(78-130)

\# Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate diluted out

ATTACHMENT A – 3

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZO-2M
Site: SRSNE -- Southington, CT
Date: June 9,1998

Q(actual)	5	gpm	t	240	min	Q (comp)	5.000	gpm
S (est)	0.01		s	1.02	ft	T (comp)	7105.3	gpd/ft
r(w)	0.34	ft	LS	10	ft	K	3.4E-02	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	7100	4.9965
2	7100	4.9968
3	7101	4.9970
4	7101	4.9972
5	7101	4.9973
6	7102	4.9975
7	7102	4.9977
8	7102	4.9978
9	7102	4.9980
10	7102	4.9981
11	7103	4.9982
12	7103	4.9983
13	7103	4.9984
14	7103	4.9985
15	7103	4.9986
16	7103	4.9987
17	7104	4.9988
18	7104	4.9989
19	7104	4.9990
20	7104	4.9990
21	7104	4.9991
22	7104	4.9992
23	7104	4.9992
24	7104	4.9993
25	7104	4.9993
26	7104	4.9994
27	7104	4.9994
28	7104	4.9994
29	7105	4.9995
30	7105	4.9995
31	7105	4.9995
32	7105	4.9996
33	7105	4.9996
34	7105	4.9996
35	7105	4.9996
36	7105	4.9997

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZO-2D
Site: SRSNE -- Southington, CT
Date: June 8, 1998

Q(actual)	3.4	gpm	|	t	250	min	|	Q (comp)	3.400	gpm
S (est)	0.01		|	s	1.17	ft	|	T (comp)	4037.5	gpd/ft
r(w)	0.34	ft	|	LS	10	ft	|	K	1.9E-02	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	4030	3.3942
2	4031	3.3947
3	4031	3.3951
4	4032	3.3955
5	4032	3.3958
6	4032	3.3961
7	4033	3.3964
8	4033	3.3967
9	4034	3.3970
10	4034	3.3972
11	4034	3.3974
12	4034	3.3976
13	4035	3.3978
14	4035	3.3980
15	4035	3.3981
16	4035	3.3983
17	4035	3.3984
18	4036	3.3985
19	4036	3.3986
20	4036	3.3987
21	4036	3.3988
22	4036	3.3989
23	4036	3.3990
24	4036	3.3991
25	4036	3.3992
26	4036	3.3992
27	4037	3.3993
28	4037	3.3993
29	4037	3.3994
30	4037	3.3994
31	4037	3.3995
32	4037	3.3995
33	4037	3.3996
34	4037	3.3996
35	4037	3.3996
36	4037	3.3997

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZO-3M
Site: SRSNE -- Southington, CT
Date: June 3, 1998

Q(actual)	0.166	gpm	t	90	min	Q (comp)	0.166	gpm
S (est)	0.01		s	46.51	ft	T (comp)	1.2	gpd/ft
r(w)	0.34	ft	LS	10	ft	K	5.8E-06	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	1.2	0.1636
2	1	0.1638
3	1	0.1640
4	1	0.1642
5	1	0.1644
6	1	0.1645
7	1	0.1646
8	1	0.1648
9	1	0.1649
10	1	0.1650
11	1	0.1651
12	1	0.1652
13	1	0.1652
14	1	0.1653
15	1	0.1654
16	1	0.1654
17	1	0.1655
18	1	0.1655
19	1	0.1656
20	1	0.1656
21	1	0.1656
22	1	0.1657
23	1	0.1657
24	1	0.1657
25	1	0.1658
26	1	0.1658
27	1	0.1658
28	1	0.1658
29	1	0.1658
30	1	0.1658
31	1	0.1659
32	1	0.1659
33	1	0.1659
34	1	0.1659

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZO-3D
Site: SRSNE -- Southington, CT
Date: June 2, 1998

Q(actual)	0.82	gpm	t	265	min	Q (comp)	0.820	gpm
S (est)	0.01		s	45.55	ft	T (comp)	16.7	gpd/ft
r(w)	0.17	ft	LS	10	ft	K	7.9E-05	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	16	0.7914
2	16	0.8038
3	16	0.8108
4	17	0.8148
5	17	0.8170
6	17	0.8183
7	17	0.8190
8	17	0.8195
9	17	0.8197
10	17	0.8198
11	17	0.8199
12	17	0.8199
13	17	0.8200
14	17	0.8200
15	17	0.8200
16	17	0.8200
17	17	0.8200
18	17	0.8200
19	17	0.8200
20	17	0.8200
21	17	0.8200
22	17	0.8200
23	17	0.8200
24	17	0.8200
25	17	0.8200
26	17	0.8200
27	17	0.8200
28	17	0.8200
29	17	0.8200
30	17	0.8200
31	17	0.8200
32	17	0.8200
33	17	0.8200
34	17	0.8200
35	17	0.8200
36	17	0.8200

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

```
------------ ---------- ------ ----- --------- ------------ -------- ---- ---------------- ------------ -------------
                                     Well:   PZO-6S
                                     Site:   SRSNE -- Southington, CT
                                     Date:   June 11,  1998
======= ====== ==== === ===== ======= ==== == ========= ======= =======
Q(actual)      3  gpm   |    t         195  min   |   Q (comp)     3.000  gpm
 S (est)    0.01        |    s       13.59  ft    |   T (comp)     227.6  gpd/ft
  r(w)      0.34  ft    |    LS         10  ft    |          K   1.1E-03  cm/sec
======= ====== ==== === ===== ======= ==== == ========= ======= =======
                                   T,               computed Q,
         Iteration               gpd/ft                gpm
------------ ---------- ------ ----- --------- ------------ -------- ---- ---------------- ------------ -------------
                 1                   4              0.0957
                 2                 294              3.7724
                 3                 217              2.8774
                 4                 229              3.0213
                 5                 227              2.9964
                 6                 228              3.0006
                 7                 228              2.9999
                 8                 228              3.0000
                 9                 228              3.0000
                10                 228              3.0000
                11                 228              3.0000
                12                 228              3.0000
                13                 228              3.0000
                14                 228              3.0000
                15                 228              3.0000
                16                 228              3.0000
                17                 228              3.0000
                18                 228              3.0000
                19                 228              3.0000
                20                 228              3.0000
                21                 228              3.0000
                22                 228              3.0000
                23                 228              3.0000
                24                 228              3.0000
                25                 228              3.0000
                26                 228              3.0000
                27                 228              3.0000
                28                 228              3.0000
                29                 228              3.0000
                30                 228              3.0000
                31                 228              3.0000
                32                 228              3.0000
                33                 228              3.0000
                34                 228              3.0000
                35                 228              3.0000
                36                 228              3.0000
```

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZO-121S
Site: SRSNE -- Southington, CT
Date: June 9, 1998

Q(actual)	5	gpm	t	240	min	Q (comp)	5.000	gpm
S (est)	0.01		s	2.03	ft	T (comp)	3358.6	gpd/ft
r(w)	0.34	ft	LS	10	ft	K	1.6E-02	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	3300	4.9201
2	3308	4.9310
3	3315	4.9404
4	3321	4.9486
5	3326	4.9556
6	3330	4.9616
7	3334	4.9669
8	3338	4.9714
9	3340	4.9753
10	3343	4.9787
11	3345	4.9816
12	3347	4.9841
13	3348	4.9863
14	3350	4.9881
15	3351	4.9897
16	3352	4.9911
17	3353	4.9924
18	3354	4.9934
19	3354	4.9943
20	3355	4.9951
21	3355	4.9957
22	3356	4.9963
23	3356	4.9968
24	3357	4.9973
25	3357	4.9976
26	3357	4.9980
27	3357	4.9982
28	3357	4.9985
29	3358	4.9987
30	3358	4.9989
31	3358	4.9990
32	3358	4.9992
33	3358	4.9993
34	3358	4.9994
35	3358	4.9995
36	3358	4.9995

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZO-204S
Site: SRSNE -- Southington, CT
Date: June 10, 1998

Q(actual)	0.75	gpm	t	240	min	Q (comp)	0.750	gpm
S (est)	0.01		s	3.07	ft	T (comp)	261.6	gpd/ft
r(w)	0.34	ft	LS	10	ft	K	1.2E-03	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	4	0.0208
2	77	0.2538
3	127	0.3934
4	162	0.4901
5	188	0.5592
6	207	0.6094
7	221	0.6461
8	232	0.6730
9	239	0.6929
10	245	0.7077
11	249	0.7185
12	253	0.7266
13	255	0.7326
14	257	0.7371
15	258	0.7404
16	259	0.7429
17	260	0.7447
18	260	0.7460
19	260	0.7471
20	261	0.7478
21	261	0.7484
22	261	0.7488
23	261	0.7491
24	261	0.7493
25	261	0.7495
26	261	0.7496
27	262	0.7497
28	262	0.7498
29	262	0.7498
30	262	0.7499
31	262	0.7499
32	262	0.7499
33	262	0.7500
34	262	0.7500
35	262	0.7500
36	262	0.7500

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

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                    SPECIFIC CAPACITY TEST DATA REDUCTION
------------- ---------- ------ ----- --------- ------------ -------- ---- ---------------- ------------ -------------
                                      Well:    PZO-204M
                                      Site:    SRSNE -- Southington, CT
                                      Date:    June 10,  1998
======= ====== ==== === ===== ======= ==== == ========= ======= =======
Q(actual)  0.47  gpm   |    t       240  min   |   Q (comp)    0.470  gpm
 S (est)   0.01        |    s     48.65  ft    |   T (comp)      6.2  gpd/ft
  r(w)     0.34  ft    |   LS        10  ft    |          K  2.9E-05  cm/sec
======= ====== ==== === ===== ======= ==== == ========= ======= =======
                                   T,              computed Q,
         Iteration               gpd/ft               gpm
------------- ---------- ------ ----- --------- ------------ -------- ---- ---------------- ------------ -------------
                 1                   6             0.4574
                 2                   6             0.4653
                 3                   6             0.4682
                 4                   6             0.4693
                 5                   6             0.4697
                 6                   6             0.4699
                 7                   6             0.4700
                 8                   6             0.4700
                 9                   6             0.4700
                10                   6             0.4700
                11                   6             0.4700
                12                   6             0.4700
                13                   6             0.4700
                14                   6             0.4700
                15                   6             0.4700
                16                   6             0.4700
                17                   6             0.4700
                18                   6             0.4700
                19                   6             0.4700
                20                   6             0.4700
                21                   6             0.4700
                22                   6             0.4700
                23                   6             0.4700
                24                   6             0.4700
                25                   6             0.4700
                26                   6             0.4700
                27                   6             0.4700
                28                   6             0.4700
                29                   6             0.4700
                30                   6             0.4700
                31                   6             0.4700
                32                   6             0.4700
                33                   6             0.4700
                34                   6             0.4700
                35                   6             0.4700
                36                   6             0.4700
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QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-1R
Site: SRSNE -- Southington, CT
Date: 12/04/97

Q(actual)	0.037	gpm	t	277	min	Q (comp)	0.037	gpm
S (est)	0.0001		s	86.29	ft	T (comp)	0.45	gpd/ft
r(w)	0.17	ft	LS	24	ft	K	8.8E-07	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	0.5000	0.0407
2	0.4961	0.0404
3	0.4926	0.0401
4	0.4892	0.0399
5	0.4862	0.0397
6	0.4833	0.0394
7	0.4807	0.0393
8	0.4782	0.0391
9	0.4759	0.0389
10	0.4738	0.0388
11	0.4719	0.0386
12	0.4701	0.0385
13	0.4684	0.0384
14	0.4668	0.0382
15	0.4654	0.0381
16	0.4640	0.0380
17	0.4628	0.0380
18	0.4616	0.0379
19	0.4606	0.0378
20	0.4596	0.0377
21	0.4587	0.0376
22	0.4578	0.0376
23	0.4570	0.0375
24	0.4563	0.0375
25	0.4556	0.0374
26	0.4550	0.0374
27	0.4544	0.0373
28	0.4539	0.0373
29	0.4534	0.0373
30	0.4529	0.0372
31	0.4525	0.0372
32	0.4521	0.0372
33	0.4517	0.0371
34	0.4514	0.0371
35	0.4511	0.0371
36	0.4508	0.0371

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-2R
Site: SRSNE -- Southington, CT
Date: 12/05/97

Q(actual)	0.0055	gpm	t	243	min	Q (comp)	0.0055	gpm
S (est)	0.0001		s	30.36	ft	T (comp)	0.17	gpd/ft
r(w)	0.17	ft	LS	22.8	ft	K	3.5E-07	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	0.1900	0.0062
2	0.1894	0.0061
3	0.1887	0.0061
4	0.1881	0.0061
5	0.1875	0.0061
6	0.1870	0.0061
7	0.1864	0.0061
8	0.1859	0.0061
9	0.1853	0.0060
10	0.1848	0.0060
11	0.1843	0.0060
12	0.1838	0.0060
13	0.1834	0.0060
14	0.1829	0.0060
15	0.1825	0.0060
16	0.1820	0.0059
17	0.1816	0.0059
18	0.1812	0.0059
19	0.1808	0.0059
20	0.1805	0.0059
21	0.1801	0.0059
22	0.1797	0.0059
23	0.1794	0.0059
24	0.1790	0.0059
25	0.1787	0.0058
26	0.1784	0.0058
27	0.1781	0.0058
28	0.1778	0.0058
29	0.1775	0.0058
30	0.1772	0.0058
31	0.1769	0.0058
32	0.1766	0.0058
33	0.1764	0.0058
34	0.1761	0.0058
35	0.1759	0.0058
36	0.1756	0.0058

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-2DR
Site: SRSNE -- Southington, CT
Date: 11/21/97

Q(actual)	0.076	gpm	t	244	min	Q (comp)	0.076	gpm
S (est)	0.0001		s	41.07	ft	T (comp)	2.24	gpd/ft
r(w)	0.17	ft	LS	23.5	ft	K	4.5E-06	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	2.210	0.0746
2	2.211	0.0746
3	2.212	0.0746
4	2.213	0.0747
5	2.214	0.0747
6	2.214	0.0747
7	2.215	0.0747
8	2.216	0.0748
9	2.217	0.0748
10	2.218	0.0748
11	2.218	0.0748
12	2.219	0.0749
13	2.220	0.0749
14	2.220	0.0749
15	2.221	0.0749
16	2.222	0.0749
17	2.222	0.0750
18	2.223	0.0750
19	2.223	0.0750
20	2.224	0.0750
21	2.224	0.0750
22	2.225	0.0750
23	2.225	0.0751
24	2.226	0.0751
25	2.226	0.0751
26	2.227	0.0751
27	2.227	0.0751
28	2.228	0.0751
29	2.228	0.0751
30	2.228	0.0751
31	2.229	0.0752
32	2.229	0.0752
33	2.229	0.0752
34	2.230	0.0752
35	2.230	0.0752
36	2.230	0.0752

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-3R
Site: SRSNE -- Southington, CT
Date: 12/08/97

Q(actual)	0.29	gpm	|	t	313	min	|	Q (comp)	0.29	gpm
S (est)	0.0001		|	s	67.45	ft	|	T (comp)	6.03	gpd/ft
r(w)	0.13	ft	|	LS	21.5	ft	|	K	1.3E-05	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	6.0000	0.2838
2	6.0012	0.2839
3	6.0024	0.2839
4	6.0035	0.2840
5	6.0045	0.2840
6	6.0055	0.2840
7	6.0065	0.2841
8	6.0074	0.2841
9	6.0083	0.2842
10	6.0092	0.2842
11	6.0100	0.2842
12	6.0108	0.2843
13	6.0115	0.2843
14	6.0122	0.2843
15	6.0129	0.2844
16	6.0135	0.2844
17	6.0142	0.2844
18	6.0148	0.2844
19	6.0153	0.2845
20	6.0159	0.2845
21	6.0164	0.2845
22	6.0169	0.2845
23	6.0174	0.2846
24	6.0178	0.2846
25	6.0182	0.2846
26	6.0187	0.2846
27	6.0191	0.2846
28	6.0194	0.2846
29	6.0198	0.2847
30	6.0202	0.2847
31	6.0205	0.2847
32	6.0208	0.2847
33	6.0211	0.2847
34	6.0214	0.2847
35	6.0217	0.2847
36	6.0219	0.2848

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-4R
Site: SRSNE -- Southington, CT
Date: 11/11/98

Q(actual)	0.67	gpm	t	114	min	Q (comp)	0.67	gpm
S (est)	0.0001		s	2.22	ft	T (comp)	532.58	gpd/ft
r(w)	0.17	ft	LS	26.5	ft	K	9.5E-04	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	532.6000	0.6723
2	532.5998	0.6723
3	532.5995	0.6723
4	532.5993	0.6723
5	532.5991	0.6723
6	532.5988	0.6723
7	532.5986	0.6723
8	532.5984	0.6723
9	532.5981	0.6723
10	532.5979	0.6723
11	532.5977	0.6723
12	532.5975	0.6723
13	532.5973	0.6723
14	532.5971	0.6723
15	532.5969	0.6723
16	532.5967	0.6723
17	532.5965	0.6723
18	532.5963	0.6723
19	532.5961	0.6723
20	532.5959	0.6723
21	532.5957	0.6723
22	532.5955	0.6723
23	532.5953	0.6723
24	532.5951	0.6723
25	532.5949	0.6723
26	532.5948	0.6723
27	532.5946	0.6723
28	532.5944	0.6723
29	532.5942	0.6723
30	532.5940	0.6723
31	532.5939	0.6723
32	532.5937	0.6723
33	532.5935	0.6723
34	532.5934	0.6723
35	532.5932	0.6723
36	532.5930	0.6723

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-4DR
Site: SRSNE -- Southington, CT
Date: 12/04/97

Q(actual)	0.11	gpm	t	246	min	Q (comp)	0.11	gpm
S (est)	0.0001		s	40.93	ft	T (comp)	3.32	gpd/ft
r(w)	0.17	ft	LS	23.3	ft	K	6.8E-06	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	10.0000	0.2943
2	8.1327	0.2435
3	6.7734	0.2059
4	5.7895	0.1784
5	5.0808	0.1583
6	4.5727	0.1438
7	4.2096	0.1334
8	3.9511	0.1259
9	3.7674	0.1206
10	3.6371	0.1168
11	3.5448	0.1141
12	3.4795	0.1121
13	3.4333	0.1108
14	3.4007	0.1098
15	3.3776	0.1092
16	3.3614	0.1087
17	3.3499	0.1083
18	3.3418	0.1081
19	3.3360	0.1079
20	3.3320	0.1078
21	3.3291	0.1077
22	3.3271	0.1077
23	3.3257	0.1076
24	3.3247	0.1076
25	3.3240	0.1076
26	3.3235	0.1076
27	3.3231	0.1076
28	3.3229	0.1075
29	3.3227	0.1075
30	3.3226	0.1075
31	3.3225	0.1075
32	3.3224	0.1075
33	3.3224	0.1075
34	3.3224	0.1075
35	3.3223	0.1075
36	3.3223	0.1075

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-5R
Site: SRSNE -- Southington, CT
Date: 10/30/97

Q(actual)	0.069	gpm	t	312	min	Q (comp)	0.069	gpm
S (est)	0.0001		s	27.49	ft	T (comp)	3.25	gpd/ft
r(w)	0.17	ft	LS	23.2	ft	K	6.6E-06	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	3.0000	0.0644
2	3.0482	0.0654
3	3.0869	0.0661
4	3.1181	0.0667
5	3.1432	0.0672
6	3.1634	0.0676
7	3.1797	0.0679
8	3.1928	0.0682
9	3.2034	0.0684
10	3.2119	0.0686
11	3.2187	0.0687
12	3.2243	0.0688
13	3.2287	0.0689
14	3.2323	0.0689
15	3.2352	0.0690
16	3.2375	0.0690
17	3.2394	0.0691
18	3.2409	0.0691
19	3.2421	0.0691
20	3.2431	0.0692
21	3.2439	0.0692
22	3.2445	0.0692
23	3.2450	0.0692
24	3.2454	0.0692
25	3.2458	0.0692
26	3.2460	0.0692
27	3.2463	0.0692
28	3.2464	0.0692
29	3.2466	0.0692
30	3.2467	0.0692
31	3.2468	0.0692
32	3.2468	0.0692
33	3.2469	0.0692
34	3.2470	0.0692
35	3.2470	0.0692
36	3.2470	0.0692

ATTACHMENT A – 4

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

NAPL ZONE HYDRAULIC GRADIENT MONITORING DATA

Date	Time	Depth to Water		Ground-Water Elevation*		Head Difference	Depth to Water		Ground-Water Elevation*		Head Difference
		CPZ-4A	CPZ-4	CPZ-4A	CPZ-4	(Max = 3.46')	TW-7A	CPZ-6	TW-7A	CPZ-6	(Max = 4.68')
08/17/98	10:39 PM	10.17	10.44	149.30	148.36	0.94	6.84	5.88	151.88	148.59	3.29
08/18/98	08:53 AM	10.25	10.47	149.22	148.33	0.89	6.85	5.82	151.87	148.65	3.22
08/18/98	07:50 PM	10.30	10.51	149.17	148.29	0.88	6.89	5.85	151.83	148.62	3.21
08/19/98	07:40 AM	10.48	10.56	148.99	148.24	0.75	7.03	5.84	151.69	148.63	3.06
08/19/98	07:55 PM	10.48	10.56	148.99	148.24	0.75	7.00	5.81	151.72	148.66	3.06
08/20/98	08:28 AM	10.54	10.60	148.93	148.20	0.73	7.04	5.84	151.68	148.63	3.05
08/20/98	07:14 PM	10.46	10.59	149.01	148.21	0.80	6.91	5.74	151.81	148.73	3.08
08/21/98	08:23 AM	10.46	10.61	149.01	148.19	0.82	6.89	5.67	151.83	148.80	3.03
08/21/98	07:50 PM	10.43	10.61	149.04	148.19	0.85	6.84	5.61	151.88	148.86	3.02
08/22/98	07:53 AM	10.51	10.63	148.96	148.17	0.79	6.93	5.64	151.79	148.83	2.96
08/22/98	07:52 PM	10.48	10.64	148.99	148.16	0.83	6.87	5.61	151.85	148.86	2.99
08/23/98	07:50 AM	10.51	10.65	148.96	148.15	0.81	6.89	5.66	151.83	148.81	3.02
08/23/98	07:55 PM	10.41	10.66	149.06	148.14	0.92	6.79	5.60	151.93	148.87	3.06
08/24/98	08:02 AM	10.51	10.68	148.96	148.12	0.84	6.84	5.59	151.88	148.88	3.00
08/24/98	06:50 PM	10:50	10.69	148.97	148.11	0.86	6.82	5.60	151.90	148.87	3.03
08/25/98	07:39 AM	10.62	10.74	148.85	148.06	0.79	6.98	5.77	151.74	148.70	3.04

Notes: **All measurements are in feet; elevations are referenced to the NGVD of 1929.**

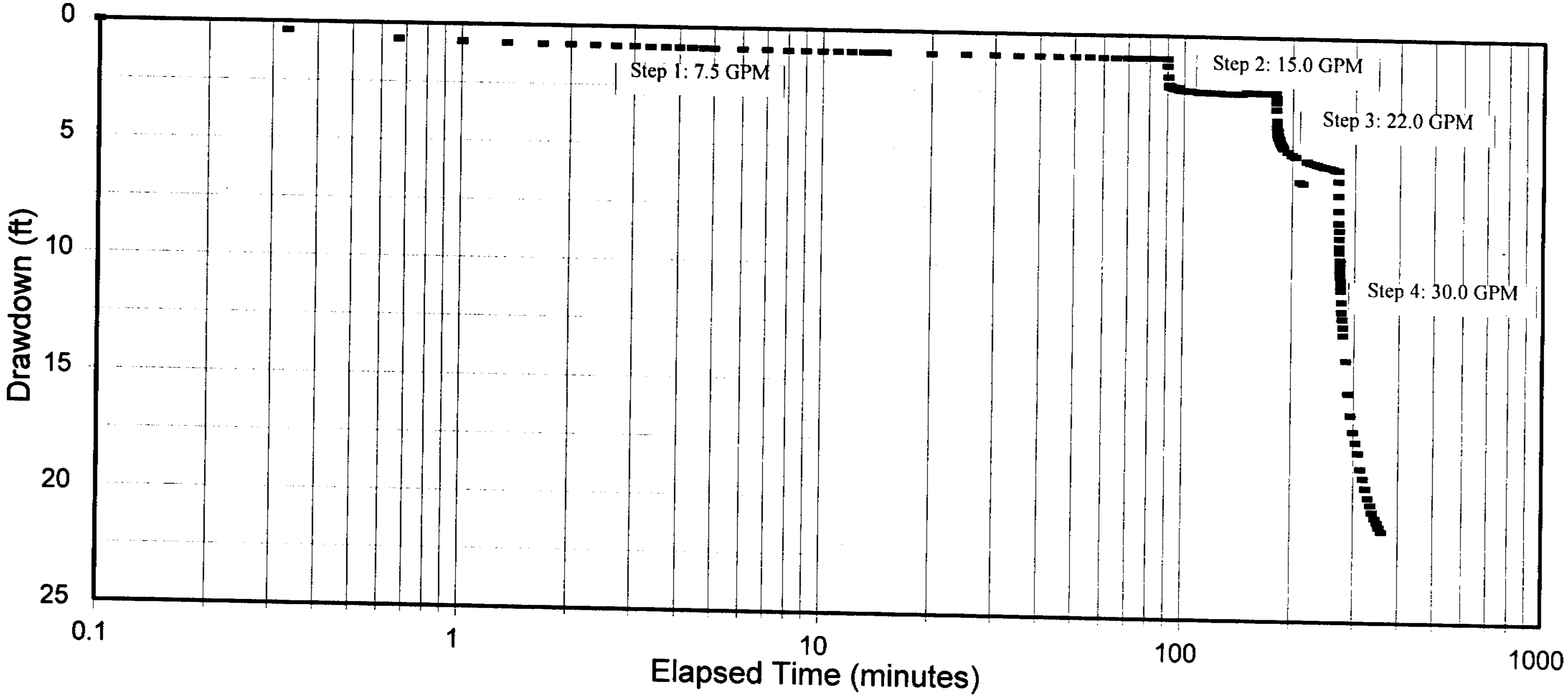
1) * Ground-water elevations based on the following measuring point elevations:
CPZ-4A: 159.47; CPZ-4: 158.80; TW-7A: 158.72; CPZ-6: 154.47.

2) Maximum head differences determined based on weekly data collected as part of NTCRA 1 compliance monitoring between July 1995 and July 1998.

ATTACHMENT A – 5

Step Drawdown Test -- Well RW-13

SRSNE Site -- Southington, CT



Test Date: 8/12/98

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

PUMPING WELL RW-13

MEASURING POINT ELEVATION: 152.40

STATIC DEPTH TO WATER: 5.43 @ 8:01

Date	Time (Hr:Min:Sec)	Depth to Water	Running Time (Min)	Drawdown
08/12/98	08:14:00 AM	5.43	0.00	0.00
08/12/98	08:14:20 AM	5.80	0.33	0.37
08/12/98	08:14:40 AM	6.11	0.67	0.68
08/12/98	08:15:00 AM	6.17	1.00	0.74
08/12/98	08:15:20 AM	6.21	1.33	0.78
08/12/98	08:15:40 AM	6.22	1.67	0.79
08/12/98	08:16:00 AM	6.23	2.00	0.80
08/12/98	08:16:20 AM	6.25	2.33	0.82
08/12/98	08:16:40 AM	6.27	2.67	0.84
08/12/98	08:17:00 AM	6.27	3.00	0.84
08/12/98	08:17:20 AM	6.28	3.33	0.85
08/12/98	08:17:40 AM	6.28	3.67	0.85
08/12/98	08:18:00 AM	6.29	4.00	0.86
08/12/98	08:18:20 AM	6.29	4.33	0.86
08/12/98	08:18:40 AM	6.30	4.67	0.87
08/12/98	08:19 AM	6.30	5.00	0.87
08/12/98	08:20 AM	6.32	6.00	0.89
08/12/98	08:21 AM	6.34	7.00	0.91
08/12/98	08:22 AM	6.35	8.00	0.92
08/12/98	08:23 AM	6.35	9.00	0.92
08/12/98	08:24 AM	6.36	10.00	0.93
08/12/98	08:25 AM	6.36	11.00	0.93
08/12/98	08:26 AM	6.36	12.00	0.93
08/12/98	08:27 AM	6.36	13.00	0.93
08/12/98	08:28 AM	6.36	14.00	0.93
08/12/98	08:29 AM	6.36	15.00	0.93
08/12/98	08:34 AM	6.37	20.00	0.94
08/12/98	08:39 AM	6.38	25.00	0.95
08/12/98	08:44 AM	6.38	30.00	0.95
08/12/98	08:49 AM	6.39	35.00	0.96
08/12/98	08:54 AM	6.40	40.00	0.97

Notes: **All measurements are in feet; elevations are referenced to the NGVD of 1929.**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

PUMPING WELL RW-13

MEASURING POINT ELEVATION: 152.40

STATIC DEPTH TO WATER: 5.43 @ 8:01

Date	Time (Hr:Min:Sec)	Depth to Water	Running Time (Min)	Drawdown
08/12/98	08:59 AM	6.40	45.00	0.97
08/12/98	09:04 AM	6.40	50.00	0.97
08/12/98	09:09 AM	6.40	55.00	0.97
08/12/98	09:14 AM	6.41	60.00	0.98
08/12/98	09:19 AM	6.41	65.00	0.98
08/12/98	09:24 AM	6.41	70.00	0.98
08/12/98	09:29 AM	6.42	75.00	0.99
08/12/98	09:34 AM	6.42	80.00	0.99
08/12/98	09:39 AM	6.42	85.00	0.99
08/12/98	09:44 AM	6.42	90.00	0.99
08/12/98	09:44:20 AM	6.73	90.33	1.30
08/12/98	09:44:40 AM	7.20	90.67	1.77
08/12/98	09:45:00 AM	7.55	91.00	2.12
08/12/98	09:45:20 AM	7.62	91.33	2.19
08/12/98	09:45:40 AM	7.60	91.67	2.17
08/12/98	09:46:00 AM	7.59	92.00	2.16
08/12/98	09:46:20 AM	7.60	92.33	2.17
08/12/98	09:46:40 AM	7.62	92.67	2.19
08/12/98	09:47 AM	7.64	93.00	2.21
08/12/98	09:47:20 AM	7.66	93.33	2.23
08/12/98	09:47:40 AM	7.65	96.67	2.22
08/12/98	09:48:00 AM	7.70	94.00	2.27
08/12/98	09:48:20 AM	7.70	94.33	2.27
08/12/98	09:48:40 AM	7.71	94.67	2.28
08/12/98	09:49 AM	7.71	95.00	2.28
08/12/98	09:50 AM	7.73	96.00	2.30
08/12/98	09:51 AM	7.74	97.00	2.31
08/12/98	09:52 AM	7.75	98.00	2.32
08/12/98	09:53 AM	7.76	99.00	2.33
08/12/98	09:54 AM	7.77	100.00	2.34
08/12/98	09:59 AM	7.79	105.00	2.36
08/12/98	10:04 AM	7.82	110.00	2.39

Notes: **All measurements are in feet; elevations are referenced to the NGVD of 1929.**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

PUMPING WELL RW-13

MEASURING POINT ELEVATION: 152.40

STATIC DEPTH TO WATER: 5.43 @ 8:01

Date	Time (Hr:Min:Sec)	Depth to Water	Running Time (Min)	Drawdown
08/12/98	10:09 AM	7.82	115.00	2.39
08/12/98	10:14 AM	7.85	120.00	2.42
08/12/98	10:19 AM	7.85	125.00	2.42
08/12/98	10:24 AM	7.86	130.00	2.43
08/12/98	10:29 AM	7.87	135.00	2.44
08/12/98	10:34 AM	7.87	140.00	2.44
08/12/98	10:39 AM	7.87	145.00	2.44
08/12/98	10:44 AM	7.81	150.00	2.38
08/12/98	10:49 AM	7.81	155.00	2.38
08/12/98	10:54 AM	7.81	160.00	2.38
08/12/98	10:59 AM	7.82	165.00	2.39
08/12/98	11:04 AM	7.82	170.00	2.39
08/12/98	11:09 AM	7.82	175.00	2.39
08/12/98	11:14 AM	7.82	180.00	2.39
08/12/98	11:14:20 AM	8.00	180.33	2.57
08/12/98	11:14:40 AM	8.21	180.67	2.78
08/12/98	11:15:00 AM	8.52	181.00	3.09
08/12/98	11:15:20 AM	9.01	181.33	3.58
08/12/98	11:15:40 AM	9.18	181.67	3.75
08/12/98	11:16:00 AM	9.35	182.00	3.92
08/12/98	11:16:20 AM	9.43	182.33	4.00
08/12/98	11:16:40 AM	9.51	182.67	4.08
08/12/98	11:17:00 AM	9.59	183.00	4.16
08/12/98	11:17:20 AM	9.64	183.33	4.21
08/12/98	11:17:40 AM	9.68	183.67	4.25
08/12/98	11:18:00 AM	9.73	184.00	4.30
08/12/98	11:18:20 AM	9.77	184.33	4.34
08/12/98	11:18:40 AM	9.80	184.67	4.37
08/12/98	11:19:00 AM	9.83	185.00	4.40
08/12/98	11:20 AM	9.93	186.00	4.50
08/12/98	11:21 AM	10.00	187.00	4.57

Notes: **All measurements are in feet; elevations are referenced to the NGVD of 1929.**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

PUMPING WELL RW-13

MEASURING POINT ELEVATION: 152.40

STATIC DEPTH TO WATER: 5.43 @ 8:01

Date	Time (Hr:Min:Sec)	Depth to Water	Running Time (Min)	Drawdown
08/12/98	11:22 AM	10.06	188.00	4.63
08/12/98	11:23 AM	10.11	189.00	4.68
08/12/98	11:24 AM	10.17	190.00	4.74
08/12/98	11:29 AM	10.33	195.00	4.90
08/12/98	11:34 AM	10.45	200.00	5.02
08/12/98	11:39 AM	10.53	205.00	5.10
08/12/98	11:44 AM	11.60	210.00	6.17
08/12/98	11:49 AM	11.67	215.00	6.24
08/12/98	11:54 AM	10.72	220.00	5.29
08/12/98	11:59 AM	10.77	225.00	5.34
08/12/98	12:04 PM	10.82	230.00	5.39
08/12/98	12:09 PM	10.86	235.00	5.43
08/12/98	12:14 PM	10.90	240.00	5.47
08/12/98	12:19 PM	10.94	245.00	5.51
08/12/98	12:24 PM	10.96	250.00	5.53
08/12/98	12:29 PM	10.99	255.00	5.56
08/12/98	12:34 PM	11.03	260.00	5.60
08/12/98	12:39 PM	11.06	265.00	5.63
08/12/98	12:44 PM	11.09	270.00	5.66
08/12/98	12:44:20 PM	11.55	270.33	6.12
08/12/98	12:44:40 PM	12.18	270.67	6.75
08/12/98	12:45:00 PM	12.82	271.00	7.39
08/12/98	12:45:20 PM	13.35	271.33	7.92
08/12/98	12:45:40 PM	13.67	271.67	8.24
08/12/98	12:46:00 PM	14.02	272.00	8.59
08/12/98	12:46:20 PM	14.38	272.33	8.95
08/12/98	12:46:40 PM	14.60	272.67	9.17
08/12/98	12:47:00 PM	14.94	273.00	9.51
08/12/98	12:47:20 PM	15.16	273.33	9.73
08/12/98	12:47:40 PM	15.39	273.67	9.96
08/12/98	12:48 PM	15.61	274.00	10.18

Notes: **All measurements are in feet; elevations are referenced to the NGVD of 1929.**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

PUMPING WELL RW-13

MEASURING POINT ELEVATION: 152.40

STATIC DEPTH TO WATER: 5.43 @ 8:01

Date	Time (Hr:Min:Sec)	Depth to Water	Running Time (Min)	Drawdown
08/12/98	12:48:20 PM	15.81	274.33	10.38
08/12/98	12:48:40 PM	16.09	274.67	10.66
08/12/98	12:49 PM	16.25	275.00	10.82
08/12/98	12:50 PM	16.73	276.00	11.30
08/12/98	12:51 PM	17.15	277.00	11.72
08/12/98	12:52 PM	17.45	278.00	12.02
08/12/98	12:53 PM	17.80	279.00	12.37
08/12/98	12:54 PM	18.14	280.00	12.71
08/12/98	12:59 PM	19.23	285.00	13.80
08/12/98	01:04 PM	20.63	290.00	15.20
08/12/98	01:09 PM	21.56	295.00	16.13
08/12/98	01:14 PM	22.24	300.00	16.81
08/12/98	01:19 PM	22.71	305.00	17.28
08/12/98	01:24 PM	23.15	310.00	17.72
08/12/98	01:29 PM	23.85	315.00	18.42
08/12/98	01:34 PM	24.25	320.00	18.82
08/12/98	01:39 PM	24.67	325.00	19.24
08/12/98	01:44 PM	25.07	330.00	19.64
08/12/98	01:49 PM	25.39	335.00	19.96
08/12/98	01:54 PM	25.69	340.00	20.26
08/12/98	01:59 PM	25.95	345.00	20.52
08/12/98	02:04 PM	26.14	350.00	20.71
08/12/98	02:09 PM	26.33	355.00	20.90
08/12/98	02:14 PM	26.52	360.00	21.09

Notes: **All measurements are in feet; elevations are referenced to the NGVD of 1929.**

ATTACHMENT A – 6

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
CPZ-1	565212	286107	157.44	159.73	9.75	149.98	9.98	149.75	0.23	O
CPZ-2	565216	286045	156.44	158.64	7.48	151.16	7.93	150.71	0.45	O
CPZ-3	565290	286163	156.74	159.49	11.80	147.69	11.82	147.67	0.02	O
CPZ-4	565322	286092	155.21	158.80	10.41	148.39	10.69	148.11	0.28	O
CPZ-5	565376	286312	155.99	158.60	17.69	140.91	16.99	141.61	-0.70	O
CPZ-6	565480	286325	152.31	154.47	5.97	148.50	5.60	148.87	-0.37	O
CPZ-7	565343	286467	156.81	159.54	7.21	152.33	7.13	152.41	-0.08	O
CPZ-8	565397	286529	157.29	160.35	6.61	153.74	6.60	153.75	-0.01	O
PZ-9	565229	286575	158.31	160.56	5.82	154.74	5.86	154.70	0.04	O
CPZ-10	565237	286643	158.51	160.97	4.94	156.03	5.00	155.97	0.06	O
CPZ-1R	565209	286103	157.44	161.32	5.25	156.07	5.67	155.65	0.42	R
CPZ-2R	565217	286039	156.74	160.79	4.77	156.02	5.23	155.56	0.46	R
CPZ-3R	565286	286158	156.67	160.83	9.38	151.45	9.47	151.36	0.09	R
CPZ-4R	565322	286085	154.91	158.73	8.51	150.22	8.77	149.96	0.26	R
CPZ-5R	565374	286319	155.69	158.52	11.86	146.66	11.63	146.89	-0.23	R
CPZ-6R	565480	286318	152.41	154.49	6.20	148.29	6.56	147.93	0.36	R
CPZ-7R	565338	286472	156.81	158.61	4.51	154.10	4.63	153.98	0.12	R
CPZ-8R	565395	286533	157.51	160.80	7.84	152.96	7.87	152.93	0.03	R
CPZ-9R	565244	286575	158.41	162.45	5.31	157.14	5.75	156.70	0.44	R
CPZ-10R	565233	286642	158.71	160.97	3.31	157.66	3.65	157.32	0.34	R
CPZ-2A	565219	286090	156.34	158.86	7.40	151.46	7.76	151.10	0.36	O
CPZ-4A	565300	286147	156.11	159.47	10.22	149.25	10.50	148.97	0.28	O
CPZ-6A	565396	286321	155.37	158.17	8.01	150.16	7.86	150.31	-0.15	O
CW-10-78	565317	284256	149.90	151.35	5.90	145.45	5.94	145.41	0.04	O
CW-1-78	565213	285075	157.80	158.46	12.66	145.80	12.85	145.61	0.19	O
CW-2-75	565407	285677	152.60	153.69	7.11	146.58	7.47	146.22	0.36	O

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
CW-2-78	565073	285036	161.00	163.81	17.75	146.06	NA	NA	NA	O
CW-3-75	565678	285115	152.00	153.04	7.48	145.56	7.58	145.46	0.10	O
CW-3-78	565162	284652	145.90	150.56	6.18	144.38	6.24	144.32	0.06	O
CW-4-75	565312	285355	150.60	151.42	4.93	146.49	5.24	146.18	0.31	O
CW-4-78	565155	284650	145.70	147.28	3.10	144.18	2.87	144.41	-0.23	R
CW-5-75	565286	285030	152.80	153.12	7.94	145.18	8.02	145.10	0.08	O
CW-5-78	565251	284543	152.60	153.11	7.18	145.93	7.22	145.89	0.04	O
CW-6-75	565222	284832	150.10	151.31	5.80	145.51	6.80	144.51	1.00	O
W-6-78	565396	284625	146.00	147.43	2.58	144.85	2.58	144.85	0.00	O
CW-7-75	565316	284843	150.80	151.10	6.76	144.34	6.45	144.65	-0.31	O
CW-7-78	565366	284159	151.10	153.39	7.77	145.62	7.81	145.58	0.04	O
CW-7A	565314	284843	150.80	151.13	6.38	144.75	6.84	144.29	0.46	O
CW-8-78	565457	284171	150.90	153.06	6.82	146.24	6.84	146.22	0.02	O
CW-9-78	565527	284271	150.00	152.27	6.98	145.29	7.00	145.27	0.02	O
CW-B-77	565310	285711	150.52	151.72	5.34	146.38	5.66	146.06	0.32	O
DP-1	565620	286146	147.67	150.11	4.69	145.42	4.79	145.32	0.10	O
DP-2	565597	286323	147.81	149.33	4.20	145.13	4.44	144.89	0.24	O
DP-3	565578	286481	148.19	149.95	DRY	DRY	DRY	DRY	NA	O
DP-4	565524	286655	149.06	150.87	2.95	147.92	2.99	147.88	0.04	O
DP-5	565602	287100	147.94	149.71	3.20	146.51	3.33	146.38	0.13	O
DP-6	565599	286886	147.91	150.04	3.89	146.15	3.95	146.09	0.06	O
MW-01	565281	285950	155.00	157.73	8.84	148.89	9.31	148.42	0.47	OR
MW-02	565307	285338	150.30	153.18	7.01	146.17	7.38	145.80	0.37	OR
MW-03	565509	285065	149.80	153.11	8.27	144.84	8.49	144.62	0.22	O
MW-04	565622	285470	148.80	151.62	4.64	146.98	5.75	145.87	1.11	OR
MW-05	565651	286030	147.40	150.67	2.78	147.89	3.54	147.13	0.76	R

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
MW-06	565660	286017	148.20	150.84	2.75	148.09	3.54	147.30	0.79	O
MW-07	565646	286028	147.30	150.36	2.91	147.45	4.12	146.24	1.21	O
MW-08	565654	286015	147.20	150.19	2.69	147.50	3.50	146.69	0.81	O
MW-121A	565539	285834	150.51	153.06	5.52	147.54	6.34	146.72	0.82	R
MW-121B	565532	285817	150.96	153.05	6.16	146.89	7.10	145.95	0.94	O
MW-121C	565535	285826	151.12	153.08	8.94	144.14	NA	NA	NA	R
MW-123A	565280	286128	156.33	158.50	2.85	155.65	3.27	155.23	0.42	R
MW-123C	565274	286126	156.72	158.55	7.87	150.68	8.19	150.36	0.32	O
W-124C	565238	285852	155.98	158.51	7.12	151.39	7.62	150.89	0.50	R
MW-125A	565403	286393	155.83	158.10	4.37	153.73	4.43	153.67	0.06	R
MW-125C	565402	286382	155.97	158.18	7.95	150.23	8.00	150.18	0.05	R
MW-126B	565124	287008	162.79	162.46	4.28	158.18	4.48	157.98	0.20	O
MW-126C	565123	287011	162.78	162.62	3.74	158.88	4.03	158.59	0.29	R
MW-127B	565403	285087	147.86	149.84	3.96	145.88	4.24	145.60	0.28	O
MW-127C	565404	285081	147.58	150.05	4.15	145.90	4.42	145.63	0.27	R
MW-128	565211	285319	155.43	157.24	10.60	146.64	10.88	146.36	0.28	R
MW-129	563866	286975	227.54	226.62	3.76	222.86	4.48	222.14	0.72	R
MW-201A	565732	287690	154.29	156.97	9.06	147.91	9.14	147.83	0.08	R
MW-201B	565737	287694	154.48	156.82	9.16	147.66	9.23	147.59	0.07	O
MW-202A	566031	287225	156.25	155.90	7.31	148.59	7.38	148.52	0.07	R
MW-202B	566037	287225	156.28	156.10	7.83	148.27	8.01	148.09	0.18	O
MW-203A	566355	285360	188.78	188.39	37.64	150.75	37.78	150.61	0.14	R
MW-203B	566351	285359	188.47	188.23	37.22	151.01	37.53	150.70	0.31	O
MW-204A	565669	285566	148.83	150.87	3.72	147.15	5.14	145.73	1.42	R
MW-204B	565652	285569	148.74	150.63	3.72	146.91	5.01	145.62	1.29	O
MW-205A	565559	284997	150.29	152.70	6.88	145.82	7.00	145.70	0.12	R

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
MW-205B	565551	284992	149.96	152.18	6.46	145.72	6.59	145.59	0.13	O
MW-206A	565732	284158	153.13	152.71	6.64	146.07	6.70	146.01	0.06	R
MW-206B	565726	284159	153.20	152.90	6.85	146.05	6.90	146.00	0.05	O
MW-207A	565484	284175	150.70	152.98	plugged	plugged	plugged	plugged	NA	R
MW-208A	565678	283622	156.82	156.55	9.55	147.00	9.64	146.91	0.09	R
MW-209A	564582	286263	196.13	198.25	22.53	175.72	22.74	175.51	0.21	R
MW-209B	564582	286258	195.81	198.31	16.95	181.36	DRY	DRY	NA	O
MW-408	565318	286324	156.98	159.56	11.54	148.02	11.33	148.23	-0.21	R
IW-409	565320	286332	157.14	159.60	6.01	153.59	6.14	153.46	0.13	O
MW-410	565305	286329	157.04	160.01	6.30	153.71	6.41	153.60	0.11	O
MW-411	565299	286341	157.22	160.29	10.32	149.97	10.38	149.91	0.06	R
MW-412	565302	286335	157.13	159.74	10.42	149.32	13.13	146.61	2.71	O
MW-413	565278	286350	158.00	160.66	6.90	153.76	6.98	153.68	0.08	O
MW-414	565273	286339	158.29	161.37	11.03	150.34	10.96	150.41	-0.07	R
MW-415	565275	286346	158.15	160.86	6.92	153.94	7.03	153.83	0.11	O
MW-416	565264	286291	157.42	160.06	9.53	150.53	9.15	150.91	-0.38	R
MW-501A	565838	286346	169.26	169.15	20.81	148.34	21.35	147.80	0.54	R
MW-501B	565837	286343	169.35	169.17	20.80	148.37	21.33	147.84	0.53	O
MW-501C	565838	286350	169.17	168.94	22.84	146.10	22.50	146.44	-0.34	O
MW-502	565495	286270	153.07	155.62	8.04	147.58	8.28	147.34	0.24	O
MW-701DR	564579	286254	196.15	198.71	18.31	180.40	18.57	180.14	0.26	R
MW-702DR	564912	286075	179.13	181.30	21.02	160.28	21.56	159.74	0.54	R
MW-703D	565300	285097	153.02	155.42	9.76	145.66	9.98	145.44	0.22	O
MW-703DR	565299	285073	153.04	155.20	9.50	145.70	9.70	145.50	0.20	R
MW-703S	565299	285087	153.40	155.68	10.14	145.54	10.34	145.34	0.20	O
MW-704D	565540	285591	150.84	153.48	6.75	146.73	8.21	145.27	1.46	O

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
MW-704DR	565552	285565	150.55	153.06	6.02	147.04	7.49	145.57	1.47	R
MW-704M	565557	285574	150.58	152.63	5.91	146.72	7.45	145.18	1.54	O
MW-704R	565568	285583	150.52	152.00	5.31	146.69	8.48	143.52	3.17	R
MW-704S	565557	285583	150.53	152.69	6.29	146.40	6.73	145.96	0.44	O
MW-705D	565421	286754	159.39	161.58	5.49	156.09	5.56	156.02	0.07	O
MW-705DR	565429	286750	158.79	160.89	5.66	155.23	5.81	155.08	0.15	R
MW-705R	565422	286744	159.54	161.50	7.24	154.26	7.22	154.28	-0.02	R
MW-706DR	565668	286216	147.82	149.91	1.61	148.30	2.08	147.83	0.47	R
W-707D	565599	285102	153.78	156.00	10.18	145.82	10.34	145.66	0.16	O
MW-707DR	565567	285124	154.72	156.72	11.39	145.33	12.44	144.28	1.05	R
MW-707M	565605	285109	153.41	155.12	9.32	145.80	9.45	145.67	0.13	O
MW-707R	565599	285115	153.91	155.85	9.61	146.24	10.31	145.54	0.70	R
MW-707S	565608	285116	153.16	154.94	9.25	145.69	9.45	145.49	0.20	O
MW-708S	566241	286418	222.10	224.57	75.48	149.09	75.52	149.05	0.04	O
MW-708M	566245	286405	223.30	226.08	76.52	149.56	76.60	149.48	0.08	O
MW-708R	566254	286408	223.20	225.60	75.22	150.38	75.38	150.22	0.16	R
MW-708DR	566251	286424	221.90	224.85	75.92	148.93	76.10	148.75	0.18	R
MW-709R	565403	287092	161.60	161.53	6.30	155.23	6.49	155.04	0.19	R
MW-709DR	565403	287092	161.60	161.53	4.80	156.73	5.09	156.44	0.29	R
MW-710S	566112	284847	165.00	164.93	16.95	147.98	17.10	147.83	0.15	O
MW-710R	566110	284836	165.00	164.58	17.36	147.22	17.50	147.08	0.14	R
MW-710DR	566113	284857	165.00	164.99	17.66	147.33	17.74	147.25	0.08	R
MWD-601	565228	286572	158.31	160.45	5.84	154.61	5.86	154.59	0.02	O
MWL-301	565261	286598	158.82	160.57	4.65	155.92	4.54	156.03	-0.11	O
MWL-302	565359	286603	159.15	161.72	6.93	154.79	6.93	154.79	0.00	O
MWL-303	565457	286604	156.96	158.81	9.51	149.30	9.55	149.26	0.04	O

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
MWL-304	565265	286466	157.96	160.22	5.60	154.62	5.66	154.56	0.06	O
MWL-305	565354	286450	157.55	159.03	5.97	153.06	6.07	152.96	0.10	O
MWL-306	565502	286450	153.80	155.48	8.43	147.05	8.25	147.23	-0.18	O
MWL-307	565259	286297	157.71	159.29	5.63	153.66	5.76	153.53	0.13	O
MWL-308	565354	286304	155.88	157.81	4.31	153.50	4.73	153.08	0.42	O
MWL-309	565505	286302	152.78	154.77	10.04	144.73	DRY	DRY	NA	O
MWL-310	565251	286147	157.34	159.74	9.02	150.72	9.29	150.45	0.27	O
MWL-311	565351	286149	155.46	157.47	8.77	148.70	9.01	148.46	0.24	O
WL-312	565509	286154	153.75	155.83	7.90	147.93	8.56	147.27	0.66	O
MWL-313	565352	285992	154.52	156.61	9.71	146.90	10.00	146.61	0.29	O
MWL-314	565502	286001	153.68	155.53	8.85	146.68	9.18	146.35	0.33	O
P-10	565316	286803	160.84	162.84	8.93	153.91	6.01	156.83	-2.92	O
P-101A	565674	286226	148.05	150.49	2.32	148.17	2.90	147.59	0.58	R
P-101B	565675	286232	148.19	150.62	2.43	148.19	3.03	147.59	0.60	O
P-101C	565676	286238	148.34	150.73	4.59	146.14	4.72	146.01	0.13	O
P-102A	565702	286458	148.77	151.01	2.62	148.39	3.10	147.91	0.48	R
P-102B	565702	286465	148.74	151.06	2.75	148.31	3.20	147.86	0.45	O
P-102C	565702	286472	148.71	151.20	4.75	146.45	4.83	146.37	0.08	O
P-11A	565583	286220	151.80	153.84	5.80	148.04	6.39	147.45	0.59	R
P-11B	565583	286220	152.22	155.25	7.26	147.99	7.84	147.41	0.58	O
P-12	565321	287115	161.27	164.56	7.81	156.75	8.00	156.56	0.19	O
P-12A	565321	287105	161.21	163.62	7.29	156.33	7.50	156.12	0.21	R
P-13	565242	285851	155.88	158.43	11.15	147.28	11.50	146.93	0.35	O
P-14	565582	286212	151.96	154.23	5.96	148.27	6.44	147.79	0.48	R
P-15	564917	285631	179.18	181.65	21.01	160.64	21.02	160.63	0.01	R
P-16	565129	286518	165.35	165.03	9.65	155.38	9.71	155.32	0.06	O

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
P-1A	565124	286367	166.20	165.71	8.16	157.55	8.69	157.02	0.53	R
P-1B	565125	286372	166.15	165.69	10.69	155.00	10.78	154.91	0.09	O
P-2A	565118	286221	166.41	165.94	7.98	157.96	8.65	157.29	0.67	R
P-2B	565116	286223	166.41	166.03	10.04	155.99	10.42	155.61	0.38	O
P-3A	565576	286459	148.20	150.22	1.24	148.98	1.49	148.73	0.25	R
P-3B	565570	286457	148.13	150.09	2.60	147.49	2.39	147.70	-0.21	O
P-4A	565008	286294	167.94	169.75	9.68	160.07	10.11	159.64	0.43	R
P-4B	565011	286294	167.60	169.78	9.70	160.08	9.96	159.82	0.26	O
-5B	565391	286283	155.24	158.28	6.25	152.03	6.05	152.23	-0.20	O
P-6	565500	286294	152.74	153.93	5.36	148.57	5.60	148.33	0.24	R
P-7	565439	286805	158.06	160.31	4.42	155.89	4.53	155.78	0.11	O
P-8	564918	286064	179.72	181.25	21.06	160.19	21.24	160.01	0.18	O
P-8A	564921	286067	179.66	181.62	21.59	160.03	22.02	159.60	0.43	R
P-9	565412	286584	157.66	159.49	5.62	153.87	5.63	153.86	0.01	O
PW-406	565291	286337	157.71	160.40	11.17	149.23	11.06	149.34	-0.11	R
PW-407	565291	286331	157.43	160.31	6.54	153.77	6.64	153.67	0.10	O
PZO-1	565335	286384	157.39	158.54	5.76	152.78	5.84	152.70	0.08	O
PZO-2	565351	286370	157.11	159.85	7.32	152.53	7.37	152.48	0.05	O
PZO-3	565313	286507	157.51	160.40	6.95	153.45	6.98	153.42	0.03	O
PZO-5	564621	287042	197.60	197.16	4.81	192.35	4.92	192.24	0.11	O
PZO-6	564176	285978	222.00	221.68	DRY	DRY	DRY	DRY	NA	O
PZO-7	564951	286483	167.25	169.83	8.40	161.43	DRY	DRY	NA	O
PZO-2M	565586	285328	152.70	154.81	8.64	146.17	9.05	145.76	0.41	O
PZO-2D	565578	285340	152.48	154.29	8.02	146.27	8.51	145.78	0.49	O
PZO-3M	565736	285211	150.59	152.58	6.54	146.04	6.74	145.84	0.20	O
PZO-3D	565726	285210	150.85	153.13	6.30	146.83	6.73	146.40	0.43	O

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
PZO-6S	565487	285569	151.28	153.07	6.62	146.45	7.01	146.06	0.39	O
PZO-121S	565547	285820	150.14	152.14	5.95	146.19	6.24	145.90	0.29	O
PZO-204S	565649	285565	149.06	151.16	5.33	145.83	5.55	145.61	0.22	O
PZO-204M	565658	285562	149.18	151.16	4.60	146.56	5.44	145.72	0.84	O
PZR-1	565331	286383	157.39	157.94	10.49	147.45	9.43	148.51	-1.06	R
PZR-2	565349	286365	157.11	159.16	9.26	149.90	9.22	149.94	-0.04	R
PZR-4	565355	286289	157.01	157.85	9.86	147.99	8.88	148.97	-0.98	R
PZR-5	564616	287042	197.70	197.60	9.52	188.08	9.70	187.90	0.18	R
ZR-6	564177	285975	221.90	221.55	15.79	205.76	15.98	205.57	0.19	R
PZR-7	564948	286483	167.50	170.21	9.43	160.78	9.88	160.33	0.45	R
PZR-1R	565722	285404	148.72	151.07	2.48	148.59	2.84	148.23	0.36	R
PZR-2R	565562	285330	152.10	153.77	7.23	146.54	7.95	145.82	0.72	R
PZR-2DR	565579	285319	153.41	154.92	8.40	146.52	9.11	145.81	0.71	R
PZR-3R	565745	285220	149.92	152.39	5.68	146.71	6.41	145.98	0.73	R
PZR-4R	565369	285471	152.36	153.95	7.36	146.59	7.84	146.11	0.48	R
PZR-4DR	565388	285464	151.15	153.25	3.49	149.76	3.81	149.44	0.32	R
PZR-5R	565280	285532	152.12	154.84	6.58	148.26	7.48	147.36	0.90	R
RW-1	565265	286133	157.14	157.56	22.50	135.06	23.86	133.70	1.36	O
RW-2	565377	286288	156.21	156.51	26.98	129.53	26.97	129.54	-0.01	O
RW-3	565365	286384	156.79	157.24	23.30	133.94	25.12	132.12	1.82	O
RW-4	565314	286498	157.31	158.19	13.80	144.39	16.92	141.27	3.12	O
RW-5	565250	286570	158.51	159.90	16.51	143.39	17.23	142.67	0.72	O
RW-6	565225	286413	158.89	159.23	15.05	144.18	18.40	140.83	3.35	O
RW-7	565223	286113	157.04	157.16	16.32	140.84	17.06	140.10	0.74	O
RW-8	565304	286179	156.34	156.92	24.10	132.82	25.11	131.81	1.01	O
RW-9	565344	286238	156.64	156.68	28.75	127.93	28.93	127.75	0.18	O

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
RW-10	565370	286333	156.19	156.47	37.42	119.05	26.84	129.63	-10.58	O
RW-11	565354	286446	156.91	157.82	22.10	135.72	23.73	134.09	1.63	O
RW-12	565281	286161	157.36	158.50	20.50	138.00	21.95	136.55	1.45	O
RW-13	565560	285602	150.12	152.40	5.56	146.84	38.36	114.04	32.80	O
RW-1R	565571	285561	149.80	152.18	4.98	147.20	6.51	145.67	1.53	R
SG-701	565635	286250		148.89	3.60	145.29	NA	NA	NA	O
SG-702	565506	287057		148.89	1.71	147.18	1.66	147.23	-0.05	O
SRS-1	565194	285871	159.89	160.86	9.17	151.69	9.88	150.98	0.71	O
RS-2	565200	285871	159.64	160.68	10.36	150.32	10.59	150.09	0.23	O
SRS-3	565394	285864	151.38	152.68	4.91	147.77	5.42	147.26	0.51	O
SRS-4	565392	285868	151.51	152.65	4.77	147.88	DRY	DRY	NA	O
SRS-5	565530	285997	152.57	154.35	7.25	147.10	8.00	146.35	0.75	O
SRS-6	565578	286010	152.81	153.88	6.51	147.37	7.26	146.62	0.75	O
SW-A	565964	285255		148.75	4.28	144.47	4.36	144.39	0.08	O
SW-B	565749	285688		150.32	5.00	145.32	5.10	145.22	0.10	O
SW-C	565685	285974		150.59	5.07	145.52	5.28	145.31	0.21	O
SW-D+	565622	286151		150.54	NA	NA	NA	NA	NA	O
SW-E	565682	286278		150.37	4.82	145.55	4.80	145.57	-0.02	O
SW-F+	565628	286472		150.41	NA	NA	NA	NA	NA	O
SW-G	565609	287092		149.79	3.60	146.19	3.48	146.31	-0.12	O
SW-701	565681	287171		155.33	8.92	146.41	9.00	146.33	0.08	O
SW-702	565590	283894		153.52	5.49	148.03	5.50	148.02	0.01	O
SW-703	565552	284184		153.73	8.29	145.44	8.26	145.47	-0.03	O
SW-704	564861	284208		154.53	10.58	143.95	10.62	143.91	0.04	O
TW-01	565344	284065	150.50	152.21	6.55	145.66	6.60	145.61	0.05	O
TW-02	565355	283770	149.80	151.81	6.02	145.79	6.04	145.77	0.02	O

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

COMPREHENSIVE GROUND-WATER AND SURFACE-WATER ELEVATION MEASUREMENT ROUNDS

Location	X (Easting)	Y (Northing)	Ground Surface Elev.	Meas. Point Elev.	Depth to Water 8/17/98	Water Elev. 8/17/98	Depth to Water 8/24/98	Water Elev. 8/24/98	Apparent Drawdown	Well Formation *
TW-03	565269	284027	150.10	150.92	5.17	145.75	5.20	145.72	0.03	O
TW-04	565245	283814	148.90	151.01	5.18	145.83	5.22	145.79	0.04	O
TW-05	565149	284350	151.10	152.72	7.56	145.16	7.59	145.13	0.03	O
TW-07A	565393	286384	156.20	158.72	6.95	151.77	6.82	151.90	-0.13	O
TW-08A	565213	286406	157.90	160.55	6.04	154.51	6.12	154.43	0.08	O
TW-11	565282	285956	155.60	157.39	9.22	148.17	9.58	147.81	0.36	O
TW-12	565269	287366	175.00	177.15	21.61	155.54	21.05	156.10	-0.56	O
WE-1	565220	286787	163.00	163.01	5.08	157.93	5.34	157.67	0.26	R
/E-2	565220	286808	162.10	162.29	5.21	157.08	5.31	156.98	0.10	O

Notes:

All measurements are in feet; elevations are referenced to the NGVD of 1929.

Water elevations on 8/17/98 were measured prior to initiating the overburden pump test of pumping well RW-13 on 8/17/98; water elevations on 8/24/98 were measured prior to terminating pumping at well RW-13 on 8/24/98.

Apparent drawdown indicates net negative change in water elevation following 7 days of pumping at approximately 22.5 gpm from middle/deep overburden pumping well RW-13. Positive apparent drawdown indicates water elevation decline.

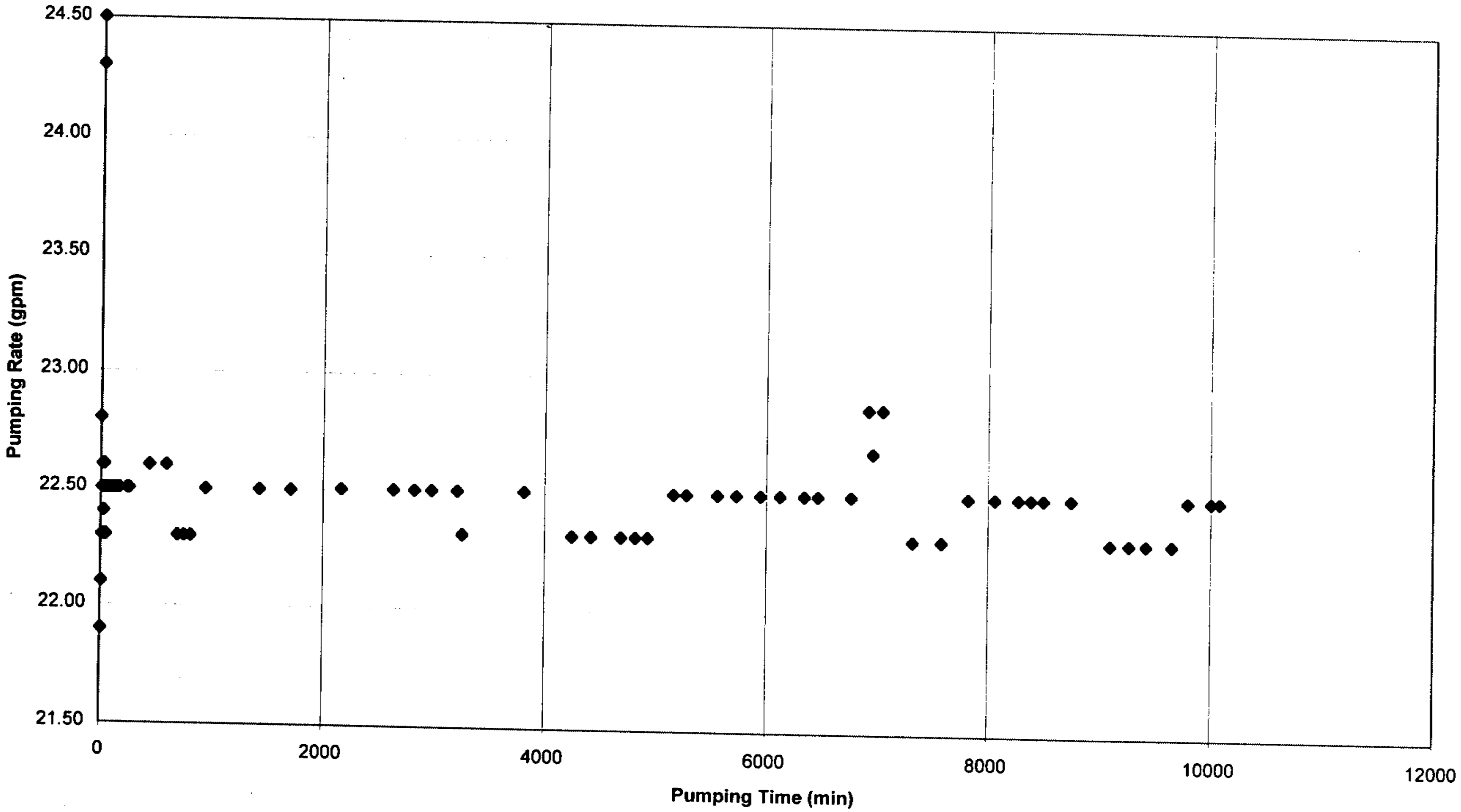
NA - Not available

\+ Surface water measurement stakes destroyed/removed.

* O = Overburden
R = Bedrock

ATTACHMENT A – 7

Overburden Pumping Test -- Pumping Well RW-13
RW-13 Pumping Rate
SRSNE Site -- Southington, CT



SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

PUMPING RATE MONITORING DATA

Date	Time (Hr:Min:Sec)	Totallizer Reading (gal)	Running Time (min)	Cumulative Pumping Rate (gpm)	Instantaneous Pumping Rate (gpm)
8/17/98	20:01:50	39	1	39.0	22.80
8/17/98	20:02:00	70	2	35.0	24.50
8/17/98	20:03:45	81	3	27.0	24.30
8/17/98	20:05:15	125	5	25.0	21.90
8/17/98	20:07:00	161	7	23.0	22.10
8/17/98	20:08:30	187	8	23.4	22.10
8/17/98	20:09:00	203	9	22.6	22.50
8/17/98	20:10:09	226	10	22.6	22.30
8/17/98	20:11:29	257	11	23.4	22.50
8/17/98	20:12:27	279	12	23.3	22.30
8/17/98	20:13:03	296	13	22.8	22.50
8/17/98	20:14:43	326	14	23.3	22.50
8/17/98	20:15:47	359	15	23.9	22.50
8/17/98	20:17:06	383	17	22.5	22.50
8/17/98	20:17:53	407	17	23.9	22.60
8/17/98	20:19:03	429	19	22.6	22.60
8/17/98	20:19:30	445	19	23.4	22.50
8/17/98	20:21:01	476	21	22.7	22.50
8/17/98	20:22:00	495	22	22.5	22.60
8/17/98	20:23:15	523	23	22.7	22.60
8/17/98	20:24:01	545	24	22.7	22.50
8/17/98	20:26:02	589	26	22.7	22.40
8/17/98	20:27:09	619	27	22.9	22.50
8/17/98	20:28:45	650	28	23.2	22.50
8/17/98	20:30:07	680	30	22.7	22.60
8/17/98	20:31:24	709	31	22.9	22.50
8/17/98	20:32:26	721	32	22.5	22.50
8/17/98	20:33:10	747	33	22.6	22.50
8/17/98	20:34:29	776	34	22.8	22.50
8/17/98	20:35:38	803	35	22.9	22.30
8/17/98	20:36:48	829	36	23.0	22.50
8/17/98	20:39:48	879	39	22.5	22.30
8/17/98	20:41:30	938	41	22.9	22.30
8/17/98	20:42:58	968	42	23.0	22.50
8/17/98	20:43:52	991	43	23.0	22.30
8/17/98	20:44:07	1007	44	22.9	22.50
8/17/98	20:45:57	1035	45	23.0	22.30
8/17/98	21:03:45	1466	63	23.3	22.50
8/17/98	21:14:30	1708	74	23.1	22.50
8/17/98	21:26:45	1973	86	22.9	22.50
8/17/98	21:32:30	2114	92	23.0	22.50
8/17/98	21:52:30	2566	112	22.9	22.50
8/17/98	22:17:30	3130	137	22.8	22.50
8/17/98	22:49:00	3839	169	22.7	22.50

Date	Time (Hr:Min:Sec)	Totallizer Reading (gal)	Running Time (min)	Cumulative Pumping Rate (gpm)	Instantaneous Pumping Rate (gpm)
8/17/98	23:54:30	5337	234	22.8	22.50
8/18/98	0:14:00	5896	254	23.2	22.50
8/18/98	3:15:00	9876	435	22.7	22.60
8/18/98	5:47:00	13346	587	22.7	22.60
8/18/98	7:29:00	15509	689	22.5	22.30
8/18/98	8:29:00	16842	749	22.5	22.30
8/18/98	9:27:00	18146	807	22.5	22.30
8/18/98	11:41:00	21155	941	22.5	22.50
8/18/98	19:44:00	32085	1424	22.5	22.50
8/19/98	0:29:00	39402	1709	23.1	22.50
8/19/98	8:03:00	48616	2163	22.5	22.51
8/19/98	15:53:00	59142	2633	22.5	22.51
8/19/98	19:03:00	63697	2823	22.6	22.51
8/19/98	21:37:00	66732	2977	22.4	22.51
8/20/98	1:29:00	72857	3209	22.7	22.51
8/20/98	6:44:00	79038	3254	24.3	22.32
8/20/98	11:33:00	85358	3813	22.4	22.51
8/20/98	18:44:00	95166	4244	22.4	22.32
8/20/98	21:37:27	99429	4417	22.5	22.32
8/21/98	2:08:53	105168	4688	22.4	22.32
8/21/98	4:19:27	108091	4819	22.4	22.32
8/21/98	6:11:29	110588	4931	22.4	22.32
8/21/98	10:01:00	115823	5161	22.4	22.51
8/21/98	11:59:00	118527	5279	22.5	22.51
8/21/98	16:39:00	124833	5559	22.5	22.51
8/21/98	19:30:11	128688	5730	22.5	22.51
8/21/98	23:08:12	133608	5948	22.5	22.51
8/22/98	2:03:50	137573	6123	22.5	22.51
8/22/98	5:43:45	142514	6343	22.5	22.51
8/22/98	7:44:00	145230	6464	22.5	22.51
8/22/98	12:44:00	151982	6764	22.5	22.51
8/22/98	15:18:00	158163	6918	22.9	22.88
8/22/98	15:57:00	159064	6957	22.9	22.69
8/22/98	17:25:00	161073	7045	22.9	22.88
8/22/98	21:59:54	164424	7319	22.5	22.32
8/23/98	2:20:27	170231	7580	22.5	22.32
8/23/98	6:18:45	175622	7818	22.5	22.51
8/23/98	10:17:00	180903	8057	22.5	22.51
8/23/98	13:48:00	185663	8268	22.5	22.51
8/23/98	15:41:00	188195	8381	22.5	22.51
8/23/98	17:34:00	190850	8494	22.5	22.51
8/23/98	21:39:35	195003	8739	22.3	22.51
8/24/98	3:31:24	204219	9091	22.5	22.32
8/24/98	6:25:07	208102	9265	22.5	22.32
8/24/98	8:58:00	211411	9418	22.4	22.32
8/24/98	12:51:00	216610	9651	22.4	22.32
8/24/98	15:12:00	219754	9792	22.4	22.51
8/24/98	18:41:00	224456	10001	22.4	22.51
8/24/98	19:57:00	226769	10077	22.5	22.51

ATTACHMENT A – 8

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: RW-13

MEASURING POINT ELEVATION: 152.40

STATIC DEPTH TO WATER: 5.55

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	08:00:00 PM	5.55	146.85	0.00
08/17/98	08:04:00 PM	11.08	141.32	5.53
08/17/98	08:07:00 PM	11.49	140.91	5.94
08/17/98	08:11:00 PM	11.84	140.56	6.29
08/17/98	08:16:30 PM	12.23	140.17	6.68
08/17/98	08:18:30 PM	12.38	140.02	6.83
08/17/98	08:23:30 PM	12.49	139.91	6.94
08/17/98	08:27:30 PM	12.59	139.81	7.04
08/17/98	08:32:00 PM	12.71	139.69	7.16
08/17/98	08:36:00 PM	12.77	139.63	7.22
08/17/98	08:41:30 PM	12.89	139.51	7.34
08/17/98	08:56:00 PM	13.17	139.23	7.62
08/17/98	09:07:00 PM	13.26	139.14	7.71
08/17/98	09:13:00 PM	13.33	139.07	7.78
08/17/98	09:17:00 PM	13.37	139.03	7.82
08/17/98	09:21:30 PM	13.40	139.00	7.85
08/17/98	09:28:30 PM	13.47	138.93	7.92
08/17/98	09:36:30 PM	13.59	138.81	8.04
08/17/98	09:41:30 PM	13.61	138.79	8.06
08/17/98	09:47:00 PM	13.67	138.73	8.12
08/17/98	09:55:30 PM	13.72	138.68	8.17
08/17/98	10:00:00 PM	13.76	138.64	8.21
08/17/98	10:20:00 PM	13.90	138.50	8.35
08/17/98	11:11:30 PM	14.21	138.19	8.66
08/18/98	12:02:00 AM	14.45	137.95	8.90
08/18/98	04:22:10 AM	15.44	136.96	9.89
08/18/98	08:08:20 AM	15.98	136.42	10.43
08/18/98	12:12:30 PM	16.60	135.80	11.05
08/18/98	04:08:30 PM	17.06	135.34	11.51
08/18/98	08:06:00 PM	17.40	135.00	11.85
08/18/98	08:04:10 AM	18.56	133.84	13.01

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: RW-13

MEASURING POINT ELEVATION: 152.40

STATIC DEPTH TO WATER: 5.55

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/19/98	02:05:20 PM	19.14	133.26	13.59
08/19/98	08:04:15 PM	19.69	132.71	14.14
08/20/98	08:09:30 AM	20.81	131.59	15.26
08/20/98	02:04:00 PM	21.36	131.04	15.81
08/20/98	08:00:00 PM	21.90	130.50	16.35
08/21/98	08:06:00 AM	23.57	128.83	18.02
08/21/98	02:08:00 PM	24.35	128.05	18.80
08/21/98	08:06:30 PM	25.11	127.29	19.56
08/22/98	08:05:30 AM	26.73	125.67	21.18
08/22/98	02:04:30 PM	27.57	124.83	22.02
08/22/98	08:07:00 PM	28.58	123.82	23.03
08/23/98	08:03:30 AM	31.10	121.30	25.55
08/23/98	02:05:30 PM	32.27	120.13	26.72
08/23/98	08:05:30 PM	33.42	118.98	27.87
08/24/98	08:12:00 AM	36.00	116.40	30.45
08/24/98	03:11:00 PM	37.71	114.69	32.16
08/24/98	07:12:00 PM	38.36	114.04	32.81
08/25/98	07:49:30 AM	5.88	146.52	0.33

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: CW-2-75

MEASURING POINT ELEVATION: 153.69

STATIC DEPTH TO WATER: 7.11

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	07:56:45 PM	7.11	146.58	0.00
08/17/98	08:02:30 PM	7.12	146.57	0.01
08/17/98	08:07:30 PM	7.13	146.56	0.02
08/17/98	08:13:45 PM	7.13	146.56	0.02
08/17/98	08:20:45 PM	7.13	146.56	0.02
08/17/98	08:29:15 PM	7.14	146.55	0.03
08/17/98	08:38:00 PM	7.14	146.55	0.03
08/17/98	08:44:00 PM	7.14	146.55	0.03
08/17/98	08:56:30 PM	7.14	146.55	0.03
08/17/98	09:03:10 PM	7.14	146.55	0.03
08/17/98	09:10:58 PM	7.14	146.55	0.03
08/17/98	09:18:20 PM	7.14	146.55	0.03
08/17/98	09:25:00 PM	7.15	146.54	0.04
08/17/98	09:31:20 PM	7.14	146.55	0.03
08/17/98	09:38:10 PM	7.14	146.55	0.03
08/17/98	09:44:30 PM	7.15	146.54	0.04
08/17/98	09:50:25 PM	7.15	146.54	0.04
08/17/98	09:56:30 PM	7.15	146.54	0.04
08/17/98	10:33:30 PM	7.15	146.54	0.04
08/17/98	11:59:20 PM	7.15	146.54	0.04
08/18/98	04:39:10 AM	7.23	146.46	0.12
08/18/98	08:24:55 AM	7.18	146.51	0.07
08/18/98	12:12:40 PM	7.18	146.51	0.07
08/18/98	04:18:20 PM	7.20	146.49	0.09
08/18/98	08:17:55 PM	7.17	146.52	0.06
08/19/98	08:15:50 AM	7.18	146.51	0.07
08/19/98	02:13:45 PM	7.20	146.49	0.09
08/19/98	08:15:00 PM	7.22	146.47	0.11
08/20/98	08:15:45 AM	7.24	146.45	0.13
08/20/98	02:12:30 PM	7.25	146.44	0.14
08/20/98	08:06:00 PM	7.26	146.43	0.15

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: CW-2-75

MEASURING POINT ELEVATION: 153.69

STATIC DEPTH TO WATER: 7.11

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/21/98	08:12:00 AM	7.28	146.41	0.17
08/21/98	02:14:00 PM	7.30	146.39	0.19
08/21/98	08:14:00 PM	7.32	146.37	0.21
08/22/98	08:11:00 AM	7.35	146.34	0.24
08/22/98	02:09:30 PM	7.36	146.33	0.25
08/22/98	08:13:00 PM	7.38	146.31	0.27
08/23/98	08:09:00 AM	7.40	146.29	0.29
08/23/98	02:11:00 PM	7.41	146.28	0.30
08/23/98	08:12:00 PM	7.43	146.26	0.32
08/24/98	08:18:00 AM	7.44	146.25	0.33
08/24/98	03:19:00 PM	7.46	146.23	0.35
08/24/98	06:58:30 PM	7.47	146.22	0.36
08/25/98	07:56:30 AM	7.43	146.26	0.32

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: CW-B-77

MEASURING POINT ELEVATION: 151.72

STATIC DEPTH TO WATER: 5.34

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	08:00:03 PM	5.34	146.38	0.00
08/17/98	08:08:45 PM	5.34	146.38	0.00
08/17/98	08:15:00 PM	5.34	146.38	0.00
08/17/98	08:23:00 PM	5.34	146.38	0.00
08/17/98	08:31:00 PM	5.34	146.38	0.00
08/17/98	08:39:00 PM	5.34	146.38	0.00
08/17/98	08:50:00 PM	5.34	146.38	0.00
08/17/98	08:58:10 PM	5.34	146.38	0.00
08/17/98	09:06:00 PM	5.34	146.38	0.00
08/17/98	09:12:40 PM	5.34	146.38	0.00
08/17/98	09:20:30 PM	5.35	146.37	0.01
08/17/98	09:26:00 PM	5.35	146.37	0.01
08/17/98	09:32:45 PM	5.35	146.37	0.01
08/17/98	09:39:50 PM	5.35	146.37	0.01
08/17/98	09:45:30 PM	5.35	146.37	0.01
08/17/98	09:51:45 PM	5.35	146.37	0.01
08/17/98	09:58:10 PM	5.35	146.37	0.01
08/17/98	10:37:00 PM	5.35	146.37	0.01
08/17/98	11:58:00 PM	5.36	146.36	0.02
08/18/98	04:49:23 AM	3.45	148.27	-1.89
08/18/98	08:26:35 AM	5.38	146.34	0.04
08/18/98	12:14:00 PM	5.38	146.34	0.04
08/18/98	04:19:30 PM	5.39	146.33	0.05
08/18/98	08:21:42 PM	5.38	146.34	0.04
08/19/98	08:17:10 AM	5.38	146.34	0.04
09/19/98	02:15:20 PM	5.39	146.33	0.05
08/19/98	08:16:30 PM	5.41	146.31	0.07
08/20/98	08:18:30 AM	5.43	146.29	0.09
08/20/98	02:14:00 PM	5.44	146.28	0.10
08/20/98	08:07:30 PM	5.46	146.26	0.12
08/21/98	08:14:00 AM	5.48	146.24	0.14

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: CW-B-77

MEASURING POINT ELEVATION: 151.72

STATIC DEPTH TO WATER: 5.34

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/21/98	02:15:00 PM	5.49	146.23	0.15
08/21/98	08:15:30 PM	5.52	146.20	0.18
08/22/98	08:12:30 AM	5.54	146.18	0.20
08/22/98	02:11:30 PM	5.56	146.16	0.22
08/22/98	08:14:30 PM	5.57	146.15	0.23
08/23/98	08:10:00 AM	5.60	146.12	0.26
08/23/98	02:12:30 PM	5.60	146.12	0.26
08/23/98	08:13:00 PM	5.62	146.10	0.28
08/24/98	08:18:30 AM	5.64	146.08	0.30
08/24/98	03:19:30 PM	5.65	146.07	0.31
08/24/98	07:02:00 PM	5.66	146.06	0.32
08/25/98	07:58:00 AM	5.65	146.07	0.31

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO-2M

MEASURING POINT ELEVATION: 154.81

STATIC DEPTH TO WATER: 8.64

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	12:02 PM	8.64	146.17	0.00
08/17/98	07:34 PM	8.62	146.19	-0.02
08/17/98	10:25 PM	8.73	146.08	0.09
08/18/98	08:44 AM	8.79	146.02	0.15
08/18/98	04:26 PM	8.81	146.00	0.17
08/19/98	04:44 PM	8.74	146.07	0.10
08/20/98	04:44 PM	8.83	145.98	0.19
08/21/98	04:44 PM	8.90	145.91	0.26
08/22/98	04:44 PM	8.96	145.85	0.32
08/23/98	04:00 PM	9.00	145.81	0.36
08/24/98	07:25 PM	9.05	145.76	0.41
08/25/98	08:33 AM	8.87	145.94	0.23

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO-2D

MEASURING POINT ELEVATION: 154.29

STATIC DEPTH TO WATER: 8.02

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	12:04 PM	8.02	146.27	0.00
08/17/98	07:36 PM	8.02	146.27	0.00
08/17/98	10:24 PM	8.19	146.10	0.17
08/18/98	08:22 AM	8.24	146.05	0.22
08/18/98	04:25 PM	8.28	146.01	0.26
08/19/98	04:44 PM	8.28	146.01	0.26
08/20/90	04:44 PM	8.29	146.00	0.27
08/21/98	04:44 PM	8.35	145.94	0.33
08/22/98	04:44 PM	8.42	145.87	0.40
08/23/98	04:44 PM	8.46	145.83	0.44
08/24/98	07:25 PM	8.51	145.78	0.49
08/25/98	08:35 AM	8.27	146.02	0.25

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO-121S

MEASURING POINT ELEVATION: 152.14

STATIC DEPTH TO WATER: 5.95

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	07:53:20 PM	5.95	146.19	0.00
08/17/98	08:04:13 PM	5.95	146.19	0.00
08/17/98	08:11:00 PM	5.95	146.19	0.00
08/17/98	08:17:30 PM	5.96	146.18	0.01
08/17/98	08:26:00 PM	5.96	146.18	0.01
08/17/98	08:33:30 PM	5.96	146.18	0.01
08/17/98	08:42:45 PM	5.96	146.18	0.01
08/17/98	08:53:00 PM	5.96	146.18	0.01
08/17/98	09:00:30 PM	5.96	146.18	0.01
08/17/98	09:08:05 PM	5.96	146.18	0.01
08/17/98	09:14:45 PM	5.96	146.18	0.01
08/17/98	09:22:05 PM	5.96	146.18	0.01
08/17/98	09:28:24 PM	5.96	146.18	0.01
08/17/98	09:35:01 PM	5.96	146.18	0.01
08/17/98	09:41:50 PM	5.96	146.18	0.01
08/17/98	09:47:35 PM	5.96	146.18	0.01
08/17/98	09:53:43 PM	5.96	146.18	0.01
08/17/98	10:00:05 PM	5.96	146.18	0.01
08/17/98	10:40:30 PM	5.96	146.18	0.01
08/18/98	12:02:11 AM	5.96	146.18	0.01
08/18/98	04:33:10 AM	5.98	146.16	0.03
08/18/98	08:22:15 AM	5.97	146.17	0.02
08/18/98	12:09:30 PM	5.97	146.17	0.02
08/18/98	04:15:00 PM	5.98	146.16	0.03
08/18/98	08:16:07 PM	5.99	146.15	0.04
08/19/98	08:12:30 AM	5.97	146.17	0.02
08/19/98	02:11:00 PM	5.98	146.16	0.03
08/19/98	04:26:00 PM	5.98	146.16	0.03
08/19/98	08:12:30 PM	6.01	146.13	0.06
08/20/98	08:12:45 AM	6.01	146.13	0.06
08/20/98	02:09:30 PM	6.02	146.12	0.07

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO-121S

MEASURING POINT ELEVATION: 152.14

STATIC DEPTH TO WATER: 5.95

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/20/98	08:03:30 PM	6.04	146.10	0.09
08/21/98	08:09:30 AM	6.06	146.08	0.11
08/21/98	02:12:00 PM	6.08	146.06	0.13
08/21/98	06:14:24 AM	6.07	146.07	0.12
08/21/98	08:11:00 PM	6.09	146.05	0.14
08/22/98	08:08:00 AM	6.12	146.02	0.17
08/22/98	02:08:00 PM	6.13	146.01	0.18
08/22/98	04:26:00 PM	6.14	146.00	0.19
08/22/98	08:11:00 PM	6.15	145.99	0.20
08/23/98	08:07:00 AM	6.18	145.96	0.23
08/23/98	02:08:00 PM	6.19	145.95	0.24
08/23/98	04:26:00 PM	6.19	145.95	0.24
08/23/98	08:09:30 PM	6.20	145.94	0.25
08/24/98	08:15:00 AM	6.22	145.92	0.27
08/24/98	03:16:30 PM	6.24	145.90	0.29
08/24/98	07:18:00 PM	6.24	145.90	0.29
08/25/98	07:54:00 AM	6.25	145.89	0.30

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO-121B

MEASURING POINT ELEVATION: 153.05

STATIC DEPTH TO WATER: 6.16

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	07:54:30 PM	6.16	146.89	0.00
08/17/98	08:05:10 PM	6.28	146.77	0.12
08/17/98	08:12:15 PM	6.40	146.65	0.24
08/17/98	08:18:30 PM	6.46	146.59	0.30
08/17/98	08:27:30 PM	6.51	146.54	0.35
08/17/98	08:35:10 PM	6.54	146.51	0.38
08/17/98	08:43:45 PM	6.55	146.50	0.39
08/17/98	08:54:00 PM	6.58	146.47	0.42
08/17/98	09:01:30 PM	6.60	146.45	0.44
08/17/98	09:09:00 PM	6.62	146.43	0.46
08/17/98	09:16:02 PM	6.62	146.43	0.46
08/17/98	09:23:00 PM	6.63	146.42	0.47
08/17/98	09:29:30 PM	6.63	146.42	0.47
08/17/98	09:36:05 PM	6.64	146.41	0.48
08/17/98	09:42:55 PM	6.64	146.41	0.48
08/17/98	09:48:30 PM	6.65	146.40	0.49
08/17/98	09:54:30 PM	6.65	146.40	0.49
08/17/98	10:01:30 PM	6.66	146.39	0.50
08/17/98	10:44:00 PM	6.69	146.36	0.53
08/18/98	12:03:20 AM	6.72	146.33	0.56
08/18/98	04:34:49 AM	6.75	146.30	0.59
08/18/98	08:23:20 AM	6.78	146.27	0.62
08/18/98	12:10:40 PM	6.82	146.23	0.66
08/18/98	04:16:20 PM	6.84	146.21	0.68
08/18/98	08:16:39 PM	6.81	146.24	0.65
08/19/98	08:14:02 AM	6.79	146.26	0.63
08/19/98	02:12:00 PM	6.80	146.25	0.64
08/19/98	08:13:30 PM	6.84	146.21	0.68
08/20/98	08:14:00 AM	6.88	146.17	0.72
08/20/98	02:10:30 PM	6.88	146.17	0.72
08/20/98	08:04:30 PM	6.90	146.15	0.74

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO-121B

MEASURING POINT ELEVATION: 153.05

STATIC DEPTH TO WATER: 6.16

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/21/98	08:10:00 AM	6.93	146.12	0.77
08/21/98	12:12:30 PM	6.94	146.11	0.78
08/21/98	08:12:30 PM	6.97	146.08	0.81
08/22/98	08:08:30 AM	6.99	146.06	0.83
08/22/98	02:08:30 PM	7.00	146.05	0.84
08/22/98	08:11:30 AM	7.02	146.03	0.86
08/23/98	08:07:30 AM	7.05	146.00	0.89
08/23/98	02:08:30 PM	7.05	146.00	0.89
08/23/98	08:10:00 PM	7.06	145.99	0.90
08/24/98	08:15:30 AM	7.08	145.97	0.92
08/24/98	03:17:30 PM	7.09	145.96	0.93
08/24/98	07:01:00 PM	7.10	145.95	0.94
08/25/98	07:55:00 AM	6.46	146.59	0.30

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-121B

MEASURING POINT ELEVATION: 153.05

STATIC DEPTH TO WATER: 6.16

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	07:54:30 PM	6.16	146.89	0.00
08/17/98	08:05:10 PM	6.28	146.77	0.12
08/17/98	08:12:15 PM	6.40	146.65	0.24
08/17/98	08:18:30 PM	6.46	146.59	0.30
08/17/98	08:27:30 PM	6.51	146.54	0.35
08/17/98	08:35:10 PM	6.54	146.51	0.38
08/17/98	08:43:45 PM	6.55	146.50	0.39
08/17/98	08:54:00 PM	6.58	146.47	0.42
08/17/98	09:01:30 PM	6.60	146.45	0.44
08/17/98	09:09:00 PM	6.62	146.43	0.46
08/17/98	09:16:02 PM	6.62	146.43	0.46
08/17/98	09:23:00 PM	6.63	146.42	0.47
08/17/98	09:29:30 PM	6.63	146.42	0.47
08/17/98	09:36:05 PM	6.64	146.41	0.48
08/17/98	09:42:55 PM	6.64	146.41	0.48
08/17/98	09:48:30 PM	6.65	146.40	0.49
08/17/98	09:54:30 PM	6.65	146.40	0.49
08/17/98	10:01:30 PM	6.66	146.39	0.50
08/17/98	10:44:00 PM	6.69	146.36	0.53
08/18/98	12:03:20 AM	6.72	146.33	0.56
08/18/98	04:34:49 AM	6.75	146.30	0.59
08/18/98	08:23:20 AM	6.78	146.27	0.62
08/18/98	12:10:40 PM	6.82	146.23	0.66
08/18/98	04:16:20 PM	6.84	146.21	0.68
08/18/98	08:16:39 PM	6.81	146.24	0.65
08/19/98	08:14:02 AM	6.79	146.26	0.63
08/19/98	02:12:00 PM	6.80	146.25	0.64
08/19/98	08:13:30 PM	6.84	146.21	0.68
08/20/98	08:14:00 AM	6.88	146.17	0.72
08/20/98	02:10:30 PM	6.88	146.17	0.72
08/20/98	08:04:30 PM	6.90	146.15	0.74

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-121B

MEASURING POINT ELEVATION: 153.05

STATIC DEPTH TO WATER: 6.16

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/21/98	08:10:00 AM	6.93	146.12	0.77
08/21/98	12:12:30 PM	6.94	146.11	0.78
08/21/98	08:12:30 PM	6.97	146.08	0.81
08/22/98	08:08:30 AM	6.99	146.06	0.83
08/22/98	02:08:30 PM	7.00	146.05	0.84
08/22/98	08:11:30 AM	7.02	146.03	0.86
08/23/98	08:07:30 AM	7.05	146.00	0.89
08/23/98	02:08:30 PM	7.05	146.00	0.89
08/23/98	08:10:00 PM	7.06	145.99	0.90
08/24/98	08:15:30 AM	7.08	145.97	0.92
08/24/98	03:17:30 PM	7.09	145.96	0.93
08/24/98	07:01:00 PM	7.10	145.95	0.94
08/25/98	07:55:00 AM	6.46	146.59	0.30

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-202B

MEASURING POINT ELEVATION: 156.10

STATIC DEPTH TO WATER: 7.83

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	02:00 PM	7.83	148.27	0.00
08/17/98	05:54 PM	7.80	148.30	-0.03
08/17/98	10:49 PM	7.96	148.14	0.13
08/18/98	09:06 AM	7.89	148.21	0.06
08/18/98	04:33 PM	7.90	148.20	0.07
08/19/98	05:00 PM	7.83	148.27	0.00
08/20/98	05:00 PM	7.89	148.21	0.06
08/21/98	05:00 PM	7.94	148.16	0.11
08/22/98	05:00 PM	7.96	148.14	0.13
08/23/98	05:00 PM	8.00	148.10	0.17
08/24/98	07:37 PM	8.01	148.09	0.18
08/25/98	08:53 AM	8.00	148.10	0.17

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-203B

MEASURING POINT ELEVATION: 188.23

STATIC DEPTH TO WATER: 37.22

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	07:45 AM	37.22	151.01	0.00
08/17/98	06:02 PM	37.11	151.12	-0.11
08/17/98	10:55 PM	37.22	151.01	0.00
08/18/98	09:13 AM	37.30	150.93	0.08
08/18/98	04:37 PM	36.25	151.98	-0.97
08/19/98	05:13 PM	37.28	150.95	0.06
08/20/98	05:13 PM	37.32	150.91	0.10
08/21/98	05:13 PM	37.36	150.87	0.14
08/22/98	05:13 PM	37.39	150.84	0.17
08/23/98	05:13 PM	37.43	150.80	0.21
08/24/98	07:51 PM	37.53	150.70	0.31
08/25/98	07:09 PM	37.53	150.70	0.31

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO - 204S

MEASURING POINT ELEVATION: 151.16

STATIC DEPTH TO WATER: 5.33

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	07:55:00 PM	5.33	145.83	0.00
08/17/98	08:04:15 PM	5.33	145.83	0.00
08/17/98	08:09:20 PM	5.34	145.82	0.01
08/17/98	08:14:45 PM	5.34	145.82	0.01
08/17/98	08:21:30 PM	5.34	145.82	0.01
08/17/98	08:26:45 PM	5.34	145.82	0.01
08/17/98	08:32:49 PM	5.34	145.82	0.01
08/17/98	08:38:30 PM	5.34	145.82	0.01
08/17/98	08:44:21 PM	5.34	145.82	0.01
08/17/98	08:51:00 PM	5.34	145.82	0.01
08/17/98	08:56:32 PM	5.34	145.82	0.01
08/17/98	09:01:25 PM	5.34	145.82	0.01
08/17/98	09:06:40 PM	5.34	145.82	0.01
08/17/98	09:11:30 PM	5.34	145.82	0.01
08/17/98	09:16:25 PM	5.35	145.81	0.02
08/17/98	09:21:00 PM	5.35	145.81	0.02
08/17/98	09:25:43 PM	5.35	145.81	0.02
08/17/98	09:30:03 PM	5.35	145.81	0.02
08/17/98	09:35:10 PM	5.35	145.81	0.02
08/17/98	09:43:25 PM	5.35	145.81	0.02
08/17/98	09:48:13 PM	5.35	145.81	0.02
08/17/98	09:52:55 PM	5.35	145.81	0.02
08/17/98	09:58:23 PM	5.35	145.81	0.02
08/17/98	11:02:30 PM	5.35	145.81	0.02
08/18/98	12:12:30 AM	5.34	145.82	0.01
08/18/98	04:00:00 AM	5.30	145.86	-0.03
08/18/98	08:18:00 AM	5.39	145.77	0.06
08/18/98	12:09:00 PM	5.23	145.93	-0.10
08/18/98	04:03:30 PM	5.35	145.81	0.02
08/18/98	08:01:00 PM	5.10	146.06	-0.23
08/19/98	08:00:20 AM	4.93	146.23	-0.40

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO - 204S

MEASURING POINT ELEVATION: 151.16

STATIC DEPTH TO WATER: 5.33

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/19/98	02:02:08 PM	5.00	146.16	-0.33
08/19/98	08:02:30 PM	5.09	146.07	-0.24
08/20/98	08:02:15 AM	5.13	146.03	-0.20
08/20/98	02:01:00 PM	5.17	145.99	-0.16
08/20/98	07:56:00 PM	5.25	145.91	-0.08
08/21/98	08:01:30 AM	5.27	145.89	-0.06
08/21/98	02:02:00 PM	5.30	145.86	-0.03
08/21/98	08:00:30 PM	5.36	145.80	0.03
08/22/98	08:01:00 AM	5.38	145.78	0.05
08/22/98	02:00:30 PM	5.40	145.76	0.07
08/22/98	08:01:00 PM	5.45	145.71	0.12
08/23/98	07:59:45 AM	5.48	145.68	0.15
08/23/98	02:01:00 PM	5.48	145.68	0.15
08/23/98	08:01:00 PM	5.50	145.66	0.17
08/24/98	08:07:00 AM	5.51	145.65	0.18
08/24/98	03:07:00 PM	5.53	145.63	0.20
08/24/98	06:54:00 PM	5.55	145.61	0.22
08/25/98	07:44:00 AM	5.54	145.62	0.21

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO - 204M

MEASURING POINT ELEVATION: 151.16

STATIC DEPTH TO WATER: 4.60

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/18/98	07:58:00 PM	4.60	146.56	0.00
08/18/98	08:05:10 PM	4.64	146.52	0.04
08/18/98	08:10:15 PM	4.72	146.44	0.12
08/18/98	08:15:50 PM	4.80	146.36	0.20
08/18/98	08:22:30 PM	4.87	146.29	0.27
08/18/98	08:28:00 PM	4.88	146.28	0.28
08/18/98	08:33:49 PM	4.88	146.28	0.28
08/18/98	08:39:40 PM	4.98	146.18	0.38
08/18/98	08:45:30 PM	4.98	146.18	0.38
08/18/98	08:51:49 PM	4.98	146.18	0.38
08/18/98	08:57:16 PM	4.98	146.18	0.38
08/18/98	09:02:40 PM	4.99	146.17	0.39
08/18/98	09:07:00 PM	5.00	146.16	0.40
08/18/98	09:12:04 PM	5.00	146.16	0.40
08/18/98	09:16:47 PM	5.02	146.14	0.42
08/18/98	09:21:23 PM	5.02	146.14	0.42
08/18/98	09:26:07 PM	5.02	146.14	0.42
08/18/98	09:30:25 PM	5.02	146.14	0.42
08/18/98	09:35:55 PM	5.02	146.14	0.42
08/18/98	09:43:58 PM	5.03	146.13	0.43
08/18/98	09:48:52 PM	5.04	146.12	0.44
08/18/98	09:53:20 PM	5.04	146.12	0.44
08/18/98	09:58:57 PM	5.04	146.12	0.44
08/18/98	11:07:00 PM	5.08	146.08	0.48
08/18/98	12:10:00 AM	5.10	146.06	0.50
08/18/98	04:03:15 AM	5.11	146.05	0.51
08/18/98	08:17:00 AM	5.13	146.03	0.53
08/18/98	12:10:30 PM	5.16	146.00	0.56
08/18/98	04:01:10 PM	5.18	145.98	0.58
08/18/98	08:00:00 PM	5.12	146.04	0.52
08/19/98	08:00:00 AM	5.06	146.10	0.46

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: PZO - 204M

MEASURING POINT ELEVATION: 151.16

STATIC DEPTH TO WATER: 4.60

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/19/98	02:00:00 PM	5.08	146.08	0.48
08/19/98	08:00:30 PM	5.13	146.03	0.53
08/20/98	08:00:00 AM	5.17	145.99	0.57
08/20/98	02:00:30 PM	5.19	145.97	0.59
08/20/98	07:55:30 PM	5.20	145.96	0.60
08/21/98	08:00:00 AM	5.25	145.91	0.65
08/21/98	02:00:30 PM	5.26	145.90	0.66
08/21/98	07:59:00 PM	5.28	145.88	0.68
08/22/98	08:00:00 AM	5.31	145.85	0.71
08/22/98	01:59:00 PM	5.32	145.84	0.72
08/22/98	08:00:00 PM	5.34	145.82	0.74
08/23/98	07:59:00 AM	5.36	145.80	0.76
08/23/98	02:00:00 PM	5.38	145.78	0.78
08/23/98	08:00:00 PM	5.39	145.77	0.79
08/24/98	08:05:30 AM	5.39	145.77	0.79
08/24/98	03:07:30 PM	5.41	145.75	0.81
08/24/98	06:53:00 PM	5.44	145.72	0.84
08/25/98	07:42:00 AM	4.86	146.30	0.26

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW - 204B

MEASURING POINT ELEVATION: 150.63

STATIC DEPTH TO WATER: 3.72

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	07:56:08 PM	3.72	146.91	0.00
08/17/98	08:03:15 PM	4.14	146.49	0.42
08/17/98	08:08:30 PM	4.32	146.31	0.60
08/17/98	08:13:30 PM	4.38	146.25	0.66
08/17/98	08:25:55 PM	4.43	146.20	0.71
08/17/98	08:32:14 PM	4.46	146.17	0.74
08/17/98	08:37:40 PM	4.50	146.13	0.78
08/17/98	08:43:47 PM	4.50	146.13	0.78
08/17/98	08:50:16 PM	4.50	146.13	0.78
08/17/98	08:55:35 PM	4.52	146.11	0.80
08/17/98	09:00:00 PM	4.53	146.10	0.81
08/17/98	09:06:20 PM	4.54	146.09	0.82
08/17/98	09:11:11 PM	4.55	146.08	0.83
08/17/98	09:16:07 PM	4.56	146.07	0.84
08/17/98	09:20:40 PM	4.56	146.07	0.84
08/17/98	09:25:22 PM	4.56	146.07	0.84
08/17/98	09:29:48 PM	4.56	146.07	0.84
08/17/98	09:34:55 PM	4.57	146.06	0.85
08/17/98	09:43:00 PM	4.58	146.05	0.86
08/17/98	09:47:49 PM	4.59	146.04	0.87
08/17/98	09:52:38 PM	4.59	146.04	0.87
08/17/98	09:58:00 PM	4.60	146.03	0.88
08/17/98	11:05:00 PM	4.64	145.99	0.92
08/18/98	12:10:55 AM	4.65	145.98	0.93
08/18/98	04:12:23 AM	4.68	145.95	0.96
08/18/98	08:16:00 AM	4.70	145.93	0.98
08/18/98	12:08:30 PM	4.78	145.85	1.06
08/18/98	04:03:00 PM	4.75	145.88	1.03
08/18/98	08:00:30 PM	4.71	145.92	0.99
08/19/98	08:01:49 AM	4.68	145.95	0.96
08/19/98	02:00:30 PM	4.70	145.93	0.98

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-204B

MEASURING POINT ELEVATION: 150.63

STATIC DEPTH TO WATER: 3.72

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/20/98	08:00:30 AM	4.77	145.86	1.05
08/20/98	02:00:00 PM	4.78	145.85	1.06
08/20/98	07:55:45 PM	4.78	145.85	1.06
08/21/98	08:00:30 AM	4.84	145.79	1.12
08/21/98	02:01:00 PM	4.86	145.77	1.14
08/21/98	07:59:30 PM	4.88	145.75	1.16
08/22/98	08:00:30 AM	4.90	145.73	1.18
08/22/98	01:59:30 PM	4.91	145.72	1.19
08/22/98	08:00:30 PM	4.93	145.70	1.21
08/23/98	07:59:30 AM	4.95	145.68	1.23
08/23/98	02:00:30 PM	4.96	145.67	1.24
08/23/98	08:00:30 PM	4.97	145.66	1.25
08/24/98	08:06:00 AM	4.98	145.65	1.26
08/24/98	06:52:30 PM	5.01	145.62	1.29
08/25/98	07:43:00 AM	4.00	146.63	0.28

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-704S

MEASURING POINT ELEVATION: 152.69

STATIC DEPTH TO WATER: 6.29

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	05:58:30 PM	6.29	146.40	0.00
08/17/98	08:03:00 PM	6.26	146.43	-0.03
08/17/98	08:09:00 PM	6.26	146.43	-0.03
08/17/98	08:16:00 PM	6.27	146.42	-0.02
08/17/98	08:18:00 PM	6.29	146.40	0.00
08/17/98	08:22:00 PM	6.30	146.39	0.01
08/17/98	08:25:30 PM	6.29	146.40	0.00
08/17/98	08:30:00 PM	6.29	146.40	0.00
08/17/98	08:34:00 PM	6.30	146.39	0.01
08/17/98	08:37:30 PM	6.30	146.39	0.01
08/17/98	08:53:00 PM	6.30	146.39	0.01
08/17/98	09:09:30 PM	6.31	146.38	0.02
08/17/98	09:19:00 PM	6.31	146.38	0.02
08/17/98	09:24:30 PM	6.31	146.38	0.02
08/17/98	09:31:00 PM	6.33	146.36	0.04
08/17/98	09:44:30 PM	6.32	146.37	0.03
08/17/98	09:49:30 PM	6.32	146.37	0.03
08/17/98	09:57:30 PM	6.32	146.37	0.03
08/17/98	10:27:00 PM	6.33	146.36	0.04
08/17/98	11:15:00 PM	6.34	146.35	0.05
08/18/98	12:06:00 AM	6.35	146.34	0.06
08/18/98	04:27:00 AM	6.42	146.27	0.13
08/18/98	08:09:40 AM	6.39	146.30	0.10
08/18/98	12:14:45 PM	6.40	146.29	0.11
08/18/98	04:11:30 PM	6.42	146.27	0.13
08/18/98	08:09:47 PM	6.38	146.31	0.09
08/19/98	08:06:45 AM	6.36	146.33	0.07
08/19/98	02:07:15 PM	6.39	146.30	0.10
08/19/98	04:13:00 PM	6.45	146.24	0.16
08/19/98	08:07:30 PM	6.43	146.26	0.14
08/20/98	08:06:30 AM	6.45	146.24	0.16

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-704S

MEASURING POINT ELEVATION: 152.69

STATIC DEPTH TO WATER: 6.29

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/20/98	02:05:00 PM	6.47	146.22	0.18
08/20/98	07:58:00 PM	6.49	146.20	0.20
08/21/98	08:03:30 AM	6.52	146.17	0.23
08/21/98	02:04:00 PM	6.54	146.15	0.25
08/21/98	04:13:00 PM	6.56	146.13	0.27
08/21/98	08:02:00 PM	6.57	146.12	0.28
08/22/98	08:02:00 AM	6.59	146.10	0.30
08/22/98	02:02:00 PM	6.61	146.08	0.32
08/22/98	04:13:00 PM	6.61	146.08	0.32
08/22/98	08:04:00 PM	6.63	146.06	0.34
08/23/98	08:01:30 AM	6.66	146.03	0.37
08/23/98	02:03:00 PM	6.66	146.03	0.37
08/23/98	04:13:00 PM	6.68	146.01	0.39
08/23/98	08:04:00 PM	6.68	146.01	0.39
08/24/98	08:10:30 AM	6.70	145.99	0.41
08/24/98	03:09:00 PM	6.72	145.97	0.43
08/24/98	07:04:30 PM	6.73	145.96	0.44
08/25/98	07:46:00 AM	6.59	146.10	0.30

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-704M

MEASURING POINT ELEVATION: 152.55

STATIC DEPTH TO WATER: 5.91

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	05:57:00 PM	5.91	146.64	0.00
08/17/98	08:01:00 PM	6.29	146.26	0.38
08/17/98	08:05:20 PM	6.68	145.87	0.77
08/17/98	08:08:00 PM		152.55	-5.91
08/17/98	08:13:00 PM	6.84	145.71	0.93
08/17/98	08:17:30 PM	6.86	145.69	0.95
08/17/98	08:20:00 PM	6.90	145.65	0.99
08/17/98	08:24:30 PM	6.90	145.65	0.99
08/17/98	08:29:30 PM	6.92	145.63	1.01
08/17/98	08:33:00 PM	6.93	145.62	1.02
08/17/98	08:37:00 PM	6.94	145.61	1.03
08/17/98	08:43:30 PM	6.96	145.59	1.05
08/17/98	08:59:00 PM	6.99	145.56	1.08
08/17/98	09:08:30 PM	7.01	145.54	1.10
08/17/98	09:18:00 PM	7.02	145.53	1.11
08/17/98	09:23:00 PM	7.02	145.53	1.11
08/17/98	09:30:00 PM	7.03	145.52	1.12
08/17/98	09:43:30 PM	7.04	145.51	1.13
08/17/98	09:49:00 PM	7.05	145.50	1.14
08/17/98	09:56:00 PM	7.06	145.49	1.15
08/17/98	10:22:30 PM	7.07	145.48	1.16
08/17/98	11:13:00 PM	7.10	145.45	1.19
08/18/98	12:04:00 AM	7.11	145.44	1.20
08/18/98	04:25:00 AM	7.19	145.36	1.28
08/18/98	08:10:50 AM	7.17	145.38	1.26
08/18/98	12:14:00 PM	7.19	145.36	1.28
08/18/98	04:10:20 PM	7.21	145.34	1.30
08/18/98	08:09:11 PM	7.16	145.39	1.25
08/18/98	08:05:40 AM	7.14	145.41	1.23
08/18/98	02:06:45 PM	7.16	145.39	1.25
08/18/98	08:05:40 PM	7.19	145.36	1.28

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-704M

MEASURING POINT ELEVATION: 152.55

STATIC DEPTH TO WATER: 5.91

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/20/98	08:05:30 AM	7.22	145.33	1.31
08/20/98	02:03:30 PM	7.23	145.32	1.32
08/20/98	07:58:30 PM	7.25	145.30	1.34
08/21/98	08:04:00 AM	7.30	145.25	1.39
08/21/98	02:05:00 PM	7.31	145.24	1.40
08/21/98	08:02:30 PM	7.33	145.22	1.42
08/22/98	08:02:30 AM	7.35	145.20	1.44
08/22/98	02:02:30 PM	7.35	145.20	1.44
08/22/98	08:05:30 PM	7.37	145.18	1.46
08/23/98	08:02:00 AM	7.38	145.17	1.47
08/23/98	02:03:30 PM	7.40	145.15	1.49
08/23/98	08:04:30 PM	7.40	145.15	1.49
08/24/98	08:10:00 AM	7.42	145.13	1.51
08/24/98	03:09:30 PM	7.43	145.12	1.52
08/24/98	06:55:30 PM	7.45	145.10	1.54
08/25/98	07:47:00 AM	6.16	146.39	0.25

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-704D

MEASURING POINT ELEVATION: 153.37

STATIC DEPTH TO WATER: 6.74

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	05:55:00 PM	6.74	146.63	0.00
08/17/98	08:02:00 PM	7.21	146.16	0.47
08/17/98	08:06:20 PM	7.44	145.93	0.70
08/17/98	08:10:00 PM	7.51	145.86	0.77
08/17/98	08:15:00 PM	7.57	145.80	0.83
08/17/98	08:19:30 PM	7.60	145.77	0.86
08/17/98	08:22:30 PM	7.62	145.75	0.88
08/17/98	08:26:00 PM	7.63	145.74	0.89
08/17/98	08:31:00 PM	7.65	145.72	0.91
08/17/98	08:34:30 PM	6.66	146.71	-0.08
08/17/98	08:38:30 PM	6.67	146.70	-0.07
08/17/98	08:54:30 PM	7.68	145.69	0.94
08/17/98	09:03:00 PM	7.72	145.65	0.98
08/17/98	09:11:30 PM	7.73	145.64	0.99
08/17/98	09:20:30 PM	7.74	145.63	1.00
08/17/98	09:26:00 PM	7.74	145.63	1.00
08/17/98	09:32:00 PM	7.75	145.62	1.01
08/17/98	09:46:00 PM	7.76	145.61	1.02
08/17/98	09:51:30 PM	7.77	145.60	1.03
08/17/98	09:58:30 PM	7.78	145.59	1.04
08/17/98	10:28:30 PM	7.78	145.59	1.04
08/17/98	11:16:00 PM	7.81	145.56	1.07
08/18/98	12:07:00 AM	7.82	145.55	1.08
08/18/98	04:09:20 AM	7.91	145.46	1.17
08/18/98	08:12:00 AM	7.88	145.49	1.14
08/18/98	12:15:00 PM	7.90	145.47	1.16
08/18/98	04:12:40 PM	7.92	145.45	1.18
08/18/98	08:06:30 PM	7.88	145.49	1.14
08/19/98	08:08:00 AM	7.86	145.51	1.12
08/19/98	02:04:00 PM	7.88	145.49	1.14
08/19/98	08:08:45 PM	7.91	145.46	1.17

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-704D

MEASURING POINT ELEVATION: 153.37

STATIC DEPTH TO WATER: 6.74

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/20/98	08:07:45 AM	7.96	145.41	1.22
08/20/98	02:00:00 PM	7.96	145.41	1.22
08/20/98	07:59:00 PM	7.98	145.39	1.24
08/21/98	08:05:00 AM	8.02	145.35	1.28
08/21/98	02:07:00 PM	8.04	145.33	1.30
08/21/98	08:04:30 PM	8.05	145.32	1.31
08/22/98	08:03:00 AM	8.07	145.30	1.33
08/22/98	02:03:00 PM	8.07	145.30	1.33
08/22/98	08:06:00 PM	8.09	145.28	1.35
08/23/98	08:02:30 AM	8.12	145.25	1.38
08/23/98	02:04:00 PM	8.13	145.24	1.39
08/23/98	08:05:00 PM	8.13	145.24	1.39
08/24/98	08:11:00 AM	8.15	145.22	1.41
08/24/98	03:10:00 PM	8.17	145.20	1.43
08/24/98	06:56:00 PM	8.21	145.16	1.47
08/25/98	07:48:30 AM	6.98	146.39	0.24

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-710S

MEASURING POINT ELEVATION: 164.93

STATIC DEPTH TO WATER: 16.95

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	08:03 AM	16.95	147.98	0.00
08/18/98	09:21 AM	16.99	147.94	0.04
08/19/98	08:42 AM	16.85	148.08	-0.10
08/20/98	08:38 AM	16.95	147.98	0.00
08/20/98	05:22 PM	16.98	147.95	0.03
08/21/98	08:30 AM	17.02	147.91	0.07
08/22/98	07:44 AM	17.04	147.89	0.09
08/22/98	05:20 PM	17.05	147.88	0.10
08/23/98	07:38 AM	17.07	147.86	0.12
08/23/98	05:20:00 PM	17.08	147.85	0.13
08/24/98	08:43:30 AM	17.10	147.83	0.15

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-710R

MEASURING POINT ELEVATION: 164.58

STATIC DEPTH TO WATER: 17.36

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	08:02 AM	17.36	147.22	0.00
08/18/98	09:23 AM	17.37	147.21	0.01
08/19/98	08:44 AM	17.22	147.36	-0.14
08/20/98	08:37 AM	17.35	147.23	-0.01
08/21/98	08:28 AM	17.40	147.18	0.04
08/22/98	07:42 AM	17.45	147.13	0.09
08/23/98	07:37 AM	17.48	147.10	0.12
08/24/98	08:44:30 AM	17.50	147.08	0.14

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

MANUAL GROUND-WATER ELEVATION MONITORING DATA

WELL/PIEZOMETER: MW-710DR

MEASURING POINT ELEVATION: 164.99

STATIC DEPTH TO WATER: 17.66

Date	Time (Hr:Min:Sec)	Depth to Water	Ground-Water Elevation	Drawdown
08/17/98	08:00 AM	17.66	147.33	0.00
08/18/98	09:18 AM	17.65	147.34	-0.01
08/19/98	08:41 AM	17.60	147.39	-0.06
08/20/98	08:39 AM	17.61	147.38	-0.05
08/21/98	08:34 AM	17.65	147.34	-0.01
08/22/98	07:45:30 AM	17.67	147.32	0.01
08/23/98	07:40:00 AM	17.71	147.28	0.05
08/24/98	08:42:00 AM	17.74	147.25	0.08

Notes: **All measurements are in feet; elevations are referenced to the NGVD**

ATTACHMENT A – 9

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

SUMMARY OF 24-HOUR POTENTIOMETRIC CHANGES FOR EVALUATION OF STEADY-STATE CONDITIONS

Location	Date: Distance From RW-13 (ft)	08/19/98	08/20/98	08/21/98	08/22/98	08/23/98	08/24/98
MW-704S	15	0.03	-0.03	-0.08	-0.05	-0.07	-0.04
PZO-121S	185	0.00	-0.06	-0.03	-0.07	-0.03	-0.05
PZO-2M	250	-0.07	-0.09	-0.07	-0.06	-0.04	-0.05
PZO-2D	250	-0.08	-0.09	-0.06	-0.07	-0.04	-0.05
MW-202B	850	-0.07	-0.06	-0.05	-0.02	-0.04	-0.01
MW-203B	1700	1.03	-0.04	-0.04	-0.03	-0.04	-0.10

Notes:

1) All measurements are in feet

2) Data presented above indicate head change observed in the previous 24-hour period, ending at the date and time specified above, based on the manual data recorded at each location.

3) Measurements obtained between 16:13 and 17:13 on each of the dates indicated above.

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09-Sep-98

ATTACHMENT A – 10

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

PRECIPITATION AND BAROMETRIC PRESSURE MONITORING DATA

Date	Time	Rain Gauge Change (in.)	Barometer Reading (in., Hg)	Comments*
08/17/98	09:18:10 AM	0.00	30.10	slight drizzle, overcast, ~75, Humd, a bit foggy
08/17/98	10:49:00 AM	0.00	30.03	slight drizzle
08/17/98	05:51:30 PM	0.07	29.85	no rain
08/17/98	10:50:00 PM	0.03	29.84	light rain resumes
08/18/98	12:00:00 AM	0.10	29.83	harder rain
08/18/98	08:00:00 AM	0.03	29.84	clear to partly cloudy, ~68
08/18/98	12:18:30 PM	0.00	29.72	sunny, ~75
08/18/98	07:53:30 PM	0.75	29.79	raining
08/19/98	07:54:15 AM	0.10	30.05	cloudy, cool, slight breeze, ~65
08/19/98	02:56:15 PM	0.00	29.94	clear, slight breeze, ~73
08/19/98	07:58:15 PM	0.00	30.13	clear, ~70
08/20/98	07:55:20 AM	0.00	30.21	clear, ~60
08/20/98	01:56:30 PM	0.00	30.05	clear, ~73
08/20/98	07:49:44 PM	0.00	30.17	clear, ~67
08/21/98	07:57:44 AM	0.00	30.15	clear, ~61
08/21/98	02:18:30 PM	0.00	29.73	clear,sunny,~75
08/21/98	05:53:00 PM	0.00	30.03	clear,~63
08/22/98	07:56:30 AM	0.00	30.12	clear,~65
08/22/98	01:56:00 PM	0.00	29.65	clear, ~80
08/22/98	07:54:00 PM	0.00	29.96	clear, ~65
08/23/98	07:53:00 AM	0.00	29.97	hazy, humid,~70
08/23/98	01:59:00 PM	0.00	29.53	hazy, humid, ~75
08/23/98	07:58:00 PM	0.00	29.76	hazy, humid, ~70
08/24/98	08:03:30 AM	0.00	29.45	hazy, humid, ~70
08/24/98	03:04:00 PM	0.00	29.51	overcast, breezy, ~80
08/24/98	06:50:00 PM	0.00	29.57	cloudy, humid, ~75
08/25/98	08:00:00 AM	0.00	29.73	cloudy, humid, ~75

Notes: * Temperatures in degrees Fahrenheit.

ATTACHMENT A – 11

VOLATILE ANALYTICAL REPORT

Galson Laboratories

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 20-AUG-98
Date Sampled : 19-AUG-98

Matrix : Water
Method : SW846 8260
Units : UG/L

Galson ID: Client ID:	L45070-1 RW-13	L45070-2 TRIP BLANK	QCB082498-2 Method Blank
Vinyl Chloride	<1	<1	<1
Methylene Chloride	<4	<4	4.
Acetone	<10	<10	<10
1,1-Dichloroethene	<1	<1	<1
cis-1,2-Dichloroethene	8.	<2	<2
trans-1,2-Dichloroethene	<2	<2	<2
1,2-Dichloroethane	<1	<1	<1
2-Butanone	<10	<10	<10
1,1,1-Trichloroethane	<1	<1	<1
Trichloroethene	3.	<0.9	<0.9
1,1,2-Trichloroethane	<1	<1	<1
Benzene	3.	<0.2	<0.2
4-Methyl-2-Pentanone	<10	<10	<10
Tetrachloroethene	<0.8	<0.8	<0.8
Toluene	<1	<1	<1
Ethylbenzene	<1	<1	<1
Styrene	<5	<5	<5
Xylene (Total)	<5	<5	<5
Tetrahydrofuran	7.	<5	<5
Dilution Factor	1	1	1
Analysis Date	08/24/98	08/24/98	08/24/98

(DAY 2)

Approved by : CMR
Date : 14-SEP-98
QC by :
Date : 9/14/98
NYS DOH # : 11626
Footnotes:

Galson
Laboratories

GC/FID ANALYTICAL REPORT

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 20-AUG-98
Date Sampled : 19-AUG-98
Date Extracted: NA

Matrix : Water
Method : SW846 8015
Units : mg/L

Galson ID: Client ID:	L45070-1 RW-13	QC5082598-1 Method Blank
Methanol	<1	<1
Ethanol	<1	<1
Isopropanol	<1	<1
sec-Butanol	<1	<1
Analysis Date	08/25/98	08/25/98
Dilution Factor	1	1

Approved by : Oommen Kappil
Date : 10-SEP-98
QC by :
Date : 9/14/98
NYS DOH # : 11626
Footnotes:

METALS ANALYTICAL REPORT

Galson
Laboratories

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 20-AUG-98
Date Sampled : 19-AUG-98

Matrix : Water
Method : SW846 6010B

Galson ID: Client ID:	Units	L45070-1 RW-13	QM980824-1 BLANK
Copper	mg/l	<0.01	<0.01
Iron	mg/l	<0.1	<0.1
Lead	mg/l	0.0081	<0.003
Nickel	mg/l	<0.02	<0.02
Zinc	mg/l	0.070	<0.01

pH (field msmt)
6.5

Approved by : Lisa Kovach
Date : 24-AUG-98
QC by :
Date : 9/14/98
NYS DOH # : 11626
Footnotes:

Galson Laboratories

INORGANIC ANALYTICAL REPORT

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 20-AUG-98
Date Sampled : 19-AUG-98

Matrix : Water

Galson ID: L45070-1
Client ID: RW-13

	Method	Units	L45070-1 RW-13
T. Suspended Solids	EPA 160.2	mg/L	6

Approved by : Mary Withrow
Date : 27-AUG-98
QC by :
Date : 9/14/98
NYS DOH # : 11626
Footnotes:

WATER VOLATILE SURROGATE RECOVERY

Client : Blasland, Bouck & Lee

Login # : L45070

SAMPLE NO.	SMC1 (DCE) #	SMC2 (TOL) #	SMC3 (BFB) #	OTHER	TOT OUT
TRIP BLANK	103	90	99	BB0824	0
RW-13	108	91	98	BB0824	0
Method Blank-QCB082498-2	105	100	91	BB0824	0

		QC LIMITS
SMC1 (DCE)	= 1,2-Dichloroethane-d4	(58-134)
SMC2 (TOL)	= Toluene-d8	(74-123)
SMC3 (BFB)	= Bromofluorobenzene	(72-118)

\# Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate diluted out

GALSON LABORATORIES
6601 Kirkville Road East
E. Syracuse, NY 13057
315-432-0506
800-950-0506

Company Name: BBL

Project Name / Number: SRSNE

Turn-Around Time
- Standard Service
[ ] - * Rush Service

Date requested by:
Ph # (315)-446-9120
Fax # (315)-449-2353

Page 1 of 1

Send Report to:
Mike Gefell
Blasland Bouck & Lee
6723 Towpath Rd
Syracuse NY 13214

Send Invoice to:
Mike Gefell
BBL

P.O. #

Chain of Custody Record

Laboratory ID Number

Blasland, Bouck & Lee [illegible]

Blasland, Bouck & Lee [illegible]

PARAMETERS FOR ANALYSIS

SAMPLE ID	Date	Time	TYPE Comp.	TYPE Grab	Aqueous	Soil	Other	VOCs EPA method 624	EPA method 8015 Sw 846	Sw 846 method 6010	EPA method 160.2
RW-13 (40 HR)	8/19	1115			X			3	3	1	1
TRIP BLANK	8/18	~~1115~~ 1500			X			3			

Total Containers - [illegible]

REMARKS: SAMPLE CHILLED ON ICE TO ≤ 4°C
Method 6010 FOR TOTAL Cu, Fe, Pb, Ni, Zn
Method 8015 FOR ETHANOL, METHANOL, 2-Butanol and 2 Propanol
INCLUDE Benzene in method 624 SCAN → see attached lists w/ reporting limits

SAMPLER'S NAME: BRIAN LOOMIS SIGNATURE: B L

SAMPLES RELINQUISHED BY:

NAME: Brian Loomis DATE: 8/19/98
SIGNATURE: B L TIME: 1230
NAME: DATE:
SIGNATURE: TIME:
NAME: DATE:
SIGNATURE: TIME:

SAMPLES RECEIVED BY:

NAME: DATE:
SIGNATURE: TIME:
Received For Laboratory By: (Signature) TK DATE: 8-20-98 TIME: 1020
Received For Laboratory By: (Signature) DATE: TIME:

VOC Pres U P AU NA

Custody Seal Intact? ☒ Yes ☐ No ☐ N.A.
Shipment Complete? [✓ Yes] No

Temp 7 °C TS TB IM TG

Airbill # 805904715040

VOLATILE ANALYTICAL REPORT

Galson Laboratories

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 25-AUG-98
Date Sampled : 23-AUG-98 - 24-AUG-98

Matrix : Water
Method : SW846 8260
Units : UG/L

Galson ID: Client ID:	L45158-1 RW-13 (DAY 6)	L45158-2 RW-13 (FINAL)	L45158-3 TRIP BLANK
Vinyl Chloride	<1	<1	<1
Methylene Chloride	<4	<4	<4
Acetone	<10	<10	<10
1,1-Dichloroethene	<1	<1	<1
cis-1,2-Dichloroethene	8.	8.	<2
trans-1,2-Dichloroethene	<2	<2	<2
1,2-Dichloroethane	<1	<1	<1
2-Butanone	<10	<10	<10
1,1,1-Trichloroethane	<1	<1	<1
Trichloroethene	4.	4.	<0.9
1,1,2-Trichloroethane	<1	<1	<1
Benzene	6.	6.	<0.2
4-Methyl-2-Pentanone	<10	<10	<10
Tetrachloroethene	<0.8	<0.8	<0.8
Toluene	<1	<1	<1
Ethylbenzene	<1	<1	<1
Styrene	<5	<5	<5
Xylene (Total)	<5	<5	<5
Tetrahydrofuran	46.	62.	<5
Dilution Factor	1	1	1
Analysis Date	08/25/98	08/25/98	08/25/98

Approved by : CMR
Date : 14-SEP-98
QC by :
Date : 9/17/98
NYS DOH # : 11626
Footnotes:

Galson Laboratories

VOLATILE ANALYTICAL REPORT

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 25-AUG-98
Date Sampled : 23-AUG-98 - 24-AUG-98

Matrix : Water
Method : SW846 8260
Units : UG/L

Galson ID:	QCB082598-1
Client ID:	Method Blank
Vinyl Chloride	<1
Methylene Chloride	<4
Acetone	<10
1,1-Dichloroethene	<1
cis-1,2-Dichloroethene	<2
trans-1,2-Dichloroethene	<2
1,2-Dichloroethane	<1
2-Butanone	<10
1,1,1-Trichloroethane	<1
Trichloroethene	<0.9
1,1,2-Trichloroethane	<1
Benzene	<0.2
4-Methyl-2-Pentanone	<10
Tetrachloroethene	<0.8
Toluene	<1
Ethylbenzene	<1
Styrene	<5
Xylene (Total)	<5
Tetrahydrofuran	<5
Dilution Factor	1
Analysis Date	08/25/98

Approved by : CMR
Date : 14-SEP-98
QC by :
Date : 9/17/98
NYS DOH # : 11626
Footnotes:

GC/FID ANALYTICAL REPORT

Galson
Laboratories

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 25-AUG-98
Date Sampled : 23-AUG-98 - 24-AUG-98
Date Extracted: NA

Matrix : Water
Method : SW846 8015
Units : mg/L

Galson ID: Client ID:	L45158-1 RW-13 (DAY 6)	L45158-2 RW-13 (FINAL)	QC5091698-1 Method Blank
Methanol	<1	<1	<1
Ethyl Alcohol	<1	<1	<1
sec-Butanol	<1	<1	<1
Isopropanol	<1	<1	<1
Analysis Date	09/16/98	09/16/98	09/16/98
Dilution Factor	1	1	1

Approved by : Oommen Kappil
Date : 17-SEP-98
QC by :
Date : 9/17/98
NYS DOH # : 11626
Footnotes:

Galson Laboratories

METALS ANALYTICAL REPORT

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 25-AUG-98
Date Sampled : 23-AUG-98 - 24-AUG-98

Matrix : Water
Method : SW846 6010B

Galson ID: Client ID:	Units	L45158-1 RW-13 (DAY 6)	L45158-2 RW-13 (FINAL)	QM980827-1 BLANK
Copper	mg/l	<0.01	<0.01	<0.01
Iron	mg/l	<0.1	0.11	<0.1
Lead	mg/l	<0.003	<0.003	<0.003
Nickel	mg/l	<0.02	<0.02	<0.02
Zinc	mg/l	0.075	0.077	<0.01
pH (Field msmt)		5.7	5.7	

Approved by : Lisa Kovach
Date : 27-AUG-98
QC by :
Date : 9/17/98
NYS DOH # : 11626
Footnotes:

INORGANIC ANALYTICAL REPORT

Galson Laboratories

Client : Blasland, Bouck & Lee
Account # : 10624
Site : SRSNE

Date Received : 25-AUG-98
Date Sampled : 23-AUG-98 - 24-AUG-98

Matrix : Water

Galson ID: Client ID:	Method	Units	L45158-1 RW-13 (DAY 6)	L45158-2 RW-13 (FINAL)
T. Suspended Solids	EPA 160.2	mg/L	9	<4

Approved by : Mary Withrow
Date : 27-AUG-98
QC by :
Date : 9/17/98
NYS DOH # : 11626
Footnotes:

WATER VOLATILE SURROGATE RECOVERY

Client : Blasland, Bouck & Lee

Login # : L45158

SAMPLE NO.	SMC1 (DCE)#	SMC2 (TOL)#	SMC3 (BFB)#	OTHER	TOT OUT
Method Blank-QCB082598-1	76	116	90	BB0825	0
TRIP BLANK	104	95	89	BB0825	0
RW-13 (DAY 6)	106	97	92	BB0825	0
RW-13 (FINAL)	107	102	91	BB0825	0

		QC LIMITS
SMC1 (DCE)	= 1,2-Dichloroethane-d4	(58-134)
SMC2 (TOL)	= Toluene-d8	(74-123)
SMC3 (BFB)	= Bromofluorobenzene	(72-118)

\# Column to be used to flag recovery values
* Values outside of QC limits
D Surrogate diluted out

GALSON LABORATORIES
6601 Kirkville Road East
E. Syracuse, NY 13057
315-432-0506
800-950-0506

Company Name: BBL

Project Name / Number: SRSNE

Turn-Around Time
☒ - Standard Service
☐ - * Rush Service
Date requested by:
Ph # (315) - 446 - 9120
Fax # (315) - 449 - 8353

Page 1 of 1

Send Report to:
MIKE GAFELL
BLASLAND BOUCK & LEE
6723 TOWPATH
SYRACUSE NY 13214

Send Invoice to:
MIKE GAFELL
6723 TOWPATH
SYRACUSE NY 13214
P.O. # 60831 012

Chain of Custody Record

SAMPLE ID	Date	Time	TYPE Comp.	TYPE Grab	Aqueous	Soil	Other	Laboratory ID Number	EPA METHOD 624	SW-846 Method 8015	SW-846 Method 6010	EPA Method 160.2
RW-13 (DAY 6)	8/23/98	1145			X			L, Bouck & Lee [illegible] Water RW 13 (DAY 6)	3	3	1	1
RW-13 (FINAL)	8/24/98	1545			X			Bouck & Lee [illegible] Water RW 13 (FINAL)	3	3	1	1
* TRIP BLANK					X			Blasland, Bouck & Lee [illegible] [illegible] Water TRIP BLANK				
* receive 6 trip	BlANKS				TK							

Total Containers -

REMARKS: SAMPLES CHILLED ON ICE TO ≤ 4°C
METHOD 6010 FOR TOTAL Cu, Fe, Pb, Ni, Zn
METHOD 8015 FOR ETHANOL, METHANOL, 2-Butanol, & 2-Propanol
INCLUDE BENZENE IN METHOD 624 SCAN → SEE ATTACHED LISTS W/ REPORTING LIMITS
624 will be analyzed by 8260 per Galson quote to M. Cefelli BAW 8/24

SAMPLER'S NAME: BRIAN LOOMIS
SIGNATURE:

SAMPLES RELINQUISHED BY:

NAME: BRIAN LOOMIS DATE: 8/24/98
SIGNATURE: TIME: 1630
NAME: DATE:
SIGNATURE: TIME:
NAME: DATE:
SIGNATURE: TIME:

SAMPLES RECEIVED BY:

NAME: DATE:
SIGNATURE: TIME:
Received For Laboratory By: *(Signature)* DATE: TIME:
Received For Laboratory By: *(Signature)* DATE: 8-25-98 TIME: 1025

VOC Pres U P AU NA
Custody Seal Intact? ☐ Yes ☐ No ☐ N.A.
Shipment Complete? ☐ Yes ☐ No
Temp 4 °C TS TB TM TG
Airbill # FEDEX 805904 715039

ATTACHMENT A – 12

SRSNE SITE
SOUTHINGTON, CONNECTICUT
OVERBURDEN PUMPING TEST -- PUMPING WELL RW-13

SUMMARY OF CONSTANT-RATE TEST RESULTS -- DRAWDOWN CURVE ANALYSIS

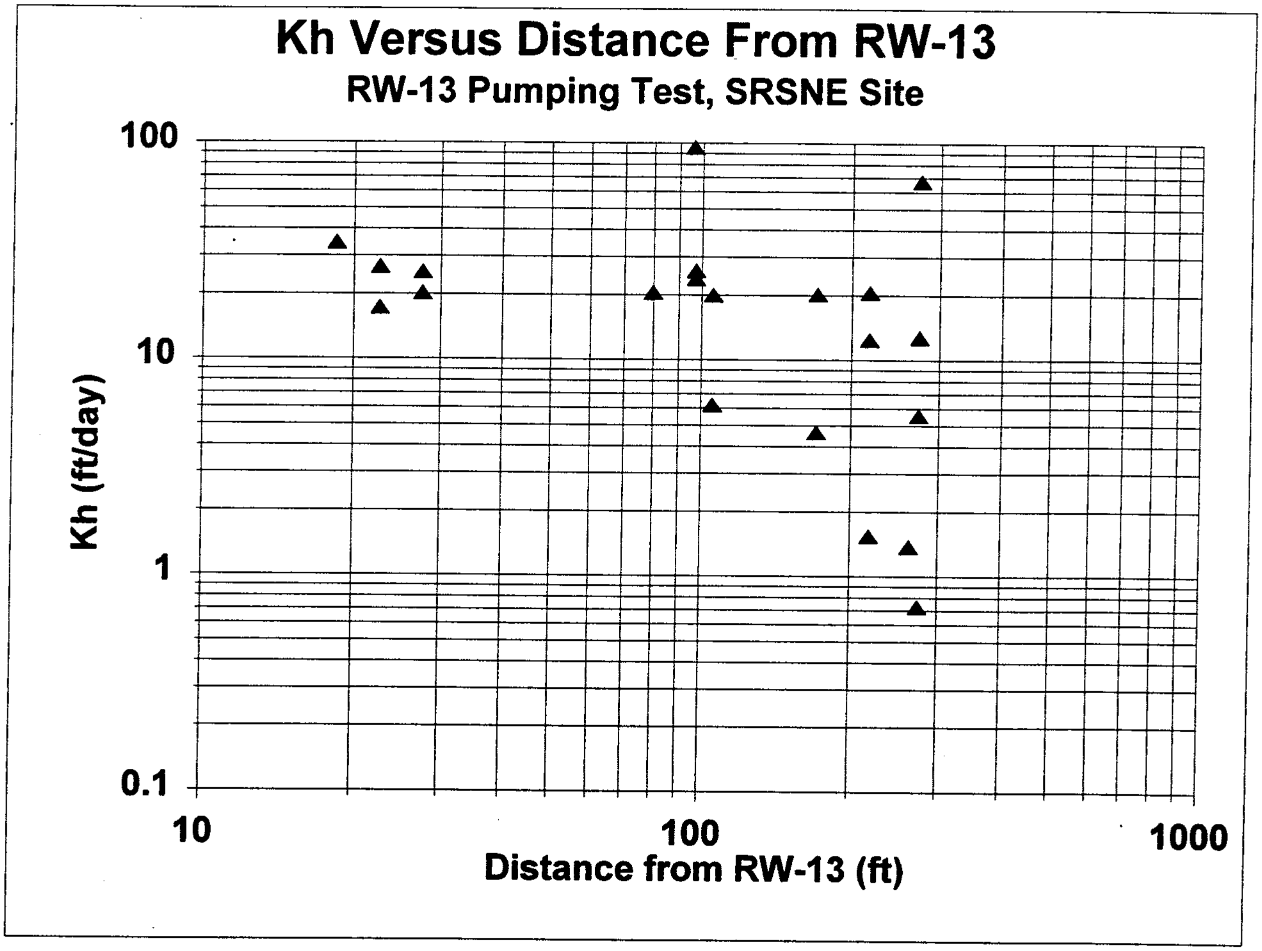
Well	Analysis	r [ft]	T [ft^2/min]	Avg. T* [ft^2/min]	Avg. K* [ft/d]	S	Sy	Beta	Kv/Kh	Kh/Kv
CW-2-75	Theis	170.7	1.046	1.046	20.0832		0.3856			
CW-2-75	Neuman	170.7	0.2414	0.2414	4.63488	0.001271	0.2912	7	1.4E+00	7.4E-01
CW-B-77	Theis	273.3	0.6648	0.6648	12.76416		0.1176			
CW-B-77	Neuman	273.3	0.2888	0.2888	5.54496	0.003514	0.1324	7	5.3E-01	1.9E+00
PZO-121S	Neuman	218.3	0.08	0.08	1.536	0.024	0.2	0.1	1.2E-02	8.5E+01
MW-121B	Theis	217.1	1.068	1.068	20.5056	0.000609				
MW-121B	Theis	217.1	1.068				0.01123			
MW-121B	Neuman	217.1	0.6467	0.6467	12.41664	0.00057	0.03813	0.4	4.8E-02	2.1E+01
PZO-204S	Neuman	96.3	5	5	96	0.02	0.3	0.04	2.4E-02	4.1E+01
PZO-204M	Theis	105.5	1.057	1.0375	19.92	0.002929				
PZO-204M	Theis	105.5	1.018				0.126			
PZO-204M	Neuman	105.5	0.3217	0.3217	6.17664	0.001306	0.4064	1	5.1E-01	2.0E+00
MW-204B	Theis	97.5	1.679	1.3405	25.7376	0.000233				
MW-204B	Theis	97.5	1.002				0.04517			
MW-204B	Neuman	97.5	1.232	1.232	23.6544	0.000384	0.01532	0.06	3.6E-02	2.8E+01
MW-704S	Neuman	18.5	1.8	1.8	34.56	0.02	0.3	0.01	1.6E-01	6.1E+00
MW-704M	Theis	27.6	1.315	1.315	25.248	0.001721				
MW-704M	Theis	27.6	1.315				0.03409			
MW-704M	Neuman	27.6	1.056	1.056	20.2752	0.002258	0.1128	0.01	7.4E-02	1.4E+01
MW-704D	Theis	22.7	1.391	1.391	26.7072	0.009311				
MW-704D	Theis	22.7	1.391				0.4159			
MW-704D	Neuman	22.7	0.9003	0.9003	17.28576	0.009669	0.6413	0.06	6.5E-01	1.5E+00
PZO-2M	Theis	274.5	6.278	3.50345	67.26624	0.001607				
PZO-2M	Theis	274.5	0.7289				0.06812			
PZO-2M	Neuman	274.5	0.0378	0.0378	0.72576	0.000429	0.1105	7	5.2E-01	1.9E+00
PZO-2D	Neuman	262.5	0.0715	0.0715	1.3728	0.000792	0.1619	5	4.1E-01	2.5E+00
PZO-6SN	Neuman	80.1	1.065	1.065	20.448	0.006491	0.866	2	1.8E+00	5.7E-01
Geometric Mean				**0.67**	**13**					**5.2**
Arithmetic Mean						**0.0041**	**0.18**		**0.23**	**7.6**

Notes: * -- Average transmissivity (T) values calculated when more than one Theis analysis performed for one data set. Two Theis curves indicate estimate curve associated with early (S) response and late (Sy) response, respectively. Same with hydraulic conductivity (K = T/H, where H is the intitial saturated thickness of the aquifer, approximately 75 feet).

Arithmetic mean K for MW-704 cluster (MW-704S, MW-704M, and MW-704D), located adjacent to overburden pumping well RW-13, is 25 ft/day. Arithmetic mean K estimate based on specific capacity tests at the MW-704 cluster was 27 ft/day (BBL, June 1998).

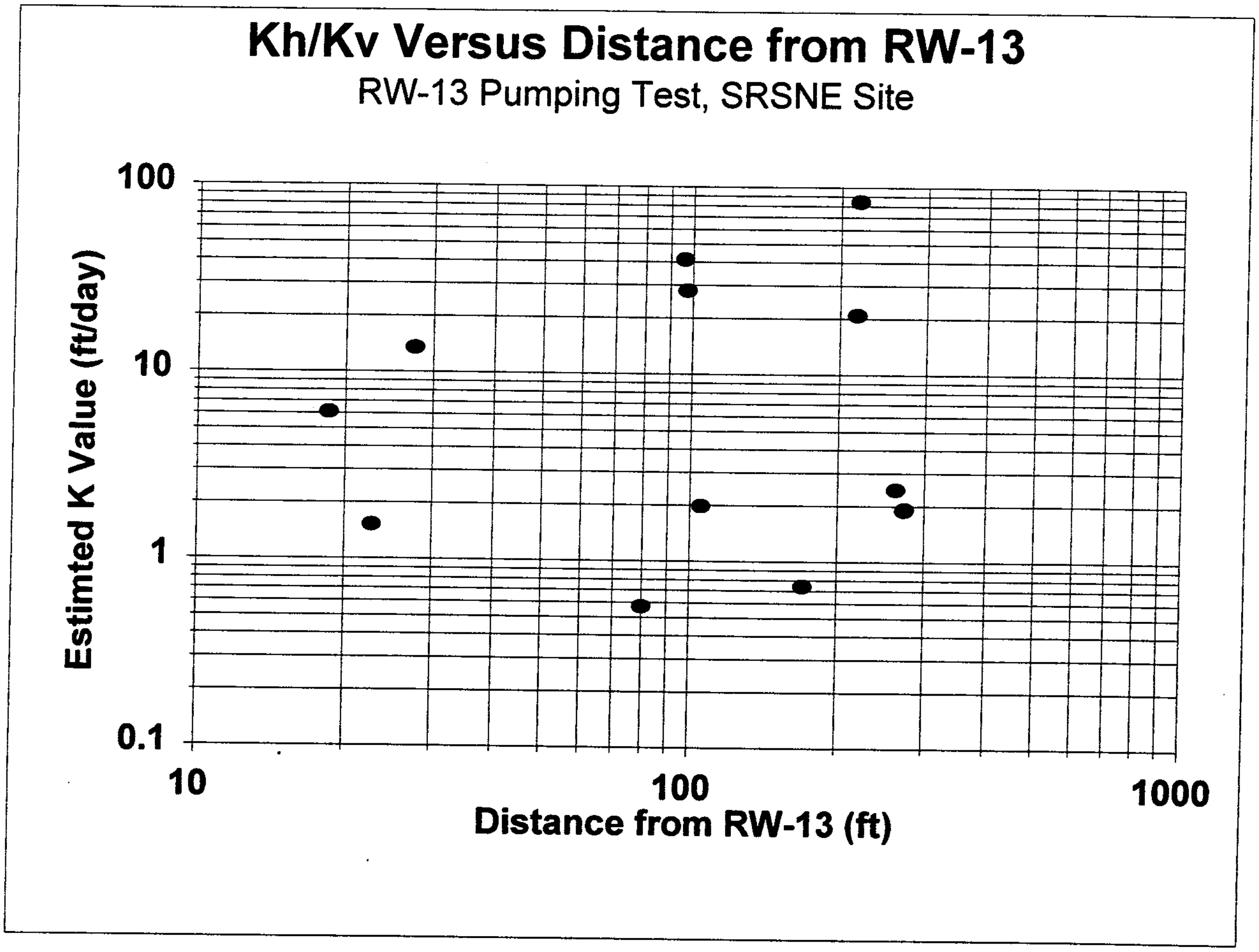
References: Neuman, S.P., 1975, Analysis of pumping test data from anisotropic unconfined aquifers considering delayed gravity response. Water Resources Research, Vol. 11, pp. 329 - 342.

Theis, C.V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. Transcripts of the American Geophysical Union, Vol. 16, pp. 519-524.



Kh Versus Distance From RW-13

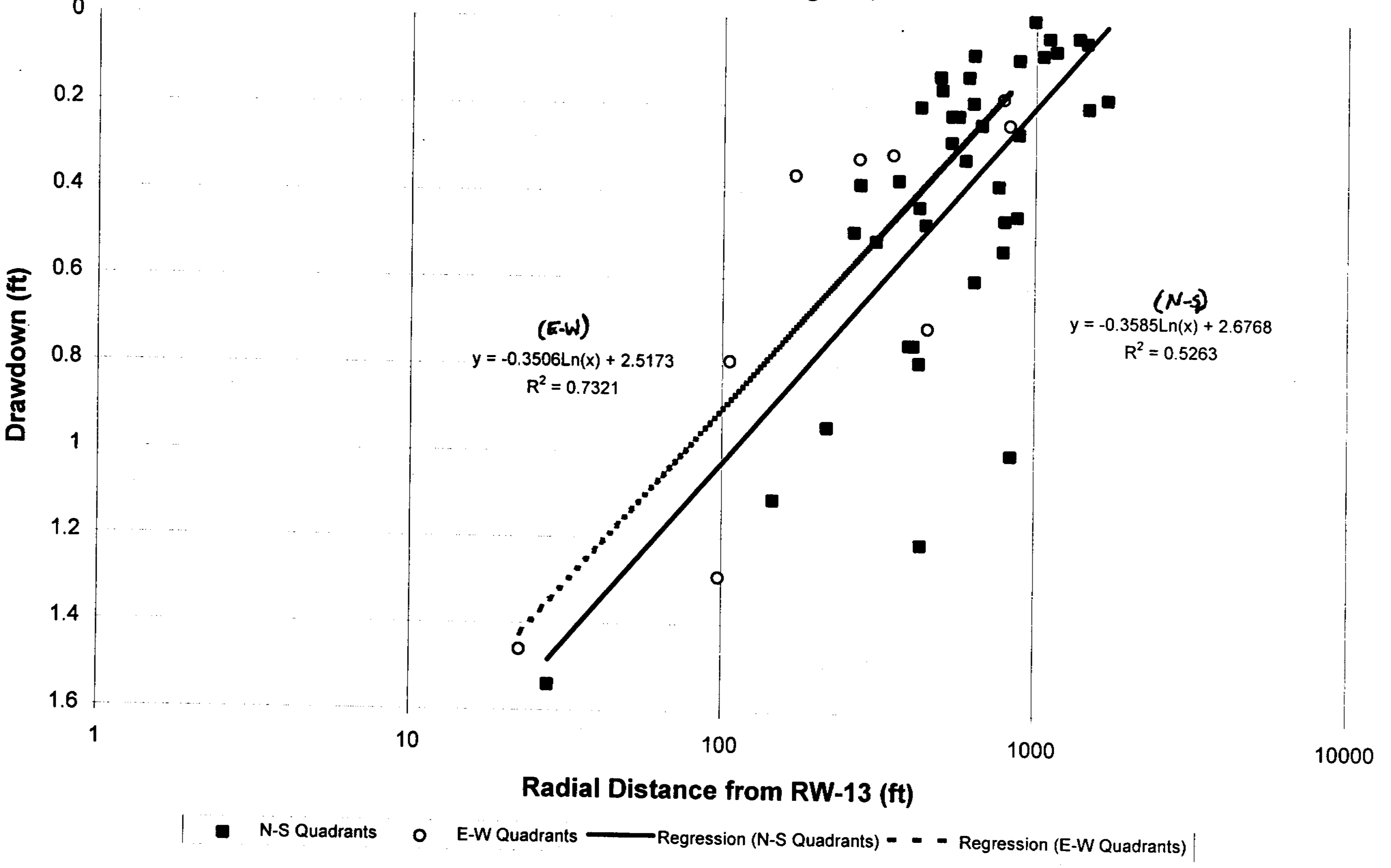
RW-13 Pumping Test, SRSNE Site



Kh/Kv Versus Distance from RW-13

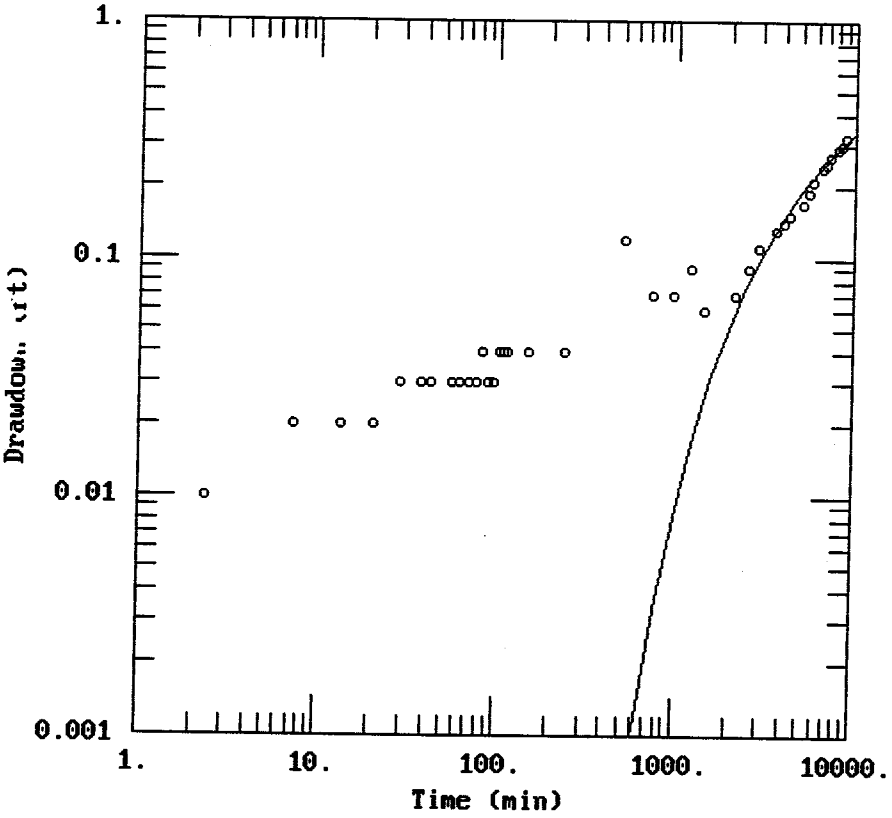
RW-13 Pumping Test, SRSNE Site

Distance - Drawdown Plot, Middle & Deep Overburden Locations
Well RW-13 Pumping Test
SRSNE Site -- Southington, CT



CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
CW-2-75T.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: CW-2-75

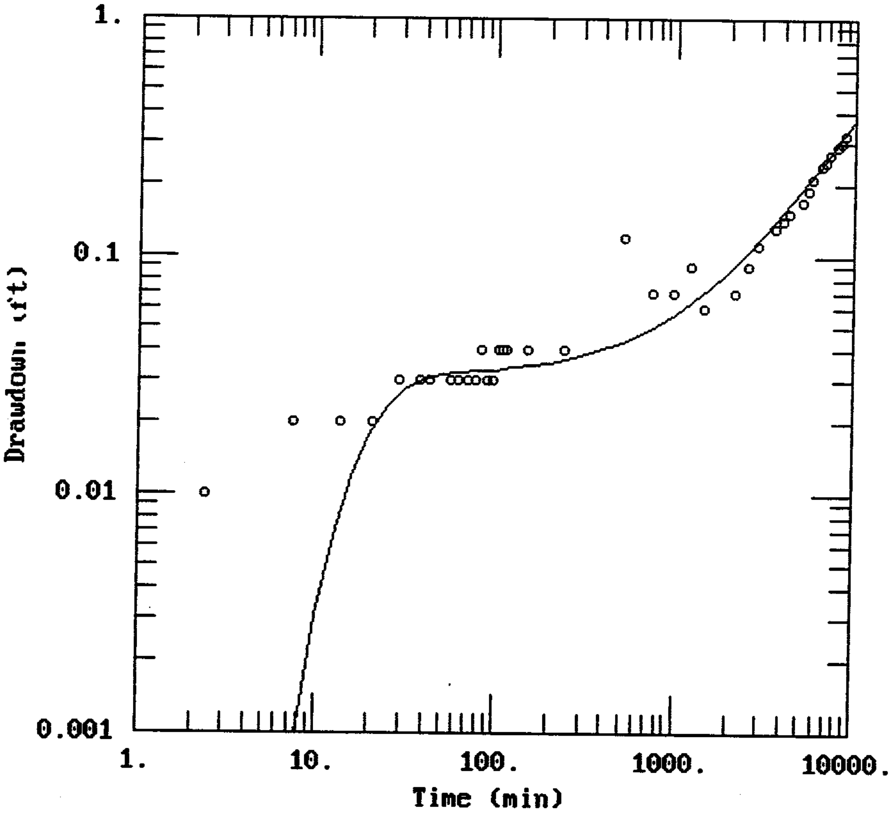
TEST DATA:
$Q = 3.\ ft^3/min$
$r = 170.7\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot. = 74.98 ft
Piezometer Depth:
setting = 60. ft

PARAMETER ESTIMATES:
$T = 1.046\ ft^2/min$
$S = 0.3856$

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
CW-2-75N.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: CW-2-75

TEST DATA:
$Q = 3.\ ft^3/min$
$r = 170.7\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 60. ft

PARAMETER ESTIMATES:
$T = 0.2414\ ft^2/min$
$S = 0.001271$
$Sy = 0.2912$
$\beta = 7.$

AQTESOLV

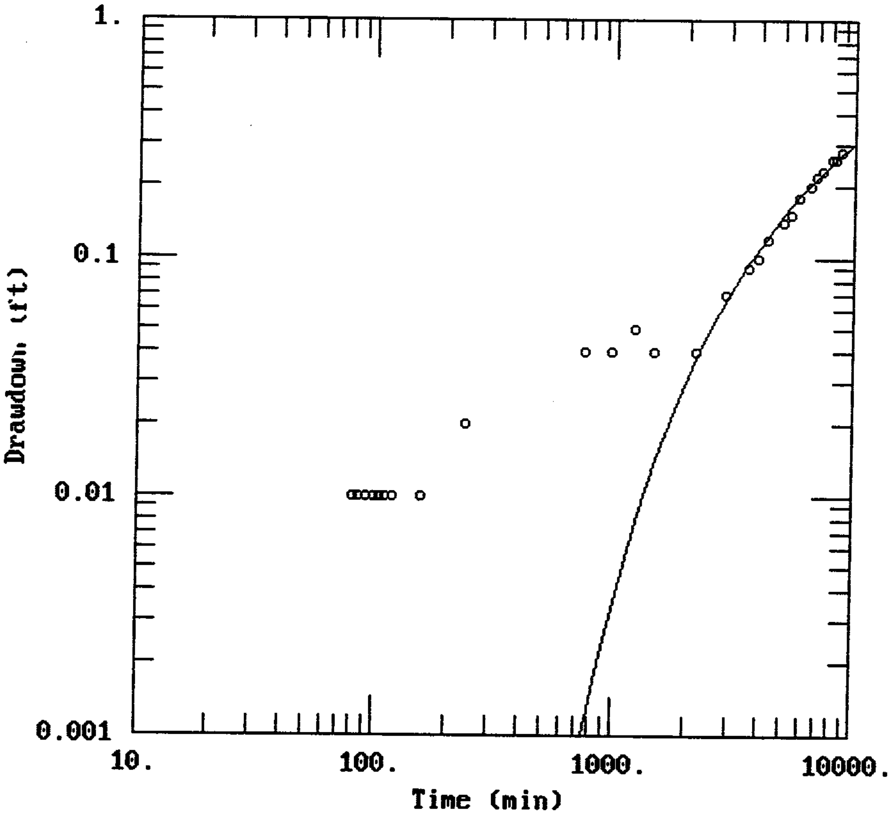
CLIENT: SRSNE

COMPANY: BBL, Inc.

LOCATION: SRSNE Site, CT

PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
CW-B-77T.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: CW-B-77

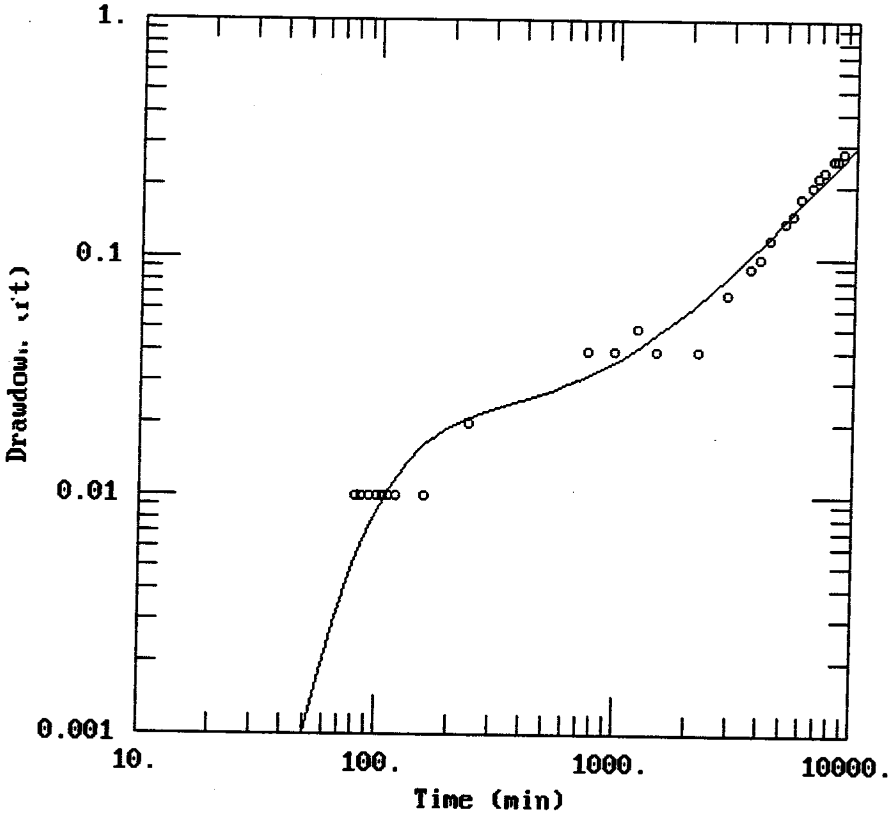
TEST DATA:
Q = 3. ft^3/min
r = 273.3 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 38.9 ft

PARAMETER ESTIMATES:
T = 0.6648 ft^2/min
S = 0.1176

AQTESOLV

CLIENT: SRSNE	**COMPANY:** BBL, Inc.
LOCATION: SRSNE Site, CT	**PROJECT:** 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
CW-B-77N.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: CW-B-77

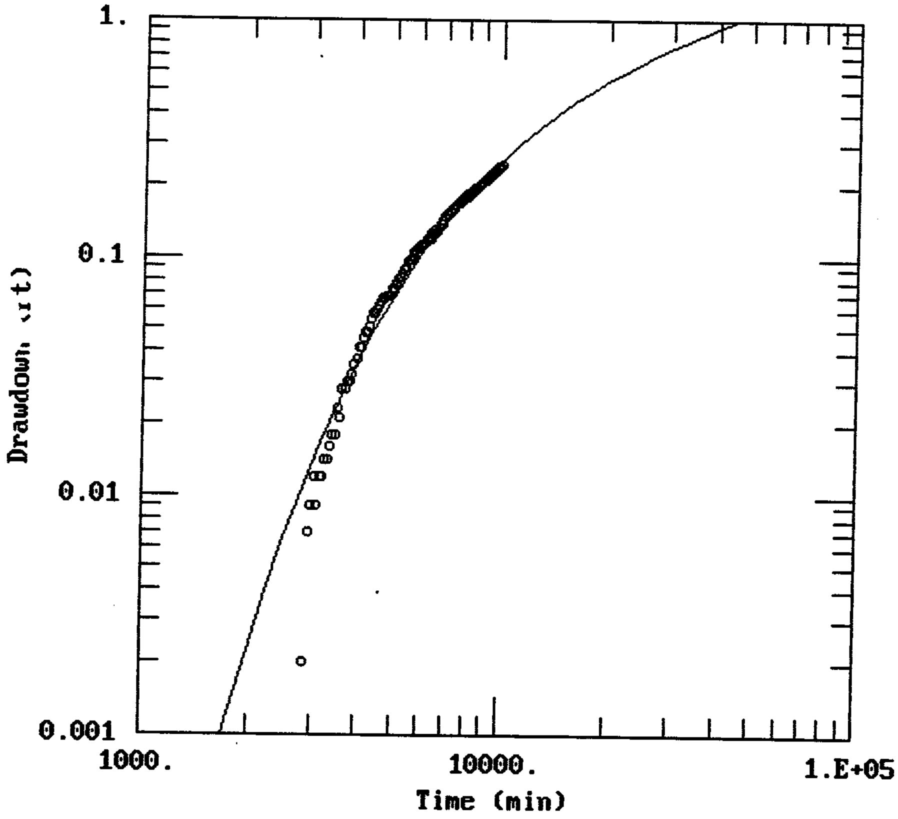
TEST DATA:
Q = 3. ft^3/min
r = 273.3 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 38.9 ft

PARAMETER ESTIMATES:
T = 0.2888 ft^2/min
S = 0.003514
Sy = 0.1324
ß = 7.

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
PZO-121S.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: PZO-121S

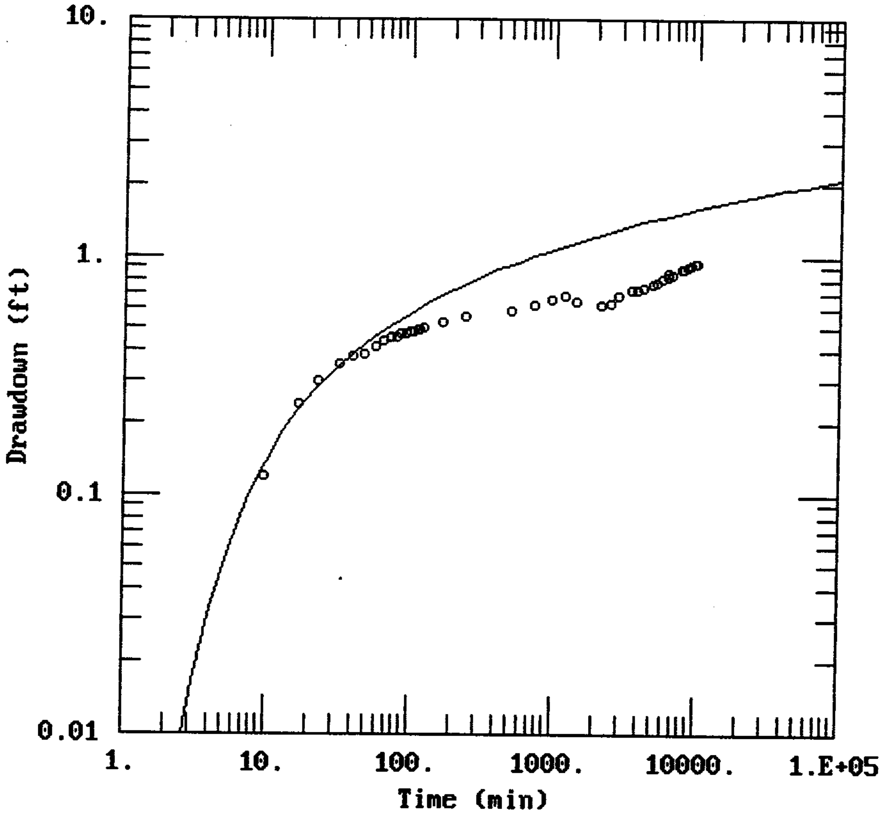
TEST DATA:
Q = 3. ft^3/min
r = 218.3 ft
r_c = 0.6667 ft
r_w = 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot. = 74.98 ft
Piezometer Depth:
setting = 6.94 ft

PARAMETER ESTIMATES:
T = 0.08 ft^2/min
S = 0.024
Sy = 0.2
β = 0.1

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW-121BT.PAR
09/18/98

AQUIFER MODEL:
Confined
SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-121B

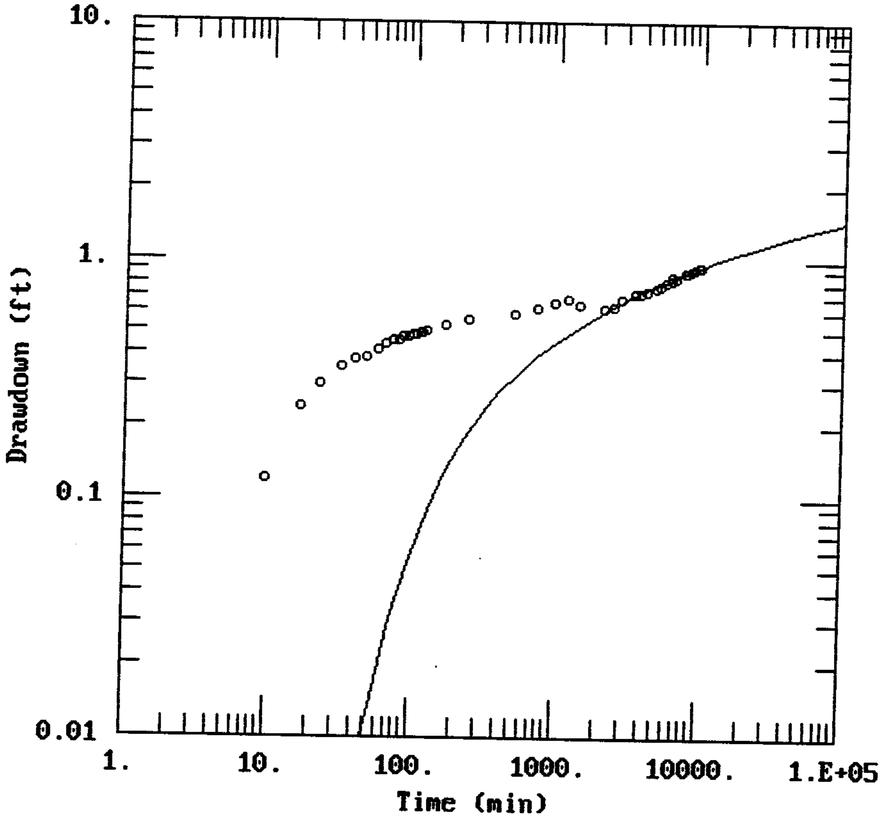
TEST DATA:
$Q = 3.\ ft^3/min$
r = 217.1 ft
r_c = 0.6667 ft
r_w = 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot. = 74.98 ft
Piezometer Depth:
setting = 60.09 ft

PARAMETER ESTIMATES:
$T = 1.068\ ft^2/min$
S = 0.0006093

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW-121BT.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-121B

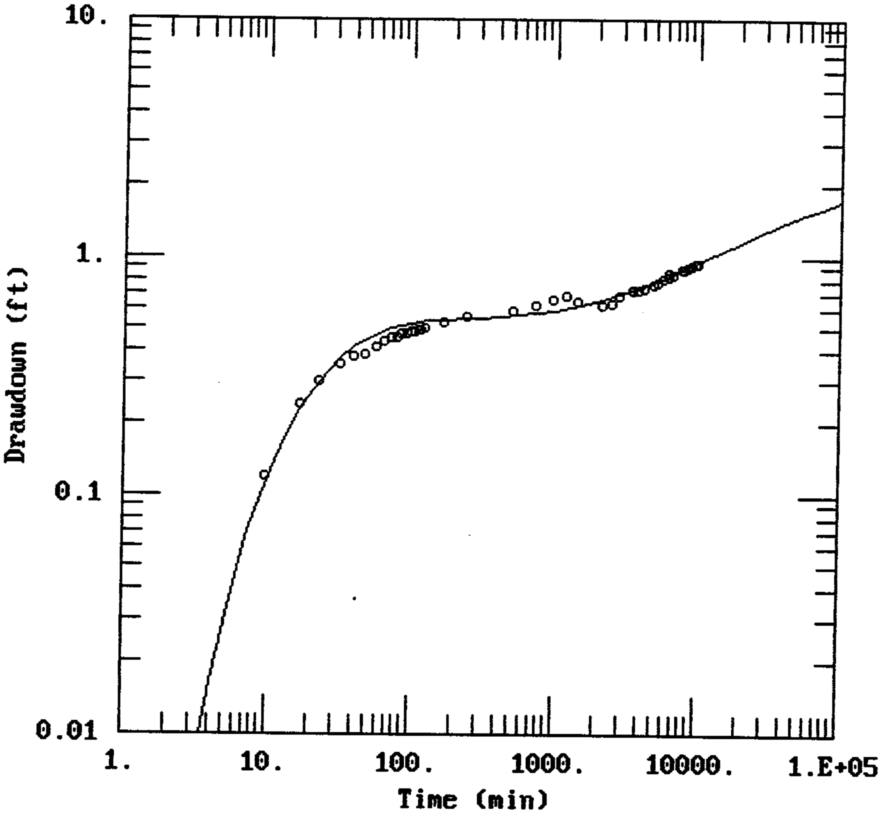
TEST DATA:
Q = 3. ft^3/min
r = 217.1 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 60.09 ft

PARAMETER ESTIMATES:
T = 1.068 ft^2/min
S = 0.01123

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
MW-121BT.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-121B

TEST DATA:
$Q = 3.\ ft^3/min$
$r = 217.1\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 60.09 ft

PARAMETER ESTIMATES:
$T = 0.6467\ ft^2/min$
$S = 0.00057$
$Sy = 0.03813$
$\beta = 0.4$

AQTESOLV

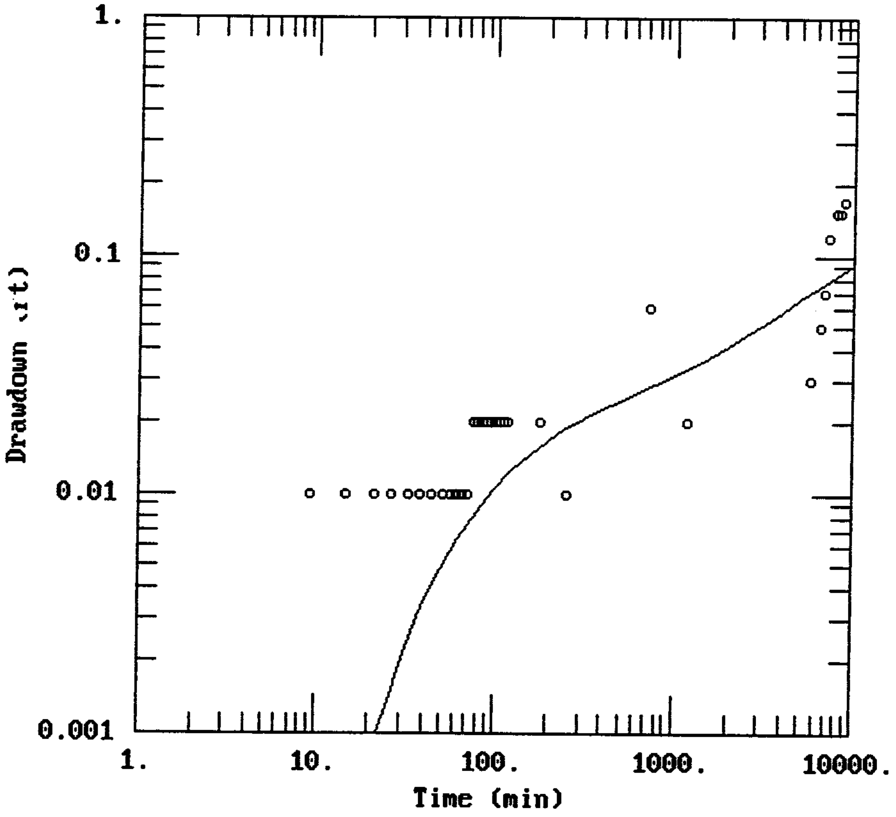
CLIENT: SRSNE

COMPANY: BBL, Inc.

LOCATION: SRSNE Site, CT

PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
PZO-204S.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: PZO-204S

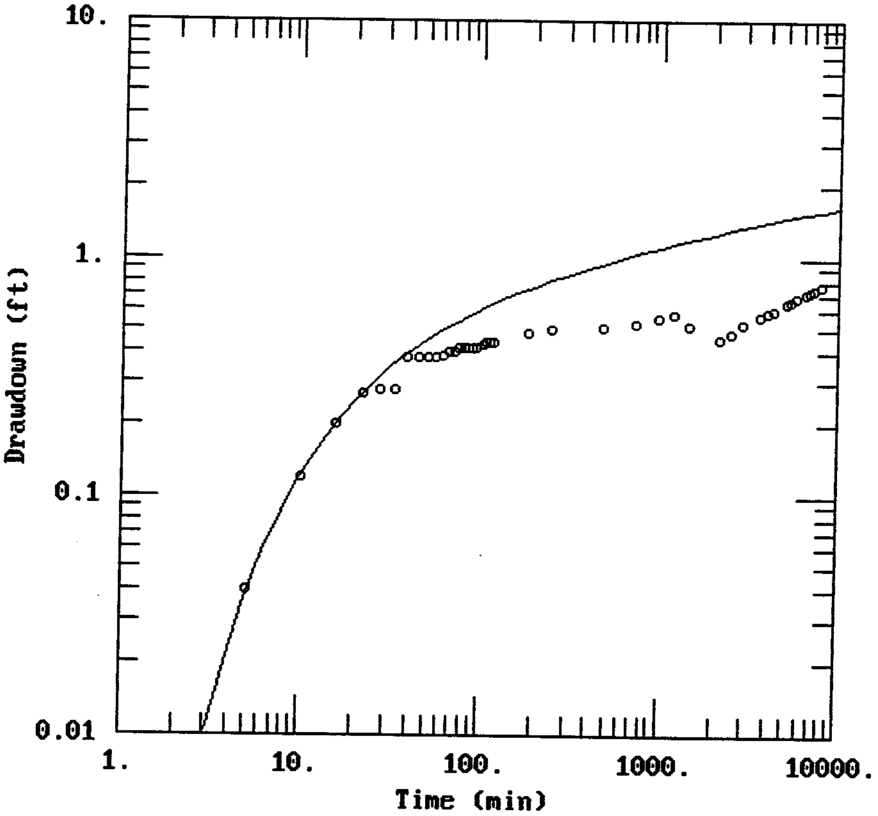
TEST DATA:
$Q = 3.\ ft^3/min$
$r = 96.3\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 7.64 ft

PARAMETER ESTIMATES:
$T = 5.\ ft^2/min$
$S = 0.02$
$Sy = 0.3$
$\beta = 0.04$

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
PZO-204M.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: PZO-204M

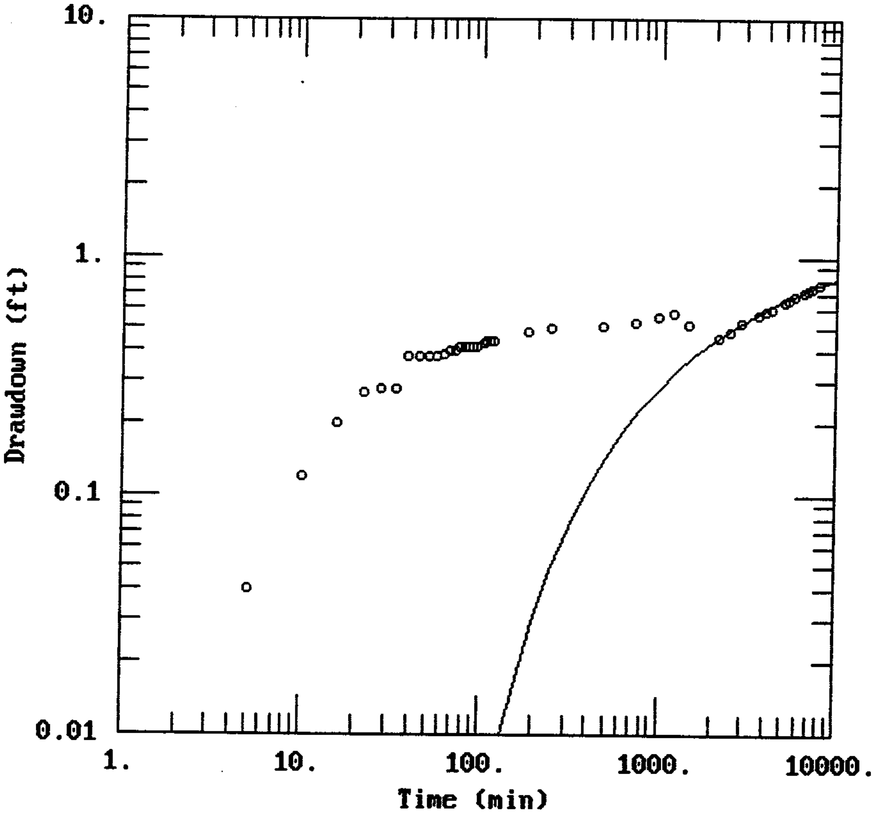
TEST DATA:
Q = 3. ft^3/min
r = 105.5 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 47. ft

PARAMETER ESTIMATES:
T = 1.057 ft^2/min
S = 0.002929

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
PZO-204M.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: PZO-204M

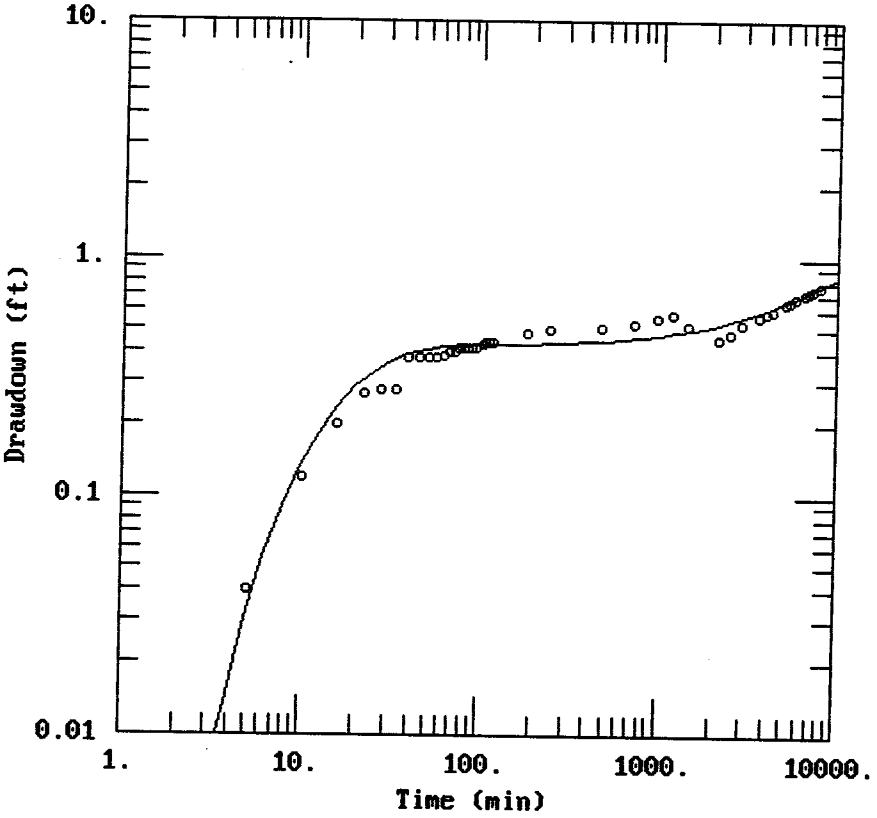
TEST DATA:
Q = 3. ft^3/min
r = 105.5 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 47. ft

PARAMETER ESTIMATES:
T = 1.018 ft^2/min
S = 0.126

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
PZ0204MN.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: PZ0-204M

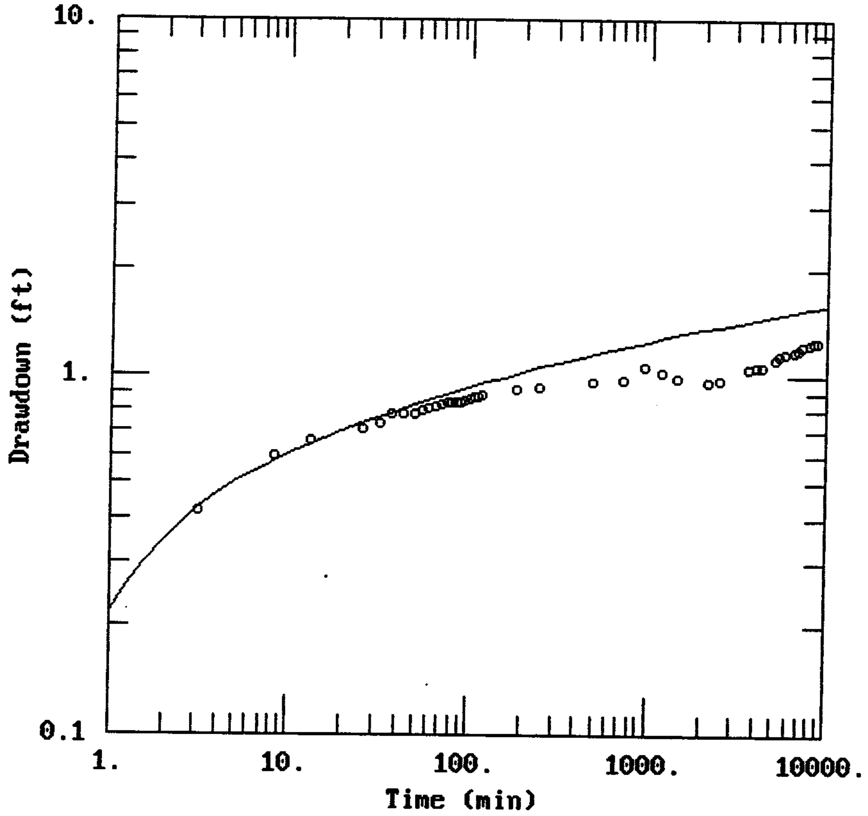
TEST DATA:
$Q = 3.\ ft^3/min$
$r = 105.5$ ft
$r_c = 0.6667$ ft
$r_w = 0.6667$ ft
$b = 75.$ ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 47. ft

PARAMETER ESTIMATES:
$T = 0.3217\ ft^2/min$
$S = 0.001306$
$Sy = 0.4064$
$\beta = 1.$

AQTESOLV

CLIENT: SRSNE	**COMPANY:** BBL, Inc.
LOCATION: SRSNE Site, CT	**PROJECT:** 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW204BT.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-204B

TEST DATA:
Q = 3. ft^3/min
r = 97.5 ft
r_c = 0.6667 ft
r_w = 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
  top = 34.98 ft
  bot. = 74.98 ft
Piezometer Depth:
  setting = 66.72 ft

PARAMETER ESTIMATES:
T = 1.679 ft^2/min
S = 0.0002326

AQTESOLV

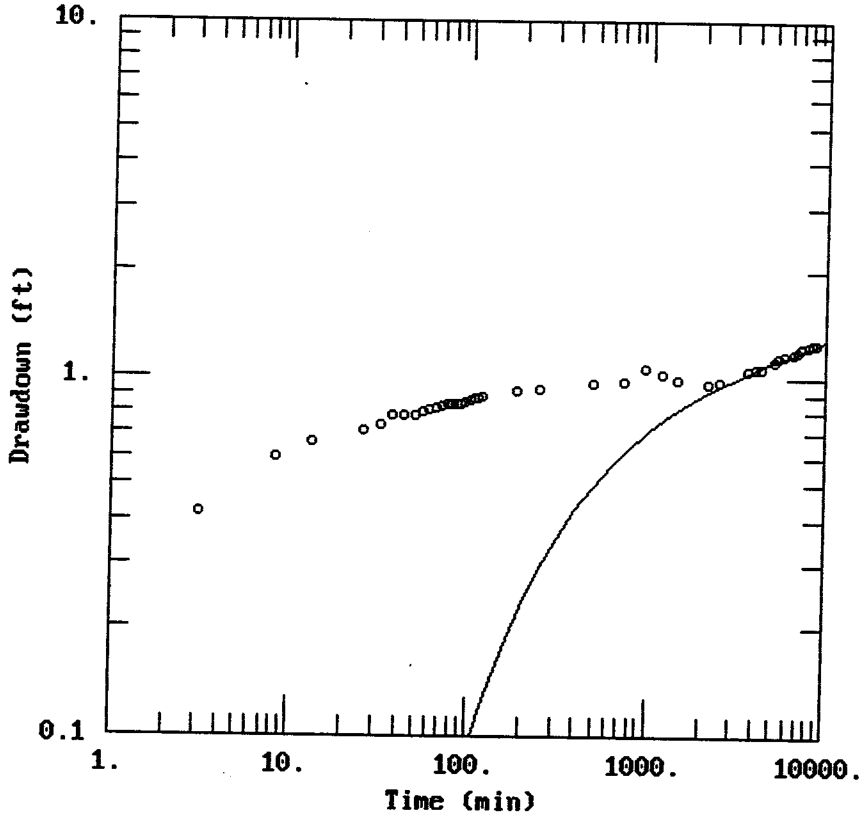
CLIENT: SRSNE

COMPANY: BBL, Inc.

LOCATION: SRSNE Site, CT

PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW204BT.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-204B

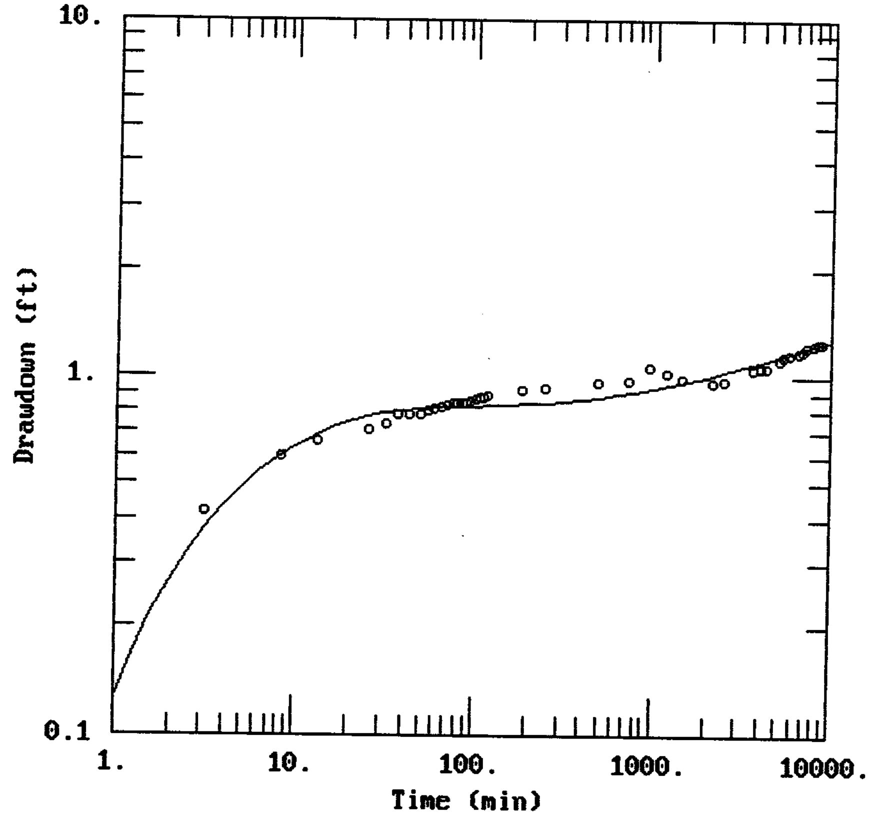
TEST DATA:
$Q = 3.\ ft^3/min$
r = 97.5 ft
r_c = 0.6667 ft
r_w = 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 66.72 ft

PARAMETER ESTIMATES:
$T = 1.002\ ft^2/min$
S = 0.04517

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
MW204BN.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-204B

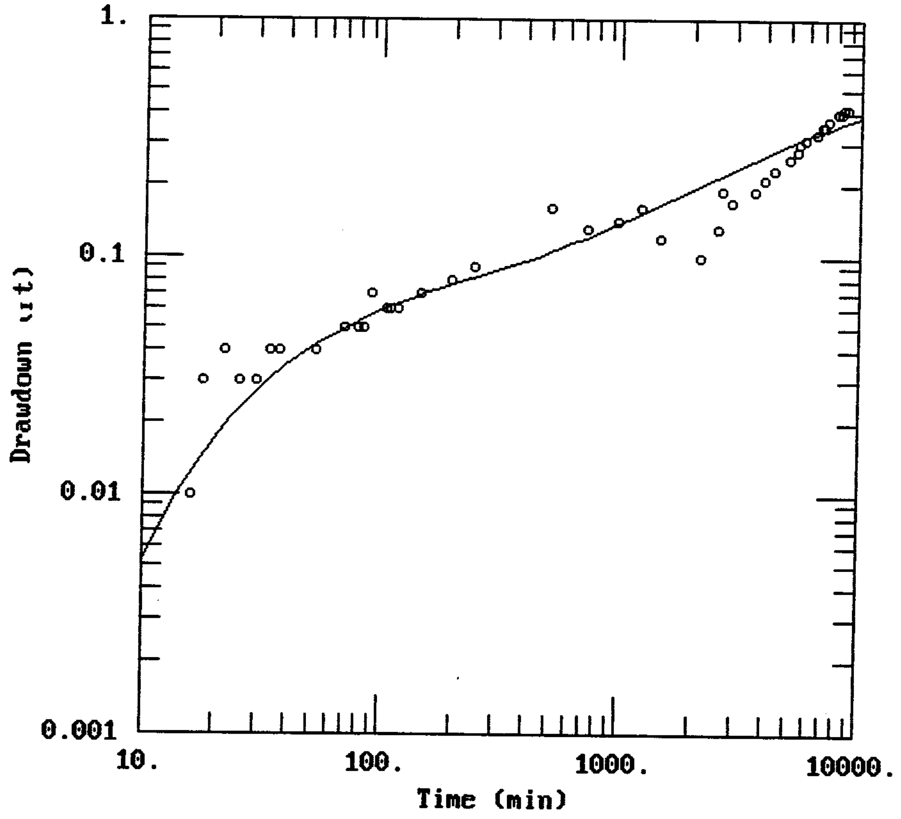
TEST DATA:
$Q = 3.\ ft^3/min$
r = 97.5 ft
$r_c = 0.6667$ ft
$r_w = 0.6667$ ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 66.72 ft

PARAMETER ESTIMATES:
$T = 1.232\ ft^2/min$
S = 0.0003841
Sy = 0.01532
ß = 0.06

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
MW704SN.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-704S

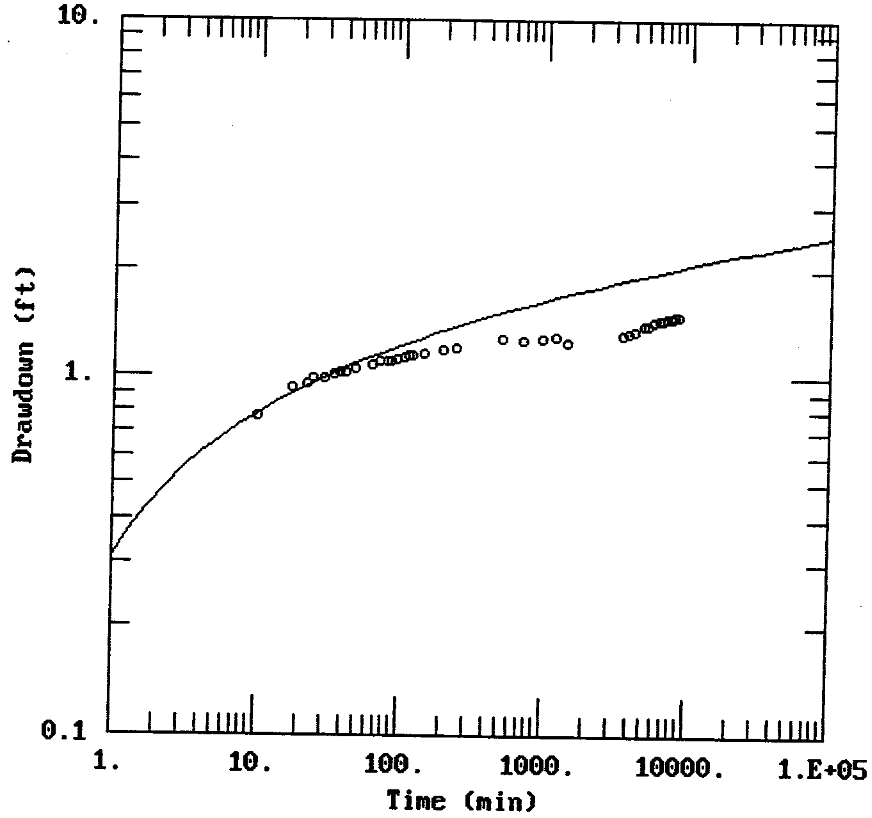
TEST DATA:
Q = 3. ft^3/min
r = 18.5 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
  top = 34.98 ft
  bot.= 74.98 ft
Piezometer Depth:
  setting = 7.8 ft

PARAMETER ESTIMATES:
T = 1.8 ft^2/min
S = 0.02
Sy = 0.3
ß = 0.01

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW704MT.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-704M

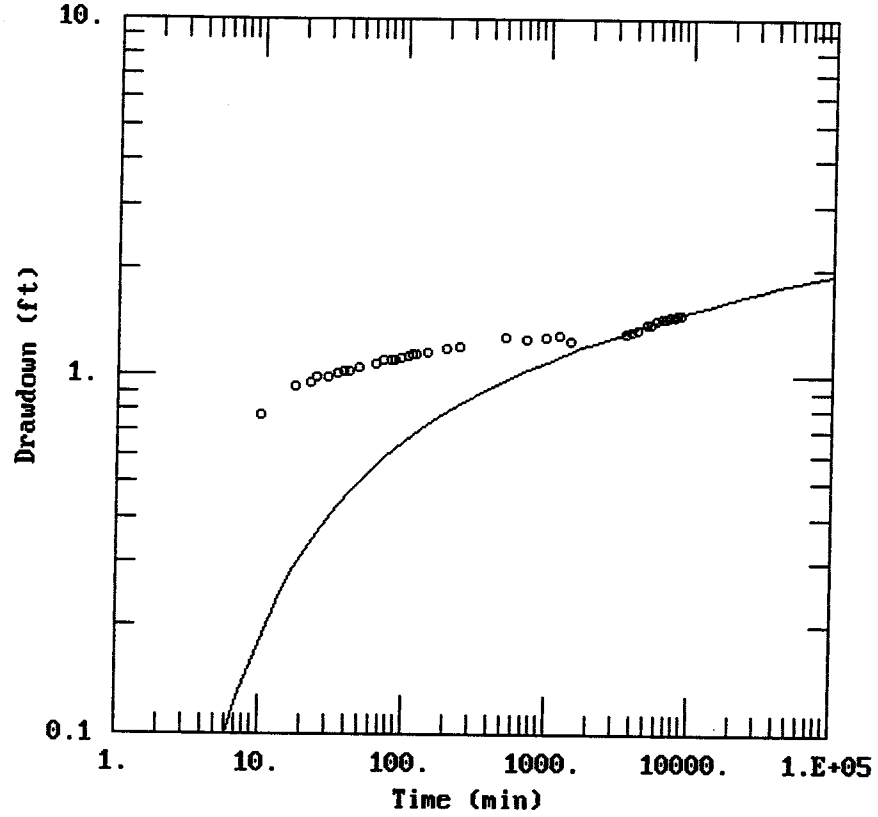
TEST DATA:
$Q = 3.\ ft^3/min$
$r = 27.6\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 40.05 ft

PARAMETER ESTIMATES:
$T = 1.315\ ft^2/min$
$S = 0.001721$

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW704MT.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-704M

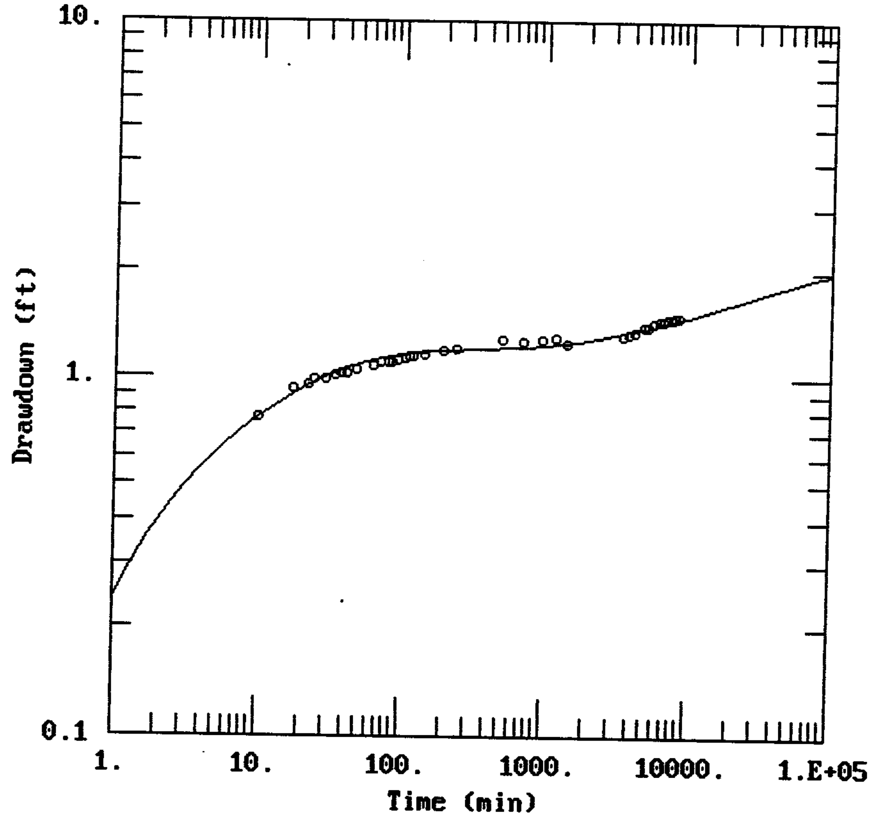
TEST DATA:
$Q = 3.\ ft^3/min$
r = 27.6 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 40.05 ft

PARAMETER ESTIMATES:
$T = 1.315\ ft^2/min$
S = 0.03409

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
MW704MN.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: MW-704M

TEST DATA:
$Q = 3.\ ft^3/min$
$r = 27.6\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
  top = 34.98 ft
  bot.= 74.98 ft
Piezometer Depth:
  setting = 40.05 ft

PARAMETER ESTIMATES:
$T = 1.056\ ft^2/min$
$S = 0.002258$
$Sy = 0.1128$
$\beta = 0.01$

AQTESOLV

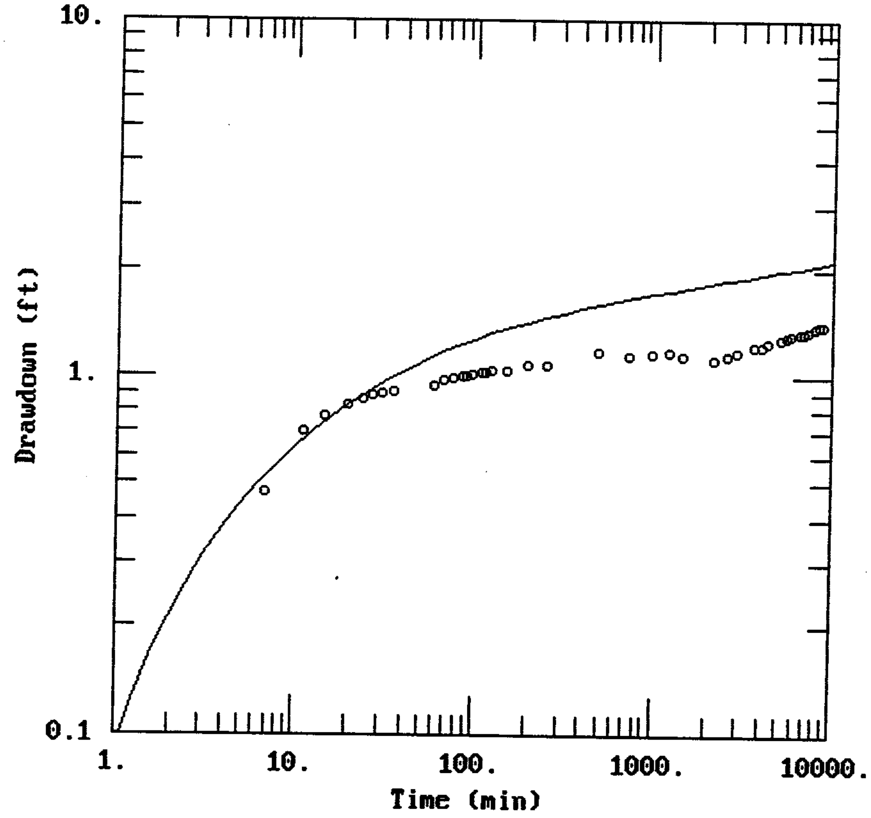
CLIENT: SRSNE

COMPANY: BBL, Inc.

LOCATION: SRSNE Site, CT

PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW704DT.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: MW-704D

TEST DATA:
$Q = 3.\ ft^3/min$
$r = 22.7\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 57.02 ft

PARAMETER ESTIMATES:
$T = 1.391\ ft^2/min$
$S = 0.009311$

AQTESOLV

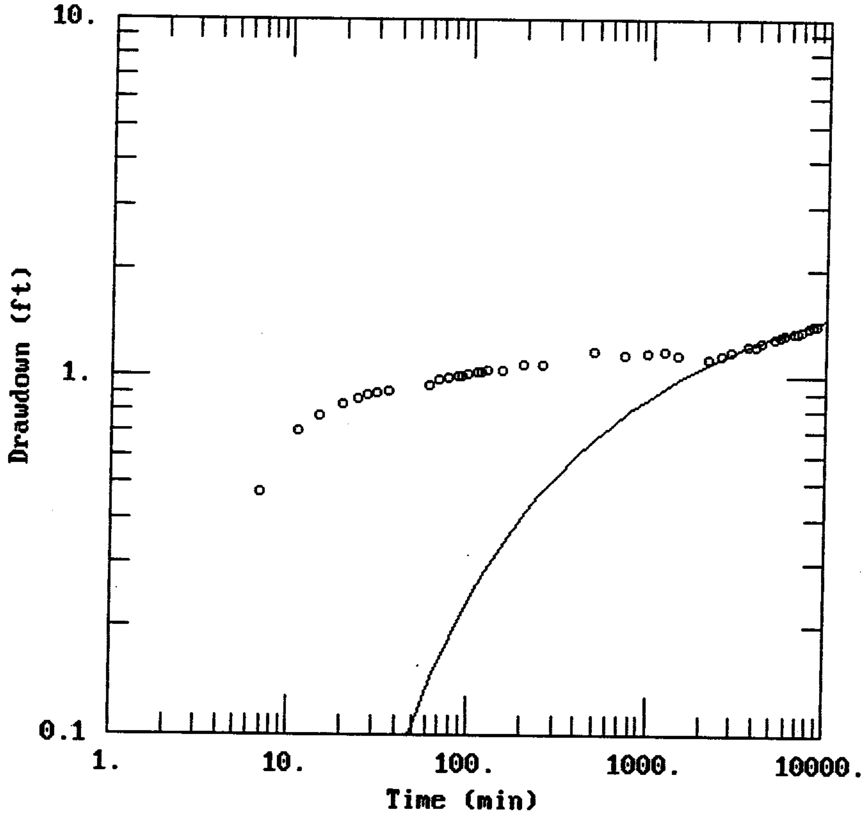
CLIENT: SRSNE

COMPANY: BBL, Inc.

LOCATION: SRSNE Site, CT

PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
MW704DT.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: MW-704D

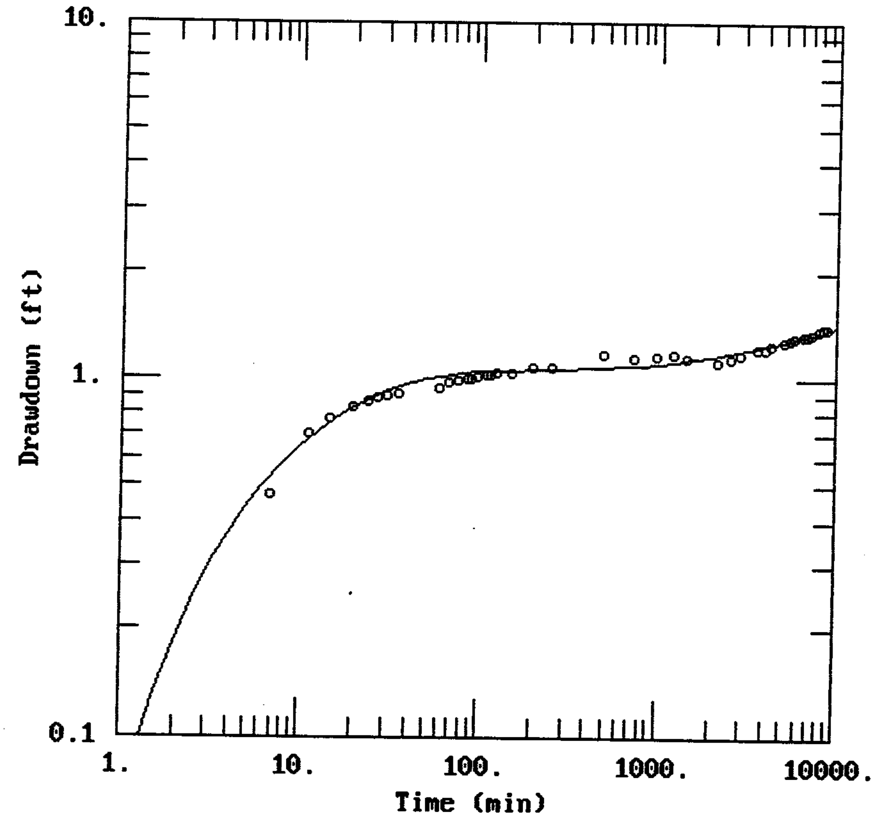
TEST DATA:
Q = 3. ft^3/min
r = 22.7 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 57.02 ft

PARAMETER ESTIMATES:
T = 1.391 ft^2/min
S = 0.4159

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
MW704DN.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: MW-704D

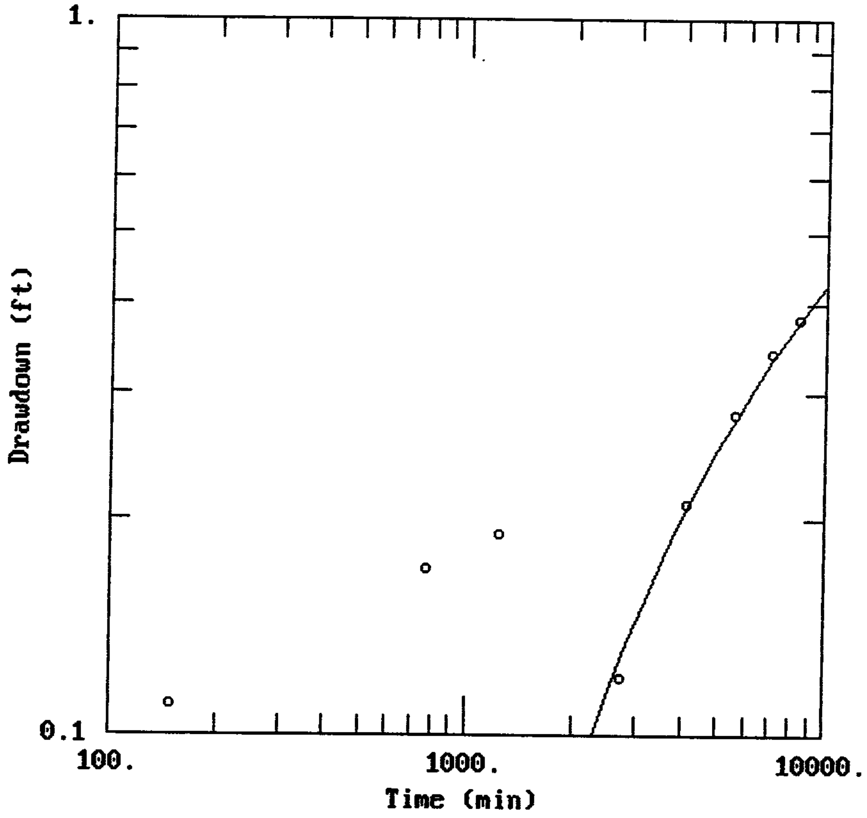
TEST DATA:
Q = 3. ft^3/min
r = 22.7 ft
r_c= 0.6667 ft
r_w= 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 57.02 ft

PARAMETER ESTIMATES:
T = 0.9003 ft^2/min
S = 0.009669
Sy = 0.6413
ß = 0.06

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
PZO-2MT1.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: PZO-2M

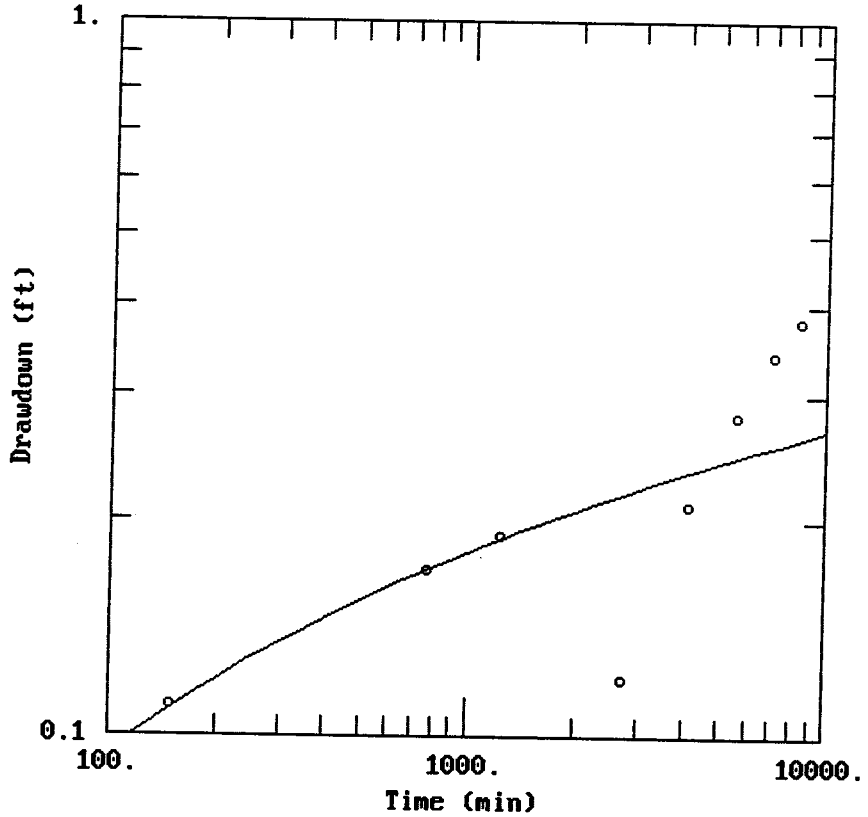
TEST DATA:
$Q = 3.\ ft^3/min$
$r = 274.5\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 34.59 ft

PARAMETER ESTIMATES:
$T = 0.7289\ ft^2/min$
$S = 0.06812$

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
PZO-2MT1.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: PZO-2M

TEST DATA:
$Q = 3.\ ft^3/min$
$r = 274.5\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 34.59 ft

PARAMETER ESTIMATES:
$T = 6.278\ ft^2/min$
$S = 0.001607$

AQTESOLV

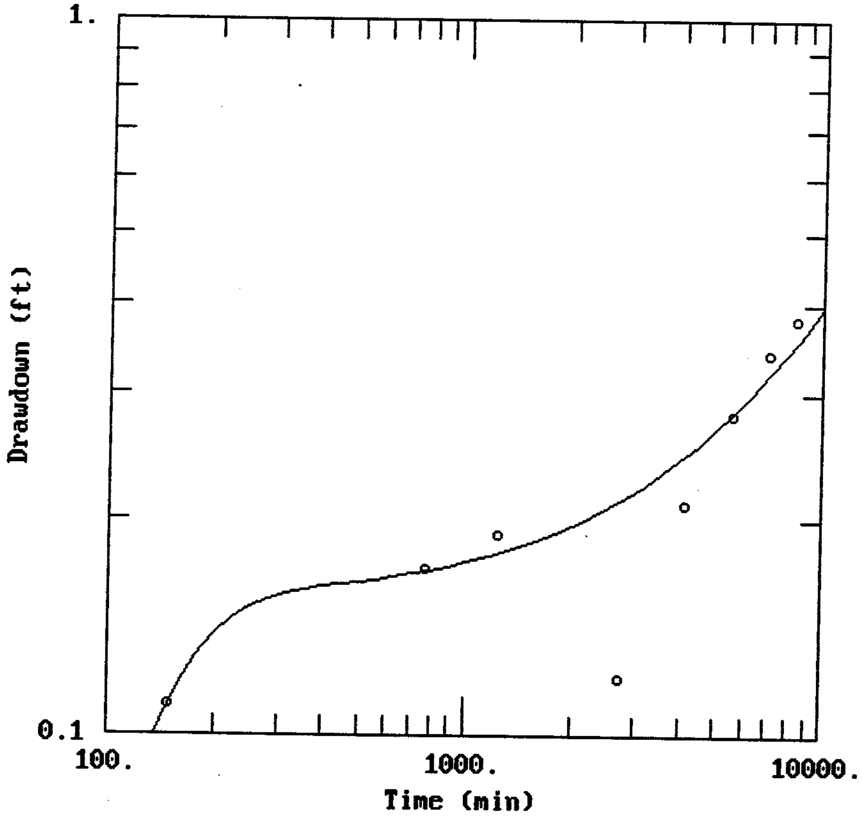
CLIENT: SRSNE

COMPANY: BBL, Inc.

LOCATION: SRSNE Site, CT

PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
PZ0-2M5.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: PZ0-2M

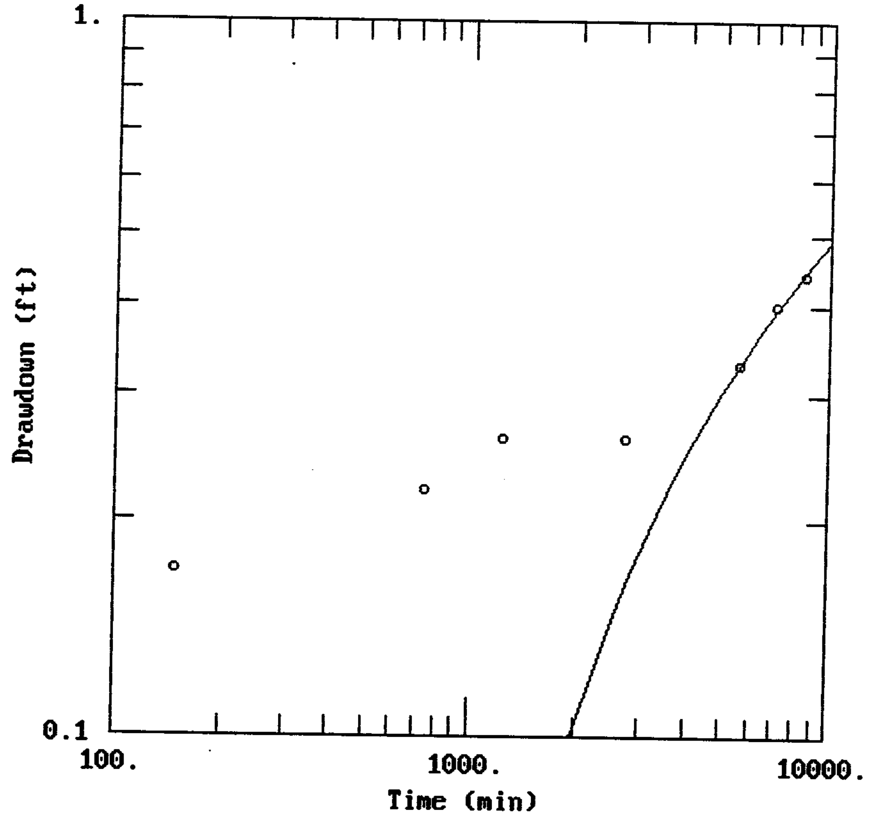
TEST DATA:
$Q = 3.\ ft^3/min$
$r = 274.5\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot. = 74.98 ft
Piezometer Depth:
setting = 34.59 ft

PARAMETER ESTIMATES:
$T = 0.03378\ ft^2/min$
$S = 0.0004294$
$Sy = 0.1105$
$\beta = 7.$

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - THEIS



DATA SET:
PZO-2DT1.PAR
09/18/98

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Theis

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: PZO-2D

TEST DATA:
$Q = 3.\ ft^3/min$
$r = 262.5\ ft$
$r_c = 0.6667\ ft$
$r_w = 0.6667\ ft$
$b = 75.\ ft$
Pumping Well Screen Depth:
top = 34.98 ft
bot.= 74.98 ft
Piezometer Depth:
setting = 57.96 ft

PARAMETER ESTIMATES:
$T = 0.6744\ ft^2/min$
$S = 0.08441$

AQTESOLV

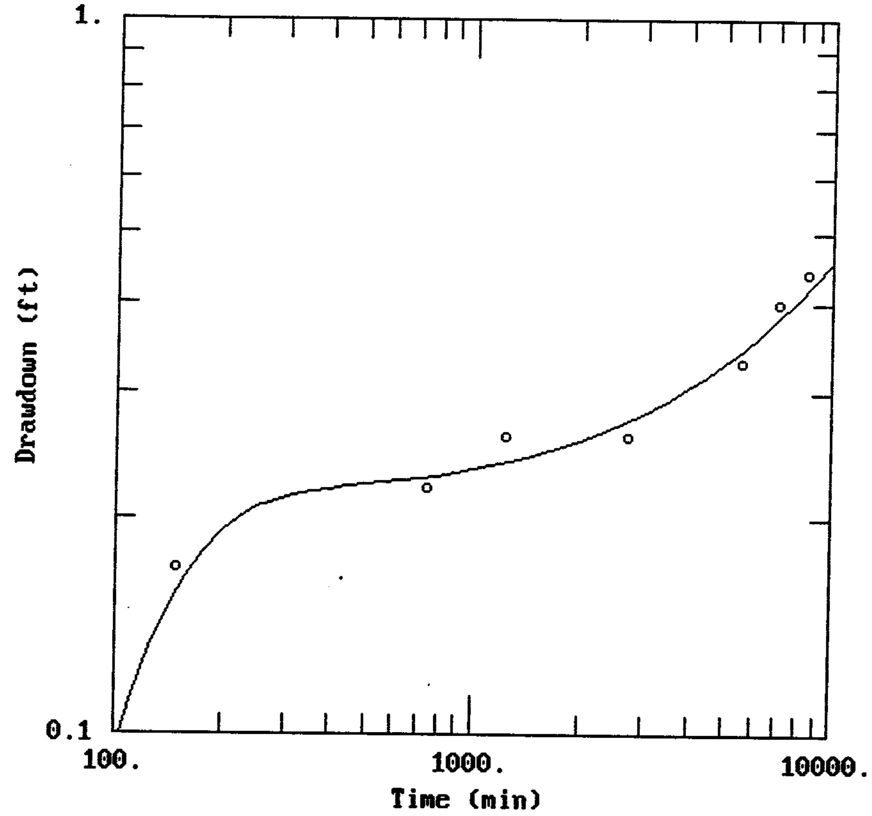
CLIENT: SRSNE

COMPANY: BBL, Inc.

LOCATION: SRSNE Site, CT

PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
PZO-2DN5.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 08/17/98 - 08/23/98
test well: RW-13
obs. well: PZO-2D

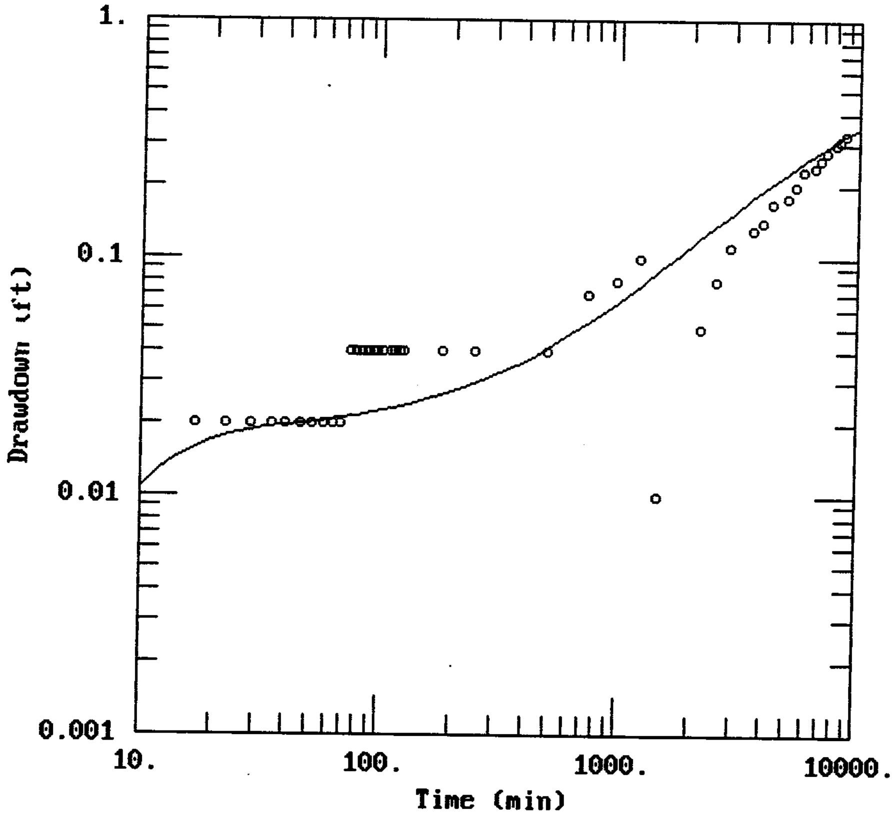
TEST DATA:
Q = 3. ft^3/min
r = 262.5 ft
r_c = 0.6667 ft
r_w = 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot. = 74.98 ft
Piezometer Depth:
setting = 57.96 ft

PARAMETER ESTIMATES:
T = 0.0715 ft^2/min
S = 0.0007919
Sy = 0.1619
ß = 5.

AQTESOLV

CLIENT: SRSNE	COMPANY: BBL, Inc.
LOCATION: SRSNE Site, CT	PROJECT: 083.31

PUMPING TEST ANALYSIS - NEUMAN



DATA SET:
PZO-6SN3.PAR
09/18/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

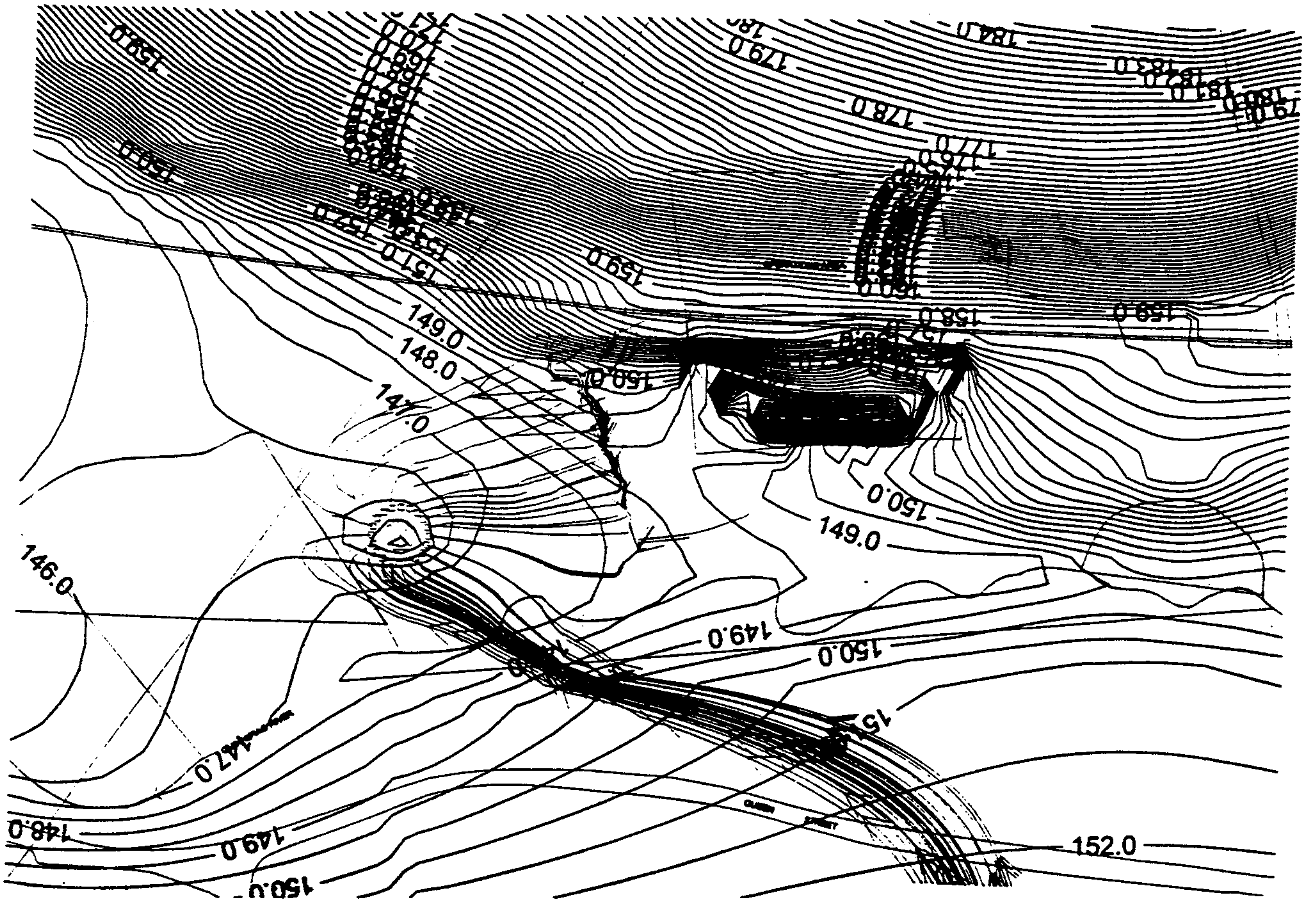
PROJECT DATA:
test date: 08/17/98 - 08/24/98
test well: RW-13
obs. well: PZO-6S

TEST DATA:
$Q = 3.\ ft^3/min$
r = 80.1 ft
r_c = 0.6667 ft
r_w = 0.6667 ft
b = 75. ft
Pumping Well Screen Depth:
top = 34.98 ft
bot. = 74.98 ft
Piezometer Depth:
setting = 12.86 ft

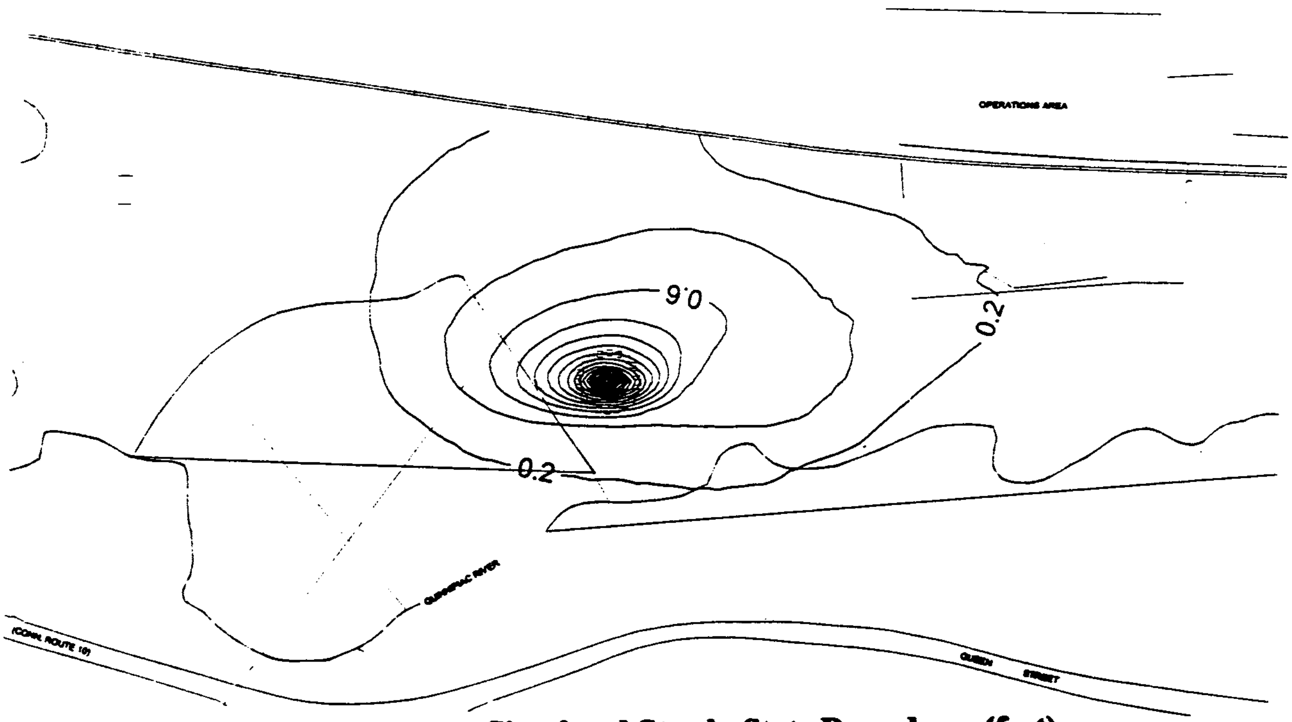
PARAMETER ESTIMATES:
$T = 1.056\ ft^2/min$
S = 0.006491
Sy = 0.866
ß = 2.

AQTESOLV

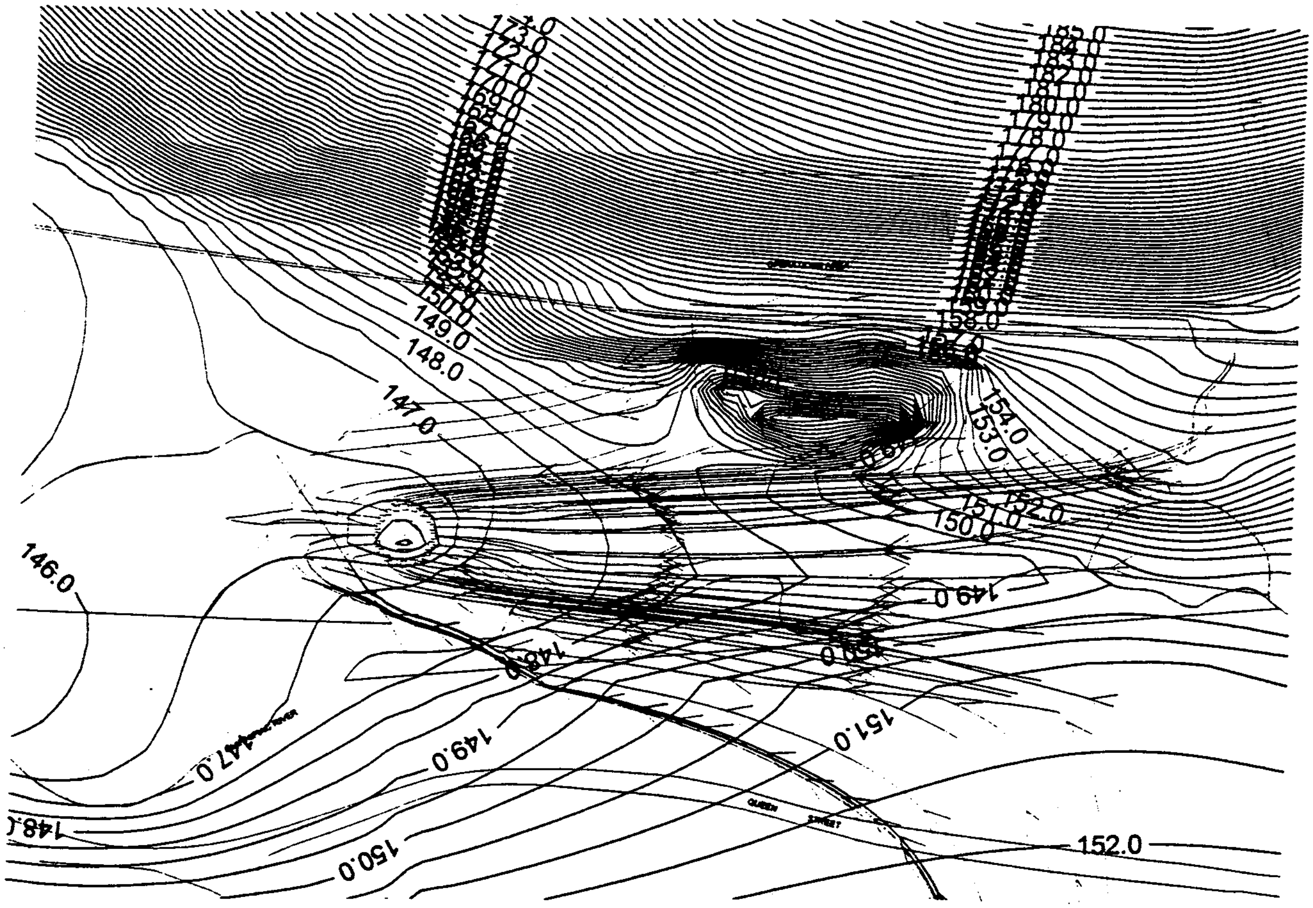
ATTACHMENT A – 13



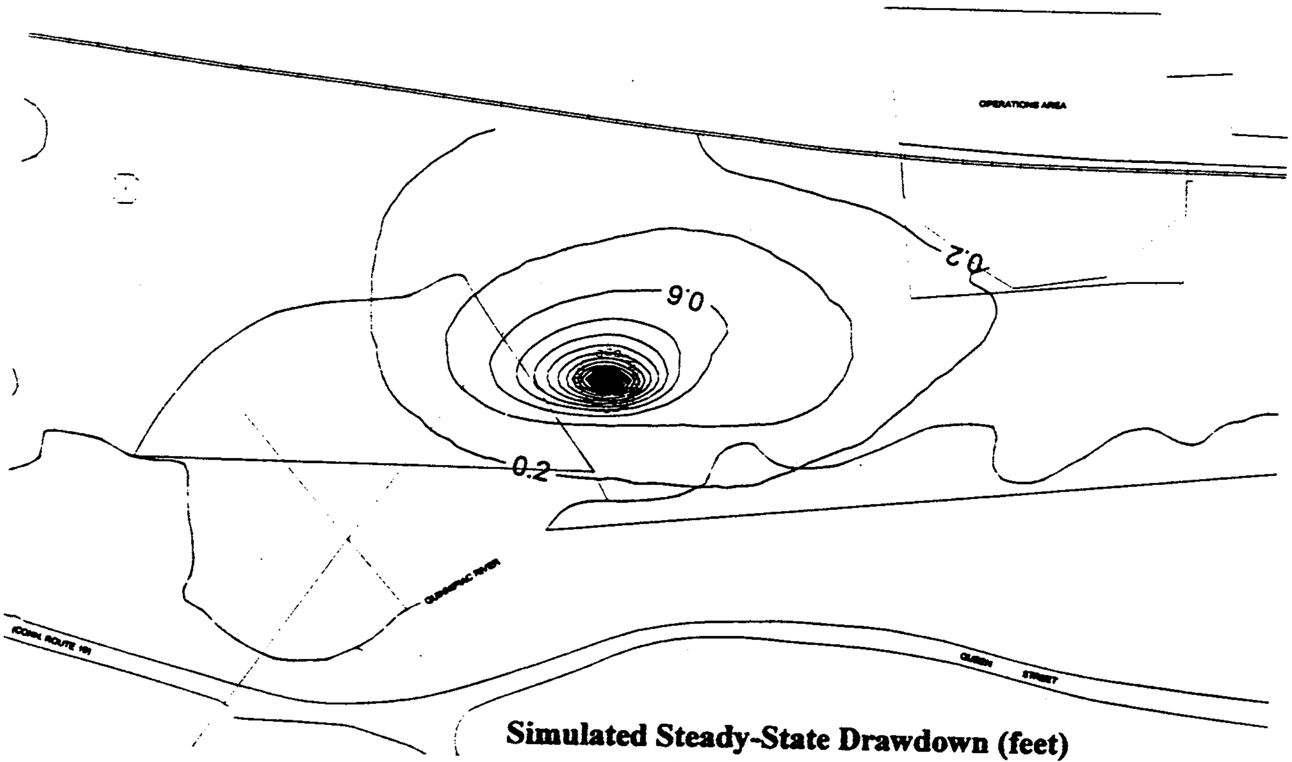
Simulated Steady-State Heads (feet) and Capture Zone
Middle and Deep Overburden
RW-13 Pumping 22.5 GPM



Simulated Steady-State Drawdown (feet)
Middle and Deep Overburden
RW-13 Pumping 22.5 GPM



Simulated Steady-State Heads (feet) and Capture Zone
Shallow Bedrock
RW-13 Pumping 22.5 GPM



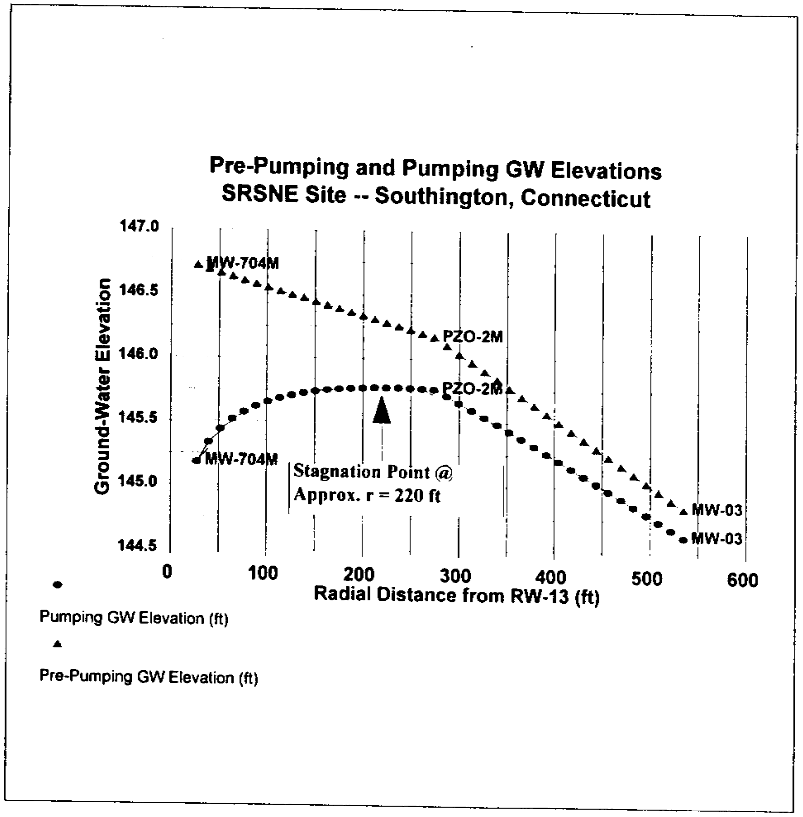
Simulated Steady-State Drawdown (feet)
Shallow Bedrock
RW-13 Pumping 22.5 GPM

ATTACHMENT A – 14

SRSNE SITE
SOUTHINGTON, CONNECTICUT

ESTIMATION OF STAGNATION POINT LOCATION
MIDDLE OVERBURDEN

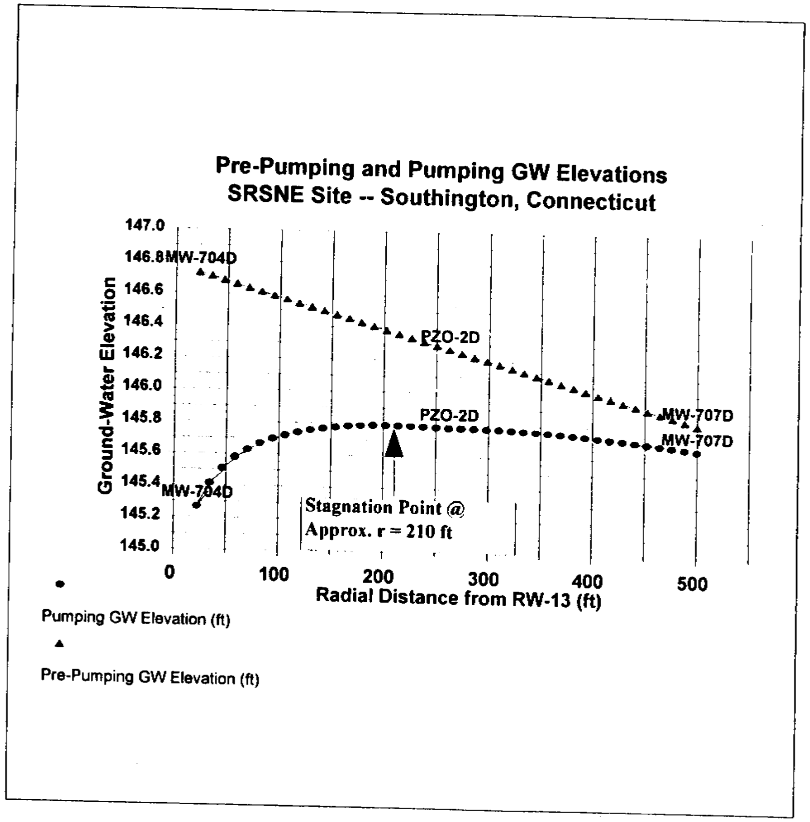
	r (ft)	log r (ft)	Pre-Pump GW Elev.	Drawdown	Pumping GW Elev.	
MW-704M	**27.6**	**1.44**	**146.72**	**1.54**	**145.18**	"Upgradient"
	39.9	1.60	146.69	1.36	145.33	Observation
	52.3	1.72	146.67	1.23	145.44	Well
	64.6	1.81	146.64	1.12	145.52	
	77.0	1.89	146.61	1.04	145.57	
	89.3	1.95	146.58	0.96	145.62	
	101.7	2.01	146.56	0.90	145.66	
	114.0	2.06	146.53	0.84	145.69	
	126.4	2.10	146.50	0.79	145.71	
	138.7	2.14	146.47	0.75	145.73	
	151.1	2.18	146.44	0.70	145.74	
	163.4	2.21	146.42	0.67	145.75	
	175.7	2.24	146.39	0.63	145.76	
	188.1	2.27	146.36	0.60	145.77	
	200.4	2.30	146.33	0.56	145.77	
	212.8	2.33	146.31	0.54	145.77	Stagnation Point @
	225.1	2.35	146.28	0.51	145.77	Approx. r = 220 ft.
	237.5	2.38	146.25	0.48	145.77	
	249.8	2.40	146.22	0.46	145.77	
	262.2	2.42	146.20	0.43	145.76	
PZO-2M	**274.5**	**2.44**	**146.17**	**0.41**	**145.76**	"Middle"
	287.5	2.46	146.10	0.40	145.71	Observation
	300.6	2.48	146.04	0.38	145.65	Well
	313.6	2.50	145.97	0.37	145.60	
	326.6	2.51	145.90	0.36	145.54	
	339.6	2.53	145.84	0.35	145.49	
	352.6	2.55	145.77	0.34	145.43	
	365.7	2.56	145.70	0.33	145.38	
	378.7	2.58	145.64	0.32	145.32	
	391.7	2.59	145.57	0.31	145.26	
	404.7	2.61	145.51	0.30	145.21	
	417.8	2.62	145.44	0.29	145.15	
	430.8	2.63	145.37	0.28	145.09	
	443.8	2.65	145.31	0.27	145.03	
	456.8	2.66	145.24	0.26	144.97	
	469.9	2.67	145.17	0.26	144.92	
	482.9	2.68	145.11	0.25	144.86	
	495.9	2.70	145.04	0.24	144.80	
	508.9	2.71	144.97	0.23	144.74	"Downgradient"
	522.0	2.72	144.91	0.23	144.68	Observation
MW-03	**535.0**	**2.73**	**144.84**	**0.22**	**144.62**	Well


Pre-Pumping and Pumping GW Elevations
SRSNE Site -- Southington, Connecticut

SRSNE SITE
SOUTHINGTON, CONNECTICUT

ESTIMATION OF STAGNATION POINT LOCATION
DEEP OVERBURDEN

	r (ft)	log r (ft)	Pre-Pump GW Elev.	Drawdown	Pumping GW Elev.	
MW-704D	**22.7**	**1.36**	**146.73**	**1.46**	**145.27**	"Upgradient"
	34.7	1.54	146.71	1.29	145.42	Observation
	46.7	1.67	146.68	1.17	145.51	Well
	58.7	1.77	146.66	1.08	145.58	
	70.7	1.85	146.64	1.01	145.63	
	82.7	1.92	146.62	0.95	145.67	
	94.6	1.98	146.59	0.89	145.70	
	106.6	2.03	146.57	0.85	145.72	
	118.6	2.07	146.55	0.80	145.74	
	130.6	2.12	146.52	0.77	145.76	
	142.6	2.15	146.50	0.73	145.77	
	154.6	2.19	146.48	0.70	145.78	
	166.6	2.22	146.45	0.67	145.78	
	178.6	2.25	146.43	0.64	145.79	
	190.6	2.28	146.41	0.62	145.79	
	202.6	2.31	146.39	0.59	145.79	Stagnation Point @
	214.5	2.33	146.36	0.57	145.79	Approx. r = 210 ft.
	226.5	2.36	146.34	0.55	145.79	
	238.5	2.38	146.32	0.53	145.79	
	250.5	2.40	146.29	0.51	145.78	
PZO-2D	**262.5**	**2.42**	**146.27**	**0.49**	**145.78**	"Middle"
	274.4	2.44	146.25	0.47	145.78	Observation
	286.3	2.46	146.23	0.45	145.78	Well
	298.1	2.47	146.20	0.42	145.78	
	310.0	2.49	146.18	0.40	145.78	
	321.9	2.51	146.16	0.39	145.77	
	333.8	2.52	146.13	0.37	145.77	
	345.6	2.54	146.11	0.35	145.76	
	357.5	2.55	146.09	0.33	145.76	
	369.4	2.57	146.07	0.32	145.75	
	381.3	2.58	146.04	0.30	145.75	
	393.1	2.59	146.02	0.28	145.74	
	405.0	2.61	146.00	0.27	145.73	
	416.9	2.62	145.98	0.25	145.72	
	428.8	2.63	145.95	0.24	145.72	
	440.6	2.64	145.93	0.22	145.71	
	452.5	2.66	145.91	0.21	145.70	
	464.4	2.67	145.89	0.20	145.69	
	476.3	2.68	145.86	0.18	145.68	"Downgradient"
	488.1	2.69	145.84	0.17	145.67	Observation
MW-707D	**500.0**	**2.70**	**145.82**	**0.16**	**145.66**	Well



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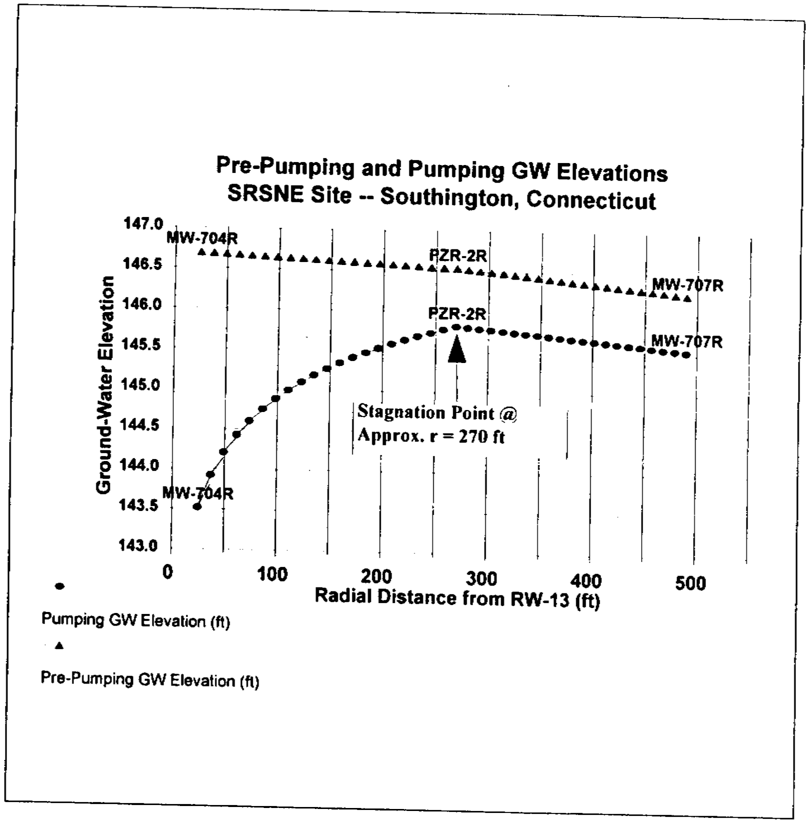
28-Oct-9

SRSNE SITE
SOUTHINGTON, CONNECTICUT

ESTIMATION OF STAGNATION POINT LOCATION
SHALLOW BEDROCK

	r (ft)	log r (ft)	Pre-Pump GW Elev.	Drawdown	Pumping GW Elev.	
MW-704R	**25.0**	**1.40**	**146.69**	**3.17**	**143.52**	"Upgradient"
	37.3	1.57	146.68	2.76	143.92	Observation
	49.5	1.69	146.68	2.47	144.21	Well
	61.8	1.79	146.67	2.24	144.43	
	74.0	1.87	146.66	2.05	144.61	
	86.3	1.94	146.65	1.89	144.76	
	98.5	1.99	146.65	1.76	144.89	
	110.8	2.04	146.64	1.64	145.00	
	123.0	2.09	146.63	1.53	145.10	
	135.3	2.13	146.62	1.43	145.19	
	147.5	2.17	146.62	1.34	145.27	
	159.8	2.20	146.61	1.26	145.35	
	172.0	2.24	146.60	1.18	145.42	
	184.3	2.27	146.59	1.11	145.48	
	196.5	2.29	146.59	1.05	145.54	
	208.8	2.32	146.58	0.98	145.59	
	221.0	2.34	146.57	0.93	145.64	
	233.3	2.37	146.56	0.87	145.69	Stagnation Point @
	245.5	2.39	146.56	0.82	145.74	Approx. r = 270 ft.
	257.8	2.41	146.55	0.77	145.78	
PZR-2R	**270.0**	**2.43**	**146.54**	**0.72**	**145.82**	"Middle"
	281.0	2.45	146.53	0.72	145.81	Observation
	292.0	2.47	146.51	0.72	145.79	Well
	303.0	2.48	146.50	0.72	145.78	
	314.0	2.50	146.48	0.71	145.77	
	325.0	2.51	146.47	0.71	145.75	
	336.0	2.53	146.45	0.71	145.74	
	347.0	2.54	146.44	0.71	145.72	
	358.0	2.55	146.42	0.71	145.71	
	369.0	2.57	146.41	0.71	145.70	
	380.0	2.58	146.39	0.71	145.68	
	391.0	2.59	146.38	0.71	145.67	
	402.0	2.60	146.36	0.71	145.65	
	413.0	2.62	146.35	0.71	145.64	
	424.0	2.63	146.33	0.70	145.63	
	435.0	2.64	146.32	0.70	145.61	
	446.0	2.65	146.30	0.70	145.60	
	457.0	2.66	146.29	0.70	145.58	
	468.0	2.67	146.27	0.70	145.57	"Downgradient"
	479.0	2.68	146.26	0.70	145.55	Observation
MW-707R	**490.0**	**2.69**	**146.24**	**0.7**	**145.54**	Well



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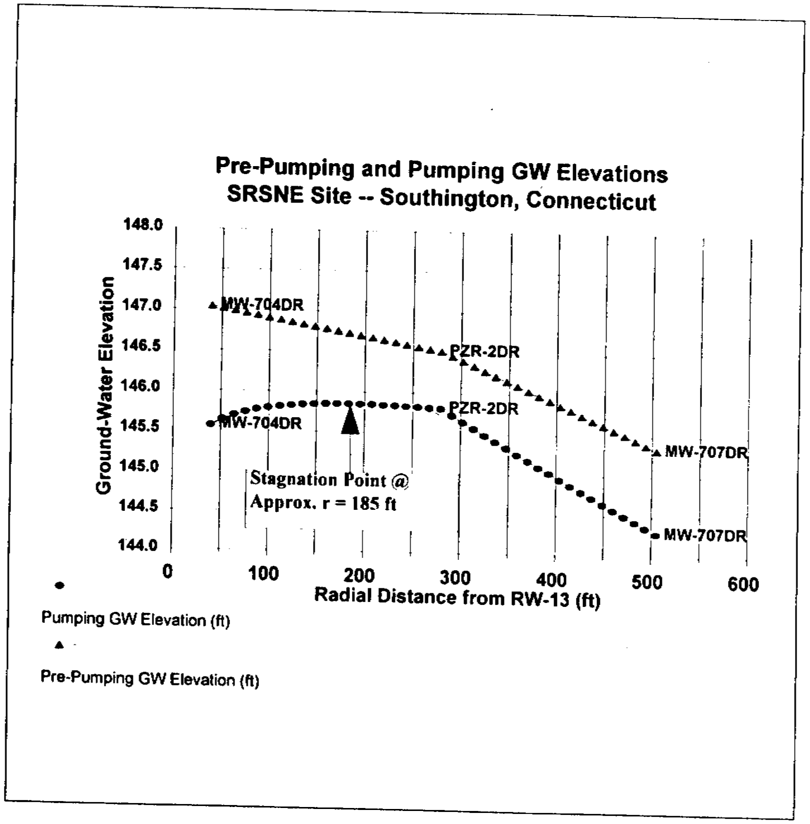
28-Oct-98

SRSNE SITE
SOUTHINGTON, CONNECTICUT

ESTIMATION OF STAGNATION POINT LOCATION
DEEP BEDROCK

	r (ft)	log r (ft)	Pre-Pump GW Elev.	Drawdown	Pumping GW Elev.	
MW-704DR	**40.0**	**1.60**	**147.04**	**1.47**	**145.57**	"Upgradient"
	52.0	1.72	147.01	1.37	145.65	Observation
	64.0	1.81	146.99	1.29	145.70	Well
	76.0	1.88	146.96	1.22	145.74	
	88.0	1.94	146.94	1.16	145.77	
	100.0	2.00	146.91	1.11	145.80	
	112.0	2.05	146.88	1.07	145.82	
	124.0	2.09	146.86	1.03	145.83	
	136.0	2.13	146.83	0.99	145.84	
	148.0	2.17	146.81	0.96	145.85	
	160.0	2.20	146.78	0.93	145.85	
	172.0	2.24	146.75	0.90	145.85	
	184.0	2.26	146.73	0.87	145.85	Stagnation Point @
	196.0	2.29	146.70	0.85	145.85	Approx. r = 185 ft.
	208.0	2.32	146.68	0.83	145.85	
	220.0	2.34	146.65	0.80	145.85	
	232.0	2.37	146.62	0.78	145.84	
	244.0	2.39	146.60	0.76	145.83	
	256.0	2.41	146.57	0.74	145.83	
	268.0	2.43	146.55	0.73	145.82	
PZR-2DR	**280.0**	**2.45**	**146.52**	**0.71**	**145.81**	"Middle"
	291.3	2.46	146.46	0.73	145.73	Observation
	302.5	2.48	146.40	0.75	145.65	Well
	313.8	2.50	146.34	0.78	145.57	
	325.0	2.51	146.28	0.80	145.49	
	336.3	2.53	146.22	0.82	145.41	
	347.5	2.54	146.16	0.83	145.33	
	358.8	2.55	146.10	0.85	145.25	
	370.0	2.57	146.04	0.87	145.17	
	381.3	2.58	145.98	0.89	145.10	
	392.5	2.59	145.92	0.90	145.02	
	403.8	2.61	145.87	0.92	144.94	
	415.0	2.62	145.81	0.94	144.87	
	426.3	2.63	145.75	0.95	144.79	
	437.5	2.64	145.69	0.97	144.72	
	448.8	2.65	145.63	0.98	144.65	
	460.0	2.66	145.57	1.00	144.57	
	471.3	2.67	145.51	1.01	144.50	
	482.5	2.68	145.45	1.02	144.43	"Downgradient"
	493.8	2.69	145.39	1.04	144.35	Observation
MW-707DR	**505.0**	**2.70**	**145.33**	**1.05**	**144.28**	Well


Pre-Pumping and Pumping GW Elevations
SRSNE Site -- Southington, Connecticut

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28-Oct-98

Appendix C

NAPL Delineation Pilot Study

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

MEMORANDUM

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

To: Karen Lumino, USEPA Region 1

Date: 12/15/03

From: Michael Gefell, BBL

cc:
Martin Beskind, P.E., CT DEP
Liyang Chu, TetraTech NUS
William Morris, UIS
Bruce Thompson, *de maximis, inc.*
Bernard Kueper, Queens University
Gary Cameron, BBL

Re: NAPL Delineation Pilot Study
SRSNE Site -- Southington, Connecticut

Introduction

This document describes the results of a pilot study of field methods used to visually identify non-aqueous phase liquids (NAPLs) in soil at the Solvents Recovery Service of New England (SRSNE) Site (the Site) in Southington, Connecticut. The pilot study was performed as described in a letter from Blasland, Bouck & Lee, Inc. (BBL) to the United States Environmental Protection Agency (USEPA) dated October 24, 2003. BBL prepared this letter on behalf of the Potentially Responsible Parties (PRP Group or "the Group") for submittal to the USEPA and the Connecticut Department of Environmental Protection (CT DEP). This document presents the following information:

- Historical NAPL Observations in Overburden;
- Pilot Study Purpose and Objectives;
- Soil Sample Collection;
- Soil Sample Evaluation for NAPL Presence or Absence;
- Selection of Subsequent Soil Boring Locations; and
- Results.

The NAPL delineation pilot study was performed during the week of November 3-7, 2003. Attendees who participated in conducting the field program included: USEPA's geologist (Steve Mangion, November 3-7); USEPA's hydrogeologic consultant (Michael Healey, November 3-7); Dr. Bernard H. Kueper (November 3-4); the Group's project management consultants from *de maximis, inc.* (Bruce Thompson, intermittent attendance November 3-7 and John Hunt, November 3-7); two BBL geologists (Michael Gefell, November 3-5 and Michael Cobb, November 3-7); and drilling crews from O&M, Inc. and BBL (November 3-7). Additional visitors on November 3 and 4 included: Karen Lumino and Dick Willey (USEPA), Martin Beskind (CT DEP), and Gus Moody (Technical Committee Chairman).

The one-week field program consisted of drilling soil borings using two direct-push rigs, visually examining soil samples to identify NAPL, documenting soil types and observations regarding visual NAPL presence/absence, and selecting follow-up boring locations. The pertinent necessary information was obtained by direct visual observation of the soil samples including the

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use of hydrophobic dye to enhance NAPL visibility, as appropriate. Drilling locations were selected based on collaborative discussions between the technical representatives listed above.

A total of 39 soil borings, PTB-1 through PTB-39, were performed at the locations shown on Figure 1. Soil samples were collected continuously from ground surface to the depth of equipment refusal, which was generally consistent with expected top of bedrock depths. Soil sampling activities were performed in accordance with the existing Health and Safety Plan (BBL, August 1996). In addition, the collection and evaluation of soil samples and management of pilot-study derived waste was performed pursuant to the existing Field Sampling Plan (BBL, August 1996), as amended by the information presented in BBL's letter to USEPA dated October 24, 2003. The soil samples were collected using direct-push sampling equipment following the Standard Operating Procedure presented in Attachment 2 to the October 24, 2003 letter, rather than split spoons as described in the existing FSP. This modification reduced the quantity of soil cuttings requiring management and improved soil sample quality and drilling production.

The remainder of this letter presents background information and the purpose and results of the NAPL delineation pilot study.

Historical NAPL Observations in Overburden

Previous investigations at the site encountered visible NAPL at 13 locations in the overburden (Figures 1 and 2). These include:

- LNAPL layers and/or sheens in three overburden groundwater monitoring wells in the former SRSNE Operations Area;
- NAPL, sheens, or positive hydrophobic dye tests observed during overdrilling and grouting of eight former on-site interceptor system wells in the former SRSNE Operations Area;
- Recoverable DNAPL at one downgradient groundwater extraction well (RW-5) – approximately 3 gallons were recovered, but no DNAPL has been observed there since 1995; and
- Observation in a split-spoon during drilling next to well RW-5 and subsequent recovery of DNAPL in the co-located DNAPL monitoring well (DMW-601) – approximately 1 gallon was recovered, but no DNAPL has been observed there since 1995.

Overburden LNAPL and DNAPL samples have had similar chemical composition and dark brown color. Figure 3a shows a representative example of the NAPL color, which is DNAPL from well DMW-601. Due to their dark color, the NAPLs are visible in the light to medium, reddish-brown to tan soil (Figure 3b). In addition, NAPL sheens are sometimes observed in soil samples and in soil-water shake tests. The DNAPL from well DMW-601 produced an obvious sheen during a soil-water shake test and a positive reaction with hydrophobic dye (Sudan IV; see Figure 3c); however, it did not produce a noteworthy response under ultraviolet light. The overburden NAPL density and viscosity have been measured, and are similar to those of water.

Pilot Study Purpose and Objectives

The purpose of the NAPL delineation pilot study was to drill soil borings in and around the zone where NAPL had already been visually observed in soil or monitoring wells and assess the new soil samples for the presence of visible NAPL using a specified procedure described in detail in BBL's October 24, 2003 letter to the USEPA. Specific objectives were to: 1) identify the horizontal and vertical locations of NAPL; 2) characterize soil strata containing visible NAPL in terms of grain-size, texture, etc.; and 3) interpret the degree of NAPL saturation in soil (pooled versus residual).

The pilot study field approach entailed drilling as many soil borings as practicable using two direct-push drilling rigs within the stated one-week period. In addition to providing information regarding the effectiveness and implementability of the field methods described herein, the NAPL delineation pilot study provided further data to assist in delineating the source zone to be evaluated for potential remedial technologies in the Feasibility Study.

The field methods that were used for visually identifying NAPL in soil samples were tested by *de maximis* and BBL during a pre-pilot assessment on October 20, 2003, as detailed in the October 24, 2003 letter.

Soil Sample Collection

A total of 39 pilot test borings ("PTB" series) were drilled between November 3 and 7, 2003, at locations in the Operations Area and the former Cianci Property, as shown on Figure 1. Dual-tube, direct-push drilling was conducted using two rigs, which were operated by BBL and O&M, Inc. Soil samples were obtained continuously from ground surface to the depth of equipment refusal, which generally corresponded well to the expected top of bedrock depth, as estimated based on prior boring data (see October 24, 2003 letter). Thirty of the 39 borings encountered bedrock within 2 feet of the expected depth. Three borings were advanced 2.5 to 4 feet deeper than expected, and 6 borings met refusal between 3 and 7 feet above the expected top of bedrock surface. The 6 borings that did not reach the expected top of bedrock were generally clustered near the south end of the sheetpile wall or the north end of the sheetpile wall, and include: PTB-3, PTB-4, PTB-9, PTB-10, PTB-28, and PTB-29. These borings likely encountered cobbles or boulders in the deep overburden. Each soil boring location was grouted upon completion, staked and labeled in the field.

Each soil sample was retrieved in a Lexan sleeve, capped at both ends, and taken to a central sample processing area next to the NTCRA 1 treatment system building. The Lexan sleeve was cut open axially, and the sample underwent evaluation for the presence or absence of visible NAPL. In addition, following the evaluation of the sample for visible NAPL, a BBL geologist classified the soil sample in terms of: 1) soil type; 2) color; 3) percent recovery; 4) relative moisture content; 5) texture; 6) grain size and shape; 7) consistency; 8) staining, if any; 9) odors, if any; and 10) any other noteworthy observations. BBL soil boring logs are included in Attachment 1 to this memorandum. USEPA's hydrogeologic consultant also independently logged soil descriptions. Non-disposable subsurface sampling devices used to collect analytical soil samples were decontaminated between boring locations using an Alconox scrub and/or potable water rinse.

Soil Sample Evaluation for NAPL Presence or Absence

After opening the Lexan™ sleeve, the soil sample in the sleeve was quickly screened for volatile organic vapors using a photoionization detector (PID). During screening, the soil was split open using a stainless steel trowel and the PID probe was placed in the opening. Such readings were obtained along the entire length of the sample. Specific soil intervals that indicated a PID reading >100 parts per million total detectible organic vapors underwent further detailed evaluation for visible NAPL. The assessment for NAPL included a combination of the following tests/observations.

- Evaluation for visible NAPL sheen or dark brown NAPL in soil – NAPL sheens generally were not observed in soil samples. NAPL was observed within the unopened Lexan™ sleeve in some circumstances. For example, NAPL was observed as a separate phase liquid above the soil within the Lexan™ sleeve for the 12-15 ft depth interval at boring PTB-39 (Attachment 2). In addition, NAPL droplets were observed inside the unopened Lexan™ sleeve in soil in a few soil samples (e.g., the 12-16 ft interval at PTB-2 and 8-12 ft depth interval at boring PTB-36). After opening, NAPL staining or NAPL droplets were observed within the soil sample after splitting the sample axially (e.g., the 8-12 ft interval at boring PTB-23 and the 10-12 ft interval at boring PTB-26).

- Soil/dye smear test – A portion of the selected soil interval was placed in disposable polyethylene dish, along with Oil Red O powder. The soil and dye was manually mixed and smeared in the dish to create a paste-like consistency using a new nitrile glove-covered hand for approximately 30 to 60 seconds. The dish was emptied and gently rinsed using distilled water. A positive test result was indicated by bright red (not faint pink) color on the dish and/or glove. Several examples of positive test results are included in Attachment 2. USEPA's hydrogeologic consultant performed a "blank" by mixing Oil Red O powder and distilled water in a polyethylene dish, and found that this procedure produced a pink stain on the dish and glove. Therefore, to assist in distinguishing NAPL, when present, the dish and glove used to perform soil-dye smear tests were compared to those that were previously used on October 20, 2003 with soil samples of known NAPL saturation.

- Soil-water shake test – A small quantity of soil (up to 15 cc) was placed in a clear, colorless, 40 mL vial containing an equal volume of potable or distilled water. The jar was closed and gently shaken for approximately 10 to 20 seconds. The surface of the water was then evaluated for a visible sheen or else a temporary layer of foam. A positive test result was indicated by the presence of a visible sheen or foam on the surface of water. In addition, beginning on November 5, 2003, these samples were also decanted into disposable polyethylene dishes and gently "panned" in the presence of natural light. This process was found to significantly improve the ability to identify NAPL sheens in soil.

- Oil Red O Shake Test – Following the soil-water shake test noted above, a small quantity (approximately 0.5 to 1 cc) of Oil Red O powder was placed in a jar with soil and distilled water. The jar was closed and gently shaken for approximately 10 to 20 seconds. The contents in the closed jar was examined for visible bright red-dyed liquid inside the jar. Positive test results were indicated by a reaction between the dye and a bright red coating the inside of the vial (particularly above the water line) or red-dyed liquid within the soil. The shake test vials were also compared to vials that were used to perform Oil Red O shake tests on October 20, 2003 with soil samples of known NAPL saturation. Several examples of positive Oil Red O shake test vials are shown in Attachment 2.

- FLUTe™ NAPL Ribbon – For comparison with the methods listed above, USEPA's geologist and hydrogeologic consultant also placed axially split soil cores on strips of FLUTe™ NAPL ribbon. The soil cores were allowed to "react" with the FLUTe™ NAPL ribbon material for several hours, and the ribbon was examined for signs of NAPL staining. This method proved effective at identifying NAPL when present at relatively high saturation (e.g., a NAPL pool encountered at boring PTB-2). However, the other methods were determined to be easier and quicker to implement and produced results that were obvious and definitive. Therefore, after the first few soil borings were completed, FLUTe™ NAPL ribbon was not put to significant use.

- Estimation of Relative Degree of NAPL Saturation – When NAPL was interpreted as present in a particular portion of soil, the field team estimated the relative degree of NAPL saturation in the soil. Specifically, an interpretation was made as to whether the observed NAPL is pooled (continuous section of soil in which the pore spaces are filled with a mixture of NAPL and water) or residual (isolated droplets or blebs of NAPL, surrounded by pore spaces containing only water).

The results of each test or observation were recorded on a NAPL evaluation log sheet (Table 1). Any evidence of visible NAPL in a sample was documented on the log sheet. In addition, where possible, the BBL geologist noted the thickness of the interval(s) containing visible NAPL. The primary judgment that was made with each soil sample, however, was whether visible NAPL was present or absent. This degree of soil sample evaluation allowed a relatively high degree of drilling productivity, which would not have been achieved if every soil sample containing NAPL was tested at numerous intervals to pinpoint the vertical limits of NAPL in the Lexan™ sleeve.

Subsequent soil boring locations were selected based on collaborative discussion between USEPA's geologist, USEPA's hydrogeologic consultant, Dr. Bernard H. Kueper, and a BBL geologist.

Results

Attachment 1 presents subsurface logs for the soil borings completed during the NAPL delineation pilot study, and Attachment 2 includes representative photographs of visual evidence of NAPL in soil. Table 1 summarizes visible NAPL testing results. With rare exception, interpretations regarding the presence and relative saturation of NAPL (residual or pooled) were unanimous among the technical representatives of the USEPA and the Group. Rare samples that did not yield unanimous interpretations were not included on Figures 1 and 2.

As summarized on Figure 1, visible NAPL was not interpreted as present at any of the 19 pilot test borings performed at the former Cianci Property. Pooled and or residual NAPL were identified, however, at 11 of the 20 soil borings within the former Operations Area of the site.

Figure 1 shows the 8 pilot test boring locations where pooled NAPL was interpreted as present, including: PTB-2, PTB-23, PTB-26, PTB-30, PTB-31, PTB-36, PTB-38, and PTB-39. The soil intervals containing interpreted NAPL pools were typically composed of relatively well-sorted, brown or gray-brown, fine sand or fine-to-medium sand with little to no silt or gravel. These 8 borings also contained residual NAPL at other depths. Figure 1 also shows the following pilot test boring locations that were interpreted to contain residual NAPL, but no pooled NAPL, including: PTB-20, PTB-35, and PTB-37. In plan view, the pilot test borings that contained pooled NAPL are clustered in the western and eastern portions of the Operations Area, separated by a central area where the soil borings contained only residual NAPL, or else no visible NAPL. With the exception of boring PTB-30, in the northwestern portion of the former Operations Area, borings containing visible NAPL are generally surrounded by locations that lacked visible NAPL.

Figure 2 shows schematic cross sections summarizing the depth of soil samples where pooled or residual NAPL were encountered in the former Operations Area. The borings shown on each cross section have similar ground surface elevations. Thus, for simplicity, the boring data are shown in terms of depth below ground surface. Coordinates for each boring are included on the subsurface log forms in Attachment 1. The cross sections support the following general statements:

- While the potential existence of NAPL remaining in the subsurface at the former Cianci Property cannot be ruled out, it appears that NAPL is much more prevalent in the former Operations Area of the site;

- Pooled NAPL was interpreted as present below the approximate water table at several locations in the former Operations Area;

- Residual NAPL was interpreted as present above and below the water table at several locations in the former Operations Area; and

- Pooled and residual NAPL were both encountered near the base of the overburden at several locations in the Operations Area.

These results will be used to estimate the potential range of NAPL volume within the overburden and assess remedial technologies as part of the Feasibility Study.

MJG/plf
Attachments

Table

TABLE 1

NAPL DELINEATION PILOT TEST
SRSNE SUPERFUND SITE -- SOUTHINGTON, CONNECTICUT

NAPL EVALUATION LOG SHEET

Location ID	Date	Refusal Depth (ft. bgs)	Depth Interval (feet below ground surface)		Observation/Test Results[1]						Participants Involved in Interpreting NAPL Presence[2]										Miscellaneous Comments/Observations
											Mangion		Healey		Kueper		BBL Geologist		de maximis		
			Top	Bottom	PID (ppm, maximum)	Visible NAPL Sheen	Visible NAPL	Soil-Dye Smear Test	Soil-Water Shake Test	Oil Red-O Shake Test	Residual	Pooled	Residual	Pooled	Residual	Pooled	Residual	Pooled	Residual	Pooled	
PTB-1	11/3/03	16.5	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-2	11/3/03	16.5	8	12	>1,000	-	-	+	+8.6 '-10.5-12	+	High	-	+	-	+	-	+	-	0	0	8.6 ft. and 10.5-12 ft. NAPL; entire sample PID >1000 ppm.
PTB-2	11/3/03	16.5	0	4	460 @ 2.0'	-	-	-	foam	-	+	-	+	-	+	-	+	-	0	0	
PTB-2	11/3/03	16.5	4	8	474 @ 5.9-6.1'	-	-	+	+	+	+	-	+	-	+	-	+	-	0	0	
PTB-2	11/3/03	16.5	12	16	3,300	-	+	+	+	+		+		+		+		+	0	0	NAPL droplets visible in sleeve.
PTB-2	11/3/03	16.5	16	18	5,600	-	+	+	-	+	+	-	+	-	+	-	+	-	0	0	
PTB-2	11/3/03	16.5	18	20	619	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	
PTB-2	11/3/03	16.5	20	21	256	-	-	+ slight	+ slight foam	-	+	-	+	-	-	-	+	-	0	0	
PTB-3	11/6/03	20	NT	NT	<1	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-4	11/3/03	23	20	23	34	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	
PTB-5	11/3/03	22	5	10	340	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	
PTB-5	11/3/03	22	10	15	350 @ 13.9-14'	-	-	-	foam	-	-	-	-	-	-	-	-	-	0	0	
PTB-6	11/4/03	30	NT	NT	14.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-7	11/3/03	31	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-8	11/3/03	27	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-9	11/3/03	18	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-10	11/6/03	20	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-11	11/5/03	21.5	NT	NT	1.0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-12	11/4/03	30	16	20	68 @ 17'	-	-	-	foam	-	-	-	-	-	possible	-	+	-	0	0	
PTB-12	11/4/03	30	24	24.5	85 @ 24'	-	-	-	slight foam	-	-	-	-	-	-	-	-	-	0	0	
PTB-13	11/4/03	23	NT	NT	9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-14	11/7/03	35	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-15	11/4/03	25	9	10	114	-	-	-	foam	-	-	-	-	-	-	-	-	-	0	0	
PTB-15	11/4/03	25	10	10.2	280	-	-	NA	foam	-	-	-	-	-	-	-	-	-	0	0	
PTB-16	11/5/03	23	NT	NT	15	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	

See Notes on Page 4.

TABLE 1

NAPL DELINEATION PILOT TEST
SRSNE SUPERFUND SITE -- SOUTHINGTON, CONNECTICUT

NAPL EVALUATION LOG SHEET

			Depth Interval (feet below ground surface)		Observation/Test Results[1]						Participants Involved in Interpreting NAPL Presence[2]										
											Mangion		Healey		Kueper		BBL Geologist		de maximis		
Location ID	**Date**	**Refusal Depth (ft. bgs)**	**Top**	**Bottom**	**PID (ppm, maximum)**	**Visible NAPL Sheen**	**Visible NAPL**	**Soil-Dye Smear Test**	**Soil-Water Shake Test**	**Oil Red-O Shake Test**	**Residual**	**Pooled**	**Residual**	**Pooled**	**Residual**	**Pooled**	**Residual**	**Pooled**	**Residual**	**Pooled**	**Miscellaneous Comments/Observations**
PTB-17	11/5/03	22.5	6	8	140	-	-	-	trace foam	-	-	-	-	-	0	0	-	-	-	-	Petrol. type odor; trace sheen noted in liner above next sample.
PTB-18	11/5/03	20	19	20	250	-	-	-	trace foam	-	-	-	-	-	0	0	-	-	-	-	
PTB-19	11/4/03	15	NT	NT	9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-20	11/5/03	14	0	4	800 @ 1..0'	-	-	-	foam	-	-	-	-	-	0	0	-	-	-	-	
PTB-20	11/5/03	14	4	8	840 @ 7.5-8.0'	-	-	-	slight sheen	-	+ trace	-	+ trace	-	0	0	+	-	+	-	
PTB-20	11/5/03	14	8.5		1600	-	-	-	sheen and foam	+	+	-	+	-	0	0	+	-	+	-	Piece of "rubber" at 8.5 ft. with 1600 PID. Obvious sheen in shake test and Red O shake test.
PTB-20	11/5/03	14	11		1700	-	+	-	sheen and foam	+	+	-	+	-	0	0	+	-	+	-	Red O shake test similar to 3% standard. Possible NAPL visible through Lexan at 11 ft.
PTB-20	11/5/03	14	12 ~13	14	4,200	-	-	-	foam and sheen	-	+ trace	-	+ trace	-	0	0	+	-	+	-	
PTB-21	11/5/03	16	NT	NT	10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-22	11/5/03	14	NT	NT	10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-23	11/5/03	12	1	4	1,050	+	-	+	foam sheen	+	+	-	+	-	0	0	+	-	+	-	Similar to 1-3% standards.
PTB-23	11/5/03	12	4	5	900	+	-	+ weak	foam and sheen	+ weak	+	-	+	-	0	0	+	-	+	-	
PTB-23	11/5/03	12	6	7	2,200	+	-	+ strong	foam and sheen	+ strong	+	-	+	-	0	0	+	-	+	-	Similar to 10% standard. Yellow discoloration of liner.
PTB-23	11/5/03	12	8	12	1,200	+	+	+ strong	foam and sheen	+ mod		+		+	0	0		+		+	Apparent NAPL runs out of sample.
PTB-24	11/5/03	16	8	12	150	-	-	-	foam	-	-	-	-	-	0	0	-	-	-	-	
PTB-24	11/5/03	16	12	16	240	-	-	-	-	-	-	-	-	-	0	0	-	-	-	-	
PTB-25	11/5/03	14	NT	NT	10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-26	11/6/03	16	4	6	9,900	+	-	+	+	+	+	-	+	-	0	0	+	-	+		Similar to 10% standard.
PTB-26	11/6/03	16	6	8	300	+	-	+	+	+	+	-	+	-	0	0	+	-	+	-	Near residual-pooled threshold. Similar to 30% standard.
PTB-26	11/6/03	16	8	11	500	+	+	+	+	+		+		+	0	0		+		+	Separate phase visible in dish. Similar to 30% standard.
PTB-26	11/6/03	16	12	16	300	+ strong	+	+ low	+	NA	+	-	+	-	0	0	+	-	+	-	Some probable smearing from above. Similar to 5% standard.
PTB-27	11/6/03	25	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-28	11/6/03	20	NT	NT	3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-29	11/6/03	18	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-30	11/6/03	12	6	8	570	?*	-	+	foam sheen?*	+	+	-	+	-	0	0	+	-	+	-	Similar to 5% standard.

See Notes on Page 4.

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SRSNE SUPERFUND SITE -- SOUTHINGTON, CONNECTICUT

NAPL EVALUATION LOG SHEET

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											Mangion		Healey		Kueper		BBL Geologist		de maximis		
Location ID	Date	Refusal Depth (ft. bgs)	Top	Bottom	PID (ppm, maximum)	Visible NAPL Sheen	Visible NAPL	Soil-Dye Smear Test	Soil-Water Shake Test	Oil Red-O Shake Test	Residual	Pooled	Residual	Pooled	Residual	Pooled	Residual	Pooled	Residual	Pooled	Miscellaneous Comments/Observations
PTB-30	11/6/03	12	9	11	800	?*	+	+	foam sheen?*	+		+		+	0	0		+		0	Similar to 20-30% standard.
PTB-30	11/6/03	12	11	12	300	?*	-	+ weak	foam sheen?*	+	+	-	+	-	0	0	+	-	+	-	Similar to 1-3% standards.
PTB-31	11/6/03	14	2	4	300	+ strong	-	+	foam and sheen	+	+	-	+	-	0	0	+	-	+	-	Similar to 1% standard.
PTB-31	11/6/03	14	4	8	8,300	+ moderate	-	+	foam and sheen	+	+	-	+	-	0	0	+	-	+	-	Similar to 10-20% standard.
PTB-31	11/6/03	14	8	12	3,000	+	-	+	foam and sheen	+	+	-	+	-	0	0	+	-	+	-	Similar to 10-20% standard.
PTB-31	11/6/03	14	12	14	3,500	+	+	+	foam and sheen	+		+		+	0	0		+		+	
PTB-32	11/6/03	8	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-33	11/7/03	21.5	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-34	11/7/03	14	NT	NT	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
PTB-35	11/7/03	15	6	8	150	-	-	-	foam	-	-	-	-	-	0	0	-	-	0	0	
PTB-35	11/7/03	15	8	12	800	-	-	+ weak	foam	+ weak	+	-	+	-	0	0	+	-	+	-	Very slight positive residue.
PTB-35	11/7/03	15	12	15	130	-	-	+ weak	-	-	-	-	-	-	0	0	-	-	0	0	
PTB-36	11/7/03	14	1	4	300	-	-	-	foam	-	-	-	-	-	0	0	-	-	-	-	Wood in sample.
PTB-36	11/7/03	14	4	8	600	-	-	-	foam	-	-	-	-	-	0	0	-	-	-	-	
PTB-36	11/7/03	14	8	10	1,700	+ weak	+	+	foam and sheen	+		+		+	0	0		+		+	Fine sand similar to 30%
PTB-36	11/7/03	14	10	12	1,700	+	+	+	foam and sheen	+		+		+	0	0		+		+	Fine to coarse sand similar to 30%
PTB-36	11/7/03	14	12	14	327	+	+	+	foam and sheen	+	0	0	+		0	0	+		0	0	Near residual-pooled threshold.
PTB-37	11/7/03	14	12	14	67	-	-	-	foam	-	0	0	-	-	0	0	-	-	0	0	Sample shaken from river.
PTB-37	11/7/03	14	1	4	600	-	-	-	foam	-	0	0	-	-	0	0	-	-	0	0	
PTB-37	11/7/03	14	8	12	1,000	-	-	+ weak	foam	+ weak	+	-	+	-	0	0	+	-	+	-	Very slight positive residue (≤ 1%).
PTB-38	11/7/03	14	1	4	1,100	-	-	-	-	-	0	0	+	-	0	0	+	-	0	0	Trace residual NAPL.
PTB-38	11/7/03	14	4	8	350	-	-	-	-	-	0	0	-	-	0	0	-	-	0	0	
PTB-38	11/7/03	14	8	12	4,000	+	+	+	foam and sheen	+	0	0		+	0	0		+		+	
PTB-38	11/7/03	14	12	14	3,500	-	-	-	foam	-	0	0	-	-	0	0	-	-	0	0	
PTB-39	11/7/03	15	0	4	300	-	-	-	foam	-	0	0	-	-	0	0	-	-	0	0	

See Notes on Page 4.

TABLE 1

NAPL DELINEATION PILOT TEST
SRSNE SUPERFUND SITE -- SOUTHINGTON, CONNECTICUT

NAPL EVALUATION LOG SHEET

			Depth Interval (feet below ground surface)		Observation/Test Results[1]						Participants Involved in Interpreting NAPL Presence[2]										
											Mangion		Healey		Kueper		BBL Geologist		de maximis		
Location ID	Date	Refusal Depth (ft. bgs)	Top	Bottom	PID (ppm, maximum)	Visible NAPL Sheen	Visible NAPL	Soil-Dye Smear Test	Soil-Water Shake Test	Oil Red-O Shake Test	Residual	Pooled	Residual	Pooled	Residual	Pooled	Residual	Pooled	Residual	Pooled	Miscellaneous Comments/Observations
PTB-39	11/7/03	15	4	8	450	+	-	+	foam and sheen	+	0	0	+	-	0	0	+	-	0	0	Strong residual 10-15% range.
PTB-39	11/7/03	15	8	12	2,000	+	+	+	foam and sheen	+	0	0		+	0	0		+	0	0	Very strong hit ≥ 30% standard.
PTB-39	11/7/03	15	12	15	3,500	+	+	+	foam and sheen	+	0	0		+	0	0		+		+	1/8" NAPL pooled with water above core.

Notes:

NT= Not sample tested for NAPL; field inspection did not reveal any visible NAPL; no interval exceeded 100 ppm screening threshold.
* = Sheen difficult to detect without natural light.
** = Refusal depth interpreted as top of bedrock except at PTB-9, which likely encountered a boulder in the deep overburden.
bgs = Below ground surface.

1. + = Visual test produced positive result.
   - = Visual test produced negative result.
   0 = Visual test not performed.

2. **+** = Participant present and interprets that NAPL is PRESENT at the stated degree of saturation.
   - = Participant present and interprets that NAPL is NOT PRESENT at the stated degree of saturation.
   0 = Not participating in NAPL evaluation.

Figures

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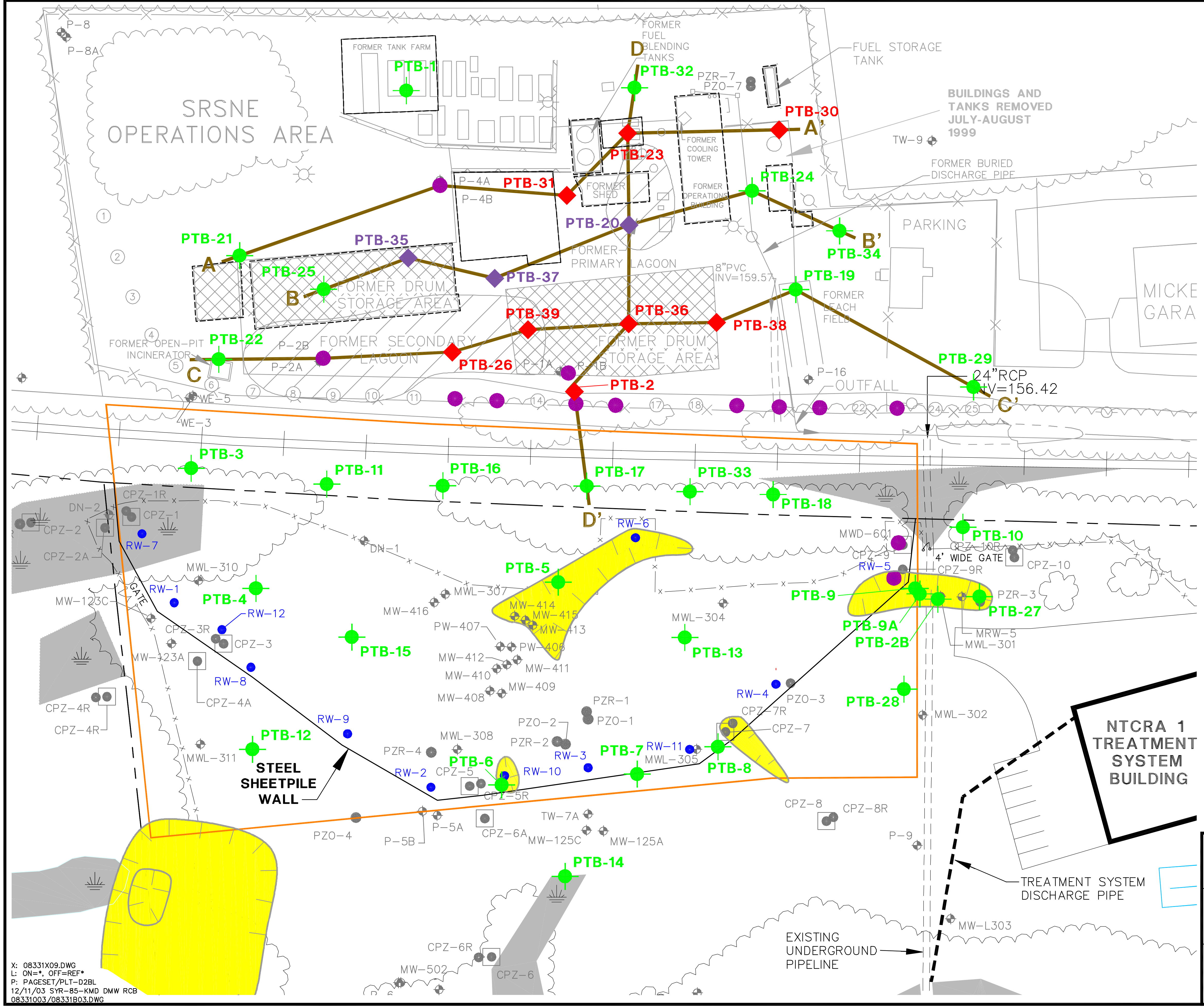

— — —	PROPERTY LINE
- - - - - -	EXISTING CONCRETE PAD
▨	WETLAND
▭	NTCRA 1 CONTAINMENT AREA
▭	EXISTING STRUCTURE
—X—X—	FENCE
⊕ P-10	MONITORING WELL
● PZR-3	NTCRA 1 PIEZOMETER
▣ CPZ-10	NTCRA 1 COMPLIANCE PIEZOMETER
● RW-1	NTCRA 1 OVERBURDEN EXTRACTION WELL
⑫	FORMER ON-SITE INTERCEPTOR INTERCEPTOR SYSTEM EXTRACTION WELL
●	LOCATIONS WITH PREVIOUS VISUAL NAPL IDENTIFICATION
⬭	DEPRESSIONS IN TOP OF BASAL TILL
⊕	PILOT-TEST BORING WITH NO NAPL DETECTED
◆	PILOT TEST BORING WITH INTERPRETED POOLED NAPL
◆	PILOT TEST BORING WITH INTERPRETED RESIDUAL NAPL
A — A'	CROSS SECTION LOCATION

NOTES:
1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY.
3. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.
4. LOCATIONS OF PTB BORINGS AND CONCRETE PADS SURVEYED BY CONKLIN & SOROKA, NOVEMBER 2003.

0 30' 60'
GRAPHIC SCALE

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

FS NAPL-DELINEATION PILOT TEST

INITIAL PILOT-TEST BORING LOCATIONS AND RELEVANT SITE FEATURES

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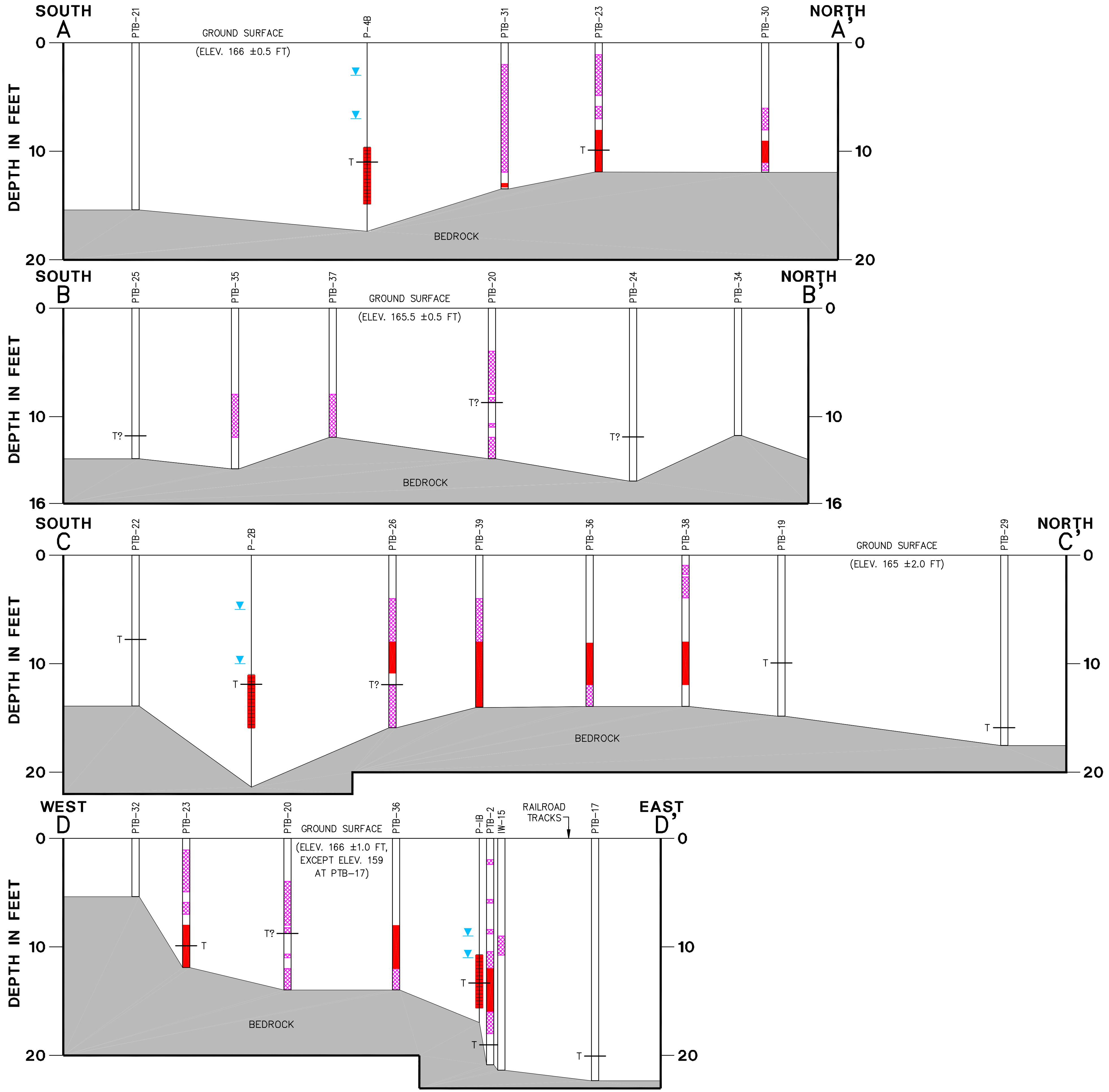
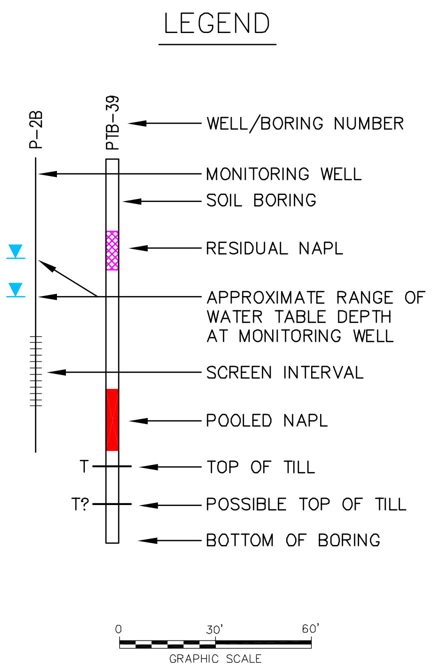
FIGURE
1

X: 08331X09.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-D2BL
12/11/03 SYR-85-KMD DMW RCB
08331003/08331B03.DWG





SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FS NAPL-DELINEATION PILOT TEST

SCHEMATIC CROSS SECTIONS WITH DEPTHS OF VISIBLE NAPL

BBL
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FIGURE
2

X: 08331X09.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-D2BL
12/11/03 SYR-85-KMD DMW RCB
08331003/08331B04.DWG

Attachment 1

BLASLAND, BOUCK & LEE, INC.
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Date Start/Finish: 11/3/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286273.5421
Easting: 564953.3911

Borehole Depth: 16.5 ft. bgs
Surface Elevation: 176.6 ft. AMSL

Descriptions By: Michael Gefell

Boring ID: PTB-1
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0		NA	0-1	NA	NA		CONCRETE pad.	Borehole backfilled with Neat Cement Grout to grade.
	175	930	1-5	4.0	0.0		Red-brown variegated fine to medium SAND and GRAVEL, dry. [FILL]	
5	170	935	5-10	5.0	0.0		Red-brown fine SAND and GRAVEL, little Silt, trace Clay. [TILL]	
10	165	940	10-15	4.0	0.0		Red-brown fine SAND and GRAVEL, trace Silt. [TILL]	
15		945	15-16.5	2.1	0.0			
	160						Refusal (inferred top of bedrock) at 16.5' bgs.	

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Date Start/Finish: 11/3/03	**Northing:** 286375.6629	**Boring ID:** PTB-2
Drilling Company: BBL	**Easting:** 565136.2533	**Client:** SRSNE
Driller's Name: J. Bowland	**Borehole Depth:** 21 ft. bgs	**Project:** NAPL Delineation Pilot Study Southington, Connecticut
Drilling Method: Direct Push	**Surface Elevation:** 165.8'	
Rig Type: AMS PowerProbe	**Descriptions By:** Michael Gefell	
Sampler Type: 4-foot Lexan Sleeves		

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							Dark brown to black GRAVEL and medium SAND, little Silt, roots, odor, dry. [FILL]	
	165						SANDSTONE Cobble. [FILL]	
		810	0-4	2.7	460		Brown fine SAND and SILT, moist. [FILL] Residual NAPL at 2.0' bgs.	
							Medium brown medium SAND. [FILL]	
5							Brown SILT and fine SAND, trace Gravel, moist. Residual NAPL at 5.9' - 6.1' bgs.	Borehole backfilled with Neat Cement Grout to grade.
	160						Yellow-tan GRAVEL and coarse SAND, dry. [FILL]	
		815	4-8	2.7	474		Brown fine SAND and SILT, wet at 6.5' bgs. [FILL]	
							Brown fine SAND, little Silt, trace Organics, Roots, moist.	
							Brown fine SAND, trace Silt, odor, wet. Residual NAPL at 8.6' bgs.	
10		820	8-12	3.1	>1000			
	155						Gray-brown medium SAND, well sorted, odor, wet. Residual NAPL at 10.5' - 12' bgs.	
		840					Fine SAND, trace Silt, trace medium to coarse Sand. Pooled NAPL from 12' - 16' bgs. NAPL visible through Lexan sleeve.	
			12-16	2.7	3300			
15		845						
	150						Gray-brown medium SAND, visible NAPL droplets (residual).	
							Gray-brown medium to coarse SAND, visible NAPL droplets (residual).	
		850	16-18	1.4	5600		Gray-brown fine SAND, trace Silt and Gravel, visible NAPL droplets (residual).	

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Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-2

Borehole Depth: 21 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
						⁘	Gray-brown medium SAND, wet.	▨
		900	18-20	1.3	619	▩	Red-brown GRAVEL, some fine Sand and Silt, dry. [TILL]	▨ Borehole backfilled with Neat Cement Grout to grade.
20	145	910	20-21	0.3	256	▩	Possible residual NAPL from 20 - 21' bgs.	▨
							Refusal (inferred top of bedrock) at 21' bgs.	
25	140							
30	135							
35	130							

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/6/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286142.8178
Easting: 565182.8401

Borehole Depth: 20 ft. bgs
Surface Elevation: 159.08'

Descriptions By: Michael Cobb

Boring ID: PTB-3
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	160							
0	155	1040	0-5	2.3	0.0		Light brown fine to medium SAND, little organics, loose. Black fine SAND and SILT, organic rich (Roots, etc.).	
5	150	1050	5-10	3.0	0.0		Gray-brown fine to medium SAND, trace coarse Sand, medium dense, wet.	Borehole backfilled with Neat Cement Grout to grade.
10	145	1230	10-15	2.2	<1		Brown fine GRAVEL, some fine Sand, little Silt, medium dense to dense, wet.	
15		1240	15-20	2.3	<1			

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Remarks: bgs = below ground surface.

Client:
SRSNE
Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-3

Borehole Depth: 20 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140	1240	15-20	2.3	<1	▨	Brown fine GRAVEL, some fine Sand, little Silt, dense, wet. [TILL]	Borehole backfilled with Neat Cement Grout to grade.
20							Refusal (inferred top of bedrock) at 20' bgs.	
	135							
25								
	130							
30								
	125							
35								

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/3/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286182.172
Easting: 565255.8048

Borehole Depth: 23 ft. bgs
Surface Elevation: 157.47'

Descriptions By: Michael Gefell

Boring ID: PTB-4

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0		1130	0-5	3.9	0.0	Brown fine SAND, trace Gravel, Roots and organic material at top oif interval, slightly moist. [FILL]	Borehole backfilled with Neat Cement Grout to grade.
	155					Brown-gray fine to medium SAND, wet.	
5		1150	5-7	0.8	NA	Red-brown fine to coarse SAND and GRAVEL, trace Silt, moist.	
	150	1300	7-10	2.8	0.0	Gray-brown fine to medium SAND, odor, wet.	
						Red GRAVEL and Cobbles.	
						Gray fine to medium SAND, some Gravel, wet.	
10		1415	10-15	5.0	140	Gray-brown medium SAND.	
	145				360	Red-brown fine to medium SAND, some Silt and Clay, odor, wet.	
15		1450	15-20	1.7	0.0	Red-brown fine to coarse SAND, trace Gravel, wet.	
	140					Red-brown fine to coarse SAND and GRAVEL, little Silt, wet.	

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Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-4

Borehole Depth: 23 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
		1450	15-20	1.7	0.0		Red-brown fine to coarse SAND and GRAVEL, little Silt, wet.	Borehole backfilled with Neat Cement Grout to grade.
20							Gray-brown fine to coarse SAND and GRAVEL, trace Silt.	
		1320	20-23	2.7	34		Red-brown fine to coarse SAND and GRAVEL, little Silt, odor.	
	135							
							Refusal (inferred top of bedrock) at 23' bgs.	
25								
	130							
30								
	125							
35								
	120							

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Remarks: bgs = below ground surface.

Project: 083.31.001
Data File: PTB-4.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/12/03

Date Start/Finish: 11/3/03 - 11/4/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286365.8676
Easting: 565252.0469

Borehole Depth: 22 ft. bgs
Surface Elevation: 158.52'

Descriptions By: Michael Gefell

Boring ID: PTB-5
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0		1610	0-5	3.4	0.0	Brown fine SAND, little Silt, Roots. [FILL]	Borehole backfilled with Neat Cement Grout to grade.
	155					Gray medium to coarse SAND, trace Silt.	
5		1630	5-10		340	Gray medium to coarse SAND.	
	150					Red-brown to gray COBBLES.	
						Red-brown GRAVEL, little Sand, wet.	
10		1650	10-15		350	Red-brown fine SAND, wet.	
	145					Red-brown fine SAND and GRAVEL, wet.	
						Red-brown SILT and fine SAND, odor, wet.	
15		1700	15-20		0.0	Brown fine to medium SAND.	

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Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-5

Borehole Depth: 22 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140						Brown fine SAND and SILT.	
		1700	15-20		0.0		Red-brown fine GRAVEL, little Sand and Silt, wet. [TILL?]	Borehole backfilled with Neat Cement Grout to grade.
20		0900	20-22	1.2	7.0		Brown fine to medium SAND, little Gravel, wet.	
							Brown fine to coarse SAND, some Gravel.	
							Refusal (inferred top of bedrock) at 22' bgs.	
	135							
25								
	130							
30								
	125							
35								

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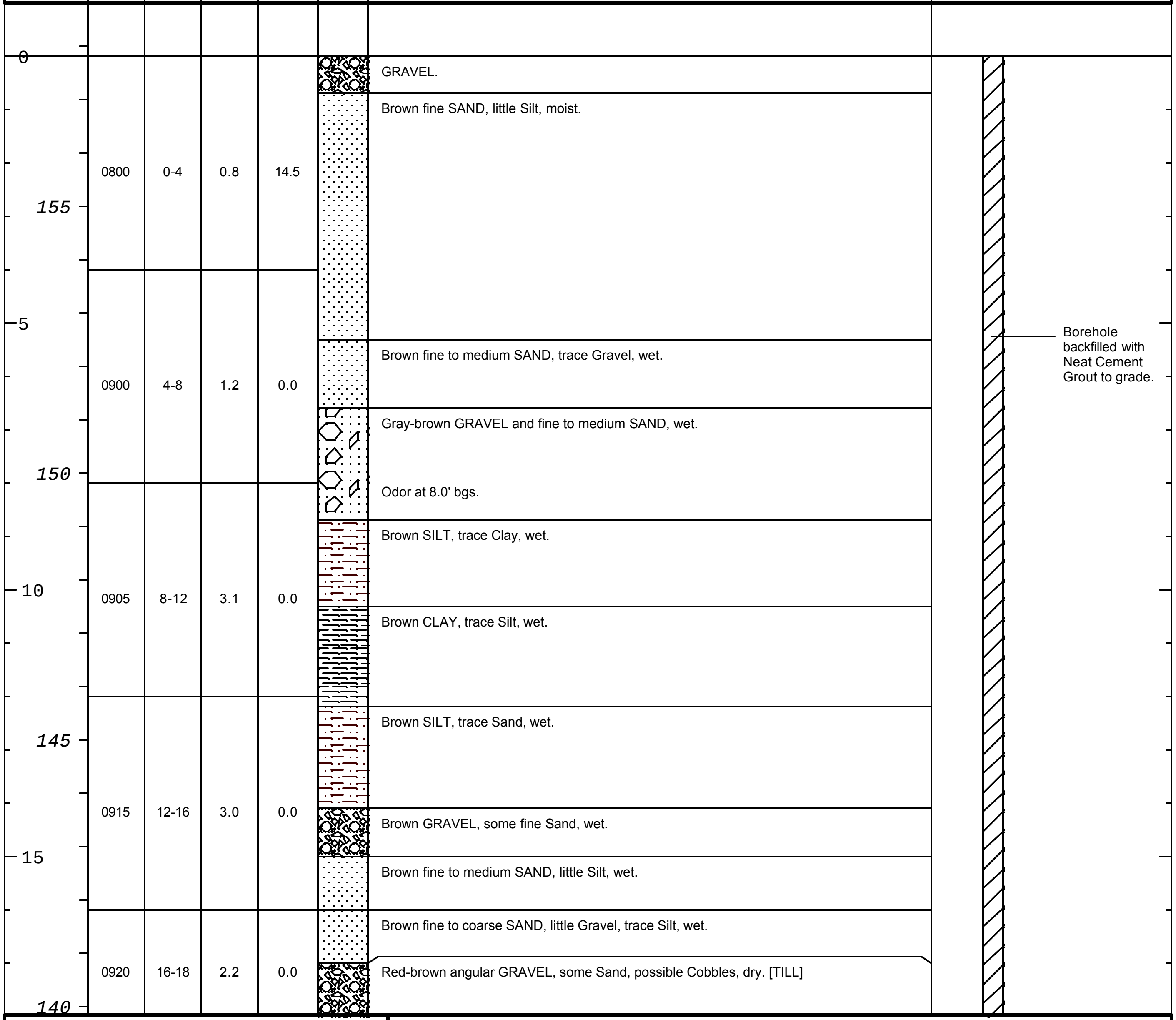
Remarks: bgs = below ground surface.

Date Start/Finish: 11/4/03 **Drilling Company:** BBLES **Driller's Name:** J. Bolland **Drilling Method:** Direct Push **Rig Type:** AMS PowerProbe **Sampler Type:** 4-foot Lexan Sleeves	**Northing:** 286331.4612 **Easting:** 565375.2519 **Borehole Depth:** 30 ft. bgs **Surface Elevation:** 157.81' **Descriptions By:** Michael Gefell	**Boring ID:** PTB-6 **Client:** SRSNE **Project:** NAPL Delineation Pilot Study Southington, Connecticut



Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)
0800	0-4	0.8	14.5
0900	4-8	1.2	0.0
0905	8-12	3.1	0.0
0915	12-16	3.0	0.0
0920	16-18	2.2	0.0

Stratigraphic Description

GRAVEL.

Brown fine SAND, little Silt, moist.

Brown fine to medium SAND, trace Gravel, wet.

Gray-brown GRAVEL and fine to medium SAND, wet.

Odor at 8.0' bgs.

Brown SILT, trace Clay, wet.

Brown CLAY, trace Silt, wet.

Brown SILT, trace Sand, wet.

Brown GRAVEL, some fine Sand, wet.

Brown fine to medium SAND, little Silt, wet.

Brown fine to coarse SAND, little Gravel, trace Silt, wet.

Red-brown angular GRAVEL, some Sand, possible Cobbles, dry. [TILL]

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Remarks: bgs = below ground surface.

Project: 083.31.001
Data File: PTB-6.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-6

Borehole Depth: 30 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
							Red-brown angular GRAVEL, some Sand, possible Cobbles, dry.	Borehole backfilled with Neat Cement Grout to grade.
		0925	18-20	1.2	12.5		Red-brown GRAVEL, some Sand, trace Silt, moist.	
20								
	135	0930	20-24	1.7	1.3		Red-brown fine to coarse SAND and GRAVEL, trace Silt, wet.	
							No sample from 24' - 25' bgs. Apparent cleaned out hole with tube.	
25			25-28	0.0	0.0		Red-brown GRAVEL, some Sand, little Silt, wet.	
	130							
			28-30	0.0	0.0		Red-brown fine to coarse SAND, some Gravel, little Silt, very dense, moist. [Possible Basal TILL]	
30							Refusal (inferred top of bedrock) at 30' bgs.	
	125							
35								
	120							

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/3/03
Drilling Company: BBL
Driller's Name: J. Bolland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286413.8082
Easting: 565368.6662

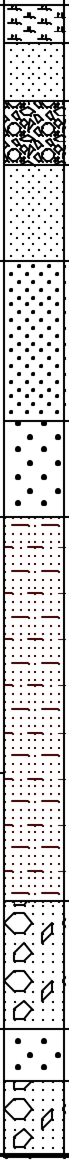
Borehole Depth: 31 ft. bgs
Surface Elevation: 156.63'

Descriptions By: Michael Gefell

Boring ID: PTB-7
Client: SRSNE
Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)
0		1440	0-4	2.2	0.0
	155				
5		1442	4-8	2.7	0.0
	150				
10		1445	8-12	2.6	0.0
	145				
15		1500	12-16	2.5	0.0
	140	1510	16-20	2.5	0.0

Geologic Column



Stratigraphic Description
Red-brown fine SAND, some fine Gravel, trace Silt, moist. [TOPSOIL]
Red-browon fine SAND, trace Clay and Gravel.
Black angular GRAVEL, trace Silt and Sand, wet.
Brown fine SAND.
Gray-brown medium to coarse SAND, wet.
Red-gray variegated coarse SAND, little Gravel, trace Silt, wet.
Red-brown fine SAND and SILT, wet. Clayey lens from 13.9' - 14' bgs.
Red-brown medium to coarse SAND and GRAVEL, little Silt, slight odor, wet.
Red-brown coarse SAND, trace Silt, wet.
Red-brown fine to coarse SAND and GRAVEL, wet.

Boring Construction

Borehole backfilled with Neat Cement Grout to grade.

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Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-7

Borehole Depth: 31 ft. bgs

DEPTH / ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
	1510	16-20	2.5	0.0	Red-brown fine to coarse SAND and GRAVEL, wet. Red-brown fine SAND and SILT/CLAY, wet.	Borehole backfilled with Neat Cement Grout to grade.
20 135	1520	20-24	1.5	0.0	Red-brown fine SAND and GRAVEL, wet. Red-brown coarse SAND, little Silt, trace Gravel, wet.	
25 130	1535	24-28	1.4	0.0	Red-brown fine to medium SAND and GRAVEL, moist. [TILL]	
30	1540	28-31	2.9	0.0	Red-brown fine to medium SAND. Red-brown medium to coarse SAND. Red-brown fine to medium SAND, little Silt, moist.	
125 35 120					Refusal (inferred top of bedrock) at 31' bgs.	

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/3/03 **Drilling Company:** BBL **Driller's Name:** J. Bolland **Drilling Method:** Direct Push **Rig Type:** AMS PowerProbe **Sampler Type:** 4-foot Lexan Sleeves	**Northing:** 286462.9004 **Easting:** 565352.0514 **Borehole Depth:** 27 ft. bgs **Surface Elevation:** 158.02' **Descriptions By:** Michael Gefell	**Boring ID:** PTB-8 **Client:** SRSNE **Project:** NAPL Delineation Pilot Study Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							Black fine to medium SAND and Roots, trace Gravel, moist. [TOPSOIL]	
	155	1220	0-4	2.0	0.0		Red-brown fine to coarse SAND, some Gravel, no odor, moist.	
5							Red-gray fine SAND, little Silt and Clay, moist.	Borehole backfilled with Neat Cement Grout to grade.
		1230	4-8	3.6	0.0		Gray fine SANd, Micas.	
							Red-brown fine SAND and GRAVEL, some slight odor, moist.	
10	150	1240	8-12	0.7	0.0		Red-brown fine SAND and GRAVEL, moist.	
15	145	1245	12-16	2.6	0.0		Red-brown fine to medium SAND, little Silt, trace Gravel, no odor, wet.	
		1250	16-20	2.7	0.0		Gray-brown fine to medium SAND, trace Gravel, wet.	

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Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-8

Borehole Depth: 27 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140	1250	16-20	2.7	0.0		Red fine SAND, no odor, wet.	Borehole backfilled with Neat Cement Grout to grade.
20		1310	20-24	2.1	0.0		Red-brown fine SAND, wet.	
							Red-brown SILT and CLAY, little Sand, wet.	
	135						Red-brown fine to medium SAND and GRAVEL, moist. [Possible TILL]	
25		1320	24-27	0.6	0.0		Red-brown fine to medium SAND, wet.	
	130						Refusal (inferred top of bedrock) at 27' bgs.	
30								
	125							
35								

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/3/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286582.7619
Easting: 565255.8762

Borehole Depth: 18 ft. bgs
Surface Elevation: 160.1 ft. AMSL

Descriptions By: Michael Gefell

Boring ID: PTB-9
Client: SRSNE
Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0	160	1030	0-4	2.2	0.0	Dark gray angular GRAVEL and coarse SAND, moist. [FILL] Red-brown fine SAND and GRAVEL, moist. Brown-green-tan fine SAND, no odor, moist.	
5	155	1035	4-8	3.6	0.0	Black to brown medium to coarse SAND, trace Silt, Roots, moist. Gray medium SAND, wet. Gray fine SAND, wet. Tan-gray medium SAND, trace Gravel, wet.	Borehole backfilled with Neat Cement Grout to grade.
10	150	1040	8-12	4.0	0.0	Brown medium SAND, trace Gravel, wet. Red to brown variegated GRAVEL.	
15	145	1045	12-16	3.6	0.0	Red-brown medium SAND, trace fine Sand, wet. Red-brown fine SAND, trace Silt, wet. Red-brown GRAVEL and fine to medium SAND, wet.	
		1050	16-18	0.5	0.0	Red-brown GRAVEL, some fine to medium Sand, little Silt, dense, cohesive. [TILL] Attempted two adjacent borings (PTB-9A and PTB-9B); both met refusal at 16-18 ft. bgs. Possible large boulder.	

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-9.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/6/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286611.6875
Easting: 565218.6642

Borehole Depth: 20.5 ft. bgs
Surface Elevation: 157.82'

Descriptions By: Michael Cobb

Boring ID: PTB-10
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)
0		1450	0-5	3.1	0.0
	155				
5		1500	5-10	2.6	0.0
	150				
10		1510	10-15	3.2	0.0
	145				
15		1520	15-20	4.2	0.0
	140				

Stratigraphic Description
Brown rounded GRAVEL, some Silt and fine Sand, Roots, cohesive, wet.
Gray-brown fine to medium SAND, trace Gravel, wet.
Gray-brown fine SAND, trace Gravel.
Dark brown medium to coarse SAND, some Gravel, little Silt, wet.
Red-brown fine SAND, some Gravel, little Silt, dense, cohesive, wet. [TILL-like]
Red-brown fine to medium SAND, trace Silt, medium dense, wet.

Boring Construction

Borehole backfilled with Neat Cement Grout to grade.

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Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-10

Borehole Depth: 20.5 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
		1520	15-20	4.2	0.0		Red-brown fine SAND, some to little Gravel, little Silt, cohesive, wet.	Borehole backfilled with Neat Cement Grout to grade.
20							No Recovery.	
							Refusal (inferred top of bedrock) at 20.5' bgs.	
	135							
25								
	130							
30								
	125							
35								
	120							

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/5/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286225.1868
Easting: 565192.525

Borehole Depth: 21.5 ft. bgs
Surface Elevation: 157.74'

Descriptions By: Michael Cobb

Boring ID: PTB-11
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							Dark olive-brown to black fine to medium SAND, little Gravel, Roots and Organics. [FILL]	
							Dark brown fine SAND, Roots, moist.	
							Light brown fine to medium SAND, trace coarse Sand, trace Silt, moist to wet.	
	155	1520	0-5	2.8	0.0			
5							Red-brown fine SAND and fine GRAVEL, some medium to coarse Sand, dense.	Borehole backfilled with Neat Cement Grout to grade.
							Red-brown SILT, soft, wet.	
							Brown fine SAND and GRAVEL, some medium to coarse Sand, little Silt, dense.	
	150	1525	5-10	2.8	0.0			
10							Brown fine to coarse SAND and GRAVEL, little Silt, pockets are predominantly fine Sand, wet.	
	145	1530	10-15	2.8	1.0			
15							Brown fine SAND, trace fine Gravel (grading to little Gravel), trace Silt.	
		1535	15-20	3.1	0.0			
	140							

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Client:
SRSNE
Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-11
Borehole Depth: 21.5 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
		1535	15-20	3.1	0.0		Brown fine SAND, some coarse Sand and fine Gravel, little Silt, cohesive, dense. [Possible TILL]	Borehole backfilled with Neat Cement Grout to grade.
20		1610	20-21.5	1.5	0.0		Brown fine SAND, trace Silt, trace coarse Sand, medium dense, wet.	
							Weathered ROCK (Sand/Gravel with structure) at 21' bgs.	
							Refusal at 21.5' bgs.	
	135							
25								
	130							
30								
	125							
35								
	120							

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Project: 083.31.001
Data File: PTB-11.dat
Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/4/03
Drilling Company: BBL
Driller's Name: J. Bolland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286180.0662
Easting: 565353.6242

Borehole Depth: 30 ft. bgs
Surface Elevation: 155.61'

Descriptions By: Michael Gefell

Boring ID: PTB-12
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0		1140	0-4	2.5	0.0		Brown fine SAND, some Gravel, trace Silt, Roots, moist. [TOPSOIL]	
	155						Red-brown SAND and angular GRAVEL, apparently reworked.	
							Gray-brown fine SAND, trace Silt, wet.	
		1145	4-6	1.2	0.0		Brown-gray medium SAND, trace Gravel and Silt, wet.	
5	150						Brown fine to medium SAND and GRAVEL, little Silt, wet. Rock in bottom of sleeve.	Borehole backfilled with Neat Cement Grout to grade.
		1205	6-8	1.2	0.0		Brown fine to medium SAND, some Gravel and Silt, wet.	
		1210	8-12	2.5	0.0		Gray-brown fine to coarse SAND, little Silt, wet.	
							Gray GRAVEL, some Sand, trace Silt, wet.	
10	145						Brown SILT, little fine Sand, wet.	
							Brown GRAVEL and fine SAND, wet.	
		1220	12-16	1.7	48		Brown fine to medium SAND, little Gravel and Silt, moist.	
15	140						Brown GRAVEL, some Silt and fine SAND, moist. Possible Residual NAPL from 16' - 20' bgs.	
		1230	16-20	2.9	68		Brown SILT, many ~1mm lenses of fine Sand, wet. Possible Residual NAPL from 16' - 20' bgs.	

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Remarks: bgs = below ground surface.

Project: 083.31.001
Data File: PTB-12.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-12

Borehole Depth: 30 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
20	135	1230	16-20	2.9	10-68		Brown SILT, many ~1mm lenses of fine Sand, wet. Possible Residual NAPL from 16' - 20' bgs.	Borehole backfilled with Neat Cement Grout to grade.
		1240	20-24	3.2	40		Brown SILT, trace to little Clay, wet.	
25	130	1240	24-28	1.2	85		Brown GRAVEL, some Sand and Silt, wet. [Possible TILL]	
		1330	28-30	1.8	0.0		Red-brown SILT, trace fine Sand and Gravel, wet.	
30	125						Refusal (inferred top of bedrock) at 30' bgs.	
35	120							

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Remarks: bgs = below ground surface.

Date Start/Finish:	11/4/03
Drilling Company:	BBL
Driller's Name:	J. Bolland
Drilling Method:	Direct Push
Rig Type:	AMS PowerProbe
Sampler Type:	4-foot Lexan Sleeves

Northing:	286442.7355
Easting:	565285.6665
Borehole Depth:	23 ft. bgs
Surface Elevation:	158.03'
Descriptions By:	Michael Gefell

Boring ID: PTB-13

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0		1420	0-4	2.0	0.0		Brown fine SAND, some coarse Sand and fine Gravel, little Silt, Organics, moist.	
	155						Reddish-brown SILT, little fine Sand, stiff, dry to moist.	
5		1440	4-8	2.8	0.0		Gray-brown fine to medium SAND, medium dense, well sorted, stiff.	Borehole backfilled with Neat Cement Grout to grade.
							Red-brown GRAVEL, some fine to medium Sand, little Silt, cohesive.	
	150	1450	8-12	3.2	0.0		Brown GRAVEL, little fine to medium Sand, trace Silt, wet.	
10							Gray fine SAND, well sorted, wet.	
	145	1500	12-16	4.0	9.0		Gray-brown fine to medium SAND, trace Silt and Gravel, wet.	
15							Red-brown fine SAND, trace Gravel, wet.	
		1510	16-20	1.8	9.0		Gray to red-brown medium SAND, little Gravel, wet.	

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Boring ID: PTB-13

Borehole Depth: 23 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140						Red-brown GRAVEL, some Sand, trace Silt, moist. [TILL]	Borehole backfilled with Neat Cement Grout to grade.
		1510	16-20	1.8	9.0			
20								
		1520	20-23	1.2	0.0		Increasing density, possible Basal Till at 21.5' bgs.	
	135						Refusal (inferred top of bedrock) at 23' bgs.	
25								
	130							
30								
	125							
35								

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/7/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286369.9702
Easting: 565430.7541

Borehole Depth: 35 ft. bgs
Surface Elevation: 154.36'

Descriptions By: Michael Cobb

Boring ID: PTB-14
Client: SRSNE
Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	155							
0	150	1200	0-5	3.2	0.0		Brown fine SAND and SILT, some Organics, moist to wet. Brown fine SAND, trace little Silt, trace Organics. Brown very fine SAND, little Silt, dilatent, trace Gravel.	
5	145	1205	5-10	3.7	0.0		Brown SILT, trace Gravel, moderately stiff, massive.	Borehole backfilled with Neat Cement Grout to grade.
10	140	1210	10-15	3.9	0.0		Brown fine SAND and fine GRAVEL, trace to little Silt, wet.	
15		1215	15-20	0.5	0.0		Poor recovery from 15' - 20' bgs.	

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Remarks: bgs = below ground surface.

Project: 083.31.001
Data File: PTB-14.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-14

Borehole Depth: 35 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	135	1215	15-20	0.5	0.0		Brown fine SAND and fine GRAVEL, trace to little Silt, wet. Poor recovery from 15' - 20' bgs.	Borehole backfilled with Neat Cement Grout to grade.
20							Brown fine to medium SAND, trace Gravel, little Silt.	
		1230	20-25	3.6	0.0		Brown very fine SAND, little Silt, wet. Pocket with some Gravel at 23' bgs.	
25	130	1430	25-30	4.5	0.0			
	125						Brown fine SAND, little Gravel, dense, wet. [Possible TILL]	
30		1455	30-35	4.1	0.0		Some little sub-rounded Gravel below 30' bgs.	
35	120						Refusal (inferred top of bedrock) at 35' bgs.	

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Remarks: bgs = below ground surface.

Project: 083.31.001
Data File: PTB-14.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/7/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286240.4609
Easting: 565285.3902

Borehole Depth: 25 ft. bgs
Surface Elevation: 157.53'

Descriptions By: Michael Gefell

Boring ID: PTB-15
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							Dark brown fine SAND, Roots. [TOPSOIL]	
							Brown fine SAND, little Gravel and Silt, trace Roots and Cinders, moist. [FILL]	
	155	1030	0-5	4.0	<10			
							Gray fine to medium SAND.	
5							Gray fine to medium SAND, trace Silt, wet.	Borehole backfilled with Neat Cement Grout to grade.
	150	1040	5-10	3.0	<10		Brown GRAVEL, some fine to coarse Sand, trace Silt, odor, wet.	
					114			
10					280		Brown SILT, some fine Gravel, wet.	
							Trace Gravel below 11.5' bgs.	
	145	1310	10-15		64			
							Brown fine SAND and GRAVEL, some Silt, odor.	
15							Brown GRAVEL, some Silt.	
							Brown medium to coarse SAND and GRAVEL, little Silt.	
		1540	15-20	3.2	25		Brown GRAVEL, some Silt and fine Sand, dense, wet. [TILL]	
	140							

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Client:
SRSNE

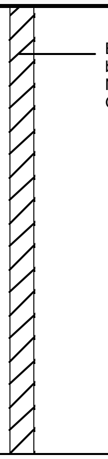
Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-15

Borehole Depth: 25 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description
		1540	15-20	3.2	25		Brown GRAVEL, some Silt and fine Sand, dense, wet. [TILL]
20							Broiwn fine SAND, trace Gravel and Silt, moist.
	135	1610	20-25	3.0	9.2		Brown fine SAND and GRAVEL, trace Silt, moist.
25							Refusal (inferred top of bedrock) at 25' bgs.
	130						
30							
	125						
35							
	120						

Boring Construction



Borehole backfilled with Neat Cement Grout to grade.

Remarks: bgs = below ground surface.

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Date Start/Finish: 11/8/03
Drilling Company: O & M
Driller's Name: O & M
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 5-foot Lexan Sleeves

Northing: 286295.7482
Easting: 565193.5261

Borehole Depth: 23 ft. bgs
Surface Elevation: 158.5'

Descriptions By: Michael Cobb

Boring ID: PTB-16
Client: SRSNE
Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0						Gray-brown fine SAND, some Organics, little Silt, moist.	
						Medium brown fine SAND, little Silt, trace Roots, wet.	
	155	1230	0-5	2.9	0.0	Olive-gray fine to medium SAND, trace coarse Sand, wet.	
5							Borehole backfilled with Neat Cement Grout to grade.
	150	1330	5-10	1.2	10	Red-brown GRAVEL, some fine to medium Sand, little Silt, wet.	
10							
	145	1340	10-15	2.1	15		
15							
		1420	15-20	4.0	0.0	Brown fine SAND, some medium coarse Sand and fine Gravel, little Silt, dense. [Possible TILL]	
	140					Brown fine SAND, little medium Sand, trace Gravel and Silt.	

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Remarks: bgs = below ground surface.

Project: 083.31.001
Data File: PTB-16.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-16

Borehole Depth: 23 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
		1420	15-20	4.0	0.0	⁘	Brown fine SAND, little medium Sand, trace Gravel and Silt.	▨ Borehole backfilled with Neat Cement Grout to grade.
						⁘	Brown fine SAND, some Gravel, little Silt, very dense. [TILL]	▨
20	135	1440	20-23	3.0	0.0	⁘	Brown fine SAND, little fine Gravel, little Silt, very dense. Pockets of pale gray color below 21' bgs.	▨
25 30 35	130 125 120						Refusal (inferred top of bedrock) at 23' bgs.	

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Remarks: bgs = below ground surface.

Date Start/Finish:	11/5/03
Drilling Company:	O & M
Driller's Name:	O & M
Drilling Method:	Direct Push
Rig Type:	Geoprobe
Sampler Type:	5-foot Lexan Sleeves
Northing:	286383.152
Easting:	565193.6039
Borehole Depth:	22.5 ft. bgs
Surface Elevation:	158.62'
Descriptions By:	Michael Cobb
Boring ID:	PTB-17
Client:	SRSNE
Project:	NAPL Delineation Pilot Study Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0	155	1010	0-5	1.5	0.0		Olive SILT, some Organics, Gravel, soft, wet. Medium brown fine to medium SAND, loose, wet.	
5	150	1050	5-10	2.6	140		Gray-brown fine to medium SAND, trace coarse Sand, loose to medium dense, wet. Red-brown GRAVEL, some Silt, little fine to coarse Sand, dense, wet.	Borehole backfilled with Neat Cement Grout to grade.
10	145	1055	10-15	1.0	10-20		Red-brown GRAVEL, some fine to coarse Sand, little Silt, trace sheens noted in silt-smear in liner above sample, dense, wet.	
15		1200	15-20	1.6	40		Faint odor below 15' bgs.	

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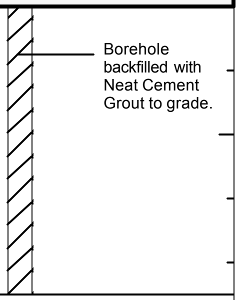
Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-17

Borehole Depth: 22.5 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140	1200	15-20	1.6	40	▨	Red-brown GRAVEL, some fine to coarse Sand, little Silt, faint odor, dense, wet.	
20		1210	20-22.5	2.5	20-30	▨	Red-brown GRAVEL, some to little Silt, little fine to coarse Sand, cohesive, faint odor, wet. [TILL]	
25 30 35	135 130 125						Refusal (inferred top of bedrock) at 22.5' bgs.	

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Remarks: bgs = below ground surface.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-18

Borehole Depth: 20 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
		0915	15-20	3.8	250	⣿	Red-brown fine SAND, little Silt, little rounded Gravel.	▨ Borehole backfilled with Neat Cement Grout to grade.
20							Refusal (inferred top of bedrock) at 20' bgs.	
	135							
25								
	130							
30								
	125							
35								
	120							

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/4/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286510.1309
Easting: 565074.3064

Borehole Depth: 15 ft. bgs
Surface Elevation: 166.0 ft. AMSL

Descriptions By: Michael Gefell

Boring ID: PTB-19
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							Pavement and Gravel.	
	165	1620	0-4	2.6	9.0		Red-brown to gray variegated GRAVEL, some fine to medium Sand, trace Silt, rubbery material, dry. [FILL]	
5	160	1625	4-8	2.7	2.0		Gray to red-brown fine SAND, little Gravel, trace Silt, wet.	Borehole backfilled with Neat Cement Grout to grade.
							Gray fine SAND.	
							Dark gray GRAVEL, some fine Sand.	
10	155	1630	8-12	3.2	0.0		Red-brown fine to medium SAND, little Gravel, trace Silt, dry. [TILL]	
		1650	12-15	2.4	3.0		Red-brown fine SAND, some Silt, little Gravel, moist.	
15	150						Refusal (inferred top of bedrock) at 15' bgs.	

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Project: 083.31.001
Data File: PTB-19.dat
Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/4/03 **Drilling Company:** BBL **Driller's Name:** J. Boland **Drilling Method:** Direct Push **Rig Type:** AMS PowerProbe **Sampler Type:** 4-foot Lexan Sleeves	**Northing:** 286408.7489 **Easting:** 565034.9788 **Borehole Depth:** 14 ft. bgs **Surface Elevation:** 166.4 ft. AMSL **Descriptions By:** Michael Gefell	**Boring ID:** PTB-20 **Client:** SRSNE **Project:** NAPL Delineation Pilot Study Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							ASPHALT and subgrade Gravel, dry.	Borehole backfilled with Neat Cement Grout to grade.
	165	0730	0-4	2.8	800		Red-brown fine SAND, little to some Gravel, odor, dry to moist.	
5	160	0735	4-8	2.6	840		Red-brown fine SAND, some Silt, little Gravel, wet. Trace residual NAPL.	
							Brown fine SAND, some Silt.	
		0744	8-12	4.0	1700		Brown to black fine SAND, some Silt, odor, sheen. Piece of rubber at 8.5' bgs. Residual NAPL at 8.5' bgs.	
10	155						Red-brown fine SAND, little Gravel and Silt, odor, moist. [Possible TILL] Apparent NAPL droplets visible through Lexan tube at 11' bgs; NAPL determined to be residue.	
		0750	12-14	1.4	4200		Red-brownfine SAND and SILT, trace Gravel. Trace residual NAPL.	
							Weathered Rock at 13.6' bgs.	
15	150						Refusal (inferred top of bedrock) at 14' bgs.	

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Project: 083.31.001
Data File: PTB-20.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/5/03

Date Start/Finish: 11/5/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286172.2426
Easting: 565053.6594

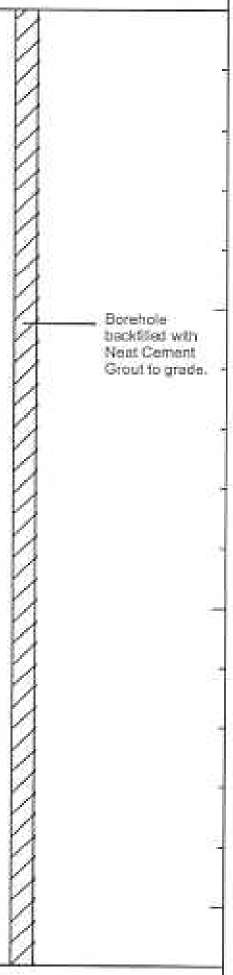
Borehole Depth: 16 ft. bgs
Surface Elevation: 167.1 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-21
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							Dark gray angular GRAVEL.	
							Brown GRAVEL, some Silt and fine Sand matrix, dense, moist. [FILL]	
	165	0920	0-4	2.4	10			
5								
		0925	4-8	2.9	10			
	160							
							Brown fine SAND, little coarse Sand and fine rounded Gravel, trace to little Silt, moist to wet. Some rounded Gravel below 8.0' bgs.	
10		0930	8-12	2.9	10			
	155							
		0940	12-16	2.9	10		Brown fine SAND, some coarse Sand and fine Gravel, little Silt, medium dense, moist to wet.	
15								
							Weathered Rock.	
							Refusal at 16' bgs.	
	150							



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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level

Project: 083.31.001
Data File: PTB-21.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/5/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286159.5747
Easting: 565116.6317

Borehole Depth: 14 ft. bgs
Surface Elevation: 167.1 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-22
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0						Dark brown SILT and Organics.	
						Broken CONCRETE.	
	165	1020	0-4	1.5	0.0	Brown fine SAND, some Gravel, little Silt and medium to coarse Sand.	
5		1025	4-8	1.4	0.0		Borehole backfilled with Neat Cement Grout to grade.
	160					Brown fine SAND, some to little Silt, medium dense, wet.	
						Brown GRAVEL, some Silt, little fine to coarse Sand, cohesive, [TILL]	
10		1030	8-12	3.0	10		
	155	1040	12-14	0.5	0.0		
15						Refusal (inferred top of bedrock) at 14' bgs.	
	150						

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Project: 083.31.001
Data File: PTB-22.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish:	11/5/03	**Northing:**	286408.0728	**Boring ID:**	PTB-23
Drilling Company:	BBL	**Easting:**	564979.37	**Client:**	SRSNE
Driller's Name:	J. Boland	**Borehole Depth:**	12 ft. bgs	**Project:**	NAPL Delineation Pilot Study Southington, Connecticut
Drilling Method:	Direct Push	**Surface Elevation:**	166.5 ft. AMSL		
Rig Type:	AMS PowerProbe	**Descriptions By:**	Michael Cobb		
Sampler Type:	4-foot Lexan Sleeves				

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							CONCRETE.	Borehole backfilled with Neat Cement Grout to grade.
	165	1400	0-4	1.7	1050		Fine GRAVEL, little fine to medium Sand. [FILL] Residual NAPL from 1.0' - 5.0' bgs.	
							Brown fine SAND, trace Gravel, trace Silt, dense, odor, moist. Residual NAPL identified 1.0- 5.0' bgs.	
5	160	1405	4-8	2.5	2200		Brown fine SAND, little Gravel, little Silt, medium hard, strong odor. Residual NAPL idenfied 6.0' - 7.0' bgs	
							Brown fine SAND, little Silt, trace fine Gravel, loose, wet. NAPL blebs visible 9-10' bgs. Pooled NAPL identified 8.0' - 12' bgs.	
10	155	1445	8-12	3.0	1200		Brown fine SAND and GRAVEL, some to little Silt, very dense. [TILL] Pooled NAPL identified 8.0' - 12' bgs.	
							Refusal (inferred top of bedrock) at 12' bgs.	
15	150							

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Project: 083.31.001
Data File: PTB-23.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/5/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286483.6103
Easting: 565014.3261

Borehole Depth: 16 ft. bgs
Surface Elevation: 166.8 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-24

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0	165	1545	0-4	1.7	2.0		ASPHALT. Brown very fine SAND, little Silt, little coarse Sand and fine Gravel, dry to moist.	
5	160	1550	4-8	2.8	60		Brown fine SAND, trace to little fine Gravel, dense, moist.	Borehole backfilled with Neat Cement Grout to grade.
10	155	1600	8-12	4.0	150			
15		1610	12-16	NA	240		Brown fine SAND, trace to little fine Gravel, very dense, dry to moist. [Possible TILL]	
	150						Refusal (inferred top of bedrock) at 16' bgs.	

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Date Start/Finish: 11/5/03 **Drilling Company:** BBL **Driller's Name:** J. Boland **Drilling Method:** Direct Push **Rig Type:** AMS PowerProbe **Sampler Type:** 4-foot Lexan Sleeves	**Northing:** 286223.3744 **Easting:** 565074.1231 **Borehole Depth:** 14 ft. bgs **Surface Elevation:** 166.3 ft. AMSL **Descriptions By:** Michael Cobb	**Boring ID:** PTB-25 **Client:** SRSNE **Project:** NAPL Delineation Pilot Study Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							CONCRETE slab.	
	165						Gray SAND and GRAVEL, [FILL]	
		1630	0-4	2.3	2.0		Brown fine SAND, some Silt, some fine Gravel, dense, dry to moist.	
5	160	1640	4-8	3.1	10		Brown fine SAND, trace Silt, medium dense, wet.	Borehole backfilled with Neat Cement Grout to grade.
10	155	1650	8-12	2.0	<1		Brown fine SAND and fine GRAVEL, little Silt, wet.	
		1655	12-14	1.4	<1		Brown fine SAND, some fine Gravel, little Silt, dense, wet. [Possible TILL]	
15	150						Refusal (inferred top of bedrock) at 14' bgs.	

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-25.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/6/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286301.4902
Easting: 565112.1704

Borehole Depth: 16 ft. bgs
Surface Elevation: 165.8 ft. AMSL

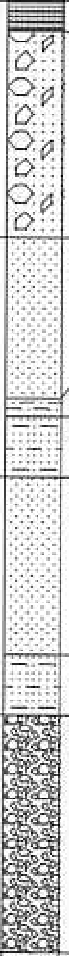
Descriptions By: Michael Cobb

Boring ID: PTB-26
Client: SRSNE

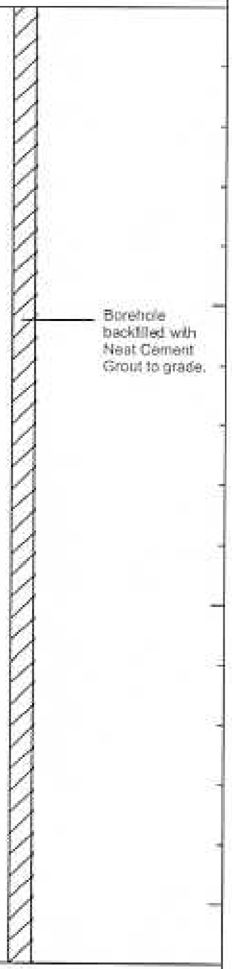
Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description
0						ASPHALT.
	165	0800	0-4	1.9	20	Red-brown to olive fine SAND and GRAVEL, some Silt, moist to wet. [FILL]
5	160	0805	4-8	3.6	9900	Brown fine SAND, some to little Silt, little coarse Sand and fine Gravel, loose, strong odor, wet. Residual NAPL.
						Black stained SILT, trace Organics. Residual NAPL.
						Medium brown fine SAND and SILT, little Gravel, wet. Residual NAPL.
10	155	0830	8-12	3.0	500	Olive-brown (periodically stained black) fine SAND, little medium Sand, little sheen and NAPL visible. Pooled NAPL identified 8.0' - 11' bgs.
						Red-brown fine SAND and SILT, trace Organics, dense.
15	150	0914	12-16	2.6	300	Red-brown fine GRAVEL, some fine to coarse Sand, little Silt, dense, potential sheens, little black staining. [Possible TILL] Residual NAPL identified 12' - 16' bgs.
						Refusal (inferred top of bedrock) at 16' bgs.

Geologic Column



Boring Construction



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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-26.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/6/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: Geoprobe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286621.817
Easting: 565260.8331

Borehole Depth: 25 ft. bgs
Surface Elevation: 158.9'

Descriptions By: Michael Cobb

Boring ID: PTB-27

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0	155	0920	0-4	2.3	0.0	Brown SILT with Organics, little Sand. Red-brown fine SAND, some Gravel, little Silt, very dense, dry to moist. Olive-gray very fine SAND, trace Silt, trace Organics (Root hairs).	
5		0925	4-8	3.2	0.0	Light brown to gray fine to medium SAND, trace fine Gravel, medium dense, wet.	Borehole backfilled with Neat Cement Grout to grade.
10	150	0930	8-12	NA*	0.0		
15	145	0935	12-16	1.8	0.0	Brown coarse SAND and fine GRAVEL, some fine to coarse Sand, little to some Silt, medium dense, wet.	
		0940	16-20	2.5	0.0	Brown medium SAND, some fine Sand, little coarse Sand and fine Gravel, trace Silt, medium dense, wet.	

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Remarks: bgs = below ground surface.
* = Sample shaken out of liner, thus recovery could not be measured.

Client:
SRSNE

Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-27

Borehole Depth: 25 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140	0940	16-20	2.5	0.0		Brown SILT, little fine Sand, medium stiff, wet.	Borehole backfilled with Neat Cement Grout to grade.
20		0950	20-24	2.7	0.0		Brown fine to coarse SAND, some fine Gravel, trace Silt, non-cohesive, wet.	
	135						Red-brown GRAVEL, some fine Sand, little Silt, very dense, cohesive. [Till-like]	
		1000	24-25	0.6	0.0			
25							Refusal (inferred top of bedrock) at 25' bgs.	
	130							
30								
	125							
35								

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Remarks: bgs = below ground surface.
* = Sample shaken out of liner, thus recovery could not be measured.

Date Start/Finish: 11/6/03 **Drilling Company:** BBL **Driller's Name:** J. Boland **Drilling Method:** Direct Push **Rig Type:** Geoprobe **Sampler Type:** 4-foot Lexan Sleeves	**Northing:** 286575.8921 **Easting:** 565317.0845 **Borehole Depth:** 20 ft. bgs **Surface Elevation:** 158.76' **Descriptions By:** Michael Cobb	**Boring ID:** PTB-28 **Client:** SRSNE **Project:** NAPL Delineation Pilot Study Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0	155	1105	0-4	2.6	2.0	Gray GRAVEL. [FILL] Brown fine SAND, little Gravel, little Silt, dense, dry to moist. Dark gray fine SAND lens. Olive-gray fine to medium SAND, medium dense.	
5		1110	4-8	1.6	0.0	Weathered SANDSTONE (likely Cobble).	Borehole backfilled with Neat Cement Grout to grade.
10	150	1148	8-12	2.3	3.0	Red-brown fine SAND, some Silt, little fineGravel and coarse Sand, dense, moist to wet. [TILL-like]	
15	145	1155	12-16	0.8	0.7		
		1155	16-20	0.8	0.7	Brown fine SAND, trace rounded Gravel, medium dense, wet.	

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Remarks: bgs = below ground surface.

Client:
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Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-28

Borehole Depth: 20 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140	1210	16-20	2.6	0.0		Brown fine SAND, trace rounded Gravel, medium dense, wet. Brown GRAVEL, some Sand, little Silt, dense. [TILL-like]	Borehole backfilled with Neat Cement Grout to grade.
20							Refusal (Inferred top of bedrock) at 20' bgs.	
	135							
25								
	130							
30								
	125							
35								

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/6/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286618.1392
Easting: 565133.5057

Borehole Depth: 18 ft. bgs
Surface Elevation: 163.1 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-29

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							ASPHALT and crushed Stone.	
							Brown fine SAND, some Gravel, little Silt, dense, moist.	
		1120	0-4	2.7	0.0			
	160							
5							Brown fine SAND, little Gravel, some to little Silt, medium dense.	Borehole backfilled with Neat Cement Grout to grade.
		1130	4-8	2.2	0.0		Black fine SAND, some Silt.	
							Gray-brown fine to medium SAND, wet.	
	155						Gray-brown fine to medium SAND, trace fine Gravel. Fines gradually with depth.	
10		1430	8-12	4.0	0.0			
							Gray-brown fine SAND, well sorted, wet.	
							Brown fine SAND, some Gravel.	
	150						Brown medium to coarse SAND and GRAVEL, trace Silt, medium dense, wet.	
		1440	12-16	2.9	0.0			
15								
							Brown fine SAND, little coarse Sand and fine Gravel, trace Silt, dense. [Possible TILL]	
		1447	16-18	2.0	0.0			
							Weathered ROCK. Refusal at 18' bgs.	

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Date Start/Finish: 11/6/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286500.037
Easting: 564977.2113

Borehole Depth: 12 ft. bgs
Surface Elevation: 167.5 ft. AMSL

Descriptions By: Michael Cobb

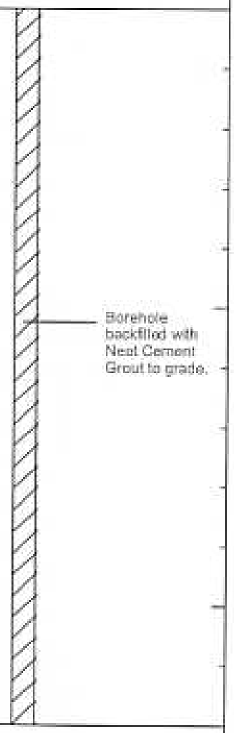
Boring ID: PTB-30

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description
0							Black ASPHALT and GRAVEL.
							Brown-black fine SAND and GRAVEL. [FILL]
	165	1700	0-4	2.6	14		Brown fine SAND, trace Gravel.
5	160	1710	4-8	3.0	570		Brown fine SAND, trace Gravel, strong odor, dense, moist. Residual NAPL from 6.0' - 8.0' bgs.
10		1720	8-11	2.8	600		Brown fine SAND, trace Gravel, pockets of grey Sand, dense. Visible NAPL 9'-10.2' bgs. Pooled NAPL identified 8'-11' bgs. Pooled NAPL from 9.0' - 11' bgs.
							Brown fine to medium SAND, trace Silt. Pooled NAPL identified 8' - 11' bgs.
							SANDSTONE Cobble.
		1730	11-12	1.0	300		Red-brown fine SAND, dense. (Possible Weathered Rock at 11.4' bgs) Residual NAPL identified 11' - 12' bgs.
	155						Refusal at 12' bgs.
15							
	150						

Boring Construction


Borehole backfilled with Neat Cement Grout to grade.

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-30.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/6/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286370.9857
Easting: 565017.0982

Borehole Depth: 14 ft. bgs
Surface Elevation: 166.7' AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-31
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							ASPHALT and CONCRETE.	
	165						Gray-brown fine to coarse SAND, some Gravel, odor, wet.	
							Brown fine SAND, little Silt, odor, wet.	
		1525	1.5-4	1.8	300		Brown fine SAND, some Gravel, trace Silt, wet. Residual NAPL from 2.0' - 4.0' bgs.	
							Brown fine SAND, some to little fine Gravel and coarse Sand, dense, strong odor, moist. Residual NAPL identified 4.0' - 8.0' bgs.	
5	160	1535	4-8	3.9	8300		Brown fine SAND, trace to little fine Gravel, strong odor, dense, moist. Residual NAPL identified 4.0' - 8.0' bgs.	Borehole backfilled with Neat Cement Grout to grade.
10	155	1545	8-12	3.4	3000		Brown fine SAND, some fine Gravel, trace to little Silt, strong odor, dense. Residual NAPL identified 8.0' - 12' bgs.	
		1550	12-14	2.0	3500		Pooled NAPL visible 13' - 13.3' bgs.	
							Brown fine SAND, little Silt, little fine Gravel, cohesive, dense.	
							Probable Weathered Rock at 13.6' bgs. Refusal at 14' bgs.	
15	150							

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Date Start/Finish: 11/6/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286412.1792
Easting: 564951.6354

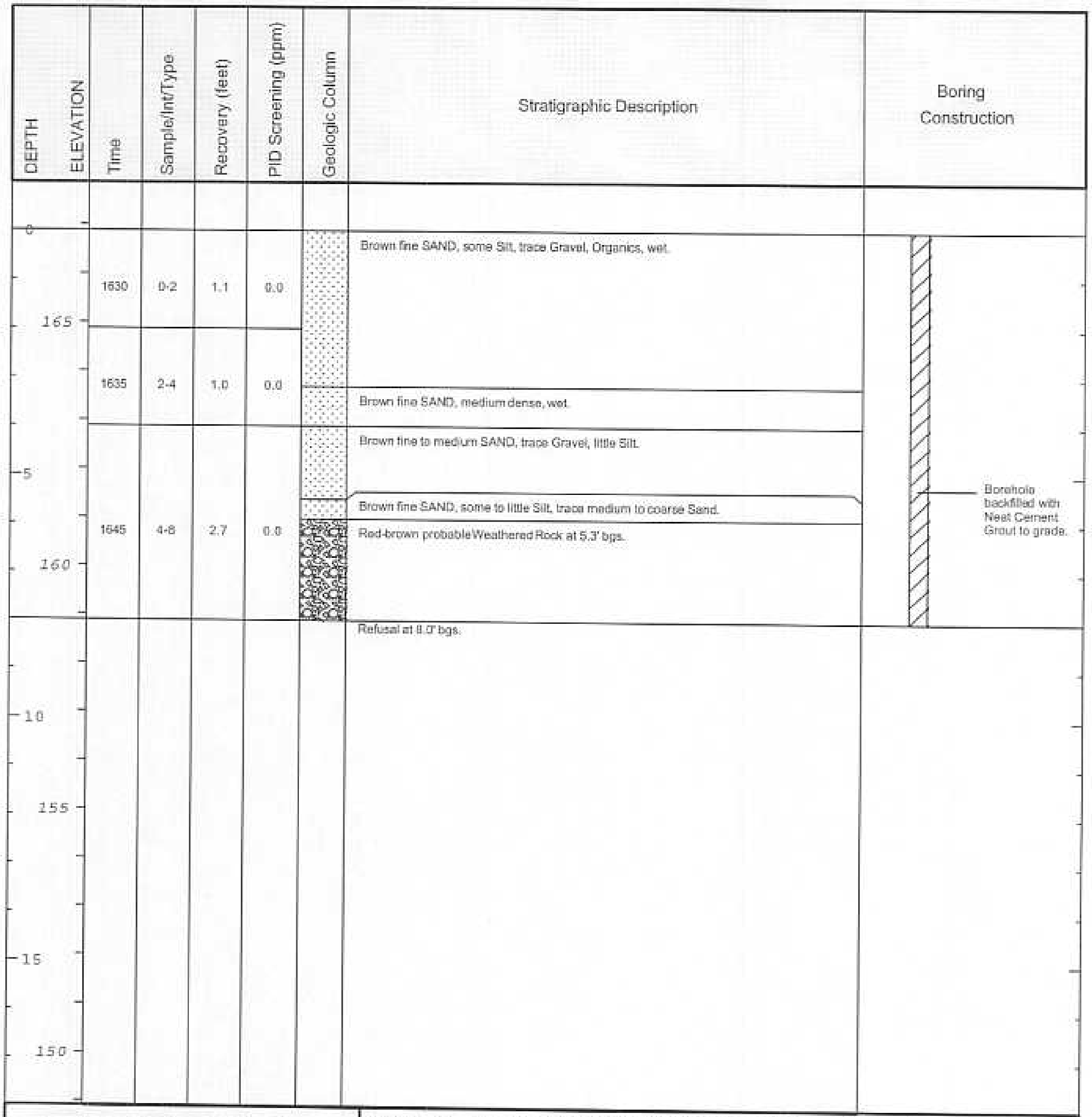
Borehole Depth: 8.0 ft. bgs
Surface Elevation: 166.9 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-32

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut



Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description
1630	0-2	1.1	0.0	Brown fine SAND, some Silt, trace Gravel, Organics, wet.
1635	2-4	1.0	0.0	Brown fine SAND, medium dense, wet.
1645	4-8	2.7	0.0	Brown fine to medium SAND, trace Gravel, little Silt. Brown fine SAND, some to little Silt, trace medium to coarse Sand. Red-brown probable Weathered Rock at 5.3' bgs.
				Refusal at 8.0' bgs.

Boring Construction

Borehole backfilled with Neat Cement Grout to grade.

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-32.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/7/03 **Drilling Company:** O & M **Driller's Name:** O & M **Drilling Method:** Direct Push **Rig Type:** Geoprobe **Sampler Type:** 5-foot Lexan Sleeves	**Northing:** 286445.9039 **Easting:** 565197.052 **Borehole Depth:** 21.5 ft. bgs **Surface Elevation:** 159.14' **Descriptions By:** Michael Cobb	**Boring ID:** PTB-33 **Client:** SRSNE **Project:** NAPL Delineation Pilot Study Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	160							
0							Black-brown fine SAND, little Silt and Organics (soil horizon).	
		0950	0-5	2.5	0.0		Light brown fine to medium SAND, trace coarse Sand, moist.	
	155							
5							Little coarse Sand at 5.0' bgs.	Borehole backfilled with Neat Cement Grout to grade.
		1000	5-10	3.1	0.0		Little black staining , moderate odor at 7.0' bgs.	
	150							
10							Brown fine GRAVEL and fine to coarse SAND, little Silt, no odor, dense, wet.	
		1010	10-15	2.6	0.0			
	145							
15		1020	15-20	2.8	0.0			
							Brown fine SAND, trace Gravel, dense. [TILL]	

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Remarks: bgs = below ground surface.

Project: 083.31.001
Data File: PTB-33.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Client:
SRSNE
Project:
NAPL Delineation Pilot Study
Southington, Connecticut

Boring ID: PTB-33

Borehole Depth: 21.5 ft. bgs

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
	140	1020	15-20	2.8	0.0	⸬	Brown fine SAND, some Gravel, dense. (Possible Weathered Rock at 18' bgs)	Borehole backfilled with Neat Cement Grout to grade.
20							No Recovery.	
							Refusal at 21.5' bgs.	
	135							
25								
	130							
30								
	125							
35								

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Remarks: bgs = below ground surface.

Date Start/Finish: 11/7/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286536.7263
Easting: 565038.5881

Borehole Depth: 14 ft. bgs
Surface Elevation: 166.7 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-34

Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Stratigraphic Description	Boring Construction
0						ASPHALT and GRAVEL bedding.	
	165	0810	0-4	3.3	0.0	Reddish-brown fine SAND, little Gravel, little to trace Silt, moist. Brown fine SAND, little Silt and Gravel, moist to wet.	
5	160	0815	4-8	2.8	0.0	Brown fine SAND, trace Silt. Brown fine SAND, little fine Gravel, little Silt, moist to wet.	Borehole backfilled with Neat Cement Grout to grade.
10	155	0820	8-12	2.7	0.0		
		0825	12-14	1.6	0.0	Brown weathered Rock as fine SAND, very dense.	
15	150					Refusal (inferred top of bedrock) at 14' bgs.	

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-34.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/7/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

Northing: 286274.579
Easting: 565055.0686

Borehole Depth: 15 ft. bgs
Surface Elevation: 166.3 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-35
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0							Coarse SAND and fine GRAVEL.	
	165						Brown fine SAND, some Gravel, little Silt, moist.	
		1120	0-4	1.5	0.0			
							Brown fine to medium SAND, trace fine Gravel, slight odor, wet.	
5								Borehole backfilled with Neat Cement Grout to grade.
	160	1130	4-8	2.9	100		Some to little Gravel, trace Silt, wet below 7' bgs.	
							Fine SAND, some fine Gravel, trace medium to coarse Sand and Silt, odor. Trace residual NAPL.	
10		1145	8-12	1.0	800			
	155							
							Brown SILT, some fine Sand, trace Gravel.	
							Brown medium to coarse Sand, little fine Sand and Gravel.	
		1155	12-15	2.3	130			
							Weathered Rock.	
15							Refusal (inferred top of bedrock) at 15' bgs.	
	150							

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-35.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/7/03
Drilling Company: BBL
Driller's Name: J. Boland
Drilling Method: Direct Push
Rig Type: AMS PowerProbe
Sampler Type: 4-foot Lexan Sleeves

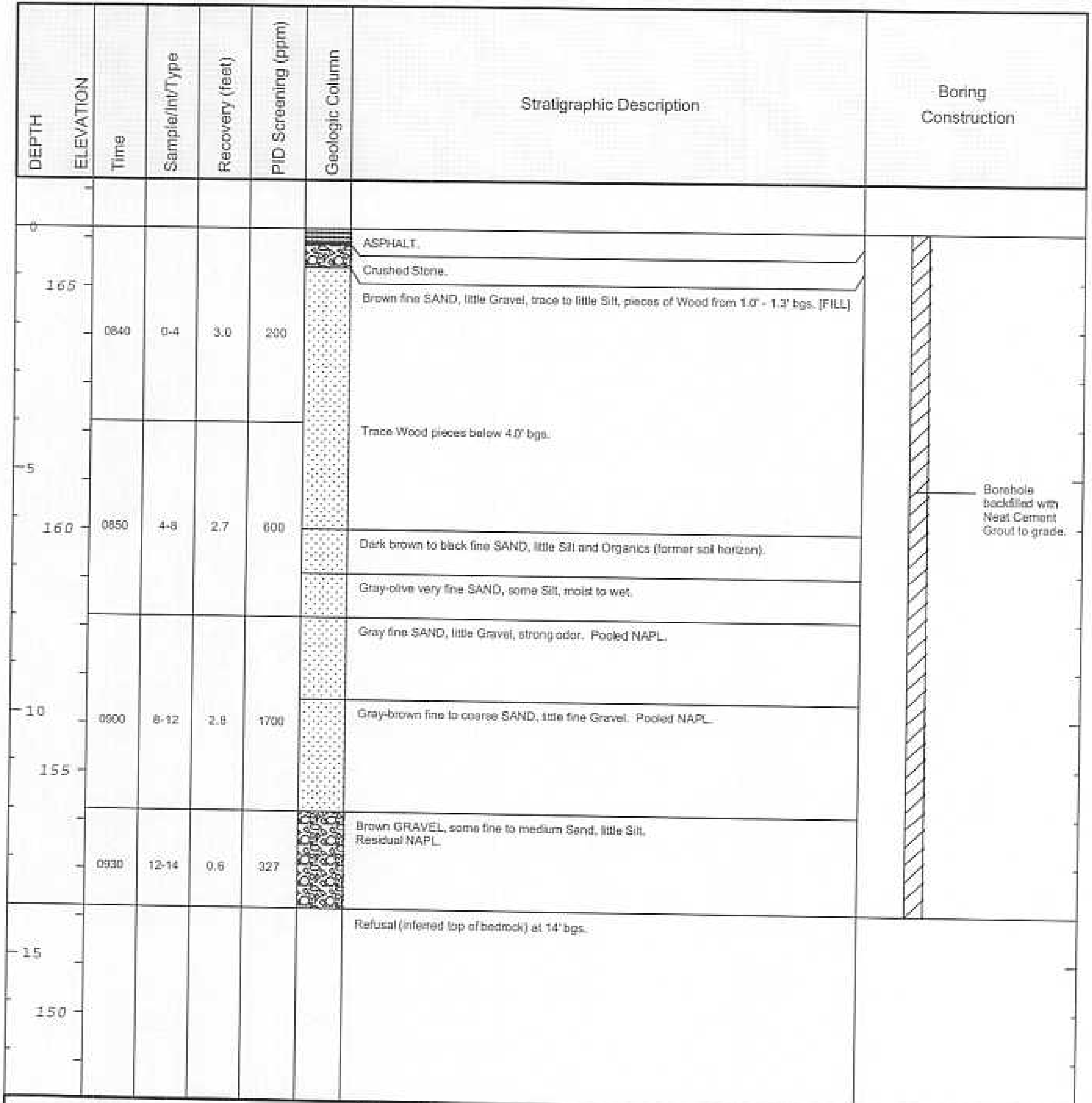
Northing: 286408.6294
Easting: 565095.0593

Borehole Depth: 14 ft. bgs
Surface Elevation: 166.2 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-36
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut



Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)
0840	0-4	3.0	200
0850	4-8	2.7	600
0900	8-12	2.8	1700
0930	12-14	0.6	327

ASPHALT.

Crushed Stone.

Brown fine SAND, little Gravel, trace to little Silt, pieces of Wood from 1.0' - 1.3' bgs. [FILL]

Trace Wood pieces below 4.0' bgs.

Dark brown to black fine SAND, little Silt and Organics (former soil horizon).

Gray-olive very fine SAND, some Silt, moist to wet.

Gray fine SAND, little Gravel, strong odor. Pooled NAPL.

Gray-brown fine to coarse SAND, little fine Gravel. Pooled NAPL.

Brown GRAVEL, some fine to medium Sand, little Silt.
Residual NAPL.

Refusal (inferred top of bedrock) at 14' bgs.

Borehole backfilled with Neat Cement Grout to grade.

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-36.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish:	11/7/03
Drilling Company:	BBL
Driller's Name:	J. Boland
Drilling Method:	Direct Push
Rig Type:	AMS Power Probe
Sampler Type:	4-foot Lexan Sleeves

Northing: 286327.2039
Easting: 565067.4143

Borehole Depth: 14 ft. bgs
Surface Elevation: 166.9 ft. AMSL

Descriptions By: Michael Cobb

Boring ID: PTB-37
Client: SRSNE

Project: NAPL Delineation Pilot Study
Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0	165	1040	0-4	2.6	600		ASPHALT. GRAVEL bedding. Brown fine SAND, little Gravel, little Silt, Roots, Fill traces.	
5	160	1045	4-8	1.8	95		Brown fine SAND and SILT, trace fine Gravel, trace Roots. Red Sandstone Cobble (fractured) at 7.9' bgs.	Borehole backfilled with Neat Cement Grout to grade.
10	155	1050	8-12	1.5	1000		Olive-brown fine SAND, some Silt, trace Gravel, trace Roots, medium dense, odor, wet. Residual NAPL identified.	
		1100	12-14	NA*	68		SAND and GRAVEL. (Probable Weathered Rock)	
15	150						Refusal at 14' bgs.	

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.
* = Partial recovery shaken from sleeve.

Project: 083.31.001
Data File: PTB-37.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish: 11/7/03 **Drilling Company:** BBL **Driller's Name:** J. Boland **Drilling Method:** Direct Push **Rig Type:** AMS PowerProbe **Sampler Type:** 4-foot Lexan Sleeves	**Northing:** 286461.9442 **Easting:** 565094.3148 **Borehole Depth:** 14 ft. bgs **Surface Elevation:** 165.9 ft. AMSL **Descriptions By:** Michael Cobb	**Boring ID:** PTB-38 **Client:** SRSNE **Project:** NAPL Delineation Pilot Study Southington, Connecticut

DEPTH	ELEVATION	Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)	Geologic Column	Stratigraphic Description	Boring Construction
0	165	1300	0-4	1.4	1100		ASPHALT. GRAVEL bedding. Red-brown fine SAND, little fine Gravel, odor. Residual NAPL identified 1.0' - 4.0' bgs.	
5	160	1320	4-8	0.4	350		Dark brown fine SAND, little Silt, odor. Pooled NAPL from 8.0' - 12' bgs.	Borehole backfilled with Neat Cement Grout to grade.
10	155	1330	8-12	3.3	4000		Gray-brown fine to medium SAND, trace Gravel. Pooled NAPL from 8.0' - 12' bgs. Gray-brown fine SAND. Pooled NAPL from 8.0' - 12' bgs. Red-brown GRAVEL, some fine to coarse Sand, little Silt. Pooled NAPL from 8.0' - 12' bgs.	
		1340	12-14	0.7	3500		Weathered GRAVEL or Cobbles, dry.	
15	150						Refusal (inferred top of bedrock) at 14' bgs.	

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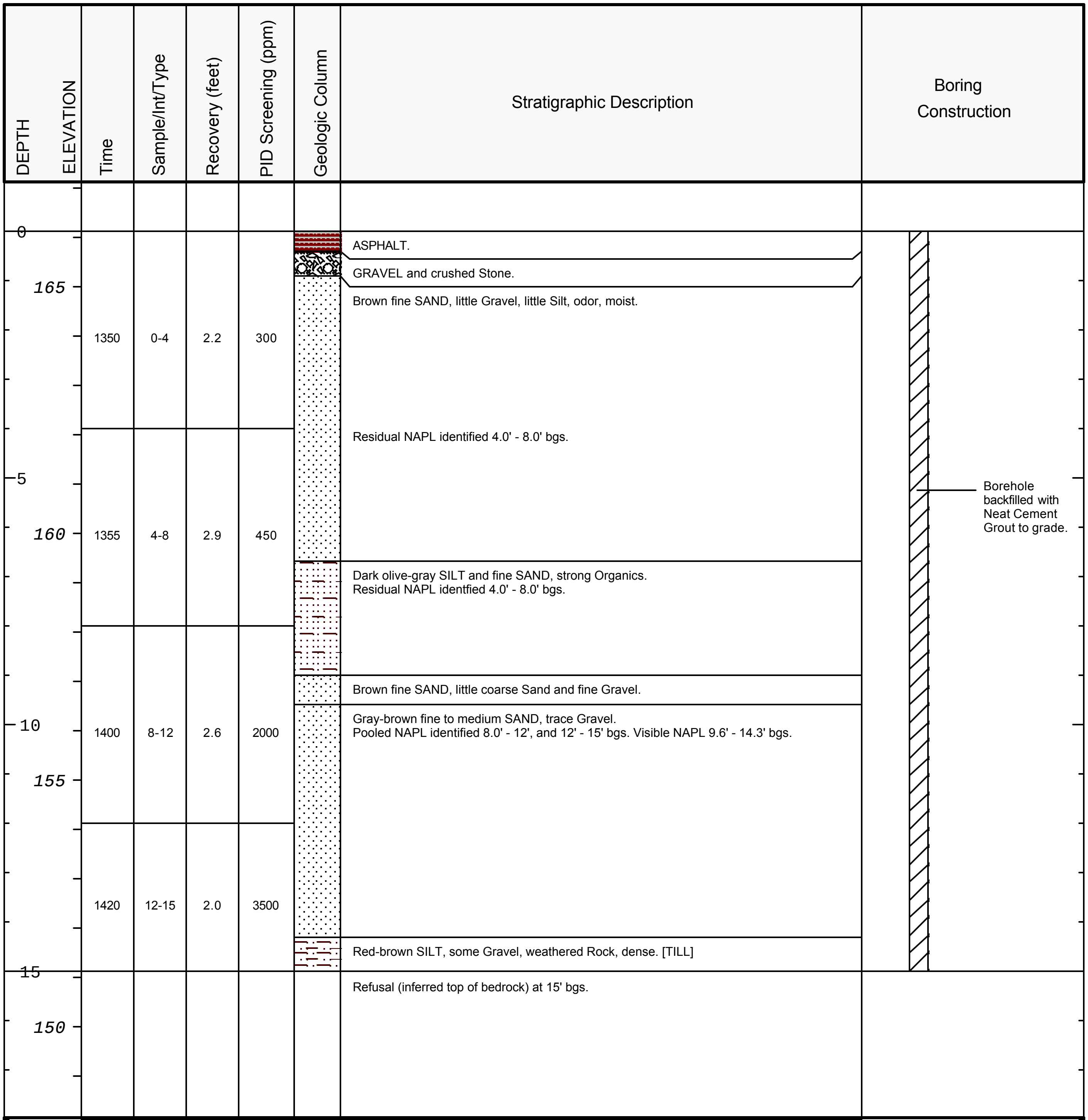
Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Project: 083.31.001
Data File: PTB-38.dat

Template: J:/rockware/Logplot 2001/Logfiles/08331/SRS.ldf
Date: 11/17/03

Date Start/Finish:	11/7/03
Drilling Company:	BBL
Driller's Name:	J. Boland
Drilling Method:	Direct Push
Rig Type:	AMS PowerProbe
Sampler Type:	4-foot Lexan Sleeves
Northing:	286347.3521
Easting:	565098.6127
Borehole Depth:	15 ft. bgs
Surface Elevation:	166.1 ft. AMSL
Descriptions By:	Michael Cobb
Boring ID:	PTB-39
Client:	SRSNE
Project:	NAPL Delineation Pilot Study Southington, Connecticut



Time	Sample/Int/Type	Recovery (feet)	PID Screening (ppm)
1350	0-4	2.2	300
1355	4-8	2.9	450
1400	8-12	2.6	2000
1420	12-15	2.0	3500

Stratigraphic Description
ASPHALT.
GRAVEL and crushed Stone.
Brown fine SAND, little Gravel, little Silt, odor, moist. Residual NAPL identified 4.0' - 8.0' bgs.
Dark olive-gray SILT and fine SAND, strong Organics. Residual NAPL identfied 4.0' - 8.0' bgs.
Brown fine SAND, little coarse Sand and fine Gravel.
Gray-brown fine to medium SAND, trace Gravel. Pooled NAPL identified 8.0' - 12', and 12' - 15' bgs. Visible NAPL 9.6' - 14.3' bgs.
Red-brown SILT, some Gravel, weathered Rock, dense. [TILL]
Refusal (inferred top of bedrock) at 15' bgs.

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Remarks: bgs = below ground surface; AMSL = above Mean Sea Level.

Attachment 2

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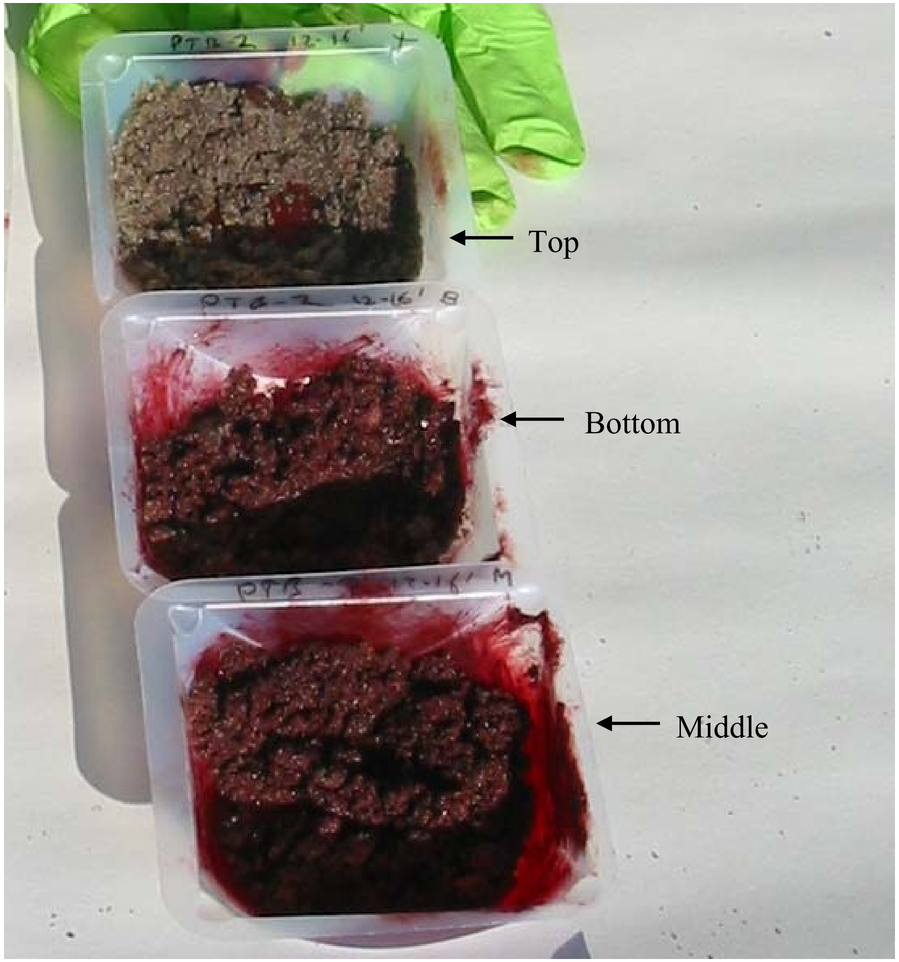
PTB-2 (12-16 feet bgs)



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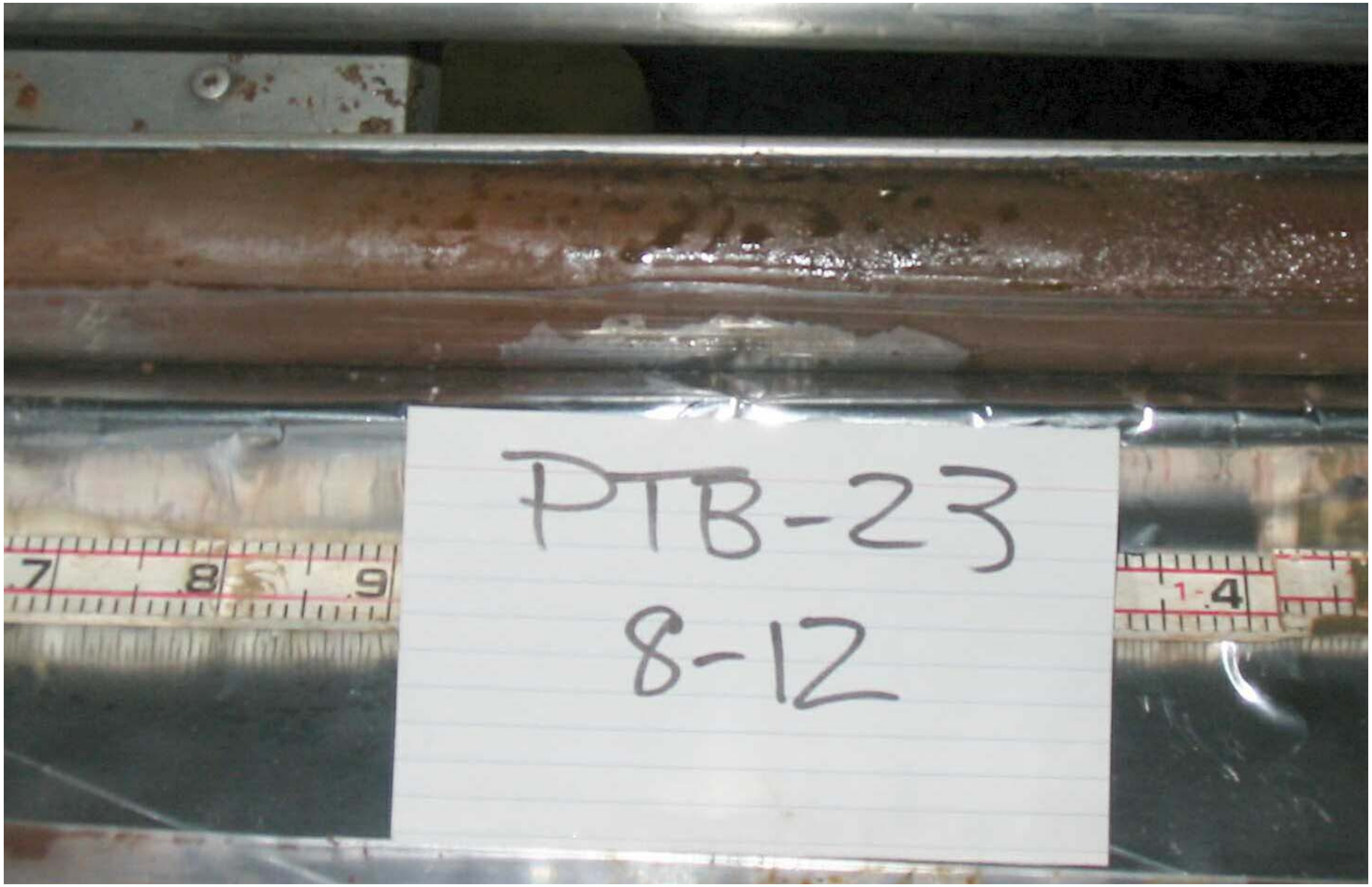
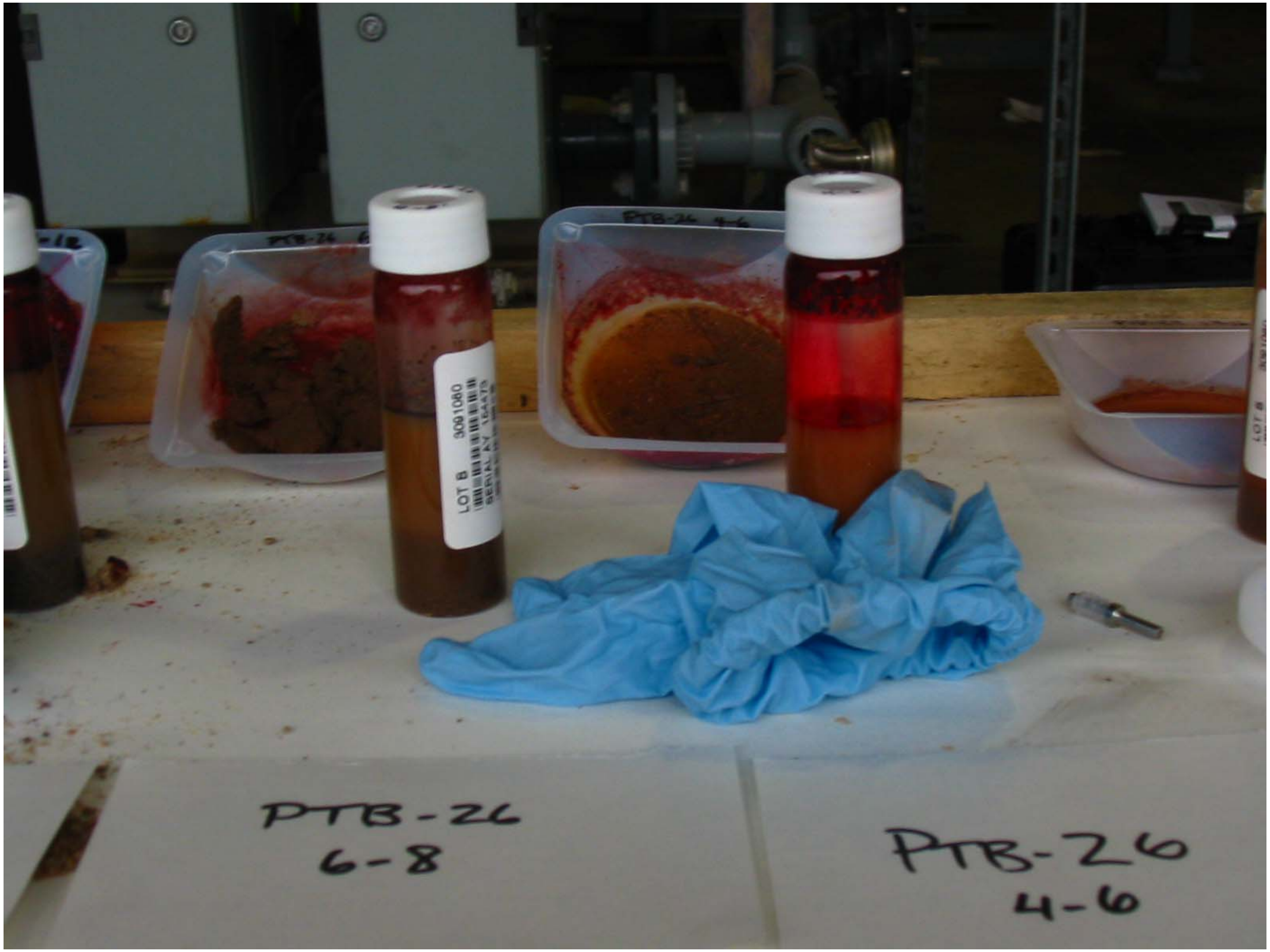
PTB-23 (8-12 feet bgs)



PTB-26 (4-8 feet bgs)

SRSNE Superfund Site
Southington, Connecticut
NAPL Delineation Pilot Study



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PTB-26 (8-16 feet bgs)

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PTB-30 (9-11 feet bgs)

SRSNE Superfund Site
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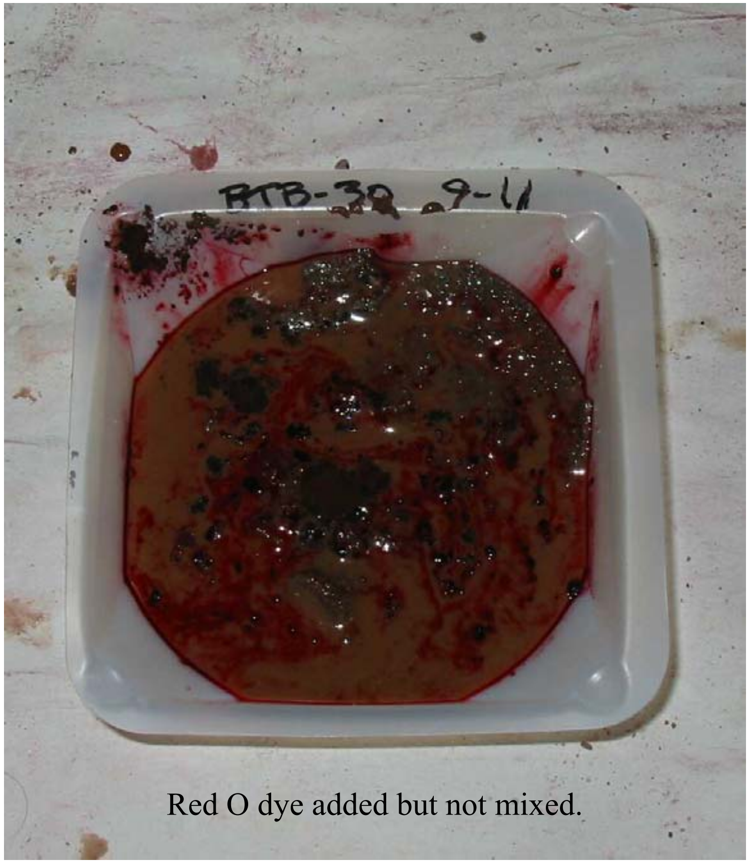
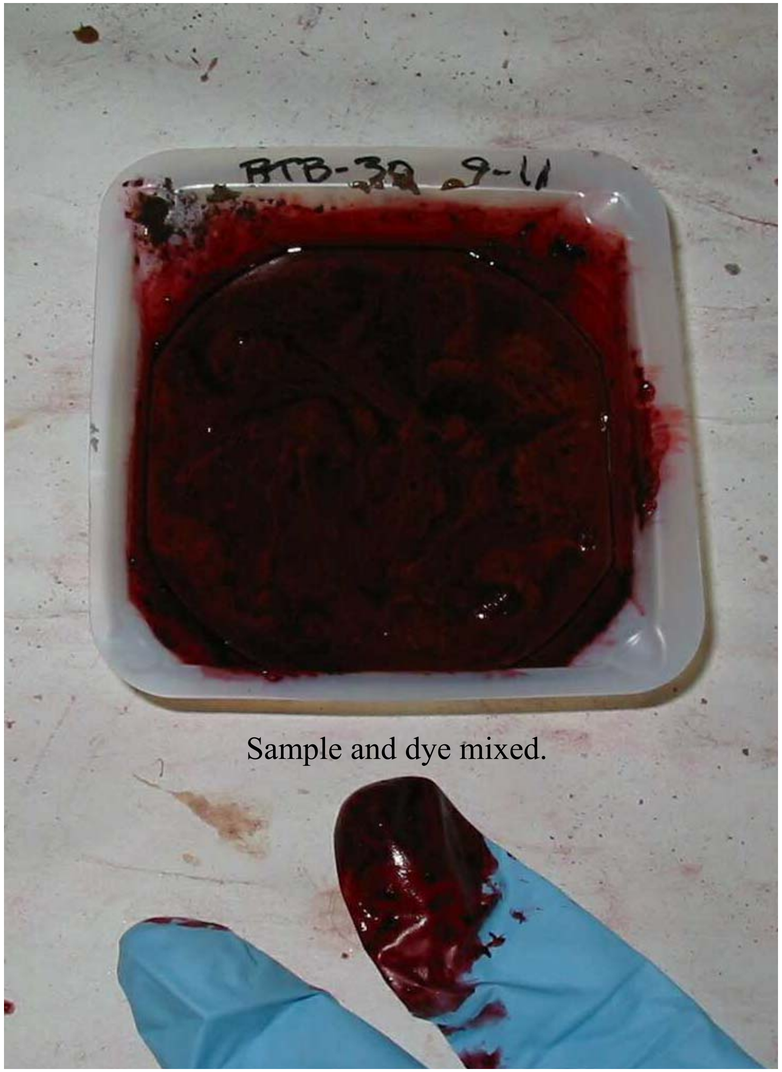


Red O dye added but not mixed.



Sample and dye mixed.

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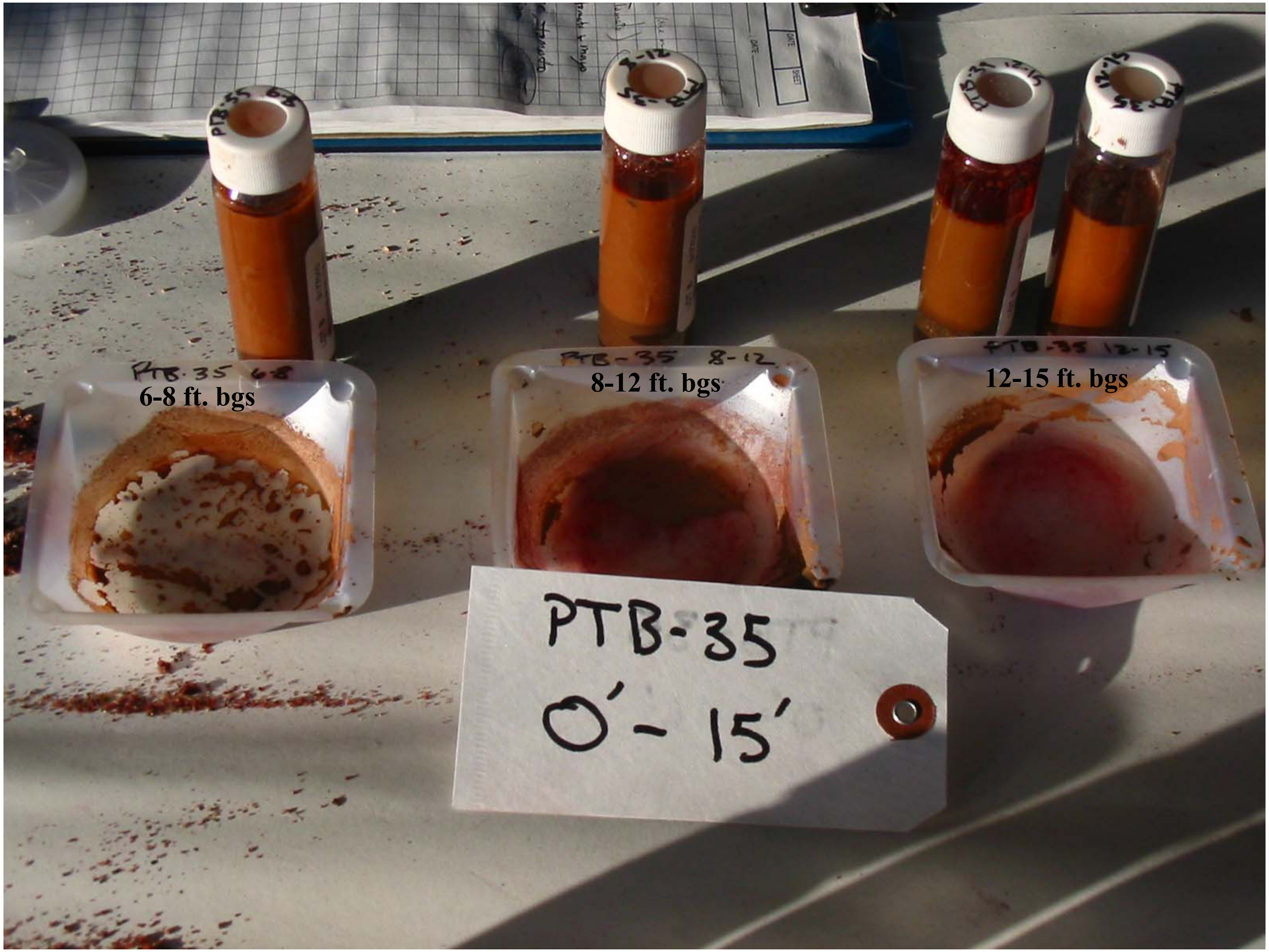
PTB-35 (0-15 feet bgs)

SRSNE Superfund Site
Southington, Connecticut
NAPL Delineation Pilot Study



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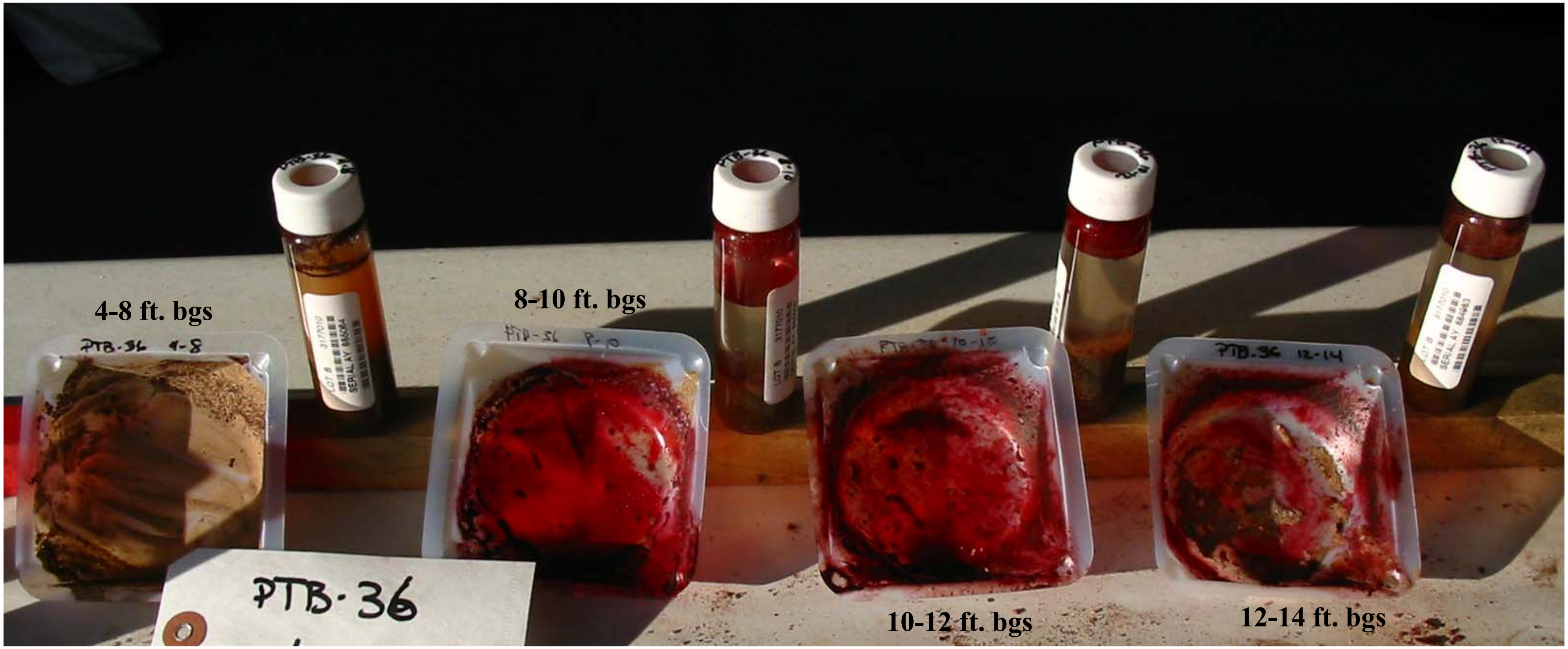
PTB-36 (4-14 feet bgs)

SRSNE Superfund Site
Southington, Connecticut
NAPL Delineation Pilot Study



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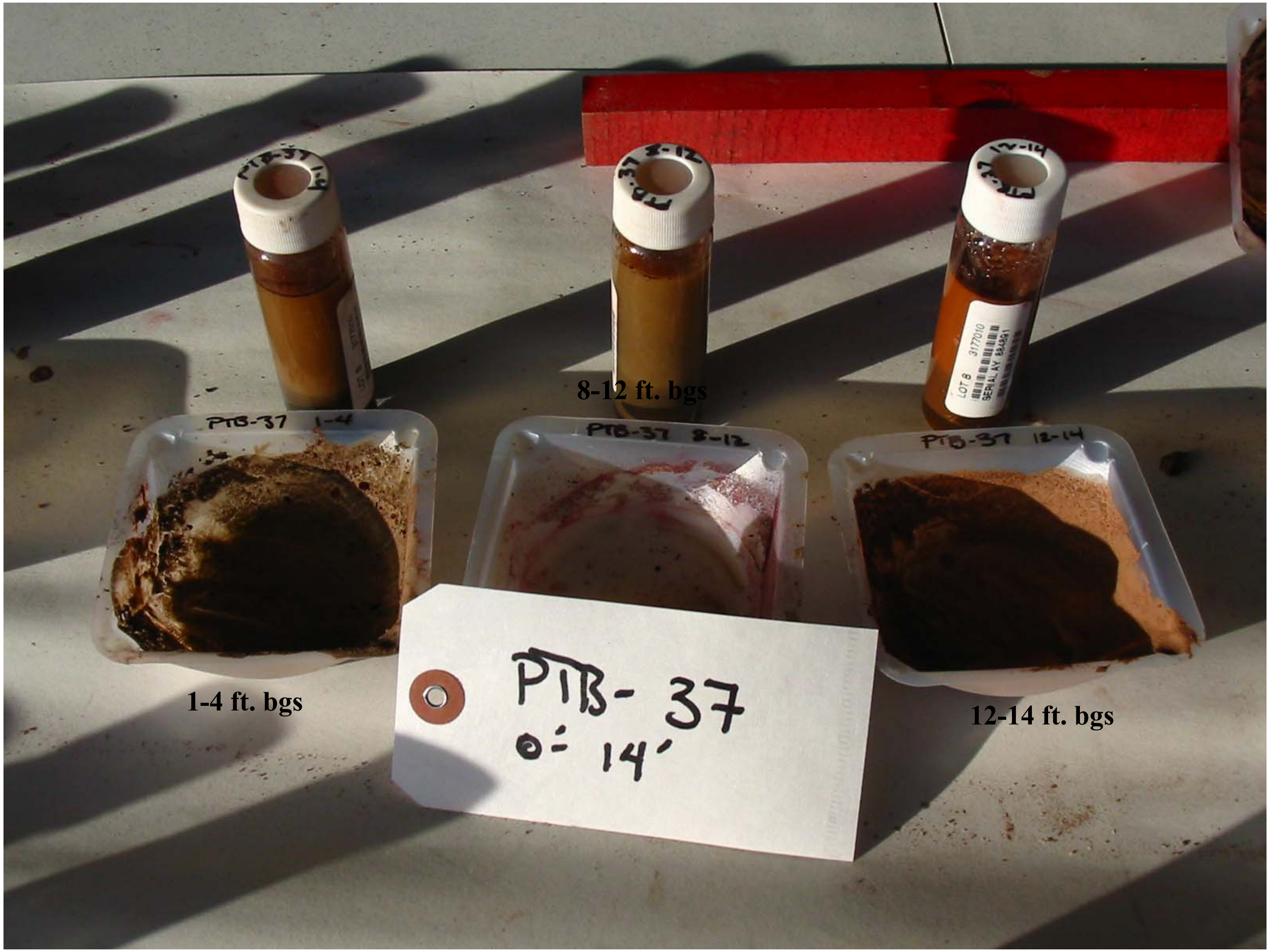
PTB-36 (8-12 feet bgs)

PTB-37 (1-14 feet bgs)



PTB-38 (1-14 feet bgs)

SRSNE Superfund Site
Southington, Connecticut
NAPL Delineation Pilot Study

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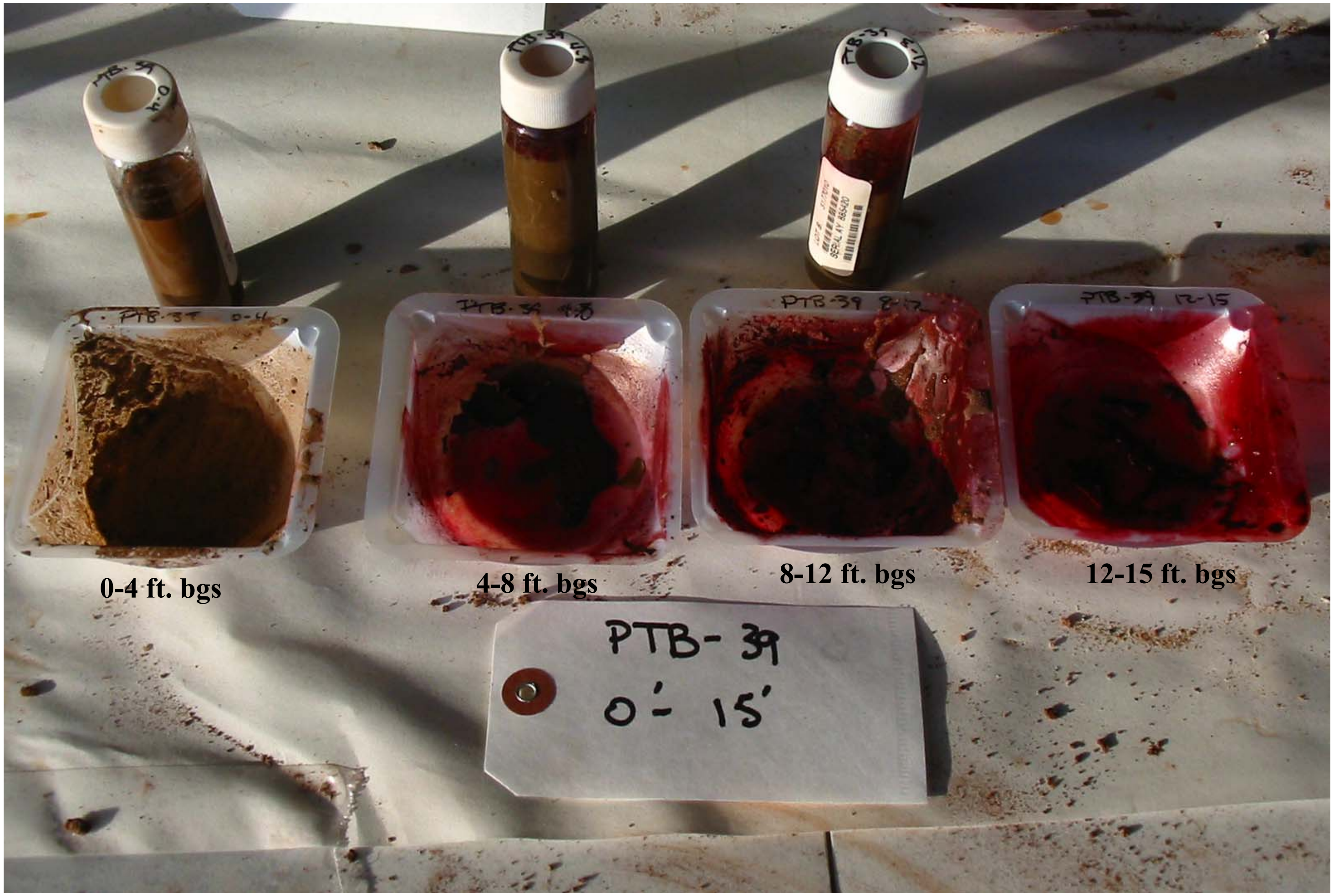
PTB-39 (0-15 feet bgs)



Appendix D

Calculation of NAPL Volume and Mass in Observed NAPL in Overburden Groundwater Unit

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Appendix D – Calculation of NAPL Volume and Mass in Observed NAPL in Overburden Groundwater Unit

D.1 General

This appendix describes calculations performed by Blasland, Bouck & Lee, Inc. (BBL) to support the completion of the Feasibility Study (FS) for the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. Specifically, this appendix presents an estimate of the volume and mass of non-aqueous phase liquids (NAPLs) in the Observed NAPL in Overburden Groundwater Unit. The general calculation methods described herein were discussed with representatives of the United States Environmental Protection Agency (USEPA), the Connecticut Department of Environmental Protection (CT DEP), and the SRSNE Potentially Responsible Party (PRP) Group in Boston on December 16, 2003.

D.2 Purpose for Calculating NAPL Volume and Mass

The feasibility of the remedial technologies will depend, to varying degrees, on the volume and mass of NAPLs within the Observed NAPL in Overburden Groundwater Unit. This appendix presents calculations performed to estimate these quantities in support of the FS.

The Observed NAPL in Overburden Groundwater Unit was delineated based on the distribution of soil borings and overburden monitoring wells where NAPL has been visually observed, and includes much of the former Operations Area of the site, extending eastward to the former location of the Boston and Maine Railroad tracks and including a small area at the northern end of the NTCRA 1 Containment Area (Figure D-1). The total soil volume and saturated soil volume in the Observed NAPL in Overburden Groundwater Unit are approximately 47,300 and 31,800 cubic yards (cy), respectively. The total soil volume was calculated between the top of rock and the ground surface. The saturated soil volume was calculated between the top of rock and the approximate seasonal high water table, as approximated by the March 20, 1995, water level data.

D.3 Calculation Methods

As shown on Figure 1, the Observed NAPL in Overburden Groundwater Unit includes four zones where pooled and/or residual NAPL has been observed. Zones 1 and 2 contained visible NAPL, interpreted as either pooled and residual, in soil samples obtained from borings performed in the former Operations Area between November 3 and 7, 2003 (PTB series; see FS Appendix C). In addition, these zones include overburden monitoring wells where DNAPL and/or LNAPL were observed. Zone 3 contains soil borings where residual NAPL, but no pooled NAPL, was interpreted based on the November 2004 soil borings. Although no soil borings were performed between November 3 and 7, 2003 in Zone 4, this zone contains two overburden wells where DNAPL has historically been observed (MWD-601 and RW-5). DNAPL was removed from these two wells and ceased to accumulate shortly after the startup of the NTCRA 1 groundwater extraction wells, including recovery well RW-5, in 1995. It is postulated that some pooled and residual NAPL still exists in Zone 4.

To estimate the volumes of pooled NAPL in Zones 1 and 2, an average sampled interval length was calculated for all the soil samples in which pooled NAPL was interpreted as present at each boring. Because the primary objective of the PTB series of borings was to perform as many borings as possible within one week to identify the locations and approximate depth of visible NAPL, individual soil samples were not always dissected to refine the exact top and bottom of NAPL in every sample containing visible NAPL. To simplify the calculation process, it was assumed that pooled NAPL occupied approximately one half of the length of each soil sample containing interpreted pooled NAPL. The total thickness of soil containing pooled NAPL at each soil boring in Zone 1 or Zone 2 was averaged, and divided by 2 to obtain an estimated average pool thickness in each zone (1.5 and 2.2 feet, respectively). No pools were interpreted as present at the PTB soil borings performed in Zone 3. As discussed above, Zone 4 is known to have contained pooled NAPL in the past and it is considered reasonable to assume that some remains, albeit perhaps not in the immediate vicinity of recovery well RW-5. A representative pool thickness of 0.5 feet was assumed for Zone 4. The average pool thickness in each of these zones was assumed to apply to the entire associated zone. To estimate the volume of pooled NAPL in Zones 1, 2, and 4, the volume of NAPL per unit pool area (equal to zone area) was estimated as a function of average pool height based on graphs presented by Kueper (December 2003, see FS Appendix E).

The volumes of residual NAPL in Zones 1, 2, and 3 were calculated similar to the pool calculations. To simplify the calculation process, it was assumed that residual NAPL occupied approximately one half of the length of each soil sample containing interpreted residual NAPL. The total thickness of soil containing residual NAPL at each soil boring in Zone 1, 2, or 3 was averaged, and divided by 2 to obtain an estimated average residual thickness in each zone (2.1, 1.8, and 2.6 feet, respectively). A representative residual thickness of 2 feet was assumed for Zone 4. The average residual NAPL thickness in each of these zones was assumed to apply to the entire associated zone. The average residual NAPL saturation was assumed to be 10% of porosity.

D.4 Results

The estimated NAPL volume and mass in the Observed NAPL in Overburden Groundwater Unit are summarized in Table 1. The total volume of pooled NAPL was estimated as 96,000 gallons, and the total volume of residual NAPL was estimated as 25,000 gallons. The total combined NAPL volume was estimated as 120,000 gallons, corresponding to an approximate total NAPL mass of 460,000 kg within the Observed NAPL in Overburden Groundwater Unit. Approximately 80% of the pooled NAPL and 70% of the total NAPL mass was estimated to exist in Zone 2. In contrast, Zones 3 and 4 were calculated as having only 7% of the total NAPL mass, combined.

TABLE

TABLE 1

FEASIBILITY STUDY
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

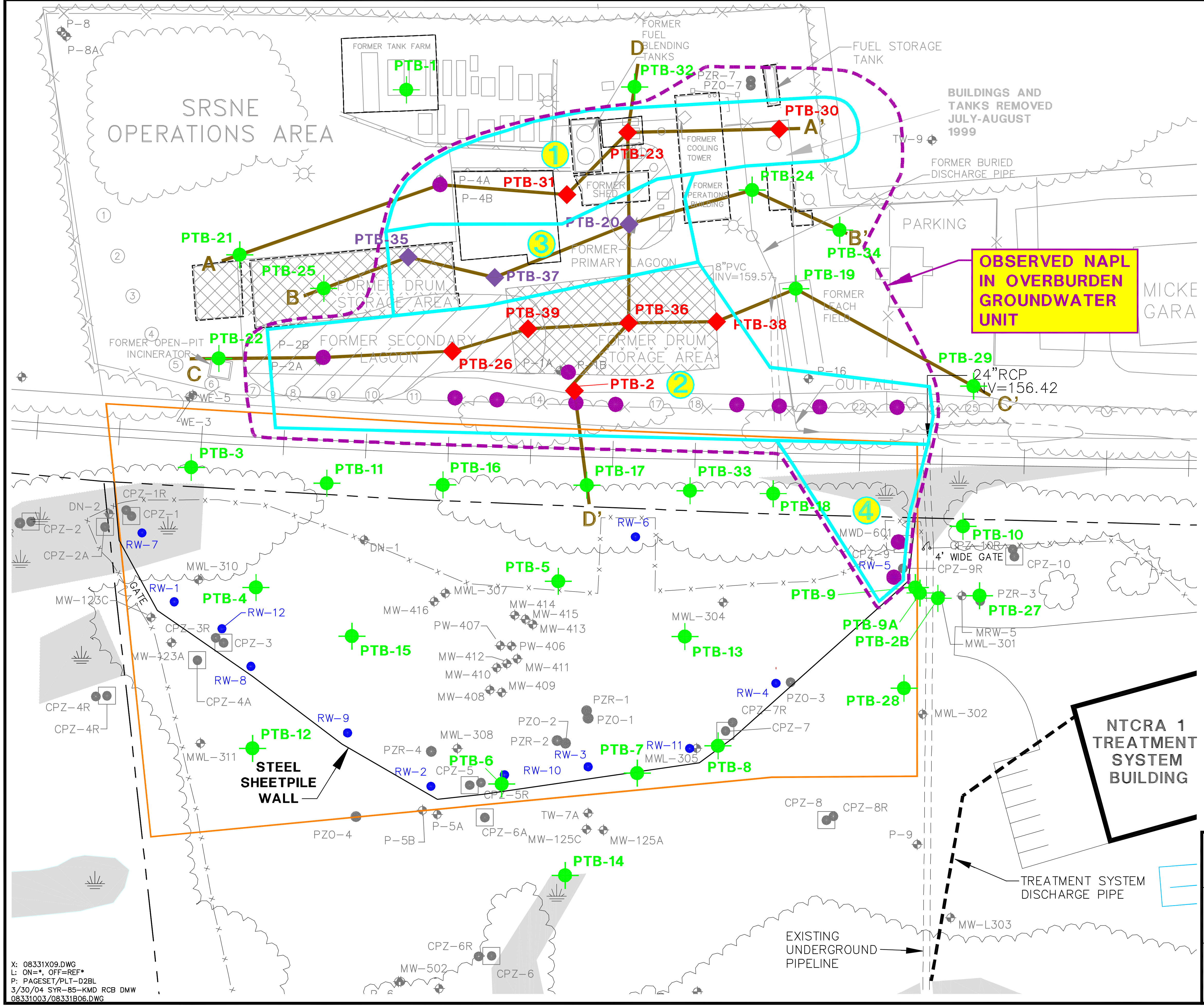
SUMMARY OF NAPL VOLUME CALCULATIONS

Zone (see Figure 1)	Zone Area (ft^2)	Zone Area (m^2)	Est. Avg Thickness of Pools (ft)	Est. Avg Thickness of Pools (m)	Est. NAPL Vol. Per Unit Pool Area (m^3/m^2)	Est. NAPL Volume in Pools (m^3)	Est. NAPL Volume in Pools (gal)	Est. Soil Thickness with Resid. NAPL (ft)	Est. Soil Thickness with Resid. NAPL (m)	Est. NAPL Volume Per Unit Residual Vol. (m^3/m^3)	Est. NAPL Volume in Residual (m^3)	Est. Residual NAPL Volume (gal)	Est. Total NAPL in Zone (m^3)	Est. Total NAPL in Zone (gal)
1	13,000	1,208	1.5	0.46	0.06	72	19,145	2.1	0.64	0.03	23	6,127	96	25,272
2	28,000	2,601	2.2	0.67	0.11	286	75,599	1.8	0.55	0.03	43	11,312	329	86,911
3	9,000	836	NA	NA	NA	NA	NA	2.6	0.79	0.03	20	5,252	20	5,252
4	4,700	437	0.5	0.15	0.012	5	1,384	2	0.61	0.03	8	2,110	13	3,494
		Total					96,128					24,801		120,929

Notes:

1) Estimated average thickness of pools in each zone is an average of the conditions at the soil borings in each zone. Calculation assumes the thickness of pooled NAPL at each soil boring is one half of the total soil interval containing soil samples in which pooled NAPL was interpreted as present. Soil borings included in this evaluation were the PTB series of borings, obtained November 3 to 7, 2003.
2) Estimated NAPL volume per unit pool area based on Kueper (2004) for the specified average pool thickness values and an estimated soil K of 5.8 ft/day (2.0x10-3cm/sec), which is the geometric mean of K measurements at overburden wells in former Operations Area (P-1B, P-2B, P-4B, P-15, PZO-7).
3) Estimated average thickness of soil with residual NAPL in each zone is an average of the conditions at the soil borings in each zone. Calculation assumes the thickness of soil containing residual NAPL at e soil boring is one half of the total soil interval containing soil samples in which residual NAPL (but not pooled NAPL) was interpreted as present.
4) Estimated NAPL volume per unit residual volume assumes residual NAPL saturation is 10% of porosity.
5) Estimated NAPL mass assumes average NAPL density of 1 kg/L, and accounts for the fact that LNAPL and DNAPL have both been identified in the area of interest.

FIGURE



PROPERTY LINE

EXISTING CONCRETE PAD

WETLAND

NTCRA 1 CONTAINMENT AREA

EXISTING STRUCTURE

FENCE

P-10 MONITORING WELL

PZR-3 NTCRA 1 PIEZOMETER

CPZ-10 NTCRA 1 COMPLIANCE PIEZOMETER

RW-1 NTCRA 1 OVERBURDEN EXTRACTION WELL

⑫ FORMER ON-SITE INTERCEPTOR INTERCEPTOR SYSTEM EXTRACTION WELL

● LOCATIONS WITH PREVIOUS VISUAL NAPL IDENTIFICATION

⊕ PILOT-TEST BORING WITH NO NAPL DETECTED

◆ PILOT TEST BORING WITH INTERPRETED POOLED NAPL

◆ PILOT TEST BORING WITH INTERPRETED RESIDUAL NAPL

A —— A' CROSS SECTION LOCATION

NOTES:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY.
3. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.
4. LOCATIONS OF PTB BORINGS AND CONCRETE PADS SURVEYED BY CONKLIN & SOROKA, NOVEMBER 2003.

0 30' 60'
GRAPHIC SCALE

X: 08331X09.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-D2BL
3/30/04 SYR-85-KMD RCB DMW
08331003/08331B06.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

FEASIBILITY STUDY

PILOT-TEST BORING LOCATIONS AND NAPL VOLUME CALCULATION ZONES

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1

Appendix E

Calculation of DNAPL Pool Volume

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Calculation of DNAPL Pool Volume
SRSNE, Southington, CT

Prepared by B.H. Kueper
December 7, 2003

Introduction

The purpose of this calculation procedure is to estimate the volume of DNAPL in a pool of specified height and shape. Site-specific properties are used whenever possible, and example calculations are provided.

Theory

The relationship between capillary pressure and fluid saturation in a two-phase porous media system can be described by (Brooks and Corey, 1966):

$$S_e = \left(\frac{P_C}{P_d} \right)^{-l} \qquad (1)$$

where P_C is the capillary pressure between the DNAPL and water, P_d is the porous media displacement pressure, l is the pore size distribution index, and S_e is an effective wetting phase (water) saturation given by:

$$S_e = \frac{S_w - S_r}{1 - S_r} \qquad (2)$$

where S_w is the wetting phase (water) saturation expressed as a fraction of pore space, and S_r is the residual wetting phase saturation. Note that the wetting phase (water) and non-wetting phase (DNAPL) saturations sum to unity such that $S_w + S_n = 1.0$ where S_n is the non-wetting phase saturation. This allows (1) and (2) to be combined such that the non-wetting phase saturation can be expressed as a function of the capillary pressure according to:

$$S_n = 1 - \left(\frac{P_C}{P_d} \right)^{-l} (1 - S_r) - S_r \qquad (3)$$

The total volume of non-wetting phase (DNAPL) in a pool can be calculated as:

$$V_n = Af\int_0^H S_n dz \tag{4}$$

where V_n is the DNAPL volume of interest, A is the area (footprint in plan view) of the pool, H is the height of the pool, and z is the vertical Cartesian coordinate. Note that (4) assumes the DNAPL pool is of uniform thickness, H, at all locations within the pool. This is illustrated schematically in Figure 1.

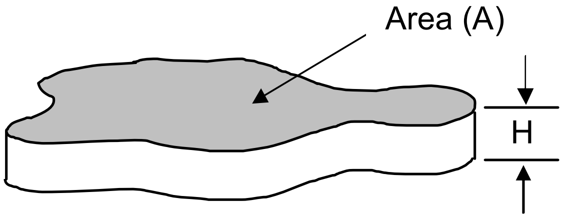


Figure 1 – Schematic Illustration of Pool Under Consideration

Evaluation of (4) following substitution of (3) provides the following relationship between DNAPL volume and pool height (Longino and Kueper, 1995):

$$V_n = Af\left(H - S_r H - \frac{P_d^{l}\left(1 - S_r\right)}{\left(1 - l\right)\left(\Delta r g\right)}\left[\left(P_d + \Delta r g H\right)^{1-l} - P_d^{1-l}\right]\right) \tag{5}$$

where Dr is the difference in density between the DNAPL and water (i.e., $Dr = r_n - r_w$), and g is the acceleration due to gravity. Equation (5) assumes that the pool of interest is under drainage conditions. In cases where the pool is under wetting conditions, (5) should be viewed as an approximation.

Example Calculations

Employment of (5) requires that certain site-specific parameters be defined. The displacement pressure, P_d, is known to be correlated to the intrinsic permeability through (Leverett, 1941):

$$P_d^{\mathrm{dim}} = \frac{P_d}{s}\left(\frac{k}{f}\right)^{0.5} \tag{6}$$

where P_d^{dim} is a dimensionless displacement pressure, P_d is a measured displacement pressure, s is the DNAPL-water interfacial tension, k is the intrinsic permeability, and f

is the porosity. The dimensionless displacement pressure can be calculated given a known set of parameters on the right hand side of (6). Kueper and Frind (1991) report that P_d = 3677 Pa for a fine sand having a porosity of 0.38 and an intrinsic permeability of 4.38507E-12 m^2 for a DNAPL-water system characterized by an interfacial tension of 0.040 N/m. Substituting these values into (6) yields a dimensionless displacement pressure of 0.3123. Figure 2 presents the relationship between displacement pressure and hydraulic conductivity using this value of the dimensionless displacement pressure and a DNAPL-water interfacial tension of 0.00663 N/m (average of 3 measurements from SRSNE site), and a porosity of 0.275 (BBL, SRSNE Remedial Investigation Report).

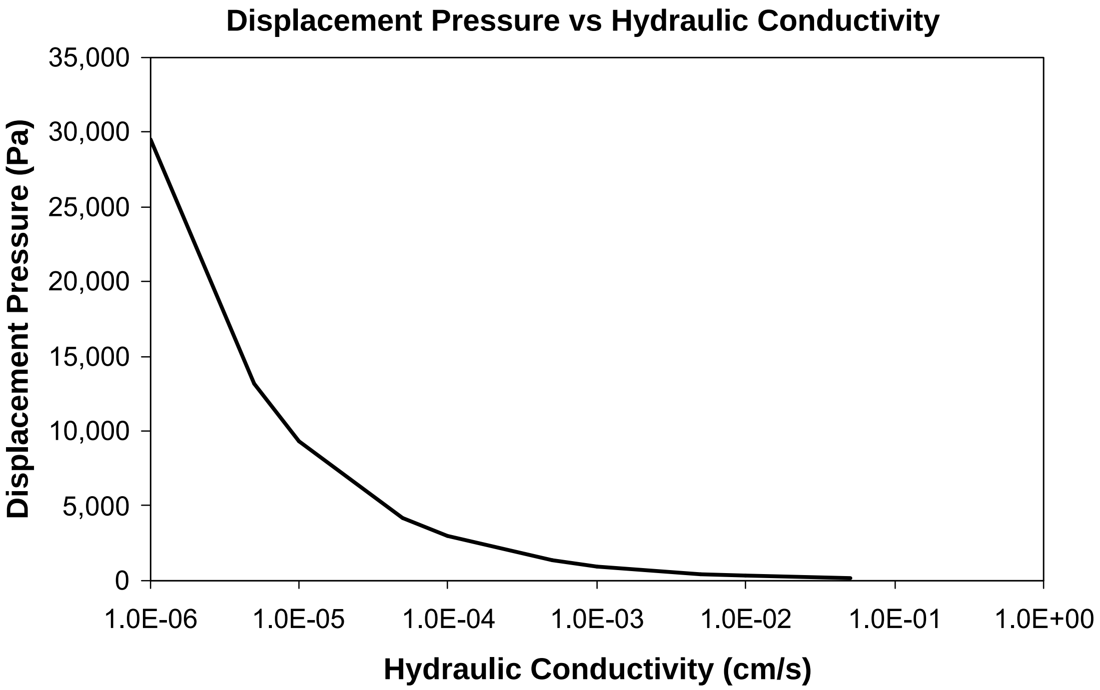


Figure 2 – Displacement Pressure versus Hydraulic Conductivity

The displacement pressures illustrated in Figure 2 can be used in conjunction with equation (5) to estimate the volume of DNAPL in a pool on a per unit area basis (i.e., V_n/A) for a variety of hydraulic conductivities. Recall that the hydraulic conductivity represented in Figure (2), and therefore the displacement pressure represented in (5) correspond to the material that the DNAPL pool is present in, not the material (capillary barrier) upon which the pool is perched.

Figure 3 presents a plot of DNAPL volume per unit area of pool versus pool height for a variety of hydraulic conductivities. A pore size distribution index of 2.5 and a residual wetting phase saturation of 0.10 have been employed (both of these values are typical of sandy deposits). The figure illustrates that finer grained materials will retain less DNAPL volume for a prescribed pool height, and that there is a weakly non-linear relationship between pool height and DNAPL volume. It should also be noted that higher DNAPL density and lower DNAPL-water interfacial tension both lead to larger volumes of DNAPL per unit area of pool.

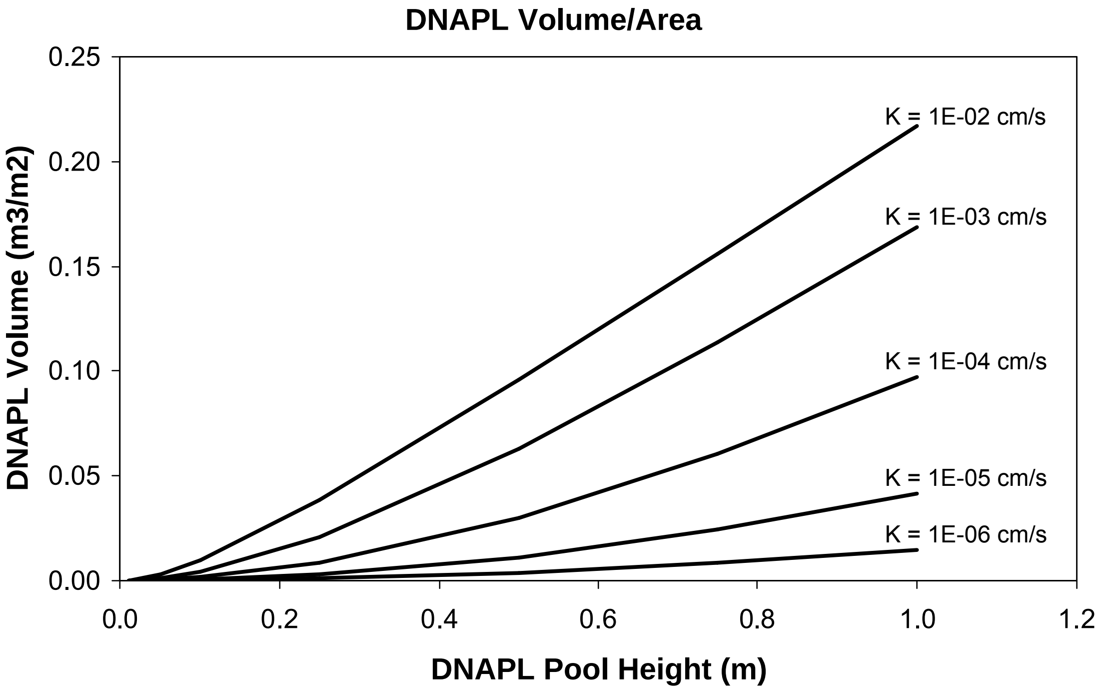


Figure 3 – DNAPL Volume Per Unit Area of Pool versus Pool Height for a Variety of Hydraulic Conductivity Values

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Appendix F

Simulation of Plume Migration in Fractured Bedrock Subject to Aqueous Phase Decay and Source Zone Decay

Simulation of Plume Migration in Fractured Bedrock Subject to Aqueous Phase Decay and Source Zone Decay

DRAFT

April 16, 2004

Prepared for: Bruce Thompson
de maximis, inc.

Prepared by: B.H. Kueper and M.R. West

Disclaimer

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Executive Summary

This report presents the results of screening calculations intended to examine plume behaviour in fractured bedrock at the SRSNE Site located in Southington, CT. Specifically, this report examines the influence of both source zone decay and plume decay on the longevity and extent of constituents in bedrock groundwater. The screening calculations were performed using a recently developed analytical solution presented by West et al. (2004).

The results of this study indicate the following:

- Given a modest amount of aqueous phase degradation in the plume (half-life of 15 years) and a modest amount of source zone concentration degradation (half-life of 10 years), the bedrock plume should begin to recede in approximately 125 years. Under these conditions, all bedrock groundwater should reach regulated concentration levels (assumed to be 5 ppb) in approximately 225 years.
- There is very little difference in plume extent and persistence between the following two scenarios: (1) complete removal of all DNAPL from bedrock at this point in time, and (2) an exponential source zone concentration decay characterized by a half-life of between 10 years and 20 years. The reason that complete source removal does not have a noticeable short-term beneficial effect is because of back-diffusion from the sandstone matrix.

1.0 - Introduction

The purpose of this study is to examine the influence of both aqueous phase decay (i.e., plume decay) and source zone concentration decay on the migration of trichloroethylene (TCE) in fractured bedrock at the SRSNE site (Site) located in Southington, CT. Previous work (Kueper, 1999) examined the migration of TCE in bedrock at the Site in the absence of decay mechanisms. The study performed by Kueper (1999) indicated that bedrock groundwater would remain out of compliance for periods in excess of 1000 years following complete removal of the DNAPL source as a result of back-diffusion from the rock matrix.

The 1999 study was completed using an analytical solution developed by Sudicky and Frind (1982) that assumes solute transport is occurring through a set of parallel, equally spaced fractures of constant aperture subject to an infinitely wide source at the origin. Input parameters to the model were based on the results of site-specific measurements obtained during the Remedial Investigation (RI). The current study employs a newly-developed analytical solution (West et al., 2004) that offers certain advantages in comparison to the Sudicky and Frind (1982) model.

The newly-developed model incorporates a finite-width source zone such that horizontal transverse dispersion can be accounted for in the fractures. In addition, the model can account for decay of both the source concentration and the aqueous phase plume (independent half-lives), and is capable of simulating a finite period of time with a constant concentration source followed by a subsequent period of time that incorporates source concentration decay mechanisms. This latter feature is intended to represent either natural process or the effects of implementing future remedial measures that bring about decay of the source zone concentration. Because the analytical solution assumes that fractures are equally spaced and parallel to each other, the calculations presented here should be viewed as screening calculations.

2.0 - Boundary Value Problem

The solution domain of interest is illustrated in Figures 1 and 2. Contaminant transport in this system can be described by two separate transport equations; a two-dimensional advection-dispersion equation (ADE) for the fracture in the *x*-*y* plane, and a one-dimensional (in *z*) diffusion equation for the matrix. The equations are coupled by the continuity of solute flux at the interface between the fracture and the matrix. The governing equation for the fracture component of the system is described by:

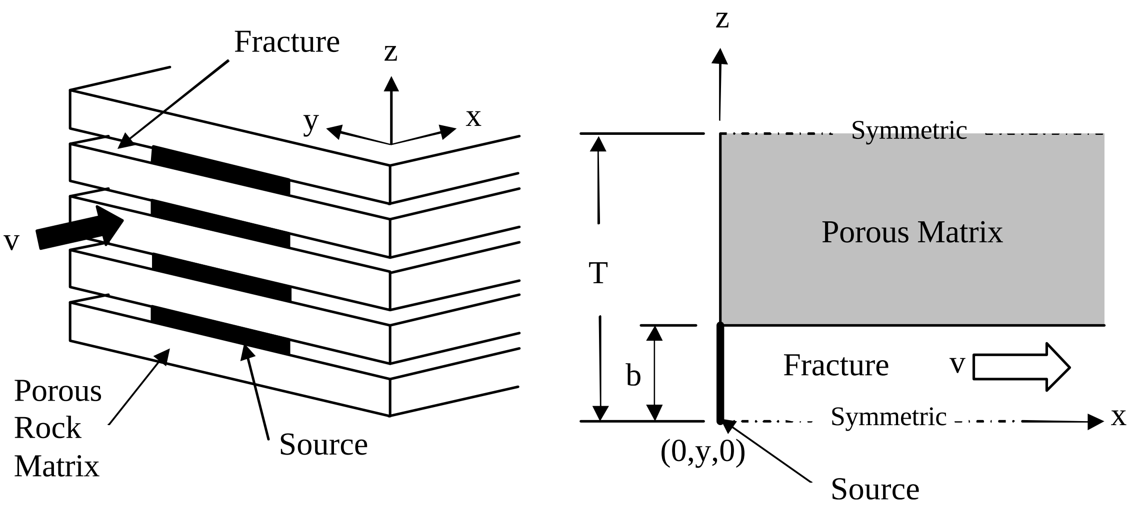
$$\frac{\partial c}{\partial t}+\frac{v}{R}\frac{\partial c}{\partial x}-\frac{D_x}{R}\frac{\partial^2 c}{\partial x^2}-\frac{D_y}{R}\frac{\partial^2 c}{\partial y^2}+l\,c-\frac{2q}{R(2b)}=0 \qquad \begin{array}{l} 0\le x\le\infty \\ 0\le y\le H \end{array} \qquad (1)$$

where $c = c(x,y,z,t)$ is the concentration of the solute [M/L^3], y is the transverse spatial coordinate [L], x is the longitudinal spatial coordinate [L], t is time [T], v is the average linear steady-state groundwater velocity in the fracture assumed to be unidirectional in x [L/T], R is the retardation coefficient for the fracture walls, D_x is the coefficient of longitudinal dispersion [L^2/T], D_y is coefficient of transverse dispersion [L^2/T], *?* is the aqueous phase decay constant [1/T], *2b* is the fracture aperture [L], and q is the source/sink term representing diffusion of solute across the matrix wall.

The dispersion terms D_x and D_y are given by:

$$D_x = a_L v + D^* \qquad (2)$$

$$D_y = a_T v + D^* \qquad (3)$$



(a) Physical System (b) Cross-section of Mathematical Domain

Figure 1 - (a) Physical system. Groundwater flow is horizontal in x-direction through the set of parallel fractures. The coordinate 'z' represents the vertical direction. (b) Mathematical representation in vertical cross-section (x-z plane)

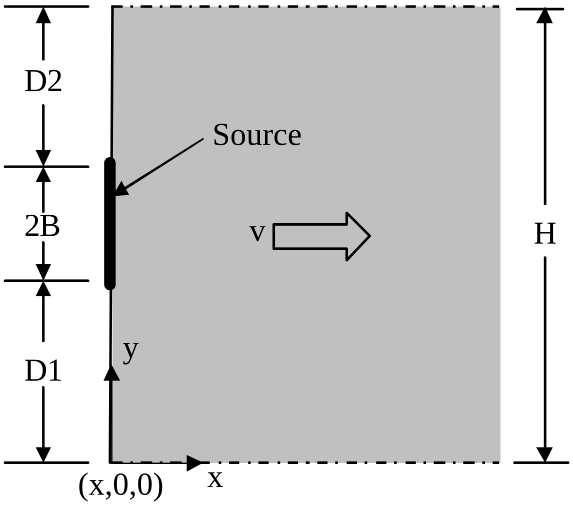


Figure 2 – Mathematical representation in plan view (x-y plane). Groundwater flow is horizontal in x-direction. Source represents DNAPL in fractures.

where a_L is the longitudinal dispersivity [L], a_T is the transverse dispersivity [L], and D^* is the free solution molecular diffusion coefficient [L^2/T].

The aqueous phase decay constant is approximated using a first-order relationship:

$$l = \frac{\ln 2}{t_{1/2}} \tag{4}$$

where $t_{1/2}$ is the half-life of the solute [T].

The retardation coefficient for the fracture, R, describes the process of contaminant adsorption on the fracture face and is defined below assuming a linear adsorption isotherm:

$$R = 1 + \frac{2K_f}{(2b)} \tag{5}$$

where K_f [L] is the fracture distribution coefficient, representing the mass of sorbed solute per unit area of the fracture face relative to the concentration of solute in solution. It is assumed that both the aqueous phase solute and the sorbed solute decay.

The source/sink term (q) represents the transfer of solute between the fracture and the porous matrix, and is equal to the diffusive flux across the fracture-matrix interface. The diffusive flux is approximated using Fick's first law:

$$q = -qD' \left.\frac{\partial c'}{\partial z}\right|_{z=b} \tag{6}$$

where *c'* is concentration in the matrix [M/L^3], *?* is the matrix porosity, and *D'* is the effective diffusion coefficient [L^2/T], given by:

$$D' = t\,D* \tag{7}$$

where *t* is the matrix tortuosity.

The governing equation for diffusive transport in the matrix is described by:

$$\frac{\partial c'}{\partial t} - \frac{D'}{R'}\frac{\partial^2 c'}{\partial z^2} + l\,c' = 0 \qquad \begin{array}{l} b \le z \le T \\ 0 \le y \le H \\ 0 \le x \le \infty \end{array} \tag{8}$$

where *c'= c'(x,y,z,t)* is the concentration in the porous rock matrix [M/L^3], *T* is the half-width between centerlines of equally spaced, parallel fractures [L], *H* is the finite width of the transverse domain [L], and *z* is the spatial coordinate perpendicular to the fracture plane [L]. Note that (8) assumes one-dimensional diffusive transport perpendicular to the orientation of the fracture planes. The matrix retardation coefficient, *R'*, describes the adsorption of solute within the matrix, as follows:

$$R' = 1 + \frac{r_b}{q} K_m \tag{9}$$

where $?_b$ is the dry bulk density of the matrix [M/L^3] and K_m is the porous matrix distribution coefficient [L^3/M].

The final form of the partial differential equation governing contaminant transport in the fracture is obtained by substituting (6) into (1), which gives:

$$\frac{\partial c}{\partial t}+\frac{v}{R}\frac{\partial c}{\partial x}-\frac{D_x}{R}\frac{\partial^2 c}{\partial x^2}-\frac{D_y}{R}\frac{\partial^2 c}{\partial y^2}+l\,c-\frac{2qD'}{R(2b)}\left(\frac{\partial c'}{\partial z}\right)\Bigg|_{z=b}=0 \qquad \begin{array}{l} 0\le x\le\infty \\ 0\le y\le H \\ 0\le z\le b \end{array} \qquad (10)$$

The initial and boundary conditions for (10) are given as:

$$c(x,y,z,0)=0 \qquad (11a)$$

$$c(\infty,y,z,t)=0 \qquad (11b)$$

$$c(0,y,z,t)=\begin{cases} 0 & t\le 0 \\ c_o\ d(y-y') & t<t^* \\ c_o e^{-gt}\,d(y-y') & t\ge t^* \end{cases} \qquad for \quad D1\le y\le (D1+2B) \qquad (11c)$$

$$\frac{\partial c}{\partial y}(x,0,z,t)=0 \qquad (11d)$$

$$\frac{\partial c}{\partial y}(x,H,z,t)=0 \qquad (11e)$$

The initial and boundary conditions for (8) are provided below.

$$c'(x,y,z,0)=0 \qquad (12a)$$

$$c'(x,y,b,t)=c(x,y,b,t) \qquad (12b)$$

$$\frac{\partial c'}{\partial z}(x,y,T,t)=0 \qquad (12c)$$

Note that (12b) expresses the coupling relationship between the fracture and the matrix at the fracture-matrix interface, and (11c) allows for a finite constant concentration source ($0 < t < t^*$), followed by 1st order decay of the source concentration ($t^* < t$). In (12b) the value b represents the half-aperture of the fracture. A constant concentration source is provided by setting ? = 0.

The general transient solutions to (5) and (10) are derived using Laplace and Fourier integral transforms. The governing partial differential equations are transformed into ordinary differential equations using Laplace and finite cosine Fourier transforms, and solved for concentration in both the fracture and the matrix in Laplace and Fourier transform space. Subsequently, the inverse finite cosine Fourier transform is applied to the transformed concentration solution, followed by integration with respect to source zone geometry. The final solution is presented in Laplace transform space, and can be found in West et al. (2004).

3.0 – Model Application

3.1 – Input Parameters and Model Calibration

The input parameters utilized in this study are based on those employed by Kueper (1999) and are summarized in Table 1. The initial source zone concentration is assigned a value of 780 ppm, consistent with the concentration of trichloroethylene (TCE) measured in bedrock monitoring wells at the site (e.g., monitoring well MW-705DR). The DNAPL in bedrock is composed primarily of TCE, justifying the use of this compound as the solute of interest in this study. The concentration of TCE in the bedrock matrix at $t = 0$ is set to a value of zero, consistent with the fact that a time of $t = 0$ in the simulations corresponds to the time at which TCE rich DNAPL first entered bedrock.

BBL (1998) report an average measured matrix porosity of 0.077 and a dry bulk density of 2.49 g/cc for bedrock at the site. The average measured bedrock matrix fraction organic carbon is reported as 0.0036 (BBL, 1998), which yields a matrix retardation factor for TCE of 15.7 assuming a TCE organic carbon partition coefficient of 126 ml/g (Cohen and Mercer, 1993).

BBL (1998) report that the average fracture aperture and average fracture spacing at the site are 96 microns and 1.42 m, respectively. For the purposes of model calibration, the fracture spacing was held constant at a value of 1.42 m. The aperture was adjusted during calibration to yield a TCE concentration of 5 ppb at a distance of x = 300 m from the source at a time of 40 years. This distribution of TCE (780 ppm at x = 0 and 5 ppb at x = 300 m) is consistent with observations at the site in the mid 1990s (i.e., approximately 40 years after DNAPL could have first entered bedrock).

Changes in fracture aperture will bring about changes in groundwater velocity as predicted by the cubic law (Bear, 1972):

$$v = \frac{e^2 rg}{12m} \nabla h \tag{13}$$

where v is the groundwater velocity of interest, r is the density of groundwater, g is the acceleration due to gravity, m is the viscosity of groundwater, and ∇h is the hydraulic gradient in the fracture. In the calibration exercise, groundwater velocity was calculated using equation (13) given a specified fracture aperture.

In the model calibration exercise, the hydraulic gradient was set to a value of 0.005. The matrix tortuosity was set to a value of 0.2 (Pankow and Cherry, 1996), and the longitudinal dispersivity in the fractures was set to a value of 0.3 m. Changes in the longitudinal dispersivity do not significantly influence the predicted concentration profiles or breakthrough curves, consistent with the fact that matrix diffusion has a much larger influence on dispersion of the evolving plume than local dispersity in the fractures.

Calibration was achieved using a constant source concentration of 780 ppm for 40 years (no source decay) and an aqueous phase decay half-life of 15 years. A modest amount of aqueous phase decay was assigned to the calibration exercise, consistent with the fact that degradation of TCE in bedrock is occurring at the site.

A final calibrated solution was obtained using a fracture aperture of 144 microns. This value is close to the value of 140 microns that was arrived at by Kueper (1999) assuming no aqueous phase degradation, and is within the range of fracture apertures measured at the site (BBL, 1998). The calibration presented by Kueper (1999) utilized the identical input parameters as those listed in Table 1 with the exception of groundwater velocity and fracture aperture. Figure 3 presents a comparison between the 1999 and current calibrated concentration profiles.

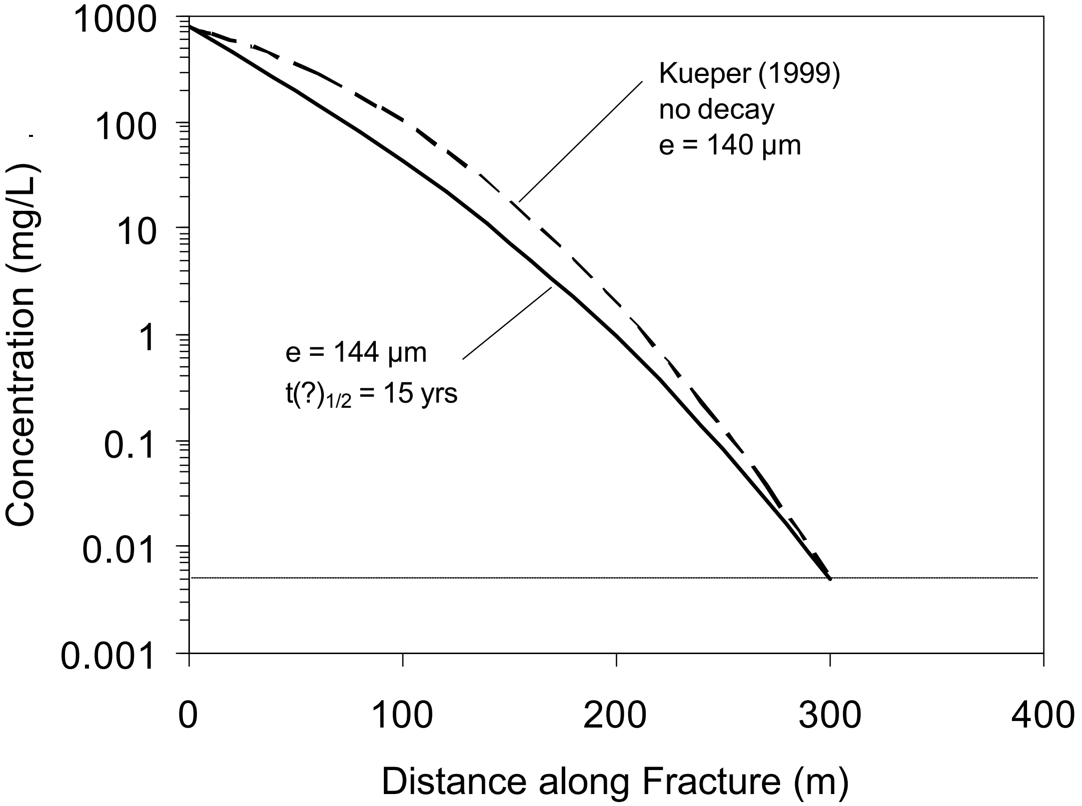


Figure 3 – Concentration versus distance along plume centerline at t = 40 years with and without plume degradation. Upper curve represents a non-degrading solute, lower curve represents a degrading solute with half-life of 15 years.

Kueper (1999) presents a sensitivity analysis examining the influence of various parameter ranges on the predicted plume profiles. The current study differs from the previous one in that emphasis is given here on the role of decay mechanisms, and the fact that two-dimensional solute transport in the fractures is accounted for (i.e., source of finite width). The simulations presented in this study adopt the input parameters presented in Table 1. The horizontal transverse dispersivity (not required in the 1999 study) is set to a value of 0.03 m (1/10th of the longitudinal dispersivity). The assigned values of source zone and aqueous phase decay half lives are discussed further below.

Table 1 – Model input parameters

Parameter	Value
Initial source zone concentration	0.780 kg/m^3
Initial concentration in matrix	0.0 kg/m^3
Groundwater velocity in fractures	8.4757E-05 m/s
Fracture aperture	144.0E-06 m
Fracture spacing	1.42 m
Matrix porosity	0.077
Fracture longitudinal dispersivity	0.3 m
Matrix tortuosity	0.2
Free solution diffusion coefficient	10.0E-10 m^2/s
R (matrix)	15.7
Hydraulic gradient	0.005

3.2 – Outline of Performed Simulations and Discussion of Results

Table 2 presents a summary of the simulations performed in this study. The parameter t^* is the length of time that the source zone is represented as a constant concentration source. The constant concentration is assumed to result from the presence of DNAPL in fractures. No source zone decay occurs during this time period. After the initial t^* period the source is either completely removed (Runs 1 through 5), or subjected to exponential decay in concentration (Runs 7 through 15); Run #6 simulates a constant source concentration for all time. The complete removal of the source in Runs 1 through 5 occurs at t = 40 years. If DNAPL was first introduced to bedrock in 1955, for example, this would correspond to complete DNAPL removal from the source zone in 1995.

With respect to degradation of the solute in the plume, all of the presented simulations incorporate a certain amount of aqueous phase exponential decay. The aqueous phase decay half lives are presented in the fourth column of Table 2. The adopted half lives range between 5 and 15 years depending on the specific simulation. In general, these are rather modest half lives and therefore represent conditions that could be occurring naturally in the bedrock plume.

Run #1 is a base-case scenario that incorporates a source zone width of 50 m, no decay mechanisms in the source, a plume half-life of 15 years, and a constant source concentration of 780 ppm for a period of 40 years. Following the 40 year ‘source on’ period, the source concentration is reduced to 0 ppm to simulate complete removal of the source. This can also be thought of as injection of clean water at the inlet to the system of fractures (i.e., no more contribution to plume from DNAPL dissolution). Run #2 is identical to the base case except for the fact that it incorporates a 10 m wide source zone. Run #3 incorporates a 100 m source zone width. Collectively, Runs #1 through #3 represent a sensitivity analysis to source zone width in the absence of any source zone decay mechanisms. Note, however, that continuous aqueous phase decay of the plume is

Table 2 – Outline of Performed Simulations

Run#	t^* (yrs)	Source half-life for $t > t^*$ (yrs)	Plume half-life for all t (yrs)	Description of Source History	Source width (m)
1	40	**0**	**15**	C_o = 780 ppm for 40 yrs, then complete removal giving C_o = 0 ppm for t > 40 yrs	**50**
2	40	0	15	C_o = 780 ppm for 40 yrs, then complete removal giving C_o = 0 ppm for t > 40 yrs	**10**
3	40	0	15	C_o = 780 ppm for 40 yrs, then complete removal giving C_o = 0 ppm for t > 40 yrs	**100**
4	40	0	**5**	C_o = 780 ppm for 40 yrs, then complete removal giving C_o = 0 ppm for t > 40 yrs	50
5	40	0	**10**	C_o = 780 ppm for 40 yrs, then complete removal giving C_o = 0 ppm for t > 40 yrs	50
6	8	**8**	15	C_o = 780 ppm for all time; therefore no source removal or decay	50
7	40	**10**	15	C_o = 780 ppm for 40 yrs, then exp decay of source after 40 yrs	50
8	40	**20**	15	C_o = 780 ppm for 40 yrs, then exp decay of source after 40 yrs	50
9	**40**	**30**	**15**	C_o = 780 ppm for 40 yrs, then exp decay of source after 40 yrs	50
10	40	30	**5**	C_o = 780 ppm for 40 yrs, then exp decay of source after 40 yrs	50
11	40	30	**10**	C_o = 780 ppm for 40 yrs, then exp decay of source after 40 yrs	50
12	**30**	30	15	C_o = 780 ppm for 30 yrs, then exp decay of source after 30 years	50
13	**20**	30	15	C_o = 780 ppm for 20 yrs, then exp decay of source after 20 years	50
14	**10**	30	15	C_o = 780 ppm for 10 yrs, then exp decay of source after 10 years	50
15	**0**	30	15	Exp decay of source from t = 0 onwards; no initial constant concentration period	50

occurring at all times subject to a half-life of 15 years (both during the source on period, and following removal of the source).

Figure 4 presents a plot of concentration in the fractures versus time since source removal for Runs #1 through #3 along the plume centerline at a distance of x = 300 m downgradient of the source zone. The figure indicates that there is little difference in model behaviour for source zone widths greater than 10 m. Concentration in the fractures increases up to approximately 60 years following source removal, after which a decline is observed. Concentrations persist at levels above 5 ppb for approximately 150 years following source removal despite the relatively high groundwater velocity in the fractures because of the effects of back diffusion from the matrix.

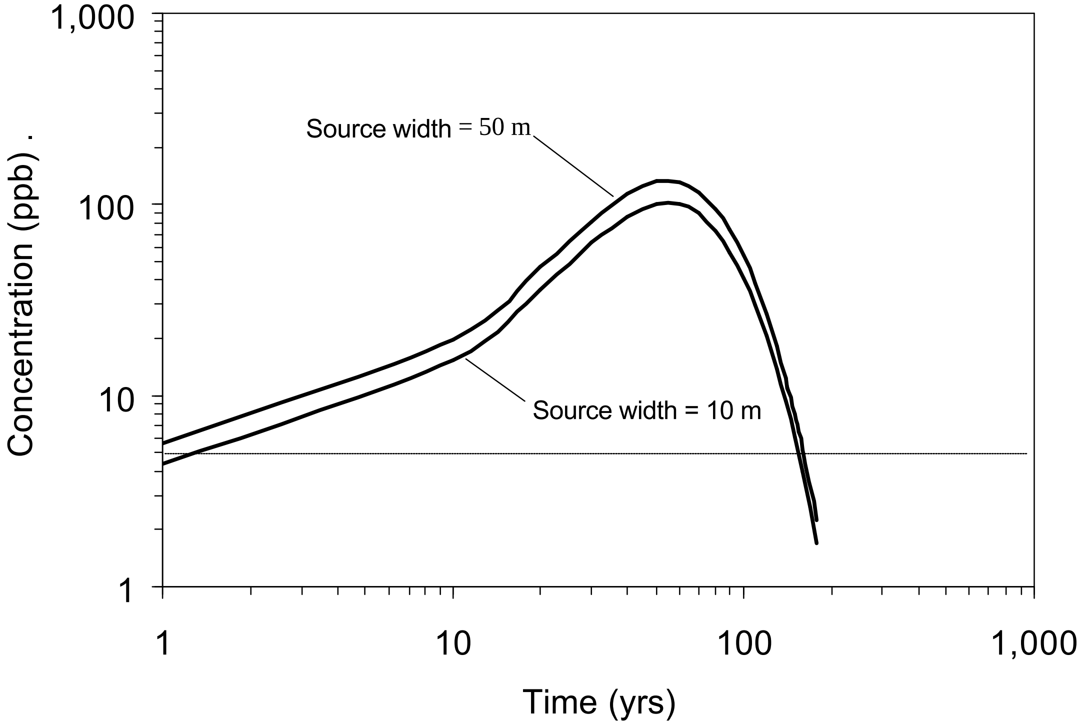


Figure 4 – Concentration versus time since source is removed for Runs #1 through #3 at x = 300 m downgradient of the source. For the time axis utilized in the figure, the source is completely removed at t = 0.

Run #4 is identical to the base case simulation (Run #1) except for the fact that an aqueous phase half-life of 5 years is assigned to represent the effects of TCE biodegradation in the plume (fractures and matrix). As with Runs 1 through 3, aqueous phase biodegradation is applied during the 40 year 'source on' period, as well as for all times after the source is removed. Run #5 is identical to Run #4 except for the fact that an aqueous phase half-life of 10 years is applied. Collectively, Run #1 (base case) and Runs #4 and #5 illustrate the influence of aqueous phase decay on TCE plume migration.

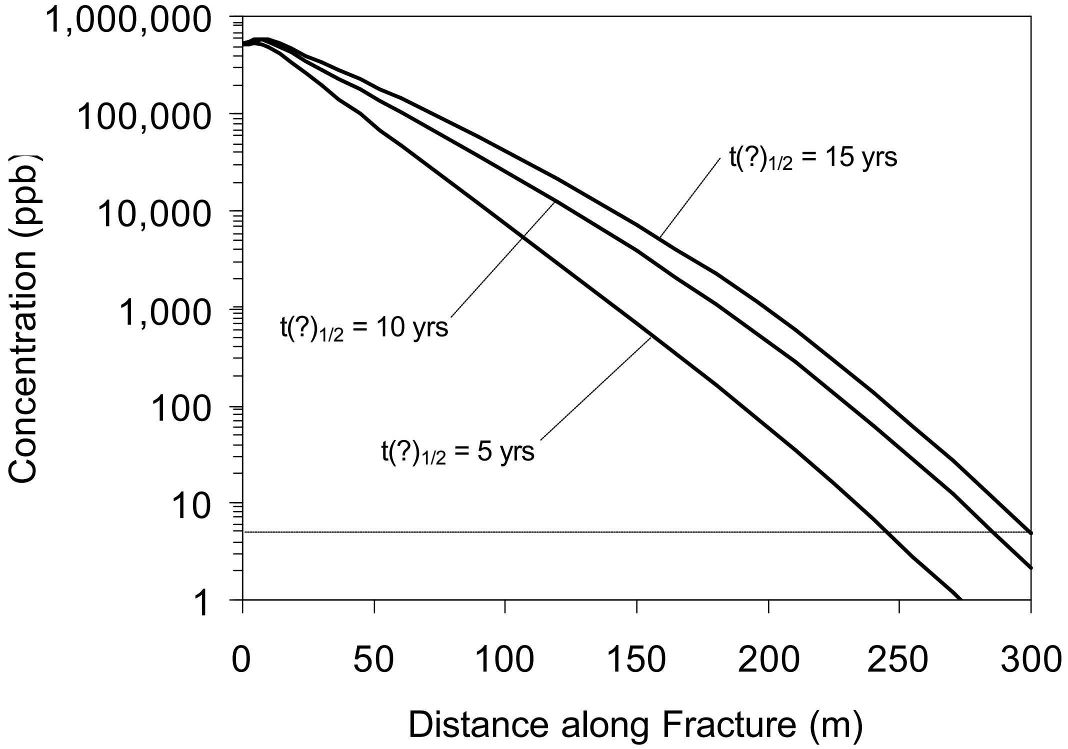


Figure 5 – Concentration versus distance along plume centerline for Run #1 and Runs #4 and #5 at the time of source removal (i.e., after 40 years of a constant concentration source).

Figure 5 presents a plot of TCE concentration in the fractures versus distance along the plume centerline at the end of the 40 year 'source on' period for Run #1 and Runs #4 and #5. The figure illustrates that the incorporation of a shorter aqueous phase decay half-life results in decreased TCE concentrations throughout the fractures. Assuming that the leading edge of the plume is defined by a concentration of 5 ppb, it is clear that shorter half-lives result in a progressive shortening of the plume. A factor of three decrease in the plume half-life results in approximately 50 m less travel distance of the leading edge of the plume at this point in time.

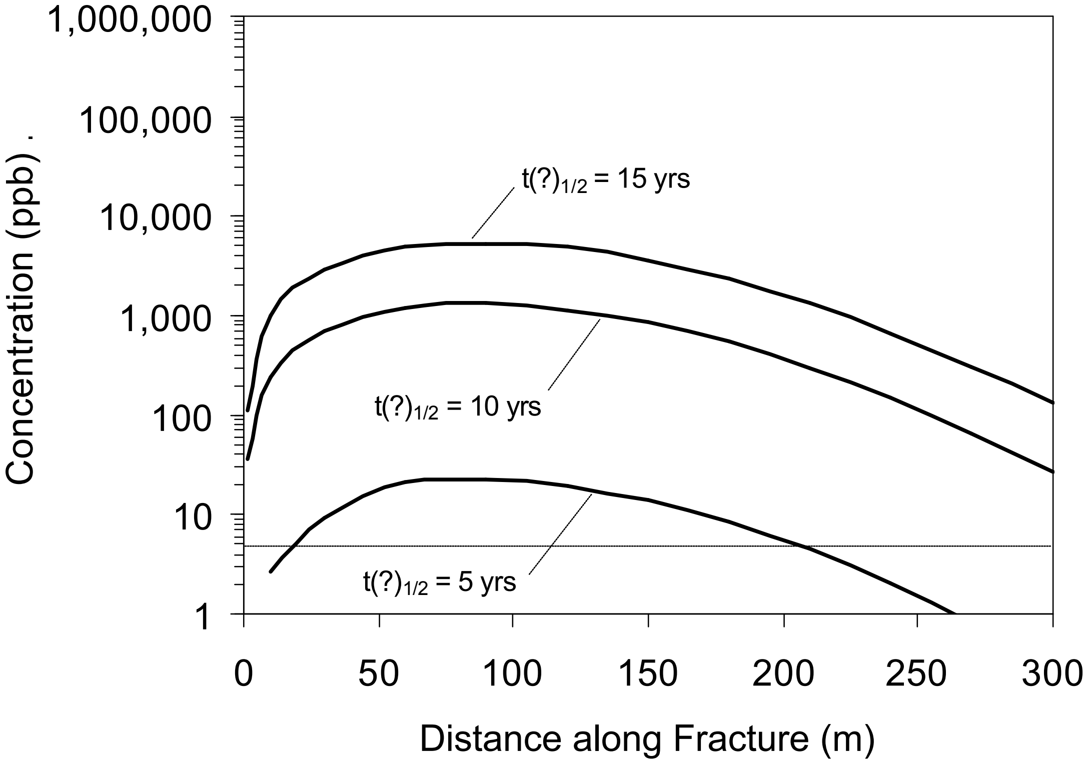


Figure 6 - Concentration versus distance along plume centerline for Run #1 and Runs #4 and #5 at a time of 50 years following complete source removal.

Figure 6 presents a plot of concentration in the fractures versus distance along the centerline of the plume at a time of 50 years following complete source removal for Run #1 and Runs #4 and #5. The figure indicates that shorter half-lives result in progressively lower concentrations. An aqueous phase degradation half-life of 5 years results in concentrations of less than approximately 20 ppb throughout the system. Although the source of DNAPL was removed from the fractures 50 years ago, measurable concentrations of TCE still persist throughout the system as a result of back-diffusion from the rock matrix.

Figure 7 presents a plot of concentration in the fractures versus distance along the plume centerline at a time of 100 years following complete source removal for Run #1 and Runs #4 and #5. As with Figure 6, the figure indicates that shorter half-lives result in progressively lower concentrations. Of particular note is the fact that all concentrations are below 5 ppb for Run #4 which incorporated an aqueous phase TCE degradation half-life of 5 years.

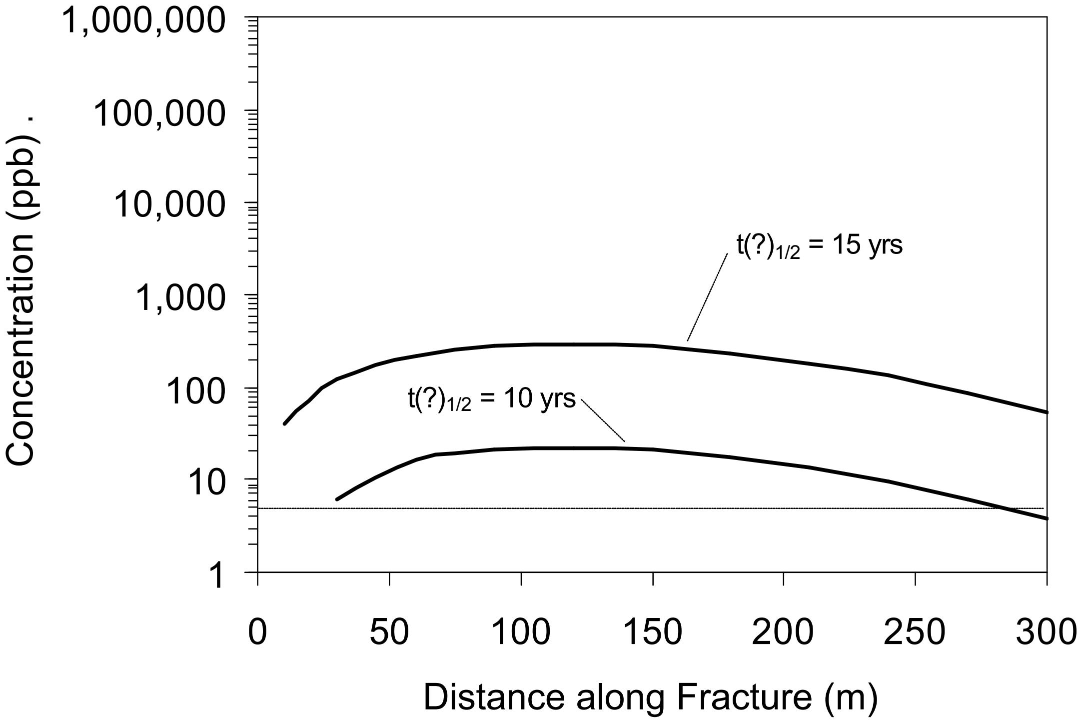


Figure 7 - Concentration versus distance along plume centerline for Run #1 and Runs #4 and #5 at a time of 100 years following complete source removal

Figure 8 presents a plot of concentration in the fractures versus distance along the plume centerline for a time of 200 years following complete source removal for Run #1 and Runs #4 and #5. As with Figures 6 and 7, this figure indicates that shorter half-lives result in progressively lower concentrations. Of particular note is the fact that all concentrations are below 5 ppb for all simulations, and that measurable concentrations persist only for the 15 year plume half-life simulation (Run #1).

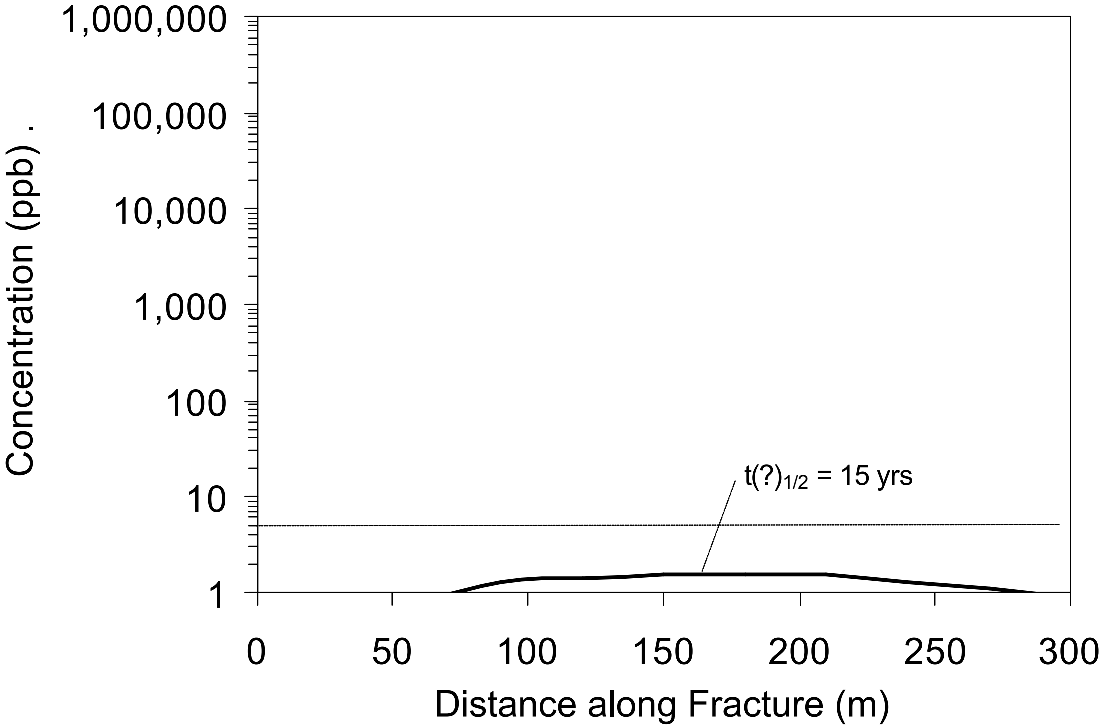


Figure 8 - Concentration versus distance for Run #1 and Runs #4 through #6 at a time of 200 years following complete source removal

Runs #6 through #9 are identical to the base case simulation except for the fact that they incorporate varying degrees of exponential decay of the source concentration following the 40 year period during which the source concentration was held constant at 780 ppm. After 40 years, the source concentration is allowed to decay in response to either natural depletion processes, or the implementation of a partial mass removal technology presumed to result in such behaviour. Runs #7, #8 and #9 incorporate source concentration decay half lives of 10 years, 20 years, and 30 years, respectively. Run #6 incorporates a half-life of infinity and therefore represents a constant concentration source for all times (i.e., ‘source on’ at a constant concentration of 780 ppm for time beyond 40 years). Run #6 represents the case where no source depletion occurs. Although this is an unreasonable expectation, the simulation is included here as a point of comparison.

Figure 9 presents a plot of TCE concentration in the fractures versus time (starting at the 40 year mark) at a distance of x = 300 m downgradient of the source for Run #1 (complete source removal), and Runs #6 through #9. For the case of no source decay (Run #6), TCE concentrations increase for the first 100 years and remain relatively stable from then on. The incorporation of source concentration decay, however, results in maximum concentrations being achieved at a time of approximately 50 years, followed by a moderately fast decline in concentrations. Of particular note is the imperceptible difference between the complete source removal curve and the curve representing a source concentration decay half-life of 10 years. This implies that there is little difference in plume persistence and concentrations between the case of complete DNAPL removal from the source zone and the case of natural or engineered source decay achieving a source zone concentration half-life of 10 years. Further examination of the figure reveals that substantial reductions in plume persistence and concentration are also achieved for cases where the source zone concentration decay half-life is between 10 years and 30 years. Figure 9 suggests that if 200 years were a reasonable period of time for the plume to persist above a clean-up standard of 5 ppb, either natural processes or an engineered remedy would need to achieve a source zone concentration decay half-life of between 20 years and 30 years.

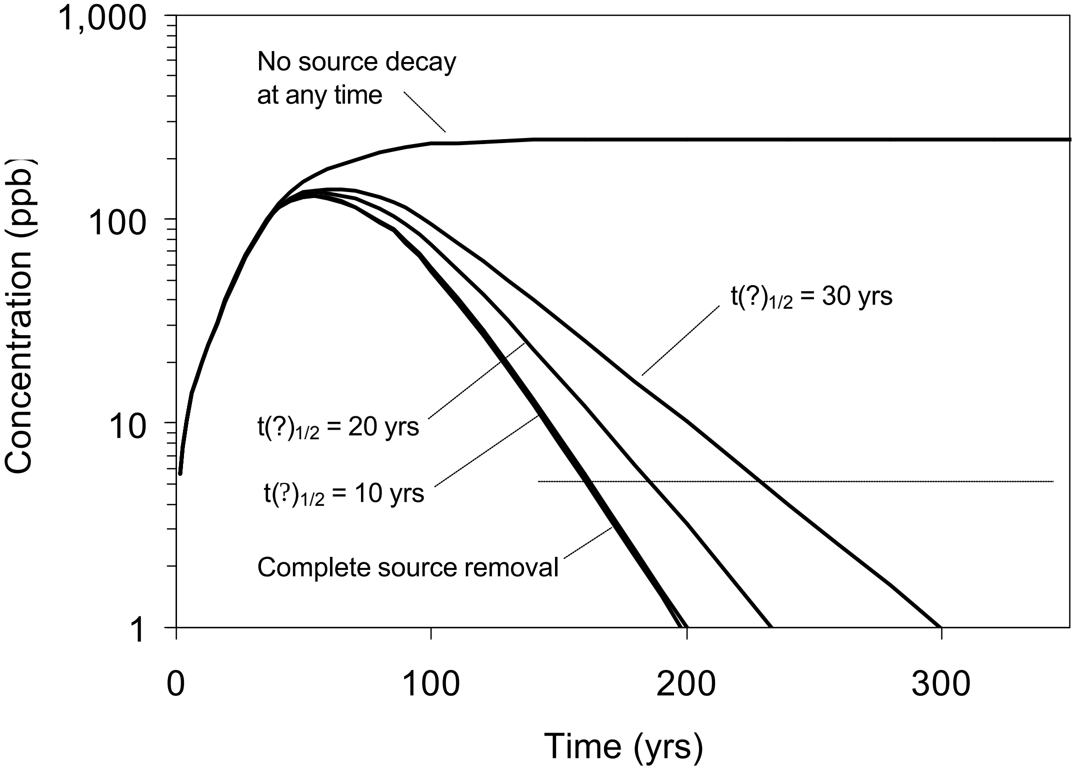


Figure 9 – Concentration in the fractures versus time since the 40 year mark at x = 300 m for Run #1 and Runs #6 through #9. The upper most curve (Run #6) represents no source decay while the lowermost curve (Run #1) represents complete source removal at t = 0 on the time axis.

Runs #9 through #11 incorporate a 40 year ‘source on’ period during which source concentrations are maintained at 780 ppm, followed by exponential decay of the source concentration characterized by a half-life of 30 years. These three runs differ with respect to the aqueous phase decay half-life assigned to the plume. Runs #9, #10 and #11 adopt aqueous phase decay half lives of 15 years, 5 years, and 10 years, respectively.

Figure 10 presents a plot of TCE concentration in the fractures versus time following the initial ‘source on’ period at a distance of x = 300 m from the source zone for Runs #9 through #11. Run #10 is not shown because an aqueous phase decay half-life of 5 years results in non-detectable (less than 1 ppb) concentrations for all times at this distance. It is clear that the incorporation of a small amount of source zone decay (half-life = 30 years) in conjunction with moderate aqueous phase decay half lives (10 year to 15 year) leads to groundwater at the x = 300 m location coming into compliance (less than 5 ppb) in times on the order of 150 years to 250 years.

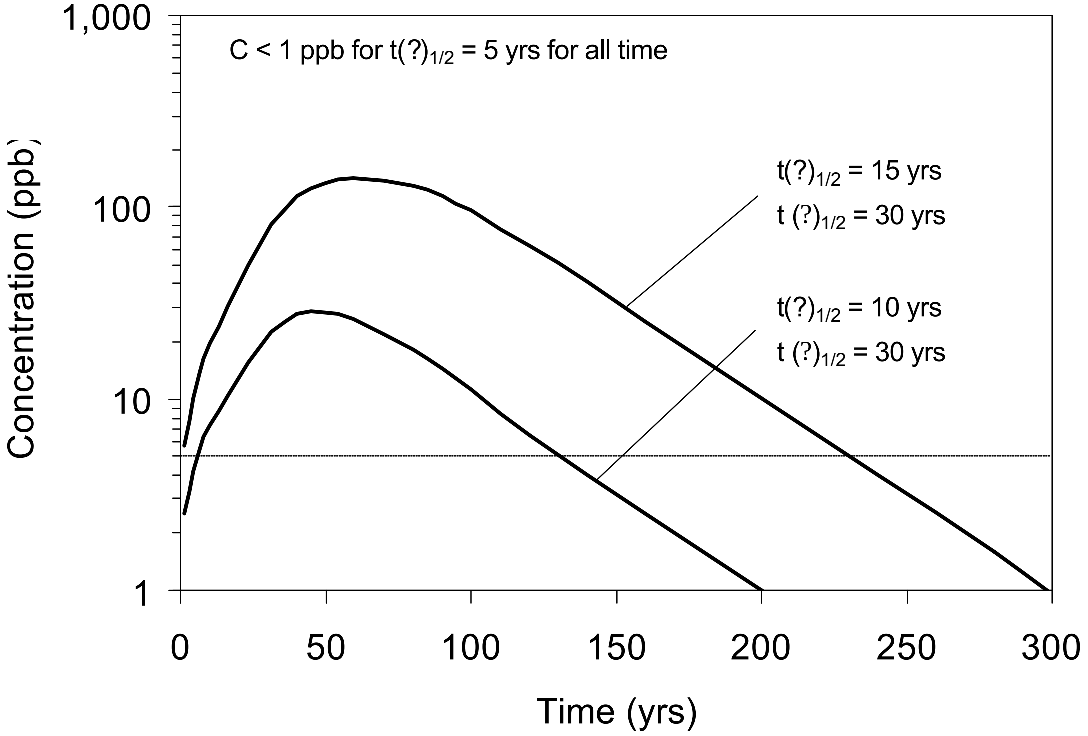


Figure 10 – Concentration in fractures versus time since 40 year mark at a distance of x = 300 m along plume centerline for Runs #9 and #11. Run #10 is not shown because an aqueous phase decay half-life of 5 years results in non-detectable (less than 1 ppb) concentrations for all times at this distance.

Runs #12 through #15 are intended to illustrate the effects of implementing a partial source zone mass removal technology prior to the 40 year time. These simulations could also be viewed as illustrating the effects of when TCE was first released to the subsurface. Runs #12 through #15 all adopt an aqueous phase decay half-life of 15 years, and a source zone concentration decay half-life of 30 years. The four runs differ with respect to when the source zone concentrations begin to decay. Run #12 incorporates a constant source concentration of 780 ppm for a period of 30 years followed by exponential decay of the source concentration. Run #13 incorporates a constant source concentration of 780 ppm for a period of 20 years followed by exponential decay of the source concentration. Run #14 incorporates a constant source concentration of 780 ppm for a period of 10 years followed by exponential decay of the source concentration. Run #15 has no period of constant source concentration, but rather assumes that exponential decay of the source is initiated as soon as TCE enters bedrock.

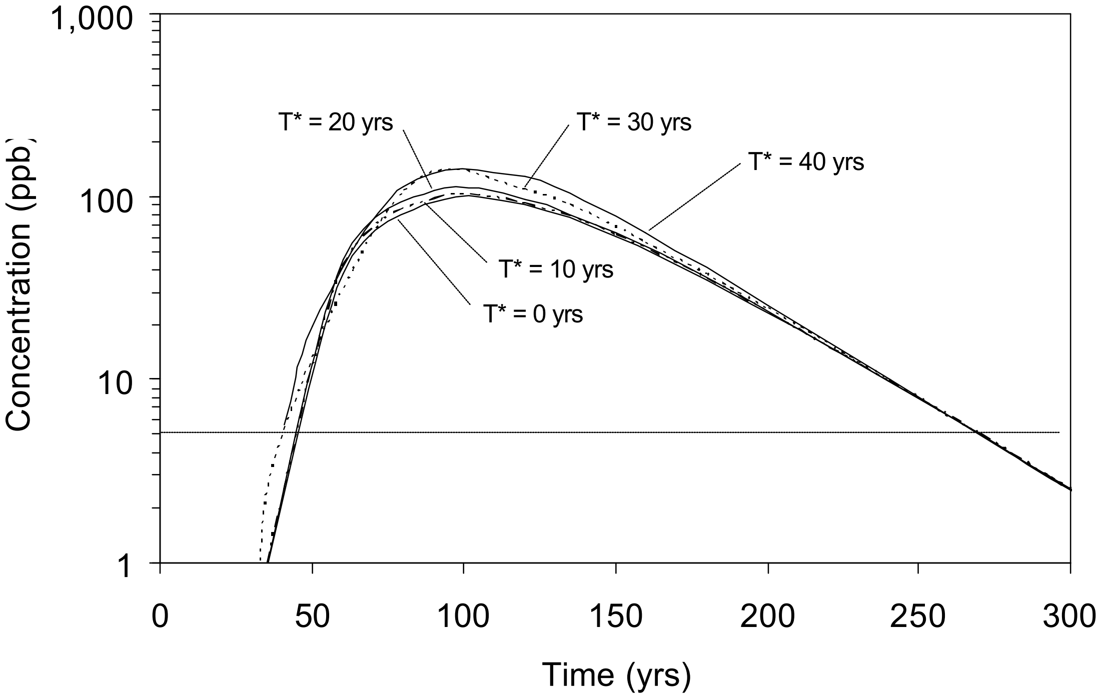


Figure 11 – Concentration in fractures versus time at a distance of x = 300 m for Runs #12 through #15. Run #9 (t^* = 40 years) is also plotted for comparison purposes. In this case, the time axis represents time since DNAPL first entered bedrock.

Figure 11 presents a plot of concentration in the fractures versus time at a distance of x = 300 m downgradient of the source for Runs #12 through #15, and Run #9. The figure indicates that the breakthrough curves are relatively insensitive to when source concentration decay is initiated. In all cases, concentrations reach their highest levels at approximately 100 years, following which they slowly decline.

Also of interest in this study is the maximum spatial extent of the bedrock plume. Figure 12 presents a plot of the distance between the source and the 5 ppb leading contour of the plume as a function of time for Runs # 1, #6, and #7. Recall that Run #1 involved a constant concentration 780 ppm source for a period of 40 years, followed by complete removal of the source. Run #6 involved a constant concentration 780 ppm source for all times (no removal, and no source concentration decay). Run #7 involved a constant concentration 780 ppm source for a period of 40 years, followed by an exponential decay in source concentration characterized by a half-life of 10 years. Figure 12 shows that there is virtually no difference in the rate of plume advance for the first 100 years. In all three cases, the plume grows fastest at early time and progressively slows in its rate of advance. Beyond 100 years, however, the case of no source decay (Run #6, upper curve in figure) shows that the plume reaches a steady-state length of approximately 450 m after approximately 150 years. Beyond this point in time, the plume does not expand beyond the 450 m distance. In contrast to this behaviour, Runs #1 and #7 display receding plumes. In these two cases the plume reaches its maximum length at approximately 125 years, after which it recedes. By approximately 225 years, all concentrations in the system are below 5 ppb for Runs #1 and #7. Of particular note is the fact that Runs #1 and #7 display remarkably similar behaviour. In other words, there is very little difference between complete DNAPL source removal at t = 40 years, and the implementation of either an engineered remedy or natural processes that bring about an exponential decay in source concentrations characterized by a half-life of 10 years.

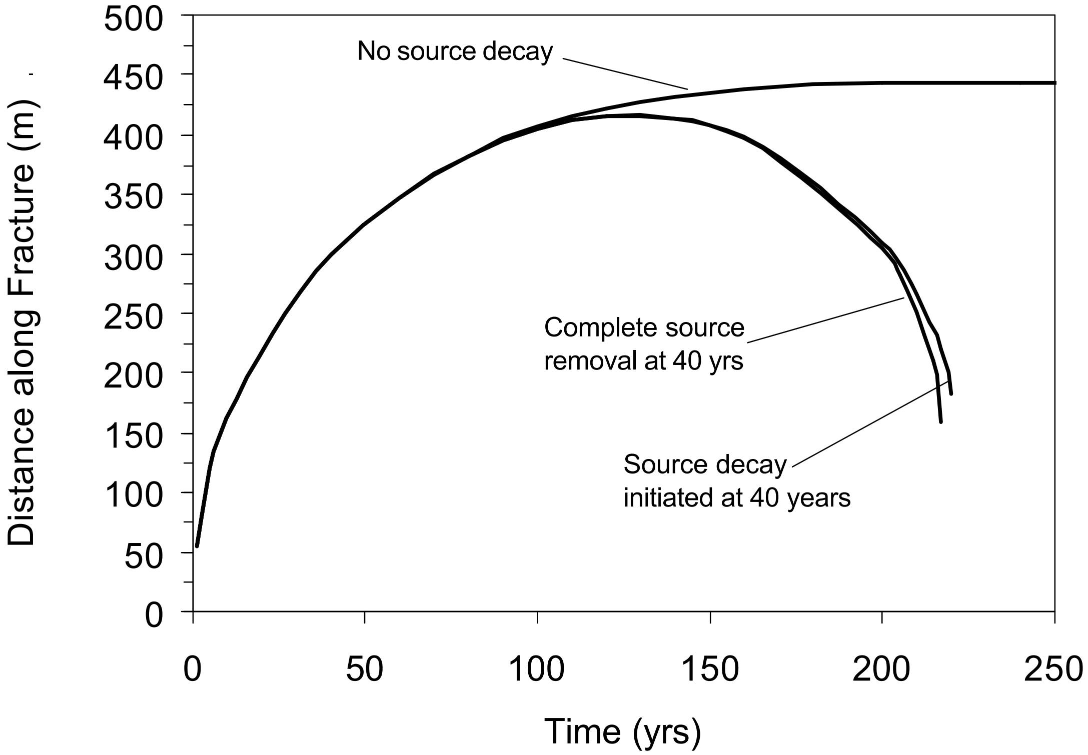


Figure 12 – Length of plume (defined by leading 5 ppb concentration contour) versus time for Runs #1 (lower curve), #6 (upper curve), and #7 (middle curve). Run #6 reaches a steady-state plume length of approximately 450 m after approximately 150 years. Runs #1 and #7 display receding plumes after approximately 125 years, with complete plume disappearance by approximately 225 years.

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Appendix G

Site Specific Assessment and Evaluation of Enhanced In Situ Bioremediation as a Remedial Technology

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SITE SPECIFIC ASSESSMENT AND EVALUATION OF ENHANCED IN SITU BIOREMEDIATION AS A REMEDIAL TECHNOLOGY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC., SUPERFUND SITE, SOUTHINGTON, CT

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GeoSyntec Project Number TR0119
21 June 2004

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

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1. INTRODUCTION

Hydraulic displacement, in situ chemical oxidation (ISCO) and thermal treatment are being evaluated to remove dense non-aqueous phase liquid (DNAPL) from the Observed NAPL in Overburden Groundwater Unit (ONOGU) at the Solvents Recovery Services of New England, Inc. (SRSNE) Superfund Site in Southington, CT (the Site). However, none of these technologies are expected to achieve complete removal of the DNAPL and, therefore, enhanced in situ bioremediation (EISB) is proposed as a post treatment to further contain, treat and remove any remaining residual phase chemicals. The different preliminary technologies will result in varying masses and different compositions of chemicals (i.e., the various preliminary technologies treat chemicals in different ways and to different degrees so the starting conditions for EISB post-treatment will be slightly different for each technology).

The primary chemicals of concern at the Site are chlorinated ethenes and ethanes and in all cases the residual DNAPL and dissolved chemicals, remaining after preliminary treatment, are still likely to be chlorinated ethenes and ethanes. This appendix describes how EISB can accelerate the removal of DNAPLs. The remainder of this appendix presents an overview of this technology (Section 2), a summary of laboratory and field evidence supporting the use of bioremediation for DNAPL remediation (Section 3), and field evidence from other sites where natural biological processes currently are improving the rate of DNAPL mass removal (Section 4).

2. TECHNOLOGY REVIEW

As discussed in detail in Appendix H (Biodegradation Mechanisms), chlorinated volatile organic compounds (cVOCs) can be biodegraded via the following four mechanisms: (1) reductive dechlorination; (2) aerobic cometabolism; (3) anaerobic oxidation; and (4) direct oxidation. Of these processes, reductive dechlorination is the most common mechanism for the treatment of most chlorinated solvent DNAPLs for the following reasons:

1. **Energetically favorable:** microorganisms that cometabolize chlorinated solvents do not derive energy or carbon from the process. In contrast, halorespiring microorganisms derive significant energy during dechlorination. Anaerobic and direct oxidation reactions are also energetically favorable, but only occur for the lesser chlorinated VOCs (e.g., dichloroethenes [DCE], vinyl chloride [VC], 1,2-dichloroethane [1,2-DCA]) and will not be significant within DNAPL where the more chlorinated VOCs (e.g., tetrachloroethene [PCE], trichloroethene [TCE]) dominate.

2. **Limited solubility constraints:** nutrients used to stimulate or support reductive dechlorination (electron donors such as sugars, alcohols, fatty acids that are fermented to hydrogen and used for reductive dechlorination) are more soluble than the cVOCs, so they can be applied in amounts that equal or exceed reductive dechlorination demand, and create concentration gradients that encourage microbial growth near or at the DNAPL: water interface (Chu *et al.*, 2003).

3. **Relative insensitivity to high concentrations:** whereas non-dechlorinating microorganisms that compete for hydrogen are inhibited at concentrations approaching the aqueous solubility limit of PCE/TCE; dechlorinating microorganisms are not. Therefore, DNAPLs provide a unique environment within which halorespiring microorganisms have a competitive advantage. A corollary to this advantage is an improved cost effectiveness of nutrient addition because a greater percentage of the hydrogen produced

during the fermentation of added electron donors is consumed by dechlorinating microorganisms and not wasted in support of other microbial processes such as methanogenesis (Yang and McCarty, 1998 and 2000).

As a DNAPL source zone technology, bioremediation accelerates the remediation of DNAPL sources by various processes including:

1. Dechlorination of the parent cVOCs (e.g., PCE, TCE) in the dissolved phase near the DNAPL/ water interface increases the concentration gradient resulting in enhanced dissolution and an increase in the overall mass transfer of the solvent from the DNAPL to the dissolved phase (Carr *et al.,* 2000; Cope and Hughes, 2001), thus depleting the DNAPL at a faster rate; and

2. Dechlorination of the parent cVOCs to species that have higher saturated solubilities and thus faster dissolution rates; resulting in a directly proportional increase in the dissolution rate and decrease in the DNAPL longevity (Carr *et al.*, 2000; Cope and Hughes, 2001).

The achieved rate of DNAPL removal is affected by: the total effective surface area over which biodegradation can occur; the biodegradation rate; and the partitioning behavior of the degradation products (into the remaining DNAPL and into water). Other factors include: groundwater flow rate, nutrient availability, concentrations of alternate electron acceptors, and biofilms if formed near the water: DNAPL interface.

3. SUMMARY OF LABORATORY AND FIELD STUDIES SUPPORTING APPLICATION OF BIOREMEDIATION TO TREAT DNAPL SOURCES

A review of 118 case studies of DNAPL treatment technologies was recently completed by the Naval Facilities Engineering Command (GeoSyntec, 2004). One finding was that bioremediation was being applied at 25% of these sites, suggesting that application of this technology for source remediation is not novel. Furthermore, laboratory and field studies have demonstrated that reductive dechlorination does enhance DNAPL dissolution rates and decreases the time for their removal. A summary of key laboratory studies is provided below.

1. Carr et al. (2000) showed the effect of biodegradation on the removal of a NAPL mixture, composed of PCE and tridecane, in a continuous flow stirred tank reactor having a residence time of approximately three days. Under abiotic conditions, a total of 0.19 millimoles (mmoles) of this NAPL mixture was removed in 144 days, whereas, 0.57 mmoles was removed in the same time when the reactor was stimulated with the addition of nutrients and formate. This represents an enhancement of the dissolution rate of approximately three times over the abiotic dissolution rate.
2. Yang and McCarty (2000) conducted experiments using one dimensional columns containing PCE DNAPL. The residence time within the columns was approximately 14 days, with an aqueous PCE concentration of 0.9 mmoles per liter. Bioactive columns were fed a mineral media and pentanol. After 150 days of operation, the biotic columns had removed approximately five times as much cVOC mass compared to flushing alone. Cope and Hughes (2001) conducted similar experiments using a PCE and tridecane mixture, and achieved an enhancement of 6.5 times more mass removal in the biotic versus the abiotic columns.

To evaluate the impact of enhanced bioremediation on the rate of DNAPL removal at the field-scale and to develop design protocols for technology implementation in high concentration source areas, ESTCP is currently funding multiple projects evaluating the impact of biodegradation on DNAPL removal rates, including demonstrations at Dover Air Force Base (Delaware), Cape Canaveral Air Force Station (Florida), and Fort Lewis

(Washington). In each case, groundwater recirculation systems have been designed to control electron donor delivery to the source area, and detailed monitoring is being performed to evaluate the impact of biodegradation processes on contaminant removal and degradation rates. The following sections summarize on-going field scale experiments evaluating DNAPL source bioremediation. .

1. NASA Launch Complex 34. A pilot-scale technology demonstration employing bioaugmentation was completed at Launch Complex 34, Kennedy Space Center, by GeoSyntec and was carried out under the auspices of the USEPA SITE program. The mean TCE soil concentration prior to bioremediation was 82 milligrams per kilogram (mg/kg), with lower and upper bounds of 46 to 117 mg/kg, respectively. The TCE concentrations in groundwater samples prior to bioremediation ranged from 105 to 1,220 milligrams per liter (mg/L) (Battelle, 2004). Total dissolved and DNAPL TCE masses were estimated to be 26 and 3 kilograms (kg), respectively. Groundwater was recirculated through a saturated volume that was 20 feet wide and long, to a depth of 19 feet, and amended with ethanol. Ethanol addition stimulated only minimal conversion of TCE to ethene, but bioaugmentation with KB-1™, which contains various strains of *Dehalococcoides* (DHC), caused rapid increases in the rate and extent of TCE conversion to ethene. At the end of the eight month pilot test, the total dissolved and DNAPL TCE masses were estimated to be 0.4 and 0 kg, respectively, representing about 99% removal (Battelle, 2004).
2. Caldwell Trucking Superfund Site. A large pilot test (approximately 120 feet wide, 40 feet long and 80 feet deep) was conducted at this site in the overburden and bedrock to treat TCE/PCE residual mass in a source area. The TCE concentrations in the groundwater samples ranged from 6 to 700 mg/L. Bioremediation involved batch addition to six wells screened in the overburden and bedrock with a mixture of methanol, ethanol, acetate and lactate and a single bioaugmentation event with KB-1™. PCE and TCE were reduced by an average of approximately 95% (average PCE and TCE concentrations were 0.13 and 0.79 mg/L, respectively, with non- detects in groundwater samples collected from two downgradient monitoring wells). Complete conversion to ethene was observed with decreases in intermediate degradation products.

4. ENHANCED IN SITU BIOREMEDIATION AT THE SITE

In June 2003, 31 monitoring wells at the Site were sampled for a range of bioremediation assessment parameters (e.g., dissolved hydrocarbon gases, volatile fatty acids, anions, dissolved metals, alkalinity and other key natural attenuation parameters). The results from this comprehensive sampling event and previous Site data were used to evaluate the status of natural bioremediation processes inside the Non-Time Critical Removal Action-1 (NTCRA-1) and NTCRA-2 containment areas. The following sections summarize the interpretation of these data (Section 4.1) and describe what the data represents in terms of DNAPL removal processes at the Site (Section 4.2).

4.1 Evidence for Enhanced Bioremediation

Reductive dechlorination is a prominent removal mechanism that is in operation at the Site as evidenced by the production of cis-1,2-dichloroethene (cDCE), VC, ethene, and chloride, which are dechlorination products of PCE and TCE. A summary of selected groundwater quality data for the 1996 and 2003 sampling events are presented in Table 1. The groundwater sample chloride and chlorinated ethene compound concentration data from the 1996 and 2003 sampling events are shown in Figure 1.

Figure 1 presents the results from a monitoring well transect, beginning at a background location (P-8B), following along a groundwater flow path through the NTCRA-1 containment area and ultimately to the NTCRA-2 containment area. In both data sets, PCE and TCE are largely undetected due to elevated laboratory quantitation limits as a result of dilutions required for other compounds with higher concentrations in the NTCRA-1 containment area (e.g., cDCE). Plots of overburden groundwater TCE and cDCE concentrations over time are shown in Figures 2 and 3, respectively. These data indicate that any continued dissolution of PCE and TCE are being rapidly degraded through reductive dechlorination to cDCE in the NTCRA-1 containment area. However, the concentrations of VC and ethene within the NTCRA-1 containment area are generally much lower than the cDCE concentrations. Between the NTCRA-1 and NTCRA-2 containment areas, cVOC concentrations are generally below laboratory quantitation limits, with the exception of CPZ-6a located adjacent to the NTCRA-1 containment system in 2003.

There is also evidence of significant increases in groundwater chloride concentrations that can be associated primarily with the degradation of chlorinated ethenes. Plots of all available groundwater sample chloride data are presented in Figure 4. The background groundwater chloride concentrations are less than 10 mg/L in samples collected from overburden well P-8B, and bedrock wells P-8A and MW-702DR. Chloride concentrations greater than 100 mg/L are found in overburden groundwater samples collected near and downgradient of the NTCRA-1 containment area.

Field parameter data collected during the 2003 sampling event indicate that anaerobic conditions, as indicated by low dissolved oxygen readings and negative oxidation-reduction potential measurements, which are required for reductive dechlorination have been established in the NTCRA-1 containment area. These data are consistent with the cVOC data described above.

Screening for DHC-like organisms using polymerase chain reaction (PCR) was conducted to assess the presence and relative abundance of these organisms at the Site. This species has been documented to facilitate the reductive dechlorination of PCE and TCE (Hendrickson et al., 2002). The DHC PCR results presented in Table 1a indicate that there is abundant DHC present in the groundwater sampled from the NTCRA-1 containment area. While efficient degradation, from cDCE to VC and ethene is expected based upon the abundant DHC, it does not appear to be the case in the NTCRA-1 containment area as indicated by the low ethene concentrations observed in groundwater samples collected during the 2003 sampling event. One possibility is that the strain of DHC present at the Site is not optimal. Hendrickson et al. (2002) and He et al. (2003) have indicated that DHC related to the Cornell strain only co-metabolically dechlorinates VC to ethene, a relatively inefficient process. In contrast, DHC strains related to Pinellas and BAV1 halo-respire and derive energy from the conversion of VC to ethene, which leads to rapid removal of VC and accumulation of ethene. However, there may also be some anaerobic oxidation reactions occurring that can remove cDCE, VC and ethene by oxidation to carbon dioxide (CO_2). These could explain why the observed concentrations of ethene were far lower than what would be expected based on stoichiometric conversion of TCE to ethene, particularly given the evidence that DHC was detected at the Site. In addition, the groundwater samples contain more chloride than would be expected from cVOC data used to estimate the extent of reductive dechlorination of the parent compounds, again supporting the hypothesis that anaerobic oxidation processes are active in the NTCRA-1 containment area.

There are a number of electron donors present at the Site including: alcohols (e.g., isopropanol); toluene, ethyl benzene and xylenes (TEX); and ketones (e.g., 4-methyl-2-pentanone [MIBK], acetone). The electron donors are fermented to provide hydrogen for reductive dechlorination; however, biodegradation in the NTCRA-1 containment area may be limited by the quantity, quality and/or distribution of the electron donors. For example, electron donors are present at elevated concentrations at monitoring wells P-1B, MW-409, MW-413 and CPZ-7R, but not at MWD-601, CPZ-9, CPZ-9R and MWL-305 where high concentrations of cVOCs are present.

Elevated cVOC concentrations will limit methanogenesis (methane production) through suppression of the microorganisms that mediate this process. There is limited methane production in the NTCRA-1 containment area (Tables 1a and 1b), which indicates that methanogens (methane producing organisms) are suppressed in this area. This implies that electron donor use for reductive dechlorination will be more efficient in areas with high cVOC concentrations as donors and will not be consumed by methanogens. Methane concentrations increase downgradient of the containment system suggesting methanogenesis is occurring outside of the DNAPL area.

4.2 Impact of Current Biological Processes on DNAPL Removal

Table 2 compares theoretical extracted mass based on measured DNAPL composition. Tables 3 and 4 present the results of various estimates of mass removal that could be attributable to biological processes based on VOC concentrations from:

- theoretical aqueous concentrations from the DNAPL samples;
- monitoring wells within the NTCRA-1 containment area;
- NTCRA-1 extraction wells; and

- chloride and degradation products from TCE.

These data have been combined with the volume of groundwater extracted from the NTCRA-1 recovery wells to provide the estimates presented. Key results presented in these tables are discussed in the following paragraphs.

Table 3 presents the mass of dissolved DNAPL constituents that would theoretically be extracted (based on the geomean and arithmetic mean of these constituents that were measured in three DNAPL samples, and their dissolution into the dissolved phase following Raoult's Law – see Table 2) versus the actual mass extracted from NTCRA-1. NTCRA-1 has extracted a total mass of about 10,000 pounds (lbs) or 4,500 kg over an eight year period versus a theoretical maximum of between 210,000 and 220,000 kg. In the NTCRA-1 containment area, groundwater is generally not in equilibrium with the DNAPL, however, on a small scale DNAPL equilibrium may occur. The small amount of mass extracted is consistent with DNAPL not being in equilibrium with all the groundwater.

Table 4 presents the evaluation of TCE and its degradation products along with chloride data to evaluate the amount of mass of chlorinated ethenes being extracted by the NTCRA-1 containment system versus that being biodegraded in situ. Using the relationship that each dechlorination step of TCE will release one mole of chloride, the total amount of TCE equivalents can be estimated using the NTCRA-1 monitoring well and the NTCRA-1 recovery well chemistry data. These mass estimates can be compared to the actual amount of TCE and degradation products extracted by the NTCRA-1 containment system. Based on this analysis, the total amount of TCE and degradation products being biodegraded in situ ranges from approximately 61,800 to 149,300 kg over eight years. In contrast, the amount of TCE and its degradation products extracted is approximately 2,100 kg over the same time period. These data indicate that in situ biodegradation processes are removing approximately 30 to 72 times more TCE mass equivalent than the NTCRA-1 containment system.

There are some indications that the rate of cVOC degradation within the NTCRA-1 containment area is decreasing as electron donors are depleted, but this effect is not uniform. The 2003 NTCRA-1 containment area chlorinated ethene concentration data have been converted to TCE equivalents in Figure 5. For example, at wells MW-408, MW-409, MW-413 and MW-415, which all have relatively high concentrations of electron donors present, the TCE equivalents are primarily contributed by cDCE and chloride, indicating rapid degradation of any TCE dissolving from DNAPL. While at CPZ-9R, where electron donor concentrations are relatively low, the total TCE equivalents from the cVOCs (including TCE) is greater than that from the chloride data, indicating that the rate of cVOC degradation may be donor limited. However, at CPZ-9 and MWD-601, where electron donor concentrations are also relatively low, there is little TCE present and TCE equivalents are present as chloride and cDCE. This may indicate either that there are more complex electron donors present in some areas of the NTCRA-1 containment area not considered as this part of the analysis, or that degradation products observed at CPZ-9 and MWD-601 are the result of reactions from upgradient areas with electron donors and that cVOC DNAPL is not present in these areas.

Based on chloride equivalents presented in Table 4, approximately 61,800 to 149,300 kg of TCE equivalents have been degraded in the NTCRA-1 containment area. The total VOC mass extracted to date based on data from the NTCRA containment systems is approximately 10,000 lbs or 4,500 kg (Table 3). This difference is likely due to other anaerobic degradation mechanisms (other than reductive dechlorination [e.g., anaerobic oxidation]), which release chloride, and remove cDCE/ VC without degradation to ethene and could explain the relatively low levels of ethene given the DNAPL concentrations of TCE.

Table 3 shows that the theoretical amount of chlorinated ethene (PCE, TCE and cDCE) mass that could have been extracted based on the average DNAPL composition is about 170,000 kg. However, Table 3 indicates that approximately 1,600 kg of chlorinated ethene mass was extracted over eight years of operation, and as stated earlier the groundwater in the NTCRA-1 containment area is generally not in equilibrium with the DNAPL, however, on a local scale DNAPL equilibrium can occur. In contrast, the estimate of DNAPL mass removed based on TCE equivalents suggests that biological processes are creating the effect of achieving between 36% to a 88% of the maximum theoretical extracted amount of chlorinated ethene mass. This discrepancy is attributed to other potential anaerobic oxidation mechanisms that destroy chlorinated ethenes and also accounting for complete dechlorination to ethene. More importantly, these percentages suggest that biological processes are enhancing mass transfer from the DNAPL surface.

A simplified case analysis of the potential impact of biological degradation at the Site demonstrates that the amount of DNAPL mass removed approaches estimates based on the TCE equivalent analysis presented above. The following assumptions were used for this analysis:

- source geometry was conceptualized as a DNAPL pool that has accumulated at the geologic interface between the overburden and bedrock units;
- the dimensions of DNAPL was 250 ft and 400 ft in directions parallel and perpendicular to the principal direction of groundwater flow, respectively;
- overburden porosity was assumed to be 0.3;
- biodegradation was represented by a simple first-order decay;
- dispersive transport was primarily in the transverse vertical direction, and dominated by diffusion rather than hydrodynamic dispersion (e.g., Rivett et al., 2002; Rajaram and Gelhar, 1991); and
- the free diffusion coefficient for TCE ($10.1\text{x}10^{-6}$ cm^2/s; Parker et al., 1994) was corrected for tortuosity effects using Millington (1959):

$$D_e = D_{fee}\phi^{1/3}$$

where ϕ is the bulk porosity and D_e is the effective diffusion coefficient in the porous media.

A closed-form analytical expression for the 1-D steady-state transport equation with diffusion and first-order decay with the following boundary conditions was used:

$$C(O,\infty) = C_0$$

$$C(\infty,\infty)=0$$

which is given by:

$$C(x,\infty)=C_s e^{-x\sqrt{k/D_e}}$$

where *Cs* is the effective solubility of the DNAPL, and *k* is the first-order decay rate coefficient.

This equation was used to generate typical steady-state diffusion profiles as shown in Figure 6.

Using the diffusion profiles presented in Figure 6, the concentration gradients at the DNAPL: water interface were determined to calculate the rate of mass discharge from the pool using Fick's First Law,

$$M=-D_e\frac{\Delta C}{\Delta X}A$$

where; *M* is the mass discharge (M/T), $\Delta C/\Delta X$ is the concentration gradient and *A* is area of the pool (e.g., 250 ft x 400 ft = 100,000 ft^2). Figure 7 shows the mass discharge as function of the biodegradation rate (as half-lives) that ranged between 1 to 100 days.

Figure 7 shows that at a TCE biodegradation half-life of two days (often observed in donor amended treatability studies), there is a significant enhancement in mass removal rate. In this case, a two day half-life would remove approximately 10,000 kg per year of TCE mass, or 80,000 kg over eight years. The above analysis is inherently conservative because of the simplified assumptions, particularly:

- the pool geometry used will result in a much smaller effective DNAPL surface area that what exists naturally at the Site; and
- the effective diffusion co-efficient used is much lower then would exist at the Site because hydrodynamic dispersion was ignored and transport from the DNAPL was assumed to be diffusion controlled.

Similar mass removal rates can occur at much lower biodegradation half-lives when hydrodynamic dispersion is incorporated (which increases the effective diffusion co-efficient) and increasing the available surface area. Obviously this is a simple analysis but it gives some insight into the relative importance of biological processes. It uses an extremely simple DNAPL distribution in place of what is sure to be a highly complex distribution, and neglects any advection through the DNAPL itself, which under some circumstances could significantly contribute to the rate of mass removal.

5. APPLICATION OF EISB FOLLOWING PRIMARY TREATMENT

The preceding sections demonstrated that under the current (up to June 2003) Site conditions, without the addition of supplemental electron donors, there is evidence that biological degradation of the Site chemicals is promoting the enhanced dissolution of DNAPLs over what would be expected based solely on abiotic dissolution mechanisms. Furthermore, the current Site data suggests that electron donors that exist with the DNAPL are being depleted. Therefore, it is reasonable to expect that the dissolution rate can be maintained and enhanced by adding additional suitable electron donors to the groundwater, and that EISB can be used as a follow-on remedial technology to continue the enhanced removal of NAPL residuals that remain after the application of initial treatment technologies. EISB will rely primarily on reductive dechlorination, the sequential replacement of chlorine atoms on the organic molecule by hydrogen atoms (described in more detail in Section 2.4 in Appendix H). As indicated in Appendix H, specific halorespiring microorganisms are required to carry out complete dechlorination of the chlorinated ethenes to ethene, in the presence of a suitable electron donor (e.g., alcohols). Several field demonstrations have shown the utility of bioaugmentation to improve the application of EISB technology (Ellis et al., 2000; Lendvay et al., 2003; Major et al., 2002). Bioaugmentation can significantly reduce the time to reestablish activity (from years to weeks) and, therefore, reduce the degree that plumes will reform from any remaining NAPL phases.

The principal cost of EISB is the electron donor as it will be added periodically. The amount of electron donor, in this case, emulsified vegetable oil (oil), is based on the likely range of biodegradation rates and their impact on the enhanced loading rate of the Site chemicals during the application of EISB, the stoichiometric amount of oil required to meet the loading rate of Site chemicals to promote their complete degradation, and a safety factor to account for loss of electron donor to competing microbial processes (i.e., less than 100% of the electron donor is used during the reduction of chlorinated solvents).

For each technology description that includes EISB, a site specific evaluation of EISB following this primary technology is included in Appendices S, U, and X. The following sections review the anticipated design of EISB following hydraulic displacement (Section 5.1) and a review of factors that might affect the performance of the proposed technology design (Sections 5.2 through 5.7).

5.1 Technology Demonstrations at Comparable Sites or Scale

As identified in Sections 2 and 3, both laboratory and field investigations have indicated that EISB could be applied at this Site and Section 4 clearly identifies that EISB is likely already occurring on a large scale at the Site. These lines of evidence support the application of EISB as a component of the Site remedy. As noted above, EISB is intended to act as follow on treatment process at the Site.

5.2 Risks and/or Benefits of Implementation

The risks and benefits of implementing EISB are summarized below.

<u>Risks</u>:

- <u>Once EISB is established there may be an increase in the dissolution rate</u>. This rate may overwhelm the ability of microorganisms to completely dechlorinate the Site chemicals until their population densities increase. This could result in the short-term production of intermediate degradation compounds like vinyl chloride. However, this risk is mitigated by bioaugmentation to increase cell densities of key halorespiring microorganisms, and by use of the non-time critical removal action (NTCRA-2) containment system.

- <u>Methane will be produced as a by-product of microbial activity.</u> Systems will need to be designed to ensure methane is handled appropriately. Methane production (methanogenesis) is not typically associated with NAPL residuals of chlorinated ethenes as elevated concentrations of chlorinated ethenes inhibit methanogenesis.

- EISB may not enhance current degradation rates. There are already reliable indications that enhanced degradation is occurring. So, at minimum, electron donor addition is expected to sustain the current degradation process. Lack of enhancing (increasing) the degradation rate would, therefore, have little impact other than extending remedial time frames.

- Biofouling, of wells may occur. This could lead to increased costs associated with well rehabilitation.

- Mobilization of metals may occur. Once the Site is returned to anaerobic conditions, possible secondary water impacts, such as increase in the mobilization of reduced metals may occur, particularly those associated with manganese oxides.

Benefits:

- Increase in dissolution rate of residual NAPLs can shorten overall time frame for remediation. This will make the remedy less expensive to achieve overall remedial goal.

- Technology is capable of complete detoxification in situ. At some point this may preclude the use of ex situ treatment systems.

- If degradation rates are sufficiently fast, then “biocontainment” of dissolved phases, may be sufficient and further groundwater extraction and treatment may not be necessary in the future.

- Creation of larger ‘smear’ zones from superseding technologies (e.g., hydraulic displacement and cosolvent flushing) which are more available for biodegradation than large pools.

- Creation of larger ‘smear’ zones from superseding technologies (i.e., hydraulic displacement) which are more available for biodegradation than large pools.

5.3 Cost Sensitivity

The factors most affecting the application cost of EISB include:

- Achieved rate of degradation and the impact this has on the loading of chemicals from the residual NAPL to dissolved phases.
- Unit cost of electron donors. The major cost of EISB is electron donor and the change in costs may be substantial based on changes in electron donor types.
- Ability to distribute oil. The delivery of the oil will also affect the total amount of oil that needs to be delivered yearly to obtain adequate oil coverage to the target areas. As an electron donor is added, it is also consumed during its travel. Assuming that the time to degrade one half the electron donor mass is 10 days, and the it takes 30 days for oil to be advected between an injection and target location, then approximately six times more donor would need to be added at the injection well to achieve the required concentration of oil near the target location. However, increasing the number of injection wells so there is only 10 days of travel time between injection and target locations would require only injecting three times the required mass. There is a trade off between increasing the number of injection locations and total donor required. For longer term cleanups, the increase in cost for additional permanent injection locations is saved through overall decrease in electron donor costs. The detailed design process would evaluate the optimization of wells and electron donor cost.

5.4 Endpoints and How is Performance Measured/Quantified

The performance of EISB is assessed through:

- Increase in flux of parent and degradation products (chlorinated, non-chlorinated and inorganic compounds). This measurement provides an indication of mass removed and enhancement of dissolution rates, and is obtained by use of flux meters or simple measurement of the concentration of target analytes and using groundwater flow velocities to calculate fluxes;

- Calculation of degradation rates using changes in concentrations of parent and degradation products along defined flow paths; and
- Increase in abundance and distribution of key microbial species or their activities.

5.5 Scale-Up and Potential for Implementation of the Technology

EISB is readily scaleable to the Site through the addition of electron donor to existing or added wells. Factors to consider during scale up may include:

- <u>Control of Intermediary Chlorinated Volatile Organic Compounds (cVOCs)</u>. Due to the confined nature of the treatment zone at the Site (underlying confining layer, downgradient sheet pile wall and hydraulic controls) the possible formation of degradation intermediates (cDCE, VC) is not a concern.
- <u>Supplemental Addition of Electron Donor.</u> The existing system of injection and extraction wells installed for the ISCO application are believed to be sufficient for the addition of electron donor and bacterial culture, if required. If the groundwater extraction is no longer ongoing, additional injection points or wells may need to be installed to provide adequate coverage for electron donor addition.
- <u>Permitting.</u> If bioaugmentation with bacterial culture is deemed to be necessary, than a permit may be required.
- <u>Biofouling Controls.</u> The specific biofouling controls will need to be addressed when the final well configuration has been designed.

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TABLES

TABLE 1a
SELECTED ANALYTICAL RESULTS - 1996 SAMPLING EVENT
Solvents Recovery Service of New England, Inc., Southington, CT

			Background		Within NTCRA-1 Containment												NTCRA-1 Extraction Wells			
			P-8B	MW-702DR	P-16	P-1B	TW-08A	MWL-307	MW-408	MW-409	MW-413	MW-415	CPZ-7R	MWD-601	CPZ-9	CPZ-9R	RW-9	RW-10	RW-3	RW-5
Group	Parameter	Units	(OB)	(BR)	(OB)	(OB)	(OB)	(OB)	(BR)	(OB)	(OB)	(OB)	(BR)	(OB)	(OB)	(BR)	(OB)	(OB)	(OB)	(OB)
Chlorinated Ethenes	Tetrachloroethene	µg/L	<1.0	<1.0	<100	<1,000	<250	<2,000	**18**	<1,000	<250	**51**	**75,000 E**	**14,000**	**590 E**	**49,000**	<2,500	<5,000	<1,000	<2,500
	Trichloroethene	µg/L	<1.0	<1.0	<100	<10,000	<250	**970**	**140 EJ**	<1,000	<250	**190**	**890,000 E**	**95,000**	**780 E**	**210,000**	<2,500	<8,100	<1,000	<15,000
	cis-1,2-Dichloroethene	µg/L	<1.0	**5.0**	**14,000 E**	**77,000 E**	**120,000 D**	**32,000 EJ**	**1,300 E**	**76,000 E**	**48,000 E**	**13,000 E**	**140,000 E**	<53,000	**2,400 E**	<63,000	<40,000	<64,000	<12,000	<9,600
	trans-1,2-Dichloroethene	µg/L	<1.0	<1.0	<100	<10,000	<250	<50.0	**17**	<1,000	<250	**70**	<2,500	<5,000	<5.0	<10,000	<2,500	<5,000	<1,000	<2,500
	Vinyl chloride	µg/L	<1.0	<1.0	**1,400**	<10,000	**300**	**14,000 EJ**	**1,200 E**	**7,800**	**420**	**740 EJ**	<2,500	<5,000	**1,000 E**	<10,000	<5,800	<13,000	<1,300	<2,500
Dissolved Hydrocarbon Gases	Ethane	ng/L	--		--	**21.6**	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Ethene	ng/L	--		--	**238**	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Methane	µg/L	--		--	**1,336**	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bioremediation Parameters	Chloride	mg/L	<9.0		--	**61.5**	--	--	--	--	--	**62**	--	--	--	--	--	--	--	--
	Nitrate-Nitrogen	mg/L	<0.20		--	<2.5	--	--	--	--	--	<0.20	--	--	--	--	--	--	--	--
	Sulfate	mg/L	**21.6**		--	<17.8	--	--	--	--	--	**21**	--	--	--	--	--	--	--	--
	Sulfide	mg/L	**1.7**		--	<0.68	--	--	--	--	--	**1.3**	--	--	--	--	--	--	--	--
	Total Organic Carbon (TOC)	mg/L	<1.0		--	<39.9	--	--	--	--	--	**45**	--	--	--	--	--	--	--	--

			Immediately Downgradient of NTCRA-1				Further Downgradient			NTCRA-2		Extraction Well
			MW-125C	CPZ-6	CPZ-6A	MW-502	MW-07	SRS-5	MW-121B	MW-704D	MW-704M	RW-13
Group	Parameter	Units	(BR)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)
Chlorinated Ethenes	Tetrachloroethene	µg/L	<2,000	<50.0	<5,000	<1,000	<10.0	<1.0	**140**	<10.0	<2..0	<5,000
	Trichloroethene	µg/L	970	360	<5,000	<1,000	<10.0	<1.0	<350	<10.0	**7.0**	**<8,100**
	cis-1,2-Dichloroethene	µg/L	**32,000EJ**	<50.0	<5,000	<1,000	<10.0	<1.0	<160	<10.0	**13**	<64,000
	trans-1,2-Dichloroethene	µg/L	<50.0	<50.0	<5,000	<1,000	<10.0	<1.0	<100	<10.0	<2.0	<5,000
	Vinyl chloride	µg/L	**14,000EJ**	<50.0	<5,000	<1,000	<10.0	**1.0**	<100	<10.0	<2.0	<13,000
	Ethane	ng/L	--	--	--	**282**	--	--	--	**1,020**	**285**	--
	Ethene	ng/L	--	--	--	**11**	--	--	--	**0.38**	**0.3**	--
	Methane	µg/L	--	--	--	**29,606**	--	--	--	**17,770**	**4,769**	--
Bioremediation Parameters	Chloride	mg/L	--	--	--	**211**	--	--	--	**68**	**20**	--
	Nitrate-Nitrogen	mg/L	--	--	--	<20.0	--	--	--	<0.20	<0.23	--
	Sulfate	mg/L	--	--	--	<301	--	--	--	<7.0	<12.4	--
	Sulfide	mg/L	--	--	--	<1.8	--	--	--	<1.1	<1.5	--
	Total Organic Carbon (TOC)	mg/L	--	--	--	<47.4	--	--	--	<6.0	<1.4	--

Notes:

mg/L - milligrams per liter
µg/L - micrograms per liter
ng/L - nanograms per liter
EJ - compound was positively identified; however, the associated numerical value is an estimated concentration only, as it was quantitated above the calibration range
E - compound was quantitated above the calibration range
D - sample was diluted
< - non-detect sample (value is quantitation limit)
-- - not available
OB - well screened in overburden
BR - well screened in bedrock

TABLE 1b
SELECTED ANALYTICAL RESULTS - 2003 SAMPLING EVENT
Solvents Recovery Service of New England, Inc., Southington, CT

			Background		Within NTCRA-1 Containment												Extraction Wells			
			P-8B	MW-702DR	P-16	P-1B	TW-08A	MWL-307	MW-408	MW-409	MW-413	MW-415	CPZ-7R	MWD-601	CPZ-9	CPZ-9R	RW-9	RW-10	RW-3	RW-5
Group	Parameter	Units	(OB)	(BR)	(OB)	(OB)	(OB)	(OB)	(BR)	(OB)	(OB)	(OB)	(BR)	(OB)	(OB)	(BR)	(OB)	(OB)	(OB)	(OB)
Chlorinated Ethenes	Tetrachloroethene	µg/L	<5.0	<1.0	**13**	<2,500	<2,500	--	<50.0	<1,000	<2,500	<2,500	<13,000	<2,500	**11**	**70,000**	<500	<1300	<500	<5.0
	Trichloroethene	µg/L	<5.0	<1.0	<5.0	<2,500	<2,500	--	**260**	<1,000	<2,500	<2,500	<13,000	<2,500	**16**	**590,000**	<500	<1300	<500	**11**
	cis-1,2-Dichloroethene	µg/L	<5.0	**5**	**180**	**24,000**	**63,000**	--	**1,200**	**36,000**	**77,000**	**58,000**	**66,000**	**90,000**	**34**	**630,000**	**9,200**	**26,000**	**13,000**	**23**
	trans-1,2-Dichloroethene	µg/L	<5.0	<1.0	<5.0	<2,500	<2,500	--	<50.0	<1,000	<2,500	<2,500	<13,000	<2,500	**5.3**	<2,500	<500	<1300	<500	<5.0
	Vinyl chloride	µg/L	<5.0	<1.0	**82**	<2,500	**2,600**	--	<50.0	**3,100**	**4,400**	<2,500	**100,000**	<2,500	<5.0	**15,000**	**3,600**	**2,000**	**630**	<5.0
Dissolved Hydrocarbon Gases	Ethane	ng/L	<5.0	**13**	**120,000**	**40,000**	**45,000**	**47,000**	**2,100**	**9,700**	**24,000**	**18,000**	**7,700**	**5,500**	**32.0**	**1,600**	**60,000**	**94,000**	**96,000**	**130**
	Ethene	ng/L	**24**	<5.0	**13,000**	**430,000**	**220,000**	**300,000**	**3,500**	**90,000**	**230,000**	**120,000**	**190,000**	**9,300**	**340**	**22,000**	**490,000**	**240,000**	**43,000**	**46**
	Methane	µg/L	0.19	**0.24**	**1500**	**1500**	**530**	**1,000**	**79**	**180**	**640**	**290**	**880**	**10**	**3.6**	**260**	**900**	**970**	**130**	**5.3**
Bioremediation Parameters	Alkalinity as CaCO3	mg/L	**6.3**	**110**	**100**	**150**	**170**	**99.0**	**100**	**140**	**200**	**130**	**92**	**160**	**100**	**110**	**200**	**210**	**97**	**44**
	Chloride	mg/L	**4.3**	**9.4**	**9.0**	**27**	**69**	**29**	**10**	**41**	**100**	**52**	**120**	**54**	**14**	**51**	**32**	**38**	**21**	**18**
	Nitrate-Nitrogen	mg/L	<0.50	**6.3**	<0.50	<0.50	<0.50	<0.50	**2.1**	<0.50	<0.50	<0.50	<0.50	<0.50	**8.9**	<0.50	<50.0	<50.0	<50.0	<50.0
	Nitrite-Nitrogen	mg/L	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<50.0	<50.0	<50.0	<50.0
	Sulfate	mg/L	**13**	**210**	**9.4**	**7.3**	**6.4**	**5.0**	**140**	**4.3**	<1.0	<1.0	**52**	**9.0**	**13**	**89**	**4.7**	**5.0**	**9.9**	**16**
	Sulfide	mg/L	**0.98J**	**1.6**	**2.3**	**0.98**	<2.0	**0.98**	**1.6**	<2.0	**0.65**	**1.6**	**1.6**	<2.0	**0.65**	**0.98**	**1.3**	0.7	**2.9**	<2.0
	Total Organic Carbon (TOC)	mg/L	<5.0	<5.0	**6.6**	**22**	**47.0**	**26**	**1.4**	**47**	**93**	**84**	**23**	**3.7**	**1.5**	**23**	**22**	**26**	**18**	**3.1**
	Dehalococcoides (DHC-PCR) Assay	-	ND	NS	**NS**	**++++**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**++++**	**NS**	**NS**
Metals	Divalent Maganese	mg/L	<1.0	<1.0	**3.6**	**5.6**	**6.9**	**3.8**	<1.0	**4.1**	**9.0**	**5.7**	**1.1**	**2.3**	<1.0	<1.0	**4.1**	**4.1**	**3.0**	**0.1**
	Ferric Iron	mg/L	<1.0	**0.58J**	**0.81**	<1.0	**0.80**	<1.0	**1.7**	<1.0	**0.89**	<1.0	<1.0	<1.0	**2.0**	<1.0	<1.0	**1.0**	**23**	**0.8**
Organic Acids	Acetic Acid	mg/L	<1.0	<1.0	<1.0	**23**	**21**	**22**	<1.0	**52**	**110**	<1.0	<1.0	<1.0	<1.0	<1.0	**3.9**	<1.0	<1.0	<1.0
	Butyric Acid	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Lactic Acid	mg/L	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0
	Propionic Acid	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	**2.2**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Pyruvic Acid	mg/L	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0

			Immediately Downgradient of NTCRA-1				Further Downgradient			NTCRA-2		Extraction Well
			MW-125C	CPZ-6	CPZ-6A	MW-502	MW-07	SRS-5	MW-121B	MW-704D	MW-704M	RW-13
Group	Parameter	Units	(BR)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)	(OB)
Chlorinated Ethenes	Tetrachloroethene	µg/L	<50.0	<25.0	**480**	<100	<100	<10.0	<50.0	<100	<10.0	<50.0
	Trichloroethene	µg/L	<50.0	<25.0	**8,400**	<100	<100	<10.0	<50.0	<100	<10.0	<50.0
	cis-1,2-Dichloroethene	µg/L	430	<25.0	**1,300**	<100	<100	<10.0	<50.0	<100	<10.0	<50.0
	trans-1,2-Dichloroethene	µg/L	<50.0	<25.0	<250	<100	<100	<10.0	<50.0	<100	<10.0	<50.0
	Vinyl chloride	µg/L	<50.0	<25.0	<250	<100	<100	<10.0	<50.0	<100	<10.0	<50.0
Dissolved Hydrocarbon Gases	Ethane	ng/L	**110,000**	**640,000**	**450,000**	**200,000**	**650,000**	**71,000**	**100,000**	**12,000**	**71,000**	**74**
	Ethene	ng/L	**920,000**	**18,000**	**1,600**	**3,500**	**430**	**60**	**470**	**870**	**200**	<5.0
	Methane	µg/L	**2,500**	**19,000**	**18,000**	**23,000**	**24,000**	**4,300**	**23,000**	**300**	**3,300**	**1.8**
Bioremediation Parameters	Alkalinity as CaCO3	mg/L	**330**	**470**	**780**	**600**	**360**	**120**	**350**	**120**	**150**	**180**
	Chloride	mg/L	**170**	**87**	**250**	**260**	**120**	**22**	**100**	**10**	**20**	**29**
	Nitrate-Nitrogen	mg/L	<50.0	<50.0	<50.0	<50.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Nitrite-Nitrogen	mg/L	**0.4**	<50.0	<50.0	<50.0	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	Sulfate	mg/L	**4.4**	**6.0**	**4.2**	<1.0	<1.0	**8.9**	<1.0	**14.0**	**8.8**	**9.8**
	Sulfide	mg/L	**0.65**	**2.9**	**1.3**	**2.9**	**0.65**	**1.3**	<2.0	**1.6**	<2.0	**1.6**
	Total Organic Carbon (TOC)	mg/L	**110**	**7.9**	**34**	**66**	**10**	**3.9**	**11**	**1.8**	**2.9**	**23**
	Dehalococcoides (DHC-PCR) Assay	-	**NS**	**NS**	+++	**NS**	**NS**	**NS**	**NS**	**NS**	++	**NS**
Metals	Divalent Maganese	mg/L	<1.0	**4.6**	**2.2**	**3.0**	**4.0**	**1.7**	**4.4**	**1.7**	**2.2**	**3.9**
	Ferric Iron	mg/L	<1.0	**2.7**	<1.0	**0.66**	<1.0	**0.76**	<1.0	<1.0	<1.0	**70**
Organic Acids	Acetic Acid	mg/L	**200**	**1.5**	<1.0	**7.8**	**2.9**	<1.0	**1.9**	<1.0	<1.0	<1.0
	Butyric Acid	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Lactic Acid	mg/L	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0
	Propionic Acid	mg/L	**16**	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	Pyruvic Acid	mg/L	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0	<10.0

Notes:

mg/L - milligrams per liter

µg/L - micrograms per liter

ng/L - nanograms per liter

J - compound was positively identified; however, the associated numerical value is an estimated concentration only.

< - non-detect sample (value is quantitation limit)

-- - not available

OB - well screened in overburden

BR - well screened in bedrock

DHC results:

++++ very high band intensity (greater than 100% of positive control)

+++ high band intensity (67-100% of positive control)

++ moderate band intensity (34-66% of positive control)

\+ low band intensity (4-33% of positive control)

-/+ inconclusive (1-3% of positive control)

ND - not detected

NS - not sampled

TABLE 2
COMPARISON OF MEASURED AND THEORETICAL AQUEOUS COMPOSITION FROM DNAPL ANALYSIS
Solvents Recovery Service of New England, Inc., Southington, CT

Location	Parameter	DNAPL Concentration[1]	Molecular Weight	DNAPL Molarity	Maximum Mole Fraction[2] (all Compounds Listed)	Maximum Mole Fraction[3] (Chlorinated Compounds)	Pure Compound Solubility[4]	Maximum Theoretical Aqueous Concentration[5]
	Term:	A	B	A/B	C	D	E	C x E
		(mg/L)	(g/mol)	(mmol/L)	(-)	(-)	(mg/L)	(mg/L)
MW-705DR	Tetrachloroethene	160,000	165.8	970	14%	18%	200	28
	Trichloroethene	550,000	131	4,200	60%	78%	1,100	660
	1,1,1-Trichloroethane	29,000	133.4	220	3.1%	4.0%	1,330	41
	Ethyl benzene	21,000	106.16	200	2.8%	--	161	4.5
	m&p-Xylene	46,000	106.17	430	6.2%	--	156	9.6
	o-Xylene	12,000	106.16	110	1.6%	--	178	2.9
	Toluene	81,000	92.13	880	13%	--	526	66
MWD-601	Tetrachloroethene	46,000	165.8	280	12%	18%	200	25
	Trichloroethene	160,000	131	1,200	55%	80%	1,100	600
	cis-1,2-Dichloroethene	440	96.9	4.5	0.20%	0.29%	3,500	7.1
	1,1,1-Trichloroethane	4,400	133.4	33	1.5%	2.1%	1,330	19
	1,1,2-Trichloroethane	5.8	133.4	0.043	0.0019%	0.0028%	4,420	0.085
	1,1-Dichloroethane	13	98.97	0.13	0.0057%	0.0083%	5,060	0.29
	1,1-Dichloroethene	190	96.94	2.0	0.085%	0.12%	2,250	1.9
	1,2-Dichloroethane	9.0	98.97	0.091	0.0040%	0.0058%	8,520	0.34
	Chloroform	14	119.4	0.12	0.0052%	0.0075%	7,920	0.41
	Benzene	50	78.11	0.64	0.028%	--	1,750	0.49
	Ethyl benzene	5,200	106.16	49	2.2%	--	161	3.5
	m&p-Xylene	12,000	106.17	110	5.0%	--	156	7.8
	o-Xylene	4,200	106.16	40	1.7%	--	178	3.1
	Styrene	1,100	104.16	11	0.45%	--	310	1.4
	Toluene	45,000	92.13	490	22%	--	526	110
RW-5	Tetrachloroethene	13,000	165.8	78	9.5%	14%	200	19
	Trichloroethene	57,000	131	440	54%	80%	1,100	590
	cis-1,2-Dichloroethene	1,300	96.9	13	1.7%	2.5%	3,500	59
	1,1,1-Trichloroethane	2,300	133.4	17	2.1%	3.2%	1,330	28
	1,1-Dichloroethene	130	96.94	1.3	0.16%	0.24%	2,250	3.6
	Dichloromethane (Methylene chloride)	60	84.94	0.71	0.087%	0.13%	13,000	11
	Chloroform	16	119.4	0.13	0.016%	0.024%	7,920	1.3
	4-Methyl-2-pentanone	75	100.16	0.75	0.092%	--	20,400	19
	Benzene	70	78.11	0.9	0.11%	--	1,750	1.9
	Ethyl benzene	3,800	106.16	36	4.4%	--	161	7.0
	m&p-Xylene	3,600	106.17	34	4.2%	--	156	6.6
	o-Xylene	2,600	106.16	24	3.0%	--	178	5.3
	Styrene	640	104.16	6.1	0.76%	--	310	2.4
	Toluene	15,000	92.13	160	20%	--	526	110

Notes:
mg/L - milligrams per liter
g/mol - grams per mole
mmol/L - millimoles per liter
-- - not applicable
DNAPL - dense non-aqueous phase liquid

1 - Concentration in DNAPL sample (Source: Table 5, Remedial Investigation Report, BBL, June 1998)
2 - Calculated by dividing the molarity of the given compound by the sum of the molarities of all detected compounds in the DNAPL sample
3 - Calculated by dividing the molarity of the given compound by the sum of the molarities of all detected chlorinated compounds in the DNAPL sample
4 - Solubility reported in P.H. Howard, Handbook of Environmental Fate & Exposure Data, Vol I-V, CRC Press, Boca Raton, FL, 1989
5 - The theoretical aqueous concentration that would result from complete dissolution of the DNAPL sample (calculated by multiplying the mole fraction by the solubility)

TABLE 3
COMPARISON OF THEORETICAL EXTRACTED AQUEOUS DNAPL COMPOSITION AND EXTRACTED GROUNDWATER COMPOSITION
Solvents Recovery Service of New England, Inc., Southington, CT

	Geomean Theoretical Aqueous Concentration[1]	Theoretical Mass Extracted[2]	Arithmetic Mean Theoretical Aqueous Concentration[1]	Theoretical Mass Extracted[2]	Actual Mass Extracted[3]
Term:	A	B = A x (Total Volume Extracted)	C	D = C x (Total Volume Extracted)	E
Parameter	(mg/L)	(kg)	(mg/L)	(kg)	(kg)
Tetrachloroethene	24	6,000	24	6,000	2.7
Trichloroethene	618	160,000	618	160,000	14
cis-1,2-Dichloroethene	20	5,200	33	8,300	1,600
1,1,1-Trichloroethane	28	7,200	30	7,500	310
1,1,2-Trichloroethane	0.08	22	0.085	22	12
1,1-Dichloroethane	0.29	73	0.29	73	--
1,1-Dichloroethene	2.6	670	2.8	700	23
1,2-Dichloroethane	0.34	87	0.34	87	13
Chloroform	0.73	190	0.86	220	--
Dichloromethane (Methylene chloride)	11	2,900	11	2,900	70
4-Methyl-2-pentanone	19	4,800	19	4,800	63
Benzene	1.0	250	1.21	310	--
Ethyl benzene	4.8	1,200	5.0	1,300	410
m&p-Xylene	7.9	2,000	8.0	2,000	320
o-Xylene	3.6	920	3.8	960	320
Styrene	1.8	460	1.9	470	6.6
Toluene	92	23,000	95	24,000	1,300
Total (chlorinated ethenes)	660	170,000	680	170,000	1,600
Total (all compounds)	840	210,000	850	220,000	4,500

Total Volume Extracted[4] (7-1995 to 6-2003)= 254,006,200 L

Notes:

mg/L - milligrams per liter
kg - kilograms
L - liter
-- - not available
DNAPL - dense non-aqueous phase liquid

[1] - Calculated as the average of all detected theoretical aqueous concentrations of the compound in the three DNAPL samples (see Table 2, term C x E)

[2] - The mass of the compound that theoretically would have been extracted since recovery system initiation if the entire DNAPL mass at the site is in contact with groundwater, and each DNAPL component was at equilibrium with its respective theoretical aqueous concentration

[3] - The cumulative mass extracted from the treatment system as of 20-June-2003 (provided by de maximis, inc.)

[4] - Calculated as the NTCRA-1 portion (i.e., 67%) of the total volume extracted from the NTCRA-1 and NTCRA-2 systems as of 20-June-2003

Assumptions:

-the mean DNAPL composition of the three DNAPL samples is representative of the entire NTCRA-1 containment area DNAPL composition
-the mean DNAPL composition has been at steady state since recovery system initation

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Last Updated: 1-December-2003

TABLE 4
MASS BALANCE OF TRICHLOROETHENE AND DEGRADATION PRODUCTS
Solvents Recovery Service of New England, Inc., Southington, CT

Cluster	Trichloroethene	Trichloroethene Mass Extracted Over Time[2]		Degradation Products (mmol/L)					Total Degradation Products Mass Extracted Over Time[2]		Actual Mass Extracted[5]
	(mmol/L)	(mmol)	(kg)	cis-1,2-Dichloroethene	Vinyl chloride	Ethene	Chloride[1]	Sum	(mmol)	(kg)	(kg)
Containment Area Monitoring Wells											
Geomean Concentration	0.004	1.02E+06	133.1	0.040	0.0090	0.0015	0.83	0.88			
Trichloroethene Equivalents	0.004	1.02E+06	133.1	0.040	0.0090	0.0015	2.5	2.5	6.46E+08	84,600	2,084
Arithmetic Mean Concentration	0.28	7.21E+07	9450	0.659	0.1276	0.0048	1.23	2.02			
Trichloroethene Equivalents	0.28	7.21E+07	9450	0.659	0.1276	0.0048	3.7	4.5	1.14E+09	149,300	2,084
NTCRA-1 Recovery Wells[4]											
Geomean Concentration	0.0019	4.72E+05	61.9	0.030	0.0062	0.00077	0.61	0.64			
Trichloroethene Equivalents	0.0019	4.72E+05	61.9	0.030	0.0062	0.00077	1.8	1.9	4.72E+08	61,800	2,084
Arithmetic Mean Concentration	0.0040	1.02E+06	133.1	0.124	0.0249	0.00678	0.65	0.80			
Trichloroethene Equivalents	0.0040	1.02E+06	133.1	0.124	0.0249	0.00678	1.9	2.1	5.33E+08	69,800	2,084

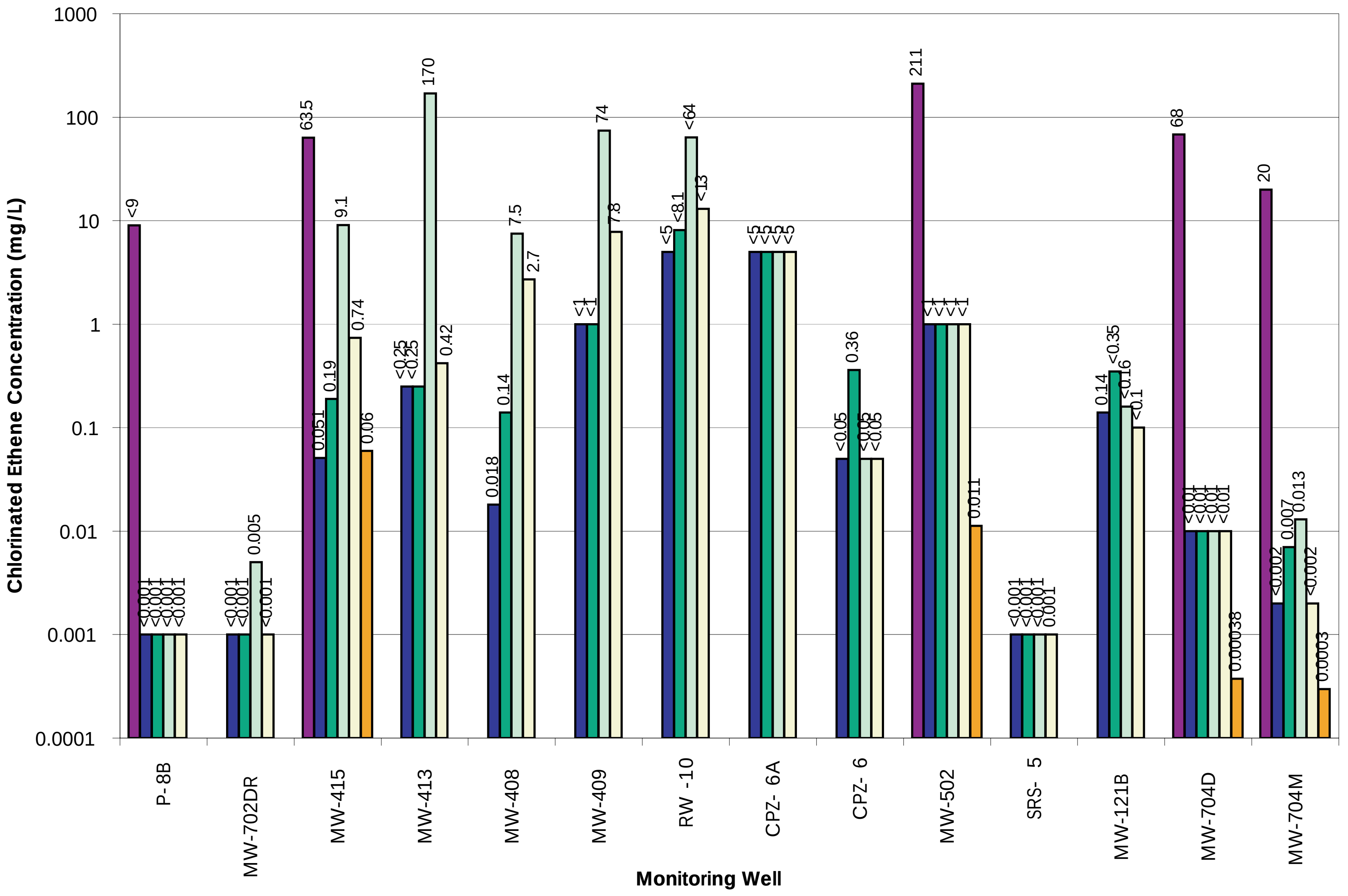
Total Volume Extracted[3] (7-1995 to 6-2003) = 254,006,200 L

Notes:
mmol - millimoles
mmol/L - millimoles per liter
L - liter
kg - kilograms
1 - Background value (0.12 mmol/L for overburden wells, 0.19 mmol/L for overburden and bedrock wells) subtracted from chloride values prior to averaging
2 - Calculated by multiplying the molarity sum by the total volume extracted. Time is from NTCRA-1 treatment system startup.
3 - Calculated as the NTCRA-1 portion (i.e. 67%) of the total volume extracted from the NTCRA-1 and NTCRA-2 systems as of 20-June-2003
4 - Complete datasets available only from RW-3, RW-5, RW-9 and RW-10, therefore these data only are used in the referenced calculation
5 - The cumulative mass of trichloroethene, cis-1,2-dichloroethene and vinyl chloride extracted from the treatment system as of 20-June-2003 (provided by de maximis, inc.)
Non-detects were assigned a value of one-half the detection limit prior to averaging

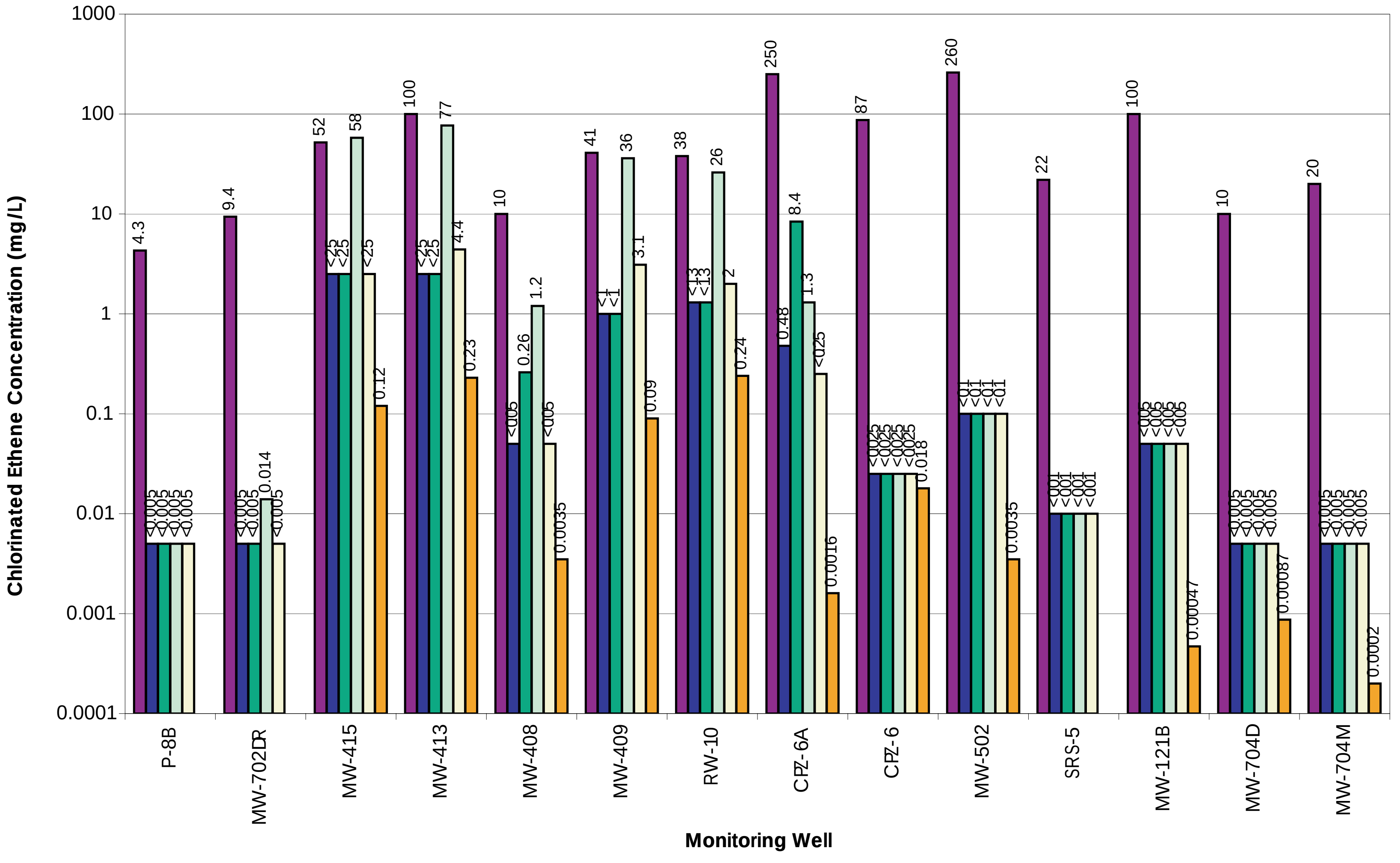
Assumptions:
-the mean groundwater sample composition is representative of the entire site groundwater composition
-the mean groundwater sample composition has been at steady state since recovery system initiation
-the contribution of species other than chlorinated ethenes is not acounted for in the stated chloride concentration

FIGURES

A) Chlorinated Ethene Concentration Data - 1996



B) Chlorinated Ethene Concentration Data - 2003



🟪 Chloride
🟦 Tetrachloroethene
🟩 Trichloroethene
▨ cis-1,2-Dichloroethene
⬜ Vinyl chloride
🟧 Ethene

mg/L - milligrams per liter

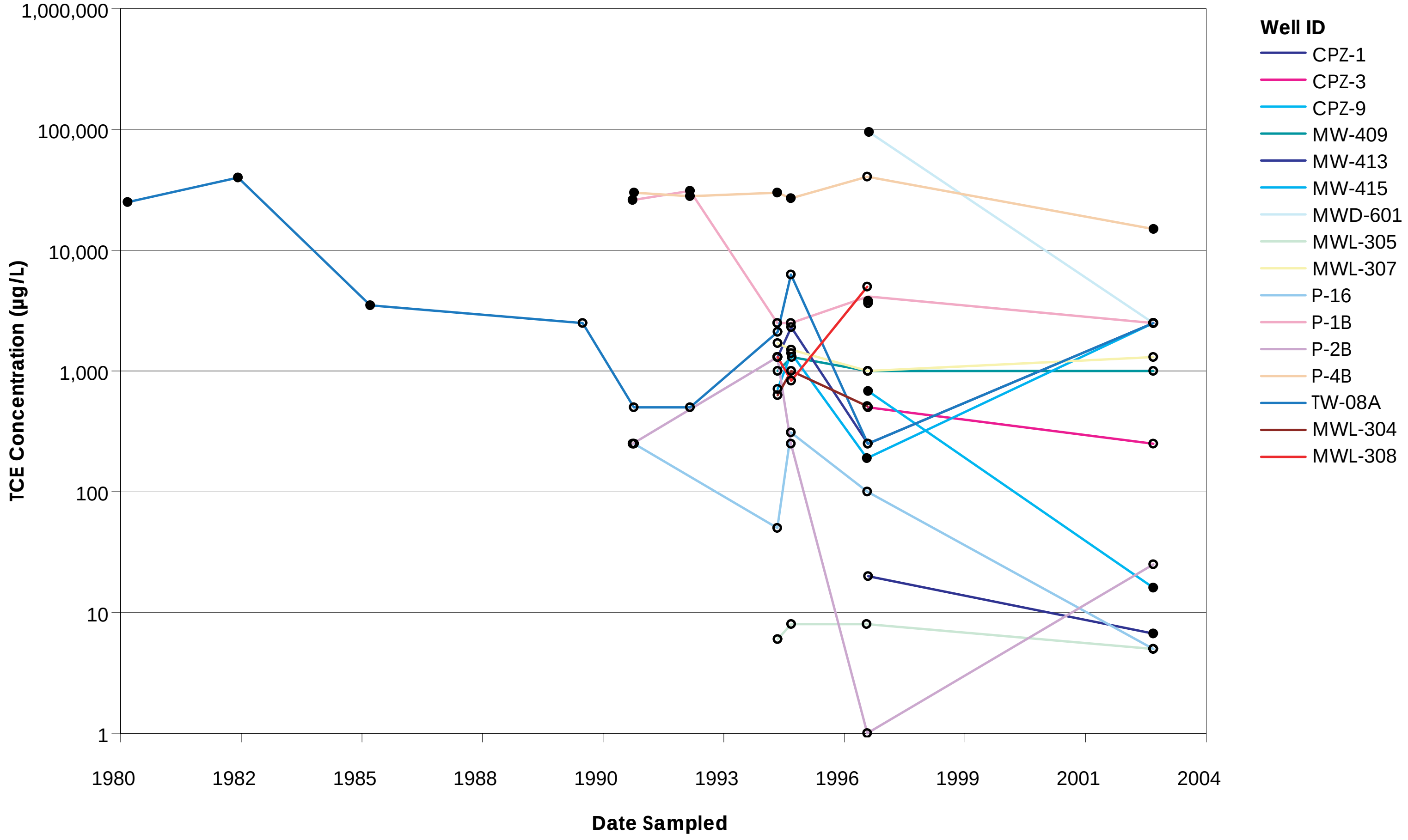
Note:
Chloride and ethene analyses were not performed on all samples

(Original Excel File Path: P:\PRJ\Projects\TR0119 - SRSNE\SRSNE_DatabaseIS\Outputs\Fig_EthenesChart)

Chlorinated Ethene Concentration Data - 1996 and 2003
Solvents Recovery Services of New England, Southington, CT

May 2004	Figure: **1**	GEOSYNTEC CONSULTANTS

graph figures_TR0119.ai



TCE - trichloroethene
µg/L - micrograms per liter
○ Non-detect value (plotted at quantitation limit)
● Detect value

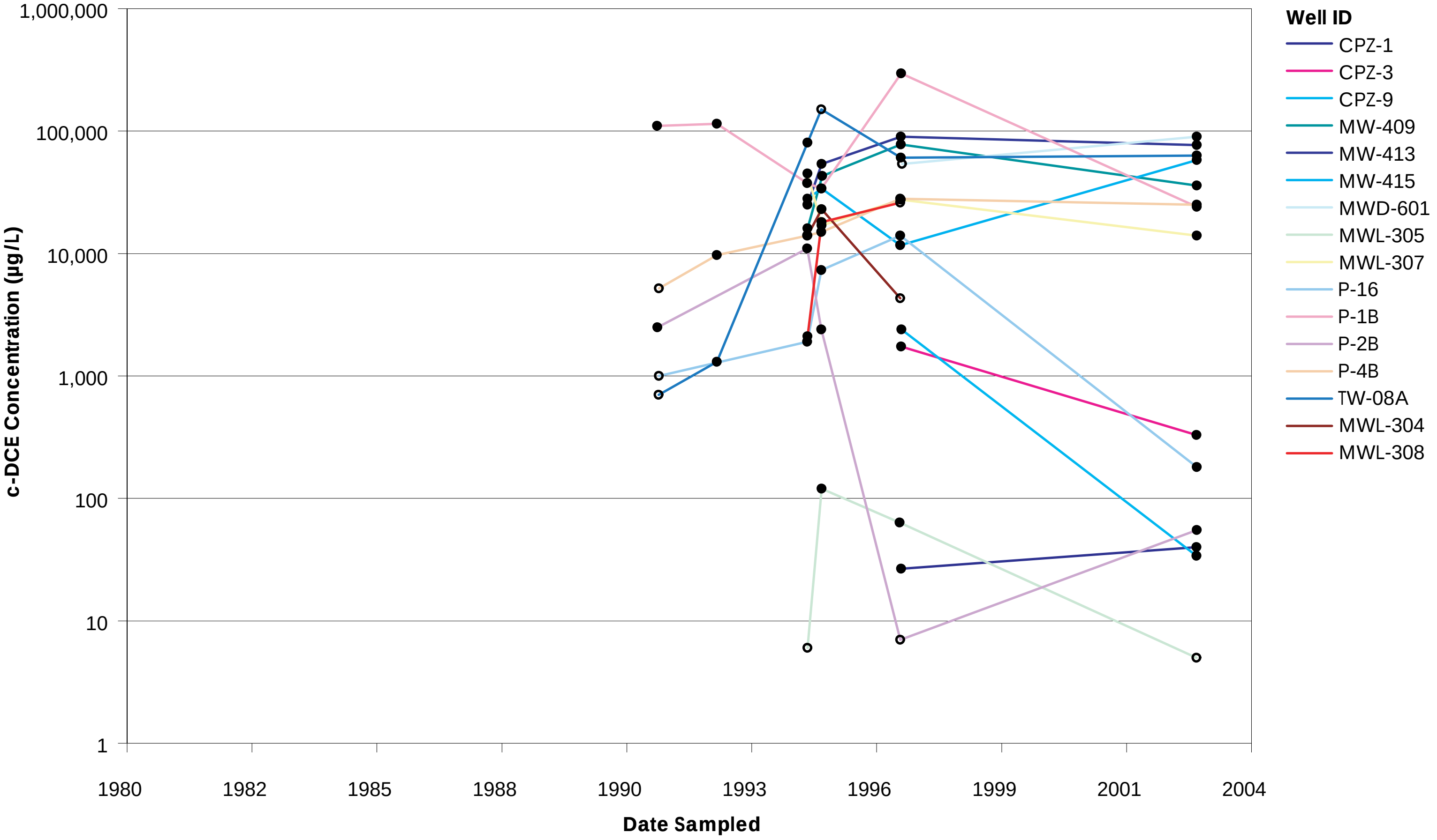
(Original Excel File Path: P:\PRJ\Projects\TR0119 - SRSNE\SRSNE_DatabaseIS\Outputs\cVOC-TTV.xls)

Overburden Groundwater Trichloroethene Time-Series Data for the NTCRA-1 Containment Area

Solvents Recovery Services of New England, Southington, CT

May 2004	Figure: **2**	GEOSYNTEC CONSULTANTS

graph figures_TR0119.ai



cDCE - cis-1,2-dichloroethene

µg/L - micrograms per liter

● Non-detect value (plotted at quantitation limit)

● Detect value

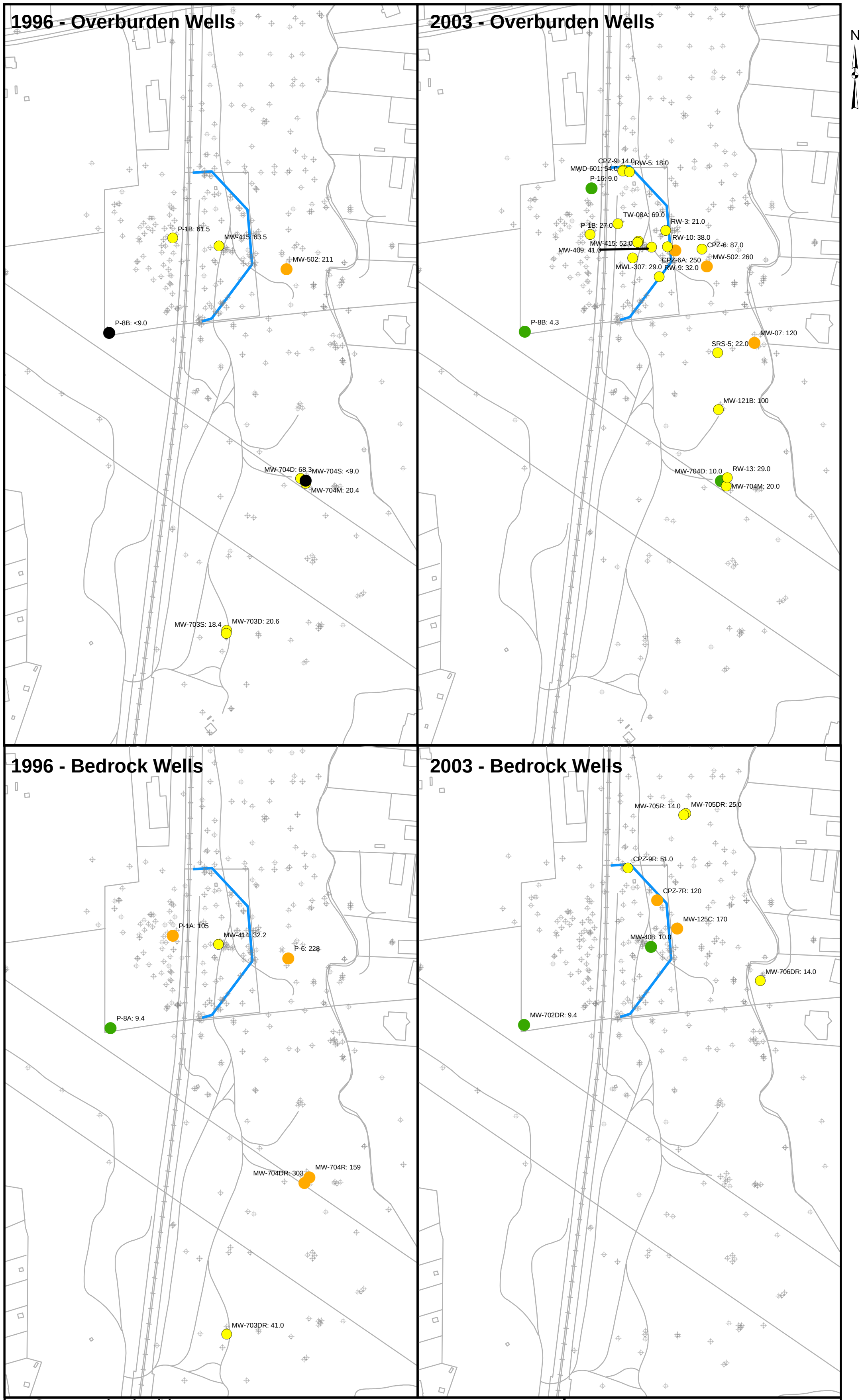
(Original Excel File Path: P:\PRJ\Projects\TR0119 - SRSNE\SRSNE_DatabaseIS\Outputs\cVOC-TTV.xls)

Overburden Groundwater cis-1,2-Dichloroethene Time-Series Data for the NTCRA-1 Containment Area

Solvents Recovery Services of New England, Southington, CT

May 2004	Figure: **3**	GeoSyntec Consultants

graph figures_TR0119.ai

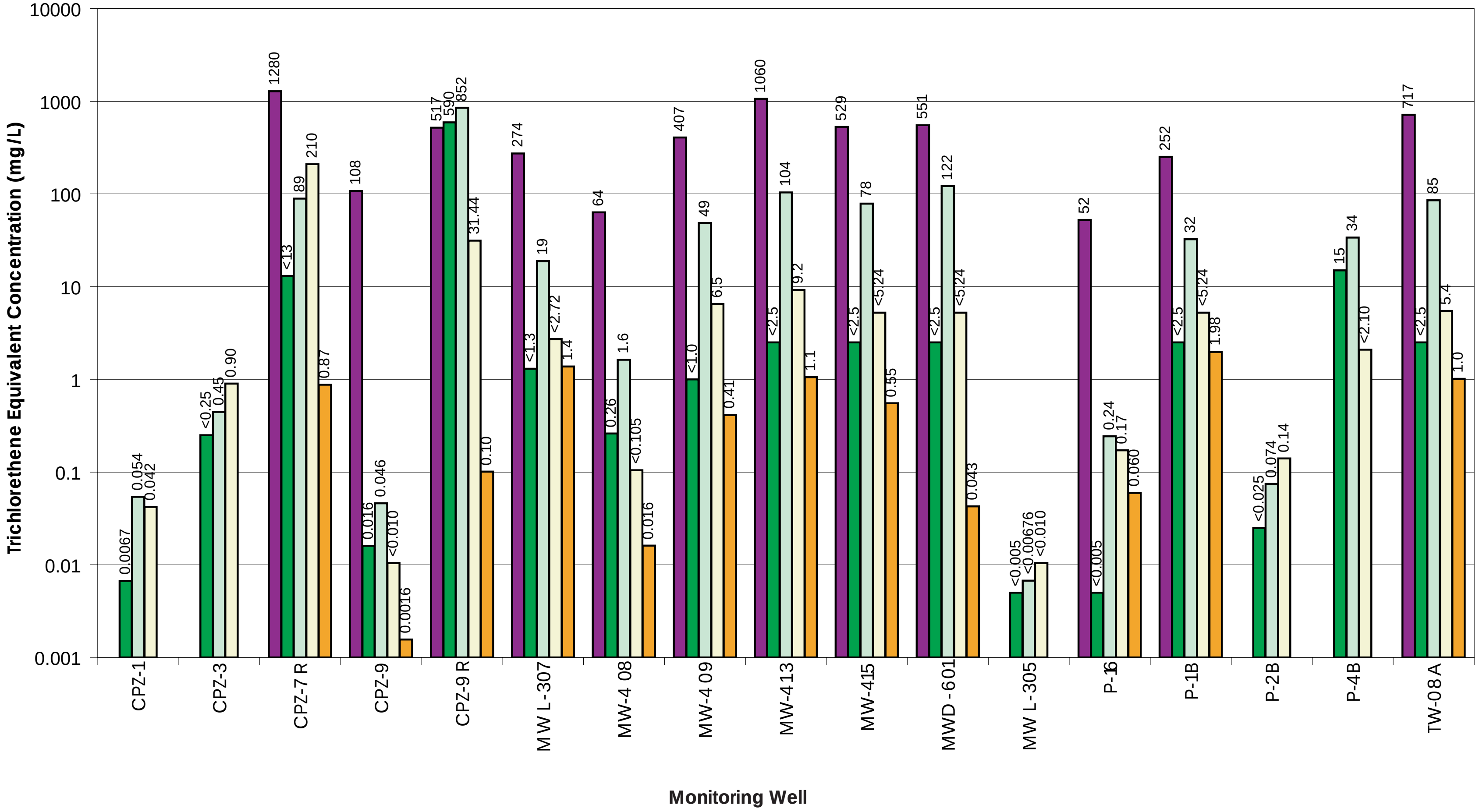


Chloride Concentrations in Groundwater

Solvents Recovery Service of New England
Southington, CT

June 2004	Figure: **4**	GeoSyntec Consultants

P:\PRJ\Projects\TR0119 - SRSNE\SRSNE_Database&GIS\GIS\SRSNE_WellTypes.mxd 29-Jan-04



🟪 Chloride
🟩 cis-1,2-Dichloroethene
🟧 Ethene
🟩 Trichloroethene
🟨 Vinyl chloride

Note: Chloride and Ethene analyses were
not performed on all samples

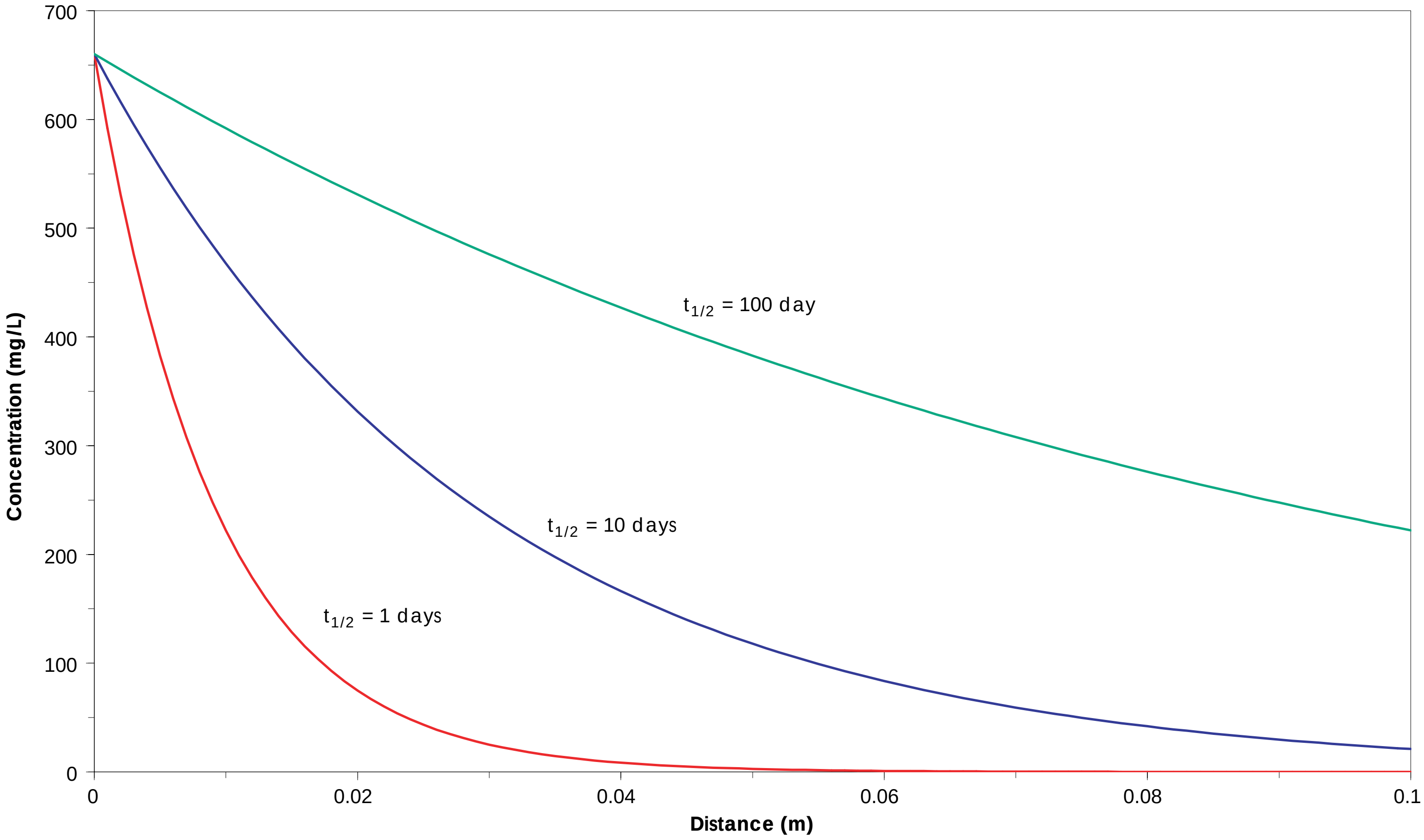
mg/L - milligrams per liter
cVOCs - chlorinated volatile organic compounds

(Original Excel File Path: P:\PRJ\Projects\TR0119 - SRSNE\ SRSNE_DatabaseIS\Outputs\TCE_EquivBarChart)

Trichloroethene Equivalent Concentration for
cVOCs in the NTCRA-1 Containment Wells - 2003
Solvents Recovery Services of New England, Southington, CT

May 2004	Figure: **5**	GEOSYNTEC CONSULTANTS

graph figures_TR0119.ai



mg/L - milligrams per liter
m - meter (s)

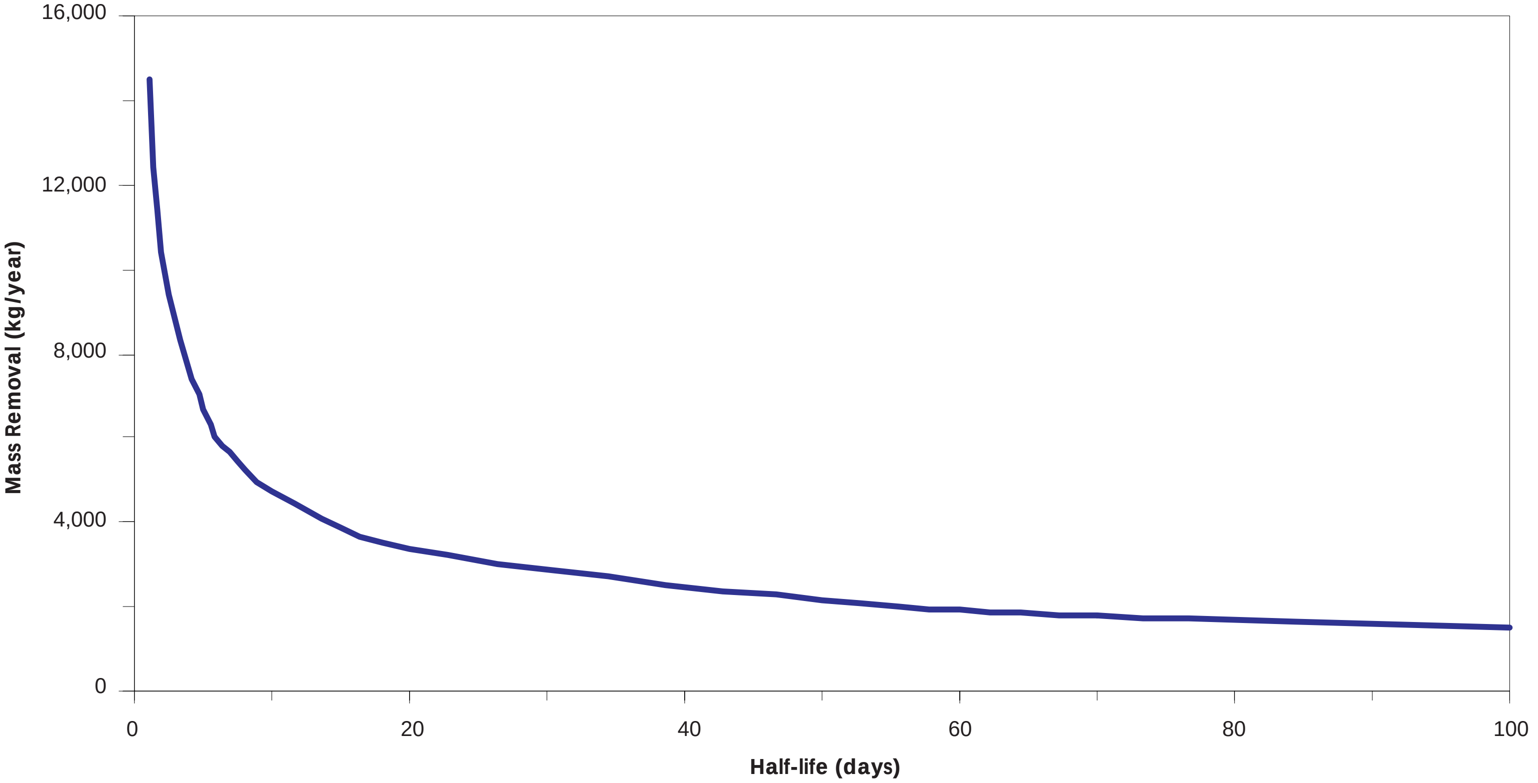
(Original Excel File Path: P:\PRJ\Projects\TR0119 - SRSNE\SRSNE_DatabaseIS\Outputs\cVOC-TTV.xls)

graph figures_TR0119.ai

Steady-state Diffusion Profiles for Contaminant Half-lives of 1, 10, and 100 days

Solvents Recovery Services of New England, Southington, CT

May 2004	Figure: **6**	GeoSyntec Consultants



kg/year - kilograms per year

(Original Excel File Path: P:\PRJ\Projects\TR0119 - SRSNE\SRSNE_DatabaseIS\Outputs\cVOC-TTV.xls)

Effect of Half-life of the Rate of Mass Discharge at the DNAPL Pool Interface

Solvents Recovery Services of New England, Southington, CT

May 2004	Figure: **7**	GEOSYNTEC CONSULTANTS

Appendix H

Evaluation of Biodegradation Mechanisms for Site Chemicals

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DRAFT

EVALUATION OF BIODEGRADATION MECHANISMS FOR SITE CHEMICALS

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC., SUPERFUND SITE SOUTHINGTON, CT

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GeoSyntec Project Number TR0119
18 June 2004

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

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1. INTRODUCTION

Hydraulic displacement, in situ chemical oxidation (ISCO) and thermal treatment are being evaluated to remove dense non-aqueous phase liquid (DNAPL) from the Observed NAPL in Overburden Groundwater Unit (ONOGU) at the Solvents Recovery Services of New England, Inc. (SRSNE) Superfund Site in Southington, CT (the Site). As none of these technologies are expected to achieve complete removal of the DNAPL, monitored natural attenuation (MNA) and enhanced in situ bioremediation (EISB) are proposed post treatment polishing options to further contain, treat and remove any remaining residual phase chemicals. The purpose of this review is to provide a brief summary of the current knowledge of the biodegradation of Site chemicals. Section 2 presents an overview of the major biodegradation mechanisms, while Section 3 discusses the biodegradation of specific Site chemicals.

2. BIODEGRADATION REACTIONS AND REQUIREMENTS

Organic chemicals can undergo biodegradation through two major mechanisms; direct oxidation and cometabolism. Direct oxidation involves the direct use of the target substrate as an electron donor, coupled to the reduction of an electron acceptor such as oxygen (in aerobic environments) or nitrate, iron, sulfate or carbon dioxide (CO_2) (in anaerobic environments). Depending on the electron acceptor used, the process is termed aerobic oxidation or anaerobic oxidation. Cometabolism involves the metabolism of a primary substrate other than the target chemical of concern (COC) as an electron donor, with coincident degradation of the target COC. In the case of aerobic cometabolism (generally termed co-oxidation), bacteria oxidize a primary substrate such as methane or toluene, and fortuitously co-oxidize other substrates such as chlorinated solvents. In the case of anaerobic cometabolism (generally termed reductive dechlorination), bacteria use an organic co-substrate or hydrogen (H_2) as an electron donor and chlorinated compounds as electron acceptors, reducing these compounds. The following sections provide descriptions of the main biodegradation mechanisms for organic compounds, including the key groups of microorganisms involved in aerobic oxidation, aerobic cometabolism, anaerobic oxidation and reductive dechlorination.

2.1 Aerobic Oxidation

The oxidation of organic compounds results from the transfer of electrons from an organic compound (i.e., the electron donor or primary substrate) to an electron acceptor. Under aerobic conditions, oxygen serves as the electron acceptor and is reduced as the primary substrate (i.e., contaminant) is oxidized. The oxidation of the primary substrate results in its mineralization to harmless by-products (i.e., CO_2 and water). In many cases, the primary substrate can serve as both a carbon and an energy source for microbial populations. This means that the substrate being oxidized provides both carbon atoms for molecular processes and energy for cellular processes. Many common groundwater contaminants (e.g., petroleum hydrocarbons) can serve as both energy and carbon sources for microorganisms. The microorganisms use enzymes (proteins which promote specific reactions) to break down the substrates to carbon and energy sources. In aerobic oxidation the enzymes that mediate the oxidation of organic material are called oxygenases. There are two kinds of oxygenases: dioxygenases, that catalyze the incorporation of both atoms of oxygen (O_2) into the molecule; and monoxygenases, that catalyze the transfer of only one of the two O_2 atoms to an organic compound. In monoxygenase systems, the O_2 molecule is split with one oxygen atom forming a hydroxyl radical (OH^-), which is then incorporated into the organic compound; and the other oxygen atom combines with hydrogen (H) to form water (H_2O). Geochemical evidence of this activity is a depletion of oxygen coinciding with a decrease of the target chemical, and increase in CO_2 (rise in alkalinity).

The bacteria involved in aerobic oxidation can be divided into three groups, the obligate aerobes (those that require O_2), the facultative aerobes (those that do not require O_2 but grow better in the presence of O_2), and microaerophillic bacteria (those that require O_2 at levels that are lower than atmospheric). Obligate aerobes require oxygen mainly for respiration and as a terminal electron acceptor whereby oxygen is reduced to H_2O.

2.2 Aerobic Cometabolism (Co-oxidation)

A wide variety of organic compounds can be fortuitously oxidized to CO_2 and water (and chloride for chlorinated constituents) by non-specific microbial oxygenase enzymes produced by a variety of aerobic microorganisms. These enzymes are produced to metabolize specific compounds (e.g., methane, propane, toluene, phenol, ammonia and ethene) termed cometabolites that serve as the primary substrate (electron donor) for these microorganisms. Various other organic compounds (e.g., chlorinated ethenes, ethanes and methanes) can fortuitously react with these enzymes, producing unstable intermediates (e.g., epoxides) that spontaneously decompose to CO_2, water, and chloride. The microorganisms that produce the oxygenase enzymes and mediate the cometabolic biodegradation reactions rarely derive benefit from degradation of these organic constituents. In fact, the epoxide intermediates produced by some solvents can adversely impact cellular intermediates. In subsurface environments, the active zone where cometabolic biodegradation reactions occur tends to be located at the fringes of the plumes where redox conditions transition from anaerobic to aerobic. For cometabolic reactions to occur, the primary substrate (referred to as the cometabolite), O_2, and the target organic chemical must be present in relatively balanced proportions. In groundwater environments, a variety of cometabolites (e.g., methane, ammonia and ethene) can be produced through the metabolic activities of indigenous microorganisms within anaerobic redox zones (e.g., source areas). At some sites, the cometabolite is present in the groundwater as a result of co-release (e.g., for toluene, phenol). At these sites, cometabolic biodegradation of organic constituents can occur naturally where the correct ratios of cometabolite, oxygen and COC exist.

Methanotrophic and aromatic/alkane oxidizing bacteria are widely distributed in the environment. These bacteria produce the various oxygenase enzymes responsible for co-metabolic reactions. Methanotrophic, aromatic and alkane oxidizers use methane, BTEX (benzene, toluene, ethylbenzene and xylenes), or natural gases (propane/propene and n-alkanes up to C16), respectively, as a source of carbon and energy and are oxidized to CO_2 or incorporated into biomass. Because these oxidizers are capable of cometabolic oxidation of chlorinated compounds such as trichloroethene (TCE) and other persistent chemicals, they have a particular potential for natural attenuation and bioremediation.

2.3 Anaerobic Oxidation

The anaerobic oxidation of organic compounds results from the transfer of electrons from an organic compound (the electron donor or primary substrate) to an electron acceptor. Under anaerobic conditions, an inorganic compound that contains oxygen acts as the electron acceptor and becomes reduced as the primary substrate (e.g., contaminant) is oxidized. The oxidation of the primary substrate results in its mineralization to harmless by-products (i.e., CO_2 and water). The oxygen atom can be provided from various sources such as water (H_2O), ferrous hydroxides ($Fe(OH)_3$), manganese oxides, sulfate and even carbonates. Anaerobic oxidation results in a large amount of electron acceptor being reduced. The reduced electron acceptor (e.g., nitrite (NO_2^-), sulfide and methane) is often excreted from the cells, resulting in geochemical changes in the environment. These gross geochemical changes can be used as indicators of biological activity in assessing the nature, rate and extent of biodegradation.

The key bacteria involved in anaerobic oxidation are the denitrifying, sulfate, and iron reducing bacteria, which are widely distributed in the natural environment. Denitrifying, sulfate, iron, bacteria use nitrate (NO_3^-), sulfate (SO_4^{2-}), oxidized iron and manganese as their electron acceptors, and subsequently reduce them to nitrogen gas (N_2) or ammonia (NH_4^+), hydrogen sulfide (H_2S), and dissolved (ferrous) iron, respectively.

2.4 Reductive Dechlorination

Reductive dechlorination involves the sequential replacement of chlorine atoms on the organic molecule by hydrogen atoms. The reaction occurs primarily under anaerobic and reducing redox conditions that typically favor methanogenesis, although reductive dechlorination has been observed in bulk aerobic aquifers (the activity occurs within anaerobic micro-habitats). The chlorinated volatile organic compounds (cVOCs) serve as electron acceptors for the halorespiring bacteria that carryout these degradation reactions; simple organic carbon compounds (e.g., alcohols, fatty acids, sugars, petroleum hydrocarbons and natural organic carbon substances such as humic/fulvic acids) can serve as electron donors. Reductive dechlorination is one of the most common mechanisms for biodegradation of most highly chlorinated compounds such as tetrachloroethene (PCE), TCE, 1,1,1-trichloroethane (1,1,1-TCA) and carbon tetrachloride (CT).

Although reductive dechlorination is caused by halorespiring bacteria, these bacteria appear to be present in environments that are associated with methanogenesis. In these environments, various anaerobic bacteria interact to completely decompose organic compounds to methane, and in the process produce hydrogen as an intermediate. Hydrogen is used by the halorespiring bacteria to reduce cVOCs. There is some indication that halorespiring bacteria also derive other trace nutrients from bacteria that are active in methanogenic environments, such as the acetogenic bacteria that produce acetate.

3. BIOTRANSFORMATION OF SPECIFIC ORGANIC CHEMICALS

The following sections discuss the biodegradation reactions that have potential to be occurring for each of the main classes of organic chemicals that are detected at the Site. Table 1 provides a summary of the aerobic, anaerobic and abiotic degradation processes that are known to occur for each of these classes of compounds. Table 2 provides details regarding the specific aerobic biodegradation mechanisms for each of these classes of compounds. Table 3 provides details regarding the specific anaerobic biodegradation mechanisms for each of these classes of compounds. Attachment 1 contains chemical-specific Fact Sheets for COCs that are common to the Site. These fact sheets contain key information on the physical properties of each chemical and information on their biodegradation properties and mechanisms.

3.1 Chlorinated Ethenes

Chlorinated ethenes (e.g., PCE, TCE, dichloroethene [DCE] and vinyl chloride [VC]) have been shown to biodegrade under a variety of anaerobic and aerobic redox conditions. The biodegradation mechanism most commonly observed in the environment for chlorinated ethenes is reductive dechlorination (see Section 2.4), which typically occurs in anaerobic, reduced environments characterized by the activity of sulfate-reducing and methanogenic bacteria. The sequential dechlorination of PCE proceeds via TCE, cis-1,2-DCE (preferentially over the trans-isomer), and VC to ethene and/or ethane, as shown in Figure 1. For this type of reaction to be thermodynamically favorable, the redox potential of the groundwater must be very low (i.e., negative oxidation-reduction potential [ORP] or Eh), thereby excluding the presence of dissolved oxygen (DO). Complete dechlorination of PCE and TCE to ethene has been widely documented through laboratory and field studies (e.g., Freedman and Gossett, 1989; Major et al., 1991 and 1995; Edwards and Cox, 1997; and Maymo-Gatell et al., 1997). Complete dechlorination of PCE and TCE to ethane has also been documented by deBruin et al. (1992).

In addition to reductive dechlorination, several chlorinated ethenes, such as VC and 1,2-DCE, can undergo anaerobic oxidation reactions to CO_2 (Figure 1, Section 2.3). For example, Bradley and Chappelle (1996) have documented anaerobic oxidation of VC under iron-reducing conditions, while Bradley et al. (1998) have documented anaerobic oxidation of 1,2-DCE under manganese-reducing conditions. Most recently, VC has been shown to undergo anaerobic oxidation in the presence of NO_3^- (Dijk et al., 2000). There is a propensity for these anaerobic oxidation reactions to occur at all sites where anaerobic reductive dechlorination is occurring. However, the ubiquity of these reactions has not been established, so additional evidence must be collected to verify their occurrence and relative contribution to natural attenuation at a site.

Under aerobic conditions, PCE, TCE, 1,2-DCE, 1,1-DCE (produced via the abiotic elimination of 1,1,1-TCA) and VC can be fortuitously oxidized to CO_2 by non-specific microbial oxygenase enzymes produced by a variety of aerobic microorganisms in a process called co-metabolism. This process occurs in transition zones where anaerobic waters containing cometabolites and aerobic waters mix, such as where groundwater discharges to surface waters, infiltration of oxygenated water with anaerobic groundwater, wetlands and landfills.

The oxygenase enzymes are produced to metabolize specific growth substrates (e.g., methane, propane, toluene, phenol, ammonia and ethene) termed cometabolites that can serve as a primary food source for these microorganisms. However, TCE, 1,2-DCE and VC can fortuitously react with these enzymes, producing unstable epoxide intermediates (e.g., TCE-epoxide) that spontaneously decompose to CO_2, chloride and water. As indicated above, the microorganisms that produce the enzymes and mediate the cometabolic biodegradation reactions do not derive benefit from degradation of the chlorinated ethenes. The cometabolism of cVOCs to CO_2 in the presence of methane (Semprini et al., 1990; Hazen et al., 1994), toluene (Hopkins et al., 1993; Goltz et al., 1997) and phenol (Hopkins et al, 1995) has been widely documented. Ryoo et al. (2000) documented PCE cometabolism with the toluene-o-xylene monooxygenase enzyme found in *Pseudomonas stutzeri* suggesting that selected microorganisms are able to cometabolize PCE. PCE cometabolism was not detected in other microbes known to cometabolize the chlorinated ethenes.

In addition to cometabolic reactions, VC can be directly aerobically oxidized to CO_2 and chloride (Hartmans and deBont, 1985; Davis and Carpenter, 1990). This reaction will be observed when VC laden groundwater mixes with oxygenated water (as discussed above). In this reaction, VC serves as the electron donor and is oxidized to CO_2; oxygen serves as the electron acceptor. Studies by Cox et al. (1995) and Edwards and Cox (1997) have documented that this reaction occurs in groundwater environments and that the process can control the migration of VC in groundwater. Recent scientific literature (Klecka et al., 1997; Klier et al., 1997) also indicates that 1,2-DCE may be similarly oxidized to CO_2, however the extent of this reaction in subsurface environments is unknown. Aerobic oxidation reactions require the input of oxygen, and therefore 1,2-DCE and VC oxidation occurs under aerobic-oxidizing conditions. No evidence exists at this time for the direct aerobic oxidation of either TCE or PCE.

3.2 Chlorinated Ethanes

Chlorinated ethanes such as 1,1,2-TCA, 1,1,1-TCA, 1,2-DCA, 1,1-DCA and CA have been shown to degrade under a variety of anaerobic and aerobic redox conditions, as shown in Figures 2 and 3. Abiotic substitution and elimination reactions often dominate the initial transformation of chlorinated ethanes containing more than two chlorine atoms. The biodegradation mechanism most commonly observed in the environment for chlorinated ethanes is reductive dechlorination which typically occurs in anaerobic, reduced environments characterized by the activity of sulfate-reducing and methanogenic bacteria). In anaerobic groundwater systems, both 1,1,2-TCA and 1,1,1-TCA can undergo sequential reductive dechlorination via dichloroethane (1,2-DCA or 1,1-DCA) and chloroethane (CA) to ethane (Figures 2 and 3). 1,1,2-TCA is also known to readily undergo anaerobic dihaloelimination, producing VC (Chen et al., 1996).

1,2-DCA can biodegrade in anaerobic environments via several mechanisms (Figure 2), including: dihaloelimination directly to ethene, as documented in laboratory studies by Egli et al. (1987) and at field sites by Bosma et al. (1998) and Cox et al. (1998 and 2000); reductive dechlorination via CA to ethane, as documented by Holliger et al. (1990); and anaerobic oxidation to CO_2 under nitrate-reducing conditions (Gerritse et al., 1999 and Cox et al., 2000). Of these reactions, dihaloelimination to ethene appears to be the dominant anaerobic biodegradation pathway observed at most field sites. The ratio of ethene produced to 1,2-DCA reduced appears to relate to the presence/abundance of exogenous electron donor (such as acetate, ethanol, formate). If external electron donor is present, then 1,2-DCA serves only as the electron acceptor, and the resulting production of ethene approaches 100% of the 1,2-DCA reduced. If external electron donor availability is low, then 1,2-DCA will serve as both electron donor and acceptor in a fermentation reaction, and the ethene end product will account for approximately 65% of the 1,2-DCA reduced; CO_2 will account for the balance (Gerritse et al., 1999).

In aerobic groundwater environments, 1,1,1-TCA can be biodegraded cometabolically (see Section 2.2) to CO_2 by methanotrophic bacteria (Oldenhuis et al., 1989). Propane-oxidizing bacteria have also been shown to cometabolize 1,1,1-TCA (Keenan et al., 1993). CA can be directly oxidized to CO_2 in aerobic environments. Cometabolic reactions will be observed where anaerobic groundwater containing the chlorinated ethenes along with cometabolites is mixed with aerobic groundwater or as it discharges in to aerobic surface waters.

Janssen et al. (1985) demonstrated the direct oxidation of 1,2-DCA to CO_2 under aerobic conditions in laboratory microcosms. In this reaction, 1,2-DCA serves as a source of carbon for microbial growth (i.e., electron donor; oxygen is the electron acceptor). During the aerobic degradation of 1,2-DCA, chloroethanol and chloroacetic acid were observed as intermediates (Janssen et al., 1994). Aerobic degradation of 1,2-DCA in groundwater has been documented by Stucki et al. (1992), Lee et al. (1995) and

Cox et al. (1998 and 2000). Degradation of 1,2-DCA using methane as a cometabolite has also been reported by Speitel et al. (1991).

3.3 Chlorinated Methanes

Chlorinated methanes, including CT, chloroform (CF), dichloromethane (DCM; also known as methylene chloride or MeCl), and chloromethane (CM) have been shown to biodegrade under a variety of anaerobic and aerobic redox conditions, as shown in Figure 4. The biodegradation mechanism most commonly observed in the environment for chlorinated methanes is reductive dechlorination (see Section 2.4 Reductive Dechlorination), which typically occurs in anaerobic, reduced environments characterized by the activity of sulfate-reducing and methanogenic bacteria. In anaerobic environments, chlorinated methanes can biodegrade via numerous reactions, producing a wide range of intermediates and end products. For example, Stromeyer et al. (1992) have documented the sequential reductive dehalogenation of CT via CF, DCM and CM to methane. However, reductive dehalogenation of DCM and CM is typically slow in natural environments, and the principal biodegradation mechanism for DCM is mineralization to CO_2 via acetate and/or formate by anaerobic oxidation (see Section 2.3).

During anaerobic oxidation DCM is used directly as a growth substrate under anaerobic conditions. Freedman and Gossett (1991) and Braus-Stromeyer et al. (1993) have isolated mixed methanogenic and acetogenic cultures that can grow anaerobically on DCM as their sole source of carbon and energy and in the process produce quantitative amounts of acetate and hydrogen. Messmer and Leisinger (1997) have also shown the formation of acetate and formate from DCM. The acetate and formate produced by these reactions may then serve as electron donors in the dechlorination of chlorinated ethenes (Fiorenza et al., 1994; Lehmicke et al., 1996; Cox et al., 1996). DCM has also been shown to serve as a direct growth substrate under denitrification conditions (Kohler-Staub et. al., 1995). This process is mediated by the same facultatively methylotrophic bacteria that grow on DCM aerobically as described below. However, in this case, the microorganisms use NO_3^- as the electron acceptor in the anaerobic oxidation of DCM (DCM is the electron donor; nitrate is the electron acceptor).

The anaerobic reduction of CT and CF can also result in the production of intermediates and end products such as carbon monoxide, carbon disulfide (CS_2) and formic acid as well as complete oxidation to CO_2 (Krone et al., 1991; Braus-Stromeyer et al., 1993; Freedman et al., 1995). These reactions have been attributed to non-enzymatic processes mediated by either the metal-centered cofactors found in many bacteria such as iron, nickel and cobalt porphyrines (Egli et al., 1987; Krone et al., 1989; Stromeyer et al., 1992) or other byproducts of their metabolism. CO_2 is the main product, whereas the formation of CS_2 is dependent on the occurrence of sulfide and sulfate in groundwater (Stromeyer et al., 1992).

Under <u>aerobic</u> conditions, DCM and CM can be directly biodegraded to CO_2 as growth substrates (see Section 2.1). Gälli and Leisinger (1985) have shown DCM metabolism as a carbon and energy source by methylotrophic bacteria, which contain the well characterized glutathione-dependent DCM dehalogenase enzyme (Leisinger et al., 1994). Hartmans et al., (1985) have shown CM use as a growth substrate by methylotrophic organisms. Field evidence of DCM oxidation has been documented by Cox et al. (1995) and more recently Biehle et al. (1999). CF can be cometabolized to CO_2 by methanotrophic bacteria and ammonia oxidizers, and to some extent by toluene oxidizers, as has been documented by Oldenhuis et al. (1991) and Strand and Shippert (1986), Vannelli et al. (1990), and McClay et al. (1996), respectively.

3.4 Aromatic Hydrocarbons (BTEX, Dichlorobenzene, Chlorobenzene, Naphthalene, 4-Methylphenol, Phenol)

Considerable laboratory and field research has demonstrated that BTEX compounds and chlorinated benzenes can be biodegraded under a variety of redox conditions by microorganisms that are naturally present in groundwater environments. BTEX biodegradation has been widely documented under aerobic conditions whereby oxygen serves as an electron acceptor and as a co-substrate (Smith, 1990). However, oxygen is a limiting factor due to its low solubility in water and diffusional constraints in subsurface environments (Hutchins et al., 1991). In the absence of oxygen as a terminal electron acceptor, energy can be derived by anaerobic respiration with nitrate (Evans et al., 1991), ferric iron (Lovley and Lonergan, 1990), manganese (Langenhoff et al., 1997) or sulfate (Rabus et al., 1993). Under methanogenic conditions, several hydrocarbons such as benzene and toluene can be transformed into CO_2 and methane (Edwards & Gribic-Galic,1994). These biodegradation processes are so well understood that commercial predictive models (Bioplume and Bioscreen; Rifai et al., 1995) have been developed that can calculate the mass of hydrocarbon removal based on the use of electron acceptors (e.g., O_2, NO_3^- and SO_4^{2-}).

The fate of chlorinated benzene compounds depends largely upon the extent of chlorination. For example, the isomers of dichlorobenzene (1,2-, 1,3- and 1,4-dichlorobenzene) have been shown to be degradable under both aerobic and anaerobic conditions (de Bont et al., 1986; Oltmans et al., 1988; Haigler et al., 1988; Spain et al., 1987; and Schraa et al. 1986). Under anaerobic conditions, degradation mechanisms are typically reductive dechlorination to chlorobenzene and, to some extent, benzene. While biodegradation of chlorobenzene and benzene under anaerobic conditions in laboratory studies has been documented (e.g., Edwards & Gribic-Galic, 1994), the extent of these reactions in field environments appears to be limited. Under aerobic conditions, dichlorobenzenes are typically oxidized to chlorocatechols, which then can be subsequently biodegraded to CO_2, chloride and water. While some bacteria are able to use dichlorobenzenes as sole carbon and energy sources (Schraa et al., 1986 and Haigler et al. 1988), it generally appears that microbial consortia are required to achieve complete degradation of the chlorinated benzenes and their degradation intermediates.

The biodegradation of chlorobenzene typically occurs through aerobic oxidation. Degradation rates can be rapid. For example, a groundwater microbial degradation half-life of seven days was reported by Nishino et al. (1992). At a site in Texas, a chlorobenzene plume is being contained by natural attenuation. At this site, the natural population of microbes has adapted through gene transfer to utilize chlorobenzene in the groundwater (van der Meer et al., 1998).

Cresols, such as 4-methylphenol, are the simplest alkyl phenols but the different isomers vary in their anaerobic biodegradability and pathways of decomposition. Studies show 4-methylphenol is the most susceptible to anaerobic metabolism of the cresols (Suflita et al. 1989). Bossert and Young (1986) isolated a mixed culture that anaerobically utilized 4-methylphenol as a growth substrate under nitrate-reducing conditions. One of the isolates oxidized the methyl group of 4-methyl phenol to form the metabolic intermediate p-hydroxybenzoate which was then further metabolized by the second isolate. Suflita et al. (1989) also proposed anaerobic decomposition through p-hydroxybenzoate under sulfate-reducing conditions, which then decomposed to benzoic acid and phenol. Haggblom et al. (1990) were able to anaerobically biodegrade 4-methylphenol under denitrifying, sulfidogenic and methanogenic conditions, and also found that the degradation pathway was sequential oxidation of the methyl group to p-hydroxybenzaldehyde, then to p-hydroxybenzoate. Harrison et al. (2001) showed that aerobic biodegradation of 4-methylphenol was concentration dependent, with half lives ranging from 8 days (3-/4-methylphenol concentration of 33 mg/L) to 693 days (3-/4-methylphenol concentration of 110 mg/L). Likewise, Bell et al. (2004) provide anaerobic pathways showing phenol degradation with Clostridium and hydroxybenzoicum JW/Z-1, both going through intermediates 4-hydroxybenzoate and benzoate. Harrison et al. (2001) found that aerobic degradation rates for phenol were concentration dependent in microcosm studies, with half lives ranging from 9 days (starting concentration 76 milligrams per liter [mg/L]) to 347 days (320 mg/L).

Biodegradation of polycyclic aromatic hydrocarbons (PAHs), such as naphthalene has been documented (Annweiler et al. 2002). Annweiler et al. (2002) used a sulfate-reducing enrichment culture to anaerobically degrade naphthalene through 2-naphthoic acid to the final reductive degradation metabolite cis-2-carboxycyclohexylacetic acid, a saturated monocyclic structure. Rockne and Strand (2001) were able to partially mineralize naphthalene in a fluidized bed reactor, but found that the PAH biodegradation was dependent on nitrate reduction. Aerobic hydrocarbon degradation occurs readily with the provision of hydroxyl groups (e.g., oxygen). A microbial consortium from a mixture of garden soil and an enrichment of a coal-tar contaminated sediment found that rates of mineralization were similar in the presence of O_2 and NO_3^- but slower with SO_4^{2-} (Ramsay et al. 2003).

3.5 Ketones, Phthalates and Ethers (acetone, MEK, MIBK, BEHP, BCEE, 1,4-Dioxane, THF)

A variety of ketones, phthalates and ethers can be present in groundwater at industrial sites. Ketones such as acetone, methyl ethyl ketone (MEK; also known as 2-butanone) and methyl isobutyl ketone (MIBK; also known as 2-pentanone) are known to biodegrade through a variety of aerobic and anaerobic oxidation reactions, using O_2, NO_3^- or SO_4^{2-} as electron acceptors. The end products of these biodegradation reactions are typically CO_2 and water (Platen and Schink, 1989 and 1990; Mormile et al., 1994 and Suflita and Mormile 1993). Similarly, bis-2-ethylhexyl phthalate (BEHP) has been shown to biodegrade under aerobic conditions by Saeger and Tucker (1973), Johnson and Lulves (1975), Nakazawa and Hayashi (1977), O'Grady et al. (1985) and Kurane (1986). Chlorinated ethers such as bis(2-chloroethyl) ether (BCEE) have been documented to biodegrade under anaerobic and/or aerobic conditions in subsurface environments. For example, Van den Wijngaard et al., (1993) documented the aerobic biodegradation of BCEE in slurries from brackish water sediments, while Cox et al. (unpublished) have observed the aerobic biotransformation of BCEE in aerobic groundwater (half-life of 19 days) and surface water (half-life of 28 days) microcosms from a landfill in New Jersey. The hypothesized pathway of biodegradation was hydrolytic dehalogenation to produce the corresponding alcohol from the ether. More recently, Al-Yousfi et al. (2000) documented the attenuation of BCEE in groundwater at an industrial facility under anaerobic conditions, with diethylene ether (DEE) detected as an intermediate. Cyclic ethers, such as 1,4-dioxane and tetrahydrofuran (THF) are persistent chemicals and have not been amenable to biodegradation (Parales, 1994). Parales et al. (1994) isolated an actinomycete (CB1190) from dioxane contaminated sludge. CB1190 was capable of degradation of THF, and as such was maintained on THF and was eventually capable of mineralizing 1,4-dioxane (Parales et al., 1994). Burback and Perry (1993) were able to partially (less than 50 %) degrade 1,4-dioxane on it's own with a pure culture of *Mycobacterium vaccae*. Studies have found, however, that the two ethers will cometabolize when present together (Sock, 1993). Zenker et al. (2000, 2003) were able to biodegrade 1,4-dioxane in the presence of THF, and Raj et al. (1997) were able to co-metabolize 1,4-dioxane in the presence of acetic acid with a mixed culture. There are limited studies to provide pathways of 1,4-dioxane or THF degradation, and there are limited data on rates of THF degradation, as the compound is not commonly present in groundwater.

3.6 Estimation of Natural Attenuation half-lives for Select Chemicals in the Severed Plume at SRSNE

Table 5 presents a summary of published estimates of natural attenuation rates for chemicals that are present in Site groundwater referred to as the severed plume (BBL, Appendix F of Feasibility Study). These chemicals exist beyond the target treatment zone in the ONOGU. As stated in Appendix F, a successful groundwater remedy will need to address, via hydraulic containment and/or natural attenuation, the ground water that exceeds regulatory criteria for VOCs related to the Site. The portion of the plume that is not controlled by pumping would be allowed to naturally attenuate to meet Applicable or Relevant and Appropriate Requirements (ARARs) within a reasonable time frame. The portion of the plume downgradient of the non time critical removal action (NTCRA 2) capture zone has already attenuated to less than drinking water standards. Thus, continued operation of NTCRA 2 can be considered a feasible remedy for dissolved phase VOCs in groundwater unless (and until) the Town of Southington reactivates Production Wells No. 4 and 6.

Natural degradation rates were taken from published literature values from studies where no additional exogenous nutrient sources or microbial cultures were added, to be consistent with the natural attenuation evaluation for the severed plume. There will be a wide range of natural attenuation rates which will be dependent on many factors, including the geochemical status of the groundwater (aerobic, anaerobic); and Site specific chemical compounds.

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TABLES

TABLE 1

SUMMARY OF DEGRADATION PROCESSES FOR COMMON CHEMICALS AT SITE

Class		**Aerobic***		**Anaerobic***		**Abiotic***
	Compound	**Oxidation**	**Co-metabolism**	**Oxidation [1]**	**Reduction**	**Hydrolysis [2]**
Chlorinated ethenes	Tetrachloroethene	X	✓	X	✓	✓
	Trichloroethene	X	✓	X	✓	X
	trans/cis-1,2-Dichloroethene	✓	✓	✓	✓	
	1,1-Dichloroethene	✓	✓		✓	X
	Vinyl chloride	✓	✓	✓	✓	X
Chlorinated ethanes	1,1,2-Trichloroethane	X	✓		✓	✓
	1,1,1-Trichloroethane	X	✓		✓	✓
	1,2-Dichloroethane	✓	✓		✓	✓
	1,1-Dichloroethane		✓		✓	
	Chloroethane	✓			✓	✓
Chlorinated methanes	Carbon tetrachloride	X	X	✓	✓	✓
	Chloroform		✓		✓	X
	Chloromethane	✓	✓		✓	
	Dichloromethane (Methylene chloride)	✓	✓	✓	✓	✓
Aromatics	1,4-Dioxane	✓	✓	X		
	4-Methyphenol	✓				
	Benzene	✓		✓		X
	Chlorobenzene	✓				X
	Ethylbenzene	✓		✓		X
	Naphthalene	✓	✓	✓		X
	Phenol	✓		✓		X
	Tetrahydrofuran	✓	✓			
	Toluene	✓		✓		
	Xylenes (all isomers)	✓		✓		
Ketones	4-Methyl-2-Pentanone (MIBK)	✓		✓		X
	2-Butanone (MEK)	✓		✓		X
	Acetone	✓		denitnitrification		X

Notes:
✓- literature indicates that degradation occurs through the specified mechanism
X - literature indicates that degradation does not occur through the specified mechanism
* - a blank cell implies that degradation through the specified mechanism is unknown or uncertain
1. Oxidation under iron, manganese, nitrate or sulfate reducing conditions
2. Those compounds having large half-lives (ie. > 100 years) are considered not subject to hydrolysis in groundwater

TABLE 2
AEROBIC BIODEGRADATION PROCESSES FOR COMMON CHEMICALS AT SITE

Class	Parameter	Biodegradation Processes	References
Chlorinated Ethenes	tetrachloroethene	*Cometabolism* : occurs when the appropriate primary substrate is present (e.g. methane, toluene) to stimulate appropriate enzymes; more research needed to determine extent to which this reaction will occur in groundwater	Ryoo et al., 2000
	trichloroethene	*Cometabolism* : occurs when the appropriate primary substrate is present (e.g. methane, toluene, propane, ammonia, phenol, ethene); rapid process	Ensign et al., 1992; Goltz et al., 1997; Hazen et al., 1994; Hopkins et al., 1993; Hopkins et al., 1995; Nelson et al., 1988; Semprini et al, 1990; Vannelli et al., 1990; Wackett and Gibson, 1988; Wackett et al., 1989; Wilson and Wilson, 1985
	trans/cis-1,2-dichloroethene	*Oxidation* : occurs rapidly; more research needed to determine extent to which this reaction will occur in groundwater C*ometabolism* : occurs when the appropriate primary substrate is present (e.g. methane, toluene, propane, ammonia, phenol, ethene); rapid process	Ensign et al., 1992; Goltz et al., 1997; Hazen et al., 1994; Hopkins et al., 1993; Hopkins et al., 1995; Klecka et al., 1997; Klier et al., 1997; Nelson et al., 1988; Semprini et al, 1990; Vannelli et al., 1990; Wackett and Gibson, 1988; Wackett et al., 1989; Wilson and Wilson, 1985
	1,1-dichloroethene	*Oxidation* : occurs rapidly; more research needed to determine extent to which this reaction will occur in groundwater C*ometabolism* : occurs when the appropriate primary substrate is present (e.g. methane, toluene, propane, ammonia, phenol, ethene)	Hazen et al., 1994; Klier et al., 1997; Klecka et al., 1997
	vinyl chloride	*Oxidation* : occurs very rapidly C*ometabolism* : occurs when the appropriate primary substrate is present (e.g. methane, toluene, propane, ammonia, phenol, ethene); rapid process	Cox et al., 1995 and 1996; Davis and Carpenter, 1990; Edwards and Cox, 1997; Ensign et al., 1992; Goltz et al., 1997; Hartmans et al., 1985; Hazen et al., 1994; Hopkins et al., 1993; Hopkins et al., 1995; Klecka et al., 1997; Klier et al., 1997; Nelson et al., 1988; Semprini et al, 1990; Vannelli et al., 1990; Wackett and Gibson, 1988; Wackett et al., 1989; Wilson and Wilson, 1985

TABLE 2
AEROBIC BIODEGRADATION PROCESSES FOR COMMON CHEMICALS AT SITE

Class	Parameter	Biodegradation Processes	References
Chlorinated Ethanes	1,1,2-trichloroethane	*Cometabolism* : occurs when the appropriate primary substrate is present (e.g. methane and propane); rapid process	Oldenhuis et al., 1989; Keenan et al., 1993
	1,1,1-trichloroethane	*Cometabolism:* occurs when the appropriate primary substrate is present (e.g. methane and propane); rapid process	Oldenhuis et al., 1989; Keenan et al., 1993
	1,2-dichloroethane	*Oxidation* : occurs rapidly; chloroethanol and chloroacetic acid observed as intermediates *Cometabolism* : occurs when methane present	Janssen et al., 1985 and 1994; Stucki et al., 1992; Lee et al., 1995; Cox et al., 1998 and 2000; Speitel et al., 1991
	1,1-dichloroethane	*Cometabolism:* occurs with methanotrophs	Oldenhuis et al., 1989
	chloroethane	*Oxidation* : occurs rapidly	
Chlorinated Methanes	carbon tetrachloride	no evidence of aerobic biodegradation	
	chloroform	*Cometabolism* : occurs when the appropriate primary substrate is present (e.g. methane, toluene, ammonia)	Galli and Leisinger, 1985; McClay et al., 1996; Oldhenius et al., 1991; Strand and Shippert, 1986; Vannelli et al., 1990
	chloromethane	*Oxidation:* occurs with methylotrophic organisms. *Cometabolism* - can occur	Hartmans et al., (1985) Vanelli et al., (1998)
	dichloromethane (methylene chloride)	*Oxidation* : rapid process	Biehle et al., 1999; Cox et al., 1995; Galli and Leisinger, 1985; Leisinger et al., 1994
Aromatics	1,4-dioxane	*Oxidation* : occurs with actinomycete, CB1190. C*ometabolism* : occurs when the appropriate primary substrate is present (e.g. tetrahydrofuran, acetic acid)	Parales et al., 1994 M.J. Zenker et al., 2000, 2003; C.B.C. Raj et al., 1997
	4-methyphenol	*Oxidation:* rate is concentration dependent	Harrison et al., 2001
	benzene	*Oxidation* : rapid process	Smith, 1990 and numerous others
	chlorobenzene	*Oxidation* : rapid process *Cometabolism* : occurs when the appropriate primary substrate is present (e.g. toluene)	Herrington et al., 2000; Nishino et al., 1992; Pettigrew et al., 1991; van der Meer et al., 1998
	ethylbenzene	*Oxidation* : rapid process	Smith, 1990 and numerous others
	naphthalene	*Oxidation* : Oxidation: rate and extent unknown.	Zeng, Y., 2000.
	phenol	*Oxidation:* rate is concentration dependent	Harrison et al., 2001
	tetrahydrofuran	*Oxidation* : occurs with actinomycete, CB1190. C*ometabolism* : occurs when the appropriate primary substrate is present (e.g. 1,4-dioxane)	Parales et al., 1994
	toluene	*Oxidation* : rapid process	Smith, 1990 and numerous others
	xylenes (all isomers)	*Oxidation* : rapid process	Smith, 1990 and numerous others
Ketones	2-methyl-4-pentanone	*Oxidation* : rapid process	
	2-butanone (MEK)	*Oxidation:* to CO_2	Nelson et al., (1993)
	acetone	*Oxidation:* relatively rapid process	Howard, P.H., 1991

TABLE 3
ANAEROBIC BIODEGRADATION PROCESSES FOR COMMON CHEMICALS AT SITE

Class	Parameter	Biodegradation Processes	References
Chlorinated Ethenes	tetrachloroethene	*Reductive Dechlorination:* occurs under strongly reducing conditions (e.g. sulfate-reducing and methanogenic); TCE is daughter product	Freedman and Gossett, 1989; Major et al., 1991 and 1995; Edwards and Cox, 1997; and Maymo-Gatell et al., 1997
	trichloroethene	*Reductive Dechlorination:* occurs under strongly reducing conditions (e.g. sulfate-reducing and methanogenic); cis-1,2-DCE is daughter product	Freedman and Gossett, 1989; Major et al., 1991 and 1995; Edwards and Cox, 1997; and Maymo-Gatell et al., 1997
	trans/cis-1,2-dichloroethene	*Oxidation:* occurs under manganese-reducing conditions *Reductive Dechlorination:* occurs under strongly reducing conditions (e.g. sulfate-reducing and methanogenic); vinyl chloride is daughter product	Freedman and Gossett, 1989; Major et al., 1991 and 1995; Edwards and Cox, 1997; and Maymo-Gatell et al., 1997; Bradley et al., 1998
	1,1-dichloroethene	*Reductive Dechlorination* : daughter product is vinyl chloride	Barrio-Lage et al., 1986
	vinyl chloride	*Oxidation:* occurs under iron(III)-reducing conditions *Reductive Dechlorination:* occurs under reducing conditions; ethene is end product	Dijk et al., 2000; Freedman and Gossett, 1989; Major et al., 1991 and 1995; Edwards and Cox, 1997; and Maymo-Gatell et al., 1997; Bradley and Chapelle, 1996
Chlorinated Ethanes	1,1,2-trichloroethane	*Reductive Dechlorination:* 1,2-DCA is daughter product *Dilahoelimination* : occurs readily; vinyl chloride is daughter product	Chen et al., 1996
	1,1,1-trichloroethane	*Oxidation:* to CO2 *Reductive Dechlorination:* to 1,1-DCA	Chen et al., 1999
	1,2-dichloroethane	*Dihaloelimination* : ethene is daughter product; most dominant anaerobic process; *Reductive Dechlorination* : chloroethane is daughter product *Oxidation* : occurs under nitrate-reducing conditions	Bosma et al., 1998; Cox et al., 1998 and 2000; Egli et al., 1987; Gerritse et al., 1999; Holliger et al., 1990;
	1,1-dichloroethane	*Reductive Dechlorination:* occurs under methanogenic conditions	Chen et al., 1996
	chloroethane	*Reductive Dechlorination:* ethane is daughter product of reaction *Oxidation* : occurs rapidly	Holliger et al., 1990

TABLE 3
ANAEROBIC BIODEGRADATION PROCESSES FOR COMMON CHEMICALS AT SITE

Class	Parameter	Biodegradation Processes	References
Chlorinated Methanes	carbon tetrachloride	*Reductive Dechlorination:* chloroform is daughter product; typically observed under nitrate-reducing, iron-reducing, sulfate-reducing or methanogenic conditions; iron-sulfides produced by iron-reducing microorganisms may be responsible for abiotic degradation of chlorinated methanes *Oxidation* : intermediate products can include carbon monoxide, carbon disulfide, and formic acid; the formation of carbon disulfide is dependent on occurrence of sulfate and sulfide in groundwater	Braus-Stromeyer et al., 1993; Brouns et al., 1991; Criddle et al., 1990; de Best et al., 1998; Egli et al., 1987; Freedman et al., 1995; Krone et al., 1989 and 1991; Picardal et al., 1993; Petrovskis et al., 1995; Stromeyer et al., 1992
	chloroform	*Reductive Dechlorination:* methylene chloride is daughter product; typically observed under nitrate-reducing, sulfate-reducing or methanogenic conditions *Oxidation* : intermediate products can include carbon monoxide, carbon disulfide, and formic acid; the formation of carbon disulfide is dependent on occurrence of sulfate and sulfide in groundwater	Braus-Stromeyer et al., 1993; Brouns et al., 1991; Criddle et al., 1990; de Best et al., 1998; Egli et al., 1987; Freedman et al., 1995; Krone et al., 1989 and 1991; Stromeyer et al., 1992
	chloromethane	*Reductive Dechlorination and Oxidation:* occurs in sulfate-reducing and methanogenic conditions	Braus-Stromeyer, S., et al. 1993; Vannelli, T., et al. 1998; McAnulla, C. 2001.
	methylene chloride	*Reductive Dechlorination:* chloromethane is daughter product; slow process; typically observed only under methanogenic conditions *Fermentation* : occurs under methanogenic and acetogenic conditions; results in production of acetate, formate, and hydrogen; these intermediates may be used as electron donors during reductive dechlorination of chlorinated ethenes *Oxidation* : occurs under nitrate-reducing conditions	Braus-Stromeyer et al., 1993; Cox et al., 1996; de Best et al., 1998; Fiorenza et al., 1994; Freedman and Gossett, 1991; Kohler-Staub et al., 1995; Lehmicke et al., 1996; Magli et al., 1995; Messmer and Leisinger, 1997; Stromeyer et al., 1992

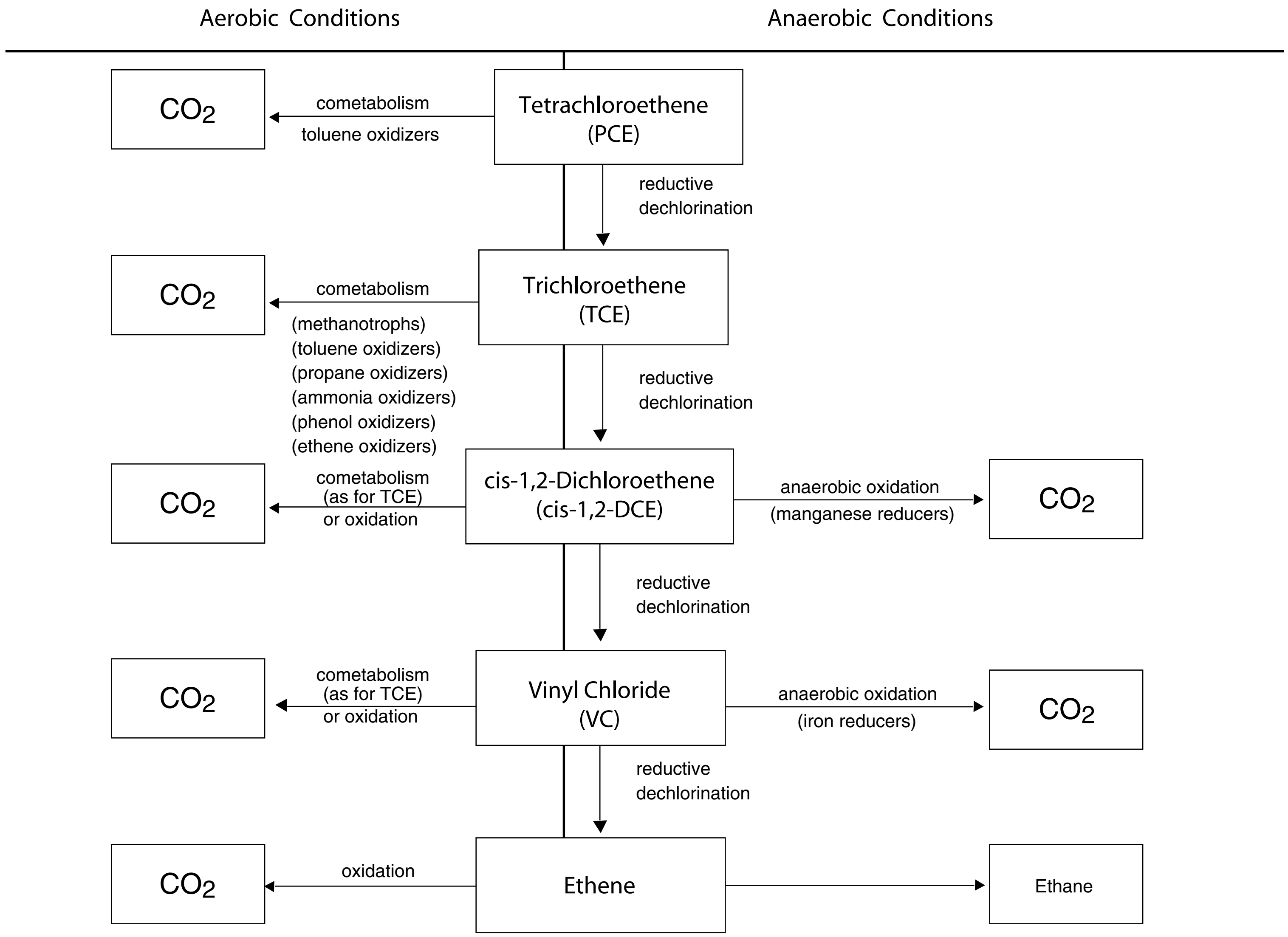
TABLE 3
ANAEROBIC BIODEGRADATION PROCESSES FOR COMMON CHEMICALS AT SITE

Class	Parameter	Biodegradation Processes	References
Aromatics	1,4-dioxane	no evidence of anaerobic biodegradation	
	4-methylphenol	*Oxidation:* occurs under nitrate, iron (II)-reducing and sulfate-reducing conditions	Harrison, I., et al., 2001; Spence, M.J., et al., 2001.
	benzene	*Oxidation* : rapid process occurs under nitrate- and sulphate-reducing and methanogenic conditions	Burland and Edwards, 1999; Caldwell and Suflits, 2000; Kazumi et al., 1997; Lovely et al., 1995; Lovely et al., 1996
	chlorobenzene	no evidence of anaerobic biodegradation	Ramanand et al., 1993
	ethylbenzene	*Oxidation* : rapid process occurs under nitrate- and sulphate-reducing conditions	Ball et al., 1996; Johnson and Spromann, 1999; Rabus and Widdel, 1995
	naphthalene	*Oxidation:* occurs under nitrate and sulfate-reducing conditions	Annweiler, E., et al., 2002; Rockne, K.J. and S.E. Strand, 2001
	phenol	*Oxidation:* occurs under nitrate and methanogenic conditions	Spence, M.J., et al., 2001; Tay. J.H. et al. 2001.
	tetrahydrofuran	limited literature exists at this time	
	toluene	*Oxidation* : rapid process occurs under nitrate- iron and sulphate-reducing conditions	Biegert et al., 1996; Gorny and Schink, 1994; Lovley and Lonergan, 1990
	xylenes (all isomers)	*Oxidation* : rapid process occurs under nitrate- and sulphate-reducing conditions	Häner et al., 1995; Harms et al., 1999
Ketones	2-methyl-4-pentanone	Biodegradation observed under nitrate- and sulphate-reducing conditions	Mormile et al., 1994;
	2-butanone (MEK)	*Oxidation:* occurs under nitrate, sulfate-reducing and methanogenic conditions	Sufilta and Mormile 1993
	acetone	*Oxidation:* occurs in presence of nitrate	Platen, H., B. Schink. 1990.

TABLE 4
ABIOTIC DEGRADATION PROCESSES FOR COMMON CHEMICALS AT SITE

Class	Parameter	Abiotic Processes	References
Chlorinated Ethenes	tetrachloroethene	*Hydrolysis* : moderate rate, experimental half-life of about 1 year	Dilling et al., 1975
	trichloroethene	*Hydrolysis* : not likely	Montgomery, 2000
	trans/cis-1,2-dichloroethene	*Hydrolysis* : not likely	Jeffers et al., 1989
	1,1-dichloroethene	*Hydrolysis* : not likely	Jeffers et al., 1989
	vinyl chloride	*Hydrolysis* : not likely	Montgomery, 2000
Chlorinated Ethanes	1,1,2-trichloroethane	*Hydrolysis:* very slow (half-life of 170 years)	Vogel et al., 1987
	1,1,1-trichloroethane	*Hydrolysis:* moderate rate, half-life of about 0.73 years	Montgomery, 2000
	1,2-dichloroethane	*Hydrolysis* : occurs slowly; ethylene glycol is product at neutral pH; vinyl chloride is product at pH>10	Jeffers et al., 1989; Bosma et al., 1998
	1,1-dichloroethane	*Hydrolysis:* not likely	
	chloroethane	*Hydrolysis* : occurs very rapidly (half-life of 0.12 years)	Vogel et al., 1987
Chlorinated Methanes	carbon tetrachloride	*Hydrolysis:* very slow Carbon tetrachloride can also react with hydrogen sulphide to from carbon disulphide	Kreigman-King and Reinhard, 1992
	chloroform	*Hydrolysis* : not likely	Montgomery, 2000
	chloromethane	*Hydrolysis* : moderate rate, half life of about 0.75 years	Montgomery, 2000
	methylene chloride	*Hydrolysis* : moderate rate, experimental half-life of 1.5 years	Dilling et al., 1975
Aromatics	1,4-dioxane	*Hydrolysis* : not likely	
	4-methylphenol	*Hydrolysis:* not likely	
	benzene	does not contain a hydrolyzable functional group	Montgomery, 2000
	chlorobenzene	*Hydrolysis* : not likely	Montgomery, 2000
	ethylbenzene	*Hydrolysis* : not likely	Montgomery, 2000
	naphthalene	*Hydrolysis:* not likely	
	phenol	*Hydrolysis:* not likely	Montgomery, 2000
	tetrahydrofuran	*Hydrolysis:* not likely	
	toluene	*Hydrolysis:* not likely	
	xylenes (all isomers)	*Hydrolysis:* not likely	
Ketones	2-methyl-4-pentanone	does not contain a hydrolyzable functional group	Montgomery, 2000
	2-butanone (MEK)	*Hydrolysis:* not likely	
	acetone	*Hydrolysis:* not likely	

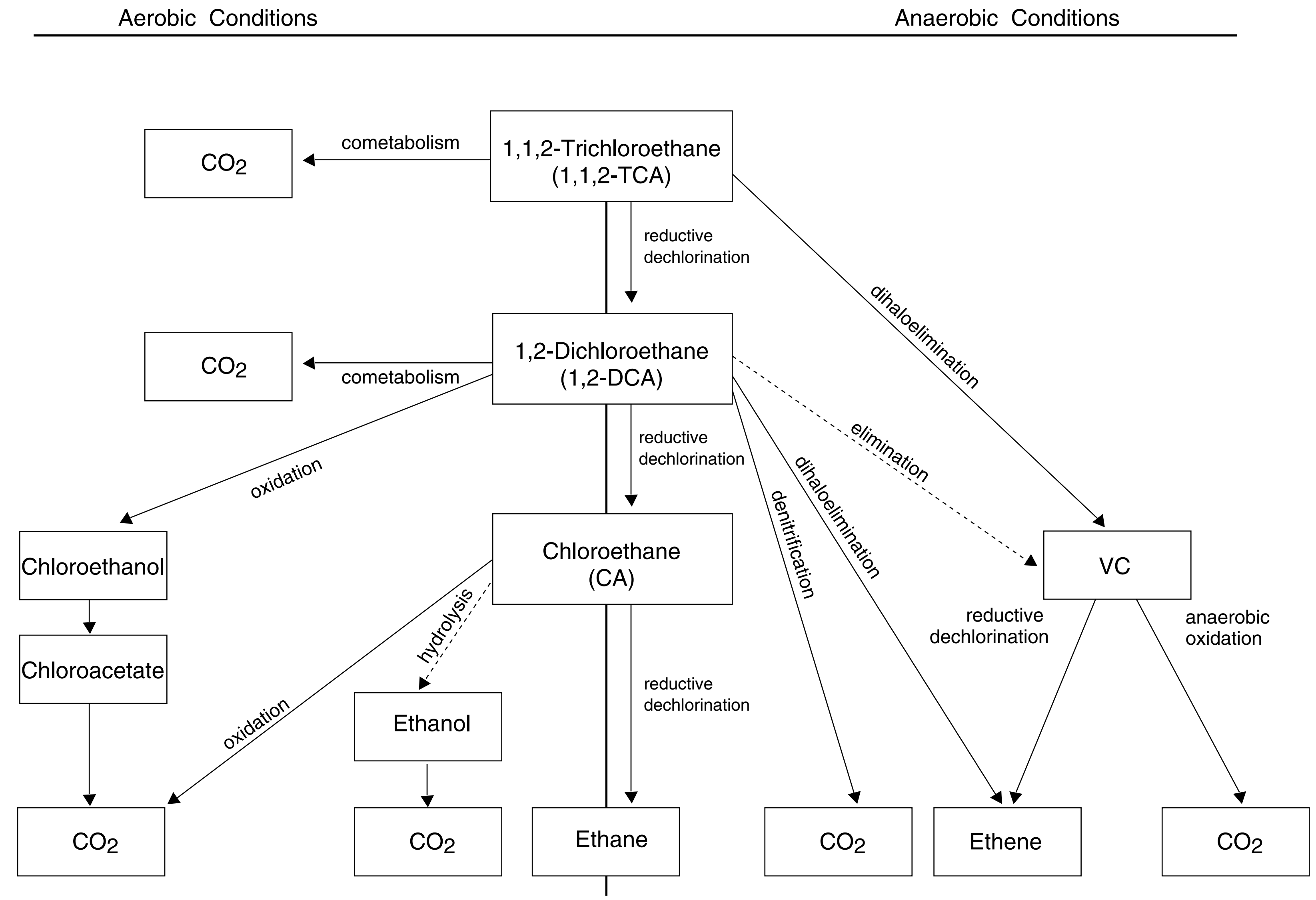
FIGURES



Pathways for the Degradation of Chlorinated Ethenes

SRSNE, Southington CT

May 2004	Figure: **1**	GEOSYNTEC CONSULTANTS

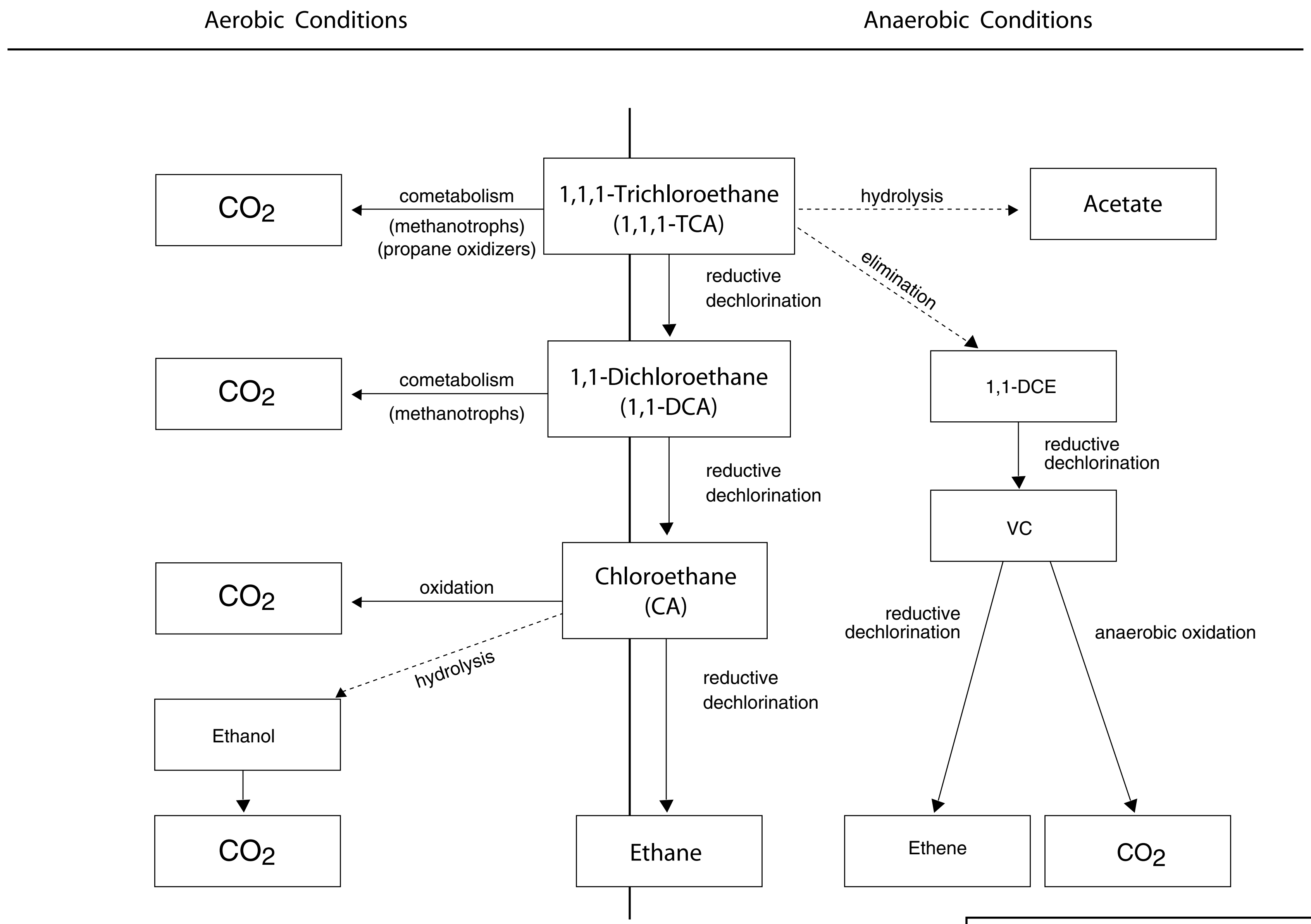


→ biological reaction

- - - → abiotic reaction

Pathways for the Degradation of
1,1,2-Trichloroethane and 1,2-Dichloroethane
SRSNE, Southington CT

May 2004	Figure: **2**	GeoSyntec Consultants



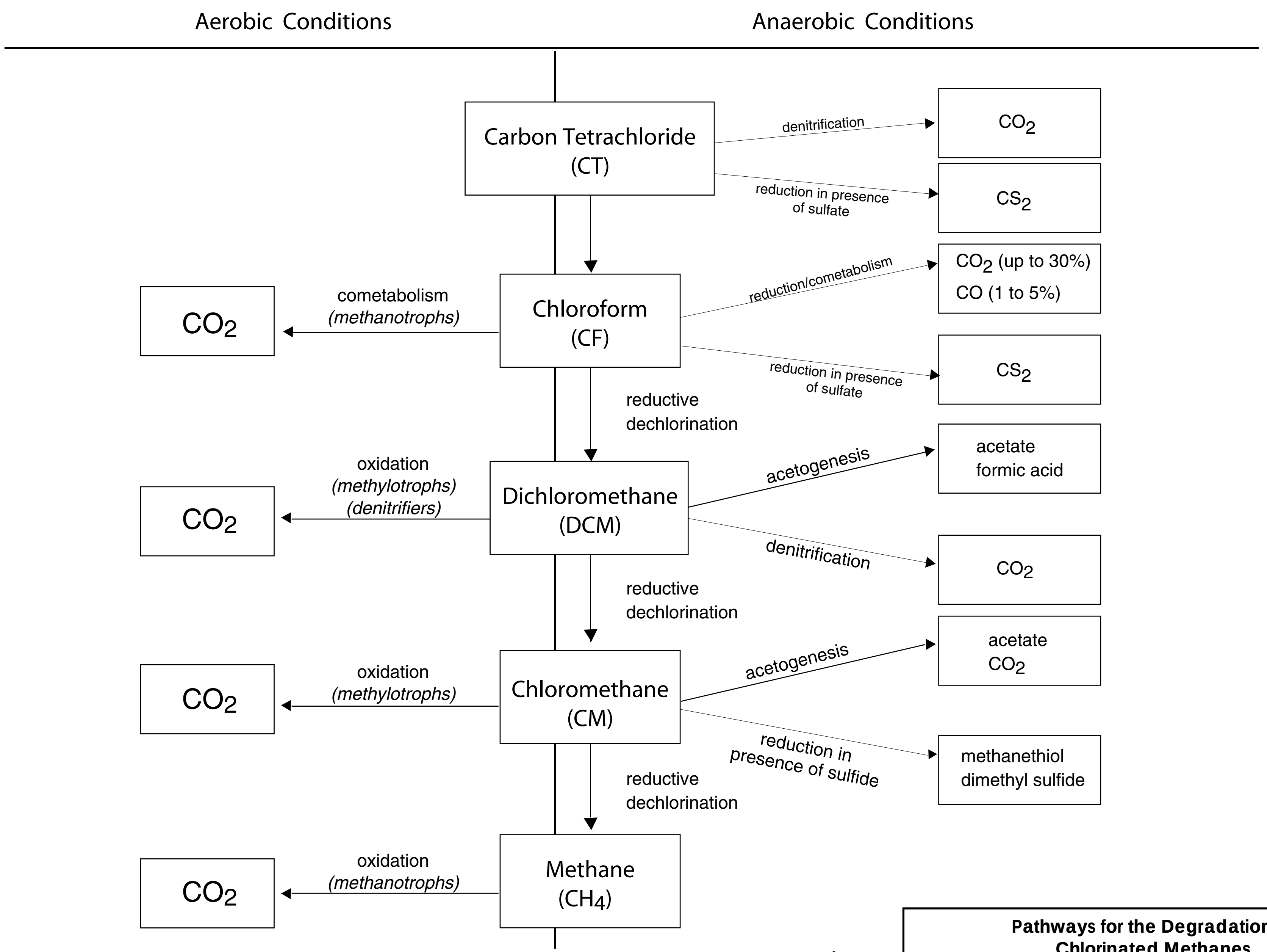
→ biological reaction

⇢ abiotic reaction

Pathways for the Degradation of
1,1,1-Trichloroethane
SRSNE, Southington CT

May 2004	Figure: **3**	GEOSYNTEC CONSULTANTS

pathway_1,1,1-TCA.ai



Pathways for the Degradation of Chlorinated Methanes

SRSNE, Southington CT

May 2004

Figure: **4**

GeoSyntec Consultants

pathway_methanes.ai

Attachment 1

Compound Fact Sheet

Compound Name: 1,1,1-Trichloroethane (1,1,1-TCA)

CAS # 71-55-6

Common Synonyms: 1,1,1-TCA, 2-Trichloroethane, Methyltrichloromethane

Physical Properties [1]

Chemical Formula $C_2H_3Cl_3$

Molecular Weight: 133.40 g/mol

Solubility in Water: 480 to 1,360 mg/L at 20 °C

Density: 1.3390 g/cm^3 at $\frac{20}{4}$C

Vapor Pressure: 96 mmHg at 20 °C

Henry's Law Constant: 12.6 x 10^{-3} to 15 x 10^{-3} atm·m^3/mol

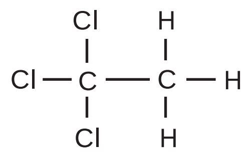
Octanol/Water Partition Coefficient (Log K_{OW}): 2.17 to 2.49

Soil Sorption Coefficient (Log K_{OC}): 1.95 to 3.40

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 200 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L 1,1,1-trichloroethane = 7.49 µ mol 1,1,1-trichloroethane

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 20-39 weeks, groundwater: 20-78 weeks[2] Abiotic degradation half-life is significant (1.05 yr). Half lives: 73-730 days[4] (abiotic half life is about 1yr)

Microcosm studies

Enhanced:

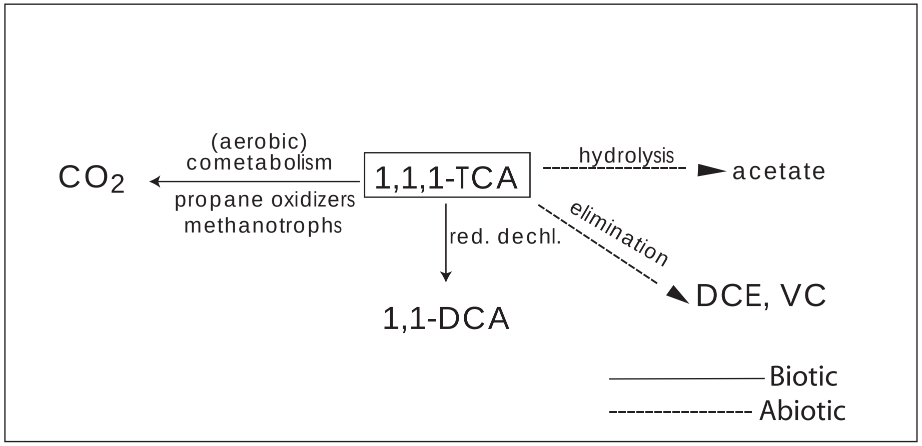
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✗			
	Cometabolic	✓	CO_2		
Anaerobic	Denitrifying	✗			
	Fe/Mn-reducing	?			
	Sulfate reducing	✓			
	Methanogenic	✓	1,1 DCA		
Abiotic	-	✓	1,1-Dichloroethene, acetic acid, hydrochloric acid, VC	?	elimination/ hydrolysis

Selected References listed on reverse

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GeoSyntec Consultants

1,1,1-Trichloroethane References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 987-990.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko .1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 113-114.

3. Chen, C., J. A. Puhakka and J. F. Ferguson. 1996. Transformations of 1,1,2,2-Tetrachloroethane under Methanogenic Conditions. *Environ. Sci. Technol*. 30(2): 542-547.

4. Gauthier, T.D. and B. L Murphy. 2003. "Uncertainties in Age Dating Groundwater Plumes Using 11-DCE/1,1,1-TCA Ratios." In V.S. Magar and M.E. Kelley (Eds). Proceedings of the Seventh International In Situ and On Site Bioremediation Symposium (Orlando FL June 2003). Paper I-04

Compound Fact Sheet

Compound Name: 1,1,2-Trichloroethane (1,1,2-TCA)

CAS # 79-00-5

Common Synonyms: 1,1,2-Trichloroethane, 1,1,2-TCA

Physical Properties [1]

Chemical Formula $C_2H_3Cl_3$

Molecular Weight: 133.40g/mol

Solubility in Water: 3,704 mg/L at 25 °C

Density: 1.434 g/cm^3 at $\frac{20^{\circ}}{4}$C

Vapor Pressure: 19 mmHg at 20 °C

Henry's Law Constant: 0.660×10^{-3} to 0.740×10^{-3} atm·m^3/mol at 20 °C

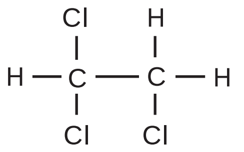
Octanol/Water Partition Coefficient (Log K_{OW}): 1.98 at 25 °C

Soil Sorption Coefficient (Log K_{OC}): 1.78 to 2.03

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 5 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1mg/L 1,1,2-trichloroethane = 7.49µ mol 1,1,2-trichloroethane

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 4.5 months - 1 year, groundwater: 4.5 months - 2 years (abiotic)[2]

Microcosm studies

Enhanced:

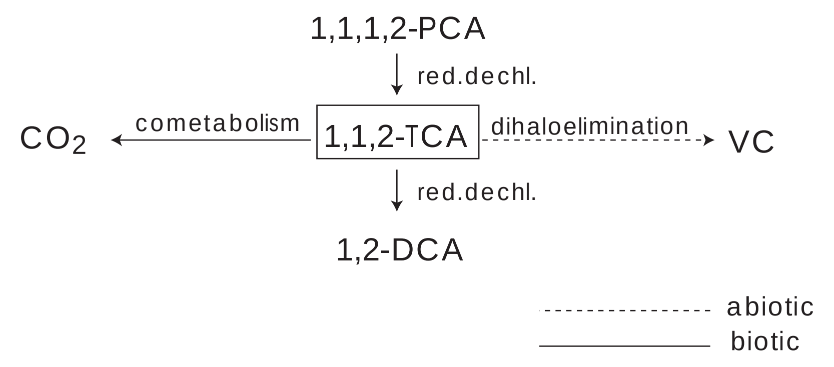
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen				
	Cometabolic	✓	CO_2		
Anaerobic	Denitrifying	?			
	Fe/Mn-reducing	?			
	Sulfate reducing	?	D		
	Methanogenic	✓	1,2 DCA	PCA	
Abiotic	-	✓	chloracetaldehyde, 1,1-dichloroethene, hydrochloric acid, 1,2-dichloroethene (under alkaline conditions)	✓	elimination/ hydrolysis

** Cross-Reference Table*
References listed on reverse

DRAFT

GeoSyntec Consultants

1,1,2-Trichloroethane References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 991-993.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko (1991) Handbook of Environmental Degradation Rates. Lewis Publishers: 188-189.

3. Chen, C., J. A. Puhakka and J. F. Ferguson. 1996. Transformations of 1,1,2,2-tetrachloroethane under methanogenic conditions. *Environ. Sci. Technol*. 30(2): 542-547.

Compound Fact Sheet

Compound Name: 1,1-Dichloroethane

CAS # 75-34-3

Common Synonyms: 1,1,-DCA, chorinated hydrochloric ether

Physical Properties [1]

Chemical Formula $C_2H_4Cl_2$

Molecular Weight: 98.96 g/mol

Solubility in Water: 5,500 mg/L at 20 °C

Density: 1.1757 g/cm^3 at $\frac{20}{4}$°C

Vapor Pressure: 227 to 234 mmHg at 25 °C

Henry's Law Constant: 5.63×10^{-3} to 7.0×10^{-3} atm·m^3/mol

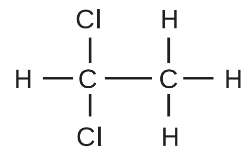
Octanol/Water Partition Coefficient (Log K_{OW}): 1.48 to 1.82

Soil Sorption Coefficient (Log K_{OC}):

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: none

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1mg/L 1,1 dichloroethane 10.1μ mol 1,1 dichloroethane

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 32 days -22 weeks, groundwater: 64 days - 22 weeks[2]

Half lives: 490-650 days[4]

Microcosm studies

Enhanced:

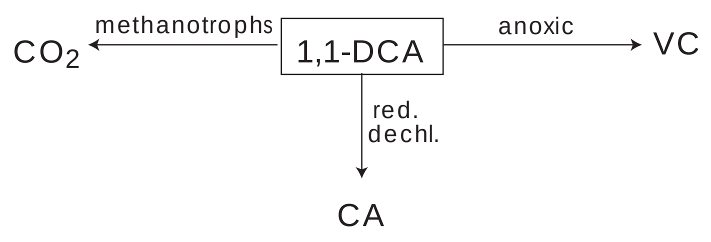
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen				
	Cometabolic	✓	CO_2		
Anaerobic	Denitrifying	?			
	Fe/Mn-reducing	?			
	Sulfate reducing	?			
	Methanogenic	✓	CA	1,1,2-TCA	
Abiotic	-	?			

Selected References listed on reverse

DRAFT

GeoSyntec Consultants

1,1-Dichloroethane References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 344-346.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko (1991) Handbook of Environmental Degradation Rates.
Lewis Publishers: 148-149.

3. Chen, C., J. A. Puhakka and J. F. Ferguson. 1996. Transformations of 1,1,2,2-tetrachloroethane under methanogenic conditions.
Environ. Sci. Technol. 30(2): 542-547.

4. Ravi, V., Chen, J. S., Wilson, J. T., Johnson, J. A., Gierke, W., Murdie, L., 1998. "Evaluation of Natural Attenuation of Benzene and Dichloroethanes at the KL Landfill." Bioremediation Jour., 2(3&4):239-258.

Compound Fact Sheet

Compound Name: 1,1-Dichloroethene

CAS # 75-35-4

Common Synonyms: 1,1-DCE, 1,1-Dichloroethylene, vinylidine chloride

Physical Properties [1]

Chemical Formula $C_2H_4Cl_2$

Molecular Weight: 96.94 g/mol

Solubility in Water: 400 mg/L at 20 °C

Density: 1.2132 to 1.218 g/cm^3 at $\frac{20}{4}$°C

Vapor Pressure: 495 mmHg at 20 °C

Henry's Law Constant: 2.18 x 10^{-2} to 2.29 x 10^{-2} atm.m^3/mol at 20 °C

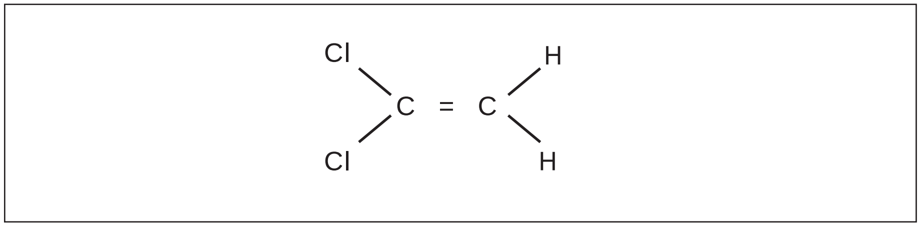
Octanol/Water Partition Coefficient (Log K_{OW}): 1.48 to 2.13

Soil Sorption Coefficient (Log K_{OC}): 1.79

Subject to Isotope Fractionation: ☑ Yes ☐ No ☐ Unknown

EPA MCL: 7 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L 1,1-dichloroethene = 10.32 µ mol 1,1-dichloroethene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 4 weeks-6 months, groundwater: 8 weeks- 19 weeks[2] hydrolysis: 1.2 x 10^8 yr at 25°C and pH7[1]. Half lives: 10-2100 days[5]

Microcosm studies

Enhanced:

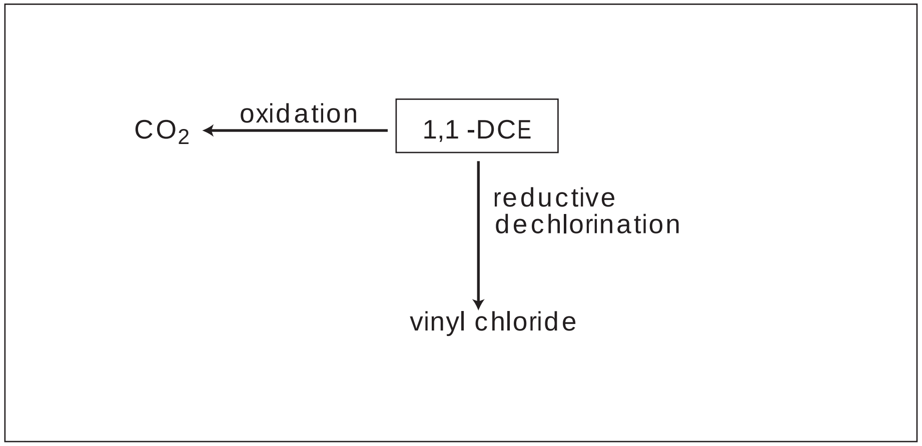
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO2		
	Cometabolic	✓			
Anaerobic	Denitrifying	?			
	Fe/Mn-reducing	✓	VC	PCE/TCE	slower than 1,2-DCE
	Sulfate reducing	✓	VC	PCE/TCE	slower than 1,2-DCE
	Methanogenic	✓	VC	PCE/TCE	slower than 1,2-DCE
Abiotic	-	✗ (very slow)	chloroacetylne (alkaline)	?	

Selected References listed on reverse

GeoSyntec Consultants

1,1-Dichloroethene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 351-353.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko .1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 150-151.

3. Chauhan, S., P. Barbieri and T. Wood. 1998. Oxidatioin of Trichloroethylene, 1,1-Dichloroethylene, and Chloroform by Toluene/0-Xylene Monooxygenase from *Pseudomonas stutzeri* OX1. *Appl. Environ. Microbiol.* 64(8): 3023-3024.

4. Bradley, P. M. and F. H. Chapelle. 1997. Kinetics of DCE and VC mineralization under methanogenic and Fe(III)-reducing conditions. *Environ. Sci. Technol.* 31(9): 2692-2696.

5. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name: **1,2-Dichloroethane**

CAS # 107-06-2

Common Synonyms: 1,2-DCA, Ethylene chloride, EDC

Physical Properties [1]

Chemical Formula $C_2H_4Cl_2$

Molecular Weight: 96.96 g/mol

Solubility in Water: 8,450 to 8,800 mg/L at 20 °C

Density: 1.25280 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 78.7 mmHg at 20 °C

Henry's Law Constant: 0.909×10^{-3} to 1.50×10^{-3} atm·m^3/mol

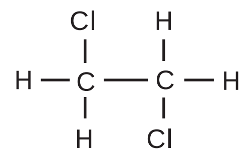
Octanol/Water Partition Coefficient (Log K_{OW}): 1.45 to 1.50

Soil Sorption Coefficient (Log K_{OC}): 1.34 to 1.88

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 5 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L 1,2-dichloroethane = 10.31 µ mol 1,2-dichloroethane

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 100 days-6 months, groundwater: 100 days - 12 months[2]

Abiotic half life in water 139.2 yr[1]

Microcosm studies

Enhanced:

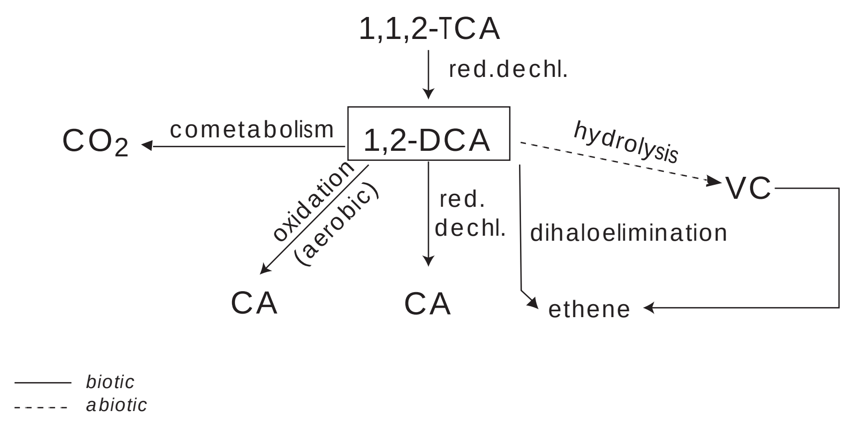
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CA		
	Cometabolic	✓	CO_2		electron donors, methane
Anaerobic	Denitrifying	✓	CO_2		
	Fe/Mn-reducing	?			
	Sulfate reducing	✓	CA / ethene	1,1,2-TCA	
	Methanogenic	✓	CA / ethene	1,1,2-TCA	
Abiotic	-	✓	Vinyl Chloride (alkaline), ethylene glycol (neutral)	✓	hydrolysis (very slow)

Selected References listed on reverse

DRAFT

GeoSyntec Consultants

1,1-Dichloroethane References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 344-346.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko (1991) Handbook of Environmental Degradation Rates.
Lewis Publishers: 148-149.

3. Chen, C., J. A. Puhakka and J. F. Ferguson. 1996. Transformations of 1,1,2,2-tetrachloroethane under methanogenic conditions.
Environ. Sci. Technol. 30(2): 542-547.

Compound Fact Sheet

Compound Name: 1,4-Dioxane

CAS # 123-91-1

Common Synonyms: Diethylene Dioxide; 1,4-Diethylene Dioxide; Diethylene Ether

Physical Properties[1]

Chemical Formula $C_4H_8O_2$

Molecular Weight: 88.11 g/mol

Solubility in Water: miscible

Density: 1.0337 g/cm^3 at 20/4 °C

Vapor Pressure: 29mm Hg at 20 °C

Henry's Law Constant: 7.14×10^{-6} atm·m^3/mol at 25 °C

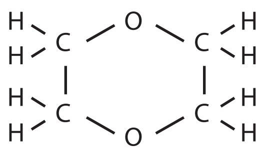
Octanol/Water Partition Coefficient (Log K_{OW}): -0.42

Soil Sorption Coefficient (Log K_{OC}): 0.54

Subject to Isotope Fractionation: ☐ Yes ☐ No ☒ Unknown

EPA MCL: none

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L 1,4-Dioxane = 11.3 $\frac{\mu mol}{L}$ 1,4-Dioxane

Transformation Rates from Selected Publications[2]

Field rates

Enhanced:

Natural: Half lives, aqueous: aerobic 4 weeks - 6 months, anaerobic: 16 weeks - 24 months. Half lives: 365-1825 days[7] median 1095 (extrapolation from Sock, 1993)

Microcosm studies

Enhanced:

Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260B	12 µg/L	at 4 °C & sodium bisulpate to pH<2	14 days	80mL	40mL VOA vial

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen[3]	✓	CO_2		
	Cometabolic	with THF,[4,5] acetic acid[6]		No	
Anaerobic	Denitrifying	?			
	Fe/Mn-reducing	?			
	Sulfate reducing	?			
	Methanogenic	?			
Abiotic	-	?			

Selected References listed on reverse

DRAFT

GeoSyntec Consultants

1,4-Dioxane References:

1. Montgomery, J.H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 447-449.

2. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan and E. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 492

3. Parales, R.E., J.E.Adamus, N. White, H.D. May. 1994. Degradation of 1,4-Dioxane by an Actinomycete in pure culture. Applied and Environmental Microbiology; 60(12), 4527-4530.

4. Zenker, M.J., R.C.Borden, M.A. Barlaz. 2002. Modeling Cometabolism of Cyclic Ethers. Environmental Engineering Science: 19(4), 215-226.

5. Zenker, M.J., R.C.Borden, M.A. Barlaz. 2000 Mineralization of 1,4-dioxane in the presence of a structural anolog. Biodegradation: 11, 239-246.

6. Raj., C.B.C., N. Ramkumar, A.H.J. Siraj, Sp. Chidambaram. 1997. Biodegradation of Acetic, Benzoic, Isophthalic, Toluic and Terephthalic Acids Using a Mixed Culture: Effluents of PTA Production, Process Safety and Envronmental Protection - Transactions of the Institution of Chemical Engineers: 75 (B), 245-256.

7. Sock, S. M. 1993. "A comprehensive evaluation of biodegration as a treatment alternative for the removal of 1,4-dioxane." MS Thesis. Clemson University.

Compound Fact Sheet

Compound Name:[1] 4-Methylphenol

CAS # 106-44-5

Common Synonyms: 4-Cresol; p-Cresol; p-Cresylic acid;
1-Hydroxy-4-methylbenzene

Physical Properties

Chemical Formula C_7H_8O

Molecular Weight: 108.14 g/mol

Solubility in Water: 230 mmol/L (25g/L) 25 °C

Density: 1.0178 g/cm^3 at 20/4 °C

Vapor Pressure: 4 x 10^{-2} mm Hg at 20 °C

Henry's Law Constant: 7.69 x 10^{-2} atm·m^3/mol at 25 °C

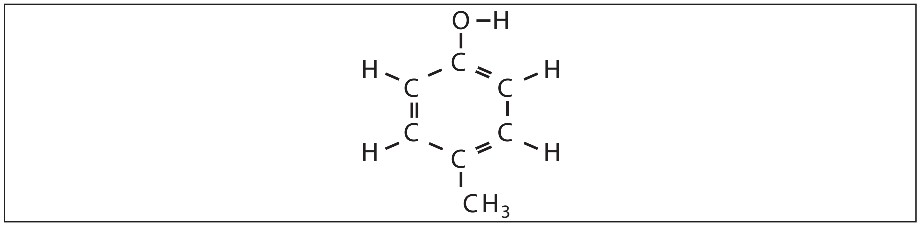
Octanol/Water Partition Coefficient (Log K_{OW}): 1.67 to 3.01

Soil Sorption Coefficient (Log K_{OC}): 1.69 to 3.53

Subject to Isotope Fractionation: ☐ Yes ☐ No ☐ Unknown

EPA MCL:

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L 4-Methylphenol = 9.247 $\frac{\mu mol}{L}$

Transformation Rates from Selected Publications

Field rates

Enhanced:[2] Removal / Secondary Treatment: 99.4% (Based on continuous activated sludge treatment)

Natural:[2] Half lives, aqueous: Aerobic: 1-16 hours
Anaerobic: 10-28 days

Microcosm studies

Enhanced:

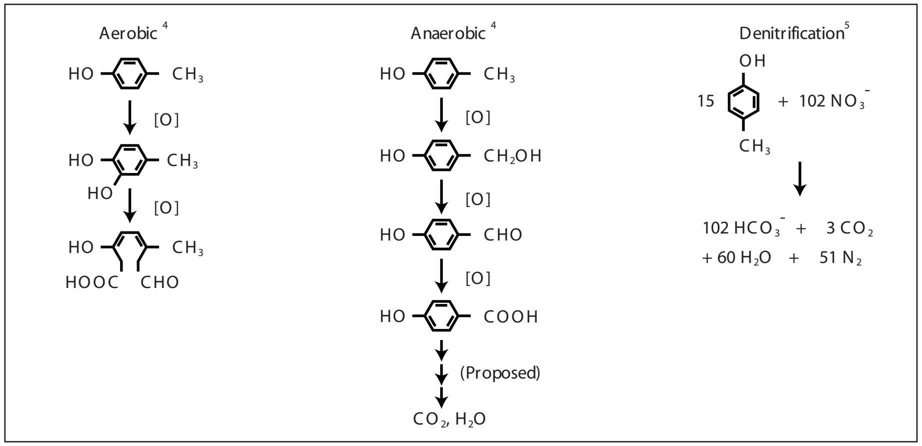
Natural:[4] Half lives, Aqueous: 8-693 days
Anaerobic: 53 days

Sampling Considerations[3]

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8270C	0.10µg/L	4°C	7 days until extraction	4L	1L amber VOA vial

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen[4]	Yes	See above	Yes	See above
	Cometabolic	?	?	?	
Anaerobic	Denitrifying[5]	77%	HCO_3^-, CO_2, H_2O, N_2	Yes	See above
	Fe-reducing[4]	Yes	CO_2, Fe^{2+}	Yes	
	Sulfate reducing[4]	Yes	CO_2, S_2^-,H_2O	Yes	
	Methanogenic	?	?	?	
Abiotic	-	?	?	?	

Selected References listed on reverse

GeoSyntec Consultants

4-Methylphenol References:

1. Montgomery, J.H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 722-723.

2. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan and E. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 366

3. U.S. EPA. 1996. Test Methods for evaluating Soild Waste, Physical / Chemical Methods (SW-846). Method 8270C and chapter 4.

4. Harrison, I, G.M. Williams, J.J.W. Higgo, R.U. Leader, A.W. Kim, D.J. Noy, 2001. Microcosm studies of microbial degradation in a coal tar distillate plume. Journal of Contaminant Hydrology, 53. 319-340

5. Spence, M.J., S.H. Bottrell, J.J.W. Higgo, I. Harrison, A.E. Fallick, 2001. Denitrification and phenol degradation in a contaminanted aquifer. Journal of Contaminant Hydrology, 53. 305-318

Compound Fact Sheet

Compound Name: Acetone

CAS # 67-64-1

Common Synonyms: 2-Propanone, Dimethyl ketone, DMK, Methyl ketone, Propanone

Physical Properties [1]

Chemical Formula C_3H_6O

Molecular Weight: 58.08 g/mol

Solubility in Water: 440.6 g/L at 25 °C

Density: 0.7899 g/cm^3 at $\frac{20}{4}$°C

Vapor Pressure: 180 mmHg at 20 °C

Henry's Law Constant: 3.30×10^{-5} to 4.00×10^{-5} $atm \cdot m^3/mol$ at 25 °C

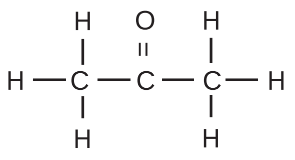
Octanol/Water Partition Coefficient (Log K_{OW}): -0.48 to -0.23

Soil Sorption Coefficient (Log K_{OC}): -0.588

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: none

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L acetone = 17.2 µ mol acetone

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 1-7 days[4] (aerobic), groundwater: 2-14 days[4] (aerobic)

Half lives: 15-150 days[7] (with sulfate present in groundwater)

Microcosm studies

Enhanced: denitryifing bacteria - (no ADP/$MgCl_2$) decarboxylation occured below 2nmol $min^{-1}mg^{-1}$protein [2]

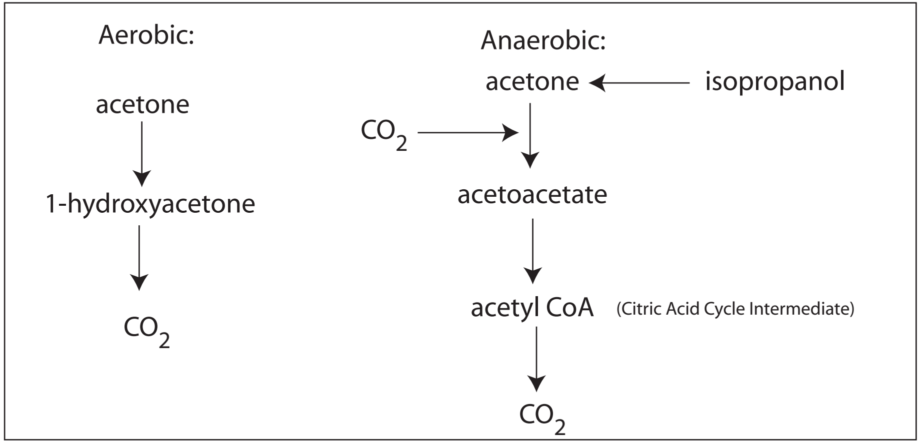
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	10 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2		
	Cometabolic				
Anaerobic	Denitrifying	✓	CO_2		CO_2 dependent
	Fe/Mn-reducing				
	Sulfate reducing				
	Methanogenic	✗			
Abiotic	-	✗	NA		no hydrolyzable group

Selected References listed on reverse

GeoSyntec Consultants

Acetone references:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 16-19.

2. Platen, H., B. Schink. 1990. Enzymes Involved in Anaerobic Degradation of Acetone by a Denitrifying Bacterium. *Biodegradation* 1: 243-251.

3. Stefan, M. I. J. R. Bolton .1999. Reinvestigation of the Acetone Degradation Mechanism in Dilute Aqueous Solution by the UV/H202 Process. *Environ. Sci. and Technol.* 33(6): 870-873.

4. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991.
   Handbook of Environmental Degradation Rates.
   Lewis Publishers: 97-98.

5. Sluis, M.K., F. J. Small, J.R. Allen and S.A. Ensign, 1996. Involvement of an ATP-dependent carboxlase in a CO_2 - dependent pathway of acetone metabolism by *Xanthobacter* strain Py2.
   Journal of Bacteriology. 178: 4020-4026.

6. Janssen, P.H., B. Schink. 1995. Catabolic and anabolic enzyme activities and energetics of acetone metabolism of the sulfate-reducing bacterium *Desulfococcus biacutus*.
   Journal of Bacteriology. 178: 4020-4026.

7. Keith, N.G., and others. 2003. "Design, construction and operation of a sulfate biobarrier to treat chlorinated and non-chlorinated VOCs." In V.S. Magar and M.E. Kelley (Eds). Proceedings of the Seventh International In Situ and On Site Bioremediation Symposium (Orlando FL June 2003). Paper K-07

Compound Fact Sheet

Compound Name: Benzene

CAS # 71-43-2

Common Synonyms: Benzol, Cyclohexatriene, Phene, Phenyl hydride, Pyrobenzol, Pyrobenzole

Physical Properties [1]

Chemical Formula C_6H_6

Molecular Weight: 78.11 g/mol

Solubility in Water: 1,710 to 1,796 mg/L at 20 °C

Density: 0.87891 g/cm^3 at $\frac{20}{4}$°C

Vapor Pressure: 76 mmHg at 20 °C

Henry's Law Constant: 4.52×10^{-3} to 4.54×10^{-3} atm·m^3/mol at 20 °C

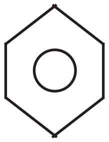
Octanol/Water Partition Coefficient (Log K_{OW}): 1.56 to 2.28

Soil Sorption Coefficient (Log K_{OC}): 1.00 to 3.01

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 5 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L benzene = 12.8 µ mol benzene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: NRC 2000 concludes this compound has high likelihood of success for natural attenuation[9]. Half lives: 70-700 days[10]

Microcosm studies

Enhanced:

Natural: 100% degradation of 24 mg/L in 84h. 0.056 g^{-1}h^{-1}

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.1 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Aerobic

$$C_6H_6 + 7.5\,O_2 \longrightarrow 6CO_2 + 3\,H_2O$$

Denitrifying

$$6NO_3^- + 6H^+ \, C_6H_6 \longrightarrow 6CO_2 + 3N_2 + 6H_2O$$

Iron Reducing

$$30\,Fe(OH)_3 + 60H^- + C_6H_6 \longrightarrow 6CO_2 + 78\,H_2O + 30\,Fe^{2+}$$

Sulfate Reducing

$$3.75\,SO_4^{-2} + 7.5H^+ + C_6H_6 \longrightarrow 6\,CO_2 + 3\,H_2O + 3.75\,H_2S$$

Methanogenic

$$C_6H_6 + 4.5\,H_2O \longrightarrow 2.25\,CO_2 + 3.75\,CH_4$$

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2	✗	
	Cometabolic				
Anaerobic	Denitrifying	✓	N_2		
	Fe/Mn-reducing	✓	Fe^{2+}		
	Sulfate reducing	✓	H_2S		
	Methanogenic	✓	CH_4	chlorobenzene	
Abiotic	-	✗	NA	✗	

Selected References listed on reverse

DRAFT

GeoSyntec Consultants

Benzene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 72-78.

2. Anderson, R., T., J. N. Rooney-Varga, C. V. Gaw and D. R. Lovley. 1998. Anaerobic benzene oxidation in the Fe(III) reduction zone of petroleum-contaminated aquifers. *Environ. Sci. Technol.* 32(9): 1222-1229.

3. Burland, S. and E. Edwards. 1999. Anaerobic benzene biodegradation linked to nitrate reduction. *Appl. Environ. Microbiol.* 65(2): 529-533.

4. Caldwell, M. E. and J. M. Sulflita. 2000. Detection of phenol and benzoate as intermediates of anaerobic benzene biodegradation under different terminal electron-accepting conditions. *Environ. Sci. Technol.* 34(7): 1216-1220.

5. Kazumi, J., M.E. Caldwell, J.M. Sulflita, D.R. Lovely, L. M. Young. 1997. Anaerobic degradation of benzene in diverse anoxic environments. *Environ. Sci. Technol.* 31(3): 813-818.

6. Phelps, C. D., L. J. Kerkhof and L. Y. Young. 1998. Molecular characterization of a sulfate-reducing consortium which mineralizes benzene. *FEMS Microbiol. Ecology* 27: 269-279.

7. Smith, M. R. 1990. The biodegradation of aromatic hydrocarbons by bacteria. *Biodegradation* 1: 191-206.

8. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 111-112.

9. National Research Council. 2000. Natural Attenuation for Groundwater Remediation National Academy Press. Washington, D.C., P.8.

10. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name: **Carbon Tetrachloride**

CAS # 56-23-5

Common Synonyms: Tetrachloromethane, CT

Physical Properties [1]

Chemical Formula CCl_4

Molecular Weight: 153.82 g/mol

Solubility in Water: 785 mg/L at 20 °C

Density: 1.59472 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 90 mmHg at 90 °C

Henry's Law Constant: 24×10^{-3} to 2.226×10^{-3} $atm \cdot m^3/mol$ at 20 °C

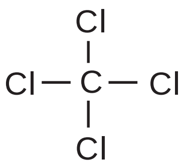
Octanol/Water Partition Coefficient (Log K_{OW}): 2.73 to 2.83

Soil Sorption Coefficient (Log K_{OC}): 1.78 to 2.62

Subject to Isotope Fractionation: ☐ Yes ☑ No ☐ Unknown

EPA MCL: 5 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L carbon tetrachloride = 6.51 µ mol carbon tetrachloride

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 6 months- 1 year, groundwater: 7 days- 1 year[2]

4.5 - 7,000 yr (abiotic)

Microcosm studies

Enhanced: Half lives from 1.5 days - 30 days [7]

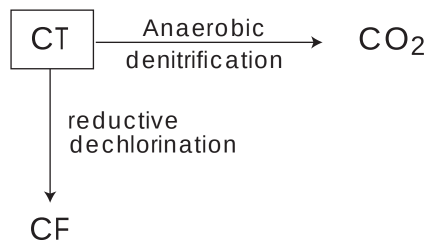
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✗			
	Cometabolic	✗			
Anaerobic	Denitrifying	✓	CF, CO_2	✗	
	Fe/Mn-reducing	✓	CF	✗	
	Sulfate reducing	✓	CF	✗	
	Methanogenic	✓	CF	✗	
Abiotic	-	✓	Chloroform, CO_2, HCl	✗	hydrolysis

Selected References listed on reverse

DRAFT

GeoSyntec Consultants

Carbon Tetrachloride References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 200-203.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko .1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 34-35.

3. de Best, J. H., E. Salminen, H.J. Doddema, D.B. Janssen, W. Harder. 1998. Transformation of carbon tetrachloride under sulfate reducing conditions. *Biodegradation* 8: 429-436.

4. de Best, J. H., P. Hunneman, H. J. Doddema, D. B. Janssen and W. Harder. 1999. Transformation of carbon tetrachloride in an anaerobic packed-bed reactor without addition of another electron donor. *Biodegradation* 10: 287-295.

5. Freedman, D., M. Lasecki and S. Hashsham. 1995. Accelerated biotransformation of carbon tetrachloride and chloroform by sulfate-reducing enrichment cultures. Symposium on natural attenuation of chlorinated organics in groundwater. Washington DC, Batelle.

6. Liss, S. N. and K.H. Baker. 1994. Anoxic/ Anaerobic Bioremediation. In: Bioremediation McGraw-Hill. 307.

7. Devlin, J.F. 1994. Enhanced in situ biodegradation of carbon tetrachloride and trichloroethene using a permeable wall injection system. PhD. Thesis, University of Waterloo. P. 5.

Compound Fact Sheet

Compound Name: Chlorobenzene

CAS # 108-90-7

Common Synonyms: Benzene Chloride, Monochlorobenzene, MCB, Chlorobenzene, Chlorobenzol

Physical Properties [1]

Chemical Formula $C_6 H_5 Cl$

Molecular Weight: 112.56 g/mol

Solubility in Water: 295 to 503 mg/L at 25 °C

Density: 1.10646 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 9 mmHg at 20 °C

Henry's Law Constant: 2.84 x 10^{-3} to 3.41 x 10^{-3} atm·m^3/mol

Octanol/Water Partition Coefficient (Log K_{OW}): 2.65 to 2.98

Soil Sorption Coefficient (Log K_{OC}): 1.91 to 2.70

Subject to Isotope Fractionation: ☐ Yes ☑ No ☐ Unknown

EPA MCL: 100 µg/L

Chemical Structure:

Sample Calculation of Concentration Conversion to Moles

☐ 1mg/L chlorobenzene = 0.89 µ mol chlorobenzene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: 4.6 - 21 days - [2,3,7]

Microcosm studies

Enhanced: 90% of 10 ppm chlorobenzene degraded in 7 days by *Phanerochaete chrysosporium*[7]

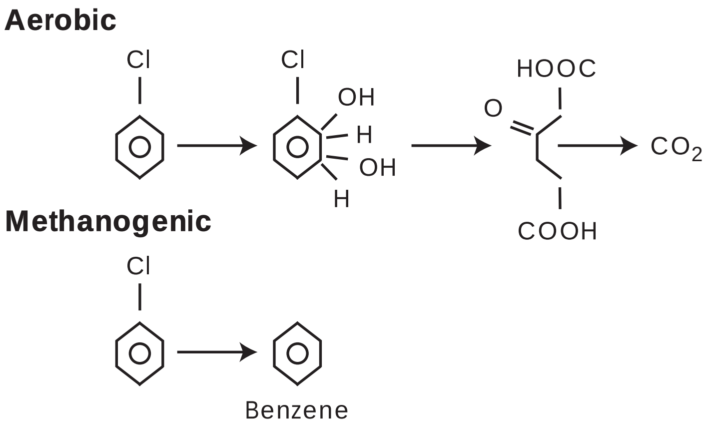
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	10 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways [6]



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓		DCB	ring cleavage
	Cometabolic	-			
Anaerobic	Denitrifying	-			not observed [4]
	Fe/Mn-reducing	-			
	Sulfate reducing	-			
	Methanogenic	✓	Benzene	DCB	
Abiotic	-	✗	NA		

Selected References listed on reverse

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GeoSyntec Consultants

Chlorobenzene References:

1. Montgomery, J. H. (2000). Groundwater Chemicals. Boca Raton, Lewis Publishers. 219-223.

2. Herrington, T., J. Hicks, D. Downey. 2000. Natural Attenuation of Chlorinated Benzenes at Site S-1, Kelly AFB, Texas. The second international conference on remediation of chlorinated and recalcitrant compounds: 1-9.

3. Nishino, S. F., Spain, Belcher and Litchfield. 1992. Chlorobenzene Degradation by Bacteria Isolated from Contaminated Groundwater. *Appl Environ Micro*. 58(5): 1719-1726.

4. Ramanand, K., Balba and Duffy. 1993. Reductive dehalogenation of Chlorinated Benzenes and Toluenes under Methanogenic Conditions. American society of microbiology 59(10): 3266-3272.

5. Rapp, P. and K. Timmis. 1999. Degradation of chlorobenzenes at nanomolar concentrations by Burkholderia sp. strain PS14 in liquid cultures and in soil. Appl. Environ. Microbial 65(6): 2547-2552.

6. Van der Meer, J. R., C.werlen, S. Nishino and J. Spain. 1998. Evolution of a Pathway for Chlorobenzene Metabolism Leads to Natural Attenuation in Containinated Groundwater. Appl. Env. Microbial 64(11): 4185-4193.

7. Yadav, J. S., R. E. Wallace and C. A. Reddy. 1995. Mineralication of Mono- and Dichlorobenzenes amd simultaneous Degradation of Chloro- and Methyl-substituted Benzenes by the white rot fungus Phanerochaete chrysosporium. Appl. Environ. Microbiol 61(2): 677-680.

Compound Fact Sheet

Compound Name: **Chloroethane**

CAS # 75-00-3

Common Synonyms: CA, Monochloroethane, Ethyl Chloride

Physical Properties [1]

Chemical Formula C_2H_5Cl

Molecular Weight: 64.52 g/mol

Solubility in Water: 5,710 mg/L at 20 °C

Density: $0.8706\ g/cm^3$ at $\frac{25}{4}$ °C

Vapor Pressure: 1,011 mmHg at 20 °C

Henry's Law Constant: $11.0 \times 10^{-3}\ atm \cdot m^3/mol$

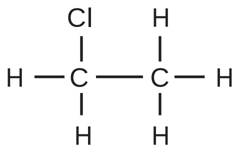
Octanol/Water Partition Coefficient (Log K_{OW}): 1.43 to 1.54

Soil Sorption Coefficient (Log K_{OC}): 0.51

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: none (listed for regulation 1996)

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L Chloroethane = 15.49 µ mol chloroethane

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: water: 38 days[1] - 0.12 years

Microcosm studies

Enhanced:

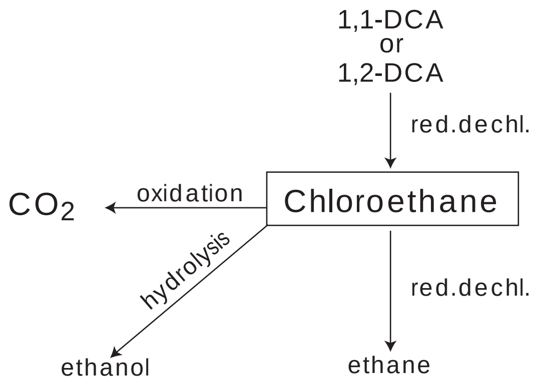
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.5 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2		oxidation
	Cometabolic	?			
Anaerobic	Denitrifying	?			
	Fe/Mn-reducing	?			
	Sulfate reducing	?			
	Methanogenic	✓	DCA Ethane		
Abiotic	-	✓	ethanol	✓	nonbiological processes

Selected References listed on reverse

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GeoSyntec Consultants

Chloroethane References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 228-230.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko .1991. Handbook of Environmental Degradation Rates.nLewis Publishers: 136-137.

3. Bradley, P. M. and F. H. Chapelle. 1999. Methane as a product of chloroethane biodegradation under methanogenic conditions. *Environ. Sci. Technol.* 33(4): 653-656.

4. Vogel, T. and P. Mccarty. 1987. Abiotic and biotic transformations of 1,1-trichloroethane under methanogenic conditions. *Environ. Sci. Technol.* 21(12): 1208-1213.

Compound Fact Sheet

Compound Name: **Chloroform**

CAS # 67-66-3

Common Synonyms: CF, Trichloromethane

Physical Properties [1]

Chemical Formula $CHCl_3$

Molecular Weight: 119.38 g/mol

Solubility in Water: 8,200 mg/L at 20 °C

Density: 1.4832 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 150.5 to 160 mmHg at 20 °C

Henry's Law Constant: 3.00×10^{-3} to 33.2×10^{-3} $atm \cdot m^3/mol$

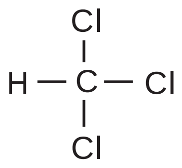
Octanol/Water Partition Coefficient (Log K_{OW}): 1.94 to 2.00

Soil Sorption Coefficient (Log K_{OC}): 1.44 to 2.79

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 100 μg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L chloroform = 8.38 μ mol chloroform

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 4 weeks-6 months, groundwater: 8 weeks- 5years[2]
15 months (abiotic)

Microcosm studies

Enhanced: Half lives, anaerobic: 1.8 days - 8weeks, aerobic: 9- 25 weeks[6]
18 uM chloroform degraded by methanol fed enrichment in *5.0 hr*[3]

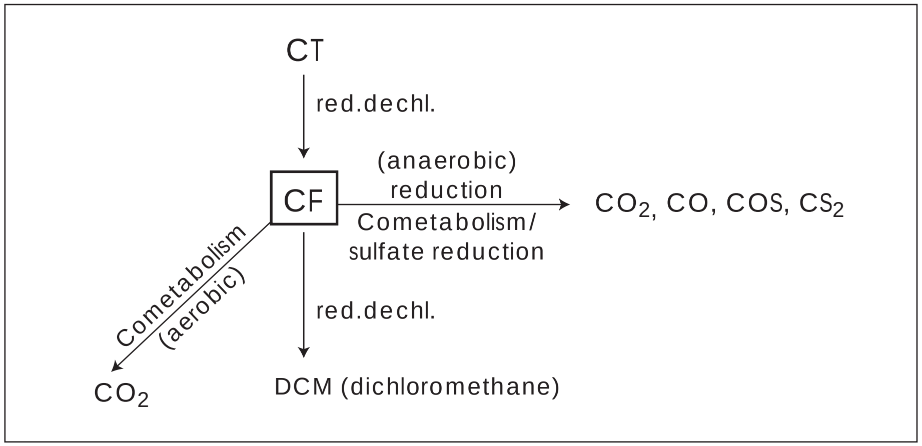
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 μg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2		
	Cometabolic	✓			methane, toluene as e^- donor
Anaerobic	Denitrifying	✓			
	Fe/Mn-reducing	✗			
	Sulfate reducing	✓	*	CT	
	Methanogenic	✓	*	CT	
Abiotic	Neutral-	✓	carbon monoxide, HCl, CS_2	✓	hydrolysis

* *See above figure*

Selected References listed on reverse

GeoSyntec Consultants

Chloroform References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 233-236.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 99-100.

3. Bagley, D.M. and J.M. Gosset. 1995. Chloroform degradation in methanogenic methanol enrichment cultures and by *Methanosarcina barkeri* 227. *Appl. Environ. Microbiol.* 61: 3195 3201.

4. Hamamura, H., C. Page, T. Long, L. Semprini and D.J. Arp. 1997. Chloroform cometabolism by butane-Grown CF8, *Pseudomonas butanovora*, and *Myocobacterium vaccae* JOB5 and methane-grown *Methylosinus trichosporium*. *Appl. Environ. Microbiol.* 63: 3607- 3613.

5. McClay, K., B.G. Fox and R.J. Steffan. 1996. Chloroform mineralization by toluene-oxidizing bacteria *Appl. Environ. Microbiol.* 62: 2716-2722.

6. Devlin, J.F. 1994. Enhanced in situ biodegradation of carbon tetrachloride and trichloroethene using a permeable wall injection system. PhD. Thesis, University of Waterloo. P. 7.

Compound Fact Sheet

Compound Name: **Chloromethane**

CAS # 74-87-3

Common Synonyms: Methyl chloride, CM

Physical Properties [1]

Chemical Formula CH_3Cl

Molecular Weight: 50.48 g/mol

Solubility in Water: 6,450 to 7,250 mg/L at 20 °C

Density: 0.9159 to 0.9214 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 3,756 mmHg at 20 °C

Henry's Law Constant: 7.69×10^{-3} $atm \cdot m^3/mol$

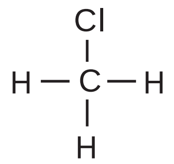
Octanol/Water Partition Coefficient (Log K_{OW}): 0.91

Soil Sorption Coefficient (Log K_{OC}): 0.78

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: none (listed for regulation 1996)

Chemical Structure:

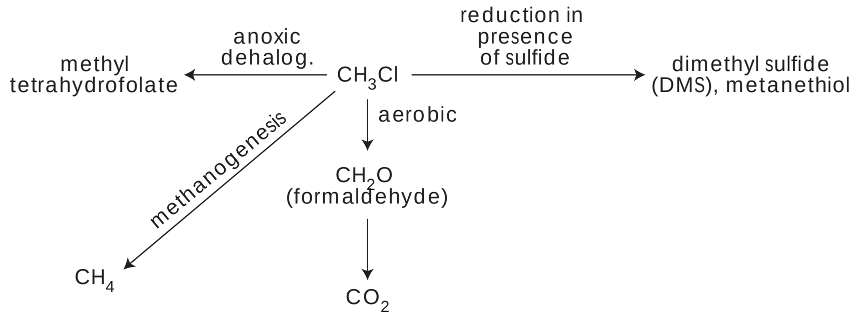


Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	1.0 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	*		
	Cometabolic	✓	*		
Anaerobic	Denitrifying				
	Fe/Mn-reducing				
	Sulfate reducing	✓	*	DCM	
	Methanogenic	✓	CH_4	DCM	
Abiotic	Neutral pH	✓	methane	✓	hydrolysis

∗ *See above figure*

Selected References listed on reverse

Sample Calculation of Concentration Conversion to Moles

1 mg/L chloromethane = 19.8 µ mol chloromethane

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 7 days- 4weeks, ground water: 14 days-8 weeks[2]

Microcosm studies

Enhanced: 8.0mM chloromethane degraded in 30hr by Methylobacterium CM4[5]

Natural:

GEOSYNTEC CONSULTANTS

Chloromethane References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 665-667.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko .1991. Handbook of Environmental Degradation Rates. Lewis Publishers. 128-129.

3. Coulter, C., J.T.G. Hamilton, W. C. Mc Roberts , L. Kulakov, M.J. Larkin and D.B. Harper. 1999. Halomethane:Bisulfide/halide ion methyltransferase, an unusual corrinoid enzyme of environmental significance isolated from an aerobic methyltroph using chloromethane as the sole carbon source. *Appl. Environ. Microbiol.* 65: 4301-4312.

4. Braus-Stromeyer, S., A. Cook and T. Leisinger. 1993. Biotransformation of chloromethane to methanethiol. *Environ. Sci. Technol.* 27(8): 1577-1579.

5. Vannelli, T., A. Studer and M. Kertesz. 1998. Chloromethane metabolism by *Methylobacterium* sp. strain CM4. *Appl. Environ. Microbiol.* 64(5): 1933-1936.

6. McAnulla, C. C.A. Woodall, I. R. McDonald, A Studer, S. Vuilleumier, T. Leisinger and J. C. Murrell. 2001. Chloromethane utilization gene cluster from *Hyphomicrobium chloromethanicum* strain CM2^T and development of functional gene probes to detect halomethane-degrading bacteria. *Appl. Environ. Microbiol.* 67(1): 307-316.

Compound Fact Sheet

Compound Name: cis-1,2-Dichloroethene (cis-DCE)

CAS # 540-59-0

Common Synonyms: cis-1,2-Dichloroethylene, cis-1,2-DCE, 1,2-Dichloroethene

Physical Properties [1-5]

Chemical Formula $C_2H_2Cl_2$

Molecular Weight: 96.94 g/mol

Solubility in Water: 3500- 6,300 mg/L at 25 °C

Density: 1.2565 g/cm^3 at $\frac{20}{4}$°C

Vapor Pressure: 265 mmHg at 20 °C

Henry's Law Constant: 4.08×10^{-3} to 9.38×10^{-3} atm·m^3/mol at 20 °C

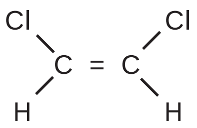
Octanol/Water Partition Coefficient (Log K_{OW}): 1.86 to 2.09

Soil Sorption Coefficient (Log K_{OC}): 1.88 - 1.97

Subject to Isotope Fractionation: ☑ Yes ☐ No ☐ Unknown

EPA MCL: 70 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1mg/L 1,2-dichloroethene = 10.3µ mol 1,2-dichloroethene

Transformation Rates from Selected Publications

Field rates

Enhanced: 0.01 to 11.87/yr [1]

Natural: Half lives: 10-2100 days[10]

Microcosm studies 0.01 to 6.07/yr [6,9]

Enhanced: propane-oxidizing bacteria (aerobic) cis-54 ± 4% in 2h trans-7 ± 4% in 2h[3]; 1-1.5 mM Cl-/day anaerobic reductive dechlorination to ethene[8]

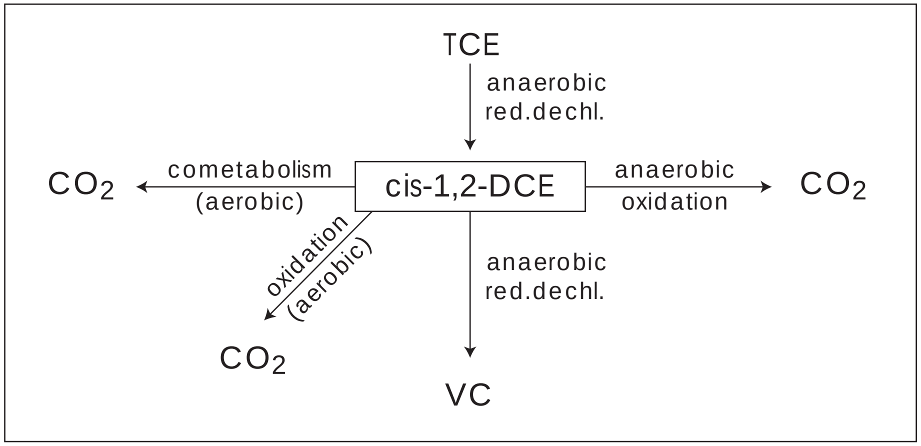
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2	✓	
	Cometabolic	✓	CO_2		cometabolism aerobic with methane, toluene, propane, ammonia, phenol, ethene
Anaerobic	Denitrifying				
Anaerobic	Denitrifying	?			
	Fe/Mn reducing				
	Fe/Mn-reducing	✓	CO_2	TCE	
	Sulfate reducing				
	Sulfate reducing	✓	VC	TCE	
	Methanogenic				
	Methanogenic	✓	VC	TCE	
Abiotic	-				
Abiotic	-	✗			

Selected References listed on reverse

Selected references listed on reverse

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cis-1,2-Dichloroethene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 354-356.

2. Boublik,T.; Fried,V.; Hala,E. 1984. The vapor pressures of pure substances: selected values of the temperature dependence of the vapour pressures of some pure substances in the normal and low pressure region. vol. 17.; Amsterdam, Netherlands: Elsevier Sci. Publ.; 1984.

3. Gossett, J.M. 1987. Measurement of henry's law constant for c1 and c2 chlorinated hydrocarbons; *Environ Sci Tech*; 21: 202-206.

4. Hansch, C.; Leo,A.J.; .1985. Medchem Project.; Claremont, Ca: Pomona College. Issue # 26.

5. SRC. 1988. Syracuse Research Corporation CalculatedValues.

6. Major, D. M., E. W. Hodgins and B. J. Butler .1991. Field and Laboratory Evidence of In Situ Biotransformation fo Tetrachloroethene to Ethene and Ethane at a Chemical Transfer Facility in North Toronto. On-Site Bioremediation. R. E. Hinchee and R. F. Olfenbuttel. Stoneham, Butterworth-Heinemann: 147-171.

7. Wackett, L., G. Brusseau and S. Householder. 1989. Survey of microbial oxygenases: trichloroethylene degradation by propane-oxidizing bacteria. *Appl. Environ. Microbiol.* 55(11): 2960-2964.

8. de Bruin, W. P., G. Schraa and A. J. B. Zehnder. 1993. Complete anaerobic reductive dechlorination of tetrachloroethene in a bioreactor. In Situ and On-Site Bioreclamation: The second International Symposium.

9. Wiedemeier, T., M. Swanson and D. Moutoux .1996. Overview of the technical protocol for natural attenuation of chlorinated aliphatic hydrocarbons in ground water under development for the US air force center for environmental excellence. Symposium on natural attenuation of chlorinated organics in ground water. Washington DC, NTIS: 35-59.

10. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name: Dichloromethane

CAS # 75-09-2

Common Synonyms: Methylene chloride, DCM

Physical Properties [1]

Chemical Formula $CH_2 Cl_2$

Molecular Weight: 84.93 g/mol

Solubility in Water: 13,000 to 19,400 mg/L at 25 °C

Density: 1.3266 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 362.4 mmHg at 20 °C

Henry's Law Constant: 1.94 x 10^{-3} to 3.03 x 10^{-3} atm·m^3/mol at 20 °C

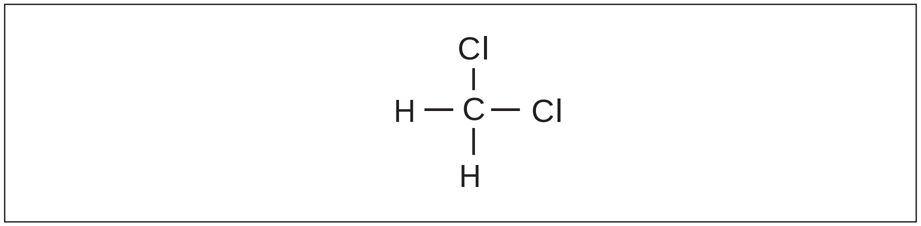
Octanol/Water Partition Coefficient (Log K_{OW}): 1.25 to 1.35

Soil Sorption Coefficient (Log K_{OC}): 1.00 to 1.44

Subject to Isotope Fractionation: ☑ Yes ☐ No ☐ Unknown

EPA MCL: 5 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L dichloromethane = 11.8 µ mol dichloromethane

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: 7 days - 4 weeks, groundwater: 14 days - 8 weeks[2]

Microcosm studies

Enhanced:

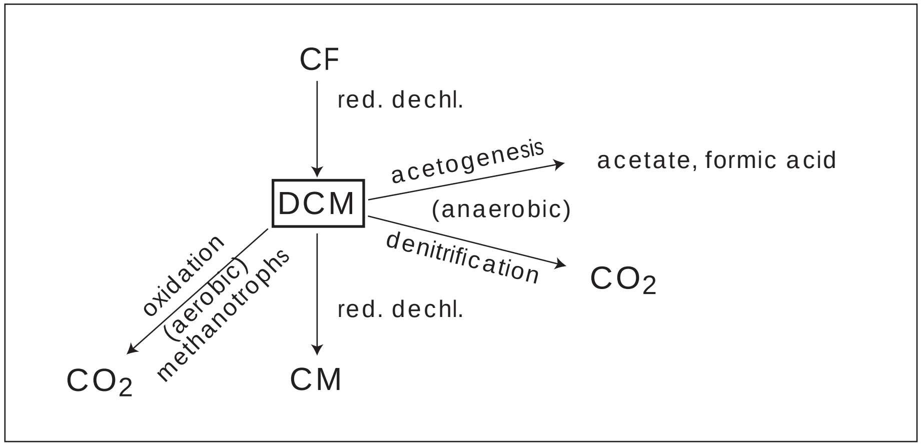
Natural: Anaerobic dehalogenation: 5 mM DCM in 7 days by *Dehalobacterium formicoaceticum* [3]

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	1.0 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2		
	Cometabolic	✓	CO_2		
Anaerobic	Denitrifying	✓	CO_2		
	Fe/Mn-reducing	✓	CM, CO_2	CF	
	Sulfate reducing	✓	CM	CF	
	Methanogenic	✓	CM	CF	
Abiotic	-	✓	chloromethane, methanol	✓	hydrolysis

Selected References listed on reverse

GeoSyntec Consultants

Dichloromethane References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 676-679.
2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko 1991 Handbook of Environmental Degradation Rates. Lewis Publishers: 142-143.
3. Andreas Magli, Matthais Wendt, Thomas Leisinger, 1996. Isolation and Characterization of *Dehalobacterium formicoaceticum gen.* nov. sp. nov., a strictly anaerobic bacterium utilizing DCM as a Source of Carbon and Energy. *Arch. Microbiol.* 166:101-108.
4. Henson M.J., 1989. Metabolism of Chlorinated Methanes, Ethanes, and Ethylenes by a Mixed Bacterial Culture Growing on Methane. *J. Indust. Microbiol.* 4:29-35.
5. Stromeyer, S.A. 1991. Dichloromethane Utilized by an Anaerobic Mixed Culture: *acetogenesis and methanogenesis*. *Biodegradation* 2:129-137.
6. Heraty, L. J. , M.E. Fuller, L. Huang, T. Abrajano Jr and N.C. Sturchio. 1999. Isotopic fractionation of carbon and chlorine by microbial degradation of dichloromethane. *Organic Geochemistry.* 30: 793-799.

Compound Fact Sheet

Compound Name: Ethyl Benzene

CAS # 100-41-4

Common Synonyms: EB, Ethylbenzol, Phenylethane

Physical Properties [1]

Chemical Formula C_8H_{10}

Molecular Weight: 106.17 g/mol

Solubility in Water: 181 mg/L at 20 °C

Density: 0.8670 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 7.08 mmHg at 20 °C

Henry's Law Constant: 5.75 x 10^{-3} to 6.01 x 10^{-3} atm·m^3/mol at 20 °C

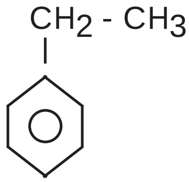
Octanol/Water Partition Coefficient (Log K_{OW}): 3.13 to 3.15

Soil Sorption Coefficient (Log K_{OC}): 2.22 to 2.77

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 700µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1mg/L ethyl benzene = 9.42µ mol ethyl benzene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: NRC 2000 concludes this compound has high likelihood of success for natural attenuation.[5] Half-life soil: 3-10 days, groundwater: 6-228 days [6]

Microcosm studies

Enhanced: 14 days

Natural: 30 µM/day at initial concentration of 600 µM

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Aerobic

$$C_8H_{10} + 10.5\,O_2 \longrightarrow 8CO_2 + 5\,H_2O$$

Denitrifying

$$8.4NO_3^- + 8.4H^+\ C_8H_{10} \longrightarrow 8CO_2 + 4.2N_2 + 9.2H_2O$$

Iron Reducing

$$42\,Fe\,(OH)_3 + 84H^+ + C_8H_{10} \longrightarrow 8CO_2 + 110\,H_2O + 42\,Fe^{2+}$$

Sulfate Reducing

$$5.25\,SO_4^{-2} + 10.5H^+ + C_8H_{10} \longrightarrow 8\,CO_2 + 5\,H_2O + 5.25\,H_2S$$

Methanogenic

$$C_8H_{10} + 5.5\,H_2O \longrightarrow 2.75\,CO_2 + 5.25\,CH_4$$

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	*	✗	
	Cometabolic	?	*		
Anaerobic	Denitrifying	✓	*	✗	
	Fe/Mn-reducing	✓	*		
	Sulfate reducing	✓	*		
	Methanogenic	✓	*		
Abiotic	-	✗	NA	✗	

* *See above figure*

Selected References listed on reverse

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Ethyl Benzene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 491-495

2. Johnson, H. A. and A. M. Spormen, 1999. In vitro studies on the initial reactions of anaerobic ethylbenzene mineralization. *Journal of Bacteriology*. 181: 5662-5668.

3. Heider, J., A.M. Spormann., H.R. Beller and F. Waddel. 1998. Anaerobic bacterial metabolism of hydrocarbons. *FEMS Microbiol. Rev.* 22: 459-473.

4. Smith, M. R. 1990. The biodegradation of aromatic hydrocarbons by bacteria. *Biodegradation* 1: 191-206.

5. National Research Council. 2000 Natural Attenuation for Groundwater Remediation National Academy Press. Washington, D.C. 8.

6. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. 340-341.

Compound Fact Sheet

Compound Name: Methyl Ethyl Ketone (MEK)

CAS # 78-93-3

Common Synonyms: 2-Butanone, Butanone, Ethyl Methyl Ketone, Methyl Acetone

Physical Properties [1]

Chemical Formula C_4H_8O

Molecular Weight: 72.11 g/mol

Solubility in Water: 268 to 353 g/L

Density: 0.8054 g/cm^3 at $\frac{20}{4}$°C

Vapor Pressure: 71.2 to 77.5 mmHg at 20 °C

Henry's Law Constant: 1.05 x 10^{-5} to 13 x 10^{-5} atm·m^3/mol at 25 °C

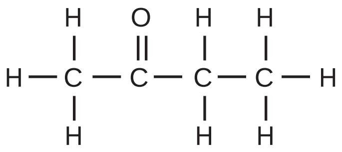
Octanol/Water Partition Coefficient (Log K_{OW}): 0.25 to 0.69

Soil Sorption Coefficient (Log K_{OC}): 1.47 to 1.53

Subject to Isotope Fractionation: ☐ Yes ☑ No ☐ Unknown

EPA MCL: none

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L MEK = 13.87μ mol MEK

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, soil: aerobic 1-7 days, anaerobic 4-28 days[2]
Half lives: 30-150 days[6] (with sulfate present in groundwater)

Microcosm studies

Enhanced: 20 ppm-1ppm in 24 hours[3] 50 ppm degraded to below detection limit in 244 days[4]

Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	5.0 μg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Sulfate Reducing

MEK
↓
$CO_2 + H_2S$

Aerobic

MEK
↓
Ethyl Acetate
↓
Acetate + Ethanol
↓
Acetaldehyde
↓
CO_2

Methanogenic

MEK
↓
$CO_2 + CH_4$

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2		
	Cometabolic	?			
Anaerobic	Denitrifying	✓	CO_2		
	Fe/Mn-reducing	?			
	Sulfate reducing	✓	CO_2 , H_2S		
	Methanogenic	✓	CO_2 , CH_4		
Abiotic	-	✗	NA	✗	no hydrolyzable functional group[1]

Selected References listed on reverse

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GeoSyntec Consultants

MEK References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 157-158.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko.1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 186-187.

3. Nelson, M.J.K. , G. C. Compeau, T. Mazianiz and W.R. Mahaffey. 1993. In: Bioremediation field experience. Ed. P.E. Flathman, D.E. Jerger, J. H. Exner. Lewis Publishers, Boca Raton. 74.

4. Mormile, M.R., S. Liu and J.M. Suflita. 1994. Anaerobic biodegradation of gasoline oxygenates: extrapolation of information to multiple sites and redox conditions. *Environ. Sci. Technol. 28: 1727-1732.*

5. Sulflita, J.M. and M.R. Mormile. 1993. Anaerobic biodegradation of known and potential gasoline oxygenates in the terrestrial subsurface. *Environ. Sci. Technol.* 27: 976-978.

6. Keith, N.G., and others. 2003. "Design, construction and operation of a sulfate biobarrier to treat chlorinated and non-chlorinated VOCs." In V.S. Magar and M.E. Kelley (Eds). Proceedings of the Seventh International In Situ and On Site Bioremediation Symposium (Orlando FL June 2003). Paper K-07

Compound Fact Sheet

Compound Name: Methyl Isobutyl Ketone (MIBK)

CAS # 108-10-1

Common Synonyms: 4-methyl-2-pentanone, Hexanone, Isobutyl Methyl Ketone, Isopropylacetone

Physical Properties[1]

Chemical Formula $C_6H_{12}O$

Molecular Weight: 100.16 g/mol

Solubility in Water: 1.77 to 1.91 wt%

Density: 0.7978 g/mL at 20/4 °C

Vapor Pressure: 14.5 mmHg at 20 °C

Henry's Law Constant: 3.9×10^{-4} atm·m^3/mol

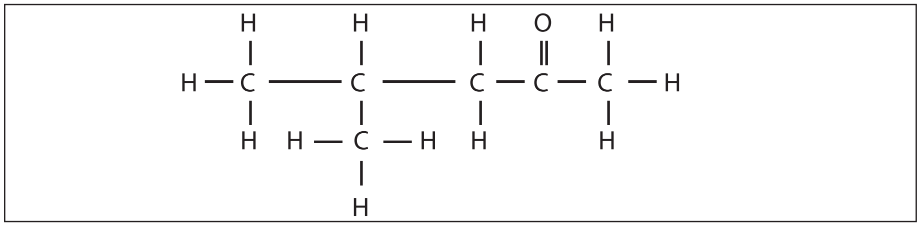
Octanol/Water Partition Coefficient (Log K_{OW}): 1.09 to 1.31

Soil Sorption Coefficient (Log K_{OC}): 0.79 (estimated)

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: none

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L MIBK = 9.98 $\frac{\mu \text{ mol}}{\text{L}}$ MIBK

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives, aqueous: aerobic 1-7 days, anaerobic 4-28 days[2]
Half lives: 30-150 days[6] (with sulfate present in groundwater)

Microcosm studies

Enhanced: 21 ppm - 1 ppm in 24 hrs[3]

Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260B	5-25 µg/L	at 4 °C	14d	80mL	40mL VOA vial

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2 [4,5]		
	Cometabolic				
Anaerobic	Denitrifying	✓	CO_2 [4,5]		
	Fe/Mn-reducing				
	Sulfate reducing				
	Methanogenic				
Abiotic	-	✗	NA	✗	

Selected References listed on reverse

GeoSyntec Consultants

MIBK References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 709-711.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 398-399.

3. Nelson, M.J.K. , G. C. Compeau, T. Mazianiz and W.R. mahaffey. 1993. In: Bioremediation field experience. Ed. P.E. Flathman, D.E. Jerger, J. H. Exner. Lewis Publishers, Boca Raton. 74.

4. Mormile, M.R., S. Liu and J.M. Suflita. 1994. Anaerobic *bi*odegradation gasoline oxygenates: extrapolation of information to multiple sites and redox conditions. *Environ. Sci. Technol. 28:1727-1732.*

5. Sulflita, J.M. and M.R. Mormile. 1993. Anaerobic biodegradation of known and potential gasoline oxygenates in the terrestrial subsurface. *Environ. Sci. Technol.* 27: 976-978.

6. Keith, N.G., and others. 2003. "Design, construction and operation of a sulfate biobarrier to treat chlorinated and non-chlorinated VOCs." In V.S. Magar and M.E. Kelley (Eds). Proceedings of the Seventh International In Situ and On Site Bioremediation Symposium (Orlando FL June 2003). Paper K-07

Compound Fact Sheet

Compound Name: m-Xylene

CAS # 108-38-3

Common Synonyms: 1,3-Dimethylbenzene, m-Dimethylbenzene, m-Methyltoluene, 1,3-Xylene, m-Xylol

Physical Properties [1]

Chemical Formula C_8H_{10}

Molecular Weight: 106.17 g/mol

Solubility in Water: 157 to 196 mg/L at 25 °C

Density: $0.8642\ g/cm^3$ at $\frac{20}{4}$ °C

Vapor Pressure: 8.3 mmHg at 25 °C

Henry's Law Constant: $5.98 \times 10^{-3}\ atm \cdot m^3/mol$ at 20 °C

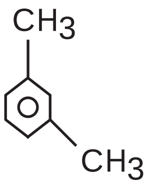
Octanol/Water Partition Coefficient (Log K_{OW}): 3.13 to 3.28

Soil Sorption Coefficient (Log K_{OC}): 2.11 to 2.46

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 10 mg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L m-xylene = 9.42 µ mol m-xylene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: High likelihood of success for natural attenuation.[5] Half-life aqueous, aerobic: 1-4 weeks[9]. Aqueous, anaerobic 4-16 weeks. Half lives: 70-700 days[10]

Microcosm studies

Enhanced: 14 days

Natural: 30 µM/day at initial concentration of 600 µM

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Aerobic

$C_8H_{10} + 10.5\ O_2 \longrightarrow 8CO_2 + 5\ H_2O$

Denitrifying

$8.4NO_3^- + 8.4H^+\ C_8H_{10} \longrightarrow 8CO_2 + 4.2N_2 + 9.2H_2O$

Iron Reducing

$42\ Fe\ (OH)_3 + 84H^+ + C_8H_{10} \longrightarrow 8CO_2 + 110\ H_2O + 42\ Fe^{2+}$

Sulfate Reducing

$5.25\ SO_4^{-2} + 10.5H^+ + C_8H_{10} \longrightarrow 8\ CO_2 + 5\ H_2O + 5.25\ H_2S$

Methanogenic

$C_8H_{10} + 5.5\ H_2O \longrightarrow 2.75\ CO_2 + 5.25\ CH_4$

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	*	✗	
	Cometabolic	?		-	
Anaerobic	Denitrifying	✓	*	✗	
	Fe/Mn-reducing	✓	*	✗	
	Sulfate reducing	✓	*	✗	
	Methanogenic	✓	*	✗	
Abiotic	-	✗	NA	✗	

* *see above figure*

Selected References listed on reverse

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GeoSyntec Consultants

m-Xylene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 1056-1059.

2. Edwards, E. A. and D. Grbic-Galic. 1994. Anaerobic degradation of toluene and o-xylene by a methanogenic consortium. *Appl. Environ. Microbiol.* 60(1): 313-322.

3. Krieger, C. J., H. R. Beller, M. Reinhard and A. M. Spormann. 1999. Initial reactions in anaerobic oxidation of m-xylene by the denitrifying bacterium *Azoarcus* sp. Strain C. *Journal of Bacteriology* 181(20): 6403-6410.

4. Norris, Hinchee, Brown, McCarty, Semprini, Wilson, Kampbell, Reinhard, Bouwer, Borden, Vogel, Thomas and Ward. 1994. Handbook of Bioremediation. Boca Raton, Lewis Publishers.

5. National Research Council. 2000. Natural Attenuation for Groundwater Remediation National Academy Press. Washington, D.C., P.8.

6. Evans, P. J., D. T. Mang and L. Y. Young. 1991. Degradation of toluene and m-xylene and transformation of o-xylene by denitrifying enrichment cultures. *Appl. Environ. Microbiol.* 57(2): 450-454.

7. EPA (1999). Monitored natural attenuation of chlorinated solvents. Washington DC, US Environmental Protection Agency: 1-3.

8. Smith, M. R. 1990. The biodegradation of aromatic hydrocarbons by bacteria. *Biodegradation* 1: 191-206.

9. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 400-401.

10. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name:[1] Naphthalene

CAS # 91-20-3

Common Synonyms: Camphor Tar, Mothballs, Mighty 150

Physical Properties

Chemical Formula $C_{10}H_8$

Molecular Weight: 128.1732 g/mol

Solubility in Water: 31 mg/L

Density: 1.145 g/cm^3 at 20/4 °C or 10.4 x 10^{-2} mmHg @ 25°C

Vapor Pressure: 10.4 x 10^{-2} mm Hg at 25 °C

Henry's Law Constant: 4.19 to 7.59 x 10^{-4} atm·m^3/mol at 25 °C

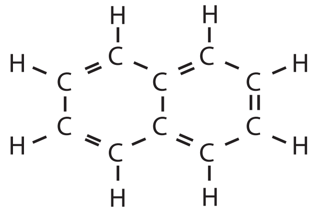
Octanol/Water Partition Coefficient (Log K_{OW}): 3.23 to 3.59

Soil Sorption Coefficient (Log K_{OC}): 2.0 to 4.8

Subject to Isotope Fractionation: ☐ Yes ☐ No ☐ Unknown

EPA MCL:

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L Naphthalene = 7.802 $\frac{\mu mol}{L}$

Transformation Rates from Selected Publications[2]

Field rates

Enhanced: Removal / Secondary Treatment: 77% - 98.6% (Based on continuous activated sludge treatment)

Natural: Half lives, aqueous; Aerobic: 12h - 20 days

Anaerobic: 25 days - 258 days

Microcosm studies

Enhanced:

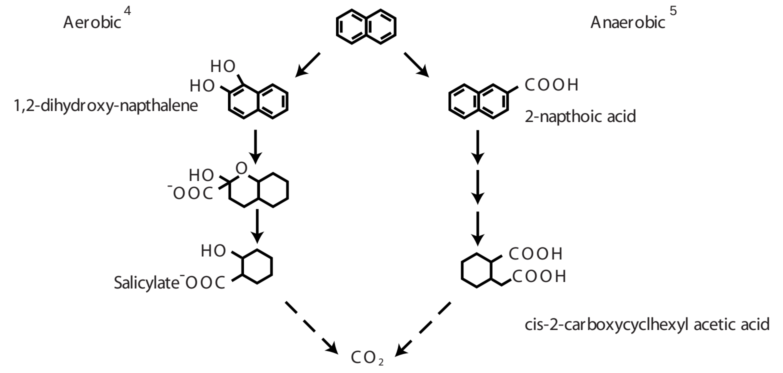
Natural:

Sampling Considerations[3]

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260B	0.10µg/L	4 °C & pH<2 with H_2SO_4, HCl, $NaHSO_4$	14 days	80mL	40mL VOA vial

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen[6]	✓	end CO_2		
	Cometabolic	✓			
Anaerobic	Denitrifying[7]	✓	CO_2	possibly	requires nitrate
	Fe/Mn-reducing		CO_2		
	Sulfate reducing[5]	✓	CO_2		partial mineralization possible
	Methanogenic				
Abiotic	-	X	NA	X	NA

Selected References listed on reverse

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GEOSYNTEC CONSULTANTS

Naphthalene References:

1. Montgomery, J.H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 739-746.

2. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan and E. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 260-261

3. U.S. EPA. 1996. Test Methods for evaluating Soild Waste, Physical / Chemical Methods (SW-846). Method 8260B and chapter 4.

4. Zeng,Y. 2002. Naphthalene Pathway. University of Minnesota, http://umbbd.ahc.umn.edu/naph/naph_image_map.html

5. Annweiler,E., W. Micaelis, R.U. Meckenstock. 2002. Identical ring cleavage products during anaerobic degradation of Naphthalene, 2-Methylnaphthalene, and Tetralin indicate a new metabolic pathway. Applied and Environmental Microbiology: 68(2), 852-858.

6. Ramsay. JA, Hao Li R.S.Brown and B.A. Ramsay. 2003. Napthalene and anthracene mineralization linked to oxygen, nitrate, Fe(III) and sulphate reduction in mixed microbial population. Biodegradation: 14, 321-329.

7. Rockne, K.J. and S.E. Strand. 2001. Anaerobic biodegradation naphthalene, phenanthrene and biphenyl by a denitrfying enrichment culture. Water Resources 35(1), 291-299.

Compound Fact Sheet

Compound Name: o-Xylene

CAS # 95-47-6

Common Synonyms: 1,2-Dimethylbenzene, o-Dimethylbenzene, o-Methyltoluene, 1,2-xylene, o-Xyol

Physical Properties [1]

Chemical Formula C_8H_{10}

Molecular Weight: 106.17 g/mol

Solubility in Water: 152 mg/L at 20 °C

Density: $0.8802\ g/cm^3$ at $\frac{20}{4}$ °C

Vapor Pressure: 6.6 mmHg at 25 °C

Henry's Law Constant: $4.74 \times 10^{-3}\ atm{\cdot}m^3/mol$ at 20 °C

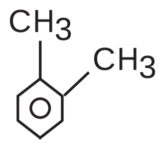
Octanol/Water Partition Coefficient (Log K_{OW}): 2.73 to 3.19

Soil Sorption Coefficient (Log K_{OC}): 1.68 to 3.30

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 10,000 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1mg/L o-xylene = 9.42 µ mol o-xylene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: High likelihood of success for natural attenuation.[7] Half-life aqueous, aerobic: 1-4 weeks[9]. Aqueous, anaerobic 6-12 months. Half lives: 70-700 days[10]

Microcosm studies

Enhanced: 14 days

Natural: 30 µM/day at initial concentration of 600 µM

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Aerobic

$$C_8H_{10} + 10.5\,O_2 \longrightarrow 8CO_2 + 5\,H_2O$$

Denitrifying

$$8.4NO_3^- + 8.4H^+ \, C_8H_{10} \longrightarrow 8CO_2 + 4.2N_2 + 9.2H_2O$$

Iron Reducing

$$42\,Fe\,(OH)_3 + 84H^+ + C_8H_{10} \longrightarrow 8CO_2 + 110\,H_2O + 42\,Fe^{2+}$$

Sulfate Reducing

$$5.25\,SO_4^{-2} + 10.5H^+ + C_8H_{10} \longrightarrow 8\,CO_2 + 5\,H_2O + 5.25\,H_2S$$

Methanogenic

$$C_8H_{10} + 5.5\,H_2O \longrightarrow 2.75\,CO_2 + 5.25\,CH_4$$

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	*		
	Cometabolic	?	*		
Anaerobic	Denitrifying	✓	*		
	Fe/Mn-reducing	✓	*		
	Sulfate reducing	✓	*		
	Methanogenic	✓	*		
Abiotic	-				

** see above figure*

Selected References listed on reverse

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GeoSyntec Consultants

O-Xylene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 1051-1055.

2. Edwards, E. A. and D. Grbic-Galic. 1994. Anaerobic Degradation of toluene and o-xylene by a methanogenic consortium. *Appl. Environ. Microbiol.* 60(1): 313-322.

3. Harms, G., K. Zengler, R. Rabus, F. Aeckersberg, D. Minz, R. Rossello-Mora and F. Widdel. 1999. Anaerobic Oxidation of o-Xylene, m-Xylene and Homologous Alkylbenzenes by New Types of Sulfate-reducing Bacteria. *Appl. Environ. Microbiol.* 65(3): 999-1004.

4. Norris, Hinchee, Brown, McCarty, Semprini, Wilson, Kampbell, Reinhard, Bouwer, Borden, Vogel, Thomas and Ward. 1994. Handbook of Bioremediation. Boca Raton, Lewis Publishers.

5. Smith, M. R. 1990. The biodegradation of aromatic hydrocarbons by bacteria. *Biodegradation* 1: 191-206.

6. AFCEE and EPA .1998. Technical Protocol for Evaluation Natural Attenuation of Chlorinated Solvents in Ground Water. Washington DC: 53.

7. Evans, P. J., D. T. Mang and L. Y. Young. 1991. Degradation of Toluene and m-Xylene and Transformation of o-Xylene by Denitrifying Enrichment Cultures. *Appl. Environ. Microbiol.* 57(2): 450-454.

8. National Research Council. 2000. Natural Attenuation for Groundwater Remediation National Academy Press. Washington, D.C., P.8.

9. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 292-293.

10. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name:[1] Phenol

CAS # 108-95-2

Common Synonyms: Benzenol, Carbolic Acid, Hydroxy Benzene

Physical Properties

Chemical Formula C_6H_6O

Molecular Weight: 94.11 g/mol

Solubility in Water: 0.90 mol/L 25 ºC

Density: 1.0576 g/cm^3 at 20/4 ºC

Vapor Pressure: 20 x 10^{-2} mm Hg at 20 ºC

Henry's Law Constant: 2.7 to 3.45 x 10^{-7} atm·m^3/mol at 25 ºC

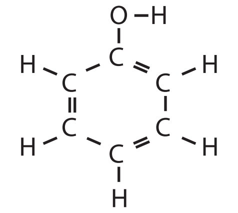
Octanol/Water Partition Coefficient (Log K_{OW}): 1.31 to 1.57

Soil Sorption Coefficient (Log K_{OC}): 1.24 to 3.49

Subject to Isotope Fractionation: ☐ Yes ☐ No ☒ Unknown

EPA MCL: none listed - California Action Level 4200 µg\L (toxicity)

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L Phenol = 10.63 $\frac{\mu mol}{L}$ Phenol

Transformation Rates from Selected Publications

Field rates

Enhanced:[2] Removal / Secondary Treatment: 90% - 99.9% (Based on continuous activated sludge treatment)

Natural:[2] Half lives, aqueous: Aerobic 0.25 - 3.5 days, Anaerobic: 8 - 28 days

[1]Basic sandy loam: Aerobic 4.1 days, Acidic clay soil aerobic: 23 days

Microcosm studies

Enhanced:

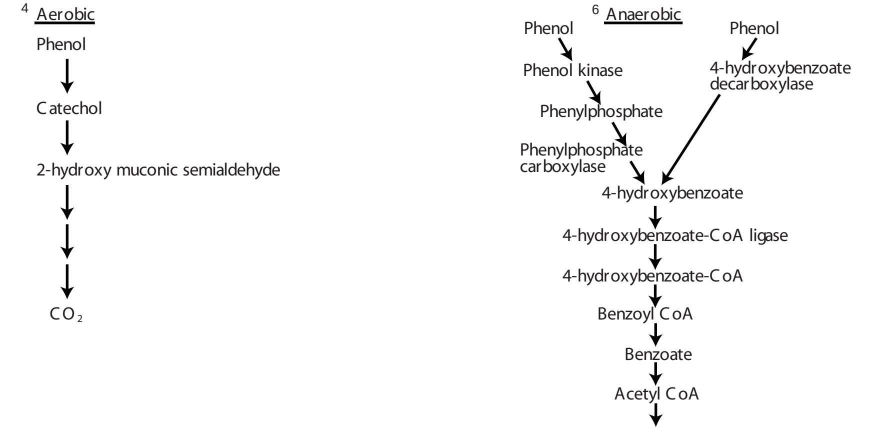
Natural: [4]Aerobic rate constant: 0.047-0.080 days^{-1}; [5]0.06-0.15 days^{-1}

Sampling Considerations [3]

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8270C	0.10µg/L	4ºC	7 days until extraction	4L	1L amber VOA vial

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen[4]	Yes		Possibly from Chlorophenols	See above
	Cometabolic	?			
Anaerobic	Denitrifying[7]	Yes		Possibly from Chlorophenols	See above
	Fe/Mn-reducing	?			
	Sulfate reducing	?			
	Methanogenic[8]	Yes	CO_2,CH_4	Possibly from Chlorophenols	Biological Inocula
Abiotic	-	X	NA	X	

Selected References listed on reverse

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GEOSYNTEC CONSULTANTS

Phenol References:

1. Montgomery, J.H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 859-864.

2. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan and E. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 414

3. U.S. EPA. 1996. Test Methods for evaluating Soild Waste, Physical / Chemical Methods (SW-846). Method 8270C and chapter 4.

4. I. Harrison, G.M. Williams, J.J.W. Higgo, R.U. Leader, A.W. Kim and D.J. Noy, 2001. Microcosm studies of microbial degradation in a coal tar distillate plume. Journal of Contaminant Hydrology 53, 319-340.

5. B. Antizar-Ladislao and N.I. Galil, 2003. Simulation of bioremediation of chlorophenols in a sandy aquifer. Water Reasearch, 37, 238-244.

6. Bell, J., E. Young S. Stephens, 2004 Phenol Pathway (Anaerobic). University of Minnesota, http://umbbd.ahc.umn.edu/phe/phe_map.html

7. Spence, M.J., S.H. Bottrell, J.J.W. Higgo, I. Harrison, A.E. Fallick, 2001. Denitrification and phenol degradation in a contaminanted aquifer. Journal of Contaminant Hydrology, 53. 305-318

8. Joo-Hwa Tay, Yan-Xin He, and Yue-Gen Yan, 2001. Improved Anaerobic Degradation of Phenol with Supplemental Glucose. Journal of Environmental Engineering: 38-45, citing:
   Dwyer, D. F., Krumme, M.L., Boyd, S.A., and Tiedje, J.M. 1986.
   Kinetics of phenol biodegradation by an immobilised methanogenic consortium. Appl. Envir. Microbiology: 52(2), 345-351.

Compound Fact Sheet

Compound Name: p-Xylene

CAS # 106-42-3

Common Synonyms: Chromar, 1,4-Dimethylbenzene, p-Dimethylbenzene, p-Methyltoluene, 1,4-Xylene, p-Xylol

Physical Properties [1]

Chemical Formula C_8H_{10}

Molecular Weight: 106.17 g/mol

Solubility in Water: 180 to 200 mg/L at 25 °C

Density: 0.86314 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 8.8 mmHg at 25 °C

Henry's Law Constant: 6.45 x 10^{-3} atm·m^3/mol at 20 °C

Octanol/Water Partition Coefficient (Log K_{OW}): 3.15 to 3.18

Soil Sorption Coefficient (Log K_{OC}): 2.31 to 2.87

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 10,000µg/L

Chemical Structure:

Sample Calculation of Concentration Conversion to Moles

1mg/L p-xylene = 9.42µ mol p-xylene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: High likelihood of success for natural attenuation.[5] Half-life aqueous, aerobic: 1-4 weeks[6]. Aqueous, anaerobic 4-16 weeks. Half lives: 70-700 days[7]

Microcosm studies

Enhanced: 14 days

Natural: 30 µM/day at initial concentration of 600 µM

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Aerobic

$C_8H_{10} + 10.5\ O_2 \longrightarrow 8CO_2 + 5\ H_2O$

Denitrifying

$8.4NO_3^- + 8.4H^+\ C_8H_{10} \longrightarrow 8CO_2 + 4.2N_2 + 9.2H_2O$

Iron Reducing

$42\ Fe\ (OH)_3 + 84H^+ + C_8H_{10} \longrightarrow 8CO_2 + 110\ H_2O + 42\ Fe^{2+}$

Sulfate Reducing

$5.25\ SO_4^{-2} + 10.5H^+ + C_8H_{10} \longrightarrow 8\ CO_2 + 5\ H_2O + 5.25\ H_2S$

Methanogenic

$C_8H_{10} + 5.5\ H_2O \longrightarrow 2.75\ CO_2 + 5.25\ CH_4$

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	*	✗	
	Cometabolic				
Anaerobic	Denitrifying	✓	*	✗	
	Fe/Mn-reducing	✓	*	✗	
	Sulfate reducing	✓	*	✗	
	Methanogenic	✓	*	✗	
Abiotic	-				

** see above figure*

Selected References listed on reverse

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GeoSyntec Consultants

p-Xylene references:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 1060-1063.
2. Smith, M. R. 1990. The biodegradation of aromatic hydrocarbons by bacteria. *Biodegradation* 1: 191-206.
3. AFCEE and EPA .1998. Technical Protocol for Evaluation Natural Attenuation of Chlorinated Solvents in Ground Water. Washington DC: 53.
4. Norris, Hinchee, Brown, McCarty, Semprini, Wilson, Kampbell, Reinhard, Bouwer, Borden, Vogel, Thomas and Ward .1994. Handbook of Bioremediation. Boca Raton, Lewis Publishers.
5. National Research Council. 2000. Natural Attenuation for Groundwater Remediation National Academy Press. Washington, D.C., P.8.
6. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. 364-365.
7. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name: Tetrachloroethene (PCE)

CAS # 127-18-4

Common Synonyms: Tetrachloroethylene, PCE, Perchloroethene, Perchloroethylene, TCE

Physical Properties [1]

Chemical Formula C_2Cl_4

Molecular Weight: 165.83 g/mol

Solubility in Water: 150 mg/L at 20 °C

Density: 1.623 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 14 mmHg at 20 °C

Henry's Law Constant: 1.43 x 10^{-3} to 20.0 x 10^{-3} atm·m^3/mol at 20 °C

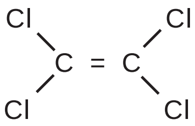
Octanol/Water Partition Coefficient (Log K_{OW}): 2.10 to 2.60

Soil Sorption Coefficient (Log K_{OC}): 2.28 to 3.04

Subject to Isotope Fractionation: ☑ Yes ☐ No ☐ Unknown

EPA MCL: 5.0 μg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L tetrachloroethene = 6.03 μ mol tetrachloroethene

Transformation Rates from Selected Publications

Field rates

Enhanced: Reductive dechlorination requires electron donor

Natural: Half lives, soil: 6 months -1 year, groundwater 1-2 years [2]

Half lives: 58-365[6]

Microcosm studies

Enhanced: aerobic cometabolism: 0.48 to 1.16 nmol min^{-1} mg^{-1} for protein at 8.1 to 32.3 μM[3]

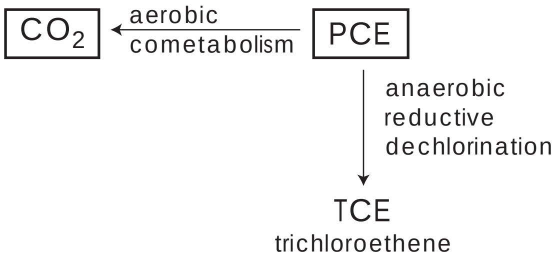
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 μg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✗			
	Cometabolic	✓	CO_2	✗	requires toluene substrate / Pseudomonas
Anaerobic	Denitrifying	✗			
	Fe/Mn-reducing	✗			
	Sulfate reducing	✓	TCE, DCE,VC Ethene	✗	
	Methanogenic	✓	TCE, DCE,VC Ethene	✗	
Abiotic	-	✗	TCE	✗	hydrolysis half life 1.3x10^6 yrs

Selected References listed on reverse

GeoSyntec Consultants

Tetrachloroethene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 941-944.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 502-503.

3. Ryoo, D., H. Shim, K. Canada, P. Barbieri, T.K. Wood. 2000. Aerobic degradation of tetrachloroethylene by toluene-o-xylene nonooxygenase of *Pseudomonas stutzeri* 0X1. *Nature Biotechnology* 18: 775-778.

4. Maymo-Gatell, X., T. Anguish and S. Zinder. 1999. Reductive dechlorination of chlorinated ethenes and 1,2-dichloroethane by *Dehalococcoides ethenogenes*. *Appl. Environ. Microbiol.* 65(7): 3108-3113.

5. Liss, S. N. and K.H. Baker. 1994. Anoxic / Anaerobic Bioremediation. In: Bioremediation McGraw-Hill. 307.

6. RTDF. 2002. RTDF teaching practice manual.

Compound Fact Sheet

Compound Name:[1] Tetrahydrofuran

CAS # 109-99-9

Common Synonyms: Butylene Oxide; Cyclotetramethylene Oxide; Diethylene Oxide

Physical Properties[1]

Chemical Formula C_4H_8O

Molecular Weight: 72.11 g/mol

Solubility in Water: miscible or 42 M at 25 °C

Density: 0.8892 g/cm^3 at 20/4 °C

Vapor Pressure: 131.5mm Hg at 20 °C

Henry's Law Constant: 7.14×10^{-5} atm·m^3/mol at 25 °C

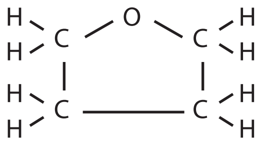
Octanol/Water Partition Coefficient (Log K_{OW}): 0.46

Soil Sorption Coefficient (Log K_{OC}): 1.26 to 1.37

Subject to Isotope Fractionation: ☐ Yes ☐ No ☒ Unknown

EPA MCL: none

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

$1\ \text{mg/L THF} = 13.9\ \frac{\underline{\mu\text{mol}}}{\text{L}}\ \text{THF}$

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: Half lives: 182.5-1460 days[3] median 730 days (extrapolation from Sock, 1993)

Microcosm studies

Enhanced:

Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260B	variable	at 4 °C & sodium bisulpate to pH<2	14 days	80mL	40mL VOA vial

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen[2]	✓	?		
	Cometabolic[2]	with 1,4-dioxane	?		
Anaerobic	Denitrifying	?			
	Fe/Mn-reducing	?			
	Sulfate reducing	?			
	Methanogenic	?			
Abiotic	-	?			

Selected References listed on reverse

DRAFT

GeoSyntec Consultants

Tetrahydrofuran References:

1. Montgomery, J.H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 947-948.

2. Parales, R.E., J.E.Adamus, N. White, H.D. May. 1994. Degradation of 1,4-Dioxane by an Actinomycete in pure culture. Applied and Environmental microbiology; 60(12), 4527-4530.

3. Sock, S. M. 1993. "A comprehensive evaluation of biodegradation as a treatment alternative for the removal of 1,4-dioxane." MS Thesis. Clemson University.

Compound Fact Sheet

Compound Name: **Toluene**

CAS # 108-88-3

Common Synonyms: Methylbenzene, Methylbenzol, Phenylmethane, Toluol, Tolusol,

Physical Properties [1]

Chemical Formula C_7H_8

Molecular Weight: 92.14 g/mol

Solubility in Water: 500 to 627 mg/L at 25 °C

Density: 0.86689 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 22 mmHg at 20 °C

Henry's Law Constant: 4.92×10^{-3} to 5.55×10^{-3} $atm{\cdot}m^3/mol$ at 20 °C

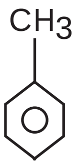
Octanol/Water Partition Coefficient (Log K_{OW}): 2.11 to 2.79

Soil Sorption Coefficient (Log K_{OC}): 1.65 to 4.04

Subject to Isotope Fractionation: ☐ Yes ☐ No ☑ Unknown

EPA MCL: 1,000 μg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1mg/L toluene = 10.85 μ mol toluene

Transformation Rates from Selected Publications

Field rates

Enhanced: 2.61 g /m^{-2} day^{-1}, NCR 2000 concludes this compound has high likelihood of success for natural attenuation[3]

Natural: 1.49 g / m^{-2} day^{-1}

Microcosm studies

Enhanced: 14 days

Natural: 30 μM/day at initial concentration of 600 μM

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 μg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways

Aerobic

$C_7 H_8 + 9 O_2 \longrightarrow 7CO_2 + 4 H_2O$

Denitrifying

$7.2NO_3^- + 7.2H^+ C_7 H_8 \longrightarrow 7CO_2 + 3.6N_2 + 7.6H_2O$

Iron Reducing

$36 Fe (OH)_3 + 72H^+ + C_7 H_8 \longrightarrow 7CO_2 + 94 H_2O + 36 Fe^{2+}$

Sulfate Reducing

$4.5 SO_4^{-2} + 9H^+ + C_7 H_8 \longrightarrow 7 CO_2 + 4 H_2O + 4.5 H_2S$

Methanogenic

$C_7 H_8 + 5 H_2O \longrightarrow 2.5 CO_2 + 4.5 CH_4$

Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	*	xylene	Genus *Pseudomonas* Genus *Burkholderia*
	Cometabolic	?			
Anaerobic	Denitrifying	✓	*	✗	*Proteobacteria*
	Fe/Mn-reducing	✓	*	✗	*Proteobacteria*
	Sulfate reducing	✓	*	✗	*Proteobacteria*
	Methanogenic	✓	*	✗	
Abiotic	-	✗		✗	hydrolysis

* *see above figure*

Selected References listed on reverse

DRAFT

GEOSYNTEC CONSULTANTS

Toluene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Boca Raton, Lewis Publishers. 960-966.
2. Smith, M. R. 1990. The biodegradation of aromatic hydrocarbons by bacteria. *Biodegradation* 1: 191-206.
3. National Research Council . 2000. Natural Attenuation for Groundwater Remediation National Academy Press. Washington, D.C., P.8.
4. Edwards, E. A. and D. Grbic-Galic. 1994. Anaerobic Degradation of toluene and o-xylene by a methanogenic consortium. *Appl. Environ. Microbiol.* 60(1): 313-322.

Compound Fact Sheet

Compound Name: trans-1,2-Dichloroethene

CAS # 156-60-5

Common Synonyms: trans-1,2-Dichloroethylene, trans-1,2-DCE, 1,2-Dichloroethene

Physical Properties [1]

Chemical Formula $C_2H_2Cl_2$

Molecular Weight: 96.94 g/mol

Solubility in Water: 6,300 mg/L at 25 °C

Density: 1.2565 g/cm^3 at $\frac{20}{4}$ °C

Vapor Pressure: 265 mmHg at 20 °C

Henry's Law Constant: 7.64×10^{-3} to 11.8×10^{-3} $atm \cdot m^3/mol$ at 20 °C

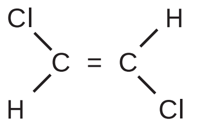
Octanol/Water Partition Coefficient (Log K_{OW}): 2.06 to 2.09

Soil Sorption Coefficient (Log K_{OC}): 1.58

Subject to Isotope Fractionation: ☑ Yes ☐ No ☐ Unknown

EPA MCL: 100 g/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L 1,2-dichloroethene = 10.3 µ mol 1,2-dichloroethene

Transformation Rates from Selected Publications

Field rates

Enhanced: 0.01 to 11.87/yr [1]

Natural: Half lives: 10.95-2080.5 days[6] median 171.55

Microcosm studies 0.01 to 6.07/yr [2,5]

Enhanced: propane-oxidizing bacteria (aerobic) cis-54 ± 4% in 2h trans-7 ± 4% in 2h [3]; 1-1.5 mM Cl-/day anaerobic reductive dechlorination to ethene [4]

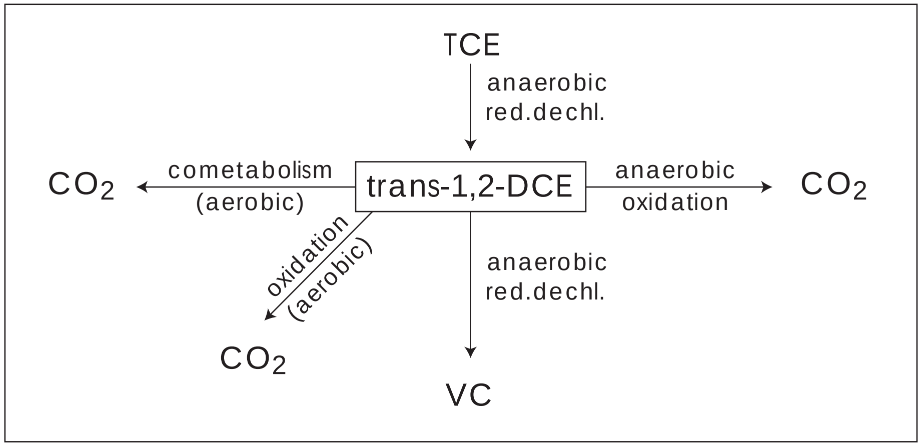
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2	TCE	
	Cometabolic	✓	CO_2	TCE	cometabolism aerobic with methane, toluene, propane, ammonia, phenol, ethene
Anaerobic	Denitrifying	✗			
	Fe/Mn-reducing	✓	VC/CO_2	TCE	
	Sulfate reducing	✓	VC	TCE	
	Methanogenic	✓	VC	TCE	
Abiotic	-	✗			

Selected References listed on reverse

DRAFT

GeoSyntec Consultants

trans-1,2-Dichloroethene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 354-356.

2. Major, D. M., E. W. Hodgins and B. J. Butler .1991. Field and Laboratory Evidence of In Situ Biotransformation fo Tetrachloroethene to Ethene and Ethane at a Chemical Transfer Facility in North Toronto. On-Site Bioremediation. R. E. Hinchee and R. F. Olfenbuttel. Stoneham, Butterworth-Heinemann: 147-171.

3. Wackett, L., G. Brusseau and S. Householder. 1989. Survey of microbial oxygenases: trichloroethylene degradation by propane-oxidizing bacteria. *Appl. Environ. Microbiol.* 55(11): 2960-2964.

4. de Bruin, W. P., G. Schraa and A. J. B. Zehnder. 1993. Complete anaerobic reductive dechlorination of tetrachloroethene in a bioreactor. In Situ and On-Site Bioreclamation: The second International Symposium: ??

5. Wiedemeier, T., M. Swanson and D. Moutoux (1996). Overview of the technical protocol for natural attenuation of chlorinated aliphatic hydrocarbons in ground water under development for the US air force center for environmental excellence. Symposium on natural attenuation of chlorinated organics in ground water. Washington DC, NTIS: 35-59.

6. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name: Trichloroethene (TCE)

CAS # 79-01-6

Common Synonyms: Trichloroethylene, TCE, 1,1,2-Trichloroethene

Physical Properties [1]

Chemical Formula C_2HCl_3

Molecular Weight: 131.39 g/mol

Solubility in Water: 1,100 mg/L at 20 °C

Density: $1.461\ g/cm^3$ at $\frac{20}{4}$°C

Vapor Pressure: 56.8 mmHg at 20 °C

Henry's Law Constant: 7.42×10^{-3} to 11.4×10^{-3} $atm \cdot m^3/mol$ at 20 °C

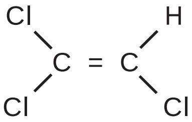
Octanol/Water Partition Coefficient (Log K_{OW}): 2.29 to 3.30

Soil Sorption Coefficient (Log K_{OC}): 1.66 to 2.41

Subject to Isotope Fractionation: ☑ Yes ☐ No ☐ Unknown

EPA MCL: 5 µg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1 mg/L trichloroethene = 7.61 µ mol trichloroethene

Transformation Rates from Selected Publications

Field rates

Enhanced:

Natural: 0.30 to 5.00/yr [6,7] Abiotic half life is significant 1.3×10^6 yr
Half lives 69.35-693.5 days[8] median 171.55 days

Microcosm studies 0.01 to 18.99/yr [2]

Enhanced: propane-oxidizing bacteria (Myco bacterium vaccae JOB5), 99% of 20µM TCE removed in 24h[3], 10% ± 7% in 24h[3] $3.2 \times 10^{-4} h^{-1}$ to $8.7 \times 10^{-4} h^{-1}$ [4] (aerobic)

Natural:

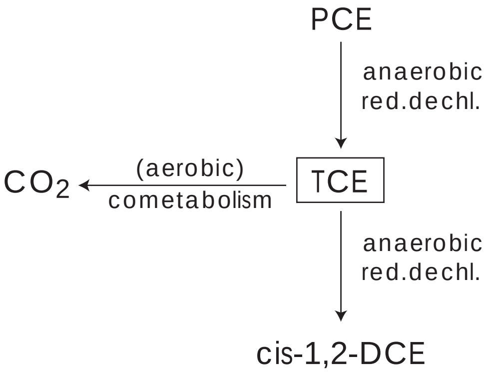
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 µg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✗			
	Cometabolic	✓	CO_2		with toluene, propane, ammonia, phenol, ethene, methane
Anaerobic	Denitrifying	possible			
	Fe/Mn-reducing	possible			
	Sulfate reducing	✓	cis 1,2-DCE	PCE	
	Methanogenic	✓	cis 1,2-DCE	PCE	
Abiotic	-	✓	cis 1,2-DCE	✓	hydrolysis 1/2 life is 10^6 yrs

Selected References listed on reverse

GeoSyntec Consultants

Trichloroethene References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 994-999.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 190-191.

3. Wackett, L., G. Brusseau and S. Householder. 1989. Survey of microbial oxygenases: trichloroethylene degradation by propane-oxidizing bacteria. *Appl. Environ. Microbiol.* 55(11): 2960-2964.

4. Barrio-Lage, G., F. Parsons and R. Nassar. 1987. Kinetics of the depletion of trichloroethene. *Environ. Sci Technol.* 21(4): 366-370.

5. Liss, S. N. and K.H. Baker. 1994. Anoxic/ Anaerobic Bioremediation. In: Bioremediation McGraw-Hill. 307.

6. Wiedemeier, T., M. Swanson and D. Moutoux .1996. Overview of the technical protocol for natural attenuation of chlorinated aliphatic hydrocarbons in ground water under development for the US air force center for environmental excellence. Symposium on natural attenuation of chlorinated organics in ground water. Washington DC, NTIS: 35-59.

7. Major, D. M., E. W. Hodgins and B. J. Butler .1991. Field and Laboratory Evidence of In Situ Biotransformation fo Tetrachloroethene to Ethene and Ethane at a Chemical Transfer Facility in North Toronto. On-Site Bioremediation. R. E. Hinchee and R. F. Olfenbuttel. Stoneham, Butterworth-Heinemann: 147-171.

8. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Compound Fact Sheet

Compound Name: Vinyl Chloride (VC)

CAS # 75-01-4

Common Synonyms: Chloroethene, Chloroethylene, VC

Physical Properties[1]

Chemical Formula C_2H_3Cl

Molecular Weight: 62.50 g/mol

Solubility in Water: 1,100 mg/L at 25 °C

Density: $0.9106\ g/cm^3$ at $\frac{20}{4}$°C

Vapor Pressure: 2,320 to 2,531 mmHg at 20 °C

Henry's Law Constant: 21.7×10^{-3} to $1{,}219 \times 10^{-3}\ atm{\cdot}m^3/mol$ at 20 °C

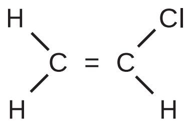
Octanol/Water Partition Coefficient (Log K_{OW}): 1.38

Soil Sorption Coefficient (Log K_{OC}): 0.39

Subject to Isotope Fractionation: ☑ Yes ☐ No ☐ Unknown

EPA MCL: 2 μg/L

Chemical Structure:



Sample Calculation of Concentration Conversion to Moles

1mg/L vinyl chloride = 16.0μ mol vinyl chloride

Transformation Rates from Selected Publications

Field rates

Enhanced: 0.07 to 5.00/yr [7,8]

Natural: Half lives: 18.25-474.5 days[9]

Microcosm studies 0.07 to 6.33/yr [1,2]

Enhanced: propane-oxidizing bacteria (aerobic), 100 ± 4% in 2h [3]

1-1.5 mM Cl^-/day anaerobic reductive dechlorination to ethene [4]

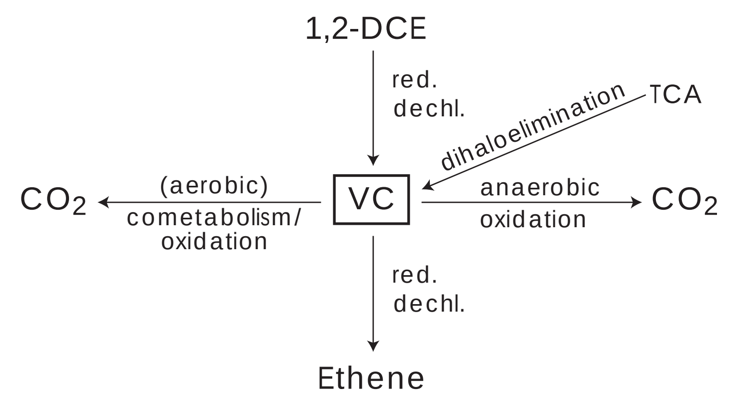
Natural:

Sampling Considerations

EPA Method	Typical Detection Limit	Preservative	Holding Time	Sample Volume	Container Type
8260	0.2 μg/L	HCl	14d	80mL	40mL vials

Notes: Detection limit is for non-diluted sample

Transformation Pathways



Conditions		Degradation Expected?	Degradation Product(s)	Can Compound be produced from parent?	Characteristics/ degradation mechanism
Aerobic	Oxygen	✓	CO_2		readily degradable
	Cometabolic	✓	CO_2		methane, toluene, propane, ammonia, phenol, ethene
Anaerobic	Denitrifying	✓	ethene/CO_2	DCE	
	Fe/Mn-reducing	✓	ethene/CO_2	DCE	slow
	Sulfate reducing	✓	ethene	DCE	
	Methanogenic	✓	ethene	DCE	slow
Abiotic	-	✗	NA	✗	-

Selected References listed on reverse

GeoSyntec Consultants

Vinyl Chloride References:

1. Montgomery, J. H. 2000. Groundwater Chemicals. Lewis Publishers. 1046-1048.

2. Howard, P. H., R. S. Boethling, W. F. Jarvis, W. M. Meylan and E. M. Michalenko . 1991. Handbook of Environmental Degradation Rates. Lewis Publishers: 138-139.

3. Wackett, L., G. Brusseau and S. Householder. 1989. Survey of microbial oxygenases: trichloroethylene degradation by propane-oxidizing bacteria. *Appl. Environ. Microbiol.* 55(11): 2960-2964.

4. de Bruin, W. P., G. Schraa and A. J. B. Zehnder. 1993. Complete anaerobic reductive dechlorination of tetrachloroethene in a bioreactor. In Situ and On-Site Bioreclamation: The second International Symposium:

5. Bradley, P. M. and F. H. Chapelle. 1997. Kinetics of DCE and VC mineralization under methanogenic and Fe(III)-reducing conditions. *Environ. Sci. Technol.* 31(9): 2692-2696.

6. Verce, M. F., R. L. Urlich and D.L. Freedman. 2000. Characterization of an isolate that uses vinyl chloride as a growth substrate under aerobic conditions. *Appl. Environ. Microbiol.* 66: 3535-3542.

7. Major, D. M., E. W. Hodgins and B. J. Butler .1991. Field and Laboratory Evidence of In Situ Biotransformation fo Tetrachloroethene to Ethene and Ethane at a Chemical Transfer Facility in North Toronto. On-Site Bioremediation. R. E. Hinchee and R. F. Olfenbuttel. Stoneham, Butterworth-Heinemann: 147-171.

8. Wiedemeier, T., M. Swanson and D. Moutoux. 1996. Overview of the technical protocol for natural attenuation of chlorinated aliphatic hydrocarbons in ground water under development for the US air force center for environmental excellence. Symposium on natural attenuation of chlorinated organics in ground water. Washington DC, NTIS: 35-59.

9. Newell, C.J. Et al. 2002. "Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies." EPA/540/S-02/500

Appendix I

Hydraulic Displacement of DNAPL for Application at the SRSNE Site, Southington, CT

Hydraulic Displacement of DNAPL for Application at the SRSNE Site, Southington, CT.

June 12, 2004

Prepared for: Bruce Thompson
de maximis, inc.

Prepared by: Dr. B.H. Kueper, Ph.D., P.Eng.

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Executive Summary

The screening analysis presented in this report indicates that hydraulic displacement is a viable and reliable means of recovering pooled DNAPL from overburden at the SRSNE site located in Southington, CT. The relatively low interfacial tension of the DNAPL and the moderate permeability of overburden materials should allow mobilization of DNAPL pools as short as 1 m. The screening calculations presented here assume that water will be injected at the upgradient end of the DNAPL distribution, with pumping of both DNAPL and water at downgradient recovery wells. Given an injection – withdrawal well spacing of 50 ft and gradients of approximately 0.16, the duration of hydraulic displacement should be limited to approximately 100 days, with periods of peak DNAPL production occurring for periods of less than 50 days. Because the analysis presented here did not consider porous media heterogeneity, and because the occurrence of pooled DNAPL is based on visual observation, the presented DNAPL extraction rates should be viewed as order-of-magnitude estimates.

Given uncertainty regarding the saturation of DNAPL in pools, an estimate of how much DNAPL will remain following application of hydraulic displacement is more reliable than an estimate of how much DNAPL will be removed. Given the initial volume estimates provided by BBL (2003), it is estimated here that the volume of DNAPL remaining in the ONOGU following application of hydraulic displacement will be 61.2 m^3 (Zone 1), 162.8 m^3 (Zone 2), 20 m^3 (Zone 3), and 12.5 m^3 (Zone 4) for a combined total volume of DNAPL left in place throughout the ONOGU following hydraulic displacement of 256.5 m^3 (68,000 gallons). Given the initial volume estimates provided by BBL (2003), the maximum amount of DNAPL that will be recovered using hydraulic displacement is estimated to be 200 m^3 (52,800 gallons). It is recommended that this value be used as a maximum amount for designing treatment facilities.

In addition to reducing mass and eliminating DNAPL mobility, the hydraulic displacement technology has an additional benefit in that it will lead to an increase in DNAPL – water interfacial area available for mass transfer. This fact alone indicates that regardless of how much DNAPL is recovered during application of hydraulic displacement, it will be a beneficial means of pre-conditioning the treatment zone prior to subsequent application of technologies that would benefit from an increase in DNAPL – water interfacial area. Such technologies include cosolvent flushing, oxidant flushing, DNAPL dissolution through pump-and-treat, monitored natural attenuation, and enhanced in-situ biodegradation.

Hydraulic displacement is a reliable technology that can be viewed as a form of pump-and-treat. It does not involve phase changes in the subsurface, does not rely on mass transfer, does not utilize chemical injection, and does not require a complicated produced fluids treatment system. There is considerable experience within the contaminant hydrogeology community and at the SRSNE site regarding the installation of groundwater recovery wells, and operation of pumping systems. As a result of these factors, full-scale hydraulic displacement can be implemented at the SRSNE site expeditiously without a field-scale pilot test. The risk of vertical pool mobilization is small given the fact that hydraulic displacement is a 'depleting' technology that does not involve the build up of NAPL banks.

Table of Contents

1.0 – Introduction

Mobilizing NAPL pools through increases in the groundwater hydraulic gradient is referred to as ‘hydraulic displacement’. The fact that increases in the hydraulic gradient can bring about changes in capillary pressure, and therefore NAPL mobilization, was first recognized by the petroleum industry where the technique is referred to as ‘waterflooding’. The petroleum industry developed a thorough technical understanding of waterflooding during the 1940s and 1950s through extensive research and development efforts carried out by private corporations and university labs. The technique starting seeing widespread field application in the 1960s and 1970s, and is still used today as a primary means of recovering oil from petroleum reservoirs. Willhite (1986) presents a comprehensive summary of the technology from a petroleum industry perspective.

Applications of hydraulic displacement for NAPL recovery in the contaminant hydrogeology community began in the 1970s with efforts to remove LNAPLs such as gasoline and other fuel oils from the subsurface. The technology has since been used to recover DNAPLs from unconsolidated deposits. Hydraulic displacement applications range from simple bailing or pumping of DNAPL from a single well, to large-scale injection-withdrawal systems aimed at recovering substantial quantities. The technology is more efficient at removing NAPL if water injection is utilized, but this need not necessarily be the case. Passive systems, that involve only the removal of fluids from recovery wells or drains, can also be implemented.

Hydraulic displacement is capable of removing pooled NAPL from the subsurface, but is not capable of removing residual NAPL. The technology is therefore suited for applications where the primary objectives are (i) to remove DNAPL mass, (ii) to reduce DNAPL mobility to zero, and (iii) to increase the DNAPL-water interfacial area available for mass transfer. The third objective, increasing DNAPL-water interfacial area, is desirable in cases where a mass transfer based technology will be applied after execution of hydraulic displacement. Examples of technologies that benefit from increases in DNAPL-water interfacial area include cosolvent flushing, oxidant flushing, enhanced in-situ biodegradation, monitored natural attenuation, and pump-and-treat.

2.0 – Technology Description

2.1 – Pool Mobilization

Increasing the groundwater hydraulic gradient through a DNAPL pool will bring about a capillary pressure imbalance across the ends of the pool, thereby initiating pool movement if the capillary pressure at the leading edge of the pool exceeds the entry pressure of the geological material at that location. The entry pressure is the threshold capillary pressure required for DNAPL to enter a water-saturated medium. In a one-dimensional system, the relationship between hydraulic gradient and the ability to mobilize a pool can be seen through inspection of the following (Kueper, 1998):

$$\frac{\Delta\rho}{\rho_W} L \sin\alpha + \Delta h > \frac{P_E(L) - P_C(0)}{\rho_W g} \qquad (1)$$

where $\Delta\rho$ is the density difference between the DNAPL and water, ρ_W is the water density, L is the length of the DNAPL pool, α is the dip of the geological layer upon which pooling is taking place (defined from horizontal), Δh is the difference in hydraulic head between the leading edge and trailing edge of the pool, $P_E(L)$ is the entry pressure at the leading edge of the pool, $P_C(0)$ is the capillary pressure at the trailing edge of the pool, and g is the acceleration due to gravity. If the terms on the left side of equation (1) exceed those on the right, the DNAPL pool will be mobilized. Equation (1) shows that increasing the hydraulic gradient through a pool will bring about an increase in Δh across the ends of the pool, and that a sufficient increase in this quantity would allow the pool to overcome the capillary resistance characterized by the right side of the equation. Equation (1) also illustrates that longer DNAPL pools are easier to mobilize through increases in the groundwater hydraulic gradient than shorter DNAPL pools.

A practical use of equation (1) is to explore what ranges in hydraulic gradient would be required to mobilize DNAPL pools given a range of entry pressures. Recall that the entry pressure is inversely proportional to the hydraulic conductivity of an unconsolidated medium, and proportional to the DNAPL-water interfacial tension. Low interfacial tension DNAPLs that are pooled in moderate to high permeability media will therefore be relatively easy to mobilize through increases in the hydraulic gradient, while high interfacial tension DNAPLs and low permeability media would necessitate relatively high hydraulic gradients to bring about pool mobilization.

2.2 – Rate of DNAPL Recovery

Equation (1) is limited in that it assumes a simple one-dimensional system, and in that it only provides the condition required to initiate pool mobilization. To evaluate (i) the transient fate of a mobilized pool following initiation of mobilization, (ii) three-dimensional aspects of the flow field, and (iii) the rate of DNAPL recovery during hydraulic displacement, a numerical model is typically required. Numerical models capable of simulating DNAPL pool mobilization in porous media are based on the following two partial differential equations:

$$\frac{\partial}{\partial x_i}\left[\frac{k_{ij}k_{r,W}}{\mu_W}\left(\frac{\partial P_W}{\partial x_j} + \rho_W g \frac{\partial z}{\partial x_j}\right)\right] + S_W\left(\alpha + \phi\beta_W\right)\frac{\partial P_W}{\partial t} - \phi\frac{\partial S_W}{\partial t} = 0 \qquad i,j=x,y,z \qquad (2)$$

$$\frac{\partial}{\partial x_i}\left[\frac{k_{ij}k_{r,N}}{\mu_N}\left(\frac{\partial\left(P_C + P_W\right)}{\partial x_j} + \rho_N g \frac{\partial z}{\partial x_j}\right)\right] + \left(1 - S_W\right)\left(\alpha\right)\frac{\partial P_W}{\partial t} + \phi\frac{\partial S_W}{\partial t} = 0 \qquad i,j=x,y,z \qquad (3)$$

where k_{ij} is a second-order tensor defining porous medium permeability, $k_{r,W}$ and $k_{r,N}$ are the relative permeabilities to the wetting (water) and nonwetting (DNAPL) phases, μ_W and μ_N are the respective phase viscosities, P_W is the wetting phase pressure, P_C is the capillary pressure, α is the porous medium compressibility, β_W is the wetting phase compressibility, ϕ is the medium porosity, ρ_N is the nonwetting phase density, t is time, S_W is the wetting phase saturation, and g is the acceleration due to gravity. Equations (2) and (3) incorporate the fact that the phase saturations sum to unity (i.e., $S_W + S_{NW} = 1.0$), and the fact that the capillary pressure is defined as $P_C = P_{NW} - P_W$.

Application of numerical models based on equations (2) and (3) reveal the following aspects regarding the use of hydraulic displacement for DNAPL recovery:

1) Larger groundwater hydraulic gradients result in faster rates of DNAPL recovery, and allow lower permeability capillary barriers to be invaded enroute to recovery wells.
2) Lower DNAPL viscosity, higher permeability media, and higher initial DNAPL saturations result in faster rates of DNAPL recovery.
3) Closer well spacings result in shorter duration applications.
4) Rates of DNAPL recovery are highest at early time when nonwetting saturations are high, and decay to lower values at late time, eventually reaching zero when DNAPL saturations have been reduced to residual levels.

2.3 – Increase in DNAPL-Water Interfacial Area

The DNAPL-water interfacial area available for mass transfer is dependent on the pore-scale distribution of fluids. At high DNAPL saturations most of the pore space is occupied by the DNAPL, thereby reducing the amount of water in contact with the DNAPL (see Figure 1). At very low DNAPL saturations, only a certain percentage of the pores are occupied by DNAPL, again leading to low DNAPL-water interfacial area. At intermediate saturations, the DNAPL-water interfacial area is increased relative to high and low DNAPL saturations (see Figure 2). This behaviour is consistent with the fact that DNAPL pools (high DNAPL saturation) require more pore volumes of water flushing to dissolve a specified mass of DNAPL than DNAPL at residual saturation levels.

The relationship between fluid saturation and DNAPL-water interfacial area can be described by (Mason and Kueper, 1996):

$$A_o = S_W^3 - S_W^5 \tag{4}$$

where A_o is the DNAPL-water interfacial area per unit volume of porous media, and S_W is the wetting phase saturation. Figure 3 illustrates the use of equation (4) to characterize the relationship between A_o and DNAPL saturation. As shown, the DNAPL-water interfacial area reaches a maximum at DNAPL saturations of approximately 25% of pore space. This saturation is a typical residual DNAPL saturation that would be left in place following

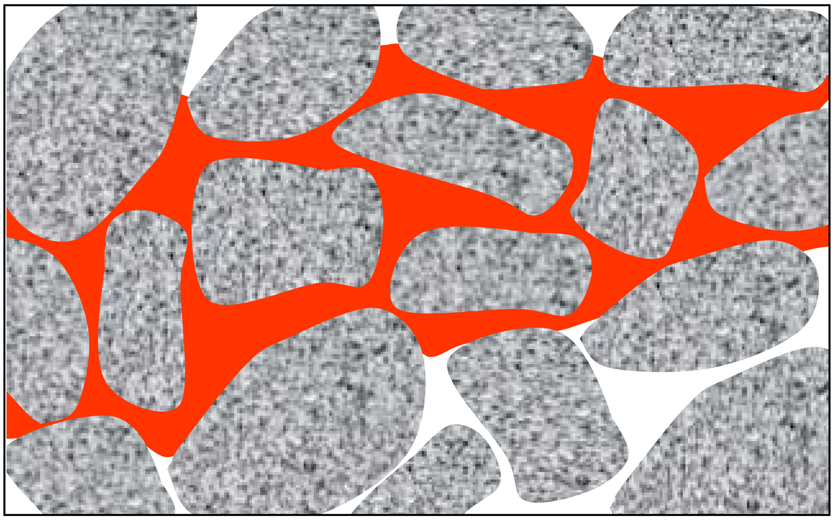


Figure 1 – Pooled DNAPL (shown in red) in porous medium. Majority of mass transfer from DNAPL to water will occur at edges of pool.

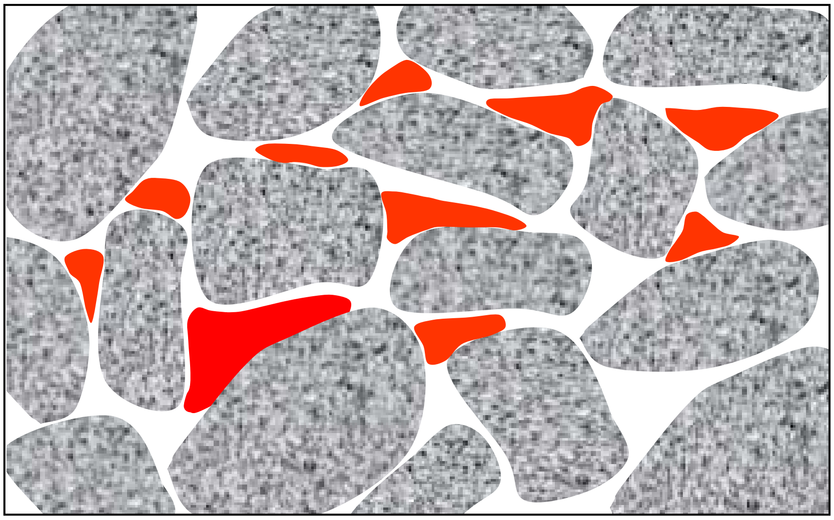


Figure 2 – DNAPL (shown in red) at residual saturation in pore space. DNAPL-water interfacial area is increased relative to that depicted in Figure 1.

application of hydraulic displacement. It follows that the rate of DNAPL dissolution (mass transfer to aqueous phase) would increase following application of hydraulic displacement activities that reduce DNAPL pools down to residual saturation levels.

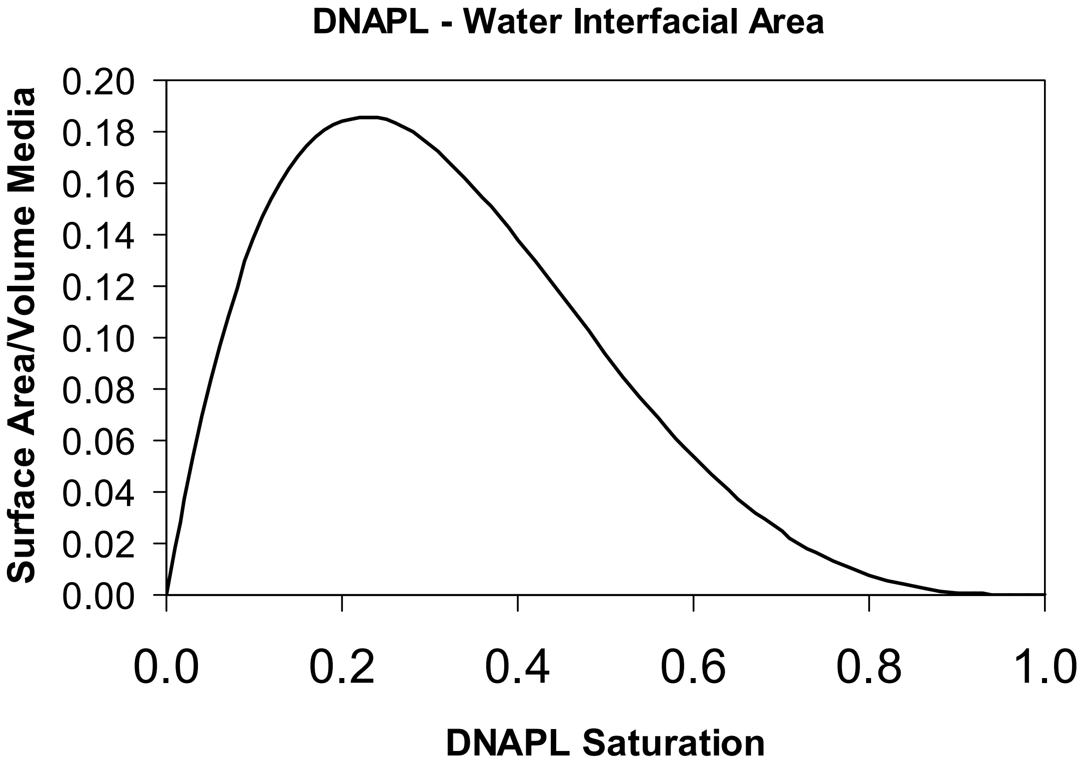


Figure 3 – DNAPL-water interfacial area as a function of DNAPL saturation.

2.4 – Benefits of Implementation

The application of hydraulic displacement to sites containing residual and pooled DNAPL include the following:

1. **Mass removal** – pooled DNAPL will be removed from the subsurface, thereby reducing the total amount of contaminant mass present.
2. **Risk reduction** – the conversion of pooled DNAPL to residual saturation levels will eliminate DNAPL mobility.
3. **Increased DNAPL-water interfacial area** – the increase in DNAPL-water interfacial area associated with hydraulic displacement preconditions the site for the application

of subsequent treatment technologies that rely on mass transfer for removing contaminants from the subsurface. Examples of such subsequent technologies include enhanced in-situ bioremediation, cosolvent flushing, oxidant flushing, pump-and-treat, and thermal methods.

2.5 – Risks of Implementation

Hydraulic displacement is associated with low risks of implementation in that DNAPL-water interfacial tension is not reduced, dangerous chemicals are not utilized, and the contaminant is not converted to a more mobile phase (c.f., thermal technologies where a high concentration vapour stream is created). When hydraulic gradients are used to mobilize pooled DNAPL, the DNAPL saturations within the pool are continuously reduced. Hydraulic displacement is a 'depleting' technique in that DNAPL banks are not created or built up. In the case where pooled DNAPL is spatially continuous between injection and extraction wells, DNAPL saturations will be steadily reduced during application of the technology.

In cases where a DNAPL pool is situated in isolation between injection and withdrawal wells, the pool may be mobilized into previously un-invaded porous media en-route to the recovery wells. This scenario does involve some risk in that the previously un-invaded portion of the subsurface may contain high permeability pathways to bedrock, or to other regions outside of the capture zone of recovery wells. In the vicinity of recovery wells, however, an upward component to the hydraulic gradient will exist, thereby off-setting the risk of vertical mobilization. The risk of vertical mobilization during application of hydraulic displacement will be greatest for high density DNAPLs such as PCE (density = 1.62 g/cc), and less for lower density DNAPLs (e.g., creosote, coal tar, and mixed DNAPLs containing LNAPL compounds such as toluene, cutting oils, etc.). It should also be pointed out that saturations within the isolated pool will begin to decrease upon mobilization, implying that the risk of having this mobilized pool penetrate an underlying capillary barrier will decrease as the pool migrates towards recovery wells. In certain instances, the entire pool may be smeared to residual (zero mobility) prior to reaching recovery wells.

2.6 – Shut Down Criteria

Hydraulic displacement systems typically display a declining rate of DNAPL removal with time (as will be illustrated in later sections of this report). Shut down criteria typically focus on plotting cumulative NAPL recovered as a function of time. Once the cumulative recovery curve has 'flattened', a brief shut-down period is applied, followed by restarting the system. The shut-down period will allow any pooled DNAPL, if it still exists, to accumulate in permeable pathways. If additional DNAPL is not recovered upon restarting the system, the hydraulic displacement is considered to be complete.

If the original design gradients were not particularly aggressive, the shut-down evaluation may also involve a brief period of increased hydraulic gradient effected by injecting and withdrawing water at increased rates. The period of increased hydraulic gradients will impart a stronger mobilizing force on any DNAPL pools that may still be in place. If the period of increased hydraulic gradient does not yield additional DNAPL recovery, the hydraulic displacement is considered to be complete.

The shut-down criteria require that the volume of recovered DNAPL is monitored as a function of time. It is also advisable to monitor the volume of water recovered as a function of time, so that the 'oil to water ratio' can be plotted. This ratio is expected to decline with time as pooled DNAPL is depleted. Ideally, the rates of DNAPL and water recovered should be measured for each individual extraction well. The advantage of this level of detail is that individual recovery wells can be shut down while others are still producing DNAPL. In some instances, however, this level of detail may not be practicable, and fluid recovery rates may instead be monitored at common points such as manifold headers. In this case, there may not exist a basis for shutting down individual wells while others are still operating. In any case, the fluid recovery rates do not necessarily need to be measured using in-line flowmeters; bulk volume measurements at regular time intervals will typically suffice.

2.7 – Performance Evaluation

Performance evaluation for hydraulic displacement systems typically involves routine monitoring for DNAPL presence in existing monitoring wells following application of the technology. If the hydraulic displacement was effective, DNAPL should no longer be accumulating in on-site wells. With respect to increasing DNAPL-water interfacial area, groundwater quality measurements can be monitored with time following application of hydraulic displacement. An increase in DNAPL-water interfacial area will typically manifest itself as an increase in downstream contaminant concentrations

2.8 – Design Considerations

The design and application of a hydraulic displacement system in porous media will require the following:

1) Measurement of DNAPL density, DNAPL viscosity, and DNAPL-water interfacial tension.
2) Measurement of formation permeability and an assessment of heterogeneity and bedding structure.
3) Assessment of the relative proportion of residual versus pooled DNAPL.
4) Identification of the overall volume of saturated porous media containing pooled DNAPL.
5) Application of numerical models to select injection/withdrawal well locations, well spacings, water injection rates, and DNAPL recovery rates.
6) Assessment of the ability (i.e., geochemical considerations) to re-inject extracted (treated or untreated) water.

7) Construction of necessary conveyance systems and treatment facilities.

Because hydraulic displacement is a mature technology, there is typically no need to perform a field-scale pilot test prior to full-scale implementation. This is particularly the case at sites where experience already exists regarding the ability to drill wells and pump groundwater.

3.0 – Technology Demonstration

Examples of full-scale application of hydraulic displacement for the recovery of DNAPLs from unconsolidated deposits include Sale and Applegate (1997), Gerhard et al., 2001), and various applications not reported in the refereed literature. Sale and Applegate (1997) describe the use of hydraulic displacement to recover creosote DNAPL from an unconfined sand aquifer located in Laramie, WY. The application displayed 'classic' waterflood behaviour in that production rates were highest at early time, increased in response to higher rates of water injection, and decayed smoothly towards no recovery. The authors state that 95% of the initial mobile DNAPL in place was recovered using the technology. Gerhard et al. (2001) discuss the design of a hydraulic displacement system employing horizontal drains to remove the mobile portion of a large, chlorinated solvent DNAPL pool located at an industrial site in Lake Charles, LA. The system was designed using recovery drains only (no water injection), and is being operated in sequenced on/off cycles between two modules to better balance contaminant loading to an on-site treatment plant.

It should be pointed out that hydraulic displacement is essentially a pump-and-treat technology in that water is simply injected into upgradient wells, while DNAPL and water are recovered from downgradient wells. There is a vast amount of experience within the contaminant hydrogeology community regarding the design, construction, and implementation of pump-and-treat systems for fluid recovery in unconsolidated deposits. The use of screened wells to inject and withdraw groundwater from the subsurface has been demonstrated at thousands of sites throughout North America in the past several decades. It can be concluded that hydraulic displacement is a reliable, proven technology for mass removal and DNAPL-water interfacial area manipulation at hazardous waste sites where pooled DNAPL is known to be present in the subsurface.

4.0 – Application to SRSNE Site

4.1 – General

DNAPL delineation activities summarized by BBL (1998) indicated that DNAPL is present in overburden throughout the site operations area (west of railway tracks) as well as within the NTCRA1 containment area (east of railway tracks). This delineation has been confirmed through visual observation of DNAPL in monitoring wells in both of these areas (e.g., in wells MWD-601 and RW-5 east of the railway tracks; in former on-site interception wells west of the railway tracks). Recent boring activities conducted at the site during the week of November 3rd, 2003 further confirmed the occurrence of DNAPL west of the railway tracks

(BBL, 2003). The 2003 field program was a focused effort designed to visually identify DNAPL in borings extracted from a selected number of locations.

On the basis of recent discussions between USEPA, CTDEP, regulatory oversight consultants, and the PRP group and its consultants, an 'observed NAPL in overburden groundwater unit' (ONOGU) has been identified for evaluation in the Feasibility Study. The ONOGU is the volume of overburden considered here for application of hydraulic displacement. BBL (2004) report that the ONOGU has a total saturated volume (from the top of bedrock to the seasonal high watertable as represented by March, 1995 data) of 31,840 cubic yards. Using an effective porosity of 0.25 (note that total porosity has been measured to be 0.275), this corresponds to a total fluid pore volume of 1,607,920 U.S. gallons.

The 2003 boring program results presented by BBL (2003) distinguished between observations of residual NAPL and pooled NAPL. Using the relationship between capillary pressure and fluid saturation, measured DNAPL and porous media properties for the site, and the observed occurrences of NAPL at the site, BBL (2004) estimate that the ONOGU contains approximately 121,000 gallons of DNAPL (96,000 gallons pooled + 25,000 gallons at residual saturation). BBL (2004) estimate that 80% of the pooled DNAPL is present within Zone 2 of the ONOGU (see Appendix E of FS, 'Calculation of NAPL Pool Volume').

The above observations suggest that hydraulic displacement would be a viable means of both removing DNAPL from the ONOGU, and increasing the DNAPL-water interfacial area available for mass transfer as a pre-conditioning step for subsequent application of technologies such as cosolvent flushing, NAPL dissolution through pump-and-treat, enhanced in-situ bioremediation, monitored natural attenuation, and oxidant flushing. Hydraulic displacement will completely and irreversibly eliminate NAPL pool mobility.

4.2 – Pool Mobilization

Equation (1) can be used to perform screening level calculations to assess what range of hydraulic gradients will be required to initiate pool mobilization during application of hydraulic displacement. Use of equation (1) requires knowledge of entry pressures. It is well established that porous media entry pressures are correlated to permeability, with lower permeability media exhibiting higher entry pressures (e.g., Corey, 1986). Kueper and Frind (1991b) present measured DNAPL-water entry pressures for unconsolidated porous media similar to that encountered at the SRSNE site (i.e., fine to medium grained sands). The entry pressures were measured for six porous media samples ranging in hydraulic conductivity from 1.0E-03 cm/s to 1.2E-02 cm/s. Figure 4 presents the relationship between entry pressure (expressed as cm of water) and hydraulic conductivity reported by Kueper and Frind (1991b). The values were obtained using a PCE-water system characterized by an interfacial tension of 45 dynes/cm. The graph utilizes a linear scale for hydraulic conductivity and therefore should only be interpreted over the range of reported values. To apply the results presented in Figure 1 to DNAPL-water systems with different interfacial tensions, it is appropriate to linearly scale the entry pressures (e.g., Leverett, 1941).

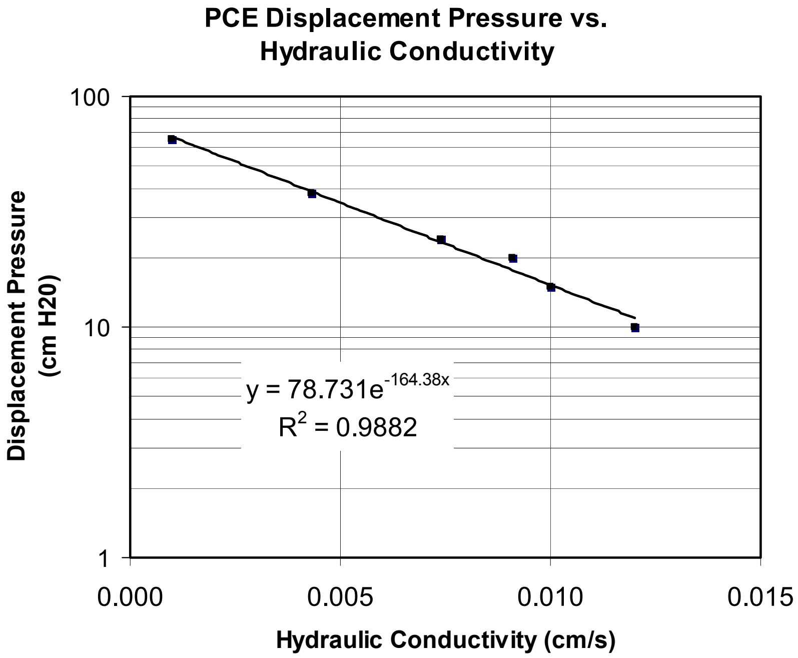


Figure 4 – Entry pressure (displacement pressure) versus hydraulic conductivity for DNAPL-water system characterized by an interfacial tension of 45 dynes/cm (after Kueper and Frind, 1991b)

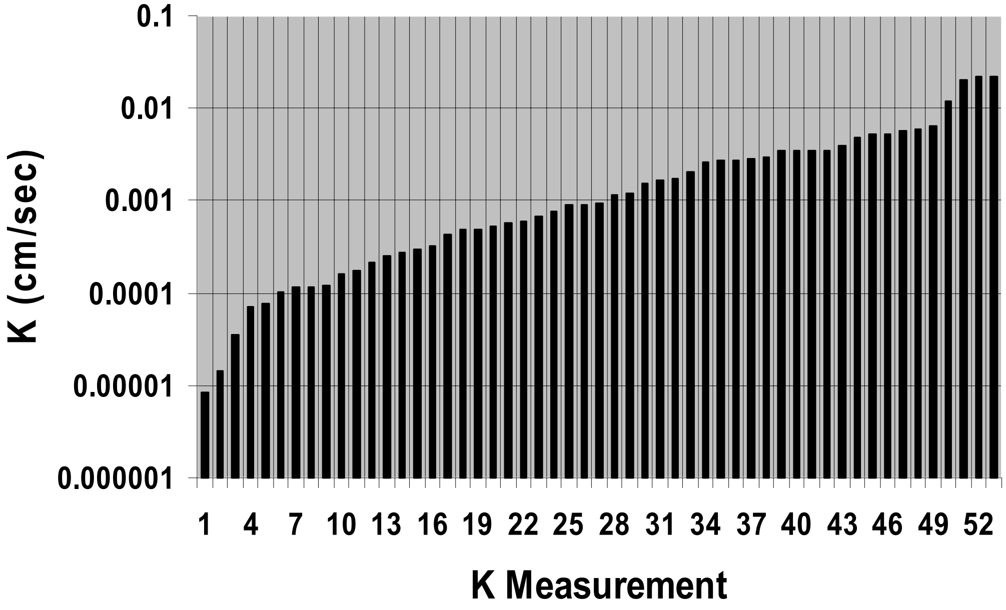


Figure 5 – Overburden hydraulic conductivity measurements (BBL, 1998)

Figure 5 presents the range of hydraulic conductivity values measured in overburden at the SRSNE site (BBL, 1998). The figure indicates that hydraulic conductivity ranges from approximately 1.0E-05 cm/s to approximately 1E-02 cm/s. BBL (2004) report that the geometric mean of hydraulic conductivity values measured at overburden wells located in the site operations area is 2.0E-03 cm/s. This value is within the range of values illustrated in Figure 5.

Figure 6 presents a plot of the critical gradient required to initiate pool mobilization in overburden at the SRSNE site as a function of the hydraulic conductivity of the geological material immediately ahead of the pool to be mobilized. The figure was created using equation (1) assuming (i) the pools are horizontal such that $\sin\alpha = 0$, (ii) the capillary pressure at the trailing end of a mobilized pool is zero such that $P_C(0) = 0$, and (iii) the entry pressures provided in Figure 4 can be scaled according to interfacial tension to arrive at the $P_E(L)$ values for SRSNE (i.e., entry pressures scaled by ratio of interfacial tensions). Figure 6 was created using an interfacial tension value of 3.1 dynes/cm, which is the lowest measured interfacial tension for the site. The low interfacial tension implies that pools should be relatively easy to mobilize, as reflected in the figure. Figure 6 shows that pools as short as 1 m can be mobilized into K = 1.0E-03 cm/s material (fine sand) by hydraulic gradients less than 0.05. Consistent with equation (1), Figure 6 also illustrates that longer pools (e.g., 5 m case) are easier to mobilize than shorter pools.

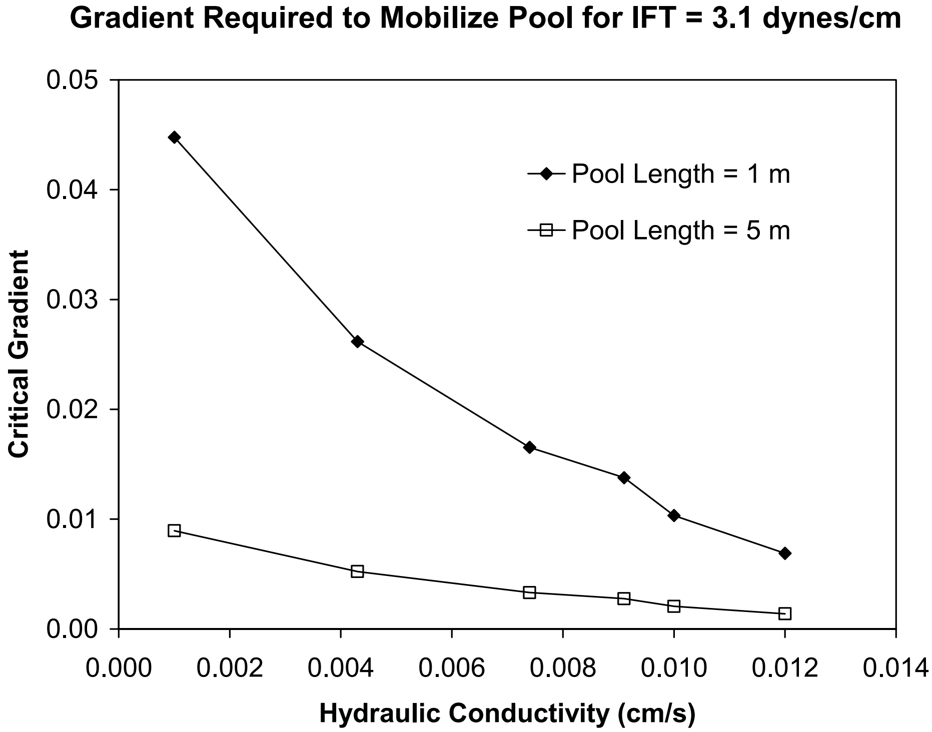


Figure 6 – Critical gradient required to mobilize a DNAPL pool into material with a specified hydraulic conductivity. The figure adopts the lowest measured value of interfacial tension (3.1 dynes/cm) for the SRSNE site.

Figure 7 presents a plot of the critical gradient required to initiate pool mobilization in overburden at the SRSNE site as a function of the hydraulic conductivity of the geological material immediately ahead of the pool to be mobilized for the case of an interfacial tension of 9 dynes/cm. The assumptions adopted in creating Figure 7 are identical to those that were adopted in creating Figure 6. The 9 dynes/cm interfacial tension value is the highest measured value available for the site (DNAPL obtained from bedrock well MW-705DR). Comparison of Figure 7 to Figure 6 shows that adopting a higher interfacial tension value leads to larger critical hydraulic gradients required to mobilize pools. Overall, however, even pools as short as 1m can be mobilized into fine sands (K = 1.0E-03 cm/s) with hydraulic gradients less than 0.14.

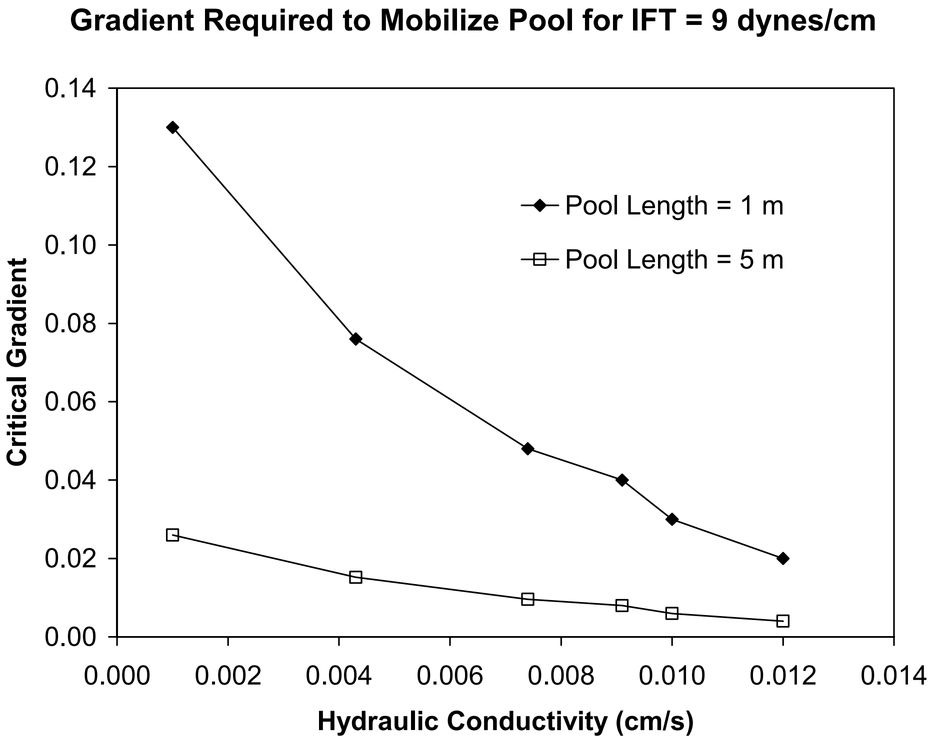


Figure 7 – Critical gradient required to mobilize a DNAPL pool into material with a specified hydraulic conductivity. The figure adopts the highest measured value of interfacial tension (9.0 dynes/cm) for the SRSNE site.

The results presented in Figures 6 and 7 lead to the conclusion that the moderate permeability materials present at the SRSNE site in conjunction with the relatively low interfacial tension values will allow DNAPL pools as short as 1 m to be mobilized into fine sand materials with hydraulic gradients less than 0.14. Longer pools and lower interfacial tension DNAPLs will be mobilized by lower hydraulic gradients. These calculations are consistent with the fact that operation of the NTCRA1 recovery wells mobilized pooled DNAPL towards recovery well RW-5.

Overall, the above results support the use of hydraulic displacement to recover DNAPL from overburden at the SRSNE site. In terms of initiating pool mobilization, it appears that a hydraulic gradient of approximately 0.15 would be desirable. While this would not necessarily mobilize all pools (e.g., short pools resting against low permeability material), it is expected that the vast majority of pools would indeed be mobilized towards recovery wells.

4.3 – Rate of DNAPL Recovery and Duration of Application

To estimate the length of time that hydraulic displacement activities would need to be implemented at the SRSNE site, and the rate of DNAPL recovery as a function of time, use is made here of a numerical two-phase flow model developed by Kueper and Frind (1991a). The model has been peer reviewed on a number of occasions (e.g., Kueper and Frind, 1991ab; Kueper and Gerhard, 1995; Gerhard and Kueper, 2003abc), and has been used to design full-scale hydraulic displacement systems (e.g., Gerhard et al., 1998, 2001). This model has been validated against controlled laboratory experiments and simulates the transient movement of DNAPL and groundwater in heterogeneous porous media following equations (2) and (3). For the screening level purposes presented here, the model is applied in one dimension in homogeneous porous media, assuming that all fluids and media are incompressible. These simulations should therefore not be considered design level calculations. Use of the model for design should be carried out in three dimensions, incorporating both heterogeneity of the hydraulic conductivity distribution and compressibility of fluids and media.

Table 1 summarizes the screening level simulations that have been carried out. Run #1 is a base case scenario that adopts a hydraulic conductivity of 2.0E-03 cm/s. This value represents the geometric mean of hydraulic conductivity measurements obtained at overburden wells in the former site operations area (BBL, 2004). The DNAPL is assigned a viscosity of 1.37 cP, which represents a measured value for DNAPL obtained from the site (measured at 8.5 ^{o}C). All simulations adopt an injection-withdrawal well spacing of 50 ft. The base case assigns a hydraulic gradient between these wells of 0.16, which is equivalent to 4 ft of injection pressure at the injection wells, and 4 ft of drawdown at the withdrawal wells. The base case adopts an initial DNAPL saturation of 0.50 between the injection and withdrawal wells. The DNAPL is distributed over a distance of 47 ft, with 1 ft of NAPL free material adjacent to the withdrawal well, and 2 ft of NAPL free material adjacent to the water injection well. The base case adopts an entry pressure of 2000 Pa, a node spacing of 1 ft, a porosity of 0.25, a residual wetting phase saturation of 0.15, and a Brooks-Corey pore size distribution index of 2.5 (required to characterize the capillary pressure and relative permeability functions).

Because the numerical model is applied here in one dimension, the results can be better interpreted given an assumed cross-sectional area for flow in the other two dimensions. All simulations presented here assume flow through a rectangular cross-sectional area characterized by a height of 4 ft and a width of 80 ft. The model therefore simulates unidirectional flow through a rectangular volume 50 ft in length (in the direction of flow) by 4 ft high by 80 ft wide. This can be thought of as application of the technology utilizing an 80 ft long line of injection wells (or an 80 ft long injection trench), spaced 50 ft from an 80 ft long line of withdrawal wells (or an 80 ft long withdrawal trench).

Table 1 – Summary of Screening Level DNAPL Recovery Simulations

RUN#	**K (cm/s)**	**NAPL Viscosity (cP)**	**Hydraulic Gradient (-)**	**Initial NAPL Saturation**
1	2.0E-03	1.37[1]	0.16	0.50
2	**4.0E-03**	1.37[1]	0.16	0.50
3	**1.0E-03**	1.37[1]	0.16	0.50
4	2.0E-03	**1.00**	0.16	0.50
5	2.0E-03	**2.00**	0.16	0.50
6	2.0E-03	1.37[1]	**0.24**	0.50
7	2.0E-03	1.37[1]	**0.08**	0.50
8	2.0E-03	1.37[1]	0.16	0.40
9	2.0E-03	1.37[1]	0.16	isolated

NOTE: 1.37 cP equivalent to 1.23 cS (measured value at 8.5 °C)

Run #2 is identical to Run #1 except for the fact that the hydraulic conductivity has been increased to 4.0E-03 cm/s. Run #3 is identical to the base case except for the fact that the hydraulic conductivity as been decreased to 1.0E-03 cm/s. Runs 1 through 3 therefore represent a sensitivity to hydraulic conductivity. Figure 8 presents a plot of cumulative DNAPL volume recovered versus time for Runs 1 through 3. The figure shows that recovery of DNAPL tails off substantially at times approaching 100 days, and that DNAPL recovery is greater at a particular point in time for higher permeability media. The overall shape of the DNAPL recovery curves presented in Figure 8 are consistent with field measured DNAPL recovery curves presented by Sale and Applegate (1997).

Figure 9 presents a plot of the rate of NAPL removal versus time for Runs 1 through 3. The figure indicates that NAPL recovery rates are greatest at early time when saturations are highest, and tail towards low values at late time as DNAPL saturations are depleted. The figure indicates that a shorter duration, high recovery period occurs in the more permeable case, and that lower permeability media display lower rates of peak NAPL production, but over longer periods of time. Overall, Figure 9 indicates that the period of high NAPL production is limited to less than 30 days for this set of simulations.

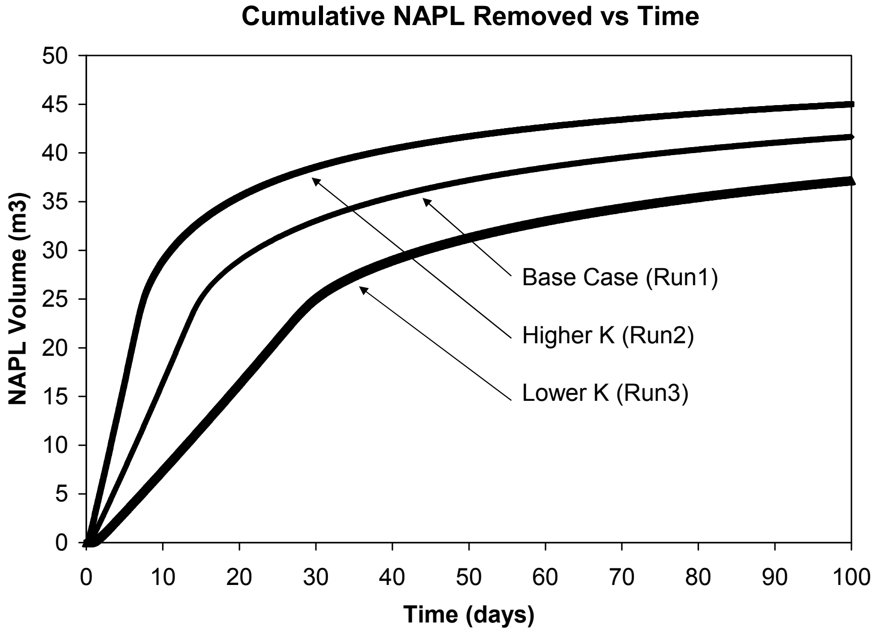


Figure 8 – Cumulative DNAPL removed versus time for Runs 1 through 3.

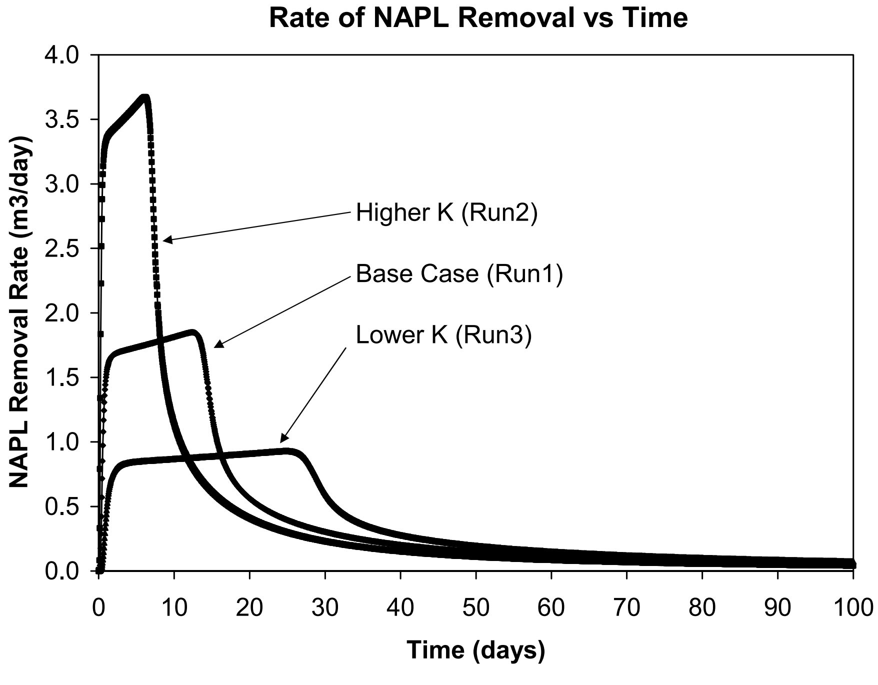


Figure 9 – Rate of DNAPL removal versus time for Runs 1 through 3.

Run #4 is identical to the base case except for the fact that it adopts a DNAPL viscosity of 1.0 cP. Run #5 is identical to the base case simulation except for the fact that it adopts a DNAPL viscosity of 2.0 cP. Runs 1, 4 and 5 therefore represent a sensitivity to DNAPL viscosity. Figure 10 presents a plot of cumulative DNAPL recovery versus time for Runs 1, 4 and 5. As expected, lower values of DNAPL viscosity result in faster rates of DNAPL recovery. As with Figure 9, DNAPL recovery flattens substantially by approximately 100 days of system operation.

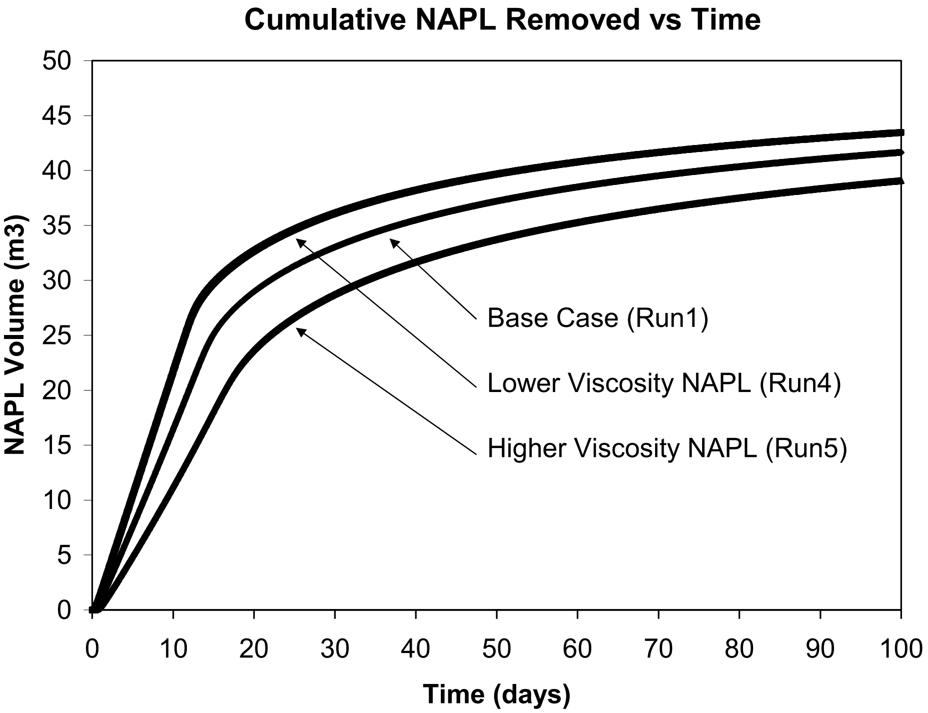


Figure 10 – Cumulative DNAPL recovery versus time for Runs 1, 4 and 5.

Figure 11 presents a plot of the rate of NAPL recovery versus time for Runs 1, 4 and 5. Adopting a lower DNAPL viscosity results in faster rates of recovery. In all three cases shown, the period of high DNAPL recovery ends at approximately 15 days, followed by tailing towards very low rates of recovery at 100 days.

Run #6 is identical to the base case simulation except for the fact that the hydraulic gradient has been increased to a value of 0.24. Given a 50 ft well (or trench) spacing, this implies that the water injection wells can maintain an excess head of 6 ft, and that withdrawal wells can be operated with a 6 ft decline in waterlevel. Run #7 is identical to the base case simulation except for the fact that the hydraulic gradient has been decreased to a value of 0.08. This corresponds to an excess head of 2 ft in the water injection wells, and a 2 ft depression in waterlevel in the recovery wells. Runs 1, 6 and 7 collectively provide a sensitivity to groundwater hydraulic gradient.

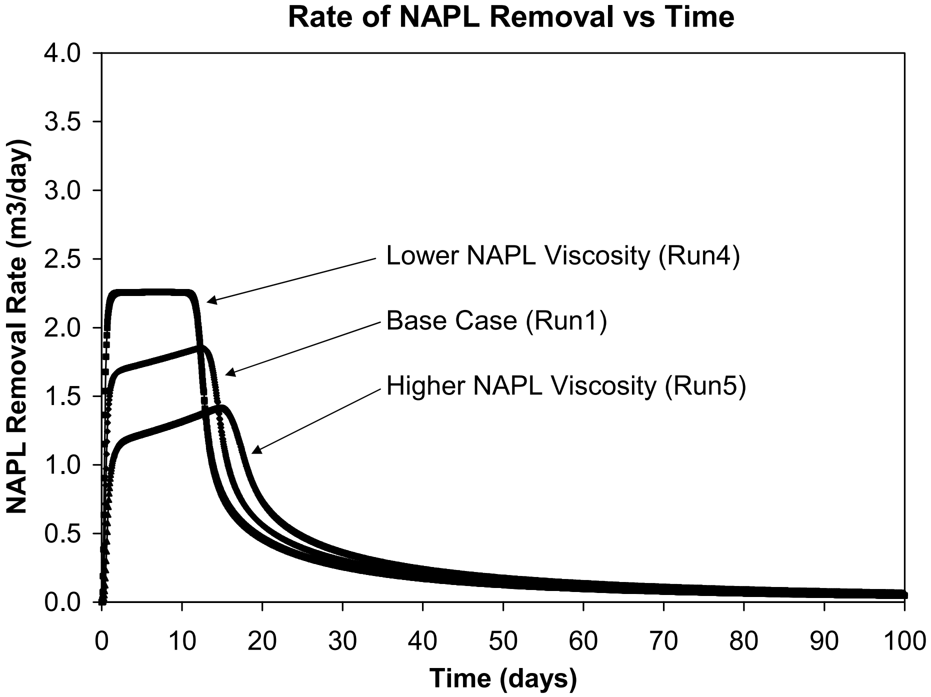


Figure 11 – Rate of DNAPL recovery versus time for Runs 1, 4 and 5. This set of simulations provides a sensitivity to DNAPL viscosity.

Figure 12 presents a plot of cumulative DNAPL recovery versus time for Runs 1, 6 and 7. The figure clearly illustrates that higher hydraulic gradients lead to increased volumes of DNAPL recovery. In all three cases shown, the cumulative DNAPL recovery curve flattens at around 100 days. In a practical context, such flattening of the cumulative NAPL recovery curve usually indicates that continued operation of the hydraulic displacement system is not justified beyond that point in time. Figure 13 presents a plot of the rate of DNAPL recovery versus time for Runs 1, 6 and 7. The figure shows that increases in the hydraulic gradient result in higher peak NAPL production rates, but over shorter periods of time. For all three simulations, the period of peak NAPL production is limited to less than approximately 30 days.

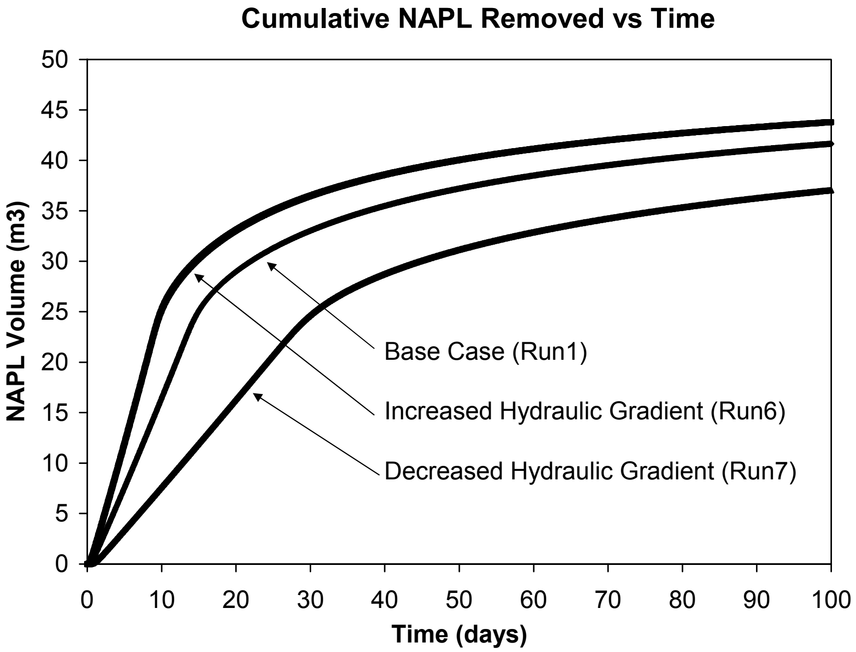


Figure 12 – Cumulative NAPL removed versus time for Runs 1, 6 and 7.

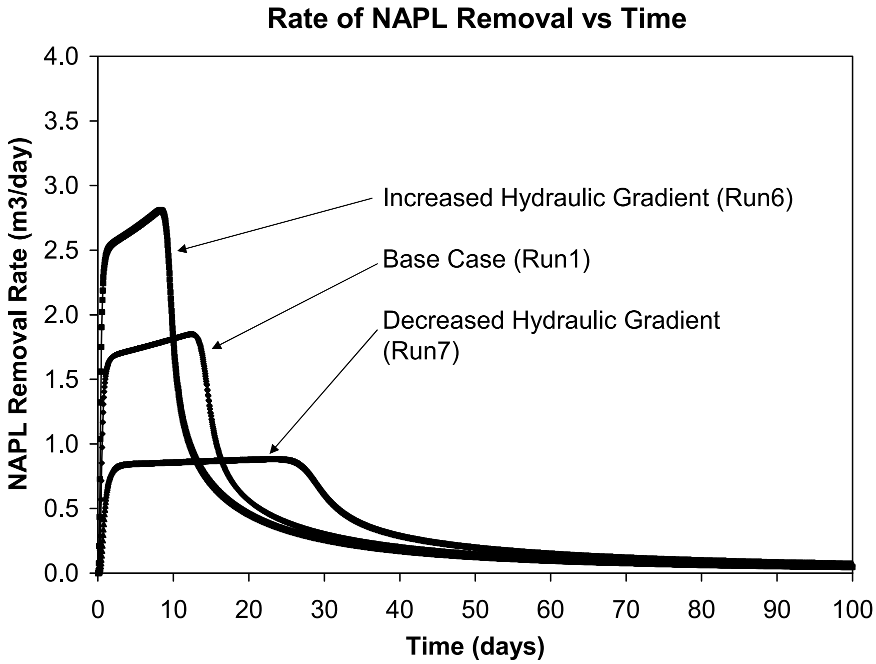


Figure 13 – Rate of DNAPL recovery versus time for Runs 1, 6 and 7.

Run #8 is identical to the base case simulation except for the fact that the initial DNAPL saturation has been reduced to a value of 0.40 (i.e., 40% of pore space). Run #9 is identical to the base case simulation except for the fact that the 47 ft long distribution of DNAPL at a saturation of 0.50 has been changed to a 20 ft long distribution of DNAPL at a saturation of 0.60. The 20 ft long DNAPL pool is located in the middle of the 50 ft long domain. Runs 1, 8 and 9 collectively illustrate the influence of initial DNAPL distribution on the rates and duration of DNAPL recovery.

Figure 14 presents a plot of cumulative DNAPL recovery versus time for Runs 1, 8 and 9. The figure shows that reducing the amount of initial NAPL in place results in less recovery, but that flattening of the cumulative NAPL recovery curve occurs at approximately the same time as for the base case (i.e., 100 days). Figure 14 shows that having a shorter, isolated pool of DNAPL in the center of the domain (Run 9) results in a delay in the onset of NAPL production, and that the cumulative NAPL recovery curve is essentially flat at a time of approximately 100 days. Figure 15 presents a plot of the rate of DNAPL recovery versus time for Runs 1, 8 and 9. The figure shows that the case of an isolated DNAPL pool (Run #9) results in a shorter duration period of peak DNAPL recovery compared to the other two simulations that incorporate a more uniform initial distribution DNAPL. In all three cases, however, the period of peak NAPL production is limited to less than approximately 30 days.

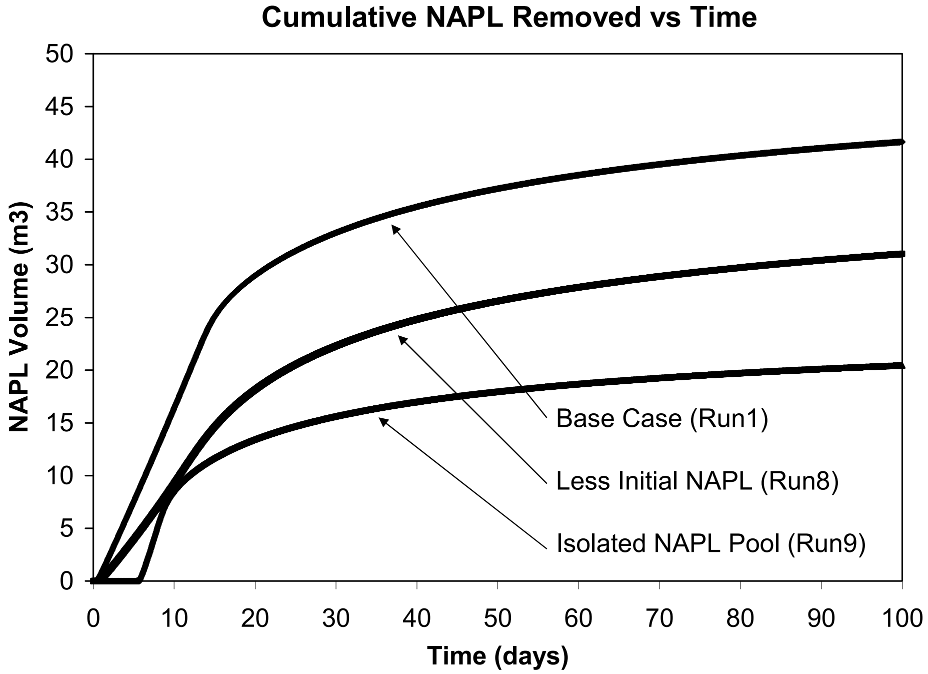


Figure 14 – Cumulative DNAPL recovery versus time for Runs 1, 8 and 9.

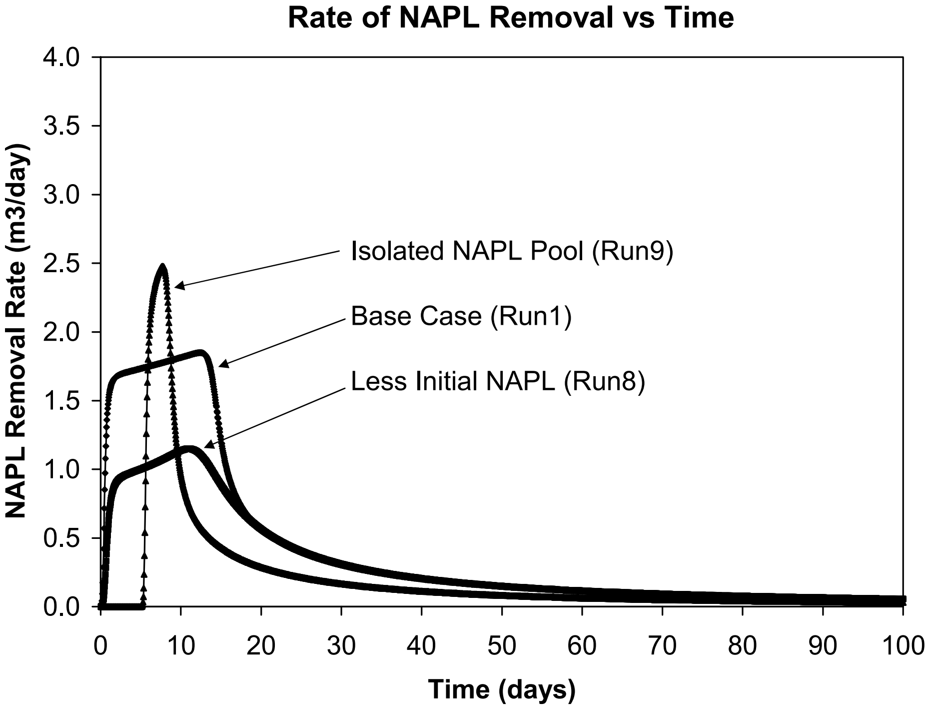


Figure 15 – Rate of DNAPL recovery versus time for Runs 1, 8 and 9.

In summary, the numerical simulations presented here indicate that hydraulic displacement is a viable means of recovering pooled DNAPL from overburden at the SRSNE site. The length of application of the hydraulic displacement operation can be assumed to be approximately 100 days for purposes of screening in the Feasibility Study, with peak NAPL production periods of less than 50 days. If required, full scale design simulations can be used to further refine this time estimate in the future. Because the simulations presented here adopt homogeneous porous media conditions, the rates of NAPL production are possibly overestimates relative to what may be expected in the field.

5.0 – Expected Results

The numerical simulations presented by BBL (attachment to this FS) indicate that achieving hydraulic gradients on the order of 0.16 will be possible at the SRSNE site using injection/withdrawal well spacings of 50 ft. The site is currently subject to a full-scale pump-and-treat system, which has provided valuable experience and insight regarding site hydraulics, viable drilling and well installation methods, etc. It can be concluded that the geology, hydrogeology, and DNAPL properties at SRSNE are suitable for implementation of hydraulic displacement.

Because the 2003 boring program was limited to visual observation and because of the fact that there can be considerable uncertainty regarding the delineation of pooled DNAPL on the basis of visual observation in borings alone, it should be noted that there is uncertainty regarding the total amount of DNAPL present within the ONOGU and the proportion of pooled versus residual DNAPL within this zone. It is therefore difficult to predict the amount of DNAPL that will be recovered using hydraulic displacement. It can be concluded, however, that there will be a significant benefit in increasing DNAPL-water interfacial area regardless of how much DNAPL is recovered. This increase in DNAPL-water interfacial area will be beneficial to any subsequent treatment technologies that rely on mass transfer for mass removal.

The NAPL soil boring program summarized in BBL (2003) and the NAPL volume calculations presented by BBL (2004; Appendix E to this FS) can be used to estimate the volume of residual NAPL remaining in the subsurface following application of hydraulic displacement. This estimate is summarized in Table 2 below, and is considered more reliable than an estimate of the volume of NAPL removed during application of hydraulic displacement. As discussed in BBL (2004; Appendix E to this FS), the ONOGU can be subdivided into four overall zones. Zones 1, 2 and 4 are assumed to contain pooled NAPL, while Zone 3 is assumed to contain only residual NAPL. Table 2 assumes that all pooled NAPL zones will be reduced to residual saturation levels, taken to be 25% of pore space. The total volumes of DNAPL remaining in the four zones following application of hydraulic displacement (see column 5) are therefore 61.2 m^3 (Zone 1), 162.8 m^3 (Zone 2), 20 m^3 (Zone 3), and 12.5 m^3 (Zone 4) for a combined total volume of DNAPL left in place throughout the ONOGU following hydraulic displacement of 256.5 m^3 (68,000 gallons).

As discussed above, the estimate of how much DNAPL is left behind as residual following application of hydraulic displacement is more reliable than the estimate of how much will be removed during hydraulic displacement. This stems from the fact that the exact saturation of pooled NAPL was not measured during the 2003 boring program, and from uncertainty regarding the spatial continuity of DNAPL pools. It is reasonable to assume, however, that hydraulic displacement will not be able to reduce DNAPL saturations below 25% of pore space. This residual saturation value, in conjunction with the area within which DNAPL has been observed, are the primary values used to estimate the volume of NAPL remaining after application of hydraulic displacement. Table 1 suggests that the maximum amount of DNAPL that will be recovered as a result of hydraulic displacement is 200 m^3. This should be taken as a maximum value for purposes of designing treatment facilities.

Table 2 – Volume of DNAPL remaining in place following application of hydraulic displacement (column 5)

Zone	Initial Residual (m^3)[1]	Initial Pooled (m^3)[1]	Pool Thickness (m)[1]	Post HD Residual (m^3)[2]	Volume Recovered by HD (m^3)	Zone Area (m^2)
1	23	72	0.46	61.2	33.8	1208
2	43	286	0.67	162.8	166.2	2601
3	20	0	0	20	0	836
4	8	5	0.15	12.5	0.5	437
Totals	94	363		256.5	200.5	5082

NOTES: 1 – initial (before hydraulic displacement) residual NAPL volume, pooled NAPL volume, and pool thickness based on BBL, 2004 (Appendix E to this FS).

2 – post hydraulic displacement (HD) NAPL volume assumes that pooled zones have been reduced to a NAPL saturation of 25% pore space. Entry in this column of the table includes the initial residual NAPL volume as well (assumed to be un-altered by application of hydraulic displacement). Calculations assume a porosity of 0.275.

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Attachment I-1

Hydraulic Displacement Modeling

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment I-1 – Hydraulic Displacement Modeling

1. General

This attachment describes two-dimensional, steady-state, groundwater flow modeling performed by Blasland, Bouck & Lee, Inc. (BBL) to support the completion of the Feasibility Study (FS) for the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. Specifically, this attachment presents WinTran™ modeling that was used to develop a conceptual hydraulic displacement system design.

Hydraulic displacement is being considered to address pooled non-aqueous phase liquids (NAPLs) within the Observed NAPL in Overburden Groundwater Unit. If implemented, the purpose of the hydraulic displacement system will be to enhance the horizontal component of the hydraulic gradient within the Observed NAPL in Overburden Groundwater Unit to remove NAPL pools and/or deplete them to a residual (i.e., immobile) distribution. To enhance the horizontal component of the hydraulic gradient, water would be injected or extracted from alternating lines of wells within the Observed NAPL in Overburden Groundwater Unit. It is presumed that the extracted groundwater would be treated using the existing NTCRA 1 groundwater treatment system. The source of Injected water may be effluent from the NTCRA 1 groundwater treatment system or else water from the public, potable water system.

2. Purpose for Modeling

The purpose for the modeling presented in this attachment was to estimate the following conceptual design parameters pertinent to a potential hydraulic displacement system:

- number and spacing of injection and extraction wells;
- hydraulic gradients and groundwater travel times between injection and extraction points;
- drawdown and potentiometric rise associated with pumping; and
- total combined pumping rates and per-well pumping rates.

While additional modeling may be performed during the remedial design for the hydraulic displacement system, if implemented, the simulation results presented herein are considered suitable for evaluating hydraulic displacement in the FS Report.

3. Modeling Methods

BBL used WinTran™ software (Version 1.12, Environmental Simulations, Inc., 1995) for the groundwater flow modeling described herein. WinTran™ is a two-dimensional, analytic element flow and numerical solute transport model. All flow simulations and particle tracking simulations assumed steady-state flow conditions.

As shown on Figure 1, the conceptual hydraulic displacement system includes parallel lines of injection wells and extraction wells covering the Observed NAPL in Overburden Groundwater Unit. To facilitate the modeling process, BBL used head-specified linesinks to represent lines of injection or extraction wells. WinTran™ calculates the pumping rate of each linesink, hydraulic head and gradient values, and groundwater travel distance for particle pathlines. The model input parameters are summarized in the notes in Table 1.

To assist in model setup, BBL performed preliminary calculations to estimate the appropriate potentiometric drawdown or rise at each line of extraction or injection wells required to achieve a hydraulic gradient of approximately 0.16 across the Observed NAPL in Overburden Groundwater Unit. It is expected that, with a spacing of 50 feet between injection and withdrawal wells and gradients of 0.16, the duration of hydraulic displacement should be limited to 100 days with periods of peak NAPL production within the first 50 days (Kueper, May 2004).

4. Modeling Results

Well Number and Spacing

Table 1 and Figures 1 through 5 summarize the WinTran™ simulation results. The conceptual hydraulic displacement system includes 37 injection wells and 41 extraction wells arrayed in lines, with a well spacing of 40 feet within each line. The separation between lines in the direction parallel to the pre-pumping hydraulic gradient ranged from 10 to 55 feet. Figure 6 shows the conceptual hydraulic displacement system on the basemap of the Observed NAPL in Overburden Groundwater Unit.

Hydraulic Gradients and Groundwater Travel Times

The simulated hydraulic head contours shown on Figure 1 illustrate that the model predicted a uniform distribution of hydraulic gradients throughout the Observed NAPL in Overburden Groundwater Unit. Calculated hydraulic gradients generally ranged from approximately 0.1 to 0.2 feet per foot, as summarized in Table 1. Over the majority of the Observed NAPL in Overburden Groundwater Unit, the calculated hydraulic gradient was approximately 0.16 to 0.17 feet per foot. The maximum predicted groundwater travel time between adjacent lines of injection and extraction lines wells ranged from 15 to 25 days, as summarized on Figures 2 through 5, respectively.

Drawdown and Rise in Extraction and Injection Wells

The drawdown within the extraction wells ranged from 5 to 15 feet. The potentiometric rise within the injection wells ranged from 0 to 5 feet. These potentiometric changes are within the range of available drawdown without causing a well to pump dry or without causing a potentiometric rise above ground surface. The maximum drawdown was at Line J (in the NTCRA 1 containment area), where the saturated overburden thickness is approximately 25 feet. Over the majority of the area with simulated pumping wells, the average saturated overburden thickness is only 8 feet, which was assumed as an overall average thickness in the model. The well efficiency was assumed to be 50%, such that the head changes specified in the model were actually one half of the expected in-well potentiometric changes discussed above.

Pumping Rates

The total combined pumping rates were calculated by WinTran™ as 99 gallons per minute (gpm) injection and 101 gpm extraction. The predicted average per-well injection rates ranged from 1.2 to 3.3 gpm. The predicted average per-well extraction rates ranged from 1.5 to 3.1 gpm. It is reasonable to assume that the actual per-well injection or extraction rates would vary over a larger range due to formation heterogeneity and variations based on well location within a given line.

Supplemental Simulation for Small Anomalous Area

Although a simulated gradient of 0.16 to 0.17 was achieved over the majority of the Observed NAPL in Overburden Groundwater Unit, lower hydraulic gradients of 0.04 to 0.1 were predicted within the small area between Lines H and I. The injection rate at Line I is limited by the fact that the pre-existing water table is very close to ground surface in that area. It is postulated that, upon initial startup of the hydraulic displacement system, adjustments can made to effectively mobilize and remove NAPL pools, if any, from this area. BBL performed a supplemental WinTran™ simulation with Line I operating alone in *extraction* mode rather than injection mode. This simulation indicated that a hydraulic gradient of between 0.16 and 0.19 can be achieved within the small area between Lines H and I with an in-well drawdown of 15 feet and an estimated total combined pumping rate of 6 gpm at Line I. The associated groundwater travel time between the locations of Lines H and I was approximately 3 days.

Comparison to NTCRA 1 DNAPL Removal

The drawdown (15 feet) and pumping rate (6 gpm) in the supplemental simulation discussed above are similar to those at nearby NTCRA 1 extraction well RW-5, which was activated in July 1995. Shortly after the start-up of the NTCRA 1 Ground-Water Containment System, DNAPL was observed in the sump of extraction well RW-5. DNAPL was observed for only a few months at well RW-5, but accumulated at rates up to 2 liters per week from August 1995 through October 1995 (BBL, June 1998). These observations provide a degree of confirmation that the pumping rates and gradients discussed in this attachment should be capable of mobilizing and removing NAPL pools, or else reducing them to residual.

4. References

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TABLE 1

FEASIBILITY STUDY
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SUMMARY OF CONCEPTUAL HYDRAULIC DISPLACEMENT SYSTEM

Line of Wells (see Figure 1)	Operating Mode	Model Linesink Length (ft)	Model Linesink Flow (cfd)	Model Linesink Flow (gpm)	Number of Wells	Avg. Flow Per Well (gpm)	Conceptual Well Spacing Within Line (ft)	Distance Between Lines (ft)	Maximum Groundwater Travel Time Between Lines (days)	Hydraulic Gradient Range Btw. Lines (ft/ft)	Generalized Hydraulic Gradient Between Lines (ft/ft)	In-Well Head Change (ft)	Simulated Head Change (ft)
A	Injection	160	-1,149	-6.0	5	-1.2	40					+5.0	+2.5
								40	15	0.12- 0.17	0.16		
B	Extraction	240	3,675	19.1	7	2.7	40					-5.6	-2.8
								25	15	0.10-0.20	0.17		
C	Injection	280	-4,537	-23.6	8	-2.9	40					+5.0	+2.5
								40	15	0.12-0.22	0.17		
D	Extraction	320	5,027	26.1	9	2.9	40					-5.0	-2.5
								25	15	0.07 - 0.19	0.16		
E	Injection	360	-5,475	-28.4	10	-2.8	40					+5.0	+2.5
								40	15	0.12 - 0.20	0.16		
F	Extraction	400	6,665	34.6	11	3.1	40					-5.0	-2.5
								25	15	0.013- 0.19	0.16		
G	Injection	400	-7,000	-36.4	11	-3.3	40					+5.0	+2.5
								45	20	0.10 - 0.19	0.17		
H	Extraction	400	3,101	16.1	11	1.5	40					-8.0	-4
								10	20	0.04 - 0.10	0.06		
I	Injection	80	-879	-4.6	3	-1.5	40					0	0
								55	25	0.1 2- 0.19	0.16		
J	Extraction	80	885	4.6	3	1.5	40					-15	-7.5

Total Injection		-19,040	**-99**	**37**
Total Extraction		19,353	**101**	**41**

Notes: 1) WinTran™ model parameters:

? K = 5.8 ft/day (2.0x10-3cm/sec) -- geometric mean of K measurements at overburden wells in former Operations Area (P-1B, P-2B, P-4B, P-16, PZO-7).
? Pre-pumping hydraulic gradient = 0.04 --mean value of gradients measured between wells P-4B and P-1B, and between PZO-7 and P-16.
? Average saturated thickness = 8 feet -- representative value at overburden wells in former Operations Area, accounting for seasonal fluctuations.
Note that the actual saturated thickness increases to approximately 25 feet in the NTCRA 1 Containment Area, enabling 15 ft of drawdown at Line J.
? Travel times assume porosity of 0.3.

FIGURE 1

FEASIBILITY STUDY
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

CONCEPTUAL HYDRAULIC DISPLACEMENT SYSTEM

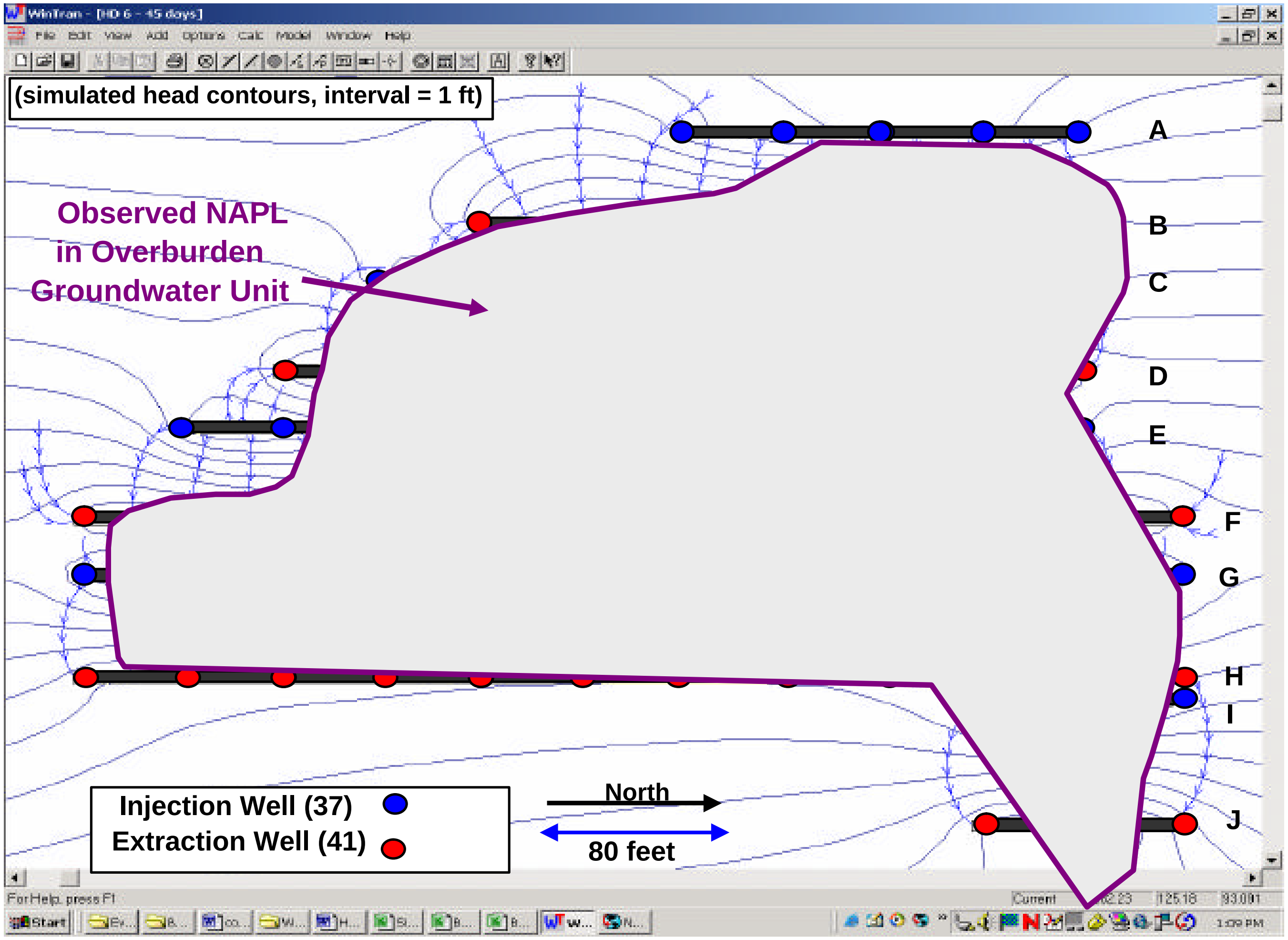

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FIGURE 2

FEASIBILITY STUDY
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SIMULATED GROUNDWATER FLOW DISTANCE - 10 DAYS

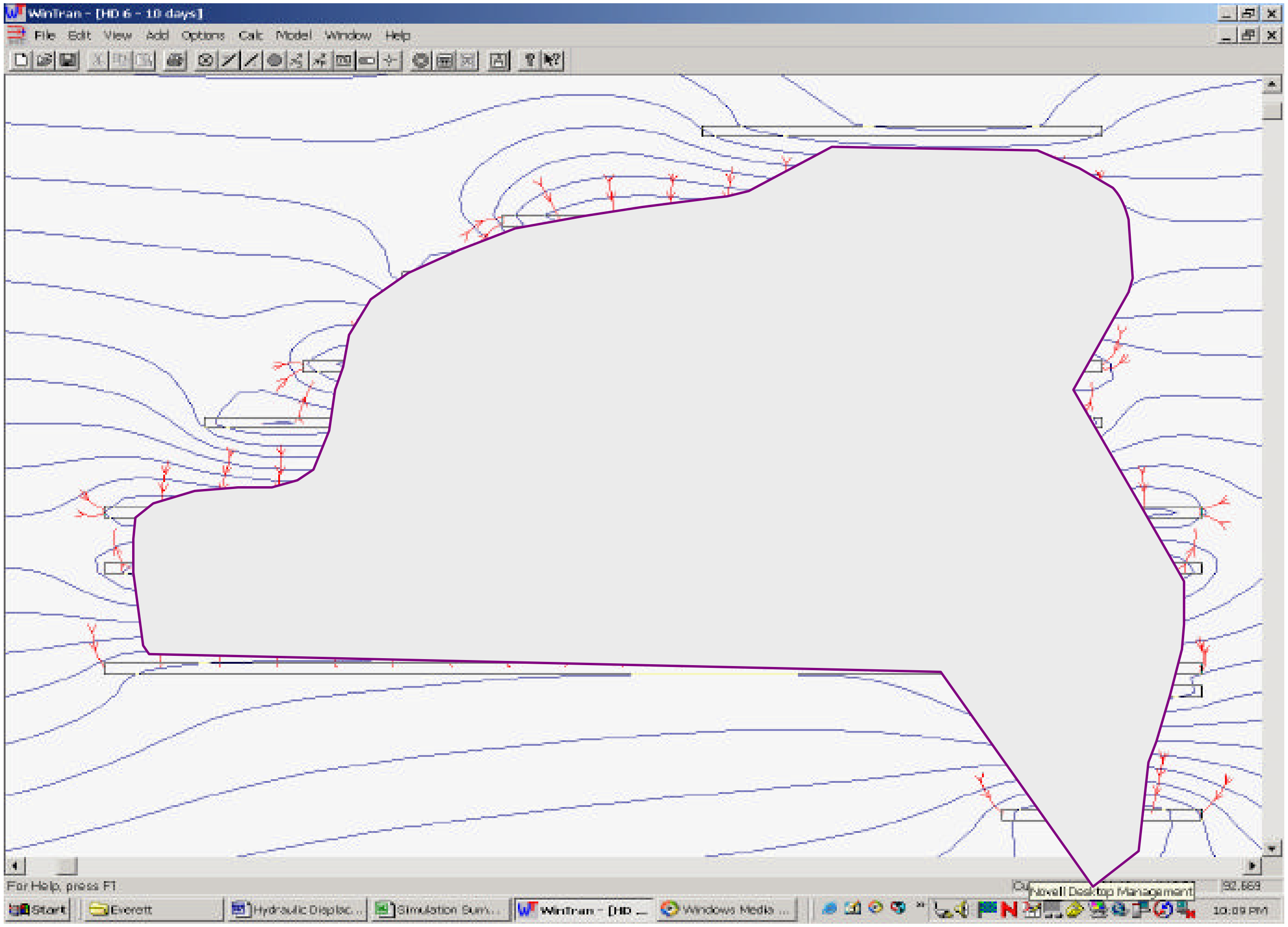

FIGURE 3

FEASIBILITY STUDY
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SIMULATED GROUNDWATER FLOW DISTANCE - 15 DAYS

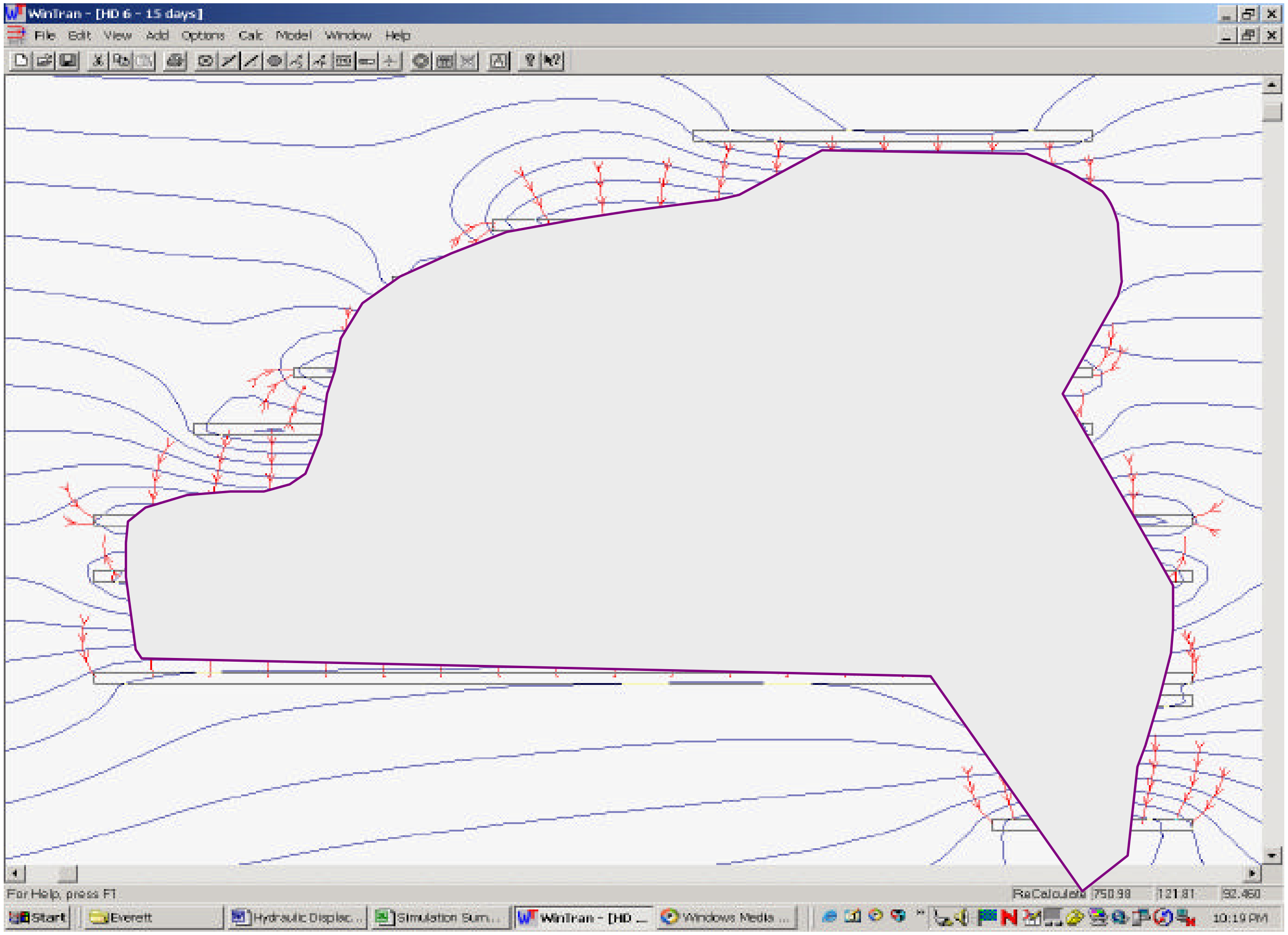

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FIGURE 4

FEASIBILITY STUDY
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SIMULATED GROUNDWATER FLOW DISTANCE - 20 DAYS

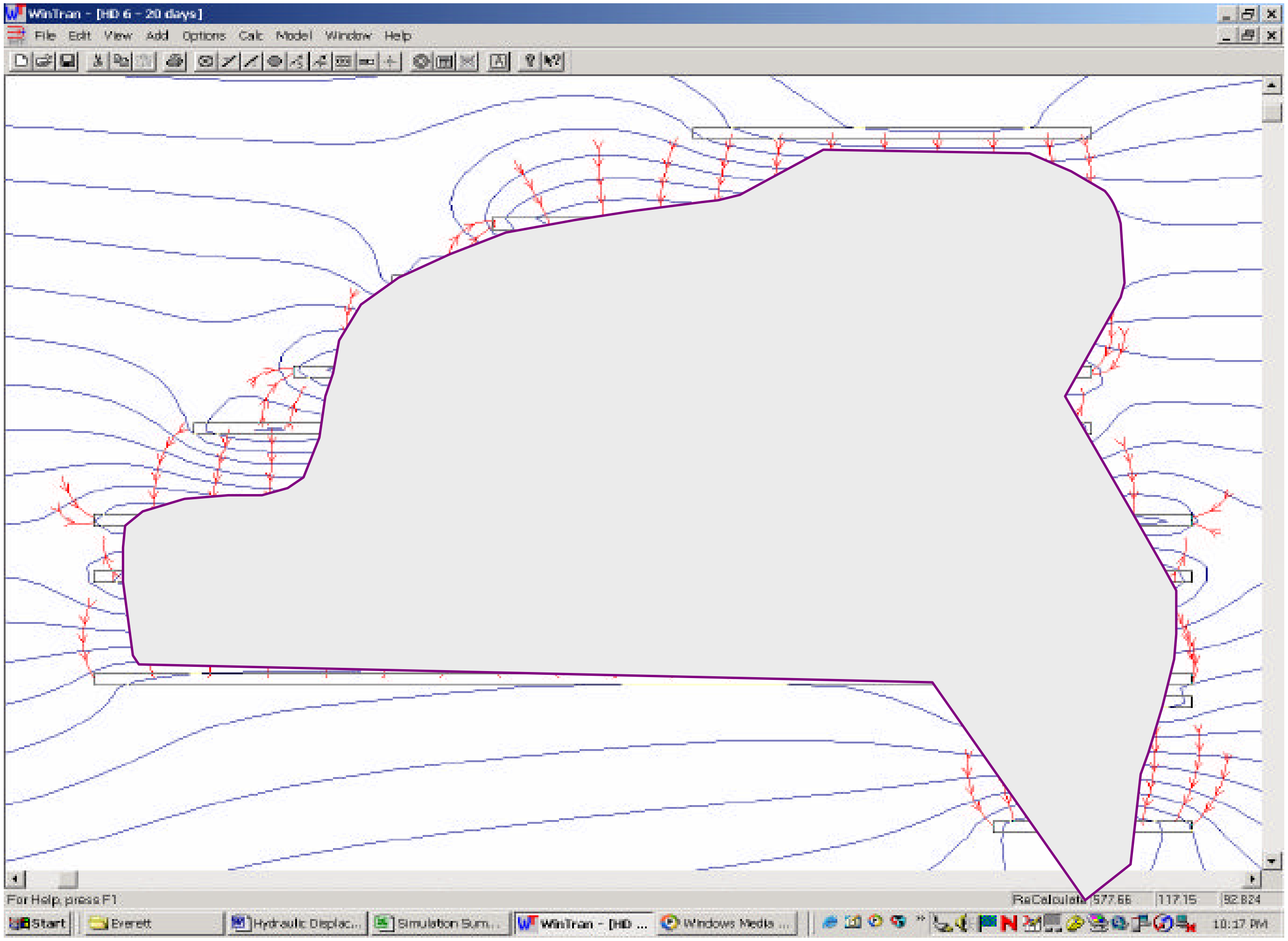

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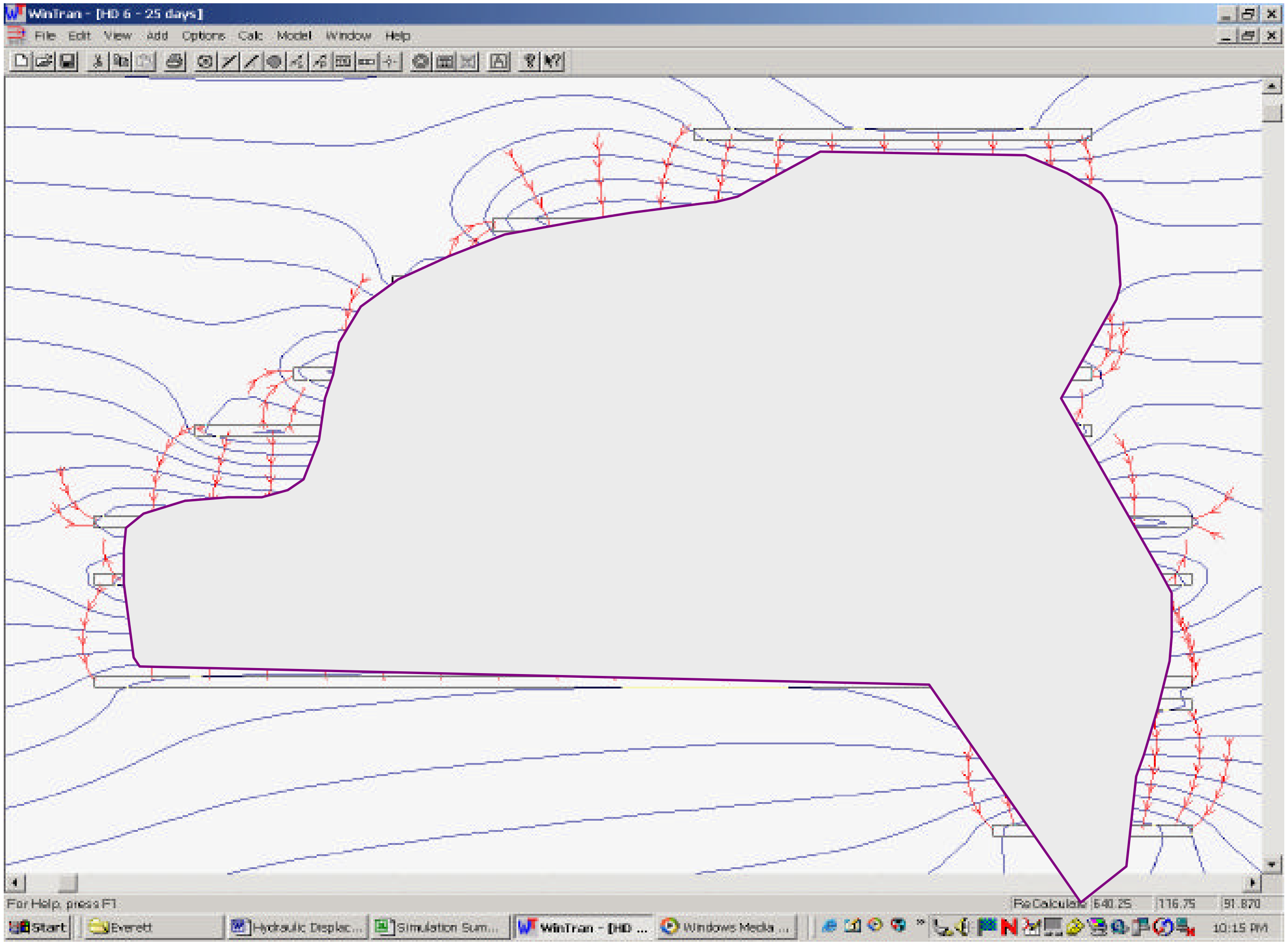
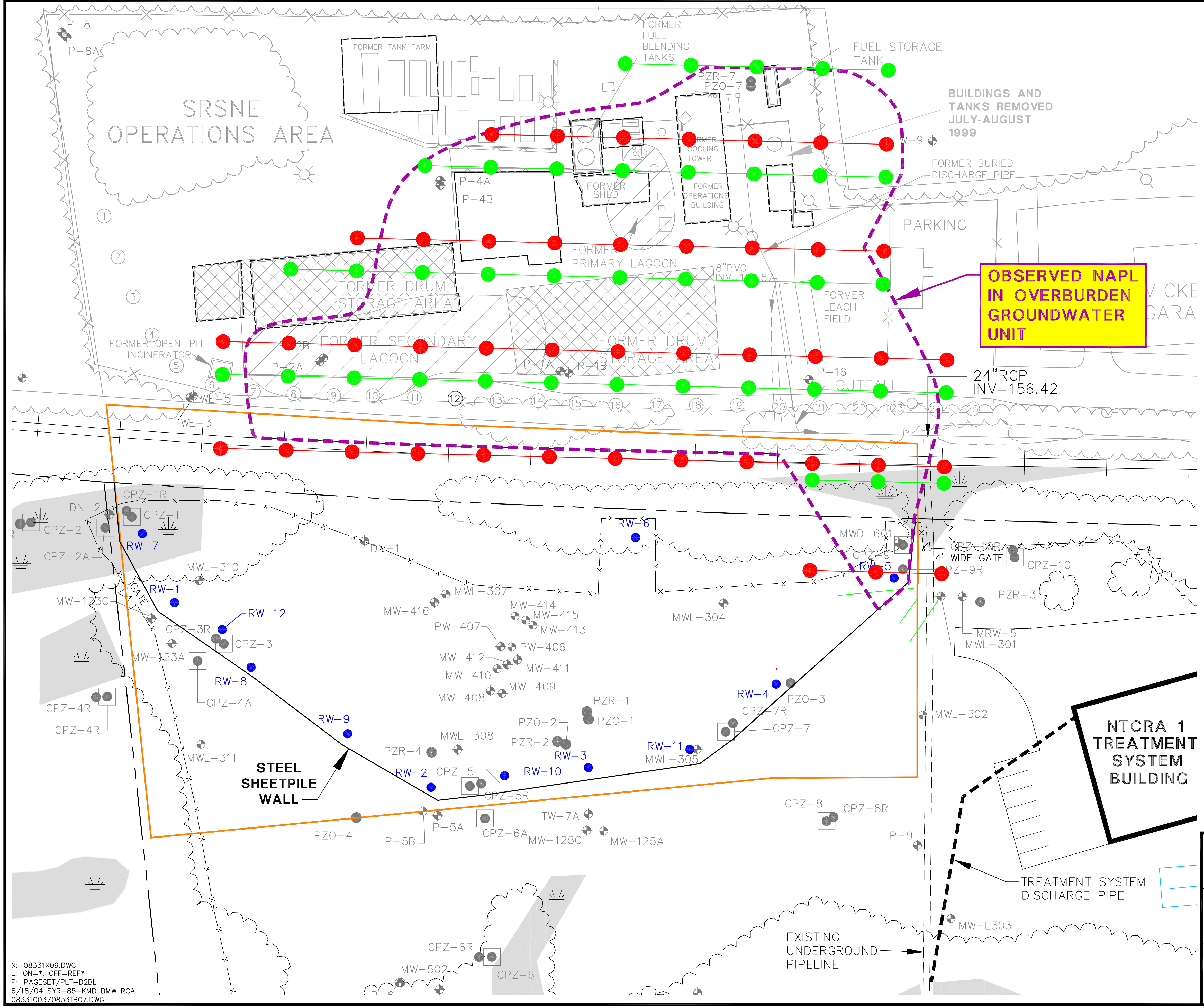
FIGURE 5

FEASIBILITY STUDY
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND SUPERFUND SITE
SOUTHINGTON, CONNECTICUT

SIMULATED GROUNDWATER FLOW DISTANCE - 25 DAYS





PROPERTY LINE
EXISTING CONCRETE PAD
WETLAND
NTCRA 1 CONTAINMENT AREA
EXISTING STRUCTURE
FENCE
P-10 MONITORING WELL
PZR-3 NTCRA 1 PIEZOMETER
CPZ-10 NTCRA 1 COMPLIANCE PIEZOMETER
● RW-1 NTCRA 1 OVERBURDEN EXTRACTION WELL
⑫ FORMER ON-SITE INTERCEPTOR INTERCEPTOR SYSTEM EXTRACTION WELL
🟢 PROPOSED INJECTION WELL
🔴 PROPOSED EXTRACTION WELL

NOTES:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY.
3. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.
4. LOCATIONS OF PTB BORINGS AND CONCRETE PADS SURVEYED BY CONKLIN & SOROKA, NOVEMBER 2003.

0 30' 60'
GRAPHIC SCALE

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

FEASIBILITY STUDY

CONCEPTUAL HYDRAULIC DISPLACEMENT SYSTEM

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
6

X: 08331X09.DWG
L: ON=*, OFF=REF*
P: PAGESET/PLT-D2BL
6/18/04 SYR-85-KMD DMW RCA
08331003/08331B07.DWG

Appendix J

Human Health Risk Assessment Update

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Appendix J - Human Health Risk Assessment Update

J.1 Introduction

This report presents an update to the HNUS (1994) baseline human health risk assessment (RA) for the Solvents Recovery Service of New England, Inc., (SRSNE) Site in Southington, Connecticut. The HNUS (1994) RA was conducted prior to the collection of additional RI data (BBL, June, 1998), and evaluated potential risks posed by organic and inorganic constituents in ground water and soils at the Site. The purpose of the RA update is to incorporate data collected subsequent to the HNUS (1994) RA and to apply current risk assessment guidance that was not available to HNUS during the preparation of the Baseline RA. The RA update evaluates those exposure pathways identified as posing the highest potential risks in the Baseline RA (ingestion of ground water and incidental ingestion of soil). Risks associated with dermal contact with surface and subsurface soils are also evaluated. Potential risks associated with human exposure to sediment and surface water of the Quinnipiac River are not quantitatively evaluated. These media are briefly described in Section J.4 and in the Ecological Risk Assessment for the site (See Section 1.5.2 of the Feasibility Study).

Three areas of concern are evaluated for potential exposure to ground water: the Operations Area Plume, Queen Street Plume and the Upgradient Area. Risks associated with exposure to surface soils are evaluated for both the North and South Cianci Properties. Subsurface soils are not evaluated for the North and South Cianci Properties due to the paucity of subsurface soil data for these locations, and because institutional controls will soon be in place that will prohibit subsurface excavation. Subsurface soils are evaluated for the Operations Area/Railroad Gradient only. In addition to residential exposure scenarios used in the Baseline RA, the RA update evaluates an industrial/commercial land scenario for surface soils of the North and South Cianci Properties and subsurface soils of the Operations Area/Railroad Property (based on a future excavation scenario). Soils for the Town Well Field Property are not evaluated in the RA update because human health risks were previously found to be below levels of concern (HNUS, 1994), and detected chemical concentrations were below Region 9 Preliminary Remediation Goals (PRGs) for residential soil (See Attachment J-1).

The RA update calculates exposure point concentrations according to USEPA (1989;1992) guidance. The HNUS (1994) Baseline RA used the arithmetic mean and maximum detected concentrations for each medium to characterize central tendency and reasonable maximum exposure, respectively. For soils, the RA update uses the 95% upper confidence limit (UCL) on the arithmetic mean concentration or the maximum detected concentration, whichever is less. This approach is consistent with USEPA (1989) and USEPA (1992) guidance. For ground water, the RA update calculates ground-water exposure point concentrations as the highest average concentration observed from all wells, when concentrations in each well are averaged over the period in which the well was sampled, consistent with USEPA (1994) Region 1 Guidance (Risk Update 2).

The human health RA process consists of the following four steps: 1) data evaluation to identify site-related chemicals of interest; 2) exposure assessment to determine potential exposure pathways and quantify the magnitude of potential exposure; 3) toxicity assessment to determine what types of effects are associated with exposures in general; and 4) risk characterization to quantify cancer and non-cancer risks associated with the specific exposure at this site. Tabulated information and results of the risk evaluation are presented in USEPA (1998) RAGS Part D format. Consideration of Connecticut Regulatory Standard Requirements (RSRs), and their significance are noted in other Sections of the Feasibility Study (Section 2.3 and 2.4, and Appendix N).

J.2 Data Evaluation

The analytical data used in the RA update consist of the ground-water data for the Operations Area Plume, Queen Street Plume and the Upgradient Area, surface soils data for the North and South Cianci Properties, and subsurface soils data for the Operations Area/Railroad Gradient. Surface soils are characterized as being less than two feet, and subsurface soils are defined as two feet to ten feet or to the water table, whichever is shallower. Ground-water and soils data include data presented in the HNUS RI Report (May 1994) and subsequent data collected by ENSR (June 1994) and BBL (1998, 1999). Data used in the RA update are presented in Tables J1-A to J1-M.

In accordance with USEPA (1994) guidance, exposure point concentrations for ground water are the highest average concentration observed from all wells, when concentrations observed in each well are averaged over the period in which it the well sampled. However, due to the paucity of data for the Queen Street Plume and Upgradient Area, the maximum detected concentration is used as the exposure point concentration. Exposure point concentrations for soils are the lesser of the 95% UCL on the arithmetic mean or the maximum detected concentration. RAGS Part D Tables 2.1 to 2.6 show all constituents identified in ground water. Constituents detected in surface soils at the North and South Cianci Properties and subsurface soils of the Operations Area/Railroad Gradient are presented in RAGS Part D Tables 2.7 to 2.9.

Chemicals were selected as a chemical of potential concern (COPC) if they exceeded Region 9 PRGs for tap water or residential soil. At the request of USEPA (1999a), one-fifth of the PRG was used for non-carcinogens (HQ=0.2) to account for potential risks due to multiple compounds. Compounds were not considered COPC if they were detected in less than 5% of the samples, were an essential nutrient, or were observed at levels less than the Region 9 PRGs. In addition, when Region 9 PRGs were not available, and there was a USEPA Maximum Contaminant Level (MCL) for ground water or Connecticut Direct Exposure Criterion (DEC) for soils, chemical concentrations were screened against these latter values. For example, because there was no Region 9 PRG for lead, lead in ground water was screened against the MCL for lead. COPC retained for evaluation are presented in RAGS Part D Tables 3.1 to 3.6 (ground water) and RAGS Part D Tables 3.7 to 3.9 (soils).

J.3 Toxicity Assessment

The toxicity assessment identifies the potential effects that are generally associated with exposure to a given chemical. USEPA evaluates two types of potential toxic effects: carcinogenic effects and non-carcinogenic effects. To quantify carcinogenic effects, USEPA has derived cancer slope factors (SFs) for those chemicals found to cause a dose-related, statistically-significant increase in tumors relative to the numbers of tumors observed in an unexposed population, usually as determined in a laboratory animal study. SFs are typically developed based on oral toxicity studies and are reported as risk per dose in units of inverse milligrams per kilogram body weight per day [$(\text{mg/kg-day})^{-1}$]. SFs are used to quantify the potential risk of cancer associated with a given exposure.

To quantify non-carcinogenic effects, USEPA has derived oral references doses (RfDs) by determining dose-specific effect levels from the available quantitative studies and applying uncertainty factors. RfDs represent a threshold of toxicity and are reported in units of (mg/kg-day). RfDs are an exposure that the human population would be exposed to daily for an entire lifetime without appreciable risk of harmful effects.

The SFs and RfDs used in this RA Update are generally taken from the USEPA Integrated Risk Information System (IRIS) on-line database. Other sources of toxicity information include HEAST, NCEA, and PPRTV values as presented in the USEPA Region 9 Preliminary Remediation Goals. A summary of the RfDs and SFs used in the RA Update is presented in RAGS Part D Tables 5.1 and 6.1.

J.4 Exposure Assessment

The exposure assessment identifies the potential pathways by which people may be exposed to ground-water and soil constituents, and estimates the magnitude of that exposure. This process involves consideration of constituent concentrations in soils, land use, potentially exposed receptor populations and their activity patterns. A discussion of chemical fate and transport, land use patterns and demographics, toxicity profiles, and similar information was presented in the HNUS (1994) Baseline RA.

4.1 Exposure Pathways

Exposure pathways considered in the RA Update are presented in RAGS Part D Table 1. For ground water, there are no current pathways of direct human exposure. Potential future potable use of ground water under a hypothetical future use scenario is considered in evaluating potential ground-water human health risks. For soils, incidental soil ingestion and dermal contact are considered as potential routes of exposure. For surface soils, both residential (children and adults) and non-residential (trespassers, workers) receptors are considered for the North and South Cianci Properties. Residential (children and adults) and non-residential (workers) are evaluated for potential risks associated with exposure to subsurface soils of the Operations Area/Railroad Gradient. Because of the low likelihood of significant exposure, risks are not evaluated for trespassers to the Operations Area/Railroad Gradient.

Potential exposure of humans to sediment and surface water are not quantitatively evaluated in this risk assessment update. Potential risks/hazards associated with human exposure to surface water and sediment were quantified in the HNUS (1994) risk assessment and were found to be within USEPA's target range (i.e., target cancer risk level of 1×10^{-4} to 1×10^{-6} and a hazard index of 1). In addition constituent concentrations in sediment were not present at levels greater than direct contact human health criteria for sediment (i.e., CT direct contact standards for soil adjusted to reflect an exposure frequency of 36.5 days per year).

4.2 Exposure Factors

Exposure factors used in risk calculations are reported in RAGS Part D Table 4. As a conservative approach, USEPA default values are used for all exposure scenarios.

4.3 Exposure Point Concentration

An exposure point concentration is the concentration of a constituent at a location where human exposure may occur. When evaluating data, USEPA (1989) places emphasis on determining the "Reasonable Maximum Exposure" (RME), and considers the 95% upper confidence limit (UCL) of the arithmetic mean concentration to be appropriate for determining RME. The upper 95% UCL of the arithmetic mean for a lognormal distribution is calculated following the USEPA (1992) approach:

$$\mathrm{UCL} = e^{\{(\mathrm{mean} + 0.5s\ 2 + sH\ /\ \mathrm{SQRT}\ n\ -\ 1)\}}$$

Where:

UCL = 95% upper confidence limit
e = constant (base of the natural log, equal to 2.718)
mean = Arithmetic mean of transformed data
s = Standard deviation of the transformed data
H = H-statistic (Land, 1975)
n = Number of samples

For soils, arithmetic mean concentrations were determined by averaging all detected concentrations, and one-half the sample quantitation limit for samples in which the compound was not detected. Per USEPA (1989) guidance, the exposure point concentration is either the 95% UCL or the maximum detected concentration, whichever is lower. For ground water, in accordance with USEPA (1994) Region 1 Guidance, the exposure point concentrations is the highest average concentration observed from all wells, when concentrations observed in each well are averaged over the period in which the well was sampled.

4.4 Intakes

Human intakes over a period of chronic (long-term) exposure are calculated for each ground-water and soil constituent. Intakes are expressed in units of mg/kg-day, and are calculated based on the exposure point concentration and applying appropriate exposure factors which account for contact rates, exposure frequency, exposure duration, body weights, and averaging time. Intake equations and exposure factors used in this assessment, which are USEPA-recommended default values, are presented in RAGS Part D Table 4. Calculated intakes associated with potential exposure to ground water are presented in RAGS Part D Tables 7.1 to 7.6. Intakes associated with incidental ingestion and dermal contact with surface soils of the North and South Cianci Properties, and subsurface soils of the Operations Gradient/Railroad Property are presented in RAGS Part D Tables 7.7 to 7.17.

J.5 Risk Characterization

The risk characterization integrates the results of the data evaluation, toxicity assessment, and exposure assessment to evaluate potential risks associated with estimated exposures. Consistent with USEPA (1989) guidance, the potential for carcinogenic and non-carcinogenic risks are evaluated separately. A summary of cancer and non-cancer risks associated with exposure to ground water and soils is presented in Table J-2.

5.1 Non-Carcinogenic Risk

The hazard index approach is used to characterize the overall potential for non-carcinogenic effects associated with exposure to multiple chemicals. This approach assumes that subthreshold chronic exposures to multiple chemicals are additive. The hazard index is calculated as follows:

$$HI = E1/RfD1 + E2/RfD2 + \ldots + Ei/RfDi$$

Where:
HI = Hazard Index (HI)
E/RfD = Hazard Quotient (HQ)
Ei = Exposure intake for the ith chemical (mg/kg-day)

RfDi = RfD for the ith chemical

A HQ value greater than 1 indicates that a calculated exposure is greater than the RfD for a given constituent, and that there may be some potential for health concerns. Similarly, a HI greater than 1 indicates that overall exposure to all chemicals of interest may pose a threat to human health. Note, however, when a HI is greater than 1, a target organ-specific HI is calculated. This allows one to adjust the HI for all constituents based on target organ toxicity, and as a result, multiple HIs may be developed. A target organ-specific HI greater than 1 may indicate a potential threat to human health for select constituents (i.e., those that target a specific organ). The non-cancer HQs and HIs (and target organ-specific HIs) are shown in RAGS Part D Tables 9.1 to 9.17 (HQ values can only be calculated for those constituents for which RfDs have been derived [RAGs Part D Table 5.1.).

The majority of constituents in overburden and bedrock ground water for the Operations Area Plume exceed a HQ of 1, with a total HI of 1000, for overburden and bedrock ground water, indicating a potentially significant non-cancer risk under the hypothetical future potable use scenario for ground water in this area. (The highest target organ-specific HIs (for potential effects on the liver) for overburden and bedrock groundwater for this area are 600 and 700, respectively. Note, however, that the highest concentrations for the Operations Area Plume occur within the NAPL Zone under the Operations Area and former Cianci Property - other portions of the Operations Area Plume have constituent concentrations below federal drinking water standards. HQ values and the HI are below 1 for chemicals in bedrock ground water for the Queen Street Plume, indicating than non-cancer risks are not significant for ground water from this area (there are no COPC for overburden ground water for the Queen Street Plume). HQ values for ground water constituents of the Upgradient Area were slightly above and below 1, ranging from 0.5 to 7 for overburden ground water, and from 0.003 to 10 for bedrock ground water. A HI greater than 1 was determined for both overburden and bedrock ground water from this location (HI of 10 and 20, respectively), indicating a potentially significant non-cancer risk for ground water for the Upgradient Area. The highest target-organ specific HIs for overburden and bedrock groundwater for the Upgradient Area are 7 and 10, respectively.

For soils of the North and South Cianci Properties, all non-cancer HQs and HIs, for all receptors (residential and commercial/industrial) are much less than 1 (RAGS Part D Tables 9.7 to 9.14). These results indicate that constituent levels in surface soils of the North and South Cianci

Properties pose no significant non-cancer risk to human health under both residential and industrial scenarios. The majority of chemicals in subsurface soils of the Operations Area/Railroad Gradient have HQ values less than 1. However, the non-cancer HI for subsurface soils of the Operations Area/Railroad Gradient is slightly greater than or equal to 1 for adult residents and workers (HI = 2), and a HI of 20 was reported for children, indicating a potential for non-cancer risk for subsurface soils of the Operations Area.

5.2 Carcinogenic Risk

Carcinogenic risk is expressed as a probability of developing cancer over the course of a lifetime as a result of a given level of exposure. For a given chemical and route of exposure, carcinogenic risk is calculated as follows:

Risk~= E x SF

Where:

E = Exposure Intake (mg/kg-day)
SF = Slope Factor $(\text{mg/kg-day})^{-1}$

For exposure to multiple carcinogens, USEPA assumes that the total risk is equivalent to the sum of individual risks, and thus individual-chemical risks can be added together to calculate a total risk for a given receptor. (Cancer risks can only be calculated for those chemicals for which SFs have been derived [RAGs Part D Table 6.1].) Note that for constituents having a cancer risk level greater than 1×10^{-2} (e.g., some constituents detected in groundwater of the Operations Area Plume), risks were calculated using the USEPA (1989) linear low-dose model (or one-hit equation) which is more appropriate for high chemical intakes. Footnotes to RAGS Part D Tables 7.1 and 7.2 indicate for which chemicals this approach was applied. It should also be noted that cancer risks for vinyl chloride in groundwater and soil were derived using methods outlined in USEPA (2000) *Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on the Integrated Risk Information System).*

Regulatory agencies have policies and guidelines to determine the significance of these calculated risk levels. USEPA (1991) considers a risk of one in one million (10^{-6}) to one in ten thousand (10^{-4}) to be an acceptable upper limit of risk that is sufficient to protect public health. Specifically, USEPA (1991) states that "where the cumulative carcinogenic site risk to an individual based on reasonable and maximum exposure for both current and future land use is less than 10^{-4}, . . . action is generally not warranted." "USEPA uses the general 10^{-4} to 10^{-6} risk range as a target range within which the Agency strives to manage risks as part of a Superfund cleanup." However, the USEPA considers risks which fall below 10^{-6} as *de minimis*. As such, the RA update identifies risk drivers as those constituents with concentrations resulting in risks greater than 10^{-6}.

Potential carcinogenic risks associated with constituents in ground water are presented in RAGS Part D Tables 9.1-9.6. Briefly, carcinogenic risks associated with adult exposure to constituents in overburden and bedrock ground water for the Operations Area Plume are greater 10^{-6}. Total risks for overburden and bedrock groundwater were 1 x 10^{0} and 2 x 10^{0}, respectively. As previously mentioned with the non-carcinogenic risks, the highest constituent concentrations observed for the Operations Area Plume occur within the NAPL Zone under the Operations Area and former Cianci Property - other portions of the Operations Area Plume have constituent concentrations below federal drinking water standards. Potentially significant risks are associated with exposure to bedrock ground water of the Queen Street Plume (7 x 10^{-5}). COPCs were not identified in the Queen Street overburden ground water. A potentially significant cancer risk is also associated with exposure to overburden and bedrock ground water of the Upgradient Area (6 x 10^{-4}, and 1 x 10^{-4}, respectively).

Risks associated with exposure to surface soils of the North and South Cianci Properties are presented in RAGs Part D Tables 9.7 to 9.14. For the North and South Cianci Properties, risks are less than 10^{-6} under the recreational/trespasser scenario, and above 10^{-6} but less than or equal to 10^{-5} for the hypothetical residential and worker scenarios. Subsurface soils of the Operations Area/Railroad Gradient pose the greatest potential risk (1 x 10^{-3}) for residential (child) exposure (RAGS Part D Table 9.16). Total residential risk (child and adult resident) is 2 x 10^{-3}. Risks to adult residents and workers are 5 x 10^{-4} and 3 x 10^{-4}, respectively. (RAGS Part D Tables 9.15 and 9.17).

RAGS Part D Tables 10.1 to 10.17 summarize COPC with associated cancer and non-cancer hazards greater than 10^{-6} and/or greater than 1, respectively. COPC for overburden and bedrock ground-water summarized in Tables 10.1 and 10.2 include several organic solvents, PCB Aroclors, and inorganics (i.e., arsenic, barium, cadmium, chromium, manganese, and vanadium). For the Queen Street Plume, only trichloroethene is considered a COPC (bedrock groundwater).

Trichloroethene, arsenic and manganese are identified as COPC for the Upgradient Area. Lead was also identified as a COPC for both overburden and bedrock ground water for the Operations Area Plume and Upgradient Area, based on an exceedence of the MCL (15 ug/L). Risks associated with potential exposure to lead in ground water will be discussed in the following sections.

For surface soils of the North and South Cianci Properties, arsenic and benzo(a)pyrene are the only COPC identified as contributing potentially significant risk. For the Operations Area/Railroad Gradient, COPC in subsurface soil exceeding a cancer and/or non-cancer risk of 1×10^{-6} or 1, respectively, included PCB Aroclors, and dioxin/furan compounds, trichloroethene and tetrachloroethene, vinyl chloride, bis-2-ethylhexyl phthalate, arsenic, and cadmium. Lead was also detected in subsurface soils of the Operations Area/Railroad Gradient, and potential risks associated with lead exposure are discussed in Section J.6.

J.6 Uncertainty

There are sources of uncertainty in almost all aspects of the risk assessment process. These include, but are not limited to, uncertainties associated with exposure scenarios and toxicity assessment. The exposure estimates (ingestion and dermal exposure) are based on conservative USEPA default values. Actual exposures and associated risks are unlikely to be higher and may be much lower than reflected by the values in the RA Update.

Risks associated with lead were not explicitly evaluated in this RA Update, due to the fact that no RfD or slope factor is available. Typically, potential risks due to lead would be evaluated using biokinetic uptake models that were developed for residential exposure scenarios. However, risk associated with potential exposure to lead in subsurface soils of the Operations Area Gradient were not quantitatively evaluated because there is little or no potential for residential exposure, and because the arithmetic mean concentration for lead in subsurface soils is 315 mg/kg, which is below the actual Region 9 PRG of 400 mg/kg. Thus, lead in subsurface soils is unlikely to pose a significant threat to human health.

Lead was also detected in overburden and bedrock ground water of the Operations Area Plume. In this case, lead was not quantitatively evaluated because concentrations already exceeded the MCL for lead of 15 ug/L, indicating potential risk based on a future potable water scenario.

This risk assessment was originally prepared in 1999/2000, and several changes in regulatory guidance (including changes to toxicity data) have occurred. Although the risk assessment has been updated to include current toxicity data (as of January 2005) the COPC screening process was not re-done. An evaluation was, however, conducted to determine how the COPC list would potentially change if the current screening values were used (e.g., Region 9 PRGs updated October 2004).

For soils, a change in Region 9 residential PRGs was noted for acetone, benzene, 2-butanone, carbon tetrachloride, chloroform, cobalt, copper, 1,1-dichloroethane, 1,1-dichloroethene, fluorene, ethylbenzene, methylene chloride, 4-methyl-2-pentanone, di-n-octyl phthalate, tetrachloroethene, trichloroethene, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, thallium, vanadium, vinyl chloride, and xylene. Despite these changes, when these new PRG values were compared to site data (presented in RAGs Part D Table 2.7 to 2.9) the only change in COPCs were for vanadium and 1,1-dichloroethene. Using the updated Region 9 PRGs, vanadium would be considered a COPC for all areas, and 1,1-dichloroethene would no longer be considered COPC for the Operations Area/Railroad Gradient. These changes would not significantly affect the conclusions of the risk assessment update.

The above exercise was not performed for groundwater due to the number of COPCs and the generally higher groundwater concentrations and potential risks (e.g., overburden and bedrock groundwater of the Operations Area Plume). However, based on the above COPC evaluation for soils, it is not likely that the COPC list for groundwater would change significantly.

The total dioxin residential risk presented for soils of the Operation Area is 1 x 10^{-4} and is based on a cancer slope factor of 1.5 x 10^{5} (mg/kg-day)$^{-1}$. USEPA has proposed a draft slope factor of 1 x 10^{6} (mg/kg-day)$^{-1}$. If this new draft slope factor was applied to soils of the Operations Area/Railroad Property, cancer risks would be about 7 x 10^{-4}.

Risks associated with potential exposure to trichloroethene were quantified using a slope factor of 0.4 (mg/kg-day)$^{-1}$. While the carcinogenicity assessment and toxicity data for trichloroethene has been withdrawn from IRIS, USEPA currently recommends a slope factor range of 0.4 (mg/kg-day)$^{-1}$ to 0.02 (mg/kg-day)$^{-1}$ be used for evaluating risks associated with this constituent. Because this RA Update quantified risks using the upper-bound slope factor of 0.4 (mg/kg-day)$^{-1}$, the calculated risks are about 20 times higher than they would be if the lower bound slope factor of 0.02 (mg/kg-day)$^{-1}$ was used.

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Data Tables

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**CPZ-1**	**CPZ-2**	**CPZ-2A**	**CPZ-3**	**CPZ-4**	**CPZ-4A**	**CPZ-5**	**CPZ-6**	**CPZ-6A**	**CPZ-7**	**CPZ-8**
Sample Date	**12/19/1996**	**12/26/1996**	**12/19/1996**	**12/19/1996**	**12/26/1996**	**12/19/1996**	**12/26/1996**	**12/20/1996**	**12/26/1996**	**12/19/1996**	**12/20/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	20 U	**26 D**	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	**13**
1,1,2-Trichloroethane	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	**10**
1,1-Dichloroethane	20 U	**27**	**63**	**2,700**	10 U	100 U	1,000 U	50 U	5,000 U	**76**	**10**
1,1-Dichloroethene	20 U	**2.0**	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
1,2-Dichlorobenzene	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
1,2-Dichloroethane	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
1,2-Dichloroethene, Total	**30 J**	13 U	10 U	**1,800**	20 U	200 U	2,000 U	100 U	10,000 U	100 U	**44**
1,4-Dichlorobenzene	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
2-Butanone	**1,000**	5.0 U	25 U	2,500 U	50 U	500 U	5,000 U	250 U	**470,000**	250 U	12 U
4-Methyl-2-pentanone	100 U	5.0 U	25 U	2,500 U	50 U	500 U	5,000 U	**480**	**57,000**	250 U	12 U
Acetone	220 U	5.0 U	25 U	2,500 U	50 U	500 U	5,000 U	250 U	**320,000**	250 U	12 U
Benzene	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	**82**	5,000 U	50 U	**4.0**
Carbon disulfide	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
Carbon tetrachloride	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
Chlorobenzene	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
Chloroethane	20 U	**2.0**	**10**	**1,500**	**160**	**2,300**	**1,400**	**440**	5,000 U	**580**	**22**
Chloroform	**39**	1.0 U	**9.0**	**1,100**	10 U	**98 J**	1,000 U	50 U	5,000 U	50 U	2.0 U
Chloromethane	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
cis-1,2-Dichloroethene	**25**	12 U	5.0 U	**1,700**	10 U	100 U	1,000 U	50 U	5,000 U	50 U	**40**
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	20 U	**10**	**7.0**	**2,700**	**130**	**2,200 D**	**3,900**	**3,600 EJ**	**6,000**	**240**	**55**
M,P-Xylene	40 U	**3.0**	**5.0 J**	**460 J**	**20**	**520**	**2,000**	**1,800**	10,000 U	**410**	**110**
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	40 U	2.0 U	10 U	1,000 U	33 U	200 U	2,600 U	100 U	8,300 U	100 U	5.0 U
O-Xylene	20 U	1.0 U	5.0 U	500 U	10 U	**140**	1,000 U	**490**	5,000 U	50 U	**20**
Styrene	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
Tetrachloroethene	20 U	**3.0**	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	**250 D**
Tetrahydrofuran	200 U	10 U	50 U	5,000 U	**82 J**	1,000 U	10,000 U	**2,200**	**52,000**	500 U	25 U
Toluene	20 U	8.0 U	**12**	**5,300**	16 U	**3,500 D**	**11,000**	**6,100 EJ**	14,000 U	50 U	**61 D**
trans-1,2-Dichloroethene	20 U	1.0 U	5.0 U	500 U	10 U	100 U	1,000 U	50 U	5,000 U	50 U	2.0 U
Trichloroethene	20 U	**11**	5.0 U	500 U	10 U	220 U	1,000 U	**360**	5,000 U	50 U	**250 D**
Vinyl chloride	20 U	**8.0**	5.0 U	**1,500**	10 U	100 U	1,000 U	50 U	5,000 U	50 U	**56**
Xylenes, Total	40 U	**4.0**	**8.0 J**	**920 J**	**22**	**710**	**2,600**	**2,100**	10,000 U	**550**	**110**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**CPZ-1** **12/19/1996** **S**	**CPZ-2** **12/26/1996** **S**	**CPZ-2A** **12/19/1996** **S**	**CPZ-3** **12/19/1996** **S**	**CPZ-4** **12/26/1996** **S**	**CPZ-4A** **12/19/1996** **S**	**CPZ-5** **12/26/1996** **S**	**CPZ-6** **12/20/1996** **S**	**CPZ-6A** **12/26/1996** **S**	**CPZ-7** **12/19/1996** **S**	**CPZ-8** **12/20/1996** **S**
Ethanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U
Isopropanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	**160,000**	1,000 U	1,000 U
Methanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U
Sec-Butanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	**200,000**	1,000 U	1,000 U
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**CPZ-9**	**CPZ-10**	**CW-1-78**	**CW-1-78**	**CW-3-75**	**CW-3-78**	**CW-3-78**	**CW-3-78**	**CW-4-75**	**CW-4-75**	**CW-4-78**
Sample Date	**12/20/1996**	**12/20/1996**	**3/22/1995**	**11/20/1996**	**11/21/1996**	**3/22/1995**	**3/22/1995**	**11/20/1996**	**11/21/1996**	**12/1/1998**	**11/20/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**260 D**	**3.0**	5.0 U	1.0 U	1.0 U	5.0 U	**4.0 J**	1.0 U	**2.0**	1.0 U	1.0 U
1,1,2-Trichloroethane	**16**	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**280 EJ**	1.0 U	**6.0**	**2.0**	1.0 U	5.0 U	5.0 U	**5.0**	1.0 U	1.0 U	**4.0**
1,1-Dichloroethene	**37**	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	5.0 U	1.0 U	--	1.0 U	1.0 U	--	--	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene, Total	**2,300 D**	**21**	5.0 U	**2.0**	2.0 U	5.0 U	5.0 U	**0.70 J**	2.0 U	2.0 U	**1.0 J**
1,4-Dichlorobenzene	5.0 U	1.0 U	--	1.0 U	1.0 U	--	--	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	25 U	5.0 U	25 U	21 U	20 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	25 U	5.0 U	25 U	5.0 U	5.0 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	25 U	5.0 U	25 U	6.0 U	**8.0**	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon disulfide	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon tetrachloride	**90**	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**37**	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	8.0 U	1.0 U	10 U	1.0 U	1.0 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**2,200 D**	**19**	--	**2.0**	1.0 U	--	--	**0.70 J**	1.0 U	1.0 U	**1.0**
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**99**	**5.0**	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**220**	**4.0**	--	2.0 U	2.0 U	--	--	2.0 U	2.0 U	2.0 U	2.0 U
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	2.0 U	10 U	2.0 U	2.0 U	10 U	10 U	2.0 U	2.0 U	2.0 U	1.0 U
O-Xylene	**90**	1.0 U	--	1.0 U	1.0 U	--	--	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**540 D**	**2.0**	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	50 U	10 U	25 U	10 U	10 U	25 U	25 U	10 U	10 U	1.0 U	10 U
Toluene	**250 D**	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	5.0 U	1.0 U	--	1.0 U	1.0 U	--	--	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**580 D**	**9.0**	5.0 U	2.0 U	2.0 U	5.0 U	5.0 U	3.0 U	2.0 U	1.0 U	2.0 U
Vinyl chloride	**1,100 D**	1.0 U	10 U	1.0 U	1.0 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylenes, Total	**280**	**3.0**	5.0 U	2.0 U	2.0 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U

See notes pages.

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**CPZ-9**	**CPZ-10**	**CW-1-78**	**CW-1-78**	**CW-3-75**	**CW-3-78**	**CW-3-78**	**CW-3-78**	**CW-4-75**	**CW-4-75**	**CW-4-78**
Sample Date	**12/20/1996**	**12/20/1996**	**3/22/1995**	**11/20/1996**	**11/21/1996**	**3/22/1995**	**3/22/1995**	**11/20/1996**	**11/21/1996**	**12/1/1998**	**11/20/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**
Ethanol	1,000 U	1,000 U	--	1,000 U	1,000 U	--	--	1,000 U	1,000 U	--	1,000 U
Isopropanol	1,000 U	1,000 U	--	1,000 U	1,000 U	--	--	1,000 U	1,000 U	--	1,000 U
Methanol	1,000 U	1,000 U	--	1,000 U	1,000 U	--	--	1,000 U	1,000 U	--	1,000 U
Sec-Butanol	1,000 U	1,000 U	--	1,000 U	1,000 U	--	--	1,000 U	1,000 U	--	1,000 U
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**CW-5-75**	**CW-5-78**	**CW-5-78**	**CW-6-75**	**CW-6-78**	**CW-7-75**	**CW-B-77**	**CW-B-77**	**CW-B-77**	**DN-1**	**DN-1**
Sample Date	**11/20/1996**	**3/22/1995**	**11/21/1996**	**11/20/1996**	**11/21/1996**	**3/21/1995**	**12/13/1990**	**12/11/1996**	**12/2/1998**	**6/26/1990**	**12/13/1990**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	1.0 U	5.0 U	1.0 U	1.0 U	**2.0**	5.0 U	**20**	**24**	**14**	100 U	2.0 U
1,1,2-Trichloroethane	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	1.0 U	1.0 U	100 U	2.0 U
1,1-Dichloroethane	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	**16**	**13**	**10**	100 U	2.0 U
1,1-Dichloroethene	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	**4.0**	**2.0**	100 U	2.0 U
1,2-Dichlorobenzene	1.0 U	--	1.0 U	1.0 U	1.0 U	--	2.0 U	1.0 U	1.0 U	--	2.0 U
1,2-Dichloroethane	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	1.0 U	1.0 U	100 U	2.0 U
1,2-Dichloroethene, Total	2.0 U	5.0 U	**2.0**	**5.0**	**2.0**	5.0 U	--	11 U	**5.0**	--	--
1,4-Dichlorobenzene	1.0 U	--	1.0 U	1.0 U	1.0 U	--	2.0 U	1.0 U	1.0 U	--	2.0 U
2-Butanone	5.0 U	25 U	7.0 U	5.0 U	24 U	25 U	20 U	**9.0**	5.0 U	200 U	20 U
4-Methyl-2-pentanone	5.0 U	25 U	5.0 U	5.0 U	5.0 U	25 U	--	5.0 U	5.0 U	**44 J**	--
Acetone	5.0 U	25 U	**6.0**	**6.0**	7.0 U	25 U	--	5.0 U	5.0 U	200 U	--
Benzene	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	1.0 U	1.0 U	100 U	**9.1**
Carbon disulfide	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	--	**1.0**	1.0 U	100 UJ	--
Carbon tetrachloride	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	1.0 U	1.0 U	100 U	2.0 U
Chlorobenzene	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	1.0 U	1.0 U	100 U	**8.0**
Chloroethane	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	1.0 U	**240**	**83**
Chloroform	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	1.0 U	1.0 U	100 U	2.0 U
Chloromethane	1.0 U	10 U	1.0 U	1.0 U	1.0 U	10 U	10 U	1.0 U	1.0 U	200 U	10 U
cis-1,2-Dichloroethene	1.0 U	--	**1.0**	**5.0**	**2.0**	--	--	11 U	**5.0**	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	**11**	1.0 U	**1,500**	2.0 U
M,P-Xylene	2.0 U	--	2.0 U	2.0 U	2.0 U	--	--	**9.0**	2.0 U	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	2.0 U	10 U	**2.0**	2.0 U	2.0 U	10 U	2.0 U	2.0 U	**2.0**	100 U	2.0 U
O-Xylene	1.0 U	--	1.0 U	1.0 U	1.0 U	--	--	**2.0**	1.0 U	--	--
Styrene	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	--	1.0 U	1.0 U	100 U	--
Tetrachloroethene	1.0 U	5.0 U	1.0 U	**6.0**	1.0 U	5.0 U	2.0 U	**2.0**	1.0 U	100 U	2.0 U
Tetrahydrofuran	10 U	25 U	10 U	10 U	10 U	25 U	--	10 U	1.0 U	--	--
Toluene	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	2.0 U	2.0 U	1.0 U	100 U	**580**
trans-1,2-Dichloroethene	1.0 U	--	1.0 U	1.0 U	1.0 U	--	**7.8**	1.0 U	1.0 U	100 U	2.0 U
Trichloroethene	2.0 U	5.0 U	2.0 U	2.0 U	6.0 U	5.0 U	2.0 U	1.0 U	1.0 U	100 U	2.0 U
Vinyl chloride	1.0 U	10 U	1.0 U	1.0 U	1.0 U	10 U	10 U	1.0 U	1.0 U	200 U	10 U
Xylenes, Total	2.0 U	5.0 U	2.0 U	2.0 U	2.0 U	5.0 U	--	**12**	2.0 U	**81 J**	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**CW-5-75**	**CW-5-78**	**CW-5-78**	**CW-6-75**	**CW-6-78**	**CW-7-75**	**CW-B-77**	**CW-B-77**	**CW-B-77**	**DN-1**	**DN-1**
Sample Date	**11/20/1996**	**3/22/1995**	**11/21/1996**	**11/20/1996**	**11/21/1996**	**3/21/1995**	**12/13/1990**	**12/11/1996**	**12/2/1998**	**6/26/1990**	**12/13/1990**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	1,000 U	--	1,000 U	1,000 U	1,000 U	--	--	1,000 U	--	--	--
Isopropanol	1,000 U	--	1,000 U	1,000 U	1,000 U	--	500 U	1,000 U	--	--	500 U
Methanol	1,000 U	--	1,000 U	1,000 U	1,000 U	--	--	1,000 U	--	--	--
Sec-Butanol	1,000 U	--	1,000 U	1,000 U	1,000 U	--	--	1,000 U	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**DN-1**	**DN-2**	**DN-2**	**DN-2**	**DN-2**	**DN-2**	**DN-2**	**DN-3**	**DN-3**	**DN-3**	**DP-1**
Sample Date	**3/22/1995**	**6/27/1990**	**6/28/1990**	**6/28/1990**	**12/13/1990**	**12/1/1994**	**3/22/1995**	**6/28/1990**	**12/13/1990**	**12/11/1996**	**12/19/1996**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**730**	**53**	--	--	**66**	**220**	**140**	**53**	**67**	1.0 U	1.0 U
1,1,2-Trichloroethane	280 U	5.0 U	--	--	2.0 U	17 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**870**	**100**	--	--	**82**	**270**	**80**	**27**	**59**	1.0 U	1.0 U
1,1-Dichloroethene	280 U	**2.0 J**	--	--	**7.0**	17 U	**12**	**7.0**	**9.9**	1.0 U	1.0 U
1,2-Dichlorobenzene	--	--	10 U	--	2.0 U	--	--	--	2.0 U	1.0 U	1.0 U
1,2-Dichloroethane	280 U	5.0 U	--	--	2.0 U	17 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U
1,2-Dichloroethene, Total	**420**	--	--	--	--	**40**	**45**	--	--	2.0 U	2.0 U
1,4-Dichlorobenzene	--	--	10 U	10 U	2.0 U	--	--	--	2.0 U	1.0 U	1.0 U
2-Butanone	1,400 U	10 U	--	--	20 U	83 U	25 U	10 U	20 U	**120**	5.0 U
4-Methyl-2-pentanone	1,400 U	10 U	--	--	--	83 U	25 U	10 U	--	5.0 U	5.0 U
Acetone	1,400 U	11 U	--	--	--	83 U	**34**	10 U	--	20 U	6.0 U
Benzene	280 U	**1.0 J**	--	--	2.0 U	17 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U
Carbon disulfide	280 U	**3.0 J**	--	--	--	17 U	5.0 U	5.0 U	--	1.0 U	1.0 U
Carbon tetrachloride	280 U	5.0 U	--	--	2.0 U	17 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U
Chlorobenzene	280 U	5.0 U	--	--	2.0 U	17 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U
Chloroethane	**2,300**	**42**	--	--	10 U	17 U	**6.0**	10 U	10 U	1.0 U	1.0 U
Chloroform	280 U	5.0 U	--	--	2.0 U	17 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U
Chloromethane	560 U	10 U	--	--	10 U	33 U	10 U	10 U	10 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	--	--	--	--	--	--	--	--	--	1.0 U	1.0 U
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**730**	10 U	--	--	2.0 U	17 U	**3.8 J**	5.0 U	2.0 U	1.0 U	1.0 U
M,P-Xylene	--	--	--	--	--	--	--	--	--	2.0 U	2.0 U
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	560 U(b)	5.0 U	--	--	2.0 U	33 U	10 U(b)	5.0 U	2.0 U	2.0 U	2.0 U
O-Xylene	--	--	--	--	--	--	--	--	--	1.0 U	1.0 U
Styrene	280 U	5.0 U	--	--	--	17 U	5.0 U	5.0 U	--	1.0 U	1.0 U
Tetrachloroethene	280 U	5.0 U	--	--	2.0 U	17 U	5.0 U	**2.0 J**	2.0 U	1.0 U	1.0 U
Tetrahydrofuran	1,400 U	--	--	--	--	83 U	25 U	--	--	12 U	10 U
Toluene	**4,500**	32 U	--	--	2.0 U	17 U	**3.1 J**	5.0 U	2.0 U	1.0 U	**1.0**
trans-1,2-Dichloroethene	--	6.0 U	--	--	**16**	--	--	15 U	**15**	1.0 U	1.0 U
Trichloroethene	280 U	**3.0 J**	--	--	**5.9**	17 U	**8.0**	**2.0 J**	2.0 U	1.0 U	5.0 U
Vinyl chloride	**420 J**	**12**	--	--	20 U	**110**	**32**	10 U	10 U	1.0 U	1.0 U
Xylenes, Total	**910**	5.0 U	--	--	--	17 U	5.0 U	5.0 U	--	2.0 U	2.0 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**DN-1**	**DN-2**	**DN-2**	**DN-2**	**DN-2**	**DN-2**	**DN-2**	**DN-3**	**DN-3**	**DN-3**	**DP-1**
Sample Date	**3/22/1995**	**6/27/1990**	**6/28/1990**	**6/28/1990**	**12/13/1990**	**12/1/1994**	**3/22/1995**	**6/28/1990**	**12/13/1990**	**12/11/1996**	**12/19/1996**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	--	--	--	1.0 U	--	--	--	--	--	1,000 U	1,000 U
Isopropanol	--	--	--	**89**	500 U	--	--	--	500 U	1,000 U	1,000 U
Methanol	--	--	--	1.0 U	--	--	--	--	--	1,000 U	1,000 U
Sec-Butanol	--	--	--	**57**	--	--	--	--	--	1,000 U	1,000 U
1,2,4-Trichlorobenzene	--	--	10 U	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	10 U	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	50 U	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	10 U	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	10 U	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	10 U	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	50 U	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	10 U	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	10 U	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	10 U	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	10 U	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	10 U	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	10 U	--	--	--	--	--	--	--	--
Isophorone	--	--	10 U	--	--	--	--	--	--	--	--
Naphthalene	--	--	10 U	--	--	--	--	--	--	--	--
Phenanthrene	--	--	10 U	--	--	--	--	--	--	--	--
Phenol	--	--	10 U	10 U	--	--	--	--	--	--	--
Aroclor-1260	--	--	1.0 U	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**DP-2**	**DP-3**	**DP-4**	**DP-5**	**DP-6**	**MW-03**	**MW-03**	**MW-06**	**MW-06**	**MW-07**	**MW-07**
Sample Date	**12/19/1996**	**12/19/1996**	**12/19/1996**	**12/3/1996**	**12/3/1996**	**12/5/1996**	**12/2/1998**	**12/13/1990**	**12/11/1996**	**6/28/1990**	**12/13/1990**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
1,1,2-Trichloroethane	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
1,1-Dichloroethane	1.0 U	**22**	**2.0**	1.0 U	1.0 U	**2.0**	**7.0**	2.0 U	10 U	5.0 U	2.0 U
1,1-Dichloroethene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
1,2-Dichlorobenzene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	10 U	2.0 U
1,2-Dichloroethane	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
1,2-Dichloroethene, Total	**3.0**	**29**	2.0 U	2.0 U	2.0 U	**4.0**	**3.0**	--	20 U	--	--
1,4-Dichlorobenzene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	10 U	2.0 U
2-Butanone	5.0 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	20 U	**170**	10 U	20 U
4-Methyl-2-pentanone	5.0 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	--	50 U	10 U	--
Acetone	5.0 U	50 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	--	50 U	10 U	--
Benzene	**2.0**	10 U	**7.0**	1.0 U	1.0 U	**6.0**	**2.0**	**26**	**80**	**14**	**9.1**
Carbon disulfide	1.0 U	10 U	**3.0**	**11**	**7.0**	1.0 U	1.0 U	--	10 U	**28 J**	--
Carbon tetrachloride	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
Chlorobenzene	1.0 U	10 U	**3.0**	1.0 U	1.0 U	**3.0**	**1.0**	**17**	**30**	**9.0**	**15**
Chloroethane	**7.0**	10 U	**22**	1.0 U	1.0 U	**28 E**	**7.0**	**53**	**190**	**24**	**66**
Chloroform	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
Chloromethane	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U	10 U	10 U
cis-1,2-Dichloroethene	**2.0**	**29**	1.0 U	1.0 U	1.0 U	**4.0**	**3.0**	--	10 U	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**6.7**	10 U	19 U	**34**
M,P-Xylene	**3.0**	20 U	**8.0**	2.0 U	2.0 U	2.0 U	2.0 U	--	**100**	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	2.0 U	20 U	2.0 U	2.0 U	2.0 U	2.0 U	**2.0**	2.0 U	20 U	5.0 U	**3.3**
O-Xylene	1.0 U	10 U	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	--	10 U	--	--
Styrene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	--	10 U	5.0 U	--
Tetrachloroethene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
Tetrahydrofuran	**110**	100 U	**76**	10 U	10 U	10 U	1.0 U	--	**2,200 D**	--	--
Toluene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	8.0 U	**11**
trans-1,2-Dichloroethene	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	10 U	5.0 U	2.0 U
Trichloroethene	1.0 U	14 U	1.0 U	**1.0**	1.0 U	**1.0**	1.0 U	2.0 U	10 U	5.0 U	2.0 U
Vinyl chloride	1.0 U	**35**	1.0 U	1.0 U	1.0 U	**3.0**	**1.0**	10 U	10 U	10 U	10 U
Xylenes, Total	**4.0**	20 U	**10**	2.0 U	2.0 U	2.0 U	2.0 U	--	**110**	9.0 U	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**DP-2** **12/19/1996** **S**	**DP-3** **12/19/1996** **S**	**DP-4** **12/19/1996** **S**	**DP-5** **12/3/1996** **S**	**DP-6** **12/3/1996** **S**	**MW-03** **12/5/1996** **S**	**MW-03** **12/2/1998** **S**	**MW-06** **12/13/1990** **S**	**MW-06** **12/11/1996** **S**	**MW-07** **6/28/1990** **S**	**MW-07** **12/13/1990** **S**
Ethanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	--	--	1,000 U	--	--
Isopropanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	--	500 U	1,000 U	--	500 U
Methanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	--	--	1,000 U	--	--
Sec-Butanol	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	10 U	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	10 U	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	50 U	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	10 U	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	10 U	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	10 U	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	50 U	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	10 U	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	10 U	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	10 U	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	10 U	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	10 U	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	10 U	--
Isophorone	--	--	--	--	--	--	--	--	--	10 U	--
Naphthalene	--	--	--	--	--	--	--	--	--	10 U	--
Phenanthrene	--	--	--	--	--	--	--	--	--	10 U	--
Phenol	--	--	--	--	--	--	--	--	--	10 U	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	1.0 U	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-07**	**MW-07**	**MW-07**	**MW-07**	**MW-07**	**MW-08**	**MW-121B**	**MW-121B**	**MW-121B**	**MW-121B**	**MW-121B**
Sample Date	**8/28/1991**	**11/30/1994**	**3/28/1995**	**12/11/1996**	**12/11/1996**	**12/13/1990**	**12/8/1992**	**12/9/1992**	**11/30/1994**	**3/28/1995**	**12/13/1996**
Sample Type	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	**370**
1,1,2-Trichloroethane	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	100 U
1,1-Dichloroethane	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	100 U
1,1-Dichloroethene	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	100 U
1,2-Dichlorobenzene	5.0 UJ	--	--	10 U	10 U	2.0 U	--	50 U	--	--	100 U
1,2-Dichloroethane	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	100 U
1,2-Dichloroethene, Total	--	130 U	50 U	20 U	20 U	--	100 U	--	170 U	250 U	190 UJ
1,4-Dichlorobenzene	5.0 UJ	--	--	10 U	10 U	2.0 U	--	50 U	--	--	100 U
2-Butanone	R	630 U	250 U	50 U	**150**	20 U	100 U	--	830 U	1,300 U	**3,400**
4-Methyl-2-pentanone	25 UJ	630 U	250 U	50 U	50 U	--	100 U	--	830 U	1,300 U	500 U
Acetone	R	630 U	250 U	50 U	50 U	--	100 U	--	830 U	1,300 U	1,200 U
Benzene	**28 J**	130 U	**42 J**	**75**	**97**	**3.4**	**91 J**	--	170 U	250 U	**110**
Carbon disulfide	R	130 U	50 U	10 U	10 U	--	100 U	--	170 U	250 U	100 U
Carbon tetrachloride	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	100 U
Chlorobenzene	**14 J**	130 U	50 U	**28**	**38**	**3.8**	100 U	--	170 U	250 U	100 U
Chloroethane	**41 J**	130 U	**85**	**130**	**240**	**20**	**350**	--	**200**	**160 J**	**310**
Chloroform	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	100 U
Chloromethane	5.0 UJ	250 U	100 U	10 U	10 U	10 U	100 U	--	330 U	500 U	100 U
cis-1,2-Dichloroethene	5.0 UJ	--	--	10 U	10 U	--	--	--	--	--	160 U
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**35 J**	**140**	**340**	110 U	**120**	2.0 U	**720**	--	**140 J**	250 U	**120**
M,P-Xylene	--	--	--	**170**	**170**	--	--	--	--	--	**770**
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	26 UJ	250 U	100 U(b)	20 U	20 U	2.0 U	100 U	--	330 U	500 U(b)	230 U
O-Xylene	--	--	--	**11**	10 U	--	--	--	--	--	100 U
Styrene	5.0 UJ	130 U	50 U	10 U	10 U	--	100 U	--	170 U	250 U	100 U
Tetrachloroethene	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	**140**
Tetrahydrofuran	--	**3,000**	**1,700**	**2,500 D**	**2,300 D**	--	--	--	**5,500**	**5,400**	**5,100**
Toluene	5.5 UJ	130 U	**60**	13 U	10 U	2.0 U	**150**	--	170 U	250 U	**1,200**
trans-1,2-Dichloroethene	5.0 UJ	--	--	10 U	10 U	2.0 U	--	--	--	--	100 U
Trichloroethene	5.0 UJ	130 U	50 U	10 U	10 U	2.0 U	100 U	--	170 U	250 U	350 U
Vinyl chloride	5.0 UJ	250 U	100 U	10 U	10 U	10 U	100 U	--	330 U	500 U	100 U
Xylenes, Total	**42 J**	130 U	**180**	**180**	**160**	--	**1,900**	--	**530**	**200 J**	**770**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**MW-07** **8/28/1991** **S**	**MW-07** **11/30/1994** **S**	**MW-07** **3/28/1995** **S**	**MW-07** **12/11/1996** **S**	**MW-07** **12/11/1996** **D**	**MW-08** **12/13/1990** **S**	**MW-121B** **12/8/1992** **S**	**MW-121B** **12/9/1992** **S**	**MW-121B** **11/30/1994** **S**	**MW-121B** **3/28/1995** **S**	**MW-121B** **12/13/1996** **S**
Ethanol	--	--	--	1,000 U	1,000 U	--	--	--	--	--	1,000 U
Isopropanol	--	--	--	1,000 U	1,000 U	500 U	--	--	--	--	1,000 U
Methanol	--	--	--	1,000 U	1,000 U	--	--	--	--	--	1,000 U
Sec-Butanol	--	--	--	1,000 U	1,000 U	--	--	--	--	--	1,000 U
1,2,4-Trichlorobenzene	5.0 UJ	--	--	--	--	--	--	50 U	--	--	--
2,4-Dimethylphenol	**2.0 J**	--	--	--	--	--	--	50 U	--	--	--
2,4-Dinitrophenol	25 U	--	--	--	--	--	--	130 U	--	--	--
2-Methylnaphthalene	10 U	--	--	--	--	--	--	50 U	--	--	--
2-Methylphenol	10 U	--	--	--	--	--	--	50 U	--	--	--
4-Methylphenol	**1.0 J**	--	--	--	--	--	--	50 U	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	10 U	--	--	--	--	--	--	50 U	--	--	--
Butyl benzyl phthalate	10 U	--	--	--	--	--	--	50 U	--	--	--
Di-n-butyl phthalate	10 U	--	--	--	--	--	--	50 U	--	--	--
Di-n-octyl phthalate	10 U	--	--	--	--	--	--	50 U	--	--	--
Diethyl phthalate	10 U	--	--	--	--	--	--	50 U	--	--	--
Dimethyl phthalate	10 U	--	--	--	--	--	--	50 U	--	--	--
Isophorone	10 U	--	--	--	--	--	--	50 U	--	--	--
Naphthalene	**1.0 J**	--	--	--	--	--	--	50 U	--	--	--
Phenanthrene	10 U	--	--	--	--	--	--	50 U	--	--	--
Phenol	10 U	--	--	--	--	--	--	50 U	--	--	--
Aroclor-1260	1.0 U	--	--	--	--	--	--	1.0 U	--	--	--

See notes pages.

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-123C**	**MW-123C**	**MW-123C**	**MW-123C**	**MW-126B**	**MW-126B**	**MW-126B**	**MW-126B**	**MW-127B**	**MW-127B**	**MW-127B**
Sample Date	**8/28/1991**	**11/30/1994**	**3/27/1995**	**12/16/1996**	**8/15/1991**	**11/29/1994**	**3/21/1995**	**11/22/1996**	**8/13/1991**	**12/2/1992**	**12/4/1992**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	500 UJ	**7,100**	**19,000**	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	4.0 UJ	--	10 U
1,1,2-Trichloroethane	500 UJ	1,300 U	1,300 U	2.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U	2.0 UJ	--	10 U
1,1-Dichloroethane	500 UJ	**15,000**	**12,000**	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**6.0 J**	--	**3.0 J**
1,1-Dichloroethene	500 UJ	1,300 U	1,300 U	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
1,2-Dichlorobenzene	10 U	--	--	2.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	10 U	--
1,2-Dichloroethane	500 UJ	1,300 U	1,300 U	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
1,2-Dichloroethene, Total	--	**7,400**	**13,000**	5.0 U	--	**5.0**	**8.0**	**5.0**	--	--	10 U
1,4-Dichlorobenzene	**1.0 J**	--	--	2.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	10 U	--
2-Butanone	R	6,300 U	6,300 U	42 U	R	25 U	25 U	5.0 U	R	--	10 U
4-Methyl-2-pentanone	2,500 UJ	6,300 U	6,300 U	12 U	5.0 UJ	25 U	25 U	5.0 U	5.0 UJ	--	10 U
Acetone	R	6,300 U	**5,200 J**	22 U	R	25 U	25 U	5.0 U	R	--	10 U
Benzene	500 UJ	1,300 U	1,300 U	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
Carbon disulfide	R	1,300 U	1,300 U	2.0 U	R	5.0 U	5.0 U	1.0 U	R	--	10 U
Carbon tetrachloride	500 UJ	1,300 U	1,300 U	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**0.50 J**	--	10 U
Chlorobenzene	500 UJ	1,300 U	1,300 U	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
Chloroethane	500 UJ	**6,200**	**4,500**	**45**	2.0 UJ	5.0 U	5.0 U	1.0 U	2.0 UJ	--	10 U
Chloroform	500 UJ	1,300 U	1,300 U	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
Chloromethane	500 UJ	2,500 U	2,500 U	2.0 U	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	--	10 UJ
cis-1,2-Dichloroethene	500 UJ	--	--	2.0 U	**7.7 J**	--	--	**5.0**	1.0 UJ	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**850 J**	**6,700**	**9,100**	**7.0**	1.0 UJ	5.0 U	5.0 U	1.0 U	**0.50 J**	--	10 U
M,P-Xylene	--	--	--	5.0 U	--	--	--	2.0 U	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	9,800 UJ	2,500 U	2,500 U(b)	3.0 U	2.0 UJ	10 U	10 U	2.0 U	3.0 UJ	--	10 U
O-Xylene	--	--	--	2.0 U	--	--	--	1.0 U	--	--	--
Styrene	500 UJ	1,300 U	1,300 U	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
Tetrachloroethene	500 UJ	1,300 U	1,300 U	2.0 U	**1.4 J**	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
Tetrahydrofuran	--	6,300 U	6,300 U	25 U	--	25 U	25 U	10 U	--	--	--
Toluene	500 UJ	**27,000**	**27,000**	2.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--	10 U
trans-1,2-Dichloroethene	500 UJ	--	--	2.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--	--
Trichloroethene	500 UJ	1,300 U	1,300 U	2.0 U	**11 J**	5.0 U	5.0 U	7.0 U	**0.40 J**	--	10 U
Vinyl chloride	500 UJ	**3,300**	**2,100 J**	2.0 U	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	--	10 U
Xylenes, Total	500 UJ	**3,100**	**2,900**	**9.0**	1.0 UJ	5.0 U	5.0 U	2.0 U	**1.0 J**	--	10 U

See notes pages.

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-123C**	**MW-123C**	**MW-123C**	**MW-123C**	**MW-126B**	**MW-126B**	**MW-126B**	**MW-126B**	**MW-127B**	**MW-127B**	**MW-127B**
Sample Date	**8/28/1991**	**11/30/1994**	**3/27/1995**	**12/16/1996**	**8/15/1991**	**11/29/1994**	**3/21/1995**	**11/22/1996**	**8/13/1991**	**12/2/1992**	**12/4/1992**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	--
Isopropanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	--
Methanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	--
Sec-Butanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	--
1,2,4-Trichlorobenzene	**4.0 J**	--	--	--	2.0 UJ	--	--	--	2.0 UJ	10 U	--
2,4-Dimethylphenol	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
2,4-Dinitrophenol	25 UJ	--	--	--	25 UJ	--	--	--	50 UJ	25 U	--
2-Methylnaphthalene	**6.0 J**	--	--	--	10 U	--	--	--	20 U	10 U	--
2-Methylphenol	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
4-Methylphenol	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
Butyl benzyl phthalate	10 UJ	--	--	--	10 UJ	--	--	--	20 U	10 U	--
Di-n-butyl phthalate	10 U	--	--	--	10 U	--	--	--	**1.0 J**	10 U	--
Di-n-octyl phthalate	10 U	--	--	--	10 UJ	--	--	--	20 U	10 U	--
Diethyl phthalate	10 U	--	--	--	10 U	--	--	--	**2.0 J**	10 U	--
Dimethyl phthalate	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
Isophorone	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
Naphthalene	**21**	--	--	--	1.0 UJ	--	--	--	1.0 UJ	10 U	--
Phenanthrene	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
Phenol	10 U	--	--	--	10 U	--	--	--	20 U	10 U	--
Aroclor-1260	1.0 U	--	--	--	1.0 U	--	--	--	1.0 U	1.0 U	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-127B**	**MW-127B**	**MW-127B**	**MW-127B**	**MW-204B**	**MW-204B**	**MW-204B**	**MW-204B**	**MW-204B**	**MW-204B**	**MW-205B**
Sample Date	**11/29/1994**	**3/23/1995**	**11/21/1996**	**12/2/1998**	**12/1/1992**	**12/3/1992**	**12/1/1994**	**3/28/1995**	**12/5/1996**	**12/1/1998**	**12/1/1992**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**3.9 J**	**3.6 J**	**4.0**	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
1,1,2-Trichloroethane	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
1,1-Dichloroethane	**3.1 J**	5.0 U	**8.0**	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
1,1-Dichloroethene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
1,2-Dichlorobenzene	--	--	1.0 U	1.0 U	10 U	--	--	--	1.0 U	1.0 U	10 U
1,2-Dichloroethane	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
1,2-Dichloroethene, Total	5.0 U	5.0 U	2.0 U	2.0 U	--	**7.0 J**	5.0 U	**2.5 J**	**6.0**	**4.0**	--
1,4-Dichlorobenzene	--	--	1.0 U	1.0 U	10 U	--	--	--	1.0 U	1.0 U	10 U
2-Butanone	25 U	25 U	19 U	5.0 U	--	10 U	25 U	25 U	5.0 U	5.0 U	--
4-Methyl-2-pentanone	25 U	25 U	5.0 U	5.0 U	--	10 U	25 U	25 U	5.0 U	5.0 U	--
Acetone	25 U	**18 J**	8.0 U	5.0 U	--	10 U	25 U	25 U	5.0 U	5.0 U	--
Benzene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Carbon disulfide	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Carbon tetrachloride	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Chlorobenzene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Chloroethane	5.0 U	5.0 U	**6.0**	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Chloroform	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Chloromethane	10 U	10 U	1.0 U	1.0 U	--	10 UJ	10 U	10 U	1.0 U	1.0 U	--
cis-1,2-Dichloroethene	--	--	1.0 U	1.0 U	--	--	--	--	**6.0**	**4.0**	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
M,P-Xylene	--	--	2.0 U	2.0 U	--	--	--	--	2.0 U	2.0 U	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	10 U(b)	3.0 U	**2.0**	--	10 U	10 U	10 U(b)	2.0 U	**1.0 JB**	--
O-Xylene	--	--	1.0 U	1.0 U	--	--	--	--	1.0 U	1.0 U	--
Styrene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Tetrachloroethene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	1.0 U	1.0 U	--
Tetrahydrofuran	25 U	25 U	10 U	1.0 U	--	--	25 U	25 U	10 U	1.0 U	--
Toluene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U	**1.0**	1.0 U	--
trans-1,2-Dichloroethene	--	--	1.0 U	1.0 U	--	--	--	--	1.0 U	1.0 U	--
Trichloroethene	5.0 U	5.0 U	2.0 U	1.0 U	--	10 U	5.0 U	5.0 U	**2.0**	**2.0**	--
Vinyl chloride	10 U	10 U	1.0 U	1.0 U	--	10 U	10 U	10 U	1.0 U	1.0 U	--
Xylenes, Total	5.0 U	5.0 U	2.0 U	2.0 U	--	10 U	5.0 U	5.0 U	2.0 U	2.0 U	--

See notes pages.

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TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	MW-127B	MW-127B	MW-127B	MW-127B	MW-204B	MW-204B	MW-204B	MW-204B	MW-204B	MW-204B	MW-205B
Sample Date	11/29/1994	3/23/1995	11/21/1996	12/2/1998	12/1/1992	12/3/1992	12/1/1994	3/28/1995	12/5/1996	12/1/1998	12/1/1992
Sample Type	S	S	S	S	S	S	S	S	S	S	S
Ethanol	--	--	1,000 U	--	--	--	--	--	1,000 U	--	--
Isopropanol	--	--	1,000 U	--	--	--	--	--	1,000 U	--	--
Methanol	--	--	1,000 U	--	--	--	--	--	1,000 U	--	--
Sec-Butanol	--	--	1,000 U	--	--	--	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	--	--	--	10 U	--	--	--	--	--	10 U
2,4-Dimethylphenol	--	--	--	--	10 U	--	--	--	--	--	10 U
2,4-Dinitrophenol	--	--	--	--	25 U	--	--	--	--	--	25 U
2-Methylnaphthalene	--	--	--	--	10 U	--	--	--	--	--	10 U
2-Methylphenol	--	--	--	--	10 U	--	--	--	--	--	10 U
4-Methylphenol	--	--	--	--	10 U	--	--	--	--	--	10 U
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	10 U	--	--	--	--	--	10 U
Butyl benzyl phthalate	--	--	--	--	10 U	--	--	--	--	--	10 U
Di-n-butyl phthalate	--	--	--	--	10 U	--	--	--	--	--	10 U
Di-n-octyl phthalate	--	--	--	--	10 U	--	--	--	--	--	10 U
Diethyl phthalate	--	--	--	--	10 U	--	--	--	--	--	10 U
Dimethyl phthalate	--	--	--	--	10 U	--	--	--	--	--	10 U
Isophorone	--	--	--	--	10 U	--	--	--	--	--	10 U
Naphthalene	--	--	--	--	10 U	--	--	--	--	--	10 U
Phenanthrene	--	--	--	--	10 U	--	--	--	--	--	10 U
Phenol	--	--	--	--	10 U	--	--	--	--	--	10 U
Aroclor-1260	--	--	--	--	1.0 U	--	--	--	--	--	1.0 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-205B**	**MW-205B**	**MW-205B**	**MW-205B**	**MW-205B**	**MW-409**	**MW-409**	**MW-409**	**MW-413**	**MW-413**	**MW-413**
Sample Date	**12/4/1992**	**11/29/1994**	**3/23/1995**	**11/21/1996**	**12/1/1998**	**11/30/1994**	**3/27/1995**	**12/16/1996**	**11/29/1994**	**3/22/1995**	**12/16/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	**17,000**	**12,000**	**2,100**	**1,300 J**	**7,100**
1,1,2-Trichloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
1,1-Dichloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	**780 J**	**2,900**	**15,000**	**7,600**	**7,700**	**3,100**
1,1-Dichloroethene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	**520**
1,2-Dichlorobenzene	--	--	--	1.0 U	1.0 U	--	--	1,000 U	--	--	250 U
1,2-Dichloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
1,2-Dichloroethene, Total	10 U	5.0 U	5.0 U	R	2.0 U	**16,000**	**43,000**	**79,000 D**	**25,000**	**54,000**	**180,000 D**
1,4-Dichlorobenzene	--	--	--	1.0 UJ	1.0 U	--	--	1,000 U	--	--	250 U
2-Butanone	10 U	25 U	25 U	20 UJ	5.0 U	5,000 U	**10,000**	5,000 U	**8,600**	**22,000**	13,000 U
4-Methyl-2-pentanone	10 U	25 U	25 U	5.0 U	5.0 U	**3,100 J**	**2,900 J**	5,000 U	**4,100 J**	**7,100 J**	**3,100**
Acetone	10 U	25 U	**23 J**	9.0 UJ	**10**	5,000 U	6,300 U	58,000 U	**6,000 J**	**13,000**	8,900 U
Benzene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Carbon disulfide	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Carbon tetrachloride	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Chlorobenzene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Chloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	**2,100**	**1,300**	1,000 U	1,300 U	**2,100 J**	250 U
Chloroform	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Chloromethane	10 UJ	10 U	10 U	1.0 U	1.0 U	2,000 U	2,500 U	1,000 U	2,500 U	4,500 U	250 U
cis-1,2-Dichloroethene	--	--	--	**3.0**	1.0 U	--	--	**74,000 D**	--	--	**170,000 D**
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	**7,900**	**12,000**	**8,200**	**9,400**	**12,000**	**3,300**
M,P-Xylene	--	--	--	R	2.0 U	--	--	**5,200**	--	--	**2,900**
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	10 U	10 U(b)	2.0 UJ	2.0 U	2,500 U	2,500 U(b)	3,000 U	2,500 U	4,000 U(b)	2,500 U
O-Xylene	--	--	--	R	1.0 U	--	--	**1,700**	--	--	**920**
Styrene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Tetrachloroethene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Tetrahydrofuran	--	25 U	25 U	10 U	1.0 U	5,000 U	6,300 U	10,000 U	6,300 U	11,000 U	2,500 U
Toluene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	**19,000**	**41,000**	**45,000 D**	**30,000**	**34,000**	**72,000 D**
trans-1,2-Dichloroethene	--	--	--	1.0 U	1.0 U	--	--	1,000 U	--	--	250 U
Trichloroethene	10 U	5.0 U	5.0 U	4.0 U	1.0 U	1,000 U	1,300 U	1,000 U	1,300 U	2,300 U	250 U
Vinyl chloride	10 U	10 U	10 U	1.0 U	1.0 U	**7,700**	**5,800**	**7,800**	**10,000**	**8,000**	**420**
Xylenes, Total	10 U	5.0 U	5.0 U	2.0 U	2.0 U	**7,100**	**8,100**	**8,700**	**7,200**	**8,400**	**4,000**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**MW-205B** **12/4/1992** **S**	**MW-205B** **11/29/1994** **S**	**MW-205B** **3/23/1995** **S**	**MW-205B** **11/21/1996** **S**	**MW-205B** **12/1/1998** **S**	**MW-409** **11/30/1994** **S**	**MW-409** **3/27/1995** **S**	**MW-409** **12/16/1996** **S**	**MW-413** **11/29/1994** **S**	**MW-413** **3/22/1995** **S**	**MW-413** **12/16/1996** **S**
Ethanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	1,000 U
Isopropanol	--	--	--	1,000 U	--	--	--	**3,500**	--	--	**9,400**
Methanol	--	--	--	1,000 U	--	--	--	**2,800**	--	--	**5,400**
Sec-Butanol	--	--	--	1,000 U	--	--	--	**25,000**	--	--	**69,000**
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-415**	**MW-415**	**MW-415**	**MW-501B**	**MW-501B**	**MW-501B**	**MW-501C**	**MW-501C**	**MW-502**	**MW-502**	**MW-502**
Sample Date	**11/29/1994**	**3/23/1995**	**12/10/1996**	**3/24/1995**	**12/6/1996**	**12/2/1998**	**3/24/1995**	**12/3/1996**	**3/21/1995**	**12/18/1996**	**12/3/1998**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**1,800**	**38,000**	**4,100 D**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
1,1,2-Trichloroethane	710 U	1,400 U	**140**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
1,1-Dichloroethane	**3,900**	**3,400**	**2,700 EJ**	5.0 U	**2.0**	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
1,1-Dichloroethene	710 U	**1,000 J**	**760 EJ**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
1,2-Dichlorobenzene	--	--	10 U	--	1.0 U	1.0 U	--	1.0 U	--	1,000 U	200 U
1,2-Dichloroethane	710 U	1,400 U	**110**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
1,2-Dichloroethene, Total	**28,000**	**34,000**	**10,000 D**	**34**	**27**	**4.0**	5.0 U	2.0 U	250 U	2,000 U	400 U
1,4-Dichlorobenzene	--	--	10 U	--	1.0 U	1.0 U	--	1.0 U	--	1,000 U	200 U
2-Butanone	**2,900 J**	6,900 U	**7,800 D**	25 U	5.0 U	5.0 U	25 U	5.0 U	**28,000**	5,000 U	**10,000**
4-Methyl-2-pentanone	**1,200 J**	6,900 U	5,000 U	25 U	5.0 U	5.0 U	25 U	5.0 U	**14,000**	**7,200**	**5,600**
Acetone	**2,100 J**	6,900 U	4,800 U	25 U	5.0 U	5.0 U	**27**	25 U	**44,000**	22,000 U	**14,000**
Benzene	710 U	1,400 U	**230**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	**160 J**	1,000 U	200 U
Carbon disulfide	710 U	1,400 U	10 U	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
Carbon tetrachloride	710 U	1,400 U	10 U	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
Chlorobenzene	710 U	1,400 U	**14**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
Chloroethane	710 U	1,400 U	**540 EJ**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	**1,500**	1,000 U	**320**
Chloroform	710 U	1,400 U	**62**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	2,000 U	200 U
Chloromethane	1,400 U	2,800 U	10 U	10 U	1.0 U	1.0 U	10 U	1.0 U	500 U	1,000 U	200 U
cis-1,2-Dichloroethene	--	--	**9,100 D**	--	**25**	**3.0**	--	1.0 U	--	1,000 U	200 U
Ethylene	--	--	--	--	--	--	--	--	--	**11.2**	--
Ethane	--	--	--	--	--	--	--	--	--	**281.9**	--
Ethylbenzene	**6,800**	**19,000**	**1,500 D**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	**5,300**	**4,400**	**4,800**
M,P-Xylene	--	--	**2,700 EJ**	--	2.0 U	2.0 U	--	2.0 U	--	**1,200 J**	**1,500**
Methane	--	--	--	--	--	--	--	--	--	**29,605.50**	--
Methylene chloride	2,300 U	2,800 U(b)	**1,700 EJB**	10 U	2.0 U	**2.0**	10 U	2.0 U	500 U	2,000 U	**210 JB**
O-Xylene	--	--	**1,600 EJ**	--	1.0 U	1.0 U	--	1.0 U	--	1,000 U	**510**
Styrene	710 U	1,400 U	10 U	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
Tetrachloroethene	710 U	1,400 U	**51**	5.0 U	1.0 U	1.0 U	5.0 U	1.0 U	250 U	1,000 U	200 U
Tetrahydrofuran	3,600 U	6,900 U	1,200 U	25 U	10 U	1.0 U	25 U	10 U	**12,000**	**9,500 J**	**6,300**
Toluene	**17,000**	**38,000**	**8,600 D**	**18**	1.0 U	1.0 U	**4.3 J**	1.0 U	**11,000**	**7,000**	**4,400**
trans-1,2-Dichloroethene	--	--	**70**	--	1.0 U	1.0 U	--	1.0 U	--	1,000 U	200 U
Trichloroethene	710 U	1,400 U	**190**	**13**	**24**	**3.0**	5.0 U	**1.0**	250 U	1,000 U	200 U
Vinyl chloride	**1,300 J**	**880 J**	**740 EJ**	10 U	1.0 U	1.0 U	10 U	1.0 U	500 U	1,000 U	200 U
Xylenes, Total	**8,600**	**5,900**	**4,100 EJ**	5.0 U	2.0 U	2.0 U	5.0 U	2.0 U	**2,200**	**1,400 J**	**2,000**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**MW-415** **11/29/1994** **S**	**MW-415** **3/23/1995** **S**	**MW-415** **12/10/1996** **S**	**MW-501B** **3/24/1995** **S**	**MW-501B** **12/6/1996** **S**	**MW-501B** **12/2/1998** **S**	**MW-501C** **3/24/1995** **S**	**MW-501C** **12/3/1996** **S**	**MW-502** **3/21/1995** **S**	**MW-502** **12/18/1996** **S**	**MW-502** **12/3/1998** **S**
Ethanol	--	--	1,000 U	--	1,000 U	--	--	1,000 U	--	1,000 U	--
Isopropanol	--	--	**2,700**	--	1,000 U	--	--	1,000 U	--	**2,500**	--
Methanol	--	--	**2,500**	--	1,000 U	--	--	1,000 U	--	1,000 U	--
Sec-Butanol	--	--	**23,000**	--	1,000 U	--	--	1,000 U	--	**3,800**	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-703D**	**MW-703S**	**MW-704D**	**MW-704D**	**MW-704M**	**MW-704S**	**MW-705D**	**MW-707D**	**MW-707D**	**MW-707M**	**MW-707S**
Sample Date	**12/9/1996**	**12/9/1996**	**12/18/1996**	**12/3/1998**	**12/17/1996**	**12/17/1996**	**12/9/1996**	**12/6/1996**	**12/1/1998**	**12/5/1996**	**12/5/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	1.0 U	1.0 U	**12**	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	1.0 U	1.0 U	10 U	1.0 U	**4.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene, Total	2.0 U	**1.0 J**	20 U	2.0 U	**14**	2.0 U	2.0 U	2.0 U	2.0 U	**2.0**	**2.0**
1,4-Dichlorobenzene	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	5.0 U	5.0 U	50 U	5.0 U	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	5.0 U	5.0 U	50 U	5.0 U	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	5.0 U	5.0 U	83 U	5.0 U	18 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0 U	1.0 U	**46**	1.0 U	**8.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon disulfide	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon tetrachloride	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	1.0 U	1.0 U	**11**	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	1.0 U	1.0 U	**300 D**	**3.0**	**76**	1.0 U	1.0 U	1.0 U	1.0 U	**2.0**	1.0 U
Chloroform	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	1.0 U	**1.0**	10 U	1.0 U	**13**	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	**2.0**
Ethylene	--	--	**0.4**	--	**0.3**	**0**	--	--	--	--	--
Ethane	--	--	**1,019.70**	--	**285.2**	**0.22**	--	--	--	--	--
Ethylbenzene	1.0 U	1.0 U	**12**	1.0 U	**11**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	2.0 U	2.0 U	**45**	2.0 U	**5.0**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methane	--	--	**17,769.50**	--	**4,768.60**	**6.1**	--	--	--	--	--
Methylene chloride	2.0 U	2.0 U	20 U	**9.0 B**	3.0 U	2.0 U	2.0 U	2.0 U	2.0 U	3.0 U	2.0 U
O-Xylene	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	10 U	10 U	**210**	1.0 U	**37**	10 U	10 U	10 U	1.0 U	10 U	10 U
Toluene	1.0 U	1.0 U	**29**	1.0 U	**12**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	1.0 U	1.0 U	10 U	1.0 U	**7.0**	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	**2.0**
Vinyl chloride	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylenes, Total	2.0 U	2.0 U	**50**	2.0 U	**8.0**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-703D**	**MW-703S**	**MW-704D**	**MW-704D**	**MW-704M**	**MW-704S**	**MW-705D**	**MW-707D**	**MW-707D**	**MW-707M**	**MW-707S**
Sample Date	**12/9/1996**	**12/9/1996**	**12/18/1996**	**12/3/1998**	**12/17/1996**	**12/17/1996**	**12/9/1996**	**12/6/1996**	**12/1/1998**	**12/5/1996**	**12/5/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U
Isopropanol	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U
Methanol	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U
Sec-Butanol	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U	1,000 U	1,000 U	--	1,000 U	1,000 U
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MWD-601**	**MWL-301**	**MWL-301**	**MWL-301**	**MWL-302**	**MWL-302**	**MWL-302**	**MWL-303**	**MWL-303**	**MWL-303**	**MWL-304**
Sample Date	**12/26/1996**	**11/29/1994**	**3/22/1995**	**11/22/1996**	**11/29/1994**	**3/22/1995**	**11/22/1996**	**11/29/1994**	**3/22/1995**	**11/22/1996**	**11/29/1994**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**14,000**	5.0 U	5.0 U	**14**	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
1,1,2-Trichloroethane	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
1,1-Dichloroethane	5,000 U	5.0 U	5.0 U	**19**	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	**970**
1,1-Dichloroethene	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
1,2-Dichlorobenzene	5,000 U	--	--	1.0 U	--	--	1.0 U	--	--	1.0 U	--
1,2-Dichloroethane	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
1,2-Dichloroethene, Total	56,000 U	**7.0**	5.0 U	**54 D**	5.0 U	5.0 U	**1.0 J**	5.0 U	5.0 U	**0.90 J**	**14,000**
1,4-Dichlorobenzene	5,000 U	--	--	1.0 U	--	--	1.0 U	--	--	1.0 U	--
2-Butanone	25,000 U	25 U	25 U	5.0 U	25 U	25 U	15 U	25 U	25 U	22 U	**1,600 J**
4-Methyl-2-pentanone	25,000 U	25 U	25 U	**12**	25 U	25 U	5.0 U	25 U	25 U	5.0 U	**1,700 J**
Acetone	25,000 U	25 U	25 U	31 U	25 U	25 U	5.0 U	25 U	25 U	15 U	**3,100**
Benzene	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
Carbon disulfide	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
Carbon tetrachloride	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
Chlorobenzene	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
Chloroethane	5,000 U	5.0 U	5.0 U	**10**	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
Chloroform	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
Chloromethane	5,000 U	10 U	10 U	1.0 U	10 U	10 U	1.0 U	10 U	10 U	1.0 U	1,300 U
cis-1,2-Dichloroethene	53,000 U	--	--	**58 D**	--	--	**0.90 J**	--	--	1.0 U	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5,000 U	5.0 U	5.0 U	**8.0**	5.0 U	5.0 U	1.0 U	**7.0**	5.0 U	**0.90 J**	**3,300**
M,P-Xylene	**8,600 J**	--	--	**5.0**	--	--	2.0 U	--	--	**0.90 J**	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10,000 U	10 U	10 U	2.0 U	10 U	10 U	1.0 U	10 U	10 U	2.0 U	1,300 U
O-Xylene	5,000 U	--	--	**3.0**	--	--	1.0 U	--	--	1.0 U	--
Styrene	5,000 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	630 U
Tetrachloroethene	**14,000**	5.0 U	5.0 U	**1.0**	5.0 U	5.0 U	**2.0**	5.0 U	5.0 U	1.0 U	630 U
Tetrahydrofuran	50,000 U	25 U	25 U	**12**	25 U	25 U	10 U	**15 J**	25 U	10 U	3,100 U
Toluene	17,000 U	5.0 U	5.0 U	**13 D**	5.0 U	5.0 U	**2.0**	5.0 U	5.0 U	**2.0**	**10,000**
trans-1,2-Dichloroethene	5,000 U	--	--	1.0 U	--	--	1.0 U	--	--	1.0 U	--
Trichloroethene	**95,000**	5.0 U	5.0 U	9.0 U	5.0 U	5.0 U	13 U	5.0 U	5.0 U	2.0 U	630 U
Vinyl chloride	5,000 U	10 U	10 U	**9.0**	10 U	10 U	1.0 U	10 U	10 U	1.0 U	**19,000**
Xylenes, Total	**14,000**	5.0 U	5.0 U	**8.0**	5.0 U	5.0 U	2.0 U	5.0 U	5.0 U	**2.0**	**3,500**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**MWD-601** **12/26/1996** **S**	**MWL-301** **11/29/1994** **S**	**MWL-301** **3/22/1995** **S**	**MWL-301** **11/22/1996** **S**	**MWL-302** **11/29/1994** **S**	**MWL-302** **3/22/1995** **S**	**MWL-302** **11/22/1996** **S**	**MWL-303** **11/29/1994** **S**	**MWL-303** **3/22/1995** **S**	**MWL-303** **11/22/1996** **S**	**MWL-304** **11/29/1994** **S**
Ethanol	1,000 U	--	--	1,000 U	--	--	1,000 U	--	--	1,000 U	--
Isopropanol	1,000 U	--	--	1,000 U	--	--	1,000 U	--	--	1,000 U	--
Methanol	1,000 U	--	--	1,000 U	--	--	1,000 U	--	--	1,000 U	--
Sec-Butanol	**17,000**	--	--	1,000 U	--	--	1,000 U	--	--	1,000 U	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MWL-304**	**MWL-304**	**MWL-305**	**MWL-305**	**MWL-305**	**MWL-306**	**MWL-306**	**MWL-306**
Sample Date	**3/22/1995**	**12/12/1996**	**11/29/1994**	**3/23/1995**	**12/6/1996**	**12/1/1994**	**3/22/1995**	**11/22/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**1,000**	**1,200**	6.0 U	**50**	**280 D**	7.0 U	5.0 U	5.0 U
1,1,2-Trichloroethane	1,000 U	500 U	6.0 U	8.0 U	1.0 U	7.0 U	5.0 U	5.0 U
1,1-Dichloroethane	**1,600**	500 U	6.0 U	**130**	**48 D**	7.0 U	5.0 U	5.0 U
1,1-Dichloroethene	1,000 U	500 U	6.0 U	8.0 U	1.0 U	7.0 U	5.0 U	5.0 U
1,2-Dichlorobenzene	--	500 U	--	--	1.0 U	--	--	5.0 U
1,2-Dichloroethane	1,000 U	500 U	6.0 U	8.0 U	1.0 U	7.0 U	5.0 U	5.0 U
1,2-Dichloroethene, Total	**23,000**	4,200 U	6.0 U	**120**	**60 D**	7.0 U	5.0 U	10 U
1,4-Dichlorobenzene	--	500 U	--	--	1.0 U	--	--	5.0 U
2-Butanone	**6,000**	2,500 U	28 U	42 U	5.0 U	36 U	25 U	25 U
4-Methyl-2-pentanone	**3,400 J**	2,500 U	28 U	42 U	5.0 U	36 U	25 U	25 U
Acetone	**5,100**	2,500 U	**12 J**	42 U	5.0 U	36 U	25 U	62 U
Benzene	1,000 U	500 U	**2.6 J**	**4.1 J**	**2.0**	7.0 U	5.0 U	5.0 U
Carbon disulfide	1,000 U	500 U	6.0 U	8.0 U	1.0 U	7.0 U	5.0 U	5.0 U
Carbon tetrachloride	1,000 U	500 U	6.0 U	8.0 U	1.0 U	7.0 U	5.0 U	5.0 U
Chlorobenzene	1,000 U	500 U	**2.3 J**	**4.4 J**	**2.0**	7.0 U	5.0 U	5.0 U
Chloroethane	**1,500**	500 U	**170**	**190**	**17**	7.0 U	5.0 U	5.0 U
Chloroform	1,000 U	500 U	6.0 U	8.0 U	1.0 U	7.0 U	5.0 U	5.0 U
Chloromethane	2,000 U	500 U	11 U	17 U	1.0 U	14 U	10 U	5.0 U
cis-1,2-Dichloroethene	--	4,400 U	--	--	**56 D**	--	--	5.0 U
Ethylene	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--
Ethylbenzene	**3,700**	**1,300**	**19**	**170**	10 U	7.0 U	5.0 U	5.0 U
M,P-Xylene	--	**1,900**	--	--	2.0 U	--	--	10 U
Methane	--	--	--	--	--	--	--	--
Methylene chloride	2,300 U(b)	1,000 U	11 U	17 U(b)	2.0 U	14 U	10 U	6.0 U
O-Xylene	--	**720**	--	--	**2.0**	--	--	5.0 U
Styrene	1,000 U	500 U	6.0 U	8.0 U	1.0 U	7.0 U	5.0 U	5.0 U
Tetrachloroethene	1,000 U	500 U	6.0 U	8.0 U	**15**	7.0 U	5.0 U	5.0 U
Tetrahydrofuran	5,000 U	5,000 U	**25 J**	42 U	10 U	**220**	25 U	**130**
Toluene	**14,000**	3,100 U	6.0 U	**140**	1.0 U	7.0 U	5.0 U	5.0 U
trans-1,2-Dichloroethene	--	500 U	--	--	1.0 U	--	--	5.0 U
Trichloroethene	1,000 U	510 U	6.0 U	8.0 U	8.0 U	7.0 U	5.0 U	5.0 U
Vinyl chloride	**14,000**	**2,700**	11 U	**140**	**90 D**	14 U	10 U	5.0 U
Xylenes, Total	**6,200**	**2,600**	**230**	**510**	**4.0**	7.0 U	5.0 U	10 U

See notes pages.

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**MWL-304** **3/22/1995** **S**	**MWL-304** **12/12/1996** **S**	**MWL-305** **11/29/1994** **S**	**MWL-305** **3/23/1995** **S**	**MWL-305** **12/6/1996** **S**	**MWL-306** **12/1/1994** **S**	**MWL-306** **3/22/1995** **S**	**MWL-306** **11/22/1996** **S**
Ethanol	--	1,000 U	--	--	1,000 U	--	--	1,000 U
Isopropanol	--	1,000 U	--	--	1,000 U	--	--	1,000 U
Methanol	--	1,000 U	--	--	1,000 U	--	--	1,000 U
Sec-Butanol	--	1,000 U	--	--	1,000 U	--	--	1,000 U
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MWL-307**	**MWL-307**	**MWL-307**	**MWL-307**	**MWL-308**	**MWL-308**	**MWL-308**	**MWL-309**	**MWL-309**	**MWL-309**	**MWL-311**
Sample Date	**11/30/1994**	**3/23/1995**	**12/16/1996**	**12/16/1996**	**11/30/1994**	**3/23/1995**	**12/12/1996**	**12/1/1994**	**3/27/1995**	**12/6/1996**	**11/30/1994**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**41,000**	**33,000**	**35,000 D**	**40,000 D**	1,300 U	**2,800**	5,000 U	42 U	38 U	1.0 U	**1,100**
1,1,2-Trichloroethane	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
1,1-Dichloroethane	**4,500**	**4,400**	**25,000**	**24,000**	1,300 U	**970**	**8,000**	42 U	38 U	**4.0**	**6,300**
1,1-Dichloroethene	**1,300 J**	1,500 U	**1,200**	**1,100**	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
1,2-Dichlorobenzene	--	--	1,000 U	1,000 U	--	--	5,000 U	--	--	1.0 U	--
1,2-Dichloroethane	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
1,2-Dichloroethene, Total	**45,000**	**17,000**	**24,000 D**	**30,000 D**	**2,100**	**18,000**	10,000 U	42 U	38 U	**2.0**	**6,700**
1,4-Dichlorobenzene	--	--	1,000 U	1,000 U	--	--	5,000 U	--	--	1.0 U	--
2-Butanone	8,300 U	7,400 U	10,000 U	5,000 U	6,300 U	**5,500**	25,000 U	210 U	190 U	5.0 U	**1,400 J**
4-Methyl-2-pentanone	8,300 U	7,400 U	5,000 U	5,000 U	6,300 U	**2,400 J**	25,000 U	210 U	190 U	5.0 U	2,500 U
Acetone	8,300 U	7,400 U	13,000 U	9,500 U	6,300 U	**3,700 J**	25,000 U	210 U	190 U	5.0 U	2,500 U
Benzene	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	**6.0**	500 U
Carbon disulfide	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
Carbon tetrachloride	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
Chlorobenzene	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	**6.0**	500 U
Chloroethane	1,700 U	**1,400 J**	**9,000**	**8,800**	**3,300**	**1,900**	5,000 U	42 U	38 U	**5.0**	**1,200**
Chloroform	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
Chloromethane	3,300 U	2,900 U	1,000 U	1,000 U	2,500 U	1,700 U	5,000 U	83 U	77 U	1.0 U	1,000 U
cis-1,2-Dichloroethene	--	--	**25,000 D**	**29,000 D**	--	--	42,000 U	--	--	**2.0**	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**22,000**	**11,000**	**19,000**	**19,000**	**8,600**	**7,300**	5,000 U	42 U	38 U	1.0 U	**3,000**
M,P-Xylene	--	--	**3,000**	**3,200**	--	--	10,000 U	--	--	2.0 U	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	3,300 U	2,900 U(b)	3,000 U	2,500 U	3,100 U	1,800 U(b)	10,000 U	83 U	77 U(b)	2.0 U	1,000 U
O-Xylene	--	--	**1,000**	**910 J**	--	--	5,000 U	--	--	1.0 U	--
Styrene	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
Tetrachloroethene	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
Tetrahydrofuran	8,300 U	7,400 U	10,000 U	10,000 U	6,300 U	4,200 U	50,000 U	**1,300**	**820**	**1,800 D**	**1,400 J**
Toluene	**59,000**	**22,000**	**40,000 D**	**47,000 D**	**20,000**	**21,000**	17,000 U	42 U	38 U	1.0 U	**9,600**
trans-1,2-Dichloroethene	--	--	1,000 U	1,000 U	--	--	5,000 U	--	--	1.0 U	--
Trichloroethene	1,700 U	1,500 U	1,000 U	1,000 U	1,300 U	830 U	5,000 U	42 U	38 U	1.0 U	500 U
Vinyl chloride	**2,100 J**	**840 J**	**2,000**	**1,900**	**4,700**	**7,200**	**10,000**	83 U	77 U	**2.0**	**1,500**
Xylenes, Total	**6,500**	**2,400**	**4,700**	**5,000**	**3,900**	**5,500**	10,000 U	42 U	38 U	2.0 U	**950**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MWL-307**	**MWL-307**	**MWL-307**	**MWL-307**	**MWL-308**	**MWL-308**	**MWL-308**	**MWL-309**	**MWL-309**	**MWL-309**	**MWL-311**
Sample Date	**11/30/1994**	**3/23/1995**	**12/16/1996**	**12/16/1996**	**11/30/1994**	**3/23/1995**	**12/12/1996**	**12/1/1994**	**3/27/1995**	**12/6/1996**	**11/30/1994**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	--	--	**3,400**	**3,000**	--	--	1,000 U	--	--	1,000 U	--
Isopropanol	--	--	1,000 U	1,000 U	--	--	**1,300**	--	--	1,000 U	--
Methanol	--	--	**1,400**	**1,300**	--	--	**2,900**	--	--	1,000 U	--
Sec-Butanol	--	--	**6,800**	**9,300**	--	--	**13,000**	--	--	1,000 U	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MWL-311**	**MWL-311**	**MWL-312**	**MWL-312**	**MWL-312**	**MWL-312**	**MWL-313**	**MWL-313**	**MWL-313**	**MWL-314**	**MWL-314**
Sample Date	**3/27/1995**	**12/13/1996**	**12/1/1994**	**3/27/1995**	**11/22/1996**	**12/1/1998**	**11/30/1994**	**3/28/1995**	**12/6/1996**	**11/30/1994**	**3/28/1995**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**7,900**	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	**7.0 J**	**55**	1.0 U	5.0 U	**68**
1,1,2-Trichloroethane	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
1,1-Dichloroethane	**10,000**	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	**200**	**70**	1.0 U	**2.4 J**	**520**
1,1-Dichloroethene	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	**10 J**
1,2-Dichlorobenzene	--	1.0 U	--	--	1.0 U	1.0 U	--	--	1.0 U	--	--
1,2-Dichloroethane	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
1,2-Dichloroethene, Total	**19,000**	2.0 U	5.0 U	5.0 U	2.0 U	2.0 U	**16**	**26**	2.0 U	5.0 U	**920**
1,4-Dichlorobenzene	--	1.0 U	--	--	1.0 U	1.0 U	--	--	1.0 U	--	--
2-Butanone	**2,900 J**	5.0 U	25 U	25 U	5.0 U	5.0 U	42 U	25 U	5.0 U	25 U	78 U
4-Methyl-2-pentanone	5,000 U	5.0 U	25 U	25 U	5.0 U	5.0 U	42 U	25 U	5.0 U	25 U	78 U
Acetone	**3,700 J**	5.0 U	25 U	**17 J**	5.0 U	5.0 U	42 U	25 U	5.0 U	25 U	78 U
Benzene	1,000 U	**0.90 J**	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Carbon disulfide	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Carbon tetrachloride	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Chlorobenzene	1,000 U	**2.0**	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Chloroethane	**1,200**	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	**23**	**30**	1.0 U	5.0 U	**310**
Chloroform	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Chloromethane	2,000 U	1.0 U	10 U	10 U	1.0 U	1.0 U	17 U	10 U	1.0 U	10 U	31 U
cis-1,2-Dichloroethene	--	1.0 U	--	--	1.0 U	1.0 U	--	--	1.0 U	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**13,000**	**16**	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
M,P-Xylene	--	**110 D**	--	--	2.0 U	2.0 U	--	--	2.0 U	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	2,000 U(b)	2.0 U	10 U	10 U	2.0 U	2.0 U	17 U	10 U(b)	2.0 U	10 U	36 U(b)
O-Xylene	--	**3.0**	--	--	1.0 U	1.0 U	--	--	1.0 U	--	--
Styrene	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Tetrachloroethene	1,000 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Tetrahydrofuran	5,000 U	10 U	25 U	**32**	10 U	1.0 U	42 U	25 U	10 U	25 U	78 U
Toluene	**27,000**	**5.0**	5.0 U	5.0 U	1.0 U	1.0 U	**7.0 J**	5.0 U	1.0 U	5.0 U	**31**
trans-1,2-Dichloroethene	--	1.0 U	--	--	1.0 U	1.0 U	--	--	1.0 U	--	--
Trichloroethene	1,000 U	1.0 U	5.0 U	5.0 U	2.0 U	1.0 U	8.0 U	5.0 U	1.0 U	5.0 U	16 U
Vinyl chloride	**2,600**	1.0 U	10 U	10 U	1.0 U	1.0 U	17 U	10 U	1.0 U	10 U	**210**
Xylenes, Total	**2,700**	**75**	5.0 U	5.0 U	2.0 U	2.0 U	8.0 U	5.0 U	2.0 U	5.0 U	16 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID Sample Date Sample Type	MWL-311 3/27/1995 S	MWL-311 12/13/1996 S	MWL-312 12/1/1994 S	MWL-312 3/27/1995 S	MWL-312 11/22/1996 S	MWL-312 12/1/1998 S	MWL-313 11/30/1994 S	MWL-313 3/28/1995 S	MWL-313 12/6/1996 S	MWL-314 11/30/1994 S	MWL-314 3/28/1995 S
Ethanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
Isopropanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
Methanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
Sec-Butanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MWL-314**	**P-1B**	**P-1B**	**P-1B**	**P-1B**	**P-1B**	**P-1B**	**P-1B**	**P-1B**	**P-3B**	**P-3B**
Sample Date	**12/6/1996**	**8/15/1991**	**12/4/1992**	**12/4/1992**	**11/28/1994**	**11/28/1994**	**3/20/1995**	**12/18/1996**	**12/18/1996**	**8/29/1991**	**12/1/1994**
Sample Type	**S**	**S**	**S**	**D**	**S**	**D**	**S**	**S**	**D**	**S**	**S**
1,1,1-Trichloroethane	1.0 U	**78,000 J**	**55,000**	**52,000**	**86,000**	**77,000**	**61,000**	**120,000 D**	**120,000**	1.0 UJ	31 U
1,1,2-Trichloroethane	1.0 U	1,250 UJ	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	1,000 U	10,000 U	2.0 UJ	31 U
1,1-Dichloroethane	**2.0**	**2,900 J**	10,000 U	10,000 U	**7,300**	**6,900**	**5,400**	**10,000**	**93,000 J**	**70 J**	31 U
1,1-Dichloroethene	1.0 U	**7,400 J**	10,000 U	10,000 U	**2,200 J**	**1,900 J**	2,500 U	**4,800**	10,000 U	1.0 UJ	31 U
1,2-Dichlorobenzene	1.0 U	10 UJ	500 U	500 U	--	--	--	1,000 U	10,000 U	**2.0 J**	--
1,2-Dichloroethane	1.0 U	**940 J**	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	1,000 U	10,000 U	**3.0 J**	31 U
1,2-Dichloroethene, Total	**2.0**	--	**120,000**	**110,000**	**39,000**	**36,000**	**34,000**	**60,000 D**	**660,000**	--	31 U
1,4-Dichlorobenzene	1.0 U	10 UJ	500 U	500 U	--	--	--	1,000 U	10,000 U	1.0 UJ	--
2-Butanone	5.0 U	R	**110,000 J**	**110,000 J**	**10,000 J**	**9,900 J**	13,000 U	11,000 U	700,000 U	R	160 U
4-Methyl-2-pentanone	5.0 U	**22,000 J**	**17,000 J**	**16,000 J**	13,000 U	13,000 U	13,000 U	5,000 U	50,000 U	**360 J**	160 U
Acetone	5.0 U	R	**41,000**	**42,000**	**13,000**	**11,000 J**	13,000 U	16,000 U	50,000 U	R	160 U
Benzene	1.0 U	**610 J**	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	1,000 U	10,000 U	**88 J**	**47**
Carbon disulfide	1.0 U	R	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	1,000 U	10,000 U	**22 J**	31 U
Carbon tetrachloride	1.0 U	**9,100 J**	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	1,000 U	10,000 U	1.0 UJ	31 U
Chlorobenzene	1.0 U	1,250 UJ	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	1,000 U	10,000 U	**39 J**	**18 J**
Chloroethane	1.0 U	1,250 UJ	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	**2,200**	10,000 U	**600 J**	**370**
Chloroform	1.0 U	1,250 UJ	10,000 U	10,000 U	2,500 U	2,500 U	2,500 U	1,000 U	210,000 U	1.0 UJ	31 U
Chloromethane	1.0 U	1,250 UJ	10,000 U	10,000 U	5,000 U	5,000 U	5,000 U	1,000 U	160,000 U	2.0 UJ	63 U
cis-1,2-Dichloroethene	**1.0**	**110,000 J**	--	--	--	--	--	**55,000 D**	**610,000**	**6.4 J**	--
Ethylene	--	--	--	--	--	--	--	**237.8**	--	--	--
Ethane	--	--	--	--	--	--	--	**21.6**	--	--	--
Ethylbenzene	1.0 U	**60,000 J**	**96,000**	**72,000**	**38,000**	**29,000**	**24,000**	**40,000 D**	**400,000**	1.0 UJ	**1,200**
M,P-Xylene	2.0 U	--	--	--	--	--	--	**6,300**	20,000 U	--	--
Methane	--	--	--	--	--	--	--	**1,335.80**	--	--	--
Methylene chloride	2.0 U	23,000 UJ	44,000 U	44,000 U	5,000 U	5,000 U	5,000 U(b)	3,400 U	20,000 U	33 UJ	63 U
O-Xylene	1.0 U	--	--	--	--	--	--	**2,100**	10,000 U	--	--
Styrene	1.0 U	**49,000 J**	**65,000**	**54,000**	**1,600 J**	**1,300 J**	2,500 U	1,000 U	10,000 U	1.0 UJ	31 U
Tetrachloroethene	1.0 U	**2,000 J**	**2,700 J**	**2,000 J**	2,500 U	2,500 U	2,500 U	1,000 U	10,000 U	1.0 UJ	31 U
Tetrahydrofuran	10 U	--	--	--	13,000 U	13,000 U	13,000 U	**3,100 J**	10,000 U	--	**990**
Toluene	1.0 U	**81,000 J**	**110,000**	**100,000**	**75,000**	**64,000**	**54,000**	**120,000 D**	**120,000**	1.0 UJ	**110**
trans-1,2-Dichloroethene	1.0 U	1,250 UJ	--	--	--	--	--	1,000 U	10,000 U	**6.0 J**	--
Trichloroethene	1.0 U	**26,000 J**	**32,000**	**30,000**	2,500 U	2,500 U	2,500 U	**1,200**	10,000 U	**1.6 J**	31 U
Vinyl chloride	**1.0**	1,250 UJ	10,000 U	10,000 U	5,000 U	5,000 U	5,000 U	**2,400**	10,000 U	2.0 UJ	63 U
Xylenes, Total	2.0 U	8,300 UJ	**25,000**	**21,000**	**8,100**	**6,500**	**4,500**	**9,800**	20,000 U	1.0 UJ	**1,100**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	MWL-314	P-1B	P-1B	P-1B	P-1B	P-1B	P-1B	P-1B	P-1B	P-3B	P-3B
Sample Date	**12/6/1996**	**8/15/1991**	**12/4/1992**	**12/4/1992**	**11/28/1994**	**11/28/1994**	**3/20/1995**	**12/18/1996**	**12/18/1996**	**8/29/1991**	**12/1/1994**
Sample Type	**S**	**S**	**S**	**D**	**S**	**D**	**S**	**S**	**D**	**S**	**S**
Ethanol	1,000 U	--	--	--	--	--	--	1,000 U	1,000 U	--	--
Isopropanol	1,000 U	--	--	--	--	--	--	1,000 U	1,000 U	--	--
Methanol	1,000 U	--	--	--	--	--	--	1,000 U	1,000 U	--	--
Sec-Butanol	1,000 U	--	--	--	--	--	--	1,000 U	**9,000**	--	--
1,2,4-Trichlorobenzene	--	10 UJ	500 U	500 U	--	--	--	--	--	2.0 UJ	--
2,4-Dimethylphenol	--	10 UJ	**210 J**	**230 J**	--	--	--	--	--	10 U	--
2,4-Dinitrophenol	--	25 UJ	1,300 U	1,300 U	--	--	--	--	--	25 U	--
2-Methylnaphthalene	--	10 UJ	500 U	500 U	--	--	--	--	--	10 U	--
2-Methylphenol	--	10 UJ	**140 J**	**140 J**	--	--	--	--	--	**23**	--
4-Methylphenol	--	10 UJ	**700**	**820**	--	--	--	--	--	**17**	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	**11,100**	1,100 U	500 U	--	--	--	--	--	10 UJ	--
Butyl benzyl phthalate	--	**63 J**	500 U	500 U	--	--	--	--	--	10 U	--
Di-n-butyl phthalate	--	**52 J**	500 U	500 U	--	--	--	--	--	**1.0 J**	--
Di-n-octyl phthalate	--	**26 J**	500 U	500 U	--	--	--	--	--	10 U	--
Diethyl phthalate	--	**5.0 J**	500 U	500 U	--	--	--	--	--	10 U	--
Dimethyl phthalate	--	**17**	500 U	500 U	--	--	--	--	--	10 U	--
Isophorone	--	10 UJ	**120 J**	**110 J**	--	--	--	--	--	**2.0 J**	--
Naphthalene	--	10 UJ	500 U	500 U	--	--	--	--	--	**9.0 J**	--
Phenanthrene	--	**10 J**	500 U	500 U	--	--	--	--	--	10 U	--
Phenol	--	**4,200**	**2,500**	**2,800**	--	--	--	--	--	**7.0 J**	--
Aroclor-1260	--	**85 ***	**104 J**	--	--	--	--	--	--	1.0 U	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-3B**	**P-3B**	**P-4B**	**P-4B**	**P-4B**	**P-4B**	**P-4B**	**P-5B**	**P-5B**	**P-5B**	**P-7**
Sample Date	**3/23/1995**	**12/16/1996**	**8/28/1991**	**12/3/1992**	**11/28/1994**	**3/20/1995**	**12/12/1996**	**11/30/1994**	**3/24/1995**	**12/13/1996**	**11/29/1994**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	38 U	**190**	**240,000 J**	**240,000**	**210,000**	**160,000**	**170,000 D**	250 U	290 U	**55 D**	5.0 U
1,1,2-Trichloroethane	38 U	120 U	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
1,1-Dichloroethane	38 U	120 U	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
1,1-Dichloroethene	38 U	120 U	**15,000 J**	**9,900 J**	**1,900 J**	6,300 U	**4,600**	250 U	290 U	1.0 U	5.0 U
1,2-Dichlorobenzene	--	120 U	**30**	**31**	--	--	2,500 U	--	--	1.0 U	--
1,2-Dichloroethane	38 U	120 U	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
1,2-Dichloroethene, Total	38 U	130 U	--	**9,700**	**14,000**	**15,000**	27,000 U	250 U	**2,800**	**33 D**	5.0 U
1,4-Dichlorobenzene	--	120 U	10 U	10 U	--	--	2,500 U	--	--	1.0 U	--
2-Butanone	190 U	620 U	R	2,000 U	25,000 U	31,000 U	12,000 U	1,300 U	1,500 U	5.0 U	25 U
4-Methyl-2-pentanone	190 U	620 U	25,000 UJ	2,000 U	25,000 U	31,000 U	12,000 U	1,300 U	**660 J**	5.0 U	25 U
Acetone	190 U	1,300 U	R	2,000 U	25,000 U	31,000 U	12,000 U	1,300 U	**1,300 J**	9.0 U	25 U
Benzene	**33 J**	120 U	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
Carbon disulfide	38 U	120 U	R	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	**1.0**	5.0 U
Carbon tetrachloride	38 U	120 U	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
Chlorobenzene	38 U	120 U	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
Chloroethane	**280**	**300**	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	**760**	**2,100**	**2.0**	5.0 U
Chloroform	38 U	120 U	5,000 UJ	2,000 U	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
Chloromethane	77 U	120 U	5,000 UJ	2,000 U	10,000 U	13,000 U	2,500 U	500 U	590 U	1.0 U	10 U
cis-1,2-Dichloroethene	--	130 U	5,200 UJ	--	--	--	29,000 U	--	--	**29 D**	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**640**	**1,500**	5,000 UJ	**3,000**	5,000 U	**3,500 J**	**4,200**	**4,000**	**7,600**	**15**	5.0 U
M,P-Xylene	--	**270**	--	--	--	--	**7,600**	--	--	**23**	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	77 U(b)	270 U	11,000 UJ	2,000 U	10,000 U	13,000 U	11,000 U	500 U	590 U(b)	4.0 U	10 U
O-Xylene	--	**180**	--	--	--	--	2,500 U	--	--	**6.0**	--
Styrene	38 U	120 U	5,000 UJ	**1,200 J**	5,000 U	6,300 U	2,500 U	250 U	290 U	1.0 U	5.0 U
Tetrachloroethene	38 U	120 U	5,000 UJ	**5,100**	**5,800**	**5,800 J**	**12,000**	250 U	290 U	**7.0**	5.0 U
Tetrahydrofuran	**780**	**500 J**	--	--	25,000 U	31,000 U	25,000 U	**890 J**	1,500 U	10 U	25 U
Toluene	**93**	1,000 U	120,000 UJ	**160,000**	**140,000**	**140,000**	**160,000 D**	**240 J**	**10,000**	**84 D**	5.0 U
trans-1,2-Dichloroethene	--	120 U	5,000 UJ	--	--	--	2,500 U	--	--	1.0 U	--
Trichloroethene	38 U	120 U	**30,000 J**	**28,000**	**30,000**	**27,000**	41,000 U	250 U	290 U	14 U	5.0 U
Vinyl chloride	77 U	120 U	5,000 UJ	2,000 U	10,000 U	13,000 U	2,500 U	500 U	**2,300**	**10**	10 U
Xylenes, Total	**540**	**540**	6,000 UJ	**12,000**	**8,200**	**6,400**	**10,000**	**1,200**	**3,700**	**20 D**	5.0 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-3B**	**P-3B**	**P-4B**	**P-4B**	**P-4B**	**P-4B**	**P-4B**	**P-5B**	**P-5B**	**P-5B**	**P-7**
Sample Date	**3/23/1995**	**12/16/1996**	**8/28/1991**	**12/3/1992**	**11/28/1994**	**3/20/1995**	**12/12/1996**	**11/30/1994**	**3/24/1995**	**12/13/1996**	**11/29/1994**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	--	1,000 U	--	--	--	--	1,000 U	--	--	1,000 U	--
Isopropanol	--	1,000 U	--	--	--	--	1,000 U	--	--	1,000 U	--
Methanol	--	1,000 U	--	--	--	--	1,000 U	--	--	1,000 U	--
Sec-Butanol	--	1,000 U	--	--	--	--	**9,700**	--	--	1,000 U	--
1,2,4-Trichlorobenzene	--	--	10 U	10 U	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	**7.0 J**	10 U	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	**6.0 J**	25 U	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	**3.0 J**	**3.0 J**	--	--	--	--	--	--	--
2-Methylphenol	--	--	**49**	**32**	--	--	--	--	--	--	--
4-Methylphenol	--	--	**64**	**30**	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	10 UJ	10 U	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	10 UJ	10 U	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	10 U	10 U	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	10 U	10 U	--	--	--	--	--	--	--
Diethyl phthalate	--	--	12 U	10 U	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	**2.0 J**	10 U	--	--	--	--	--	--	--
Isophorone	--	--	**8.0 J**	**6.0 J**	--	--	--	--	--	--	--
Naphthalene	--	--	**44**	**52**	--	--	--	--	--	--	--
Phenanthrene	--	--	10 U	10 U	--	--	--	--	--	--	--
Phenol	--	--	**22**	10 U	--	--	--	--	--	--	--
Aroclor-1260	--	--	1.0 U	100 U	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**P-7** **3/22/1995** **S**	**P-7** **12/3/1996** **S**	**P-8B** **11/29/1994** **S**	**P-8B** **3/21/1995** **S**	**P-8B** **12/10/1996** **S**	**P-9** **8/14/1991** **S**	**P-10** **11/29/1994** **S**	**P-10** **3/22/1995** **S**	**P-10** **11/22/1996** **S**	**P-11B** **8/26/1991** **S**	**P-11B** **8/27/1991** **S**
1,1,1-Trichloroethane	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
1,1,2-Trichloroethane	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U	2.0 UJ	--
1,1-Dichloroethane	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**1.1 J**	--
1,1-Dichloroethene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
1,2-Dichlorobenzene	--	1.0 U	--	--	1.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--
1,2-Dichloroethane	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
1,2-Dichloroethene, Total	5.0 U	2.0 U	5.0 U	5.0 U	2.0 U	--	5.0 U	5.0 U	2.0 U	--	--
1,4-Dichlorobenzene	--	1.0 U	--	--	1.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--
2-Butanone	25 U	5.0 U	25 U	25 U	5.0 U	R	25 U	25 U	16 U	R	--
4-Methyl-2-pentanone	25 U	5.0 U	25 U	25 U	5.0 U	5.0 UJ	25 U	25 U	5.0 U	5.0 UJ	--
Acetone	25 U	5.0 U	25 U	25 U	5.0 U	R	25 U	25 U	6.0 U	R	--
Benzene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**9.8 J**	--
Carbon disulfide	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	R	5.0 U	5.0 U	1.0 U	R	--
Carbon tetrachloride	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
Chlorobenzene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**5.0 J**	--
Chloroethane	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U	**9.2 J**	--
Chloroform	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
Chloromethane	10 U	1.0 U	10 U	10 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	--
cis-1,2-Dichloroethene	--	1.0 U	--	--	1.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**2.4 J**	--
M,P-Xylene	--	2.0 U	--	--	2.0 U	--	--	--	2.0 U	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	2.0 U	10 U	8.0 U(b)	2.0 U	2.0 UJ	10 U	10 U	2.0 U	4.2 UJ	--
O-Xylene	--	1.0 U	--	--	1.0 U	--	--	--	1.0 U	--	--
Styrene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
Tetrachloroethene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
Tetrahydrofuran	25 U	10 U	25 U	25 U	10 U	--	25 U	25 U	10 U	--	--
Toluene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	--
trans-1,2-Dichloroethene	--	1.0 U	--	--	1.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--
Trichloroethene	5.0 U	1.0 U	5.0 U	5.0 U	1.0 U	**0.80 J**	5.0 U	5.0 U	2.0 U	1.0 UJ	--
Vinyl chloride	10 U	1.0 U	10 U	10 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	--
Xylenes, Total	5.0 U	2.0 U	5.0 U	5.0 U	2.0 U	1.0 UJ	5.0 U	5.0 U	2.0 U	1.2 UJ	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-7**	**P-7**	**P-8B**	**P-8B**	**P-8B**	**P-9**	**P-10**	**P-10**	**P-10**	**P-11B**	**P-11B**
Sample Date	**3/22/1995**	**12/3/1996**	**11/29/1994**	**3/21/1995**	**12/10/1996**	**8/14/1991**	**11/29/1994**	**3/22/1995**	**11/22/1996**	**8/26/1991**	**8/27/1991**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
Isopropanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
Methanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
Sec-Butanol	--	1,000 U	--	--	1,000 U	--	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	2.0 UJ	--	--	--	2.0 UJ	--
2,4-Dimethylphenol	--	--	--	--	--	20 U	--	--	--	--	10 U
2,4-Dinitrophenol	--	--	--	--	--	50 UJ	--	--	--	--	25 U
2-Methylnaphthalene	--	--	--	--	--	20 U	--	--	--	--	10 U
2-Methylphenol	--	--	--	--	--	20 U	--	--	--	--	10 U
4-Methylphenol	--	--	--	--	--	20 U	--	--	--	--	10 U
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	10 U	--	--	--	--	10 UJ
Butyl benzyl phthalate	--	--	--	--	--	20 U	--	--	--	--	10 U
Di-n-butyl phthalate	--	--	--	--	--	20 U	--	--	--	--	10 U
Di-n-octyl phthalate	--	--	--	--	--	20 U	--	--	--	--	10 U
Diethyl phthalate	--	--	--	--	--	20 U	--	--	--	--	10 U
Dimethyl phthalate	--	--	--	--	--	20 U	--	--	--	--	10 U
Isophorone	--	--	--	--	--	20 U	--	--	--	--	**1.0 J**
Naphthalene	--	--	--	--	--	1.0 UJ	--	--	--	1.0 UJ	--
Phenanthrene	--	--	--	--	--	20 U	--	--	--	--	10 U
Phenol	--	--	--	--	--	20 U	--	--	--	--	10 U
Aroclor-1260	--	--	--	--	--	1.0 U	--	--	--	--	1.0 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-11B**	**P-11B**	**P-11B**	**P-11B**	**P-11B**	**P-12**	**P-12**	**P-12**	**P-12**	**P-13**	**P-13**
Sample Date	**12/1/1994**	**12/1/1994**	**3/27/1995**	**12/4/1996**	**12/4/1996**	**8/13/1991**	**11/29/1994**	**3/21/1995**	**11/22/1996**	**8/14/1991**	**11/30/1994**
Sample Type	**S**	**D**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**59 *J**	**36**
1,1,2-Trichloroethane	5.0 U	5.0 U	25 U	2.0 U	1.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U	2.0 UJ	5.0 U
1,1-Dichloroethane	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**75 *J**	**30**
1,1-Dichloroethene	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**10 J**	**2.8 J**
1,2-Dichlorobenzene	--	--	--	2.0 U	1.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--
1,2-Dichloroethane	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**2.0 J**	5.0 U
1,2-Dichloroethene, Total	5.0 U	5.0 U	25 U	4.0 U	**2.0**	--	5.0 U	5.0 U	2.0 U	--	**16**
1,4-Dichlorobenzene	--	--	--	2.0 U	1.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--
2-Butanone	25 U	25 U	130 U	10 U	5.0 U	R	25 U	25 U	20 U	R	25 U
4-Methyl-2-pentanone	25 U	25 U	130 U	10 U	5.0 U	5.0 UJ	25 U	25 U	5.0 U	5.0 UJ	25 U
Acetone	25 U	25 U	130 U	10 U	5.0 U	R	25 U	25 U	7.0 U	R	25 U
Benzene	**4.0 J**	5.0 U	**21 J**	**40**	**58 D**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U
Carbon disulfide	5.0 U	5.0 U	25 U	2.0 U	1.0 U	R	5.0 U	5.0 U	1.0 U	R	5.0 U
Carbon tetrachloride	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**8.0 J**	5.0 U
Chlorobenzene	5.0 U	5.0 U	25 U	**14**	**23**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U
Chloroethane	5.0 U	5.0 U	**25**	**94 D**	**98 D**	2.0 UJ	5.0 U	5.0 U	1.0 U	**3.0 J**	5.0 U
Chloroform	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U
Chloromethane	10 U	10 U	50 U	2.0 U	**6.0**	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	10 U
cis-1,2-Dichloroethene	--	--	--	2.0 U	1.0 U	1.0 UJ	--	--	1.0 U	**23 J**	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U
M,P-Xylene	--	--	--	**66**	**60 D**	--	--	--	2.0 U	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	10 U	50 U(b)	**6.0**	**4.0**	2.0 UJ	10 U	10 U	1.0 U	8.0 UJ	10 U
O-Xylene	--	--	--	2.0 U	1.0 U	--	--	--	1.0 U	--	--
Styrene	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U
Tetrachloroethene	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U
Tetrahydrofuran	**16 J**	25 U	**550**	**1,200 D**	**1,100 D**	--	25 U	25 U	10 U	--	25 U
Toluene	5.0 U	5.0 U	25 U	2.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	5.0 U
trans-1,2-Dichloroethene	--	--	--	2.0 U	**1.0**	1.0 UJ	--	--	1.0 U	**1.0 J**	--
Trichloroethene	5.0 U	5.0 U	25 U	2.0 U	**1.0**	1.0 UJ	5.0 U	5.0 U	2.0 U	**3.0 J**	5.0 U
Vinyl chloride	10 U	10 U	50 U	2.0 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	10 U
Xylenes, Total	5.0 U	5.0 U	25 U	**65**	**60 D**	1.0 UJ	5.0 U	5.0 U	2.0 U	1.0 UJ	5.0 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-11B**	**P-11B**	**P-11B**	**P-11B**	**P-11B**	**P-12**	**P-12**	**P-12**	**P-12**	**P-13**	**P-13**
Sample Date	**12/1/1994**	**12/1/1994**	**3/27/1995**	**12/4/1996**	**12/4/1996**	**8/13/1991**	**11/29/1994**	**3/21/1995**	**11/22/1996**	**8/14/1991**	**11/30/1994**
Sample Type	**S**	**D**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	--	--	--	1,000 U	1,000 U	--	--	--	1,000 U	--	--
Isopropanol	--	--	--	1,000 U	1,000 U	--	--	--	1,000 U	--	--
Methanol	--	--	--	1,000 U	1,000 U	--	--	--	1,000 U	--	--
Sec-Butanol	--	--	--	1,000 U	1,000 U	--	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	2.0 UJ	--	--	--	2.0 UJ	--
2,4-Dimethylphenol	--	--	--	--	--	20 U	--	--	--	10 U	--
2,4-Dinitrophenol	--	--	--	--	--	50 U	--	--	--	25 UJ	--
2-Methylnaphthalene	--	--	--	--	--	20 U	--	--	--	10 U	--
2-Methylphenol	--	--	--	--	--	20 U	--	--	--	10 U	--
4-Methylphenol	--	--	--	--	--	20 U	--	--	--	10 U	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	20 U	--	--	--	10 U	--
Butyl benzyl phthalate	--	--	--	--	--	20 U	--	--	--	10 U	--
Di-n-butyl phthalate	--	--	--	--	--	20 U	--	--	--	**1.0 J**	--
Di-n-octyl phthalate	--	--	--	--	--	20 U	--	--	--	10 U	--
Diethyl phthalate	--	--	--	--	--	20 U	--	--	--	**1.0 J**	--
Dimethyl phthalate	--	--	--	--	--	20 U	--	--	--	10 U	--
Isophorone	--	--	--	--	--	20 U	--	--	--	10 U	--
Naphthalene	--	--	--	--	--	1.0 UJ	--	--	--	1.0 UJ	--
Phenanthrene	--	--	--	--	--	20 U	--	--	--	10 U	--
Phenol	--	--	--	--	--	20 U	--	--	--	10 U	--
Aroclor-1260	--	--	--	--	--	1.0 U	--	--	--	1.0 U	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-13**	**P-13**	**P-13**	**P-13**	**P-16**	**P-16**	**P-16**	**P-16**	**P-101B**	**P-101B**	**P-101B**
Sample Date	**3/28/1995**	**11/20/1996**	**12/1/1998**	**12/1/1998**	**8/28/1991**	**11/28/1994**	**3/20/1995**	**12/12/1996**	**12/8/1992**	**12/8/1992**	**12/3/1994**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**D**	**S**
1,1,1-Trichloroethane	**40**	1.0 U	**18**	**24**	550 UJ	**39 J**	**1,000**	**1,900**	2,000 U	12,000 U	2,500 U
1,1,2-Trichloroethane	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
1,1-Dichloroethane	**14**	**14**	**12**	**15**	**290 J**	**1,400**	**1,000**	**3,000 D**	2,000 U	12,000 U	2,500 U
1,1-Dichloroethene	**3.1 J**	2.0 U	**2.0**	**3.0**	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
1,2-Dichlorobenzene	--	1.0 U	1.0 U	1.0 U	10 U	--	--	100 U	200 U	200 U	--
1,2-Dichloroethane	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
1,2-Dichloroethene, Total	**12**	**10**	**8.0**	**10**	--	**1,900**	**7,300**	**14,000 D**	2,000 U	12,000 U	2,500 U
1,4-Dichlorobenzene	--	1.0 U	1.0 U	1.0 U	10 U	--	--	100 U	200 U	200 U	--
2-Butanone	25 U	5.0 U	5.0 U	5.0 U	R	250 U	1,600 U	500 U	**160,000 J**	**190,000 J**	**17,000**
4-Methyl-2-pentanone	25 U	5.0 U	5.0 U	5.0 U	1,250 UJ	250 U	1,600 U	500 U	**27,000 J**	**24,000 J**	**27,000**
Acetone	25 U	5.0 U	5.0 U	5.0 U	R	250 U	1,600 U	500 U	**220,000**	**240,000**	**47,000**
Benzene	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Carbon disulfide	5.0 U	1.0 U	1.0 U	1.0 U	R	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Carbon tetrachloride	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Chlorobenzene	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Chloroethane	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	**660**	310 U	**1,100**	**1,700 J**	12,000 U	2,500 U
Chloroform	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Chloromethane	10 U	1.0 U	1.0 U	1.0 U	250 UJ	100 U	630 U	100 U	2,000 U	12,000 U	5,000 U
cis-1,2-Dichloroethene	--	**11**	**7.0**	**10**	1,000 UJ	--	--	**13,000 D**	--	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5.0 U	1.0 U	1.0 U	1.0 U	**870 J**	**1,500**	**3,100**	**4,200 D**	**7,200**	**8,000 J**	**6,800**
M,P-Xylene	--	2.0 U	2.0 U	2.0 U	--	--	--	**5,600 D**	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U(b)	7.0 U	2.0 U	2.0 U	5,400 UJ	100 U	870 U(b)	410 U	2,000 U	12,000 U	5,000 U
O-Xylene	--	1.0 U	1.0 U	1.0 U	--	--	--	**1,800**	--	--	--
Styrene	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Tetrachloroethene	5.0 U	1.0 U	1.0 U	1.0 U	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Tetrahydrofuran	25 U	10 U	1.0 U	1.0 U	--	250 U	1,600 U	1,000 U	--	--	**18,000**
Toluene	5.0 U	1.0 U	1.0 U	1.0 U	970 UJ	**910**	**3,700**	**7,800 DB**	**19,000**	**22,000**	**18,000**
trans-1,2-Dichloroethene	--	1.0 U	1.0 U	1.0 U	250 UJ	--	--	100 U	--	--	--
Trichloroethene	5.0 U	4.0 U	**1.0**	**2.0**	250 UJ	50 U	310 U	100 U	2,000 U	12,000 U	2,500 U
Vinyl chloride	10 U	1.0 U	1.0 U	1.0 U	**360 J**	**660**	**790**	**1,400**	2,000 U	12,000 U	5,000 U
Xylenes, Total	5.0 U	2.0 U	2.0 U	2.0 U	490 UJ	**2,200**	**6,000**	**7,600 D**	**6,900**	**6,300 J**	**4,900**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-13**	**P-13**	**P-13**	**P-13**	**P-16**	**P-16**	**P-16**	**P-16**	**P-101B**	**P-101B**	**P-101B**
Sample Date	**3/28/1995**	**11/20/1996**	**12/1/1998**	**12/1/1998**	**8/28/1991**	**11/28/1994**	**3/20/1995**	**12/12/1996**	**12/8/1992**	**12/8/1992**	**12/3/1994**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**D**	**S**
Ethanol	--	1,000 U	--	--	--	--	--	1,000 U	--	--	--
Isopropanol	--	1,000 U	--	--	--	--	--	1,000 U	--	--	--
Methanol	--	1,000 U	--	--	--	--	--	1,000 U	--	--	--
Sec-Butanol	--	1,000 U	--	--	--	--	--	**5,500**	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	10 U	--	--	--	200 U	200 U	--
2,4-Dimethylphenol	--	--	--	--	**11**	--	--	--	**160 J**	**160 J**	--
2,4-Dinitrophenol	--	--	--	--	25 UJ	--	--	--	500 U	500 U	--
2-Methylnaphthalene	--	--	--	--	10 U	--	--	--	200 U	200 U	--
2-Methylphenol	--	--	--	--	**14**	--	--	--	200 U	200 U	--
4-Methylphenol	--	--	--	--	**14**	--	--	--	**1,100**	**1,100**	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Butyl benzyl phthalate	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Di-n-butyl phthalate	--	--	--	--	**1.0 J**	--	--	--	200 U	200 U	--
Di-n-octyl phthalate	--	--	--	--	10 UJ	--	--	--	200 U	200 U	--
Diethyl phthalate	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Dimethyl phthalate	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Isophorone	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Naphthalene	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Phenanthrene	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Phenol	--	--	--	--	10 U	--	--	--	200 U	200 U	--
Aroclor-1260	--	--	--	--	1.0 U	--	--	--	1.0 U	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-101B**	**P-101B**	**P-101B**	**P-101C**	**P-101C**	**P-101C**	**P-101C**	**P-102B**	**P-102B**	**P-102B**	**P-102B**
Sample Date	**3/27/1995**	**12/19/1996**	**12/3/1998**	**12/3/1994**	**3/27/1995**	**12/10/1996**	**12/2/1998**	**12/8/1992**	**12/9/1992**	**12/2/1994**	**3/29/1995**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	**28 J**
1,1,2-Trichloroethane	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
1,1-Dichloroethane	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	**71 J**	--	**78 J**	**78**
1,1-Dichloroethene	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
1,2-Dichlorobenzene	--	250 U	100 U	--	--	1.0 U	2.0 U	10 U	--	--	--
1,2-Dichloroethane	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
1,2-Dichloroethene, Total	1,800 U	500 U	200 U	5.0 U	**7.0 J**	3.0 U	4.0 U	**1,500**	--	**1,500**	**1,600**
1,4-Dichlorobenzene	--	250 U	100 U	--	--	1.0 U	2.0 U	10 U	--	--	--
2-Butanone	**34,000**	1,200 U	500 U	25 U	50 U	5.0 U	10 U	100 U	--	420 U	190 U
4-Methyl-2-pentanone	**24,000**	1,200 U	500 U	25 U	50 U	5.0 U	10 U	100 U	--	420 U	190 U
Acetone	**59,000**	1,200 U	500 U	25 U	50 U	5.0 U	**17**	100 U	--	420 U	190 U
Benzene	1,800 U	250 U	100 U	**12**	**28**	**20 D**	**13**	100 U	--	83 U	38 U
Carbon disulfide	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
Carbon tetrachloride	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
Chlorobenzene	1,800 U	250 U	100 U	**5.0**	**10**	**9.0**	**5.0**	100 U	--	83 U	38 U
Chloroethane	1,800 U	**1,300**	**360**	**65**	**140**	**95 D**	**66**	100 U	--	83 U	38 U
Chloroform	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
Chloromethane	3,600 U	250 U	100 U	10 U	20 U	1.0 U	2.0 U	100 U	--	170 U	76 U
cis-1,2-Dichloroethene	--	250 U	100 U	--	--	1.0 U	2.0 U	--	--	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**6,500**	**5,400**	**840**	**6.0**	**26**	5.0 U	2.0 U	100 U	--	83 U	38 U
M,P-Xylene	--	**3,000**	**890**	--	--	5.0 U	4.0 U	--	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	3,600 U(b)	500 U	**2,000 B**	10 U	20 U(b)	2.0 U	**7.0 B**	100 U	--	180 U	91 UB
O-Xylene	--	**880**	**190**	--	--	1.0 U	2.0 U	--	--	--	--
Styrene	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
Tetrachloroethene	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
Tetrahydrofuran	**44,000**	2,500 U	**2,400**	**65**	**250**	**110 D**	**19**	--	--	420 U	190 U
Toluene	**15,000**	**11,000 D**	100 U	5.0 U	10 U	1.0 U	2.0 U	100 U	--	83 U	38 U
trans-1,2-Dichloroethene	--	250 U	100 U	--	--	**1.0**	2.0 U	--	--	--	--
Trichloroethene	1,800 U	250 U	100 U	5.0 U	10 U	1.0 U	2.0 U	**130**	--	**110**	**130**
Vinyl chloride	3,600 U	250 U	100 U	10 U	20 U	**1.0**	2.0 U	**1,700**	--	**1,100**	**860**
Xylenes, Total	**4,900**	**4,000**	**1,100**	5.0 U	**18**	6.0 U	4.0 U	100 U	--	83 U	38 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID Sample Date Sample Type	P-101B 3/27/1995 S	P-101B 12/19/1996 S	P-101B 12/3/1998 S	P-101C 12/3/1994 S	P-101C 3/27/1995 S	P-101C 12/10/1996 S	P-101C 12/2/1998 S	P-102B 12/8/1992 S	P-102B 12/9/1992 S	P-102B 12/2/1994 S	P-102B 3/29/1995 S
Ethanol	--	1,000 U	--	--	--	1,000 U	--	--	--	--	--
Isopropanol	--	1,000 U	--	--	--	1,000 U	--	--	--	--	--
Methanol	--	1,000 U	--	--	--	1,000 U	--	--	--	--	--
Sec-Butanol	--	1,000 U	--	--	--	1,000 U	--	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	10 U	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	10 U	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	25 U	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	10 U	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	10 U	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	10 U	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	10 U	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	10 U	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	10 U	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	10 U	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	10 U	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	10 U	--	--	--
Isophorone	--	--	--	--	--	--	--	10 U	--	--	--
Naphthalene	--	--	--	--	--	--	--	10 U	--	--	--
Phenanthrene	--	--	--	--	--	--	--	10 U	--	--	--
Phenol	--	--	--	--	--	--	--	10 U	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	1.0 U	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-102B**	**P-102B**	**P-102C**	**P-102C**	**P-102C**	**PZO-7**	**RW-1**	**RW-1**	**RW-2**	**RW-2**	**RW-2**
Sample Date	**3/29/1995**	**12/6/1996**	**12/2/1994**	**3/29/1995**	**12/4/1996**	**12/12/1996**	**9/30/1994**	**12/26/1996**	**9/30/1994**	**10/3/1994**	**12/27/1996**
Sample Type	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**32 J**	**39 EJ**	5.0 U	5.0 U	1.0 U	**35**	**2,500**	50 U	--	1,500 U	3,600 U
1,1,2-Trichloroethane	34 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	600 U	50 U	--	1,500 U	1,000 U
1,1-Dichloroethane	**86**	**90 EJ**	5.0 U	5.0 U	1.0 U	**14**	**3,100**	**580**	--	1,500 U	**2,500**
1,1-Dichloroethene	34 U	**14**	5.0 U	5.0 U	1.0 U	1.0 U	**600**	50 U	--	1,500 U	1,000 U
1,2-Dichlorobenzene	--	1.0 U	--	--	1.0 U	1.0 U	--	50 U	--	--	1,000 U
1,2-Dichloroethane	34 U	**6.0**	5.0 U	5.0 U	1.0 U	1.0 U	600 U	50 U	--	1,500 U	1,000 U
1,2-Dichloroethene, Total	**1,700**	**1,300 D**	5.0 U	5.0 U	2.0 U	**15**	--	330 U	--	--	18,000 U
1,4-Dichlorobenzene	--	1.0 U	--	--	1.0 U	1.0 U	--	50 U	--	--	1,000 U
2-Butanone	170 U	5.0 U	25 U	25 U	5.0 U	5.0 U	**10,000**	250 U	--	**40,000**	5,000 U
4-Methyl-2-pentanone	170 U	5.0 U	25 U	25 U	5.0 U	5.0 U	2,000 U	250 U	--	**6,000**	5,000 U
Acetone	170 U	5.0 U	25 U	25 U	5.0 U	5.0 U	**3,000**	250 U	--	**36,000**	5,000 U
Benzene	34 U	**5.0**	5.0 U	5.0 U	1.0 U	1.0 U	600 U	50 U	--	1,500 U	1,000 U
Carbon disulfide	34 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	--	50 U	--	--	1,000 U
Carbon tetrachloride	34 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	--	50 U	--	--	1,000 U
Chlorobenzene	34 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	--	50 U	--	--	1,000 U
Chloroethane	34 U	**20**	5.0 U	5.0 U	1.0 U	1.0 U	**2,800**	**2,500 D**	--	1,500 U	**4,400**
Chloroform	34 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	--	50 U	--	--	1,000 U
Chloromethane	68 U	1.0 U	10 U	10 U	1.0 U	1.0 U	--	50 U	--	--	1,000 U
cis-1,2-Dichloroethene	--	**1,300 D**	--	--	1.0 U	**16**	**1,900**	320 U	--	**2,000**	16,000 U
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	34 U	1.0 U	5.0 U	5.0 U	1.0 U	**83 D**	**1,700**	**820**	--	**8,500**	4,900 U
M,P-Xylene	--	2.0 U	--	--	2.0 U	**140 D**	--	**210**	--	--	2,700 U
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	68 U(b)	2.0 U	10 U	10 U(b)	2.0 U	2.0 U	**600**	120 U	--	**2,500**	2,000 U
O-Xylene	--	**1.0**	--	--	1.0 U	**36 D**	--	**72**	--	--	**920 J**
Styrene	34 U	1.0 U	5.0 U	5.0 U	1.0 U	**2.0**	600 U	50 U	--	1,500 U	1,000 U
Tetrachloroethene	34 U	**15**	5.0 U	5.0 U	1.0 U	**6.0**	600 U	50 U	--	1,500 U	1,000 U
Tetrahydrofuran	170 U	**540 EJ**	25 U	25 U	10 U	10 U	600 U	500 U	--	1,500 U	10,000 U
Toluene	34 U	1.0 U	5.0 U	5.0 U	1.0 U	**43 D**	**10,000**	**870**	--	**15,000**	19,000 U
trans-1,2-Dichloroethene	--	**4.0**	--	--	1.0 U	1.0 U	--	50 U	--	--	1,000 U
Trichloroethene	**140**	**300 D**	5.0 U	5.0 U	1.0 U	3.0 U	600 U	50 U	--	1,500 U	1,000 U
Vinyl chloride	**960**	**640 D**	10 U	10 U	1.0 U	**1.0**	**700**	**460**	--	1,500 U	2,900 U
Xylenes, Total	34 U	2.0 U	5.0 U	5.0 U	2.0 U	**180 D**	**600**	**320**	--	**2,500**	3,900 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**P-102B** **3/29/1995** **D**	**P-102B** **12/6/1996** **S**	**P-102C** **12/2/1994** **S**	**P-102C** **3/29/1995** **S**	**P-102C** **12/4/1996** **S**	**PZO-7** **12/12/1996** **S**	**RW-1** **9/30/1994** **S**	**RW-1** **12/26/1996** **S**	**RW-2** **9/30/1994** **S**	**RW-2** **10/3/1994** **S**	**RW-2** **12/27/1996** **S**
Ethanol	--	1,000 U	--	--	1,000 U	1,000 U	1,000 U	1,000 U	1,000 U	--	**1,800**
Isopropanol	--	1,000 U	--	--	1,000 U	1,000 U	1,000 U	1,000 U	**56,000**	--	**2,400**
Methanol	--	1,000 U	--	--	1,000 U	1,000 U	**10,000**	1,000 U	1,000 U	--	**1,600**
Sec-Butanol	--	1,000 U	--	--	1,000 U	1,000 U	1,000 U	1,000 U	**33,000**	--	**7,000**
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**RW-3**	**RW-3**	**RW-3**	**RW-4**	**RW-4**	**RW-4**	**RW-4**	**RW-5**	**RW-5**	**RW-5**	**RW-6**
Sample Date	**9/30/1994**	**10/6/1994**	**12/27/1996**	**9/29/1994**	**9/30/1994**	**12/27/1996**	**12/27/1996**	**9/30/1994**	**10/4/1994**	**12/27/1996**	**12/27/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	--	600 U	4,900 U	**350**	--	5,000 U	5,000 U	--	30 U	2,500 U	18,000 U
1,1,2-Trichloroethane	--	600 U	1,000 U	150 U	--	5,000 U	5,000 U	--	30 U	2,500 U	5,000 U
1,1-Dichloroethane	--	600 U	**950 J**	150 U	--	5,000 U	5,000 U	--	30 U	2,500 U	**6,300**
1,1-Dichloroethene	--	600 U	1,000 U	150 U	--	5,000 U	5,000 U	--	30 U	2,500 U	5,000 U
1,2-Dichlorobenzene	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
1,2-Dichloroethane	--	600 U	1,000 U	150 U	--	5,000 U	5,000 U	--	30 U	2,500 U	5,000 U
1,2-Dichloroethene, Total	--	--	13,000 U	--	--	82,000 U	80,000 U	--	--	8,900 U	86,000 U
1,4-Dichlorobenzene	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
2-Butanone	--	**5,000**	5,000 U	500 U	--	25,000 U	25,000 U	--	30 U	12,000 U	25,000 U
4-Methyl-2-pentanone	--	**2,600**	5,000 U	500 U	--	25,000 U	25,000 U	--	**100**	12,000 U	25,000 U
Acetone	--	**7,000**	5,000 U	**1,100**	--	25,000 U	25,000 U	--	**100**	12,000 U	25,000 U
Benzene	--	600 U	1,000 U	150 U	--	5,000 U	5,000 U	--	30 U	2,500 U	5,000 U
Carbon disulfide	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
Carbon tetrachloride	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
Chlorobenzene	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
Chloroethane	--	600 U	1,000 U	150 U	--	5,000 U	5,000 U	--	30 U	2,500 U	5,000 U
Chloroform	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
Chloromethane	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
cis-1,2-Dichloroethene	--	**2,000**	12,000 U	**8,400**	--	88,000 U	84,000 U	--	**720**	9,600 U	92,000 U
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	**3,200**	1,500 U	**1,100**	--	5,000 U	5,700 U	--	**160**	2,600 U	5,500 U
M,P-Xylene	--	--	2,200 U	--	--	10,000 U	10,000 U	--	--	5,700 U	10,000 U
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	--	**600**	2,000 U	**180**	--	13,000 U	12,000 U	--	30 U	5,400 U	18,000 U
O-Xylene	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
Styrene	--	600 U	1,000 U	150 U	--	5,000 U	5,000 U	--	30 U	2,500 U	5,000 U
Tetrachloroethene	--	600 U	1,000 U	**180**	--	5,000 U	5,000 U	--	30 U	2,500 U	5,000 U
Tetrahydrofuran	--	600 U	10,000 U	150 U	--	50,000 U	50,000 U	--	30 U	25,000 U	50,000 U
Toluene	--	**6,400**	8,400 U	**3,100**	--	13,000 U	18,000 U	--	**170**	6,600 U	29,000 U
trans-1,2-Dichloroethene	--	--	1,000 U	--	--	5,000 U	5,000 U	--	--	2,500 U	5,000 U
Trichloroethene	--	600 U	1,000 U	**1,300**	--	5,000 U	5,000 U	--	30 U	15,000 U	5,000 U
Vinyl chloride	--	600 U	1,300 U	**2,800**	--	11,000 U	8,900 U	--	30 U	2,500 U	5,000 U
Xylenes, Total	--	**1,400**	2,800 U	**1,200**	--	10,000 U	10,000 U	--	**60**	5,600 U	10,000 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**RW-3** **9/30/1994** **S**	**RW-3** **10/6/1994** **S**	**RW-3** **12/27/1996** **S**	**RW-4** **9/29/1994** **S**	**RW-4** **9/30/1994** **S**	**RW-4** **12/27/1996** **S**	**RW-4** **12/27/1996** **D**	**RW-5** **9/30/1994** **S**	**RW-5** **10/4/1994** **S**	**RW-5** **12/27/1996** **S**	**RW-6** **12/27/1996** **S**
Ethanol	1,000 U	--	1,000 U	--	1,000 U	1,000 U	1,000 U	1,000 U	--	1,000 U	**1,200**
Isopropanol	**11,000**	--	1,000 U	--	**1,300**	1,000 U	1,000 U	1,000 U	--	1,000 U	**7,400**
Methanol	1,000 U	--	1,000 U	--	1,000 U	**3,000**	**3,100**	**14,000**	--	1,000 U	**4,200**
Sec-Butanol	**6,600**	--	**3,900**	--	1,000 U	**12,000**	**13,000**	1,000 U	--	**3,300**	**33,000**
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**RW-7**	**RW-7**	**RW-8**	**RW-9**	**RW-10**	**RW-11**	**RW-12**	**SRS-1**	**SRS-1**	**SRS-2**	**SRS-3**
Sample Date	**12/26/1996**	**12/26/1996**	**12/27/1996**	**12/27/1996**	**12/27/1996**	**12/27/1996**	**12/26/1996**	**12/13/1990**	**12/11/1996**	**12/13/1990**	**12/13/1990**
Sample Type	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	20 U	**35**	1,400 U	12,000 U	5,000 U	**510 EJ**	200 U	**20**	1.0 U	2.0 U	**43**
1,1,2-Trichloroethane	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	2.0 U	1.0 U	2.0 U	2.0 U
1,1-Dichloroethane	42 U	**120 D**	**2,600**	**13,000**	**8,800**	**510 EJ**	**730**	**6.0**	**110**	2.0 U	**130**
1,1-Dichloroethene	20 U	5.0 U	500 U	2,500 U	5,000 U	**21**	200 U	2.0 U	1.0 U	2.0 U	2.0 U
1,2-Dichlorobenzene	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	2.0 U	1.0 U	2.0 U	2.0 U
1,2-Dichloroethane	20 U	5.0 U	500 U	2,500 U	5,000 U	**21**	200 U	2.0 U	1.0 U	2.0 U	**5.2**
1,2-Dichloroethene, Total	31 U	30 U	1,000 U	43,000 U	70,000 U	**4,200 D**	730 U	--	**16**	--	--
1,4-Dichlorobenzene	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	2.0 U	1.0 U	2.0 U	2.0 U
2-Butanone	100 U	25 U	2,500 U	12,000 U	25,000 U	50 U	1,000 U	20 U	**50**	20 U	20 U
4-Methyl-2-pentanone	100 U	25 U	2,500 U	12,000 U	25,000 U	50 U	1,000 U	--	5.0 U	--	--
Acetone	100 U	25 U	2,500 U	12,000 U	25,000 U	50 U	1,000 U	--	12 U	--	--
Benzene	20 U	5.0 U	500 U	2,500 U	5,000 U	**27**	200 U	2.0 U	**2.0**	2.0 U	2.0 U
Carbon disulfide	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	--	1.0 U	--	--
Carbon tetrachloride	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	2.0 U	1.0 U	2.0 U	2.0 U
Chlorobenzene	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	2.0 U	1.0 U	2.0 U	2.0 U
Chloroethane	**100**	**110 D**	**1,100**	**2,800**	5,000 U	**320 EJ**	**1,800**	10 U	**140**	10 U	**34**
Chloroform	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	2.0 U	1.0 U	2.0 U	2.0 U
Chloromethane	20 U	20 U	500 U	2,500 U	5,000 U	10 U	200 U	10 U	1.0 U	10 U	10 U
cis-1,2-Dichloroethene	20 U	28 U	3,900 U	40,000 U	64,000 U	**3,800 D**	350 U	--	**17**	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	20 U	**53**	2,300 U	**8,400**	5,000 U	**810 EJ**	**570**	2.0 U	**74**	2.0 U	2.0 U
M,P-Xylene	40 U	**10**	1,000 U	**3,600 J**	10,000 U	**1,100 D**	400 U	--	**57**	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	40 U	7.0 U	1,000 U	5,000 U	10,000 U	20 U	400 U	2.0 U	2.0 U	2.0 U	2.0 U
O-Xylene	20 U	5.0 U	500 U	2,500 U	5,000 U	**250 EJ**	200 U	--	**20**	--	--
Styrene	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	--	1.0 U	--	--
Tetrachloroethene	20 U	**8.0**	500 U	2,500 U	5,000 U	10 U	200 U	2.0 U	1.0 U	2.0 U	2.0 U
Tetrahydrofuran	200 U	50 U	5,000 U	25,000 U	50,000 U	**200**	2,000 U	--	10 U	--	--
Toluene	20 U	5.0 U	6,200 U	30,000 U	31,000 U	**2,700 D**	**2,300**	2.0 U	**260 EJ**	2.0 U	2.0 U
trans-1,2-Dichloroethene	20 U	5.0 U	500 U	2,500 U	5,000 U	10 U	200 U	**5.8**	1.0 U	2.0 U	**6.7**
Trichloroethene	20 U	**19**	500 U	2,500 U	8,100 U	18 U	200 U	2.0 U	1.0 U	2.0 U	**6.1**
Vinyl chloride	20 U	**28**	1,300 U	5,800 U	13,000 U	**3,100 D**	510 U	10 U	**31**	10 U	10 U
Xylenes, Total	40 U	**19**	500 U	**6,200**	10,000 U	**1,300 D**	**550**	--	**78**	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**RW-7** **12/26/1996** **S**	**RW-7** **12/26/1996** **D**	**RW-8** **12/27/1996** **S**	**RW-9** **12/27/1996** **S**	**RW-10** **12/27/1996** **S**	**RW-11** **12/27/1996** **S**	**RW-12** **12/26/1996** **S**	**SRS-1** **12/13/1990** **S**	**SRS-1** **12/11/1996** **S**	**SRS-2** **12/13/1990** **S**	**SRS-3** **12/13/1990** **S**
Ethanol	1,000 U	1,000 U	1,000 U	**1,600**	1,000 U	1,000 U	1,000 U	--	1,000 U	--	--
Isopropanol	1,000 U	1,000 U	1,000 U	1,000 U	**3,300**	1,000 U	1,000 U	500 U	1,000 U	500 U	500 U
Methanol	1,000 U	1,000 U	1,000 U	**2,400**	**4,100**	1,000 U	1,000 U	--	1,000 U	--	--
Sec-Butanol	1,000 U	1,000 U	**1,400**	**14,000**	**20,000**	1,000 U	1,000 U	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2,4-Dinitrophenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Benzoic Acid	--	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Dimethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**SRS-3**	**SRS-4**	**SRS-4**	**SRS-5**	**SRS-5**	**SRS-6**	**SRS-6**	**TW-07A**	**TW-07A**	**TW-07A**	**TW-07A**
Sample Date	**12/11/1996**	**12/13/1990**	**12/10/1996**	**12/13/1990**	**12/11/1996**	**12/13/1990**	**12/11/1996**	**6/25/1990**	**12/13/1990**	**8/26/1991**	**12/3/1992**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	7.0 U	**10**	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
1,1,2-Trichloroethane	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
1,1-Dichloroethane	**60 D**	**6.9**	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
1,1-Dichloroethene	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
1,2-Dichlorobenzene	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	R	500 U	10 U	50 U
1,2-Dichloroethane	**1.0**	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
1,2-Dichloroethene, Total	**7.0**	--	2.0 U	--	2.0 U	--	100 U	--	--	--	1,000 U
1,4-Dichlorobenzene	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	R	500 U	10 U	50 U
2-Butanone	5.0 U	20 U	5.0 U	**7,800**	5.0 U	400 U	**1,100**	**83,000**	**83,000**	R	**4,800 J**
4-Methyl-2-pentanone	5.0 U	--	5.0 U	--	130 U	--	250 U	**18,000**	--	R	**6,400 J**
Acetone	5.0 U	--	8.0 U	--	18 U	--	250 U	55,000 U	--	R	**5,900**
Benzene	**2.0**	2.0 U	1.0 U	**74**	**68 D**	**78**	**76**	5,000 U	500 U	R	1,000 U
Carbon disulfide	1.0 U	--	1.0 U	--	**2.0**	--	50 U	5,000 U	--	R	1,000 U
Carbon tetrachloride	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
Chlorobenzene	1.0 U	2.0 U	1.0 U	40 U	**17**	40 U	50 U	5,000 U	500 U	R	1,000 U
Chloroethane	**56 D**	10 U	1.0 U	**330**	**310 D**	**670**	**560**	10,000 U	2,500 U	R	**1,100**
Chloroform	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
Chloromethane	1.0 U	10 U	1.0 U	200 U	1.0 U	200 U	50 U	10,000 U	2,500 U	R	1,000 U
cis-1,2-Dichloroethene	**6.0**	--	1.0 U	--	1.0 U	--	50 U	--	--	R	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	4.0 U	2.0 U	1.0 U	**2,300**	**750 D**	**3,100**	**1,300 D**	**8,900**	**8,900**	R	**7,500**
M,P-Xylene	2.0 U	--	2.0 U	--	**490 D**	--	**750**	--	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	2.0 U	2.0 U	2.0 U	40 U	5.0 U	40 U	100 U	5,000 U	**680**	R	1,000 U
O-Xylene	1.0 U	--	1.0 U	--	**190 D**	--	**170**	--	--	--	--
Styrene	1.0 U	--	1.0 U	--	1.0 U	--	50 U	5,000 U	--	R	1,000 U
Tetrachloroethene	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
Tetrahydrofuran	69 U	--	10 U	--	**2,300 D**	--	**2,100**	--	--	--	--
Toluene	6.0 U	2.0 U	1.0 U	**2,800**	**270 D**	**2,500**	79 U	**21,000**	**20,000**	R	**13,000**
trans-1,2-Dichloroethene	1.0 U	**11**	1.0 U	40 U	1.0 U	40 U	50 U	**3,700 J**	500 U	R	--
Trichloroethene	1.0 U	2.0 U	1.0 U	40 U	1.0 U	40 U	50 U	5,000 U	500 U	R	1,000 U
Vinyl chloride	**2.0**	10 U	1.0 U	200 U	**1.0**	200 U	50 U	**4,900 J**	2,500 U	R	1,000 U
Xylenes, Total	4.0 U	--	2.0 U	--	**710 D**	--	**950**	**6,800**	--	R	**8,400**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**SRS-3**	**SRS-4**	**SRS-4**	**SRS-5**	**SRS-5**	**SRS-6**	**SRS-6**	**TW-07A**	**TW-07A**	**TW-07A**	**TW-07A**
Sample Date	**12/11/1996**	**12/13/1990**	**12/10/1996**	**12/13/1990**	**12/11/1996**	**12/13/1990**	**12/11/1996**	**6/25/1990**	**12/13/1990**	**8/26/1991**	**12/3/1992**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	1,000 U	--	1,000 U	--	1,000 U	--	1,000 U	--	--	--	--
Isopropanol	1,000 U	500 U	1,000 U	10,000 U	1,000 U	10,000 U	1,000 U	--	125,000 U	--	--
Methanol	1,000 U	--	1,000 U	--	1,000 U	--	1,000 U	--	--	--	--
Sec-Butanol	1,000 U	--	1,000 U	--	1,000 U	--	1,000 U	--	--	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	R	--	**2.0 J**	50 U
2,4-Dimethylphenol	--	--	--	--	--	--	--	**66**	--	**47 J**	**29 J**
2,4-Dinitrophenol	--	--	--	--	--	--	--	500 U	--	25 U	130 U
2-Methylnaphthalene	--	--	--	--	--	--	--	R	--	**2.0 J**	50 U
2-Methylphenol	--	--	--	--	--	--	--	100 U	--	**46**	**52**
4-Methylphenol	--	--	--	--	--	--	--	**730**	--	**760 J**	**630**
Benzoic Acid	--	--	--	--	--	--	--	**360 J**	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	R	--	10 U	50 U
Butyl benzyl phthalate	--	--	--	--	--	--	--	R	--	10 U	50 U
Di-n-butyl phthalate	--	--	--	--	--	--	--	R	--	10 U	50 U
Di-n-octyl phthalate	--	--	--	--	--	--	--	R	--	10 U	50 U
Diethyl phthalate	--	--	--	--	--	--	--	R	--	10 U	50 U
Dimethyl phthalate	--	--	--	--	--	--	--	R	--	10 U	50 U
Isophorone	--	--	--	--	--	--	--	R	--	10 U	50 U
Naphthalene	--	--	--	--	--	--	--	**42 J**	--	**31**	**25 J**
Phenanthrene	--	--	--	--	--	--	--	R	--	10 U	50 U
Phenol	--	--	--	--	--	--	--	100 U	--	**33**	50 U
Aroclor-1260	--	--	--	--	--	--	--	1.0 U	--	1.0 U	1.0 U

See notes pages.

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**TW-07A**	**TW-07A**	**TW-07A**	**TW-07A**	**TW-07A**	**TW-08A**	**TW-08A**	**TW-08A**	**TW-08A**	**TW-08A**	**TW-08A**
Sample Date	**12/3/1992**	**12/9/1992**	**11/30/1994**	**3/23/1995**	**12/10/1996**	**6/28/1990**	**8/26/1991**	**12/3/1992**	**3/14/1994**	**11/30/1994**	**11/30/1994**
Sample Type	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**
1,1,1-Trichloroethane	--	500 U	330 U	170 U	50 U	**2,600**	500 UJ	500 U	--	**9,600**	**10,000**
1,1,2-Trichloroethane	--	500 U	330 U	170 U	50 U	2,500 U	500 UJ	500 U	--	2,500 U	1,700 U
1,1-Dichloroethane	--	500 U	330 U	170 U	50 U	3,400 U	**210 J**	500 U	--	**7,200**	**6,900**
1,1-Dichloroethene	--	500 U	330 U	170 U	50 U	2,500 U	500 UJ	500 U	--	2,500 U	**1,100 J**
1,2-Dichlorobenzene	100 U	--	--	--	50 U	50 U	10 U	10 U	--	--	--
1,2-Dichloroethane	--	500 U	330 U	170 U	50 U	2,500 U	**114 J**	500 U	--	2,500 U	1,700 U
1,2-Dichloroethene, Total	--	500 U	330 U	170 U	100 U	--	--	**1,300**	--	**81,000**	**80,000**
1,4-Dichlorobenzene	100 U	--	--	--	50 U	50 U	10 U	10 U	--	--	--
2-Butanone	--	**4,800**	1,700 U	830 U	250 U	**5,400**	R	**2,800 J**	--	**26,000**	**23,000**
4-Methyl-2-pentanone	--	**6,200 J**	1,700 U	830 U	250 U	6,900 U	**1,900 J**	**950 J**	--	**9,300 J**	**8,400**
Acetone	--	**5,700**	1,700 U	830 U	250 U	16,000 U	R	**3,000**	--	13,000 U	**26,000**
Benzene	--	500 U	330 U	170 U	**140**	2,500 U	**62 J**	500 U	--	2,500 U	1,700 U
Carbon disulfide	--	500 U	330 U	170 U	50 U	2,500 UJ	R	500 U	--	2,500 U	1,700 U
Carbon tetrachloride	--	500 U	330 U	170 U	50 U	2,500 U	500 UJ	500 U	--	2,500 U	1,700 U
Chlorobenzene	--	500 U	330 U	170 U	**52**	2,500 U	500 UJ	500 U	--	2,500 U	1,700 U
Chloroethane	--	**980**	**360**	**400**	**690**	5,000 U	**280 J**	500 U	--	2,500 U	1,700 U
Chloroform	--	500 U	330 U	170 U	50 U	2,500 U	500 UJ	500 U	--	2,500 U	1,700 U
Chloromethane	--	500 U	670 U	330 U	50 U	5,000 U	500 U	500 U	--	5,000 U	3,300 U
cis-1,2-Dichloroethene	--	--	--	--	50 U	--	700 UJ	--	--	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	--	**6,200**	**5,900**	**4,700**	**2,300 D**	7,400 U	**4,900 J**	**3,200**	--	**11,000**	**12,000**
M,P-Xylene	--	--	--	--	**1,900 D**	--	--	--	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	--	500 U	670 U	330 U(b)	50 U	2,500 U	1,500 UJ	500 U	--	11,000 U	11,000 U
O-Xylene	--	--	--	--	**600 D**	--	--	--	--	--	--
Styrene	--	500 U	330 U	170 U	**49 J**	2,500 U	500 UJ	500 U	--	2,500 U	1,700 U
Tetrachloroethene	--	500 U	330 U	170 U	50 U	2,500 U	500 UJ	500 U	--	2,500 U	1,700 U
Tetrahydrofuran	--	--	**910 J**	**1,500**	**3,400**	--	--	--	--	13,000 U	8,300 U
Toluene	--	**9,100**	**5,500**	**2,800**	**640**	26,000 U	5,700 UJ	**6,900**	--	**36,000**	**37,000**
trans-1,2-Dichloroethene	--	--	--	--	50 U	41,000 U	500 UJ	--	--	--	--
Trichloroethene	--	500 U	330 U	170 U	50 U	2,500 U	500 UJ	500 U	--	2,500 U	1,700 U
Vinyl chloride	--	500 U	670 U	330 U	50 U	**6,800**	**2,700 J**	500 U	--	**8,900**	**9,900**
Xylenes, Total	--	**7,100**	**4,000**	**2,900**	**2,500 D**	5,200 U	2,400 UJ	**4,900**	--	**14,000**	**15,000**

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**TW-07A** **12/3/1992** **D**	**TW-07A** **12/9/1992** **S**	**TW-07A** **11/30/1994** **S**	**TW-07A** **3/23/1995** **S**	**TW-07A** **12/10/1996** **S**	**TW-08A** **6/28/1990** **S**	**TW-08A** **8/26/1991** **S**	**TW-08A** **12/3/1992** **S**	**TW-08A** **3/14/1994** **S**	**TW-08A** **11/30/1994** **S**	**TW-08A** **11/30/1994** **D**
Ethanol	--	--	--	--	1,000 U	--	--	--	1,000 U	--	--
Isopropanol	--	--	--	--	1,000 U	--	--	--	**2,000**	--	--
Methanol	--	--	--	--	1,000 U	--	--	--	**1,000**	--	--
Sec-Butanol	--	--	--	--	1,000 U	--	--	--	**4,200**	--	--
1,2,4-Trichlorobenzene	100 U	--	--	--	--	50 U	**7.0 J**	**5.0 J**	--	--	--
2,4-Dimethylphenol	**44 J**	--	--	--	--	**37 J**	**27**	**12**	--	--	--
2,4-Dinitrophenol	250 U	--	--	--	--	250 U	25 UJ	25 U	--	--	--
2-Methylnaphthalene	100 U	--	--	--	--	50 U	**3.0 J**	**3.0 J**	--	--	--
2-Methylphenol	100 U	--	--	--	--	**58**	**32**	**13**	--	--	--
4-Methylphenol	**610**	--	--	--	--	**190**	**140**	**88**	--	--	--
Benzoic Acid	--	--	--	--	--	**910**	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	100 U	--	--	--	--	50 U	10 UJ	10 U	--	--	--
Butyl benzyl phthalate	100 U	--	--	--	--	50 U	10 U	10 U	--	--	--
Di-n-butyl phthalate	100 U	--	--	--	--	50 U	10 U	10 U	--	--	--
Di-n-octyl phthalate	100 U	--	--	--	--	50 U	10 U	10 U	--	--	--
Diethyl phthalate	100 U	--	--	--	--	50 U	10 UJ	10 U	--	--	--
Dimethyl phthalate	100 U	--	--	--	--	50 U	10 UJ	10 U	--	--	--
Isophorone	100 U	--	--	--	--	**30 J**	10 U	10 U	--	--	--
Naphthalene	**35 J**	--	--	--	--	**47 J**	**27**	**24**	--	--	--
Phenanthrene	100 U	--	--	--	--	50 U	10 U	10 U	--	--	--
Phenol	100 U	--	--	--	--	**420**	**180**	**57**	--	--	--
Aroclor-1260	--	--	--	--	--	1.0 U	1.0 U	1.0 U	--	--	--

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**TW-08A**	**TW-08A**	**TW-11**	**TW-11**	**TW-11**	**WE-2**	**WE-2**	**WE-2**	**WE-2**
Sample Date	**3/21/1995**	**12/16/1996**	**6/26/1990**	**12/13/1990**	**11/30/1994**	**6/26/1990**	**11/29/1994**	**3/22/1995**	**12/2/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**12,000**	**7,100 EJ**	**9.0**	**35**	**54**	5.0 U	5.0 U	5.0 U	**2.0**
1,1,2-Trichloroethane	6,300 U	250 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
1,1-Dichloroethane	**4,300 J**	**1,600**	**4.0 J**	**17**	**36**	5.0 U	5.0 U	5.0 U	1.0 U
1,1-Dichloroethene	6,300 U	**340**	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
1,2-Dichlorobenzene	--	250 U	10 U	2.0 U	--	10 U	--	--	1.0 U
1,2-Dichloroethane	6,300 U	250 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
1,2-Dichloroethene, Total	150,000 U	**120,000 D**	--	--	**36**	--	5.0 U	5.0 U	**35**
1,4-Dichlorobenzene	--	250 U	10 U	2.0 U	--	10 U	--	--	1.0 U
2-Butanone	**92,000**	5,300 U	10 U	20 U	25 U	R	25 U	25 U	5.0 U
4-Methyl-2-pentanone	**32,000**	1,200 U	10 U	--	25 U	10 U	25 U	25 U	5.0 U
Acetone	**140,000**	5,200 U	10 U	--	25 U	10 U	25 U	25 U	7.0 U
Benzene	6,300 U	250 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
Carbon disulfide	6,300 U	250 U	5.0 UJ	--	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
Carbon tetrachloride	6,300 U	250 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
Chlorobenzene	6,300 U	250 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
Chloroethane	6,300 U	250 U	10 U	10 U	5.0 U	10 U	5.0 U	5.0 U	1.0 U
Chloroform	6,300 U	250 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
Chloromethane	13,000 U	250 U	10 UJ	10 U	10 U	10 U	10 U	10 U	1.0 U
cis-1,2-Dichloroethene	--	**120,000 D**	--	--	--	--	--	--	**35**
Ethylene	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--
Ethylbenzene	**10,000**	**1,600**	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
M,P-Xylene	--	**2,500**	--	--	--	--	--	--	2.0 U
Methane	--	--	--	--	--	--	--	--	--
Methylene chloride	13,000 U	1,800 U	5.0 U	**2.5**	10 U	5.0 U	10 U	10 U	2.0 U
O-Xylene	--	**780**	--	--	--	--	--	--	1.0 U
Styrene	6,300 U	250 U	5.0 U	--	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
Tetrachloroethene	6,300 U	250 U	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
Tetrahydrofuran	31,000 U	2,500 U	--	--	25 U	--	25 U	25 U	10 U
Toluene	**41,000**	**10,000 B**	5.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U
trans-1,2-Dichloroethene	--	250 U	5.0 U	**35**	--	5.0 U	--	--	1.0 U
Trichloroethene	6,300 U	250 U	5.0 U	2.0 U	**3.4 J**	5.0 U	5.0 U	5.0 U	8.0 U
Vinyl chloride	13,000 U	**300**	10 U	10 U	10 U	10 U	10 U	10 U	1.0 U
Xylenes, Total	**15,000**	**3,400**	5.0 U	--	5.0 U	5.0 U	5.0 U	5.0 U	2.0 U

See notes pages.

TABLE J-1A

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**TW-08A**	**TW-08A**	**TW-11**	**TW-11**	**TW-11**	**WE-2**	**WE-2**	**WE-2**	**WE-2**
Sample Date	**3/21/1995**	**12/16/1996**	**6/26/1990**	**12/13/1990**	**11/30/1994**	**6/26/1990**	**11/29/1994**	**3/22/1995**	**12/2/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Ethanol	--	1,000 U	--	--	--	--	--	--	1,000 U
Isopropanol	--	**2,600**	--	500 U	--	--	--	--	1,000 U
Methanol	--	**3,100**	--	--	--	--	--	--	1,000 U
Sec-Butanol	--	**37,000**	--	--	--	--	--	--	1,000 U
1,2,4-Trichlorobenzene	--	--	10 U	--	--	10 U	--	--	--
2,4-Dimethylphenol	--	--	10 U	--	--	10 U	--	--	--
2,4-Dinitrophenol	--	--	50 U	--	--	50 U	--	--	--
2-Methylnaphthalene	--	--	10 U	--	--	10 U	--	--	--
2-Methylphenol	--	--	10 U	--	--	10 U	--	--	--
4-Methylphenol	--	--	10 U	--	--	10 U	--	--	--
Benzoic Acid	--	--	50 U	--	--	50 U	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	10 U	--	--	10 U	--	--	--
Butyl benzyl phthalate	--	--	10 U	--	--	10 U	--	--	--
Di-n-butyl phthalate	--	--	10 U	--	--	10 U	--	--	--
Di-n-octyl phthalate	--	--	10 U	--	--	10 U	--	--	--
Diethyl phthalate	--	--	10 U	--	--	10 U	--	--	--
Dimethyl phthalate	--	--	10 U	--	--	10 U	--	--	--
Isophorone	--	--	10 U	--	--	10 U	--	--	--
Naphthalene	--	--	10 U	--	--	10 U	--	--	--
Phenanthrene	--	--	10 U	--	--	10 U	--	--	--
Phenol	--	--	10 U	--	--	10 U	--	--	--
Aroclor-1260	--	--	1.0 U	--	--	1.0 U	--	--	--

See notes pages.

TABLE J-1B

INORGANIC CONSTITUENTS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	DN-2	MW-07	MW-07	MW-121B	MW-123C	MW-126B	MW-127B	MW-127B	MW-204B	MW-205B	MW-415
Sample Date	**6/28/1990**	**6/28/1990**	**8/28/1991**	**12/9/1992**	**8/28/1991**	**8/15/1991**	**8/13/1991**	**12/2/1992**	**12/1/1992**	**12/1/1992**	**12/10/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	--	--	--	--	--	--	--	--	--	--	**63,500**
Nitrate	--	--	--	--	--	--	--	--	--	--	200 U
Sulfate	--	--	--	--	--	--	--	--	--	--	**23,200**
Aluminum	**250,000**	**24,000**	**660 J**	**95,800**	**27,000 J**	**22,000**	**110,000**	**274**	**27,300**	**14,000**	--
Arsenic	**17**	**3.7**	**2.0 J**	**18.3**	**20**	--	**7.0 J**	1.9 U	4.3 UJ	2.2 U	--
Barium	**20,000**	**1,200**	**1,600**	**4,140**	**980**	**770**	**2,900 J**	**178**	**818 J**	**441 J**	--
Beryllium	**30**	--	--	**5.8**	**2.6 J**	**1.0 J**	**9.7 J**	0.40 U	**2.6**	0.77 U	--
Cadmium	**8.0**	--	--	1.9 UJ	--	--	--	2.0 U	1.5 U	1.5 U	--
Calcium	**170,000**	**82,000**	**130,000**	**250,000**	**54,000**	**46,000**	**130,000**	**30,400**	**113,000**	**51,800**	--
Chromium	**420**	**46**	--	**160**	**96**	**34**	**170**	4.5 UJ	**38.8 J**	**20.9 J**	--
Cobalt	**180**	26 U	--	**77.8**	**32**	**10**	**110 J**	2.7 U	**22.2**	**11.3**	--
Copper	**440**	**30**	**5.8**	**130**	**130**	**10**	**220 J**	3.5 UJ	52.3 UJ	28.2 UJ	--
Iron	**300,000**	**37,000**	**2,800 J**	**138,000**	**61,000 J**	**17,000**	**120,000**	**366 J**	**37,900**	**19,300**	**2,970**
Lead	**80 J**	**41 J**	**1.0 J**	**54.9 J**	**19 J**	**10**	**36 J**	5.1 U	**17**	**11.7**	--
Magnesium	**120,000**	**23,000**	**19,000**	**68,700**	**13,000**	**8,600**	**61,000**	**3,170**	**18,300**	**10,600**	--
Manganese	**9,400**	**4,000**	**5,000**	**10,500**	**4,400**	**320**	**8,000 J**	**12.5**	**1,730**	**688**	**4,120**
Mercury	**0.20 J**	--	--	0.10 U	--	--	--	0.10 U	0.10 U	0.10 U	--
Nickel	**320**	**26**	--	**147**	**72**	21 U	**190 J**	5.4 U	**40.3**	**21.8**	--
Potassium	**54,000**	**8,900**	1,300 U	**27,000**	**11,000**	3,400 U	**28,000 J**	**470 J**	**9,180**	**4,890**	--
Silver	**40**	**9.6**	--	3.6 UJ	--	--	7.3 UJ	2.5 UJ	3.6 UJ	3.6 UJ	--
Sodium	**12,000**	**9,900**	**13,000**	**59,300**	**29,000**	**23,000**	**8,700 J**	**6,020**	**6,380**	**6,310**	--
Sulfide (S)	--	--	--	--	--	--	--	--	--	--	**1,380**
Thallium	--	--	--	3.8 UJ	--	--	--	3.8 U	1.3 U	1.3 U	--
Vanadium	**750**	**71**	2.6 UJ	**255**	**58**	**30 J**	**270 J**	2.8 U	**88.8**	**40**	--
Zinc	**810 J**	**260 J**	25 UJ	**357 J**	**150**	**67**	**480**	27.8 UJ	**119 J**	**82.9 J**	--
Ammonia (As N)	--	--	--	--	--	--	--	--	--	--	**2,780**
Orthophosphate-P	--	--	--	--	--	--	--	--	--	--	**320**

See notes pages.

TABLE J-1B

INORGANIC CONSTITUENTS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-415**	**MW-502**	**MW-703D**	**MW-703S**	**MW-704D**	**MW-704M**	**MW-704S**	**P-1B**	**P-1B**	**P-1B**
Sample Date	**12/10/1996**	**12/18/1996**	**12/9/1996**	**12/9/1996**	**12/18/1996**	**12/17/1996**	**12/17/1996**	**8/15/1991**	**12/4/1992**	**12/18/1996**
Sample Type	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	**61,900**	211,000 U	**20,600**	**18,400**	68,300 U	20,400 U	9,000 U	--	--	61,500 U
Nitrate	200 U	200 U	**1,340**	**250**	200 U	230 U	200 U	--	--	2,480 U
Sulfate	**21,100**	301,000 U	**45,300**	**18,400**	7,000 U	12,400 U	23,700 U	--	--	17,800 U
Aluminum	--	--	--	--	--	--	--	**12,000**	**35,900 J**	--
Arsenic	--	--	--	--	--	--	--	**21**	**63 J**	--
Barium	--	--	--	--	--	--	--	**3,500 J**	**1,980**	--
Beryllium	--	--	--	--	--	--	--	**1.2 J**	**2.8**	--
Cadmium	--	--	--	--	--	--	--	**4.7**	**87.2**	--
Calcium	--	--	--	--	--	--	--	**350,000**	**177,000**	--
Chromium	--	--	--	--	--	--	--	**89**	**205 J**	--
Cobalt	--	--	--	--	--	--	--	**45 J**	**44.7**	--
Copper	--	--	--	--	--	--	--	**44 J**	**144**	--
Iron	**2,900**	**7,390**	**638**	**625**	**1,340**	**460**	**3,770**	**84,000**	**71,300**	**2,130**
Lead	--	--	--	--	--	--	--	**28**	**141 J**	--
Magnesium	--	--	--	--	--	--	--	**20,000**	**21,700**	--
Manganese	**3,970**	**5,500**	**28.6**	**20.8**	**4,270**	**206**	**204**	**37,000**	**20,800**	**7,190**
Mercury	--	--	--	--	--	--	--	0.83 UJ	**0.18 J**	--
Nickel	--	--	--	--	--	--	--	**32 J**	**58.8**	--
Potassium	--	--	--	--	--	--	--	**14,000 J**	**13,900**	--
Silver	--	--	--	--	--	--	--	--	4.0 UJ	--
Sodium	--	--	--	--	--	--	--	**110,000 J**	**89,200**	--
Sulfide (S)	**1,310**	1,760 U	**3,150**	**2,930**	1,120 U	1,500 U	930 U	--	--	680 U
Thallium	--	--	--	--	--	--	--	--	3.8 U	--
Vanadium	--	--	--	--	--	--	--	**38 J**	**123**	--
Zinc	--	--	--	--	--	--	--	**66**	**2,790 J**	--
Ammonia (As N)	**2,790**	630 U	630 U	630 U	630 U	630 U	630 U	--	--	630 U
Orthophosphate-P	**280**	200 U	200 U	200 U	200 U	200 U	200 U	--	--	570 U

See notes pages.

TABLE J-1B

INORGANIC CONSTITUENTS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-3B**	**P-4B**	**P-4B**	**P-8B**	**P-9**	**P-11B**	**P-12**	**P-13**	**P-16**	**P-101B**
Sample Date	**8/29/1991**	**8/28/1991**	**12/3/1992**	**12/10/1996**	**8/14/1991**	**8/27/1991**	**8/13/1991**	**8/14/1991**	**8/28/1991**	**12/8/1992**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	--	--	--	9,000 U	--	--	--	--	--	--
Nitrate	--	--	--	200 U	--	--	--	--	--	--
Sulfate	--	--	--	**21,600**	--	--	--	--	--	--
Aluminum	**29,000 J**	**52,000 J**	**35,500 J**	--	**58,000**	**13,000**	**140,000**	**12,000**	**24,000 J**	**125,000**
Arsenic	**6.0**	**7.0**	**3.8 J**	--	**3.0 J**	**2.0 J**	**9.0 J**	**3.0 J**	**10**	**39.2 J**
Barium	**1,400**	**690**	**508**	--	**760**	**670**	**2,300 J**	**240**	**600**	**10,600**
Beryllium	**1.9 J**	**5.4 J**	**3.1**	--	**4.9 J**	--	**11 J**	**1.4 J**	**1.6 J**	**7.4**
Cadmium	--	**2.6 J**	3.0 UJ	--	3.8 UJ	--	--	3.2 U	**6.3**	1.0 UJ
Calcium	**150,000**	**81,000**	**45,900**	--	**49,000**	**57,000**	**120,000**	**51,000**	**37,000**	**637,000**
Chromium	**53**	**110**	**89.8 J**	--	**120**	24 U	**250**	**77**	**51**	**219**
Cobalt	**25**	**140**	**55.9**	--	**150**	**11**	**130 J**	**14**	**20**	**123**
Copper	**39**	**320**	**181**	--	**160**	**25**	**300 J**	37 U	**66**	**308**
Iron	**48,000 J**	**67,000 J**	**44,900**	**892**	**78,000**	**20,000**	**190,000**	**19,000**	**48,000 J**	**210,000**
Lead	**16 J**	**28 J**	**27.1 J**	--	**31 J**	**5.4**	**69 J**	7.1 U	**53 J**	**50**
Magnesium	**30,000**	**26,000**	**19,200**	--	**37,000**	**13,000**	**83,000**	**10,000**	**9,500**	**125,000**
Manganese	**4,000**	**8,300**	**8,280**	**53.1**	**1,700 J**	**1,900**	**6,500 J**	**590 J**	**7,600**	**14,000**
Mercury	--	--	0.10 U	--	--	--	--	--	**0.35 J**	0.10 U
Nickel	**44**	**84**	**60.8**	--	**100**	17 U	**250 J**	**47**	**33**	**243**
Potassium	**9,800**	**13,000**	**9,730**	--	**16,000**	**4,600**	**45,000 J**	**5,500**	**6,700**	**41,000**
Silver	--	--	2.5 UJ	--	4.3 UJ	--	7.2 UJ	4.7 UJ	--	2.5 UJ
Sodium	**12,000**	**11,000**	**7,550**	--	**8,600**	**9,800**	**14,000 J**	**6,200**	**22,000**	**193,000**
Sulfide (S)	--	--	--	**1,690**	--	--	--	--	--	--
Thallium	--	--	3.8 U	--	--	--	**2.0 J**	--	--	3.8 U
Vanadium	**92**	**110**	**83.7**	--	**170**	**37 J**	**430 J**	**43**	**50**	**361**
Zinc	**130**	**150**	**131 J**	--	**260**	54 UJ	**650**	**64**	**110**	**618**
Ammonia (As N)	--	--	--	630 U	--	--	--	--	--	--
Orthophosphate-P	--	--	--	200 U	--	--	--	--	--	--

See notes pages.

TABLE J-1B

INORGANIC CONSTITUENTS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-101B**	**P-102B**	**TW-07A**	**TW-07A**	**TW-07A**	**TW-08A**	**TW-08A**	**TW-08A**	**TW-11**	**WE-2**
Sample Date	**12/8/1992**	**12/8/1992**	**6/25/1990**	**8/26/1991**	**12/3/1992**	**6/28/1990**	**8/26/1991**	**12/3/1992**	**6/26/1990**	**6/26/1990**
Sample Type	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	--	--	--	--	--	--	--	--	--	--
Nitrate	--	--	--	--	--	--	--	--	--	--
Sulfate	--	--	--	--	--	--	--	--	--	--
Aluminum	**113,000**	**7,210**	**25,000 J**	**30,000**	**23,800 J**	**24,000**	**6,600**	**23,400 J**	**32,000 J**	**9,900 J**
Arsenic	**17.1 J**	**3.6 J**	**28 J**	**17**	**12.8 J**	**25**	**18**	**23.3 J**	**15 J**	**3.0 J**
Barium	**10,600**	**282**	**3,400**	**3,300 J**	**2,710 J**	**1,100**	**790**	**797**	**570**	**390**
Beryllium	**6.8**	0.40 U	**6.7**	**2.9 J**	1.7 U	**4.0**	--	0.40 U	--	**6.0**
Cadmium	1.0 UJ	1.0 UJ	--	--	1.0 UJ	**5.2**	**2.2 J**	8.5 UJ	--	--
Calcium	**630,000**	**33,200**	**230,000**	**220,000**	**177,000**	**91,000**	**69,000**	**52,200**	**33,000**	**50,000**
Chromium	**194**	5.2 UJ	**61 J**	**53**	**66.6 J**	**130**	**56**	**165 J**	**73 J**	**37 J**
Cobalt	**115**	5.7 U	**51**	**50 J**	**36.9**	32 U	**17**	**23.5**	**21**	**19**
Copper	**295**	22.6 U	19 U	**54 J**	**35.7 J**	**82**	**50**	**115**	**74**	**59**
Iron	**187,000**	**10,000**	**130,000**	**120,000**	**101,000**	**68,000**	**43,000**	**52,400**	**35,000**	**180,000**
Lead	**62**	10 U	**16**	**19**	**31.7 J**	**19 J**	**11**	**34.4 J**	**20**	**23**
Magnesium	**119,000**	**11,300**	**30,000**	**29,000**	**25,400**	**14,000**	**5,400**	**11,000**	**14,000**	**7,200**
Manganese	**13,700**	**279**	**28,000**	**23,000**	**18,200**	**9,100**	**7,300**	**5,560**	**710**	**1,100**
Mercury	0.10 U	0.10 U	--	--	**0.13 J**	--	--	0.10 U	--	--
Nickel	**229**	**7.9 J**	**61**	**63 J**	**61.1**	**50**	23 U	**55.3**	**57**	**100**
Potassium	**37,100**	**3,720**	**9,100**	**11,000 J**	**8,960**	**10,000**	**4,800**	**7,740**	**5,900**	**2,000**
Silver	2.5 UJ	2.5 UJ	**19**	--	2.5 UJ	**13**	--	2.5 UJ	**18**	**14**
Sodium	**193,000**	**6,600**	**76,000**	**67,000 J**	**62,500 J**	**50,000**	**36,000**	**27,100**	**5,700**	**26,000**
Sulfide (S)	--	--	--	--	--	--	--	--	--	--
Thallium	3.8 UJ	3.8 U	--	--	3.8 U	--	--	3.8 UJ	--	--
Vanadium	**327**	**37.6**	**70**	**98 J**	**81.6**	**89**	**26 J**	**76.1**	**77**	--
Zinc	**576**	36 U	**140**	**140**	**225 J**	**110 J**	57 UJ	**138 J**	**130**	**12,000**
Ammonia (As N)	--	--	--	--	--	--	--	--	--	--
Orthophosphate-P	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1C

DRAFT

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID Sample Date Sample Type	**CPZ-1R 12/18/1996 S**	**CPZ-2R 12/18/1996 S**	**CPZ-3R 12/19/1996 S**	**CPZ-4R 12/26/1996 S**	**CPZ-5R 12/26/1996 S**	**CPZ-6R 12/20/1996 S**	**CPZ-7R 12/19/1996 S**	**CPZ-8R 12/20/1996 S**	**CPZ-9R 12/20/1996 S**	**CPZ-10R 12/18/1996 S**	**MW-05 6/28/1990 S**
1,1,1-Trichloroethane	**75 D**	**83 D**	10 U	**21**	100 U	500 U	2,500 U	**12,000**	**20,000**	**60**	5.0 U
1,1,2-Trichloroethane	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	**160**	10,000 U	10 U	5.0 U
1,1-Dichloroethane	**24**	**23**	**1,100 D**	**19**	100 U	500 U	2,500 U	**250**	10,000 U	10 U	5.0 U
1,1-Dichloroethene	**21**	**28**	10 U	5.0 U	100 U	500 U	**5,100**	**1,400 EJ**	10,000 U	**9.0 J**	5.0 U
1,2-Dichlorobenzene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	10 U
1,2-Dichloroethane	2.0 U	2.0 U	**43**	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	5.0 U
1,2-Dichloroethene, Total	**42**	**53**	**46**	28 U	**2,100**	1,000 U	**120,000 D**	**73,000 EJ**	70,000 U	**660 D**	--
1,2-Dichloropropane	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	5.0 U
1,3-Dichlorobenzene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	10 U
1,4-Dichlorobenzene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	10 U
2-Butanone	12 U	12 U	50 U	25 U	**2,300**	3,600 U	12,000 U	**2,900**	50,000 U	50 U	10 U
2-Hexanone	12 U	12 U	50 U	25 U	500 U	**1,600 J**	12,000 U	250 U	50,000 U	50 U	10 U
4-Methyl-2-pentanone	12 U	12 U	50 U	25 U	**570**	2,500 U	**14,000**	**6,000**	50,000 U	50 U	10 U
Acetone	31 U	12 U	100 U	25 U	**6,100**	3,400 U	12,000 U	**1,200**	50,000 U	70 U	23 U
Benzene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	**640**	10,000 U	10 U	**37**
Bromomethane	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	10 U
Carbon disulfide	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	**3.0 J**
Carbon tetrachloride	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	**3,000**	10,000 U	10 U	5.0 U
Chlorobenzene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	**28**
Chloroethane	2.0 U	2.0 U	**46**	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	**33**
Chloroform	4.0 U	4.0 U	10 U	**7.0**	100 U	500 U	2,500 U	**260**	10,000 U	10 U	5.0 U
Chloromethane	3.0 U	4.0 U	10 U	5.0 U	100 U	610 U	2,500 U	50 U	18,000 U	10 U	10 U
cis-1,2-Dichloroethene	**38**	**48**	**45**	26 U	**2,000**	500 U	**110,000 D**	**67,000 EJ**	63,000 U	**630 D**	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	2.0 U	2.0 U	**20**	**60**	**940**	500 U	**8,200**	**3,200 E**	**9,300 J**	**18**	**99**
M,P-Xylene	5.0 U	5.0 U	**12 J**	**48**	**880**	1,000 U	**17,000**	**6,900 E**	**18,000 J**	**24**	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	5.0 U	4.0 U	20 U	16 U	240 U	2,300 U	**11,000**	**1,000**	20,000 U	28 U	5.0 U
O-Xylene	2.0 U	2.0 U	10 U	**19**	**330**	500 U	**6,600**	**2,000 E**	10,000 U	**11**	--
Styrene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	5.0 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**CPZ-1R**	**CPZ-2R**	**CPZ-3R**	**CPZ-4R**	**CPZ-5R**	**CPZ-6R**	**CPZ-7R**	**CPZ-8R**	**CPZ-9R**	**CPZ-10R**	**MW-05**
Sample Date	**12/18/1996**	**12/18/1996**	**12/19/1996**	**12/26/1996**	**12/26/1996**	**12/20/1996**	**12/19/1996**	**12/20/1996**	**12/20/1996**	**12/18/1996**	**6/28/1990**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	2.0 U	2.0 U	10 U	**120**	100 U	500 U	**51,000 D**	**17,000 EJ**	**49,000**	**130**	5.0 U
Tetrahydrofuran	25 U	25 U	**5,800 D**	**23 J**	**570 J**	**900 J**	25,000 U	500 U	100,000 U	100 U	--
Toluene	2.0 U	2.0 U	**40**	**90**	**2,000**	700 U	**92,000 D**	**33,000 EJ**	42,000 U	**98**	5.0 U
trans-1,2-Dichloroethene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	5.0 U
trans-1,3-Dichloropropene	2.0 U	2.0 U	10 U	5.0 U	100 U	500 U	2,500 U	50 U	10,000 U	10 U	5.0 U
Trichloroethene	**6.0**	**14**	10 U	**210 D**	100 U	500 U	**730,000 D**	**230,000 D**	**210,000**	**1,200 D**	5.0 U
Vinyl chloride	2.0 U	2.0 U	**24**	5.0 U	**2,000**	500 U	2,500 U	**5,900 EJ**	10,000 U	10 U	10 U
Xylenes, Total	5.0 U	5.0 U	**18 J**	**78**	**1,400**	1,000 U	**25,000**	**7,500 E**	**25,000**	**42**	**69**
Isopropanol	1,000 U	1,000 U	1,000 U	1,000 U	**1,600**	**12,000**	1,000 U	1,000 U	1,000 U	1,000 U	--
Methanol	1,000 U	1,000 U	1,000 U	1,000 U	**1,500**	1,000 U	1,000 U	**1,700**	1,000 U	1,000 U	--
Sec-Butanol	1,000 U	1,000 U	1,000 U	1,000 U	**1,900**	**5,000**	**17,000**	**14,000**	**12,000**	1,000 U	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	10 U
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	10 U
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	10 U
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	10 U
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--	--	**50 J**
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	10 U
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	10 U
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	10 U
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	10 U
Isophorone	--	--	--	--	--	--	--	--	--	--	**2.0 J**
Naphthalene	--	--	--	--	--	--	--	--	--	--	10 U
Phenol	--	--	--	--	--	--	--	--	--	--	10 U
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--	--	1.0 U
4,4'-DDD	--	--	--	--	--	--	--	--	--	--	0.10 U
Aldrin	--	--	--	--	--	--	--	--	--	--	0.1 U
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--	--	0.1 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-05**	**MW-05**	**MW-05**	**MW-05**	**MW-05**	**MW-121A**	**MW-121A**	**MW-121A**	**MW-121A**	**MW-121A**	**MW-121C**
Sample Date	**12/13/1990**	**8/28/1991**	**11/30/1994**	**3/28/1995**	**12/11/1996**	**8/29/1991**	**12/10/1992**	**11/30/1994**	**3/28/1995**	**12/12/1996**	**8/13/1991**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	**56 J**
1,1,2-Trichloroethane	2.0 U	5,000 UJ	630 U	280 U	10 U	2.0 UJ	10 U	5.0 U	5.0 U	10 U	**2.0 J**
1,1-Dichloroethane	2.0 U	5,000 UJ	630 U	280 U	10 U	**6.0 J**	**7.0 J**	5.0 U	5.0 U	10 U	**220 J**
1,1-Dichloroethene	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	**12 J**
1,2-Dichlorobenzene	2.0 U	10 U	--	--	10 U	1.0 UJ	10 U	--	--	10 U	**2.0 J**
1,2-Dichloroethane	2.0 U	5,000 UJ	630 U	280 U	10 U	**1.4 J**	10 U	5.0 U	5.0 U	10 U	**62 J**
1,2-Dichloroethene, Total	--	--	630 U	280 U	20 U	--	10 U	5.0 U	5.0 U	20 U	--
1,2-Dichloropropane	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	1.0 UJ
1,3-Dichlorobenzene	2.0 U	10 U	--	--	10 U	1.0 UJ	10 U	--	--	10 U	**0.50 J**
1,4-Dichlorobenzene	2.0 U	10 U	--	--	10 U	1.0 UJ	10 U	--	--	10 U	**0.70 J**
2-Butanone	20 U	R	3,100 U	1,400 U	50 U	R	10 U	25 U	25 U	50 U	R
2-Hexanone	--	R	3,100 U	1,400 U	50 U	5.0 UJ	10 U	25 U	25 U	50 U	R
4-Methyl-2-pentanone	--	25,000 UJ	3,100 U	1,400 U	50 U	**18 J**	10 U	25 U	25 U	50 U	**2,100 J**
Acetone	--	R	3,100 U	1,400 U	50 U	R	10 U	25 U	25 U	50 U	**2,300 J**
Benzene	**26**	5,000 UJ	630 U	280 U	**100**	**7.1 J**	**6.0 J**	**6.0**	**7.0**	**10**	**110 J**
Bromomethane	10 U	5,000 UJ	1,300 U	560 U	10 U	2.0 UJ	10 U	10 U	10 U	10 U	2.0 UJ
Carbon disulfide	--	R	630 U	280 U	10 U	R	**3.0 J**	**11**	5.0 U	10 U	**21 J**
Carbon tetrachloride	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	**5.0 J**
Chlorobenzene	**22**	5,000 UJ	630 U	280 U	**57**	**2.0 J**	10 U	5.0 U	**2.3 J**	10 U	**22 J**
Chloroethane	**63**	5,000 UJ	630 U	280 U	**160**	**100 J**	**56**	**13**	**48**	**95**	**130 J**
Chloroform	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	**1.0 J**
Chloromethane	10 U	5,000 UJ	1,300 U	560 U	10 U	2.0 UJ	10 U	10 U	10 U	10 U	2.0 UJ
cis-1,2-Dichloroethene	--	5,000 UJ	--	--	10 U	**20 J**	--	--	--	10 U	**2,100 J**
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	2.0 U	5,000 UJ	630 U	**230 J**	130 U	**15 J**	**33**	**11**	**8.0**	**11**	**2,900 J**
M,P-Xylene	--	--	--	--	**240**	--	--	--	--	20 U	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	2.0 U	10,000 UJ	1,300 U	560 U(b)	20 U	6.0 UJ	10 U	10 U	10 U(b)	60 U	9.0 UJ
O-Xylene	--	--	--	--	**13**	--	--	--	--	10 U	--
Styrene	--	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	1.0 UJ

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-05**	**MW-05**	**MW-05**	**MW-05**	**MW-05**	**MW-121A**	**MW-121A**	**MW-121A**	**MW-121A**	**MW-121A**	**MW-121C**
Sample Date	**12/13/1990**	**8/28/1991**	**11/30/1994**	**3/28/1995**	**12/11/1996**	**8/29/1991**	**12/10/1992**	**11/30/1994**	**3/28/1995**	**12/12/1996**	**8/13/1991**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	1.0 UJ
Tetrahydrofuran	--	--	**6,400**	**7,000**	**11,000 DEJ**	--	--	**43**	**65**	100 U	--
Toluene	**3.1**	5,000 UJ	630 U	**240 J**	10 U	**45 J**	10 U	**4.0 J**	**7.0**	10 U	**4,400 J**
trans-1,2-Dichloroethene	2.0 U	5,000 UJ	--	--	10 U	1.0 UJ	--	--	--	10 U	**6.0 J**
trans-1,3-Dichloropropene	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	10 U	1.0 UJ
Trichloroethene	2.0 U	5,000 UJ	630 U	280 U	10 U	1.0 UJ	10 U	5.0 U	5.0 U	70 U	**0.50 J**
Vinyl chloride	10 U	5,000 UJ	1,300 U	560 U	10 U	**13 J**	**7.0 J**	**4.3 J**	10 U	10 U	**1,900 J**
Xylenes, Total	--	5,000 UJ	630 U	**1,100**	**260**	**19 J**	**11**	5.0 U	**4.2 J**	20 U	**2,100 J**
Isopropanol	500 U	--	--	--	1,000 U	--	--	--	--	1,000 U	--
Methanol	--	--	--	--	1,000 U	--	--	--	--	1,000 U	--
Sec-Butanol	--	--	--	--	1,000 U	--	--	--	--	1,000 U	--
1,2,4-Trichlorobenzene	--	10 U	--	--	--	2.0 UJ	10 U	--	--	--	**1.0 J**
2,4-Dimethylphenol	--	**2.0 J**	--	--	--	10 U	10 U	--	--	--	20 U
2-Methylnaphthalene	--	10 U	--	--	--	10 U	10 U	--	--	--	20 U
2-Methylphenol	--	10 U	--	--	--	10 U	10 U	--	--	--	20 U
4,6-Dinitro-2-methylphenol	--	25 U	--	--	--	25 U	25 U	--	--	--	50 U
4-Methylphenol	--	**1.0 J**	--	--	--	10 U	10 U	--	--	--	**84**
Di-n-butyl phthalate	--	10 U	--	--	--	10 U	10 U	--	--	--	**1.0 J**
Di-n-octyl phthalate	--	10 U	--	--	--	10 U	10 U	--	--	--	20 U
Diethyl phthalate	--	10 U	--	--	--	10 U	10 U	--	--	--	**6.0 J**
Isophorone	--	10 U	--	--	--	10 U	10 U	--	--	--	20 U
Naphthalene	--	**1.0 J**	--	--	--	1.0 UJ	10 U	--	--	--	**13 J**
Phenol	--	10 U	--	--	--	10 U	10 U	--	--	--	**28**
1,1,1,2-Tetrachloroethane	--	5,000 UJ	--	--	--	1.0 UJ	--	--	--	--	1.0 UJ
Aroclor-1254	--	1.0 U	--	--	--	1.0 U	1.0 U	--	--	--	1.0 U
4,4'-DDD	--	0.10 U	--	--	--	0.10 U	0.10 U	--	--	--	0.10 U
Aldrin	--	0.1 U	--	--	--	0.1 U	0.1 U	--	--	--	0.1 U
gamma-BHC (Lindane)	--	0.1 U	--	--	--	0.1 U	**0.1 J**	--	--	--	0.1 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**MW-121C** **12/8/1992** **S**	**MW-121C** **12/9/1992** **S**	**MW-121C** **11/30/1994** **S**	**MW-121C** **3/28/1995** **S**	**MW-121C** **12/12/1996** **S**	**MW-123A** **8/14/1991** **S**	**MW-123A** **11/30/1994** **S**	**MW-123A** **3/27/1995** **S**	**MW-123A** **12/6/1996** **S**	**MW-124C** **8/27/1991** **S**	**MW-124C** **11/30/1994** **S**
1,1,1-Trichloroethane	200 U	--	130 U	140 U	100 U	**86 J**	**120**	**61**	**38 D**	**95 J**	**13**
1,1,2-Trichloroethane	200 U	--	130 U	140 U	100 U	2.0 UJ	5.0 U	5.0 U	1.0 U	2.0 U	5.0 U
1,1-Dichloroethane	200 U	--	130 U	140 U	100 U	**2.0 J**	**4.6 J**	**2.9 J**	**2.0**	**9.2**	5.0 U
1,1-Dichloroethene	200 U	--	130 U	140 U	100 U	**37 J**	**9.0**	**10**	**11**	**33 J**	**3.4 J**
1,2-Dichlorobenzene	--	10 U	--	--	100 U	1.0 UJ	--	--	1.0 U	1.0 U	--
1,2-Dichloroethane	200 U	--	130 U	140 U	100 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U
1,2-Dichloroethene, Total	200 U	--	130 U	140 U	200 U	--	**54**	**34**	**31**	--	**5.0**
1,2-Dichloropropane	200 U	--	130 U	140 U	100 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U
1,3-Dichlorobenzene	--	10 U	--	--	100 U	1.0 UJ	--	--	1.0 U	1.0 U	--
1,4-Dichlorobenzene	--	10 U	--	--	100 U	1.0 UJ	--	--	1.0 U	1.0 U	--
2-Butanone	**420 J**	--	630 U	710 U	500 U	R	25 U	25 U	5.0 U	R	25 U
2-Hexanone	200 U	--	630 U	710 U	500 U	R	25 U	25 U	5.0 U	R	25 U
4-Methyl-2-pentanone	**2,100 J**	--	630 U	710 U	500 U	5.0 UJ	25 U	25 U	5.0 U	5.0 U	25 U
Acetone	**1,800**	--	630 U	710 U	500 U	R	25 U	25 U	5.0 U	R	25 U
Benzene	**96 J**	--	130 U	140 U	100 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U
Bromomethane	200 U	--	250 U	290 U	100 U	2.0 UJ	10 U	10 U	1.0 U	2.0 U	10 U
Carbon disulfide	200 U	--	130 U	140 U	100 U	R	5.0 U	5.0 U	1.0 U	R	5.0 U
Carbon tetrachloride	200 U	--	130 U	140 U	100 U	**8.0 J**	5.0 U	5.0 U	1.0 U	**11**	5.0 U
Chlorobenzene	200 U	--	130 U	140 U	100 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U
Chloroethane	**230**	--	**140**	**200**	**470**	2.0 UJ	5.0 U	5.0 U	1.0 U	2.0 U	5.0 U
Chloroform	200 U	--	130 U	140 U	100 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U
Chloromethane	200 U	--	250 U	290 U	100 U	2.0 UJ	10 U	10 U	1.0 U	2.0 U	10 U
cis-1,2-Dichloroethene	--	--	--	--	100 U	**11 J**	--	--	**26 D**	**18**	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**3,300**	--	**750**	**850**	**550**	1.0 UJ	**7.0**	**5.0**	1.0 U	1.0 U	5.0 U
M,P-Xylene	--	--	--	--	**440**	--	--	--	2.0 U	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	200 U	--	250 U	290 U(b)	460 U	2.0 UJ	10 U	10 U(b)	2.0 U	1.0 U	10 U
O-Xylene	--	--	--	--	100 U	--	--	--	1.0 U	--	--
Styrene	200 U	--	130 U	140 U	100 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-121C**	**MW-121C**	**MW-121C**	**MW-121C**	**MW-121C**	**MW-123A**	**MW-123A**	**MW-123A**	**MW-123A**	**MW-124C**	**MW-124C**
Sample Date	**12/8/1992**	**12/9/1992**	**11/30/1994**	**3/28/1995**	**12/12/1996**	**8/14/1991**	**11/30/1994**	**3/27/1995**	**12/6/1996**	**8/27/1991**	**11/30/1994**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	200 U	--	130 U	140 U	100 U	**2.0 J**	5.0 U	5.0 U	1.0 U	**2.0**	5.0 U
Tetrahydrofuran	--	--	**3,200**	**3,300**	1,000 U	--	25 U	25 U	10 U	--	25 U
Toluene	**5,300 ***	--	130 U	140 U	100 U	1.0 UJ	**17**	**2.8 J**	1.0 U	1.0 U	5.0 U
trans-1,2-Dichloroethene	--	--	--	--	100 U	1.0 UJ	--	--	1.0 U	1.0 U	--
trans-1,3-Dichloropropene	200 U	--	130 U	140 U	100 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U
Trichloroethene	200 U	--	130 U	140 U	100 U	**6.0 J**	**6.0**	**4.0 J**	5.0 U	**9.7**	5.0 U
Vinyl chloride	200 U	--	250 U	290 U	100 U	2.0 UJ	10 U	10 U	1.0 U	2.0 U	10 U
Xylenes, Total	**3,800**	--	**790**	**710**	**500**	1.0 UJ	5.0 U	5.0 U	2.0 U	1.0 U	5.0 U
Isopropanol	--	--	--	--	1,000 U	--	--	--	1,000 U	--	--
Methanol	--	--	--	--	1,000 U	--	--	--	1,000 U	--	--
Sec-Butanol	--	--	--	--	1,000 U	--	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	**2.0 J**	--	--	--	2.0 UJ	--	--	--	2.0 U	--
2,4-Dimethylphenol	--	10 U	--	--	--	10 U	--	--	--	10 U	--
2-Methylnaphthalene	--	**1.0 J**	--	--	--	10 U	--	--	--	10 U	--
2-Methylphenol	--	10 U	--	--	--	10 U	--	--	--	10 U	--
4,6-Dinitro-2-methylphenol	--	25 U	--	--	--	25 U	--	--	--	25 U	--
4-Methylphenol	--	**130**	--	--	--	10 U	--	--	--	10 U	--
Di-n-butyl phthalate	--	10 U	--	--	--	10 U	--	--	--	10 U	--
Di-n-octyl phthalate	--	10 U	--	--	--	10 U	--	--	--	10 U	--
Diethyl phthalate	--	10 U	--	--	--	10 U	--	--	--	10 U	--
Isophorone	--	10 U	--	--	--	10 U	--	--	--	10 U	--
Naphthalene	--	**11**	--	--	--	1.0 UJ	--	--	--	1.0 U	--
Phenol	--	10 U	--	--	--	10 U	--	--	--	10 U	--
1,1,1,2-Tetrachloroethane	--	--	--	--	--	1.0 UJ	--	--	--	1.0 U	--
Aroclor-1254	--	2.0 U	--	--	--	1.0 U	--	--	--	1.0 U	--
4,4'-DDD	--	0.20 U	--	--	--	0.10 U	--	--	--	0.10 U	--
Aldrin	--	0.10 U	--	--	--	0.1 U	--	--	--	0.1 U	--
gamma-BHC (Lindane)	--	0.10 U	--	--	--	0.1 U	--	--	--	0.1 U	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-124C**	**MW-124C**	**MW-124C**	**MW-125A**	**MW-125A**	**MW-125A**	**MW-125A**	**MW-125A**	**MW-125C**	**MW-125C**	**MW-125C**
Sample Date	**3/28/1995**	**11/20/1996**	**11/20/1996**	**8/27/1991**	**8/28/1991**	**12/4/1992**	**3/24/1995**	**12/6/1996**	**8/27/1991**	**12/4/1992**	**11/30/1994**
Sample Type	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**33**	1.0 U	1.0 U	18 U	--	**19**	**17**	**3.0**	1,700 UJ	**1,100 J**	5,000 U
1,1,2-Trichloroethane	5.0 U	1.0 U	1.0 U	2.0 U	--	10 U	13 U	1.0 U	500 UJ	4,000 U	5,000 U
1,1-Dichloroethane	**2.6 J**	1.0 U	1.0 U	**1.4 J**	--	**4.0 J**	**12 J**	**4.0**	**1,700 J**	**1,300 J**	5,000 U
1,1-Dichloroethene	**10**	**25**	**7.0**	**7.5**	--	**7.0 J**	13 U	1.0 U	**990 J**	4,000 U	5,000 U
1,2-Dichlorobenzene	--	1.0 U	1.0 U	1.0 U	--	10 U	--	1.0 U	10 UJ	50 U	--
1,2-Dichloroethane	5.0 U	1.0 U	1.0 U	1.0 U	--	10 U	13 U	1.0 U	**420 J**	4,000 U	5,000 U
1,2-Dichloroethene, Total	**14**	**18**	**15**	--	--	**7.0 J**	**100**	**7.0**	--	**66,000**	**77,000**
1,2-Dichloropropane	5.0 U	1.0 U	1.0 U	1.0 U	--	10 U	13 U	1.0 U	500 UJ	4,000 U	5,000 U
1,3-Dichlorobenzene	--	1.0 U	1.0 U	1.0 U	--	10 U	--	1.0 U	10 UJ	50 U	--
1,4-Dichlorobenzene	--	1.0 U	1.0 U	1.0 U	--	10 U	--	1.0 U	10 UJ	50 U	--
2-Butanone	25 U	5.0 U	5.0 U	R	--	10 U	**180**	**86**	R	**82,000 J**	**68,000**
2-Hexanone	25 U	5.0 U	5.0 U	R	--	10 U	63 U	5.0 U	R	4,000 U	25,000 U
4-Methyl-2-pentanone	25 U	5.0 U	5.0 U	5.0 U	--	**25 J**	**63**	5.0 U	**13,000 J**	**9,400 J**	**13,000 J**
Acetone	25 U	5.0 U	5.0 U	R	--	**17**	**150**	**10**	R	**63,000**	**51,000**
Benzene	5.0 U	1.0 U	1.0 U	1.0 U	--	10 U	13 U	**1.0**	**250 J**	4,000 U	5,000 U
Bromomethane	10 U	1.0 U	1.0 U	2.0 U	--	10 U	25 U	1.0 U	500 UJ	4,000 U	10,000 U
Carbon disulfide	5.0 U	1.0 U	1.0 U	R	--	10 U	13 U	1.0 U	R	4,000 U	5,000 U
Carbon tetrachloride	5.0 U	1.0 U	1.0 U	**2.2**	--	10 U	13 U	1.0 U	**203 J**	4,000 U	5,000 U
Chlorobenzene	5.0 U	1.0 U	1.0 U	1.0 U	--	10 U	13 U	1.0 U	500 UJ	4,000 U	5,000 U
Chloroethane	5.0 U	1.0 U	1.0 U	2.0 U	--	10 U	13 U	1.0 U	500 UJ	4,000 U	5,000 U
Chloroform	5.0 U	1.0 U	1.0 U	1.0 U	--	10 U	13 U	1.0 U	500 UJ	4,000 U	5,000 U
Chloromethane	10 U	1.0 U	1.0 U	2.0 U	--	10 U	25 U	1.0 U	500 UJ	4,000 U	10,000 U
cis-1,2-Dichloroethene	--	**14**	**15**	**10**	--	--	--	**6.0**	**55,000 J**	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5.0 U	1.0 U	1.0 U	1.0 U	--	**61**	**42**	2.0 U	**6,000 J**	**6,400**	**4,200 J**
M,P-Xylene	--	2.0 U	2.0 U	--	--	--	--	2.0 U	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U(b)	2.0 U	**4.0**	1.0 U	--	10 U	25 U(b)	2.0 U	9,100 UJ	6,900 U	14,000 U
O-Xylene	--	1.0 U	1.0 U	--	--	--	--	1.0 U	--	--	--
Styrene	5.0 U	1.0 U	1.0 U	1.0 U	--	10 U	13 U	1.0 U	500 UJ	4,000 U	5,000 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-124C**	**MW-124C**	**MW-124C**	**MW-125A**	**MW-125A**	**MW-125A**	**MW-125A**	**MW-125A**	**MW-125C**	**MW-125C**	**MW-125C**
Sample Date	**3/28/1995**	**11/20/1996**	**11/20/1996**	**8/27/1991**	**8/28/1991**	**12/4/1992**	**3/24/1995**	**12/6/1996**	**8/27/1991**	**12/4/1992**	**11/30/1994**
Sample Type	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	5.0 U	**0.90 J**	1.0 U	**2.9**	--	**3.0 J**	**9.0 J**	1.0 U	**2,800 J**	**4,600**	5,000 U
Tetrahydrofuran	25 U	10 U	10 U	--	--	--	63 U	10 U	--	--	25,000 U
Toluene	**3.1 J**	1.0 U	1.0 U	1.0 U	--	**44**	**130**	1.0 U	**17,000 J**	**23,000**	**17,000**
trans-1,2-Dichloroethene	--	1.0 U	1.0 U	1.0 U	--	--	--	1.0 U	500 UJ	--	--
trans-1,3-Dichloropropene	5.0 U	1.0 U	1.0 U	1.0 U	--	10 U	13 U	1.0 U	500 UJ	4,000 U	5,000 U
Trichloroethene	**4.3 J**	**4.0**	**5.0**	**50 J**	--	**45**	**130**	**24**	**41,000 J**	**53,000**	**6,800**
Vinyl chloride	10 U	1.0 U	1.0 U	2.0 U	--	10 U	25 U	**10**	500 UJ	**31,000**	**10,000**
Xylenes, Total	5.0 U	2.0 U	2.0 U	1.0 U	--	**50**	**38**	2.0 U	**6,000 J**	**12,000**	**6,400**
Isopropanol	--	1,000 U	1,000 U	--	--	--	--	1,000 U	--	--	--
Methanol	--	1,000 U	1,000 U	--	--	--	--	1,000 U	--	--	--
Sec-Butanol	--	1,000 U	1,000 U	--	--	--	--	1,000 U	--	--	--
1,2,4-Trichlorobenzene	--	--	--	2.0 U	--	10 U	--	--	10 UJ	50 U	--
2,4-Dimethylphenol	--	--	--	--	10 U	10 U	--	--	**6.0 J**	50 U	--
2-Methylnaphthalene	--	--	--	--	10 U	10 U	--	--	**2.0 J**	50 U	--
2-Methylphenol	--	--	--	--	10 U	10 U	--	--	**18 J**	**16 J**	--
4,6-Dinitro-2-methylphenol	--	--	--	--	25 U	25 U	--	--	25 U	130 U	--
4-Methylphenol	--	--	--	--	10 U	10 U	--	--	**130 J**	**78**	--
Di-n-butyl phthalate	--	--	--	--	10 U	10 U	--	--	**2.0 J**	50 U	--
Di-n-octyl phthalate	--	--	--	--	10 U	10 U	--	--	10 U	50 U	--
Diethyl phthalate	--	--	--	--	10 U	10 U	--	--	10 UJ	50 U	--
Isophorone	--	--	--	--	10 U	10 U	--	--	**10 J**	50 U	--
Naphthalene	--	--	--	1.0 U	--	10 U	--	--	**18 J**	**21 J**	--
Phenol	--	--	--	--	10 U	10 U	--	--	**200 J**	**150**	--
1,1,1,2-Tetrachloroethane	--	--	--	1.0 U	--	--	--	--	500 UJ	--	--
Aroclor-1254	--	--	--	--	1.0 U	100 U	--	--	1.0 U	1.0 U	--
4,4'-DDD	--	--	--	--	0.10 U	10 U	--	--	0.10 U	0.10 U	--
Aldrin	--	--	--	--	0.1 U	5.0 U	--	--	0.1 U	0.1 U	--
gamma-BHC (Lindane)	--	--	--	--	0.1 U	5.0 U	--	--	0.1 U	0.1 U	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-125C**	**MW-125C**	**MW-125C**	**MW-126C**	**MW-126C**	**MW-126C**	**MW-126C**	**MW-126C**	**MW-127C**	**MW-127C**	**MW-127C**
Sample Date	**3/24/1995**	**12/20/1996**	**12/20/1996**	**8/27/1991**	**11/29/1994**	**3/21/1995**	**11/22/1996**	**11/22/1996**	**8/13/1991**	**12/2/1992**	**12/4/1992**
Sample Type	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**
1,1,1-Trichloroethane	3,100 U	50 U	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	12 UJ	--	**10**
1,1,2-Trichloroethane	3,100 U	50 U	2,000 U	2.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	2.0 UJ	--	10 U
1,1-Dichloroethane	3,100 U	**550**	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**37 J**	--	**21**
1,1-Dichloroethene	3,100 U	**410**	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**4.0 J**	--	**3.0 J**
1,2-Dichlorobenzene	--	50 U	2,000 U	1.0 UJ	--	--	1.0 U	1.0 U	1.0 UJ	10 U	--
1,2-Dichloroethane	3,100 U	**130**	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**1.0 J**	--	10 U
1,2-Dichloroethene, Total	**82,000**	**33,000 EJ**	**57,000**	--	**11**	**17**	2.0 U	2.0 U	--	--	**3.0 J**
1,2-Dichloropropane	3,100 U	50 U	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 UJ	--	10 U
1,3-Dichlorobenzene	--	50 U	2,000 U	1.0 UJ	--	--	1.0 U	1.0 U	1.0 UJ	10 U	--
1,4-Dichlorobenzene	--	50 U	2,000 U	1.0 UJ	--	--	1.0 U	1.0 U	1.0 UJ	10 U	--
2-Butanone	**67,000**	**140,000 EJ**	10,000 U	R	25 U	25 U	5.0 U	5.0 U	R	--	10 U
2-Hexanone	16,000 U	250 U	10,000 U	R	25 U	25 U	5.0 U	5.0 U	R	--	10 U
4-Methyl-2-pentanone	**8,900 J**	**14,000 EJ**	**9,600 J**	5.0 UJ	25 U	25 U	5.0 U	5.0 U	**13 J**	--	10 U
Acetone	**33,000**	**61,000 EJ**	**89,000**	R	25 U	25 U	5.0 U	5.0 U	R	--	10 U
Benzene	3,100 U	**130**	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**3.0 J**	--	**2.0 J**
Bromomethane	6,300 U	50 U	2,000 U	2.0 UJ	10 U	10 U	1.0 U	1.0 U	2.0 UJ	--	10 U
Carbon disulfide	3,100 U	50 U	2,000 U	R	5.0 U	5.0 U	1.0 U	1.0 U	R	--	10 U
Carbon tetrachloride	3,100 U	50 U	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**1.0 J**	--	10 U
Chlorobenzene	3,100 U	50 U	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**0.90 J**	--	10 U
Chloroethane	3,100 U	50 U	2,000 U	2.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**33 J**	--	**29**
Chloroform	3,100 U	50 U	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 UJ	--	10 U
Chloromethane	6,300 U	50 U	2,000 U	2.0 UJ	10 U	10 U	1.0 U	1.0 U	2.0 UJ	--	10 UJ
cis-1,2-Dichloroethene	--	**32,000 EJ**	**51,000**	1.0 UJ	--	--	1.0 U	1.0 U	**7.0 J**	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**3,100**	**3,700 EJ**	**2,500**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**12 J**	--	**7.0 J**
M,P-Xylene	--	**4,400 EJ**	**4,500**	--	--	--	2.0 U	2.0 U	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	6,300 U(b)	**220**	4,000 U	3.4 UJ	10 U	10 U	1.0 U	1.0 U	3.0 UJ	--	10 U
O-Xylene	--	**1,800 EJ**	2,000 U	--	--	--	1.0 U	1.0 U	--	--	--
Styrene	3,100 U	50 U	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 UJ	--	10 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-125C**	**MW-125C**	**MW-125C**	**MW-126C**	**MW-126C**	**MW-126C**	**MW-126C**	**MW-126C**	**MW-127C**	**MW-127C**	**MW-127C**
Sample Date	**3/24/1995**	**12/20/1996**	**12/20/1996**	**8/27/1991**	**11/29/1994**	**3/21/1995**	**11/22/1996**	**11/22/1996**	**8/13/1991**	**12/2/1992**	**12/4/1992**
Sample Type	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**
Tetrachloroethene	3,100 U	**180**	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 UJ	--	10 U
Tetrahydrofuran	16,000 U	500 U	20,000 U	--	25 U	25 U	10 U	10 U	--	--	--
Toluene	**12,000**	**12,000 EJ**	**8,100**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	17 UJ	--	10 U
trans-1,2-Dichloroethene	--	50 U	2,000 U	1.0 UJ	--	--	1.0 U	1.0 U	**0.20 J**	--	--
trans-1,3-Dichloropropene	3,100 U	50 U	2,000 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 UJ	--	10 U
Trichloroethene	**4,100**	**970**	2,000 U	1.0 UJ	5.0 U	5.0 U	2.0 U	2.0 U	**0.80 J**	--	10 U
Vinyl chloride	**7,400**	**14,000 EJ**	**16,000**	2.0 UJ	10 U	10 U	1.0 U	1.0 U	**3.0 J**	--	10 U
Xylenes, Total	**5,000**	**6,200 EJ**	**4,100**	1.0 UJ	5.0 U	5.0 U	2.0 U	2.0 U	8.0 UJ	--	10 U
Isopropanol	--	**3,200**	1,000 U	--	--	--	1,000 U	1,000 U	--	--	--
Methanol	--	**4,800**	**4,200**	--	--	--	1,000 U	1,000 U	--	--	--
Sec-Butanol	--	**29,000**	**30,000**	--	--	--	1,000 U	1,000 U	--	--	--
1,2,4-Trichlorobenzene	--	--	--	2.0 UJ	--	--	--	--	2.0 UJ	10 U	--
2,4-Dimethylphenol	--	--	--	10 U	--	--	--	--	20 U	10 U	--
2-Methylnaphthalene	--	--	--	10 U	--	--	--	--	20 U	10 U	--
2-Methylphenol	--	--	--	10 U	--	--	--	--	20 U	10 U	--
4,6-Dinitro-2-methylphenol	--	--	--	25 U	--	--	--	--	50 U	25 U	--
4-Methylphenol	--	--	--	10 U	--	--	--	--	20 U	10 U	--
Di-n-butyl phthalate	--	--	--	10 U	--	--	--	--	20 U	10 U	--
Di-n-octyl phthalate	--	--	--	10 U	--	--	--	--	20 U	10 U	--
Diethyl phthalate	--	--	--	10 U	--	--	--	--	20 U	10 U	--
Isophorone	--	--	--	10 U	--	--	--	--	20 U	10 U	--
Naphthalene	--	--	--	1.0 UJ	--	--	--	--	1.0 UJ	10 U	--
Phenol	--	--	--	10 U	--	--	--	--	20 U	10 U	--
1,1,1,2-Tetrachloroethane	--	--	--	1.0 UJ	--	--	--	--	1.0 UJ	--	--
Aroclor-1254	--	--	--	1.0 U	--	--	--	--	1.0 U	1.0 U	--
4,4'-DDD	--	--	--	0.10 U	--	--	--	--	0.10 U	0.10 U	--
Aldrin	--	--	--	0.1 U	--	--	--	--	0.1 U	0.1 U	--
gamma-BHC (Lindane)	--	--	--	0.1 U	--	--	--	--	0.1 U	0.1 U	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-128**	**MW-128**	**MW-128**	**MW-128**
Sample Date	**11/29/1994**	**3/23/1995**	**11/21/1996**	**12/3/1998**	**12/2/1992**	**12/4/1992**	**3/23/1995**	**8/29/1991**	**11/29/1994**	**3/23/1995**	**11/21/1996**
Sample Type	**S**	**S**	**S**	**S**	**D**	**D**	**D**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**24**	**31**	**78 DJ**	**10**	--	**10**	**31**	5.0 UJ	5.0 U	5.0 U	1.0 U
1,1,2-Trichloroethane	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U
1,1-Dichloroethane	**35**	**30**	**36 D**	**15**	--	**21**	**30**	1.0 UJ	5.0 U	5.0 U	1.0 U
1,1-Dichloroethene	5.0 U	**4.3 J**	**9.0**	**3.0**	--	**3.0 J**	**4.1 J**	**1.1 J**	5.0 U	5.0 U	1.0 U
1,2-Dichlorobenzene	--	--	1.0 U	1.0 U	10 U	--	--	1.0 UJ	--	--	1.0 U
1,2-Dichloroethane	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
1,2-Dichloroethene, Total	5.0 U	**7.0**	**10**	**2.0**	--	**3.0 J**	**7.0**	--	5.0 U	5.0 U	2.0 U
1,2-Dichloropropane	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
1,3-Dichlorobenzene	--	--	1.0 U	1.0 U	10 U	--	--	1.0 UJ	--	--	1.0 U
1,4-Dichlorobenzene	--	--	1.0 U	1.0 U	10 U	--	--	1.0 UJ	--	--	1.0 U
2-Butanone	25 U	25 U	5.0 U	5.0 U	--	10 U	25 U	R	25 U	25 U	33 U
2-Hexanone	25 U	25 U	5.0 U	5.0 U	--	10 U	25 U	R	25 U	25 U	5.0 U
4-Methyl-2-pentanone	25 U	25 U	5.0 U	5.0 U	--	10 U	25 U	5.0 UJ	25 U	25 U	5.0 U
Acetone	25 U	25 U	5.0 U	5.0 U	--	10 U	25 U	R	25 U	**15 J**	5.0 U
Benzene	5.0 U	5.0 U	1.0 U	**1.0**	--	**2.0 J**	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
Bromomethane	10 U	10 U	1.0 U	1.0 U	--	10 U	10 U	2.0 UJ	10 U	10 U	1.0 U
Carbon disulfide	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	R	5.0 U	5.0 U	1.0 U
Carbon tetrachloride	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
Chlorobenzene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
Chloroethane	5.0 U	**9.0**	**7.0**	**18**	--	**28**	**10**	2.0 UJ	5.0 U	5.0 U	1.0 U
Chloroform	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
Chloromethane	10 U	10 U	1.0 U	1.0 U	--	10 UJ	10 U	2.0 UJ	10 U	10 U	1.0 U
cis-1,2-Dichloroethene	--	--	**9.0**	**2.0**	--	--	--	1.0 UJ	--	--	1.0 U
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5.0 U	5.0 U	1.0 U	1.0 U	--	**7.0 J**	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
M,P-Xylene	--	--	2.0 U	2.0 U	--	--	--	--	--	--	2.0 U
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	10 U	2.0 U	**7.0 B**	--	10 U	10 U(b)	1.2 UJ	10 U	10 U(b)	3.0 U
O-Xylene	--	--	1.0 U	1.0 U	--	--	--	--	--	--	1.0 U
Styrene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-127C**	**MW-128**	**MW-128**	**MW-128**	**MW-128**
Sample Date	**11/29/1994**	**3/23/1995**	**11/21/1996**	**12/3/1998**	**12/2/1992**	**12/4/1992**	**3/23/1995**	**8/29/1991**	**11/29/1994**	**3/23/1995**	**11/21/1996**
Sample Type	**S**	**S**	**S**	**S**	**D**	**D**	**D**	**S**	**S**	**S**	**S**
Tetrachloroethene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	**1.0**
Tetrahydrofuran	25 U	25 U	**8.0 J**	**6.0**	--	--	25 U	--	25 U	25 U	**12**
Toluene	5.0 U	**2.8 J**	1.0 U	1.0 U	--	10 U	**2.3 J**	1.0 UJ	5.0 U	5.0 U	1.0 U
trans-1,2-Dichloroethene	--	--	1.0 U	1.0 U	--	--	--	1.0 UJ	--	--	1.0 U
trans-1,3-Dichloropropene	5.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U
Trichloroethene	5.0 U	5.0 U	2.0 U	1.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	6.0 U
Vinyl chloride	10 U	10 U	1.0 U	1.0 U	--	10 U	10 U	2.0 UJ	10 U	10 U	1.0 U
Xylenes, Total	5.0 U	5.0 U	2.0 U	2.0 U	--	10 U	5.0 U	1.0 UJ	5.0 U	5.0 U	2.0 U
Isopropanol	--	--	1,000 U	--	--	--	--	--	--	--	1,000 U
Methanol	--	--	1,000 U	--	--	--	--	--	--	--	1,000 U
Sec-Butanol	--	--	1,000 U	--	--	--	--	--	--	--	1,000 U
1,2,4-Trichlorobenzene	--	--	--	--	10 U	--	--	2.0 UJ	--	--	--
2,4-Dimethylphenol	--	--	--	--	10 U	--	--	10 U	--	--	--
2-Methylnaphthalene	--	--	--	--	10 U	--	--	10 U	--	--	--
2-Methylphenol	--	--	--	--	10 U	--	--	10 U	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	25 U	--	--	25 U	--	--	--
4-Methylphenol	--	--	--	--	10 U	--	--	10 U	--	--	--
Di-n-butyl phthalate	--	--	--	--	10 U	--	--	10 U	--	--	--
Di-n-octyl phthalate	--	--	--	--	**1.0 J**	--	--	10 U	--	--	--
Diethyl phthalate	--	--	--	--	10 U	--	--	10 U	--	--	--
Isophorone	--	--	--	--	10 U	--	--	10 U	--	--	--
Naphthalene	--	--	--	--	10 U	--	--	1.0 UJ	--	--	--
Phenol	--	--	--	--	10 U	--	--	10 U	--	--	--
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	1.0 UJ	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	1.0 U	--	--	--
4,4'-DDD	--	--	--	--	--	--	--	0.10 U	--	--	--
Aldrin	--	--	--	--	--	--	--	0.1 U	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--	--	0.1 U	--	--	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-128**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-205A**	**MW-205A**	**MW-205A**	**MW-205A**
Sample Date	**12/2/1998**	**12/1/1992**	**12/3/1992**	**12/1/1994**	**3/28/1995**	**12/20/1996**	**12/3/1998**	**12/2/1992**	**12/4/1992**	**11/29/1994**	**3/23/1995**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	1.0 U	--	**6.0 J**	8.0 U	**3.2 J**	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
1,1,2-Trichloroethane	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
1,1-Dichloroethane	1.0 U	--	**22**	**16**	**10**	**18**	1.0 U	--	10 U	5.0 U	**4.0 J**
1,1-Dichloroethene	1.0 U	--	10 U	8.0 U	5.0 U	**2.0**	1.0 U	--	10 U	5.0 U	5.0 U
1,2-Dichlorobenzene	1.0 U	10 U	--	--	--	1.0 U	1.0 U	10 U	--	--	--
1,2-Dichloroethane	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
1,2-Dichloroethene, Total	2.0 U	--	**170**	**190**	**110**	**180 D**	**17**	--	10 U	5.0 U	**4.8 J**
1,2-Dichloropropane	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
1,3-Dichlorobenzene	1.0 U	10 U	--	--	--	1.0 U	1.0 U	10 U	--	--	--
1,4-Dichlorobenzene	1.0 U	10 U	--	--	--	1.0 U	1.0 U	10 U	--	--	--
2-Butanone	5.0 U	--	10 U	42 U	25 U	5.0 U	5.0 U	--	10 U	25 U	25 U
2-Hexanone	5.0 U	--	10 U	42 U	25 U	5.0 U	5.0 U	--	10 U	25 U	25 U
4-Methyl-2-pentanone	5.0 U	--	10 U	42 U	25 U	**8.0**	5.0 U	--	10 U	25 U	25 U
Acetone	**7.0**	--	**28**	42 U	25 U	24 U	**11**	--	10 U	25 U	25 U
Benzene	1.0 U	--	**7.0 J**	8.0 U	5.0 U	**1.0**	1.0 U	--	10 U	5.0 U	5.0 U
Bromomethane	1.0 U	--	10 U	17 U	10 U	1.0 U	1.0 U	--	10 U	10 U	10 U
Carbon disulfide	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
Carbon tetrachloride	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
Chlorobenzene	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
Chloroethane	1.0 U	--	**18**	8.0 U	5.0 U	**9.0**	1.0 U	--	10 U	5.0 U	5.0 U
Chloroform	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
Chloromethane	1.0 U	--	10 UJ	17 U	10 U	1.0 U	1.0 U	--	10 UJ	10 U	10 U
cis-1,2-Dichloroethene	1.0 U	--	--	--	--	**160 D**	**16**	--	--	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	1.0 U	--	10 U	8.0 U	5.0 U	**20**	1.0 U	--	10 U	5.0 U	5.0 U
M,P-Xylene	2.0 U	--	--	--	--	**30 EJ**	2.0 U	--	--	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	**2.0**	--	10 U	17 U	10 U(b)	2.0 U	**7.0 B**	--	10 U	10 U	10 U(b)
O-Xylene	1.0 U	--	--	--	--	**9.0 J**	1.0 U	--	--	--	--
Styrene	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-128**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-204A**	**MW-205A**	**MW-205A**	**MW-205A**	**MW-205A**
Sample Date	**12/2/1998**	**12/1/1992**	**12/3/1992**	**12/1/1994**	**3/28/1995**	**12/20/1996**	**12/3/1998**	**12/2/1992**	**12/4/1992**	**11/29/1994**	**3/23/1995**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	1.0 U	--	10 U	8.0 U	5.0 U	**48 D**	1.0 U	--	10 U	5.0 U	5.0 U
Tetrahydrofuran	1.0 U	--	--	42 U	25 U	**26 E**	1.0 U	--	--	25 U	25 U
Toluene	1.0 U	--	**13**	8.0 U	**3.9 J**	**38 D**	1.0 U	--	10 U	5.0 U	5.0 U
trans-1,2-Dichloroethene	1.0 U	--	--	--	--	1.0 U	1.0 U	--	--	--	--
trans-1,3-Dichloropropene	1.0 U	--	10 U	8.0 U	5.0 U	1.0 U	1.0 U	--	10 U	5.0 U	5.0 U
Trichloroethene	1.0 U	--	**30**	**34**	**16**	**300 D**	1.0 U	--	10 U	5.0 U	5.0 U
Vinyl chloride	1.0 U	--	**170**	**55**	10 U	**13**	1.0 U	--	10 U	10 U	10 U
Xylenes, Total	2.0 U	--	10 U	8.0 U	5.0 U	**39 J**	2.0 U	--	10 U	5.0 U	5.0 U
Isopropanol	--	--	--	--	--	1,000 U	--	--	--	--	--
Methanol	--	--	--	--	--	1,000 U	--	--	--	--	--
Sec-Butanol	--	--	--	--	--	1,000 U	--	--	--	--	--
1,2,4-Trichlorobenzene	--	10 U	--	--	--	--	--	10 U	--	--	--
2,4-Dimethylphenol	--	10 U	--	--	--	--	--	10 U	--	--	--
2-Methylnaphthalene	--	10 U	--	--	--	--	--	10 U	--	--	--
2-Methylphenol	--	10 U	--	--	--	--	--	10 U	--	--	--
4,6-Dinitro-2-methylphenol	--	25 U	--	--	--	--	--	25 U	--	--	--
4-Methylphenol	--	10 U	--	--	--	--	--	10 U	--	--	--
Di-n-butyl phthalate	--	10 U	--	--	--	--	--	10 U	--	--	--
Di-n-octyl phthalate	--	10 U	--	--	--	--	--	10 U	--	--	--
Diethyl phthalate	--	10 U	--	--	--	--	--	10 U	--	--	--
Isophorone	--	10 U	--	--	--	--	--	10 U	--	--	--
Naphthalene	--	10 U	--	--	--	--	--	10 U	--	--	--
Phenol	--	10 U	--	--	--	--	--	10 U	--	--	--
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	1.0 U	--	--	--	--	--	1.0 U	--	--	--
4,4'-DDD	--	0.10 U	--	--	--	--	--	0.10 U	--	--	--
Aldrin	--	0.1 U	--	--	--	--	--	0.1 U	--	--	--
gamma-BHC (Lindane)	--	0.1 U	--	--	--	--	--	0.1 U	--	--	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID **Sample Date** **Sample Type**	**MW-205A** **11/21/1996** **S**	**MW-205A** **12/2/1998** **S**	**MW-408** **11/30/1994** **S**	**MW-408** **3/27/1995** **S**	**MW-408** **12/5/1996** **S**	**MW-408** **3/27/1995** **D**	**MW-414** **11/29/1994** **S**	**MW-414** **3/24/1995** **S**	**MW-414** **12/10/1996** **S**	**MW-416** **11/30/1994** **S**	**MW-416** **3/24/1995** **S**
1,1,1-Trichloroethane	1.0 U	1.0 U	**110 J**	**310**	**320 EJ**	**290**	500 U	830 U	**14**	**220 J**	**260**
1,1,2-Trichloroethane	1.0 U	1.0 U	170 U	42 U	**2.0**	89 U	500 U	830 U	1.0 U	500 U	250 U
1,1-Dichloroethane	1.0 U	**2.0**	170 U	42 U	**470 EJ**	89 U	**1,000**	**690 J**	**10**	**250 J**	**500**
1,1-Dichloroethene	1.0 U	1.0 U	170 U	**55**	**83 EJ**	**48 J**	500 U	830 U	**4.0**	500 U	250 U
1,2-Dichlorobenzene	1.0 U	1.0 U	--	--	**2.0**	--	--	--	1.0 U	--	--
1,2-Dichloroethane	1.0 U	1.0 U	170 U	42 U	**22**	89 U	500 U	830 U	1.0 U	500 U	250 U
1,2-Dichloroethene, Total	**9.0**	2.0 U	**970**	**2,000**	**8,000 D**	**2,000**	**5,200**	**3,900**	**92 EJ**	**450 J**	**430**
1,2-Dichloropropane	1.0 U	1.0 U	170 U	42 U	1.0 U	89 U	500 U	830 U	1.0 U	500 U	250 U
1,3-Dichlorobenzene	1.0 U	1.0 U	--	--	1.0 U	--	--	--	1.0 U	--	--
1,4-Dichlorobenzene	1.0 U	1.0 U	--	--	**1.0**	--	--	--	1.0 U	--	--
2-Butanone	17 U	5.0 U	830 U	210 U	**890 EJ**	450 U	**16,000**	**11,000**	**90**	2,500 U	1,300 U
2-Hexanone	5.0 U	5.0 U	830 U	210 U	5.0 U	450 U	2,500 U	4,200 U	5.0 U	2,500 U	1,300 U
4-Methyl-2-pentanone	5.0 U	5.0 U	**760 J**	**110 J**	**890 EJ**	450 U	**3,600**	**3,100 J**	20 U	2,500 U	1,300 U
Acetone	**7.0**	5.0 U	830 U	210 U	**350 EJ**	450 U	**18,000**	**14,000**	46 U	2,500 U	1,300 U
Benzene	1.0 U	1.0 U	170 U	42 U	**45 EJ**	89 U	500 U	830 U	**1.0**	500 U	250 U
Bromomethane	1.0 U	1.0 U	330 U	83 U	**2.0**	180 U	1,000 U	1,700 U	1.0 U	1,000 U	500 U
Carbon disulfide	1.0 U	1.0 U	170 U	42 U	**9.0**	89 U	500 U	830 U	1.0 U	500 U	250 U
Carbon tetrachloride	1.0 U	1.0 U	170 U	42 U	1.0 U	89 U	500 U	830 U	1.0 U	500 U	250 U
Chlorobenzene	**2.0**	1.0 U	170 U	42 U	**11**	89 U	500 U	830 U	1.0 U	500 U	250 U
Chloroethane	1.0 U	1.0 U	**570**	**91**	**1,000 EJ**	**92**	500 U	**790 J**	**18**	**2,100**	**1,900**
Chloroform	1.0 U	1.0 U	170 U	42 U	**2.0**	89 U	500 U	830 U	1.0 U	500 U	250 U
Chloromethane	1.0 U	1.0 U	330 U	83 U	**1.0**	180 U	1,000 U	1,700 U	1.0 U	1,000 U	500 U
cis-1,2-Dichloroethene	**8.0**	1.0 U	--	--	**7,500 D**	--	--	--	**96 D**	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	1.0 U	1.0 U	**1,900**	**360**	**3,000 D**	**360**	**550**	**2,200**	**31 D**	**3,100**	**2,900**
M,P-Xylene	2.0 U	2.0 U	--	--	**36**	--	--	--	**10**	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	**2.0**	2.0 U	330 U	83 U(b)	**120 EJ**	180 U(b)	1,000 U	1,700 U(b)	4.0 U	1,000 U	500 U(b)
O-Xylene	1.0 U	1.0 U	--	--	**240 EJ**	--	--	--	**4.0**	--	--
Styrene	1.0 U	1.0 U	170 U	42 U	**17**	89 U	500 U	830 U	1.0 U	500 U	250 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-205A**	**MW-205A**	**MW-408**	**MW-408**	**MW-408**	**MW-408**	**MW-414**	**MW-414**	**MW-414**	**MW-416**	**MW-416**
Sample Date	**11/21/1996**	**12/2/1998**	**11/30/1994**	**3/27/1995**	**12/5/1996**	**3/27/1995**	**11/29/1994**	**3/24/1995**	**12/10/1996**	**11/30/1994**	**3/24/1995**
Sample Type	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	1.0 U	1.0 U	170 U	**61**	**18**	89 U	500 U	830 U	**5.0**	500 U	250 U
Tetrahydrofuran	**6.0 J**	**4.0**	**940**	**310**	**1,000 EJ**	450 U	**1,400 J**	4,200 U	**31**	2,500 U	1,300 U
Toluene	1.0 U	1.0 U	**3,200**	**420**	**6,800 D**	**450**	**2,800**	**8,400**	**110 D**	**7,800**	**7,200**
trans-1,2-Dichloroethene	1.0 U	1.0 U	--	--	**17**	--	--	--	1.0 U	--	--
trans-1,3-Dichloropropene	1.0 U	1.0 U	170 U	42 U	1.0 U	89 U	500 U	830 U	1.0 U	500 U	250 U
Trichloroethene	**4.0**	1.0 U	**260**	**1,000**	**140 EJ**	**930**	500 U	830 U	**94 D**	500 U	250 U
Vinyl chloride	1.0 U	1.0 U	**120 J**	**50 J**	**2,700 D**	180 U	1,000 U	**1,200 J**	**9.0**	1,000 U	500 U
Xylenes, Total	2.0 U	2.0 U	**830**	**160**	**1,400 JD**	**150**	500 U	**1,000**	**15**	**2,000**	**1,500**
Isopropanol	1,000 U	--	--	--	1,000 U	--	--	--	1,000 U	--	--
Methanol	1,000 U	--	--	--	1,000 U	--	--	--	1,000 U	--	--
Sec-Butanol	1,000 U	--	--	--	**1,500**	--	--	--	**1,400**	--	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDD	--	--	--	--	--	--	--	--	--	--	--
Aldrin	--	--	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-416**	**MW-416**	**MW-501A**	**MW-501A**	**MW-501A**	**MW-702DR**	**MW-703DR**	**MW-703DR**	**MW-704DR**	**MW-704DR**	**MW-704R**
Sample Date	**12/10/1996**	**3/24/1995**	**3/24/1995**	**12/3/1996**	**12/2/1998**	**12/3/1996**	**12/9/1996**	**12/1/1998**	**12/17/1996**	**12/3/1998**	**12/17/1996**
Sample Type	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**380 D**	**280**	5.0 U	**3.0**	2.0 U	**14**	1.0 U	1.0 U	**9.0**	1.0 U	20 U
1,1,2-Trichloroethane	1.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
1,1-Dichloroethane	**440 D**	**350**	5.0 U	**7.0**	**3.0**	1.0 U	1.0 U	1.0 U	**13**	**5.0**	20 U
1,1-Dichloroethene	**96 EJ**	190 U	5.0 U	1.0 U	2.0 U	**3.0**	1.0 U	1.0 U	2.0 U	1.0 U	20 U
1,2-Dichlorobenzene	1.0 U	--	--	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
1,2-Dichloroethane	7.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
1,2-Dichloroethene, Total	**1,300 D**	**490**	**45**	**71 D**	**34**	**5.0**	2.0 U	2.0 U	**10**	2.0 U	40 U
1,2-Dichloropropane	1.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
1,3-Dichlorobenzene	1.0 U	--	--	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
1,4-Dichlorobenzene	1.0 U	--	--	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
2-Butanone	**210 EJ**	960 U	25 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	24 U	5.0 U	850 U
2-Hexanone	5.0 U	960 U	25 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	12 U	5.0 U	100 U
4-Methyl-2-pentanone	19 U	960 U	25 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	12 U	5.0 U	100 U
Acetone	48 U	960 U	25 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	40 U	5.0 U	200 U
Benzene	**8.0**	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	**2.0**	**1.0**	**34**
Bromomethane	1.0 U	380 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
Carbon disulfide	1.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	**23**	1.0 U	**25**
Carbon tetrachloride	1.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
Chlorobenzene	**2.0**	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
Chloroethane	**110 EJ**	**1,400**	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	**53**	**15**	**400**
Chloroform	1.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
Chloromethane	1.0 U	380 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
cis-1,2-Dichloroethene	**1,300 D**	--	--	**67 D**	**32**	**5.0**	1.0 U	1.0 U	**9.0**	1.0 U	20 U
Ethylene	--	--	--	--	--	--	--	--	**5.2**	--	**0.9**
Ethane	--	--	--	--	--	--	--	--	**83.6**	--	**795.3**
Ethylbenzene	**170 D**	**1,900**	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	**35**	**1.0**	**95**
M,P-Xylene	**72 EJ**	--	--	2.0 U	4.0 U	2.0 U	2.0 U	2.0 U	**14**	2.0 U	**100**
Methane	--	--	--	--	--	--	--	--	**3,293.00**	--	**20,270.30**
Methylene chloride	**65 EJ**	380 U(b)	10 U	2.0 U	**3.0 J**	2.0 U	2.0 U	2.0 U	3.0 U	**8.0 B**	40 U
O-Xylene	**28 EJ**	--	--	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	**6.0**	1.0 U	20 U
Styrene	1.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-416**	**MW-416**	**MW-501A**	**MW-501A**	**MW-501A**	**MW-702DR**	**MW-703DR**	**MW-703DR**	**MW-704DR**	**MW-704DR**	**MW-704R**
Sample Date	**12/10/1996**	**3/24/1995**	**3/24/1995**	**12/3/1996**	**12/2/1998**	**12/3/1996**	**12/9/1996**	**12/1/1998**	**12/17/1996**	**12/3/1998**	**12/17/1996**
Sample Type	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	**26 EJ**	190 U	5.0 U	**2.0**	2.0 U	1.0 U	1.0 U	1.0 U	**4.0**	1.0 U	20 U
Tetrahydrofuran	**76**	960 U	25 U	10 U	2.0 U	10 U	10 U	1.0 U	**190**	**51 E**	200 U
Toluene	**640 D**	**5,100**	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	**44**	1.0 U	20 U
trans-1,2-Dichloroethene	**2.0**	--	--	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
trans-1,3-Dichloropropene	1.0 U	190 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
Trichloroethene	**220 D**	**200**	**19**	**39 D**	**14**	1.0 U	1.0 U	1.0 U	**53**	1.0 U	**79**
Vinyl chloride	**110 D**	380 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	20 U
Xylenes, Total	**100 EJ**	**1,000**	5.0 U	2.0 U	4.0 U	2.0 U	2.0 U	2.0 U	**21**	2.0 U	**120**
Isopropanol	1,000 U	--	--	1,000 U	--	1,000 U	1,000 U	--	1,000 U	--	1,000 U
Methanol	1,000 U	--	--	1,000 U	--	1,000 U	1,000 U	--	1,000 U	--	1,000 U
Sec-Butanol	1,000 U	--	--	1,000 U	--	1,000 U	1,000 U	--	1,000 U	--	1,000 U
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	--
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--	--	--
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--	--
Phenol	--	--	--	--	--	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--	--	--
4,4'-DDD	--	--	--	--	--	--	--	--	--	--	--
Aldrin	--	--	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-705R**	**MW-706DR**	**MW-706DR**	**MW-706DR**	**MW-707DR**	**MW-707DR**	**MW-707R**	**MW-707R**	**MW-709DR**	**MW-709R**	**P-1A**
Sample Date	**12/9/1996**	**12/10/1996**	**12/3/1998**	**12/3/1998**	**12/30/1996**	**12/1/1998**	**12/13/1996**	**2/7/1997**	**12/12/1996**	**12/12/1996**	**8/15/1991**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	1.0 U	1.0 U	200 U	**23**	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	**17,000 J**
1,1,2-Trichloroethane	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
1,1-Dichloroethane	1.0 U	6.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	**15**	100 U	**940 J**
1,1-Dichloroethene	1.0 U	**47 EJ**	200 U	**40**	1.0 U	1.0 U	2.0 U	1.0 U	**180 EJ**	100 U	**1,600 J**
1,2-Dichlorobenzene	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	10 U
1,2-Dichloroethane	1.0 U	**8.0**	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
1,2-Dichloroethene, Total	**7.0**	**28**	400 U	**99**	2.0 U	2.0 U	5.0 U	2.0 U	**1,200 EJ**	**3,200**	--
1,2-Dichloropropane	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
1,3-Dichlorobenzene	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	**2.0 J**
1,4-Dichlorobenzene	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	**10**
2-Butanone	5.0 U	**16**	1,000 U	100 U	5.0 U	5.0 U	12 U	5.0 U	12 U	500 U	R
2-Hexanone	5.0 U	5.0 U	1,000 U	100 U	5.0 U	5.0 U	12 U	5.0 U	12 U	500 U	R
4-Methyl-2-pentanone	5.0 U	2,500 U	1,000 U	**240**	5.0 U	5.0 U	12 U	5.0 U	**930 EJ**	500 U	**2,100 J**
Acetone	5.0 U	20 U	1,000 U	**150**	32 U	5.0 U	12 U	5.0 U	150 U	500 U	R
Benzene	1.0 U	**5.0**	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	**16**	100 U	250 UJ
Bromomethane	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
Carbon disulfide	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	R
Carbon tetrachloride	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	**2,000 J**
Chlorobenzene	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
Chloroethane	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	**6.0**	1.0 U	2.0 U	100 U	250 UJ
Chloroform	1.0 U	**4.0**	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	**16**	100 U	250 UJ
Chloromethane	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
cis-1,2-Dichloroethene	**7.0**	**30 EJ**	200 U	**98**	1.0 U	1.0 U	2.0 U	1.0 U	**1,300 EJ**	**3,300 D**	**5,300 J**
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	1.0 U	13 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	4.0 U	100 U	**740 J**
M,P-Xylene	2.0 U	**31**	400 U	**22 J**	2.0 U	2.0 U	5.0 U	2.0 U	**74**	200 U	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	2.0 U	**73 EJ**	**430 B**	**290 JDB**	2.0 U	2.0 U	5.0 U	2.0 U	**180 EBJ**	200 U	1,400 UJ
O-Xylene	1.0 U	**15**	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	**44**	100 U	--
Styrene	1.0 U	**4.0**	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-705R**	**MW-706DR**	**MW-706DR**	**MW-706DR**	**MW-707DR**	**MW-707DR**	**MW-707R**	**MW-707R**	**MW-709DR**	**MW-709R**	**P-1A**
Sample Date	**12/9/1996**	**12/10/1996**	**12/3/1998**	**12/3/1998**	**12/30/1996**	**12/1/1998**	**12/13/1996**	**2/7/1997**	**12/12/1996**	**12/12/1996**	**8/15/1991**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	**3.0**	1.0 U	**240**	**250 D**	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
Tetrahydrofuran	10 U	10 U	200 U	20 U	10 U	1.0 U	25 U	10 U	20 U	1,000 U	--
Toluene	1.0 U	**220 EJ**	200 U	**190**	1.0 U	1.0 U	2.0 U	1.0 U	**630 EJ**	100 U	2,300 UJ
trans-1,2-Dichloroethene	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	250 UJ
trans-1,3-Dichloropropene	1.0 U	1.0 U	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	100 U	**390 J**
Trichloroethene	**21**	**7,000 D**	**6,600**	**7,200 D**	1.0 U	1.0 U	24 U	1.0 U	**12,000 D**	780 U	250 UJ
Vinyl chloride	1.0 U	**1.0**	200 U	20 U	1.0 U	1.0 U	2.0 U	1.0 U	**13**	100 U	**110 J**
Xylenes, Total	2.0 U	**46**	400 U	**35 J**	2.0 U	2.0 U	5.0 U	2.0 U	**120**	200 U	280 UJ
Isopropanol	1,000 U	1,000 U	--	--	1,000 U	--	1,000 U	1,000 U	1,000 U	1,000 U	--
Methanol	1,000 U	1,000 U	--	--	1,000 U	--	1,000 U	1,000 U	1,000 U	1,000 U	--
Sec-Butanol	1,000 U	1,000 U	--	--	1,000 U	--	1,000 U	1,000 U	1,000 U	**2,100**	--
1,2,4-Trichlorobenzene	--	--	--	--	--	--	--	--	--	--	10 U
2,4-Dimethylphenol	--	--	--	--	--	--	--	--	--	--	10 U
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--	10 U
2-Methylphenol	--	--	--	--	--	--	--	--	--	--	**12**
4,6-Dinitro-2-methylphenol	--	--	--	--	--	--	--	--	--	--	25 U
4-Methylphenol	--	--	--	--	--	--	--	--	--	--	**13**
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--	**3.0 J**
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--	10 UJ
Diethyl phthalate	--	--	--	--	--	--	--	--	--	--	10 U
Isophorone	--	--	--	--	--	--	--	--	--	--	**9.0 J**
Naphthalene	--	--	--	--	--	--	--	--	--	--	**2.0 J**
Phenol	--	--	--	--	--	--	--	--	--	--	**14**
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	250 UJ
Aroclor-1254	--	--	--	--	--	--	--	--	--	--	**13**
4,4'-DDD	--	--	--	--	--	--	--	--	--	--	0.10 U
Aldrin	--	--	--	--	--	--	--	--	--	--	0.1 U
gamma-BHC (Lindane)	--	--	--	--	--	--	--	--	--	--	0.1 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-1A**	**P-1A**	**P-1A**	**P-1A**	**P-2A**	**P-2A**	**P-2A**	**P-2A**	**P-2A**	**P-3A**	**P-3A**
Sample Date	**12/4/1992**	**11/28/1994**	**3/21/1995**	**12/18/1996**	**8/16/1991**	**11/28/1994**	**3/21/1995**	**12/12/1996**	**8/16/1991**	**8/29/1991**	**12/20/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**
1,1,1-Trichloroethane	**590**	**530**	**96**	**190 D**	5.2 UJ	**820**	**200**	**320 D**	1.0 UJ	1,000 UJ	100 U
1,1,2-Trichloroethane	50 U	13 U	5.0 U	10 U	2.0 UJ	25 U	5.0 U	1.0 U	**4.7 J**	1,000 UJ	100 U
1,1-Dichloroethane	**170**	**170**	**54**	**240 D**	**79 J**	**380**	**90**	**260 D**	**110 J**	**1,200 J**	100 U
1,1-Dichloroethene	50 U	**30**	**11**	**32**	**140 J**	**54**	**24**	1.0 U	**240 J**	1,000 UJ	100 U
1,2-Dichlorobenzene	10 U	--	--	10 U	1.0 UJ	--	--	1.0 U	1.0 UJ	10 U	100 U
1,2-Dichloroethane	50 U	13 U	5.0 U	10 U	**1.0 J**	25 U	5.0 U	1.0 U	**1.6 J**	1,000 UJ	100 U
1,2-Dichloroethene, Total	**300**	**510**	**69**	**140**	--	**300**	**87**	**200 D**	--	--	200 U
1,2-Dichloropropane	50 U	13 U	5.0 U	10 U	1.0 UJ	25 U	5.0 U	1.0 U	**0.70 J**	1,000 UJ	100 U
1,3-Dichlorobenzene	**2.0 J**	--	--	10 U	1.0 UJ	--	--	1.0 U	1.0 UJ	10 U	100 U
1,4-Dichlorobenzene	**8.0 J**	--	--	10 U	1.0 UJ	--	--	1.0 U	1.0 UJ	10 U	100 U
2-Butanone	50 U	63 U	25 U	**72**	R	130 U	25 U	5.0 U	R	R	**12,000 D**
2-Hexanone	50 U	63 U	25 U	50 U	R	130 U	25 U	5.0 U	R	5,000 UJ	500 U
4-Methyl-2-pentanone	50 U	63 U	25 U	50 U	**13 J**	130 U	25 U	5.0 U	**32 J**	**12,000 J**	**9,200 D**
Acetone	50 U	63 U	25 U	63 U	R	130 U	25 U	5.0 U	R	R	**34,000 D**
Benzene	50 U	13 U	5.0 U	**11**	1.0 UJ	25 U	5.0 U	1.0 U	**1.9 J**	1,000 UJ	**190**
Bromomethane	50 U	25 U	10 U	10 U	2.0 UJ	50 U	10 U	1.0 U	2.0 UJ	1,000 UJ	100 U
Carbon disulfide	50 U	13 U	5.0 U	10 U	R	25 U	5.0 U	1.0 U	R	R	100 U
Carbon tetrachloride	50 U	13 U	5.0 U	**57**	**83 J**	25 U	5.0 U	1.0 U	**56 J**	1,000 UJ	100 U
Chlorobenzene	50 U	13 U	5.0 U	10 U	1.0 UJ	25 U	5.0 U	1.0 U	1.0 UJ	1,000 UJ	100 U
Chloroethane	50 U	13 U	5.0 U	**16**	**2.2 J**	25 U	5.0 U	**5.0**	**2.0 J**	1,000 UJ	**660**
Chloroform	50 U	13 U	5.0 U	10 U	1.0 UJ	25 U	5.0 U	1.0 U	1.0 UJ	1,000 UJ	100 U
Chloromethane	50 U	25 U	10 U	10 U	2.0 UJ	50 U	10 U	1.0 U	2.0 UJ	1,000 UJ	100 U
cis-1,2-Dichloroethene	--	--	--	**130**	**190 J**	--	--	**180 D**	**360 J**	**16,000 J**	100 U
Ethylene	--	--	--	**20.4**	--	--	--	--	--	--	--
Ethane	--	--	--	**117.8**	--	--	--	--	--	--	--
Ethylbenzene	**47 J**	13 U	5.0 U	**82**	**30 J**	25 U	5.0 U	**23**	**72 J**	**8,700 J**	**4,300 D**
M,P-Xylene	--	--	--	**63**	--	--	--	**12**	--	--	**4,800**
Methane	--	--	--	**11,804.90**	--	--	--	--	--	--	--
Methylene chloride	13 U	25 U	10 U	13 U	19 UJ	50 U	10 U	2.0 U	40 UJ	1,000 UJ	390 U
O-Xylene	--	--	--	**27**	--	--	--	**4.0**	--	--	**2,000**
Styrene	50 U	13 U	5.0 U	10 U	**5.3 J**	25 U	5.0 U	1.0 U	**14 J**	1,000 UJ	100 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-1A**	**P-1A**	**P-1A**	**P-1A**	**P-2A**	**P-2A**	**P-2A**	**P-2A**	**P-2A**	**P-3A**	**P-3A**
Sample Date	**12/4/1992**	**11/28/1994**	**3/21/1995**	**12/18/1996**	**8/16/1991**	**11/28/1994**	**3/21/1995**	**12/12/1996**	**8/16/1991**	**8/29/1991**	**12/20/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**
Tetrachloroethene	**240**	**56**	**13**	10 U	**3.4 J**	25 U	5.0 U	**3.0**	**5.7 J**	1,000 UJ	**210**
Tetrahydrofuran	--	63 U	25 U	**180**	--	130 U	25 U	10 U	--	--	**5,600 JD**
Toluene	**170**	**43**	5.0 U	**200**	1.0 UJ	**71**	5.0 U	**18**	1.0 UJ	23,000 UJ	**13,000 D**
trans-1,2-Dichloroethene	--	--	--	10 U	**0.70 J**	--	--	1.0 U	**1.0 J**	1,000 UJ	100 U
trans-1,3-Dichloropropene	50 U	13 U	5.0 U	10 U	1.0 UJ	25 U	5.0 U	1.0 U	1.0 UJ	1,000 UJ	100 U
Trichloroethene	**180**	**76**	**8.0**	**20**	**10 J**	25 U	5.0 U	12 U	**18 J**	1,000 UJ	**1,000**
Vinyl chloride	**94**	**6.0 J**	10 U	**96**	**7.2 J**	**32 J**	**10 J**	**42 EJ**	**8.8 J**	**7,300 J**	100 U
Xylenes, Total	**37 J**	13 U	5.0 U	**95**	**26 J**	25 U	5.0 U	**16**	**61 J**	8,300 UJ	**6,800**
Isopropanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	**28,000**
Methanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	1,000 U
Sec-Butanol	--	--	--	1,000 U	--	--	--	1,000 U	--	--	**12,000**
1,2,4-Trichlorobenzene	**1.0 J**	--	--	--	2.0 UJ	--	--	--	2.0 UJ	10 U	--
2,4-Dimethylphenol	10 U	--	--	--	10 U	--	--	--	--	10 U	--
2-Methylnaphthalene	10 U	--	--	--	10 U	--	--	--	--	10 U	--
2-Methylphenol	10 U	--	--	--	**14**	--	--	--	--	**92 J**	--
4,6-Dinitro-2-methylphenol	25 U	--	--	--	25 U	--	--	--	--	25 U	--
4-Methylphenol	10 U	--	--	--	**8.0 J**	--	--	--	--	**570**	--
Di-n-butyl phthalate	**2.0 J**	--	--	--	10 U	--	--	--	--	**1.0 J**	--
Di-n-octyl phthalate	**5.0 J**	--	--	--	10 UJ	--	--	--	--	10 U	--
Diethyl phthalate	10 U	--	--	--	10 U	--	--	--	--	10 U	--
Isophorone	10 U	--	--	--	10 U	--	--	--	--	10 U	--
Naphthalene	10 U	--	--	--	**3.0 J**	--	--	--	1.0 UJ	10 U	--
Phenol	10 U	--	--	--	10 U	--	--	--	--	**270**	--
1,1,1,2-Tetrachloroethane	--	--	--	--	**1.8 J**	--	--	--	1.0 UJ	1,000 UJ	--
Aroclor-1254	**180**	--	--	--	1.0 U	--	--	--	--	1.0 U	--
4,4'-DDD	10 U	--	--	--	0.10 U	--	--	--	--	**0.17**	--
Aldrin	5.0 U	--	--	--	0.1 U	--	--	--	--	**0.1**	--
gamma-BHC (Lindane)	5.0 U	--	--	--	0.1 U	--	--	--	--	0.1 U	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-4A**	**P-4A**	**P-4A**	**P-4A**	**P-4A**	**P-4A**	**P-5A**	**P-5A**	**P-5A**	**P-6**	**P-6**
Sample Date	**8/28/1991**	**12/3/1992**	**11/28/1994**	**3/21/1995**	**12/2/1996**	**12/2/1996**	**11/30/1994**	**3/24/1995**	**12/13/1996**	**12/1/1994**	**3/27/1995**
Sample Type	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**320,000 J**	**670**	**380**	**37**	**110 D**	**97 D**	83 U	50 U	1,000 U	330 U	260 U
1,1,2-Trichloroethane	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
1,1-Dichloroethane	5,000 UJ	**70 J**	**68**	**15**	**43 D**	**25**	83 U	50 U	1,000 U	**300 J**	**200 J**
1,1-Dichloroethene	**2,300 J**	**33 J**	**24**	5.0 U	**11**	**8.0**	83 U	50 U	1,000 U	330 U	260 U
1,2-Dichlorobenzene	10 U	10 U	--	--	1.0 U	1.0 U	--	--	1,000 U	--	--
1,2-Dichloroethane	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
1,2-Dichloroethene, Total	--	**200**	**140**	**12**	**34 D**	**22**	83 U	**270**	**70,000 D**	**3,000**	**950**
1,2-Dichloropropane	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
1,3-Dichlorobenzene	10 U	10 U	--	--	1.0 U	1.0 U	--	--	1,000 U	--	--
1,4-Dichlorobenzene	10 U	10 U	--	--	1.0 U	1.0 U	--	--	1,000 U	--	--
2-Butanone	R	80 U	63 U	25 U	5.0 U	35 U	420 U	**370**	5,000 U	**6,800**	**7,100**
2-Hexanone	R	80 U	63 U	25 U	5.0 U	5.0 U	420 U	250 U	5,000 U	1,700 U	1,300 U
4-Methyl-2-pentanone	25,000 UJ	80 U	63 U	25 U	5.0 U	5.0 U	420 U	250 U	5,000 U	**3,300**	**3,200**
Acetone	R	80 U	63 U	25 U	5.0 U	8.0 U	420 U	250 U	12,000 U	**9,400**	**4,300**
Benzene	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Bromomethane	5,000 UJ	80 U	25 U	10 U	1.0 U	1.0 U	170 U	100 U	1,000 U	670 U	530 U
Carbon disulfide	R	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Carbon tetrachloride	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Chlorobenzene	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Chloroethane	5,000 UJ	80 U	13 U	5.0 U	**3.0**	**2.0**	83 U	50 U	1,000 U	330 U	**280**
Chloroform	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Chloromethane	5,000 UJ	80 U	25 U	10 U	1.0 U	1.0 U	170 U	100 U	1,000 U	670 U	530 U
cis-1,2-Dichloroethene	6,700 UJ	--	--	--	**36 D**	**22**	--	--	**64,000 D**	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	**200**	**210**	**7,800**	**3,200**	**2,500**
M,P-Xylene	--	--	--	--	2.0 U	2.0 U	--	--	**9,900**	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	18,000 UJ	80 U	25 U	10 U	2.0 U	2.0 U	170 U	100 U(b)	2,000 U	670 U	530 U(b)
O-Xylene	--	--	--	--	1.0 U	1.0 U	--	--	**3,500**	--	--
Styrene	**2,300 J**	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-4A**	**P-4A**	**P-4A**	**P-4A**	**P-4A**	**P-4A**	**P-5A**	**P-5A**	**P-5A**	**P-6**	**P-6**
Sample Date	**8/28/1991**	**12/3/1992**	**11/28/1994**	**3/21/1995**	**12/2/1996**	**12/2/1996**	**11/30/1994**	**3/24/1995**	**12/13/1996**	**12/1/1994**	**3/27/1995**
Sample Type	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	**6,400 J**	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Tetrahydrofuran	--	--	63 U	25 U	10 U	10 U	**2,300**	**1,600**	10,000 U	**1,700**	**2,100**
Toluene	**150,000 J**	**45 J**	**150**	5.0 U	**5.0**	**4.0**	**500**	**490**	**23,000**	**9,000**	**6,100**
trans-1,2-Dichloroethene	5,000 UJ	--	--	--	1.0 U	1.0 U	--	--	1,000 U	--	--
trans-1,3-Dichloropropene	5,000 UJ	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Trichloroethene	**41,000 J**	80 U	13 U	5.0 U	1.0 U	1.0 U	83 U	50 U	1,000 U	330 U	260 U
Vinyl chloride	5,000 UJ	80 U	25 U	10 U	**6.0**	**4.0**	**100 J**	**240**	**22,000**	**2,900**	**1,500**
Xylenes, Total	7,300 UJ	80 U	**11 J**	5.0 U	2.0 U	2.0 U	**220**	**230**	**14,000**	**3,000**	**2,100**
Isopropanol	--	--	--	--	1,000 U	1,000 U	--	--	**3,600**	--	--
Methanol	--	--	--	--	1,000 U	1,000 U	--	--	**9,500**	--	--
Sec-Butanol	--	--	--	--	1,000 U	1,000 U	--	--	**19,000**	--	--
1,2,4-Trichlorobenzene	10 U	10 U	--	--	--	--	--	--	--	--	--
2,4-Dimethylphenol	**2.0 J**	10 U	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	10 U	10 U	--	--	--	--	--	--	--	--	--
2-Methylphenol	**16**	10 U	--	--	--	--	--	--	--	--	--
4,6-Dinitro-2-methylphenol	25 U	25 U	--	--	--	--	--	--	--	--	--
4-Methylphenol	**4.0 J**	10 U	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	10 U	10 U	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	10 U	10 U	--	--	--	--	--	--	--	--	--
Diethyl phthalate	10 U	10 U	--	--	--	--	--	--	--	--	--
Isophorone	**2.0 J**	10 U	--	--	--	--	--	--	--	--	--
Naphthalene	**3.0 J**	10 U	--	--	--	--	--	--	--	--	--
Phenol	10 U	10 U	--	--	--	--	--	--	--	--	--
1,1,1,2-Tetrachloroethane	5,000 UJ	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	1.0 U	1.0 U	--	--	--	--	--	--	--	--	--
4,4'-DDD	0.10 U	0.10 U	--	--	--	--	--	--	--	--	--
Aldrin	0.1 U	0.1 U	--	--	--	--	--	--	--	--	--
gamma-BHC (Lindane)	0.1 U	0.1 U	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-6**	**P-8A**	**P-8A**	**P-8A**	**P-8A**	**P-11A**	**P-11A**	**P-11A**	**P-11A**	**P-11A**	**P-12A**
Sample Date	**12/10/1996**	**8/27/1991**	**11/28/1994**	**3/21/1995**	**12/10/1996**	**8/26/1991**	**12/1/1994**	**3/27/1995**	**12/10/1996**	**12/3/1998**	**8/13/1991**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**19**	1.0 UJ	5.0 U	5.0 U	**9.0**	1.0 UJ	130 U	140 U	5.0 U	**13**	1.0 UJ
1,1,2-Trichloroethane	5.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U	2.0 UJ	130 U	140 U	5.0 U	5.0 U	2.0 UJ
1,1-Dichloroethane	26 U	1.0 UJ	5.0 U	5.0 U	1.0 U	**1.1 J**	130 U	140 U	5.0 U	**19**	1.0 UJ
1,1-Dichloroethene	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
1,2-Dichlorobenzene	**5.0**	1.0 UJ	--	--	1.0 U	1.0 UJ	--	--	5.0 U	5.0 U	1.0 UJ
1,2-Dichloroethane	**8.0**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
1,2-Dichloroethene, Total	10 U	--	5.0 U	5.0 U	2.0 U	--	130 U	140 U	**27 EJ**	**190**	--
1,2-Dichloropropane	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
1,3-Dichlorobenzene	5.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--	--	5.0 U	5.0 U	1.0 UJ
1,4-Dichlorobenzene	5.0 U	1.0 UJ	--	--	1.0 U	1.0 UJ	--	--	5.0 U	5.0 U	1.0 UJ
2-Butanone	**7,300 D**	R	25 U	25 U	5.0 U	R	630 U	690 U	25 U	25 U	R
2-Hexanone	25 U	R	25 U	25 U	5.0 U	R	630 U	690 U	25 U	25 U	R
4-Methyl-2-pentanone	**9,200 D**	5.0 UJ	25 U	25 U	5.0 U	**140 J**	**2,600**	**2,000**	25 U	25 U	5.0 UJ
Acetone	**12,000 D**	R	25 U	25 U	5.0 U	R	810 U	**650 J**	25 U	25 U	R
Benzene	**170 EJ**	1.0 UJ	5.0 U	5.0 U	1.0 U	**1.9 J**	**63 J**	140 U	**20**	**15**	1.0 UJ
Bromomethane	5.0 U	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	250 U	280 U	5.0 U	5.0 U	2.0 UJ
Carbon disulfide	5.0 U	R	5.0 U	5.0 U	1.0 U	R	130 U	140 U	5.0 U	5.0 U	R
Carbon tetrachloride	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
Chlorobenzene	**44**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
Chloroethane	**830 JD**	2.0 UJ	5.0 U	5.0 U	1.0 U	**1.9 J**	130 U	**200**	**17**	**17**	2.0 UJ
Chloroform	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
Chloromethane	5.0 U	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	250 U	280 U	5.0 U	5.0 U	2.0 UJ
cis-1,2-Dichloroethene	11 U	1.0 UJ	--	--	2.0 U	1.2 UJ	--	--	**27**	**190**	**11 J**
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**6,300 D**	1.0 UJ	5.0 U	5.0 U	1.0 U	**44 J**	**2,100**	**1,800**	**390 D**	**160**	1.0 UJ
M,P-Xylene	**2,900 D**	--	--	--	2.0 U	--	--	--	**180 D**	**100**	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	34 U	4.6 UJ	10 U	11 U(b)	2.0 U	8.8 UJ	250 U	280 U(b)	10 U	**42 B**	3.0 UJ
O-Xylene	**1,300 EJ**	--	--	--	1.0 U	--	--	--	**52 D**	5.0 U	--
Styrene	**49**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-6**	**P-8A**	**P-8A**	**P-8A**	**P-8A**	**P-11A**	**P-11A**	**P-11A**	**P-11A**	**P-11A**	**P-12A**
Sample Date	**12/10/1996**	**8/27/1991**	**11/28/1994**	**3/21/1995**	**12/10/1996**	**8/26/1991**	**12/1/1994**	**3/27/1995**	**12/10/1996**	**12/3/1998**	**8/13/1991**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Tetrachloroethene	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
Tetrahydrofuran	**5,800 JD**	--	25 U	25 U	10 U	--	**3,100**	**2,600**	**630 D**	**180**	--
Toluene	**13,000 D**	1.2 UJ	5.0 U	5.0 U	1.0 U	**110 J**	**3,600**	**3,100**	9.0 U	**15**	1.0 UJ
trans-1,2-Dichloroethene	**10**	1.0 UJ	--	--	1.0 U	1.0 UJ	--	--	5.0 U	5.0 U	1.0 UJ
trans-1,3-Dichloropropene	5.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	1.0 UJ
Trichloroethene	7.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	**5.0**	**2.0 J**
Vinyl chloride	**12**	2.0 UJ	10 U	10 U	1.0 U	2.0 UJ	250 U	280 U	**56 D**	**120**	2.0 UJ
Xylenes, Total	**4,500 D**	1.0 UJ	5.0 U	5.0 U	2.0 U	**26 J**	**1,500**	**1,200**	**260 D**	**100**	1.0 UJ
Isopropanol	**9,400**	--	--	--	1,000 U	--	--	--	1,000 U	--	--
Methanol	1,000 U	--	--	--	1,000 U	--	--	--	1,000 U	--	--
Sec-Butanol	**2,600**	--	--	--	1,000 U	--	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	--	2.0 UJ	--	--	--	2.0 UJ	--	--	--	--	2.0 UJ
2,4-Dimethylphenol	--	10 U	--	--	--	**31**	--	--	--	--	20 U
2-Methylnaphthalene	--	10 U	--	--	--	**1.0 J**	--	--	--	--	20 U
2-Methylphenol	--	10 U	--	--	--	10 U	--	--	--	--	20 U
4,6-Dinitro-2-methylphenol	--	25 U	--	--	--	25 U	--	--	--	--	50 U
4-Methylphenol	--	10 U	--	--	--	**290 J**	--	--	--	--	20 U
Di-n-butyl phthalate	--	10 U	--	--	--	10 U	--	--	--	--	20 U
Di-n-octyl phthalate	--	10 U	--	--	--	10 U	--	--	--	--	20 U
Diethyl phthalate	--	10 U	--	--	--	10 U	--	--	--	--	20 U
Isophorone	--	10 U	--	--	--	10 U	--	--	--	--	20 U
Naphthalene	--	1.0 UJ	--	--	--	**15**	--	--	--	--	1.0 UJ
Phenol	--	10 U	--	--	--	**62**	--	--	--	--	20 U
1,1,1,2-Tetrachloroethane	--	1.0 UJ	--	--	--	1.0 UJ	--	--	--	--	1.0 UJ
Aroclor-1254	--	1.0 U	--	--	--	1.0 U	--	--	--	--	1.0 U
4,4'-DDD	--	0.10 U	--	--	--	0.10 U	--	--	--	--	0.10 U
Aldrin	--	0.1 U	--	--	--	0.1 U	--	--	--	--	0.1 U
gamma-BHC (Lindane)	--	0.1 U	--	--	--	0.1 U	--	--	--	--	0.1 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-12A**	**P-12A**	**P-12A**	**P-12A**	**P-14**	**P-14**	**P-101A**	**P-101A**	**P-101A**	**P-101A**	**P-101A**
Sample Date	**11/29/1994**	**3/22/1995**	**11/22/1996**	**8/13/1991**	**8/15/1991**	**12/18/1996**	**12/4/1992**	**12/8/1992**	**12/3/1994**	**3/27/1995**	**12/10/1996**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	5.0 U	5.0 U	1.0 U	1.0 UJ	2.7 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U
1,1,2-Trichloroethane	5.0 U	5.0 U	1.0 U	2.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U
1,1-Dichloroethane	5.0 U	5.0 U	1.0 U	1.0 UJ	**1.0 J**	7.0 U	--	2,000 U	83 U	63 U	5.0 U
1,1-Dichloroethene	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U
1,2-Dichlorobenzene	--	--	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	50 U	--	--	1.0 U
1,2-Dichloroethane	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	**3.0**
1,2-Dichloroethene, Total	**9.0**	**31**	**9.0**	--	--	13 U	--	2,000 U	83 U	63 U	3.0 U
1,2-Dichloropropane	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U
1,3-Dichlorobenzene	--	--	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	50 U	--	--	1.0 U
1,4-Dichlorobenzene	--	--	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	50 U	--	--	1.0 U
2-Butanone	25 U	25 U	5.0 U	R	R	33 U	--	**36,000 J**	420 U	310 U	5.0 U
2-Hexanone	25 U	25 U	5.0 U	R	R	33 U	--	2,000 U	420 U	310 U	5.0 U
4-Methyl-2-pentanone	25 U	25 U	5.0 U	5.0 UJ	**21 J**	33 U	--	**5,900 J**	420 U	310 U	19 U
Acetone	25 U	25 U	5.0 U	R	R	60 U	--	**47,000**	420 U	310 U	5.0 U
Benzene	5.0 U	5.0 U	1.0 U	1.0 UJ	**48 J**	**32**	--	2,000 U	**73 J**	**45 J**	33 U
Bromomethane	10 U	10 U	1.0 U	2.0 UJ	**2.6 J**	7.0 U	--	2,000 U	170 U	130 U	1.0 U
Carbon disulfide	5.0 U	5.0 U	1.0 U	R	R	7.0 U	--	2,000 U	83 U	63 U	1.0 U
Carbon tetrachloride	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U
Chlorobenzene	5.0 U	5.0 U	1.0 U	1.0 UJ	**25 J**	**10**	--	2,000 U	83 U	63 U	**17**
Chloroethane	5.0 U	5.0 U	1.0 U	2.0 UJ	**38 J**	**41**	--	2,000 U	**240**	**130**	**330 D**
Chloroform	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	13 U	--	2,000 U	83 U	63 U	1.0 U
Chloromethane	10 U	10 U	1.0 U	2.0 UJ	**24 J**	7.0 U	--	2,000 U	170 U	130 U	1.0 U
cis-1,2-Dichloroethene	--	--	**8.0**	**12 J**	2.5 UJ	7.0 U	--	--	--	--	2.0 U
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	5.0 U	5.0 U	1.0 U	1.0 UJ	**92 J**	**55**	--	**2,000**	**430**	**230**	**670 D**
M,P-Xylene	--	--	2.0 U	--	--	**40**	--	--	--	--	**640 D**
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	10 U	2.0 U	3.0 UJ	6.7 UJ	13 U	--	2,000 U	170 U	130 U(b)	4.0 U
O-Xylene	--	--	1.0 U	--	--	**11**	--	--	--	--	**120 D**
Styrene	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U

See notes pages.

TABLE J-1C

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	P-12A	P-12A	P-12A	P-12A	P-14	P-14	P-101A	P-101A	P-101A	P-101A	P-101A
Sample Date	11/29/1994	3/22/1995	11/22/1996	8/13/1991	8/15/1991	12/18/1996	12/4/1992	12/8/1992	12/3/1994	3/27/1995	12/10/1996
Sample Type	S	S	S	D	S	S	S	S	S	S	S
Tetrachloroethene	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U
Tetrahydrofuran	25 U	25 U	10 U	--	--	**530**	--	--	**3,200**	**1,500**	**1,400 D**
Toluene	5.0 U	5.0 U	1.0 U	1.0 UJ	8.0 UJ	**35**	--	**5,000**	**370**	63 U	33 U
trans-1,2-Dichloroethene	--	--	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	--	--	--	1.0 U
trans-1,3-Dichloropropene	5.0 U	5.0 U	1.0 U	1.0 UJ	2.5 UJ	7.0 U	--	2,000 U	83 U	63 U	1.0 U
Trichloroethene	5.0 U	5.0 U	2.0 U	**1.0 J**	**0.70 J**	**11**	--	2,000 U	83 U	63 U	1.0 U
Vinyl chloride	10 U	10 U	1.0 U	2.0 UJ	2.5 UJ	7.0 U	--	2,000 U	170 U	**57 J**	**4.0**
Xylenes, Total	5.0 U	5.0 U	2.0 U	1.0 UJ	**44 J**	**52**	--	**1,800 J**	**510**	**170**	**810 D**
Isopropanol	--	--	1,000 U	--	--	1,000 U	--	--	--	--	1,000 U
Methanol	--	--	1,000 U	--	--	1,000 U	--	--	--	--	1,000 U
Sec-Butanol	--	--	1,000 U	--	--	1,000 U	--	--	--	--	1,000 U
1,2,4-Trichlorobenzene	--	--	--	2.0 UJ	2.5 UJ	--	--	50 U	--	--	--
2,4-Dimethylphenol	--	--	--	--	10 U	--	--	**39 J**	--	--	--
2-Methylnaphthalene	--	--	--	--	10 U	--	--	50 U	--	--	--
2-Methylphenol	--	--	--	--	10 U	--	--	**25 J**	--	--	--
4,6-Dinitro-2-methylphenol	--	--	--	--	25 U	--	--	130 U	--	--	--
4-Methylphenol	--	--	--	--	10 U	--	--	**380**	--	--	--
Di-n-butyl phthalate	--	--	--	--	10 U	--	--	50 U	--	--	--
Di-n-octyl phthalate	--	--	--	--	10 U	--	--	50 U	--	--	--
Diethyl phthalate	--	--	--	--	10 U	--	--	50 U	--	--	--
Isophorone	--	--	--	--	10 U	--	--	50 U	--	--	--
Naphthalene	--	--	--	1.0 UJ	**1.4 J**	--	--	50 U	--	--	--
Phenol	--	--	--	--	10 U	--	--	50 U	--	--	--
1,1,1,2-Tetrachloroethane	--	--	--	1.0 UJ	2.5 UJ	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	1.0 U	--	1.0 U	--	--	--	--
4,4'-DDD	--	--	--	--	0.10 U	--	0.10 U	--	--	--	--
Aldrin	--	--	--	--	0.1 U	--	0.1 U	--	--	--	--
gamma-BHC (Lindane)	--	--	--	--	0.1 U	--	0.1 U	--	--	--	--

See notes pages.

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-102A**	**P-102A**	**P-102A**	**P-102A**	**PZR-7**	**WE-1**	**WE-1**	**WE-1**	**WE-1**	**WE-1**	**WE-3**
Sample Date	**12/9/1992**	**12/2/1994**	**3/28/1995**	**12/4/1996**	**12/12/1996**	**6/26/1990**	**11/29/1994**	**3/22/1995**	**12/2/1996**	**11/29/1994**	**6/28/1990**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**
1,1,1-Trichloroethane	**4.0 J**	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	**91**
1,1,2-Trichloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
1,1-Dichloroethane	**12**	5.0 U	**2.7 J**	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	**46**
1,1-Dichloroethene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	**17**
1,2-Dichlorobenzene	10 U	--	--	1.0 U	1.0 U	10 U	--	--	1.0 U	--	10 U
1,2-Dichloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
1,2-Dichloroethene, Total	**180**	**9.0**	**42**	**14**	2.0 U	--	**15**	**45**	2.0 U	**12**	--
1,2-Dichloropropane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
1,3-Dichlorobenzene	10 U	--	--	1.0 U	1.0 U	10 U	--	--	1.0 U	--	10 U
1,4-Dichlorobenzene	10 U	--	--	1.0 U	1.0 U	10 U	--	--	1.0 U	--	10 U
2-Butanone	10 U	25 U	25 U	5.0 U	5.0 U	10 U	25 U	25 U	28 U	25 U	10 U
2-Hexanone	10 U	25 U	25 U	5.0 U	5.0 U	10 U	25 U	25 U	5.0 U	25 U	10 U
4-Methyl-2-pentanone	**6.0 J**	25 U	25 U	5.0 U	5.0 U	10 U	25 U	25 U	5.0 U	25 U	10 U
Acetone	**10**	25 U	25 U	5.0 U	5.0 U	10 U	25 U	25 U	10 U	25 U	10 U
Benzene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
Bromomethane	10 U	10 U	10 U	1.0 U	1.0 U	10 U	10 U	10 U	1.0 U	10 U	10 U
Carbon disulfide	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
Carbon tetrachloride	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
Chlorobenzene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
Chloroethane	10 U	5.0 U	5.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	5.0 U	10 U
Chloroform	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
Chloromethane	10 U	10 U	10 U	1.0 U	1.0 U	10 U	10 U	10 U	1.0 U	10 U	10 U
cis-1,2-Dichloroethene	--	--	--	**14**	1.0 U	--	--	--	1.0 U	--	--
Ethylene	--	--	--	--	--	--	--	--	--	--	--
Ethane	--	--	--	--	--	--	--	--	--	--	--
Ethylbenzene	**26**	**7.0**	**8.0**	**2.0**	1.0 U	**1.0 J**	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
M,P-Xylene	--	--	--	2.0 U	2.0 U	--	--	--	2.0 U	--	--
Methane	--	--	--	--	--	--	--	--	--	--	--
Methylene chloride	10 U	10 U	10 U(b)	2.0 U	2.0 U	5.0 U	10 U	10 U	2.0 U	10 U	5.0 U
O-Xylene	--	--	--	1.0 U	1.0 U	--	--	--	1.0 U	--	--
Styrene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U

See notes pages.

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-102A**	**P-102A**	**P-102A**	**P-102A**	**PZR-7**	**WE-1**	**WE-1**	**WE-1**	**WE-1**	**WE-1**	**WE-3**
Sample Date	**12/9/1992**	**12/2/1994**	**3/28/1995**	**12/4/1996**	**12/12/1996**	**6/26/1990**	**11/29/1994**	**3/22/1995**	**12/2/1996**	**11/29/1994**	**6/28/1990**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**
Tetrachloroethene	10 U	5.0 U	5.0 U	**1.0**	1.0 U	**1.0 J**	5.0 U	5.0 U	1.0 U	5.0 U	**1.0 J**
Tetrahydrofuran	--	**12 J**	**20 J**	10 U	10 U	--	25 U	25 U	10 U	25 U	--
Toluene	**12**	5.0 U	**7.0**	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
trans-1,2-Dichloroethene	--	--	--	1.0 U	1.0 U	**42**	--	--	1.0 U	--	28 U
trans-1,3-Dichloropropene	10 U	5.0 U	5.0 U	1.0 U	1.0 U	5.0 U	5.0 U	5.0 U	1.0 U	5.0 U	5.0 U
Trichloroethene	**24**	**12**	**17**	**16 D**	1.0 U	**9.0**	5.0 U	5.0 U	1.0 U	5.0 U	**4.0 J**
Vinyl chloride	**190**	10 U	**19**	**16**	1.0 U	10 U	10 U	10 U	1.0 U	10 U	10 U
Xylenes, Total	**26**	5.0 U	5.0 U	2.0 U	2.0 U	5.0 U	5.0 U	5.0 U	2.0 U	5.0 U	5.0 U
Isopropanol	--	--	--	1,000 U	1,000 U	--	--	--	1,000 U	--	--
Methanol	--	--	--	1,000 U	1,000 U	--	--	--	1,000 U	--	--
Sec-Butanol	--	--	--	1,000 U	1,000 U	--	--	--	1,000 U	--	--
1,2,4-Trichlorobenzene	10 U	--	--	--	--	10 U	--	--	--	--	10 U
2,4-Dimethylphenol	10 U	--	--	--	--	10 U	--	--	--	--	10 U
2-Methylnaphthalene	10 U	--	--	--	--	10 U	--	--	--	--	10 U
2-Methylphenol	10 U	--	--	--	--	10 U	--	--	--	--	10 U
4,6-Dinitro-2-methylphenol	25 U	--	--	--	--	50 U	--	--	--	--	50 U
4-Methylphenol	10 U	--	--	--	--	10 U	--	--	--	--	10 U
Di-n-butyl phthalate	10 U	--	--	--	--	10 U	--	--	--	--	10 U
Di-n-octyl phthalate	10 U	--	--	--	--	10 U	--	--	--	--	10 U
Diethyl phthalate	10 U	--	--	--	--	10 U	--	--	--	--	10 U
Isophorone	10 U	--	--	--	--	10 U	--	--	--	--	10 U
Naphthalene	10 U	--	--	--	--	10 U	--	--	--	--	10 U
Phenol	10 U	--	--	--	--	10 U	--	--	--	--	10 U
1,1,1,2-Tetrachloroethane	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	1.0 U	--	--	--	--	1.0 U	--	--	--	--	1.0 U
4,4'-DDD	0.10 U	--	--	--	--	0.10 U	--	--	--	--	0.10 U
Aldrin	0.1 U	--	--	--	--	0.1 U	--	--	--	--	0.1 U
gamma-BHC (Lindane)	0.1 U	--	--	--	--	0.1 U	--	--	--	--	0.1 U

See notes pages.

TABLE J-1D

INORGANIC CONSTITUENTS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-05**	**MW-05**	**MW-121A**	**MW-121A**	**MW-121C**	**MW-121C**	**MW-123A**	**MW-124C**	**MW-125A**	**MW-125A**
Sample Date	**6/28/1990**	**8/28/1991**	**8/29/1991**	**12/10/1992**	**8/13/1991**	**12/9/1992**	**8/14/1991**	**8/27/1991**	**8/27/1991**	**12/4/1992**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	--	--	--	--	--	--	--	--	--	--
Nitrate	--	--	--	--	--	--	--	--	--	--
Sulfate	--	--	--	--	--	--	--	--	--	--
Aluminum	**33,000**	**9,800 J**	**9,000 J**	**77,100**	**23,000**	**77,200**	**1,700**	**300**	**2,200**	**1,640 J**
Antimony	55 U	17 UJ	12 UJ	14.8 U	**61**	14.8 U	12 UJ	14 UJ	14 UJ	16.9 U
Arsenic	**8.1**	**4.0**	**3.0 J**	**19.6**	**4.0 J**	11.4 U	**3.0 J**	**2.0 J**	--	**3.2 J**
Barium	**1,900**	**1,700**	**180**	**1,090**	**2,300**	**3,270**	**81**	**28**	**68**	**68.9**
Beryllium	--	--	**1.1 J**	**8.7**	**2.7 J**	**5.8**	--	--	--	0.40 U
Cadmium	--	--	--	6.0 U	3.5 UJ	1.5 U	2.0 UJ	--	--	2.2 UJ
Calcium	**180,000**	**140,000**	**140,000**	**259,000**	**210,000**	**273,000**	**21,000**	**52,000**	**25,000**	**33,900**
Chromium	**61**	17 U	17 U	**133**	**59**	**130**	27 U	17 U	**56**	**9.4 J**
Cobalt	37 U	**12**	**4.1 J**	**19.8**	**19**	**45**	--	--	**3.0 J**	2.7 U
Copper	**120**	**33**	**14**	**81.1**	73 U	**221**	15 U	**5.1**	**8.1**	8.2 UJ
Iron	**47,000**	**17,000 J**	**9,900 J**	**81,200**	**45,000**	**121,000**	**2,600**	660 U	**4,000**	**3,640**
Lead	**37 J**	**9.3 J**	**12 J**	**117 J**	**10 J**	**37.4 J**	1.9 UJ	--	**8.9**	7.7 UJ
Magnesium	**41,000**	**28,000**	**4,600**	**18,900**	**24,000**	**46,300**	**940**	**390**	**840**	**1,240**
Manganese	**5,200**	**4,300**	**440**	**1,670**	**8,000 J**	**10,700**	**84 J**	**28**	**170**	**658**
Mercury	--	**0.30 J**	--	**1.1**	--	0.10 U	--	--	--	0.10 U
Nickel	**52**	17 U	13 U	**83.3**	**50**	**136**	14 U	10 U	**35**	**10.2 J**
Potassium	**11,000**	**4,600**	3,200 U	**12,900**	**8,900**	**22,200**	**1,100**	1,100 U	1,600 U	**1,560**
Selenium	--	--	1.0 UJ	18 UJ	--	18 UJ	**5.0 J**	2.0 UJ	2.0 UJ	R
Silver	**12**	--	--	3.6 UJ	5.1 UJ	4.6 UJ	2.6 UJ	--	--	2.9 UJ
Sodium	**18,000**	**15,000**	**73,000**	**82,100**	**60,000**	**66,900**	**37,000**	**24,000**	**38,000**	**33,300**
Sulfide (S)	--	--	--	--	--	--	--	--	--	--
Thallium	3.4 U	--	--	3.8 UJ	--	3.8 UJ	--	--	--	3.8 UJ
Vanadium	**100**	**28**	13 U	**85.7**	**71**	**176**	**39**	**20 J**	10 UJ	7.0 U
Zinc	**250 J**	**70**	**110**	**776 J**	**100**	**241 J**	26 UJ	10 UJ	39 UJ	18.4 UJ

See notes pages.

TABLE J-1D

DRAFT

INORGANIC CONSTITUENTS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-125C**	**MW-125C**	**MW-126C**	**MW-127C**	**MW-127C**	**MW-128**	**MW-204A**	**MW-205A**	**MW-414**	**MW-703DR**
Sample Date	**8/27/1991**	**12/4/1992**	**8/27/1991**	**8/13/1991**	**12/2/1992**	**8/29/1991**	**12/1/1992**	**12/2/1992**	**12/10/1996**	**12/9/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	--	--	--	--	--	--	--	--	**32,200**	**41,000**
Nitrate	--	--	--	--	--	--	--	--	200 U	**1,520**
Sulfate	--	--	--	--	--	--	--	--	**26,500**	**917,000**
Aluminum	**4,600**	**790 J**	**12,000 J**	**23,000**	**1,140**	**390 J**	**53,000**	**512**	--	--
Antimony	--	16.9 U	12 UJ	39 U	16.9 U	--	14.8 UJ	14.8 UJ	--	--
Arsenic	--	**8.0 J**	**3.0 J**	**3.0 J**	1.9 UJ	--	8.3 UJ	R	--	--
Barium	**240 J**	**420**	**670**	**250**	**99.8**	**24 J**	**952 J**	**164 J**	--	--
Beryllium	--	0.40 U	**2.0 J**	**2.5 J**	0.40 U	--	**5.4**	0.30 U	--	--
Cadmium	--	1.6 UJ	--	2.7 UJ	1.2 UJ	--	1.5 U	1.7 UJ	--	--
Calcium	**170,000**	**171,000**	**53,000**	**89,000**	**48,100**	**410,000**	**136,000**	**31,200**	--	--
Chromium	9.4 U	**10.1 J**	21 U	**49**	4.5 UJ	--	**79.3 J**	**4.2 J**	--	--
Cobalt	--	2.7 U	**24**	**19**	2.7 U	--	**38.7**	1.3 U	--	--
Copper	--	7.8 UJ	**44**	33 U	3.5 UJ	--	**115**	**433**	--	--
Iron	**5,900**	**1,390**	**17,000 J**	**25,000**	**3,060 J**	**740 J**	**71,500**	**696**	**2,100**	**2,280**
Lead	**6.1**	13.7 U	**12 J**	**11 J**	4.0 U	--	**25.6**	**38.4**	--	--
Magnesium	**4,700**	**3,240**	**9,000**	**12,000**	**2,300**	**1,800**	**32,200**	**3,770**	--	--
Manganese	**310**	**249**	**590**	**1,100 J**	**369**	**83**	**2,690**	**299**	**202**	**150**
Mercury	--	0.10 U	--	--	0.10 U	--	0.10 U	0.10 U	--	--
Nickel	5.0 UJ	**11**	15 U	**32**	5.4 U	--	**80.9**	**7.9**	--	--
Potassium	2,900 U	**1,740**	**5,500**	**7,800**	**1,260**	1,900 U	**17,300**	**925**	--	--
Selenium	--	R	--	--	**3.2**	--	R	R	--	--
Silver	--	2.5 UJ	--	4.4 UJ	2.5 UJ	--	3.6 UJ	3.6 UJ	--	--
Sodium	**40,000 J**	**39,200**	**20,000**	**26,000**	**18,300**	**87,000 J**	**13,800**	**18,600**	--	--
Sulfide (S)	--	--	--	--	--	--	--	--	**1,820**	**2,930**
Thallium	--	3.8 U	--	--	**3.8**	--	1.3 U	1.3 UJ	--	--
Vanadium	**20 J**	4.7 UJ	**37**	**59**	5.7 U	7.3 U	**174**	**3.0**	--	--
Zinc	30 UJ	29.9 UJ	**54 J**	**92**	**46 J**	13 UJ	**217 J**	**88 J**	--	--

See notes pages.

TABLE J-1D

INORGANIC CONSTITUENTS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**MW-704DR**	**MW-704R**	**P-1A**	**P-1A**	**P-1A**	**P-2A**	**P-3A**	**P-4A**	**P-4A**	**P-6**
Sample Date	**12/17/1996**	**12/17/1996**	**8/15/1991**	**12/3/1992**	**12/18/1996**	**8/16/1991**	**8/29/1991**	**8/27/1991**	**12/3/1992**	**12/10/1996**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	303,000 U	159,000 U	--	--	17,400 U	--	--	--	--	**228,000**
Nitrate	200 U	200 U	--	--	530 U	--	--	--	--	200 U
Sulfate	222,000 U	47,400 U	--	--	12,400 U	--	--	--	--	**91,700**
Aluminum	--	--	**71,000**	**16,600 J**	--	**74,000 J**	**190 J**	**9,500**	**13,000 J**	--
Antimony	--	--	--	16.9 U	--	13 UJ	15 UJ	12 UJ	16.9 U	--
Arsenic	--	--	**8.0 J**	**7.8 J**	--	**9.0**	**3.0 J**	**4.0 J**	2.2 U	--
Barium	--	--	**2,700 J**	**1,280**	--	**2,400 J**	**3,100 J**	**780**	**554**	--
Beryllium	--	--	**8.5 J**	**2.6**	--	**8.2 J**	--	**1.9 J**	0.40 U	--
Cadmium	--	--	--	1.4 UJ	--	**6.5**	--	--	3.6 UJ	--
Calcium	--	--	**140,000**	**42,700**	--	**82,000**	**310,000**	**44,000**	**32,400**	--
Chromium	--	--	**180**	**46.6 J**	--	**160 J**	5.2 UJ	22 U	**9.6 J**	--
Cobalt	--	--	**44 J**	**30.7**	--	**390 J**	--	**10**	8.9 U	--
Copper	--	--	**1,500 J**	**695**	--	**1,600 J**	--	**57**	28 UJ	--
Iron	**185**	**4,740**	**90,000**	**30,500**	**670**	**140,000 J**	**21,000 J**	**13,000**	**11,100**	**4,520**
Lead	--	--	**50 J**	**25.5 J**	--	**52 J**	--	**14**	**15.7 J**	--
Magnesium	--	--	**33,000**	**8,410**	--	**31,000 J**	**22,000**	**5,700**	**6,670**	--
Manganese	**105**	**1,640**	**4,000 J**	**14,500**	**912**	**3,100 J**	**22,000**	**1,800**	**2,040**	**1,460**
Mercury	--	--	--	0.10 U	--	--	--	--	0.10 U	--
Nickel	--	--	**100 J**	**39.6**	--	**150 J**	8.2 U	17 U	**10.2 J**	--
Potassium	--	--	**20,000 J**	**4,810**	--	**17,000 J**	2,400 U	3,200 U	**3,680**	--
Selenium	--	--	--	R	--	1.0 UJ	1.0 UJ	--	R	--
Silver	--	--	6.6 UJ	2.5 UJ	--	--	--	--	2.5 UJ	--
Sodium	--	--	**13,000 J**	**8,260**	--	**9,000 J**	**100,000 J**	**6,900**	**6,450**	--
Sulfide (S)	680 U	680 U	--	--	2,400 U	--	--	--	--	**1,630**
Thallium	--	--	--	3.8 U	--	--	--	--	3.8 U	--
Vanadium	--	--	**150 J**	**78.9**	--	**190 J**	--	**33 J**	**27.4**	--
Zinc	--	--	**890**	**87.1 J**	--	**590 J**	14 UJ	45 UJ	**110 J**	--

See notes pages.

TABLE J-1D

INORGANIC CONSTITUENTS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Location ID	**P-8A**	**P-8A**	**P-11A**	**P-12A**	**P-14**	**P-101A**	**P-102A**	**WE-1**	**WE-3**
Sample Date	**8/27/1991**	**12/10/1996**	**8/26/1991**	**8/13/1991**	**8/15/1991**	**12/8/1992**	**12/9/1992**	**6/26/1990**	**6/28/1990**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Chloride	--	**9,390**	--	--	--	--	--	--	--
Nitrate	--	**1,800**	--	--	--	--	--	--	--
Sulfate	--	**2,320,000**	--	--	--	--	--	--	--
Aluminum	**910**	--	**430,000**	**100,000**	**620**	**1,840**	**10,100**	**65,000 J**	**730**
Antimony	--	--	32 U	--	--	16.9 U	16.9 U	37 U	--
Arsenic	--	--	**49**	**8.0 J**	--	2.9 UJ	2.9 UJ	**22 J**	--
Barium	**110**	--	**12,000 J**	**2,900 J**	**600**	**1,380**	**66.5**	**2,300**	**380**
Beryllium	--	--	**52**	**16**	--	0.40 U	0.40 U	**14**	--
Cadmium	--	--	**20**	--	--	1.0 UJ	1.0 UJ	--	--
Calcium	**59,000**	--	**990,000**	**180,000**	**98,000**	**178,000**	**101,000**	**51,000**	**42,000**
Chromium	25 U	--	**760**	**150**	4.8 UJ	4.5 UJ	**64.2**	**120 J**	**7.3**
Cobalt	--	--	**320 J**	**62 J**	--	2.7 U	6.2 U	**57**	--
Copper	**5.6**	--	**1,100 J**	**160 J**	**3.7 J**	3.5 U	**74.6**	**140**	**43**
Iron	**1,900**	**6,990**	**690,000**	**110,000**	**1,700**	**9,910**	**11,400**	**260,000**	1,700 U
Lead	**5.3**	--	**150**	**55 J**	**1.0 J**	9.0 U	**22.2**	**190**	--
Magnesium	**1,500**	--	**260,000**	**49,000**	**12,000**	**18,600**	**6,080**	**29,000**	**1,900**
Manganese	**46**	**291**	**27,000**	**43,000 J**	**1,700**	**2,910**	**222**	**2,400**	**430**
Mercury	--	--	--	--	--	**0.12 J**	0.10 U	--	--
Nickel	9.4 U	--	**790 J**	**130 J**	--	5.4 U	**38.4**	**92**	--
Potassium	1,300 U	--	**120,000 J**	**25,000 J**	2,400 U	**2,950**	**4,410**	**17,000**	1,400 U
Selenium	1.0 UJ	--	--	--	--	3.8 UJ	3.8 UJ	--	--
Silver	--	--	--	6.8 UJ	--	2.5 UJ	2.5 UJ	**27**	--
Sodium	**6,300**	--	**66,000 J**	**25,000 J**	**60,000**	**73,900**	**62,300**	**7,900**	**6,200**
Sulfide (S)	--	**2,110**	--	--	--	--	--	--	--
Thallium	--	--	--	--	--	3.8 UJ	3.8 UJ	--	--
Vanadium	8.8 UJ	--	**1,300 J**	**210 J**	5.8 UJ	6.5 U	**48.5**	**150**	11 U
Zinc	18 UJ	--	**1,700**	**440**	16 UJ	18.3 U	**66.6**	**370**	31 U

See notes pages.

TABLE J-1E

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
QUEEN STREET PLUME

Location ID	**MW-710S**
Sample Date	**6/13/1997**
Sample Type	**S**
Methylene chloride	**1.0 JB**

See notes pages.

TABLE J-1F

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
QUEEN STREET PLUME

Location ID	**MW-710DR**	**MW-710R**	**MW-710R**
Sample Date	**6/13/1997**	**6/13/1997**	**6/13/1997**
Sample Type	**S**	**S**	**D**
1,1,1-Trichloroethane	1.0 U	**1.0**	**2.0**
1,2-Dichloroethene, Total	**6.0**	**15**	**15**
Acetone	**17**	5.0 U	**4.0 J**
Chloroform	**1.0**	1.0 U	1.0 U
cis-1,2-Dichloroethene	**6.0**	**14**	**15**
Methylene chloride	**1.0 JB**	2.0 U	**1.0 JB**
Trichloroethene	**6.0**	**15**	**15**

See notes pages.

TABLE J-1G

ORGANIC COMPOUNDS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
UPGRADIENT AREA

Location ID	**MW-209B**	**TW-12**	**TW-12**	**TW-12**
Sample Date	**12/4/1996**	**6/27/1990**	**8/14/1991**	**12/3/1996**
Sample Type	**S**	**S**	**S**	**S**
Trichloroethene	**2.0**	5.0 U	1.0 UJ	1.0 U

TABLE J-1H

INORGANIC CONSTITUENTS DETECTED IN OVERBURDEN GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
UPGRADIENT AREA

Location ID **Sample Date** **Sample Type**	**TW-12** **6/27/1990** **S**	**TW-12** **8/14/1991** **S**
Aluminum	**96,000 J**	**75,000**
Arsenic	**35 J**	**3.0 J**
Barium	**1,200**	**710 J**
Beryllium	**7.9 J**	**5.9 J**
Calcium	**34,000 J**	**22,000**
Chromium	**140 J**	**140**
Cobalt	**150**	**95 J**
Copper	**170**	**120 J**
Iron	**140,000 J**	**120,000**
Lead	**24**	**19 J**
Magnesium	**56,000 J**	**42,000**
Manganese	**5,700 J**	**3,400 J**
Nickel	**160 J**	**130 J**
Potassium	**25,000 J**	**22,000 J**
Silver	**27 J**	5.6 UJ
Sodium	**6,400**	**5,600 J**
Vanadium	**360 J**	**230 J**
Zinc	**500 J**	**340**

See notes pages.

TABLE J-1I

ORGANIC COMPOUNDS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
UPGRADIENT AREA

Location ID	**MW-129**	**MW-129**	**MW-209A**	**MW-209A**	**MW-209A**	**MW-209A**	**MW-209A**	**MW-701DR**	**TW-09**	**TW-10**	**TW-10**
Sample Date	**8/28/1991**	**12/19/1996**	**12/4/1992**	**12/1/1994**	**3/29/1995**	**12/4/1996**	**2/7/1997**	**12/4/1996**	**6/27/1990**	**6/27/1990**	**8/28/1991**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	1.0 UJ	330 U	10 U	5.0 U	5.0 U	25 U	1.0 U	1.0 U	**13**	**12**	10 UJ
1,2-Dichloroethene, Total	--	**370 J**	10 U	5.0 U	5.0 U	50 U	2.0 U	2.0 U	--	--	--
Carbon disulfide	R	330 U	**4.0 J**	5.0 U	5.0 U	**28**	1.0 U	1.0 U	5.0 U	5.0 U	R
Chloroform	1.0 UJ	330 U	10 U	5.0 U	5.0 U	25 U	**1**	1.0 U	5.0 U	5.0 U	10 UJ
cis-1,2-Dichloroethene	1.0 UJ	**350**	--	--	--	25 U	1.0 U	1.0 U	--	--	10 UJ
Ethylbenzene	1.0 UJ	330 U	10 U	5.0 U	5.0 U	25 U	1.0 U	1.0 U	5.0 U	23 U	**192 J**
Toluene	1.0 UJ	**950**	10 U	5.0 U	5.0 U	25 U	1.0 U	1.0 U	5.0 U	5.0 U	17 UJ
Trichloroethene	1.0 UJ	330 U	10 U	5.0 U	5.0 U	25 U	1.0 U	1.0 U	**3.0 J**	5.0 U	10 UJ

See notes pages.

TABLE J-1J

INORGANIC CONSTITUENTS DETECTED IN BEDROCK GROUNDWATER

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
UPGRADIENT AREA

Location ID	MW-129	MW-209A	TW-09	TW-10	TW-10
Sample Date	8/28/1991	12/1/1992	6/27/1990	6/27/1990	8/28/1991
Sample Type	S	S	S	S	S
Aluminum	**25 J**	**1,870**	**86,000 J**	**26,000 J**	**58,000 J**
Arsenic	--	R	8.0 U	8.2 U	**8.0**
Barium	**880**	**289 J**	**2,100**	**860**	**1,500**
Beryllium	--	0.45 UJ	**8.7 J**	--	**7.3 J**
Calcium	**87,000**	**31,100**	**42,000 J**	**26,000 J**	**35,000**
Chromium	--	**6.6 J**	**120 J**	**33 J**	**73**
Cobalt	--	1.8 UJ	**80**	**22**	**40**
Copper	--	9.5 UJ	**160**	**83**	**140**
Iron	**36 J**	**3,310**	**120,000 J**	**24,000 J**	**47,000 J**
Lead	--	7.5 U	**20**	**39**	**68 J**
Magnesium	**3,600**	**3,250**	**43,000 J**	**11,000 J**	**22,000**
Manganese	**2.9**	**62.7**	**8,900 J**	**3,700 J**	**5,400**
Nickel	--	**3.5**	**150 J**	**38 J**	**67**
Potassium	1,100 U	**1,120**	**25,000 J**	**5,200 J**	**12,000**
Silver	--	3.6 UJ	**21 J**	--	--
Sodium	**9,600**	**7,650**	**5,600**	**6,300**	**6,500**
Vanadium	3.7 UJ	**5.0**	**300 J**	**69 J**	**120**
Zinc	9.2 UJ	**85 J**	**370 J**	110 U	**170**

TABLE J-1K

ORGANIC COMPOUNDS DETECTED IN SURFACE SOILS

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
NORTH CIANCI PROPERTY

Location ID	**SB-917**	**SB-918**	**SB-919**	**SB-919**	**SB-920**	**SB-921**	**SB-922**	**SB-923**	**SB-924**	**SB-925**	**SB-926**	**SB-927**	**SB-928**	**SS3-A1**
Sample Depth	**(0.0 - 1.7')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 1.5')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 1.4')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 0.5')**
Sample Date	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**12/9/1991**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
2-Butanone	**0.0034 J**	**0.0039 J**	**0.0064 J**	**0.0066 J**	**0.0071 J**	**0.0055 J**	0.011 U	0.01 U	**0.0057 J**	0.01 U	**0.0039 J**	**0.011**	**0.01 J**	0.011 U
Acetone	**0.027**	**0.025**	**0.044**	**0.048**	**0.044**	**0.045**	**0.066**	**0.045**	**0.068**	**0.057**	**0.025**	**0.11**	**0.1**	0.042 UJ
cis-1,2-Dichloroethene	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0052 U	0.0056 U	0.0052 U	0.0055 U	0.005 U	0.0058 U	**0.0041 J**	0.0051 U	--
Toluene	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0052 U	0.0056 U	0.0052 U	0.0055 U	0.005 U	0.0058 U	**0.0025 J**	**0.0015 J**	0.011 U
Trichloroethene	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0052 U	0.0056 U	0.0052 U	0.0055 U	0.005 U	0.0058 U	**0.0023 J**	0.0051 U	0.011 U
Acenaphthylene	0.37 U	0.37 U	0.36 U	0.36 U	0.37 U	**0.046 J**	0.38 U	0.38 U	0.37 U	0.37 U	0.41 U	0.38 U	0.39 U	0.34 U
Anthracene	0.37 U	0.37 U	0.36 U	0.36 U	0.37 U	**0.079 J**	0.38 U	0.38 U	0.37 U	0.37 U	0.41 U	0.38 U	0.39 U	0.34 U
Benzo(a)anthracene	0.37 U	0.37 U	0.36 U	**0.039 J**	0.37 U	**0.220 J**	**0.048 J**	**0.043 J**	0.37 U	0.37 U	**0.096 J**	0.38 U	**0.065 J**	0.34 U
Benzo(a)pyrene	0.37 U	0.37 U	0.36 U	**0.065 J**	0.37 U	**0.260 J**	0.38 U	0.38 U	0.37 U	0.37 U	**0.130 J**	0.38 U	**0.073 J**	0.34 U
Benzo(b)fluoranthene	0.37 U	0.37 U	0.36 U	**0.066 J**	0.37 U	**0.250 J**	**0.068 J**	**0.055 J**	0.37 U	0.37 U	**0.110 J**	0.38 U	**0.085 J**	**0.058 J**
Benzo(g,h,i)perylene	0.37 U	0.37 U	0.36 U	0.36 U	0.37 U	**0.170 J**	0.38 U	0.38 U	0.37 U	0.37 U	**0.069 J**	0.38 U	**0.052 J**	0.34 U
Benzo(k)fluoranthene	0.37 U	0.37 U	0.36 U	**0.05 J**	0.37 U	**0.270 J**	**0.081 J**	**0.072 J**	0.37 U	0.37 U	**0.150 J**	0.38 U	**0.058 J**	**0.058 J**
bis(2-Ethylhexyl)phthalate	**0.120 JB**	**0.190 JB**	**0.140 JB**	**0.170 JB**	**0.130 JB**	**0.160 JB**	**0.160 JB**	**0.180 JB**	0.37 U	**0.130 JB**	**0.230 JB**	**0.140 JB**	**0.150 JB**	0.34 U
Chrysene	0.37 U	0.37 U	0.36 U	**0.047 J**	0.37 U	**0.240 J**	**0.069 J**	**0.055 J**	0.37 U	0.37 U	**0.130 J**	0.38 U	**0.074 J**	0.34 U
Di-n-butyl phthalate	0.37 U	0.37 U	0.36 U	0.36 U	0.37 U	0.36 U	0.38 U	**0.038 J**	0.37 U	0.37 U	**0.052 J**	0.38 U	0.39 U	0.34 U
Fluoranthene	0.37 U	0.37 U	0.36 U	**0.077 J**	0.37 U	**0.46**	**0.083 J**	**0.086 J**	0.37 U	0.37 U	**0.150 J**	**0.062 J**	**0.110 J**	0.34 U
Fluorene	0.37 U	0.37 U	0.36 U	0.36 U	0.37 U	**0.042 J**	0.38 U	0.38 U	0.37 U	0.37 U	0.41 U	0.38 U	0.39 U	0.34 U
Indeno(1,2,3-cd)pyrene	0.37 U	0.37 U	0.36 U	0.36 U	0.37 U	**0.150 J**	0.38 U	0.38 U	0.37 U	0.37 U	**0.063 J**	0.38 U	**0.046 J**	0.34 U
Phenanthrene	0.37 U	0.37 U	0.36 U	0.36 U	0.37 U	**0.41**	**0.061 J**	**0.053 J**	0.37 U	0.37 U	**0.075 J**	0.38 U	**0.087 J**	0.34 U
Pyrene	0.37 U	0.37 U	0.36 U	**0.120 J**	0.37 U	**0.67**	**0.180 J**	**0.130 J**	0.37 U	0.37 U	**0.240 J**	**0.08 J**	**0.210 J**	0.34 U
Aroclor-1254	0.018 U	0.019 U	0.018 U	0.018 U	0.018 U	**0.12**	0.019 U	0.019 U	0.018 U	**0.051**	0.021 U	**0.09**	0.019 U	**0.029 J**
Aroclor-1260	0.018 U	0.019 U	0.018 U	0.018 U	0.018 U	**0.092**	0.019 U	0.019 U	0.018 U	**0.041**	0.021 U	**0.11**	0.019 U	0.035 UJ
PCBs, Total	ND	ND	ND	ND	ND	**0.212**	ND	ND	ND	**0.092**	ND	**0.2**	ND	**0.029**

See notes pages.

TABLE J-1L

INORGANIC CONSTITUENTS DETECTED IN SURFACE SOILS

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
NORTH CIANCI PROPERTY

Location ID	SB-917	SB-918	SB-919	SB-919	SB-920	SB-921	SB-922	SB-923	SB-924	SB-925	SB-926	SB-927	SB-928	SS3-A1
Sample Depth	**(0.0 - 1.7')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 1.5')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 1.4')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 0.5')**
Sample Date	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**12/9/1991**
Sample Type	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
Aluminum	**4,650**	**6,940**	**7,340**	**8,300**	**6,270**	**7,640**	**8,690**	**7,680**	**7,630**	**7,050**	**7,580**	**8,180**	**7,870**	**8,310**
Arsenic	**0.98 B**	**1.2**	**1.5**	**1.4**	**1.4**	**2.4**	**2**	**1.6**	**1.5**	**1.4**	**0.94 B**	**2.7**	**3.3**	**3.6**
Barium	**17.5 B**	**28.1**	**33**	**36.6**	**32.9**	**45.8**	**46.8**	**43.8**	**35.9**	**36**	**36.2**	**62.6**	**65.6**	**24.6**
Beryllium	**0.23 B**	**0.25 B**	**0.34 B**	**0.36 B**	**0.33 B**	**0.42 B**	**0.46 B**	**0.42 B**	**0.35 B**	**0.30 B**	**0.35 B**	**0.48 B**	**0.38 B**	0.21 UJ
Cadmium	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	**0.48 B**	**0.96**	0.12 U	0.63 UJ
Calcium	**318 B**	**256 B**	**771**	**1,260**	**410 B**	**1,020**	**547 B**	**657**	**522 B**	**446 B**	**447 B**	**794**	**673**	**5,970**
Chromium	**5.6**	**6.8**	**9.4**	**9.6**	**9.9**	**9.8**	**12.9**	**12**	**9.4**	**7.6**	**14.4**	**11.3**	**9**	7.7 U
Cobalt	**2.8 B**	**3.2 B**	**4.9 B**	**6**	**4.9 B**	**6.9**	**5.0 B**	**5.0 B**	**4.7 B**	**3.5 B**	**5.7 B**	**6.6**	**3.4 B**	**11.6**
Copper	**4.7**	**4.1**	**8.2**	**10**	**6.6**	**14.7**	**10**	**8.9**	**8.8**	**5.1**	**11.8**	**8.4**	**7.7**	**43.2**
Iron	**7,060**	**8,110**	**11,100**	**13,500**	**11,700**	**15,300**	**12,300**	**12,000**	**11,400**	**9,680**	**13,300**	**14,000**	**10,600**	**21,800**
Lead	**3.9 N**	**4.0 N**	**7.6 N**	**9.3 N**	**5.6 N**	**8.7 N**	**15.3 N**	**9.7 N**	**9.2 N**	**5.6 N**	**9.9 N**	**12.8 N**	**15.8 N**	**24.5 J**
Magnesium	**1,080**	**1,150**	**2,100**	**2,660**	**1,990**	**2,620**	**2,090**	**2,150**	**2,160**	**1,420**	**2,850**	**2,250**	**1,600**	**5,230**
Manganese	**71.1 N**	**65 N**	**149 N**	**213 N**	**211 N**	**294 N**	**259 N**	**256 N**	**173 N**	**169 N**	**202 N**	**698 N**	**136 N**	**296 J**
Mercury	0.057 U	0.056 U	**0.079 B**	0.055 U	0.056 U	0.055 U	**0.093 B**	**0.069 B**	**0.075 B**	**0.078 B**	**0.11 B**	0.057 U	**0.082 B**	0.09 UJ
Nickel	**4.7**	**4.9**	**8.2**	**8.9**	**8.2**	**7.8**	**9.5**	**9**	**8.2**	**6.2**	**11.7**	**8.7**	**6.4**	**7.8**
Potassium	**423 B**	**372 B**	**696**	**867**	**806**	**730**	**807**	**830**	**759**	**493 B**	**1,140**	**866**	**465 B**	**313**
Selenium	0.45 U	0.45 U	0.44 U	0.44 U	0.44 U	**0.44 B**	**0.49 B**	0.46 U	0.44 U	0.45 U	0.50 U	**0.68**	0.47 U	0.83 UJ
Sodium	52.1 U	52.3 U	50.9 U	**69 B**	51.6 U	51.5 U	53.2 U	53.7 U	51.8 U	52.4 U	**82.2 B**	52.3 U	**62.4 B**	**338**
Thallium	**1.0 B**	0.45 U	**0.67 B**	0.44 U	**0.55 B**	0.44 U	**0.73 B**	**0.54 B**	**0.47 B**	0.45 U	**0.79 B**	**1.2**	0.47 U	0.21 U
Vanadium	**10.9**	**13.2**	**18.5**	**22.5**	**20.4**	**31.4**	**23.3**	**23**	**18.6**	**16.8**	**21.8**	**26.6**	**21**	**41.5**
Zinc	**12.6**	**16.5**	**21.9**	**25.7**	**17.4**	**25.4**	**26.4**	**25.4**	**25.2**	**17.9**	**32.8**	**27.5**	**31.3**	**52.1**

See notes pages.

TABLE J-1M

ORGANIC COMPOUNDS DETECTED IN SURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
SOUTH CIANCI PROPERTY

Location ID	**SB-902**	**SB-903**	**SB-905**	**SB-906**	**SB-909**	**SB-910**	**SB-911**	**SB-912**
Sample Depth	**(0.0 - 1.5')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**
Sample Date	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**
Sample Type	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
2-Butanone	**0.021**	0.015 U	**0.0094 J**	**0.012**	**0.0079 J**	**0.017**	**0.004 J**	**0.0077 J**
Acetone	**0.24**	**0.2**	**0.12**	**0.11**	**0.09**	**0.092**	**0.07**	**0.12**
Bromomethane	0.006 U	0.0073 U	0.0056 U	**0.0011 J**	0.0048 U	0.0058 U	0.0061 U	0.0059 U
cis-1,2-Dichloroethene	0.006 U	0.0073 U	0.0056 U	**0.0021 J**	0.0048 U	0.0058 U	0.0061 U	0.0059 U
Methylene chloride	0.006 U	0.0073 U	0.0056 U	**0.0011 J**	0.0048 U	0.0058 U	0.0061 U	0.0059 U
Toluene	**0.0036 J**	0.0073 U	**0.0033 J**	**0.0024 J**	**0.001 J**	0.0058 U	0.0061 U	0.0059 U
Trichloroethene	0.006 U	0.0073 U	0.0056 U	**0.0012 J**	0.0048 U	0.0058 U	0.0061 U	0.0059 U
Acenaphthylene	0.41 U	0.41 U	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
Anthracene	0.41 U	0.41 U	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
Benzo(a)anthracene	0.41 U	**0.066 J**	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
Benzo(a)pyrene	0.41 U	**0.077 J**	0.37 U	**0.038 J**	0.35 U	0.39 U	0.44 U	0.41 U
Benzo(b)fluoranthene	0.41 U	**0.099 J**	0.37 U	**0.054 J**	0.35 U	0.39 U	0.44 U	0.41 U
Benzo(g,h,i)perylene	0.41 U	0.41 U	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
Benzo(k)fluoranthene	0.41 U	**0.056 J**	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
bis(2-Ethylhexyl)phthalate	0.41 U	0.41 U	0.37 U	**0.073 JB**	0.35 U	0.39 U	0.44 U	0.41 U
Butyl benzyl phthalate	0.41 U	0.41 U	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
Chrysene	0.41 U	**0.084 J**	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
Fluoranthene	0.41 U	**0.120 J**	0.37 U	**0.045 J**	**0.057 J**	0.39 U	0.44 U	0.41 U
Indeno(1,2,3-cd)pyrene	0.41 U	0.41 U	0.37 U	0.37 U	0.35 U	0.39 U	0.44 U	0.41 U
Pentachlorophenol	1.0 U	1.0 U	0.92 U	0.93 U	0.89 U	0.98 U	1.1 U	1.0 U
Phenanthrene	0.41 U	**0.10 J**	0.37 U	0.37 U	**0.038 J**	0.39 U	0.44 U	0.41 U
Pyrene	0.41 U	**0.230 J**	0.37 U	**0.046 J**	**0.076 J**	0.39 U	0.44 U	0.41 U
4,4'-DDD	--	--	--	--	--	--	--	--
4,4'-DDE	--	--	--	--	--	--	--	--
alpha-BHC	--	--	--	--	--	--	--	--
alpha-Chlordane	--	--	--	--	--	--	--	--
Aroclor-1254	0.021 U	**0.053**	0.018 U	0.018 U	0.018 U	0.02 U	0.022 U	0.021 U
Aroclor-1260	0.021 U	**0.026**	0.018 U	0.018 U	0.018 U	0.02 U	0.022 U	0.021 U
PCBs, Total	ND	**0.079**	ND	ND	ND	ND	ND	ND

See notes pages.

TABLE J-1M

ORGANIC COMPOUNDS DETECTED IN SURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
SOUTH CIANCI PROPERTY

Location ID	**SB-914**	**SS3-A2**	**SS3-A2**	**SS3-A3**	**SS3-A4**	**SS3-A5**	**SS3-B4**
Sample Depth	**(0.0 - 2.0')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**
Sample Date	**10/19/1999**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**
Sample Type	**S**	**S**	**D**	**S**	**S**	**S**	**S**
2-Butanone	**0.0074 J**	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.02 U
Acetone	**0.086**	0.058 UJ	0.059 UJ	0.017 UJ	0.01 UJ	0.02 UJ	0.02 UJ
Bromomethane	0.0062 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.02 U
cis-1,2-Dichloroethene	0.0062 U	--	--	--	--	--	--
Methylene chloride	0.0062 U	0.11 UJ	0.071 UJ	0.087 UJ	0.064 UJ	0.046 UJ	0.09 UJ
Toluene	**0.0014 J**	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.02 U
Trichloroethene	0.0062 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.02 U
Acenaphthylene	**0.098 J**	0.38 U	--	0.37 U	0.38 U	0.37 UJ	**0.130 J**
Anthracene	**0.110 J**	0.38 U	--	0.37 U	0.38 U	0.37 UJ	**0.076 J**
Benzo(a)anthracene	**0.240 J**	0.38 U	--	0.37 U	0.38 U	0.37 UJ	**0.490 J**
Benzo(a)pyrene	**0.230 J**	0.38 U	--	0.37 U	0.38 UJ	0.37 UJ	**0.740 J**
Benzo(b)fluoranthene	**0.400 J**	0.38 U	--	0.37 U	**0.140 J**	0.37 UJ	**1.80 J**
Benzo(g,h,i)perylene	**0.210 J**	0.38 U	--	0.37 U	0.38 UJ	0.37 UJ	0.65 UJ
Benzo(k)fluoranthene	0.45 U	0.38 U	--	0.37 U	**0.140 J**	0.37 UJ	**1.80 J**
bis(2-Ethylhexyl)phthalate	0.45 U	0.38 U	--	0.37 U	0.38 U	0.37 UJ	0.65 UJ
Butyl benzyl phthalate	0.45 U	0.37 UJ	--	0.37 U	0.38 U	0.37 UJ	**0.120 J**
Chrysene	**0.240 J**	0.38 U	--	0.37 U	0.38 U	0.37 UJ	**0.600 J**
Fluoranthene	**0.48**	0.38 U	--	0.37 U	**0.068 J**	0.37 UJ	**1.10 J**
Indeno(1,2,3-cd)pyrene	**0.160 J**	0.38 U	--	0.37 U	0.38 UJ	0.37 UJ	0.65 UJ
Pentachlorophenol	1.1 U	**0.057 J**	--	0.91 U	R	0.91 UJ	1.6 UJ
Phenanthrene	**0.6**	0.38 U	--	0.37 U	0.38 U	0.37 UJ	**0.540 J**
Pyrene	**0.74**	0.38 U	--	0.37 U	**0.048 J**	0.37 UJ	**0.800 J**
4,4'-DDD	--	0.0037 UJ	0.0038 UJ	**0.00027 J**	0.0038 UJ	**0.0014 J**	0.0064 UJ
4,4'-DDE	--	0.0037 UJ	0.0038 UJ	**0.00036 J**	0.0038 UJ	**0.00031 J**	0.0064 UJ
alpha-BHC	--	0.0019 UJ	0.0019 UJ	0.0019 UJ	0.0019 UJ	0.0019 UJ	**0.0003 J**
alpha-Chlordane	--	0.0019 UJ	0.0019 UJ	0.0019 UJ	**0.00034 J**	0.0019 UJ	0.0033 UJ
Aroclor-1254	**0.032**	**0.039 J**	**0.087 J**	0.038 UJ	0.038 UJ	0.038 UJ	**0.870 J**
Aroclor-1260	**0.034**	**0.0065 J**	**0.024 J**	0.038 UJ	**0.014 J**	0.038 UJ	**0.360 J**
PCBs, Total	**0.066**	**0.0455**	**0.111**	ND	**0.014**	ND	**1.23**

See notes pages.

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TABLE J-1N

INORGANIC CONSTITUENTS DETECTED IN SURFACE SOILS

SOLVENT RECOVERY SERVICE OF NEW ENGLAND, INC.
SOUTH CIANCI PROPERTY

Location ID	**SB-902**	**SB-903**	**SB-905**	**SB-906**	**SB-909**	**SB-910**	**SB-911**	**SB-912**	**SB-914**	**SS3-A2**	**SS3-A2**	**SS3-A3**	**SS3-A4**	**SS3-A5**	**SS3-B4**
Sample Depth	**(0.0 - 1.5')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**
Sample Date	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**
Sample Type	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**
Aluminum	**5,270**	**9,900**	**4,770**	**8,630**	**8,630**	**11,200**	**11,700**	**9,460**	**11,000**	**6,600**	**7,910**	**6,580**	**6,210**	**6,470**	**14,700**
Arsenic	**1.1 B**	**2.6**	**1.2**	**1.6**	**2.1**	**0.82 B**	**1.7**	**1.3 B**	**3.1**	**2.3**	**2.5**	**3.6**	**3**	**2.2**	**9.7 J**
Barium	**27.9**	**94.3**	**21 B**	**61.5**	**79.8**	**51.9**	**73.3**	**49.6**	**141**	**54.5**	**60.2**	**60.7**	**67.3**	**68.3**	**296**
Beryllium	**0.32 B**	**0.49 B**	**0.25 B**	**0.51 B**	**0.64**	**0.45 B**	**0.54 B**	**0.39 B**	**0.67 B**	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.23 UJ	0.40 UJ
Cadmium	0.13 U	**0.25 B**	0.11 U	0.11 U	0.11 U	0.12 U	0.14 U	0.13 U	**2.8**	**1.5**	1.0 U	0.67 UJ	0.66 UJ	0.68 UJ	**45.3**
Calcium	**718**	**735**	**463 B**	**1,200**	**1,940**	**4,620**	**1,070**	**273 B**	**4,210**	**1,230**	**1,080**	**1,330**	**1,680**	**1,510**	**4,410**
Chromium	**5.9**	**13**	**5.6**	**11**	**12.7**	**9.9**	**11**	**12.3**	**21.7**	**11.1**	**12.7**	**10**	**10.9**	8.1 U	**128**
Cobalt	**3.1 B**	**5.1 B**	**3.0 B**	**5.2 B**	**5.9**	**11.7**	**4.9 B**	**6.5 B**	**9.8**	**4.1**	**5.8**	**5.1**	**3.9**	**6**	**12.2**
Copper	**6.4**	**11**	**6.5**	**8.1**	**9.9**	**27.9**	**7**	**8.5**	**33.6**	**11.4**	**12.7**	**7.7**	**8.3**	**8.7**	**151**
Iron	**7,350**	**11,300**	**6,940**	**12,700**	**14,100**	**19,000**	**13,100**	**12,600**	**19,400**	**7,990**	**11,100**	**9,560**	**7,920**	**10,300**	**20,100**
Lead	**9.4 *N**	**16.9 *N**	**7.6 *N**	**8.2**	**9.2 *N**	**4.9 *N**	**8.8 *N**	**5.2 *N**	**55 *N**	**25.6 J**	**15.8 J**	**10.8 J**	**8.2 J**	**7.0 J**	**198 J**
Magnesium	**1,530**	**1,900**	**1,340**	**2,160**	**2,740**	**5,170**	**1,850**	**2,870**	**4,950**	**1,990**	**2,480**	**1,940**	**1,840**	**2,240**	**4,060**
Manganese	**119 *N**	**299 *N**	**81.2 *N**	**293**	**550 *N**	**462 *N**	**286 *N**	**233 *N**	**411 *N**	**318 J**	**592 J**	**323 J**	**298 J**	**513 J**	**1,060 J**
Mercury	0.064 U	0.065 U	0.056 U	0.056 U	0.056 U	0.061 U	0.067 U	0.065 U	0.068 U	**0.12 J**	0.11 UJ	0.10 UJ	0.10 UJ	0.10 UJ	**0.71**
Nickel	**7**	**8.6**	**7.4**	**7.8**	**8.6**	**14**	**22.9**	**11.7**	**20.2**	**6.2**	**7.7**	**6.1**	**6.2**	5.1 U	**67.8**
Potassium	**543 B**	**483 B**	**453 B**	**823**	**1,000**	**1,410**	**497 B**	**1,050**	**2,180**	**724**	**831**	**679**	**727**	**586**	**1,100**
Selenium	0.52 U	0.51 U	0.45 U	**0.48 B**	0.44 U	0.49 U	0.55 U	0.52 U	0.57 U	0.89 UJ	0.91 UJ	0.86 UJ	0.92 UJ	0.89 UJ	1.5 UJ
Silver	0.26 U	0.26 U	0.23 U	0.22 U	0.22 U	0.24 U	0.27 U	0.26 U	0.29 U	0.89 UJ	0.88 UJ	0.89 UJ	0.88 UJ	0.90 UJ	**16**
Sodium	60.2 U	59.7 U	52.6 U	51.3 U	**54.6 B**	**302 B**	64 U	60.8 U	66.7 U	69 U	79.3 U	74.1 U	80 U	81.2 U	**260**
Thallium	0.52 U	0.51 U	0.45 U	**0.81 B**	**0.90 B**	**0.74 B**	0.55 U	0.52 U	**1.3 B**	0.22 U	0.23 U	0.22 U	0.23 U	0.22 U	0.38 U
Vanadium	**12.5**	**24.5**	**11.8**	**23.4**	**28.1**	**38.3**	**22.8**	**21.1**	**40.9**	**18.6**	**25**	**26.4**	**22.3**	**27.4**	**58**
Zinc	**16.7**	**34.7**	**16.5**	**24.6**	**23.9**	**34.1**	**26.7**	**25.5**	**66.6**	**31.6**	**32.4**	22.4 U	19.4 U	21.2 U	**204**

See notes pages.

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	**B-1**	**B-14**	**B-14**	**B-15**	**B-17**	**B-18**	**B-477**	**B-479**	**B-480**	**B-484**
Sample Depth	**(2.0)**	**(2.0)**	**(2.0)**	**(4.0 - 6.0')**	**(1.0)**	**(1.0)**	**(0.5 - 1.0')**	**(2.0 - 3.0')**	**(3.5 - 4.0')**	**(3.5 - 4.0')**
Sample Date	**4/30/1991**	**5/2/1991**	**5/2/1991**	**5/3/1991**	**5/2/1991**	**5/2/1991**	**3/4/1994**	**3/10/1994**	**3/10/1994**	**3/10/1994**
Sample Type	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	--	--	--	0.72 U	--	--	**46 J**	86 U	**0.250 J**	**0.076 J**
1,1,2,2-Tetrachloroethane	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
1,1-Dichloroethane	--	--	--	**0.110 J**	--	--	53 U	86 U	2.1 U	0.71 U
1,1-Dichloroethene	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
1,2-Dichloroethene, Total	--	--	--	0.72 U	--	--	**10.0 J**	**12.0 J**	**1.10 J**	**0.340 J**
2-Butanone	--	--	--	**1.50 J**	--	--	53 U	86 U	2.1 U	4.0 U
4-Methyl-2-pentanone	--	--	--	1.4 U	--	--	53 U	86 U	2.1 U	**1.4**
Acrolein	--	--	--	--	--	--	--	--	--	--
Benzene	--	--	--	**0.190 J**	--	--	53 U	86 U	2.1 U	0.71 U
Bromoform	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
Carbon tetrachloride	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
Chlorobenzene	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
Chlorodibromomethane	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
Chloroform	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
Ethylbenzene	--	--	--	**23.0 J**	--	--	**300**	86 U	**26**	**11**
Methylene chloride	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	0.71 U
Styrene	--	--	--	0.72 U	--	--	53 U	86 U	2.1 U	**0.140 J**
Tetrachloroethene	--	--	--	**0.200 J**	--	--	**60**	**1,200**	**0.840 J**	**0.094 J**
Toluene	--	--	--	**18.0 J**	--	--	**230**	86 U	**3.2**	**1.6**
Trichloroethene	--	--	--	0.72 U	--	--	**58**	86 U	**0.280 J**	**0.220 J**
Trichlorofluoromethane	--	--	--	--	--	--	--	--	--	--
Vinyl chloride	--	--	--	1.4 U	--	--	53 U	86 U	2.1 U	**0.400 J**
Xylenes, Total	--	--	--	**150 ***	--	--	**1,200 E**	86 U	**2.5**	**2.1**
Isopropanol	--	--	--	--	--	--	--	--	--	--
2-Methylnaphthalene	--	--	--	0.75 UJ	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	**120 J***	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	**3.90 J**	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	1.5 U	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	1.0 UJ	--	--	--	--	--	--
Fluorene	--	--	--	0.75 UJ	--	--	--	--	--	--
Isophorone	--	--	--	0.75 UJ	--	--	--	--	--	--
Naphthalene	--	--	--	0.75 UJ	--	--	--	--	--	--
Phenanthrene	--	--	--	0.75 UJ	--	--	--	--	--	--
Pyrene	--	--	--	0.75 UJ	--	--	--	--	--	--

See notes pages.

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	**B-1**	**B-14**	**B-14**	**B-15**	**B-17**	**B-18**	**B-477**	**B-479**	**B-480**	**B-484**
Sample Depth	**(2.0)**	**(2.0)**	**(2.0)**	**(4.0 - 6.0')**	**(1.0)**	**(1.0)**	**(0.5 - 1.0')**	**(2.0 - 3.0')**	**(3.5 - 4.0')**	**(3.5 - 4.0')**
Sample Date	**4/30/1991**	**5/2/1991**	**5/2/1991**	**5/3/1991**	**5/2/1991**	**5/2/1991**	**3/4/1994**	**3/10/1994**	**3/10/1994**	**3/10/1994**
Sample Type	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,2,3,4,6,7,8-HpCDD	**0.00027 J**	0.000543 U	0.00121 UJ	0.000256 U	0.000985 UJ	0.0059 UJ	--	--	--	--
1,2,3,4,6,7,8-HpCDF	0.00262 UJ	0.000407 U	R	**0.00049**	R	0.0059 UJ	--	--	--	--
1,2,3,4,7,8-HxCDF	0.00012 UJ	0.00031 U	R	**0.00038**	R	0.000579 UJ	--	--	--	--
1,2,3,6,7,8-HxCDF	0.000295 UJ	0.00222 U	R	**0.00021**	R	0.0101 UJ	--	--	--	--
1,2,3,7,8-PeCDF	0.000079 UJ	0.0002 U	0.000396 UJ	**0.00016**	0.000488 UJ	0.000295 UJ	--	--	--	--
2,3,4,6,7,8-HxCDF	0.000056 UJ	0.000255 U	R	**0.00021**	R	0.000522 UJ	--	--	--	--
2,3,4,7,8-PeCDF	0.000035 UJ	0.0001 U	0.00055 UJ	**0.00034**	0.000634 UJ	0.000272 UJ	--	--	--	--
2,3,7,8-TCDF	0.000074 UJ	0.000122 U	0.000583 UJ	**0.00041**	0.000634 UJ	0.000352 UJ	--	--	--	--
HpCDDs, Total	0.000542 UJ	0.00049 U	0.00026 UJ	**0.001**	0.0003 UJ	0.00063 UJ	--	--	--	--
HpCDFs, Total	0.0024 UJ	0.00023 U	R	**0.00043**	R	0.0052 UJ	--	--	--	--
HxCDDs, Total	0.00004 UJ	0.00077 UJ	0.0002 UJ	**0.000291**	0.00025 UJ	0.00046 UJ	--	--	--	--
HxCDFs, Total	0.00027 UJ	0.002 U	R	**0.0015**	R	0.0089 UJ	--	--	--	--
OCDDs, Total	**0.00282 J**	**0.00126**	0.00451 UJ	0.000861 U	R	0.000568 UJ	--	--	--	--
PeCDDs, Total	0.000323 UJ	0.00015 U	0.0031 UJ	**0.000137**	0.0015 UJ	0.0014 UJ	--	--	--	--
PeCDFs, Total	0.000072 UJ	0.00018 U	0.011 UJ	**0.000286**	0.044 UJ	0.00026 UJ	--	--	--	--
TCDFs, Total	0.000068 UJ	0.00012 U	0.0091 UJ	**0.0062**	0.013 UJ	0.00031 UJ	--	--	--	--
2,3,7,8-TCDD (TEQ)	**0.00001 J**	**0.000001 J**	UJ	**0.0003**	UJ	UJ	--	--	--	--
Aroclor-1016	--	--	--	**1.20 J**	--	--	--	--	--	--
Aroclor-1254	--	--	--	**11.0 J**	--	--	--	--	--	--
Aroclor-1260	--	--	--	**5.00 J**	--	--	--	--	--	--
PCBs, Total	--	--	--	**17.2**	--	--	--	--	--	--

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	**B-5**	**B-7**	**B-8**	**MW-488**	**SC-1**	**SC-10**	**SC-11**	**SC-12**	**SC-13**	**SC-14**
Sample Depth	**(2.0)**	**(2.0)**	**(1.0 - 3.0')**	**(5.0 - 6.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**
Sample Date	**5/1/1991**	**5/1/1991**	**5/1/1991**	**3/9/1994**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	--	--	**0.92**	**3.00 J**	**0.051**	**35**	**8.1**	**21**	**0.012**	**0.12**
1,1,2,2-Tetrachloroethane	--	--	0.70 U	5.0 U	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
1,1-Dichloroethane	--	--	0.70 U	**1.90 J**	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
1,1-Dichloroethene	--	--	0.70 U	5.0 U	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
1,2-Dichloroethene, Total	--	--	**0.470 J**	**20**	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	**0.21**
2-Butanone	--	--	1.4 U	5.0 U	0.01 U	**35**	**38**	**44**	0.01 U	0.01 U
4-Methyl-2-pentanone	--	--	1.4 U	**1.40 J**	--	--	--	--	--	--
Acrolein	--	--	--	--	0.05 U	20 U	20 U	20 U	0.05 U	0.05 U
Benzene	--	--	0.70 U	5.0 U	0.005 U	2.0 U	2.0 U	**2.1**	0.005 U	0.005 U
Bromoform	--	--	0.70 U	5.0 U	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
Carbon tetrachloride	--	--	0.70 U	5.0 U	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
Chlorobenzene	--	--	0.70 U	5.0 U	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
Chlorodibromomethane	--	--	0.70 U	5.0 U	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
Chloroform	--	--	0.70 U	**2.10 J**	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
Ethylbenzene	--	--	**1.2**	**34**	0.005 U	**50**	**58**	**200**	**0.156**	**0.15**
Methylene chloride	--	--	0.70 U	5.0 U	**0.03**	2.0 U	2.0 U	2.0 U	**0.023**	**0.013**
Styrene	--	--	0.70 U	5.0 U	--	--	--	--	--	--
Tetrachloroethene	--	--	**2.3**	**12**	**0.088**	**160**	**15**	**570**	**0.106**	**3.57**
Toluene	--	--	**46 ***	**88**	**0.072**	**360**	**36**	**88**	**0.077**	**0.091**
Trichloroethene	--	--	**0.380 J**	**12**	**0.052**	**170**	2.0 U	**35**	**0.022**	**0.53**
Trichlorofluoromethane	--	--	--	--	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
Vinyl chloride	--	--	1.4 U	5.0 U	0.005 U	2.0 U	2.0 U	2.0 U	0.005 U	0.005 U
Xylenes, Total	--	--	**2.8**	**73**	--	--	--	--	--	--
Isopropanol	--	--	--	--	0.30 U	**50**	**96**	**78**	0.30 U	0.30 U
2-Methylnaphthalene	--	--	**0.220 J**	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	**13.0 J**	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	**4.20 J**	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	**2.30 J**	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	1.3 UJ	--	--	--	--	--	--	--
Fluorene	--	--	**0.069 J**	--	--	--	--	--	--	--
Isophorone	--	--	**0.270 J**	--	--	--	--	--	--	--
Naphthalene	--	--	**0.340 J**	--	--	--	--	--	--	--
Phenanthrene	--	--	**0.650 J**	--	--	--	--	--	--	--
Pyrene	--	--	**0.110 J**	--	--	--	--	--	--	--

See notes pages.

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	**B-5**	**B-7**	**B-8**	**MW-488**	**SC-1**	**SC-10**	**SC-11**	**SC-12**	**SC-13**	**SC-14**
Sample Depth	**(2.0)**	**(2.0)**	**(1.0 - 3.0')**	**(5.0 - 6.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**
Sample Date	**5/1/1991**	**5/1/1991**	**5/1/1991**	**3/9/1994**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,2,3,4,6,7,8-HpCDD	0.000165 UJ	0.000425 UJ	0.00021 UJ	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	0.00197 UJ	0.00719 UJ	0.000116 UJ	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDF	0.000154 UJ	0.00073 UJ	0.000188 UJ	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDF	0.00057 UJ	0.000196 UJ	0.00008 UJ	--	--	--	--	--	--	--
1,2,3,7,8-PeCDF	0.00197 UJ	0.000577 UJ	0.00032 UJ	--	--	--	--	--	--	--
2,3,4,6,7,8-HxCDF	0.000103 UJ	0.000163 UJ	0.000075 UJ	--	--	--	--	--	--	--
2,3,4,7,8-PeCDF	0.000041 UJ	0.000106 UJ	0.000082 UJ	--	--	--	--	--	--	--
2,3,7,8-TCDF	0.000121 UJ	0.000251 UJ	0.000177 UJ	--	--	--	--	--	--	--
HpCDDs, Total	0.000144 UJ	0.00039 UJ	0.00019 UJ	--	--	--	--	--	--	--
HpCDFs, Total	0.0018 UJ	0.00015 UJ	0.00076 UJ	--	--	--	--	--	--	--
HxCDDs, Total	0.000033 UJ	0.00044 UJ	0.00018 UJ	--	--	--	--	--	--	--
HxCDFs, Total	0.00052 UJ	0.00018 UJ	0.0006 UJ	--	--	--	--	--	--	--
OCDDs, Total	0.00079 UJ	0.000991 UJ	0.000839 UJ	--	--	--	--	--	--	--
PeCDDs, Total	0.000177 UJ	0.00022 UJ	0.00011 UJ	--	--	--	--	--	--	--
PeCDFs, Total	0.0018 UJ	0.000097 UJ	0.00029 UJ	--	--	--	--	--	--	--
TCDFs, Total	0.00011 UJ	0.00023 UJ	0.00016 UJ	--	--	--	--	--	--	--
2,3,7,8-TCDD (TEQ)	UJ	UJ	UJ	--	--	--	--	--	--	--
Aroclor-1016	--	--	**0.220 J**	--	--	--	--	--	--	--
Aroclor-1254	--	--	**2.00 J**	--	--	--	--	--	--	--
Aroclor-1260	--	--	**2.20 J**	--	--	--	--	--	--	--
PCBs, Total	--	--	**4.42**	--	--	--	--	--	--	--

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	**SC-15**	**SC-16**	**SC-17**	**SC-18**	**SC-19**	**SC-2**	**SC-20**	**SC-21**	**SC-22**	**SC-3**
Sample Depth	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**
Sample Date	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	2.0 U	**0.015**	**0.022**	**5.8**	**260**	**0.009**	**24**	0.005 U	**0.047**	**0.838**
1,1,2,2-Tetrachloroethane	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	**0.022**
1,1-Dichloroethane	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	**0.052**
1,1-Dichloroethene	2.0 U	0.005 U	0.01 U	2.0 U	**4.2**	0.005 U	2.0 U	0.005 U	0.005 U	0.005 U
1,2-Dichloroethene, Total	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	**0.31**
2-Butanone	2.0 U	0.01 U	0.01 U	**11**	**37**	**0.018**	**13**	0.01 U	0.01 U	0.01 U
4-Methyl-2-pentanone	--	--	--	--	--	--	--	--	--	--
Acrolein	20 U	0.05 U	0.10 U	20 U	20 U	0.05 U	20 U	0.05 U	0.05 U	**0.048**
Benzene	2.0 U	0.005 U	0.01 U	2.0 U	**2.9**	0.005 U	2.0 U	0.005 U	**0.009**	**0.019**
Bromoform	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	**0.035**
Carbon tetrachloride	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	**0.01**
Chlorobenzene	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	0.005 U
Chlorodibromomethane	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	**0.027**
Chloroform	2.0 U	**0.03**	**0.015**	**3.5**	**5.9**	**0.005**	2.0 U	0.005 U	0.005 U	**0.045**
Ethylbenzene	**150**	**0.483**	0.01 U	**20**	**57**	**0.015**	**74**	0.005 U	0.005 U	**0.19**
Methylene chloride	**3.7**	**0.02**	0.01 U	2.0 U	2.0 U	**0.105**	2.0 U	**0.015**	**0.24**	**0.553**
Styrene	--	--	--	--	--	--	--	--	--	--
Tetrachloroethene	**94**	**0.806**	**0.036**	**22**	**820**	**0.034**	**77**	**0.01**	**0.29**	**0.334**
Toluene	**20**	**0.115**	**0.035**	**20**	**500**	**0.023**	**92**	**0.01**	0.005 U	**0.372**
Trichloroethene	2.0 U	**0.019**	0.01 U	2.0 U	**52**	**0.063**	**19**	0.005 U	**0.064**	**0.295**
Trichlorofluoromethane	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	**0.014**
Vinyl chloride	2.0 U	0.005 U	0.01 U	2.0 U	2.0 U	0.005 U	2.0 U	0.005 U	0.005 U	0.005 U
Xylenes, Total	--	--	--	--	--	--	--	--	--	--
Isopropanol	20 U	0.30 U	0.30 U	20 U	**130**	**0.376**	**48**	0.30 U	0.30 U	0.30 U
2-Methylnaphthalene	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	--	--
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	--	--
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	--	--
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	--	--
Fluorene	--	--	--	--	--	--	--	--	--	--
Isophorone	--	--	--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--	--	--	--
Phenanthrene	--	--	--	--	--	--	--	--	--	--
Pyrene	--	--	--	--	--	--	--	--	--	--

See notes pages.

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	SC-15	SC-16	SC-17	SC-18	SC-19	SC-2	SC-20	SC-21	SC-22	SC-3
Sample Depth	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')
Sample Date	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985
Sample Type	S	S	S	S	S	S	S	S	S	S
1,2,3,4,6,7,8-HpCDD	--	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	--	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDF	--	--	--	--	--	--	--	--	--	--
2,3,4,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--	--
2,3,4,7,8-PeCDF	--	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDF	--	--	--	--	--	--	--	--	--	--
HpCDDs, Total	--	--	--	--	--	--	--	--	--	--
HpCDFs, Total	--	--	--	--	--	--	--	--	--	--
HxCDDs, Total	--	--	--	--	--	--	--	--	--	--
HxCDFs, Total	--	--	--	--	--	--	--	--	--	--
OCDDs, Total	--	--	--	--	--	--	--	--	--	--
PeCDDs, Total	--	--	--	--	--	--	--	--	--	--
PeCDFs, Total	--	--	--	--	--	--	--	--	--	--
TCDFs, Total	--	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDD (TEQ)	--	--	--	--	--	--	--	--	--	--
Aroclor-1016	--	--	--	--	--	--	--	--	--	--
Aroclor-1254	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	--	--	--	--	--	--	--	--	--	--
PCBs, Total	--	--	--	--	--	--	--	--	--	--

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	**SC-4**	**SC-5**	**SC-6**	**SC-7**	**SC-8**	**SC-9**	**SC-9**	**SP-485**	**SS3-C1**
Sample Depth	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(5.0 - 6.0')**	**(0.0 - 1.0')**	**(0.0 - 0.5')**
Sample Date	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**3/9/1994**	**12/9/1991**
Sample Type	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
1,1,1-Trichloroethane	**0.74**	0.01 U	**36**	**1.3**	**16**	**170**	**0.44**	**26**	0.011 U
1,1,2,2-Tetrachloroethane	0.005 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	0.02 U	15 U	0.011 U
1,1-Dichloroethane	0.05 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	0.02 U	**2.80 J**	0.011 U
1,1-Dichloroethene	0.05 U	0.01 U	2.0 U	0.01 U	2.0 U	**2.1**	0.02 U	15 U	0.011 U
1,2-Dichloroethene, Total	**1.56**	0.01 U	2.0 U	0.01 U	2.0 U	**2.3**	**0.29**	**35**	0.011 U
2-Butanone	**3.16**	**0.11**	**29**	**0.44**	**8.3**	**25**	**1.8**	15 U	0.011 U
4-Methyl-2-pentanone	--	--	--	--	--	--	--	15 U	0.011 U
Acrolein	0.50 U	0.10 U	20 U	0.10 U	20 U	20 U	0.20 U	--	--
Benzene	**0.031**	0.01 U	2.0 U	**0.013**	2.0 U	**2.6**	**0.03**	15 U	0.011 U
Bromoform	0.005 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	0.02 U	15 U	0.011 U
Carbon tetrachloride	0.005 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	0.02 U	15 U	0.011 U
Chlorobenzene	0.005 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	**1.13**	15 U	0.011 U
Chlorodibromomethane	0.005 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	0.02 U	15 U	0.011 U
Chloroform	**0.091**	**0.019**	2.0 U	**0.03**	2.0 U	**2.1**	0.02 U	15 U	0.011 U
Ethylbenzene	**68**	**0.375**	**720**	**0.54**	**40**	**45**	**3.63**	**84**	0.011 U
Methylene chloride	**0.49**	**0.096**	**2.7**	**0.069**	**3.5**	**7.4**	**1.68**	15 U	0.044 UJ
Styrene	--	--	--	--	--	--	--	15 U	0.011 U
Tetrachloroethene	**23.6**	**0.096**	**510**	**8.81**	**170**	**120**	**5.1**	**8.10 J**	0.011 U
Toluene	**6.69**	**0.211**	**380**	**0.77**	**490**	**59**	**7.2**	**200**	0.011 U
Trichloroethene	**10.4**	**0.022**	**76**	**7.03**	**49**	**430**	**6.41**	**3.70 J**	0.011 U
Trichlorofluoromethane	0.05 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	0.02 U	--	--
Vinyl chloride	0.05 U	0.01 U	2.0 U	0.01 U	2.0 U	2.0 U	0.02 U	15 U	0.011 U
Xylenes, Total	--	--	--	--	--	--	--	**320 E**	0.011 U
Isopropanol	**2.09**	0.60 U	**230**	0.60 U	**16**	**54**	**6.6**	--	--
2-Methylnaphthalene	--	--	--	--	--	--	--	--	0.38 UJ
bis(2-Ethylhexyl)phthalate	--	--	--	--	--	--	--	--	**2.70 J**
Butyl benzyl phthalate	--	--	--	--	--	--	--	--	**1.40 J**
Di-n-butyl phthalate	--	--	--	--	--	--	--	--	**0.093 J**
Di-n-octyl phthalate	--	--	--	--	--	--	--	--	**0.170 J**
Fluorene	--	--	--	--	--	--	--	--	0.38 UJ
Isophorone	--	--	--	--	--	--	--	--	**0.051 J**
Naphthalene	--	--	--	--	--	--	--	--	0.38 UJ
Phenanthrene	--	--	--	--	--	--	--	--	0.38 UJ
Pyrene	--	--	--	--	--	--	--	--	0.38 UJ

See notes pages.

TABLE J-1O

ORGANIC COMPOUNDS DETECTED IN SURFACE AND SUBSURFACE SOIL

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID **Sample Depth** **Sample Date** **Sample Type**	**SC-4** **(1.0 - 3.0')** **1/1/1985** **S**	**SC-5** **(1.0 - 3.0')** **1/1/1985** **S**	**SC-6** **(1.0 - 3.0')** **1/1/1985** **S**	**SC-7** **(1.0 - 3.0')** **1/1/1985** **S**	**SC-8** **(1.0 - 3.0')** **1/1/1985** **S**	**SC-9** **(1.0 - 3.0')** **1/1/1985** **S**	**SC-9** **(5.0 - 6.0')** **1/1/1985** **S**	**SP-485** **(0.0 - 1.0')** **3/9/1994** **S**	**SS3-C1** **(0.0 - 0.5')** **12/9/1991** **S**
1,2,3,4,6,7,8-HpCDD	--	--	--	--	--	--	--	--	--
1,2,3,4,6,7,8-HpCDF	--	--	--	--	--	--	--	--	--
1,2,3,4,7,8-HxCDF	--	--	--	--	--	--	--	--	--
1,2,3,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--
1,2,3,7,8-PeCDF	--	--	--	--	--	--	--	--	--
2,3,4,6,7,8-HxCDF	--	--	--	--	--	--	--	--	--
2,3,4,7,8-PeCDF	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDF	--	--	--	--	--	--	--	--	--
HpCDDs, Total	--	--	--	--	--	--	--	--	--
HpCDFs, Total	--	--	--	--	--	--	--	--	--
HxCDDs, Total	--	--	--	--	--	--	--	--	--
HxCDFs, Total	--	--	--	--	--	--	--	--	--
OCDDs, Total	--	--	--	--	--	--	--	--	--
PeCDDs, Total	--	--	--	--	--	--	--	--	--
PeCDFs, Total	--	--	--	--	--	--	--	--	--
TCDFs, Total	--	--	--	--	--	--	--	--	--
2,3,7,8-TCDD (TEQ)	--	--	--	--	--	--	--	--	--
Aroclor-1016	--	--	--	--	--	--	--	--	0.038 UJ
Aroclor-1254	--	--	--	--	--	--	--	--	**1.30 J**
Aroclor-1260	--	--	--	--	--	--	--	--	**0.270 J**
PCBs, Total	--	--	--	--	--	--	--	--	**1.57**

TABLE J-1P

INORGANIC CONSTITUENTS DETECTED IN SURFACE AND SUBSURFACE SOILS

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA/RAILROAD PROPERTY

Location ID	**B-15**	**B-8**	**SS3-C1**
Sample Depth	**(4.0 - 6.0')**	**(1.0 - 3.0')**	**(0.0 - 0.5')**
Sample Date	**5/3/1991**	**5/1/1991**	**12/9/1991**
Sample Type	**S**	**S**	**S**
Aluminum	**9,720**	**9,810**	**7,910**
Arsenic	**5.4**	**0.83**	**5.5**
Barium	**1,480**	**70.5**	**859**
Beryllium	**0.48**	0.46 U	0.33 UJ
Cadmium	**389**	**41.7**	**300**
Calcium	**2,010**	**1,090 J**	**1,440**
Chromium	**79**	**13.4**	**49.9**
Cobalt	**8.3**	**9.9**	**6.4**
Copper	**104 J**	**60.1 J**	**107**
Iron	**11,400**	**13,700**	**7,660**
Lead	**1,750 J**	**17.5 J**	**1,020 J**
Magnesium	**3,030**	**5,330**	**2,670**
Manganese	**338 J**	**214 J**	**273 J**
Mercury	0.10 UJ Q	0.10 UJ Q	**1.2**
Nickel	14.1 U	14.6 U	**14.1**
Potassium	**1,080 J**	**1,350**	**1,170**
Selenium	**27.9 J**	1.0 UJ Q	**5.9 J**
Sodium	**301 J**	129 U	**158**
Vanadium	**23.4**	**30.9**	**16.8**
Zinc	**171 J**	**48.2 J**	**170**

TABLE J-1 NOTES

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.

General Notes:

Groundwater results given in micrograms per liter (ug/L); equivalent to parts per billion (ppb).
Soil results given in milligrams per kilogram (mg/kg); equivalent to parts per million (ppm).

Data Qualifiers:

* = Duplicate analysis not within control limits.
B = Organics: Indicates the analyte was found in the blanks as well as the sample. The data user should use caution when applying the results of this analyte.
Inorganics: Indicates analyte result between instrument detection limit (IDL) and contract required detection limit (CRDL).
D = All compounds identified in an analysis at a secondary dilution factor.
E = Organics: Indicates that it exceeds calibration curve range.
Inorganics: Reported value is estimated because of the presence of interference.
J = Indicates that the compound was analyzed for and determined to be present in the sample below the reporting limit.
N = Spiked sample recovery not within control limits.
ND = The compound was not detected.
R = The sample results were rejected based on BBL QA/QC review.
U = Indicates that the compound was analyzed for but not detected at the associated detection limit.
UJ = Indicates that the compound was analyzed for but not detected at the associated estimated detection limit.

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Table J-2

Solvents Recovery Service of New England, Inc.
Summary of Potential Human Health Risks for Ground Water, Surface Soil, and Subsurface Soil

Location / Receptor	Surface Soils		Subsurface Soils	
	Total Excess Lifetime Cancer Risk	Total Noncancer Hazard Index	Total Excess Lifetime Cancer Risk	Total Noncancer Hazard Index
North Cianci				
Adult Resident	3E-06	1E-02	-	-
Child Resident	7E-06	1E-01	-	-
Total Residential Risk (30 year)	1E-05	1E-01	-	-
Recreational/Trespasser	3E-07	2E-03	-	-
Worker	2E-06	9E-03	-	-
South Cianci				
Adult Resident	5E-06	8E-02	-	-
Child Resident	1E-05	8E-01	-	-
Total Residential Risk (30 year)	2E-05	9E-01	-	-
Recreational/Trespasser	5E-07	2E-02	-	-
Worker	4E-06	6E-02	-	-
Operations Area/Railroad Property				
Adult Resident	-	-	5E-04	2E+00
Child Resident	-	-	1E-03	2E+01
Total Residential Risk (30 year)	-	-	2E-03	2E+01
Worker	-	-	3E-04	2E+00

Location	Bedrock Ground Water		Overburden Ground Water	
	Total Excess Lifetime Cancer Risk	Total Noncancer Hazard Index	Total Excess Lifetime Cancer Risk	Total Noncancer Hazard Index
Operations Area Plume	2E+00	1E+03	1E+00	1E+03
Queen Street Plume	7E-05	8E-02	No COPC	No COPC
Upgradient Area	1E-04	2E+01	6E-04	1E+01

Attachment

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment J-1

Solvents Recovery Service of New England, Inc.
Town Well Field Property

The following briefly summarizes the findings of a 1994 risk assessment for soils in the Town Well Property and compares Town Well Field soils data to Region 9 Preliminary Remediation Goals (PRGs). As indicated in a comment response letter to Byron Mah (USEPA), August 24, 1999, human health risks are below levels of concern and chemical concentrations in soil are below Region 9 PRGs for residential soils.

1994 Risk Assessment for the Town Well Field Property

Halliburton NUS Environmental Corporation (HNUS), 1994, conducted a human health risk assessment for soils in the Town Well Field Property and concluded the following:

1. significant site-related contamination was not detected in surface soils samples;

2. metal concentrations were similar to background concentrations; and

3. estimated life time cancer risks for carcinogenic COCs (low levels of benzo(b&k) fluoranthene, PCB Aroclors and arsenic) are within and below USEPA's target range of acceptable risks.

Comparison of Town Well Field Soil Data to Region 9 Preliminary Remediation Goals

Town Well Field surface soil data were compared to USEPA Region 9 PRGs for residential soils. A comparison of both maximum detected concentrations and 95% UCLs indicated that soil chemical concentrations in the Town Well Field are lower than Region 9 PRGs (which the exception of arsenic, which is present at levels similar to background concentrations).

Based on the above information (human health risks below levels of concern and soil chemical concentrations below Region 9 PRGs), risks associated with soils in Town Well Field were not evaluated for the RA Update for the SRSNE site.

TABLE 1

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
COMPARISON OF TOWN WELL FIELD SOIL DATA TO REGION 9 PRELIMINARY REMEDIATION GOAS (PRGS)

Chemical of Potential Concern	Number of Samples	95% UCL (mg/kg)	Maximum Detected Concentration	Region 9 PRGs (mg/kg)
Aroclor-1248	7	0.024	0.027	0.972*
Aroclor-1254	7	0.035	0.056	0.972*
Aroclor-1260	7	0.029	0.041	0.972
4,4'-DDD	7	0.005	0.0023	2.36
4,4'-DDE	7	0.047	0.027	1.66
4,4'-DDT	7	0.041	0.028	1.66
Endosulfan sulfate	7	0.0027	0.0024	na
Aluminum	7	10664	11800	74948
Arsenic	**7**	3.03	3.2	0.377
Barium	7	96	121	5155
Cadmium	7	1.01	1.70	37.5
Calcium	7	1699	1640	NUT
Chromium	7	20.3	14.9	30.1
Cobalt	7	4.87	4.70	3253
Copper	7	12.4	13.7	2784
Iron	7	12081	12700	22486
Lead	7	23.7	32.0	400
Magnesium	7	1592	1850	NUT
Manganese	7	367	586	3119
Mercury	7	1.61	1.20	5.45**
Nickel	7	9.09	9.00	1499
Potassium	7	398	472	NUT
Vanadium	7	23.5	27.8	525
Zinc	7	52.6	42.5	22486

Notes:
na = no toxicity data.
NUT = compounds are considered essential nutrients as per USEPA (1989).
* Region 9 PRG is for Aroclor 1254.
** Region 9 PRG is for methyl mercury.

RAGS Part D Tables

Table 0

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC

Site Name/OU:	Solvents Recovery Service of New England, Inc.
Region:	USEPA Region 1
EPA ID Number:	-
State:	Connecticut
Status:	-
Federal Facility (Y/N):	N
EPA Project Manager:	Ms. Karen Lumino
EPA Risk Assessor:	Ms. Sarah Levinson
Document Author:	Blasland, Bouck & Lee, Inc.
Document Title:	Risk Assessment Update for the SRSNE Superfund Site
Document Date:	Apr-05
Comments:	

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater (1)	Potable water	Resident	Adult	Ingestion	Quant	Hypothetical potable use (drinking water)
						Dermal	Qual	Exposure assumed to be less than ingestion
						Inhalation	Qual	Exposure assumed to be equal to ingestion
					Child	Ingestion	None	Exposure of children not likely to be greater than adults (USEPA, 1989)
						Dermal	None	Exposure of children not likely to be greater than adults (USEPA, 1989)
						Inhalation	None	Exposure of children not likely to be greater than adults (USEPA, 1989)
				Recreational/Trespasser	Adolescent	Ingestion	None	Exposure to groundwater is unlikely for this receptor group
						Dermal	None	Exposure to groundwater is unlikely for this receptor group
						Inhalation	None	Exposure to groundwater is unlikely for this receptor group
				Worker	Adult	Ingestion	None	Exposure of worker not likely to be greater than adult resident
						Dermal	None	Exposure to worker not likely to be greater than adult resident
						Inhalation	None	Exposure to worker not likely to be greater than adult resident
Current/Future	Surface Soil	Surface Soil (2)	Surface Soil	Resident	Adult	Ingestion	Quant	Incidental ingestion of surface soil
						Dermal	Quant	Dermal contact with surface soil
						Inhalation	Qual	Exposure considered to be less than ingestion or dermal contact
					Child	Ingestion	Quant	Incidental ingestion of surface soil
						Dermal	Quant	Dermal contact with surface soil
						Inhalation	Qual	Exposure considered to be less than ingestion or dermal contact
				Recreational/Trespasser	Adolescent	Ingestion	Quant	Incidental ingestion of surface soil
						Dermal	Quant	Dermal contact with surface soil
						Inhalation	Qual	Exposure considered to be less than ingestion or dermal contact
				Worker	Adult	Ingestion	Quant	Incidental ingestion of surface soil
						Dermal	Quant	Dermal contact with surface soil
						Inhalation	Qual	Exposure considered to be less than ingestion or dermal contact

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Subsurface soil	Subsurface soil (3)	Subsurface soil	Resident	Adult	Ingestion	Quant	Incidental ingestion of subsurface soil
						Dermal	Quant	Dermal contact with subsurface soil
						Inhalation	Qual	Exposure considered to be less than ingestion or dermal contact
					Child	Ingestion	Quant	Incidental ingestion of subsurface soil
						Dermal	Quant	Dermal contact with subsurface soil
						Inhalation	Qual	Exposure considered to be less than ingestion or dermal contact
				Worker	Adult	Ingestion	Quant	Incidental ingestion of subsurface soil
						Dermal	Quant	Dermal contact with subsurface soil
						Inhalation	Qual	Exposure considered to be less than ingestion or dermal contact

Notes:

(1) Both overburden and bedrock groundwater will be evaluated for three discrete areas: 1) Operations Area Plume, 2) Queen Street Plume, and 3) Upgradient Area (background).

(2) Surface soils will be evaluated for the Northern Cianci Property and Southern Cianci Property.

(3) Subsurface soils will be evaluated for the Operations Area/Railroad Property.

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	71-55-6	1,1,1-Trichloroethane	0.5	204000	ug/L	P-4B	84 / 264	1 - 25000	204000		158 nc	200		Y	ASL
	79-00-5	1,1,2-Trichloroethane	0.5	2500	ug/L	MW-415	3 / 264	1 - 12000	2500		0.2 c	5		N	DL5
	75-34-3	1,1-Dichloroethane	0.5	14380	ug/L	P-1B	102 / 264	1 - 12000	14380		162 nc	NA		Y	ASL
	75-35-4	1,1-Dichloroethene	0.5	6910	ug/L	P-4B	31 / 264	1 - 12000	6910		0.05 c	7		Y	ASL
	95-50-1	1,2-Dichlorobenzene	0.5	2500	ug/L	P-4B	3 / 163	1 - 10000	2500		74 nc	NA		N	DL5
	107-06-2	1,2-Dichloroethane	0.5	2500	ug/L	P-1B	9 / 264	1 - 12000	2500		0.12 c	5		N	DL5
	540-59-0	1,2-Dichloroethene, Total	1	136625	ug/L	P-1B	95 / 222	2 - 150000	136625		12(a) nc	NA		Y	ASL
	106-46-7	1,4-Dichlorobenzene	0.5	2500	ug/L	MW-123C	1 / 163	1 - 10000	2500		0.5 c	NA		N	DL5
	78-93-3	2-Butanone	2.5	470000	ug/L	CPZ-6A	38 / 250	5 - 700000	470000		380 nc	NA		Y	ASL
	108-10-1	4-Methyl-2-pentanone	2.5	57000	ug/L	CPZ-6A	33 / 249	5 - 50000	57000		32 nc	NA		Y	ASL
	67-64-1	Acetone	2.5	320000	ug/L	CPZ-6A	38 / 236	5 - 58000	320000		122 nc	NA		Y	ASL
	71-43-2	Benzene	0.5	2500	ug/L	P-1B	49 / 264	1 - 12000	2500		0.41 c	5		Y	ASL
	75-15-0	Carbon disulfide	0.5	2563	ug/L	MW-07	9 / 232	1 - 12000	2563		200 nc	NA		N	DL5
	56-23-5	Carbon tetrachloride	0.5	3870	ug/L	P-1B	4 / 259	1 - 12000	3870		0.17 c	5		N	DL5
	108-90-7	Chlorobenzene	0.5	2500	ug/L	TW-07A	28 / 259	1 - 12000	2500		22 nc	100		Y	ASL
	75-00-3	Chloroethane	0.5	3717	ug/L	MWL-307	102 / 264	1 - 12000	3717		4.6 c	NA		Y	ASL
	67-66-3	Chloroform	0.5	12175	ug/L	CP2-3	5 / 259	1 - 210000	12175		0.16 c	NA		N	DL5
	74-87-3	Chloromethane	0.5	10175	ug/L	P-1B	1 / 259	1 - 160000	10175		1.5 c	NA		N	DL5
	156-59-2	cis-1,2-Dichloroethene	0.5	221250	ug/L	P-1B	56 / 137	1 - 92000	221250		12 nc	70		Y	ASL
	BBL-Ethene	Ethylene	0.025	238	ug/L	P-1B	5/5	-	238		NA NA	NA		N	NTX
	BBL=Ethane	Ethane	0.22	1020	ug/L	MW-704D	5/5	-	1020		NA NA	NA		N	NTX
	100-41-4	Ethylbenzene	0.5	84300	ug/L	P-1B	114 / 264	1 - 10000	84300		260 nc	700		Y	ASL
	BBL-MPX	M,P-Xylene	0.9	8600	ug/L	MWD-601	48 / 118	2 - 20000	8600		280 nc	NA		Y	ASL
	BBL-Methane	Methane	3293	29606	ug/L	MW-502	5/5	-	29606		NA NA	NA		N	NTX
	75-09-2	Methylene chloride	0.5	9000	ug/L	RW-6	19 / 264	1 - 44000	9000		4.3 c	NA		Y	ASL
	95-47-6	O-Xylene	0.5	3550	ug/L	P-1B	32 / 118	1 - 10000	3550		280 nc	NA		Y	ASL
	100-42-5	Styrene	0.5	22790	ug/L	P-1B	6 / 249	1 - 12000	22790		320 nc	NA		N	DL5
	127-18-4	Tetrachloroethene	0.5	14000	ug/L	MWD-601	26 / 264	1 - 12000	14000		1.1 c	5		Y	ASL
	109-99-9	Tetrahydrofuran	2.75	52000	ug/L	CPZ-6A	49 / 217	1 - 50000	52000		8.8 c	NA		Y	ASL
	108-88-3	Toluene	0.5	132000	ug/L	P-4B	95 / 264	1 - 120000	132000		144 nc	1000		Y	ASL
	156-60-5	trans-1,2-Dichloroethene	0.5	6958	ug/L	TW-07A	14 / 155	1 - 41000	6958		24 nc	100		Y	ASL
	79-01-6	Trichloroethene	0.5	95000	ug/L	MWD-601	44 / 264	1 - 41000	95000		1.6 c	5		Y	ASL
	75-01-4	Vinyl chloride	0.5	11900	ug/L	MWL-304	65 / 264	1 - 13000	11900		0.02 c	2		Y	ASL

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	1330-20-7	Xylenes, Total	0.5	14000	ug/L	P-1B	107 / 249	1 - 20000	14000		280(b)	nc	10000		Y	ASL
	120-82-1	1,2,4-Trichlorobenzene	1	128	ug/L	TW-08A	4 / 30	2 - 500	128		38	nc	NA		Y	ASL
	105-67-9	2,4-Dimethylphenol	3.5	160	ug/L	P-1B	11 / 30	10 - 50	160		146	nc	NA		Y	ASL
	51-28-5	2,4-Dinitrophenol	9.25	331	ug/L	P-4B	1 / 30	25 - 1300	331		15	nc	NA		N	DL5
	91-57-6	2-Methylnaphthalene	3	128	ug/L	MW-123C	6 / 29	10 - 500	128		NA	NA	NA		N	NTX
	95-48-7	2-Methylphenol	5	100	ug/L	P-1B	10/30	10 - 200	100		360	nc	NA		N	BSL
	106-44-5	4-Methylphenol	3	1100	ug/L	P-101B	13 / 30	10 - 50	1100		36	nc	NA		Y	ASL
	65-85-0	Benzoic Acid	25	910	ug/L	TW-08A	2 / 6	50	910		30000	nc	NA		N	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	5	5750	ug/L	P-1B	1 / 29	10 - 1100	5750		4.8	c	NA		N	DL5
	85-68-7	Butyl benzyl phthalate	5	157	ug/L	P-1B	1 / 29	10 - 500	157		1460	nc	NA		N	DL5
	84-74-2	Di-n-butyl phthalate	1	151	ug/L	P-1B	5 / 29	10 - 500	151		720	nc	NA		N	BSL
	117-84-0	Di-n-octyl phthalate	5	138	ug/L	P-1B	1 / 29	10 - 500	138		NA	NA	NA		N	DL5
	84-66-2	Diethyl phthalate	1	128	ug/L	P-1B	3 / 29	10 - 500	128		5800	nc	NA		N	BSL
	131-11-3	Dimethyl phthalate	3.5	134	ug/L	P-1B	2 / 29	10 - 500	134		72000	nc	NA		N	BSL
	78-59-1	Isophorone	1	100	ug/L	P-1B	6 / 29	10 - 200	100		71	c	NA		Y	ASL
	91-20-3	Naphthalene	0.5	128	ug/L	P-4B	11 / 30	1 - 500	128		1.2	nc	NA		Y	ASL
	85-01-8	Phenanthrene	5	130	ug/L	P-1B	1 / 29	10 - 500	130		NA	NA	NA		N	DL5
	108-95-2	Phenol	5	3425	ug/L	P-1B	8 / 30	10 - 200	3425		4400	nc	NA		N	BSL
	11096-82-5	Aroclor-1260	0.5	95	ug/L	P-1B	2 / 30	1 - 100	95		0.03	c	0.5		Y	ASL
	64-17-5	Ethanol	0.5	3200	ug/L	MWL-307	4 / 111	1 - 1000	3200		NA	NA	NA		N	DL5
	67-63-0	Isopropanol	169.5	160000	ug/L	CPZ-6A	15 / 126	500 - 125000	160000		NA	NA	NA		N	NTX
	67-56-1	Methanol	0.5	7250	ug/L	RW-5	14 / 111	1 - 1000	7250		3600	nc	NA		Y	ASL
	78-92-2	Sec-Butanol	57	200000	ug/L	CPZ-6A	24 / 111	1000	200000		NA	NA	NA		N	NTX
	16887-00-6	Chloride	4500	62700	ug/L	MW-415	3 / 9	9000	62700		NA	NA	NA		N	NTX
	Q479	Nitrate	100	1340	ug/L	MW-703D	2 / 9	200 - 230	1340		2000	nc	NA		N	BSL
	Q605	Sulfate	3500	45300	ug/L	MW-703D	4 / 9	7000	45300		NA	NA	NA		N	NTX
	7440-38-2	Arsenic	1.1	42	ug/L	P-1B	26 / 29	1.9 - 4.3	42		0.05(c)	c	50		Y	ASL
	7429-90-5	Aluminum	274	250000	ug/L	DN-2	30/30	-	250000		7200	nc	NA		Y	ASL
	7440-39-3	Barium	178	20000	ug/L	DN-2	30/30	-	20000		520	nc	2000		Y	ASL
	7440-41-7	Beryllium	0.2	30	ug/L	DN-2	20 / 25	0.4 - 1.7	30		15	nc	4		Y	ASL
	7440-43-9	Cadmium	0.5	46	ug/L	P-1B	7 / 18	1 - 8.5	46		3.6	nc	5		Y	ASL
	7440-70-2	Calcium	30400	633500	ug/L	P-101B	30/30	-	633500		NA	NA	NA		N	NUT
	7440-47-3	Chromium	2.6	420	ug/L	DN-2	26 / 29	4.5 - 24	420		22(d)	nc	100		Y	ASL
	7440-48-4	Cobalt	2.85	180	ug/L	DN-2	25 / 29	2.7 - 32	180		440	nc	NA		N	BSL
	7440-50-8	Copper	10	440	ug/L	DN-2	24 / 30	3.5 - 52.3	440		280	nc	1300		N	BSL
	7439-89-6	Iron	460	300000	ug/L	DN-2	39 / 39	30	300000		2200	nc	NA		N	NUT

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	7439-92-1	Lead	3.55	85	ug/L	P-1B	27 / 30	5.1 - 10	85		NA	NA	15		Y	AMCL
	7439-96-5	Manganese	20.8	23067	ug/L	P-1B	39 / 39	1	23067		176	nc	NA		Y	ASL
	7439-95-4	Magnesium	3170	125000	ug/L	P-101B	30/30	-	125000		NA	NA	NA		N	NUT
	7439-97-6	Mercury	0.05	0.35	ug/L	P-16	4 / 13	0.1 - 0.83	0.35		2.2(e)	nc	NA		N	BSL
	7440-02-0	Nickel	7.9	320	ug/L	DN-2	25 / 29	5.4 - 23	320		146	nc	100		Y	ASL
	7440-09-7	Potassium	1700	54000	ug/L	DN-2	28 / 30	1300 - 3400	54000		NA	NA	NA		N	NUT
	7440-22-4	Silver	1.25	40	ug/L	DN-2	6 / 20	2.5 - 7.3	40		36	nc	NA		Y	ASL
	7440-23-5	Sodium	5700	193000	ug/L	P-101B	30/30	-	193000		NA	NA	NA		N	NUT
	18496-25-8	Sulfide (S)	340	3150	ug/L	MW-703D	4 / 9	680 - 930	3150		NA	NA	NA		N	NTX
	7440-28-0	Thallium	0.65	2	ug/L	P-12	1 / 11	1.3 - 3.8	2		0.5(f)	nc	2		Y	ASL
	7440-62-2	Vanadium	30	750	ug/L	DN-2	27 / 29	2.6 - 2.8	750		52	nc	NA		Y	ASL
	7440-66-6	Zinc	18	12000	ug/L	WE-2	25 / 30	25 - 57	12000		2200	nc	NA		Y	ASL
	BBL-AMMN	Ammonia (As N)	315	2785	ug/L	MW-415	1 / 9	630	2785		NA	NA	NA		N	NTX
	BBL-OP	Orthophosphate-P	100	300	ug/L	MW-415	1 / 9	200 - 570	300		NA	NA	NA		N	NTX

Notes:

(1) The lowest and highest average concentration observed from all wells, when concentrations observed in each well were averaged over the period in which it was sampled.

(2) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).

(3) Location of maximum detected concentration.

(4) The highest average concentration observed from all wells, when concentrations observed in each well were averaged over the period in which it was sampled.

(5) According to USEPA, background concentrations will not be used to screen chemicals of interest.

(6) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in tap water (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-cancer screening toxicity value is 1/5 the PRG (HQ=0.2).

(7) Maximum Contaminant Level (MCL) for drinking water (USEPA, National Primary Drinking Water Regulations).

(8) Considered COPC if maximum concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screening against MCLs.

(9) Rationale Codes:
ASL = above screening level
BSL = below screening level
AMCL = above maximum contaminant level (MCL)
NTX = no toxicity data
NUT = essential nutrient
DL5 = detection level <5%

(a) Toxicity value for cis-1,2-Dichloroethene.
(b) Toxicity value for m-xylene and/or p-xylene.
(c) Toxicity value for arsenic (cancer endpoint).
(d) Toxicity value for chromium VI.
(e) Toxicity value for mercury and compounds.
(f) Toxicity value for thallium is adjusted from the RfD for thallium chloride.

NA = not available
- = historical data - detection limits not available.

TABLE 2.2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	630-20-6	1,1,1,2-Tetrachloroethane	0.5	2500	ug/L	P-2A	1 / 18	1 - 5000	2500		0.43	c	NA		N	DL5
	71-55-6	1,1,1-Trichloroethane	0.5	64238	ug/L	P-4A	55 / 147	1 - 10000	64238		158	nc	200		Y	ASL
	79-00-5	1,1,2-Trichloroethane	0.5	5000	ug/L	CPZ-8R	4 / 147	1 - 10000	5000		0.2	c	5		N	DL5
	75-34-3	1,1-Dichloroethane	0.5	5000	ug/L	MW-125C	68 / 147	1 - 10000	5000		162	nc	NA		Y	ASL
	75-35-4	1,1-Dichloroethene	0.5	5100	ug/L	CPZ-7R	46 / 147	1 - 10000	5100		0.05	c	7		Y	ASL
	95-50-1	1,2-Dichlorobenzene	0.5	5000	ug/L	MW-121C	3 / 94	1 - 10000	5000		74	nc	NA		N	DL5
	107-06-2	1,2-Dichloroethane	0.5	5000	ug/L	MW-125C	11 / 146	1 - 10000	5000		0.12	c	5		Y	ASL
	540-59-0	1,2-Dichloroethene, Total	1	120000	ug/L	CPZ-7R	78 / 124	2 - 100000	120000		12(a)	nc	NA		Y	ASL
	78-87-5	1,2-Dichloropropane	0.5	5000	ug/L	P-2A	1 / 146	1 - 10000	5000		0.16	c	NA		N	DL5
	541-73-1	1,3-Dichlorobenzene	0.5	5000	ug/L	P-1A	3 / 94	1 - 10000	5000		1.1	nc	NA		N	DL5
	106-46-7	1,4-Dichlorobenzene	0.5	5000	ug/L	P-1A	4 / 94	1 - 10000	5000		0.5	c	NA		N	DL5
	78-93-3	2-Butanone	2.5	72375	ug/L	MW-125C	23 / 129	5 - 50000	72375		381	nc	NA		Y	ASL
	591-78-6	2-Hexanone	2.5	25000	ug/L	CPZ-6R	2 / 130	5 - 50000	25000		NA	NA	NA		N	DL5
	108-10-1	4-Methyl-2-pentanone	2.5	25000	ug/L	MW-125C	36 / 146	5 - 50000	25000		32	nc	NA		Y	ASL
	67-64-1	Acetone	2.5	55500	ug/L	MW-125C	27 / 128	5 - 50000	55500		122	nc	NA		Y	ASL
	71-43-2	Benzene	0.5	5000	ug/L	CPZ-8R	40 / 147	1 - 10000	5000		0.41	c	5		Y	ASL
	74-83-9	Bromomethane	0.5	5000	ug/L	P-14	2 / 146	1 - 10000	5000		1.7	nc	NA		N	DL5
	75-15-0	Carbon disulfide	0.5	5000	ug/L	MW-704R	7 / 128	1 - 10000	5000		200	nc	NA		N	DL5
	56-23-5	Carbon tetrachloride	0.5	5000	ug/L	CPZ-8R	10 / 146	1 - 10000	5000		0.17	c	5		Y	ASL
	108-90-7	Chlorobenzene	0.5	5000	ug/L	MW-05	14 / 146	1 - 10000	5000		22	nc	100		Y	ASL
	75-00-3	Chloroethane	0.5	5000	ug/L	MW-416	49 / 146	1 - 10000	5000		4.6	c	NA		Y	ASL
	67-66-3	Chloroform	0.5	5000	ug/L	CPZ-8R	6 / 147	1 - 10000	5000		0.16	c	100		N	DL5
	74-87-3	Chloromethane	0.5	9000	ug/L	P-14	2 / 146	1 - 18000	9000		1.5	c	NA		N	DL5
	156-59-2	cis-1,2-Dichloroethene	0.5	110000	ug/L	CPZ-7R	48 / 80	1 - 63000	110000		12	nc	70		Y	ASL
	BBL-Ethene	Ethylene	0.9	20	ug/L	P-1A	3/3	-	20		NA	NA	NA		N	NTX
	BBL-Ethane	Ethane	84	795	ug/L	MW-704R	3/3	-	795		NA	NA	NA		N	NTX
	100-41-4	Ethylbenzene	0.5	9300	ug/L	CPZ-9R	73 / 147	1 - 10000	9300		260	nc	700		Y	ASL
	BBL-MPX	M,P-Xylene	1	18000	ug/L	CPZ-9R	28 / 61	2 - 20000	18000		280	nc	NA		Y	ASL

TABLE 2.2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	BBL-Methane	Methane	3293	20270	ug/L	MW-704R	3/3	-	20270		NA	NA	NA		N	NTX
	75-09-2	Methylene chloride	1	11000	ug/L	CPZ-7R	15 / 146	1 - 20000	11000		4.3	c	NA		Y	ASL
	95-47-6	O-Xylene	0.5	6600	ug/L	CPZ-7R	23 / 62	1 - 10000	6600		280	nc	NA		Y	ASL
	100-42-5	Styrene	0.5	5000	ug/L	P-4A	5 / 146	1 - 10000	5000		320	nc	NA		N	DL5
	127-18-4	Tetrachloroethene	0.5	51000	ug/L	CPZ-7R	35 / 147	1 - 50000	51000		1.1	c	5		Y	ASL
	109-99-9	Tetrahydrofuran	2.75	50000	ug/L	MW-05	42 / 113	1 - 100000	50000		8.8	c	1000		Y	ASL
	108-88-3	Toluene	0.5	92000	ug/L	P-4A	66 / 147	1 - 50000	92000		144	nc	100		Y	ASL
	156-60-5	trans-1,2-Dichloroethene	0.4	5000	ug/L	WE-1	7 / 83	1 - 10000	5000		24	nc	NA		Y	ASL
	10061-02-6	trans-1,3-Dichloropropene	0.5	5000	ug/L	P-1A	1 / 146	1 - 10000	5000		NA	NA	NA		N	DL5
	79-01-6	Trichloroethene	0.5	730000	ug/L	CPZ-7R	62 / 147	1 - 50000	730000		1.6	c	5		Y	ASL
	75-01-4	Vinyl chloride	0.5	12730	ug/L	MW-125C	47 / 147	1 - 10000	12730		0.02	c	2		Y	ASL
	1330-20-7	Xylenes, Total	1	25000	ug/L	CPZ-7R; CPZ-9R	63 / 145	1 - 20000	25000		280(b)	nc	10000		Y	ASL
	120-82-1	1,2,4-Trichlorobenzene	1	25	ug/L	MW-121C	3 / 32	2 - 50	25		38	nc	NA		N	BSL
	105-67-9	2,4-Dimethylphenol	3.5	39	ug/L	P-101A	5 / 32	10 - 50	39		146	nc	NA		N	BSL
	91-57-6	2-Methylnaphthalene	1	25	ug/L	MW-125C	3 / 32	10 - 50	25		NA	NA	NA		N	NTX
	95-48-7	2-Methylphenol	5	92	ug/L	P-3A	7 / 32	10 - 20	92		360	nc	NA		N	BSL
	534-52-1	4,6-Dinitro-2-methylphenol	12.5	65	ug/L	MW-05	1 / 32	25 - 130	65		NA	NA	NA		N	DL5
	106-44-5	4-Methylphenol	3	570	ug/L	P-3A	11 / 32	10 - 20	570		36	nc	NA		Y	ASL
	84-74-2	Di-n-butyl phthalate	1	25	ug/L	P-1A	5 / 32	10 - 50	25		720	nc	NA		N	BSL
	117-84-0	Di-n-octyl phthalate	5	25	ug/L	P-1A	2/32	10 - 50	25		146	nc	NA		N	BSL
	84-66-2	Diethyl phthalate	5	25	ug/L	MW-121C	1 / 32	10 - 50	25		5800	nc	NA		N	DL5
	78-59-1	Isophorone	3.5	25	ug/L	MW-125C	4 / 32	10 - 50	25		71	c	NA		N	BSL
	91-20-3	Naphthalene	0.5	25	ug/L	MW-125C	10/32	1 - 50	25		1.2	nc	NA		Y	ASL
	108-95-2	Phenol	5	270	ug/L	P-3A	6 / 32	10 - 50	270		4400	nc	NA		N	BSL
	11097-69-1	Aroclor-1254	0.5	97	ug/L	P-1A	2 / 32	1 - 100	97		0.03	c	0.5		Y	ASL
	72-54-8	4,4'-DDD	0.05	2.53	ug/L	P-3A	1 / 32	0.1 - 10	2.53		0.28	c	NA		N	DL5
	309-00-2	Aldrin	0.025	1.26	ug/L	P-3A	1 / 32	0.05 - 5	1.26		0.004	c	NA		N	DL5
	58-89-9	gamma-BHC (Lindane)	0.025	1.26	ug/L	MW-121A	1 / 32	0.05 - 5	1.26		NA	NA	NA		N	DL5
	67-63-0	Isopropanol	375	28000	ug/L	P-3A	6/ 52	500 - 1000	28000		NA	NA	NA		N	NTX
	67-56-1	Methanol	500	9500	ug/L	P-5A	4 / 51	1000	9500		3600	nc	NA		Y	ASL
	78-92-2	Sec-Butanol	500	29500	ug/L	MW-125C	12 / 51	1000	29500		NA	NA	NA		N	NTX
	16887-00-6	Chloride	4500	228000	ug/L	P-6	4 / 7	9000	228000		NA	NA	NA		N	NTX
	Q479	Nitrate	100	1800	ug/L	P-8A	2 / 7	200 - 530	1800		2000	nc	NA		N	BSL
	Q605	Sulfate	3500	2320000	ug/L	P-8A	4 / 7	7000	2320000		NA	NA	NA		N	NTX
	7429-90-5	Aluminum	190	430000	ug/L	P-11A	32/32	-	430000		7200	nc	NA		Y	ASL
	7440-36-0	Antimony	6	34	ug/L	MW-121C	1 / 25	12 - 55	34		3	nc	NA		N	DL5
	7440-38-2	Arsenic	1.45	49	ug/L	P-11A	19 / 25	1.9 - 11.4	49		0.05	c	50		Y	ASL
	7440-39-3	Barium	24	12000	ug/L	P-11A	32/32	-	12000		520	nc	2000		Y	ASL

TABLE 2.2
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	7440-41-7	Beryllium	0.15	52	ug/L	P-11A	14 / 21	0.3 - 0.4	52		15	nc	4		Y	ASL
	7440-43-9	Cadmium	0.5	20	ug/L	P-11A	2 / 16	1 - 6	20		3.6	nc	5		Y	ASL
	7440-70-2	Calcium	21000	990000	ug/L	P-11A	32/32	-	990000		NA	NA	NA		N	NUT
	7440-47-3	Chromium	2.25	760	ug/L	P-11A	19 / 31	4.5 - 27	760		22(c)	nc	100		Y	ASL
	7440-48-4	Cobalt	0.65	390	ug/L	P-2A	16 / 24	1.3 - 37	390		440	nc	NA		N	BSL
	7440-50-8	Copper	1.75	1600	ug/L	P-2A	21 / 29	3.5 - 73	1600		280	nc	1300		Y	ASL
	7439-89-6	Iron	185	690000	ug/L	P-11A	37 / 39	30 - 1700	690000		2200	nc	NA		N	NUT
	7439-92-1	Lead	0.95	190	ug/L	WE-1	23 / 28	1.9 - 13.7	190		NA	NA	15		Y	AMCL
	7439-95-4	Magnesium	390	260000	ug/L	P-11A	32/32	-	260000		NA	NA	NA		N	NUT
	7439-96-5	Manganese	28	43000	ug/L	P-12A	39 / 39	1	43000		176	nc	NA		Y	ASL
	7439-97-6	Mercury	0.05	1.1	ug/L	MW-121A	3 / 12	0.1	1.1		2.2(d)	nc	NA		N	BSL
	7440-02-0	Nickel	2.7	790	ug/L	P-11A	18 / 29	5 - 17	790		146	nc	100		Y	ASL
	7440-09-7	Potassium	550	120000	ug/L	P-11A	22 / 32	1100 - 3200	120000		NA	NA	NA		N	NUT
	7782-49-2	Selenium	0.5	9	ug/L	MW-123A	2 / 12	1 - 18	9		36	nc	NA		N	BSL
	7440-22-4	Silver	1.25	27	ug/L	WE-1	2 / 18	2.5 - 6.8	27		36	nc	NA		N	BSL
	7440-23-5	Sodium	6200	100000	ug/L	P-3A	32/32	-	100000		NA	NA	NA		N	NUT
	18496-25-8	Sulfide (S)	340	2930	ug/L	MW-703DR	4 / 7	680	2930		NA	NA	NA		N	NTX
	7440-28-0	Thallium	0.65	3.8	ug/L	MW-127C	1 / 12	1.3 - 3.8	3.8		0.5(e)	nc	2		Y	ASL
	7440-62-2	Vanadium	2.9	1300	ug/L	P-11A	21 / 31	4.7 - 13	1300		52	nc	NA		Y	ASL
	7440-66-6	Zinc	5	1700	ug/L	P-11A	19 / 32	10 - 45	1700		2200	nc	NA		N	BSL

Notes:

(1) The lowest and highest average concentration observed from all wells, when concentrations observed in each well were averaged over the period in which it was sampled.

(2) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).

(3) Location of maximum detected concentration.

(4) The highest average concentration observed from all wells, when concentrations observed in each well were averaged over the period in which it was sampled.

(5) According to USEPA, background concentrations will not be used to screen chemicals of interest.

(6) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in tap water (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-cancer screening toxicity value is 1/5 the PRG (HQ=0.2).

(7) Maximum Contaminant Level (MCL) for drinking water (USEPA, National Primary Drinking Water Regulations).

(8) Considered COPC if maximum concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screening against MCLs.

(9) Rationale Codes:
ASL = above screening level
BSL = below screening level
AMCL = above maximum contaminant level
NTX = no toxicity data
NUT = essential nutrient
DL5 = detection limit <5%

(a) Toxicity value for cis-1,2-Dichloroethene.
(b) Toxicity value for m-xylene and/or p-xylene.
(c) Toxicity value for chromium VI.
(d) Toxicity value for mercury and compounds.
(e) Toxicity value for thallium is adjusted from the RfD for thallium chloride.

NA = not available
- = historical data - detection limits not available.

TABLE 2.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
QUEENS STREET PLUME

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)	Maximum (1) Concentration (Qualifier)	Units	Location of Maximum Concentration (2)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (5) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (6)	COPC Flag (7) (Y/N)	Rationale for Selection or Deletion (8)
Potable Water	75-09-2	Methylene chloride	1 JB	1 JB	ug/L	MW-710S	1 / 1	2	1		4.3 c	5		N	BSL

Notes:

(1) Minimum/maximum detected concentration (only one sample for this location).

(2) Location of maximum detected concentration (only one sample for this location).

(3) Because of the paucity of data for this site, maximum detected concentrations are used to screen chemicals of interest in groundwater.

(4) According to USEPA, background concentrations will not be used to screen chemicals of interest.

(5) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in tap water (c = cancer based toxicity value).

(6) Maximum Contaminant Level (MCL) for drinking water (USEPA, National Primary Drinking Water Regulations).

(7) Considered COPC if maximum concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screened against maximum contaminant levels (MCLs) for drinking water.

(8) Rationale Codes: BSL = below screening level

TABLE 2.4
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
QUEENS STREET PLUME

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)	Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	71-55-6	1,1,1-Trichloroethane	0.5	2	ug/L	MW-710R	1 / 2	1	2		158 nc	200		N	BSL
	540-59-0	1,2-Dichloroethene, Total	6	15	ug/L	MW-710R	2 / 2	2	15		12(a) nc	NA		Y	ASL
	67-64-1	Acetone	3.25	17	ug/L	MW-710DR	2 / 2	5	17		122 nc	NA		N	BSL
	67-66-3	Chloroform	0.5	1	ug/L	MW-710DR	1 / 2	1	1		0.16 c	100		Y	ASL
	156-59-2	cis-1,2-Dichloroethene	6	15	ug/L	MW-710R	2 / 2	1	15		12 nc	70		Y	ASL
	75-09-2	Methylene chloride	1	1	ug/L	MW-710R; MW-710DR	2 / 2	2	1		4.3 c	5		N	BSL
	79-01-6	Trichloroethene	6	15	ug/L	MW-710R	2 / 2	1	15		1.6 c	5		Y	ASL

Notes:

(1) Minimum/maximum detected concentration.
(2) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).
(3) Location of maximum detected concentration.
(4) Because of the paucity of data for this site, maximum detected concentrations are used to screen chemicals of interest in groundwater.
(5) According to USEPA, background concentrations will not be used to screen chemicals of interest.
(6) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in tap water (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-cancer screening toxicity value is 1/5 the PRG (HQ = 0.2).
(7) Maximum Contaminant Level (MCL) for drinking water (USEPA, National Primary Drinking Water Regulations).
(8) Considered COPC if maximum concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screened against MCLs.
(9) Rationale Codes: ASL = above screening level
BSL = below screening level

(a) Toxicity value for cis-1,2-Dichloroethene.

TABLE 2.5
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
UPGRADIENT AREA

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwate

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Units	Location of Maximum Concentration (3)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	79-01-6	Trichloroethene	1.2	2.0	ug/L	MW-209B	1 / 4	1 - 5	2.0		1.6	c	5		Y	ASL
	7429-90-5	Aluminum	75000	96000	ug/L	TW-12	2/2	-	96000		7200	nc	NA		Y	ASL
	7440-38-2	Arsenic	3	35	ug/L	TW-12	2/2	-	35		0.05	c	50		Y	ASL
	7440-39-3	Barium	710	1200	ug/L	TW-12	2/2	-	1200		520	nc	2000		Y	ASL
	7440-41-7	Beryllium	6	7.9	ug/L	TW-12	2/2	-	7.9		15	nc	4		N	BSL
	7440-70-2	Calcium	22000	34000	ug/L	TW-12	2/2	-	34000		NA	NA	NA		N	NUT
	7440-47-3	Chromium	140	140	ug/L	TW-12	2/2	-	140		22	nc	100		Y	ASL
	7440-48-4	Cobalt	95	150	ug/L	TW-12	2/2	-	150		440	nc	NA		N	BSL
	7440-50-8	Copper	120	170	ug/L	TW-12	2/2	-	170		145	nc	1300		Y	ASL
	7439-89-6	Iron	120000	140000	ug/L	TW-12	2/2	-	140000		2200	nc	NA		N	NUT
	7439-92-1	Lead	19	24	ug/L	TW-12	2/2	-	24		NA	NA	15		Y	AMCL
	7439-95-4	Magnesium	42000	56000	ug/L	TW-12	2/2	-	56000		NA	NA	NA		N	NUT
	7439-96-5	Manganese	3400	5700	ug/L	TW-12	2/2	-	5700		176	nc	NA		Y	ASL
	7440-02-0	Nickel	130	160	ug/L	TW-12	2/2	-	160		146	nc	100		Y	ASL
	7440-09-07	Potassium	22000	25000	ug/L	TW-12	2/2	-	25000		NA	NA	NA		N	NUT
	7440-23-5	Sodium	5600	6400	ug/L	TW-12	2/2	-	6400		NA	NA	NA		N	NUT
	7440-62-2	Vanadium	230	360	ug/L	TW-12	2/2	-	360		52	nc	NA		Y	ASL
	7440-66-6	Zinc	340	500	ug/L	TW-12	2/2	-	500		2200	nc	NA		N	BSL
	7440-22-4	Silver	3	27	ug/L	TW-12	1 / 2	5.6	27		36	nc	NA		N	BSL

Notes:

(1) Minimum/maximum detected concentration.

(2) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).

(3) Location of maximum detected concentration.

(4) Because of the paucity of data for this site, maximum detected concentrations are used to screen chemicals of interest in ground water.

(5) According to USEPA, background concentrations will not be used to screen chemicals of interest.

(6) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in tap water (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-cancer screening toxicity value is 1/5 the PRG (HQ = 0.2).

(7) Maximum Contaminant Level (MCL) for drinking water (USEPA, National Primary Drinking Water Regulations).

(8) Considered COPC if maximum concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screened against MCLs.

(9) Rationale Codes:
ASL = above screening level
AMCL = above Maximum Contaminant Level
BSL = below screening level
NTX = no toxicity data
NUT = essential nutrient

NA = not available
- = historical data - detection limits not available.

TABLE 2.6
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
UPGRADIENT AREA

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier) (2)	Maximum (1) Concentration (Qualifier) (2)	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (4)	Background Value (5)	Screening Toxicity Value (6) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (7)	COPC Flag (8) (Y/N)	Rationale for Selection or Deletion (9)
Potable Water	71-55-6	1,1,1-Trichloroethane	0.5	13	2 / 11	1 - 330	13		158	nc	5		N	BSL
	540-59-0	1,2-Dichloroethene, Total	1	370	1 / 7	2 - 670	370		12(a)	nc	NA		Y	ASL
	75-15-0	Carbon disulfide	0.5	28	2 / 9	1 - 330	28		200	nc	NA		N	BSL
	67-66-3	Chloroform	0.5	1	1 / 11	1 - 330	1		0.16	c	100		Y	ASL
	156-59-2	cis-1,2-Dichloroethene	0.5	350	1 / 6	1 - 330	350		12.2	nc	70		Y	ASL
	100-41-4	Ethylbenzene	0.5	192	1 / 11	1 - 330	192		260	nc	700		N	BSL
	108-88-3	Toluene	0.5	950	1 / 11	1 - 330	950		144	nc	1000		Y	ASL
	79-01-6	Trichloroethene	0.5	3	1 / 11	1 - 330	3		1.6	c	5		Y	ASL
	7429-90-5	Aluminum	25	86000	5/5	-	86000		7200	nc	NA		Y	ASL
	7440-38-2	Arsenic	4	8.0	1 / 3	8 - 8.2	8		0.05	c	50		Y	ASL
	7440-39-3	Barium	289	2100	5/5	-	2100		520	nc	2000		Y	ASL
	7440-41-7	Beryllium	0.23	8.7	2 / 3	0.45	8.7		15	nc	4		N	BSL
	7440-70-2	Calcium	26000	87000	5/5	-	87000		NA	NA	NA		N	NUT
	7440-47-3	Chromium	6.6	120	4/4	-	120		22	nc	100		Y	ASL
	7440-48-4	Cobalt	0.9	80	3 / 4	1.8	80		440	nc	NA		N	BSL
	7440-50-8	Copper	4.8	160	3 / 4	9.5	160		280	nc	1300		N	BSL
	7439-89-6	Iron	36	120000	5/5	-	120000		2200	nc	NA		N	NUT
	7439-92-1	Lead	3.8	68	3 / 4	7.5	68		NA	NA	15		Y	AMCL
	7439-95-4	Magnesium	3250	43000	5/5	-	43000		NA	NA	NA		N	NUT
	7439-96-5	Manganese	2.9	8900	5/5	-	8900		176	nc	NA		Y	ASL
	7440-02-0	Nickel	3.5	150	4/4	-	150		146	nc	100		Y	ASL
	7440-09-7	Potassium	550	25000	4 / 5	1100	25000		NA	NA	NA		N	NUT
	7440-22-4	Silver	1.8	21	1 / 2	3.6	21		36	nc	NA		N	BSL
	7440-23-5	Sodium	5600	9600	5/5	-	9600		NA	NA	NA		N	NUT
	7440-62-2	Vanadium	1.9	300	4 / 5	3.7	300		52	nc	NA		Y	ASL
	7440-66-6	Zinc	4.6	370	3 / 5	9.2 - 110	370		2200	nc	NA		N	BSL

Notes:

(1) Minimum/maximum detected concentration.

(2) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).

(3) Location of maximum detected concentration.

(4) Because of the paucity of data for this site, maximum detected concentrations are used to screen chemicals of interest in groundwater.

(5) According to USEPA, background concentrations will not be used to screen chemicals of interest.

(6) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in tap water (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-cancer screening toxicity value is 1/5 the PRG (HQ = 0.2).

(7) Maximum Contaminant Level (MCL) for drinking water (USEPA, National Primary Drinking Water Regulations).

(8) Considered COPC if maximum concentration exceeds Region 9 PRGs. If a Region 9 PRg is not available, concentrations are screened against MCLs.

(9) Rationale Codes: ASL = above screening level
AMCL = above maximum contaminant level
BSL = below screening level
NTX = no toxicity data
NUT = essential nutrient

(a) Toxicity value for cis-1,2-Dichloroethene.

NA = not available
- = historical data - detection limits not available.

TABLE 2.7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)		Maximum (1) Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (4)	COPC Flag (5) (Y/N)	Rationale for Selection or Deletion (6)
Surface Soil	78-93-3	2-Butanone	0.0034	J	0.011		mg/kg	SB-927	10 / 14	0.0094 - 0.012	0.0072		1460	nc	NA		N	BSL
	67-64-1	Acetone	0.021	UJ	0.11		mg/kg	SB-927	13 / 14	0.019 - 0.042	0.07		320	nc	500		N	BSL
	156-59-2	cis-1,2-Dichloroethene	0.00235	U	0.0041	J	mg/kg	SB-927	1 / 13	0.0047 - 0.0058	0.0029		8.6	nc	500		N	BSL
	108-88-3	Toluene	0.0015	J	0.0025	J	mg/kg	SB-927	2 / 14	0.0047 - 0.011	0.0025		520	sat	500		N	BSL
	79-01-6	Trichloroethene	0.0023	J	0.0023	J	mg/kg	SB-927	1 / 14	0.0047 - 0.011	0.0023		2.8	c	56		N	BSL
	208-96-8	Acenaphthylene	0.046	J	0.046	J	mg/kg	SB-291	1 / 14	0.34 - 0.41	0.046		740	nc	1000		N	BSL
	120-12-7	Anthracene	0.079	J	0.079	J	mg/kg	SB-291	1 / 14	0.34 - 0.41	0.079		4400	nc	1000		N	BSL
	56-55-3	Benzo(a)anthracene	0.039	J	0.22	J	mg/kg	SB-291	6 / 14	0.34 - 0.41	0.22		0.62	c	1		N	BSL
	50-32-8	Benzo(a)pyrene	0.065	J	0.26	J	mg/kg	SB-291	4 / 14	0.34 - 0.41	0.21		0.062	c	1		Y	ASL
	205-99-2	Benzo(b)fluoranthene	0.055	J	0.25	J	mg/kg	SB-921	7 / 14	0.36 - 0.41	0.2		0.62	c	1		N	BSL
	191-24-2	Benzo(g,h,i)perylene	0.052	J	0.17	J	mg/kg	SB-921	3 / 14	0.34 - 0.41	0.17		NA	NA	NA		N	NTX
	207-08-9	Benzo(k)fluoranthene	0.05	J	0.27	J	mg/kg	SB-921	7 / 14	0.36 - 0.41	0.21		6.2	c	8.4		N	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	0.12	JB	0.23	JB	mg/kg	SB-296	12 / 14	0.34 - 0.41	0.18		35	c	44		N	BSL
	218-01-9	Chrysene	0.047	J	0.24	J	mg/kg	SB-921	6 / 14	0.34 - 0.41	0.21		62	c	NA		N	BSL
	84-74-2	Di-n-butyl phthalate	0.038	J	0.052	J	mg/kg	SB-926	2 / 14	0.34 - 0.41	0.052		1220	nc	1000		N	BSL
	206-44-0	Fluoranthene	0.062	J	0.46		mg/kg	SB-921	7 / 14	0.34 - 0.41	0.22		460	nc	1000		N	BSL
	86-73-7	Fluorene	0.042	J	0.042	J	mg/kg	SB921	1 / 14	0.34 - 0.41	0.042		520	nc	1000		N	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.046	J	0.15	J	mg/kg	SB-921	3 / 14	0.34 - 0.41	0.15		0.62	c	NA		N	BSL
	85-01-8	Phenanthrene	0.053	J	0.41		mg/kg	SB-921	5 / 14	0.34 - 0.41	0.23		NA	NA	1000		N	NTX
	129-00-0	Pyrene	0.08	J	0.67		mg/kg	SB-921	7 / 14	0.34 - 0.41	0.27		460	nc	1000		N	BSL
	11097-69-1	Aroclor-1254	0.009	U	0.12		mg/kg	SB-921	4 / 14	0.018 - 0.021	0.05		0.22	c	1		N	BSL
	11096-82-5	Aroclor-1260	0.009	U	0.11		mg/kg	SB-927	3 / 14	0.018 - 0.035	0.044		0.22	c	1		N	BSL
	1336-36-3	PCBs, Total	0.029		0.212		mg/kg	SS3-A1	4 /14	-	0.212		0.22	c	1		N	BSL
	7429-90-5	Aluminum	4650		8690		mg/kg	SB-922	4/14	2.4	8065		15200	nc	NA		N	BSL
	7440-38-2	Arsenic	0.94	B	3.6		mg/kg	SS3-A1	14 / 14	0.4	2.34		0.39 (a)	c	10		Y	ASL
	7440-39-3	Barium	17.5	B	65.6		mg/kg	SB-928	14 / 14	0.1	47		1080	nc	4700		N	BSL
	7440-41-7	Beryllium	0.105	UJ	0.48	B	mg/kg	SB-927	13 / 14	0.2 - 0.21	0.43		30	nc	2		N	BSL
	7440-43-9	Cadmium	0.055	U	0.96		mg/kg	SB-927	2 / 14	0.1 - 0.63	0.31		7.4	nc	34		N	BSL
	7440-70-2	Calcium	256	B	5970		mg/kg	SS3-A1	14 / 14	5.2	1521		NA	NA	NA		N	NUT
	7440-47-3	Chromium	3.85	U	14.4		mg/kg	SB-926	13 / 14	0.2 - 7.7	11.4		30(b)	c	100		N	BSL
	7440-48-4	Cobalt	2.8	B	11.6		mg/kg	SS3-A1	14 / 14	0.1	6.5		940	nc	NA		N	BSL
	7440-50-8	Copper	4.1		43.2		mg/kg	SS3-A1	14 / 14	0.2	15		580	nc	2500		N	BSL
	7439-89-6	Iron	7060		21800		mg/kg	SS3-A1	14 / 14	2	14194		4600	nc	NA		N	NUT
	7439-92-1	Lead	3.9	N	24.5	J	mg/kg	SS3-A1	14 / 14	0.2	13.9		80	nc	500		N	BSL

TABLE 2.7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)		Maximum (1) Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (4)	COPC Flag (5) (Y/N)	Rationale for Selection or Deletion (6)
Surface Soil	7439-95-4	Magnesium	1080		5230		mg/kg	SS3-A1	14 / 14	3.2	2793		NA	NA	NA		N	NUT
	7439-96-5	Manganese	65	N	698	N	mg/kg	SB-927	14 / 14	0.2	332		360	nc	NA		N	BSL
	7439-97-6	Mercury	0.0275	U	0.11	B	mg/kg	SB-926	7 / 14	0.05 - 0.09	0.081		4.6 (c)	nc	20		N	BSL
	7440-02-0	Nickel	4.7		11.7		mg/kg	SB-926	14 / 14	0.3	9.1		320	nc	1400		N	BSL
	7440-09-7	Potassium	313		1140		mg/kg	SB-926	14 / 14	44.7	852		NA	NA	NA		N	NUT
	7782-49-2	Selenium	0.22	U	0.68		mg/kg	SB-927	3 / 14	0.4 - 0.83	0.38		78	nc	340		N	BSL
	7440-23-5	Sodium	25.45	U	338		mg/kg	SS3-A1	4 / 14	46.7 - 53.7	86.5		NA	NA	NA		N	NUT
	7440-28-0	Thallium	0.105	U	1.2		mg/kg	SB-927	8 / 14	0.21 - 0.47	0.85		0.99 (d)	nc	5.4		N	BSL
	7440-62-2	Vanadium	10.9		41.5		mg/kg	SS3-A1	14 / 14	0.2	26.4		110	nc	470		N	BSL
	7440-66-6	Zinc	12.6		52.1		mg/kg	SS3-A1	14 / 14	0.3	30.8		4600	nc	20000		N	BSL

Notes:

(1) Minimum/maximum detected concentration.

(2) As per USEPA (1989), the concentration used for screening (exposure point concentration) is the lesser of the 95% UCL and the maximum concentration.

(3) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in residential soil (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-cancer screening toxicity value is 1/5 the PRG (HQ = 0.2).

(4) Connecticut Direct Exposure Criteria (DEC) for residential soils.

(5) Considered COPC if exposure point concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screened against Conneticut DEC.

(6) Rationale Codes:
ASL = above screening level
BSL = below screening level
NTX = no toxicity data
NUT = essential nutrient
DL5 = detection level <5%

(a) Toxicity value for arsenic (cancer endpoint).

(b) Toxicity value for chromium IV.

(c) Toxicity value for mercury and compounds.

(d) Toxicity value for thallium is adjusted from the RfD for thallium chloride.

Qualifiers
B = Organics: Indicates the analyte was found in the blanks as well as the sample. The data user should use caution when applying the results of this analyte.
B= Inorganics: Indicates analytical result between instrument detection limit (IDL) and contract required detection limit (CRDL).
J = Indicates that the compound was detected for and determined to be present in the sample below the reporting limit.
N = Spiked sample recovery not within control limits.
U = Indicates that the compound was analyzed for but not detected at the associated detection limit.
UJ = Indicates that the compound was analyzed for but not detected at the associated estimated detection limit.

TABLE 2.8
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SOLVENTS RECOVERY SYSTEM OF NEW ENGLAND, INC
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)		Maximum (1) Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (4)	COPC Flag (5) (Y/N)	Rationale for Selection or Deletion (6)
Surface Soil	108-88-3	Toluene	0.001	J	0.0036	J	mg/kg	SB-902	5 / 14	0.0048 - 0.02	0.0036		520	sat	500		N	BSL
	11096-82-5	Aroclor-1260	0.009	U	0.36	J	mg/kg	SS3-B4	5 / 14	0.018 - 0.038	0.059		0.22	c	1		N	BSL
	11097-69-1	Aroclor-1254	0.009	U	0.87	J	mg/kg	SS3-B4	4 / 14	0.018 - 0.038	0.14		0.22	c	1		N	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	0.073	JB	0.073	JB	mg/kg	SB-906	1 / 14	0.35 - 0.65	0.073		35	c	44		N	BSL
	120-12-7	Anthracene	0.076	J	0.11	J	mg/kg	SB-914	2 / 14	0.35 - 0.45	0.11		4400	nc	1000		N	BSL
	129-00-0	Pyrene	0.046	J	0.8	J	mg/kg	SS3-B4	6 / 14	0.35 - 0.45	0.45		460	nc	1000		N	BSL
	1336-36-3	PCBs, total	-	ND	1.23		mg/kg	SS3-B4	5 / 14	-	0.27		0.22	c	1		Y	ASL
	156-59-2	cis-1,2-Dichloroethene	0.0021	J	0.0021	J	mg/kg	SB-906	1 / 9	0.0048 - 0.007	0.0021		8.6	nc	500		N	BSL
	191-24-2	Benzo(g,h,I)perylene	0.175	U	0.21	J	mg/kg	SB-914	1 / 14	0.35 - 0.65	0.21		NA	NA	NA		N	NTX
	193-39-5	Indeno(1,2,3-cd)pyrene	0.16	J	0.16	J	mg/kg	SB-914	1 / 14	0.35 - 0.65	0.16		0.62	c	NA		N	BSL
	205-99-2	Benzo(b)fluoranthene	0.054	J	1.8	J	mg/kg	SS3-B4	5 / 14	0.35 - 0.45	0.46		0.62	c	1		N	BSL
	206-44-0	Flouranthene	0.045	J	1.1	J	mg/kg	SS3-B4	6 / 14	0.35 - 0.45	0.43		460	nc	1000		N	BSL
	207-08-9	Benzo(k)fluoranthene	0.056	J	1.8	J	mg/kg	SS3-B4	3 / 14	0.35 - 0.45	0.42		6.2	c	8.4		N	BSL
	208-96-8	Acenaphthylene	0.098	J	0.13	J	mg/kg	SS3-B4	2 / 14	0.35 - 0.45	0.13		740	nc	1000		N	BSL
	218-01-9	Chyrsene	0.084	J	0.6	J	mg/kg	SS3-B4	3 / 14	0.35 - 0.45	0.27		62	c	NA		N	BSL
	319-84-6	alpha-BHC	0.0003	J	0.0003	J	mg/kg	SS3-B4	1 / 5	0.0019	0.0003		0.09	c	NA		N	BSL
	50-32-8	Benzo(a)pyrene	0.038	J	0.74	J	mg/kg	SS3-B4	4 / 14	0.35 - .045	0.32		0.062	c	1		Y	ASL
	5103-71-9	alpha-Chlordane	0.00034	J	0.00034	J	mg/kg	SS3-A4	1 / 5	0.0019 - 0.003	0.00034		1.6 (a)	c	0.49		N	BSL
	56-55-3	Benzo(a)anthracene	0.066	J	0.49	J	mg/kg	SS3-B4	3 / 14	0.35 - 0.45	0.26		0.62	c	1		N	BSL
	67-64-1	Acetone	0.005	UJ	0.24		mg/kg	SB-902	9 / 14	0.01 - 0.059	0.24		320	nc	500		N	BSL
	72-54-8	4,4'-DDD	0.00027	J	0.0014	J	mg/kg	SS3-A5	2 / 5	0.0037 - 0.006	0.0014		2.4	c	NA		N	BSL
	72-55-9	4,4'-DDE	0.00031	J	0.00036	J	mg/kg	SS3-A3	2 / 5	0.0037 - 0.006	0.00036		1.7	c	NA		N	BSL
	7429-90-5	Aluminum	4770		14700		mg/kg	SS3-B4	14 / 14	2.4	10378		15200	nc	NA		N	BSL
	7439-89-6	Iron	6940		20100		mg/kg	SS3-B4	14 / 14	2	14982		4600	nc	NA		N	NUT
	7439-92-1	Lead	4.9	*N	198	J	mg/kg	SS3-B4	14 / 14	0.2	45.7		80	nc	500		N	BSL
	7439-95-4	Magnesium	1340		5170		mg/kg	SB-910	14 / 14	3.2	3305		NA	NA	NA		N	NUT
	7439-96-5	Manganese	81.2	*N	1060	J	mg/kg	SS3-B4	14 / 14	0.2	585		360	nc	NA		Y	ASL
	7439-97-6	Mercury	0.028	U	0.71		mg/kg	SS3-B4	2 / 14	0.056 - 0.11	0.12		4.6 (b)	nc	20		N	BSL
	7440-02-0	Nickel	2.55	U	67.8		mg/kg	SS3-B4	13 / 14	0.3 - 5.1	23		320	nc	1400		N	BSL
	7440-09-7	Potassium	453	B	2180		mg/kg	SB-914	14 / 14	44.7	1139		NA	NA	NA		N	NUT
	7440-22-4	Silver	0.11	U	16		mg/kg	SS3-B4	3 / 14	0.22 - 0.9	2.02		78	nc	1400		N	BSL
	7440-23-5	Sodium	25.65	U	302	B	mg/kg	SB-910	3 / 14	46.7 - 81.2	108		NA	NA	NA		N	NUT
	7440-28-0	Thallium	0.11	U	1.3	B	mg/kg	SB-914	4 / 14	0.22 - 0.55	0.73		0.99 (c)	nc	5.4		N	BSL
	7440-38-2	Arsenic	0.82	B	9.7	J	mg/kg	SS3-B4	14 / 14	0.4	3.73		0.39 (d)	c	10		Y	ASL
	7440-39-3	Barium	21	B	296		mg/kg	SS3-B4	14 / 14	0.1	120		1080	nc	4700		N	BSL
	7440-41-7	Beryllium	0.11	UJ	0.67	B	mg/kg	SB-914	9 / 14	0.2 - 0.4	0.58		30	nc	2		N	BSL
	7440-43-9	Cadmium	0.055	U	45.3		mg/kg	SS3-B4	4 / 14	0.1 - 1	20.6		7.4	nc	34		Y	ASL
	7440-47-3	Chromium	4.05	U	128		mg/kg	SS3-B4	13 / 14	0.2 - 8.1	28.5		30 (e)	c	100		N	BSL
	7440-48-4	Cobalt	3	B	12.2		mg/kg	SS3-B4	14 / 14	0.1	7.93		940	nc	NA		N	BSL

TABLE 2.8
OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
SOLVENTS RECOVERY SYSTEM OF NEW ENGLAND, INC
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)		Maximum (1) Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (4)	COPC Flag (5) (Y/N)	Rationale for Selection or Deletion (6)
Surface Soil	7440-50-8	Copper	6.4		151		mg/kg	SS3-B4	14 / 14	0.2	34.6		580	nc	2500		N	BSL
	7440-62-2	Vanadium	11.8		58		mg/kg	SS3-B4	14 / 14	0.2	34.3		110	nc	470		N	BSL
	7440-66-6	Zinc	9.7	U	204		mg/kg	SS3-B4	11 / 14	0.3 - 22.4	61.7		4600	nc	20000		N	BSL
	7440-70-2	Calcium	273	B	4620		mg/kg	SB-910	14 / 14	5.2	3328		NA	NA	NA		N	NUT
	74-83-9	Bromomethane	0.0011	J	0.0011	J	mg/kg	SB-906	1 / 14	0.0048 - 0.02	0.0011		0.78	nc	NA		N	BSL
	75-09-2	Methylene chloride	0.0011	J	0.0011	J	mg/kg	SB-906	1 / 14	0.0048 - 0.11	0.0011		8.9	c	82		N	BSL
	7782-49-2	Selenium	0.22	U	0.48	B	mg/kg	SB-906	1 / 14	0.4 - 1.5	0.44		78	nc	340		N	BSL
	78-93-3	2-Butanone	0.004	J	0.021		mg/kg	SB-902	8 / 14	0.0097 - 0.02	0.012		1460	nc	NA		N	BSL
	79-01-6	Trichloroethene	0.0012	J	0.0012	J	mg/kg	SB-906	1 / 14	0.0048 - 0.02	0.0012		2.8	c	56		N	BSL
	85-01-8	Phenanthrene	0.038	J	0.6		mg/kg	SB-914	4 / 14	0.35 - 0.45	0.35		NA	NA	1000		N	NTX
	85-68-7	Butyl benzyl phthalate	0.1145	J	0.12	J	mg/kg	SS3-B4	1 / 14	0.35 - 0.45	0.12		2400	nc	1000		N	BSL
	87-86-5	Pentachlorophenol	0.049	J	0.057	J	mg/kg	SS3-A2	1 / 14	0.89 - 1.6	0.057		3	c	5.1		N	BSL

Notes:

(1) Minimum/maximum detected concentration.

(2) As per USEPA (1989), the concentration used for screening (exposure point concentration) is the lesser of the 95% UCL and the maximum concentration.

(3) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in residential soil (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-canceer screening toxicity value is 1/5 the PRG (HQ = 0.2).

(4) Connecticut Direct Exposure Criteria (DEC) for residential soils.

(5) Considered COPC if exposure point concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screened against Connecticut DEC.

(6) Rationale codes: ASL = above screening level
BSL = below screening level
NTX = no toxicity data
NUT = essential nutrient
DL5 = detection level < 5%

sat = soil saturation limit.
(a) Toxicity value for chlordane.
(b) Toxicity value for mercury and compounds.
(C) Toxicity value for thallium is adjusted from the the RfD for thallium chloride.
(d) Toxicity value for arsenic (cancer endpoint).
(e) Toxicity value for chromium VI.

Qualifiers
B = Organics: Indicates the analyte was found in the blanks as well as the sample. The data user should use caution when applying the results of this analyte.
B= Inorganics: Indicates analytical result between instrument detection limit (IDL) and contract required detection limit (CRDL).
J = Indicates that the compound was detected for and determined to be present in the sample below the reporting limit.
N = Spiked sample recovery not within control limits.
U = Indicates that the compound was analyzed for but not detected at the associated detection limit.
UJ = Indicates that the compound was analyzed for but not detected at the associated estimated detection limit.

TABLE 2.9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)		Maximum (1) Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (4)	COPC Flag (5) (Y/N)	Rationale for Selection or Deletion (6)
Subsurface Soil	100-41-4	Ethylbenzene	0.0025	U	720		mg/kg	SC-6	26 / 32	0.005 - 86	720		230	sat	500		Y	ASL
	100-42-5	Styrene	0.0055	U	0.14	J	mg/kg	B-484	1 / 9	0.011 - 86	0.14		1700	sat	500		N	BSL
	107-02-8	Acrolein	0.025	U	0.048		mg/kg	SC-3	1 / 23	0.05 - 20	0.048		0.02	nc	NA		Y	ASL
	108-10-1	4-Methyl-2-pentanone	0.0055	U	1.4	J	mg/kg	B-484; MW-488	2 / 9	0.011 - 86	1.4		158	nc	NA		N	BSL
	108-88-3	Toluene	0.0025	U	500		mg/kg	SC-19	29 / 32	0.005 - 86	500		520	sat	500		N	BSL
	108-90-7	Chlorobenzene	0.0025	U	1.1		mg/kg	SC-9	1 / 32	0.005 - 86	1.1		30	nc	500		N	BSL
	12674-11-2	Aroclor-1016	0.019	UJ	1.2	J	mg/kg	B-15	2 / 3	0.038	1.2		0.78	nc	1		Y	ASL
	11096-82-5	Aroclor-1260	0.27	J	5	J	mg/kg	B-15	3 / 3	-	5		0.22	c	1		Y	ASL
	11097-69-1	Aroclor-1254	1.3	J	11	J	mg/kg	B-15	3 / 3	-	11		0.22	c	1		Y	ASL
	1336-36-3	PCBs, Total	1.57		17.2		mg/kg	B-15	3 / 3	-	17.2		0.22	c	1		Y	ASL
	117-81-7	bis(2-Ethylhexyl)phthalate	2.7	J	120	J*	mg/kg	B-15	3 / 3	-	120		35	c	44		Y	ASL
	117-84-0	Di-n-octyl phthalate	0.17	J	0.17	J	mg/kg	SS3-C1	1 / 3	1 - 1.3	0.17		240	nc	1000		N	BSL
	124-48-1	Chlorodibromomethane	0.0025	U	0.027		mg/kg	SC-3	1 / 32	0.005 - 86	0.027		1.1	c	7.3		N	BSL
	127-18-4	Tetrachloroethene	0.0055	U	1200		mg/kg	B-479	31 / 32	0.011	1200		5.7	c	12		Y	ASL
	129-00-0	Pyrene	0.11	J	0.11	J	mg/kg	B-8	1 / 3	0.38 - 0.75	0.11		460	nc	1000		N	BSL
	1330-20-7	Xylenes, Total	0.0055	U	1200	E	mg/kg	B-477	7 / 9	0.011 - 86	1200		210	sat	500		Y	ASL
	540-59-0	1,2-Dichloroethene, Total	0.0025	U	35		mg/kg	SP-485	12 / 32	0.005 - 2	35		8.6 (a)	nc	NA		Y	ASL
	56-23-5	Carbon tetrachloride	0.0025	U	0.01		mg/kg	SC-3	1 / 32	0.005 - 86	0.01		0.24	c	NA		N	BSL
	BBL-TEQ	2,3,7,8-TCDD	0	UJ	0.0003		mg/kg	B-15	4 / 8	-	0.0003		0.0000039	c	NA		Y	ASL
	51207-31-9	2,3,7,8-TCDF	0.000037	UJ	0.00041		mg/kg	B-15	1 / 8	0.000074 - 0.000634	0.00041		0.000039 (e)	c	NA		Y	ASL
	35822-46-9	1,2,3,4,6,7,8-HpCDD	0.0000825	UJ	0.00027	J	mg/kg	B-1	1 / 8	0.000165 - 0.0059	0.00027		0.00039 (e)	c	NA		Y	BSL
	57117-31-4	2,3,4,7,8-PeCDF	0.0000175	UJ	0.00034		mg/kg	B-15	1 / 8	0.000035 - 0.000634	0.00034		0.000008 (e)	c	NA		Y	ASL
	57117-41-6	1,2,3,7,8-PeCDF	0.0000395	UJ	0.00016		mg/kg	B-15	1 / 8	0.000079 - 0.00197	0.00016		0.000078 (e)	c	NA		Y	ASL
	57117-44-9	1,2,3,6,7,8-HxCDF	3.985E-05	UJ	0.00021		mg/kg	B-15	1 / 8	0.0000797 - 0.0101	0.00021		0.000039 (e)	c	NA		Y	ASL
	60851-34-5	2,3,4,6,7,8-HxCDF	0.000028	UJ	0.00021		mg/kg	B-15	1 / 8	0.000056 - 0.000522	0.00021		0.000039 (e)	c	NA		Y	ASL
	67562-39-4	1,2,3,4,6,7,8-HpCDF	0.000058	UJ	0.00049		mg/kg	B-15	1 / 8	0.000116 - 0.00719	0.00049		0.00039 (e)	c	NA		N	ASL
	70648-26-9	1,2,3,4,7,8-HxCDF	0.00006	UJ	0.00038		mg/kg	B-15	1 / 8	0.00012 - 0.00073	0.00038		0.000039 (e)	c	NA		Y	ASL
	67-63-0	Isopropanol	0.15	U	230		mg/kg	SC-6	11 / 23	0.3 - 20	230		NA	NA	NA		N	NTX
	67-66-3	Chloroform	0.0025	U	5.9		mg/kg	SC-19	11 / 32	0.005 - 86	5.9		0.24	c	100		Y	ASL
	71-43-2	Benzene	0.0025	U	2.9		mg/kg	SC-19	9 / 32	0.005 - 86	2.9		0.67	c	21		Y	ASL
	71-55-6	1,1,1-Trichloroethane	0.0025	U	260		mg/kg	SC-19	26 / 32	0.005 - 86	260		154	nc	500		Y	ASL
	7429-90-5	Aluminum	7910		9810		mg/kg	B-8	3 / 3	-	9810		15200	nc	NA		N	BSL
	7439-89-6	Iron	7660		13700		mg/kg	B-8	3 / 3	-	13700		4600	nc	NA		N	NUT
	7439-92-1	Lead	17.5	J	1750	J	mg/kg	B-15	3 / 3	-	1750		80	nc	500		Y	ASL
	7439-95-4	Magnesium	2670		5330		mg/kg	B-8	3 / 3	-	5330		NA	NA	NA		N	NUT
	7439-96-5	Manganese	214	J	338	J	mg/kg	B-15	3 / 3	-	338		360	nc	NA		N	BSL
	7439-97-6	Mercury	0.05	UJ Q	1.2		mg/kg	SS3-C1	1 / 3	0.1	1.2		4.6 (b)	nc	20		N	BSL
	7440-02-0	Nickel	7.05	U	14.1		mg/kg	SS3-C1	1 / 3	14.1 - 14.6	14.1		320	nc	1400		N	BSL

TABLE 2.9

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum (1) Concentration (Qualifier)		Maximum (1) Concentration (Qualifier)		Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration Used for Screening (2)	Background Value	Screening Toxicity Value (3) (N/C)		Potential ARAR/TBC Value	Potential ARAR/TBC Source (4)	COPC Flag (5) (Y/N)	Rationale for Selection or Deletion (6)
Subsurface Soil	7440-09-7	Potassium	1080	J	1350		mg/kg	B-8	3 / 3	-	1350		NA	NA	NA		N	NUT
	7440-23-5	Sodium	64.5	U	301	J	mg/kg	B-15	2 / 3	129	301		NA	NA	NA		N	NUT
	7440-38-2	Arsenic	0.83		5.5		mg/kg	SS3-C1	3 / 3	-	5.5		0.39 (c)	c	10		Y	ASL
	7440-39-3	Barium	70.5		1480		mg/kg	B-15	3 / 3	-	1480		1080	nc	4700		Y	ASL
	7440-41-7	Beryllium	0.165	UJ	0.48		mg/kg	B-15	1 / 3	0.33 - 0.46	0.48		30	nc	2		N	BSL
	7440-43-9	Cadmium	41.7		389		mg/kg	B-15	3 / 3	-	389		7.4	nc	34		Y	ASL
	7440-47-3	Chromium	13.4		79		mg/kg	B-15	3 / 3	-	79		30 (d)	c	100		Y	ASL
	7440-48-4	Cobalt	6.4		9.9		mg/kg	B-8	3 / 3	-	9.9		940	nc	NA		N	BSL
	7440-50-8	Copper	60.1	J	107		mg/kg	SS3-C1	3 / 3	-	107		580	nc	2500		N	BSL
	7440-62-2	Vanadium	16.8		30.9		mg/kg	B-8	3 / 3	-	30.9		110	nc	470		N	BSL
	7440-66-6	Zinc	48.2	J	171	J	mg/kg	B-15	3 / 3	-	171		4600	nc	20000		N	BSL
	7440-70-2	Calcium	1090	J	2010		mg/kg	B-15	3 / 3	-	2010		NA	NA	NA		N	NUT
	75-01-4	Vinyl chloride	0.0025	U	0.4	J	mg/kg	B-484	1 / 32	0.005 - 86	0.4		0.02	c	0.32		Y	ASL
	75-09-2	Methylene chloride	0.005	U	7.4		mg/kg	SC-9	16 / 32	0.01 - 86	7.4		8.9	c	82		N	BSL
	75-25-2	Bromoform	0.0025	U	0.035		mg/kg	SC-3	1 / 32	0.005 - 86	0.035		62	c	78		N	BSL
	75-34-3	1,1-Dichloroethane	0.0025	U	2.8	J	mg/kg	SP-485	4 / 32	0.005 - 86	2.8		118	nc	500		N	BSL
	75-35-4	1,1-Dichloroethene	0.0025	U	4.2		mg/kg	SC-19	2 / 32	0.005 - 86	4.2		0.05	c	1		Y	ASL
	75-69-4	Trichlorofluoromethane	0.0025	U	0.014		mg/kg	SC-3	1 / 23	0.005 - 2	0.014		78	nc	NA		N	BSL
	7782-49-2	Selenium	0.5	UJ Q	27.9	J	mg/kg	B-15	2 / 3	1	27.9		78	nc	340		N	BSL
	78-59-1	Isophorone	0.051	J	0.27	J	mg/kg	B-8	2 / 3	0.75	0.27		510	c	NA		N	BSL
	78-93-3	2-Butanone	0.005	U	44		mg/kg	SC-12	15 / 32	0.01 - 86	44		1460	nc	NA		N	BSL
	79-01-6	Trichloroethene	0.0025	U	430		mg/kg	SC-9	24 / 32	0.005 - 86	430		2.8	c	56		Y	ASL
	79-34-5	1,1,2,2-Tetrachloroethane	0.0025	U	0.022		mg/kg	SC-3	1 / 32	0.005 - 86	0.022		0.38	c	3.1		N	BSL
	84-74-2	Di-n-butyl phthalate	0.093	J	2.3	J	mg/kg	B-8	2 / 3	1.5	2.3		1220	nc	1000		N	BSL
	85-01-8	Phenanthrene	0.19	UJ	0.65	J	mg/kg	B-8	1 / 3	0.38 - 0.75	0.65		NA	NA	1000		N	NTX
	85-68-7	Butyl benzyl phthalate	1.4	J	4.2	J	mg/kg	B-8	3 / 3	-	4.2		2400	nc	1000		N	BSL
	86-73-7	Fluorene	0.069	J	0.069	J	mg/kg	B-8	1 / 3	0.38 - 0.75	0.069		520	nc	1000		N	BSL
	91-20-3	Naphthalene	0.19	UJ	0.34	J	mg/kg	B-8	1 / 3	0.38 - 0.75	0.34		11.2	nc	1000		N	BSL
	91-57-6	2-Methylnaphthalene	0.19	UJ	0.22	J	mg/kg	B-8	1 / 3	0.38 - 0.75	0.22		NA	NA	NA		N	NTX

Notes:

(1) Minimum/maximum detected concentration.

(2) As per USEPA (1989), the concentration used for screening (exposure point concentration) is the lesser of the 95% UCL and the maximum concentration.

(3) Region 9 Preliminary Remediation Goals (PRGs) for chemicals in residential soil (c = cancer based toxicity value, nc = non-cancer based toxicity value). Non-cancer screening toxicity value is 1/5 the PRG (HQ = 0.2).

(4) Connecticut Direct Exposure Criteria (DEC) for residential soils.

(5) Considered COPC if exposure point concentration exceeds Region 9 PRGs. If a Region 9 PRG is not available, concentrations are screened against Connecticut DEC.

(6) Rationale Codes:
ASL = above screening level
BSL = below screening level
NTX = no toxicity data
NUT = essential nutrient
DL5 = detection level < 5%

sat = soil saturation limit.
(a) Toxicity value for cis-1,2-Dichloroethylene.
(b) Toxicity value for mercury and compounds.
(c) Toxicity value for arsenic (cancer endpoint).
(d) Toxicity value for chromium VI.
(e) Toxicity values for dioxin congeners are derived from the Region 9 PRG for 2,3,7,8-TCDD and the World Health Organizations (WHO's) TEF values.
NA = not available

Qualifiers
E = Organics: Indicated that it exceeds calibration curve range.
J = Indicates that the compound was analyzed for and determined to be present in the sample below the reporting limit.
U = Indicates that the compound was analyzed for but not detected at the associated detection limit.
UJ = Indicates that the compound was analyzed for but not detected at the associated estimated detection limit.
* = Duplicate analysis not within control limits.

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (1)	95% UCL (2) (N/T)	Maximum Concentration (Qualifier) (3)	Exposure Point Concentration			
						Value (4)	Units	Statistic (4)	Rationale
Potable Water	1,1,1-Trichloroethane	ug/L			204000	204000	ug/L		Region 1 Policy
	1,1-Dichloroethane	ug/L			14380	14380	ug/L		Region 1 Policy
	1,1-Dichloroethene	ug/L			6910	6910	ug/L		Region 1 Policy
	2-Butanone	ug/L			470000	470000	ug/L		Region 1 Policy
	4-Methyl-2-pentanone	ug/L			57000	57000	ug/L		Region 1 Policy
	Acetone	ug/L			320000	320000	ug/L		Region 1 Policy
	Benzene	ug/L			2500	2500	ug/L		Region 1 Policy
	Chlorobenzene	ug/L			2500	2500	ug/L		Region 1 Policy
	Chloroethane	ug/L			3717	3717	ug/L		Region 1 Policy
	cis-1,2-Dichloroethene	ug/L			221250	221250	ug/L		Region 1 Policy
	Ethylbenzene	ug/L			84300	84300	ug/L		Region 1 Policy
	M,P-Xylene	ug/L			8600	8600	ug/L		Region 1 Policy
	Methylene chloride	ug/L			9000	9000	ug/L		Region 1 Policy
	O-Xylene	ug/L			3550	3550	ug/L		Region 1 Policy
	Tetrachloroethene	ug/L			14000	14000	ug/L		Region 1 Policy
	Tetrahydrofuran	ug/L			52000	52000	ug/L		Region 1 Policy
	Toluene	ug/L			132000	132000	ug/L		Region 1 Policy
	trans-1,2-Dichloroethene	ug/L			6958	6958	ug/L		Region 1 Policy
	Trichloroethene	ug/L			95000	95000	ug/L		Region 1 Policy
	Vinyl chloride	ug/L			11900	11900	ug/L		Region 1 Policy
	Xylenes, Total	ug/L			14000	14000	ug/L		Region 1 Policy
	1,2,4-Trichlorobenzene	ug/L			128	128	ug/L		Region 1 Policy
	4-Methylphenol	ug/L			1100	1100	ug/L		Region 1 Policy
	2,4-Dimethylphenol	ug/L			160	160	ug/L		Region 1 Policy
	Isophorone	ug/L			100	100	ug/L		Region 1 Policy
	Naphthalene	ug/L			128	128	ug/L		Region 1 Policy
	Aroclor-1260	ug/L			95	95	ug/L		Region 1 Policy
	Methanol	ug/L			7250	7250	ug/L		Region 1 Policy
	Aluminum	ug/L			250000	250000	ug/L		Region 1 Policy
	Arsenic	ug/L			42	42	ug/L		Region 1 Policy
	Barium	ug/L			20000	20000	ug/L		Region 1 Policy
	Beryllium	ug/L			30	30	ug/L		Region 1 Policy
	Cadmium	ug/L			46	46	ug/L		Region 1 Policy
	Chromium	ug/L			420	420	ug/L		Region 1 Policy
	1,2-Dichloroethene, total	ug/L			136625	136625	ug/L		Region 1 Policy
	Lead	ug/L			85	85	ug/L		Region 1 Policy
	Manganese	ug/L			23067	23067	ug/L		Region 1 Policy
	Nickel	ug/L			320	320	ug/L		Region 1 Policy

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (1)	95% UCL (2) (N/T)	Maximum Concentration (Qualifier) (3)	Exposure Point Concentration			
						Value (4)	Units	Statistic (4)	Rationale
Potable Water	Silver	ug/L			40	40	ug/L		Region 1 Policy
	Thallium	ug/L			2	2	ug/L		Region 1 Policy
	Vanadium	ug/L			750	750	ug/L		Region 1 Policy
	Zinc	ug/L			12000	12000	ug/L		Region 1 Policy

Notes:
(1) Arithmetic mean concentrations are not used to develop RME concentrations for groundwater.
(2) 95% UCL concentrations are not used to develop RME calculations.
(3) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).
(4) The exposure point concentration for groundwater is the highest average concentration observed from all wells, when concentrations observed in each well were averaged over the period in which the well was sampled.

TABLE 3.2.RME

EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.

OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (1)	95% UCL (2) (N/T)	Maximum Concentration (Qualifier) (3)	Exposure Point Concentration			
						Value (4)	Units	Statistic (4)	Rationale
Potable Water	1,1,1-Trichloroethane	ug/L			64238	64238	ug/L		Region 1 Policy
	1,1-Dichloroethane	ug/L			5000	5000	ug/L		Region 1 Policy
	1,1-Dichloroethene	ug/L			5100	5100	ug/L		Region 1 Policy
	1,2-Dichloroethane	ug/L			5000	5000	ug/L		Region 1 Policy
	2-Butanone	ug/L			72375	72375	ug/L		Region 1 Policy
	4-Methyl-2-pentanone	ug/L			25000	25000	ug/L		Region 1 Policy
	Acetone	ug/L			55500	55500	ug/L		Region 1 Policy
	Benzene	ug/L			5000	5000	ug/L		Region 1 Policy
	Carbon tetrachloride	ug/L			5000	5000	ug/L		Region 1 Policy
	Chlorobenzene	ug/L			5000	5000	ug/L		Region 1 Policy
	Chloroethane	ug/L			5000	5000	ug/L		Region 1 Policy
	cis-1,2-Dichloroethene	ug/L			110000	110000	ug/L		Region 1 Policy
	Ethylbenzene	ug/L			9300	9300	ug/L		Region 1 Policy
	M,P-Xylene	ug/L			18000	18000	ug/L		Region 1 Policy
	Methylene chloride	ug/L			11000	11000	ug/L		Region 1 Policy
	O-Xylene	ug/L			6600	6600	ug/L		Region 1 Policy
	Tetrachloroethene	ug/L			51000	51000	ug/L		Region 1 Policy
	Tetrahydrofuran	ug/L			50000	50000	ug/L		Region 1 Policy
	Toluene	ug/L			92000	92000	ug/L		Region 1 Policy
	trans-1,2-Dichloroethene	ug/L			5000	5000	ug/L		Region 1 Policy
	Trichloroethene	ug/L			730000	730000	ug/L		Region 1 Policy
	Vinyl chloride	ug/L			12730	12730	ug/L		Region 1 Policy
	Xylenes, Total	ug/L			25000	25000	ug/L		Region 1 Policy
	4-Methylphenol	ug/L			570	570	ug/L		Region 1 Policy
	Naphthalene	ug/L			25	25	ug/L		Region 1 Policy
	Aroclor-1254	ug/L			97	97	ug/L		Region 1 Policy
	Methanol	ug/L			9500	9500	ug/L		Region 1 Policy
	Aluminum	ug/L			430000	430000	ug/L		Region 1 Policy
	Arsenic	ug/L			49	49	ug/L		Region 1 Policy
	Barium	ug/L			12000	12000	ug/L		Region 1 Policy
	Beryllium	ug/L			52	52	ug/L		Region 1 Policy
	Cadmium	ug/L			20	20	ug/L		Region 1 Policy
	Chromium	ug/L			760	760	ug/L		Region 1 Policy
	Copper	ug/L			1600	1600	ug/L		Region 1 Policy
	1,2-Dichloroethane, total	ug/L			120000	120000	ug/L		Region 1 Policy
	Lead	ug/L			190	190	ug/L		Region 1 Policy
	Manganese	ug/L			43000	43000	ug/L		Region 1 Policy

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC.
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (1)	95% UCL (2) (N/T)	Maximum Concentration (Qualifier) (3)	Exposure Point Concentration			
						Value (4)	Units	Statistic (4)	Rationale
Potable Water	Nickel	ug/L			790	790	ug/L		Region 1 Policy
	Thallium	ug/L			3.8	3.8	ug/L		Region 1 Policy
	Vanadium	ug/L			1300	1300	ug/L		Region 1 Policy

Notes:

(1) Arithmetic mean concentrations are not used to develop RME concentrations for groundwater.

(2) 95% UCL concentrations are not used to develop RME calculations.

(3) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).

(4) The exposure point concentration for ground water is the highest average concentration observed from all wells, when concentrations observed in each well were averaged over the period in which the well was sampled.

TABLE 3.3.RME
EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
QUEENS STREET PLUME

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Potable Water	No COPC (see table 2.3)								

TABLE 3.4.RME

EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC

QUEENS STREET PLUME

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (1)	95% UCL (2) (N/T)	Maximum Concentration (Qualifier) (3)	Exposure Point Concentration			
						Value (4)	Units	Statistic (4)	Rationale (5)
Potable Water	Chloroform	ug/L			1	1	ug/L		Maximum
	Trichloroethene	ug/L			15	15	ug/L		Maximum
	cis-1,2-Dichloroethene	ug/L			15.0	15	ug/L		Maximum
	1,2-Dichloroethene, total	ug/L			15	15	ug/L		Maximum

Notes:

(1) Arithmetic mean concentrations are not used to develop RME concentrations for groundwater.

(2) 95% UCL concentrations are not used to develop RME calculations.

(3) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).

(4) The exposure point concentration for ground water is the maximum detected concentration.

(5) Because of the paucity of data, the maximum detected concentration is used, rather than the highest average concentration for a single well.

TABLE 3.5.RME

EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC

UPGRADIENT AREA

Scenario Timeframe: Future
Medium: Overburden Groundwater
Exposure Medium: Overburden Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (1)	95% UCL (2) (N/T)	Maximum Concentration (Qualifier) (3)	Exposure Point Concentration			
						Value (4)	Units	Statistic (4)	Rationale (5)
Potable Water	Trichloroethene	ug/L			2	2	ug/L		Maximum
	Aluminum	ug/L			96000	96000	ug/L		Maximum
	Arsenic	ug/L			35	35	ug/L		Maximum
	Barium	ug/L			1200	1200	ug/L		Maximum
	Chromium	ug/L			140	140	ug/L		Maximum
	Copper	ug/L			170	170	ug/L		Maximum
	Lead	ug/L			24	24	ug/L		Maximum
	Manganese	ug/L			5700	5700	ug/L		Maximum
	Nickel	ug/L			160	160	ug/L		Maximum
	Vanadium	ug/L			360	360	ug/L		Maximum

Notes:

(1) Arithmetic mean concentrations are not used to develop RME concentrations for groundwater.

(2) 95% UCL concentrations are not used to develop RME calculations.

(3) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).

(4) The exposure point concentration for ground water is the maximum detected concentration.

(5) Because of the paucity of data, the maximum detected concentration is used, rather than the highest average concentration for a single well.

TABLE 3.6.RME

EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC

UPGRADIENT AREA

Scenario Timeframe: Future
Medium: Bedrock Groundwater
Exposure Medium: Bedrock Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean (1)	95% UCL (2) (N/T)	Maximum Concentration (Qualifier) (3)	Exposure Point Concentration			
						Value (4)	Units	Statistic (4)	Rationale (5)
Potable Water	Chloroform	ug/L			1	1	ug/L		Maximum
	cis-1,2-Dichloroethene	ug/L			350	350	ug/L		Maximum
	1,2-Dichloroethene, total	ug/L			370	370	ug/L		Maximum
	Trichloroethene	ug/L			3	3	ug/L		Maximum
	Aluminum	ug/L			86000	86000	ug/L		Maximum
	Arsenic	ug/L			8.0	8.0	ug/L		Maximum
	Barium	ug/L			2100	2100	ug/L		Maximum
	Chromium	ug/L			120	120	ug/L		Maximum
	Lead	ug/L			68	68	ug/L		Maximum
	Manganese	ug/L			8900	8900	ug/L		Maximum
	Nickel	ug/L			150	150	ug/L		Maximum
	Toluene	ug/L			950	950	ug/L		Maximum
	Vanadium	ug/L			300	300	ug/L		Maximum

Notes:
(1) Arithmetic mean concentrations are not used to develop RME concentrations for groundwater.
(2) 95% UCL concentrations are not used to develop RME calculations.
(3) Data qualifiers not included (potential for more than one qualifier as a result of data spanning several years).
(4) The exposure point concentration for ground water is the maximum detected concentration.
(5) Because of the paucity of data, the maximum detected concentration is used, rather than the highest average concentration for a single well.

TABLE 3.7.RME
EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value (1)	Units	Statistic (2)	Rationale
Surface Soil	Benzo(a)pyrene	mg/kg	0.16	0.21	0.26	J	0.21	mg/kg		95% UCL
	Arsenic	mg/kg	1.7	2.34	3.6		2.34	mg/kg		95% UCL

Notes:
(1) As per USEPA (1989), the exposure point concentration is the lesser of the 95% UCL and the maximum concentration.
(2) The UCL of the arithmetic mean for a lognormal distribution was calculated according to USEPA (1992), Supplemental Guidance to RAGS: Calculating the Concentration Term.

Qualifiers:
J = Indicates that the compound was analyzed for and determined to be present in the sample below the reporting limit.

TABLE 3.8.RME
EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)		Exposure Point Concentration			
							Value (1)	Units	Statistic (2)	Rationale
Surface Soil	PCBs, total	mg/kg	0.093	0.27	1.23		0.27	mg/kg		95% UCL
	Benzo(a)pyrene	mg/kg	0.18	0.32	0.74	J	0.32	mg/kg		95% UCL
	Arsenic	mg/kg	2.11	3.73	9.7	J	3.73	mg/kg		95% UCL
	Manganese	mg/kg	324	585	1060	J	585	mg/kg		95% UCL
	Cadmium	mg/kg	0.25	20.6	45.3		20.6	mg/kg		95% UCL

Notes:

(1) As per USEPA (1989), the exposure point concentration is the lesser of the 95% UCL and the maximum concentration.

(2) The UCL of the arithmetic mean for a lognormal distribution was calculated according to USEPA (1992), Supplemental Guidance to RAGS: Calculating the Concentration Term.

Qualifiers

J = Indicates that the compound was analyzed for and determined to be present in the sample below the reporting limit.

TABLE 3.9.RME

EXPOSURE POINT CONCENTRATION SUMMARY

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC

OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value (1)	Units	Statistic (2)	Rationale
Subsurface Soil	1,1,1-Trichloroethane	mg/kg	0.84	1.1E+04	260	260	mg/kg		Maximum
	Lead	mg/kg	314	1.4E+29	1750 J	1750	mg/kg		Maximum
	Arsenic	mg/kg	2.91	1.2E+05	5.5	5.5	mg/kg		Maximum
	Barium	mg/kg	447	9.9E+12	1480	1480	mg/kg		Maximum
	Cadmium	mg/kg	170	4.8E+08	389	389	mg/kg		Maximum
	Chromium	mg/kg	37.5	1.2E+05	79	79	mg/kg		Maximum
	Vinyl chloride	mg/kg	0.12	4.1E+02	0.4 J	0.4	mg/kg		Maximum
	1,1-Dichloroethene	mg/kg	0.11	2.2E+02	4.2	4.2	mg/kg		Maximum
	Trichloroethene	mg/kg	1.15	1.4E+04	430	430	mg/kg		Maximum
	Ethylbenzene	mg/kg	3.0	9.5E+05	720	720	mg/kg		Maximum
	Aroclor-1016	mg/kg	0.17	8.0E+16	1.2 J	1.2	mg/kg		Maximum
	Aroclor-1260	mg/kg	1.44	5.1E+09	5 J	5	mg/kg		Maximum
	Aroclor-1254	mg/kg	3.05	2.7E+06	11 J	11	mg/kg		Maximum
	PCBs, total	mg/kg	4.92	1.06E+07	17.2	17.2	mg/kg		Maximum
	bis(2-Ethylhexyl)phthalate	mg/kg	16.1	1.9E+17	120 J*	120	mg/kg		Maximum
	Tetrachloroethene	mg/kg	3.9	1.1E+05	1200	1200	mg/kg		Maximum
	Xylenes, total	mg/kg	13.5	4.2E+09	1200 E	1200	mg/kg		Maximum
	Chloroform	mg/kg	0.18	250	5.9	5.9	mg/kg		Maximum
	Benzene	mg/kg	0.14	319	2.9	2.9	mg/kg		Maximum
	2,3,7,8-TCDD	mg/kg	0.000011	0.0017	0.0003	0.0003	mg/kg		Maximum
	2,3,7,8-TCDF	mg/kg	0.00013	0.00046	0.0041	0.00046	mg/kg		95% UCL
	2,3,4,7,8-PeCDF	mg/kg	0.000081	0.00097	0.00034	0.00034	mg/kg		Maximum
	1,2,3,7,8-PeCDF	mg/kg	0.00019	0.00082	0.00016	0.00016	mg/kg		Maximum
	1,2,3,6,7,8-HxCDF	mg/kg	0.00029	0.033	0.00021	0.00021	mg/kg		Maximum
	2,3,4,6,7,8-HxCDF	mg/kg	0.000085	0.00040	0.00021	0.00021	mg/kg		Maximum
	1,2,3,4,6,7,8-HpCDF	mg/kg	0.00070	0.04700	0.00049	0.00049	mg/kg		Maximum
	1,2,3,4,7,8-HxCDF	mg/kg	0.00016	0.00058	0.00038	0.00038	mg/kg		Maximum
	Acrolein	mg/kg	0.45	810	0.048	0.048	mg/kg		Maximum
	1,2-Dichloroethene, total	mg/kg	0.2	393	35	35	mg/kg		Maximum

Notes:

(1) As per USEPA (1989), the exposure point concentration is the lesser of the 95% UCL and the maximum concentration.

(2) The UCL of the arithmetic mean for a lognormal distribution was calculated according to USEPA (1992), Supplemental Guidance to RAGS: Calculating the Concentration Term.

Qualifiers

J = Indicates that the compound was analyzed for and determined to be present in the sample below the reporting limit.

E = Organics: Indicates that it exceeds the calibration curve range.

* = Duplicate analysis not within control limits.

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Potable Water	CW	Chemical concentration in water	see Table 3.1-3.6. RME	mg/kg-day	USEPA, 1989	Intake = CW*IR*EF*ED/BW*AT
				IR	Ingestion rate	2	liters/day	USEPA, 1989	
				EF	Exposure frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure duration	30	years	USEPA, 1989	
				BW	Body weight	70	kg	USEPA, 1989	
				AT	Averaging time (Carcinogenic)	25, 550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	10, 950	days	USEPA, 1989	

Sources:

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Dermal Risk Assessment Interim Guidance.

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1991. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timeframe:	Current/Future
Medium:	Surface Soil
Exposure Medium:	Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Surface soil	CS	Chemical concentration in soil	see Table 3.7.-3.8.RME			Intake = CS*IR*CF*FI*EF*ED/BW*AT
				IR	Ingestion rate	100	mg/day	USEPA, 1989	
				CF	Conversion factor	10^{-6}	kg/mg	USEPA, 1989	
				FI	Fraction ingested from contaminated source	1	unitless	USEPA, 1989	
				EF	Exposure frequency	350	days/year	USEPA, 1991; 1998	
				ED	Exposure duration	24	years	USEPA, 1989; HNUS 1994	
				BW	Body weight	70	kg	USEPA, 1989	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	Surface soil	CS	Chemical concentration in soil	see Table 3.7.-3.8.RME			Absorbed Dose = CS*CF*SA*AF*ABS*EF*ED/BW*AT
				CF	Conversion factor	10^{-6}	10^{-6} kg/mg	USEPA, 1989	
				SA	Skin surface area available for contact	5700	cm^2	USEPA, 1998	
				AF	Soil to skin adherence factor	0.07	mg/cm^2	USEPA, 1998	
				ABS	Absorption factor	(a)			
				EF	Exposure Frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure Duration	24	years	USEAP 1989; HNUS, 1994	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging Time (Non-carcinogenic)	8,760	days	USEPA, 1989	

Sources:

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1991. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Dermal Risk Assessment Interim Guidance.

HNUS, 1994. Final Remedial Investigation Report. Volume 1 of 4. Remedial Investigation/Feasibility Study. Solvents Recovery Service of New England, Inc.

(a) Chemical-specific, see notes on Table 5-1.

TABLE 4.3.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timeframe	Current/Future
Medium:	Surface Soil
Exposure Medium:	Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Surface soil	CS	Chemical concentration in soil	see Table 3.7.-3.8.RME			Intake = CS*IR*CF*FI*EF*ED/BW*AT
				IR	Ingestion rate	200	mg/day	USEPA, 1989	
				CF	Conversion factor	10^{-6}	kg/mg	USEPA, 1989	
				FI	Fraction ingested from contaminated source	1	unitless	USEPA, 1989	
				EF	Exposure frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure duration	6	years	USEPA, 1991; HNUS, 1994	
				BW	Body weight	15	kg	USEPA, 1991	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	Surface soil	CS	Chemical concentration in soil	see Table 3.7.-3.8.RME			Absorbed Dose = CS*CF*SA*AF*ABS*EF*ED/BW*AT
				CF	Conversion factor	10^{-6}	10^{-6} kg/mg	USEPA, 1989	
				SA	Skin surface area available for contact	2,900	cm^2	USEPA, 1989	
				AF	Soil to skin adherence factor	0.2	mg/cm^2	USEPA, 1998	
				ABS	Absorption factor	(a)	unitless		
				EF	Exposure frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure duration	6	years	USEPA, 1991; HNUS, 1994	
				BW	Body weight	15	kg	USEPA, 1991	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	2,190	days	USEPA, 1989	

Sources:

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1991. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Dermal Risk Assessment Interim Guidance

HNUS, 1994. Final Remedial Investigation Report. Volume 1 of 4. Remedial Investigation/Feasibility Study. Solvents Recovery Service of New England, Inc.

(a) Chemical-specific, see notes on Table 5-1.

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timefram	Current/Future
Medium:	Surface Soil
Exposure Medium:	Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational/ Trespasser	Adolescents	Surface soil	CS	Chemical concentration in soil	see Table 3.7.-3.8.RME		USEPA, 1989	Intake = CS*IR*CF*FI*EF*ED/BW*AT
				IR	Ingestion rate	100	mg/day	USEPA, 1989	
				CF	Conversion factor	10^{-6}	kg/mg	USEPA, 1989	
				FI	Fraction ingested from contaminated source	1	unitless	USEPA, 1989	
				EF	Exposure frequency	50	days/year	USEPA, 1999	
				ED	Exposure duration	12	years	HNUS, 1994	
				BW	Body weight	48	kg	USEPA, 1989	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	4,380	days	USEPA, 1989	
Dermal	Recreational/ Trespasser	Adolescents	Surface soil	CS	Chemical concentration in soil	see Table 3.1.-3.8.RME			Absorbed Dose = CS*CF*SA*AF*ABS*EF*ED/BW*AT
				CF	Conversion factor	10^{-6}	10^{-6} kg/mg	USEPA, 1989	
				SA	Skin surface area available for contact	5700	cm^2	USEPA, 1998	
				AF	Soil to skin adherence factor	0.07	mg/cm^2	USEPA, 1998	
				ABS	Absorption factor	(a)	unitless		
				EF	Exposure frequency	50	days/year	USEPA, 1999	
				ED	Exposure duration	12	years	HNUS, 1994	
				BW	Body weight	48	kg	USEPA, 1989	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	4,380	days	USEPA, 1989	

Sources:

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Dermal Risk Assessment Interim Guidance

USEPA, 1999. Suggested exposure variable, Human Health Risk Assessor, USEPA Technical Support Branch, August 6, 1999.

HNUS, 1994. Final Remedial Investigation Report. Volume 1 of 4. Remedial Investigation/Feasibility Study. Solvents Recovery Service of New England, Inc.

(a) Chemical-specific, see notes on Table 5.1.

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timefram	Current/Future
Medium:	Surface Soil
Exposure Medium:	Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Worker	Adult	Surface soil	CS	Chemical concentration in soil	see Table 3.7.-3.8.RME			Intake = CS*IR*CF*FI*EF*ED/BW*AT
				IR	Ingestion rate	100	mg/day	USEPA, 1989	
				CF	Conversion factor	10^{-6}	kg/mg	USEPA, 1989	
				FI	Fraction ingested from contaminated source	1	unitless	USEPA, 1989	
				EF	Exposure frequency	250	days/year	USEPA, 1998	
				ED	Exposure duration	25	years	USEPA, 1998	
				BW	Body weight	70	kg	USEPA, 1989	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	9,125	days	USEPA, 1989	
Dermal	Worker	Adult	Surface soil	CS	Chemical concentration in soil	see Table 3.7.-3.8.RME			Absorbed Dose = CS*CF*SA*AF*ABS*EF*ED/BW*AT
				CF	Conversion factor	10^{-6}	10^{-6} kg/mg	USEPA, 1989	
				SA	Skin surface area available for contact	2,500	cm^2	USEPA, 1998	
				AF	Soil to skin adherence factor	0.2	mg/cm^2	USEPA, 1998	
				ABS	Absorption factor	(a)	unitless		
				EF	Exposure frequency	250	days/year	USEPA, 1998	
				ED	Exposure duration	25	years	USEPA, 1998	
				BW	Body weight	70	kg	USEPA, 1989	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	9,125	days	USEPA, 1989	

Sources:

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Dermal Risk Assessment Interim Guidance

(a) Chemical-specific, see notes on Table 5.1.

TABLE 4.6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Subsurface soil	CS	Chemical concentration in soil	see Table 3.9.RME			Intake = CS*IR*CF*FI*EF*ED/BW*AT
				IR	Ingestion rate	100	mg/day	USEPA, 1989	
				CF	Conversion factor	10^{-6}	kg/mg	USEPA, 1989	
				FI	Fraction ingested from contaminated source	1	unitless	USEPA, 1989	
				EF	Exposure Frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure Duration	24	years	USEPA, 1998;HNUS 1994	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT	Averaging Time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging Time (Non-carcinogenic)	8,760	days	USEPA, 1989	
Dermal	Worker	Adult	Subsurface soil	CS	Chemical concentration in soil	see Table 3.9.RME			Absorbed Dose = CS*CF*SA*AF*ABS*EF*ED/BW*AT
				CF	Conversion factor	10^{-6}	10^{-6} kg/mg	USEPA, 1989	
				SA	Skin surface area available for contact	5700	cm^2	USEPA, 1998	
				AF	Soil to skin adherence factor	0.07	mg/cm^2	USEPA, 1998	
				ABS	Absorption factor	(a)	unitless		
				EF	Exposure Frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure Duration	24	years	USEPA, 1998;HNUS, 1994	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT	Averaging Time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging Time (Non-carcinogenic)	8,760	days	USEPA, 1989	

Sources:

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1991. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Dermal Risk Assessment Interim Guidance

HNUS, 1994. Final Remedial Investigation Report. Volume 1 of 4. Remedial Investigation/Feasibility Study. Solvents Recovery Service of New England, Inc.

(a) Chemical-specific, see notes on Table 5.1.

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timeframe Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	Subsurface Soil	CS	Chemical concentration in soil	see Table 3.9.RME			Intake = CS*IR*CF*FI*EF*ED/BW*AT
				IR	Ingestion rate	200	mg/day	USEPA, 1989	
				CF	Conversion factor	10^{-6}	kg/mg	USEPA, 1989	
				FI	Fraction ingested from contaminated source	1	unitless	USEPA, 1989	
				EF	Exposure frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure duration	6	years	USEPA, 1991; HNUS, 1994	
				BW	Body weight	15	kg	USEPA, 1991	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	Subsurface Soil	CS	Chemical concentration in soil	see Table 3.9.RME			Absorbed Dose = CS*CF*SA*AF*ABS*EF*ED/BW*AT
				CF	Conversion factor	10^{-6}	10^{-6} kg/mg	USEPA, 1989	
				SA	Skin surface area available for contact	2,900	cm^2	USEPA, 1989	
				AF	Soil to skin adherence factor	0.2	mg/cm^2	USEPA, 1998	
				ABS	Absorption factor	(a)	unitless		
				EF	Exposure frequency	350	days/year	USEPA, 1991;1998	
				ED	Exposure duration	6	years	USEPA, 1991; HNUS, 1994	
				BW	Body weight	15	kg	USEPA, 1991	
				AT	Averaging time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging time (Non-carcinogenic)	2,190	days	USEPA, 1989	

Sources:

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1991. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals).

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance Dermal Risk Assessment Interim Guidance

HNUS, 1994. Final Remedial Investigation Report. Volume 1 of 4. Remedial Investigation/Feasibility Study. Solvents Recovery Service of New England, Inc.

(a) Chemical-specific, see notes on Table 5-1.

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND. INC.

Scenario Timeframe:	Future
Medium:	Subsurface soil
Exposure Medium:	Subsurface soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Worker	Adult	Subsurface soil	CS	Chemical concentration in soil	see Table 3.9.RME			Intake = CS*IR*CF*FI*EF*ED/BW*AT
				IR	Ingestion rate	100	mg/day	USEPA, 1989	
				CF	Conversion factor	10^{-6}	kg/mg	USEPA, 1989	
				FI	Fraction ingested from contaminated source	1	unitless	USEPA, 1989	
				EF	Exposure Frequency	250	days/year	USEPA, 1998	
				ED	Exposure Duration	25	years	USEPA, 1998	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT	Averaging Time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging Time (Non-carcinogenic)	9,125	days	USEPA, 1989	
Dermal	Worker	Adult	Subsurface soil	CS	Chemical concentration in soil	see Table 3.9.RME			Absorbed Dose = CS*CF*SA*AF*ABS*EF*ED/BW*AT
				CF	Conversion factor	10^{-6}	10^{-6} kg/mg	USEPA, 1989	
				SA	Skin surface area available for contact	2,500	cm^2	USEPA, 1998	
				AF	Soil to skin adherence factor	0.2	mg/cm^2	USEPA, 1998	
				ABS	Absorption factor	(a)	unitless		
				EF	Exposure Frequency	250	days/year	USEPA, 1998	
				ED	Exposure Duration	25	years	USEPA, 1998	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT	Averaging Time (Carcinogenic)	25,550	days	USEPA, 1989	
				AT	Averaging Time (Non-carcinogenic)	9125	days	USEPA, 1989	

Sources:

USEPA, 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A).

USEPA, 1998. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual Supplemental Guidance, Dermal Risk Assessment Interim Guidance

(a) Chemical-specific, see notes on Table 5.1.

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SOLVENTS RECOVERY SYSTEM OF NEW ENGLAND, INC

Chemical of Potential Concern	Chronic/ Subchronic (1)	Oral RfD (2)		Absorption Efficiency (for Dermal) (3)	Adjusted RfD (for Dermal) (4)		Primary Target Organ(s) (1)	Combined Uncertainty/Modifying Factors (5)	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
1,1,1-Trichloroethane	-	2.80E-01	mg/kg-day	-	-	-	NA	NA	NCEA	10/1/2004
1,1-Dichloroethene	Chronic	5.00E-02	mg/kg-day	-	-	-	liver	UF=1000	IRIS	8/13/2002
1,1-Dichloroethane	--	1.00E-01	mg/kg-day	--	--	--	--	--	HEAST/Region 9	10/1/2004
1,2,4-Trichlorobenzene	Chronic	1.00E-02	mg/kg-day	-	-	-	adrenal glands	UF=1000	IRIS	11/1/1996
1,2-Dichloroethene, total	Subchronic	1.00E-02	mg/kg-day	-	-	-	blood chemistry	UF=1000	IRIS	10/1/2004
2,4-Dimethylphenol	Subchronic	2.00E-02	mg/kg-day	-	-	-	blood chemistry	UF=3000	IRIS	11/1/1990
2-Butanone	Chronic	6.00E-01	mg/kg-day	-	-	-	fetal weight	UF=3000	IRIS	9/26/2004
4-Methyl-2-pentanone	Subchronic	8.00E-02	mg/kg-day	-	-	-	liver, kidney	NA	HEAST/Region 9	10/1/2004
4-Methylphenol	Subchronic	5.00E-03	mg/kg-day	-	-	-	neurotoxicity	NA	HEAST/Region 9	10/1/2004
Acetone	Subchronic	9.00E-01	mg/kg-day	-	-	-	kidney	UF=1000	IRIS	7/31/2003
Acrolein	Subchronic	5.00E-04	mg/kg-day	-	-	-	decreased survival	UF=100	IRIS	6/3/2003
Aroclor-1016	Chronic	7.00E-05	mg/kg-day	-	-	-	fetal weight	UF=100	IRIS	6/1/1994
Aroclor-1254	Chronic	2.00E-05	mg/kg-day	-	-	-	immune system	UF=300	IRIS	6/1/1994
Arsenic	Chronic	3.00E-04	mg/kg-day	-	-	-	skin	UF=3	IRIS	6/1/1995
Barium	Subchronic/Chronic	7.00E-02	mg/kg-day	0.07	4.9E-03	mg/kg-day	kidney	UF=3	IRIS	1/21/1999
Benzene		4.00E-03	mg/kg-day				decreased lymphocyte count	UF=300	IRIS	4/17/2003
Beryllium	Chronic	2.00E-03	mg/kg-day	0.007	1.4E-05	mg/kg-day	small intestine	UF=300	IRIS	4/3/1998
bis(2-Ethylhexyl)phthalate	Chronic	2.00E-02	mg/kg-day	-	-	-	liver	UF=1000	IRIS	5/1/1991
Cadmium (a)	Chronic	5.00E-04	mg/kg-day	--	--	--	kidney	UF = 10	IRIS	2/1/1994
Cadmium (b)	Chronic	1.00E-03	mg/kg-day	0.025	2.5E-05	mg/kg-day	kidney	UF=10	IRIS	2/1/1994
Carbon tetrachloride	Subchronic	7.00E-04	mg/kg-day	-	-	-	liver	UF=1000	IRIS	6/1/1991
Chlorobenzene	Subchronic	2.00E-02	mg/kg-day	-	-	-	liver	UF=1000	IRIS	4/1/1993
Chloroethane	-	4.00E-01	mg/kg-day	-	-	-	-	-	NCEA/ Region 9	10/1/2004
Chloroform	Chronic	1.00E-02	mg/kg-day	-	-	-	liver	UF=1000	IRIS	10/19/2001
Chromium (d)	Chronic	3.00E-03	mg/kg-day	0.025	7.5E-05	mg/kg-day	none *	UF=300	IRIS	9/3/1998
cis-1,2-Dichloroethene	Subchronic	1.00E-02	mg/kg-day	-	-	-	blood chemistry	NA	PPRTV/Region 9	10/1/2004
Copper	-	4.00E-02	mg/kg-day	-	-	-	-	-	HEAST/Region 9	10/1/2004
Ethylbenzene	Subchronic	1.00E-01	mg/kg-day	-	-	-	liver,kidney	UF=1000	IRIS	6/1/1991
Isophorone	Subchronic	2.00E-01	mg/kg-day	-	-	-	kidney	UF=1000	IRIS	1/1/1991
Lead (c)	-	-	-	-	-	-	--	--	--	--
M,P-Xylene (e)	Chronic	2.00E-01	mg/kg-day	-	-	-	body weight	UF=100	IRIS	2/21/2003

TABLE 5.1
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SOLVENTS RECOVERY SYSTEM OF NEW ENGLAND, INC

Chemical of Potential Concern	Chronic/ Subchronic (1)	Oral RfD (2)		Absorption Efficiency (for Dermal) (3)	Adjusted RfD (for Dermal) (4)		Primary Target Organ(s) (1)	Combined Uncertainty/Modifying Factors (5)	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Manganese (b)	Chronic	7.00E-02	mg/kg-day	0.04	2.8E-03	mg/kg-day	CNS	--	EPA-Recommened	12/2005
Manganese (a)	Chronic	2.40E-02	mg/kg-day	--	--	--	CNS	--	EPA-Recommened	12/2005
Methanol	Subchronic	5.00E-01	mg/kg-day	-	-	-	brain weight	UF=1000	IRIS	7/1/1993
Methylene chloride	Chronic	6.00E-02	mg/kg-day	-	-	-	liver	UF=100	IRIS	3/1/1998
Naphthalene	Subchronic	2.00E-02	mg/kg-day	-	-	-	body weight	UF=3000	IRIS	9/17/1998
Nickel	Chronic	2.00E-02	mg/kg-day	0.04	8.0E-04	mg/kg-day	body and organ weight	UF=300	IRIS	12/1/1996
O-Xylene (e)	Chronic	2.00E-01	mg/kg-day	-	-	-	body weight	UF=100	IRIS	2/21/2003
Silver	Chronic	5.00E-03	mg/kg-day	0.04	2.0E-04	mg/kg-day	skin	UF=3	IRIS	12/1/1996
Tetrachloroethene	Chronic	1.00E-02	mg/kg-day	-	-	-	liver	UF=1000	IRIS	3/1/1998
Tetrahydrofuran	-	2.10E-01	mg/kg-day	-	-	-	-	-	NCEA/Region 9	10/1/2004
Thallium (f)	Subchronic	6.60E-05	mg/kg-day	-	-	-	none	UF=3000	IRIS	9/1/1990
Toluene	Subchronic	2.00E-01	mg/kg-day	-	-	-	liver,kidney	UF=1000	IRIS	10/1/2004
trans-1,2-Dichloroethene	Subchronic	2.00E-02	mg/kg-day	-	-	-	blood chemistry	UF=1000	IRIS	1/1/1989
Vanadium	Chronic	7.00E-03	mg/kg-day	0.026	1.8E-04	mg/kg-day	--	NA	NCEA/PRG	10/1/2004
Viny Chloride		3.00E-03	mg/kg-day				liver	UF=30	IRIS	8/7/2000
Xylenes, total	Chronic	2.00E-01	mg/kg-day	-	-	-	body weight	UF=100	IRIS	2/21/2003
Zinc	Subchronic	3.00E-01	mg/kg-day	-	-	-	blood chemistry	UF=3	IRIS	10/1/1992

Notes:
(1) As reported in the oral RfD summary (IRIS) and oral RfD basis (EHRAV).
(2) Toxicity reference values from USEPA's Integrated Risk Information System (IRIS), and HEAST, NCEA, and PPTRV values as presented in the USEPA Region 9 Preliminary Remediation Goals (PRGs).
The Risk Assessment Information System (RAIS) was also consulted (www.risk.lsd.oml.gov/tox/tox_values) and contains toxicity reference values from IRIS, HEAST and other information sources.
(3) Dermal risk evaluated for COPC in soils only. Dermal absorption efficiencies listed in this table and dermal absorption factors (listed below) are those summarized in the Draft Dermal Absorption Guidance (USEPA, 1998).
(4) Adjusted RfD = RfD * Absorption Efficiency
(5) As listed in the IRIS Oral RfD summary.
Oral Rfd for manganese as recommended by USEPA (USEPA comments - Dec 20, 2005).

(a) Oral RfD for water exposure.
(b) Oral RfD for dietary exposure.
(c) No toxicity data.
(d) Toxicity value for Chromium VI
(e) Toxicity data for xylene
(f) Toxicity data adjusted from the RfD for thallium chloride

* No critical effect reported.

Dermal Absortion Factors used in Risk Calculations
PCBs = 0.14
PAHs = 0.13
Dioxins = 0.03
Arsenic = 0.03
Cadmium = 0.01

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
SOLVENTS RECOVERY SYSTEM OF NEW ENGLAND, INC.

Chemical of Potential Concern	Oral Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description (3)	Oral CSF:Absorption Efficiency	
	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
1,1,1-Trichloroethane (a)	-	-	D	IRIS	8/1/1991
1,1-Dichloroethene (a)	-	-	C	IRIS	8/13/2002
1,2-Dichloroethane	9.10E-02	(mg/kg-day)-1	B2	IRIS	1/1/1991
2,3,7,8-TCDD	1.50E+05	(mg/kg-day)-1	B2	(HEAST)	7/31/1999
2,3,7,8-TCDF	1.50E+04	(mg/kg-day)-1	B2	(HEAST), WHO TEF (4)	7/31/99, 12/98
2,3,4,7,8-PeCDF	7.50E+04	(mg/kg-day)-1	B2	(HEAST), WHO TEF (4)	7/31/99, 12/98
1,2,3,7,8-PeCDF	7.50E+03	(mg/kg-day)-1	B2	(HEAST), WHO TEF (4)	7/31/99, 12/98
1,2,3,6,7,8-HxCDF	1.50E+04	(mg/kg-day)-1	B2	(HEAST), WHO TEF (4)	7/31/99, 12/98
2,3,4,6,7,8-HxCDF	1.50E+04	(mg/kg-day)-1	B2	(HEAST), WHO TEF (4)	7/31/99, 12/98
1,2,3,4,6,7,8-HpCDF	1.50E+03	(mg/kg-day)-1	B2	(HEAST), WHO TEF (4)	7/31/99, 12/98
1,2,3,4,7,8-HxCDF	1.50E+04	(mg/kg-day)-1	B2	(HEAST), WHO TEF (4)	7/31/99, 12/98
Aroclor-1016 (b)	7.00E-02	(mg/kg-day)-1	B2	IRIS	12/15/1999
Aroclor-1254 (b)	2.00E+00	(mg/kg-day)-1	B2	IRIS	12/15/1999
Aroclor-1254 (d)	4.00E-01	(mg/kg-day)-1	B2	IRIS	12/15/1999
Aroclor-1260 (b)	2.00E+00	(mg/kg-day)-1	B2	IRIS	12/15/1999
Aroclor-1260 (d)	4.00E-01	(mg/kg-day)-1	B2	IRIS	12/15/1999
Arsenic	1.50E+00	(mg/kg-day)-1	A	IRIS	6/1/1995
Benzene	5.50E-02	(mg/kg-day)-1	A	IRIS	4/17/2003
Benzo(a)pyrene	7.30E+00	(mg/kg-day)-1	B2	IRIS	3/31/1987
bis(2-Ethylhexyl)phthalate	1.40E-02	(mg/kg-day)-1	B2	IRIS	2/1/1993
Carbon tetrachloride	1.30E-01	(mg/kg-day)-1	B2	IRIS	6/1/1991
Chloroethane	2.90E-03	(mg/kg-day)-1	-	NCEA/Region 9	10/1/1991
Chloroform	1.00E-02	(mg/kg-day)-1	B2	IRIS	10/19/2001
Copper (c)	-	-	-	-	-
Isophorone	9.50E-04	(mg/kg-day)-1	C	IRIS	10/1/1992
Lead (c)	-	-	-	-	-
Methylene chloride	7.50E-03	(mg/kg-day)-1	B2	IRIS	1/1/1991
PCBs, total (b)	2.00E+00	(mg/kg-day)-1	B2	IRIS	12/15/1999
PCBs, total (d)	4.00E-01	(mg/kg-day)-1	B2	IRIS	12/15/1999
Tetrachloroethene	5.40E-01	(mg/kg-day)-1		Cal-Modified/Region 9	10/1/2004
Tetrahydrofuran	7.60E-03	(mg/kg-day)-1	-	NCEA/Region 9	10/1/2004
Trichloroethene	4.00E-01	(mg/kg-day)-1	NA	NCEA/Region 9	10/1/2004
Vinyl chloride	7.20E-01	(mg/kg-day)-1	A	IRIS	8/7/2000

Notes:
(1) Toxicity reference values from USEPA's Integrated Risk Information System (IRIS), and HEAST, NCEA, and PPTRV values as presented in the USEPA Region 9 Preliminary Remediation Goals (PRGs).
The Risk Assessment Information System (RAIS) was also consulted (www.risk.lsd.oml.gov/tox/tox_values) and contains toxicity reference values from IRIS, HEAST and other information sources.
(2) Dermal risk evaluated for COPC's in soils only. COPCs listed in this table do not require adjustment of the oral slope factor for dermal risk evaluations.
(3) Weight-of-Evidence/Cancer Guideline information obtained from IRIS and RAIS (October 1999).
(4) Oral cancer slope factor for dioxin congeners is the cancer slope factor for 2,3,7,8-TCDD muliplied by the World Health Organization's (WHO's) congener-specific toxicity equivalency factors (TEFs).
(The uncertainty section of this risk assessment update describes the USEPA-proposed dioxin cancer slope factor of 1 x $10^{6.)}$
(a) No toxicity data. Oral SF removed from IRIS
(b) Upper-bound slope factor for total PCB (soil ingestion)
(c) No toxicity data
(d) Upper-bound slope factor for total PCB for ingestion of water-soluble congeners.

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Overburden Groundwater	Overburden Groundwater	Potable Water	Ingestion	1,1,1-Trichloroethane	2.04E+02	mg/L	2.4E+00	mg/kg-day	NTX	-	NA	5.6E+00	mg/kg-day	2.8E-01	mg/kg-day	2.E+01
				1,1-Dichloroethane	1.44E+01	mg/L	1.7E-01	mg/kg-day	NTX	-	NA	3.9E-01	mg/kg-day	1.0E-01	mg/kg-day	4.E+00
				1,1-Dichloroethene	6.91E+00	mg/L	8.1E-02	mg/kg-day	NTX	-	NA	1.9E-01	mg/kg-day	5.0E-02	mg/kg-day	4.E+00
				1,2-Dichlorethene,total	1.37E+02	mg/L	1.6E+00	mg/kg-day	NTX	-	NA	3.7E+00	mg/kg-day	1.0E-02	mg/kg-day	4.E+02
				1,2,4-Trichlorobenzene	1.28E-01	mg/L	1.5E-03	mg/kg-day	NTX	-	NA	3.5E-03	mg/kg-day	1.0E-02	mg/kg-day	4.E-01
				2,4-Dimethylphenol	1.60E-01	mg/L	1.9E-03	mg/kg-day	NTX	-	NA	4.4E-03	mg/kg-day	2.0E-02	mg/kg-day	2.E-01
				2-Butanone	4.70E+02	mg/L	5.5E+00	mg/kg-day	NTX	-	NA	1.3E+01	mg/kg-day	6.0E-01	mg/kg-day	2.E+01
				4-Methyl-2-pentanone	5.70E+01	mg/L	6.7E-01	mg/kg-day	NTX	-	NA	1.6E+00	mg/kg-day	8.0E-02	mg/kg-day	2.E+01
				4-Methylphenol	1.10E+00	mg/L	1.3E-02	mg/kg-day	NTX	-	NA	3.0E-02	mg/kg-day	5.0E-03	mg/kg-day	6.E+00
				Acetone	3.20E+02	mg/L	3.8E+00	mg/kg-day	NTX	-	NA	8.8E+00	mg/kg-day	9.0E-01	mg/kg-day	1.E+01
				Aluminum	2.50E+02	mg/L	2.9E+00	mg/kg-day	NTX	-	NA	6.9E+00	mg/kg-day	NTX	-	NA
				Aroclor-1260	9.45E-02	mg/L	1.1E-03	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.E-04	2.6E-03	mg/kg-day	NTX	-	NA
				Arsenic	4.20E-02	mg/L	4.9E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	7.E-04	1.2E-03	mg/kg-day	3.0E-04	mg/kg-day	4.E+00
				Barium	2.00E+01	mg/L	2.4E-01	mg/kg-day	NTX	-	NA	5.5E-01	mg/kg-day	7.0E-02	mg/kg-day	8.E+00
				Benzene	2.50E+00	mg/L	2.9E-02	mg/kg-day	5.5E-02	(mg/kg-day)-1	2.E-03	6.9E-02	mg/kg-day	4.0E-03	mg/kg-day	2.E+01
				Beryllium	3.00E-02	mg/L	3.5E-04	mg/kg-day	NTX	-	NA	8.2E-04	mg/kg-day	2.0E-03	mg/kg-day	4.E-01
				Cadmium	4.60E-02	mg/L	5.4E-04	mg/kg-day	NTX	-	NA	1.3E-03	mg/kg-day	5.0E-04	mg/kg-day	3.E+00
				Chlorobenzene	2.50E+00	mg/L	2.9E-02	mg/kg-day	NTX	-	NA	6.8E-02	mg/kg-day	2.0E-02	mg/kg-day	3.E+00
				Chloroethane	3.72E+00	mg/L	4.4E-02	mg/kg-day	2.9E-03	(mg/kg-day)-1	1.E-04	1.0E-01	mg/kg-day	4.0E-01	mg/kg-day	3.E-01
				Chromium	4.20E-01	mg/L	4.9E-03	mg/kg-day	NTX	-	NA	1.2E-02	mg/kg-day	3.0E-03	mg/kg-day	4.E+00
				cis-1,2-Dichloroethene	2.21E+02	mg/L	2.6E+00	mg/kg-day	NTX	-	NA	6.1E+00	mg/kg-day	1.0E-02	mg/kg-day	6.E+02
				Ethylbenzene	8.43E+01	mg/L	9.9E-01	mg/kg-day	NTX	-	NA	2.3E+00	mg/kg-day	1.0E-01	mg/kg-day	2.E+01
				Isophorone	1.00E-01	mg/L	1.2E-03	mg/kg-day	9.5E-04	(mg/kg-day)-1	1.E-06	2.7E-03	mg/kg-day	2.0E-01	mg/kg-day	1.E-02
				Lead	8.50E-02	mg/L	9.9E-04	mg/kg-day	NTX	-	NA	2.3E-03	mg/kg-day	NTX	-	NA
				M,P-Xylene	8.60E+00	mg/L	1.0E-01	mg/kg-day	NTX	-	NA	2.4E-01	mg/kg-day	2.0E-01	mg/kg-day	1.E+00
				Manganese	2.31E+01	mg/L	2.7E-01	mg/kg-day	NTX	-	NA	6.3E-01	mg/kg-day	2.4E-02	mg/kg-day	3.E+01
				Methanol	7.25E+00	mg/L	8.5E-02	mg/kg-day	NTX	-	NA	2.0E-01	mg/kg-day	5.0E-01	mg/kg-day	4.E-01
				Methylene chloride	9.00E+00	mg/L	1.1E-01	mg/kg-day	7.5E-03	(mg/kg-day)-1	8.E-04	2.5E-01	mg/kg-day	6.0E-02	mg/kg-day	4.E+00
				Naphthalene	1.28E-01	mg/L	1.5E-03	mg/kg-day	NTX	-	NA	3.5E-03	mg/kg-day	2.0E-02	mg/kg-day	2.E-01
				Nickel	3.20E-01	mg/L	3.8E-03	mg/kg-day	NTX	-	NA	8.8E-03	mg/kg-day	2.0E-02	mg/kg-day	4.E-01
				O-Xylene	3.55E+00	mg/L	4.2E-02	mg/kg-day	NTX	-	NA	9.7E-02	mg/kg-day	2.0E-01	mg/kg-day	5.E-01
				Silver	4.00E-02	mg/L	4.7E-04	mg/kg-day	NTX	-	NA	1.1E-03	mg/kg-day	5.0E-03	mg/kg-day	2.E-01
				Tetrachloroethene	1.40E+01	mg/L	1.6E-01	mg/kg-day	5.4E-01	-	8.E-02	3.8E-01	mg/kg-day	1.0E-02	mg/kg-day	4.E+01
				Tetrahydrofuran	5.20E+01	mg/L	6.1E-01	mg/kg-day	7.6E-03	(mg/kg-day)-1	5.E-03	1.4E+00	mg/kg-day	2.1E-01	mg/kg-day	7.E+00
				Toluene	1.32E+02	mg/L	1.6E+00	mg/kg-day	NTX	-	NA	3.6E+00	mg/kg-day	2.0E-01	mg/kg-day	2.E+01
				trans-1,2-Dichloroethene	6.96E+00	mg/L	8.2E-02	mg/kg-day	NTX	-	NA	1.9E-01	mg/kg-day	2.0E-02	mg/kg-day	1.E+01
				Trichloroethene	9.50E+01	mg/L	1.1E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.E-01	2.6E+00	mg/kg-day	NTX	-	NA
				Thallium	2.00E-03	mg/L	2.4E-05	mg/kg-day	NTX	-	NA	5.5E-05	mg/kg-day	6.6E-05	mg/kg-day	8.E-01
				Vanadium	7.50E-01	mg/L	8.8E-03	mg/kg-day	NTX	-	NA	2.1E-02	mg/kg-day	7.0E-03	mg/kg-day	3.E+00
				Vinyl chloride	1.19E+01	mg/L	--	mg/kg-day	7.2E-01	(mg/kg-day)-1	7.E-01	3.3E-01	mg/kg-day	3.0E-03	mg/kg-day	1.E+02
				Xylenes, total	1.40E+01	mg/L	1.6E-01	mg/kg-day	NTX	-	NA	3.8E-01	mg/kg-day	2.0E-01	mg/kg-day	2.E+00
				Zinc	1.20E+01	mg/L	1.4E-01	mg/kg-day	NTX	(mg/kg-day)-1	NA	3.3E-01	mg/kg-day	3.0E-01	mg/kg-day	1.E+00
			Exp. Route Total								1.E+00					1.E+03
		Exposure Point Total									1.E+00					1.E+03

Notes:

NTX = no toxicity data

NA = not available

One-hit equation (USEPA, 1989) used to derive cancer risk for trichloroethene and tetrachloroethene.

Cancer risk for vinyl chloride calculated using methods outlined in USEPA (2000) *Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on the Integrated Risk Information System).*

Total Adult Resident Risk for Overburden Groundwater	1.E+00
Total Adult Resident Hazard for Overburden Groundwater	1.E+03

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Bedrock Groundwater	Bedrock Grounndwater	Potable Water	Ingestion	1,1,1-Trichloroethane	6.42E+01	mg/L	7.5E-01	mg/kg-day	NTX	-	NA	1.8E+00	mg/kg-day	2.8E-01	mg/kg-day	6.E+00
				1,1-Dichloroethane	5.00E+00	mg/L	5.9E-02	mg/kg-day	NTX	-	NA	1.4E-01	mg/kg-day	1.0E-01	mg/kg-day	1.E+00
				1,1-Dichloroethene	5.10E+00	mg/L	6.0E-02	mg/kg-day	NTX	-	NA	1.4E-01	mg/kg-day	5.0E-02	mg/kg-day	3.E+00
				1,2-Dichloroethane	5.00E+00	mg/L	5.9E-02	mg/kg-day	9.1E-02	(mg/kg-day)-1	5.E-03	1.4E-01	mg/kg-day	NTX	-	NA
				1,2-Dichlorethene,total	1.20E+02	mg/L	1.41E+00	mg/kg-day	NTX	-	NA	3.3E+00	mg/kg-day	1.0E-02	mg/kg-day	3.E+02
				2-Butanone	7.24E+01	mg/L	8.5E-01	mg/kg-day	NTX	-	NA	2.0E+00	mg/kg-day	6.0E-01	mg/kg-day	3.E+00
				4-Methyl-2-pentanone	2.50E+01	mg/L	2.9E-01	mg/kg-day	NTX	-	NA	6.8E-01	mg/kg-day	8.0E-02	mg/kg-day	9.E+00
				4-Methylphenol	5.70E-01	mg/L	6.7E-03	mg/kg-day	NTX	-	NA	1.6E-02	mg/kg-day	5.0E-03	mg/kg-day	3.E+00
				Acetone	5.55E+01	mg/L	6.5E-01	mg/kg-day	NTX	-	NA	1.5E+00	mg/kg-day	9.0E-01	mg/kg-day	2.E+00
				Aluminum	4.30E+02	mg/L	5.1E+00	mg/kg-day	NTX	-	NA	1.2E+01	mg/kg-day	NTX	-	NA
				Aroclor 1254	9.65E-02	mg/L	1.1E-03	mg/kg-day	4.0E-01	(mg/kg-day)-1	4.E-04	2.6E-03	mg/kg-day	2.0E-05	mg/kg-day	1.E+02
				Arsenic	4.90E-02	mg/L	5.7E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.E-04	1.3E-03	mg/kg-day	3.0E-04	mg/kg-day	4.E+00
				Barium	1.20E+01	mg/L	1.4E-01	mg/kg-day	NTX	-	NA	3.3E-01	mg/kg-day	7.0E-02	mg/kg-day	5.E+00
				Benzene	5.00E+00	mg/L	5.9E-02	mg/kg-day	5.5E-02	(mg/kg-day)-1	3.E-03	1.4E-01	mg/kg-day	4.0E-03	mg/kg-day	3.E+01
				Beryllium	5.20E-02	mg/L	6.1E-04	mg/kg-day	NTX	-	NA	1.4E-03	mg/kg-day	2.0E-03	mg/kg-day	7.E-01
				Cadmium	2.00E-02	mg/L	2.3E-04	mg/kg-day	NTX	-	NA	5.5E-04	mg/kg-day	5.0E-04	mg/kg-day	1.E+00
				Carbon tetrachloride	5.00E+00	mg/L	5.9E-02	mg/kg-day	1.3E-01	(mg/kg-day)-1	8.E-03	1.4E-01	mg/kg-day	7.0E-04	mg/kg-day	2.E+02
				Chlorobenzene	5.00E+00	mg/L	5.9E-02	mg/kg-day	NTX	-	NA	1.4E-01	mg/kg-day	2.0E-02	mg/kg-day	7.E+00
				Chloroethane	5.00E+00	mg/L	5.9E-02	mg/kg-day	2.9E-03	(mg/kg-day)-1	2.E-04	1.4E-01	mg/kg-day	4.0E-01	mg/kg-day	3.E-01
				Chromium	7.60E-01	mg/L	8.9E-03	mg/kg-day	NTX	-	NA	2.1E-02	mg/kg-day	3.0E-03	mg/kg-day	7.E+00
				cis-1,2-Dichloroethene	1.10E+02	mg/L	1.3E+00	mg/kg-day	NTX	-	NA	3.0E+00	mg/kg-day	1.0E-02	mg/kg-day	3.E+02
				Copper	1.60E+00	mg/L	1.9E-02	mg/kg-day	NTX	-	NA	4.4E-02	mg/kg-day	4.0E-02	mg/kg-day	1.E+00
				Ethylbenzene	9.30E+00	mg/L	1.1E-01	mg/kg-day	NTX	-	NA	2.5E-01	mg/kg-day	1.0E-01	mg/kg-day	3.E+00
				Lead	1.90E-01	mg/L	2.2E-03	mg/kg-day	NTX	-	NA	5.2E-03	mg/kg-day	NTX	mg/kg-day	NA
				M,P-Xylene	1.80E+01	mg/L	2.1E-01	mg/kg-day	NTX	-	NA	4.9E-01	mg/kg-day	2.0E-01	mg/kg-day	2.E+00
				Manganese	4.30E+01	mg/L	5.0E-01	mg/kg-day	NTX	-	NA	1.2E+00	mg/kg-day	2.4E-02	mg/kg-day	5.E+01
				Methanol	9.50E+00	mg/L	1.1E-01	mg/kg-day	NTX	-	NA	2.6E-01	mg/kg-day	5.0E-01	mg/kg-day	5.E-01
				Methylene chloride	1.10E+01	mg/L	1.3E-01	mg/kg-day	7.5E-03	(mg/kg-day)-1	1.E-03	3.0E-01	mg/kg-day	6.0E-02	mg/kg-day	5.E+00
				Naphthalene	2.50E-02	mg/L	2.9E-04	mg/kg-day	NTX	-	NA	6.8E-04	mg/kg-day	2.0E-02	mg/kg-day	3.E-02
				Nickel	7.90E-01	mg/L	9.3E-03	mg/kg-day	NTX	-	NA	2.2E-02	mg/kg-day	2.0E-02	mg/kg-day	1.E+00
				O-Xylene	6.60E+00	mg/L	7.8E-02	mg/kg-day	NTX	-	NA	1.8E-01	mg/kg-day	2.0E-01	mg/kg-day	9.E-01
				Tetrachloroethene	5.10E+01	mg/L	6.0E-01	mg/kg-day	5.4E-01	-	3.E-01	1.4E+00	mg/kg-day	1.0E-02	mg/kg-day	1.E+02
				Tetrahydrofuran	5.00E+01	mg/L	5.9E-01	mg/kg-day	7.6E-03	(mg/kg-day)-1	4.E-03	1.4E+00	mg/kg-day	2.1E-01	mg/kg-day	7.E+00
				Thallium	3.80E-03	mg/L	4.5E-05	mg/kg-day	NTX	-	NA	1.0E-04	mg/kg-day	6.6E-05	mg/kg-day	2.E+00
				Toluene	9.20E+01	mg/L	1.1E+00	mg/kg-day	NTX	-	NA	2.5E+00	mg/kg-day	2.0E-01	mg/kg-day	1.E+01
				trans-1,2-Dichloroethene	5.00E+00	mg/L	5.9E-02	mg/kg-day	NTX	-	NA	1.4E-01	mg/kg-day	2.0E-02	mg/kg-day	7.E+00
				Trichloroethene	7.30E+02	mg/L	8.6E+00	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.E+00	2.0E+01	mg/kg-day	NTX	-	NA
				Vanadium	1.30E+00	mg/L	1.5E-02	mg/kg-day	NTX	-	NA	3.6E-02	mg/kg-day	7.0E-03	mg/kg-day	5.E+00
				Vinyl chloride	1.27E+01	mg/L	--	mg/kg-day	7.2E-01	(mg/kg-day)-1	7.E-01	3.5E-01	mg/kg-day	3.0E-03	mg/kg-day	1.E+02
				Xylenes, total	2.50E+01	mg/L	2.9E-01	mg/kg-day	NTX	-	NA	6.9E-01	mg/kg-day	2.0E-01	mg/kg-day	3.E+00
			Exp. Route Total								2.E+00					1.E+03
		Exposure Point Total									2.E+00					1.E+03

Notes:

NTX = no toxicity data

NA = not available

One-hit equation (USEPA, 1989) used to derive cancer risk for trichloroethene and tetrachloroethene.

Cancer risk for vinyl chloride calculated using methods outlined in USEPA (2000) *Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on the Integrated Risk Information System).*

Total Adult Resident Risk for Bedrock Groundwater.	2.E+00	Total Adult Resident Hazard for Bedrock Groundwater	1.E+03

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
QUEEN STREET PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Overburden Groundwater	Overburden Groundwater	Potable Water	Ingestion	No COPC (see Table 2.3)												
			Exp. Route Total													
		Exposure Point Total														

Total of Adult Resident Risk for Overburden Groundwater

Total Adult Resident Hazards for Overburden Groundwater

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
QUEEN STREET PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Bedrock Groundwater	Bedrock Groundwater		Ingestion	Chloroform	1.00E-03	mg/L	1.17E-05	mg/kg-day	1.00E-02	(mg/kg-day)-1	1.E-07	2.7E-05	mg/kg-day	1.0E-02	mg/kg-day	3.E-03
				Trichloroethene	1.50E-02	mg/L	1.76E-04	mg/kg-day	4.00E-01	(mg/kg-day)-1	7.E-05	4.1E-04	mg/kg-day	NTX	-	NA
				1,2-Dichloroethene,total	1.50E-02	mg/L	1.76E-04	mg/kg-day	NTX	-	NA	4.1E-04	mg/kg-day	1.0E-02	mg/kg-day	4.E-02
				cis-1,2-Dichloroethene	1.50E-02	mg/L	1.70E-04	mg/kg-day	NTX	-	NA	4.0E-04	mg/kg-day	1.0E-02	mg/kg-day	4.E-02
			Exp. Route Total								7.E-05					8.E-02
		Exposure Point Total									7.E-05					8.E-02

Notes:

NTX = no toxicity data

NA = not available

Total Adult Resident Risk for Bedrock Groundwater	7.E-05	Total Adult Resident Hazard for Bedrock Groundwater	8.E-02

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
UPGRADIENT AREA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Overburden Groundwater	Overburden Groundwater	Potable Water	Ingestion	Trichloroethene	2.00E-03	mg/L	2.4E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	9.E-06	5.5E-05	mg/kg-day	NTX	mgkg-day	NA
				Aluminum	9.60E+01	mg/L	1.1E+00	mg/kg-day	NTX	-	NA	2.6E+00	mg/kg-day	NTX	-	NA
				Arsenic	3.50E-02	mg/L	4.1E-04	mg/kg-day	1.5E+00	(mg/kg-day)-1	6.E-04	9.6E-04	mg/kg-day	3.0E-04	mgkg-day	3.E+00
				Barium	1.20E+00	mg/L	1.4E-02	mg/kg-day	NTX	-	NA	3.3E-02	mg/kg-day	7.0E-02	mgkg-day	5.E-01
				Chromium	1.40E-01	mg/L	1.6E-03	mg/kg-day	NTX	-	NA	3.8E-03	mg/kg-day	3.0E-03	mgkg-day	1.E+00
				Copper	1.70E-01	mg/L	2.0E-03	mg/kg-day	NTX	-	NA	4.7E-03	mg/kg-day	4.0E-02	mgkg-day	1.E-01
				Lead	2.40E-02	mg/L	6.6E-04	mg/kg-day	NTX	-	NA	2.8E-04	mg/kg-day	NTX	-	NA
				Manganese	5.70E+00	mg/L	6.7E-02	mg/kg-day	NTX	-	NA	1.6E-01	mg/kg-day	2.4E-02	mgkg-day	7.E+00
				Nickel	1.60E-01	mg/L	1.9E-03	mg/kg-day	NTX	-	NA	4.4E-03	mg/kg-day	2.0E-02	mgkg-day	2.E-01
				Vanadium	3.60E-01	mg/L	4.2E-03	mg/kg-day	NTX	-	NA	9.9E-03	mg/kg-day	7.0E-03	mgkg-day	1.E+00
			Exp. Route Total								6.E-04					1.E+01
		Exposure Point Total									6.E-04					1.E+01

Notes:
NTX = no toxicity data
NA = not available

Total Adult Resident Risk for Overburden Groundwater	6.E-04
Total Adult Resident Hazard for Overburden Groundwater	1.E+01

TABLE 7.6.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
UPGRADIENT AREA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Bedrock Groundwater	Bedrock Groundwater	Potable water	Ingestion	Chloroform	1.00E-03	mg/L	1.2E-05	mg/kg-day	1.0E-02	(mg/kg-day)-1	1.E-07	2.7E-05	mg/kg-day	1.0E-02	mg/kg-day	3.E-03
				Trichloroethene	3.00E-03	mg/L	3.5E-05	mg/kg-day	4.0E-01	(mg/kg-day)-1	1.E-05	8.2E-05	mg/kg-day	NTX	-	NA
				cis-1,2-Dichloroethene	3.50E-01	mg/L	4.1E-03	mg/kg-day	NTX	-	NA	9.6E-03	mg/kg-day	1.0E-02	mg/kg-day	1.E+00
				1,2-Dichloroethene, total	3.70E-01	mg/L	4.3E-03	mg/kg-day	NTX	-	NA	1.0E-02	mg/kg-day	1.0E-02	mg/kg-day	1.E+00
				Aluminum	8.60E+01	mg/L	1.0E+00	mg/kg-day	NTX	-	NA	2.4E+00	mg/kg-day	NTX	-	NA
				Arsenic	8.00E-03	mg/L	9.4E-05	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.E-04	2.2E-04	mg/kg-day	3.0E-04	mg/kg-day	7.E-01
				Barium	2.10E+00	mg/L	2.5E-02	mg/kg-day	NTX	-	NA	5.7E-02	mg/kg-day	7.0E-02	mg/kg-day	8.E-01
				Chromium	1.20E-01	mg/L	1.4E-03	mg/kg-day	NTX	-	NA	3.3E-03	mg/kg-day	3.0E-03	mg/kg-day	1.E+00
				Lead	6.80E-02	mg/L	8.0E-04	mg/kg-day	NTX	-	NA	1.9E-03	mg/kg-day	NTX	-	NA
				Manganese	8.90E+00	mg/L	1.1E-01	mg/kg-day	NTX	-	NA	2.4E-01	mg/kg-day	2.4E-02	mg/kg-day	1.E+01
				Nickel	1.50E-01	mg/L	1.2E-03	mg/kg-day	NTX	-	NA	4.1E-03	mg/kg-day	2.0E-02	mg/kg-day	2.E-01
				Toluene	9.50E-01	mg/L	1.1E-02	mg/kg-day	NTX	-	NA	2.6E-02	mg/kg-day	2.0E-01	mg/kg-day	1.E-01
				Vanadium	3.00E-01	mg/L	3.5E-03	mg/kg-day	NTX	(mg/kg-day)-1	NA	8.2E-03	mg/kg-day	7.0E-03	mg/kg-day	1.E+00
			Exp. Route Total								1.E-04					2.E+01
		Exposure Point Total									1.E-04					2.E+01

Notes:
NTX = no toxicity data
NA = not available

Total Adult Resident Risk for Bedrock Groundwater 1.E-04

Total Adult Resident Hazard for Bedrock Groundwater 2.E+01

TABLE 7.7.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Benzo(a)pyrene	2.10E-01	mg/kg	9.9E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.E-07	2.9E-07	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	1.1E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.E-06	3.2E-06	mg/kg-day	3.0E-04	mg/kg-day	1.E-02
			Exp. Route Total								3.E-06					1.E-02
		Exposure Point Total									3.E-06					1.E-02
			Dermal	Benzo(a)pyrene	2.10E-01	mg/kg	5.1E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.E-07	1.5E-07	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	1.3E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.E-07	3.8E-07	mg/kg-day	3.0E-04	mg/kg-day	1.E-03
			Exp. Route Total								6.E-07					1.E-03
		Exposure Point Total									6.E-07					1.E-03

Total Adult Resident Risk for Surface Soils	3.E-06
Total Adult Resident Hazard for Surface Soil	1.E-02

Notes:

NTX = no toxicity data

NA = not available

TABLE 7.8.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Benzo(a)pyrene	2.10E-01	mg/kg	2.3E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	2.E-06	2.7E-06	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	2.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.E-06	3.0E-05	mg/kg-day	3.0E-04	mg/kg-day	1.E-01
			Exp. Route Total								6.E-06					1.E-01
		Exposure Point Total									6.E-06					1.E-01
			Dermal	Benzo(a)pyrene	2.10E-01	mg/kg	8.7E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.E-07	1.0E-06	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	2.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.E-07	2.6E-06	mg/kg-day	3.0E-04	mg/kg-day	9.E-03
			Exp. Route Total								9.E-07					9.E-03
		Exposure Point Total									9.E-07					9.E-03
							Total Child Resident Risk for Surface Soil				7.E-06	Total Child Resident Hazard for Surface Soil				1.E-01

Notes:
NTX = no toxicity data
NA = not available

TABLE 7.9.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Recreational/Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Benzo(a)pyrene	2.10E-01	mg/kg	1.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	7.E-08	6.0E-08	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	1.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.E-07	6.7E-07	mg/kg-day	3.0E-04	mg/kg-day	2.E-03
			Exp. Route Total								3.E-07					2.E-03
		Exposure Point Total									3.E-07					2.E-03
			Dermal	Benzo(a)pyrene	2.10E-01	mg/kg	5.3E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.E-08	3.1E-08	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	1.4E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.E-08	8.0E-08	mg/kg-day	3.0E-04	mg/kg-day	3.E-04
			Exp. Route Total								6.E-08					3.E-04
		Exposure Point Total									6.E-08					3.E-04

Total Recreation/Trespasser Risk for Surface Soils 3.E-07

Total Recreational/Trespasser Hazard for Surface Soil 2.E-03

Notes:
NTX = no toxicity data
NA = not available

TABLE 7.10.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Benzo(a)pyrene	2.10E-01	mg/kg	7.0E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.E-07	2.1E-07	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	8.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	1.E-06	2.3E-06	mg/kg-day	3.0E-04	mg/kg-day	8.E-03
			Exp. Route Total								2.E-06					8.E-03
		Exposure Point Total									2.E-06					8.E-03
			Dermal	Benzo(a)pyrene	2.10E-01	mg/kg	4.8E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	4.E-07	1.3E-07	mg/kg-day	NTX	-	NA
				Arsenic	2.34E+00	mg/kg	1.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.E-07	3.4E-07	mg/kg-day	3.0E-04	mg/kg-day	1.E-03
			Exp. Route Total								6.E-07					1.E-03
		Exposure Point Total									6.E-07					1.E-03

Total Adult Worker Risk for Surface Soil 2.E-06

Total Adult Worker Hazard for Surface Soil 9.E-03

Notes:
NTX = no toxicity data
NA = not available

TABLE 7.11.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	PCBs, total	2.70E-01	mg/kg	1.3E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.E-07	3.7E-07	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/kg	1.5E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.E-06	4.4E-07	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	1.8E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.E-06	5.1E-06	mg/kg-day	3.0E-04	mg/kg-day	2.E-02
				Manganese	5.85E+02	mg/kg	2.8E-04	mg/kg-day	NTX	-	NA	8.0E-04	mg/kg-day	7.0E-02	mg/kg-day	1.E-02
				Cadmium	2.06E+01	mg/kg	9.7E-06	mg/kg-day	NTX	-	NA	2.8E-05	mg/kg-day	1E-03	mg/kg-day	3.E-02
			Exp. Route Total								4.E-06					6.E-02
		Exposure Point Total									4.E-06					6.E-02
			Dermal	PCBs, total	2.70E-01	mg/kg	7.1E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.E-07	2.1E-07	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/kg	7.8E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.E-07	2.3E-07	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	2.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.E-07	6.1E-07	mg/kg-day	3.0E-04	mg/kg-day	2.E-03
				Manganese	5.85E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Cadmium	2.06E+01	mg/kg	3.9E-07	mg/kg-day	NTX	-	NA	1.1E-06	mg/kg-day	5.0E-05	mg/kg-day	2.E-02
			Exp. Route Total								1.E-06					2.E-02
		Exposure Point Total									1.E-06					2.E-02

Notes:

NTX = no toxicity data

NA = not available

-- = dermal risk not evaluated

Total Adult Resident Risk for Surface Soil 5.E-06

Total Adult Resident Hazard for Surface Soil 8.E-02

TABLE 7.12.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	PCBs, total	2.70E-01	mg/kg	3.0E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	6.E-07	3.5E-06	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/kg	3.5E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	3.E-06	4.1E-06	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	4.1E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	6.E-06	4.8E-05	mg/kg-day	3.0E-04	mg/kg-day	2.E-01
				Manganese	5.85E+02	mg/kg	6.4E-04	mg/kg-day	NTX	-	NA	7.5E-03	mg/kg-day	7.0E-02	mg/kg-day	1.E-01
				Cadmium	2.06E+01	mg/kg	2.3E-05	mg/kg-day	NTX	-	NA	2.6E-04	mg/kg-day	1E-03	mg/kg-day	3.E-01
			Exp. Route Total								1.E-05					6.E-01
		Exposure Point Total									1.E-05					6.E-01
			Dermal	PCBs, total	2.70E-01	mg/kg	1.2E-07	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.E-07	1.4E-06	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/kg	1.3E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.E-06	1.5E-06	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	3.6E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.E-07	4.2E-06	mg/kg-day	3.0E-04	mg/kg-day	1.E-02
				Manganese	5.85E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Cadmium	2.06E+01	mg/kg	6.6E-07	mg/kg-day	NTX	-	NA	7.6E-06	mg/kg-day	5.0E-05	mg/kg-day	2.E-01
			Exp. Route Total								2.E-06					2.E-01
		Exposure Point Total									2.E-06					2.E-01

Notes:

NTX = no toxicity data

NA = not available

-- = dermal risk not evaluated

Total of Child Resident Risk for Surface Soil 1.E-05

Total of Child Resident Hazard for Surface Soil 8.E-01

TABLE 7.13.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Recreational/Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	PCBs, total	2.70E-01	mg/kg	1.3E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.E-08	7.7E-08	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/kg	1.6E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	1.E-07	9.1E-08	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	1.8E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.E-07	1.1E-06	mg/kg-day	3.0E-04	mg/kg-day	4.E-03
				Manganese	5.85E+02	mg/kg	2.9E-05	mg/kg-day	NTX	-	NA	1.7E-04	mg/kg-day	7.0E-02	mg/kg-day	2.E-03
				Cadmium	2.06E+01	mg/kg	1.0E-06	mg/kg-day	NTX	-	NA	5.9E-06	mg/kg-day	1E-03	mg/kg-day	6.E-03
			Exp. Route Total								4.E-07					1.E-02
		Exposure Point Total									4.E-07					1.E-02
			Dermal	PCBs, total	2.70E-01	mg/kg	7.4E-09	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.E-08	4.3E-08	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/kg	8.1E-09	mg/kg-day	7.3E+00	(mg/kg-day)-1	6.E-08	4.7E-08	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	2.2E-08	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.E-08	1.3E-07	mg/kg-day	3.0E-04	mg/kg-day	4.E-04
				Manganese	5.85E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Cadmium	2.06E+01	mg/kg	4.0E-08	mg/kg-day	NTX	-	NA	2.4E-07	mg/kg-day	5.0E-05	mg/kg-day	5.E-03
			Exp. Route Total								1.E-07					5.E-03
		Exposure Point Total									1.E-07					5.E-03

Total Recreational/Trespasser Risk of Surface Soil 5.E-07

Total Recreational/Trespasser Hazard for Surface Soil 2.E-02

Notes:

NTX = no toxicity data

NA = not available

-- = dermal risk not evaluated

TABLE 7.14.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	PCBs, total	2.70E-01	mg/kg	9.4E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.E-07	2.6E-07	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/kg	1.1E-07	mg/kg-day	7.3E+00	(mg/kg-day)-1	8.E-07	3.1E-07	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	1.3E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	2.E-06	3.7E-06	mg/kg-day	3.0E-04	mg/kg-day	1.E-02
				Manganese	5.85E+02	mg/kg	2.0E-04	mg/kg-day	NTX	-	NA	5.7E-04	mg/kg-day	7.0E-02	mg/kg-day	8.E-03
				Cadmium	2.06E+01	mg/kg	7.2E-06	mg/kg-day	NTX	-	NA	2.0E-05	mg/kg-day	1.0E-03	mg/kg-day	2.E-02
			Exp. Route Total								3.E-06					4.E-02
		Exposure Point Total									3.E-06					4.E-02
			Dermal	PCBs, total	2.70E-01	mg/kg	6.6E-08	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.E-07	1.9E-07	mg/kg-day	NTX	-	NA
				Benzo(a)pyrene	3.20E-01	mg/lg	7.3E-08	mg/kg-day	7.3E+00	(mg/kg-day)-1	5.E-07	2.0E-07	mg/kg-day	NTX	-	NA
				Arsenic	3.73E+00	mg/kg	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.E-07	5.5E-07	mg/kg-day	3.0E-04	mg/kg-day	2.E-03
				Manganese	5.85E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Cadmium	2.06E+01	mg/kg	3.6E-07	mg/kg-day	NTX	-	NA	1.0E-06	mg/kg-day	5.0E-05	mg/kg-day	2.E-02
			Exp. Route Total								9.E-07					2.E-02
		Exposure Point Total									9.E-07					2.E-02

Total Adult Worker Risk for Surface Soil 4.E-06

Total Adult Worker Hazard for Surface Soil 6.E-02

Notes:

NTX = no toxicity data

NA = not available

-- = dermal risk not evaluated

TABLE 7.15.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	ke/Exposure Concentra		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Subsurface Soil	Subsurface Soil	Subsurface Soil	Ingestion	1,1,1-Trichloroethane	4.00E+00	mg/kg	1.9E-06	mg/kg-day	NTX	-	NA	5.5E-06	mg/kg-day	2.8E-01	mg/kg-day	2.E-05
				Lead	1.75E+03	mg/kg	8.2E-04	mg/kg-day	NTX	-	NA	2.4E-03	mg/kg-day	NTX	-	NA
				Arsenic	5.50E+00	mg/kg	2.6E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.E-06	7.5E-06	mg/kg-day	3.0E-04	mg/kg-day	3.E-02
				Barium	1.48E+03	mg/kg	7.0E-04	mg/kg-day	NTX	-	NA	2.0E-03	mg/kg-day	7.0E-02	mg/kg-day	3.E-02
				Cadmium	3.89E+02	mg/kg	1.8E-04	mg/kg-day	NTX	-	NA	5.3E-04	mg/kg-day	1.0E-03	mg/kg-day	5.E-01
				Chromium	7.90E+01	mg/kg	3.7E-05	mg/kg-day	NTX	-	NA	1.1E-04	mg/kg-day	3.0E-03	mg/kg-day	4.E-02
				Vinyl chloride	4.00E-01	mg/kg	--	mg/kg-day	7.2E-01	(mg/kg-day)-1	5.E-07	5.5E-07	mg/kg-day	3.0E-03	mg/kg-day	2.E-04
				1,1-Dichloroethene	4.20E+00	mg/kg	2.0E-06	mg/kg-day	NTX	(mg/kg-day)-1	NA	5.8E-06	mg/kg-day	5.0E-02	mg/kg-day	1.E-04
				Trichloroethene	4.30E+02	mg/kg	2.0E-04	mg/kg-day	4.0E-01	(mg/kg-day)-1	8.E-05	5.9E-04	mg/kg-day	NTX	-	NA
				Ethylbenzene	7.20E+02	mg/kg	3.4E-04	mg/kg-day	NTX	-	NA	9.9E-04	mg/kg-day	1.0E-01	mg/kg-day	1.E-02
				Aroclor-1016	1.20E+00	mg/kg	5.6E-07	mg/kg-day	7.0E-02	(mg/kg-day)-1	4.E-08	1.6E-06	mg/kg-day	7.0E-05	mg/kg-day	2.E-02
				Aroclor-1260	5.00E+00	mg/kg	2.4E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	5.E-06	6.9E-06	mg/kg-day	NTX	mg/kg-day	NA
				Aroclor-1254	1.10E+01	mg/kg	5.2E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.E-05	1.5E-05	mg/kg-day	2.0E-05	mg/kg-day	8.E-01
				bis(2-Ethylhexyl)phthalate	1.20E+02	mg/kg	5.6E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	8.E-07	1.6E-04	mg/kg-day	2.0E-02	mg/kg-day	8.E-03
				Tetrachloroethene	1.20E+03	mg/kg	5.6E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	3.E-04	1.6E-03	mg/kg-day	1.0E-02	mg/kg-day	2.E-01
				Xylenes, total	1.20E+03	mg/kg	5.6E-04	mg/kg-day	NTX	-	NA	1.6E-03	mg/kg-day	2.0E-01	mg/kg-day	8.E-03
				Chloroform	5.90E+00	mg/kg	2.8E-06	mg/kg-day	1.0E-02	(mg/kg-day)-1	3.E-08	8.1E-06	mg/kg-day	1.0E-02	mg/kg-day	8.E-04
				Benzene	2.90E+00	mg/kg	1.4E-06	mg/kg-day	5.5E-02	(mg/kg-day)-1	7.E-08	4.0E-06	mg/kg-day	4.0E-03	mg/kg-day	1.E-03
				2,3,7,8-TCDD	3.00E-04	mg/kg	1.4E-10	mg/kg-day	1.5E+05	(mg/kg-day)-1	2.E-05	4.1E-10	mg/kg-day	NTX	-	NA
				2,3,7,8-TCDF	4.60E-04	mg/kg	2.2E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-06	6.0E-10	mg/kg-day	NTX	-	NA
				2,3,4,7,8-PeCDF	3.40E-04	mg/kg	1.6E-10	mg/kg-day	7.5E+04	(mg/kg-day)-1	1.E-05	5.0E-10	mg/kg-day	NTX	-	NA
				1,2,3,7,8-PeCDF	1.60E-04	mg/kg	7.5E-11	mg/kg-day	7.5E+03	(mg/kg-day)-1	6.E-07	2.0E-10	mg/kg-day	NTX	-	NA
				1,2,3,6,7,8-HxCDF	2.10E-04	mg/kg	9.9E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	1.E-06	3.0E-10	mg/kg-day	NTX	-	NA
				2,3,4,6,7,8-HxCDF	2.10E-04	mg/kg	9.9E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	1.E-06	3.0E-10	mg/kg-day	NTX	-	NA
				1,2,3,4,6,7,8-HpCDF	4.90E-04	mg/kg	2.3E-10	mg/kg-day	1.5E+03	(mg/kg-day)-1	3.E-07	6.7E-10	mg/kg-day	NTX	-	NA
				1,2,3,4,7,8-HxCDF	3.80E-04	mg/kg	1.8E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-06	5.0E-10	mg/kg-day	NTX	-	NA
				Acrolein	4.80E-02	mg/kg	2.3E-08	mg/kg-day	NTX	-	NA	6.6E-08	mg/kg-day	5.0E-04	mg/kg-day	1.E-04
				1,2-Dichloroethene, total	3.50E+01	mg/kg	1.6E-05	mg/kg-day	NTX	-	NA	4.8E-05	mg/kg-day	1.0E-02	mg/kg-day	5.E-03
			Exp. Route Total								4.E-04					2.E+00
		Exposure Point Total									4.E-04					2.E+00

TABLE 7.15.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	ke/Exposure Concentra		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	1,1,1-Trichloroethane	4.00E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Lead	1.75E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Arsenic	5.50E+00	mg/kg	3.1E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	5.E-07	9.0E-07	mg/kg-day	3.0E-04	mg/kg-day	3.E-03
				Barium	1.48E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Cadmium	3.89E+02	mg/kg	7.3E-06	mg/kg-day	NTX	-	NA	2.1E-05	mg/kg-day	5.0E-05	mg/kg-day	4.E-01
				Chromium	7.90E+01	mg/kg	--	--	--	--	--	--	--	--	--	--
				Vinyl chloride	4.00E-01	mg/kg	--	--	--	--	--	--	--	--	--	--
				1,1-Dichloroethene	4.20E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Trichloroethene	4.30E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Ethylbenzene	7.20E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Aroclor-1016	1.20E+00	mg/kg	3.2E-08	mg/kg-day	7.0E-02	(mg/kg-day)-1	2.E-08	9.2E-08	mg/kg-day	7.0E-05	mg/kg-day	1.E-03
				Aroclor-1260	5.00E+00	mg/kg	1.3E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.E-06	3.8E-06	mg/kg-day	NTX	-	NA
				Aroclor-1254	1.10E+01	mg/kg	2.9E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	6.E-06	8.4E-06	mg/kg-day	2.0E-05	mg/kg-day	4.E-01
				bis(2-Ethylhexyl)phthalate	1.20E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Tetrachloroethene	1.20E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Xylenes, total	1.20E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Chloroform	5.90E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Benzene	2.90E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				2,3,7,8-TCDD	3.00E-04	mg/kg	1.7E-11	mg/kg-day	1.5E+05	(mg/kg-day)-1	3.E-06	4.9E-11	mg/kg-day	NTX	-	NA
				2,3,7,8-TCDF	4.60E-04	mg/kg	2.6E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	4.E-07	8.0E-11	mg/kg-day	NTX	-	NA
				2,3,4,7,8-PeCDF	3.40E-04	mg/kg	1.9E-11	mg/kg-day	7.5E+04	(mg/kg-day)-1	1.E-06	6.0E-11	mg/kg-day	NTX	-	NA
				1,2,3,7,8-PeCDF	1.60E-04	mg/kg	9.0E-12	mg/kg-day	7.5E+03	(mg/kg-day)-1	7.E-08	3.0E-11	mg/kg-day	NTX	-	NA
				1,2,3,6,7,8-HxCDF	2.10E-04	mg/kg	1.2E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	2.E-07	3.0E-11	mg/kg-day	NTX	-	NA
				2,3,4,6,7,8-HxCDF	2.10E-04	mg/kg	1.2E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	2.E-07	3.0E-11	mg/kg-day	NTX	-	NA
				1,2,3,4,6,7,8-HpCDF	4.90E-04	mg/kg	2.8E-11	mg/kg-day	1.5E+03	(mg/kg-day)-1	4.E-08	8.0E-11	mg/kg-day	NTX	-	NA
				1,2,3,4,7,8-HxCDF	3.80E-04	mg/kg	2.1E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-07	6.0E-11	mg/kg-day	NTX	-	NA
				Acrolein	4.80E-02	mg/kg	--	--	--	--	--	--	--	--	--	--
				1,2-Dichloroethene, total	3.50E+01	mg/kg	--	--	--	--	--	--	--	--	--	--
			Exp. Route Total								1.E-05					8.E-01
		Exposure Point Total									1.E-05					8.E-01

Notes:

NTX = no toxicity data	Total Adult Resident Risk for Subsurface Soil	5.E-04	Total Adult Resident Hazard for Subsurface Soil	2.E+00

NA = not available

Oral cancer slope factor for dioxin congeners is the cancer slope factor for 2,3,7,8-TCDD multiplied by the World Health Organization's (WHO's) congener-specific toxic equivalency factors (TEFs).

-- = Dermal Risk not evaluated.

Cancer risk for vinyl chloride calculated using methods outlined in USEPA (2000) *Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on the Integrated Risk Information System).*

TABLE 7.16.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Subsurface Soil	Subsurface Soil	Subsurface Soil	Ingestion	1,1,1-Trichloroethane	4.00E+00	mg/kg	4.4E-06	mg/kg-day	NTX	-	NA	5.1E-05	mg/kg-day	2.8E-01	mg/kg-day	2.E-04
				Lead	1.75E+03	mg/kg	1.9E-03	mg/kg-day	NTX	-	NA	2.2E-02	mg/kg-day	NTX	-	NA
				Arsenic	5.50E+00	mg/kg	6.0E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	9.E-06	7.0E-05	mg/kg-day	3.0E-04	mg/kg-day	2.E-01
				Barium	1.48E+03	mg/kg	1.6E-03	mg/kg-day	NTX	-	NA	1.9E-02	mg/kg-day	7.0E-02	mg/kg-day	3.E-01
				Cadmium	3.89E+02	mg/kg	4.3E-04	mg/kg-day	NTX	-	NA	5.0E-03	mg/kg-day	1.0E-03	mg/kg-day	5.E+00
				Chromium	7.90E+01	mg/kg	8.7E-05	mg/kg-day	NTX	-	NA	1.0E-03	mg/kg-day	3.0E-03	mg/kg-day	3.E-01
				Vinyl chloride	4.00E-01	mg/kg	--	mg/kg-day	7.2E-01	(mg/kg-day)-1	4.E-06	5.1E-06	mg/kg-day	3.0E-03	mg/kg-day	2.E-03
				1,1-Dichloroethene	4.20E+00	mg/kg	4.6E-06	mg/kg-day	NTX	(mg/kg-day)-1	NA	5.4E-05	mg/kg-day	5.0E-02	mg/kg-day	1.E-03
				Trichloroethene	4.30E+02	mg/kg	4.7E-04	mg/kg-day	4.0E-01	(mg/kg-day)-1	2.E-04	5.5E-03	mg/kg-day	NTX	-	NA
				Ethylbenzene	7.20E+02	mg/kg	7.9E-04	mg/kg-day	NTX	-	NA	9.2E-03	mg/kg-day	1.0E-01	mg/kg-day	9.E-02
				Aroclor-1016	1.20E+00	mg/kg	1.3E-06	mg/kg-day	7.0E-02	(mg/kg-day)-1	9.E-08	1.5E-05	mg/kg-day	7.0E-05	mg/kg-day	2.E-01
				Aroclor-1260	5.00E+00	mg/kg	5.5E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.E-05	6.4E-05	mg/kg-day	NTX	-	NA
				Aroclor-1254	1.10E+01	mg/kg	1.2E-05	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.E-05	1.4E-04	mg/kg-day	2.0E-05	mg/kg-day	7.E+00
				bis(2-Ethylhexyl)phthalate	1.20E+02	mg/kg	1.3E-04	mg/kg-day	1.4E-02	(mg/kg-day)-1	2.E-06	1.5E-03	mg/kg-day	2.0E-02	mg/kg-day	8.E-02
				Tetrachloroethene	1.20E+03	mg/kg	1.3E-03	mg/kg-day	5.4E-01	(mg/kg-day)-1	7.E-04	1.5E-02	mg/kg-day	1.0E-02	mg/kg-day	2.E+00
				Xylenes, total	1.20E+03	mg/kg	1.3E-03	mg/kg-day	NTX	-	NA	1.5E-02	mg/kg-day	2.0E-01	mg/kg-day	8.E-02
				Chloroform	5.90E+00	mg/kg	6.5E-06	mg/kg-day	1.0E-02	(mg/kg-day)-1	6.E-08	7.5E-05	mg/kg-day	1.0E-02	mg/kg-day	8.E-03
				Benzene	2.90E+00	mg/kg	3.2E-06	mg/kg-day	5.5E-02	(mg/kg-day)-1	2.E-07	3.7E-05	mg/kg-day	4.0E-03	mg/kg-day	9.E-03
				2,3,7,8-TCDD	3.00E-04	mg/kg	3.3E-10	mg/kg-day	1.5E+05	(mg/kg-day)-1	5.E-05	3.8E-09	mg/kg-day	NTX	-	NA
				2,3,7,8-TCDF	4.60E-04	mg/kg	5.0E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	8.E-06	5.9E-09	mg/kg-day	NTX	-	NA
				2,3,4,7,8-PeCDF	3.40E-04	mg/kg	3.7E-10	mg/kg-day	7.5E+04	(mg/kg-day)-1	3.E-05	4.4E-09	mg/kg-day	NTX	-	NA
				1,2,3,7,8-PeCDF	1.60E-04	mg/kg	1.8E-10	mg/kg-day	7.5E+03	(mg/kg-day)-1	1.E-06	2.1E-09	mg/kg-day	NTX	-	NA
				1,2,3,6,7,8-HxCDF	2.10E-04	mg/kg	2.3E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-06	2.7E-09	mg/kg-day	NTX	-	NA
				2,3,4,6,7,8-HxCDF	2.10E-04	mg/kg	2.3E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-06	2.7E-09	mg/kg-day	NTX	-	NA
				1,2,3,4,6,7,8-HpCDF	4.90E-04	mg/kg	5.4E-10	mg/kg-day	1.5E+03	(mg/kg-day)-1	8.E-07	6.3E-09	mg/kg-day	NTX	-	NA
				1,2,3,4,7,8-HxCDF	3.80E-04	mg/kg	4.2E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	6.E-06	4.9E-09	mg/kg-day	NTX	-	NA
				Acrolein	4.80E-02	mg/kg	5.3E-08	mg/kg-day	NTX	-	NA	6.1E-07	mg/kg-day	5.0E-04	mg/kg-day	1.E-03
				1,2-Dichloroethene, total	3.50E+01	mg/kg	3.8E-05	mg/kg-day	NTX	-	NA	4.5E-04	mg/kg-day	9.0E-03	mg/kg-day	5.E-02
			Exp. Route Total								1.E-03					2.E+01
		Exposure Point Total									1.E-03					2.E+01

TABLE 7.16.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	1,1,1-Trichloroethane	4.00E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Lead	1.75E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Arsenic	5.50E+00	mg/kg	5.2E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	8.E-07	6.1E-06	mg/kg-day	3.0E-04	mg/kg-day	2.E-02
				Barium	1.48E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Cadmium	3.89E+02	mg/kg	1.2E-05	mg/kg-day	NTX	(mg/kg-day)-1	NA	1.4E-04	mg/kg-day	5.0E-05	mg/kg-day	3.E+00
				Chromium	7.90E+01	mg/kg	--	--	--	--	--	--	--	--	--	--
				Vinyl chloride	4.00E-01	mg/kg	--	--	--	--	--	--	--	--	--	--
				1,1-Dichloroethene	4.20E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Trichloroethene	4.30E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Ethylbenzene	7.20E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Aroclor-1016	1.20E+00	mg/kg	5.3E-08	mg/kg-day	7.0E-02	(mg/kg-day)-1	4.E-08	6.2E-07	mg/kg-day	7.0E-05	mg/kg-day	9.E-03
				Aroclor-1260	5.00E+00	mg/kg	2.2E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	5.E-06	2.6E-05	mg/kg-day	NTX	mg/kg-day	NA
				Aroclor-1254	1.10E+01	mg/kg	4.9E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	1.E-05	5.7E-05	mg/kg-day	2.0E-05	mg/kg-day	3.E+00
				bis(2-Ethylhexyl)phthalate	1.20E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Tetrachloroethene	1.20E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Xylenes, total	1.20E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Chloroform	5.90E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Benzene	2.90E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				2,3,7,8-TCDD	3.00E-04	mg/kg	2.9E-11	mg/kg-day	1.5E+05	(mg/kg-day)-1	4.E-06	3.3E-10	mg/kg-day	NTX	mg/kg-day	NA
				2,3,7,8-TCDF	4.60E-04	mg/kg	4.4E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	7.E-07	5.1E-10	mg/kg-day	NTX	mg/kg-day	NA
				2,3,4,7,8-PeCDF	3.40E-04	mg/kg	3.2E-11	mg/kg-day	7.5E+04	(mg/kg-day)-1	2.E-06	3.8E-10	mg/kg-day	NTX	mg/kg-day	NA
				1,2,3,7,8-PeCDF	1.60E-04	mg/kg	1.5E-11	mg/kg-day	7.5E+03	(mg/kg-day)-1	1.E-07	1.8E-10	mg/kg-day	NTX	mg/kg-day	NA
				1,2,3,6,7,8-HxCDF	2.10E-04	mg/kg	2.0E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-07	2.3E-10	mg/kg-day	NTX	mg/kg-day	NA
				2,3,4,6,7,8-HxCDF	2.10E-04	mg/kg	2.0E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-07	2.3E-10	mg/kg-day	NTX	mg/kg-day	NA
				1,2,3,4,6,7,8-HpCDF	4.90E-04	mg/kg	4.7E-11	mg/kg-day	1.5E+03	(mg/kg-day)-1	7.E-08	5.5E-10	mg/kg-day	NTX	mg/kg-day	NA
				1,2,3,4,7,8-HxCDF	3.80E-04	mg/kg	3.6E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	5.E-07	4.2E-10	mg/kg-day	NTX	mg/kg-day	NA
				Acrolein	4.80E-02	mg/kg	--	--	--	--	--	--	--	--	--	--
				1,2-Dichloroethene, total	3.50E+01	mg/kg	--	--	--	--	--	--	--	--	--	--
			Exp. Route Total								2.E-05					6.E+00
		Exposure Point Total									2.E-05					6.E+00

Notes:

NTX = no toxicity data	Total Child Resident Risk for Subsurface Soil	1.E-03	Total Child Resident Hazard for Subsurface Soil	2.E+01

NA = not available

Oral cancer slope factor for dioxin congeners is the cancer slope factor for 2,3,7,8-TCDD multiplied by the World Health Organization's (WHO's) congener-specific toxic equivalency factors (TEFs).

-- = Dermal Risk not evaluated.

Cancer risk for vinyl chloride calculated using methods outlined in USEPA (2000) *Toxicological Review of Vinyl Chloride (In Support of Summary Information Provided on the Integrated Risk Information System).*

TABLE 7.17.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Subsurface Soil	bsurface	Subsurface Soil	Ingestion	1,1,1-Trichloroethane	4.00E+00	mg/kg	1.4E-06	mg/kg-day	NTX	-	NA	3.9E-06	mg/kg-day	2.8E-01	mg/kg-day	1.E-05
				Lead	1.75E+03	mg/kg	6.1E-04	mg/kg-day	NTX	-	NA	1.7E-03	mg/kg-day	NTX	-	NA
				Arsenic	5.50E+00	mg/kg	1.9E-06	mg/kg-day	1.5E+00	(mg/kg-day)-1	3.E-06	5.4E-06	mg/kg-day	3.0E-04	mg/kg-day	2.E-02
				Barium	1.48E+03	mg/kg	5.2E-04	mg/kg-day	NTX	-	NA	1.5E-03	mg/kg-day	7.0E-02	mg/kg-day	2.E-02
				Cadmium	3.89E+02	mg/kg	1.4E-04	mg/kg-day	NTX	-	NA	3.8E-04	mg/kg-day	1.0E-03	mg/kg-day	4.E-01
				Chromium	7.90E+01	mg/kg	2.8E-05	mg/kg-day	NTX	-	NA	7.7E-05	mg/kg-day	3.0E-03	mg/kg-day	3.E-02
				Vinyl chloride	4.00E-01	mg/kg	1.4E-07	mg/kg-day	7.2E-01	(mg/kg-day)-1	1.E-07	3.9E-07	mg/kg-day	3.0E-03	mg/kg-day	1.E-04
				1,1-Dichloroethene	4.20E+00	mg/kg	1.5E-06	mg/kg-day	NTX	(mg/kg-day)-1	NA	4.1E-06	mg/kg-day	5.0E-02	mg/kg-day	8.E-05
				Trichloroethene	4.30E+02	mg/kg	1.5E-04	mg/kg-day	4.0E-01	(mg/kg-day)-1	6.E-05	4.2E-04	mg/kg-day	NTX	-	NA
				Ethylbenzene	7.20E+02	mg/kg	2.5E-04	mg/kg-day	NTX	-	NA	7.1E-04	mg/kg-day	1.0E-01	mg/kg-day	7.E-03
				Aroclor-1016	1.20E+00	mg/kg	4.2E-07	mg/kg-day	7.0E-02	(mg/kg-day)-1	3.E-08	1.2E-06	mg/kg-day	7.0E-05	mg/kg-day	2.E-02
				Aroclor-1260	5.00E+00	mg/kg	1.8E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	3.E-06	4.9E-06	mg/kg-day	NTX	-	NA
				Aroclor-1254	1.10E+01	mg/kg	3.8E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	8.E-06	1.1E-05	mg/kg-day	2.0E-05	mg/kg-day	5.E-01
				bis(2-Ethylhexyl)phthalate	1.20E+02	mg/kg	4.2E-05	mg/kg-day	1.4E-02	(mg/kg-day)-1	6.E-07	1.2E-04	mg/kg-day	2.0E-02	mg/kg-day	6.E-03
				Tetrachloroethene	1.20E+03	mg/kg	4.2E-04	mg/kg-day	5.4E-01	(mg/kg-day)-1	2.E-04	1.2E-03	mg/kg-day	1.0E-02	mg/kg-day	1.E-01
				Xylenes, total	1.20E+03	mg/kg	4.2E-04	mg/kg-day	NTX	-	NA	1.2E-03	mg/kg-day	2.0E-01	mg/kg-day	6.E-03
				Chloroform	5.90E+00	mg/kg	2.1E-06	mg/kg-day	1.0E-02	(mg/kg-day)-1	2.E-08	5.8E-06	mg/kg-day	1.0E-02	mg/kg-day	6.E-04
				Benzene	2.90E+00	mg/kg	1.0E-06	mg/kg-day	5.5E-02	(mg/kg-day)-1	6.E-08	2.8E-06	mg/kg-day	4.0E-03	mg/kg-day	7.E-04
				2,3,7,8-TCDD	3.00E-04	mg/kg	1.1E-10	mg/kg-day	1.5E+05	(mg/kg-day)-1	2.E-05	2.9E-10	mg/kg-day	NTX	-	NA
				2,3,7,8-TCDF	4.60E-04	mg/kg	1.6E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	2.E-06	4.5E-10	mg/kg-day	NTX	-	NA
				2,3,4,7,8-PeCDF	3.40E-04	mg/kg	1.2E-10	mg/kg-day	7.5E+04	(mg/kg-day)-1	9.E-06	3.3E-10	mg/kg-day	NTX	-	NA
				1,2,3,7,8-PeCDF	1.60E-04	mg/kg	5.6E-11	mg/kg-day	7.5E+03	(mg/kg-day)-1	4.E-07	1.6E-10	mg/kg-day	NTX	-	NA
				1,2,3,6,7,8-HxCDF	2.10E-04	mg/kg	7.3E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	1.E-06	2.1E-10	mg/kg-day	NTX	-	NA
				2,3,4,6,7,8-HxCDF	2.10E-04	mg/kg	7.3E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	1.E-06	2.1E-10	mg/kg-day	NTX	-	NA
				1,2,3,4,6,7,8-HpCDF	4.90E-04	mg/kg	1.7E-10	mg/kg-day	1.5E+03	(mg/kg-day)-1	3.E-07	4.8E-10	mg/kg-day	NTX	-	NA
				1,2,3,4,7,8-HxCDF	3.80E-04	mg/kg	1.3E-10	mg/kg-day	1.5E+04	(mg/kg-day)-1	2.E-06	3.7E-10	mg/kg-day	NTX	-	NA
				Acrolein	4.80E-02	mg/kg	1.7E-08	mg/kg-day	NTX	-	NA	4.7E-08	mg/kg-day	5.0E-04	mg/kg-day	9.E-05
				1,2-Dichloroethene, total	3.50E+01	mg/kg	1.2E-05	mg/kg-day	NTX	-	NA	3.4E-05	mg/kg-day	1.0E-02	mg/kg-day	3.E-03
			Exp. Route Total								3.E-04					1.E+00
		Exposure Point Total									3.E-04					1.E+00

TABLE 7.17.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal	1,1,1-Trichloroethane	4.00E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Lead	1.75E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Arsenic	5.50E+00	mg/kg	2.9E-07	mg/kg-day	1.5E+00	(mg/kg-day)-1	4.E-07	8.1E-07	mg/kg-day	3.0E-04	mg/kg-day	3.E-03
				Barium	1.48E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Cadmium	3.89E+02	mg/kg	6.8E-06	mg/kg-day	NTX	-	NA	1.9E-05	mg/kg-day	5.0E-05	mg/kg-day	4.E-01
				Chromium	7.90E+01	mg/kg	--	--	--	--	--	--	--	--	--	--
				Vinyl chloride	4.00E-01	mg/kg	--	--	--	--	--	--	--	--	--	--
				1,1-Dichloroethene	4.20E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Trichloroethene	4.30E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Ethylbenzene	7.20E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Aroclor-1016	1.20E+00	mg/kg	2.9E-08	mg/kg-day	7.0E-02	(mg/kg-day)-1	2.E-08	8.2E-08	mg/kg-day	7.0E-05	mg/kg-day	1.E-03
				Aroclor-1260	5.00E+00	mg/kg	1.2E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	2.E-06	3.4E-06	mg/kg-day	NTX	mg/kg-day	NA
				Aroclor-1254	1.10E+01	mg/kg	2.7E-06	mg/kg-day	2.0E+00	(mg/kg-day)-1	5.E-06	7.5E-06	mg/kg-day	2.0E-05	mg/kg-day	4.E-01
				bis(2-Ethylhexyl)phthalate	1.20E+02	mg/kg	--	--	--	--	--	--	--	--	--	--
				Tetrachloroethene	1.20E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Xylenes, total	1.20E+03	mg/kg	--	--	--	--	--	--	--	--	--	--
				Chloroform	5.90E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				Benzene	2.90E+00	mg/kg	--	--	--	--	--	--	--	--	--	--
				2,3,7,8-TCDD	3.00E-04	mg/kg	1.6E-11	mg/kg-day	1.5E+05	(mg/kg-day)-1	2.E-06	4.4E-11	mg/kg-day	NTX	mg/kg-day	NA
				2,3,7,8-TCDF	4.60E-04	mg/kg	2.4E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-07	6.8E-11	mg/kg-day	NTX	-	NA
				2,3,4,7,8-PeCDF	3.40E-04	mg/kg	1.8E-11	mg/kg-day	7.5E+04	(mg/kg-day)-1	1.E-06	5.0E-11	mg/kg-day	NTX	-	NA
				1,2,3,7,8-PeCDF	1.60E-04	mg/kg	8.4E-12	mg/kg-day	7.5E+03	(mg/kg-day)-1	6.E-08	2.4E-11	mg/kg-day	NTX	-	NA
				1,2,3,6,7,8-HxCDF	2.10E-04	mg/kg	1.1E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	2.E-07	3.1E-11	mg/kg-day	NTX	-	NA
				2,3,4,6,7,8-HxCDF	2.10E-04	mg/kg	1.1E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	2.E-07	3.1E-11	mg/kg-day	NTX	-	NA
				1,2,3,4,6,7,8-HpCDF	4.90E-04	mg/kg	2.6E-11	mg/kg-day	1.5E+03	(mg/kg-day)-1	4.E-08	7.2E-11	mg/kg-day	NTX	-	NA
				1,2,3,4,7,8-HxCDF	3.80E-04	mg/kg	2.0E-11	mg/kg-day	1.5E+04	(mg/kg-day)-1	3.E-07	5.6E-11	mg/kg-day	NTX	-	NA
				Acrolein	4.80E-02	mg/kg	--	--	--	--	--	--	--	--	--	--
				1,2-Dichloroethene, total	3.50E+01	mg/kg	--	--	--	--	--	--	--	--	--	--
			Exp. Route Total								1.E-05					8.E-01
		Exposure Point Total									1.E-05					8.E-01

Notes:

NTX = no toxicity data

Total Adult Worker Risk for Subsurface Soil 3.E-04

Total Adult Worker Hazard for Subsurface Soil 2.E+00

NA = not available

Oral cancer slope factor for dioxin congeners is the cancer slope factor for 2,3,7,8-TCDD multiplied by the World Health Organization's (WHO's) congener-specific toxic equivalency factors (TEFs).

-- = Dermal Risk not evaluated.

DRAFT

TABLE 8.1

CALCULATION OF RADIATION CANCER RISKS

SOLVENT RECOVERY SERVICE OF NEW ENGLAND, INC

Scenario Timeframe:
Receptor Population:
Receptor Age:

Medium	Exposure Medium	Exposure Point	Exposure Route	Radionuclide of Potential Concern	EPC		Risk Calculation Approach	Cancer Risk Calculations				
					Value	Units		Intake/External Dose		CSF/Conversion Factor		Cancer Risk
								Value	Units	Value	Units	
				None								
			Exp. Route Total									
			Exp. Route Total									
		Exposure Point Total										
			Exp. Route Total									
		Exposure Point Total										
			Exp. Route Total									
			Exp. Route Total									
		Exposure Point Total										

Radiation cancer risks not applicable to the SRSNE Site.

Total of Receptor Risks Across All Media

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

OPERATIONS AREA PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Overburden Groundwater	Overburden Groundwater	Potable Water	1,1,1-Trichloroethane	NA	-	-	-	NA	NA	2.E+01	-	-	2.E+01
			1,1-Dichloroethane	NA	-	-	-	NA	NA	4.E+00	-	-	4.E+00
			1,1-Dichloroethene	NA	-	-	-	NA	Liver	4.E+00	-	-	4.E+00
			1,2-Dichlorethene,total	NA	-	-	-	NA	Liver	4.E+02	-	-	4.E+02
			1,2,4-Trichlorobenzene	NA	-	-	-	NA	Adrenal Glands	4.E-01	-	-	4.E-01
			2,4-Dimethylphenol	NA	-	-	-	NA	Blood	2.E-01	-	-	2.E-01
			2-Butanone	NA	-	-	-	NA	Fetal Weight	2.E+01	-	-	2.E+01
			4-Methyl-2-pentanone	NA	-	-	-	NA	Liver, Kidney	2.E+01	-	-	2.E+01
			4-Methylphenol	NA	-	-	-	NA	Neurotoxicity	6.E+00	-	-	6.E+00
			Acetone	NA	-	-	-	NA	Liver, Kidney	1.E+01	-	-	1.E+01
			Aluminum	NA	-	-	-	NA	NA	NA	-	-	NA
			Aroclor-1260	4.E-04	-	-	-	4.E-04	Immune System	NA	-	-	NA
			Arsenic	7.E-04	-	-	-	7.E-04	Skin	4.E+00	-	-	4.E+00
			Barium	NA	-	-	-	NA	Kidney	8.E+00	-	-	8.E+00
			Benzene	2.E-03	-	-	-	2.E-03	NA	2.E+01	-	-	2.E+01
			Beryllium	NA	-	-	-	NA	Small Intestine	4.E-01	-	-	4.E-01
			Cadmium	NA	-	-	-	NA	Kidney	3.E+00	-	-	3.E+00
			Chlorobenzene	NA	-	-	-	NA	Liver	3.E+00	-	-	3.E+00
			Chloroethane	1.E-04	-	-	-	1.E-04	NA	3.E-01	-	-	3.E-01
			Chromium	NA	-	-	-	NA	NA	4.E+00	-	-	4.E+00
			cis-1,2-Dichloroethene	NA	-	-	-	NA	Blood	6.E+02	-	-	6.E+02
			Ethylbenzene	NA	-	-	-	NA	Liver, Kidney	2.E+01	-	-	2.E+01
			Isophorone	1.E-06	-	-	-	1.E-06	Kidney	1.E-02	-	-	1.E-02
			Lead	NA				NA	NA	NA	-	-	NA
			M,P-Xylene	NA	-	-	-	NA	Body Weight	1.E+00	-	-	1.E+00
			Manganese	NA	-	-	-	NA	CNS	3.E+01	-	-	3.E+01
			Methanol	NA	-	-	-	NA	Brain Weight	4.E-01	-	-	4.E-01
			Methylene chloride	8.E-04	-	-	-	8.E-04	Liver	4.E+00	-	-	4.E+00
			Naphthalene	NA	-	-	-	NA	Body Weight	2.E-01	-	-	2.E-01
			Nickel	NA	-	-	-	NA	Body, Organ Weight	4.E-01	-	-	4.E-01
			O-Xylene	NA	-	-	-	NA	Body Weight	5.E-01	-	-	5.E-01
			Silver	NA	-	-	-	NA	Skin	2.E-01	-	-	2.E-01
			Tetrachloroethene	9.E-02	-	-	-	8.E-02	Liver	4.E+01	-	-	4.E+01
			Tetrahydrofuran	5.E-03	-	-	-	5.E-03	NA	7.E+00	-	-	7.E+00
			Toluene	NA	-	-	-	NA	Liver,Kidney	2.E+01	-	-	2.E+01
			trans-1,2-Dichloroethene	NA	-	-	-	NA	Blood	1.E+01	-	-	1.E+01
			Trichloroethene	4.E-01	-	-	-	4.E-01	NA	NA	-	-	NA
			Thallium	NA				NA	Blood	8.E-01			8.E-01
			Vanadium	NA	-	-	-	NA	NA	3.E+00	-	-	3.E+00
			Vinyl chloride	7.E-01	-	-	-	7.E-01	NA	1.E+02	-	-	1.E+02

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

OPERATIONS AREA PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
			Xylenes, total	NA	-	-	-	NA	Body Weight	2.E+00	-	-	2.E+00
			Zinc	NA	-	-	-	NA	Blood	1.E+00	-	-	1.E+00
			Chemical Total					1.E+00					1.E+03
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						1.E+00					1.E+03

Notes:

NA = not available

Total Adult Resident Risk for Overburden Groundwater 1.E+00

Total Adult Resident Hazard for Overburden Groundwater. 1.E+03

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for overburden groundwater.

Total [Liver] HI Across Overburden Groundwater = 5.E+02
Total [Kidney] HI Across Overburdern Groundwater 8.E+01
Total [Blood] HI Across Overburden Groundwater = 6.E+02
Total [CNS/Neurotoxicity] HI Across Overburden Gr 3.E+01
Total [Body Weight] HI Across Overburden Groundw 3.E+01
Total [Skin] HI Across Overburden Groundwater = 4.E+00

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Bedrock Groundwater	Bedrock Groundwater	Potable Water	1,1,1-Trichloroethane	NA	-	-	-	NA	NA	6.E+00	-	-	6.E+00
			1,1-Dichloroethane	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
			1,1-Dichloroethene	NA	-	-	-	NA	Liver	3.E+00	-	-	3.E+00
			1,2-Dichloroethane	5.E-03	-	-	-	5.E-03	NA	NA	-	-	NA
			1,2-Dichlorethene,total	NA	-	-	-	NA	Liver	3.E+02	-	-	3.E+02
			2-Butanone	NA	-	-	-	NA	Fetal Weight	3.E+00	-	-	3.E+00
			4-Methyl-2-pentanone	NA	-	-	-	NA	Liver, Kidney	9.E+00	-	-	9.E+00
			4-Methylphenol	NA	-	-	-	NA	Neurotoxicity	3.E+00	-	-	3.E+00
			Acetone	NA	-	-	-	NA	Liver, Kidney	2.E+00	-	-	2.E+00
			Aluminum	NA	-	-	-	NA	NA	NA	-	-	NA
			Aroclor 1254	4.E-04	-	-	-	4.E-04	Immune System	1.E+02	-	-	1.E+02
			Arsenic	9.E-04	-	-	-	9.E-04	Skin	4.E+00	-	-	4.E+00
			Barium	NA	-	-	-	NA	Kidney	5.E+00	-	-	5.E+00
			Benzene	3.E-03	-	-	-	3.E-03	NA	3.E+01	-	-	3.E+01
			Beryllium	NA	-	-	-	NA	Small Intestine	7.E-01	-	-	7.E-01
			Cadmium	NA	-	-	-	NA	Kidney	1.E+00	-	-	1.E+00
			Carbon tetrachloride	8.E-03	-	-	-	8.E-03	Liver	2.E+02	-	-	2.E+02
			Chlorobenzene	NA	-	-	-	NA	Liver	7.E+00	-	-	7.E+00
			Chloroethane	2.E-04	-	-	-	2.E-04	NA	3.E-01	-	-	3.E-01
			Chromium	NA	-	-	-	NA	NA	7.E+00	-	-	7.E+00
			cis-1,2-Dichloroethene	NA	-	-	-	NA	Blood	3.E+02	-	-	3.E+02
			Copper	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
			Ethylbenzene	NA	-	-	-	NA	Liver, Kidney	3.E+00	-	-	3.E+00
			Lead	NA	-	-	-	NA	NA	NA	-	-	NA
			M,P-Xylene	NA	-	-	-	NA	Body Weight	2.E+00	-	-	2.E+00
			Manganese	NA	-	-	-	NA	CNS	8.E+00	-	-	5.E+01
			Methanol	NA	-	-	-	NA	Brain Weight	5.E-01	-	-	5.E-01
			Methylene chloride	1.E-03	-	-	-	1.E-03	Liver	5.E+00	-	-	5.E+00
			Naphthalene	NA	-	-	-	NA	Body Weight	3.E-02	-	-	3.E-02
			Nickel	NA	-	-	-	NA	Body, Organ Weight	1.E+00	-	-	1.E+00
			O-Xylene	NA	-	-	-	NA	Body Weight	9.E-01	-	-	9.E-01
			Tetrachloroethene	3.E-01	-	-	-	3.E-01	Liver	1.E+02	-	-	1.E+02
			Tetrahydrofuran	4.E-03	-	-	-	4.E-03	NA	7.E+00	-	-	7.E+00
			Thallium	NA	-	-	-	NA	Blood	2.E+00	-	-	2.E+00
			Toluene	NA	-	-	-	NA	Liver,Kidney	1.E+01	-	-	1.E+01
			trans-1,2-Dichloroethene	NA	-	-	-	NA	Blood	7.E+00	-	-	7.E+00
			Trichloroethene	3.E+00	-	-	-	1.E+00	NA	NA	-	-	NA
			Vanadium	NA	-	-	-	NA	NA	5.E+00	-	-	5.E+00
			Vinyl chloride	7.E-01	-	-	-	7.E-01	NA	1.E+02	-	-	1.E+02
			Xylenes, total	NA	-	-	-	NA	Body Weight	3.E+00	-	-	3.E+00
			Chemical Total					2.E+00					1.E+03
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						2.E+00					1.E+03

Notes:

NA = not available

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for bedrock groundwater.

Total Adult Resident Risk for Bedrock Groundwater	2.E+00
Total Adult Resident Hazard for Bedrock Groundwater	1.E+03

Total [Liver] HI Across Bedrock Groundwater =	7.E+02
Total [Kidney] HI Across Bedrock Groundwater =	3.E+01
Total [Blood] HI Across Bedrock Groundwater =	3.E+02
Total [Immune System] HI Across Bedrock Groundwater =	1.E+02
Total [CNS/neurotoxicity] HI Across Bedrock Groundwater =	5.E+01
Total [Body Weight] HI Across Bedrock Groundwater =	1.E+01
Total [Skin] HI Across Bedrock Groundwater =	4.E+00

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
QUEEN STREET PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Overburden Groundwater	Overburden Groundwater	Potable Water	No COPC (see Table 2.3)										
			Chemical Total										
			Radionuclide Total										
		Exposure Point Total											

Total Adult Resident Risk for Overburden Groundwater

Total Adult Resident Hazard for Overburden Groundwater

Total [Organ] HI Across Overburden Groundwater =
Total [Organ] HI Across Overburden Groundwater =
Total [Organ] HI Across Overburden Groundwater =

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
QUEEN STREET PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Bedrock Groundwater	Bedrock Groundwater	Potable Water	Chloroform	1.E-07	-	-	-	1.E-07	Liver	3.E-03	-	-	3.E-03
			Trichloroethene	7.E-05	-	-	-	7.E-05	NA	NA	-	-	NA
			1,2-Dichloroethene,total	NA	-	-	-	NA	Liver	4.E-02	-	-	4.E-02
			cis-1,2-Dichloroethene	NA	-	-	-	NA	Blood	4.E-02	-	-	4.E-02
			Chemical Total					7.E-05					8.E-02
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						7.E-05					8.E-02

Notes:

NA = not available

Total Adult Resident Risk for Bedrock Groundwater 7.E-05

Total Adult Resident Hazards for Bedrock Groundwater 8.E-02

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for bedrock groundwater.

Total [Liver] HI Across Bedrock Groundwater = HI below 1

Total [Blood] HI Across Bedrock Groundwater = HI below 1

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
UPGRADIENT AREA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Overburden Groundwater	Overburden Groundwater	Potable Water	Trichloroethene	9.E-06	-	-	-	9.E-06	NA	NA	-	-	NA
			Aluminum	NA	-	-	-	NA	NA	NA	-	-	NA
			Arsenic	6.E-04	-	-	-	6.E-04	Skin	3.E+00	-	-	3.E+00
			Barium	NA	-	-	-	NA	Kidney	5.E-01	-	-	5.E-01
			Chromium	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
			Copper	NA	-	-	-	NA	NA	1.E-02	-	-	1.E-02
			Lead	NA	-	-	-	NA	NA	NA	-	-	NA
			Manganese	NA	-	-	-	NA	CNS	7.E+00	-	-	7.E+00
			Nickel	NA	-	-	-	NA	Body and organ weight	2.E-01	-	-	2.E-01
			Vanadium	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
					-	-	-						
			Chemical Total					6.E-04					1.E+01
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						6.E-04					1.E+01

Notes:

NA = not available

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for overburden groundwater.

Total Adult Resident Risk for Overburden Groundwater 6.E-04

Total Adult Resident Risk for Overburden Groundwater 1.E+01

Total [Skin] HI Across Overburden Groundwater = 3.E+00

Total [CNS] HI Across Overburden Groundwater = 7.E+00

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
UPGRADIENT AREA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Bedrock Groundwater	Bedrock Groundwater	Potable Water	Chloroform	1.E-07	-	-	-	1.E-07	Liver	3.E-03	-	-	3.E-03
			Trichloroethene	1.E-05	-	-	-	1.E-05	NA	NA	-	-	NA
			cis-1,2-Dichloroethene	NA	-	-	-	NA	Blood	1.E+00	-	-	1.E+00
			1,2-Dichloroethene, total	NA	-	-	-	NA	Liver	1.E+00	-	-	1.E+00
			Aluminum	NA	-	-	-	NA	NA	NA	-	-	NA
			Arsenic	1.E-04	-	-	-	1.E-04	Skin	7.E-01	-	-	7.E-01
			Barium	NA	-	-	-	NA	Kidney	8.E-01	-	-	8.E-01
			Chromium	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
			Lead	NA	-	-	-	NA	NA	NA	-	-	NA
			Manganese	NA	-	-	-	NA	CNS	1.E+01	-	-	1.E+01
			Nickel	NA	-	-	-	NA	body and organ weight	2.E-01	-	-	2.E-01
			Toluene	NA	-	-	-	NA	liver,kidney	1.E-01	-	-	1.E-01
			Vanadium	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
			Chemical Total					1.E-04					2.E+01
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						1.E-04					2.E+01

Notes:

NA = not available

Total Adult Resident Risk for Bedrock Groundwater: 1.E-04

Total Adult Resident Hazard for Bedrock Groundwate: 2.E+01

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for overburden groundwater.

Total [CNS] HI Across Bedrock Groundwater = 1.E+01

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	7.E-07	-	4.E-07	-	1.E-06	NA	NA	-	NA	NA
			Arsenic	2.E-06	-	2.E-07	-	2.E-06	1.E-02	1.E-02	-	1.E-03	1.E-02
			Chemical Total					3.E-06					1.E-02
			Radionuclide Total					NA					NA
		Exposure Point Total						3.E-06					1.E-02

Notes:

NA = not available

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total Adult Resident Risk for Surface Soil	3.E-06
Total Adult Resident Hazard for Surface Soil	1.E-02
Total [Skin] HI Across Surface Soil =	HI below 1

TABLE 9.8.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	2.E-06	-	6.E-07	-	3.E-06	NA	NA	-	NA	-
			Arsenic	4.E-06	-	3.E-07	-	4.E-06	Skin	1.E-01	-	9.E-03	1.E-01
			Chemical Total					7.E-06					1.E-01
			Radionuclide Total					NA					NA
		Exposure Point Total						7.E-06					1.E-01

Notes:

NA = not available

Total Child Resident Risk for Surface Soil 7.E-06

Total Child Resident Hazard for Surface Soi 1.E-01

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total [Skin] HI Across Surface Soil = HI below 1

TABLE 9.9.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Recreational/Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	7.E-08	-	4.E-08	-	1.E-07	NA	NA	-	NA	NA
			Arsenic	2.E-07	-	2.E-08	-	2.E-07	Skin	2.E-03	-	3.E-04	2.E-03
			Chemical Total					3.E-07					2.E-03
			Radionuclide Total					NA					NA
		Exposure Point Total						3.E-07					2.E-03

Notes:

NA = not available

Total Trespasser/Recreational Risk for Surface Soil 3.E-07

Total Trespasser/Recreational Hazard for Surface Soil 2.E-03

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total [Skin] HI Across Surface Soil = HI below 1

TABLE 9.10.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	5.E-07	-	4.E-07	-	9.E-07	NA	NA	-	NA	NA
			Arsenic	1.E-06	-	2.E-07	-	1.E-06	Skin	8.E-03	-	1.E-03	9.E-03
			Chemical Total					2.E-06					9.E-03
			Radionuclide Total					NA					NA
		Exposure Point Total						2.E-06					9.E-03

Notes:

NA = not available

Total Adult Worker Risk for Surface Soil: 2.E-06

Total Adult Worker Hazard for Surface Soil: 9.E-03

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total [Skin] HI Across Surface Soil = HI below 1

TABLE 9.11.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	PCBs, total	3.E-07	-	1.E-07	-	4.E-07	NA	NA	-	NA	NA
			Benzo(a)pyrene	1.E-06	-	6.E-07	-	2.E-06	NA	NA	-	NA	NA
			Arsenic	3.E-06	-	3.E-07	-	3.E-06	Skin	2.E-02	-	2.E-03	2.E-02
			Manganese	NA	-	--	-	NA	CNS	1.E-02	-	NA	1.E-02
			Cadmium	NA	-	NA	-	NA	Kidney	3.E-02	-	2.E-02	5.E-02
			Chemical Total					5.E-06					8.E-02
			Radionuclide Total					NA					NA
		Exposure Point Total						5.E-06					8.E-02

Notes:

NA = not available

-- = dermal risk not evaluated

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total Adult Resident Risk Across Surface Soil	5.E-06
Total Adult Resident Hazard Across Surface Soil	8.E-02
Total [Skin] HI Across Surface Soil =	HI below 1
Total [CNS] HI Across Surface Soil =	HI below 1
Total [Kidney] HI Across Surface Soil =	HI below 1

TABLE 9.12.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	PCBs, total	6.E-07	-	2.E-07	-	8.E-07	NA	NA	-	NA	NA
			Benzo(a)pyrene	3.E-06	-	1.E-06	-	4.E-06	NA	NA	-	NA	NA
			Arsenic	6.E-06	-	5.E-07	-	7.E-06	Skin	2.E-01	-	1.E-02	2.E-01
			Manganese	NA	-	--	-	NA	CNS	1.E-01	-	--	1.E-01
			Cadmium	NA	-	NA	-	NA	Kidney	3.E-01	-	2.E-01	5.E-01
			Chemical Total					1.E-05					8.E-01
			Radionuclide Total					NA					NA
		Exposure Point Total						1.E-05					8.E-01

Notes:

NA = not available

-- = dermal risk not evaluated

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total Child Resident Risk for Surface Soil	1.E-05
Total Child Resident Hazard for Surface Soil	8.E-01
Total [Skin] HI Across Surface Soil =	HI below 1
Total [CNS] HI Across Surface Soil =	HI below 1
Total [Kidney] HI Across Surface Soil =	HI below 1

TABLE 9.13.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Recreational/Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	PCBs, total	3.E-08	-	1.E-08	-	4.E-08	NA	NA	-	NA	NA
			Benzo(a)pyrene	1.E-07	-	6.E-08	-	2.E-07	NA	NA	-	NA	NA
			Arsenic	3.E-07	-	3.E-08	-	3.E-07	Skin	4.E-03	-	4.E-04	4.E-03
			Manganese	NA	-	--	-	NA	CNS	2.E-03	-	--	2.E-03
			Cadmium	NA	-	NA	-	NA	Kidney	6.E-03	-	5.E-03	1.E-02
			Chemical Total					5.E-07					2.E-02
			Radionuclide Total					NA					NA
		Exposure Point Total						5.E-07					2.E-02

Total Recreational/Trespasser Risk for Surface Soil: 5.E-07

Total Recreational/Trespasser Hazard for Surface Soil: 2.E-02

Notes:

NA = not available

-- dermal risk not evaluated

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total [Skin] HI Across Surface Soil = HI below 1

Total [CNS] HI Across Surface Soil = HI below 1

Total [Kidney] HI Across Surface Soil = HI below 1

TABLE 9.14.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	PCBs, total	2.E-07	-	1.E-07	-	3.E-07	NA	NA	-	NA	NA
			Benzo(a)pyrene	8.E-07	-	5.E-07	-	1.E-06	NA	NA	-	NA	NA
			Arsenic	2.E-06	-	3.E-07	-	2.E-06	Skin	1.E-02	-	2.E-03	1.E-02
			Manganese	NA	-	--	-	NA	CNS	8.E-03	-	--	8.E-03
			Cadmium	NA	-	NA	-	NA	Kidney	2.E-02	-	2.E-02	4.E-02
			Chemical Total					4.E-06					6.E-02
			Radionuclide Total					NA					NA
		Exposure Point Total						4.E-06					6.E-02

Notes:

NA = not available

-- dermal risk not evaluated

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for surface soil.

Total Adult Worker Risk for Surface Soil 4.E-06

Total Adult Worker Hazard for Surface Soil 6.E-02

Total [Skin] HI Across All Media = HI below 1
Total [CNS] HI Across All Media = HI below 1
Total [Kidney] HI Across All Media = HI below 1

TABLE 9.15.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Subsurface Soil	Subsurface Soil	Subsurface Soil	1,1,1-Trichloroethane	NA	-	--	-	NA	NA	2.E-05	-	--	2.E-05
			Lead	NA	-	--	-	NA	NA	NA	-	--	NA
			Arsenic	4.E-06	-	5.E-07	-	4.E-06	Skin	3.E-02	-	3.E-03	3.E-02
			Barium	NA	-	--	-	NA	Kidney	3.E-02	-	--	NA
			Cadmium	NA	-	NA	-	NA	Kidney	5.E-01	-	4.E-01	9.E-01
			Chromium	NA	-	--	-	NA	NA	4.E-02	-	--	4.E-02
			Vinyl chloride	5.E-07	-	--	-	5.E-07	NA	2.E-04	-	--	2.E-04
			1,1-Dichloroethene	NA	-	--	-	NA	Liver	1.E-04	-	--	1.E-04
			Trichloroethene	8.E-05	-	--	-	8.E-05	NA	NA	-	--	NA
			Ethylbenzene	NA	-	--	-	NA	Liver, Kidney	1.E-02	-	--	1.E-02
			Aroclor-1016	4.E-08	-	2.E-08	-	6.E-08	Fetal Weight	2.E-02	-	1.E-03	2.E-02
			Aroclor-1260	5.E-06	-	3.E-06	-	8.E-06	Immune System	NA	-	NA	NA
			Aroclor-1254	1.E-05	-	6.E-06	-	2.E-05	Immune System	8.E-01	-	4.E-01	1.E+00
			bis(2-Ethylhexyl)phthalate	8.E-07	-	--	-	8.E-07	Liver	8.E-03	-	--	8.E-03
			Tetrachloroethene	3.E-04	-	--	-	3.E-04	Liver	2.E-01	-	--	2.E-01
			Xylenes, total	NA	-	--	-	NA	Body Weight	8.E-03	-	--	8.E-03
			Chloroform	3.E-08	-	--	-	3.E-08	Liver	8.E-04	-	--	8.E-04
			Benzene	7.E-08	-	--	-	7.E-08	NA	1.E-03	-	--	1.E-03
			2,3,7,8-TCDD	2.E-05	-	3.E-06	-	2.E-05	NA	NA	-	NA	NA
			2,3,7,8-TCDF	3.E-06	-	4.E-07	-	3.E-06	NA	NA	-	NA	NA
			2,3,4,7,8-PeCDF	1.E-05	-	1.E-06	-	1.E-05	NA	NA	-	NA	NA
			1,2,3,7,8-PeCDF	6.E-07	-	7.E-08	-	7.E-07	NA	NA	-	NA	NA
			1,2,3,6,7,8-HxCDF	1.E-06	-	2.E-07	-	1.E-06	NA	NA	-	NA	NA
			2,3,4,6,7,8-HxCDF	1.E-06	-	2.E-07	-	1.E-06	NA	NA	-	NA	NA
			1,2,3,4,6,7,8-HpCDF	3.E-07		4.E-08		3.E-07	NA	NA	-	NA	NA
			1,2,3,4,7,8-HxCDF	3.E-06	-	3.E-07	-	3.E-06	NA	NA	-	NA	NA
			Acrolein	NA	-	--	-	NA	NA	1.E-04	-	--	1.E-04
			1,2-Dichloroethene, total	NA	-	--	-	NA	Liver	5.E-03	-	--	5.E-03
			Chemical Total					5.E-04					2.E+00
			Radionuclide Total					NA					NA
		Exposure Point Total						5.E-04					2.E+00

Notes:

NA = not available

-- = Dermal risk not evaluated

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for subsurface soil.

Total Adult Resident Risk for Subsurface Soil 5.E-04

Total Adult Resident Hazard for Subsurface Soi 2.E+00

Total [Kidney] HI Across Subsurface Soil = HI below 1
Total [Liver] HI Across Subsurface Soil = HI below 1
Total [Immune] HI Across Subsurface Soil = HI below 1
Total [Skin] HI Across Subsurface Soil = HI below 1
Total [Body Weight] HI Across Subsurface Soil = HI below 1

TABLE 9.16.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Subsurface Soil	Subsurface Soil	Subsurface Soil	1,1,1-Trichloroethane	NA	-	--	-	NA	NA	2.E-04	-	--	2.E-04
			Lead	NA	-	--	-	NA	NA	NA	-	--	NA
			Arsenic	9.E-06	-	8.E-07	-	1.E-05	Skin	2.E-01	-	2.E-02	2.E-01
			Barium	NA	-	--	-	NA	Kidney	3.E-01	-	--	3.E-01
			Cadmium	NA	-	NA	-	NA	Kidney	5.E+00	-	3.E+00	8.E+00
			Chromium	NA	-	--	-	NA	NA	3.E-01	-	--	3.E-01
			Vinyl chloride	4.E-06	-	--	-	4.E-06	NA	2.E-03	-	--	2.E-03
			1,1-Dichloroethene	NA	-	--	-	NA	Liver	1.E-03	-	--	1.E-03
			Trichloroethene	2.E-04	-	--	-	2.E-04	NA	NA	-	--	NA
			Ethylbenzene	NA	-	--	-	NA	Liver, Kidney	9.E-02	-	--	9.E-02
			Aroclor-1016	9.E-08	-	4.E-08	-	1.E-07	Fetal Weight	2.E-01	-	9.E-03	2.E-01
			Aroclor-1260	1.E-05	-	5.E-06	-	1.E-05	Immune System	NA	-	NA	NA
			Aroclor-1254	2.E-05	-	1.E-05	-	3.E-05	Immune System	7.E+00	-	3.E+00	1.E+01
			bis(2-Ethylhexyl)phthalate	2.E-06	-	--	-	2.E-06	Liver	8.E-02	-	--	8.E-02
			Tetrachloroethene	7.E-04	-	--	-	7.E-04	Liver	2.E+00	-	--	2.E+00
			Xylenes, total	NA	-	--	-	NA	Body Weight	8.E-02	-	--	8.E-02
			Chloroform	6.E-08	-	--	-	6.E-08	Liver	8.E-03	-	--	8.E-03
			Benzene	2.E-07	-	--	-	2.E-07	NA	9.E-03	-	--	9.E-03
			2,3,7,8-TCDD	5.E-05	-	4.E-06	-	5.E-05	NA	NA	-	NA	NA
			2,3,7,8-TCDF	8.E-06	-	7.E-07	-	9.E-06	NA	NA	-	NA	NA
			2,3,4,7,8-PeCDF	3.E-05	-	2.E-06	-	3.E-05	NA	NA	-	NA	NA
			1,2,3,7,8-PeCDF	1.E-06	-	1.E-07	-	1.E-06	NA	NA	-	NA	NA
			1,2,3,6,7,8-HxCDF	3.E-06	-	3.E-07	-	3.E-06	NA	NA	-	NA	NA
			2,3,4,6,7,8-HxCDF	3.E-06	-	3.E-07	-	3.E-06	NA	NA	-	NA	NA
			1,2,3,4,6,7,8-HpCDF	8.E-07	-	7.E-08		9.E-07	NA	NA	-	NA	NA
			1,2,3,4,7,8-HxCDF	6.E-06	-	5.E-07	-	7.E-06	NA	NA	-	NA	NA
			Acrolein	NA	-	--	-	NA	NA	1.E-03	-	--	1.E-03
			1,2-Dichloroethene, total	NA	-	--	-	NA	Liver	5.E-02	-	--	5.E-02
			Chemical Total					1.E-03					2.E+01
			Radionuclide Total					NA					NA
		Exposure Point Total						1.E-03					2.E+01

Notes:

NA = not available

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for subsurface soil.

Total Child Resident Risk Across Subsurface Soil 1.E-03

Total Child Resident Hazard Across Subsurface Soil 2.E+01

Total [Kidney] HI Across Subsurface Soil = 8.E+00
Total [Liver] HI Across Subsurface Soil = 2.E+00
Total [Immune] HI Across Subsurface Soil = 1.E+01

TABLE 9.17.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Subsurface Soil	Subsurface Soil	Subsurface Soil	1,1,1-Trichloroethane	NA	-	--	-	NA	NA	1.E-05	-	--	1.E-05
			Lead	NA	-	--	-	NA	NA	NA	-	--	NA
			Arsenic	3.E-06	-	4.E-07	-	3.E-06	Skin	2.E-02	-	3.E-03	2.E-02
			Barium	NA	-	--	-	NA	Kidney	2.E-02	-	--	2.E-02
			Cadmium	NA	-	NA	-	NA	Kidney	4.E-01	-	4.E-01	8.E-01
			Chromium	NA	-	--	-	NA	NA	3.E-02	-	--	3.E-02
			Vinyl chloride	1.E-07	-	--	-	1.E-07	NA	1.E-04	-	--	1.E-04
			1,1-Dichloroethene	NA	-	--	-	NA	Liver	8.E-05	-	--	8.E-05
			Trichloroethene	6.E-05	-	--	-	6.E-05	NA	NA	-	--	NA
			Ethylbenzene	NA	-	--	-	NA	Liver, Kidney	7.E-03	-	--	7.E-03
			Aroclor-1016	3.E-08	-	2.E-08	-	5.E-08	Fetal Weight	2.E-02	-	1.E-03	2.E-02
			Aroclor-1260	3.E-06	-	2.E-06	-	5.E-06	Immune System	NA	-	NA	NA
			Aroclor-1254	8.E-06	-	5.E-06	-	1.E-05	Immune System	5.E-01	-	4.E-01	9.E-01
			bis(2-Ethylhexyl)phthalate	6.E-07	-	--	-	6.E-07	Liver	6.E-03	-	--	6.E-03
			Tetrachloroethene	2.E-04	-	--	-	2.E-04	Liver	1.E-01	-	--	1.E-01
			Xylenes, total	NA	-	--	-	NA	Body Weight	6.E-03	-	--	6.E-03
			Chloroform	2.E-08	-	--	-	2.E-08	Liver	6.E-04	-	--	6.E-04
			Benzene	6.E-08	-	--	-	6.E-08	NA	7.E-04	-	--	7.E-04
			2,3,7,8-TCDD	2.E-05	-	2.E-06	-	2.E-05	NA	NA	-	NA	NA
			2,3,7,8-TCDF	2.E-06	-	3.E-07	-	2.E-06	NA	NA	-	NA	NA
			2,3,4,7,8-PeCDF	9.E-06	-	1.E-06	-	1.E-05	NA	NA	-	NA	NA
			1,2,3,7,8-PeCDF	4.E-07	-	6.E-08	-	5.E-07	NA	NA	-	NA	NA
			1,2,3,6,7,8-HxCDF	1.E-06	-	2.E-07	-	1.E-06	NA	NA	-	NA	NA
			2,3,4,6,7,8-HxCDF	1.E-06	-	2.E-07	-	1.E-06	NA	NA	-	NA	NA
			1,2,3,4,6,7,8-HpCDF	3.E-07	-	4.E-08	-	3.E-07	NA	NA	-	NA	NA
			1,2,3,4,7,8-HxCDF	2.E-06	-	3.E-07	-	2.E-06	NA	NA	-	NA	NA
			Acrolein	NA	-	--	-	NA	NA	9.E-05	-	--	9.E-05
			1,2-Dichloroethene, total	NA	-	--	-	NA	Liver	3.E-03	-	--	3.E-03
			Chemical Total					3.E-04					2.E+00
			Radionuclide Total					NA					NA
		Exposure Point Total						3.E-04					2.E+00

Notes:

NA = not available

-- = Dermal risk not evaluated

Target-specific hazard indices are less than 1, and are therefore not summed in the total target organ hazard index for subsurface soil.

Total Adult Worker Risk for Subsurface Soi	3.E-04	Total Adult Worker Hazard Across Subsurface Soi	2.E+00

Total [Kidney] HI Across Subsurface Soil = HI below 1
Total [Liver] HI Across Subsurface Soil = HI below 1
Total [Immune] HI AcrossSubsurface Soil = HI below 1
Total [Body Weight] HI Across Subsurface Soil = HI below 1
Total [Skin] HI Across Subsurface Soil = HI below 1

TABLE 10.1.RME

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

OPERATIONS AREA PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Overburden Groundwater	Overburden Groundwater	Potable Water	1,1,1-Trichloroethane	NA	-	-	-	NA	NA	2.E+01	-	-	2.E+01
			1,1-Dichloroethane	NA	-	-	-	NA	NA	4.E+00	-	-	4.E+00
			1,1-Dichloroethene	NA	-	-	-	NA	Liver	4.E+00	-	-	4.E+00
			1,2-Dichlorethene,total	NA	-	-	-	NA	Liver	4.E+02	-	-	4.E+02
			2-Butanone	NA	-	-	-	NA	Fetal Weight	2.E+01	-	-	2.E+01
			4-Methyl-2-pentanone	NA	-	-	-	NA	Liver, Kidney	2.E+01	-	-	2.E+01
			4-Methylphenol	NA	-	-	-	NA	Neurotoxicity	6.E+00	-	-	6.E+00
			Acetone	NA	-	-	-	NA	Liver, Kidney	1.E+01	-	-	1.E+01
			Aluminum	NA	-	-	-	NA	NA	NA	-	-	NA
			Aroclor-1260	4.E-04	-	-	-	4.E-04	Immune System	NA	-	-	NA
			Arsenic	7.E-04	-	-	-	7.E-04	Skin	4.E+00	-	-	4.E+00
			Barium	NA	-	-	-	NA	Kidney	8.E+00	-	-	8.E+00
			Benzene	2.E-03	-	-	-	2.E-03	NA	2.E+01	-	-	2.E+01
			Cadmium	NA	-	-	-	NA	Kidney	3.E+00	-	-	3.E+00
			Chlorobenzene	NA	-	-	-	NA	Liver	3.E+00	-	-	3.E+00
			Chloroethane	1.E-04	-	-	-	1.E-04	NA	3.E-01	-	-	3.E-01
			Chromium	NA	-	-	-	NA	NA	4.E+00	-	-	4.E+00
			cis-1,2-Dichloroethene	NA	-	-	-	NA	Blood	6.E+02	-	-	6.E+02
			Ethylbenzene	NA	-	-	-	NA	Liver, Kidney	2.E+01	-	-	2.E+01
			Lead	NA				NA	NA	NA	-	-	NA
			Manganese	NA	-	-	-	NA	CNS	3.E+01	-	-	3.E+01
			Methylene chloride	8.E-04	-	-	-	8.E-04	Liver	4.E+00	-	-	4.E+00
			Tetrachloroethene	9.E-02	-	-	-	8.E-02	Liver	4.E+01	-	-	4.E+01
			Tetrahydrofuran	5.E-03	-	-	-	5.E-03	NA	7.E+00	-	-	7.E+00
			Toluene	NA	-	-	-	NA	Liver,Kidney	2.E+01	-	-	2.E+01
			trans-1,2-Dichloroethene	NA	-	-	-	NA	Blood	1.E+01	-	-	1.E+01
			Trichloroethene	4.E-01	-	-	-	4.E-01	NA	NA	-	-	NA
			Vanadium	NA	-	-	-	NA	NA	3.E+00	-	-	3.E+00
			Vinyl chloride	7.E-01	-	-	-	7.E-01	NA	1.E+02	-	-	1.E+02
			Xylenes, total	NA	-	-	-	NA	Body Weight	2.E+00	-	-	2.E+00
			Chemical Total					1.E+00					1.E+03
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						1.E+00					1.E+03

Total Adult Resident Risk for Overburden Groundwater	1.E+00
Total Adult Resident Hazard for Overburden Groundwater.	1.E+03

Notes:

Chemicals included in the risk assessment summary have cancer risks greater than 10 $^{-6}$ and/or noncancer hazards greater than 1.

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for overburden groundwater.

NA = not available

Total [Liver] HI Across Overburden Groundwater =	5.E+02
Total [Kidney] HI Across Overburdern Groundwater =	8.E+01
Total [Blood] HI Across Overburden Groundwater =	6.E+02
Total [CNS/Neurotoxicity] HI Across Overburden Groundwater	3.E+01
Total [Body Weight] HI Across Overburden Groundwater =	#REF!
Total [Skin] HI Across Overburden Groundwater =	4.E+00

TABLE 10.2.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Bedrock Groundwater	Bedrock Groundwater	Potable Water	1,1,1-Trichloroethane	NA	-	-	-	NA	NA	6.E+00	-	-	6.E+00
			1,1-Dichloroethane	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
			1,1-Dichloroethene	NA	-	-	-	NA	Liver	3.E+00	-	-	3.E+00
			1,2-Dichloroethane	5.E-03	-	-	-	5.E-03	NA	NA	-	-	NA
			1,2-Dichlorethene,total	NA	-	-	-	NA	Liver	3.E+02	-	-	3.E+02
			2-Butanone	NA	-	-	-	NA	Fetal Weight	3.E+00	-	-	3.E+00
			4-Methyl-2-pentanone	NA	-	-	-	NA	Liver, Kidney	9.E+00	-	-	9.E+00
			4-Methylphenol	NA	-	-	-	NA	Neurotoxicity	3.E+00	-	-	3.E+00
			Acetone	NA	-	-	-	NA	Liver, Kidney	2.E+00	-	-	2.E+00
			Aluminum	NA	-	-	-	NA	NA	NA	-	-	NA
			Aroclor 1254	4.E-04	-	-	-	4.E-04	Immune System	1.E+02	-	-	1.E+02
			Arsenic	9.E-04	-	-	-	9.E-04	Skin	4.E+00	-	-	4.E+00
			Barium	NA	-	-	-	NA	Kidney	5.E+00	-	-	5.E+00
			Benzene	3.E-03	-	-	-	3.E-03	NA	3.E+01	-	-	3.E+01
			Cadmium	NA	-	-	-	NA	Kidney	1.E+00	-	-	1.E+00
			Carbon tetrachloride	8.E-03	-	-	-	8.E-03	Liver	2.E+02	-	-	2.E+02
			Chlorobenzene	NA	-	-	-	NA	Liver	7.E+00	-	-	7.E+00
			Chloroethane	2.E-04	-	-	-	2.E-04	NA	3.E-01	-	-	3.E-01
			Chromium	NA	-	-	-	NA	NA	7.E+00	-	-	7.E+00
			cis-1,2-Dichloroethene	NA	-	-	-	NA	Blood	3.E+02	-	-	3.E+02
			Copper	NA	-	-	-	NA	NA	1.E+00	-	-	1.E+00
			Ethylbenzene	NA	-	-	-	NA	Liver, Kidney	3.E+00	-	-	3.E+00
			Lead	NA	-	-	-	NA	NA	NA	-	-	NA
			M,P-Xylene	NA	-	-	-	NA	Body Weight	2.E+00	-	-	2.E+00
			Manganese	NA	-	-	-	NA	CNS	8.E+00	-	-	5.E+01
			Methylene chloride	1.E-03	-	-	-	1.E-03	Liver	5.E+00	-	-	5.E+00
			Nickel	NA	-	-	-	NA	Body, Organ Weight	1.E+00	-	-	1.E+00
			Tetrachloroethene	3.E-01	-	-	-	3.E-01	Liver	1.E+02	-	-	1.E+02
			Tetrahydrofuran	4.E-03	-	-	-	4.E-03	NA	7.E+00	-	-	7.E+00
			Thallium	NA	-	-	-	NA	Blood	2.E+00	-	-	2.E+00
			Toluene	NA	-	-	-	NA	Liver,Kidney	1.E+01	-	-	1.E+01
			trans-1,2-Dichloroethene	NA	-	-	-	NA	Blood	7.E+00	-	-	7.E+00
			Trichloroethene	3.E+00	-	-	-	1.E+00	NA	NA	-	-	NA
			Vanadium	NA	-	-	-	NA	NA	5.E+00	-	-	5.E+00
			Vinyl chloride	7.E-01	-	-	-	7.E-01	NA	1.E+02	-	-	1.E+02
			Xylenes, total	NA	-	-	-	NA	Body Weight	3.E+00	-	-	3.E+00
			Chemical Total					2.E+00					1.E+03
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						2.E+00					1.E+03

Total Adult Resident Risk for Bedrock Groundwater	2.E+00
Total Adult Resident Hazard for Bedrock Groundwater	1.E+03

Notes:

Chemicals included in the risk assessment summary have cancer risks greater than 10^{-6} and/or noncancer hazards greater than 1.

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for overburden groundwater.

NA = not available

Total [Liver] HI Across Bedrock Groundwater =	7.E+02
Total [Kidney] HI Across Bedrock Groundwater =	3.E+01
Total [Blood] HI Across Bedrock Groundwater =	3.E+02
Total [Immune System] HI Across Bedrock Groundwater =	1.E+02
Total [CNS/neurotoxicity] HI Across Bedrock Groundwater =	5.E+01
Total [Body Weight] HI Across Bedrock Groundwater =	7.E+00
Total [Skin] HI Across Bedrock Groundwater =	4.E+00

TABLE 10.3.RME

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

QUEEN STREET PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Overburden Groundwater	Overburden Groundwater	Potable Water	No COPC (see Table 2.3)										
			Chemical Total										
			Radionuclide Total										
		Exposure Point Total											

Notes:

Total Adult Resident Risk for Overburden Groundwate

Total Adult Resident Hazard for Overburden Groundwate

Chemicals included in the risk assessment summary have cancer risks greater than 10^6 and/or noncancer risks greater than 1.

NA = not available

Total [Organ] HI Across Overburden Groundwater =

Total [Organ] HI Across Overburden Groundwater =

Total [Organ] HI Across Overburden Groundwater =

TABLE 10.4.RME

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

QUEEN STREET PLUME

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Bedrock Groundwater	Bedrock Groundwater	Potable Water	Trichloroethene	7.E-05	-	-	-	7.E-05	NA	NA	-	-	NA
			Chemical Total					7.E-05					NA
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						7.E-05					NA

Total Adult Resident Risk for Bedrock Groundwater	7.E-05
Total Adult Resident Hazards for Bedrock Groundwate	NA
Total [Organ] HI Across Overburden Groundwater =	NA
Total [Organ] HI Across Overburden Groundwater =	NA
Total [Organ] HI Across Overburden Groundwater =	NA

Notes:

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

NA = not available

TABLE 10.5.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
UPGRADIENT AREA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Overburden Groundwater	Overburden Groundwater	Potable Water	Trichloroethene	9.E-06	-	-	-	9.E-06	NA	NA	-	-	NA
			Arsenic	6.E-04	-	-	-	6.E-04	Skin	3.E+00	-	-	3.E+00
			Lead	NA	-	-	-	NA	NA	NA	-	-	NA
			Manganese	NA	-	-	-	NA	CNS	7.E+00	-	-	7.E+00
					-	-	-						
			Chemical Total					6.E-04					1.E+01
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						6.E-04					1.E+01

Total Adult Resident Risk for Overburden Groundwater 6.E-04

Total Adult Resident Risk for Overburden Groundwater 1.E+01

Total [Skin] HI Across Overburden Groundwater = 3.E+00

Total [CNS] HI Across Overburden Groundwater = 7.E+00

Notes:

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for overburden groundwater.

NA = not available

TABLE 10.6.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
UPGRADIENT AREA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Bedrock Groundwater	Bedrock Groundwater	Potable Water	Trichloroethene	1.E-05	-	-	-	1.E-05	NA	NA	-	-	NA
			Arsenic	1.E-04	-	-	-	1.E-04	Skin	7.E-01	-	-	7.E-01
			Lead	NA	-	-	-	NA	NA	NA	-	-	NA
			Manganese	NA	-	-	-	NA	CNS	1.E+01	-	-	1.E+01
			Chemical Total					1.E-04					1.E+01
			Radionuclide Total	NA				NA					NA
		Exposure Point Total						1.E-04					1.E+01

Total Adult Resident Risk for Bedrock Groundwater 1.E-04

Total Adult Resident Hazard for Bedrock Groundwater 1.E+01

Total [CNS] HI Across Bedrock Groundwater = 1.E+01

Notes:

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for overburden groundwater.

NA = not available

TABLE 10.7.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	7.E-07	-	4.E-07	-	1.E-06	NA	NA	-	NA	NA
			Arsenic	2.E-06	-	2.E-07	-	2.E-06	1.E-02	1.E-02	-	1.E-03	1.E-02
			Chemical Total					3.E-06					1.E-02
			Radionuclide Total					NA					NA
		Exposure Point Total						3.E-06					1.E-02

Notes:
Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

Target-specific hazard indices are less than 1, and are therefore not included in the total organ hazard index for surface soil.

NA = not available

Total Adult Resident Risk for Surface Soil 3.E-06

Total Adult Resident Hazard for Surface Soil 1.E-02

Total [Skin] HI Across Surface Soil = HI below 1

TABLE 10.8.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	2.E-06	-	6.E-07	-	3.E-06	NA	NA	-	NA	-
			Arsenic	4.E-06	-	3.E-07	-	4.E-06	Skin	1.E-01	-	9.E-03	1.E-01
			Chemical Total					7.E-06					1.E-01
			Radionuclide Total					NA					NA
		Exposure Point Total						7.E-06					1.E-01

Notes:

Total Child Resident Risk for Surface Soil 7.E-06

Total Child Resident Hazard for Surface Soi 1.E-01

Chemicals included in the risk assessment summary have cancer risks greater than 10^6 and/or noncancer risks greater than 1.

Target-specific hazard indices are less than 1, and are therefore not included in the total organ hazard index for surface soil.

Total [Skin] HI Across Surface Soil = HI below 1

NA = not available

TABLE 10.9.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Recreational/Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil											
			Chemical Total					NA					NA
			Radionuclide Total					NA					NA
		Exposure Point Total						NA					NA

Notes:

(a) No chemicals retained. Cancer and noncancer risks are less than 10^{-6} and 1, respectively.

Total Trespasser/Recreational Risk for Surface Soil NA

Total Trespasser/Recreational Hazard for Surface Soil NA

Total [Organ] HI Across Surface Soil = NA

TABLE 10.10.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
NORTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	5.E-07	-	4.E-07	-	9.E-07	NA	NA	-	NA	NA
			Arsenic	1.E-06	-	2.E-07	-	1.E-06	Skin	8.E-03	-	1.E-03	9.E-03
			Chemical Total					2.E-06					9.E-03
			Radionuclide Total					NA					NA
		Exposure Point Total						2.E-06					9.E-03

Total Adult Worker Risk for Surface Soil	2.E-06
Total Adult Worker Hazard for Surface Soi	9.E-03
Total [Skin] HI Across Surface Soil =	HI below 1

Notes:

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

Target-specific hazard indices are less than 1, and are therefore not included in the total organ hazard index for surface soil.

NA = not available

TABLE 10.11.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	1.E-06	-	6.E-07	-	2.E-06	NA	NA	-	NA	NA
			Arsenic	3.E-06	-	3.E-07	-	3.E-06	Skin	2.E-02	-	2.E-03	2.E-02
			Chemical Total					5.E-06					2.E-02
			Radionuclide Total					NA					NA
		Exposure Point Total						5.E-06					2.E-02

Total Adult Resident Risk Across Surface Soil: 5.E-06

Total Adult Resident Hazard Across Surface Soil: 2.E-02

Total [Skin] HI Across Surface Soil = HI below 1

Notes:

Chemicals included in the risk assessment summary have cancer risks greater than 10^{-6} and/or noncancer risks greater than 1.

Target-specific hazard indices are less than 1, and are therefore not included in the total organ hazard index for surface soil.

NA = not available

TABLE 10.12.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Benzo(a)pyrene	3.E-06	-	1.E-06	-	4.E-06	NA	NA	-	NA	NA
			Arsenic	6.E-06	-	5.E-07	-	7.E-06	Skin	2.E-01	-	1.E-02	2.E-01
			Chemical Total					1.E-05					2.E-01
			Radionuclide Total					NA					NA
		Exposure Point Total						1.E-05					2.E-01

Notes:

Total Child Resident Risk for Surface Soil 1.E-05

Total Child Resident Hazard for Surface Soil 2.E-01

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

Target-specific hazard indices are less than 1, and are therefore not included in the total organ hazard index for surface soil.

Total [Skin] HI Across Surface Soil = HI below 1

NA = not available

TABLE 10.13.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Recreational/Trespasser
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient					
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil											
			Chemical Total					NA					NA
			Radionuclide Total					NA					NA
		Exposure Point Total						NA					NA

Notes:

(a) No chemicals retained. Cancer and noncancer risks are less than 10^{6} and 1, respectively.

Total Recreational/Trespasser Risk for Surface Soi NA

Total Recreational/Trespasser Hazard for Surface So NA

Total [Organ] HI Across Surface Soil = NA

TABLE 10.14.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
SOUTH CIANCI PROPERTY

Scenario Timeframe: Current/Future
Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	2.E-06	-	3.E-07	-	2.E-06	Skin	1.E-02	-	2.E-03	1.E-02
			Chemical Total					2.E-06					1.E-02
			Radionuclide Total					NA					NA
		Exposure Point Total						4.E-06					1.E-02

Total Adult Worker Risk for Surface Soil 2.E-06

Total Adult Worker Hazard for Surface Soil 1.E-02

Total [Skin] HI Across All Media = HI below 1

Notes:
Chemicals included in the risk assessment summary have cancer risks greater than 10^{-6} and/or noncancer risks greater than 1.

Target-specific hazard indices are less than 1, and are therefore not included in the total organ hazard index for surface soil.

NA = not available

TABLE 10.15.RME

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	4.E-06	-	5.E-07	-	4.E-06	Skin	3.E-02	-	3.E-03	3.E-02
			Trichloroethene	8.E-05	-	--	-	8.E-05	NA	NA	-	--	NA
			Aroclor-1260	5.E-06	-	3.E-06	-	8.E-06	Immune System	NA	-	NA	NA
			Aroclor-1254	1.E-05	-	6.E-06	-	2.E-05	Immune System	8.E-01	-	4.E-01	1.E+00
			Tetrachloroethene	3.E-04	-	--	-	3.E-04	Liver	2.E-01	-	--	2.E-01
			2,3,7,8-TCDD	2.E-05	-	3.E-06	-	2.E-05	NA	NA	-	NA	NA
			2,3,7,8-TCDF	3.E-06	-	4.E-07	-	3.E-06	NA	NA	-	NA	NA
			2,3,4,7,8-PeCDF	1.E-05	-	1.E-06	-	1.E-05	NA	NA	-	NA	NA
			1,2,3,4,7,8-HxCDF	3.E-06	-	3.E-07	-	3.E-06	NA	NA	-	NA	NA
			Chemical Total					4.E-04					1.E+00
			Radionuclide Total					NA					NA
		Exposure Point Total						4.E-04					1.E+00

Notes:

-- = Dermal risk not evaluated.

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

NA = not available

Total Adult Resident Risk for Subsurface Soil 4.E-04

Total Adult Resident Hazard for Subsurface Soi 1.E+00

Total [Liver] HI Across Subsurface Soil = HI below 1
Total [Immune] HI Across Subsurface Soil = 1.E+00
Total [Skin] HI Across Subsurface Soil = HI below 1

TABLE 10.16.RME
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
OPERATIONS AREA/RAILROAD PROPERTY

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Subsurface Soil	Subsurface Soil	Subsurface Soil											
			Arsenic	9.E-06	-	8.E-07	-	1.E-05	Skin	2.E-01	-	2.E-02	2.E-01
			Cadmium	NA	-	NA	-	NA	Kidney	5.E+00	-	3.E+00	8.E+00
			Trichloroethene	2.E-04	-	--	-	2.E-04	NA	NA	-	--	NA
			Aroclor-1260	1.E-05	-	5.E-06	-	1.E-05	Immune System	NA	-	NA	NA
			Aroclor-1254	2.E-05	-	1.E-05	-	3.E-05	Immune System	7.E+00	-	3.E+00	1.E+01
			bis(2-Ethylhexyl)phthalate	2.E-06	-	--	-	2.E-06	Liver	8.E-02	-	--	8.E-02
			Tetrachloroethene	7.E-04	-	--	-	7.E-04	Liver	2.E+00	-	--	2.E+00
			2,3,7,8-TCDD	5.E-05	-	4.E-06	-	5.E-05	NA	NA	-	NA	NA
			2,3,7,8-TCDF	8.E-06	-	7.E-07	-	9.E-06	NA	NA	-	NA	NA
			2,3,4,7,8-PeCDF	3.E-05	-	2.E-06	-	3.E-05	NA	NA	-	NA	NA
			1,2,3,7,8-PeCDF	1.E-06	-	1.E-07	-	1.E-06	NA	NA	-	NA	NA
			1,2,3,6,7,8-HxCDF	3.E-06	-	3.E-07	-	3.E-06	NA	NA	-	NA	NA
			2,3,4,6,7,8-HxCDF	3.E-06	-	3.E-07	-	3.E-06	NA	NA	-	NA	NA
			1,2,3,4,6,7,8-HpCDF	8.E-07	-	7.E-08		9.E-07	NA	NA	-	NA	NA
			1,2,3,4,7,8-HxCDF	6.E-06	-	5.E-07	-	7.E-06	NA	NA	-	NA	NA
			Vinyl Chloride	4.E-06	-	--	-	4.E-06	NA	NA	-	NA	NA
			Chemical Total					1.E-03					2.E+01
			Radionuclide Total					NA					NA
		Exposure Point Total						1.E-03					2.E+01

Notes:

-- = Dermal risk not evaluated.

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

Target-specific hazard indices greater than 1 are included in the total target organ hazard index for subsurface soil.

NA = not available

Total Child Resident Risk Across Subsurface Soil 1.E-03

Total Child Resident Hazard Across Subsurface Soil 2.E+01

Total [Kidney] HI Across Subsurface Soil = 8.E+00

Total [Liver] HI Across Subsurface Soil = 2.E+00

Total [Immune] HI Across Subsurface Soil = 1.E+01

TABLE 10.17.RME

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

OPERATIONS AREA/RAILROAD PROPERTY

Receptor Population: Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Subsurface Soil	Subsurface Soil	Subsurface Soil	Arsenic	3.E-06	-	4.E-07	-	3.E-06	Skin	2.E-02	-	3.E-03	2.E-02
			Trichloroethene	6.E-05	-	--	-	6.E-05	NA	NA	-	--	NA
			Aroclor-1260	3.E-06	-	2.E-06	-	5.E-06	Immune System	NA	-	NA	NA
			Aroclor-1254	8.E-06	-	5.E-06	-	1.E-05	Immune System	5.E-01	-	4.E-01	9.E-01
			Tetrachloroethene	2.E-04	-	--	-	2.E-04	Liver	1.E-01	-	--	1.E-01
			2,3,7,8-TCDD	2.E-05	-	2.E-06	-	2.E-05	NA	NA	-	NA	NA
			2,3,7,8-TCDF	2.E-06	-	3.E-07	-	2.E-06	NA	NA	-	NA	NA
			2,3,4,7,8-PeCDF	9.E-06	-	1.E-06	-	1.E-05	NA	NA	-	NA	NA
			1,2,3,6,7,8-HxCDF	1.E-06	-	2.E-07	-	1.E-06	NA	NA	-	NA	NA
			2,3,4,6,7,8-HxCDF	1.E-06	-	2.E-07	-	1.E-06	NA	NA	-	NA	NA
			1,2,3,4,7,8-HxCDF	2.E-06	-	3.E-07	-	2.E-06	NA	NA	-	NA	NA
			Chemical Total					3.E-04					1.E+00
			Radionuclide Total					NA					NA
		Exposure Point Total						3.E-04					1.E+00

Notes:

-- = Dermal risk not evaluated.

Chemicals included in the risk assessment summary have cancer risks greater than 10^{6} and/or noncancer risks greater than 1.

Target-specific hazard indices are less than 1, and are therefore not included in the total organ hazard index for surface soil.

NA = not available

Total Adult Worker Risk for Subsurface Soil	3.E-04
Total Adult Worker Hazard Across Subsurface Soil	1.E+00
Total [Liver] HI Across Subsurface Soil =	HI below 1
Total [Immune] HI AcrossSubsurface Soil =	HI below 1
Total [Skin] HI Across Subsurface Soil =	HI below 1

Appendix K

Supplemental Sediment Sampling

TECHNICAL REPORT

Appendix K – Supplemental Sediment Sampling

SRSNE Site
Southington, Connecticut

May 2000

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Table of Contents

1. Introduction

This report describes the sediment investigation performed by Blasland, Bouck & Lee, Inc. (BBL) on the Quinnipiac River adjacent to the Solvents Recovery Service of New England (SRSNE) Superfund Site in Southington, Connecticut. This sediment evaluation includes a summary of both recent and historical data. The recent data were obtained from the sediment sampling and analysis program conducted by BBL in October/November 1999. The historical sediment data consist of the Phase I and Phase III RI data, and data provided by the Connecticut Department of Environmental Protection (CTDEP). The sediment sampling conducted by BBL in 1999 was performed in accordance with the Sediment Sampling Work Plan, which was submitted by BBL to the U.S. Environmental Protection Agency (USEPA) and CTDEP on October 22, 1999. The 1999 sediment sampling included the collection and analyses of 39 sediment samples from 15 different sediment deposits located upstream, adjacent to, and downstream of the site.

This report is organized into the following sections. Section 2 (Objectives) describes the objectives of the sediment investigation. Section 3 (BBL 1999 Sediment Sampling Methodology) describes the field methods, sample locations, and sampling and analyses used in the 1999 sediment investigation. Section 4 (Sediment Sampling Results) presents the results of the 1999 sediment investigation. Section 5 (Trend Analysis and Discussion of Site-Relatedness) includes an evaluation of the data, including an analysis of spatial trends and a comparison of chemical concentrations to sediment screening criteria. This section compares the 1999 data with the previously collected sediment data. Section 6 (Screening-Level Ecological Assessment) discusses the sediment data in terms of potential ecological risks. Lastly, Section 7 (Conclusions) summarizes the conclusions of the sediment investigation, and Section 8 (References) provides the references cited in the report.

2. Objectives

The sediment investigation was designed to address agency concerns regarding potential ecological risks posed by Site-related chemicals in sediments of the Quinnipiac River. As such, the objectives of the sediment investigation were to: 1) characterize chemical concentrations in sediment; 2) identify whether the concentrations were potentially site-related; and 3) determine if site-related chemicals were present at levels posing potential risk sufficient to require consideration of sediment remedial alternatives in the FS.

To address these issues, the sediment investigation targeted chemicals of potential concern (COPCs) in sediment in the Quinnipiac River from the culvert outfall to the power line easement, a distance of approximately 1,800 feet. Additional sediment samples from upstream background locations were collected to aid in identifying site-related COPCs. These data are used to: 1) evaluate site-relatedness of detected sediment constituents; and 2) determine whether these site-related COPCs pose potential risks based on a screening-level risk assessment. In addition, historical data from the RI and other agency sources are included in this evaluation.

3. BBL 1999 Sediment Methodology

This section describes the sediment sampling and analysis that was conducted by BBL on the Quinnipiac River in October/November 1999. The methodology for the collection and laboratory analysis of Quinnipiac River sediment samples was described in the Sediment Sampling Work Plan (BBL, 1999), which is included as Attachment 1 to this report. Specifically, this section includes a description of the sediment probing exercise, the sediment sampling locations, and the methodology used to collect and analyze the sediment samples.

3.1 Sediment Probing

Sediment probing and mapping tasks on the Quinnipiac River were conducted on October 7, 1999. The objective of the sediment probing was to identify and characterize depositional areas prior to selecting the proposed sediment sample locations. The sediment probing involved measuring the depth, location, and characteristics of sediment deposits in the river. The probing included the area from approximately 700 feet upstream of Lazy Lane downstream past the SRSNE site to the river's confluence with an unnamed tributary immediately north of the Southington Production Well No. 4 (a total stream distance of approximately 4,700 feet).

Sediment depths were measured by probing with a ½-inch-diameter pipe, and measuring the depth to refusal. Approximate length and width of the sediment deposits were also recorded. During the sediment probing, flagging was placed at each of the sediment deposits to identify the area for potential future sediment sampling. Field notes from the sediment probing are included as Attachment 2 to this report. The locations of the sediment deposits are presented in Figure 1 of the Sediment Sampling Work Plan (included as Attachment 1 of this report).

The results of the sediment probing indicated that the upper stretches of the study area (from upstream of Lazy Lane to the power line easement) are relatively well scoured. The substrate is generally fine and coarse sand, with some areas of gravel. Isolated sediment deposits, consisting of fine sand and silt, exist in some areas along the banks, and at bends in the river where the current slows. This information is included in the sediment probing field notes (Attachment 2). Additional information on the sediment characteristics is available from the grain size and total organic carbon (TOC) data for the sediment samples. This information is presented in Section 4 of this report.

Observations of the deposits from the sediment probing are presented in Table 1. The depth of the sediment deposits (depth to refusal) was generally 2 to 5 feet (see Table 1). The size of the sediment deposits varied, with a maximum length of approximately 80 feet and a maximum width of approximately 25 feet.

3.2 Sediment Sampling Location

Sediment sample locations were selected based on the sediment probing exercise. Specifically, sediment sampling locations were selected to target finer grain sediments of higher organic content. Additionally, sampling targeted long-standing deposits, based on observations of sediment composition and position within the stream channel relative to morphology. Historical aerial photographs of the Quinnipiac River were also reviewed prior to selecting proposed sediment sampling locations. The purpose of the review was to determine if there were any historical changes in stream morphology that may have affected sediment deposition patterns. Review of the available aerial photographs from 1965, 1970, 1975, and 1980 indicated that the stream channel configuration of the study area (i.e., from Lazy Lane downstream to the power line easement) has remained the same throughout this period.

Based on the evaluation described above, the sediment sampling targeted twelve sediment deposits in the Quinnipiac River between the culvert outfall and the power line easement (see Figure 2A). These twelve locations included major sediment deposits identified in this section of the river during the probing. In addition, sediment samples were collected from three reference locations upstream of Lazy Lane to provide information on upstream background chemical concentrations in sediments.

3.3 Sediment Sampling Methodology

Sediment sampling was conducted in October/November, 1999, and included both surface (0 to 6 inch) and subsurface (6 inch to refusal) sediment samples. Samples were collected using 3-inch diameter Lexan tubing. At each sampling location, a section of tubing was advanced until refusal. The sediment core samples were then characterized for color, texture, visual staining, and odors. Each core was sectioned into surface and subsurface samples, depending on depth of refusal. If depth of refusal was approximately 2 feet or less, then the subsurface sample was the entire subsurface segment from 6 inches to refusal. If, however, the depth of refusal was greater than 2 feet (i.e., sample locations 1, 2, 6, 7, 9, 10, 14, and 15), then the subsurface segment was further segmented into two subsurface samples of 6 inches to 2 feet and 2 feet to refusal. At the three largest sediment deposits (i.e., sample locations 8, 9, and 14), surface and subsurface samples were composited from three representative locations within the deposit.

Each sample from each core was placed into the appropriate sample container, labeled, and sent to the laboratory for analysis. Quality assurance/quality control (QA/QC) samples (including separate duplicate, matrix spike, and matrix spike duplicate samples, and equipment rinse samples) were also collected. Field notes from the sediment sampling are included as Attachment 3 of this report.

3.4 Laboratory Analyses

Galson Laboratories (Syracuse, NY) served as the primary analytical laboratory for the analysis of sediment samples. Target analytes were identified based upon previous sediment sampling conducted on the Quinnipiac River, discussions with the agencies, and the results of the Baseline Risk Assessment (RA) and the final Remedial Investigation Report [Halliburton NUS Environmental Corporation (HNUS), 1994a]. As such, sediment samples were analyzed for semi-volatile organic compounds (SVOCs), inorganic parameters, and polychlorinated biphenyls (PCBs). Sediment samples were also analyzed for total organic carbon (TOC) and percent moisture. The analytical methods which were used were:

Analyte	Method
PCBs	USEPA SW-846 Method 8082
SVOCs	USEPA SW-846 Method 8270
Inorganics	USEPA SW-846 Method 6010-7000; 9010
TOC	USEPA Region 2 Lloyd Kahn Method

In addition, Atlantic Testing Laboratories, Limited (Cicero, NY) analyzed 15 of the sediment samples for particle size analysis and hydrometer analysis (ASTM D 422 sieve analysis).

4. Sediment Sampling Results

In 1999 BBL collected a total of 39 sediment samples from 15 locations (12 downstream locations and three reference locations) within the Quinnipiac River. Sediment samples were analyzed for organic chemicals (SVOCs and PCBs), inorganics, and sediment grain size. The results of the BBL 1999 sediment sampling investigation are presented in Table 2 (organics), and Table 3 (inorganics). A summary of the results, including frequency of detection and range of concentrations, for the upstream (background) and downstream locations, is presented in Table 4. The data regarding physical characteristics and grain size are presented in Table 5.

A variety of organic and inorganic constituents were detected in Quinnipiac River sediment samples. For organics, the highest concentrations were usually detected in surficial sediment samples. For inorganics, concentrations did not exhibit a consistent pattern with respect to sample depth. As shown in Table 4, detected concentrations of some constituents are slightly higher adjacent to and downstream of the site in comparison to upstream (i.e., reference) samples. Subsequent sections of this report describe whether these differences are potentially significant and site-related (Section 5), and evaluate the data using a screening-level assessment (Section 6).

The grain size data for the sediment samples (Attachment 4) indicates that the sediment deposits are primarily sand, with lesser degrees of gravel and silt/clay. The sediment samples with the highest percentage of silt/clay frequently had the highest total PAH concentrations and the highest total PCB concentrations. The TOC for the sediment samples (Table 2) was relatively variable, and ranged from 0.037 % to 8.1%. In general, the samples with the highest total PAH concentrations and the highest total PCB concentrations also had the highest TOC content.

5. Trend Analysis and Discussion of Site-Relatedness

The sediment data were evaluated to determine if constituents detected in sediments exhibited a significant increase adjacent to or downstream of the Site. The evaluation of the sediment data includes two sets of analyses. The first set of analyses includes only the 1999 BBL data, and the second set includes both the 1999 data and the historic data.

The trend analysis of the BBL-only data includes both the surface and subsurface sediment data. To evaluate the BBL data, the data were arranged from upstream (i.e., background) to downstream, and were broken down into the following four reaches (with associated sample numbers):

1. Upstream of Lazy Lane: SD-10-99-1, SD-10-99-2, SD-10-99-3.
2. Vicinity of the Culvert Outfall: SD-10-99-4, SD-10-99-5.
3. Proximate Downstream of the Former Cianci Property: SD-10-99-6, SD-10-99-7, SD-10-99-8C, SD-10-99-9C, SD-10-99-10, SD-10-99-11.
4. Adjacent to the Town Wellfield: SD-10-99-12, SD-10-99-13, SD-10-99-14, SD-10-99-15.

The sediment data set used in the historical analysis included the BBL 1999 data, as well as sediment data from the Phase I (1990) and Phase III (1991) Remedial Investigation (presented in the HNUS (1994a) Final Remedial Investigation Report), and the Phase III (1993) supplemental sediment sampling. The historical analysis also included sediment data from USEPA/CTDEP (1996 and 1997), which were provided to BBL by CTDEP (1999). A summary of the historical data, along with a breakdown of samples by study reach, is presented in Table 5. The historical sediment data for the Quinnipiac River includes primarily surficial sediment samples, so only the surficial samples collected by BBL in 1999 are included in the historical data trend evaluations.

Similar to the BBL 1999 data, the historical sediment data were also categorized by reach. The reaches include the same four areas identified above, as well as data groupings for reference samples and distant downstream samples. Additional upstream samples include 1996 and 1997 USEPA data for the Quinnipiac River at Plainville and Hamlin Pond (three to four miles upstream), and the Phase I and Phase III samples collected immediately upstream of Lazy Lane. The reference samples were designated by USEPA (1997), and include the sample location (QRNF) from the North Farms Reservoir. The distant downstream locations were approximately two to four miles downstream of the SRSNE site, and include sampling locations in Hanover Pond and Cummins Lake. The locations of the additional upstream, reference, and distant downstream sediment samples are presented in Figure 1.

The specific COPCs included in the trend evaluation were selected based on the results of the HNUS (1994a) RI and Baseline RA, and discussions with the agencies. According to the Baseline RA, the only sediment-related constituents that posed a potential ecological risk in downstream areas of the Quinnipiac River (Table 7-15 of the Baseline RA) were select SVOCs and select inorganic constituents (i.e., cadmium, copper, lead, mercury, and zinc). Therefore, these constituents, along with PCBs which were detected at the culvert outfall, were evaluated to determine the potential Site-relatedness of their occurrence in sediment. It is important to note that other constituents (e.g., pesticides) were identified as sediment COPCs in the RI and Baseline RA. However, the Baseline RA (Table 7-15) predicted "no" adverse effects for these constituents for downstream sediment in the Quinnipiac River. In addition, the HNUS (1994b) Phase 3 Supplemental Sediment Sampling Results Technical Memorandum concluded that "pesticide presence in the river is likely the result of past pesticide application when much of the study area was farmland and general use of pesticides in the surrounding areas."

Therefore, pesticides are not considered to be potentially site-related, and are not included in the chemical-specific analyses.

5.1 Chemical-Specific Analyses

Graphs of the 1999 BBL sediment data and the historical data were prepared to identify discernible trends in the data and identify potential site-relatedness of COPCs. The data are presented on a dry-weight basis, and data for total PAHs and total PCBs are also presented on a TOC-normalized basis. Only the 1999 BBL data are presented on a TOC-normalized basis, because TOC data were not collected for some of the historical samples. The graphs comparing upstream to downstream sediment concentrations are presented in Figures 3 though 13. For the 1999 BBL data, sediment samples from different depths (i.e., 0 - 0.5 feet; 0.5 to 2.0 feet; and > 2 feet) are distinguishable with different symbols. Similarly, for the historical data, sediment samples from different sources (i.e., Phase I and Phase III RI data, USEPA/CTDEP data, and 1999 BBL data) are distinguishable with different symbols. Sediment screening criteria are also presented in the graphs. [Note: For a description of the sediment screening criteria, see Section 6 - Screening-Level Assessment]. Some of the screening criteria (i.e., SEL values) for organic compounds are calculated based on a sediment TOC content of 2%, which is the average TOC of 39 BBL 1999 sediment samples, seven USEPA sediment samples, and 14 HNUS Phase I sediment samples. Descriptions of the graphs and interpretation of site-relatedness are presented below for each individual chemical.

5.1.1 Total PAHs

The 1999 BBL sediment data for total PAHs are presented in Figure 6A and Figure 6B. The highest total PAH concentrations at each location were generally detected in surficial sediment samples. The highest total PAH concentration (25 mg/kg) was detected in a surficial sediment sample (SD-10-99-5) collected adjacent to the culvert outfall. Most of the total PAH concentrations detected adjacent to and downstream of the site are lower than the total PAH concentrations detected upstream of the site (maximum 17 mg/kg). The total PAH concentrations both upstream and downstream of the site typically exceed the LEL and ER-L values. None of the total PAH concentrations detected in the 1999 BBL sediment samples exceed either the ER-M or SEL values.

The TOC-normalized total PAH data are presented in Figure 6C. As shown in the figure, the highest detected TOC-normalized total PAH concentration (5,700 mg PAH/kg TOC) was detected in surficial sediment sample SD-10-99-2, which was collected upstream of Lazy Lane and is considered representative of background concentrations. In general, the higher PAH concentrations occurred in sediments having greater TOC. All of the TOC-normalized total PAH concentrations were below the SEL value. ER-L, ER-M, and LEL values are not available on a TOC-normalized basis.

The historical data for total PAHs are presented in Figure 6D and Figure 6E. The total PAH concentrations typically exceed the LEL and ER-L values both upstream and downstream of the site. None of the concentrations exceed either the ER-M or SEL values. The maximum detected concentration of total PAHs (35.8 mg/kg) was detected in a CTDEP/USEPA sample collected well downstream of the Site. The next highest total PAH concentration (31.4 mg/kg) was detected upstream of the Site during the Phase I investigation in 1990.

Collectively, the PAH data for the site (including the BBL 1999 data and the historic data) indicate that, in terms of PAHs, the SRSNE site has not significantly impacted the sediment adjacent to or downstream of the site. To address potential PAH issues further, however, three selected representative individual PAH compounds were also evaluated, as described below.

5.1.2 Anthracene

The 1999 BBL sediment data for anthracene are presented in Figure 3A and Figure 3B. As shown in the figures, the highest anthracene concentrations were generally detected in surficial (0 - 0.5 feet) sediment samples. The highest anthracene concentration (0.92 mg/kg) was detected in a surficial sediment sample (SD-10-99-5) collected from the area adjacent to the culvert outfall. Although some of the anthracene concentrations detected in sediment samples from adjacent to or downstream of the site are slightly higher than those detected in upstream sediment samples, most of the downstream anthracene concentrations are lower than those detected upstream. In addition, the difference between upstream (maximum 0.41 mg/kg) and downstream (0.92 mg/kg) concentrations does not indicate a site-related condition. Anthracene concentrations both upstream and downstream of the site typically exceed the LEL and ER-L values. None of the concentrations exceed the SEL or ER-M values.

The historical sediment data for anthracene are presented in Figure 3C and Figure 3D. The maximum detected concentration (1.4 mg/kg) was detected in the vicinity of the culvert outfall during the Phase I investigation in 1990. Subsequent sediment samples collected by BBL during the 1999 sediment investigation indicate similar but somewhat lower concentrations (maximum 0.92 mg/kg), which are more similar to concentrations detected upstream of the Site (maximum detected background concentration of 0.84 mg/kg, detected during the 1993 Phase III sediment investigation).

Collectively, the 1999 BBL and historical sediment data indicate that anthracene concentrations detected adjacent to and downstream of the site are frequently less than concentrations detected upstream or far (i.e., 2 to 4 miles) downstream of the site, thereby indicating that any site-related contributions to sediment anthracene concentrations are insignificant.

5.1.3 Benzo(a)anthracene

The 1999 BBL sediment data for benzo(a)anthracene are presented in Figure 4A and Figure 4B. At almost all of the sample locations, the highest concentrations of benzo(a)anthracene were detected in surficial samples. The highest detected benzo(a)anthracene concentration (1.8 mg/kg) was detected in a surficial sediment sample (SD-10-99-5) collected in the vicinity adjacent to the culvert outfall. However, benzo(a)anthracene concentrations in most of the downstream samples were lower than the upstream concentrations. In addition, the difference between upstream concentrations (maximum 1.2 mg/kg) and downstream concentrations (maximum 1.8 mg/kg) does not suggest a significant site-related component. Benzo(a)anthracene concentrations both upstream and downstream of the site typically exceed the LEL and ER-L values. Only the one maximum downstream concentration (1.8 mg/kg) exceeds the ER-M value. None of the concentrations exceed the SEL value.

The historical sediment data for benzo(a)anthracene are presented in Figure 4C and Figure 4D. As shown in the figures, benzo(a)anthracene concentrations adjacent to and immediately downstream of the Site are similar to concentrations detected in upstream or distant downstream samples. The maximum detected concentration of benzo(a)anthracene (2.7 mg/kg) was detected in a CTDEP/USEPA sample, which was collected well downstream (i.e., 2 to 4 miles) of the Site.

Collectively, these analyses indicate that any site-related contributions to sediment benzo(a)anthracene concentrations are insignificant.

5.1.4 Benzo(a)pyrene

The BBL 1999 sediment data for benzo(a)pyrene are presented in Figure 5A and Figure 5B. The highest benzo(a)pyrene concentrations at most locations were detected in the surficial sediment samples. The highest detected concentration of benzo(a)pyrene (1.7 mg/kg) was detected in a surficial sample (SD-10-99-5) collected adjacent to the culvert outfall. Most of the downstream samples, however, are lower than the concentrations detected upstream of the site. In addition, the maximum detected downstream concentration (1.7 mg/kg) is not substantially higher the maximum detected background concentration (1.4 mg/kg). Similar to anthracene and benzo(a)anthracene, concentrations of benzo(a)pyrene both upstream and downstream of the site typically exceed the LEL and ER-L values. Only the one maximum benzo(a)pyrene concentration exceeds the ER-M value, and none of the concentrations exceed the SEL value. These data indicate that the benzo(a)pyrene concentrations detected in the Quinnipiac River are not clearly attributable to the site.

The historical sediment data for benzo(a)pyrene are presented in Figure 5C and 5D. The benzo(a)pyrene concentrations typically exceed the LEL and ER-L values both upstream and downstream of the site. Concentrations infrequently exceed the ER-M value, and do not exceed the SEL value. The highest concentrations of benzo(a)pyrene (3.1 mg/kg and 2.6 mg/kg) were detected in CTDEP/USEPA samples, which were collected well downstream of the Site.

Based on the BBL 1999 data and the historical data, there is not a clear indication of elevated benzo(a)pyrene concentrations associated with the Site.

5.1.5 bis(2-Ethylhexyl)phthalate

To represent phthalates as a class, bis(2-ethylhexyl)phthalate was selected for evaluation. (Concentrations of most other phthalates were generally non-detectable). The 1999 BBL sediment data for bis(2-ethylhexyl)phthalate are presented in Figure 7A. The highest concentration of bis(2-ethylhexyl)phthalate (2.5 mg/kg) was detected downstream of the site in a surficial sediment sample (SD-10-99-12) collected from the area adjacent to the Town Wellfield. However, most of the concentrations detected downstream were significantly lower than background (maximum 1.4 mg/kg detected in SD-10-99-1). ER-L, ER-M, LEL and SEL values are not available for bis(2-ethylhexyl)phthalate, and other substitute criteria are used for comparison, including TEL and PEL values from Florida State (MacDonald, 1994), and FSQV from Washington State (Washington State Department of Ecology, 1997). Bis(2-ethylhexyl)phthalate concentrations both upstream and downstream of the site frequently exceed the TEL and the FSQV. None of the concentrations, however, exceed the less-conservative PEL value. Collectively, the 1999 sediment data indicate that bis(2-ethylhexyl)phthalate concentrations are slightly elevated in a couple of downstream samples (i.e., SD-10-99-12; SD-10-99-14) in comparison to background. Most of the bis(2-ethylhexyl)phthalate concentrations detected adjacent to or downstream of the site are actually lower than those in background samples obtained upstream of the site.

The historical sediment data for bis(2-ethylhexyl)phthalate are presented in Figure 7B. The maximum detected concentrations of bis(2-ethylhexyl)phthalate (40 and 41 mg/kg) were detected in CTDEP/USEPA samples collected from upstream/reference sample locations. The next highest concentration (21 mg/kg) was detected in a CTDEP/USEPA sample collected well downstream of the site. Comparatively, the bis(2-ethylhexyl)phthalate concentrations detected in the vicinity of the site (maximum 2.5 mg/kg) are relatively low.

Given the evaluation of the 1999 BBL data and the evaluation of the historical data, it does not appear that the site has contributed significantly to concentrations of bis(2-ethylhexyl)phthalate in sediment.

5.1.6 PCBs

A summary of the 1999 BBL sediment data for total PCBs is presented in Figure 8A and Figure 8B. As shown on the graphs, relatively low concentrations of PCBs were detected in sediment samples collected adjacent to or immediately downstream of the Site. The highest total PCB concentration (0.11 mg/kg) was detected in subsurface sediment sample SD-10-99-4 (0.5 - 2.0 feet). All other detected concentrations were less than 0.1 mg/kg. Several of the total PCB concentrations exceed the LEL and ER-L values, but none of the concentrations exceed the SEL or ER-M values. The PCB concentrations detected in the sediment samples were quantified as Aroclor 1254 and/or Aroclor 1260. A summary of the TOC-normalized total PCB data is presented in Figure 8C and Figure 8D. The TOC-normalized data indicate no clear pattern of distribution.

The historical sediment data for total PCBs are presented in Figure 8E and Figure 8F. As shown on the graphs, relatively low concentrations of PCBs were detected in sediment samples collected adjacent to or immediately downstream of the site. The highest total PCB concentrations were detected in Phase IIIS RI samples collected in 1993 from downstream of the former South Cianci Property (maximum 0.17 mg/kg) and adjacent to the Town Wellfield (maximum 0.29 mg/kg). The highest total PCB concentration detected in surficial sediment during the more recent 1999 sediment sampling was 0.087 mg/kg, detected downstream of the former South Cianci Property (SD-10-99-9). [As previously mentioned, a slightly higher total PCB concentration (0.11 mg/kg) was detected in subsurface sediment sample SD-10-99-4 (0.5 - 2.0 feet)]. All other detected concentrations were less than 0.1 mg/kg. Several of the total PCB concentrations exceed the LEL and ER-L values, but none of the concentrations exceed the SEL or ER-M values. The PCB concentrations detected in the sediment samples were quantified as Aroclor 1254 and/or Aroclor 1260.

Collectively, the sediment data indicate that, because PCBs were not detected upstream or distant downstream from the site, the relatively low levels of PCBs detected in Quinnipiac River sediment adjacent to and immediately downstream of the site may be site-related.

5.1.7 Cadmium

A summary of the 1999 BBL sediment data for cadmium is presented in Figure 9A. Unlike the data for PAHs and other organics, there was not a clear trend of higher concentrations in surficial sediment samples. The highest concentrations of cadmium (maximum of 75.5 mg/kg) were detected in proximate downstream samples (i.e., sample SD-10-99-11) and samples collected adjacent to the Town Wellfield (i.e., sample SD-10-99-12). However, most of the cadmium concentrations detected adjacent to or downstream of the site are actually lower than the upstream background concentrations (maximum 15.2 mg/kg). Cadmium concentrations frequently exceed the LEL and ER-L values, as well as the SEL and ER-M values, both upstream and downstream of the site.

The historical sediment data for cadmium is presented in Figure 9B. The highest cadmium concentrations (maximum 119 mg/kg) routinely were detected in CTDEP/USEPA samples collected well downstream of the Site. The next highest cadmium concentrations were detected in upstream/reference samples (maximum 63 mg/kg), and were higher than concentrations detected adjacent to or immediately downstream of the Site (maximum 43.3 mg/kg). The cadmium concentrations frequently exceed the LEL and ER-L values, as well as the SEL and ER-M values, both upstream and downstream of the site.

Collectively, these data indicate although cadmium concentrations in a few samples from adjacent to the site may be slightly elevated, distant downstream and distant upstream data indicate additional potential sources to the river. Therefore, site-related contributions to sediment cadmium concentrations within the Quinnipiac River do not appear to be significant.

5.1.8 Copper

The 1999 BBL sediment data for copper are presented in Figure 10A. Similar to cadmium, the highest concentrations of copper (maximum of 273 mg/kg) were detected in proximate downstream samples (i.e., sample SD-10-99-11) and samples collected adjacent to the Town Wellfield (i.e., sample SD-10-99-12). However, most of the copper concentrations detected adjacent to or downstream of the site are actually lower than the upstream background concentrations (maximum 77.1 mg/kg). The copper concentrations frequently exceed the LEL and ER-L values both upstream and downstream of the site. Only downstream copper concentrations exceed the SEL [a total of four samples: SD-10-99-4 (0.5 - 2'); SD-10-99-11 (0-0.5'); and SD-10-99-12 (0-0.5') and (0.5-2')] and ER-M [one sample: SD-10-99-12 (0.5-2')].

The historical sediment data for copper are presented in Figure 10B. The highest copper concentrations were detected upstream (maximum 650 mg/kg) or far downstream (maximum 514 mg/kg) from the Site. The copper concentrations frequently exceed the LEL and ER-L values, as well as the SEL and ER-M values, both upstream and downstream of the site.

Collectively, these data indicate that copper concentrations adjacent to the site may be slightly elevated in a few samples. However, distant downstream and distant upstream data indicate additional potential sources to the river. Therefore, site-related contributions to copper concentrations in Quinnipiac River sediments do not appear significant.

5.1.9 Lead

The 1999 BBL sediment data for lead are presented in Figure 11A. Similar to cadmium and copper, the highest lead concentrations (maximum of 142 mg/kg) were detected in proximate downstream samples (i.e., sample SD-10-99-11) and samples collected adjacent to the Town Wellfield (i.e., sample SD-10-99-12). Elevated lead concentrations (maximum of 126 mg/kg) were also detected in the vicinity of the culvert outfall (i.e., sample SD-10-99-4). Most of the lead concentrations detected adjacent to or downstream of the site are actually lower than the upstream background concentrations (maximum 60.7 mg/kg), however. The lead concentrations both upstream and downstream of the site exceed the LEL and ER-L values. Lead concentrations do not, however, exceed the SEL or ER-M values.

The historical sediment data for lead are presented in Figure 11B. As shown on Figure 11B, lead concentrations detected in the vicinity of the Site (maximum 212 mg/kg) are not significantly different from reference/upstream lead concentrations (maximum 134 mg/kg) and lead concentrations from far downstream of the Site (maximum 209 mg/kg). The lead concentrations often exceed the LEL and ER-L values. Lead concentrations do not, however, exceed the SEL or ER-M values.

Collectively, these data indicate that lead concentrations adjacent to the site may be slightly elevated in a few samples. However, distant downstream and distant upstream data indicate additional potential sources to the river. Therefore, site-related contributions to lead concentrations in Quinnipiac River sediments do not appear to be significant.

5.1.10 Mercury

The 1999 BBL sediment data for mercury are presented in Figure 12A and 12B. Similar to previous metals, the highest concentrations (maximum of 0.36 mg/kg) were detected in proximate downstream samples (i.e., sample SD-10-99-11), samples collected adjacent to the Town Wellfield (i.e., sample SD-10-99-12), and samples collected in the vicinity of the culvert outfall (i.e., sample SD-10-99-4). Mercury concentrations often exceed the LEL and ER-L values, but do not exceed the SEL or ER-M values. Relatively few of the downstream sample concentrations exceed the ER-L or SEL. None of the mercury concentrations exceed the ER-M or SEL values.

The historical sediment data for mercury are presented in Figure 12C and Figure 12D. As shown on Figure 12D, the highest mercury concentrations were detected in USEPA/CTDEP samples collected from far downstream of the site (maximum 0.54 mg/kg). Mercury concentrations detected in the vicinity of the site (maximum 0.31 mg/kg) are not significantly different from mercury concentrations detected upstream of the Site (maximum 0.28 mg/kg). Mercury concentrations often exceed the LEL and ER-L values, but do not exceed the SEL or ER-M values.

The evaluation of the 1999 BBL data and the historical data indicate that mercury concentrations in Quinnipiac River sediment are not site related.

5.1.11 Zinc

The 1999 BBL sediment data for zinc are presented in Figure 13A. Again, the highest concentrations (maximum of 418 mg/kg) were detected in proximate downstream samples (i.e., sample SD-10-99-11), samples collected adjacent to the Town Wellfield (i.e., sample SD-10-99-12), and samples collected in the vicinity of the culvert outfall (i.e., sample SD-10-99-4). Zinc concentrations are generally below criteria, although some samples do exceed the LEL and ER-L values, and one sample [SD-10-99-12 (0-0.5')] exceeds the ER-M value. None of the zinc concentrations exceed the SEL value.

The historical zinc data are presented in Figure 13B. As shown on Figure 13B, the highest zinc concentrations were detected in USEPA/CTDEP samples collected from far downstream of the site (maximum 896 mg/kg). Zinc concentrations detected in the vicinity of the site (maximum 418 mg/kg) are similar to zinc concentrations detected upstream of the site (maximum 305 mg/kg). Zinc concentrations are generally below criteria, although some samples do exceed the LEL and ER-L values, and a few samples (collected far downstream of the site) exceed the ER-M and SEL values.

Collectively, these data indicate that zinc concentrations adjacent to the site may be slightly elevated in a few samples. However, distant downstream and distant upstream data indicate additional potential sources to the river. Therefore, site-related contributions to sediment zinc concentrations do not appear to be significant.

5.2 Potential Source Areas

Several potential sources and migration pathways from the SRSNE site have the potential to have affected the Quinnipiac River sediments. According to the RI, overburden ground water flows east and southeast from the SRSNE Operations Area toward and under the Quinnipiac River. As such, ground water may be a source of chemical constituents to Quinnipiac River sediments. Another potentially significant pathway is the drainage ditch and the culvert outfall. The drainage ditch is adjacent to the railroad grade, between the Operations Area and Lazy Lane. The southern 500 feet of the drainage ditch collects runoff from the SRSNE Operations Area, and the northern 600 feet of the drainage ditch collect runoff from a pond located north-west of Lazy Lane. Both ends of the ditch flow into a culvert, and the culvert crosses due east across the Cianci property to an outfall that discharges into wetlands about 100 feet from the main stem of the Quinnipiac River. HNUS sampled sediment in the drainage ditch, culvert invert, outfall and in the Quinnipiac River in May 1990 and December 1991. In September 1992, EPA implemented a Removal Action to address ditch sediments identified by HNUS (SD1-4, SD3-25, SD3-24, SD3-39) with elevated VOCs and PCBs (Aroclors 1254 and 1260). The Removal Action addressed the ditch sediments between the SRSNE Operations Area outfall and the culvert inlet. The work scope included excavating surface sediment, installing gravel "french drains", and backfilling with clean soil. The HNUS ditch sampling points are identified in Appendix N, Figure N-1 as CTDEP Direct Exposure Criteria (DEC) exceedences for VOCs, PCBs, phthalates and metals, based on soil samples collected below the water table, up to 24 inches below the ditch sediment.

As shown in FS Appendix N, HNUS sampling in the railroad grade ditches north of the culvert invert (SD1-3, SD3-23), and north of Lazy Lane (SD3-22), also indicated exceedences of DECs. The criteria were exceeded for PAHs, with a maximum of 52.1 mg/kg total PAHs. These exceedences may be associated with the nearby creosoted RR ties or other asphalt debris. In addition, samples collected at the culvert outfall (SD1-5, SD3-34, 3-35, 3-36) resulted in exceedences of the DECs for up to 23.5 mg/kg total PCBs, and 2.2 mg/kg beryllium. Surface water sampling and flow estimates at the culvert invert and outfall during the RI concluded that the culvert gains flow as it crosses the Cianci property, with an increase in VOC level between inlet and discharge. Due to the exceedences of DECs in the ditches along the railroad grade and in the vicinity of the culvert outfall, and the groundwater infiltrating into the culvert, these areas have been targeted for remediation in the FS Drainage Pathways alternative. That alternative combines capping 1,050 feet of railroad grade (and redirecting surface drainage), removing the culvert, installing a new culvert crossing the Northern Cianci property, and excavating the sediments at the culvert outfall.

In terms of ground water as a potential source to the Quinnipiac River, the HNUS (1994b) Phase 3 Supplemental Sediment Sampling Results Technical Memorandum concluded that "groundwater seepage from the overburden aquifer is not a significant source of contamination to the Quinnipiac River." In addition, as noted in FS Appendix N, no CTDEP Surface Water Protection (SWP) criteria are exceeded at shallow overburden monitoring wells bordering the Quinnipiac River on the Cianci property.

The Quinnipiac River watershed is heavily developed from the headwaters about six miles north of the SRSNE Site to the eventual discharge in North Haven. There are a variety of industries and commercial centers upstream of SRSNE, primarily along Route 10/Queen Street. Other NDPES permitted discharges to the Quinnipiac River include groundwater remediation systems at the General Electric and TRW Sites and non-contact cooling water from the Tilcon facility, all about four miles upstream of SRSNE. Other industry upstream of SRSNE includes the World War II-era Pratt & Whitney engine plant (a RCRA Site approximately two miles upstream), other metal plating/finishing operations (e.g., Light Metals Coloring, Millard Metal, approximately one mile upstream; R.P. Olsen, a CERCLIS Site approximately 1/4 mile to the NE of SRSNE), six gas stations (three with LUST remediation programs), three automotive body shops, and five other oil/tire/service stations within approximately 1 mile north of, and directly west of SRSNE; and finally, the stormwater runoff from the extensive parking lots associated with the intense development (strip malls and shopping centers) on Route 10 from Plainville to SRSNE.

5.3 Summary of Site-Relatedness

The evaluation of the individual PAHs (i.e., anthracene, benzo(a)anthracene, benzo(a)pyrene) and total PAHs (both dry-weight and TOC-normalized) indicate that PAH concentrations adjacent to or immediately downstream of the site are not significantly higher than concentrations detected upstream or distant downstream of the site. As such, sediment PAH concentrations are not considered to be site-related. This conclusion is consistent with the HNUS (1994b) Phase 3 Supplemental Sediment Sampling Results Technical Memorandum, which concluded that SVOC contamination in the Quinnipiac River sediments was not attributable to the site: “it is likely that the SVOC contamination results largely from surface runoff from the large paved areas (roadways and parking lots) that comprise much of the surrounding area that drains into the Quinnipiac River.” For phthalates, trend analyses focused on bis(2-ethylhexyl)phthalate. Concentrations of other phthalates in sediments were mostly non-detectable. The evaluation of the 1999 data indicated that only three samples had bis(2-ethylhexyl)phthalate concentrations greater than background, and evaluation of the historical data indicated that the highest concentrations were detected upstream or distant downstream of the site. Therefore, observed phthalate concentrations are also not considered to be site-related.

For inorganics, sediment samples from two of the BBL 1999 sample locations (i.e., SD-10-99-11 and SD-10-99-12) had concentrations of inorganics which were frequently higher than BBL 1999 background data. The concentrations of inorganics in these two samples were not, however, greater than those observed in historical data collected upstream or far downstream of the site. In addition, the concentrations of inorganics detected in most of the sediment samples were similar upstream (background), adjacent to, and downstream of the site. Again, this conclusion is consistent with the HNUS (1994b) Phase 3 Supplemental Sediment Sampling Results Technical Memorandum. According to the report “there was no apparent correlation between metals concentrations and sample location, for example metals concentrations did not progressively increase or decrease as a function of distance downstream.” Other potential sources of inorganics to the Quinnipiac River exist upstream and downstream of the site. There are several industrial/commercial properties along the river, and these may have contributed to observed concentrations of inorganics in sediment. As such, inorganic concentrations are also not considered to be significantly site-related.

For PCBs, relatively low concentrations have been detected in sediment adjacent to and immediately downstream of the site. Because PCBs were not detected upstream of the site, it is possible that these low levels of PCBs may be site-related. This conclusion is consistent with the HNUS (1994b) Phase 3 Supplemental Sediment Sampling Results Technical Memorandum. According to HNUS (1994b), the “the culvert is a possible source of PCBs in the river; however it appears that the majority of PCBs discharged from the culvert have remained adsorbed to sediments in the wetland area at the culvert outfall and have not migrated to the river.” The HNUS (1994) report also states that “the fact that the surrounding area is a heavily developed commercial/industrial zone indicate that off-site sources likely contribute to PCB presence in the river.”

6. Screening-Level Assessment

According to the Baseline RA (HNUS, 1996), potential human health risks from exposure to sediment are minimal. To revisit this conclusion in light of the new BBL 1999 data set, CTDEP requested that the Quinnipiac River sediment data be compared to screening criteria based on a foodchain sediment-to-fish pathway for human exposure. The Connecticut Department of Public Health (CDPH) developed sediment screening concentrations using factors derived at another site, and calculated values for PCBs (0.1 mg/kg), lead (500 mg/kg), and mercury (0.2 mg/kg) and the BBL 1999 data were compared to these criteria. For PCBs, only one sample [SD-10-99-4 (0.5-2.0') = 0.11 mg/kg)] exceeded the screening value of 0.10 mg/kg, but only by a very small margin. None of the sediment samples exceeded the screening concentration for lead. Three of the samples [SD-10-99-11 (0-0.5') = 0.23 mg/kg; SD-10-99-12 (0-0.5') = 0.36 mg/kg; and SD-10-99-12 (0.5-2.0') = 0.27 mg/kg] slightly exceeded the screening criteria for mercury, but not to a significant extent. The potential human food chain pathway for fish, assuming the fish spent their entire lives within the 1,800 foot reach of the river adjacent to and immediately downstream of SRSNE, does not pose a significant risk based on the new data. In addition, human health risks due to fish consumption pathways are currently addressed through the CTDEP 1999 Fish Consumption Advisory that suggests against eating more than one meal a month of fish taken from freshwater bodies statewide. In addition, a specific advisory banning consumption of local fish is in effect for the Quinnipiac River in Southington, including the vicinity of SRSNE, due to an unrelated downstream PCB release.

To address potential ecological risks, the sediment data were compared to generic ecological sediment screening criteria, specifically lowest effect levels (LELs) and severe effect levels (SELs) from the Ontario Ministry of Environment and Energy (OME) (1993), and effects range-low (ER-L) and effects range-median (ER-M) values from Long et al. (1995). According to OME (1993), the LELs represent levels of sediment contaminants that can be tolerated by the majority of benthic organisms, and SELs represent levels at which pronounced disturbance of the sediment dwelling community can be expected. Sediment with concentrations between the LEL and SEL are defined as "marginally-significantly polluted, and concentrations will effect sediment use by some benthic organisms" (OME, 1993). The Long et al. (1995) values are supposed to represent similar levels of protection, but are based on data for estuarine and marine sediments. For some constituents [i.e., bis(2-ethylhexyl)phthalate] neither LELs/SELs nor ER-Ls/ER-Ms are available. Therefore, as requested by USEPA, threshold effect level (TEL) and probable effect level (PEL) values from MacDonald (1994) are used for comparison. Although exceedence of any of these criteria does not necessarily indicate a significant risk, the criteria provide a means for initially screening sediment data sets with regard to potential ecological risks.

According to the Baseline RA, the only sediment constituents that posed a potential ecological risk in downstream areas of the Quinnipiac River (Table 7-15 of the Baseline RA) were SVOCs and select inorganic constituents (i.e., cadmium, copper, lead, mercury, and zinc). Comparison of the 1999 BBL data to the sediment screening criteria indicates that for some COPCs (i.e., total PAHs, lead, and mercury) observed concentrations only exceed the LEL and ER-L values, indicating a minimal risk. Several other COPCs (i.e., benzo(a)pyrene, anthracene, benzo(a)anthracene, cadmium, copper, and zinc) exceed SEL and/or ER-M values in some samples, but none of these constituent concentrations are considered to be significantly site-related.

The only sediment constituents which are considered to be potentially site-related are PCBs. However, the total PCB concentrations detected in sediments are relatively low (maximum 0.11 mg/kg), and were actually non-detect in approximately one-half of the sediment samples. As shown in Figure 8B, for the 1999 BBL data, the total PCB concentrations only exceed the conservative sediment criteria (the LEL) in four out of 31 samples, although they do exceed the highly conservative ER-L in 14 samples. None of the sediment PCB concentrations exceed the less-conservative SEL or ER-M values. Given the relatively low PCB concentrations detected in the sediments and the minor exceedances of the sediment criteria, potential ecological risks from PCBs are considered minimal.

7. Conclusions

The sediment evaluation described in this report was conducted to address concerns regarding potential ecological risks posed by site-related COPCs in sediments from the Quinnipiac River. Evaluation of both the 1999 BBL sediment data and the historical sediment data indicate that sediment concentrations of SVOCs (including PAHs and phthalates) are not significantly elevated adjacent to or downstream of the site. Therefore, SVOCs are not considered site-related. Similarly, concentrations of inorganics, although slightly elevated in sediment samples collected from two locations adjacent to the site, do not show distinct concentration gradients indicative of site impacts. The only constituents considered site-related are PCBs. Relatively low concentrations (maximum 0.11 mg/kg in BBL 1999 data) were detected in sediment samples collected from adjacent to or downstream of the site. The possibility exists that these PCBs may be related to the drainage ditch and culvert outfall, which have already been targeted for removal actions.

The results of this evaluation conclude that the SRSNE Site is not contributing significantly to SVOCs or inorganic constituents in Quinnipiac River sediments. The only COPCs detected in sediment which may be related to Site conditions are low levels of PCBs which were detected in sediments adjacent to the culvert outfall, which has already been identified for remediation. As such, sediment concentrations of COPCs in the Quinnipiac River itself do not warrant consideration of remedial alternatives.

8. References

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TABLES

Table 1

Sediment Probing Summary

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

	Deposit (1)	Field Number (2)	Size of Deposit (feet) Length		Width		Depth	Notes
	A	10	50	x	7	x	4	fine sand
	B	11	26	x	8	x	3	fine sand
*	C	13	30	x	10	x	2	silt/sand
	D	14/15	25	x	10	x	3	silt/sand
*	E	16	20	x	5	x	2	silt/sand
*	F	17	20	x	10	x	4	fine sand
*	G	18	30	x	10	x	3	silt
*	H	19	70	x	5	x	3	fine sand
*	I	20/21	80	x	15	x	3	silt
*	J	22	60	x	10	x	2	sand
*	K	23	60	x	15	x	2	fine sand, slight sheen and odor
	L	24	40	x	10	x	3	silt
*	M	25	20	x	10	x	2	silt, slight sheen and odor
*	N	26	40	x	16	x	5	fine sand
*	O	27	70	x	20	x	4	silt/sand
	P	28	50	x	25	x	3	silt
*	Q	29	40	x	10	x	5	silt/sand
	R	30	20	x	10	x	2	silt
	S	31	25	x	10	x	4	fine sand

Notes:

1. Letters refer to the corresponding labels in Figure 1 of the Sediment Sampling Work Plan (Attachment 1).
2. The field number refers to the corresponding label in the field notebook (Attachment 2).

* Samples were collected from this deposit for laboratory analyses.

Sediment probing was conducted by BBL on October 7, 1999.

Table 2

1999 Sediment Data - Organic Compounds
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

					Upstream of Lazy Lane							
Sample ID:	**Sediment Criteria**				**SD-10-99-1**	**SD-10-99-1**	**SD-10-99-1**	**SD-10-99-2**	**SD-10-99-2**	**SD-10-99-2**	**SD-10-99-3**	**SD-10-99-3**
Sample Depth(Feet):	**Lower Level**		**Higher Level**		**0-0.5**	**0.5-2**	**2-4.2**	**0-0.5**	**0.5-2**	**2-5**	**0-0.5**	**0.5-2.3**
Date Collected:					**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**
PCBs												
Aroclor-1254	0.06	a	34	a	ND(0.027)	ND(0.021)	ND(0.020)	ND(0.020)	ND(0.021)	ND(0.021)	ND(0.026)	ND(0.024)
Aroclor-1260	0.005	a	24	a	ND(0.027)	ND(0.021)	ND(0.020)	ND(0.020)	ND(0.021)	ND(0.021)	ND(0.026)	ND(0.024)
Total PCBs	0.07	a	530	a	ND(0.027)	ND(0.021)	ND(0.020)	ND(0.020)	ND(0.021)	ND(0.021)	ND(0.026)	ND(0.024)
Semivolatile Organics												
4-Methylphenol	-		-		0.091 J	ND(0.42)	ND(0.40)	ND(0.40)	ND(0.40)	ND(0.41)	ND(0.51)	ND(0.49)
Acenaphthene	0.016	b	0.5	b	ND(0.54)	ND(0.42)	ND(0.40)	**0.082 J**	ND(0.40)	ND(0.41)	**0.15 J**	**0.055 J**
Acenaphthylene	0.044	b	0.64	b	0.071 J	ND(0.42)	ND(0.40)	**0.11 J**	ND(0.40)	ND(0.41)	**0.066 J**	**0.060 J**
Anthracene	0.22	a	370	a	**0.32 J**	ND(0.42)	ND(0.40)	**0.39 J**	ND(0.40)	ND(0.41)	**0.41 J**	0.22 J
Benzo(a)anthracene	0.32	a	1480	a	**0.92**	ND(0.42)	ND(0.40)	**0.88**	ND(0.40)	ND(0.41)	**1.2**	**0.63**
Benzo(a)pyrene	0.37	a	1440	a	**1.0**	ND(0.42)	ND(0.40)	**0.96**	ND(0.40)	ND(0.41)	**1.4**	**0.74**
Benzo(b)fluoranthene	-		-		1.7	ND(0.42)	ND(0.40)	1.4	ND(0.40)	ND(0.41)	2.2	0.98
Benzo(g,h,i)perylene	0.17	a	320	a	**0.70**	ND(0.42)	ND(0.40)	**0.56**	ND(0.40)	ND(0.41)	**0.98**	**0.53**
Benzo(k)fluoranthene	0.24	a	1340	a	**0.34 J**	ND(0.42)	ND(0.40)	**0.44**	ND(0.40)	ND(0.41)	**0.60**	**0.36 J**
bis(2-Ethylhexyl)phthalate	0.182	c	2.647	c	1.4	0.44	ND(0.40)	**0.22 J**	ND(0.40)	ND(0.41)	0.38 J	**0.26 J**
Butylbenzylphthalate	-		-		ND(0.54)	ND(0.42)	ND(0.40)	ND(0.40)	ND(0.40)	ND(0.41)	ND(0.51)	ND(0.49)
Chrysene	0.34	a	460	a	**1.1**	ND(0.42)	ND(0.40)	**0.92**	ND(0.40)	ND(0.41)	**1.3**	**0.73**
Dibenzo(a,h)anthracene	0.06	a	130	a	ND(0.54)	ND(0.42)	ND(0.40)	ND(0.40)	ND(0.40)	ND(0.41)	ND(0.51)	ND(0.49)
Dibenzofuran	-		-		ND(0.54)	ND(0.42)	ND(0.40)	0.054 J	ND(0.40)	ND(0.41)	0.084 J	ND(0.49)
Diethylphthalate	-		-		ND(0.54)	ND(0.42)	ND(0.40)	ND(0.40)	ND(0.40)	ND(0.41)	ND(0.51)	0.053 J
Di-n-Butylphthalate	-		-		ND(0.54)	ND(0.42)	ND(0.40)	ND(0.40)	ND(0.40)	ND(0.41)	ND(0.51)	ND(0.49)
Fluoranthene	0.75	a	1020	a	**1.9**	0.092 J	ND(0.40)	**1.7**	0.10 J	ND(0.41)	**2.3**	**1.3**
Fluorene	0.19	a	160	a	0.079 J	ND(0.42)	ND(0.40)	0.18 J	ND(0.40)	ND(0.41)	0.19 J	0.099 J
Indeno(1,2,3-cd)pyrene	0.2	a	320	a	**0.61**	ND(0.42)	ND(0.40)	**0.49**	ND(0.40)	ND(0.41)	**0.82**	**0.43 J**
Naphthalene	0.16	b	2.1	b	ND(0.54)	ND(0.42)	ND(0.40)	ND(0.40)	ND(0.40)	ND(0.41)	ND(0.51)	ND(0.49)
Phenanthrene	0.56	a	950	a	**1.3**	0.079 J	ND(0.40)	**1.6**	0.085 J	ND(0.41)	**2.1**	**1.2**
Pyrene	0.49	a	850	a	**3.0**	0.10 J	ND(0.40)	**2.6**	0.082 J	ND(0.41)	**3.7**	**1.9**
Total PAHs	4	a	10000	a	**13**	0.27	ND(0.40)	**12**	0.27	ND(0.41)	**17**	**9.2**
Waste Characterization Parameters												
Total Organic Carbon (%)					2.9	0.72	0.070	0.21	0.046	0.089	0.95	1.8
TOC Normalized Concventrations												
Total PCBs (mg/kg TOC)					ND	ND	ND	ND	ND	ND	ND	ND
Total PAHs (mg/kg TOC)					448	38	ND	5714	587	ND	1789	511

(See Notes on Page 6)

Table 2

1999 Sediment Data - Organic Compounds
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

					Vicinity of Culvert Outfall				Proximate Downstream of Former Cianci Property			
Sample ID:	**Sediment Criteria**				**SD-10-99-4**	**SD-10-99-4**	**SD-10-99-5**	**SD-10-99-5**	**SD-10-99-6**	**SD-10-99-6**	**SD-10-99-6**	**SD-10-99-7**
Sample Depth(Feet):	**Lower**		**Higher**		**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**	**2-4**	**0-0.5**
Date Collected:	**Level**		**Level**		**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**
PCBs												
Aroclor-1254	0.06	a	34	a	0.041	**0.11**	0.039	0.023	**0.062**	ND(0.021)	ND(0.020)	0.021
Aroclor-1260	0.005	a	24	a	ND(0.020)	ND(0.032)	ND(0.026)	ND(0.020)	ND(0.030)	ND(0.021)	ND(0.020)	ND(0.021)
Total PCBs	0.07	a	530	a	0.041	**0.11**	0.039	0.023	0.062	ND(0.021)	ND(0.020)	0.021
Semivolatile Organics												
4-Methylphenol	-		-		ND(0.39)	ND(0.63)	0.13 J	ND(0.42)	ND(0.61)	ND(0.41)	ND(0.40)	ND(0.42)
Acenaphthene	0.016	b	0.5	b	0.042 J	**0.14 J**	**0.31 J**	ND(0.42)	**0.18 J**	**0.045 J**	ND(0.40)	**0.059 J**
Acenaphthylene	0.044	b	0.64	b	0.14 J	**0.33 J**	**0.061 J**	**0.061 J**	**0.064 J**	ND(0.41)	ND(0.40)	**0.051 J**
Anthracene	0.22	a	370	a	**0.29 J**	**0.50 J**	**0.92**	0.18 J	**0.60 J**	0.22 J	ND(0.40)	**0.27 J**
Benzo(a)anthracene	0.32	a	1480	a	**1.0**	**1.3**	**1.8**	**0.54**	**1.4**	0.32 J	0.046 J	**0.66**
Benzo(a)pyrene	0.37	a	1440	a	**0.96**	**1.6**	**1.7**	**0.57**	**1.5**	0.31 J	0.048 J	**0.66**
Benzo(b)fluoranthene	-		-		1.2	2.1	2.2	0.77	2.2	0.42	0.069 J	1.2
Benzo(g,h,i)perylene	0.17	a	320	a	**0.77**	**1.3**	**1.2**	**0.39 J**	**1.1**	0.15 J	ND(0.40)	**0.51**
Benzo(k)fluoranthene	0.24	a	1340	a	**0.51**	**0.95**	**1.0**	0.22 J	**0.61**	0.16 J	ND(0.40)	**1.3**
bis(2-Ethylhexyl)phthalate	0.182	c	2.647	c	**0.49**	**1.0**	**0.53 J**	0.12 J	**0.45 J**	ND(0.41)	0.059 J	0.17 J
Butylbenzylphthalate	-		-		ND(0.39)	ND(0.63)	ND(0.54)	ND(0.42)	ND(0.61)	ND(0.41)	ND(0.40)	ND(0.42)
Chrysene	0.34	a	460	a	**1.1**	**1.5**	**1.8**	**0.57**	**1.5**	0.31 J	0.056 J	**0.67**
Dibenzo(a,h)anthracene	0.06	a	130	a	ND(0.39)	ND(0.63)	ND(0.54)	ND(0.42)	ND(0.61)	ND(0.41)	ND(0.40)	**0.11 J**
Dibenzofuran	-		-		ND(0.39)	0.089 J	0.16 J	ND(0.42)	0.097 J	ND(0.41)	ND(0.40)	ND(0.42)
Diethylphthalate	-		-		ND(0.39)	ND(0.63)	ND(0.54)	ND(0.42)	ND(0.61)	ND(0.41)	ND(0.40)	ND(0.42)
Di-n-Butylphthalate	-		-		ND(0.39)	ND(0.63)	ND(0.54)	ND(0.42)	ND(0.61)	ND(0.41)	ND(0.40)	ND(0.42)
Fluoranthene	0.75	a	1020	a	**1.8**	**2.9**	**2.9**	**0.96**	**2.4**	**0.76**	0.11 J	**1.1**
Fluorene	0.19	a	160	a	0.12 J	**0.23 J**	**0.37 J**	0.073 J	**0.23 J**	0.074 J	ND(0.40)	0.087 J
Indeno(1,2,3-cd)pyrene	0.2	a	320	a	**0.62**	**1.1**	**1.0**	**0.33 J**	**0.96**	0.12 J	ND(0.40)	**0.42**
Naphthalene	0.16	b	2.1	b	ND(0.39)	0.076 J	ND(0.54)	ND(0.42)	ND(0.61)	ND(0.41)	ND(0.40)	ND(0.42)
Phenanthrene	0.56	a	950	a	**1.7**	**2.6**	**3.6**	**0.88**	**2.6**	**0.67**	0.070 J	**1.1**
Pyrene	0.49	a	850	a	**2.8**	**4.4**	**5.8 D**	**1.4**	**3.9**	**0.75**	0.10 J	**1.8**
Total PAHs	4	a	10000	a	**13**	**21**	**25**	**6.9**	**19**	**4.3**	0.50	**10**
Waste Characterization Parameters												
Total Organic Carbon (%)					0.37	3.5	1.1	0.58	3.3	0.45	0.45	0.29
TOC Normalized Concventrations												
Total PCBs (mg/kg TOC)					11	3.1	3.5	4.0	1.9	ND	ND	7.2
Total PAHs (mg/kg TOC)					3514	600	2273	1190	576	956	111	3448

Table 2

1999 Sediment Data - Organic Compounds
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

					Proximate Downstream of Former Cianci Property (cont'd.)							
Sample ID:	**Sediment Criteria**				**SD-10-99-7**	**SD-10-99-7**	**SD-10-99-8C**	**SD-10-99-8C**	**SD-10-99-9C**	**SD-10-99-9C**	**SD-10-99-9C**	**SD-10-99-10**
Sample Depth(Feet):	**Lower**		**Higher**		**0.5-2**	**2-5**	**0-0.5**	**0.5-2.3**	**0-0.5**	**0.5-2**	**2-3**	**0-0.5**
Date Collected:	**Level**		**Level**		**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**11/01/99**
PCBs												
Aroclor-1254	0.06	a	34	a	ND(0.020) [ND(0.021)]	ND(0.019)	ND(0.020)	ND(0.022)	ND(0.032)	ND(0.022)	ND(0.020)	ND(0.018)
Aroclor-1260	0.005	a	24	a	ND(0.020) [ND(0.021)]	ND(0.019)	ND(0.020)	ND(0.022)	**0.087**	ND(0.022)	ND(0.020)	ND(0.018)
Total PCBs	0.07	a	530	a	ND(0.020) [ND(0.021)]	ND(0.019)	ND(0.020)	ND(0.022)	**0.087**	ND(0.022)	ND(0.020)	ND(0.018)
Semivolatile Organics												
4-Methylphenol	-		-		ND(0.41) [ND(0.42)]	ND(0.39)	ND(0.41)	ND(0.45)	ND(0.66)	ND(0.44)	ND(0.39)	ND(0.36)
Acenaphthene	0.016	b	0.5	b	**ND(0.41) [0.067 J]**	ND(0.39)	ND(0.41)	**0.10 J**	ND(0.66)	ND(0.44)	ND(0.39)	ND(0.36)
Acenaphthylene	0.044	b	0.64	b	ND(0.41) [ND(0.42)]	ND(0.39)	ND(0.41)	ND(0.45)	**0.078 J**	ND(0.44)	ND(0.39)	**0.048 J**
Anthracene	0.22	a	370	a	ND(0.41) [0.16 J]	ND(0.39)	ND(0.41)	**0.52**	0.17 J	ND(0.44)	ND(0.39)	0.066 J
Benzo(a)anthracene	0.32	a	1480	a	**0.12 J [0.35 J]**	0.066 J	0.063 J	**0.60**	**0.87**	0.072 J	ND(0.39)	0.29 J
Benzo(a)pyrene	0.37	a	1440	a	0.16 J [0.26 J]	0.076 J	0.073 J	**0.48**	**0.90**	0.083 J	ND(0.39)	0.30 J
Benzo(b)fluoranthene	-		-		0.21 J [0.37 J]	0.11 J	0.12 J	0.71	1.5	0.15 J	ND(0.39)	0.37
Benzo(g,h,i)perylene	0.17	a	320	a	0.085 J [0.16 J]	0.044 J	0.046 J	**0.28 J**	**0.66**	ND(0.44)	ND(0.39)	0.17 J
Benzo(k)fluoranthene	0.24	a	1340	a	0.11 J [0.13 J]	0.049 J	ND(0.41)	**0.28 J**	**0.41 J**	0.068 J	ND(0.39)	0.18 J
bis(2-Ethylhexyl)phthalate	0.182	c	2.647	c	**0.083 J [0.34 JB]**	ND(0.39)	0.060 J	**0.26 J**	**0.92 B**	**0.29 JB**	**0.23 JB**	0.10 JB
Butylbenzylphthalate	-		-		ND(0.41) [ND(0.42)]	ND(0.39)	ND(0.41)	ND(0.45)	ND(0.66)	ND(0.44)	ND(0.39)	ND(0.36)
Chrysene	0.34	a	460	a	0.15 J [0.34 J]	0.077 J	0.078 J	**0.60**	**1.1**	0.10 J	ND(0.39)	0.29 J
Dibenzo(a,h)anthracene	0.06	a	130	a	ND(0.41) [ND(0.42)]	ND(0.39)	ND(0.41)	ND(0.45)	ND(0.66)	ND(0.44)	ND(0.39)	ND(0.36)
Dibenzofuran	-		-		ND(0.41) [0.042 J]	ND(0.39)	ND(0.41)	0.064 J	ND(0.66)	ND(0.44)	ND(0.39)	ND(0.36)
Diethylphthalate	-		-		ND(0.41) [0.079 J]	ND(0.39)	ND(0.41)	ND(0.45)	ND(0.66)	ND(0.44)	ND(0.39)	ND(0.36)
Di-n-Butylphthalate	-		-		ND(0.41) [0.97 B]	ND(0.39)	ND(0.41)	ND(0.45)	5.9 DB	1.5 B	1.4 B	ND(0.36)
Fluoranthene	0.75	a	1020	a	**0.28 J [0.78]**	0.16 J	0.16 J	**1.3**	**1.8**	0.18 J	ND(0.39)	0.56
Fluorene	0.19	a	160	a	ND(0.41) [0.089 J]	ND(0.39)	ND(0.41)	0.16 J	0.093 J	ND(0.44)	ND(0.39)	ND(0.36)
Indeno(1,2,3-cd)pyrene	0.2	a	320	a	0.081 J [0.13 J]	ND(0.39)	ND(0.41)	**0.24 J**	**0.51 J**	ND(0.44)	ND(0.39)	0.14 J
Naphthalene	0.16	b	2.1	b	ND(0.41) [ND(0.42)]	ND(0.39)	ND(0.41)	ND(0.45)	ND(0.66)	ND(0.44)	ND(0.39)	ND(0.36)
Phenanthrene	0.56	a	950	a	**0.18 J [0.83]**	0.10 J	0.099 J	**1.4**	**1.2**	0.10 J	ND(0.39)	0.40
Pyrene	0.49	a	850	a	**0.37 J [1.0]**	0.18 J	0.17 J	**1.7**	**2.6**	0.20 J	ND(0.39)	**0.74**
Total PAHs	4	a	10000	a	**1.7 [4.7]**	0.86	0.81	**8.4**	**12**	0.95	ND(0.39)	3.6
Waste Characterization Parameters												
Total Organic Carbon (%)					0.23 [0.78]	0.18	0.62	0.89	3.3	2.1	0.037	0.087
TOC Normalized Concventrations												
Total PCBs (mg/kg TOC)					ND	ND	ND	ND	2.6	ND	ND	ND
Total PAHs (mg/kg TOC)					627	478	131	944	364	45	ND	4138

(See Notes on Page 6)

Table 2

1999 Sediment Data - Organic Compounds
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

			Proximate Downstream of Former Cianci Property (cont'd.)				**Adjacent to the Town Wellfield**			
Sample ID:	**Sediment Criteria**		**SD-10-99-10**	**SD-10-99-10**	**SD-10-99-11**	**SD-10-99-11**	**SD-10-99-12**	**SD-10-99-12**	**SD-10-99-13**	**SD-10-99-13**
Sample Depth(Feet):	**Lower**	**Higher**	**0.5-2**	**2-3**	**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**
Date Collected:	**Level**	**Level**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**
PCBs										
Aroclor-1254	0.06 a	34 a	ND(0.018)	ND(0.021)	ND(0.041)	ND(0.027)	ND(0.050)	ND(0.035)	ND(0.017)	ND(0.021)
Aroclor-1260	0.005 a	24 a	**0.021**	**0.035**	**0.086**	**0.058**	**0.055**	**0.084**	ND(0.017)	ND(0.021)
Total PCBs	0.07 a	530 a	0.021	0.035	**0.086**	0.058	0.055	**0.084**	ND(0.017)	ND(0.021)
Semivolatile Organics										
4-Methylphenol	-	-	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	ND(0.41)
Acenaphthene	0.016 b	0.5 b	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	**0.12 J**
Acenaphthylene	0.044 b	0.64 b	0.040 J	**0.073 J**	**0.085 J**	**0.088 J**	**0.10 J**	**0.12 J**	**0.097 J**	**0.055 J**
Anthracene	0.22 a	370 a	0.057 J	0.060 J	0.20 J	0.078 J	0.21 J	0.10 J	0.074 J	**0.41**
Benzo(a)anthracene	0.32 a	1480 a	0.23 J	0.30 J	**1.1**	**0.39 J**	**1.5**	**0.46 J**	**0.38**	**0.76**
Benzo(a)pyrene	0.37 a	1440 a	0.21 J	0.34 J	**1.4**	**0.45 J**	**1.5**	**0.60 J**	**0.41**	**0.69**
Benzo(b)fluoranthene	-	-	0.30 J	0.38 J	2.3	0.60	2.8	1.1	0.60	0.95
Benzo(g,h,i)perylene	0.17 a	320 a	0.11 J	**0.22 J**	**1.2**	**0.29 J**	**1.4**	**0.52 J**	**0.21 J**	**0.45**
Benzo(k)fluoranthene	0.24 a	1340 a	0.10 J	**0.25 J**	**0.86**	**0.33 J**	**1.0**	0.20 J	0.18 J	**0.33 J**
bis(2-Ethylhexyl)phthalate	0.182 c	2.647 c	0.11 JB	0.13 J	**1.6 B**	**0.40 JB**	**2.5 B**	**1.2 B**	0.11 J	**0.34 JB**
Butylbenzylphthalate	-	-	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	ND(0.41)
Chrysene	0.34 a	460 a	0.25 J	0.34 J	**1.5**	**0.52 J**	**1.8**	**0.68 J**	**0.42**	**0.69**
Dibenzo(a,h)anthracene	0.06 a	130 a	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	ND(0.41)
Dibenzofuran	-	-	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	0.064 J
Diethylphthalate	-	-	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	ND(0.41)
Di-n-Butylphthalate	-	-	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	ND(0.41)
Fluoranthene	0.75 a	1020 a	0.50	0.56	**2.4**	0.73	**2.7**	**0.92**	0.75	**1.4**
Fluorene	0.19 a	160 a	ND(0.38)	ND(0.42)	0.092 J	ND(0.56)	0.10 J	ND(0.71)	ND(0.35)	0.16 J
Indeno(1,2,3-cd)pyrene	0.2 a	320 a	0.095 J	0.16 J	**0.96**	**0.24 J**	**1.2**	**0.44 J**	0.19 J	**0.37 J**
Naphthalene	0.16 b	2.1 b	ND(0.38)	ND(0.42)	ND(0.79)	ND(0.56)	ND(1.0)	ND(0.71)	ND(0.35)	ND(0.41)
Phenanthrene	0.56 a	950 a	0.38	0.46	**1.1**	**0.60**	**1.6**	**0.60 J**	0.49	**1.5**
Pyrene	0.49 a	850 a	**0.58**	**0.93**	**3.5**	**1.4**	**4.7**	**1.7**	**0.87**	**2.4**
Total PAHs	4 a	10000 a	2.9	**4.1**	**17**	**5.7**	**21**	**7.4**	**4.7**	**10**
Waste Characterization Parameters										
Total Organic Carbon (%)			0.23	2.6	8.1	0.88	8.1	4.8	0.17	0.45
TOC Normalized Concventrations										
Total PCBs (mg/kg TOC)			9.1	1.3	1.1	6.6	0.7	1.8	ND	ND
Total PAHs (mg/kg TOC)			1261	158	210	648	259	154	2765	2222

(See Notes on Page 6)

Table 2

1999 Sediment Data - Organic Compounds
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

					Adjacent to the Town Wellfield (cont'd.)						
Sample ID:	**Sediment Criteria**				**SD-10-99-13**	**SD-10-99-14C**	**SD-10-99-14C**	**SD-10-99-14C**	**SD-10-99-15**	**SD-10-99-15**	**SD-10-99-15**
Sample Depth(Feet):	**Lower**		**Higher**		**2-5**	**0-0.5**	**0.5-2**	**2-4**	**0-0.5**	**0.5-2**	**2-5**
Date Collected:	**Level**		**Level**		**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**
PCBs											
Aroclor-1254	0.06	a	34	a	ND(0.021)	ND(0.021)	ND(0.022)	ND(0.023)	ND(0.020)	ND(0.020)	ND(0.021) [ND(0.020)]
Aroclor-1260	0.005	a	24	a	**0.060**	ND(0.021)	ND(0.022)	**0.036**	ND(0.020)	ND(0.020)	**0.065 [0.065]**
Total PCBs	0.07	a	530	a	0.060	ND(0.021)	ND(0.022)	0.036	ND(0.020)	ND(0.020)	0.065 [0.065]
Semivolatile Organics											
4-Methylphenol	-		-		ND(0.42)	ND(0.41)	ND(0.42)	ND(0.46)	ND(0.41)	ND(0.38)	ND(0.42) [ND(0.41)]
Acenaphthene	0.016	b	0.5	b	ND(0.42)	ND(0.41)	**0.057 J**	ND(0.46)	**0.057 J**	**0.046 J**	ND(0.42) [ND(0.41)]
Acenaphthylene	0.044	b	0.64	b	**0.069 J**	0.076 J	**0.056 J**	**0.14 J**	**0.14 J**	**0.15 J**	**0.093 J [0.18 J]**
Anthracene	0.22	a	370	a	0.068 J	0.085 J	**0.53**	0.18 J	**0.23 J**	0.22 J	0.055 J [0.10 J]
Benzo(a)anthracene	0.32	a	1480	a	0.28 J	**0.73**	**0.80**	**0.53**	**1.2**	**1.0**	**0.39 J [0.49]**
Benzo(a)pyrene	0.37	a	1440	a	0.35 J	**0.69**	**0.77**	**0.60**	**1.1**	**0.90**	**0.41 J [0.63]**
Benzo(b)fluoranthene	-		-		0.58	0.78	1.0	0.72	1.6	1.3	0.54 [0.86]
Benzo(g,h,i)perylene	0.17	a	320	a	**0.27 J**	**0.44**	**0.44**	**0.42 J**	**0.66**	**0.52**	**0.34 J [0.48]**
Benzo(k)fluoranthene	0.24	a	1340	a	0.10 J	**0.43**	**0.41 J**	**0.41 J**	**0.48**	**0.49**	**0.25 J [0.24 J]**
bis(2-Ethylhexyl)phthalate	0.182	c	2.647	c	**0.29 JB**	**0.27 JB**	**0.24 JB**	**2.3 B**	**0.24 JB**	**0.27 JB**	**0.23 JB [0.22 JB]**
Butylbenzylphthalate	-		-		ND(0.42)	1.5	ND(0.42)	ND(0.46)	ND(0.41)	ND(0.38)	ND(0.42) [ND(0.41)]
Chrysene	0.34	a	460	a	0.33 J	**0.73**	**0.79**	**0.61**	**1.2**	**1.0**	**0.50 [0.60]**
Dibenzo(a,h)anthracene	0.06	a	130	a	ND(0.42)	ND(0.41)	ND(0.42)	ND(0.46)	ND(0.41)	ND(0.38)	ND(0.42) [ND(0.41)]
Dibenzofuran	-		-		ND(0.42)	ND(0.41)	0.047 J	0.050 J	ND(0.41)	ND(0.38)	ND(0.42) [ND(0.41)]
Diethylphthalate	-		-		ND(0.42)	ND(0.41)	ND(0.42)	ND(0.46)	ND(0.41)	ND(0.38)	0.15 JB [ND(0.41)]
Di-n-Butylphthalate	-		-		ND(0.42)	ND(0.41)	ND(0.42)	ND(0.46)	ND(0.41)	ND(0.38)	0.80 B [ND(0.41)]
Fluoranthene	0.75	a	1020	a	0.53	0.74	**1.4**	**0.94**	**2.1**	**1.7**	0.69 [0.75]
Fluorene	0.19	a	160	a	ND(0.42)	ND(0.41)	0.13 J	0.12 J	0.11 J	0.11 J	ND(0.42) [0.050 J]
Indeno(1,2,3-cd)pyrene	0.2	a	320	a	**0.21 J**	**0.34 J**	**0.39 J**	**0.34 J**	**0.55**	**0.44**	**0.27 J [0.38 J]**
Naphthalene	0.16	b	2.1	b	ND(0.42)	ND(0.41)	ND(0.42)	0.077 J	ND(0.41)	ND(0.38)	ND(0.42) [0.041 J]
Phenanthrene	0.56	a	950	a	0.38 J	0.46	**1.5**	**1.1**	**1.4**	**1.4**	**0.46 [0.67]**
Pyrene	0.49	a	850	a	**1.0**	**1.7**	**2.2**	**1.8**	**3.7 D**	**3.0**	**1.1 [1.9]**
Total PAHs	4	a	10000	a	**4.2**	**7.2**	**10**	**8.0**	**15**	**12**	**5.1 [7.4]**
Waste Characterization Parameters											
Total Organic Carbon (%)					0.53	0.39	0.32	1.1	0.70	0.50	0.58 [0.71]
TOC Normalized Concventrations											
Total PCBs (mg/kg TOC)					11	ND	ND	3.3	ND	ND	11
Total PAHs (mg/kg TOC)					792	1846	3125	727	2143	2400	962

(See Notes on Page 6)

Table 2

1999 Sediment Data - Organic Compounds
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

Notes:

ND - Not Detected. The number in parentheses is the associated reporting limit.
B - Analyte was also detected in the associated method blank.
J - Indicates an estimated value less than the CLP-required quantitation limit.
J* - Indicates an estimated value between the instrument detection limit and the Contract Required Detection Limit.
L - Indicates laboratory duplicate analysis was outside control limits.
N - Indicates sample matrix spike analysis was outside control limits.
E - The reported value is estimated due to the presence of interference(s).
D - Compound quantitated using a secondary dilution.
Duplicate results are presented in brackets [ ].
Bold font indicates an exceedence of the lower level sediment criteria.
Shaded cells indicate an exceedence of the higher level sediment criteria.
a = LEL and SEL from OME (1993).
b = ER-L and ER-M from Long et al., (1995).
c = TEL and PEL from MacDonald (1994).

Table 3

1999 Sediment Data - Inorganics
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

					Upstream of Lazy Lane							
Sample ID:	**Sediment Criteria**				**SD-10-99-1**	**SD-10-99-1**	**SD-10-99-1**	**SD-10-99-2**	**SD-10-99-2**	**SD-10-99-2**	**SD-10-99-3**	**SD-10-99-3**
Sample Depth(Feet):	**Lower Level**		**Higher Level**		**0-0.5**	**0.5-2**	**2-4.2**	**0-0.5**	**0.5-2**	**2-5**	**0-0.5**	**0.5-2.3**
Date Collected:					**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**
Inorganics												
Aluminum	-		-		5610	3590	4940	2600	4600	3780	4060	4290
Antimony	-		-		ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N
Arsenic	6.0	a	33	a	4.20	2.10	1.60	0.870 J*	1.80	1.90	1.40 J*	2.70
Barium	-		-		175	65.0	68.2	46.1	61.2	42.9	76.4	81.3
Beryllium	-		-		ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	0.380 J*	0.350 J*	ND(0.500)	ND(0.500)
Cadmium	0.6	a	10	a	**12.5**	0.370 J*	ND(0.500)	**2.50**	0.130 J*	ND(0.500)	**5.20**	**15.2**
Calcium	-		-		1490	1050	1550	809	961	1250	1840	1390
Chromium	26	a	110	a	**63.4 E**	10.6 E	10.0 E	**30.4 E**	8.50 E	8.00 E	22.7 E	**57.5 E**
Cobalt	-		-		6.00 J*	3.20 J*	5.20 J*	3.20 J*	4.30 J*	4.10 J*	3.60 J*	5.60 J*
Copper	16	a	110	a	**77.1**	5.60	8.80	**30.1**	5.00	4.70	**34.1**	**61.3**
Iron (%)	2.0	a	4.0	a	0.839	0.607	1.01	0.523	0.991	0.925	0.652	0.753
Lead	31	a	250	a	**60.7 N**	4.30 N	1.50 N	15.7 N	5.50 N	4.50 N	26.2 N	**35.5 N**
Magnesium	-		-		1650	1160	2580	986	2320	2540	1230	1310
Manganese	460	a	1100	a	125 N	75.3 N	84.8 N	109 N	257 N	237 N	171 N	203 N
Mercury	0.2	a	2	a	0.100 J*	ND(0.100)	ND(0.100)	ND(0.100)	ND(0.100)	ND(0.100)	0.0780 J*	0.100 J*
Nickel	16	a	75	a	**71.7 E**	6.20 E	7.20 E	**23.5 E**	7.60 E	7.00 E	15.0 E	**35.5 E**
Potassium	-		-		556 J*	399 J*	1300	422 J*	1040	1070	447 J*	469 J*
Selenium	-		-		0.700 J*	0.710	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)
Silver	1.0	b	3.7	b	**6.10**	ND(1.00)	ND(1.00)	**2.10**	ND(1.00)	ND(1.00)	**3.40**	**8.20**
Sodium	-		-		119 J*	87.1 J*	ND(500)	79.9 J*	63.6 J*	78.8 J*	112 J*	98.6 J*
Thallium	-		-		ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)
Vanadium	-		-		19.5	23.5	24.9	10.0	22.5	22.4	15.7	18.3
Zinc	120	a	820	a	115	13.1	20.2	34.7	18.8	18.7	72.3	73.4

(See Notes on 6)

Table 3

1999 Sediment Data - Inorganics
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

	Sediment Criteria				Vicinity of Culvert Outfall				Proximate Downstream of Former Cianci Property			
Sample ID:					**SD-10-99-4**	**SD-10-99-4**	**SD-10-99-5**	**SD-10-99-5**	**SD-10-99-6**	**SD-10-99-6**	**SD-10-99-6**	**SD-10-99-7**
Sample Depth(Feet):	**Lower Level**		**Higher Level**		**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**	**2-4**	**0-0.5**
Date Collected:					**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**
Inorganics												
Aluminum	-		-		3280	10400	3800	2300	5750	3390	3770	2050
Antimony	-		-		ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00) N	0.830 J*N
Arsenic	6.0	a	33	a	0.950 J*	3.10	1.50 J*	0.970 J*	1.40 J*	1.00 J*	1.30	0.640 J*
Barium	-		-		22.6 J*	204	74.0	54.3	121	73.8	55.3	35.4
Beryllium	-		-		ND(0.500)	0.510 J*	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)
Cadmium	0.6	a	10	a	**0.940**	**19.4**	**8.50**	**7.70**	**7.90**	**1.00**	0.140 J*	**2.40**
Calcium	-		-		1520	3530	1710	1150	2550	1180	1490	714
Chromium	26	a	110	a	11.9 E	**86.4 E**	25.5 E	22.6 E	**41.8 E**	18.2 E	8.60 E	9.30 E
Cobalt	-		-		3.90 J*	10.0	3.70 J*	2.20 J*	5.50 J*	2.80 J*	4.00 J*	2.20 J*
Copper	16	a	110	a	**19.6**	**119**	**32.3**	**28.7**	**63.4**	**18.1**	12.0	12.1
Iron (%)	2.0	a	4.0	a	0.877	1.56	0.634	0.329	0.847	0.578	0.738	0.381
Lead	31	a	250	a	**48.4 N**	**126 N**	**35.3 N**	14.0 N	**40.0 N**	7.80 N	3.00 N	12.1 N
Magnesium	-		-		1710	3070	1210	686	1730	924	1430	769
Manganese	460	a	1100	a	67.6 N	179 N	136 N	36.2 N	83.4 N	90.7 N	67.7 N	42.5 N
Mercury	0.2	a	2	a	ND(0.100)	0.180	0.0830 J*	0.0660 J*	0.130 J*	0.0650 J*	ND(0.100)	ND(0.100)
Nickel	16	a	75	a	8.00 E	**72.7 E**	**16.6 E**	13.4 E	**27.2 E**	7.00 E	6.80 E	8.40 E
Potassium	-		-		411 J*	1120	476 J*	310 J*	644 J*	370 J*	553 J*	324 J*
Selenium	-		-		ND(0.500)	ND(0.500)	ND(0.500)	0.580 J*	0.820 J*	0.730	ND(0.500)	ND(0.500)
Silver	1.0	b	3.7	b	0.280 J*	**10.0**	**2.20**	**3.40**	**4.80**	**1.30 J***	0.270 J*	0.750 J*
Sodium	-		-		122 J*	172 J*	124 J*	84.5 J*	89.2 J*	ND(500)	133 J*	79.3 J*
Thallium	-		-		ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)
Vanadium	-		-		18.0	37.2	15.1	9.80	23.8	16.0	21.4	7.90
Zinc	120	a	820	a	53.7	**208**	75.7	31.3	104	18.6	13.6	31.8

(See Notes on 6)

Table 3

1999 Sediment Data - Inorganics
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

	Sediment Criteria		Proximate Downstream of Former Cianci Property (cont'd.)							
Sample ID:			**SD-10-99-7**	**SD-10-99-7**	**SD-10-99-8C**	**SD-10-99-8C**	**SD-10-99-9C**	**SD-10-99-9C**	**SD-10-99-9C**	**SD-10-99-10**
Sample Depth(Feet):	**Lower Level**	**Higher Level**	**0.5-2**	**2-5**	**0-0.5**	**0.5-2.3**	**0-0.5**	**0.5-2**	**2-3**	**0-0.5**
Date Collected:			**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**10/29/99**	**11/01/99**
Inorganics										
Aluminum	-	-	3680 [3750]	3140	2600	2840	4900	3490	3610	2760 L
Antimony	-	-	ND(6.00) N [ND(6.00)]	ND(6.00) N	ND(6.00) N	ND(6.00) N	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)
Arsenic	6.0 a	33 a	1.30 [1.50]	1.30	0.960 J*	4.40	1.80 J*	0.990 J*	0.790 J*	2.10 LN
Barium	-	-	57.0 [56.4]	46.2	51.5	52.8	83.6	53.1	65.4	33.2
Beryllium	-	-	ND(0.500) [ND(0.500)]	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)	ND(0.500)
Cadmium	0.6 a	10 a	**3.80 [4.10 L]**	**1.40**	**2.70**	**2.60**	**8.00 L**	**3.40 L**	ND(0.500) L	**0.910**
Calcium	-	-	1280 [1400]	1900	831	1360	1740	1280	571 J*	1470 L
Chromium	26 a	110 a	19.8 E [22.0 ELN]	12.0 E	14.1 E	9.70 E	**39.6 ELN**	19.0 ELN	9.10 ELN	8.10 L
Cobalt	-	-	3.80 J* [3.90 J*]	3.40 J*	2.60 J*	3.60 J*	4.70 J*	4.20 J*	2.70 J*	2.60 J*
Copper	16 a	110 a	**19.7 [21.7]**	11.0	**19.0**	13.9	**45.8**	**22.6**	7.10	8.00
Iron (%)	2.0 a	4.0 a	0.641 [0.671 L]	0.670	0.441	0.489	0.897 L	0.760 L	0.642 L	0.680 L
Lead	31 a	250 a	12.0 N [14.0 LN]	7.90 N	15.4 N	6.40 N	**35.0 LN**	20.5 LN	2.30 LN	13.2 L
Magnesium	-	-	1460 [1840]	1520	828	1220	1770	1560	1260	1080
Manganese	460 a	1100 a	83.4 N [83.5 LN]	94.5 N	70.8 N	43.7 N	299 LN	84.5 LN	73.9 LN	114 LN
Mercury	0.2 a	2 a	0.0660 J* [ND(0.100)]	ND(0.100)	0.0640 J*	0.0740 J*	0.200 J*	ND(0.100)	ND(0.100)	ND(0.100)
Nickel	16 a	75 a	**14.7 E [18.6 EL]**	9.60 E	10.0 E	8.70 E	**23.9 EL**	**24.7 EL**	5.00 EL	7.60
Potassium	-	-	679 [668]	779	322 J*	324 J*	624 J*	499 J*	566 J*	425 J*
Selenium	-	-	ND(0.500) [0.530 J*]	ND(0.500)	ND(0.500)	0.570 J*	0.930 J*	0.650 J*	ND(0.500)	0.620 LN
Silver	1.0 b	3.7 b	**2.50 [2.80]**	0.970 J*	**1.50**	0.630 J*	**7.50**	**1.40**	ND(1.00)	0.330 J*
Sodium	-	-	ND(500) [94.3 J*]	ND(500)	83.9 J*	164 J*	150 J*	108 J*	67.4 J*	83.9 J*
Thallium	-	-	ND(1.00) [ND(1.00)]	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)
Vanadium	-	-	16.1 [16.5]	13.7	9.60	17.0	17.2	15.5	17.6	11.0
Zinc	120 a	820 a	29.6 [30.4 LN]	20.5	40.6	25.4	81.7 LN	63.1 LN	13.9 LN	28.9

(See Notes on 6)

Table 3

1999 Sediment Data - Inorganics
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

					Proximate Downstream of Former Cianci Property (cont'd.)				Adjacent to the Town Wellfield			
Sample ID:	**Sediment Criteria**				**SD-10-99-10**	**SD-10-99-10**	**SD-10-99-11**	**SD-10-99-11**	**SD-10-99-12**	**SD-10-99-12**	**SD-10-99-13**	**SD-10-99-13**
Sample Depth(Feet):	**Lower Level**		**Higher Level**		**0.5-2**	**2-3**	**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**	**0-0.5**	**0.5-2**
Date Collected:					**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**
Inorganics												
Aluminum	-		-		2450 L	3920 L	15200 L	3310 L	17700 L	12600 L	2680 L	5860 L
Antimony	-		-		ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)
Arsenic	6.0	a	33	a	0.540 J*LN	0.820 J*LN	4.50 LN	1.00 J*LN	5.10 LN	**6.20 LN**	0.860 J*LN	1.90 LN
Barium	-		-		34.5	81.3	352	75.3	471	368	37.8	86.0
Beryllium	-		-		ND(0.500)	ND(0.500)	0.780 J*	ND(0.500)	0.880 J*	0.610 J*	ND(0.500)	0.340 J*
Cadmium	0.6	a	10	a	**3.30**	**4.10**	**36.0**	**27.8**	**38.8**	**75.5**	**1.30**	**6.10**
Calcium	-		-		666 L	1080 L	4770 L	1180 L	5350 L	4050 L	555 L	2100 L
Chromium	26	a	110	a	9.00 L	**63.7 L**	**136 L**	**114 L**	**157 L**	**293 L**	9.20 L	24.8 L
Cobalt	-		-		3.20 J*	3.70 J*	15.1	5.70 J*	18.3	16.8	3.00 J*	5.70 J*
Copper	16	a	110	a	11.3	**56.7**	**202**	**92.9**	**232**	**273**	9.40	**27.8**
Iron (%)	2.0	a	4.0	a	0.513 L	0.593 L	**2.39 L**	0.511 L	**2.99 L**	1.66 L	0.688 L	1.25 L
Lead	31	a	250	a	10.7 L	28.4 L	**122 L**	**35.4 L**	**142 L**	**119 L**	10.6 L	26.1 L
Magnesium	-		-		929	1340	4430	1040	5010	3440	1160	2440
Manganese	460	a	1100	a	115 LN	80.2 LN	366 LN	51.2 LN	**723 LN**	270 LN	193 LN	131 LN
Mercury	0.2	a	2	a	ND(0.100)	ND(0.100)	**0.230 J***	ND(0.100)	**0.360**	**0.270**	ND(0.100)	ND(0.100)
Nickel	16	a	75	a	12.6	**25.4**	**113**	**59.3**	**136**	**200**	10.0	**23.0**
Potassium	-		-		356 J*	380 J*	1380	366 J*	1590	1230	322 J*	904
Selenium	-		-		ND(0.500) LN	0.580 J*LN	2.10 LN	ND(0.500) LN	2.20 LN	1.60 LN	0.510 J*LN	0.540 J*LN
Silver	1.0	b	3.7	b	0.440 J*	**8.40**	**17.2**	**12.1**	**21.0**	**38.7**	0.500 J*	**2.40**
Sodium	-		-		89.1 J*	78.3 J*	0 J*	125 J*	277 J*	178 J*	57.9 J*	93.5 J*
Thallium	-		-		ND(1.00)	ND(1.00)	ND(0.970)	ND(1.00)	1.20 J*	ND(1.00)	ND(1.00)	ND(1.00)
Vanadium	-		-		11.2	13.7	54.7	14.3	65.8	48.0	10.7	21.5
Zinc	120	a	820	a	29.3	47.6	**357**	85.0	**418**	**267**	34.4	65.3

(See Notes on 6)

Table 3

1999 Sediment Data - Inorganics
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

					Adjacent to the Town Wellfield (cont'd.)						
Sample ID:	**Sediment Criteria**				**SD-10-99-13**	**SD-10-99-14C**	**SD-10-99-14C**	**SD-10-99-14C**	**SD-10-99-15**	**SD-10-99-15**	**SD-10-99-15**
Sample Depth(Feet):	**Lower Level**		**Higher Level**		**2-5**	**0-0.5**	**0.5-2**	**2-4**	**0-0.5**	**0.5-2**	**2-5**
Date Collected:					**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**	**11/01/99**
Inorganics											
Aluminum	-		-		4550 L	3150 L	5050 L	4430 L	5350	3220	3150 [3970]
Antimony	-		-		ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00)	ND(6.00) [ND(6.00)]
Arsenic	6.0	a	33	a	0.980 J*LN	0.920 J*LN	1.30 J*LN	1.10 J*LN	1.40	0.930 J*	0.620 J* [0.940 J*]
Barium	-		-		65.0	45.4	61.8	72.9	101	60.1	58.1 [63.3]
Beryllium	-		-		ND(0.500)	ND(0.500)	0.260 J*	ND(0.500)	0.270 J*	ND(0.500)	ND(0.500) [ND(0.500)]
Cadmium	0.6	a	10	a	**17.6**	**2.60**	**4.50**	**30.0**	**12.1 L**	**1.60 L**	**2.90 L [2.60 L]**
Calcium	-		-		1150 L	751 L	1910 L	1080 L	1680	917	869 [982]
Chromium	26	a	110	a	**65.2 L**	13.1 L	19.4 L	**124 L**	**53.2 ELN**	11.8 ELN	**36.6 ELN [35.3 ELN]**
Cobalt	-		-		5.60 J*	3.20 J*	5.70 J*	7.20	5.20 J*	2.70 J*	3.10 J* [3.80 J*]
Copper	16	a	110	a	**54.5**	15.0	**26.3**	**106**	**87.8**	**18.7**	**39.1 [37.5]**
Iron (%)	2.0	a	4.0	a	0.801 L	0.758 L	1.19 L	0.682 L	0.748 L	0.468 L	0.546 L [0.797 L]
Lead	31	a	250	a	28.8 L	17.7 L	17.8 L	**41.0 L**	**44.5 LN**	7.30 LN	**34.7 LN [29.0 LN]**
Magnesium	-		-		1940	1310	2120	1450	1450	1130	996 [1570]
Manganese	460	a	1100	a	96.8 LN	145 LN	115 LN	66.0 LN	175 LN	68.2 LN	120 LN [139 LN]
Mercury	0.2	a	2	a	ND(0.100)	ND(0.100)	ND(0.100)	0.110 J*	ND(0.100)	ND(0.100)	0.110 J* [0.0790 J*]
Nickel	16	a	75	a	**36.7**	12.0	**21.5**	**68.2**	**29.3 EL**	9.10 EL	7.40 EL [8.80 EL]
Potassium	-		-		741	527 J*	531 J*	506 J*	453 J*	382 J*	362 J* [598 J*]
Selenium	-		-		0.540 J*LN	0.580 J*LN	0.530 J*LN	ND(0.500) LN	0.810	ND(0.500)	ND(0.500) [ND(0.500)]
Silver	1.0	b	3.7	b	**11.0**	0.990 J*	**1.80**	**17.5**	**8.70**	0.730 J*	**10.0 [9.50]**
Sodium	-		-		127 J*	95.2 J*	ND(500)	ND(500)	123 J*	93.3 J*	77.9 J* [115 J*]
Thallium	-		-		ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00)	ND(1.00) [ND(1.00)]
Vanadium	-		-		17.7	13.9	21.9	16.6	20.0	14.6	11.0 [13.9]
Zinc	120	a	820	a	57.6	47.3	64.0	85.6	96.5 LN	24.1 LN	25.9 LN [29.4 LN]

(See Notes on 6)

Table 3

1999 Sediment Data - Inorganics
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

Notes:

a. Sediment criteria are the lowest effect level (LEL) and severe effect level (SEL), respectively, from Persaud et al., 1993.

b. Sediment criteria are the effects range-low (ER-L) and effects range-median (ER-M), respectively, from Long et al., 1995.

ND - Not Detected. The number in parentheses is the associated reporting limit.

J* - Indicates an estimated value between the instrument detection limit and the Contract Required Detection Limit.

L - Indicates laboratory duplicate analysis was outside control limits.

N - Indicates sample matrix spike analysis was outside control limits.

E - The reported value is estimated due to the presence of interference(s).

D - Compound quantitated using a secondary dilution.

Duplicate results are presented in brackets [ ].

Bold font indicates an exceedence of the lower (i.e., more conservative) sediment criteria.

Shaded cells indicate an exceedence of the higher (i.e., less conservative) sediment criteria.

Table 4

1999 Sediment Date Summary
(Results in ppm, dry-weight)

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

Parameter/Analyte	Background Data		Site Data	
	Detection Frequency	Range of Results	Detection Frequency	Range of Results
PCBs				
Aroclor-1254	0/8	ND	6/33	ND - 0.11
Aroclor-1260	0/8	ND	11/33	ND - 0.087
Total PCBs	0/8	ND	17/33	ND - 0.11
Semivolatile Organics				
4-Methylphenol	1/8	ND - 0.091	1/33	ND - 0.13
Acenaphthene	3/8	ND - 0.15	12/33	ND - 0.31
Acenaphthylene	4/8	ND - 0.11	24/33	ND - 0.33
Anthracene	4/8	ND - 0.41	27/33	ND - 0.92
Benzo(a)anthracene	4/8	ND - 1.2	32/33	ND - 1.8
Benzo(a)pyrene	4/8	ND - 1.4	32/33	ND - 1.7
Benzo(b)fluoranthene	4/8	ND - 2.2	32/33	ND - 2.8
Benzo(g,h,i)perylene	4/8	ND - 0.98	30/33	ND - 1.4
Benzo(k)fluoranthene	4/8	ND - 0.6	30/33	ND - 1.3
bis(2-Ethylhexyl)phthalate	5/8	ND - 1.4	31/33	ND - 2.5
Butylbenzylphthalate	0/8	ND	1/33	ND - 1.5
Chrysene	4/8	ND - 1.3	32/33	ND - 1.8
Dibenzo(a,h)anthracene	0/8	ND	1/33	ND - 0.11
Dibenzofuran	2/8	ND - 0.084	8/33	ND - 0.16
Diethylphthalate	1/8	ND - 0.053	2/33	ND - 0.15
Di-n-Butylphthalate	0/8	ND	5/33	ND - 5.9
Fluoranthene	6/8	ND - 2.3	32/33	ND - 2.9
Fluorene	4/8	ND - 0.19	18/33	ND - 0.37
Indeno(1,2,3-cd)pyrene	4/8	ND - 0.82	28/33	ND - 1.2
Naphthalene	0/8	ND	3/33	ND - 0.077
Phenanthrene	6/8	ND - 2.1	32/33	ND - 3.6
Pyrene	6/8	ND - 3.7	32/33	ND - 5.8
Total PAHs	6/8	ND - 17	32/33	ND - 25
Inorganics				
Aluminum	8/8	2600 - 5610	33/33	2050 - 17700
Antimony	0/8	ND	1/33	ND - 0.83
Arsenic	8/8	0.87 - 4.2	33/33	0.54 - 6.2
Barium	8/8	42.9 - 175	33/33	22.6 - 471
Beryllium	2/8	ND - 0.38	7/33	ND - 0.88
Cadmium	6/8	ND - 15.2	32/33	ND - 75.5
Calcium	8/8	809 - 1840	33/33	555 - 5350
Chromium	8/8	8 - 63.4	33/33	8.1 - 293
Cobalt	8/8	3.2 - 6	33/33	2.2 - 18.3
Copper	8/8	4.7 - 77.1	33/33	7.1 - 273
Iron (%)	8/8	0.523 - 1.01	33/33	0.329 - 2.99
Lead	8/8	1.5 - 60.7	33/33	2.3 - 142
Magnesium	8/8	986 - 2580	33/33	686 - 5010
Manganese	8/8	75.3 - 257	33/33	36.2 - 723
Mercury	3/8	ND - 0.1	15/33	ND - 0.36
Nickel	8/8	6.2 - 71.7	33/33	5 - 200
Potassium	8/8	399 - 1300	33/33	310 - 1590
Selenium	2/8	ND - 0.71	18/33	ND - 2.2
Silver	4/8	ND - 8.2	32/33	ND - 38.7
Sodium	7/8	ND - 119	28/33	ND - 277
Thallium	0/8	ND	1/33	ND - 1.2
Vanadium	8/8	10 - 24.9	33/33	7.9 - 65.8
Zinc	8/8	13.1 - 115	33/33	13.6 - 418
Waste Characterization Parameters				
Total Organic Carbon (%)	8/8	0.0463 - 2.9	33/33	0.0372 - 8.14

Notes:

ND - Not Detected.

Table 5

1999 Sediment Data-Physical Characteristics

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

		Physical Characteristics				Total	Total	Total
Sample ID	Sample Depth (ft)	% Gravel	% Sand	% Silt	% Clay	Organic Carbon (%)	PAH (mg/kg)	PCB (mg/kg)
SD-10-99-4	0 - 0.5	5	92	3	1	0.37	13	0.041
SD-10-99-4	0.5 - 2.0	6	56	38	1	3.5	21	0.11
SD-10-99-5	0 - 0.5	0	92	7.7 (a)		1.1	25	0.039
SD-10-99-5	0.5 - 2.0	19	74	7.2 (a)		0.58	6.9	0.023
SD-10-99-7	0 - 0.5	0	96	3.8 (a)		0.29	10	0.021
SD-10-99-7	0.5 - 2.0	3	78	20 (a)		0.51	3.2	ND
SD-10-99-7	2.0 - 5.0	0	76	24 (a)		0.18	0.86	ND
SD-10-99-8C	0 - 0.5	0	93	7.0 (a)		0.62	0.81	ND
SD-10-99-8C	0.5 - 2.3	15	76	9.4 (a)		0.89	8.4	ND
SD-10-99-9C	0 - 0.5	10	60	29	1	3.3	12	0.087
SD-10-99-9C	0.5 - 2.0	18	74	7.4 (a)		2.1	0.95	ND
SD-10-99-9C	2.0 - 3.0	4	93	3.5 (a)		0.037	ND	ND
SD-10-99-10	0 - 0.5	0	89	10.5 (a)		0.087	3.6	ND
SD-10-99-10	0.5 - 2.0	2	95	2.5 (a)		0.23	2.9	0.021
SD-10-99-10	2.0 - 3.0	23	76	1.1 (a)		2.6	4.1	0.035

Notes:

a. Combined value for silt and clay.

Table 6

Historical Sediment Data Summary

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

Location	Sample ID (1)	Date (2)	Anthracene	Benzo(a) - anthracene	Benzo(a) - pyrene	Total PAHs	bis(2- Ethylhexyl) phthalate	PCBs	Cadmium	Copper	Lead	Mercury	Zinc
Reference (8)	QRNF	Jul-96	0.14	0.44	0.57	7	41	ND	6.4	67	128	0.26	192
	QRNF	Feb-97	0.24	0.96	1.2	14.3	1.6	ND	26.9	52.5	134	0.3	205
Upstream of Lazy lane (9)	QR-HM	Jul-96	0.15	0.58	0.71	9.7	40	ND	7.1	116	105	0.11	242
	HM1	Feb-97	0.36	1.5	1.9	23.6	5.6	ND	38	109	131	0.12	305
	QR-R	Jul-96	0.11	0.34	0.39	4.3	0.74	---	63	650	101	0.029	178
	SD3-27	Dec-91	ND	0.081	0.89	1.3	0.092	ND	0.7	33.7	12.5	0.16	17.4
	SD-10-99-1	Nov-99	0.32	0.92	1	13	1.4	ND	12.5	77.1	60.7	0.1	115
	SD-10-99-2	Nov-99	0.39	0.88	0.96	12	0.22	ND	2.5	30.1	15.7	ND	34.7
	SD3-28	Dec-91	0.84	1.9	1.2	31.4	0.73	ND	4.8	33.8	45.9	ND	63.3
	SD3-29	Dec-91	ND	0.077	0.43	4.3	0.2	ND	ND	9.8	9.7	ND	23.5
	SD3-30	Dec-91	---	---	---	---	---	---	---	---	---	---	---
	SD-10-99-3	Nov-99	0.41	1.2	1.4	17	0.38	ND	5.2	34.1	26.2	0.078	72.3
	SD1-7	May-90	0.0875	0.39	0.43	5.1	0.195	ND	20.1	87.3	40	0.28	73.4
Vicinity of Culvert Outfall	QRRS	Jul-96	0.15	0.53	0.55	8.2	0.46	ND	9.2	48	37	0.001	88
	QRRS	Jul-96	0.21	0.73	0.82	10.3	0.74	ND	7.5	48	38	0.08	85
	QR-RS	Feb-97	0.47	1.4	1.5	18.8	0.99	ND	43.3	55.4	46.5	0.14	120
	SD-10-99-4	Nov-99	0.29	1	0.96	13	0.49	0.041	0.94	19.6	48.4	ND	53.7
	SD1-8	May-90	0.35	1.3	1.1	16.7	0.75	ND	12	86.7	77.6	0.31	130
	SD1-9	May-90	1.4	1.8	1.4	26.1	0.6	ND	ND	ND	212	ND	ND
	SD1-10	May-90	0.062	1	0.3	4.3	0.19	ND	2.4	22.1	14.9	ND	25.3
	SD-10-99-5	Nov-99	0.92	1.8	1.7	25	0.53	0.039	8.5	32.3	35.3	0.083	75.7

Table 6

Historical Sediment Data Summary

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

Location	Sample ID (1)	Date (2)	Anthracene	Benzo(a) - anthracene	Benzo(a) - pyrene	Total PAHs	bis(2-Ethylhexyl) phthalate	PCBs	Cadmium	Copper	Lead	Mercury	Zinc
Proximate Downstream of Former Cianci Property	SD-10-99-6	Nov-99	0.6	1.4	1.5	19	0.45	0.062	7.9	63.4	40	0.13	104
	SD-10-99-7	Nov-99	0.27	0.66	0.66	10	0.17	0.021	2.4	12.1	12.1	ND	31.8
	SD-10-99-8	Nov-99	ND	0.063	0.073	0.81	0.06	ND	2.7	19	15.4	0.064	40.6
	SD3-50	Sep-93	0.315	0.74	0.67	9.96	---	0.035	2.75	30.9	16.3	ND	44.5
	SD3-51	Sep-93	0.27	1	1.3	17.32	---	0.17	26.1	142	93.7	ND	213
	SD1-18	May-90	0.052	0.24	0.22	3	0.15	ND	2.6	18.4	ND	ND	30.4
	SD3-31	Dec-91	ND	0.066	ND	1.1	ND	ND	0.87	ND	6.1	ND	16.1
	SD3-32	Dec-91	ND	0.16	0.076	2.1	ND	ND	ND	7.8	11.6	ND	22.4
	SD-10-99-9	Nov-99	0.17	0.87	0.9	12	0.92	0.087	8	45.8	35	0.2	81.7
	SD3-33	Dec-91	0.084	0.3	0.26	4.5	ND	0.018	1.5	39.3	39.8	ND	46.3
	SD3-40	Dec-91	ND	0.26	0.26	7.2	ND	0.052	6.3	50.2	37.1	ND	53.2
	SD-10-99-10	Nov-99	0.066	0.29	0.3	3.6	0.1	ND	0.91	8	13.2	ND	28.9
	SD-10-99-11	Nov-99	0.2	1.1	1.4	17	1.6	0.086	36	202	122	0.23	357
Adjacent to the Town Wellfield	SD3-52	Sep-93	0.35	1.1	1.4	16.84	---	0.29	22	122	68.7	ND	180
	SD3-53	Sep-93	ND	ND	ND	ND	---	ND	1.4	23.6	11.5	ND	41.7
	SD-10-99-12	Nov-99	0.21	1.5	1.5	21	2.5	0.055	38.8	232	142	0.36	418
	SD1-11	May-90	0.067	0.46	0.48	5.6	0.59	ND	6.6	464	31.6	0.2	61
	SD-10-99-13	Nov-99	0.074	0.38	0.41	4.7	0.11	ND	1.3	9.4	10.6	ND	34.4
	SD-10-99-14	Nov-99	0.085	0.73	0.69	7.2	0.27	ND	2.6	15	17.7	ND	47.3
	SD-10-99-15	Nov-99	0.23	1.2	1.1	15	0.24	ND	12.1	87.8	44.5	ND	96.5
	SD1-12	May-90	ND	0.11	0.12	1.3	0.15	ND	ND	ND	ND	ND	28.1
	SD1-14	May-90	0.56	2.6	2.5	27.9	1.5	ND	3.3	25.6	29.7	ND	62.2
	SD3-54	Sep-93	ND	0.16	0.21	2.2	---	0.08	15.3	69.3	58.8	0.24	107
	SD3-55	Sep-93	0.24	0.81	0.88	10.68	---	0.084	8.3	52.3	51.3	ND	79.8
	SD1-15	May-90	---	---	---	---	---	ND	ND	ND	66.4	0.25	31.9

Table 6

Historical Sediment Data Summary

Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

Location	Sample ID (1)	Date (2)	Anthracene	Benzo(a) - anthracene	Benzo(a) - pyrene	Total PAHs	bis(2-Ethylhexyl) phthalate	PCBs	Cadmium	Copper	Lead	Mercury	Zinc
Distant Downstream (10)	QR 10	Jul-96	---	---	---	---	---	---	4.1	25	37	ND	170
	QRHP1	Jul-96	0.16	0.55	0.8	8.9	1.9	ND	17	188	104	0.29	750
	HP1	Feb-97	0.24	1.1	1.4	15.7	2.7	ND	99.8	220	112	0.37	896
	QRHP2	Jul-96	0.57	2	2.6	28.7	8.9	ND	11	514	209	0.54	657
	QRHP3	Jul-96	---	---	---	---	---	---	11	459	189	0.38	622
	HP3	Feb-97	0.56	2.7	3.1	35.8	3.9	ND	102	380	19.3	0.49	634
	QRBR	Jul-96	0.16	0.59	0.67	6.9	0.37	---	5.7	243	86	0.01	275
	QRCL	Jul-96	0.16	0.76	0.67	8.3	1.4	ND	7.3	400	95	0.28	300
	QR-CL	Feb-97	0.27	1	1.2	14.4	21	ND	119	374	95.6	0.39	317
	QRRW	Jul-96	ND	0.13	0.15	1.7	1.1	ND	4.9	183	65	0.01	216
	QRRW	Jul-96	0.1	0.39	0.47	4.8	2.6	ND	4.9	243	62	0.16	235
Sediment	ER-L (3)		0.085	0.26	0.43	4	TEL 0.182(6)	0.022	1.2	34	46.7	0.15	150
Criteria	ER-M (3)		1.1	1.6	1.6	45	PEL 2.647(6)	0.18	9.6	270	218	0.71	410
	LEL (4)		0.22	0.32	0.37	4	FSQV 0.64(7)	0.07	0.6	16	31	0.2	120
	SEL (4,5)		7.4	29.6	28.8	200		10.6	10	110	250	2	820

Notes:
1. Includes only the results of the surficial (0-6 inch) sediment samples. Values are in mg/kg.
2. The data for the May 90 samples are from the Phase I sampling, the Dec. 91 data are from the Phase III sampling, the Sept. 93 data are from the Phase IIIS sampling, the Jul. 96 and Feb. 97 data are from CTDEP/USEPA, and the Nov. 99 data are from the BBL sediment investigation.
3. Sediment criteria are from Long et al. (1995) "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marune and Estuarine Sediments."
4. Sediment criteria are from the Ontario Ministry of Environment and Energy (1993) "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario".
5. Values assume 2% organic carbon in the sediment based upon representative site-specific values.
6. Threshold effects level and probable effects levels, are from the Florida DEP (MacDonald,1994), "Sediment Quality Assessment Guidelines."
7. Freshwater sediment quality value from Washington Department of Ecology (1997) "Creation and Analysis of Freshwater Sediment Quality Values in Washington State."
8. Includes CTDEP/USEPA data from the North Farms Reservoir.
9. Includes the Phase I, Phase III, and BBL 1999 samples collected immediately (i.e., approximately 100 to 700 feet) upstream of Lazy Lane, and the USEPA data collected at Plainville and Hamlin Pond (approximately three to four miles upstream of the site).
10. Includes the CTDEP/USEPA data from approximately 2 to 4 miles downstream of the site.

ND. Not detected

--- Data not available

Table 7

Historical Sediment Data Summary - Drainage Ditch and Culvert Outfall

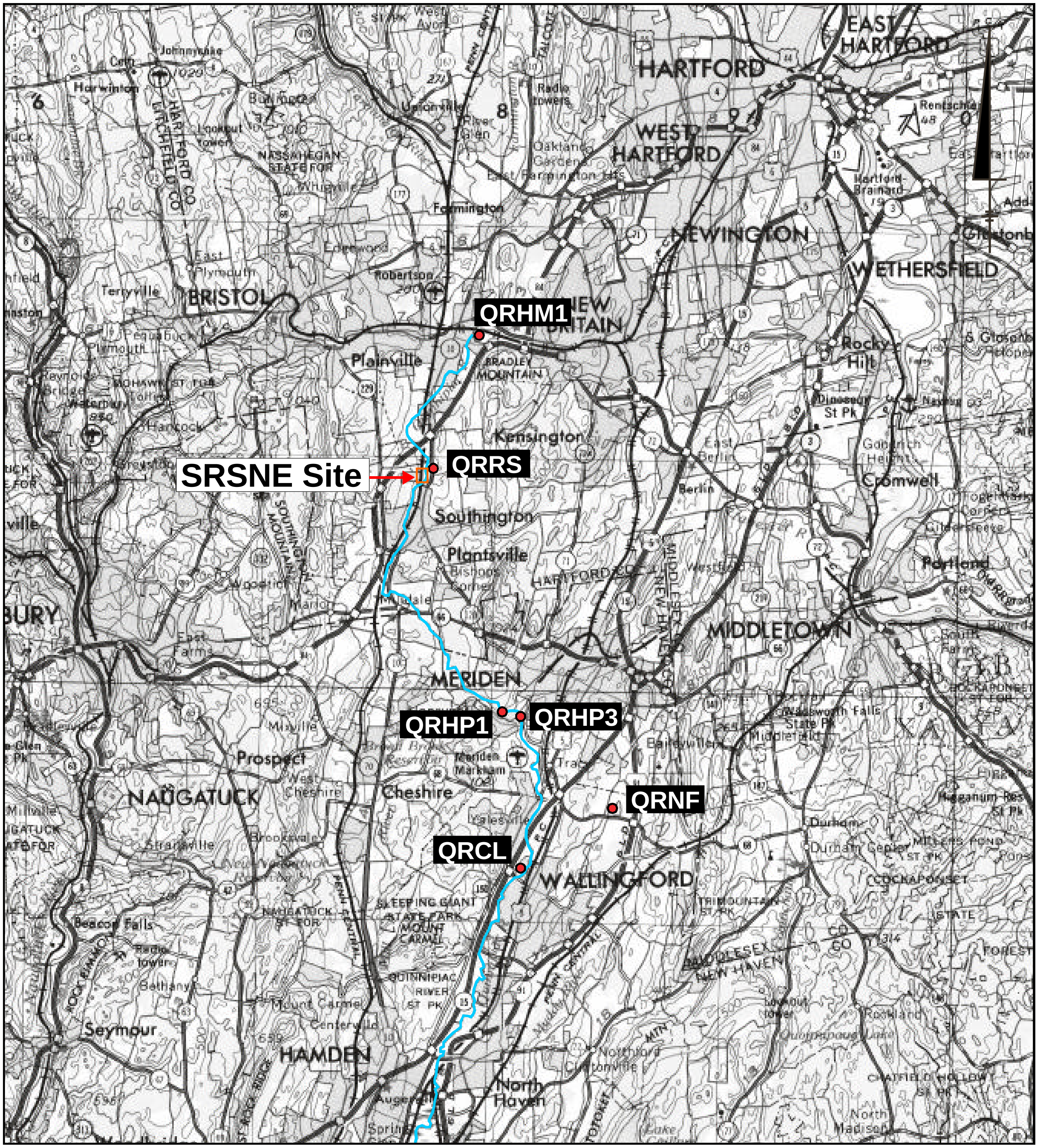
Sediment Evaluation
SRSNE, Inc. Site - Southington, CT

	SRSNE Site (2)			Quinnipiac River (3)			
	Drainage Ditch S of culvert(4)	**Drainage Ditch N of culvert**	**Culvert Outfall**	**Upstream of Lazy Lane**	**Vicinity of Culvert Outfall**	**Proximate Downstream**	**Town Wellfield**
PCBs (total)	23.5	ND	6.5	ND	0.041	0.087	0.084
PAHs (total)	20.2	52.2	4.9	17	25	19	21
Phthalates (total)	1050	11.7	15.8	1.4	1.0	0.92	2.5
Cadmium	817	12.6	12.1	15.2	19.4	36	75.5
Copper	534	67.3	76.2	77.1	119	202	273
Lead	3910	263	113	60.7	126	122	142
Mercury	8.3	0.25	1.0	0.1	0.18	0.23	0.36
Zinc	1170	162	114	115	208	357	418

Notes:

1. All concentrations reported in mg/kg.
2. Includes the results of the HNUS Phase I (May 1990) and Phase III (December 1991) RI data.
3. Includes the results of the BBL October 1999 data.
4. Surface sediment in this area removed during EPA Removal Action (September 1992).

FIGURES



REFERENCE: USGS HARTFORD, CONN, 1962, REVISED 1975.

● = USEPA/CTDEP Sediment Sampling Location

5 0 5

APPROX. SCALE: 1 = 5 miles

QUADRANGLE LOCATION

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

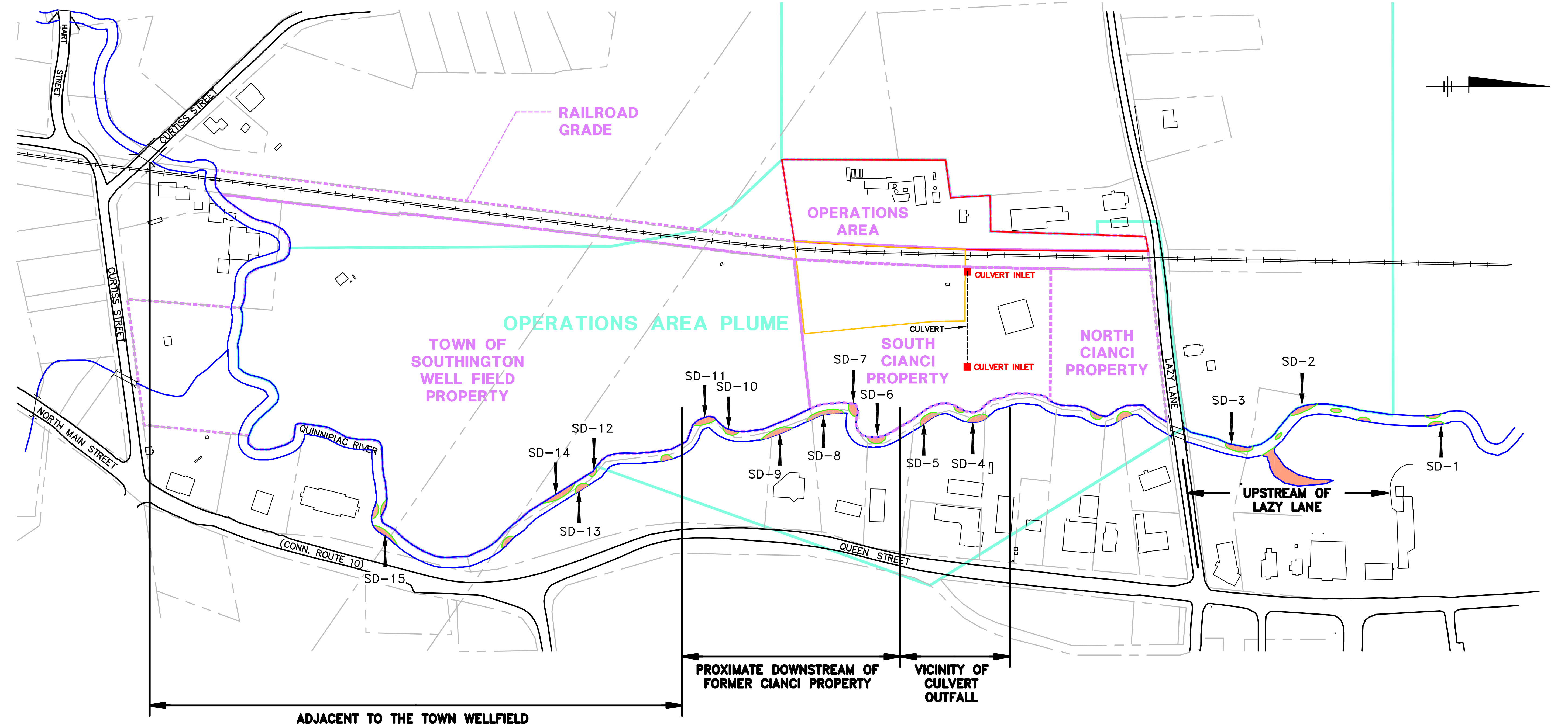
FEASIBILITY STUDY

SUPPLEMENTAL SEDIMENT INVESTIGATION SITE LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
1

05/00 SYR D54-DJH LBR
08331019/08331N01.cdr



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

LEGEND:

▨	OBSERVED SEDIMENT DEPOSIT (APPROXIMATE LOCATION)
↑	SEDIMENT SAMPLE LOCATION

0 300' 600'

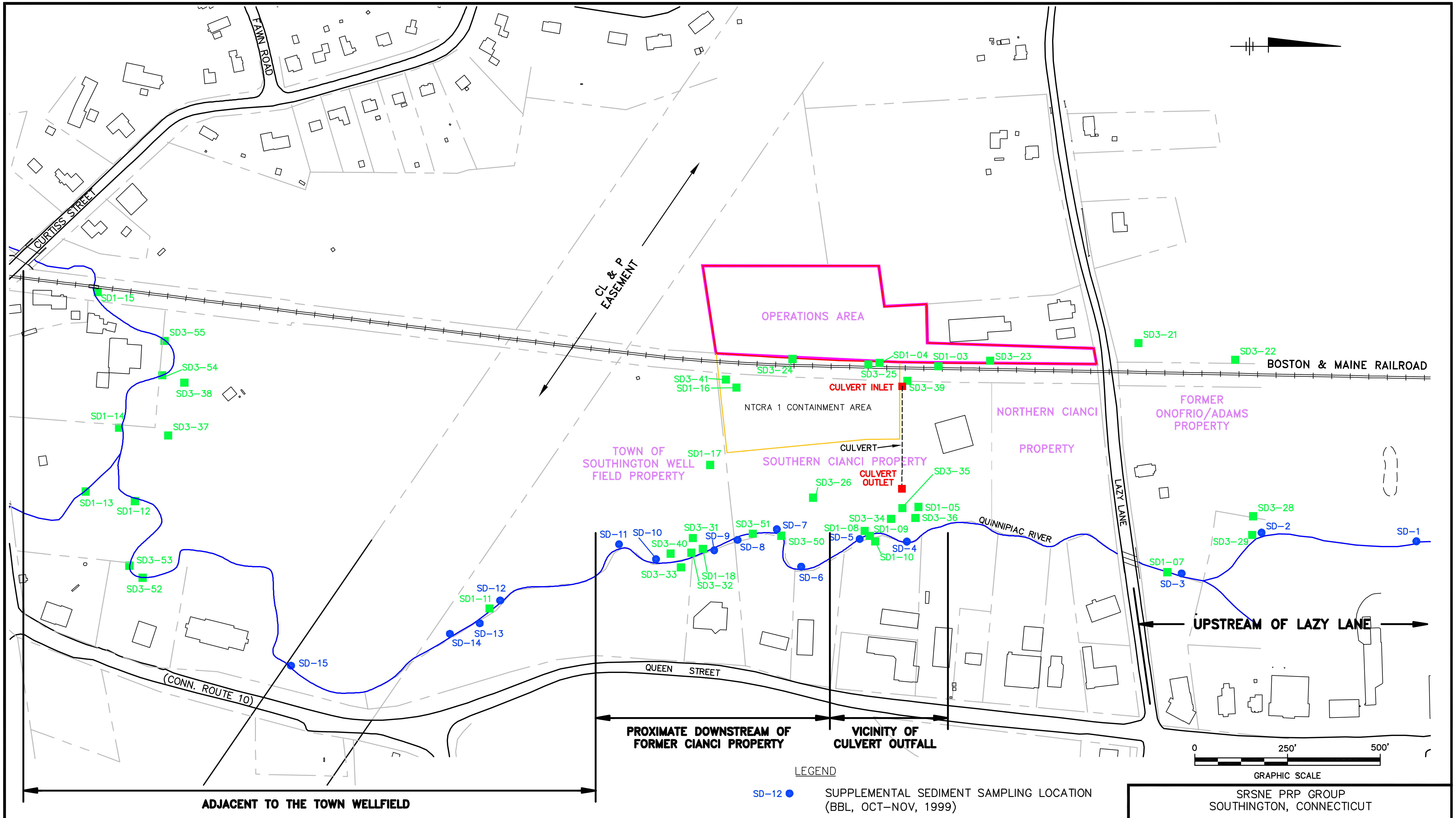
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SUPPLEMENTAL SEDIMENT INVESTIGATION SAMPLING LOCATIONS

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
2A

L: ON=*,OFF=REF
P: STD-PCP/BL
5/10/00 SYR-54-CBM RCA NES
08331019/08331P02.DWG



LEGEND

SD-12 ●	SUPPLEMENTAL SEDIMENT SAMPLING LOCATION (BBL, OCT-NOV, 1999)
SD1-11 🟩	RI SEDIMENT SAMPLING LOCATION (HNUS)
―――	APPROXIMATE PROPERTY LINE
▭	EXISTING BUILDING

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

2. ALL SITE FEATURES ARE APPROXIMATE.

X: NONE
P: B06 OR AL.PCP
L: ON= *; OFF=REF*
5/10/00 SYR-54-YCC RCA NES
08331019/08331P03.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SUMMARY OF RI AND SUPPLEMENTAL SEDIMENT SAMPLING LOCATIONS

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
2B

Figure 3A

Sediment (1999 Data Only - All Depths) - Anthracene

SRSNE, Inc. Site - Southington, CT

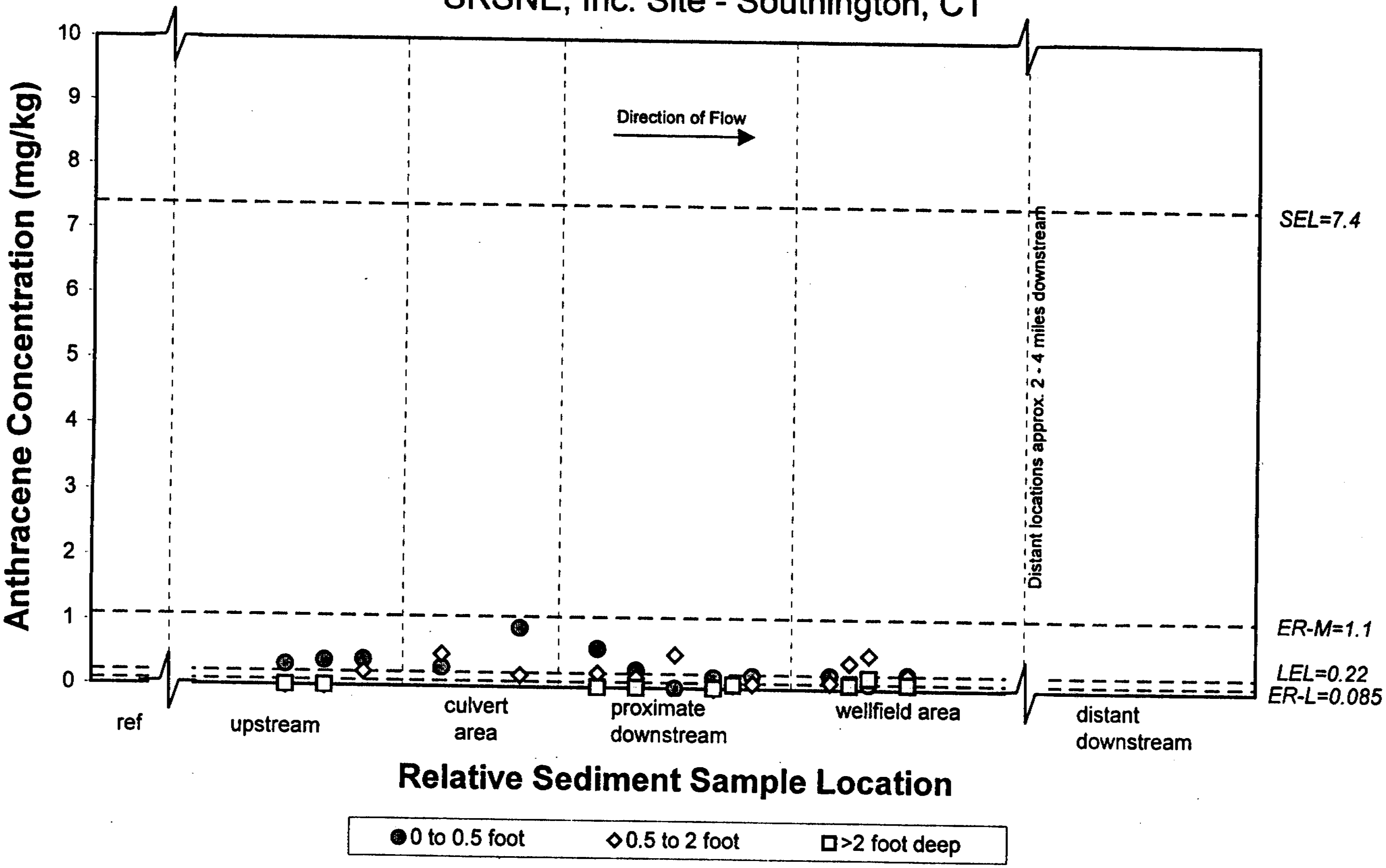


Figure 3B

Sediment (1999 Data Only - All Depths) - Anthracene

SRSNE, Inc. Site - Southington, CT

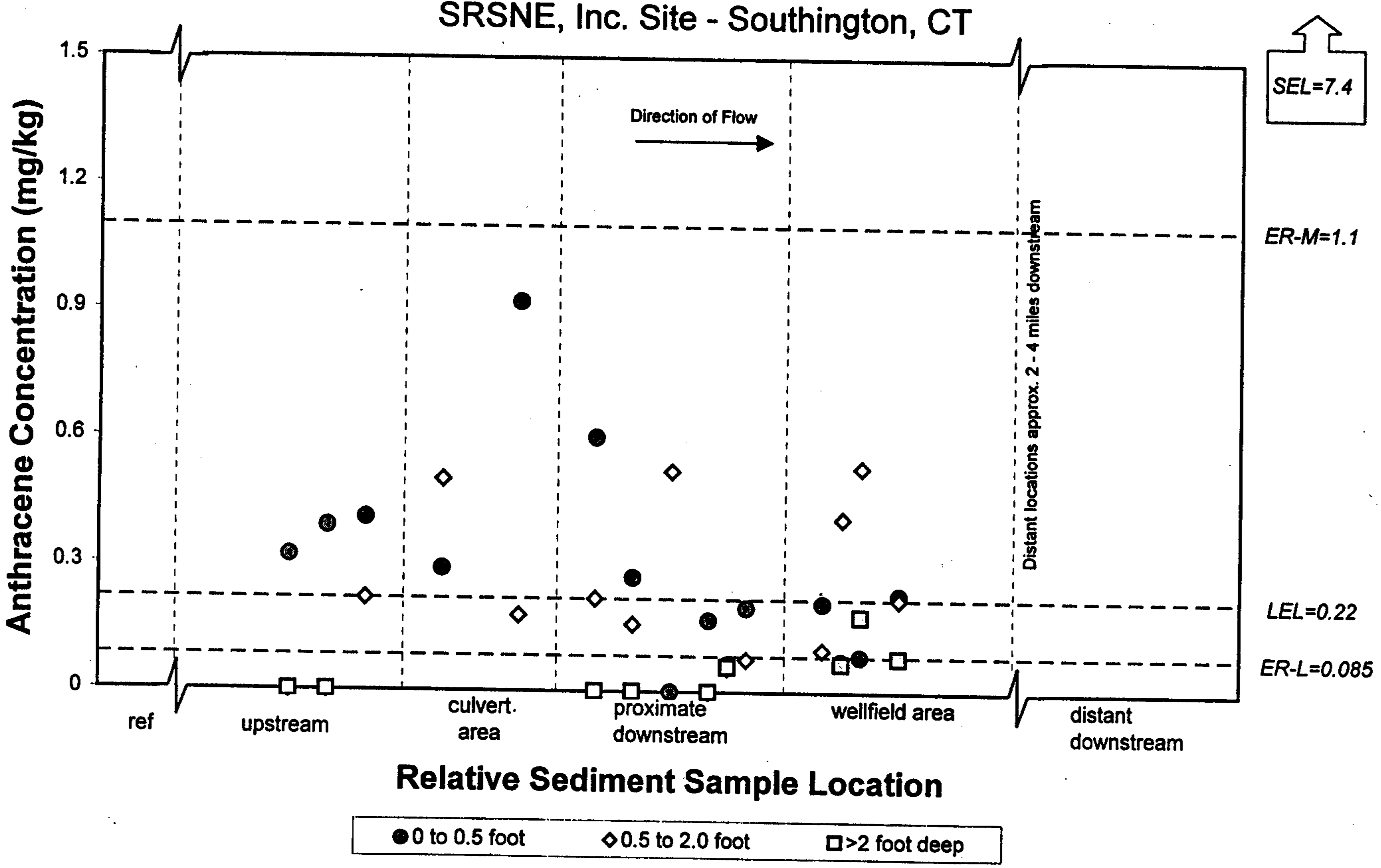


Figure 3C

Sediment (Historical Data - Surficial Only) - Anthracene

SRSNE, Inc. Site - Southington, CT

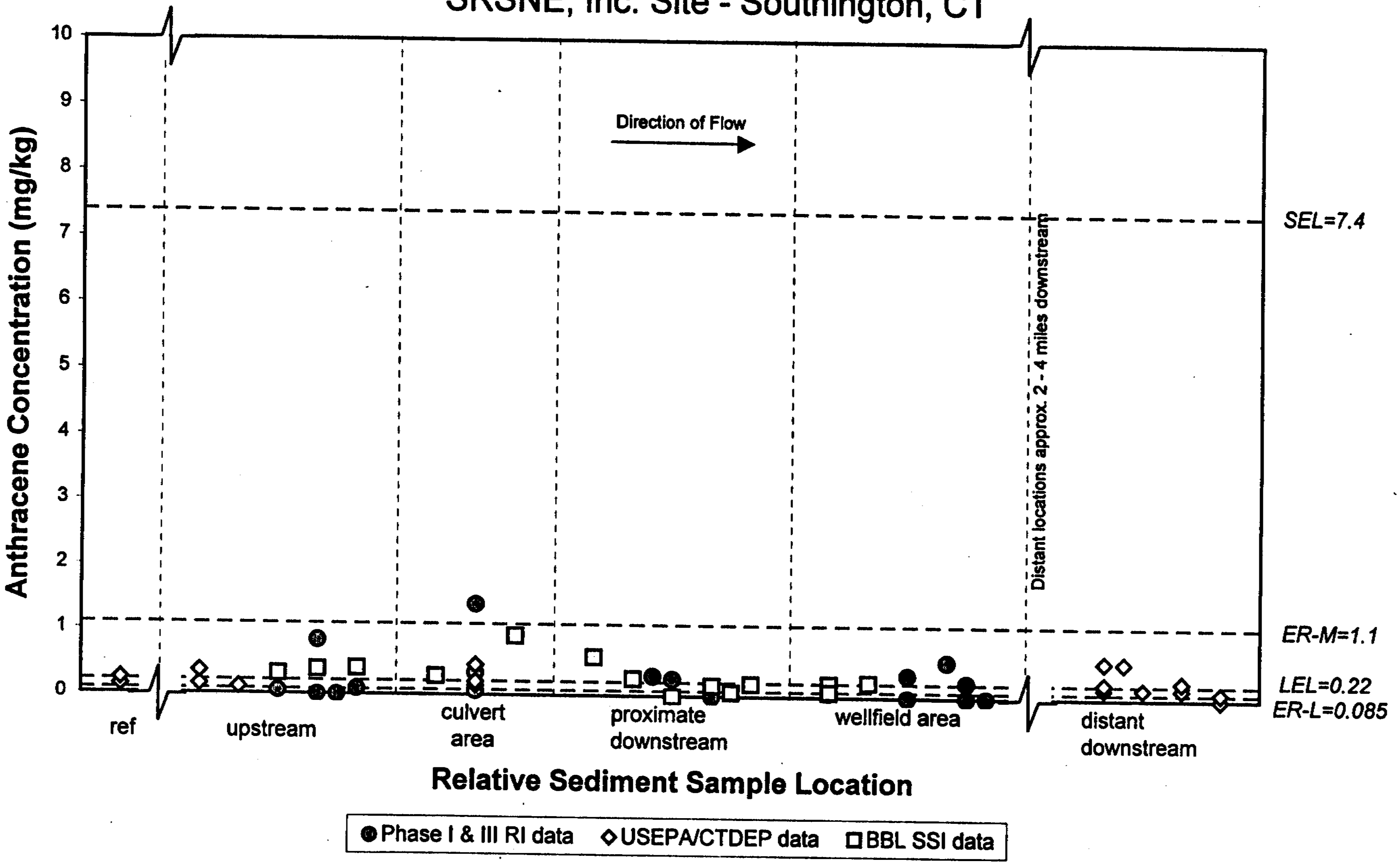


Figure 3D
Sediment (Historical Data - Surficial Only) - Anthracene
SRSNE, Inc. Site - Southington, CT

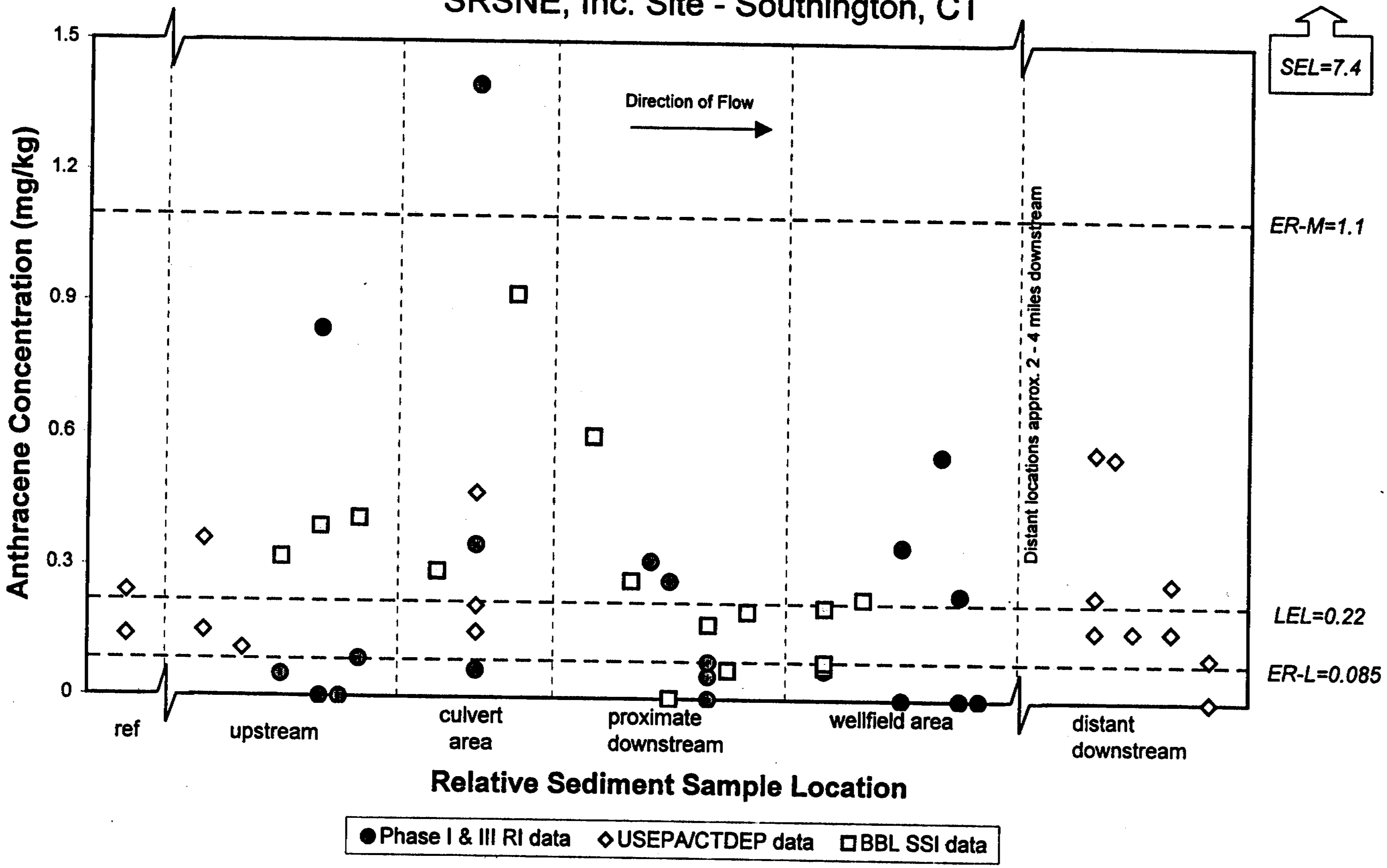


Figure 4A

Sediment (1999 Data Only - All Depths) - Benzo(a)anthracene

SRSNE, Inc. Site - Southington, CT

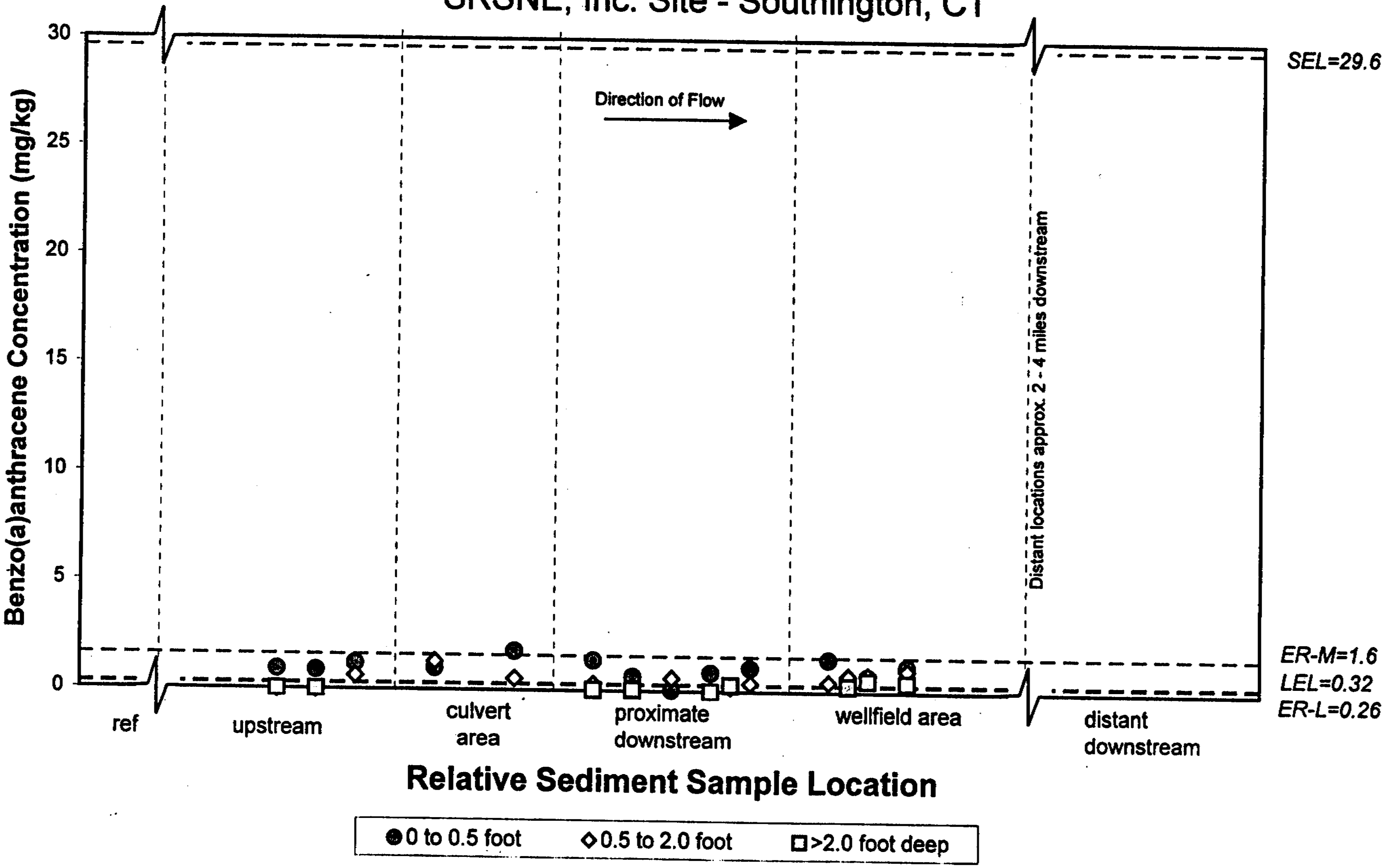
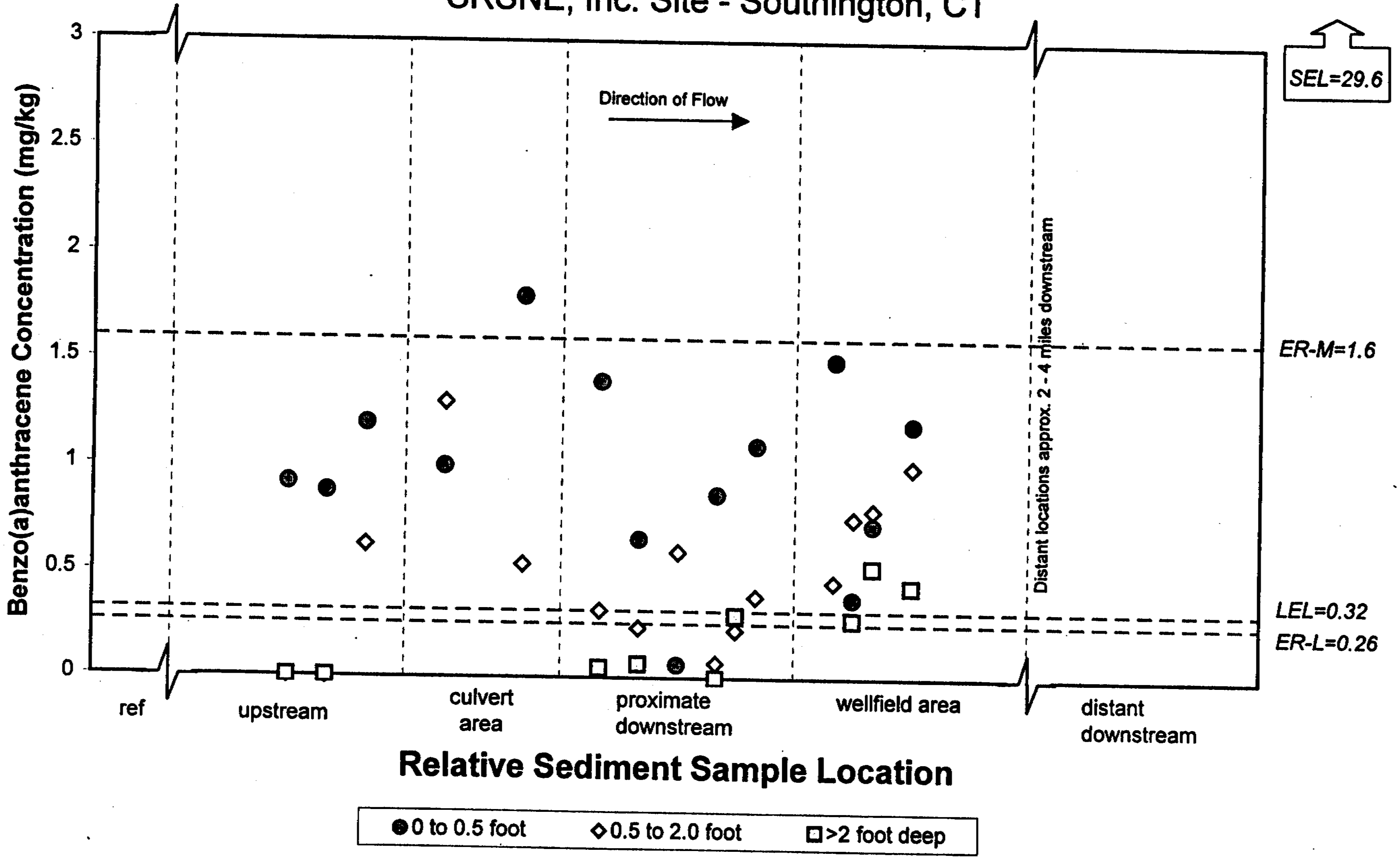


Figure 4B

Sediment (1999 Data Only - All Depths) - Benzo(a)anthracene

SRSNE, Inc. Site - Southington, CT



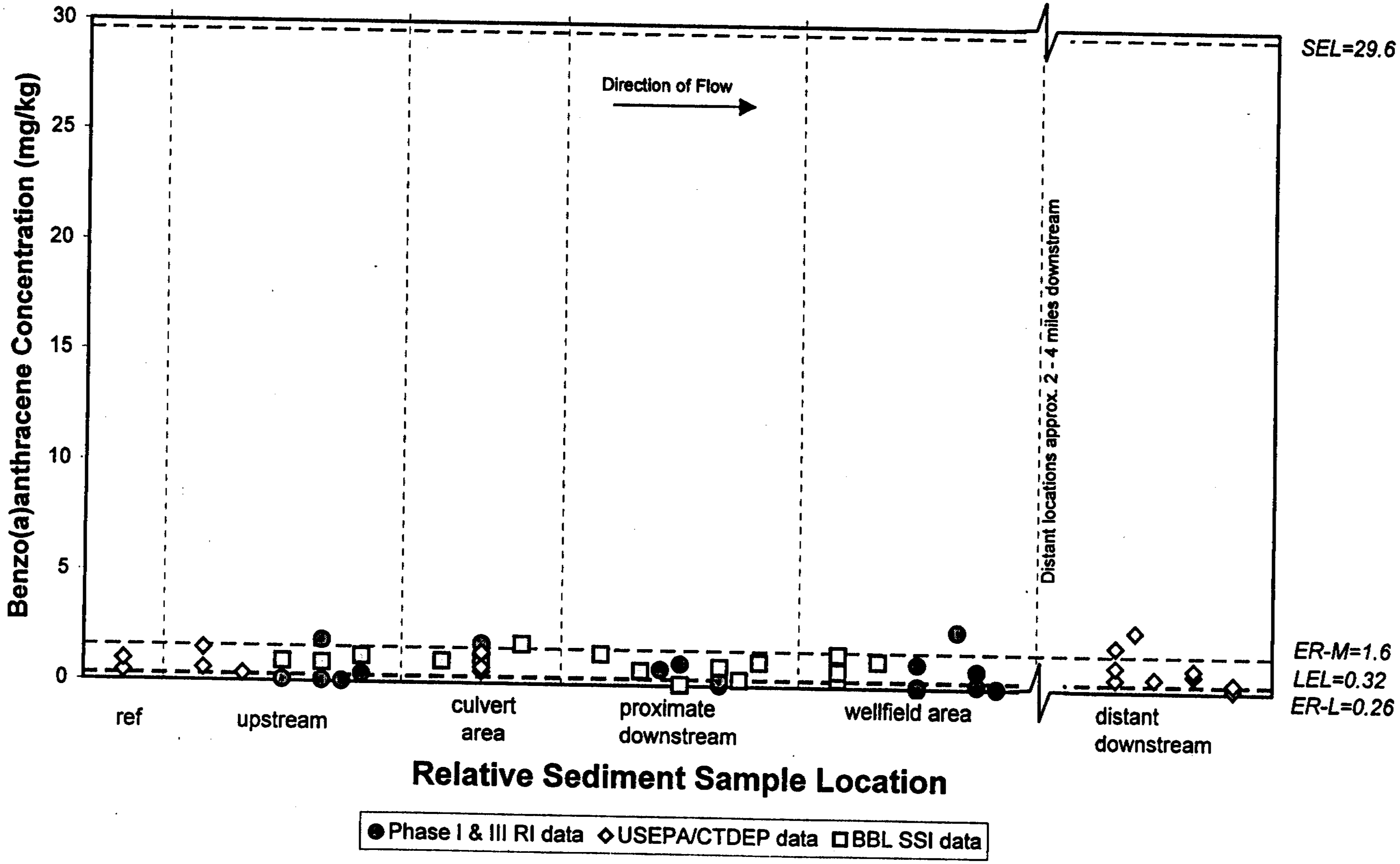


Figure 4C

Sediment (Historical Data - Surficial Only) - Benzo(a)anthracene

SRSNE, Inc. Site - Southington, CT

Figure 4D
Sediment (Historical Data - Surficial Only) - Benzo(a)anthracene
SRSNE, Inc. Site - Southington, CT

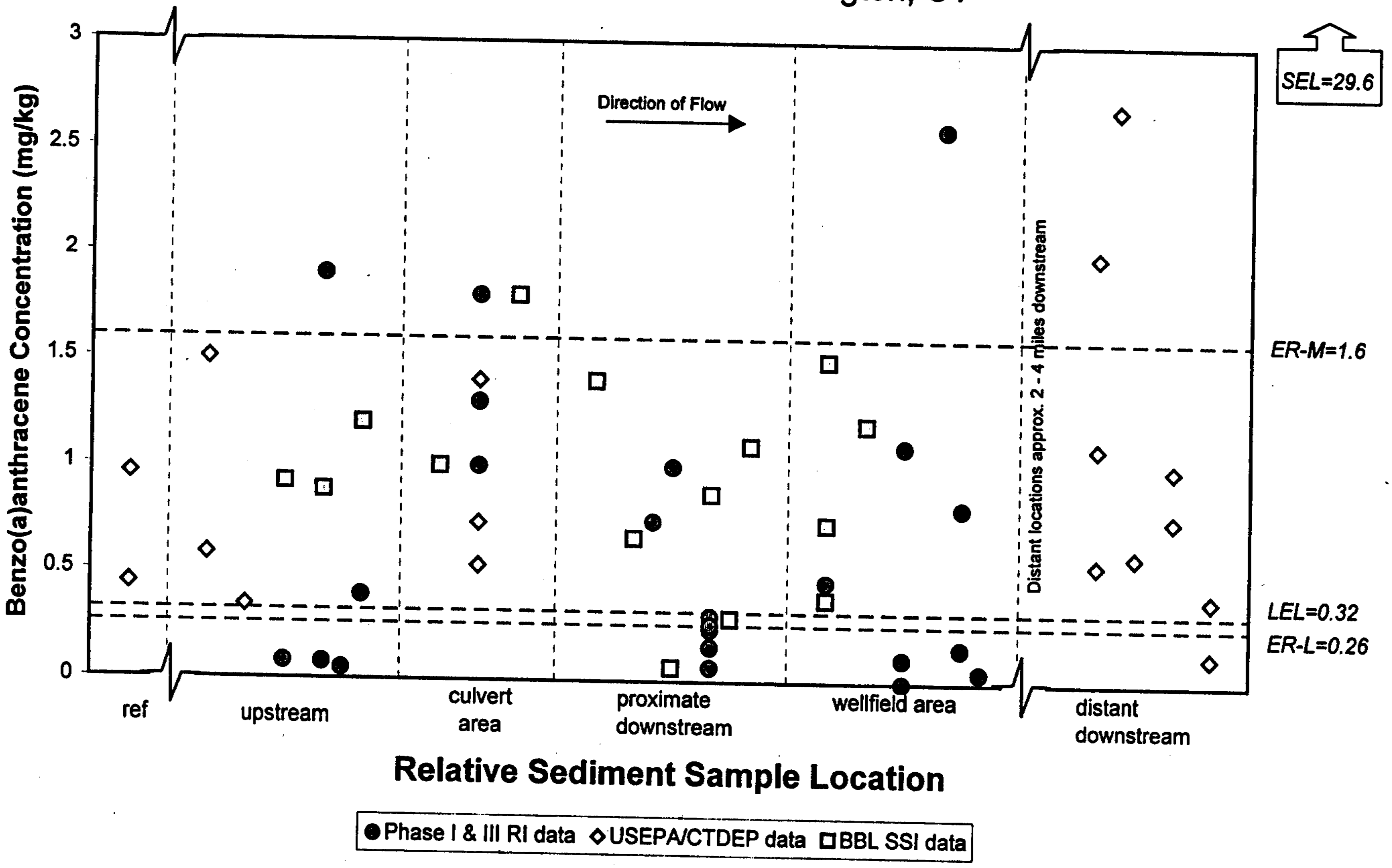


Figure 5A

Sediment (1999 Data Only - All Depths) - Benzo(a)pyrene

SRSNE, Inc. Site - Southington, CT

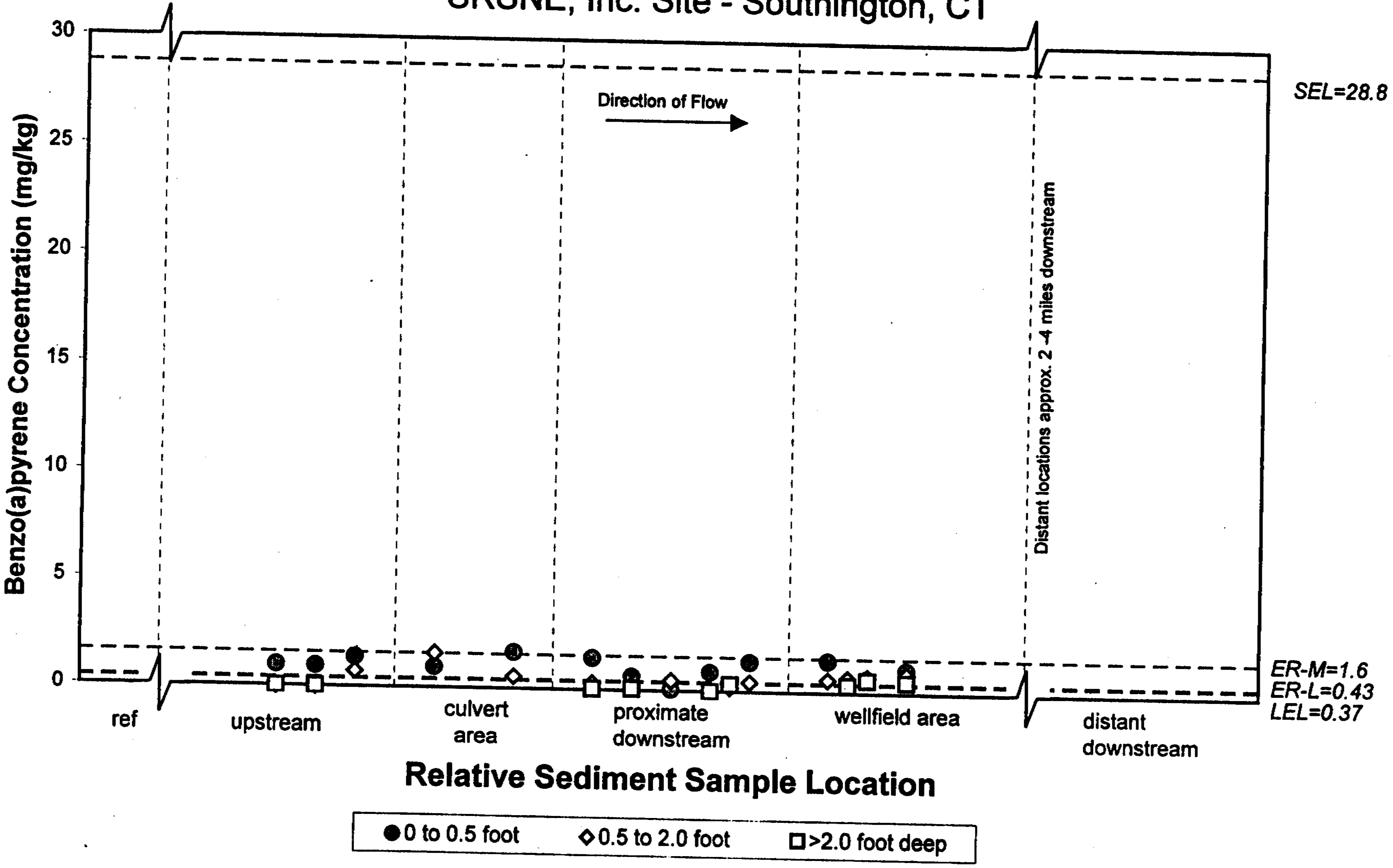


Figure 5B
Sediment (1999 Data Only - All Depths) - Benzo(a)pyrene
SRSNE, Inc. Site - Southington, CT

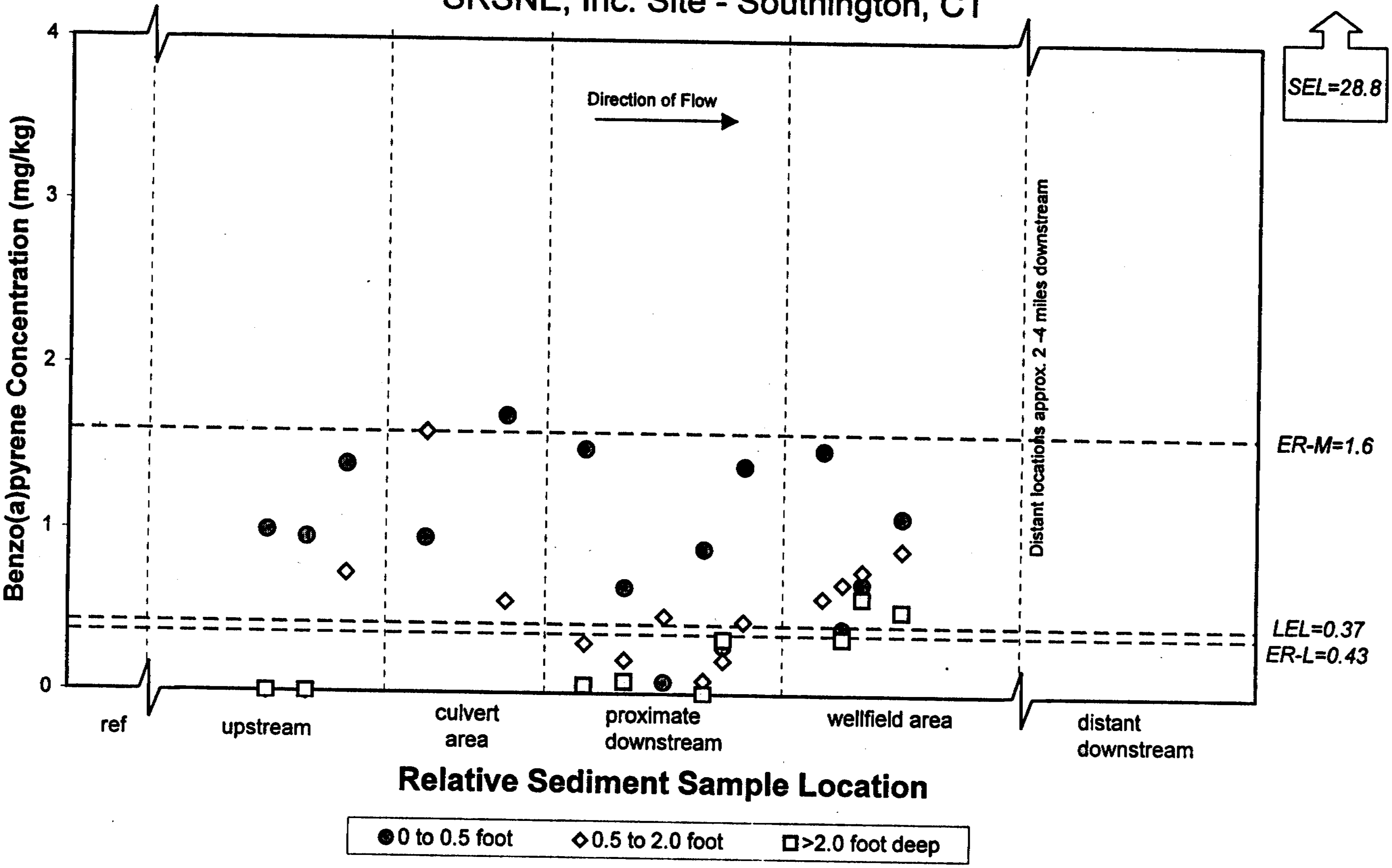


Figure 5C
Sediment (Historical Data - Surficial Only) - Benzo(a)pyrene
SRSNE, Inc. Site - Southington, CT

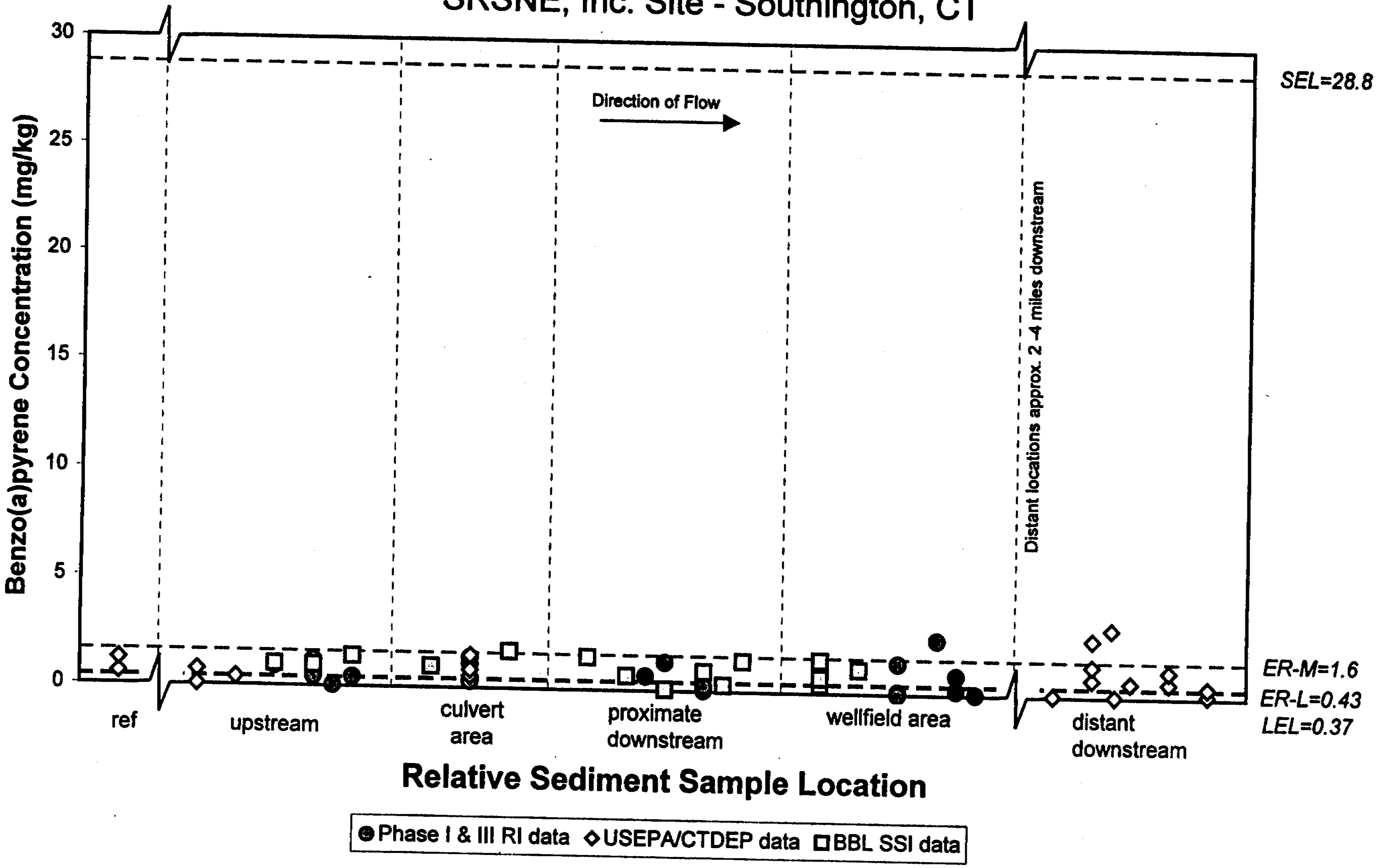


Figure 5D
Sediment (Historical Data - Surficial Only) - Benzo(a)pyrene
SRSNE, Inc. Site - Southington, CT

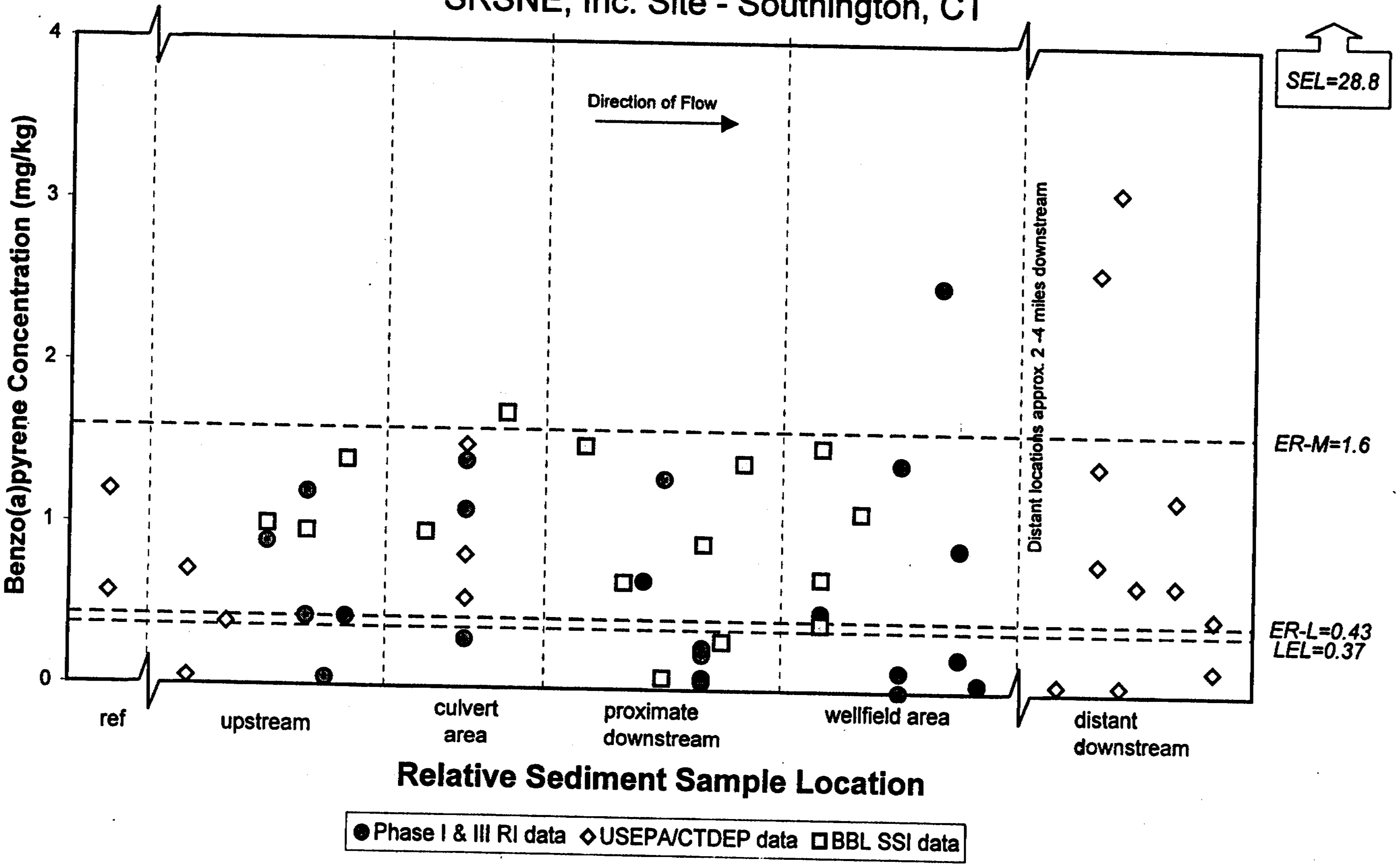


Figure 6A
Sediment (1999 Data Only - All Depths) - Total PAHs
SRSNE, Inc. Site - Southington, CT

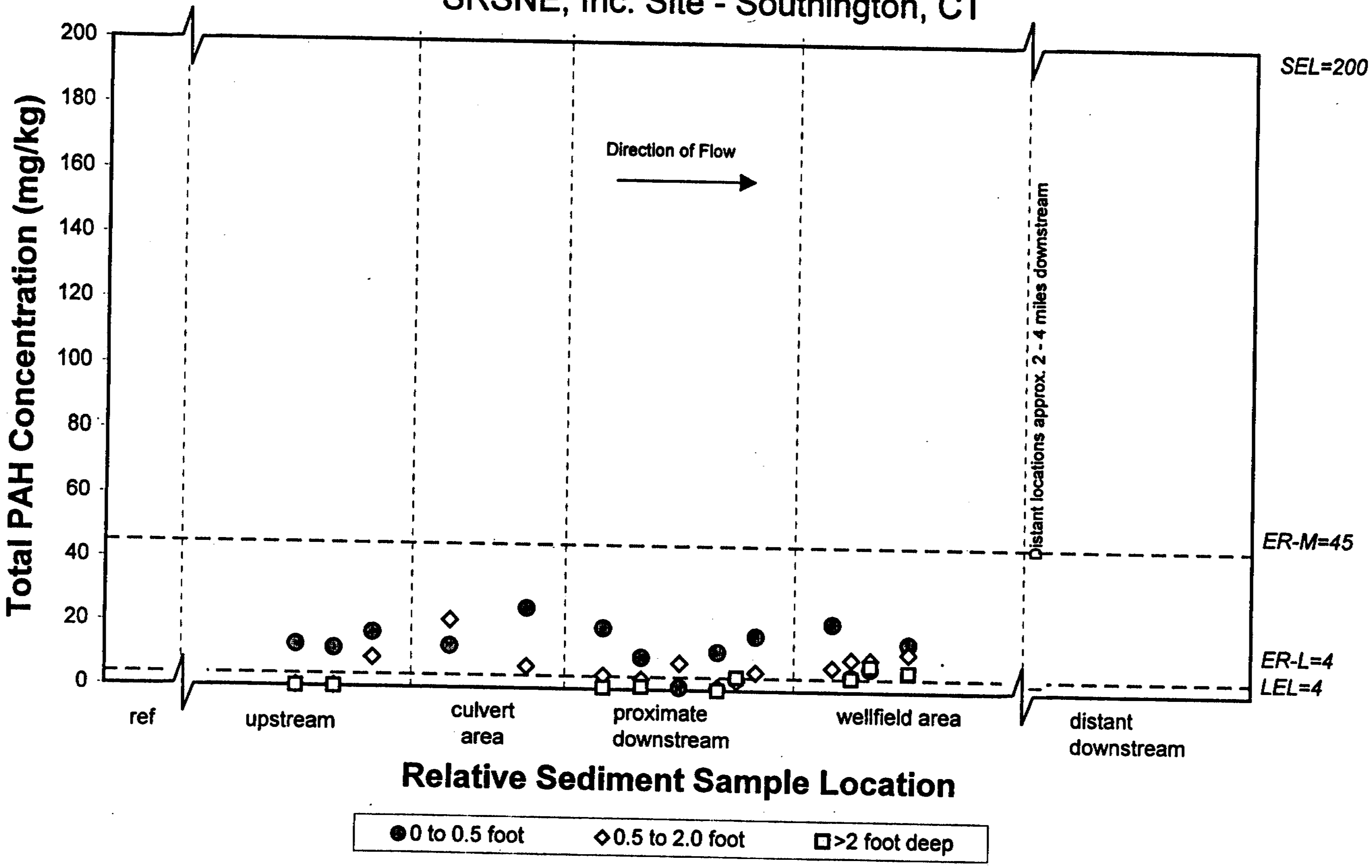


Figure 6B
Sediment (1999 Data Only - All Depths) - Total PAHs
SRSNE, Inc. Site - Southington, CT

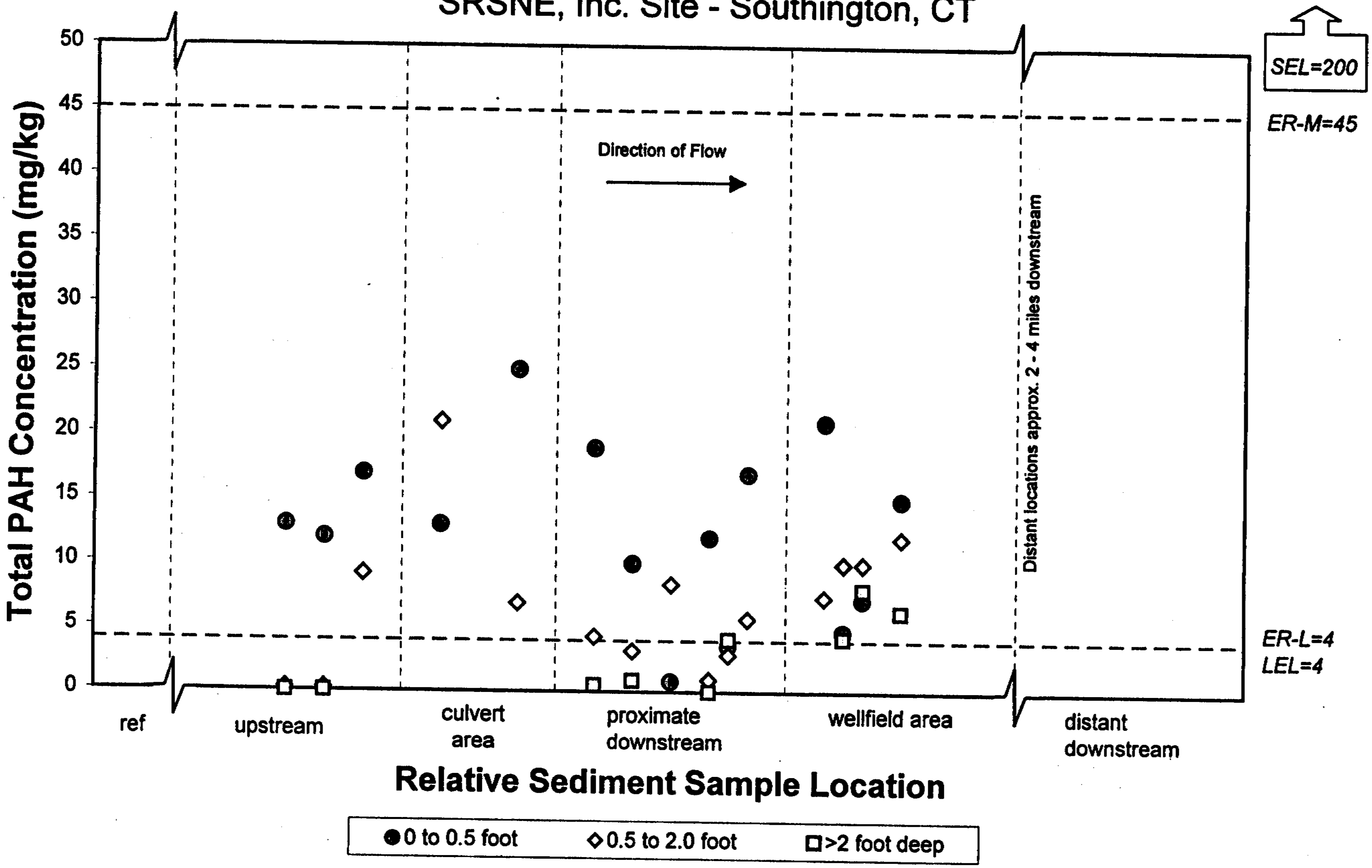


Figure 6C

Sediment (1999 Data Only - All Depths) - Total PAH/TOC

SRSNE, Inc. Site - Southington, CT

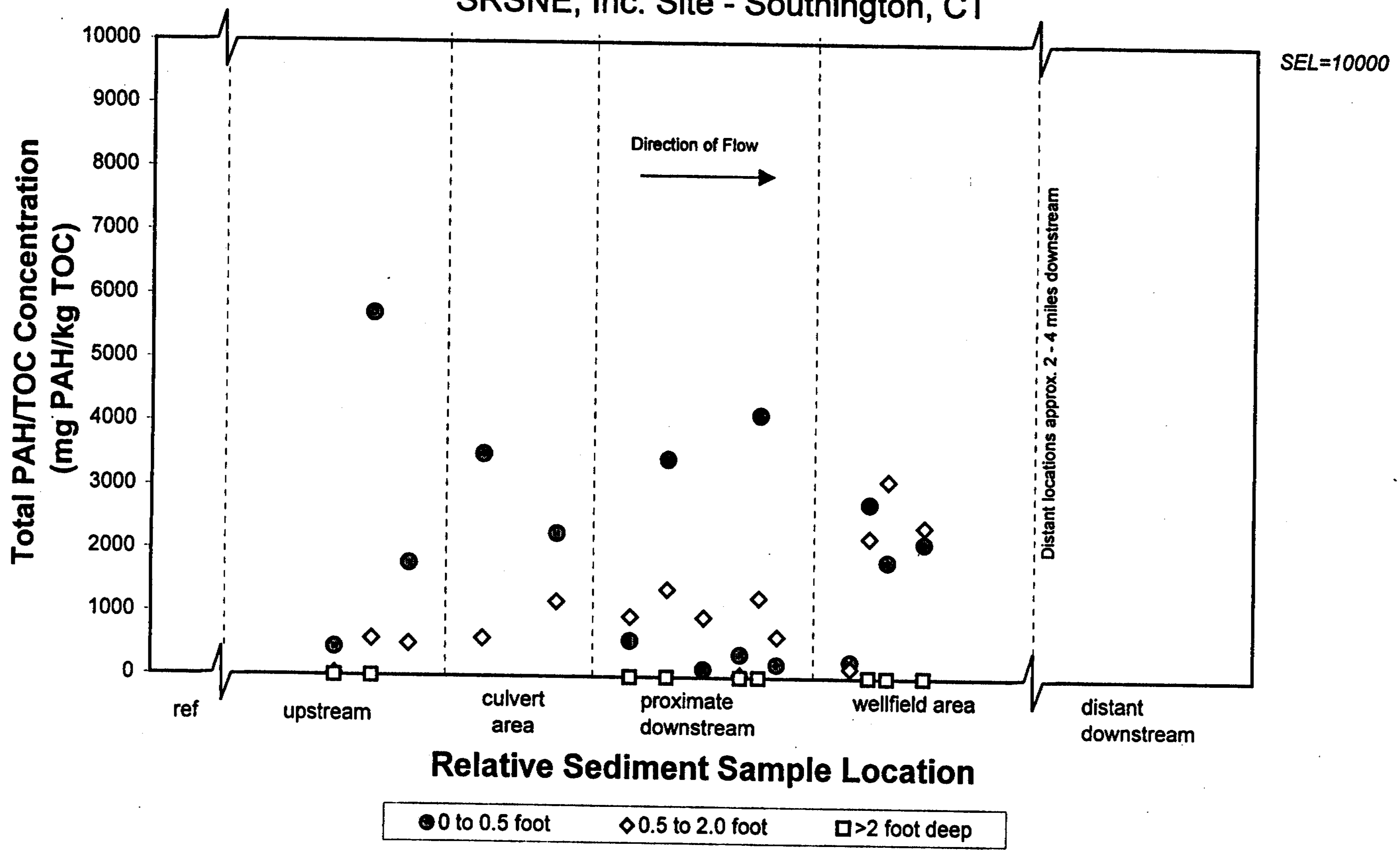


Figure 6D

Sediment (Historical Data - Surficial Only) - Total PAHs

SRSNE, Inc. Site - Southington, CT

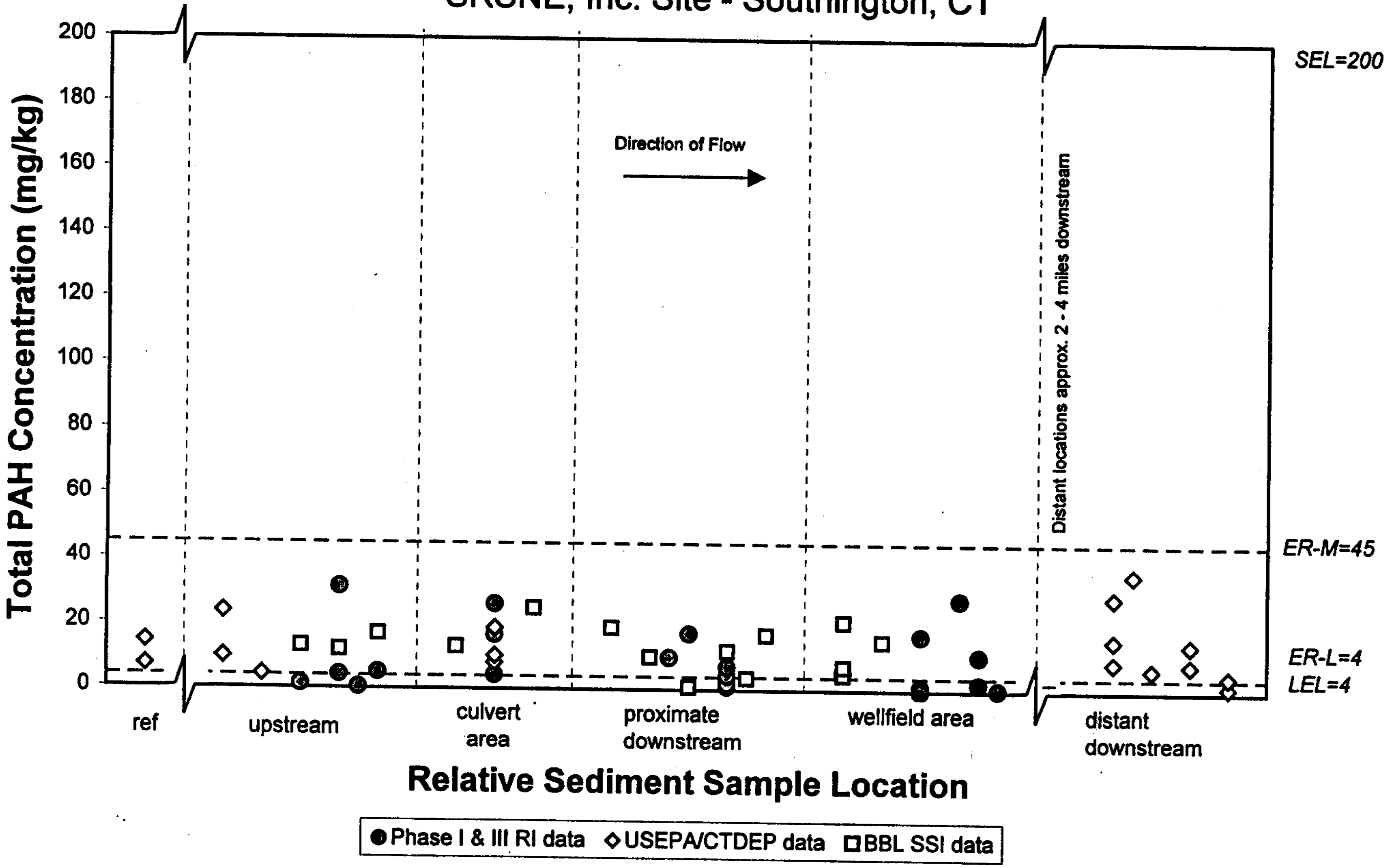


Figure 6E

Sediment (Historical Data - Surficial Only) - Total PAHs

SRSNE, Inc. Site - Southington, CT

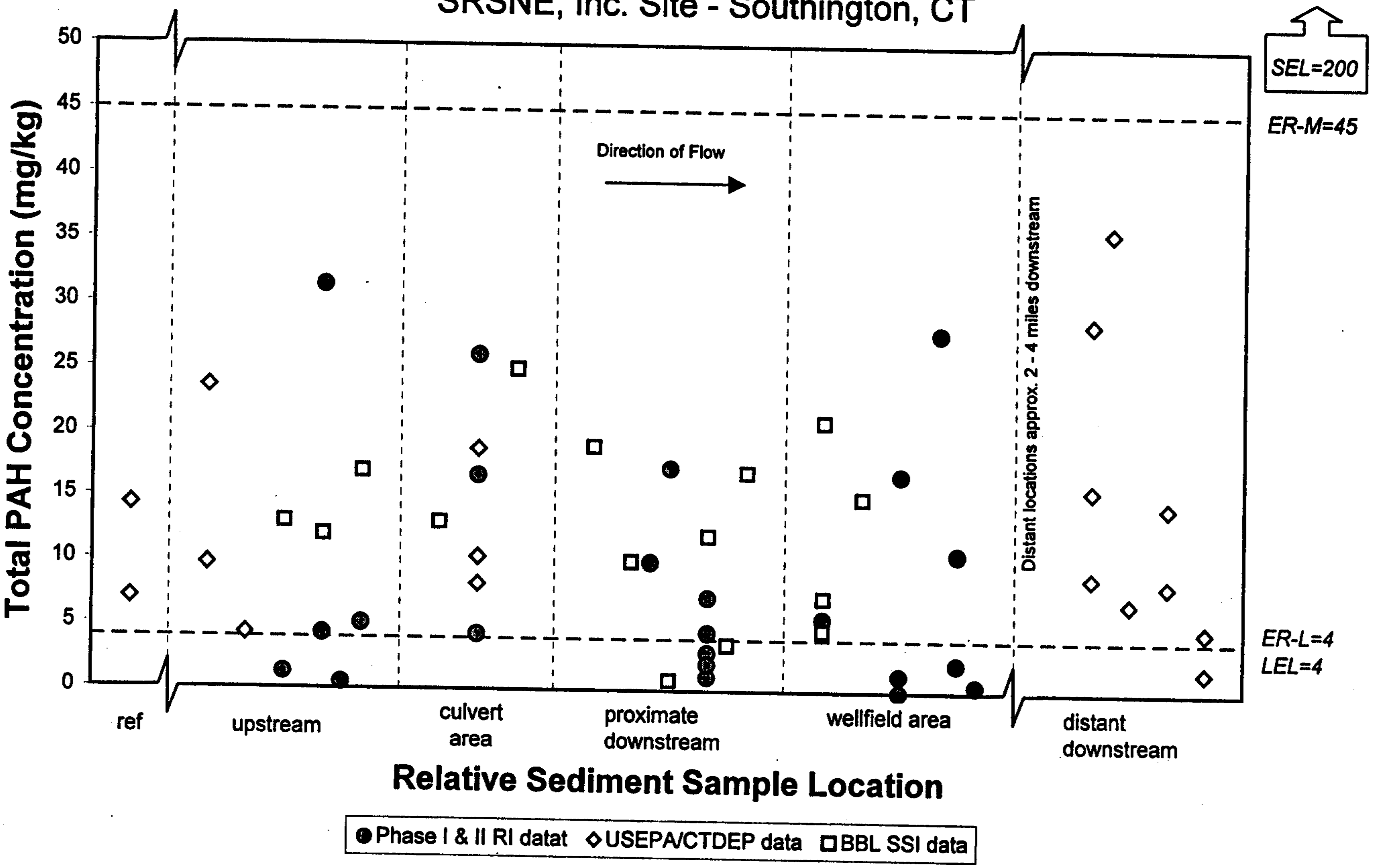


Figure 7A
Sediment (1999 Data Only - All Depths) - bis(2-Ethylhexyl)phthalate
SRSNE, Inc. Site - Southington, CT

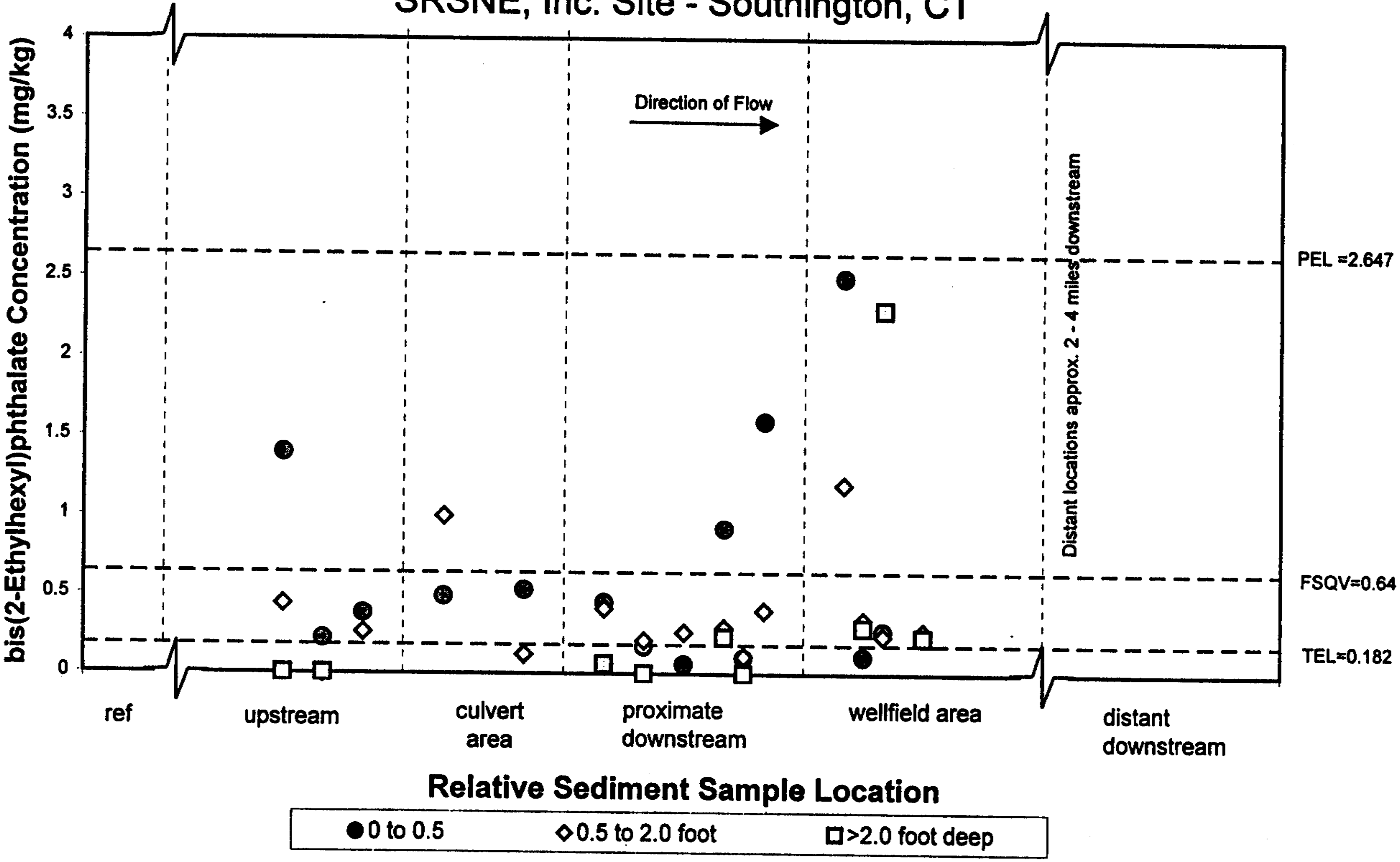


Figure 7B
Sediment (Historical Data - Surficial Only)- bis(2-Ethylhexyl)phthalate
SRSNE, Inc. Site - Southington, CT

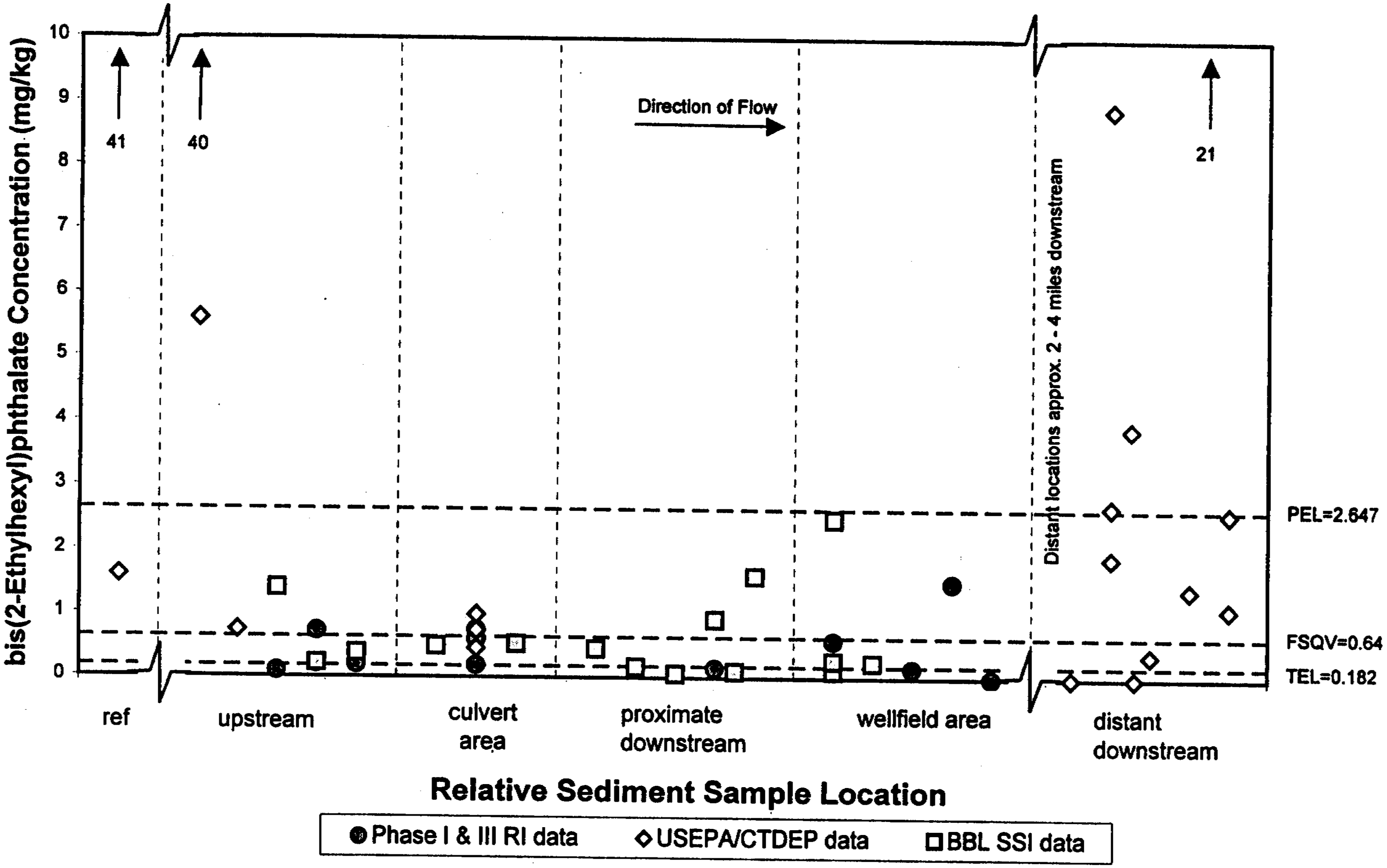


Figure 8A
Sediment (1999 Data Only - All Depths) - PCBs
SRSNE, Inc. Site - Southington, CT

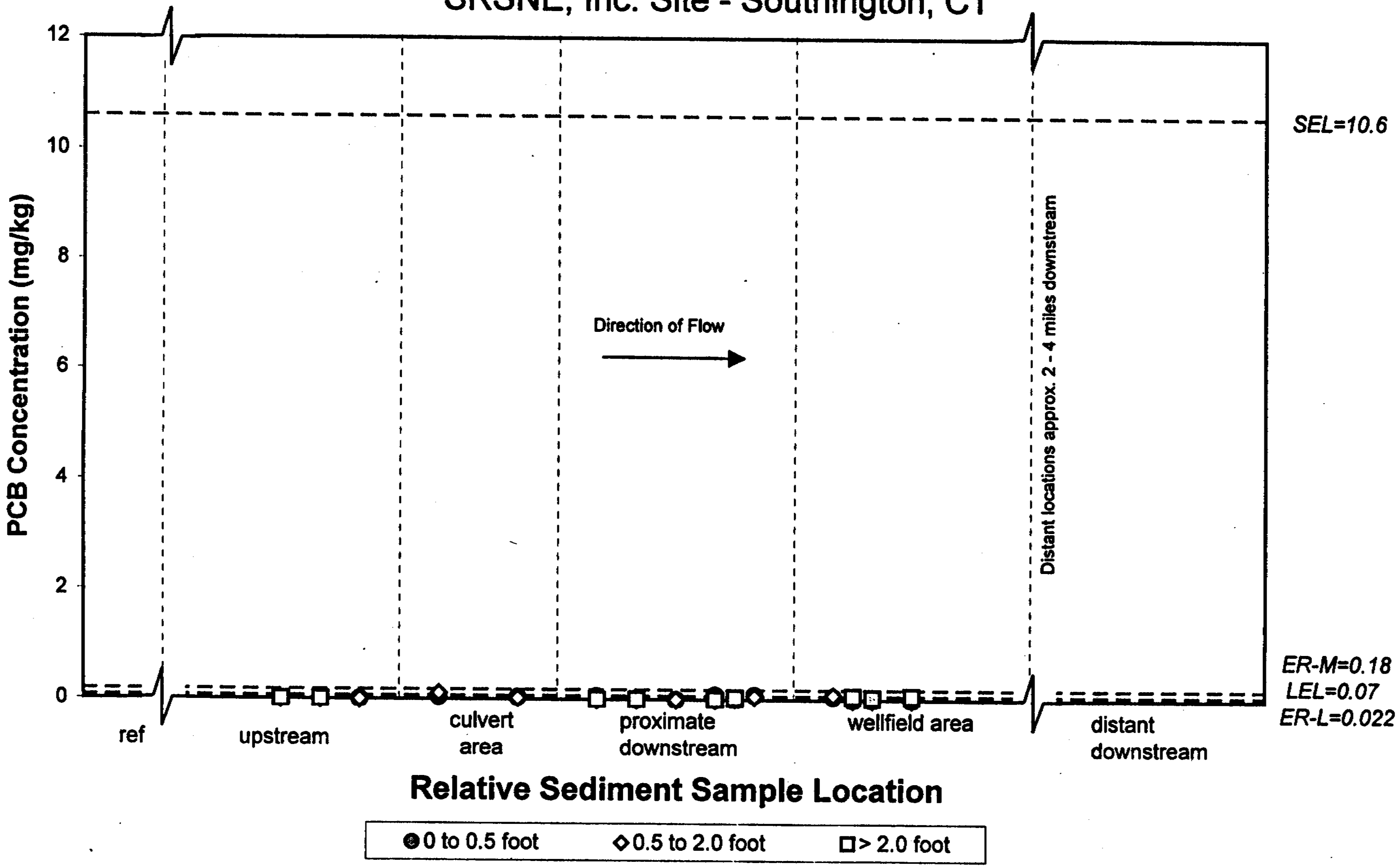


Figure 8B

Sediment (1999 Data Only - All Depths) - PCBs

SRSNE, Inc. Site - Southington, CT

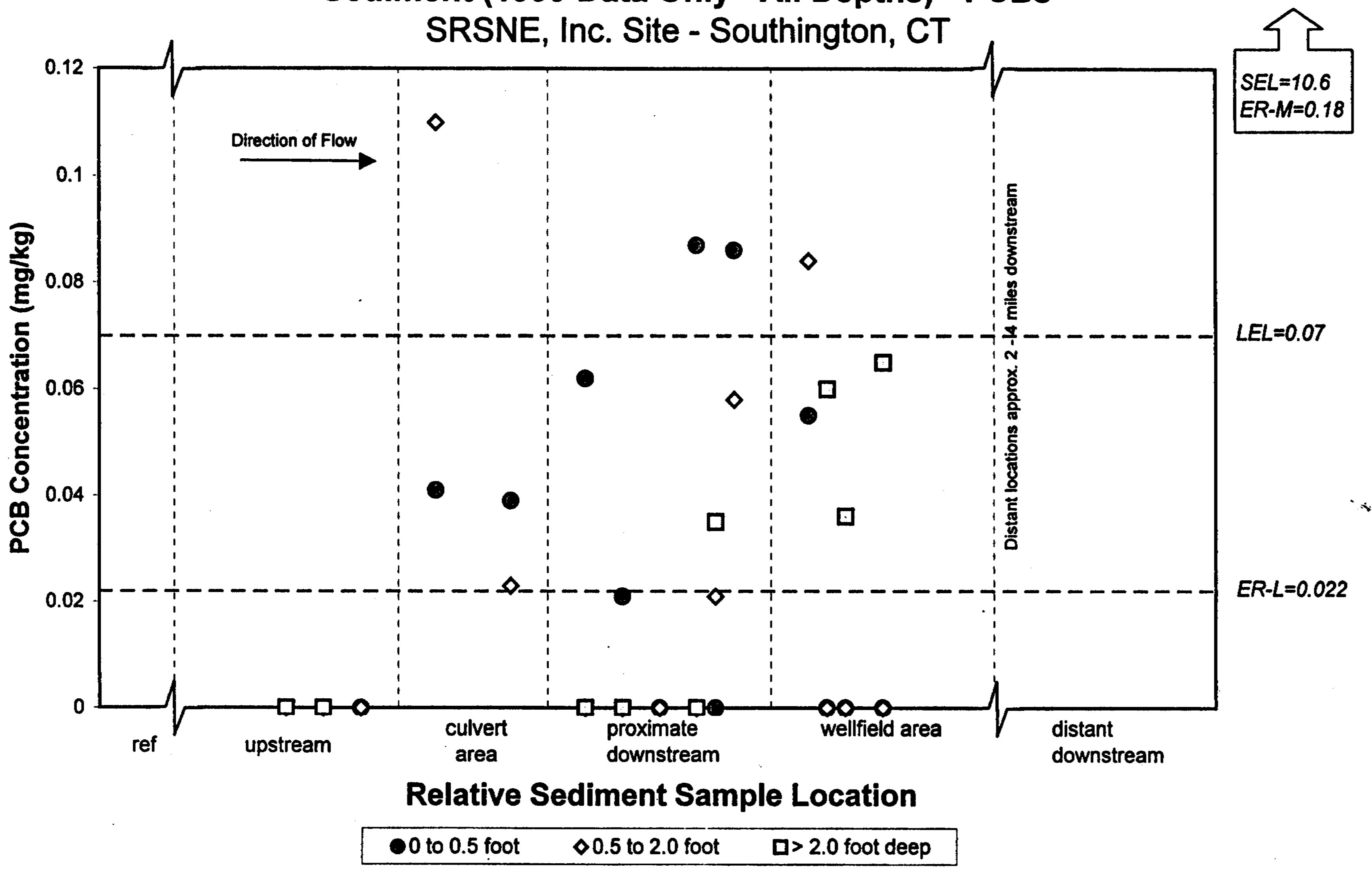


Figure 8C
Sediment (1999 Data Only - All Depths)- PCB/TOC Concentration
SRSNE, Inc. Site - Southington, CT

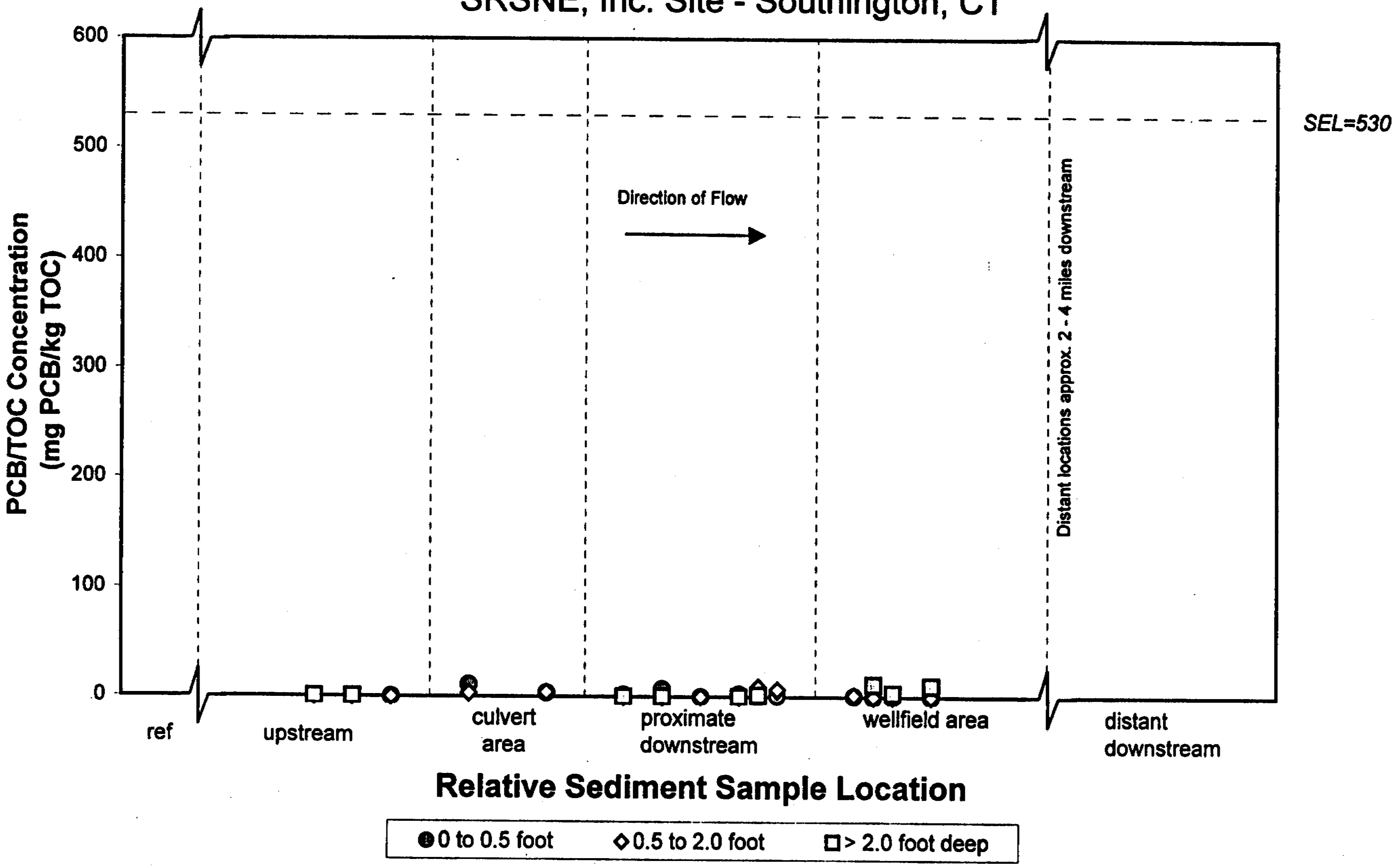


Figure 8D

Sediment (1999 Data Only - All Depths)- PCB/TOC Concentration

SRSNE, Inc. Site - Southington, CT

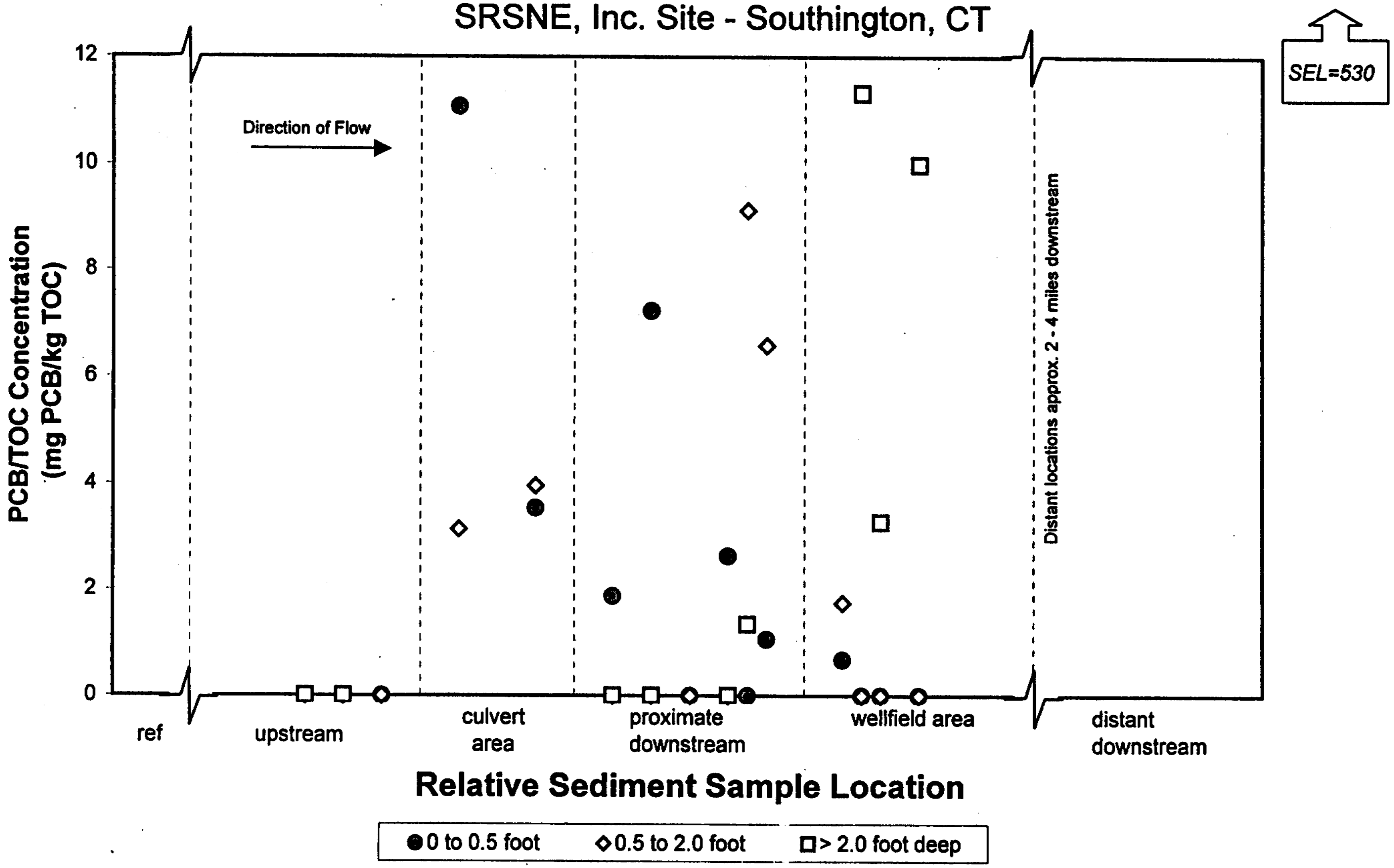


Figure 8E

Sediment (Historical Data - Surficial Only) - PCBs

SRSNE, Inc. Site - Southington, CT

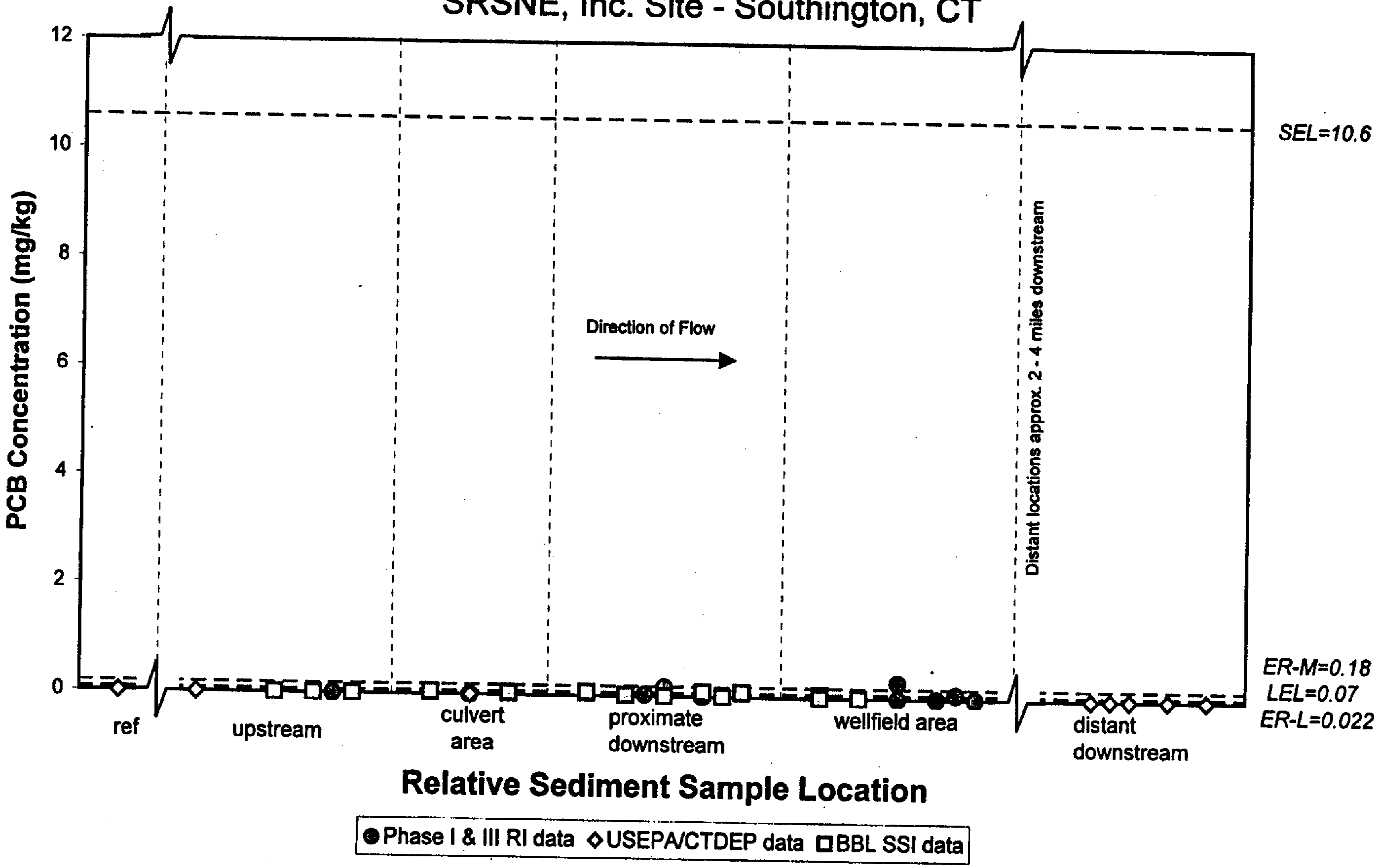


Figure 8F
Sediment (Historical Data - Surficial Only) - PCBs
SRSNE, Inc. Site - Southington, CT

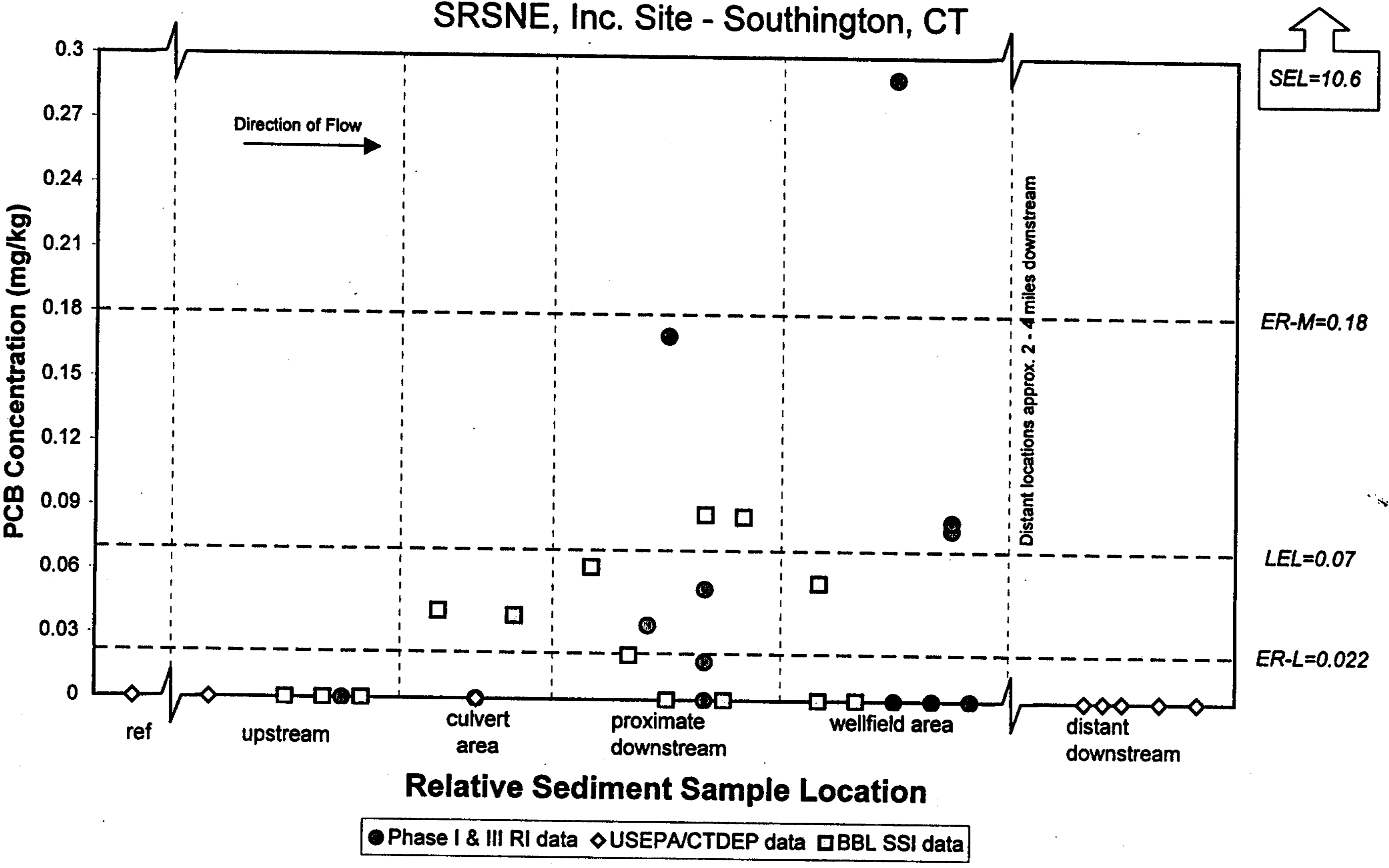


Figure 9A
Sediment (1999 Data Only - All Depths) - Cadmium
SRSNE, Inc. Site - Southington, CT

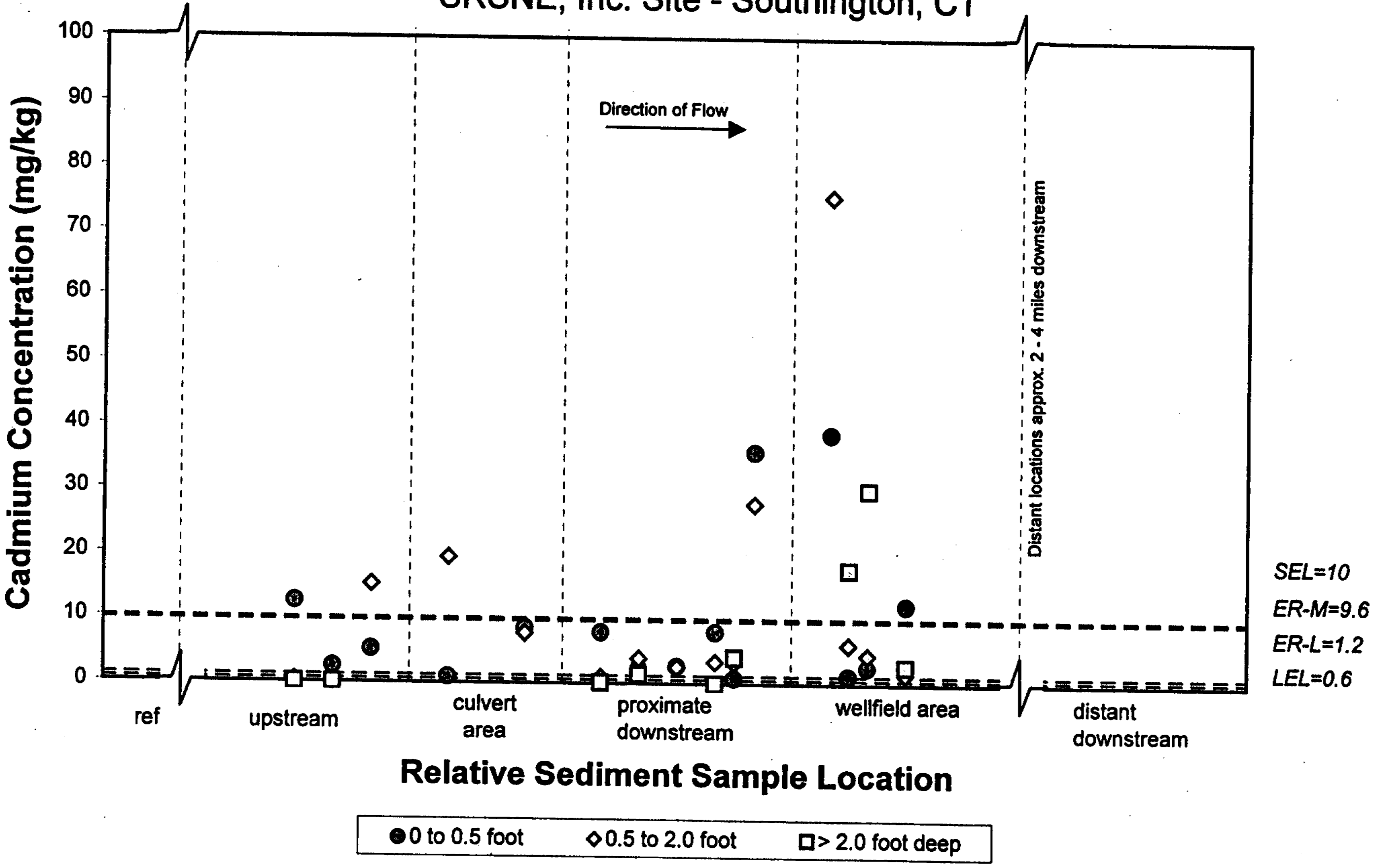


Figure 9B
Sediment (Historical Data - Surficial Only) - Cadmium
SRSNE, Inc. Site - Southington, CT

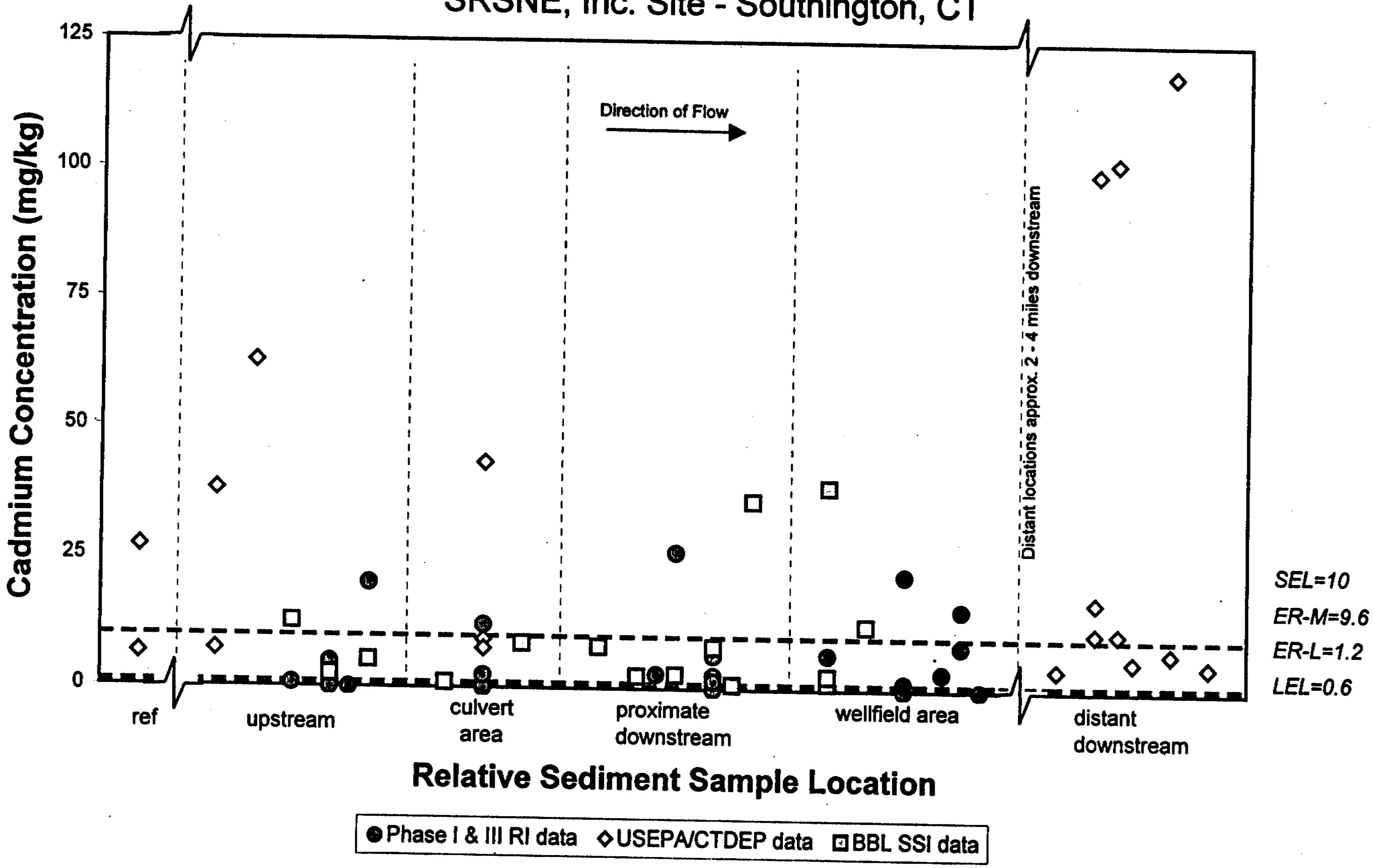


Figure 10A
Sediment (1999 Data Only - All Depths) - Copper
SRSNE, Inc. Site - Southington, CT

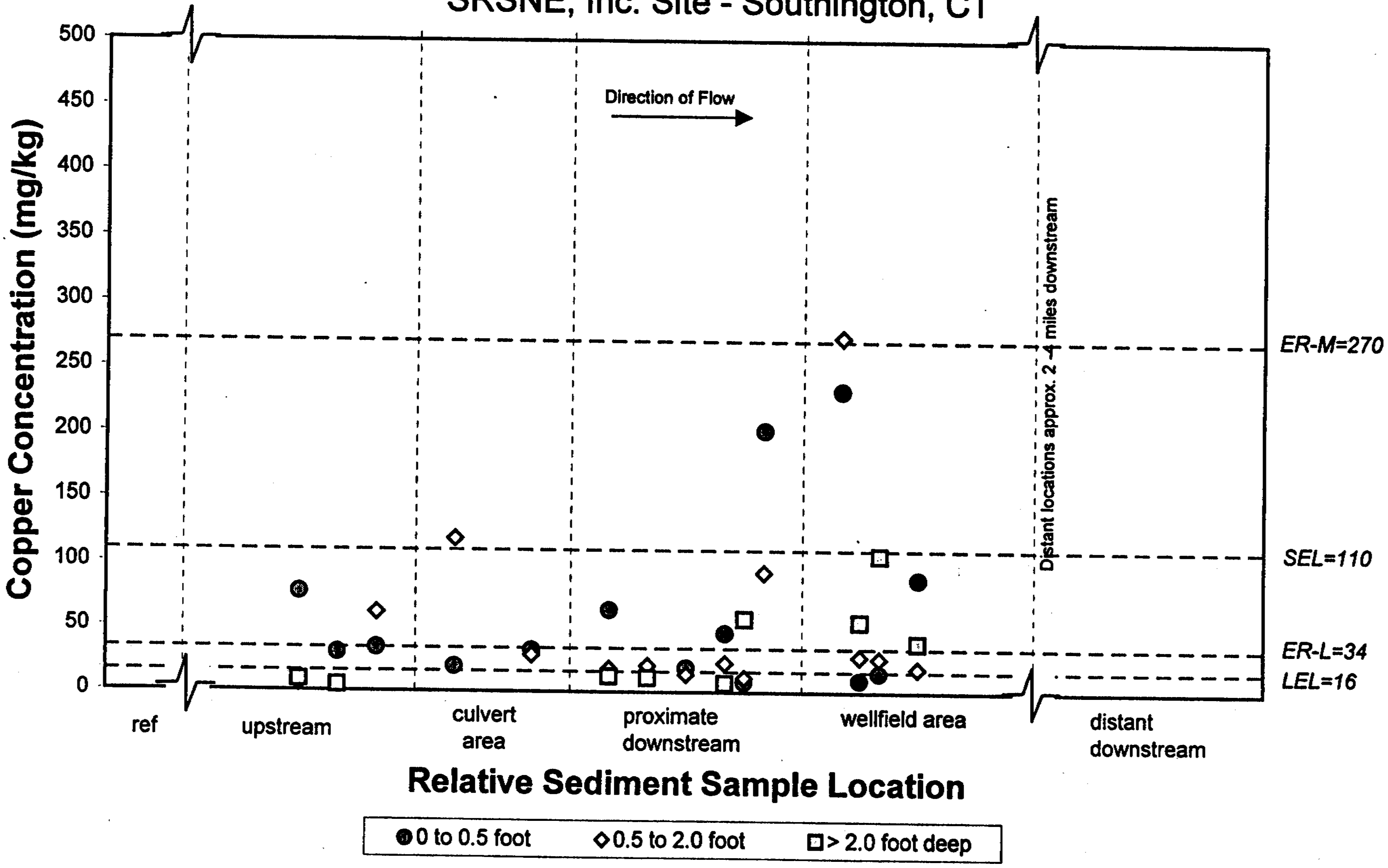


Figure 10B
Sediment (Historical Data - Surficial Only) - Copper
SRSNE, Inc. Site - Southington, CT

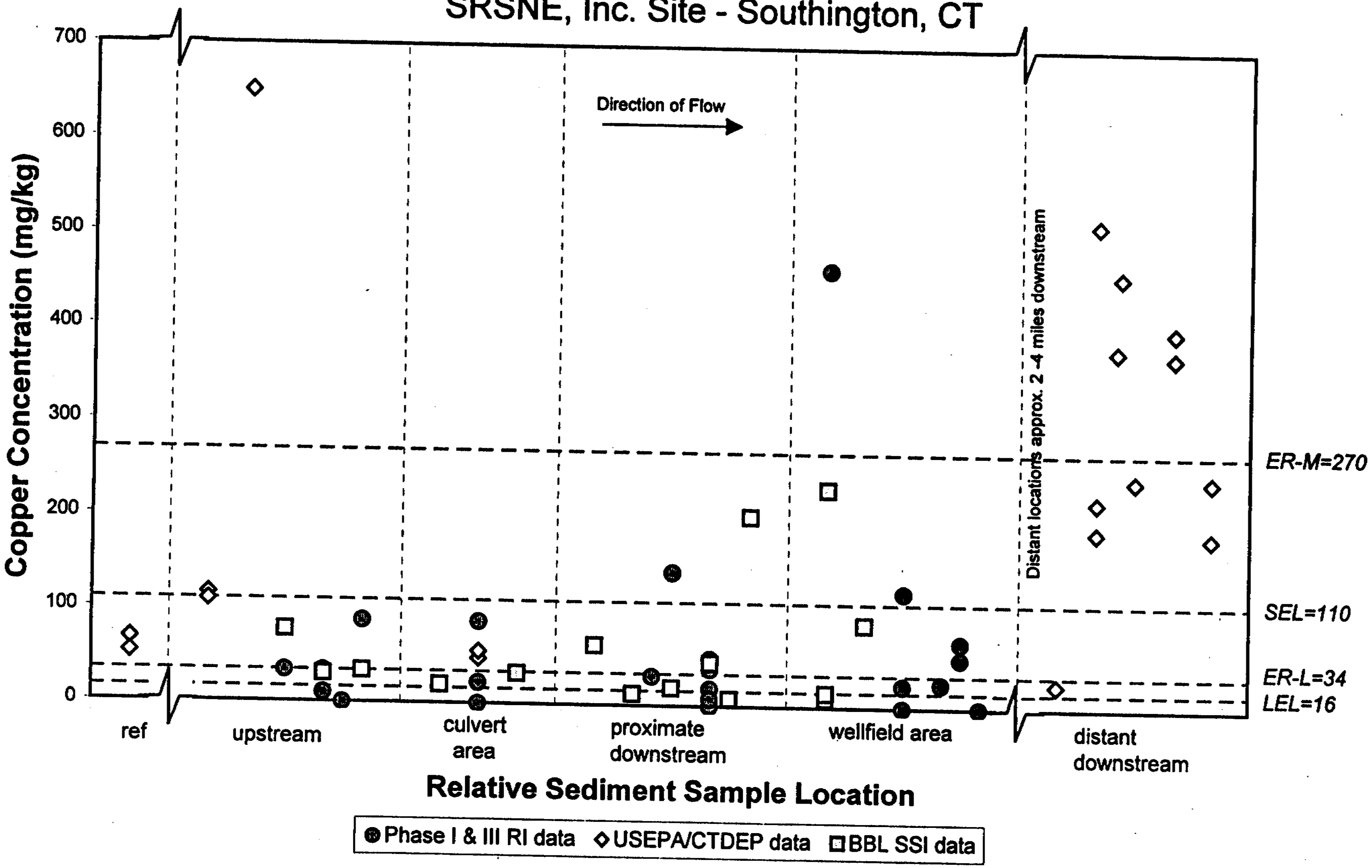


Figure 11A
Sediment (1999 Data Only - All Depths) - Lead
SRSNE, Inc. Site - Southington, CT

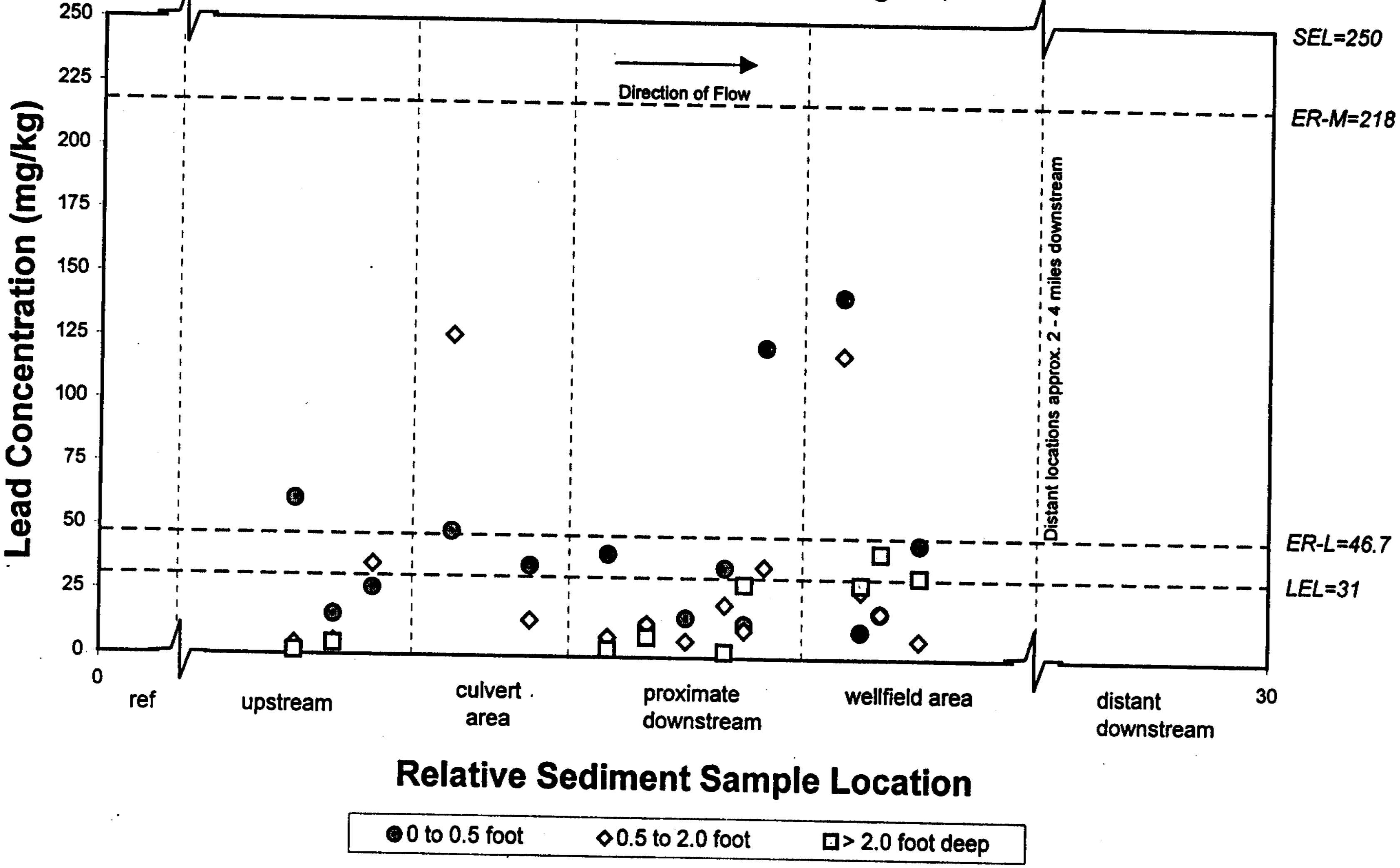


Figure 11B

Sediment (Historical Data - Surficial Only) - Lead

SRSNE, Inc. Site - Southington, CT

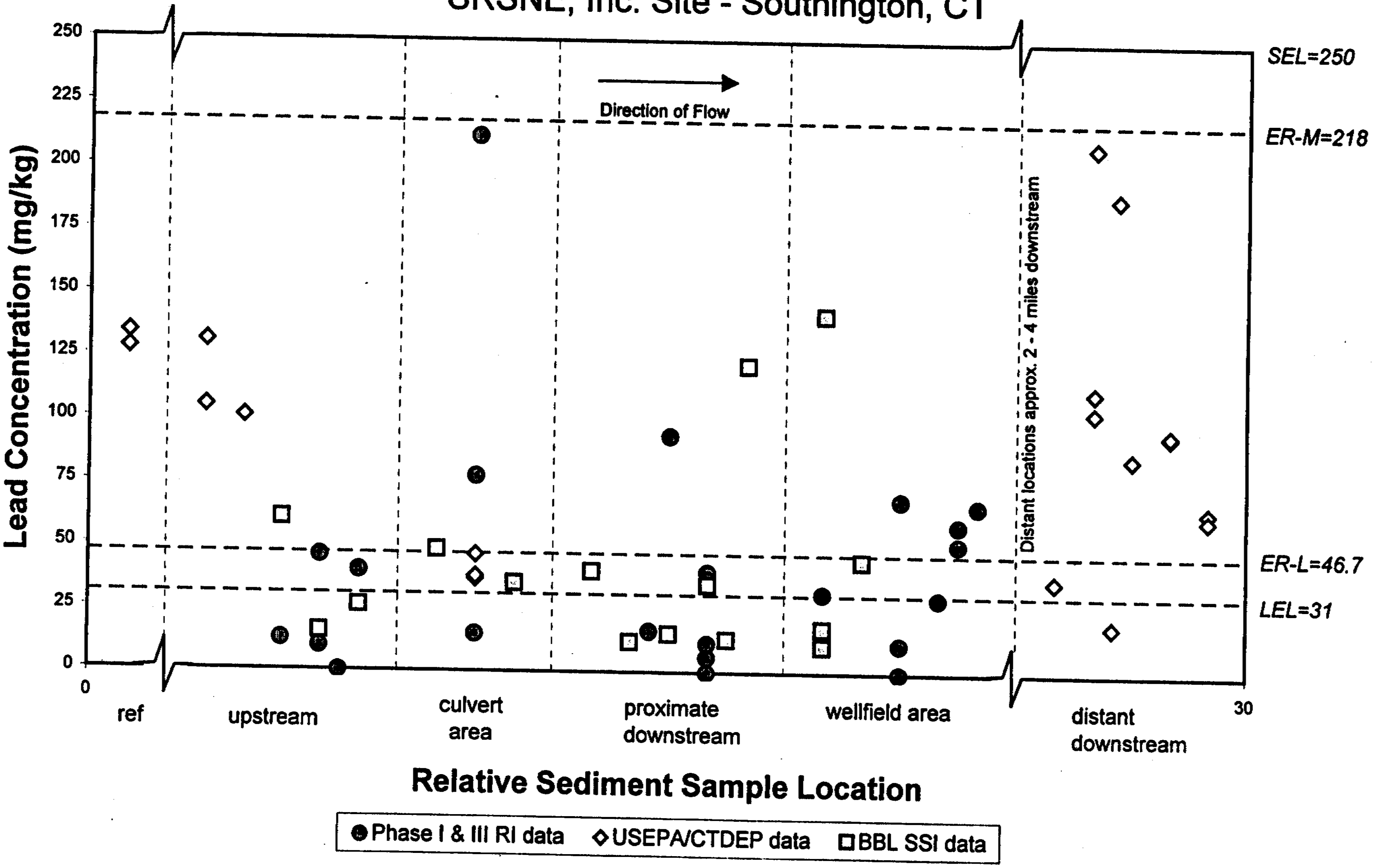


Figure 12A
Sediment (1999 Data Only - All Depths)- Mercury
SRSNE, Inc. Site - Southington, CT

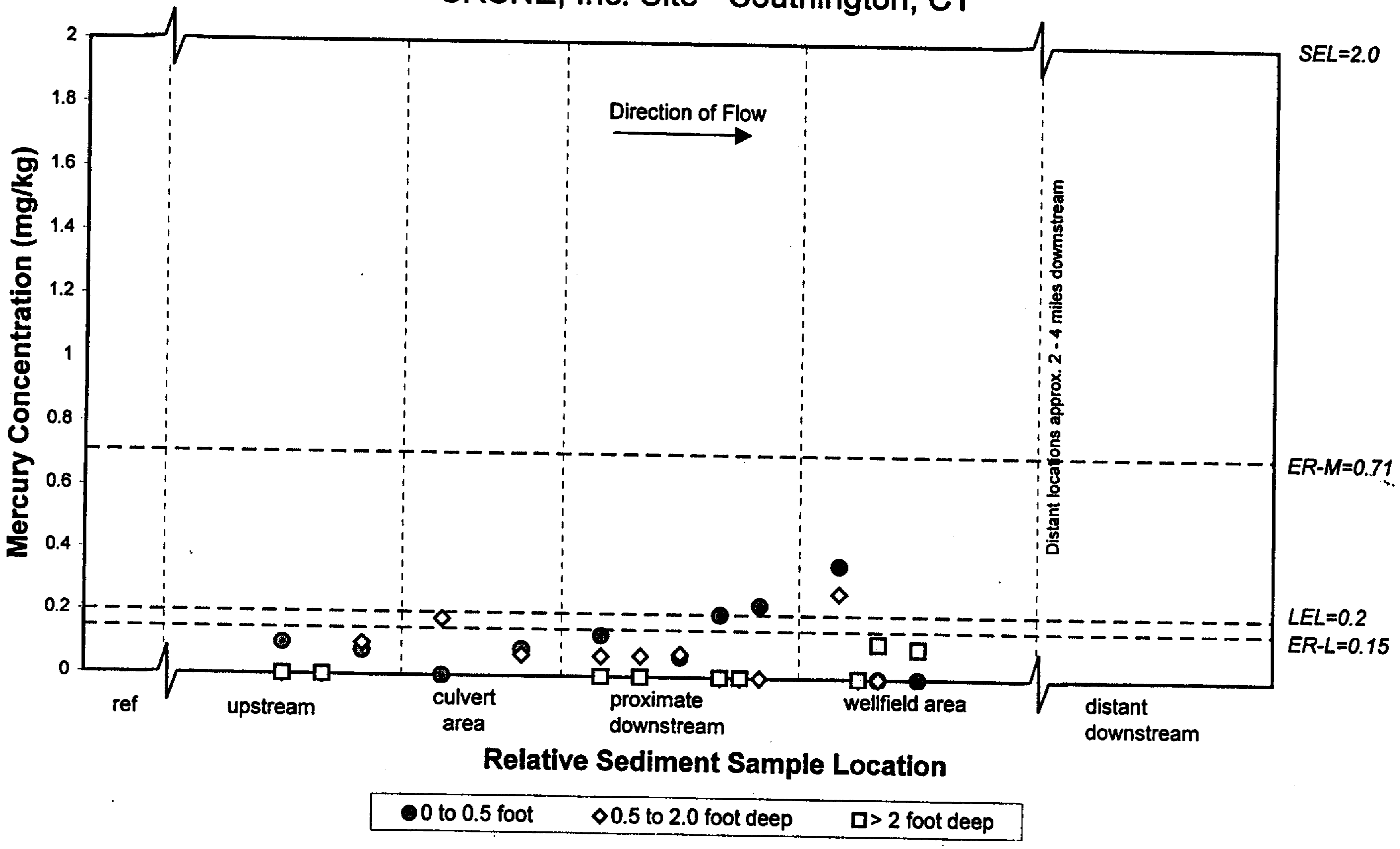


Figure 12B
Sediment (1999 Data Only - All Depths) - Mercury
SRSNE, Inc. Site - Southington, CT

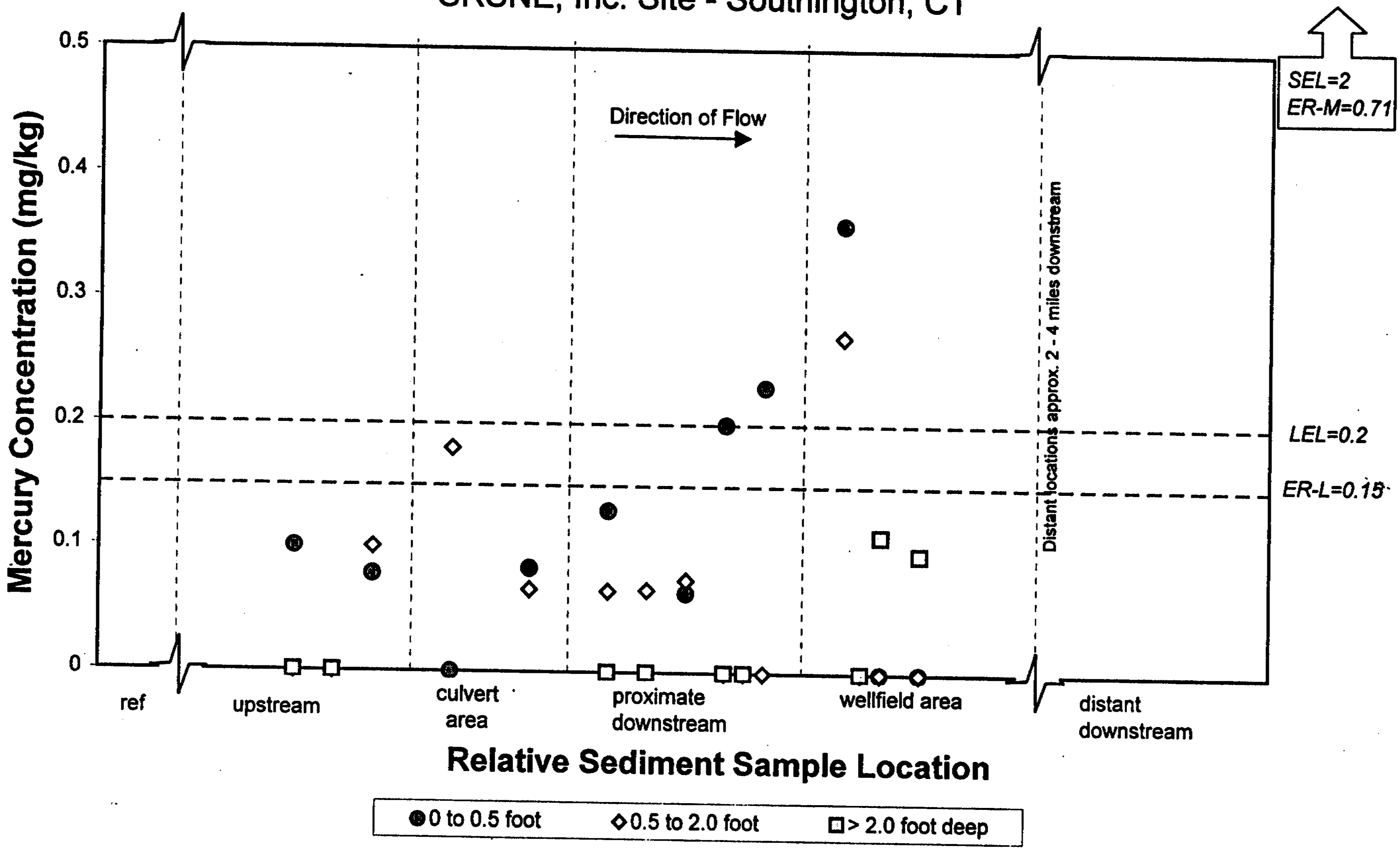


Figure 12C
Sediment (Historical Data - Surficial Only) - Mercury
SRSNE, Inc. Site - Southington, CT

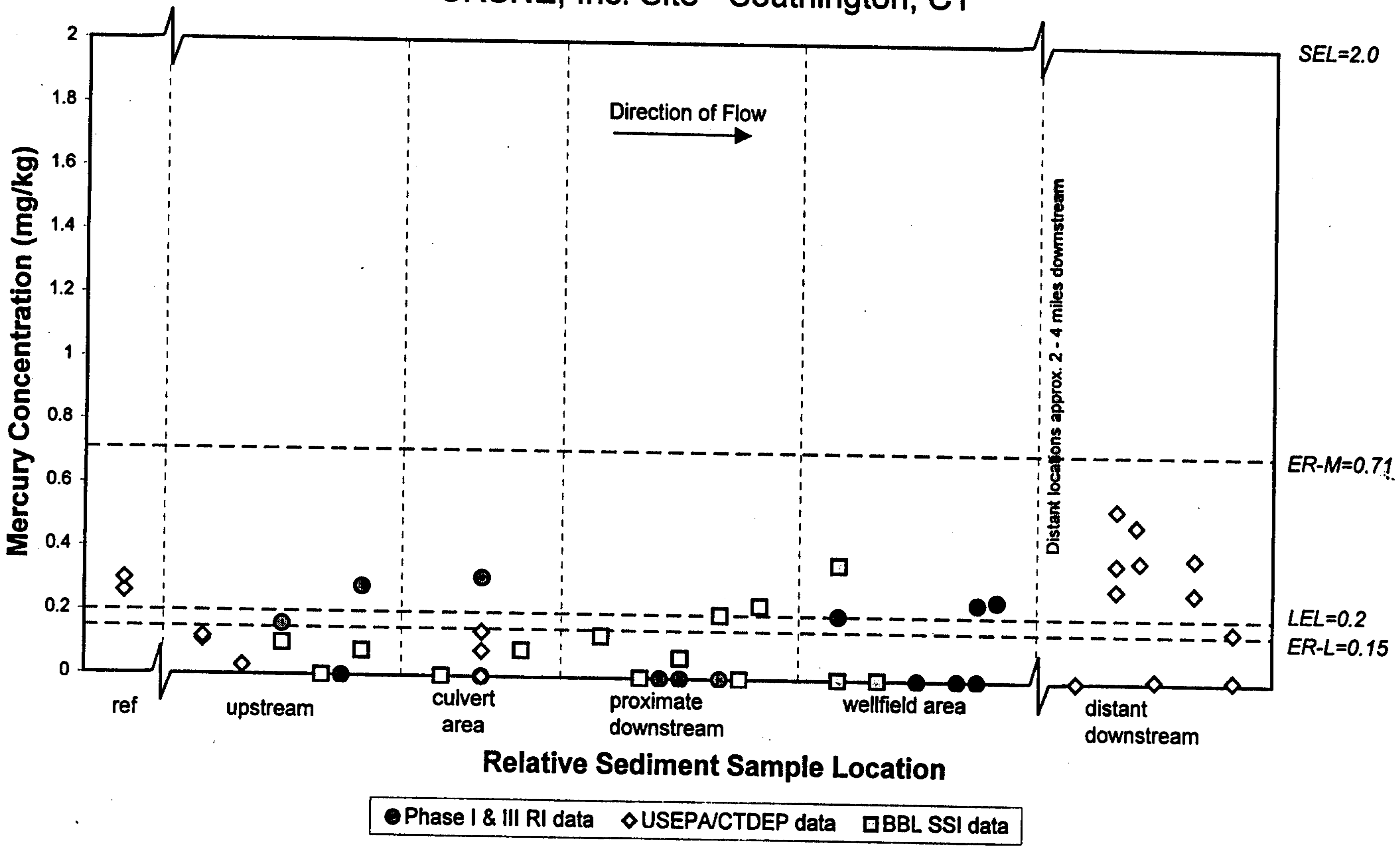


Figure 12D
Sediment (Historical Data - Surficial Only) - Mercury
SRSNE, Inc. Site - Southington, CT

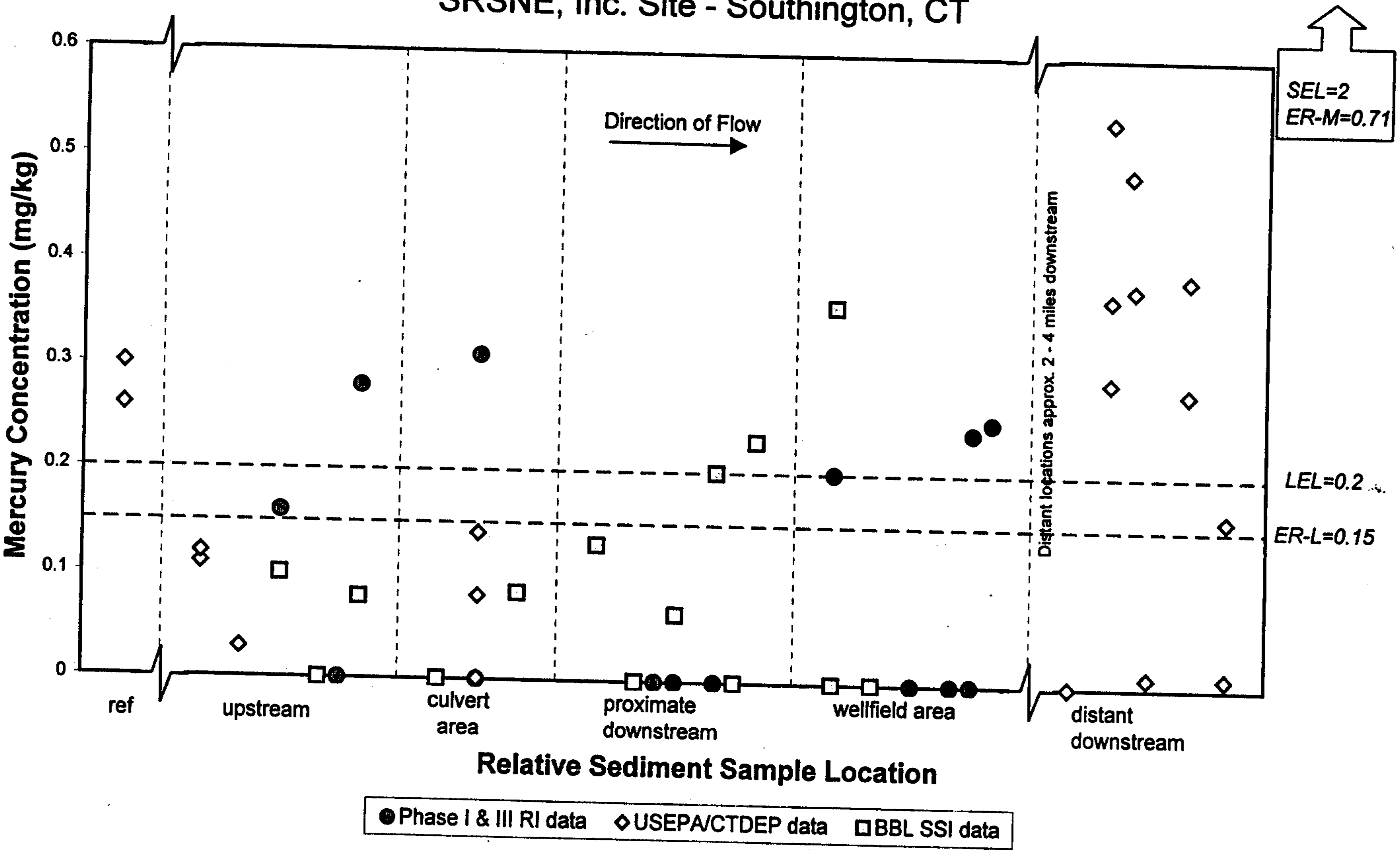


Figure 13A

Sediment (1999 Data Only - All Depths) - Zinc

SRSNE, Inc. Site - Southington, CT

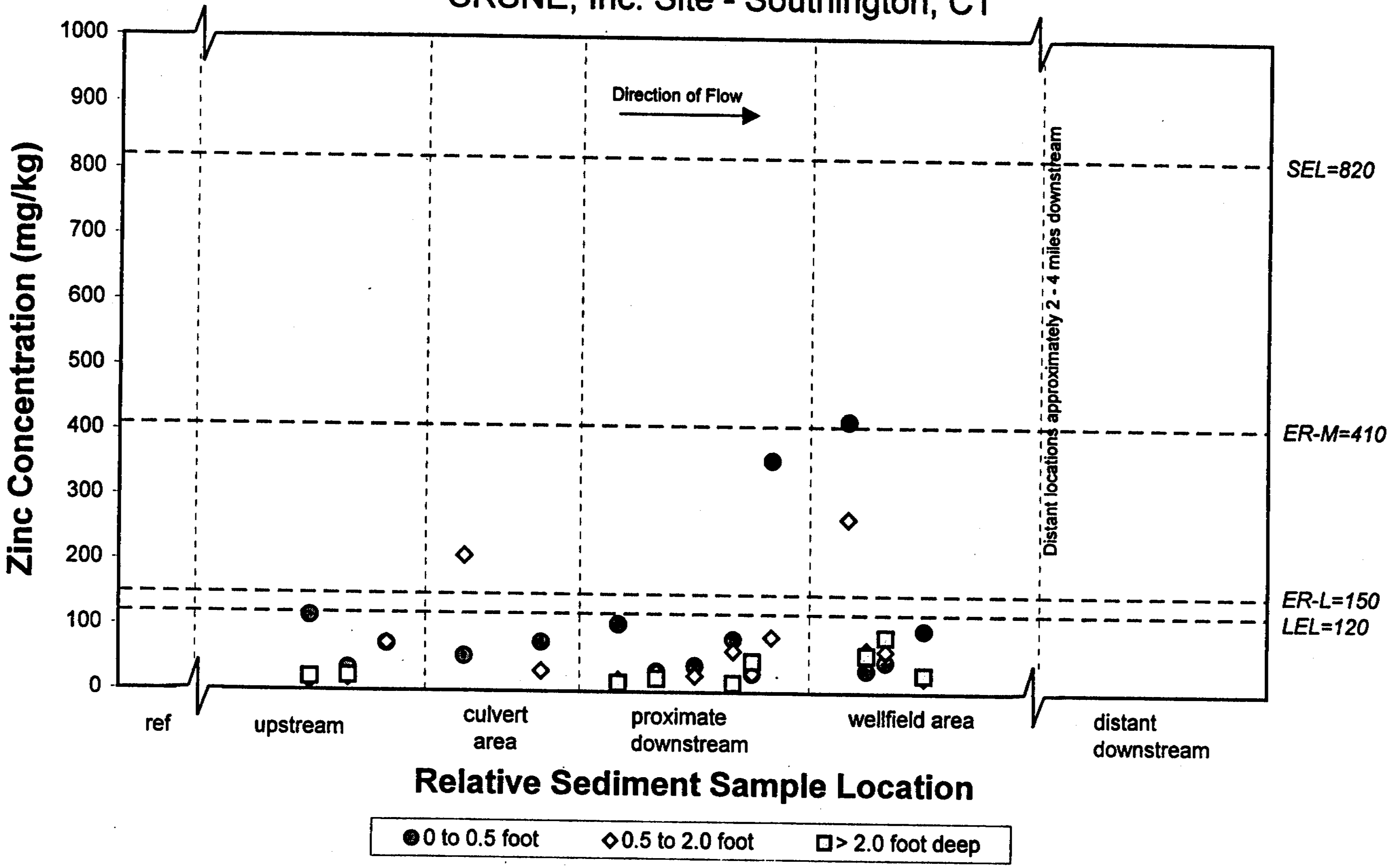
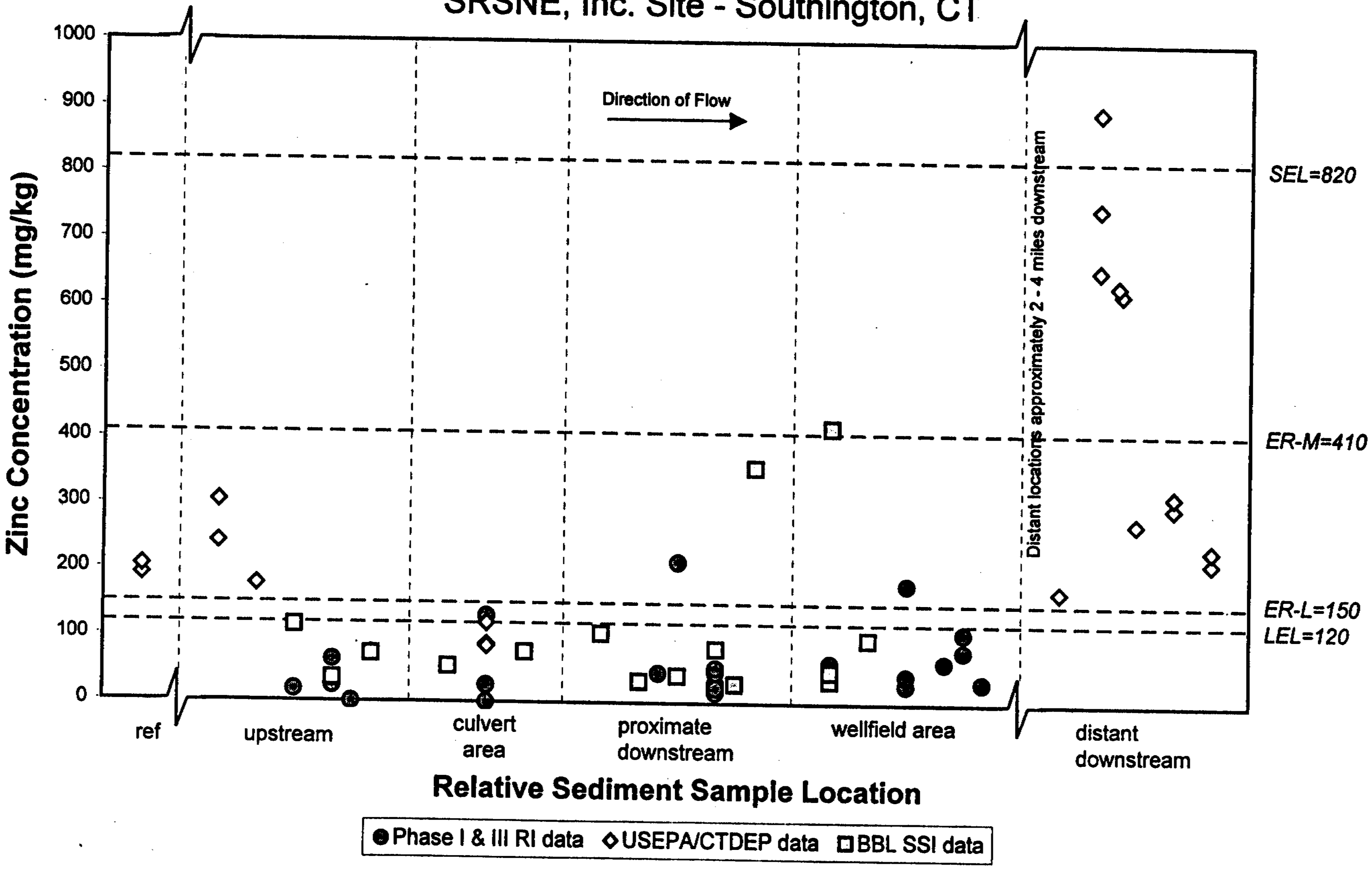


Figure 13B
Sediment (Historical Data - Surficial Only) - Zinc
SRSNE, Inc. Site - Southington, CT



ATTACHMENTS

ATTACHMENT K – 1

Sediment Sampling Work Plan

Sediment Sampling Work Plan

SRSNE Site
Southington, Connecticut

1. Introduction

This work plan describes the proposed sediment sampling to be conducted in the Quinnipiac River adjacent to the Solvent Recovery Services of New England (SRSNE) Site in Southington, Connecticut. The proposed sediment sampling plan is based on discussions with the United States Environmental Protection Agency (USEPA) and the Connecticut Department of Environmental Protection (CT DEP), and a review of the sediment data available for the Quinnipiac River. The objective of the sediment sampling is to identify and characterize site-related chemicals of potential concern (COPCs) in sediment in the Quinnipiac River from the culvert outfall to the power line easement (a distance of approximately 1,800 feet). Collection of additional sediment samples from upstream background locations will aid in identifying site-related COPCs. These data will be used to evaluate site-relatedness of detected sediment constituents and further characterize potential site risks.

Prior to selecting the proposed sediment sample locations, sediment probing and mapping tasks were conducted on October 7, 1999. The sediment probing involved measuring the depth, location, and characteristics of sediment deposits in the river from approximately 700 feet upstream of Lazy Lane downstream past the SRSNE Site to the river's confluence with an unnamed tributary approximately 900 feet upstream of Curtiss Street (a total stream distance of approximately 4,700 feet). Sediment depths were measured by probing with a ½-inch-diameter pipe, and measuring the depth to refusal. Approximate length and width of the sediment deposits were also recorded.

The results of the sediment probing indicated that the upper stretches of the study area (from upstream of Lazy Lane to the power line easement) are relatively well scoured. The substrate is generally comprised of fine and coarse sand, with some areas of gravel. Isolated sediment deposits, consisting of fine sand and silt, exist in some areas along the banks, and at bends in the river where the current slows. The depths of the sediment deposits (depth to refusal) was generally 2 to 5 feet. During the sediment probing, flagging was placed at each of the sediment deposits to identify the area for potential future sediment sampling.

Historical aerial photographs of the Quinnipiac River were also reviewed prior to selecting proposed sediment sampling locations. The purpose of the review was to determine if there were any historical changes in stream morphology that may have affected sediment deposition patterns. Review of available aerial photographs from 1965, 1970, 1975, and 1980 indicated that the stream channel configuration of the study area (i.e., from Lazy Lane downstream to the power line easement) has remained the same throughout this period.

2. Sediment Sampling Strategy

The proposed sediment sampling will consist of the collection and analysis of surficial (0-6 inches) and subsurface (6 inch to refusal) sediment samples. Sediment samples will be collected from three background locations and eleven downstream locations. Sediment sample locations, sample methods, and target analytes are described in the following sections.

Sampling Locations

The sediment sampling will target twelve identified sediment deposits in the Quinnipiac River between the culvert outfall and the power line easement (see Figure 1). These twelve locations include the major sediment deposits identified in this section of the river during the probing. In addition, sediment samples will be collected from three reference locations upstream of Lazy Lane. These samples will provide information on upstream background chemical concentrations in sediments.

Sampling Methodology

Sediment sampling will include both surface (0-6 inches) and subsurface (6 inches to refusal) sediment samples collected by Blasland, Bouck & Lee, Inc. (BBL) personnel. Samples will be collected using 2- or 3-inch-diameter Lexan tubing. At each sampling location, tubing will be advanced until refusal. If the sampling crew is unable to collect the sediment core samples using the 2- or 3-inch-diameter Lexan tubing (advanced with a stainless steel core driver block), a gravity/slide hammer coring device will be used to advance the Lexan tubing and collect the samples.

The sediment core samples will be characterized for color, texture, visual staining, and odors. Each core will be sectioned into surface and subsurface samples, depending on depth of refusal. If refusal is 2 feet or less, then the subsurface sediment sample will include the sediment core from 6 inches to refusal. If, however, the depth of refusal is greater than 2 feet, then the subsurface sediment will be further segmented into additional samples of 6 inch to 2 feet and 2 feet to refusal. At the three largest sediment deposits (marked as deposits H, I, and O on Figure 1), surface and subsurface sediment samples will be composites (of sediment from like depths) collected from three representative locations within the deposit. A representative sample from each core will be placed into the appropriate sample container, labeled, and sent to the laboratory for analysis. Quality assurance/quality control (QA/QC) samples (including separate duplicate, matrix spike, and matrix spike duplicate samples, and equipment rinse samples) will also be collected.

Sample Analysis

As a subcontractor to BBL, Galson Laboratories will serve as the primary analytical laboratory for the analysis of sediment samples. The address and telephone information for Galson Laboratories are as follows:

Galson Laboratories
6601 Kirkville Road
East Syracuse, New York 13057
(315)432-5227
Contact: Pam Weaver

Target analytes were identified based upon previous sediment sampling conducted on the Quinnipiac River, and the results of the Baseline Risk Assessment (RA) included in the final Remedial Investigation Report [Halliburton NUS Environmental Corporation (HNUS), 1994]. Polychlorinated Biphenyls (PCBs) are also identified as a target analyte for the proposed sediment sampling. Although PCBs were previously detected in only two of 17 sediment samples from the Quinnipiac River, and the detected concentrations were very low (0.018 and 0.052 mg/kg), PCBs were identified as a COPC for the culvert outfall. Sediment samples will also be analyzed for semi-volatile organic compounds (SVOCs), inorganic parameters, and total organic carbon (TOC).

Analytical methods to be used are as follows:

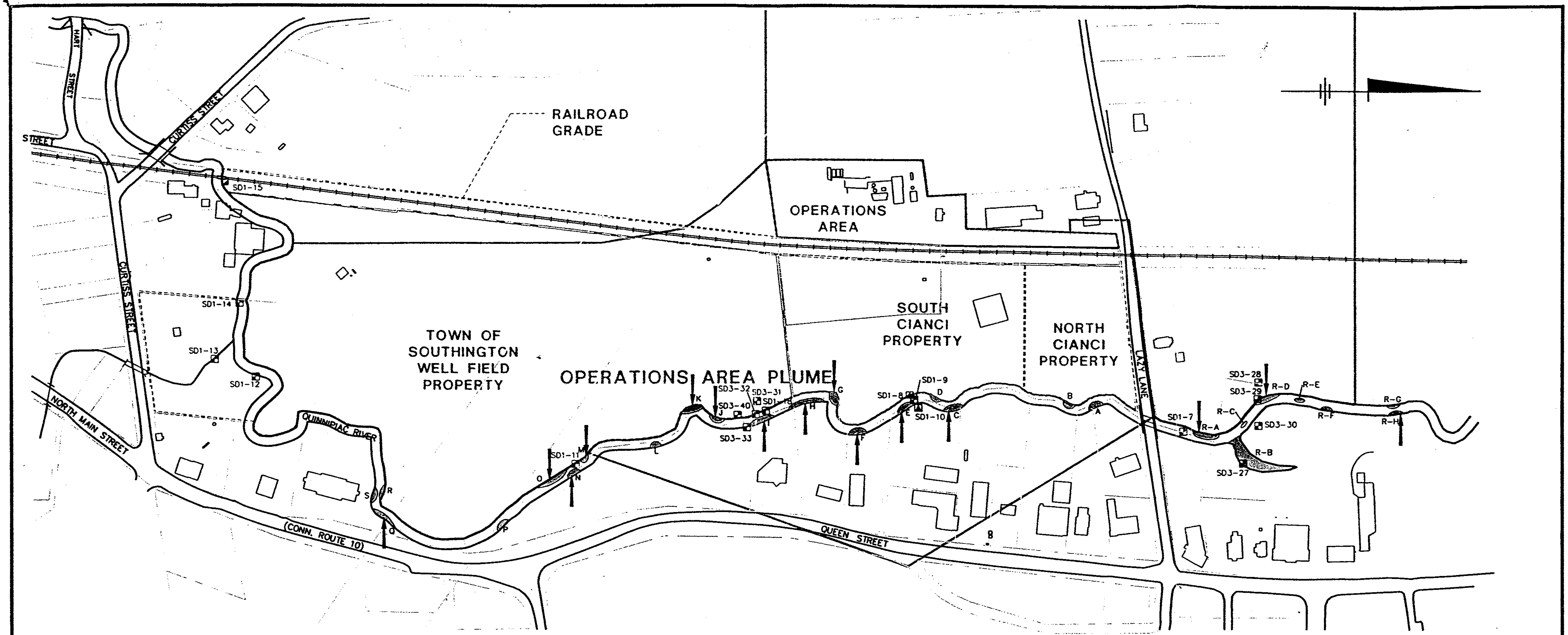
Analyte	Method
PCBs	USEPA SW-846 Method 8082
SVOCs	USEPA SW-846 Method 8270
Inorganics	USEPA SW-846 Method 6010-7000; 9010
TOC	USEPA Region 2 Lloyd Kahn Method

3. Reporting

The results of the sediment sampling investigation will be presented in a brief report to CT DEP and USEPA. The report will include a summary of the sampling and the data generated from the sediment investigation.

4. References

HNUS. 1994. Final Remedial Investigation Report. USEPA Contract No. 68-W8-0117.



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

LEGEND:

▨ A — OBSERVED SEDIMENT DEPOSIT (APPROXIMATE LOCATION)

SD1-17 ◪ — PREVIOUS SEDIMENT SAMPLE

↑ — PROPOSED SEDIMENT SAMPLE LOCATION

0 300' 600'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
SEDIMENT SAMPLING WORK PLAN

QUINNIPIAC RIVER SEDIMENT SAMPLING LOCATIONS

BBL BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
1

L: ON=*,OFF=REF
P: STD-PCP/BL
10/21/99 SYR-54-CBM
08331004/08331B04.DWG

ATTACHMENT K – 2

Sediment Probing Field Notes

– probing with 1/2" black pipe

10/07/99 DKR, GR sunny, 60°F

Start at Lazy Lane Bridge

0 few sediment deposits. rock / gravel bottom
side deposits of ≤ 3" (fine sand)
100'

0 old bridge abutment (40')
① sand bar (exposed) 3-4' deep (50'L × 15'W)
fine sand / silt
100'

0 left (looking upstream) channel: sand substrate,
1-2' deep fine sands on edges
② 1.2' fine sand in channel (30-90')
100'

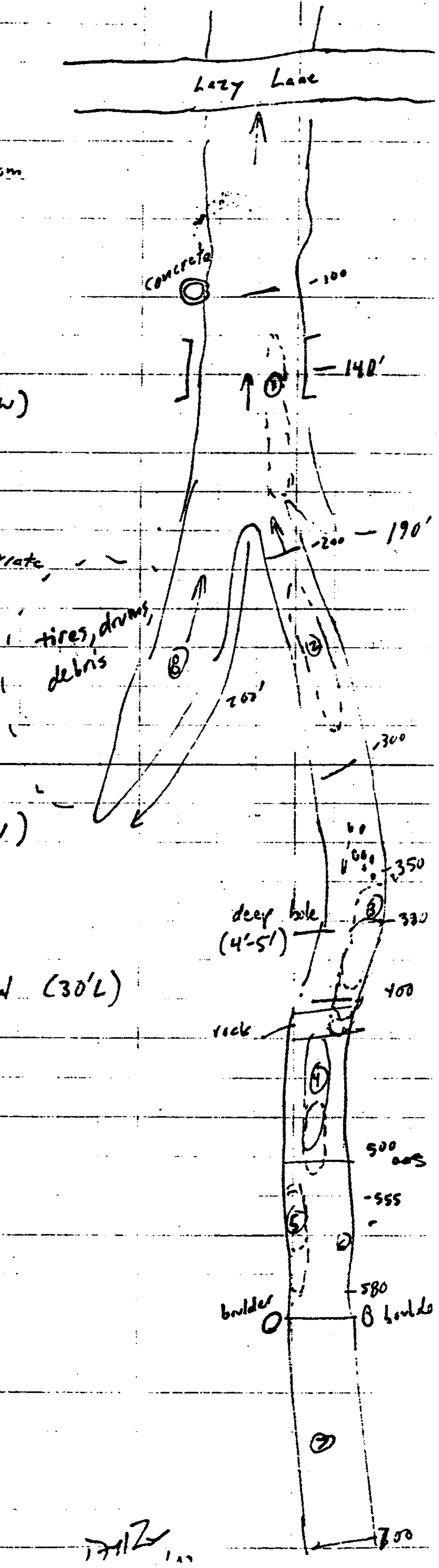
0 rocky, gravel bottom with some sand
③ pocket at curve, fine sand. 4' deep (50'L × 8'-20'W)
100'

0 rocky, gravel bottom
④ sand deposit, 3"-6" deep, fine sand across channel (30'L)
100'

0
⑤ 3-3.5' deep (5-6'W × 25'L)
⑥ 6' deep sloughed bank. silty / sand
100'

0
⑦ 1-1.5' deep soft sand deposit across channel
100

⑧ Right channel – looking upstream
3' deep, silty



Downstream Lazy Lane Bridge

0

sand gravel
⑨ soft sand (1-2½' deep) fine-course sand

100
0

⑩ sand bary (50'L × 5-7'W) 4' deep
fine sand

100
0

⑪ sand bar (26'L × 8'W) 2.5' deep

soft ~~band~~ bottom (1' deep)

100
0

soft sand bottom (1' deep)

-60'

(2' deep) due to fallen tree

100
0

sand/gravel at upper end of reach
≥ 3" of soft deposit

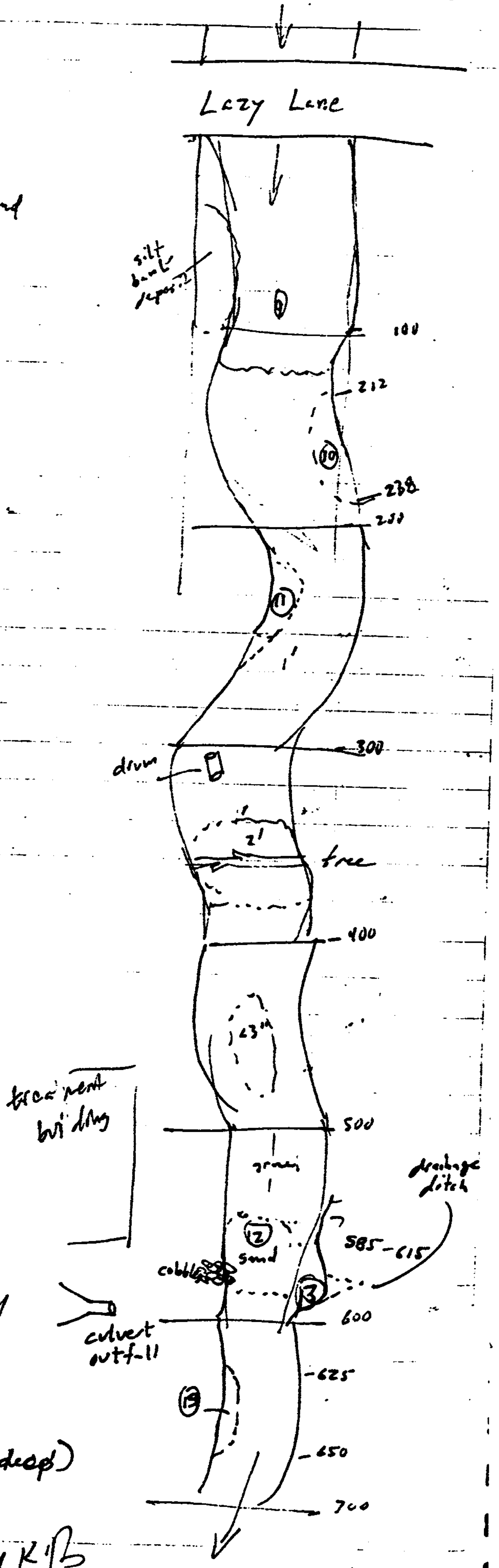
100
0

gravel upper reach turns into sand (2' deep)
at slower portion
⑫ sand deposit middle of river
⑬ (30'L × 10-12' W) 2' deep silty/sand

100
0

⑭ soft (25'L × 10'W) 3' deep silt/sand
hard gravel bottom w/ cobbles
soft sand at lower end of stretch (2' deep)

100



MKB

0

- cobble at upper end

⑯ - small deposits along bank (2-2.5' deep) left bank

100

0

-soft silt/sand (1-2' deep) across channel

no major deposits

100

⑰

0

soft sand across channel 2-4' deep

no major deposits, except all across channel

100

0

soft sand throughtout reach

⑱ band of deposit (3' deep) silt

100

0

⑲ -soft sand on left (downstream) bank

(70'L × 5'W) 2-3' deep

100

0

rocky/cobble on right bank

⑳ (40' L × 15' W) 3' deep silt

100

0

rocky/cobble on right bank

㉑ (40'L × 10'W) 2' deep silt

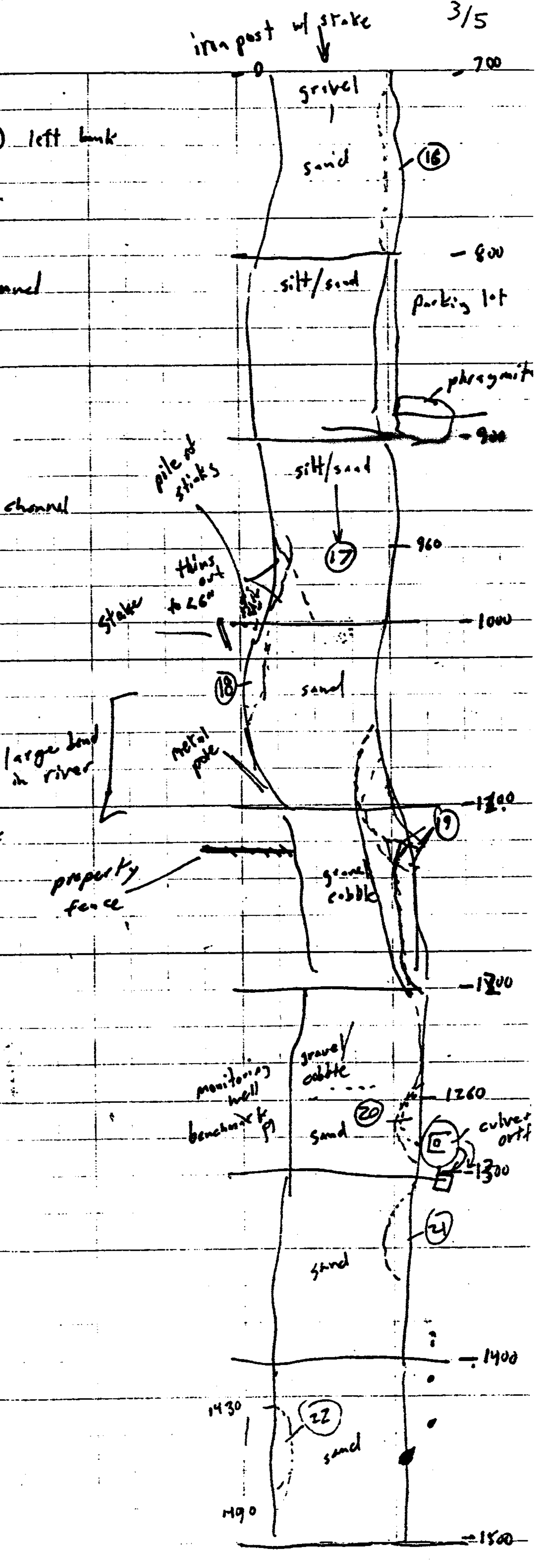
sand (<1' deep)

100

silt/sand

㉒ (60'L × 10'W) sand deposit (2-2.5' deep)

100



㉓ sand (60'L × 15'W) 2' deep
slight sheen, odor

cobble, sand bottom
㉔ (40'L × 10'W) 3'deep

gravel, cobble bottom
no isolated deposits

gravel, cobble bottom
no isolated deposits

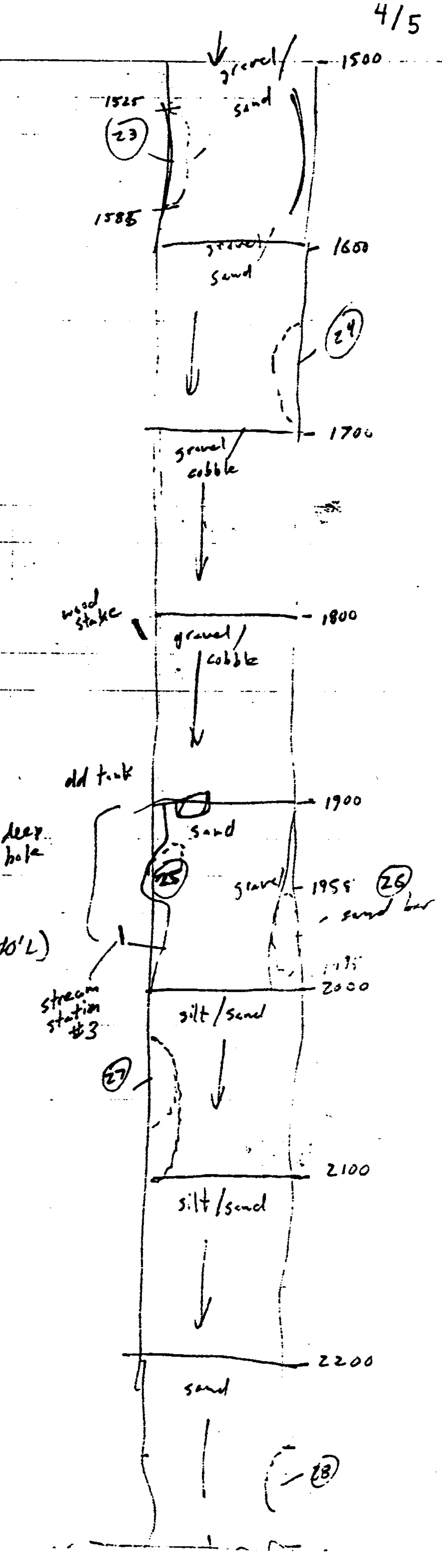
sand deposit (1-1.5' deep)

㉕ silt deposit (20'L × 10'W) 2' deep
slight sheen/odor ㉖ sand bar (16'W × 40'L)
5' deep

㉗ silt/sand deposit (70'L × 20'W) 4'deep

sand bottom (1.5' deep - 2.5' deep) all the way across
no deposits

sand bottom (1-2' deep)
㉘ (80'L × 25'W) silt 3'deep



0/5

0 sand bottom (<1' deep)

100

0 sand bottom (<1' deep')

100

0 sand / gravel bottom
well scoured

100

0 gravel, sand
silt/
㉙ sand bar (60'L × 10'W) 5' deep
right before 90° bend at house

100

0 ㉚ (20'L × 10'W) 2' deep silt
㉛ (25'L × 10'W) 4' deep sand

100

0 sand bottom with deposition and log debris

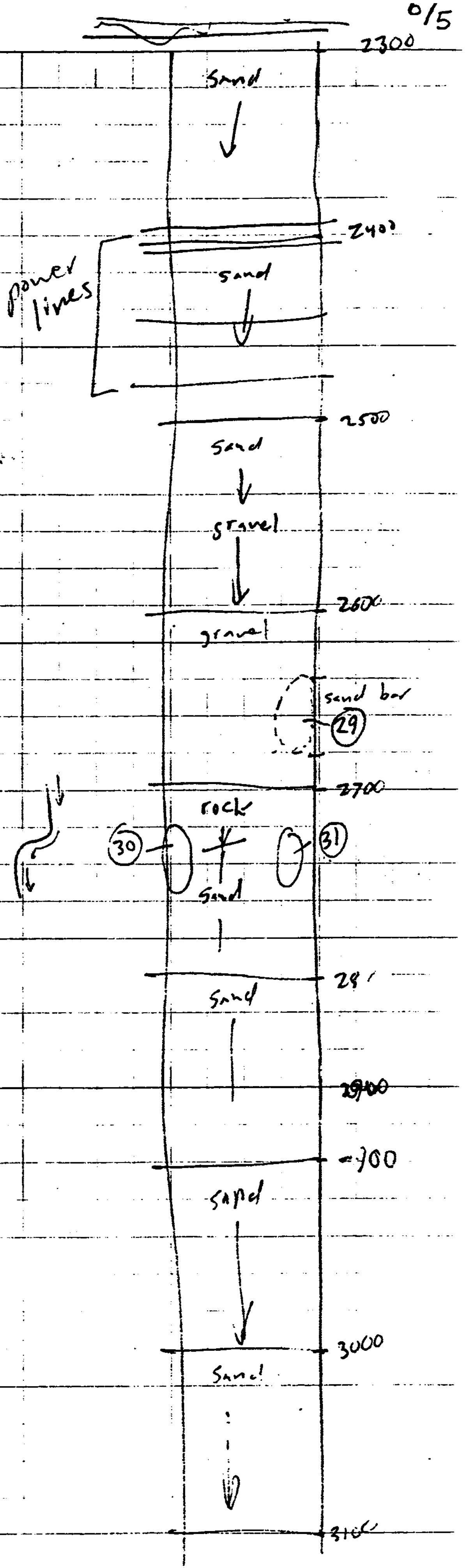
100

0 sand bottom (2' deep)

1'

sand bottom (2' deep)

100



ATTACHMENT K – 3

Sediment Sampling Field Notes

Sediment sampling
October 1999

1/15

Location: SD-10-99-1

Date 10/29/99 Time: 1045
Water Depth 1.2
Sediment Pen: 5.0 Picture: #4
Sediment Rec: 4.2

Sample ID: ~~SD~~ Description

SD-10-99-1(0:5) Brown silt & fine sand some organic matter

SD-10-99-1(0.5-2.0) Tan fine sand, some Brown silt, little orange fine sand

SD-10-99-1(2.0-4.2) Light Brown (Tan) fine sand

Analysis: Semi VOC (8270), PCBs (8082), Cyanide (CN) (6010/7000)
Grain size (Lloyd Kahn, Moisture content

cation: SD-10-99-2
Date: 10/29/99 Time: 1105
Water Depth: 2.2
Sediment Pen: 5.5 Picture: #~~3~~5 & 6
Sediment Rec: 4.6

ample ID Description

D-10-99-2 (0-0.5) Light Brown fine sand w/ red/Brown fine sand some silt

D-10-99-2 (0.5-2.0) red/Brown very fine sand

)-10-99-2 (2.0-5.0) Same as above

nalysis: Same

Location: SD-10-99-3

Date: 10/29/99

Time: 1120

Water Depth: 0.3

Sediment Pen: 2.3

Picture: # ~~3~~ 7

Sediment Rec: 2.0

<u>Sample ID</u>	<u>Desription</u>
SD-10-99-3 (0-0.5)	Light Brown fine sand w/silt & organic matter
SD-10-99-3 (05-23)	Brown silt w/ Tan fine sand, some medium to course sand w/ Trace orange fine sand

Analysis: Same

4/15

cation: SD-10-99-4

Date: 10/29/99
Water Depth: 1.3
Sediment Pen: 2.0
Sediment Rec: 1.5

Time: 1220

Photo # [illegible] -

imple ID	Description
)-10-99-4 (0-0.5)	Dark Brown fine sand
-10-99-4 (0.5-2.0)	Dark Brown silt w/ some organic matter & some fine sand

alysis: Same

Location: SD-10-99-5

Date: 10/29/99
Water Depth: 1.5
Sedimen Pen: 2.0
Sediment Rec: 2.0

Time: 1235

Photo # 8

Sample ID	Description
SD-10-99-5 (0-0.5)	Dark Brown fine sand w/organic matter w/some silt
SD-10-99-5 (0.5-2.0)	Tan fine sand, some silt, some organic matter, some gravel

Analysis: same

cation: SD-10-99-6

Date: 10/29/99
Time: 1310
Water Depth: 1.5
Sediment Pen: 4.0
Photo #9
Sediment Rec: 3.2

mple ID	Description:
D-10-99-6 (0-0.5)	Dark Brown silt & organic matter w/some fine Brown sand
D-10-99-6 (0.5-2.0)	Brown fine sand w/ silt
D-10-99-6 (2.0-4.0)	Light Brown sand w/some fine gravel

nalysis: Same

7/15

Location: SD-10-99-7

Date: 10/29/99
Water Depth: 1.6
Sediment Pen: 5.0
Sediment Rec: 4.5

Time: 1340

Photo # 10

Sample ID	Description
SD-10-99-7 (0-0.5)	Brown fine sand w/some silt & organic matter
SD-10-99-7 (0.5-2.0) -	(0.5-1.5) - Brown fine sand w/silt (1.5-2.0) - Red Brown very fine sand
SD-10-99-7 (2.0-5.0) -	(2.0-3.5) Red Brown very fine sand (3.5-5.0) Grey Brown fine sand

Analysis: Same

* MS/MSD Taken at SD-10-99-7 (2.0-5.0)
* Dup taken at (0.5-2.0) (SD-10-99-DUP1)

8/15

cation: SD-10-99-8

Date: 10/29/99 Time 1420
Water Depth: 13
Sediment Pen: 2.3', 2.4', 2.2 Photo # 11
Sediment Rec: 2.1', 2.1', 1.8'

ample ID: Description

)-10-99-8C(0-0.5') Brown + Dark-brown fine sand, some organic matter

)-10-99-8C(0.5-2.3') Brown fine sand w/ medium to coarse sand & some silt

alysis: Same

Location: SD-10-99-9

Date 10/29/99

Time 1410

Water Depth 1.8

Sediment Pen: 3.0, 2.5, ~~2.0'~~ 1.5

Photo # 12

Sediment Rec. 3.0, 2, ~~2.5~~

Sample ID | Description

SD-10-99-9C (0-0.5) - Dark-brown loose silt and organic matter

SD-10-99-9C (0.5'-2.0') - Gray-brown fine sand with medium to coarse sand, some silt, some organic matter

SD-10-99-9C (2.0-3.0') - Light-brown fine sand

Analysiss: Same

10/15

cation: SD-10-99-10

Date: ~~10/29/99~~ 11/1/99 Time 1510

WaterDepth: 0.5

Sediment Pen: 3.0' Photo # 13

Sediment Rec: 2.5'

mple ID Description

-10-99-10 (0-0.5) - Light-brown fine sand

-10-99-10 (0.5'-2.0') - Gray-brown fine sand, some medium sand

-10-99-10 (2.0'-3.0') - Light-brown fine sand with brown silt, some course sand & gravel

alysis: Same

Location SD-10-99-11

Date: ~~10/29/99~~ 11/1/99

Time: 1520

WateDepth: 1.2

Sediment Pen: 2.0'

Photo # 14

Sediment Rec: 1.2'

Sample ID Description

SD-10-99-11 (0-0.5) - Brown + Dark-Brown silt, some organic matter trace of fine sand

SD-10-99-11 (0.5'-2.0') - Grey-brown fine sand with dark-brown silt, some gravel, a little organic matter

Analysis: Same

ation: SD-10-99-12

Date: ~~10/29/99~~ 11/1/99
Water Depth: 1.2
Sediment Pen: 2.0'
Sediment Rec: 1.2'

Time: 1545

Photo # 15

mple ID Description

)-10-99-12 (0-0.5) - Brown + Dark-brown silt, some organic matter

)-10-99-12 (0.5'-2.0') - Brown + Dark-brown silt, a little fine sand + gravel

alysis: Same

13/15

Location: SD-10-99-13

Date: ~~10/29/99~~ 11/1/99 Time-1610
Water Depth: 0.0
Sedimen Pen: 5.0'
Sediment Rec: 4.4'

Photo # 16

Sample ID Description

SD-10-99-13 (0-0.5) - Brown fine sand

SD-10-99-13 (0.5'-2.0') - Reddish-brown fine sand and light brown fine sand

SD-10-99-13 (2.0-5.0') - 2'-3' - Reddish-brown fine sand
3'-3.8' - Brown silt
3.8'-5.0' - Gray fine sand

Analysis: Same

ocation: SD-10-99-14

Date: ~~10/29/99~~ 11/1/99 Time 1620

Water Depth: 0.5

Sediment Pen: 4.0', 3.5', 2.0' Photo # 17

Sediment Rec: 3.7', 2.8', 1.5'

ample ID	Description
)-10-99-14C(0-0.5)	- Brown fine sand and silt, a little organic matter
)-10-99-14C(0.5'-2.0')	- Light-brown + dark-brown fine sand, some silt, some organic matter
)-10-99-14C(2.0'-4.0')	- 2'-3' - Brown silt 3'-4' - Gray fine sand

alysis: Same

Location: SD-10-99-15

Date: ~~10/29/99~~ 11/1/99 Time 1650
Water Depth: 0.0
Sediment Pen: 5.0' Photo # 18
Sediment Rec: 4.5'

Sample I.D Description

SD-10-99-15 (0-0.5) - Light-brown fine sand, some silt, a little organic matter

SD-10-99-15 (0.5'-2.0') - Reddish-brown - light-brown fine sand, some silt

SD-10-99-15 (2.0'-5.0') - 2'-3' - Brown silt
3'-5' - Light-brown fine sand

Analysis: Same

* MS/MSD Taken at SD-10-99-15 (0.5'-2.0')
* Duplicate SD-10-99-DUP-2 is a duplicate of SD-10-99-15(2.0'-5.

ATTACHMENT K – 4

Sediment Particle Size Gradation Curves

atl ATLANTIC TESTING LABORATORIES, *Limited*

5866 State Route 31
Cicero, NY 13039
Phone: (315) 699-5281
Fax: (315) 699-3374

P.O. Box 29
6431 US Highway 11
Canton, NY 13617
Phone: (315) 386-4578
Fax: (315) 386-1012

TRANSMITTAL

January 6, 2000

Blasland, Bouck & Lee, Inc.
6723 Towpath Road
P.O. Box 66
Syracuse, New York 13214-0066

Attn: Mr. David Rigg

RE: Contaminated Soil Testing
SRSNE Site Quinnipiac River
ATL Report No.: ST2098S-01A-12-99

Ladies/Gentlemen:

On December 7, 1999 your representative delivered 15 samples to our Cicero, New York facility. The Tabulation of Laboratory Test Results and corresponding Particle Size graphs are enclosed.

Please contact our office should you have any questions or if we can be of further service.

Sincerely,
ATLANTIC TESTING LABORATORIES, Limited

Prepared by:

Donald R. Reed, Jr.
Technical Representative

Reviewed by:

Wayne Radley, P.E.
Project Manager

MMS/DR/WR

Enclosures

ATLANTIC TESTING LABORATORES, Limited

Client: Blasland, Bouck & Lee, Inc.
Project: Contaminated Soil Testing
SRSNE Site, Quinnipiac River

Project No.: ST2098
Page No.: 1 of 1

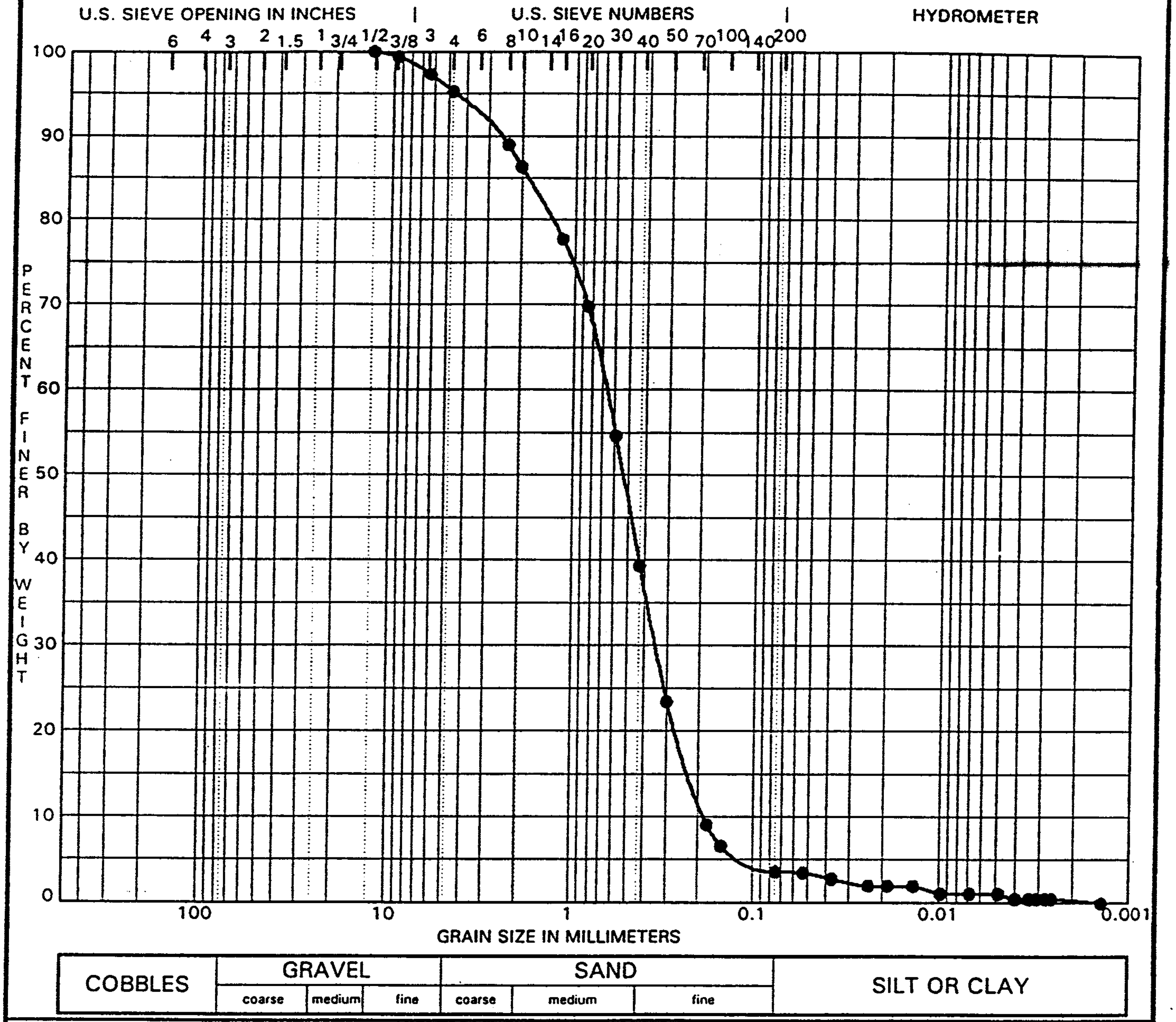
Tabulation of Laboratory Test Results

ATL Sample No.	Station Location	Sample Depth	ASTM D 422 Particle Size Analysis (Percent Passing by Weight)																	
			1½"	1"	¾"	½"	⅜"	¼"	#4	#8	#10	#16	#20	#30	#40	#50	#80	#100	#200	0.005 mm
2098S-01	SD-10-99-4	0' - 0.5'	--	--	--	100	99	97	95	89	86	78	70	55	39	23	9	7	3.6	1
2098S-02	SD-10-99-4	0.5'-2.0'	--	--	--	100	99	96	94	86	85	80	77	72	65	56	47	45	39	1
2098S-03	SD-10-99-5	0' - 0.5'	--	--	--	--	--	--	100	98	98	97	96	93	76	42	18	13	7.7	0
2098S-04	SD-10-99-5	0.5'-2.0'	100	96	92	88	86	83	81	77	76	74	70	64	53	34	15	12	7.2	0
2098S-05	SD-10-99-7	0' - 0.5'	--	--	--	--	--	--	100	99	99	98	95	74	46	25	9	7	3.8	0
2098S-06	SD-10-99-7	0.5'-2.0'	--	--	100	99	99	98	97	95	94	91	85	73	58	50	40	36	20	0
2098S-07	SD-10-99-7	2.0'-5.0'	--	--	--	--	--	--	100	99	99	95	87	73	62	59	52	47	24	0
2098S-08	SD-10-99-8C	0' - 0.5'	--	--	--	--	--	--	100	99	99	99	99	98	90	64	23	15	7.0	0
2098S-09	SD-10-99-8C	0.5'-2.3'	--	100	99	96	93	88	85	77	74	68	62	55	45	33	20	16	9.4	0
2098S-10	SD10-99-9C	0' - 0.5'	--	--	100	99	96	92	90	85	84	82	80	77	70	61	47	43	31	1
2098S-11	SD10-00-9C	0.5'-2.0'	--	100	96	91	88	84	82	74	72	63	54	43	31	22	13	11	7.4	0
2098S-12	SD10-99-9C	2.0'-3.0'	--	--	--	100	99	98	96	86	81	64	46	26	12	8	5	5	3.5	0
2098S-13	SD10-99-10	0' - 0.5'	--	--	--	--	--	--	100	97	95	88	79	61	37	24	15	14	10	0
2098S-14	SD10-99-10	0.5'-2.0'	--	--	--	--	100	99	98	93	91	81	67	40	19	9	4	3	2.5	0
2098S-15	SD10-99-10	2.0'-3.0'	--	100	97	92	87	80	77	71	69	58	37	22	8	3	2	1.4	1.1	0

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT	SRSNE Quinnipiac River Sediment Sampling	REPORT NO.	ST2098S-01-12-99
CLIENT	Blasland, Bouck & Lee	DATE	12/07/99



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 2098S-01	Brown cmf sand, trace fine gravel, trace silt, trace clay					0.97	3.6

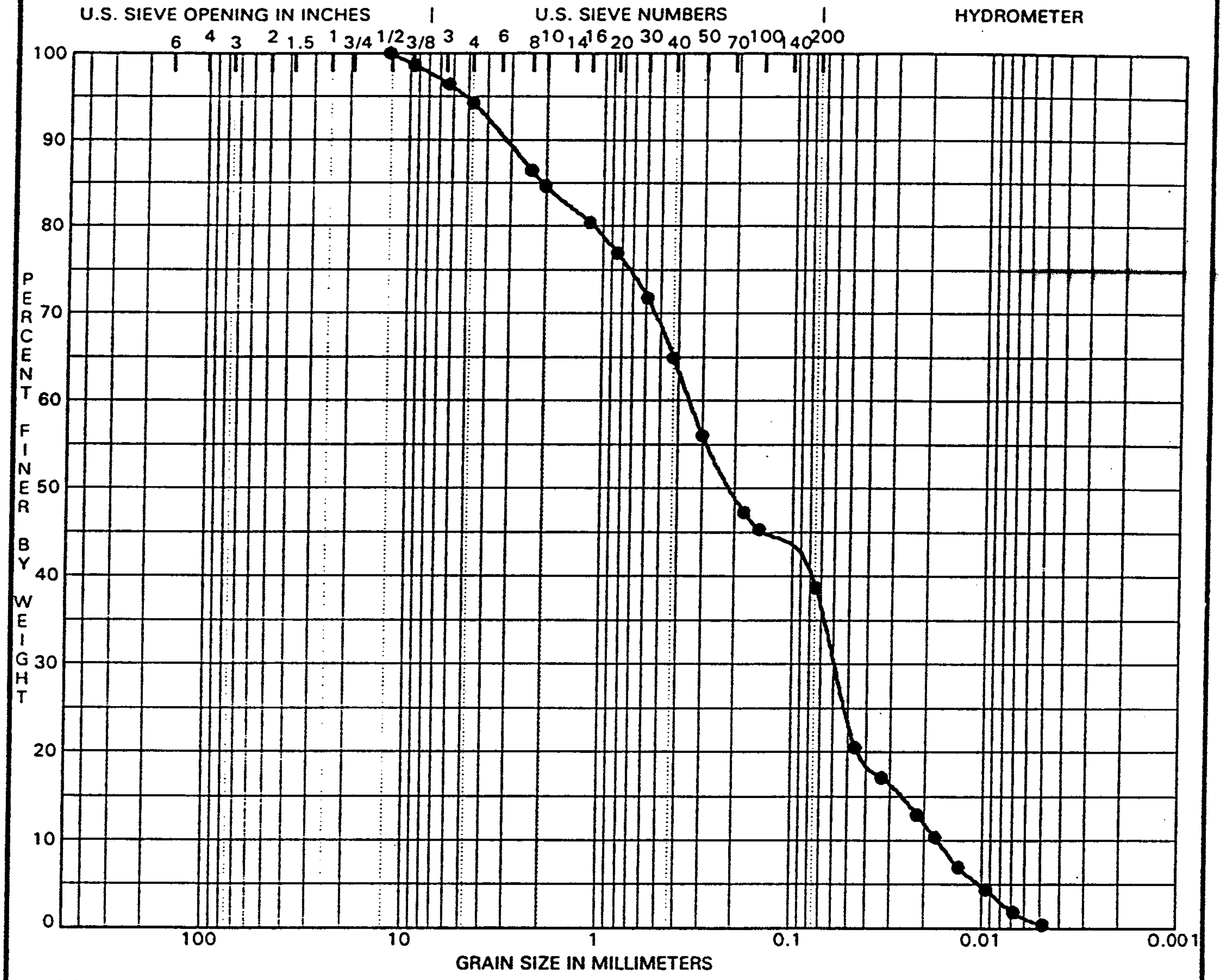
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 2098S-01	12.70	0.67	0.348	0.1859	5	92	3	1

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling
CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99
DATE 12/07/99



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-02	Brown cmf sand and silt, trace fine gravel,						
		trace clay						

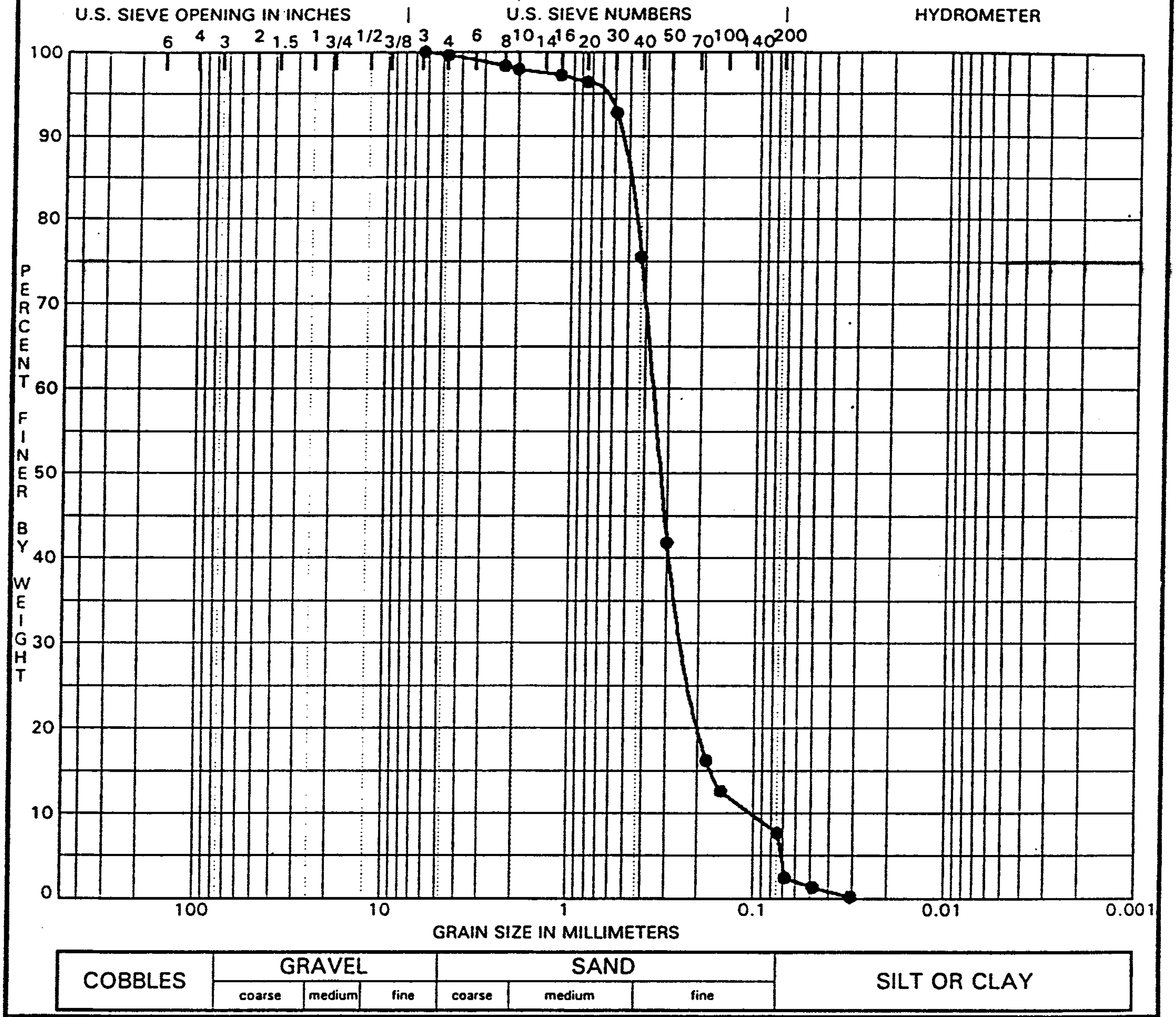
	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-02	12.70	0.35	0.059	0.0171	6	56	38	1

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling
CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99
DATE



	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-03	Brown cmf sand, trace silt/clay					1.49	3.5

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-03	6.35	0.36	0.237	0.1038	0	92	7.7	

ATLANTIC TESTING LABORATORIES, Limited

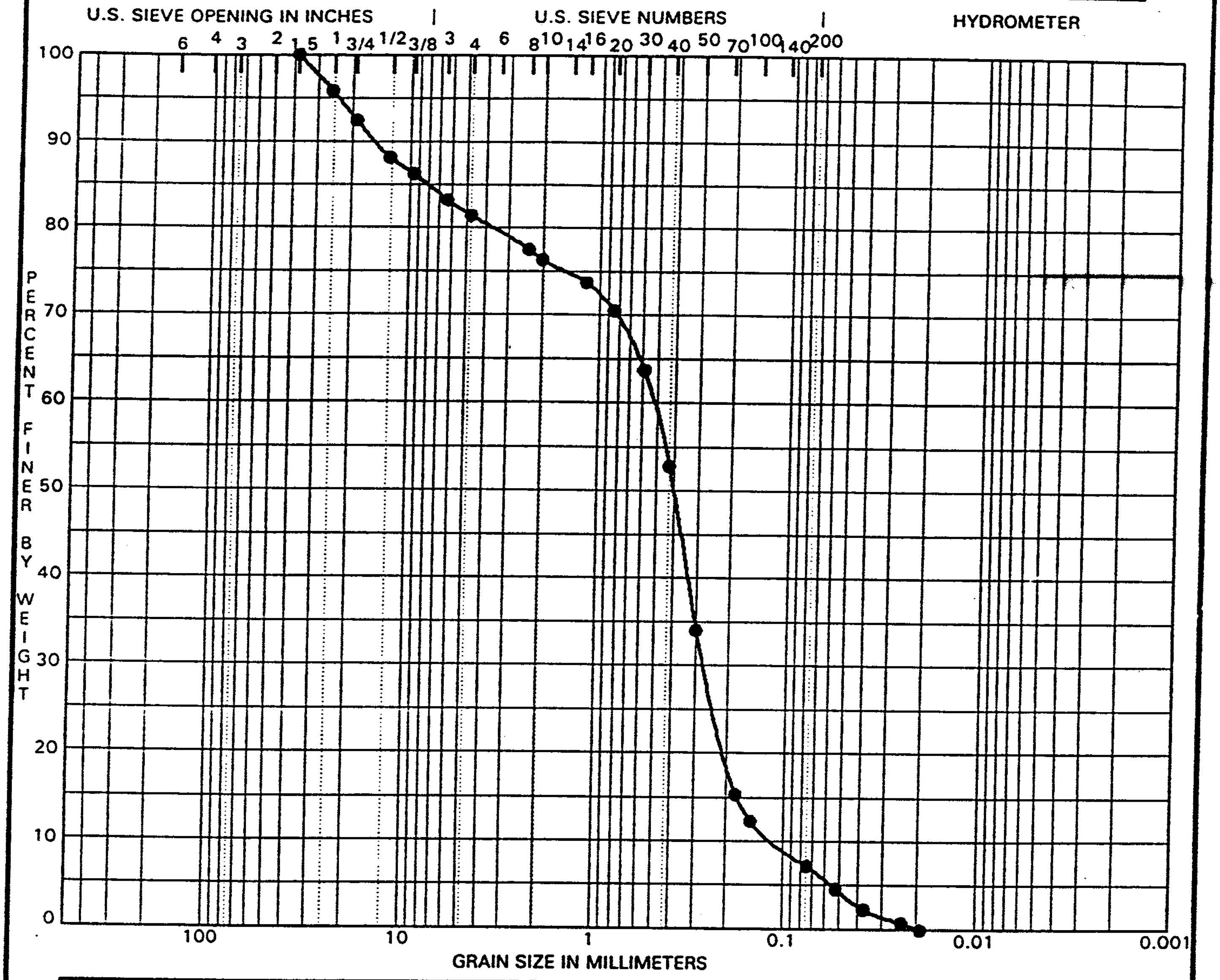
GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling

CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99

DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-04	Brown cmf sand, trace mf gravel, trace silt/clay					1.24	4.8

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-04	38.10	0.53	0.269	0.1097	19	74	7.2	

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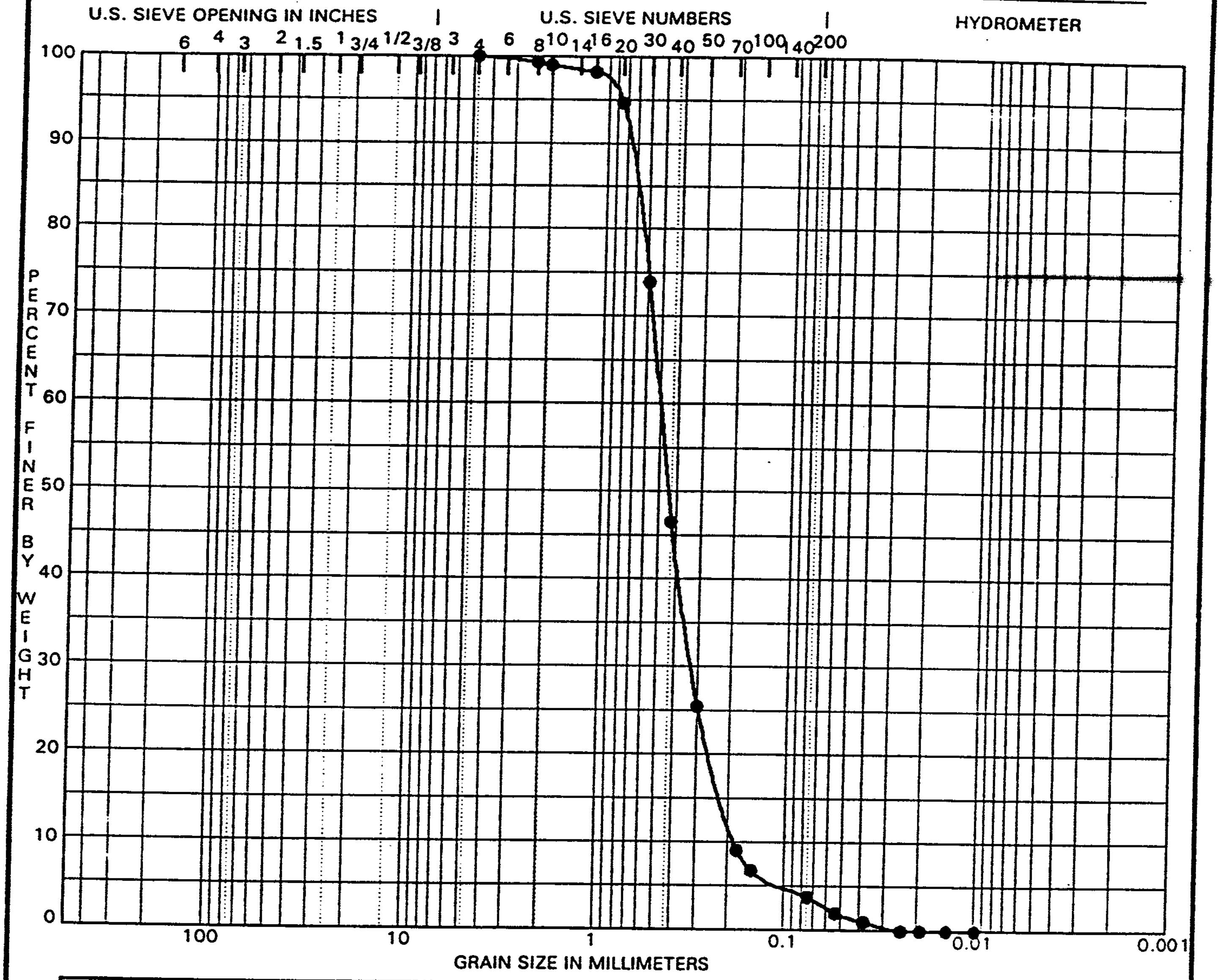
GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling
CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99
DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-05	Brown cmf sand, trace silt/clay					1.13	2.7

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-05	4.75	0.50	0.325	0.1851	0	96	3.8	

ATLANTIC TESTING LABORATORIES, Limited

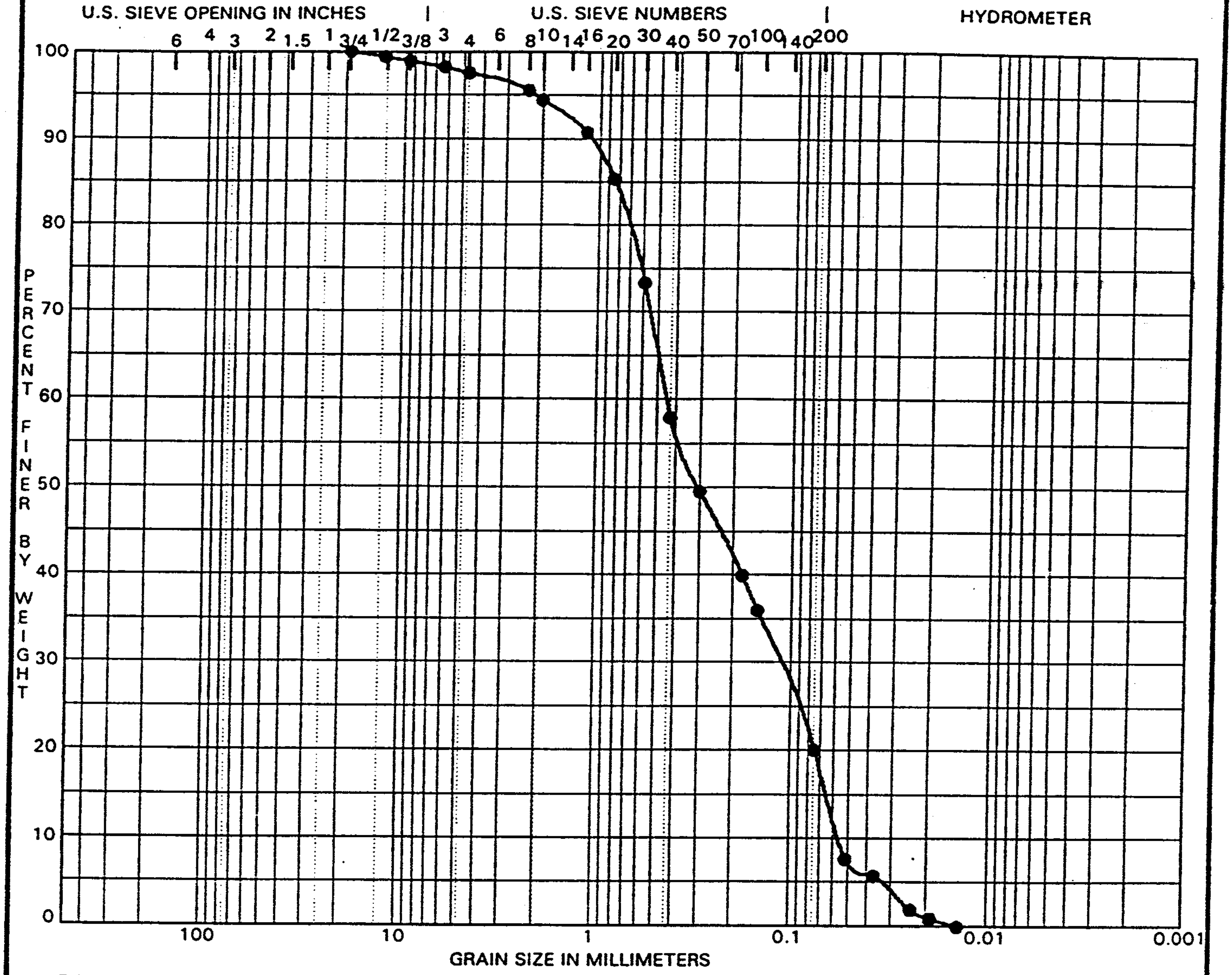
GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling

CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99

DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 2098S-06	Brown cmf sand, some silt/clay, trace mf						
	gravel						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 2098S-06	19.00	0.45	0.116	0.0556	3	78	20.0	

ATLANTIC TESTING LABORATORIES, Limited

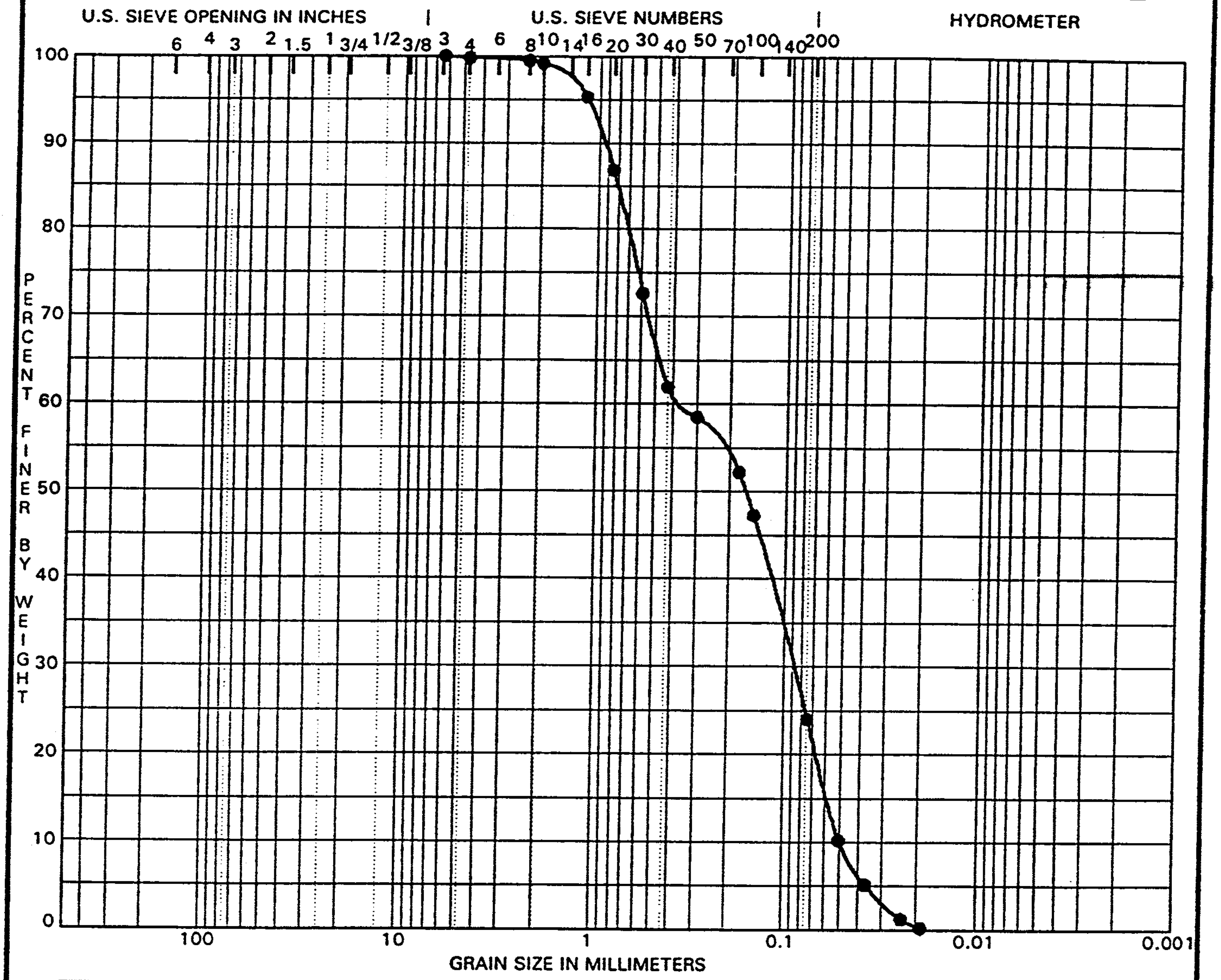
GRADATION CURVES

PROJECT **SRSNE Quinnipiac River Sediment Sampling**

CLIENT **Blasland, Bouck & Lee**

REPORT NO. **ST2098S-01-12-99**

DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

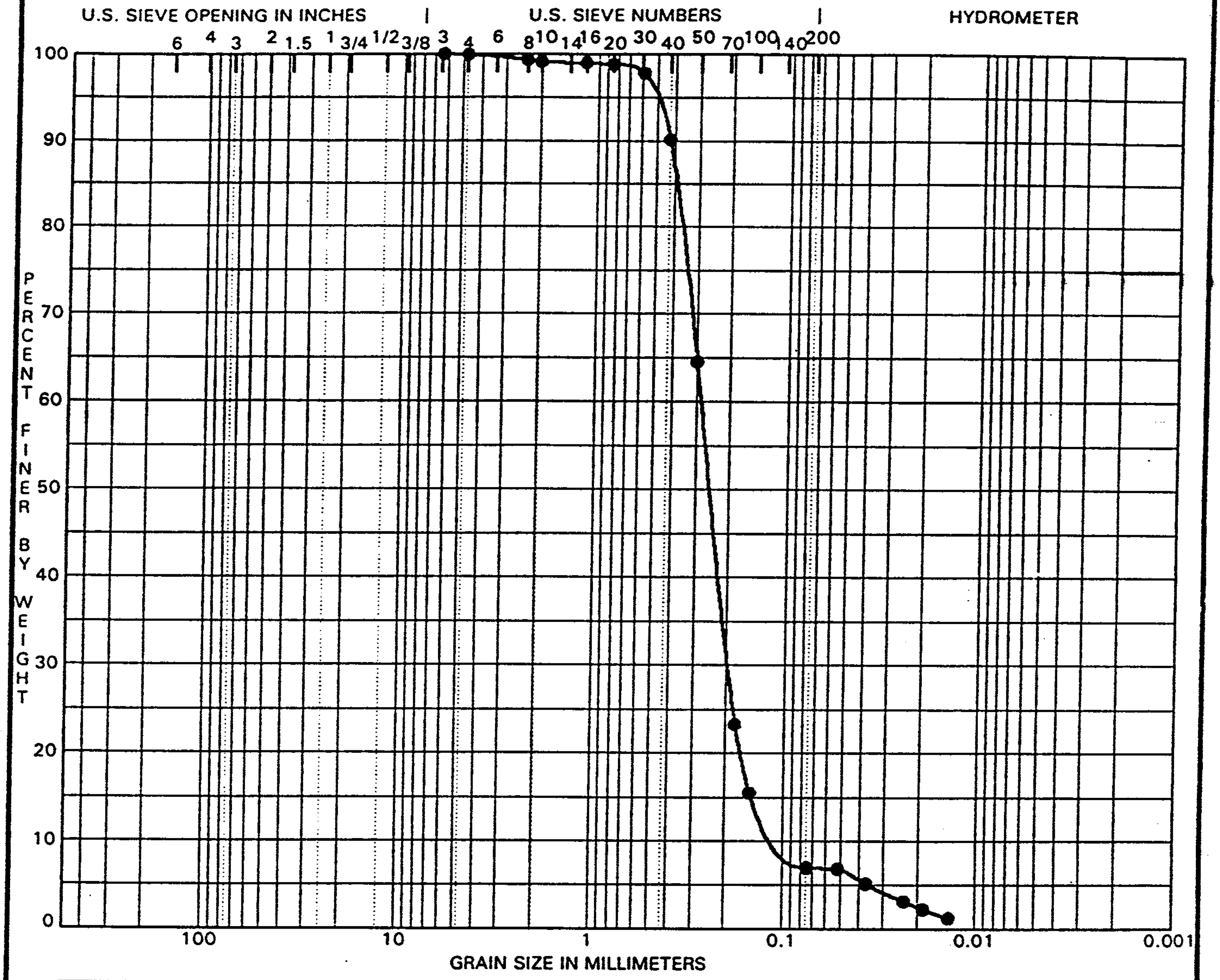
	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-07	Brown cmf sand, some silt/clay						

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-07	6.35	0.35	0.090	0.0501	0	76	24.0	

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling
CLIENT Blasland, Bouck & Lee
REPORT NO. ST2098S-01-12-99
DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-08	Brown cmf sand, trace silt/clay					1.41	3.0

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-08	6.35	0.28	0.196	0.0958	0	93	7.0	

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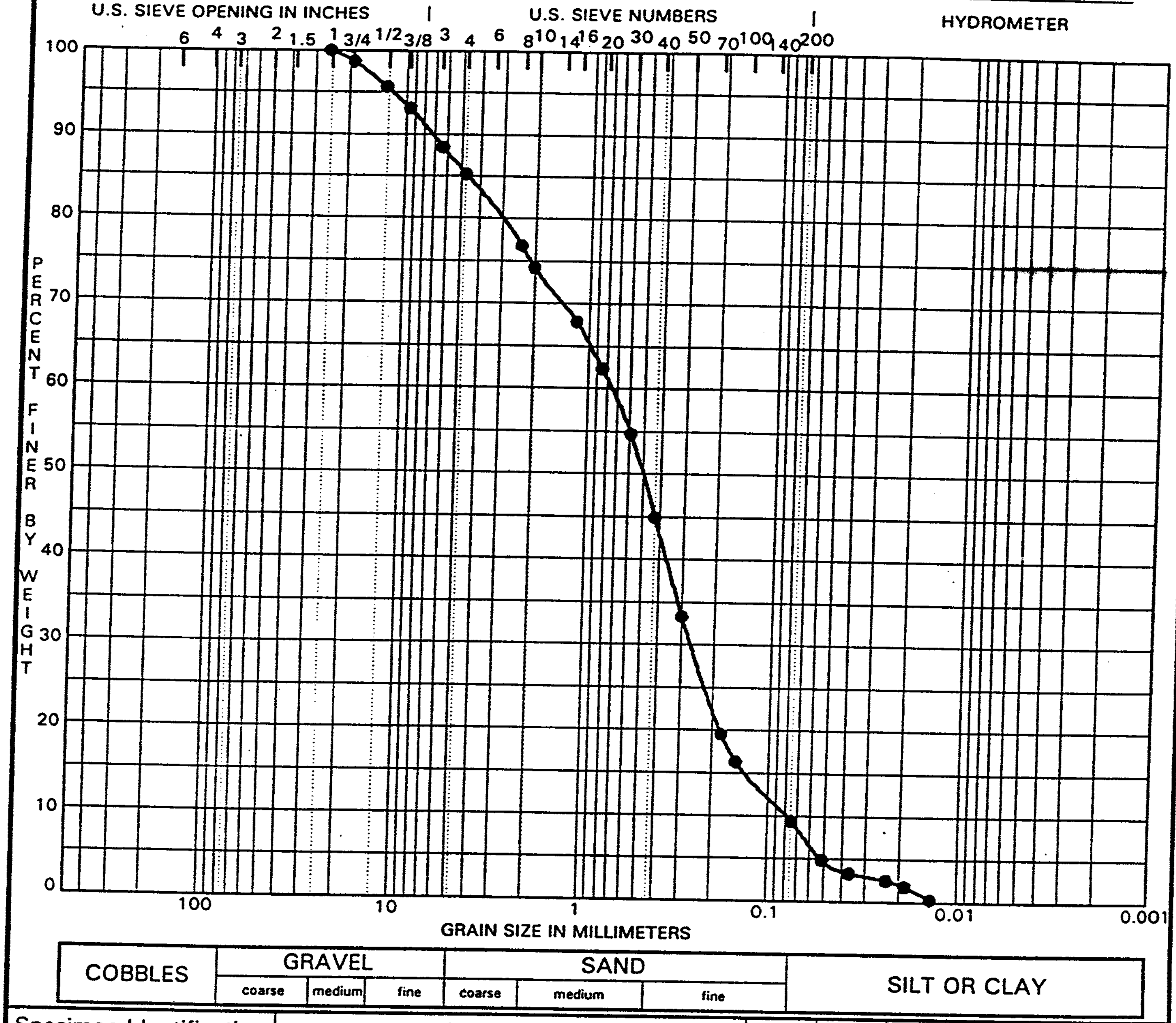
GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling
CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99
DATE



Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 2098S-09	Brown cmf sand, some mf gravel, trace					1.16	9.6
	silt/clay						

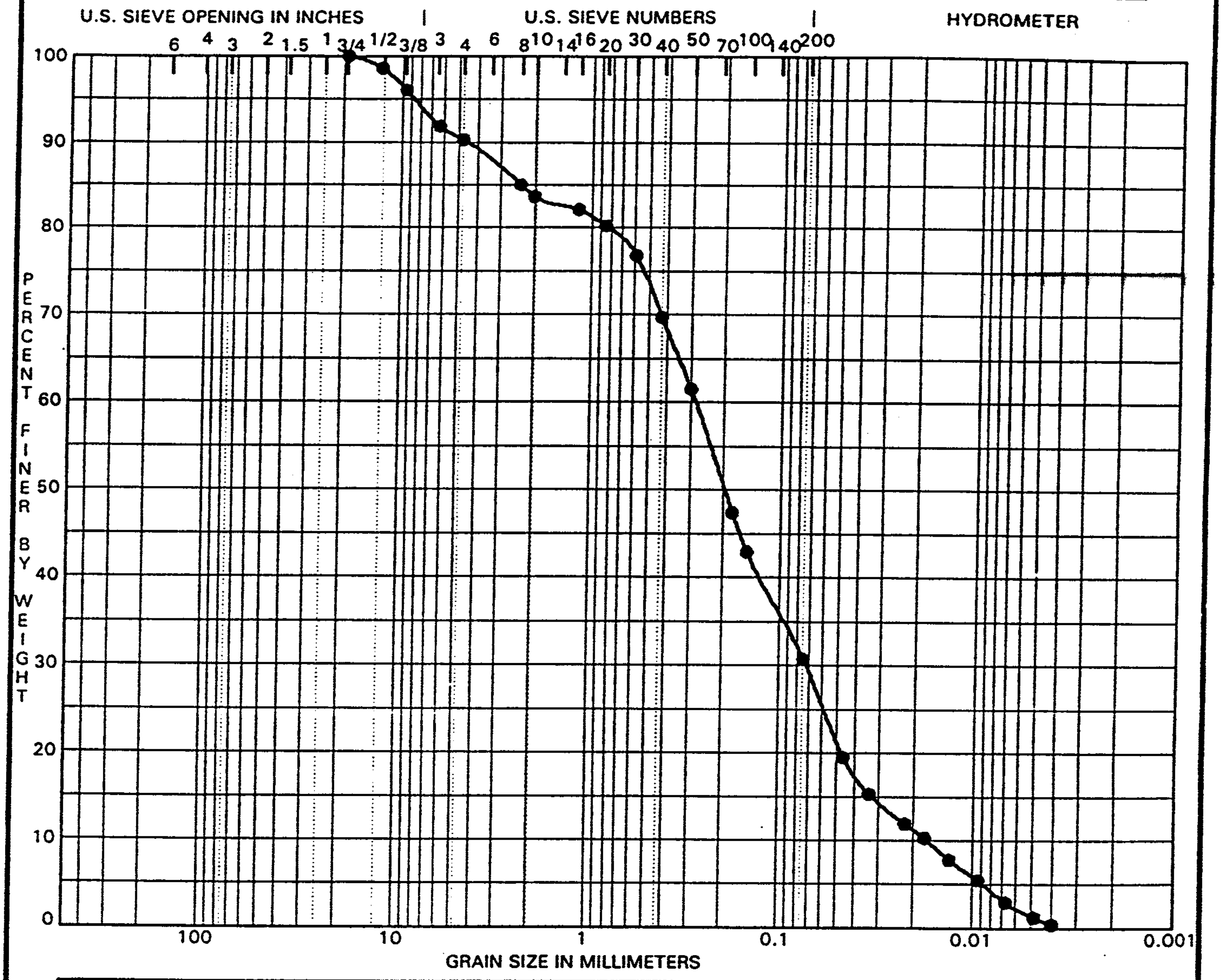
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 2098S-09	25.40	0.76	0.266	0.0797	15	76	9.4	

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling
CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99
DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-10	Brown cmf sand, some silt, little mf gravel,						
		trace clay						

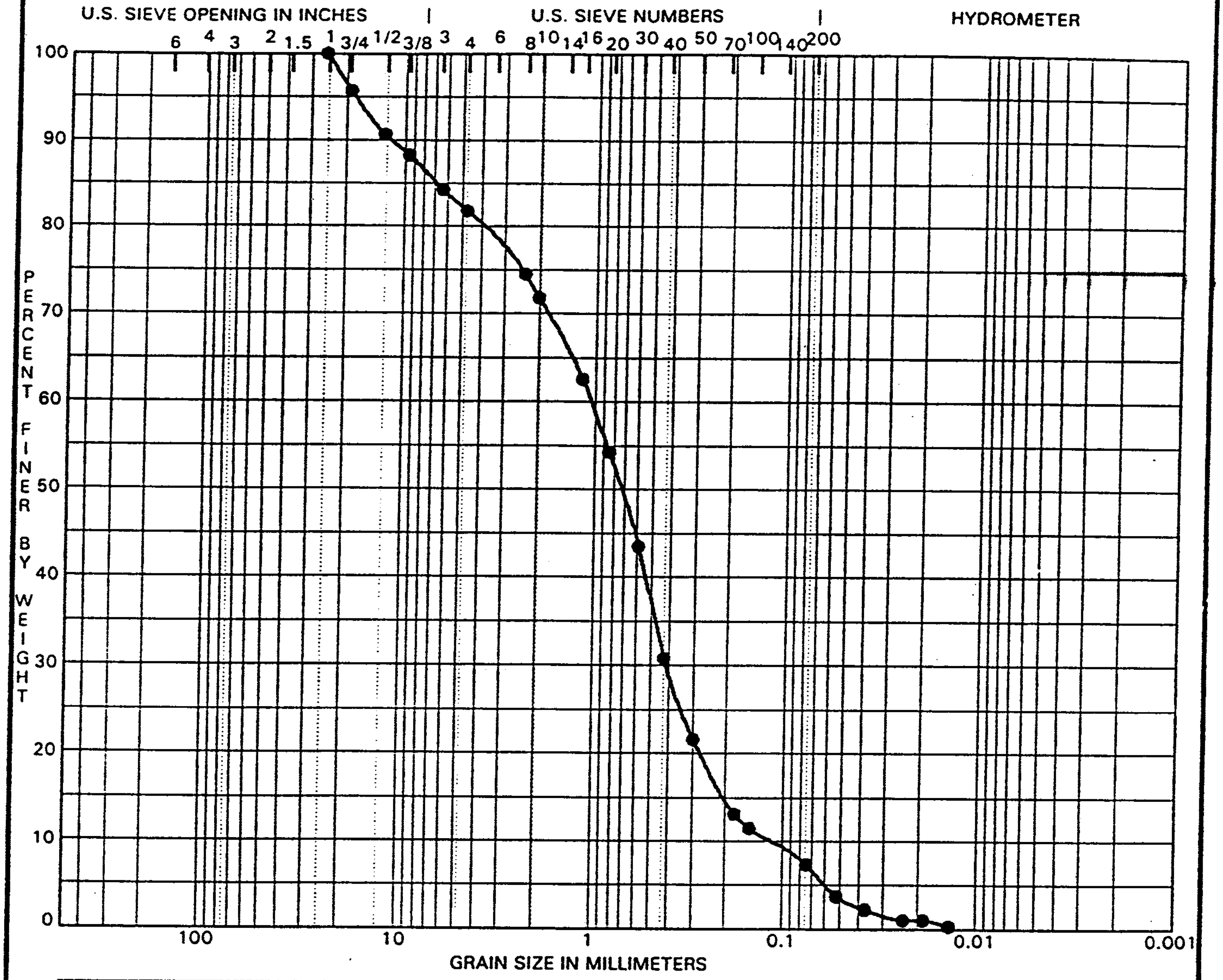
	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-10	19.00	0.28	0.073	0.0171	10	60	29	1

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling REPORT NO. ST2098S-01-12-99

CLIENT Blasland, Bouck & Lee DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-11	Brown cmf sand, little mf gravel, trace silt/clay					1.40	9.1

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-11	25.40	1.07	0.417	0.1164	18	74	7.4	

ATLANTIC TESTING LABORATORIES, Limited

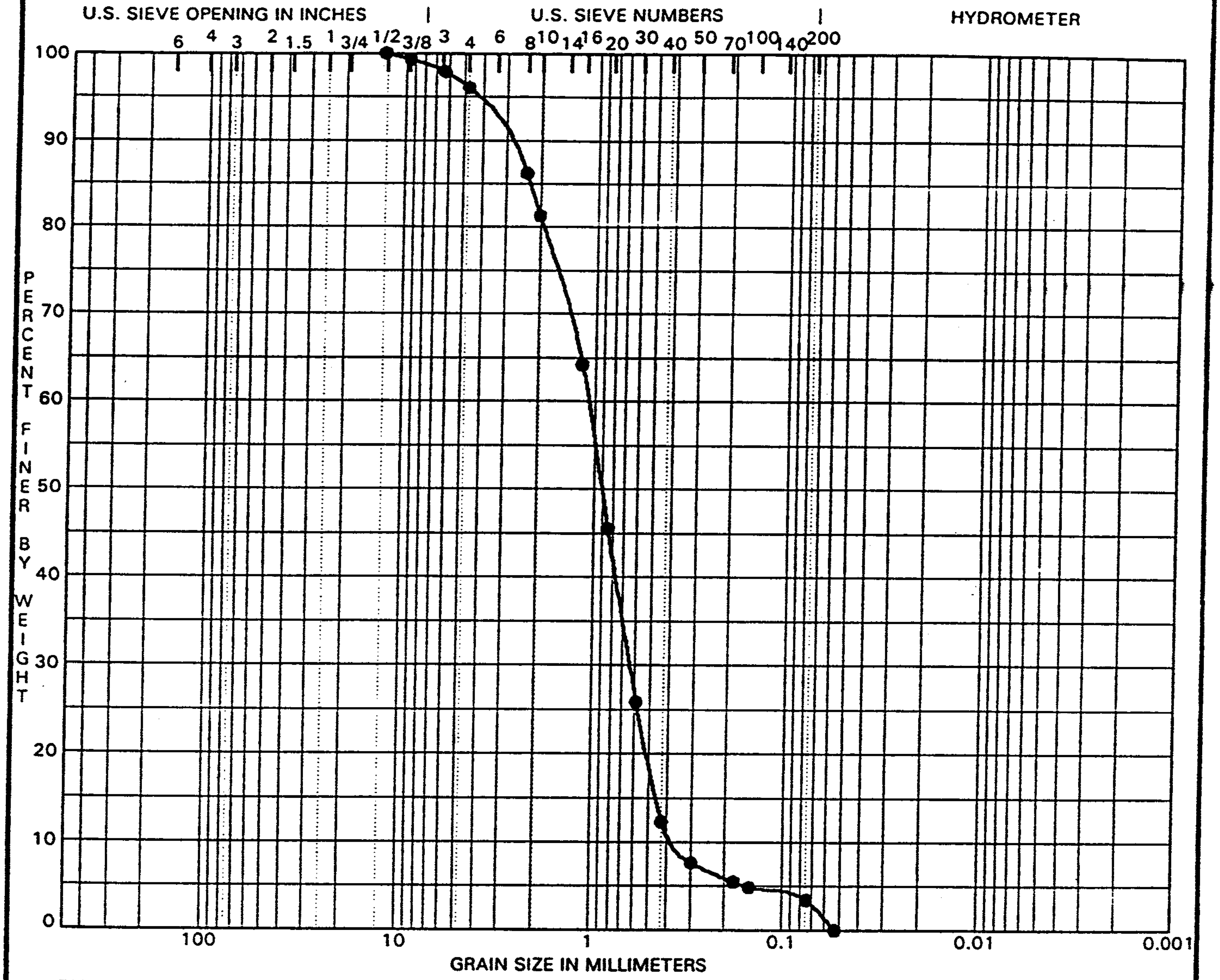
GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling

CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99

DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 2098S-12	Brown cmf sand, trace fine gravel, trace silt/clay					1.03	3.1

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 2098S-12	12.70	1.10	0.638	0.3592	4	93	3.5	

ATLANTIC TESTING LABORATORIES, Limited

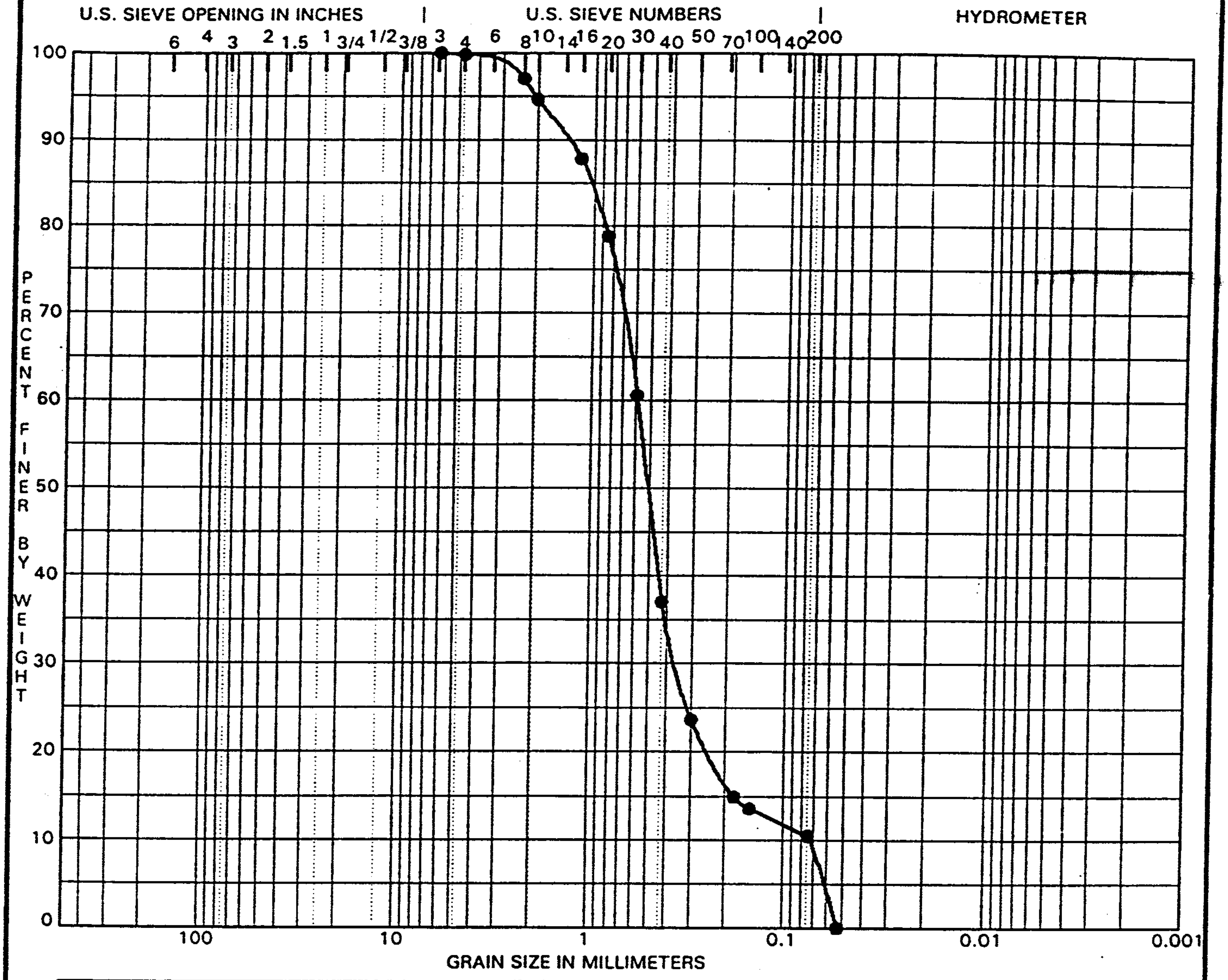
GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling

CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99

DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	2098S-13	Brown cmf sand, little silt/clay					3.10	8.4

	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	2098S-13	6.35	0.59	0.356	0.0738	0	89	10.5	

ATLANTIC TESTING LABORATORIES, Limited

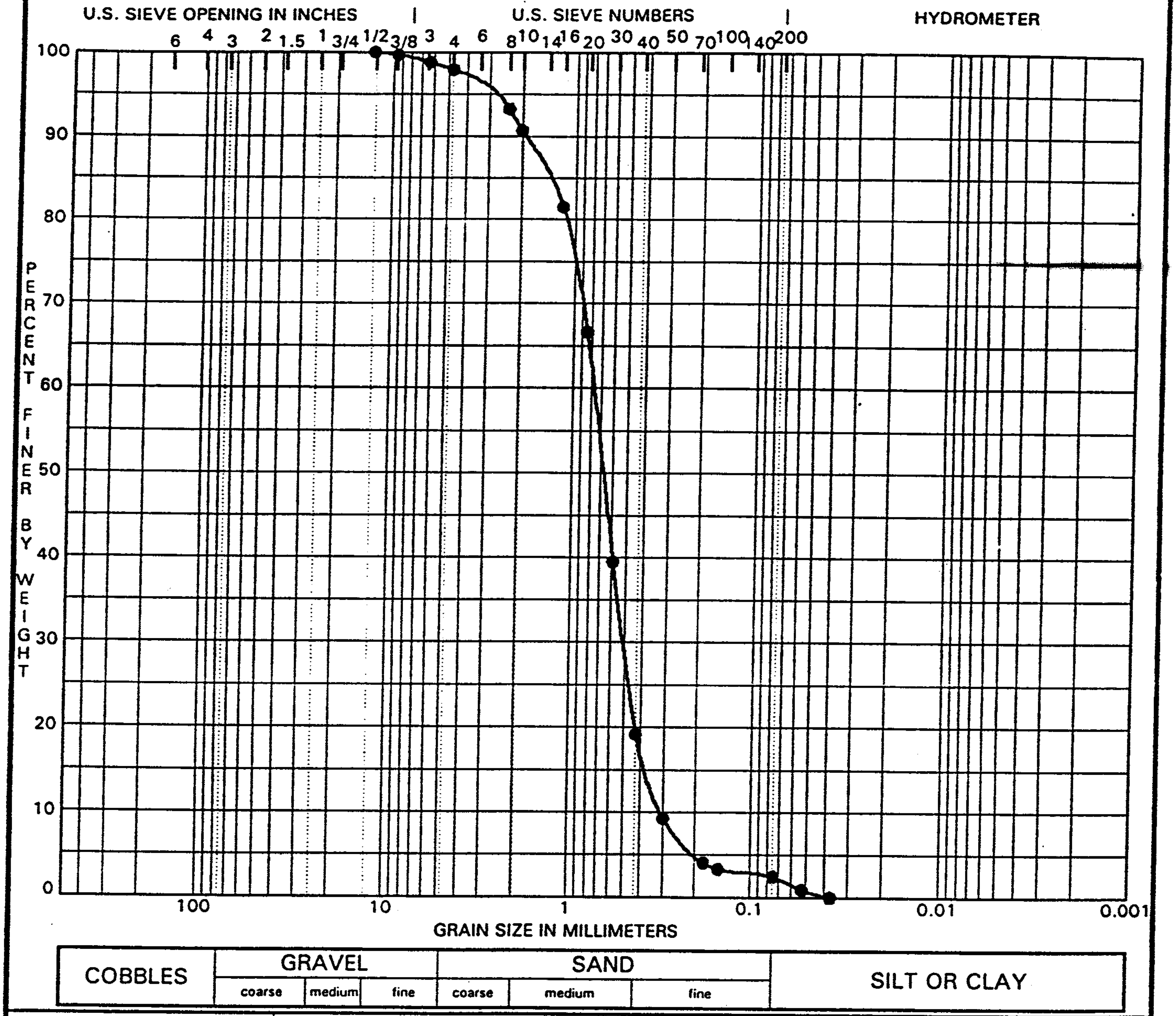
GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling

CLIENT Blasland, Bouck & Lee

REPORT NO. ST2098S-01-12-99

DATE



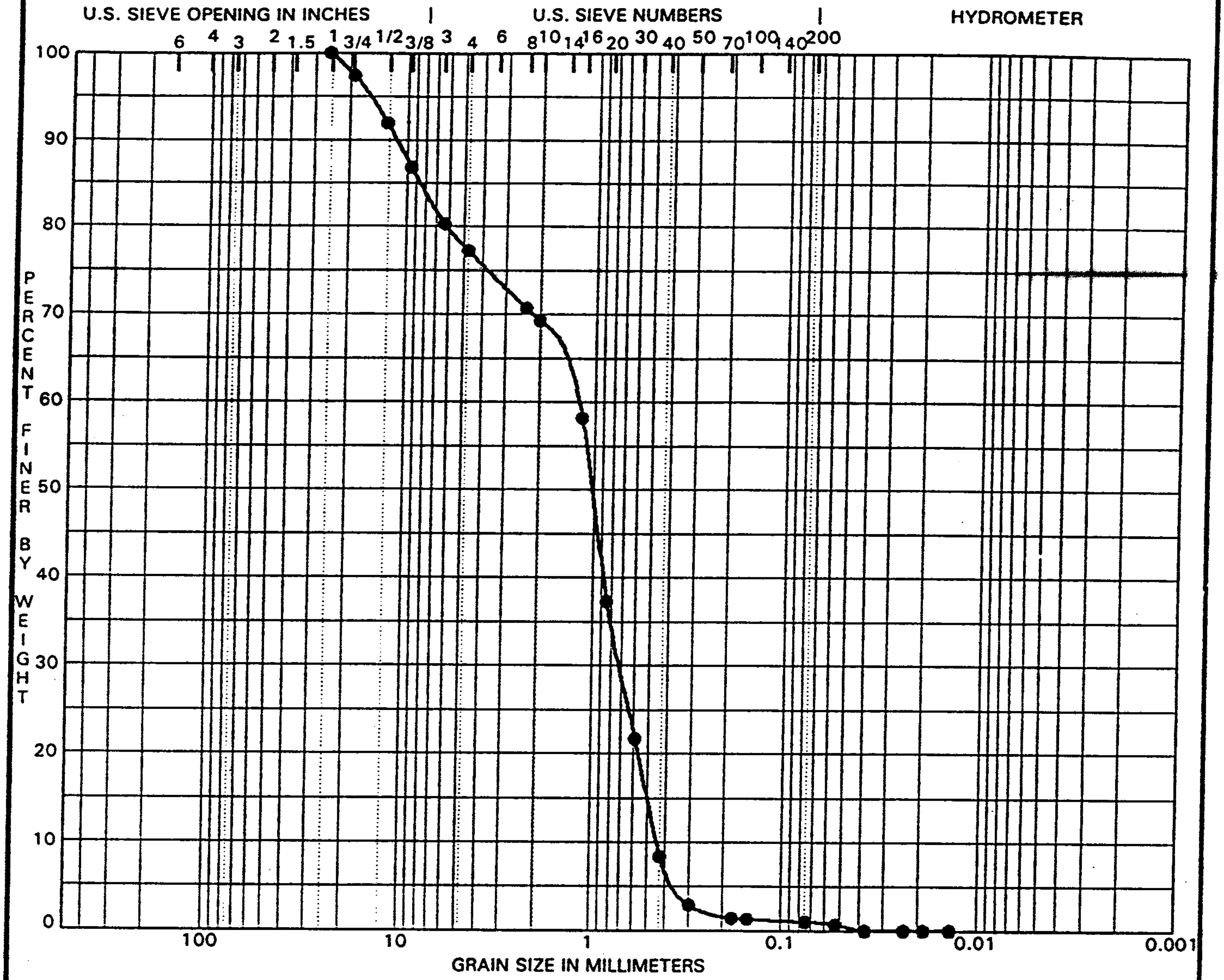
Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 2098S-14	Brown cmf sand, trace silt/clay, trace fine gravel					1.08	2.5

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 2098S-14	12.70	0.78	0.509	0.3077	2	95	2.5	

ATLANTIC TESTING LABORATORIES, Limited

GRADATION CURVES

PROJECT SRSNE Quinnipiac River Sediment Sampling
CLIENT Blasland, Bouck & Lee
REPORT NO. ST2098S-01-12-99
DATE



COBBLES	GRAVEL			SAND			SILT OR CLAY
	coarse	medium	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● 2098S-15	Brown cmf sand, some mf gravel, trace silt/clay					0.89	2.9

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 2098S-15	25.40	1.29	0.717	0.4467	23	76	1.1	

Appendix L

Interim Monitoring and Sampling Data

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Transmitted via Federal Express

December 23, 2004

Ms. Karen Lumino
USEPA Region 1
1 Congress Street, Suite 1100 (HBT)
Boston, MA 02114-2023

Re: SRSNE Site – Southington, Connecticut
Interim Monitoring and Sampling Report No. 13
BBL Project #: 1041.08331 #2.04

Dear Ms. Lumino:

This letter serves as Interim Monitoring and Sampling (IMS) Report Number 13 for the Solvents Recovery Service of New England (SRSNE) Superfund Site in Southington, Connecticut (Figure 1). This letter summarizes the results of the thirteenth IMS event, which Blasland, Bouck & Lee, Inc. (BBL) completed at the SRSNE Site on October 25 to 28, 2004. The October 2004 IMS event included groundwater sampling at 25 monitoring wells and surface water sampling at three locations along the Quinnipiac River. These biannual sampling locations were identified in the final IMS Plan (IMSP; BBL, November 1998).

Introduction

The primary purpose for the IMS program is to monitor the nature and extent of the plumes of dissolved volatile organic compounds (VOCs) associated with the SRSNE Site until the issuance of the Record of Decision (ROD). The VOC plumes were delineated in the shallow, middle, and deep overburden and the shallow and deep bedrock during the completion of the final Remedial Investigation Report (RI Report; BBL, June 1998). Surface water quality in the Quinnipiac River was also characterized during the completion of the RI. The IMS program is required by the Administrative Order on Consent (AOC) to detect any temporal changes in the plume dimensions, which may influence the appropriateness or location of the remedial technologies considered in the Feasibility Study (FS) or selected as part of the ROD. In addition, sampling is performed to assess temporal groundwater quality trends within the interior of the plumes. Lastly, surface water sampling is included to confirm the interpretation that VOCs associated with the site do not adversely impact surface water quality within the Quinnipiac River.

Background

The IMS locations and methods were described in the final IMSP, which BBL prepared on behalf of the SRSNE Site Potentially Responsible Parties (PRP) Group (the Group) and submitted to the United States Environmental Protection Agency (USEPA) and the Connecticut Department of Environmental Protection (CT DEP) on November 24, 1998. The final IMSP addressed the USEPA comments presented in letters dated October 1, 1998 and October 30, 1998, and addressed USEPA conditions for IMSP approval, as presented in the USEPA letter dated October 30, 1998. The final IMSP included a total of 25 biannual groundwater sampling locations, which are shown on Figures 2 through 6, and three surface water sampling locations shown on Figure 7. The remainder of this letter summarizes groundwater and surface water sampling, and the analytical results from the October 2004 IMS event.

Groundwater Sampling

On October 25 to 28, 2004, 25 groundwater samples (not including the associated quality assurance/quality control [QA/QC] samples) were obtained at the following locations:

- Shallow overburden monitoring wells – MWL-312, P-13, and P-101C (Figure 2);
- Middle overburden monitoring wells – CW-B-77, MW-3, MW-127B, MW-205B, MW-501B, and P-101B (Figure 3);
- Deep overburden monitoring wells – CW-4-75, MW-4, MW-204B, MW-502, MW-704D, and MW-707D (Figure 4);
- Shallow bedrock monitoring wells – MW-127C, MW-128, MW-204A, MW-205A, MW-501A, and P-11A (Figure 5); and
- Deep bedrock monitoring wells – MW-703DR, MW-704DR, MW-706DR, and MW-707DR (Figure 6).

BBL sampled all of the wells listed above between October 25 to 28, 2004, for analysis of Target Compound List (TCL) VOCs by SW-846 Method 8260 (including tetrahydrofuran) at Columbia Analytical Services (Columbia) of Rochester, New York. In addition, as discussed during a meeting between the USEPA, CT DEP, and the SRSNE PRP Group in Boston on February 10, 2004, Columbia also analyzed the groundwater samples for 1,4-dioxane by SW-846 Method 8720C. Groundwater sampling, documentation, preservation, handling, shipment, and analysis were performed in general accordance with the procedures specified in the USEPA-approved Project Operations Plan (POP; BBL, August 1996). Each sampled well was purged prior to sampling following traditional procedures (i.e., until three to five well volumes were removed, or until the well was purged dry, and then allowed to partially or fully recharge to allow sampling). Well purging was accomplished using a decontaminated submersible (Whale^{TM}) pump with polyethylene tubing, an inertia (Waterra^{TM}) pump with decontaminated, high density polyethylene tubing, or a new dedicated disposable polyethylene bailer. In accordance with the POP, QA/QC samples were also obtained and shipped to Columbia for analysis, including trip blanks, field duplicates, rinse blanks, matrix spikes, and matrix spike duplicates. The analytical results from these samples are listed, along with historical monitoring results from the same wells, in Table 1. The new analytical results from these wells are depicted in regulatory VOC plume maps on Figures 2 through 6. These figures are based on similar plume maps presented in the final RI Report and previous IMS reports, with slight modifications to reflect the October 2004 analytical results. In this document, the term “regulatory plume” denotes the zone where VOC concentrations in groundwater exceed drinking water standards. In addition, Figures 8 through 12 summarize the October 2004 groundwater analytical results for 1,4-dioxane.

Surface Water Sampling

Three surface water samples were obtained on October 25, 2004, at locations SW-C, SW-F, and SW-G, shown on Figures 7 and 13. The surface water sampling procedures, described in detail in RI Work Plan Addendum No. 6 (BBL, December 16, 1996), were consistent with the surface water sampling methods previously implemented by HNUS (May, 1994). Each sample was obtained using a new, dedicated, certified-clean, glass sample collection jar (40 milliliter [mL] volatile organic analyte [VOA] vial). Each sample was transferred from the sample collection jar into appropriate sample vials, and shipped to Columbia for analysis of TCL VOCs by SW-846 Method 8260 and 1,4-dioxane by USEPA Method 8270C. QA/QC samples were also obtained and shipped to Columbia for analysis, including a trip blank, field duplicate, matrix spike, and matrix spike duplicate. The new and historical analytical results from these sampling locations are summarized in Table 1 and on Figure 7 and 13.

Analytical Results

The VOC analytical results of the groundwater and surface water samples obtained during the October 2004 IMS event are listed in Table 1 and summarized on Figures 2 through 7. The analytical results from 1,4-dioxane analysis are listed in Table 1 and summarized on Figures 8 through 13. Results of QA/QC samples are as follows:

- Rinse blanks – none detected; and
- Trip blanks – none detected.

The key findings from the groundwater and surface water sample results are discussed below.

Groundwater

In general, the groundwater analytical results from the October 2004 IMS event indicate relatively steady VOC concentrations near the edges of the regulatory VOC plumes. The regulatory plumes were initially delineated in the final RI Report based on groundwater sampling performed between November 1996 and February 1997. Figures 2 through 6 show the current delineation of the regulatory plumes based on the October 2004 groundwater analytical results and further data interpretation.

At the 25 biannual monitoring locations, the following concentration changes are noted versus the concentrations reported in the final RI Report (excluding low concentrations of B-qualified data; see Table 1):

- Twenty-two wells indicated lower total VOC concentrations in October 2004.

- One well indicated negligible (i.e., less than 10%) change in total VOC concentrations.

- Two wells indicated a slightly higher total VOC concentration in October 2004 (MW-502 and MW-707DR).

Note that the highest relative increase in total VOC concentrations between the completion of the RI and the October 2004 IMS a change from non-detect to 9.8 ug/L total VOCs at monitoring well MW-707DR. The October 2004 data indicated a general decrease in total VOC concentrations at the IMS wells since the completion of the RI. Attachment 1 includes a graphical summary of total VOC concentration trends versus time at the IMS wells between 1995 and October 2004.

Figures 2 through 6 depict the regulatory VOC plumes in the five monitored hydrostratigraphic intervals. These figures are based on similar maps presented in the final RI Report, with appropriate modifications to reflect the October 2004 sampling results and further data evaluation. The October 2004 data indicate that, in general, the VOC plumes in the overburden and bedrock have remained relatively constant or have decreased in the downgradient (south-southeast) direction in the approximately 8-year period since the final RI sampling event. The current extent of the delineated plumes is consistent with the assumptions used as a basis for the Feasibility Study.

Natural Attenuation

During the completion of the RI, natural attenuation of dissolved VOCs was demonstrated within each of the five monitored hydrostratigraphic zones (BBL, June 1998). While the October 2004 sampling event did not generate new data regarding biologic or geochemical indicators of natural attenuation, such parameters were characterized in detail in during the completion of the RI. Degradation daughter compounds continue to be observed in the groundwater analytical data from the site. Among the degradation products detected in October 2004 were: 1) vinyl chloride, which is a product of more highly chlorinated alkenes, and degrades further to ethene; 2) chloroethane, which is a product of more highly chlorinated alkanes, and degrades further to ethane; and 3) several other higher-order breakdown products. The following noteworthy examples of degradation were observed in October 2004:

- Chloroethane was detected at: shallow overburden monitoring well P-101C; middle overburden monitoring well P-101B; deep overburden monitoring wells MW-04, MW-502 and MW-704D; shallow bedrock monitoring wells MW-127C, P-11A; and deep bedrock monitoring well MW-704DR.

- Vinyl chloride was detected at: shallow overburden well P-101C; middle overburden monitoring well P-101B; shallow bedrock monitoring well P-11A; and deep bedrock monitoring well MW-704DR.

These data indicate that VOC degradation processes are continuing in the downgradient and interior portions of the plume.

Regional Groundwater Hydraulics

In addition to natural attenuation, regional groundwater hydraulics are likely helping to limit the downgradient extent of the VOC plume in the bedrock. As described in the final RI Report, the vertical component of the hydraulic gradient within the bedrock beneath the Town of Southington Well Field Property is generally upward, as groundwater discharges upward from the bedrock to the overburden, and eventually discharges to the Quinnipiac River (BBL, June 1998). The upward migration of deep bedrock groundwater to the shallow bedrock, and from the shallow bedrock to the overburden within the Town Well Field Property, limits the lateral distance to which VOCs may migrate downgradient from the site. It is noteworthy that eight of the ten shallow bedrock and deep bedrock monitoring wells included in the IMS program had lower total VOC concentrations in October 2004 than during the completion of the RI. Of the two remaining shallow and deep bedrock IMS monitoring wells, well MW-707DR increased from ND to 9.8 ug/L total VOCs during the same period and well MW-703DR was ND during both events.

VOC Concentration Trends within Interior of Plumes

At the wells situated in the interior of the plumes, VOC concentration changes were variable since the final RI sampling event. Total VOC concentrations have decreased at monitoring wells P-11A, P-101B, and P-101C. There was a less than 10% decrease in total VOC concentrations at MW-706DR, and the total VOC concentrations have increased slightly at monitoring well MW-502. The highest total VOC concentration in the data set, approximately 48,000 ug/L, was detected at deep overburden monitoring well MW-502. During the completion of the RI, this well was interpreted as being situated in close proximity to non-aqueous phase liquids (NAPLs) in the saturated overburden. The October 2004 IMS data are consistent with this interpretation. Another possible explanation for the persistent, elevated VOC concentrations at well MW-502 could be the upward discharge of groundwater containing VOCs from the shallow bedrock; an upward hydraulic gradient generally exists between the shallow bedrock and the deep overburden in that area. Little net reduction in total VOC concentrations is expected within the interior of the VOC plumes due to ongoing NAPL dissolution. Nevertheless, as discussed above, VOCs continue to degrade in this area.

1,4-Dioxane Groundwater Analytical Data

As discussed during a meeting between the USEPA, CT DEP, and the SRSNE PRP Group in Boston on February 10, 2004, the October 2004 groundwater samples were also analyzed for 1,4-dioxane by SW-

846 Method 8720C. Table 1 and Figures 8 through 12 summarize the groundwater analytical results for 1,4-dioxane. The spatial distribution of detectable 1,4-dioxane in groundwater was similar to the distribution of VOCs above regulatory criteria. Eleven of the 17 IMS monitoring wells beyond the limits of the regulatory VOC plumes reported no detectible 1,4-dioxane. The remaining six wells that are *outside of* the regulatory VOC plumes reported 1,4-dioxane concentrations up to 23 ug/L at deep bedrock monitoring well MW-707DR. The highest concentration of 1,4-dioxane, 3,000 ug/L, was reported in the interior of the VOC plume at deep overburden monitoring well MW-502 (Figure 10); this monitoring well also had the highest reported total VOC concentration.

Another round of groundwater samples will be obtained from the 25 IMS monitoring wells for 1,4-dioxane analysis in April 2005.

Surface Water

The surface water analytical results from sampling locations SW-C, SW-F, and SW-G are consistent with surface-water quality data obtained during the RI. No VOC detections were reported at stream monitoring locations SW-C and SW-G during the October 2004 IMS event (Figure 7). In addition, 1,4-dioxane was not detected in any of the October 2004 surface water samples (Figure 13).

These data confirm previous surface water sampling results, indicating essentially no impact to surface water quality in the Quinnipiac River east of the SRSNE Site. These same three surface water sampling locations (SW-C, SW-F, and SW-G) are proposed for further sampling in April 2005. In addition, April 2005 surface-water samples will be analyzed again for 1,4-dioxane.

Schedule

The next biannual IMS event is currently scheduled for the week of April 25 to 29, 2005. The results of the April 2005 sampling event will be presented in IMS Report No. 14, which is currently scheduled to be submitted to USEPA by July 13, 2005.

We trust this information meets your needs. If you have any questions, please do not hesitate to call Mr. Bruce Thompson of de maximis, inc. at (860) 298-0541.

Sincerely,

BLASLAND, BOUCK & LEE, INC.

Michael J. Gefell, P.G.
Vice President

MJG/GRC/plf
Attachments

cc: Mike Beskind, CT DEP
Liyang Chu, Tetra Tech NUS
SRSNE Technical Committee
Bruce Thompson, de maximis, inc.
Gary Cameron, Blasland, Bouck & Lee, Inc.

Table

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			**CW-4-75**												
SCREEN	**CRITERIA**		**D**												
SAMPLE DATE	**Conn.**	**US EPA**	**9/1/82**	**5/1/83**	**11/21/96**	**12/1/98**	**5/18/99**	**11/2/99**	**4/26/00**	**10/24/00**	**4/24/01**	**10/23/01**	**4/23/02**	**10/22/02**	**4/21/03**
SAMPLE TYPE	**GA/GAA**	**MCLs**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**
1,1,1-Trichloroethane	200	200	**36**	ND	**2.0**	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U	1.0 U	**1**	**0.64 J**	**1.6**	**2.4**
1,1,2,2-Tetrachloroethane	0.5	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	ND	ND	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	7.0	7.0	ND	ND	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U
1,2-Dibromoethane	0.05	0.05	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	5.0	5.0	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	ND	- -	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	- -	- -	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	- -	- -	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	- -	- -	5.0 U	5.0 U	**6.0**	**10**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	ND	ND	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	**2.0 B**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	NL	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	5.0	5.0	ND	ND	2.0 U	2.0 U	2.0 U	**2.0**	**2.0 B**	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	NL	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	ND	ND	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	- -	- -	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	1,000	1,000	ND	ND	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	**2.0**	ND	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**38**	ND	**2.0**	ND	**6.0**	**12**	**5.0 B**	ND	ND	**1**	**0.64**	**1.6**	**2.4**
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			CW-4-75			CW-B-77											
SCREEN	CRITERIA		D			M											
SAMPLE DATE	Conn.	US EPA	10/21/03	4/20/2004	10/27/04	5/1/83	7/1/84	4/1/85	12/13/90	12/11/96	12/2/98	5/18/99		11/2/99	4/25/00	10/25/00	4/25/01
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	**1.4**	**1.2**	1.0 U	**57**	**97**	ND	**20**	**24**	**14**	**4.0**	**4.0**	1.0 U	**6.0**	**11**	**3**
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	1.0 U	1.0 U	1.0 U	**223**	**26**	**230**	**16**	**13**	**10**	**4.0**	**4.0**	1.0 U	**2.0**	**6.0**	**2**
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	ND	ND	ND	2.0 U	**4.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	2.0 U	2.0 U	2.0 U	- -	- -	- -	- -	11 U	**5.0**	**2.0**	**2.0**	2.0 U	**1.0 J**	**5.0**	**2**
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	- -	ND	ND	20 U	**9.0**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	- -	- -	- -	- -	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	- -	- -	- -	- -	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	- -	- -	- -	- -	5.0 U	5.0 U	5.0 U	5.0 U	**8.0**	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	ND	ND	ND	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	**2.0 B**	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	11 U	**5.0**	**2.0**	**2.0**	1.0 U	**1.0**	**4.0**	**1**
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	**11**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	**9.0**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	ND	ND	ND	2.0 U	2.0 U	**2.0**	2.0 U	2.0 U	**2.0**	2.0 U	**3.0 B**	2.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	ND	ND	ND	2.0 U	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	- -	- -	- -	- -	10 U	1.0 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	ND	ND	**550**	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	- -	- -	- -	**7.8**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	ND	ND	ND	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	- -	- -	- -	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	- -	- -	- -	- -	**12**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**1.4**	**1.2**	ND	**280**	**123**	**780**	**44**	**75**	**33**	**10**	**10**	**10**	**11 B**	**25 B**	**6**
1,4-Dioxane	NL	NA	--	1.9 U	1.9 U	--	--	--	--	--	--	--	--	--	--	--	--

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TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			CW-B-77							MW-03								
SCREEN	CRITERIA		M							M								
SAMPLE DATE	Conn.	US EPA	10/24/01	4/23/02	10/22/02	4/22/03	10/21/03	4/20/2004	10/28/04	12/5/96	12/2/98	5/19/99	11/4/99	4/25/00	10/25/00	4/24/01	10/24/01
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	**200**	**200**	1.0 U	**1.9**	**13**	**2.1**	**1.1**	**5**	**4.4**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	**2**	**2.5**	**6.2**	**4.1**	**1.5**	**1.4**	**2**	**2.0**	**7.0**	**41 D**	**16**	**26**	**4.0**	**14**	**2**
1,1-Dichloroethene	**7.0**	**7.0**	1.0 U	1.0 U	**1.4**	**0.56 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	**0.05**	**0.05**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	2.0 U	**0.95 J**	**4.9**	**4**	**1.2**	**2**	**2.2**	**4.0**	**3.0**	**12**	**6.0**	**9.0**	**1.0 J**	**4**	**0.50 J**
1,2-Dichloropropane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**5.5**	5.0 U	5.0 U	5.0 U	**5.0**	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**6.0**	**2.0**	**4.0**	**4.0**	**5.0**	1.0 U	**4.0**	1.0 U
Bromochloromethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	1.0 U	1.0 U	1.0 U	**0.35 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**2.0 B**	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**3.0**	**1.0**	**3.0**	**2.0**	**3.0**	1.0 U	**3**	1.0 U
Chlorodibromomethane	**0.5**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**28 E**	**7.0**	**42 D**	**11**	**32**	1.0 U	**10**	1.0 U
Chloroform	**6.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	1.0 U	**0.95 J**	**4.9**	**4**	**1.2**	**2**	**2.2**	**4.0**	**3.0**	**12**	**6.0**	**8.0**	**1.0**	**4**	**0.50 J**
cis-1,3-Dichloropropene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	**5.0**	**5.0**	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	**2.0**	2.0 U	**2.0**	2.0 U	2.0 U	2.0 U	2.0 U
O-Xylene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	**12**	**6.0**	**8.0**	3.0 U	**11**	5.0 U
Toluene	**1,000**	**1,000**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.60 J**
Vinyl Chloride	**2.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**3.0**	**1.0**	**6.0**	**2.0**	**5.0**	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**2**	**5.3**	**26**	**11**	**3.8**	**8.4**	**14.1**	**47 E**	**23**	**120 D**	**60**	**89 B**	**5.0 J**	**46**	**3.1 J**
1,4-Dioxane	**NL**	**NA**	--	--	--	--	--	1.9 U	1.9 U	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-03						MW-04								
SCREEN	CRITERIA		M						D								
SAMPLE DATE	Conn.	US EPA	4/23/02	10/22/02	4/22/03	10/21/03	4/20/2004	10/27/04	12/5/96	12/2/98	5/19/99	11/4/99	4/26/00	10/25/00	4/24/01	10/24/01	4/23/02
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0	1.0 U	1.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	0.68 J	1.4	4.7	1.9	3.5	1.0 U	4.0	2.0	2.0	3.0	1.0 U	6.0	1.0 U	1.0 U	7.7
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	2.0 U	2.0 U	1.3	2.0 U	2.0 U	2.0 U	39	17	18	9.0	2.0 U	4.0	5	2.0 U	2.4
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.1	5.0 U	5.0 U	5.0 U	8.0	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 B	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	0.66 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0	1.0 U	1.0 U	3.0	1.0 U	2.0	1.0 U	1.0 U	1.2
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	1.0 U	1.0 U	1.3	1.0 U	1.0 U	1.0 U	32 D	16	18	9.0	1.0 U	3.0	5	1.0 U	2.4
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0	2.0 U	2.0	3.0 B	3.0 B	4	2.0 U	1.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0	1.0	2.0	0.80 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	12	8.0	12	7.0	2.0	2.0	4	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			0.68	1.4	6.7	1.9	3.5	5.1	51 D	30	35	42 J	7.0 B	16 B	13	ND	11
1,4-Dioxane	NL	NA	--	--	--	--	21	9.1	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-04					MW-127B								
SCREEN	CRITERIA		D					M								
SAMPLE DATE	Conn.	US EPA	10/23/02	4/22/03	10/21/03	4/22/2004	10/27/04	8/13/91	12/4/92	11/29/94	3/23/95	11/21/96	12/2/98	5/18/99	11/1/99	4/24/00
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	**200**	**200**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	4.0 UJ	10 U	**3.9 J**	**3.6 J**	**4.0**	1.0 U	1.0 U	**1.0**	1.0 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	**5.6**	1.0 U	1.0 U	1.0 U	1.0 U	**6.0 J**	**3.0 J**	**3.1 J**	5.0 U	**8.0**	1.0 U	1.0 U	**2.0**	1.0 U
1,1-Dichloroethene	**7.0**	**7.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	**0.05**	**0.05**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	**2**	2.0 U	2.0 U	2.0 U	2.0 U	- -	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	R	10 U	25 U	25 U	19 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	R	10 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	10 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	R	10 U	25 U	**18 J**	8.0 U	5.0 U	5.0 U	**7.0**	5.0 U
Benzene	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	R	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.50 J**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	**0.5**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	- -	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	**4.6**	1.0 U	**1**	1.0 U	**1.3**	2.0 UJ	10 U	5.0 U	5.0 U	**6.0**	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	**6.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	**2**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.50 J**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	3.0 UJ	10 U	10 U	10 UB	3.0 U	**2.0**	2.0 U	**4.0 B**	**8.0 B**
O-Xylene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	- -	- -	25 U	25 U	10 U	1.0 U	1.0 U	3.0 U	3.0 U
Toluene	**1,000**	**1,000**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	1.0 U	**1.6**	1.0 U	1.0 U	1.0 U	**0.40 J**	10 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	**2.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**1.0 J**	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**12**	**1.6**	**1**	ND	**1.3**	**8.4 J**	**3.0 J**	**7.0 J**	**22 J**	**18**	**2.0**	ND	**14 B**	**8.0 B**
1,4-Dioxane	**NL**	**NA**	--	--	--	1.9 U	**21**	--	--	--	--	--	--	--	--	--

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TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-127B											MW-127C			
SCREEN	CRITERIA		M											R			
SAMPLE DATE	Conn.	US EPA	10/24/00		4/24/01	10/23/01	4/23/02	10/22/02	4/22/03	10/22/03	4/21/04	10/27/04		8/13/91	12/4/92		11/29/94
SAMPLE TYPE	GA/GAA	MCLs	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	DUP	FS
1,1,1-Trichloroethane	200	200	1.0 U	1.0 U	1.0 U	**1**	**1.1**	**1.3**	**3.5**	**1.8**	**1.8**	**1.2**	**1**	12 UJ	**10**	**10**	**24**
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	5.0 U
1,1-Dichloroethane	70	NA	1.0 U	1.0 U	1.0 U	1.0 U	**1.1**	1.0 U	**0.79 J**	1.0 U	1.0 U	1.0 U	1.0 U	**37 J**	**21**	**21**	**35**
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**4.0 J**	**3.0 J**	**3.0 J**	5.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	- -	- -	- -
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	- -
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0 J**	10 U	10 U	5.0 U
1,2-Dichloroethene (Total)	NL	NA	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**0.88 J**	2.0 U	2.0 U	2.0 U	2.0 U	- -	**3.0 J**	**3.0 J**	5.0 U
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	- -
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	- -
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	R	10 U	10 U	25 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	R	10 U	10 U	25 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**13 J**	10 U	10 U	25 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	R	10 U	10 U	25 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**3.0 J**	**2.0 J**	**2.0 J**	5.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	- -
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	10 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	R	10 U	10 U	5.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0 J**	10 U	10 U	5.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.90 J**	10 U	10 U	5.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	- -
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**33 J**	**29**	**28**	5.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 UJ	10 UJ	10 U
cis-1,2-Dichloroethene	70	70	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.88 J**	1.0 U	1.0 U	1.0 U	1.0 U	**7.0 J**	- -	- -	- -
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**12 J**	**7.0 J**	**7.0 J**	5.0 U
M,P-Xylene	NL	NL	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -
Methylene chloride	5.0	5.0	2.0 U	**2.0 B**	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	3.0 UJ	10 U	10 U	10 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
Tetrahydrofuran	NL	NA	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	- -	- -	- -	25 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**2.9**	1.0 U	1.0 U	17 UJ	10 U	10 U	5.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.20 J**	- -	- -	- -
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	10 U	10 U	5.0 U
Trichloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.80 J**	10 U	10 U	5.0 U
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**3.0 J**	10 U	10 U	10 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	8.0 UJ	10 U	10 U	5.0 U
Total Volatile Organics			ND	**2.0 B**	ND	**1**	**2.2**	**1.3**	**5.2**	**1.8**	**4.7**	**1.2**	**1**	**116 J**	**75 J**	**74 J**	**59**
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	--	1.9 U	1.9 U	2.0 U	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-127C													
SCREEN	CRITERIA		R													
SAMPLE DATE	Conn.	US EPA	3/23/95		11/21/96	12/3/98	5/19/99	11/1/99	4/26/00		10/24/00	4/25/01		10/24/01	4/24/02	10/22/02
SAMPLE TYPE	GA/GAA	MCLs	FS	DUP	FS	FS	FS	FS	FS	DUP	FS	FS	DUP	FS	FS	FS
1,1,1-Trichloroethane	200	200	**31**	**31**	**78 DJ**	**10**	**8.0**	**8.0**	**6.0**	**6.0**	**8.0**	**6**	**5**	**12**	**11**	**9.4**
1,1,2,2-Tetrachloroethane	0.5	NA	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	**30**	**30**	**36 D**	**15**	**14**	**13**	**8.0**	**7.0**	**12**	**8**	**9**	**13**	**10**	**8.7**
1,1-Dichloroethene	7.0	7.0	**4.3 J**	**4.1 J**	**9.0**	**3.0**	**2.0**	**3.0**	**2.0**	**2.0**	**3.0**	**2**	**2**	**5**	**2.2**	**1.7**
1,2-Dibromo-3-chloropropane	In Review	0.2	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	**7.0**	**7.0**	**10**	**2.0**	**3.0**	**4.0**	**2.0**	**2.0**	**3.0**	**3**	**3**	**4**	**3.5**	**2.8**
1,2-Dichloropropane	5.0	5.0	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	5.0 U	5.0 U	1.0 U	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**2.0 B**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	**9.0**	**10**	**7.0**	**18**	1.0 U	**4.0**	**1.0**	1.0 U	**5.0**	1.0 U	**2**	**3**	**2.8**	**1.7**
Chloroform	6.0	80	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	- -	- -	**9.0**	**2.0**	**3.0**	**3.0**	**2.0**	**2.0**	**3.0**	**2**	**2**	**4**	**3.5**	**2.8**
cis-1,3-Dichloropropene	NL	NA	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Methylene chloride	5.0	5.0	10 U	10 UB	2.0 U	**7.0 B**	**2.0 B**	2.0 U	2.0 U	**3.0 B**	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
O-Xylene	NL	NA	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	25 U	25 U	**8.0 J**	**6.0**	1.0 U	**4.0**	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	**4**	**0.99 J**	5.0 U
Toluene	1,000	1,000	**2.8 J**	**2.3 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.70 J**	**0.70 J**	1.0 U
Vinyl Chloride	2.0	2.0	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**84 J**	**84 J**	**147 DJ**	**62 B**	**29 B**	**39**	**19**	**22 B**	**31**	**18**	**20**	**42**	**31**	**24**
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--

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TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-127C				MW-128										
SCREEN	CRITERIA		R				R										
SAMPLE DATE	Conn.	US EPA	4/22/03	10/22/03	4/21/04	10/27/04	8/29/91	11/29/94	3/23/95	11/21/96	12/2/98	5/19/99	11/2/99	4/25/00	10/25/00	4/24/01	10/23/01
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	**17**	**20**	**8.8**	**8.1**	5.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	**2.0**	**1.0**	**2.0**	**3.0**	**2**	**3**
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	**11**	**8.1**	**6.5**	**6.7**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.50 J**
1,1-Dichloroethene	7.0	7.0	**3**	**2.9**	**2**	**2.2**	**1.1 J**	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	**1.0**	**1**	**1**
1,2-Dibromo-3-chloropropane	In Review	0.2	2.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	**7.6**	**6.6**	**3.6**	**3.6**	- -	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**0.60 J**
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	R	25 U	25 U	33 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	R	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 UJ	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	R	25 U	**15 J**	5.0 U	**7.0**	**6.0 B**	**5.0**	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	R	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	**1.1**	1.0 U	1.0 U	**1.1**	2.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	**7.6**	**6.6**	**3.6**	**3.6**	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.60 J**
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.2 UJ	10 U	10 UB	3.0 U	**2.0**	**2.0 B**	**2.0**	**6.0 B**	**3.0 B**	2.0 U	2.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	**2.5 J**	5.0 U	5.0 U	5.0 U	- -	25 U	25 U	**12**	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	**6.6**	**1.2**	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	**0.86 J**	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	6.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	1.0 UJ	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**43**	**38**	**27.5**	**22.9**	**1.1 J**	ND	**15 J**	**13**	**9.0**	**10 B**	**8.0**	**9.0 B**	**7.0 B**	**3**	**5.1 J**
1,4-Dioxane	NL	NA	--	--	**4.7**	**11**	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-128						MW-204A							
SCREEN	CRITERIA		R						R							
SAMPLE DATE	Conn.	US EPA	4/23/02	10/22/02	4/22/03	10/21/03	4/21/04	10/28/04	12/3/92	12/1/94	3/28/95	12/20/96	12/3/98	5/19/99	11/3/99	4/26/00
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	3	2.8	3.3	3.2	2.4	3	6.0 J	8.0 U	3.2 J	1.0 U	1.0 U	1.0 U	3.0	2.0
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	0.63 J	1.0 U	0.87 J	1.0 U	1.0 U	1.0 U	22	16	10	18	1.0 U	2.0	1.0 U	2.0
1,1-Dichloroethene	7.0	7.0	2.3	2.1	2.8	2.2	1.7	2.4	10 U	8.0 U	5.0 U	2.0	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	0.63 J	2.0 U	0.97 J	2.0 U	2.0 U	2.0 U	170	190	110	180 D	17	16	13	29
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	42 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	42 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	42 U	25 U	8.0	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	28	42 U	25 U	24 U	11	5.0 U	5.0	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	7.0 J	8.0 U	5.0 U	1.0	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	17 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	18	8.0 U	5.0 U	9.0	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 UJ	17 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	0.63 J	1.0 U	0.97 J	1.0 U	1.0 U	1.0 U	- -	- -	- -	160 D	16	16	12	29
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	20	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	30 EJ	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	17 U	10 UB	2.0 U	7.0 B	2.0 U	4.0	2.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	9.0 J	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	48 D	1.0 U	1.0	6.0	4.0
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	- -	42 U	25 U	26 E	1.0 U	1.0 U	3.0 U	3.0 U
Toluene	1,000	1,000	0.68 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	13	8.0 U	3.9 J	38 D	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	8.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	1.0 U	1.0 U	0.66 J	1.0 U	1.0 U	1.0 U	30	34	16	300 D	1.0 U	9.0	27	20
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	170	55	10 U	13	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	10 U	8.0 U	5.0 U	39 J	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			7.2	4.9	8.6	5.4	4.1	5.4	464 J	295	143 J	682 DEJ	35 B	28	70	57
1,4-Dioxane	NL	NA	--	--	--	--	1.9 U	1.9 U	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-204A										MW-204B				
SCREEN	CRITERIA		R										D				
SAMPLE DATE	Conn.	US EPA	10/26/00		4/25/01	10/25/01	4/23/02	10/23/02	4/22/03	10/22/03	4/22/04	10/26/04	12/3/92	12/1/94	3/28/95	12/5/96	12/1/98
SAMPLE TYPE	GA/GAA	MCLs	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	1.0 U	1.0 U	**1**	1.0 U	**3.9**	**5.7**	**2.2**	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.5**	**0.80 J**	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	- -	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	**1**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	**4.0**	2.0 U	**8**	**1.0 J**	**5.5**	**7.4**	**2.9**	**1.2**	**1**	**1.4**	**7.0 J**	5.0 U	**2.5 J**	**6.0**	**4.0**
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	- -	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	- -	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U	25 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U	25 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U	25 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U	25 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U	10 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -	5.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 UJ	10 U	10 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	**4.0**	1.0 U	**8**	**1.2**	**5.5**	**7.4**	**2.9**	**1.2**	**1**	**1.4**	- -	- -	- -	**6.0**	**4.0**
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	2.0 U	2.0 U
Methylene chloride	5.0	5.0	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U	10 UB	2.0 U	**1.0 JB**
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	**0.80 J**	1.0 U	**2**	1.0 U	**5.8**	**4.1**	**1.8**	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	- -	25 U	25 U	10 U	1.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	**1.0**	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U	5.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	**4.0**	1.0 U	**11**	**1.8**	**22**	**12**	**7.3**	**3.2**	**1**	**2.4**	10 U	5.0 U	5.0 U	**2.0**	**2.0**
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U	10 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U
Total Volatile Organics			**8.8 J**	ND	**22**	**3 J**	**38**	**31**	**15**	**4.4**	**2**	**3.8**	**7.0 J**	ND	**2.5 J**	**9.0**	**7.0 JB**
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	--	1.9 U	1.9 U	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-204B													MW-205A	
SCREEN	CRITERIA		D													R	
SAMPLE DATE	Conn.	US EPA	5/18/99	11/3/99	4/26/00	10/26/00	4/25/01	10/24/01		4/24/02	10/23/02	4/22/03	10/22/03	4/22/04	10/26/04	12/4/92	11/29/94
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
1,1-Dichloroethane	70	NA	**3.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	- -	- -
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
1,2-Dichloroethene (Total)	NL	NA	**37 D**	**2.0**	**3.0**	**5.0**	**4**	**2**	**2**	**0.74 J**	**1.4**	**1.5**	2.0 U	2.0 U	2.0 U	10 U	5.0 U
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	25 U
Benzene	1.0	5.0	1.0 U	**11**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Chlorobenzene	100	100	1.0 U	**4.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	- -
Chloroethane	NL	NA	1.0 U	**38**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	**0.95 J**	1.0 U	1.0 U	**1.4**	1.0 U	1.0 U	10 U	5.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 UJ	10 U
cis-1,2-Dichloroethene	70	70	**37 D**	**2.0**	**3.0**	**5.0**	**4**	**2**	**2**	**0.74 J**	**1.4**	**1.5**	1.0 U	1.0 U	1.0 U	- -	- -
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
M,P-Xylene	NL	NL	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -
Methylene chloride	5.0	5.0	2.0 U	**3.0**	2.0 U	2.0 U	**2**	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Tetrachloroethene	5.0	5.0	**4.0**	1.0 U	**0.80 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Tetrahydrofuran	NL	NA	1.0 U	**26**	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	- -	25 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	5.0 U
Trichloroethene	5.0	5.0	**23**	**1.0**	**4.0**	**4.0**	**3**	**2**	**2**	**1.5**	**1.3**	1.0 U	**1.3**	1.0 U	1.0 U	10 U	5.0 U
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	10 U	5.0 U
Total Volatile Organics			**69 D**	**87**	**9.8 J**	**9.0**	**9**	**4**	**4**	**3.2**	**2.7**	**1.5**	**2.7**	ND	ND	ND	ND
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	--	--	--	--	1.9 U	1.9 U	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-205A														
SCREEN	CRITERIA		R														
SAMPLE DATE	Conn.	US EPA	3/23/95	11/21/96	12/2/98	5/18/99	11/2/99	4/25/00	10/24/00	4/24/01	10/23/01	4/24/02	10/22/02	4/21/03	10/21/03	4/20/04	10/26/04
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	**200**	**200**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	**4.0 J**	1.0 U	**2.0**	**2.0**	**3.0**	**2.0**	1.0 U	**2**	**8**	**5**	**2**	**0.57 J**	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	**7.0**	**7.0**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	**0.05**	**0.05**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	**4.8 J**	**9.0**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**4**	**2.3**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	**5.0**	**5.0**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	25 U	17 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	25 U	**7.0**	5.0 U	5.0 U	**7.0**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	**1.0**	**5.0**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	**NL**	**NA**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	5.0 U	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.60 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	**0.5**	**80**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	**6.0**	**80**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	- -	**8.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**3**	**2.3**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	**NL**	**NA**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**0.80 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	**5.0**	**5.0**	10 UB	**2.0**	2.0 U	2.0 U	2.0 U	**8.0 B**	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	**NL**	**NA**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	25 U	**6.0 J**	**4.0**	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	**2.0 J**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	**1,000**	**1,000**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.80 J**	1.0 U	1.0 U	**0.49 J**	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	5.0 U	**4.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.87 J**	1.0 U	1.0 U	1.0 U
Vinyl Chloride	**2.0**	**2.0**	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.80 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**1.0 J**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**8.8 J**	**30 J**	**6.0**	**2.0**	**10**	**11 B**	ND	**2**	**16 J**	**7.3**	**2**	**1.9**	ND	ND	ND
1,4-Dioxane	**NL**	**NA**	--	--	--	--	--	--	--	--	--	--	--	--	--	1.9 U	1.9 U

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			**MW-205B**													
SCREEN	**CRITERIA**		**M**													
SAMPLE DATE	**Conn.**	**US EPA**	**12/4/92**	**11/29/94**	**3/23/95**	**11/21/96**	**12/1/98**	**5/19/99**	**11/2/99**	**4/25/00**	**10/24/00**	**4/24/01**	**10/23/01**	**4/23/02**	**10/22/02**	**4/21/03**
SAMPLE TYPE	**GA/GAA**	**MCLs**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**
1,1,1-Trichloroethane	**200**	**200**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	**3.0**	**1.0**	**7.0**	**2.0**	**3**	**0.60 J**	**0.76 J**	1.0 U	**3.3**
1,1-Dichloroethene	**7.0**	**7.0**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	- -	- -	- -	R	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U
1,2-Dibromoethane	**0.05**	**0.05**	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	10 U	5.0 U	5.0 U	R	2.0 U	**3.0**	**2.0**	**4.0**	**1.0 J**	**3**	**0.70 J**	**1.2**	2.0 U	**1.9**
1,2-Dichloropropane	**5.0**	**5.0**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	10 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	10 U	- -	- -	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	10 U	25 U	25 U	20 UJ	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	10 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	10 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	10 U	25 U	**23 J**	9.0 UJ	**10**	5.0 U	**7.0**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	**1.0**	**5.0**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	**NL**	**NA**	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	10 U	10 U	10 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	**0.5**	**80**	10 U	- -	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**6.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	**6.0**	**80**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	10 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	- -	- -	- -	**3.0**	1.0 U	**3.0**	**1.0**	**4.0**	**1.0**	**2**	**0.70 J**	**1.2**	1.0 U	**1.9**
cis-1,3-Dichloropropene	**NL**	**NA**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	- -	- -	- -	R	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**1.0 J**	1.0 U	1.0 U	1.0 U
Methylene chloride	**5.0**	**5.0**	10 U	10 U	10 UB	2.0 UJ	2.0 U	**1.0 JB**	2.0 U	**5.0 B**	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	**NL**	**NA**	- -	- -	- -	R	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.50 J**	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	- -	25 U	25 U	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	**1,000**	**1,000**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.90 J**	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	10 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	10 U	5.0 U	5.0 U	4.0 U	1.0 U	**1.0**	**1.0**	**2.0**	**1.0**	**2**	**1**	**1.5**	1.0 U	**2**
Vinyl Chloride	**2.0**	**2.0**	10 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**1.0 J**	2.0 U	2.0 U	2.0 U
Total Volatile Organics			ND	ND	**23**	**3.0**	**10**	**8.0 JB**	**12**	**24 B**	**4.0 J**	**7**	**4.7 J**	**3.5**	ND	**7.2**
1,4-Dioxane	**NL**	**NA**	--	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-205B			MW-501A											
SCREEN	CRITERIA		M			R											
SAMPLE DATE	Conn.	US EPA	10/21/03	4/20/04	10/26/04	3/24/95	12/3/96	12/2/98	5/20/99		11/3/99	4/26/00	10/25/00	4/26/01	10/25/01	4/25/02	10/23/02
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	1.0 U	1.0 U	1.0 U	5.0 U	3.0	2.0 U	1.0 U	1.0 U	1.0	1.0	0.90 J	1.0 U	0.70 J	1.0 U	1.1
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	1.8	2.7	1.0 U	5.0 U	7.0	3.0	2.0	2.0	2.0	2.0	2.0	2	2	2.1	2.7
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	2.0 U	1.3	2.0 U	45	71 D	34	24 D	23 D	28	29	24	26	28	25	30
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	25 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	25 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	25 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	25 U	5.0 U	10 U	5.0 U	5.0 U	6.0	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	1.0 U	1.3	1.0 U	- -	67 D	32	24 D	23 D	27	31	26	27	26	25	30
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	- -	2.0 U	4.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	10 U	2.0 U	3.0 J	7.0 B	7.0 B	3.0	2.0 U	2.0 B	2.0 U	2.0 U	1.0 U	1.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	5.0 U	2.0	2.0 U	1.0 U	1.0 U	1.0 U	0.80 J	1.0 U	1.0 U	0.60 J	0.67 J	1
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	25 U	10 U	2.0 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	- -	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	1.3	1.2	1.0 U	19	39 D	14	13	13	16	17	14	14	13	12	14
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	10 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	5.0 U	2.0 U	4.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			3.1	5.2	ND	64	118 D	54 J	46 BD	45 BD	83	52 J	45 BJ	43	42 J	40	49
1,4-Dioxane	NL	NA	--	22	11	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION	CRITERIA		MW-501A				MW-501B										
SCREEN			R				M										
SAMPLE DATE	Conn.	US EPA	4/23/03	10/23/03	4/22/04	10/27/04	3/24/95	12/6/96	12/2/98	5/18/99	11/3/99	4/26/00	10/25/00	4/25/01	10/25/01	4/25/02	10/23/02
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	**1.4**	**1**	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1**	1.0 U	**1.3**	**1.6**
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	**3.1**	**2**	**2.2**	**1.5**	5.0 U	**2.0**	1.0 U	1.0 U	**1.0**	1.0 U	1.0 U	**2**	1.0 U	**1.8**	**1.9**
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	2.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	**14**	**9.1**	**7.7**	**5.9**	**34**	**27**	**4.0**	**17**	**17**	**23**	**7.0**	**36**	**6.5**	**35**	**22**
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	25 U	5.0 U	5.0 U	5.0 U	**8.0**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	**14**	**9.1**	**7.7**	**5.9**	- -	**25**	**3.0**	**17**	**16**	**23**	**7.0**	**38**	**6**	**35**	**22**
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	10 U	2.0 U	**2.0**	2.0 U	**3.0**	2.0 U	**3.0 B**	2.0 U	2.0 U	1.0 U	1.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	**1.1**	**1.1**	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1**	1.0 U	**1.4**	**1.7**
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	25 U	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	**18**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	**15**	**12**	**10**	**9.6**	**13**	**24**	**3.0**	**6.0**	**9.0**	**11**	**5.0**	**16**	**4.6**	**18**	**13**
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**35**	**25**	**22**	**17**	**65**	**53**	**9.0**	**23**	**54**	**34**	**15 B**	**58**	**11**	**57**	**40**
1,4-Dioxane	NL	NA	--	--	**2**	**2.2**	--	--	--	--	--	--	--	--	--	--	--

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TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			**MW-501B**				**MW-502**												
SCREEN	**CRITERIA**		**M**				**D**												
SAMPLE DATE	**Conn.**	**US EPA**	**4/23/03**	**10/23/03**	**4/22/04**	**10/27/04**	**3/21/95**	**12/18/96**	**12/3/98**	**5/20/99**	**11/4/99**	**4/27/00**	**10/26/00**	**4/26/01**	**10/26/01**	**4/25/02**	**10/24/02**	**4/24/03**	**10/23/03**
SAMPLE TYPE	**GA/GAA**	**MCLs**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**
1,1,1-Trichloroethane	**200**	**200**	**1.5**	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,1,2-Trichloroethane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,1-Dichloroethane	**70**	**NA**	**2**	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,1-Dichloroethene	**7.0**	**7.0**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	2.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	200 U	100 U
1,2-Dibromoethane	**0.05**	**0.05**	1.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,2-Dichlorobenzene	**600**	**600**	1.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	**1.5**	100 U	100 U	100 U
1,2-Dichloroethane	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,2-Dichloroethene (Total)	**NL**	**NA**	**9**	**2.1**	**1.3**	2.0 U	250 U	2,000 U	400 U	400 U	400 U	200 U	200 U	400 U	1,000 U	**1.2**	200 U	200 U	2.0 U
1,2-Dichloropropane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
1,3-Dichlorobenzene	**600**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	**0.60 J**	100 U	100 U	100 U
1,4-Dichlorobenzene	**75**	**75**	1.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	200 U	--	200 U	100 U	100 U	200 U	500 U	**0.58 J**	100 U	100 U	100 U
2-Butanone	**400**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	**28,000**	5,000 U	**10,000**	**9,600**	**7,800**	**9,900**	**13,000**	**11,000**	**17,000**	**13,000**	**16,000**	**15,000**	**12,000**
2-Hexanone	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	1,300 U	5,000 U	1,000 U	**4,800**	1,000 U	500 U	500 U	1,000 U	2,500 U	**8.5**	500 U	500 U	500 U
4-Methyl-2-pentanone	**350**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	**14,000**	**7,200**	**5,600**	**4,800**	**5,400**	**7,400**	**6,000**	**4,100**	**3,700**	**3,100**	**3,000**	**2,100**	**2,500**
Acetone	**700**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	**44,000**	22,000 U	**14,000**	**18,000**	**11,000**	**11,000**	**11,000**	**9,800**	**14,000**	**11,000**	**13,000**	**13,000**	**12,000**
Benzene	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	**160 J**	1,000 U	200 U	400 U	200 U	**170**	**230**	200 U	500 U	**200**	**180**	**160**	**160**
Bromochloromethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Bromodichloromethane	**0.56**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Bromoform	**4.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Bromomethane	**9.8**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	500 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Carbon Disulfide	**700**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Carbon Tetrachloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Chlorobenzene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	**92**	100 U	**75 J**	100 U
Chlorodibromomethane	**0.5**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Chloroethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	**1,500**	1,000 U	**320**	400 U	**380**	**310**	**430**	200 U	**300 J**	1.0 U	**320**	**230**	**170**
Chloroform	**6.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	2,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Chloromethane	**2.7**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	500 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
cis-1,2-Dichloroethene	**70**	**70**	**9**	**2.1**	**1.3**	1.0 U	- -	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
cis-1,3-Dichloropropene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Ethylbenzene	**700**	**700**	1.0 U	1.0 U	1.0 U	1.0 U	**5,300**	**4,400**	**4,800**	**4,600**	**4,100**	**3,200**	**6,100 D**	**4,300**	**4,700**	**3,800**	**3,300**	**2,200**	**1,900**
M,P-Xylene	**NL**	**NL**	1.0 U	1.0 U	1.0 U	1.0 U	- -	**1,200 J**	**1,500**	**710 J**	**1,500**	**1,200**	**2,200**	**1,700**	**2,100**	**2,100**	**2,100**	**1,500**	**1,300**
Methylene chloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	500 U	2,000 U	**210 JB**	**580 JB**	400 U	**1,400 B**	200 U	400 U	1,000 U	**5.2**	100 U	100 U	100 U
O-Xylene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	**510**	**510**	**480**	**350**	**430**	**300**	500 U	**220**	**180**	**160**	**110**
Styrene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Tetrachloroethene	**5.0**	**5.0**	**1.6**	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Tetrahydrofuran	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	**12,000**	**9,500 J**	**6,300**	**14,000**	**11,000**	**8,600**	**18,000 D**	**14,000**	**18,000**	**17,000**	**15,000**	**12,000**	**10,000**
Toluene	**1,000**	**1,000**	1.0 U	1.0 U	1.0 U	1.0 U	**11,000**	**7,000**	**4,400**	**4,400**	**3,400**	**3,800**	**3,100**	**2,500**	**1,900**	**1,800**	**1,200**	**850**	**670**
trans-1,2-Dichloroethene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	- -	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	**1.2**	100 U	100 U	100 U
trans-1,3-Dichloropropene	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Trichloroethene	**5.0**	**5.0**	**14**	**4.7**	**3.2**	**2.4**	250 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Vinyl Chloride	**2.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	500 U	1,000 U	200 U	400 U	200 U	100 U	100 U	200 U	500 U	1.0 U	100 U	100 U	100 U
Xylene (Total)	**530**	**10,000**	2.0 U	2.0 U	2.0 U	2.0 U	**2,200**	**1,400 J**	**2,000**	**1,200**	**2,000**	**1,600**	**2,600**	**2,000**	**2,200**	**2,300**	**2,280**	**1,660**	**1,410**
Total Volatile Organics			**28**	**6.8**	**4.5**	**2.4**	**118,160 J**	**29,300**	**49,640 JB**	**62,000 JB**	**47,060**	**47,330 B**	**60,490 D**	**47,700**	**61,700 J**	**52,331**	**54,280**	**47,275**	**40,810**
1,4-Dioxane	**NL**	**NA**	--	--	1.9 U	1.9 U	--	--	--	--	--	--	--	--	--	--	--	--	--

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TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION	CRITERIA		MW-502		MW-703DR													
SCREEN			D		DR													
SAMPLE DATE	Conn.	US EPA	4/23/04	10/28/04	12/9/96	12/1/98	5/18/99	11/1/99	4/26/00	10/25/00	4/25/01	10/23/01	4/23/02	10/22/02	4/22/03	10/22/03	4/21/04	10/27/04
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	**200**	**200**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	**7.0**	**7.0**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	**0.05**	**0.05**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	200 U	200 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	**5.0**	**5.0**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	**11,000**	**16,000**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	500 U	500 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	**1,600**	**2,600**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	**10,000**	**15,000**	5.0 U	5.0 U	5.0 U	**5.0**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	**1.0**	**5.0**	**120**	**120**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	**NL**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	**0.5**	**80**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	**170**	**140**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	**6.0**	**80**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	**NL**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	**1,100**	**1,100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	**910**	**1,100**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	**5.0**	**5.0**	100 U	100 U	2.0 U	2.0 U	2.0 U	**3.0 B**	2.0 U	**4.0 B**	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	**NL**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	**13,000**	**11,000**	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	**1,000**	**1,000**	**460**	**660**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	**230**	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	**2.0**	**2.0**	100 U	100 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	**910**	**1,100**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**38,590**	**47,720**	ND	ND	ND	**8.0 B**	ND	**4.0 B**	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dioxane	**NL**	**NA**	**2,000**	**3,000**	--	--	--	**--**	--	**--**	--	--	--	--	--	--	1.9 U	1.9 U

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-704D															
SCREEN	CRITERIA		D															
SAMPLE DATE	Conn.	US EPA	12/18/96	12/3/98	5/19/99	11/4/99	4/27/00	10/26/00	4/25/01		10/24/01	4/24/02		10/23/02		4/22/03		10/22/03
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	DUP	FS	DUP	FS	DUP	FS
1,1,1-Trichloroethane	200	200	12	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	4.0	1.0 U	1.0 U	2	3.2	3.2	5.8	6.5	6.9	6.5	5.1
1,1-Dichloroethene	7.0	7.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	20 U	2.0 U	2.0 U	5.0 U	4.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	0.63 J	1.4	1.8	2.0 U	0.71 J	2.0 U
1,2-Dichloropropane	5.0	5.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	50 U	5.0 U	5.0 U	48	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	50 U	5.0 U	5.0 U	12 U	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	50 U	5.0 U	5.0 U	12 U	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	83 U	5.0 U	5.0 U	29	10 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	46	1.0 U	8.0	16	4.0	3.0	1.0 U	1.0 U	2	0.96 J	1.1	1.1	1.3	0.37 J	0.39 J	1.0 U
Bromochloromethane	NL	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	11	1.0 U	3.0	6.0	2.0	2.0	1.0 U	1.0 U	1	1.1	1.1	1	1.3	0.52 J	0.53 J	1.0 U
Chlorodibromomethane	0.5	80	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	300 D	3.0	67 D	140 D	42	18	7	1.0 U	18	18	17	13	15	8.8	7.3	4.9
Chloroform	6.0	80	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.63 J	1.4	1.8	1.0 U	0.71 J	1.0 U
cis-1,3-Dichloropropene	NL	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	12	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	45	2.0 U	2.0 U	2.0 J	4.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	5.0	5.0	20 U	9.0 B	2.0 U	48	4.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	NL	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	210	1.0 U	17	27	6.0 U	3.0 U	3.0 U	3.0 U	4	5.0 U	5.0 U	5.0 U	5.0 U	2.0 J	2.2 JB	5.0 U
Toluene	1,000	1,000	29	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	10 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.60 J	0.50 J	1.0 U	1	0.67 J	0.71 J	1.0 U
Xylene (Total)	530	10,000	50	2.0 U	2.0 U	3.0 J	4.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			665 D	12 B	95 D	319 D	48	27	7	ND	28	24	24	22	27	19	18	10
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-704D				MW-704DR											
SCREEN	CRITERIA		D				DR											
SAMPLE DATE	Conn.	US EPA	4/21/04		10/28/04		12/17/96	12/3/98	5/21/99	11/3/99	4/27/00	10/26/00	4/25/01	10/25/01		4/24/02	10/23/02	4/23/03
SAMPLE TYPE	GA/GAA	MCLs	FS	DUP	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS
1,1,1-Trichloroethane	**200**	**200**	1.0 U	1.0 U	1.0 U	1.0 U	**9.0**	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U	1.0 U	**2**	**1.8**	**6**	**22**	**8.1**
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	**7.1**	**7.6**	**4**	**3.8**	**13**	**5.0**	**6.0**	**10**	**13**	**12**	**15**	**6.2**	**5.8**	**17**	**23**	**28**
1,1-Dichloroethene	**7.0**	**7.0**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.56 J**	**1.2**	**1.1**
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U
1,2-Dibromoethane	**0.05**	**0.05**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	2.0 U	2.0 U	2.0 U	2.0 U	**10**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**0.60 J**	**0.60 J**	**3**	**8.1**	**7**
1,2-Dichloropropane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	24 U	5.0 U	5.0 U	5.0 U	**12**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	40 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**0.90 J**	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	**1.0**	**5.0**	1.0 U	1.0 U	**3.5**	**3.3**	**2.0**	**1.0**	**1.0**	**2.0**	**2.0**	**1.0**	**1**	**1.7**	**1.5**	**3.1**	**3.3**	**2.4**
Bromochloromethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	**23**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	1.0 U	1.0 U	**1.5**	**1.5**	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.60 J**	**0.60 J**	**1.4**	**1.5**	**1**
Chlorodibromomethane	**0.5**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	**5.7**	**6.7**	**20**	**20**	**53**	**15**	**13**	**28**	**12**	**11**	**9**	**12**	**12**	**17**	**19**	**17**
Chloroform	**6.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	1.0 U	1.0 U	1.0 U	1.0 U	**9.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.50 J**	**0.60 J**	**3**	**8.1**	**7**
cis-1,3-Dichloropropene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	1.0 U	1.0 U	1.0 U	1.0 U	**35**	**1.0**	**1.0**	**2.0**	**1.0**	**1.0**	**1**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	1.0 U	1.0 U	1.0 U	1.0 U	**14**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	3.0 U	**8.0 B**	**2.0 B**	**3.0**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	**6.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	**4.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	5.0 U	5.0 U	**18**	**18**	**190**	**51 E**	**46 D**	**66**	**52**	**42**	**81**	**14**	**13**	**25**	**30**	**16**
Toluene	**1,000**	**1,000**	1.0 U	1.0 U	1.0 U	1.0 U	**44**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	**53**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.7**	**3.8**	**3.2**
Vinyl Chloride	**2.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.4**	**1.8**	1.0 U
Xylene (Total)	**530**	**10,000**	2.0 U	2.0 U	2.0 U	2.0 U	**21**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**12.8**	**14.3**	**47**	**46.6**	**455**	**81 B**	**69 BD**	**111**	**93**	**67**	**107**	**38 J**	**35 J**	**76**	**114**	**84**
1,4-Dioxane	**NL**	**NA**	**12**	**12**	**90**	**70**	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-704DR			MW-706DR													
SCREEN	CRITERIA		DR			DR													
SAMPLE DATE	Conn.	US EPA	10/23/03	4/22/04	10/28/04	12/10/96	12/3/98		5/20/99	11/4/99	4/27/00	10/26/00	4/26/01	10/25/01	4/25/02		10/24/02		4/23/03
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	DUP	FS	DUP	FS
1,1,1-Trichloroethane	200	200	4.7	3.6	2.9	1.0 U	200 U	23	250 U	200 U	200 U	200 U	200 U	500 U	30	31	32	50 U	29
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.5	2	25 U	50 U	2.8
1,1-Dichloroethane	70	NA	18	18	18	6.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	4	7.5	25 U	50 U	9.4
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	47 EJ	200 U	40	250 U	200 U	200 U	200 U	200 U	500 U	41	57	55	52	74
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	2.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	8.0	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	3.9	6.9	25 U	50 U	7.7
1,2-Dichloroethene (Total)	NL	NA	3.9	4.1	15	28	400 U	99	250 U	400 U	220 J	300 J	400 U	400 J	490	470	360	340	420
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	16	1,000 U	100 U	1,200 U	1,000 U	1,000 U	1,000 U	1,000 U	2,500 U	5.0 U	5.0 U	130 U	250 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	1,000 U	100 U	1,200 U	1,000 U	1,000 U	1,000 U	1,000 U	2,500 U	5.0 U	5.0 U	130 U	250 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	2,500 U	1,000 U	240	1,200 U	1,000 U	1,000 U	1,000 U	1,000 U	2,500 U	120	140 J	310	300	270
Acetone	700	NA	5.0 U	5.0 U	5.0 U	20 U	1,000 U	150	1,200 U	1,000 U	1,000 U	1,000 U	1,000 U	2,500 U	3.6 J	8.8	130 U	250 U	12
Benzene	1.0	5.0	2.4	1.7	2.2	5.0	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	4.5	7.2	25 U	50 U	9.5
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Chloroethane	NL	NA	13	12	14	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	4.0	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	3.8	5.6	25 U	50 U	6.8
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
cis-1,2-Dichloroethene	70	70	3.9	4.1	15	30 EJ	200 U	98	250 U	200 U	230	310	200 U	400 J	490	470	360	340	420
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.6	13 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.4	12	25 U	50 U	17
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.3	31	400 U	22 J	500 U	400 U	400 U	400 U	400 U	1,000 U	5.6	32	44	50 U	46
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	73 EJ	430 B	290 JDB	1,100 B	400 U	760	400 U	400 U	400 BJ	58	100	130	130	160
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	15	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	16	22	28	50 U	28
Styrene	100	100	1.0 U	1.0 U	1.0 U	4.0	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	5.5
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	240	250 D	250 U	220	430	370	320	300 J	180	220	370	330	360
Tetrahydrofuran	NL	NA	13	14	19	10 U	200 U	20 U	250 U	600 U	600 U	600 U	600 U	2,500 U	5.0 U	5.0 U	130 U	250 U	2.6 J
Toluene	1,000	1,000	1.0 U	1.0 U	7.8	220 EJ	200 U	190	250 U	200 U	220	230	200 U	500 U	68	180	240	230	250
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	0.64 J	25 U	50 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	1.0 U	1.0 U	25 U	50 U	1.0 U
Trichloroethene	5.0	5.0	6.7	7.4	11	7,000 D	6,600	7,200 D	5,900 D	4,900	9,600	8,800	8,000	8,600	4,100	4,800	6,800	6,500	5,200
Vinyl Chloride	2.0	2.0	1.7	1.6	4.3	1.0	200 U	20 U	250 U	200 U	200 U	200 U	200 U	500 U	3.4	3.3	25 U	50 U	3.8
Xylene (Total)	530	10,000	2.0 U	2.0 U	1.3	46	400 U	35 J	500 U	400 U	400 U	400 U	400 U	1,000 U	22	54	72	100 U	74
Total Volatile Organics			63	62.4	97.1	7,454 DEJ	7,270 B	8,539 JDB	7,000 BD	5,120	11,240 J	9,710 J	8,320	9,700 J	5,135	6,106	8,369	7,882	6,914
1,4-Dioxane	NL	NA	--	24	52	--	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-706DR				MW-707D												
SCREEN	CRITERIA		DR				D												
SAMPLE DATE	Conn.	US EPA	10/23/03	4/23/04		10/28/04	12/6/96	12/1/98	5/17/99	11/1/99	4/25/00	10/24/00	4/24/01	10/23/01	4/23/02	10/22/02	4/21/03	10/21/03	
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	DUP
1,1,1-Trichloroethane	200	200	50 U	50 U	**26**	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	7.0	7.0	50 U	**65**	**51**	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	**320**	**370**	**390**	**310**	2.0 U	2.0 U	2.0 U	2.0 U	**1.0 J**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	5.0	5.0	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	250 U	250 U	130 U	250 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	250 U	250 U	130 U	250 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	250 U	**320**	**310**	250 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	250 U	250 U	130 U	250 U	5.0 U	5.0 U	5.0 U	**9.0**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	**2.0 B**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	**4.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	**320**	**370**	**390**	**310**	1.0 U	1.0 U	1.0 U	1.0 U	**0.80 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	NL	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	50 U	50 U	**34**	50 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	**0.57 J**	1.0 U	1.0 U
Methylene chloride	5.0	5.0	**61**	**150**	**130**	**76**	2.0 U	2.0 U	2.0 U	**4.0 B**	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	NL	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.31 J**	1.0 U	1.0 U
Styrene	100	100	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	**260**	**320**	**320**	**240**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	250 U	250 U	130 U	250 U	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	1,000	1,000	**120**	**210**	**220**	**130**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.67 J**	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	**6,400**	**7,600**	**7,800**	**6,400**	1.0 U	1.0 U	1.0 U	**1.0**	**1.0**	**1.0**	1.0 U	**0.80 J**	**0.94 J**	1.0 U	**1.1**	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	50 U	50 U	25 U	50 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	100 U	100 U	50 U	100 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**0.88**	2.0 U	2.0 U
Total Volatile Organics			**7,161**	**9,035**	**9,281**	**7,156**	ND	ND	ND	**14 B**	**9.8 BJ**	**1.0**	ND	**0.8 J**	**0.94**	ND	**2.7**	ND	ND
1,4-Dioxane	NL	NA	--	2.0 U	1.9 U	1.9 U	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-707D		MW-707DR													
SCREEN	CRITERIA		D		DR													
SAMPLE DATE	Conn. GA/GAA	US EPA MCLs	4/20/04	10/26/04	12/30/96	12/1/98	5/17/99	11/2/99	4/25/00	10/25/00	4/25/01	10/23/01	4/23/02	10/22/02	4/22/03	10/22/03	4/20/04	10/28/04
SAMPLE TYPE			FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	**200**	**200**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.82 J**	1.0 U	**3.8**	**4.7**
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.58 J**	1.0 U	**1.5**	**3.2**
1,1-Dichloroethene	**7.0**	**7.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	**0.05**	**0.05**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**1.0 J**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**1.3**	**1.9**
1,2-Dichloropropane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	5.0 U	5.0 U	32 U	5.0 U	5.0 U	5.0 U	**10***	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	**0.5**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	**6.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.3**	**1.9**
cis-1,3-Dichloropropene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	**5.0**	**5.0**	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	**2.0**	**8***	**3.0 B**	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	5.0 U	5.0 U	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	**1.3 JB**	5.0 U	5.0 U	5.0 U
Toluene	**1,000**	**1,000**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	**0.80 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	**2.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			ND	ND	ND	ND	**2.8 J**	**4.0 J**	**18***	**3.0 B**	ND	ND	ND	ND	**2.7**	ND	**6.6**	**9.8**
1,4-Dioxane	**NL**	**NA**	**2.2**	**14**	--	--	**--**	**--**	**--**	**--**	--	--	--	--	**--**	--	**4.2**	**23**

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TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MW-801R		MW-801S		MWL-312												
SCREEN	CRITERIA		R		S		S												
SAMPLE DATE	Conn.	US EPA	12/3/98	5/21/99	12/3/98	5/21/99	12/1/94	3/27/95	11/22/96	12/1/98	5/18/99	11/2/99	4/24/00	10/24/00	4/24/01	10/23/01	4/23/02	10/22/02	4/23/03
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	**4.0**	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	**1.0**	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	**1.0 J**	2.0 U	2.0 U	2.0 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	**14**	5.0 U	5.0 U	5.0 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	**7.0**	5.0 U	5.0 U	5.0 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	**7.0**	5.0 U	5.0 U	5.0 U	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	**13**	5.0 U	5.0 U	5.0 U	25 U	**17 J**	5.0 U	5.0 U	5.0 U	5.0 U	**29**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	- -	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	**1.0**	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	2.0 U	2.0 U	2.0 U	2.0 U	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	5.0	5.0	**1.0 JB**	**2.0 B**	**1.0 JB**	**2.0 B**	10 U	10 U	2.0 U	2.0 U	2.0 U	**3.0**	**6.0**	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	**4.0**	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	25 U	**32**	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	5.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			**48 JB**	**2.0 B**	**5.0 JB**	**2.0 B**	ND	**49 J**	ND	ND	ND	**3.0**	**35**	ND	ND	ND	ND	ND	ND
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			MWL-312			P-11A													
SCREEN	CRITERIA		S			R													
SAMPLE DATE	Conn.	US EPA	10/22/03	4/20/04	10/27/04	8/26/91	12/1/94	3/27/95	12/10/96	12/3/98	5/20/99	11/4/99	4/27/00		10/26/00	4/26/01	10/26/01	4/25/02	10/24/02
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	**13**	**12**	**62**	**21**	**25**	**19**	**170 D**	**94**	**34**	**87**
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	2.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	1.0 U	1.0 U	1.0 U	**1.1 J**	130 U	140 U	5.0 U	**19**	**16**	**20**	5.0 U	**9.0**	**10**	**8**	50 U	**11**	**27**
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	**4**	50 U	**0.76 J**	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	1.0 U	- -	- -	- -	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	2.0 UJ	- -	- -	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	**0.73 J**	1.0 U
1,2-Dichloroethene (Total)	NL	NA	2.0 U	2.0 U	2.0 U	- -	130 U	140 U	**27 EJ**	**190**	**180**	**560**	**45**	**47**	**49**	**1,200 D**	**1,100**	**190**	**122**
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	R	630 U	690 U	25 U	25 U	50 U	**89**	25 U	12 U	12 U	12 U	250 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	R	630 U	690 U	25 U	25 U	50 U	25 U	25 U	12 U	12 U	12 U	250 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	**140 J**	**2,600**	**2,000**	25 U	25 U	50 U	25 U	25 U	12 U	12 U	12 U	250 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	R	810 U	**650 J**	25 U	25 U	50 U	**69**	25 U	12 U	**14**	12 U	250 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	**1.9 J**	**63 J**	140 U	**20**	**15**	**11**	**12**	**9.0**	**11**	**9.0**	**9**	50 U	**6.8**	**7.9**
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	2.0 UJ	250 U	280 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	R	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	**1.3**	**1.7**
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	**1.9 J**	130 U	**200**	**17**	**17**	10 U	**5.0**	5.0 U	**33**	**11**	**8**	50 U	**5**	**5.8**
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	2.0 UJ	250 U	280 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	1.0 U	1.0 U	1.0 U	1.2 UJ	- -	- -	**27**	**190**	**180**	**500 D**	**45**	**44**	**49**	**1,200 D**	**1,000**	**190**	**120**
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	**44 J**	**2,100**	**1,800**	**390 D**	**160**	**100**	**130**	**63**	**68**	**44**	**67**	**30 J**	**33**	**38**
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	- -	- -	- -	**180 D**	**100**	**35**	**79**	**29**	**33**	**31**	**84**	100 U	**44**	**60**
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	8.8 UJ	250 U	280 UB	10 U	**42 B**	**79 B**	**87**	10 U	**28 B**	5.0 U	5.0 U	100 U	1.0 U	1.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	- -	- -	- -	**52 D**	5.0 U	10 U	**10**	5.0 U	**2**	2.0 U	2.0 U	50 U	**0.94 J**	**1.1**
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	**93**	50 U	**3.2**	**1.2**
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	- -	**3,100**	**2,600**	**630 D**	**180**	**160**	**190**	15 U	**72**	**110**	**110**	**70 J**	**71**	**100**
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	**110 J**	**3,600**	**3,100**	9.0 U	**15**	**17**	**14**	5.0 U	**3.0**	**3.0**	**11**	50 U	**4.8**	**3.4**
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	5.0 U	5.0 U	10 U	**10**	5.0 U	**3.0**	2.0 U	**11**	50 U	**3.7**	**1.6**
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	5.0 U	10 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	50 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 UJ	130 U	140 U	5.0 U	**5.0**	10 U	5.0 U	5.0 U	**3.0**	**10**	**1,200 D**	50 U	**16**	**3.6**
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	2.0 UJ	250 U	280 U	**56 D**	**120**	**140**	**420 D**	**83**	**80**	**56**	**380 D**	**350**	**180**	**120**
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	**26 J**	**1,500**	**1,200**	**260 D**	**100**	**35**	**92**	**36**	**36**	**32**	**87**	100 U	**45**	**61**
Total Volatile Organics			ND	ND	ND	**325 J**	**12,963 J**	**11,550 J**	**1,372 DEJ**	**976 B**	**738 B**	**2,349 D**	**250**	**414 B**	**366**	**3,355 D**	**1,544 J**	**606**	**578**
1,4-Dioxane	NL	NA	--	1.9 U	1.9 U	--	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			P-11A				P-13												
SCREEN	CRITERIA		R				S												
SAMPLE DATE	Conn.	US EPA	4/24/03	10/23/03	4/23/04	10/28/04	8/14/91	11/30/94	3/28/95	11/20/96	12/1/98		5/19/99	11/2/99		4/26/00	10/25/00	4/25/01	10/23/01
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	DUP	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	69	33	38	18	59 *J	36	40	1.0 U	18	24	17	17	16	13	15	5	12
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	0.60 J	1.0 U	1.0 U	1.0 U	2.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	12	8.6	8.8	7.4	75 *J	30	14	14	12	15	11	9.0	9.0	6.0	8.0	2	7
1,1-Dichloroethene	7.0	7.0	2	1.0 U	1.0 U	1.0 U	10 J	2.8 J	3.1 J	2.0 U	2.0	3.0	2.0	2.0	2.0	2.0	2.0	1.0 U	2
1,2-Dibromo-3-chloropropane	In Review	0.2	2.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	2.0 J	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	242.4	64.4	151.3	88	- -	16	12	10	8.0	10	9.0	9.0	9.0	5.0	8.0	2	7
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	R	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	R	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	0.92 J	5.0 U	5.0 U	5.0 U	5.0 UJ	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.9	5.0 U	5.0 U	5.0 U	R	25 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6.0	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	6.2	7.8	7.7	5.8	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	R	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	8.0 J	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.3	1.9	1.6	1.4	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	- -	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	4.5	4.8	5.6	5	3.0 J	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	2.0 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	240	62	150	88	23 J	- -	- -	11	7.0	10	9.0	8.0	8.0	5.0	8.0	2	7
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	34	17	38	21	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	46	33	55	41	- -	- -	- -	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	8.0 UJ	10 U	10 UB	7.0 U	2.0 U	2.0 U	1.0 JB	2.0 U	2.0	5.0	2.0 B	2.0 U	2.0 U
O-Xylene	NL	NA	2	1.0 U	1.0 U	1.0 U	- -	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	5.4	1.0 U	4.5	1.4	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0	1.0	0.80 J	1.0 U	1.0 U	0.60 J
Tetrahydrofuran	NL	NA	61	72	120	54	- -	25 U	25 U	10 U	1.0 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U
Toluene	1,000	1,000	4.7	1.1	4	3.6	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	2.4	2.4	1.3	1.0 U	1.0 J	- -	- -	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	35	1.0 U	19	3.3	3.0 J	5.0 U	5.0 U	4.0 U	1.0	2.0	1.0	2.0	1.0	1.0	2.0	1.0 U	1
Vinyl Chloride	2.0	2.0	150	59	180	76	2.0 UJ	10 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	48	33	55	41	1.0 UJ	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			683	303	633.5	325.9	184 *J	85 J	69 J	25	41	54	24 JB	48	54	33 J	37 B	9	30 J
1,4-Dioxane	NL	NA	--	--	120	110	--	--	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION	CRITERIA		P-13						P-101B										
SCREEN			S						M										
SAMPLE DATE	Conn.	US EPA	4/23/02	10/22/02	4/23/03	10/22/03	4/21/04	10/28/04	12/8/92		12/3/94	3/27/95	12/19/96	12/3/98	5/20/99	11/4/99		4/27/00	10/26/00
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS	FS	FS	DUP	FS	FS
1,1,1-Trichloroethane	200	200	**11**	**11**	**12**	**6.6**	**5**	**8.9**	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,1-Dichloroethane	70	NA	**6.2**	**6.8**	**2.2**	**3.6**	**2.2**	**4.3**	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,1-Dichloroethene	7.0	7.0	**1.6**	**1.7**	**0.81 J**	**1.1**	1.0 U	**1.1**	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	200 U	200 U	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,2-Dichloroethene (Total)	NL	NA	**6.6**	**6.6**	**5.2**	**3.8**	**2.2**	**4.5**	2,000 U	12,000 U	2,500 U	1,800 U	500 U	200 U	100 U	40 U	10 U	40 U	50 U
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	200 U	200 U	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	200 U	200 U	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**160,000 J**	**190,000 J**	**17,000**	**34,000**	1,200 U	500 U	500 U	100 U	25 U	100 U	120 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	2,000 U	12,000 U	13,000 U	8,900 U	1,200 U	500 U	500 U	100 U	25 U	100 U	120 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**27,000 J**	**24,000 J**	**27,000**	**24,000**	1,200 U	500 U	500 U	100 U	25 U	100 U	120 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**220,000**	**240,000**	**47,000**	**59,000**	1,200 U	500 U	500 U	100 U	25 U	100 U	120 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	**140**	**45**	**35**	**130**	**86**
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	5,000 U	3,600 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	**10**	**45**	**29**
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	- -	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1,700 J**	12,000 U	2,500 U	1,800 U	**1,300**	**360**	**620**	**180**	**130**	**540**	**280**
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	5,000 U	3,600 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
cis-1,2-Dichloroethene	70	70	**6.6**	**6.6**	**5.2**	**3.8**	**2.2**	**4.5**	- -	- -	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**7,200**	**8,000 J**	**6,800**	**6,500**	**5,400**	**840**	**2,300**	**420**	**430 D**	**2,000 D**	**200**
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	**3,000**	**890**	**1,100**	**390**	**310**	**1,600**	**1,000**
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	5,000 U	3,600 UB	500 U	**2,000 B**	**140 JB**	**350**	**64**	**80**	50 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	**880**	**190**	**470**	**33**	**30**	**24**	25 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Tetrachloroethene	5.0	5.0	**0.83 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	- -	- -	**18,000**	**44,000**	2,500 U	**2,400**	**6,000**	**1,200**	**1,000 D**	**4,400 D**	**2,000**
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**19,000**	**22,000**	**18,000**	**15,000**	**11,000 D**	100 U	100 U	20 U	**8.0**	20 U	25 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	- -	- -	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Trichloroethene	5.0	5.0	**1.3**	**1.1**	1.0 U	1.0 U	1.0 U	**1.2**	2,000 U	12,000 U	2,500 U	1,800 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2,000 U	12,000 U	5,000 U	3,600 U	250 U	100 U	100 U	20 U	5.0 U	20 U	25 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**6,900**	**6,300 J**	**4,900**	**4,900**	**4,000**	**1,100**	**1,500**	**440**	**350**	**1,700**	**1,100**
Total Volatile Organics			**28**	**27**	**20**	**15**	**9.4**	**20**	**441,800 J**	**490,300 J**	**138,700**	**187,400**	**21,580 D**	**7,780 B**	**10,770 JB**	**3,058**	**2,367 D**	**8,819 D**	**3,595**
1,4-Dioxane	NL	NA	--	--	--	--	1.9 U	1.9 U	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			P-101B									P-101C							
SCREEN	CRITERIA		M									S							
SAMPLE DATE	Conn.	US EPA	4/26/01	10/25/01	4/25/02	10/23/02	4/23/03	10/23/03		4/22/04	10/28/04	12/3/94	3/27/95	12/10/96	12/2/98	5/20/99	11/4/99	4/27/00	10/26/00
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	**1.2**	1.0 U	1.0 U	**2.9**	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,1-Dichloroethene	7.0	7.0	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	25 U	1.0 U	1.0 U	2.5 U	10 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	25 U	1.0 U	**0.97 J**	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	**1.0**
1,2-Dichloroethene (Total)	NL	NA	50 U	2.0 U	2.0 U	5.0 U	10 U	**1.3**	2.0 U	2.0 U	**7.2**	5.0 U	**7.0 J**	3.0 U	4.0 U	2.0 U	5.0 U	2.0 U	2.0 U
1,2-Dichloropropane	5.0	5.0	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	25 U	1.0 U	**0.72 J**	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
2-Butanone	400	NA	120 U	5.0 U	5.0 U	13 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	50 U	5.0 U	10 U	10 U	**47**	6.0 U	6.0 U
2-Hexanone	NL	NA	120 U	5.0 U	5.0 U	13 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	50 U	5.0 U	10 U	10 U	12 U	6.0 U	6.0 U
4-Methyl-2-pentanone	350	NA	120 U	5.0 U	5.0 U	13 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	50 U	5.0 U	10 U	10 U	12 U	6.0 U	6.0 U
Acetone	700	NA	120 U	5.0 U	5.0 U	13 U	25 U	5.0 U	5.0 U	5.0 U	5.0 U	25 U	50 U	5.0 U	**17**	10 U	**33**	6.0 U	6.0 U
Benzene	1.0	5.0	**110**	1.0 U	**52**	**34**	**55**	**22**	**24**	**24**	**12**	**12**	**28**	**20 D**	**13**	**16**	**14**	**6.0**	**16**
Bromochloromethane	NL	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Bromoform	4.0	80	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	20 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	25 U	1.0 U	**16**	**12**	**16**	**6.6**	**7.1**	**6.8**	**4.3**	**5.0**	**10**	**9.0**	**5.0**	**7.0**	**6.0**	**2.0**	**7.0**
Chlorodibromomethane	0.5	80	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	**400**	**1.8**	**190**	**130**	**180**	**74**	**74**	**82**	**52**	**65**	**140**	**95 D**	**66**	**60 D**	**80**	**34**	**92 D**
Chloroform	6.0	80	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	20 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	25 U	1.0 U	1.0 U	2.5 U	5.0 U	**1.3**	1.0 U	1.0 U	**7.2**	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	NL	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	**110**	1.0 U	**9.5**	**3.7**	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**6.0**	**26**	5.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	**1,300**	**3.4**	**510**	**300**	**550**	**66**	**98**	**62**	**12**	- -	- -	5.0 U	4.0 U	4.0 U	5.0 U	2.0 U	2.0 U
Methylene chloride	5.0	5.0	50 U	**0.60 BJ**	**1.6**	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10 U	20 UB	2.0 U	**7.0 B**	**12 B**	**13**	2.0 U	**2.0**
O-Xylene	NL	NA	25 U	1.0 U	**7**	**3.5**	**4.9 J**	**1**	**1.2**	**1.6**	1.0 U	- -	- -	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Styrene	100	100	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	**3,200 D**	**6.5**	**1,300**	**530**	**1,100**	**98**	**140**	**300**	**40**	**65**	**250**	**110 D**	**19**	**46**	**36**	4.0 U	**39**
Toluene	1,000	1,000	25 U	1.0 U	**2.7**	2.5 U	**2.0 J**	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	- -	- -	**1.0**	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	25 U	1.0 U	1.0 U	2.5 U	5.0 U	1.0 U	1.0 U	1.0 U	1.0 U	5.0 U	10 U	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	25 U	1.0 U	1.0 U	**2.6**	5.0 U	**2.3**	**1.1**	1.0 U	**12**	10 U	20 U	**1.0**	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	**1,300**	**3.3**	**520**	**300**	**554.9**	**67**	**99.2**	**63.6**	**12**	5.0 U	**18**	6.0 U	4.0 U	4.0 U	5.0 U	2.0 U	2.0 U
Total Volatile Organics			**5,120 D**	**12 BJ**	**2,090**	**1,016**	**1,908**	**272**	**345**	**476.4**	**142.4**	**153**	**479 J**	**236 D**	**127 B**	**141 BD**	**229**	**42**	**157 D**
1,4-Dioxane	NL	NA	--	--	--	--	--	--	--	**440**	**240**	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION	CRITERIA		P-101C								SW-C								
SCREEN			S								SW								
SAMPLE DATE	Conn.	US EPA	4/26/01	10/25/01	4/25/02	10/23/02	4/23/03	10/23/03	4/22/04	10/28/04	12/30/96	7/8/97	11/30/98	5/17/99	11/1/99	4/24/00	10/23/00	4/23/01	10/22/01
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	2.0 U	1.0 U	0.70 J	1.0 U	2.1	1.7	3.8	5.4	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0	1.0 U	0.80 J
1,1-Dichloroethene	7.0	7.0	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	2.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	2.0 U	1.0 U	1.0 U	1.0 U	0.39 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	2.0 U	1.0 U	0.70 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	5.0 U	1.0 J	2.2	1.4	4.17	3	4.7	6.2	2.0 U	2.0 U	2.0 U	2.0 U	2.0	2.0 U	4.0	2.0 U	2
1,2-Dichloropropane	5.0	5.0	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	12 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	7.0	5.0 U	9.0	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	16	14	16	8	13	11	7.1	7.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	6	6.3	6.8	3.8	5.7	4.5	2.8	3	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	71	28 D	79	42	65	40	33	27	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0	1.0 U	1.0 U
Chloroform	6.0	80	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	2.0 U	0.50 J	1.1	1.4	3.3	3	4.7	6.2	1.0 U	1.0 U	1.0 U	1.0 U	2.0	1.0 U	4.0	1.0 U	2
cis-1,3-Dichloropropene	NL	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	5.0 U	2.0 U	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	5.0	5.0	4.0 J	0.60 BJ	1.1	1.0 U	0.99 J	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	1.0 JB	2.0 B	3.0 B	2.0 U	2.0 U	2.0 U	2.0 U
O-Xylene	NL	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	45	31	31	17	27	20	19	22	10 U	10 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U
Toluene	1,000	1,000	2.0 U	1.0 U	1.0 U	1.0 U	0.43 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	2.0 U	1.0 U	1.1	1.0 U	0.87 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vinyl Chloride	2.0	2.0	2.0 U	1.4	2.2	4.8	7.2	11	20	20	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	5.0 U	2.0 U	1.2	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			142 J	82 DBJ	141	77	126	91	90.4	90.8	ND	ND	8.0 JB	2.0 B	16	ND	7.0	ND	2.8 J
1,4-Dioxane	NL	NA	--	--	--	--	--	--	180	180	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			SW-C						SW-F										
SCREEN	CRITERIA		SW						SW										
SAMPLE DATE	Conn.	US EPA	4/22/02	10/21/02	4/21/03	10/21/03	4/19/04	10/25/04	12/30/96	7/8/97		11/30/98		5/17/99	11/1/99	4/24/00	10/23/00	4/23/01	10/22/01
SAMPLE TYPE	GA/GAA	MCLs	FS	FS	FS	FS	FS	FS	FS	FS	DUP	FS	DUP	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	200	200	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	70	NA	1.0 U	1.0 U	**1.3**	1.0 U	1.0 U	1.0 U	1.0 U	**6.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**2.0**	1.0 U	1.0 U
1,1-Dichloroethene	7.0	7.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	In Review	0.2	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	0.05	0.05	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	600	600	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	NL	NA	2.0 U	2.0 U	**2**	**1.5**	2.0 U	2.0 U	4.0 U	**5.0**	**5.0**	2.0 U	2.0 U	2.0 U	**2.0**	**1.0 J**	**5.0**	2.0 U	**0.60 J**
1,2-Dichloropropane	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	600	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	75	75	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	400	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	350	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	700	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**5.0**	5.0 U	**9.0**	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	1.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	0.56	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	4.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	9.8	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	700	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	0.5	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U	**1.0**	1.0 U	1.0 U
Chloroform	6.0	80	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	2.7	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**3.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	70	70	1.0 U	1.0 U	**2**	**1.5**	1.0 U	1.0 U	4.0 U	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	**2.0**	**1.0**	**6.0**	1.0 U	**0.50 J**
cis-1,3-Dichloropropene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	700	700	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	NL	NL	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Methylene chloride	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**1.0 JB**	**2.0 B**	**19 B**	2.0 U	2.0 U	2.0 U
O-Xylene	NL	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	NL	NA	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	10 U	10 U	1.0 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U
Toluene	1,000	1,000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	100	100	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	0.5	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	5.0	5.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.90 J**	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.60 J**
Vinyl Chloride	2.0	2.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	530	10,000	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			ND	ND	**3.3**	**1.5**	ND	ND	**1.9 J**	**14**	**10**	ND	**5.0**	**1.0 JB**	**16 B**	**20 BJ**	**9.0**	ND	**1.1 J**
1,4-Dioxane	NL	NA	--	--	--	--	1.9 U	1.9 U	--	--	--	--	--	--	--	--	--	--	--

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			**SW-F**						**SW-G**										
SCREEN	**CRITERIA**		**SW**						**SW**										
SAMPLE DATE	**Conn.**	**US EPA**	**4/22/02**	**10/21/02**	**4/21/03**	**10/21/03**	**4/19/04**	**10/25/04**	**12/30/96**	**7/8/97**	**11/30/98**	**5/17/99**		**11/1/99**	**4/24/00**	**10/23/00**	**4/23/01**	**10/22/01**	**4/22/02**
SAMPLE TYPE	**GA/GAA**	**MCLs**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**	**DUP**	**FS**	**FS**	**FS**	**FS**	**FS**	**FS**
1,1,1-Trichloroethane	**200**	**200**	1.0 U	1.0 U	**0.94 J**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	1.0 U	1.0 U	**1.6**	1.0 U	1.0 U	**2.2**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	**7.0**	**7.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	**0.05**	**0.05**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	2.0 U	2.0 U	**2.9**	**1.7**	2.0 U	**2.1**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	**0.60 J**	2.0 U
1,2-Dichloropropane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	**7.0**	5.0 U	5.0 U	5.0 U	**7.0**	5.0 U	5.0 U	5.0 U	5.0 U	**4.0 J**
Benzene	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	**0.5**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**1.2**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	**6.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	1.0 U	1.0 U	**2.9**	**1.7**	1.0 U	**2.1**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.60 J**	1.0 U
cis-1,3-Dichloropropene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	1.0 U
Methylene chloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	2.0 U	**1.0 JB**	2.0 U	**2.0 B**	**5.0 B**	2.0 U	2.0 U	2.0 U	1.0 U
O-Xylene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	10 U	10 U	1.0 U	1.0 U	1.0 U	3.0 U	3.0 U	3.0 U	3.0 U	5.0 U	5.0 U
Toluene	**1,000**	**1,000**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	**0.50 J**	1.0 U
Vinyl Chloride	**2.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			ND	ND	**5.4**	**1.7**	ND	**5.5**	ND	**7.0**	ND	**1.0 JB**	ND	**9.0 B**	**5.0 B**	ND	ND	**1.1 J**	**4**
1,4-Dioxane	**NL**	**NA**	--	--	**--**	**--**	1.9 U	1.9 U	--	**--**	--	**--**	--	**--**	**--**	--	--	**--**	**--**

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

LOCATION			**SW-G**				
SCREEN	**CRITERIA**		**SW**				
SAMPLE DATE	**Conn.**	**US EPA**	**10/21/02**	**4/21/03**	**10/21/03**	**4/19/04**	**10/25/04**
SAMPLE TYPE	**GA/GAA**	**MCLs**	**FS**	**FS**	**FS**	**FS**	**FS**
1,1,1-Trichloroethane	**200**	**200**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2,2-Tetrachloroethane	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1,2-Trichloroethane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethane	**70**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,1-Dichloroethene	**7.0**	**7.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromo-3-chloropropane	**In Review**	**0.2**	1.0 U	2.0 U	1.0 U	1.0 U	1.0 U
1,2-Dibromoethane	**0.05**	**0.05**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichlorobenzene	**600**	**600**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethane	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,2-Dichloroethene (Total)	**NL**	**NA**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
1,2-Dichloropropane	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,3-Dichlorobenzene	**600**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
1,4-Dichlorobenzene	**75**	**75**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
2-Butanone	**400**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
2-Hexanone	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
4-Methyl-2-pentanone	**350**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Acetone	**700**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Benzene	**1.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromochloromethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromodichloromethane	**0.56**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromoform	**4.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Bromomethane	**9.8**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Disulfide	**700**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Carbon Tetrachloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorobenzene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chlorodibromomethane	**0.5**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroethane	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloroform	**6.0**	**80**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chloromethane	**2.7**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,2-Dichloroethene	**70**	**70**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
cis-1,3-Dichloropropene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	**700**	**700**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
M,P-Xylene	**NL**	**NL**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Methylene chloride	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
O-Xylene	**NL**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Styrene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrachloroethene	**5.0**	**5.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Tetrahydrofuran	**NL**	**NA**	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Toluene	**1,000**	**1,000**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,2-Dichloroethene	**100**	**100**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
trans-1,3-Dichloropropene	**0.5**	**NA**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Trichloroethene	**5.0**	**5.0**	1.0 U	**0.81 J**	1.0 U	1.0 U	1.0 U
Vinyl Chloride	**2.0**	**2.0**	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylene (Total)	**530**	**10,000**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Total Volatile Organics			ND	**0.81**	ND	ND	ND
1,4-Dioxane	**NL**	**NA**	--	**--**	--	1.9 U	1.9 U

See Notes on Page 32.

TABLE 1
GROUNDWATER AND SURFACE WATER VOC ANALYTICAL RESULTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

General Notes:

All concentrations in micrograms per liter (ug/L); equivalent to parts per billion (ppb).

Where a sample had a dilution or re-analysis run, the "best result" for each compound was selected, using the following rules:

- -If the compound was not detected during either run, the lower detection limit was used.
- -If the compound was detected during one run, but not the other, the detection was used.
- -If the compound was detected during both runs, the least qualified result was used.
- -If the compound was detected and unqualified during both runs, the higher result was used.

FS = Primary field sample.

DUP = Duplicate field sample.

Screen Interval:

S = Shallow overburden.
M = Middle overburden.
D = Deep overburden.
R = Shallow bedrock.
DR = Deep bedrock.

Connecticut GA/GAA criteria values from *State of Connecticut Regulation of Department of Environmental Protection Concerning Remediation Standard* , dated January
As amended by *Approved Criteria for Additional Polluting Substances* , dated April 30, 1999.

US EPA MCL from *Drinking Water Regulations and Health Advisories* , USEPA Office of Water, EPA-822-B-96-002, October 1996.

-- = Not Analyzed.

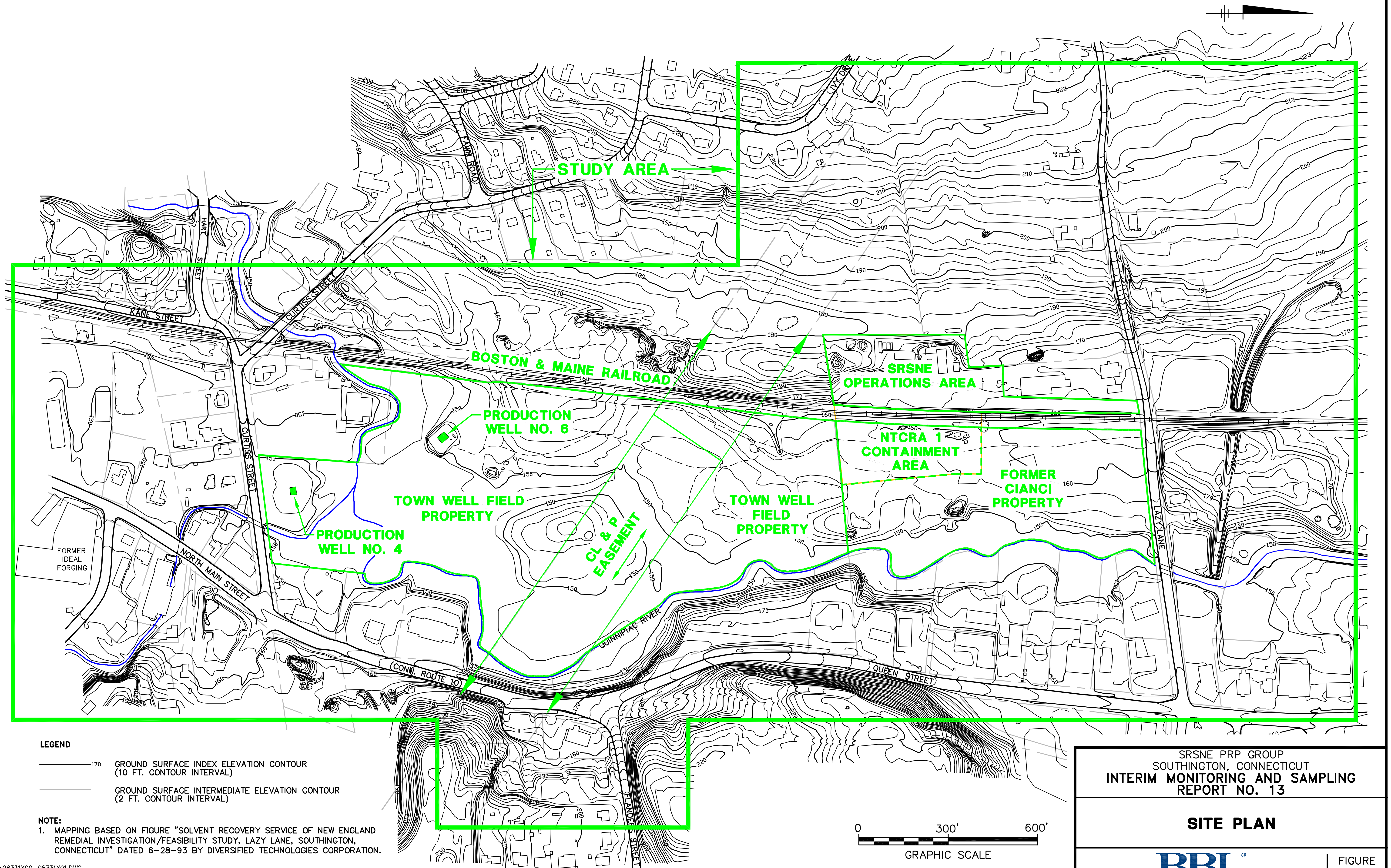
Data Qualifiers:

B = The compound has been found in the sample as well as its associated blank, its presence in the sample may be suspect.
D = Concentration is based on a diluted sample analysis.
E = The compound was quantitated above the calibration range.
J = The compound was positively identified; however, the associated numerical value is an estimated concentration only.
ND = Not detected.
U = The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ = The compound was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual
R = The sample results are rejected.
* = Surrogate recovery outside of QC limits.

Criteria Qualifiers:

NA = Not available.
NL = Not listed.

Figures



LEGEND

——— 170	GROUND SURFACE INDEX ELEVATION CONTOUR (10 FT. CONTOUR INTERVAL)
———	GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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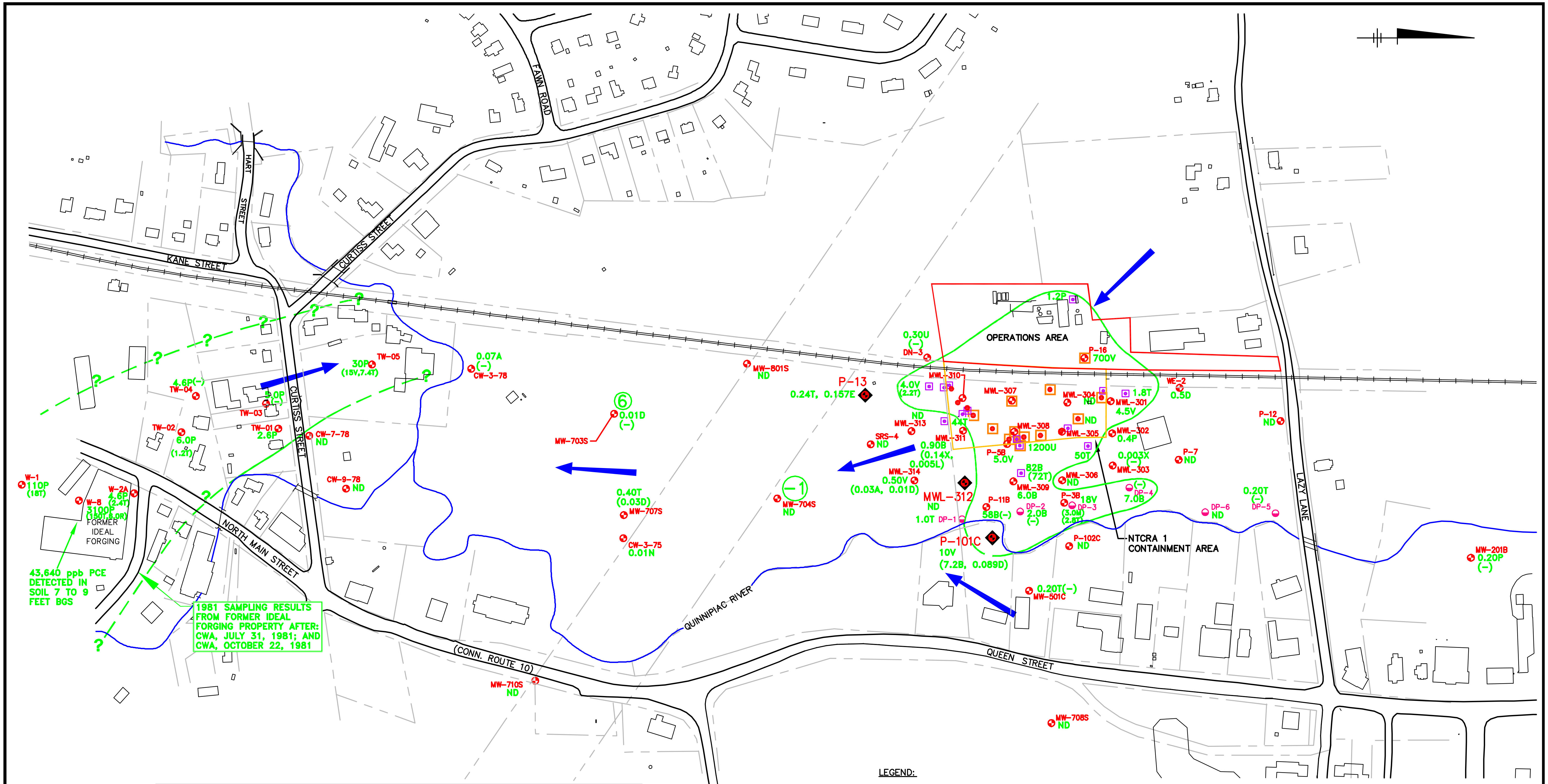
P: SYR-BL1
12/23/04 SYR-85-DMW RCA NJR
08331005/REPORT13/08331B01.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

SITE PLAN

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1



LEGEND:

◆	INTERIM MONITORING AND SAMPLING LOCATIONS
⊕	SHALLOW OVERBURDEN MONITORING WELL
●	NTCRA 1 EXTRACTION WELL
▣	NTCRA 1 COMPLIANCE PIEZOMETER
◓	NTCRA 1 WETLAND DRIVEPOINT
—	ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)
⑥	USAF NATURAL ATTENUATION RANK
☐	LOCATION WITH ALCOHOLS DETECTION IN GROUNDWATER
←	GENERALIZED GROUNDWATER FLOW DIRECTION

A	1,1-DICHLOROETHANE
B	BENZENE
C	CHLOROFORM
D	1,2-DICHLOROETHENE
E	1,1-DICHLOROETHENE
M	METHYLENE CHLORIDE
N	ACETONE
P	TETRACHLOROETHENE
R	1,1,1-TRICHLOROETHANE
T	TRICHLOROETHENE
U	2-BUTANONE
V	VINYL CHLORIDE
Z	CHLOROBENZENE
ND	NO VOCs DETECTED

NOVEMBER 1996-JANUARY 1997 GROUNDWATER SAMPLING RESULTS PLOTTED, EXCEPT AT INTERIM MONITORING AND SAMPLING, OR SUPPLEMENTAL SAMPLING LOCATIONS, WHERE NEW RESULTS ARE PLOTTED.

⊕ TW-04 4.6P

WELL WITH REGULATORY EXCEEDENCE RATIO.
NUMBERS >1.0 INDICATE GROUNDWATER REGULATORY LIMIT EXCEEDED.
NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT.
FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 4.6 INDICATES 4.6 x LIMIT)
LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO
(e.g., P = TETRACHLOROETHENE)
NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.
COMPOUNDS DETECTED IN BLANK(S) NOT INCLUDED IN THIS EVALUATION

0 300' 600'

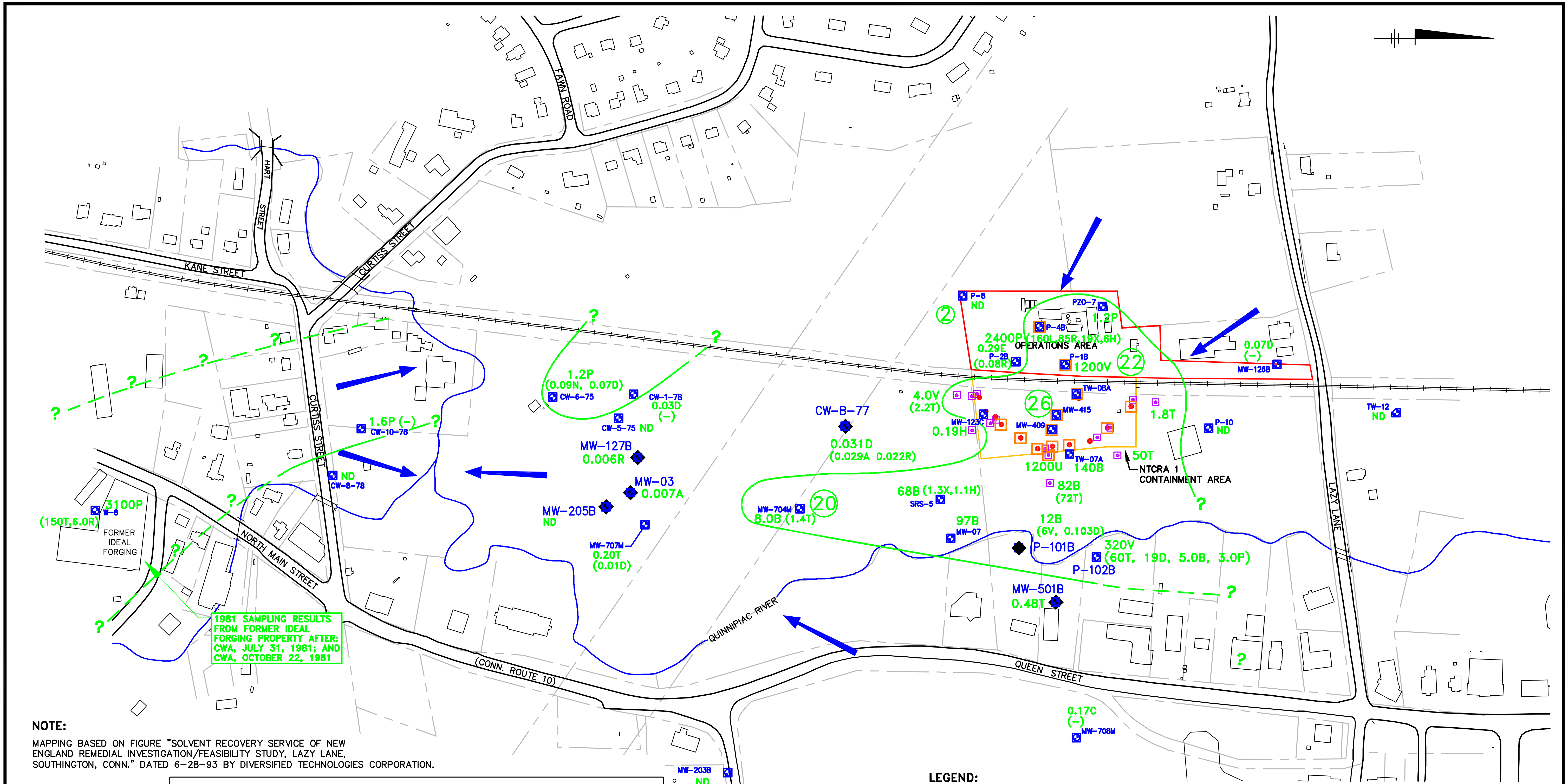
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

ESTIMATED SHALLOW OVERBURDEN GROUNDWATER REGULATORY VOC PLUME, OCTOBER 2004

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
2

X: 08331X00, 08331X01.DWG
L: ON=*; OFF=REF*; X01OFF=PIPES,TRAIL
P: SYR-BL1
12/20/04 SYR-85-RLP DMJ NES
08331005/REPORT13/08331C02.DWG



NOTE:

MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONN." DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

A	1,1-DICHLOROETHANE
B	BENZENE
C	CHLOROFORM
D	1,2-DICHLOROETHENE
E	1,1-DICHLOROETHENE
H	ETHYLBENZENE
L	TOLUENE
M	METHYLENE CHLORIDE
N	ACETONE
P	TETRACHLOROETHENE
R	1,1,1-TRICHLOROETHANE
T	TRICHLOROETHENE
U	2-BUTANONE
V	VINYL CHLORIDE
X	XYLENES
Z	CHLOROBENZENE
ND	NO VOCs DETECTED

NOVEMBER 1996-JANUARY 1997 GROUNDWATER SAMPLING RESULTS PLOTTED, EXCEPT AT INTERIM MONITORING AND SAMPLING, OR SUPPLEMENTAL SAMPLING LOCATIONS, WHERE NEW RESULTS ARE PLOTTED.

MW-07
97B

WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUNDWATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT.
FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 97 INDICATES 97 x LIMIT)
LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO
(e.g., B = BENZENE)
NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.
COMPOUNDS DETECTED IN BLANK(S) NOT INCLUDED IN THIS EVALUATION

LEGEND:

◆	INTERIM MONITORING AND SAMPLING LOCATIONS
▣	MIDDLE OVERBURDEN MONITORING WELL
●	NTCRA 1 EXTRACTION WELL
▣	NTCRA 1 COMPLIANCE PIEZOMETER
—	ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)
②	USAF NATURAL ATTENUATION RANK
☐	LOCATION WITH ALCOHOLS DETECTION IN GROUNDWATER
←	GENERALIZED GROUND-WATER FLOW DIRECTION
ND	NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUNDWATER SAMPLING EVENT

0 300' 600'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

ESTIMATED MIDDLE OVERBURDEN GROUNDWATER REGULATORY VOC PLUME, OCTOBER 2004

BBL®
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engineers, scientists, economists

FIGURE
3

X: 08331X00, 08331X01
L: ON=*; OFF=REF*,(X01OFF=PIPES,TRAIL)
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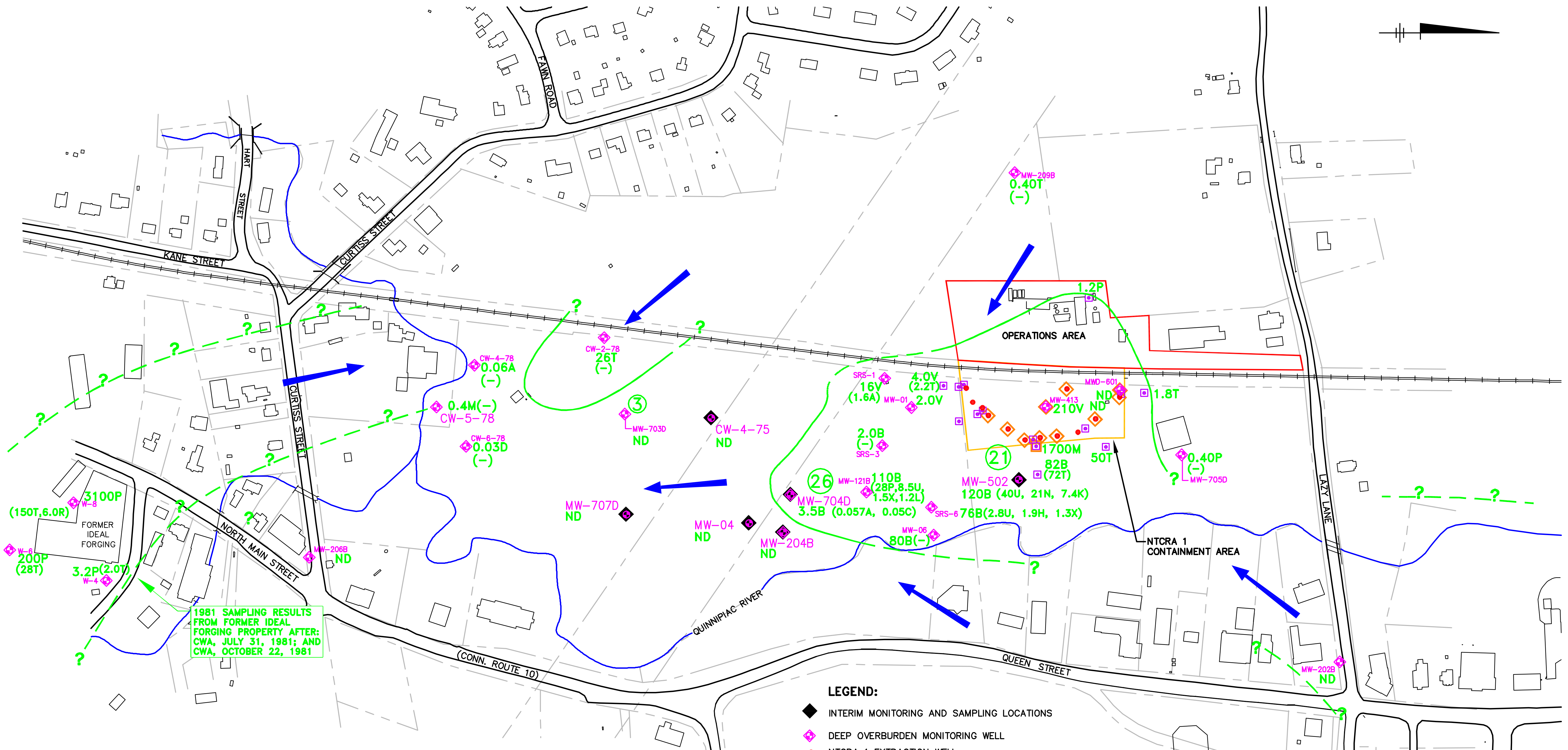
12/20/04 SYR-85-RLP DMJ NES
08331005/REPORT13/08331C03.DWG



A	1,1-DICHLOROETHANE
B	BENZENE
C	CHLOROBENZENE
D	1,2-DICHLOROETHENE
E	1,1-DICHLOROETHENE
H	ETHYLBENZENE
K	4-METHYL-2-PENTANONE (MIBK)
L	TOLUENE
M	METHYLENE CHLORIDE
N	ACETONE
P	TETRACHLOROETHENE
R	1,1,1-TRICHLOROETHANE
T	TRICHLOROETHENE
U	2-BUTANONE
V	VINYL CHLORIDE
X	XYLENES
ND	NO VOCs DETECTED
NE	NO EXCEEDANCES DETECTED

NOVEMBER 1996-JANUARY 1997 GROUNDWATER SAMPLING RESULTS PLOTTED, EXCEPT AT INTERIM MONITORING AND SAMPLING, OR SUPPLEMENTAL SAMPLING LOCATIONS, WHERE NEW RESULTS ARE PLOTTED.

◈ MW-502 3300C

WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUNDWATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 3300 INDICATES 3300 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., C = CHLOROFORM) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS. COMPOUNDS DETECTED IN BLANK(S) NOT INCLUDED IN THIS EVALUATION

LEGEND:

◆	INTERIM MONITORING AND SAMPLING LOCATIONS
◈	DEEP OVERBURDEN MONITORING WELL
●	NTCRA 1 EXTRACTION WELL
▣	NTCRA 1 COMPLIANCE PIEZOMETER
—	ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)
③	USAF NATURAL ATTENUATION RANK
◇	LOCATION WITH ALCOHOLS DETECTION IN GROUNDWATER
←	GENERALIZED GROUNDWATER FLOW DIRECTION

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

0 300' 600'

X: 08331X00, 08331X01
L: ON=*; OFF=REF*,(X01OFF=PIPES,TRAIL)
P:SYR-BL1
12/23/04 SYR-85-RLP NES NJR
08331005/REPORT13/08331C04.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

ESTIMATED DEEP OVERBURDEN GROUNDWATER REGULATORY VOC PLUME, OCTOBER 2004

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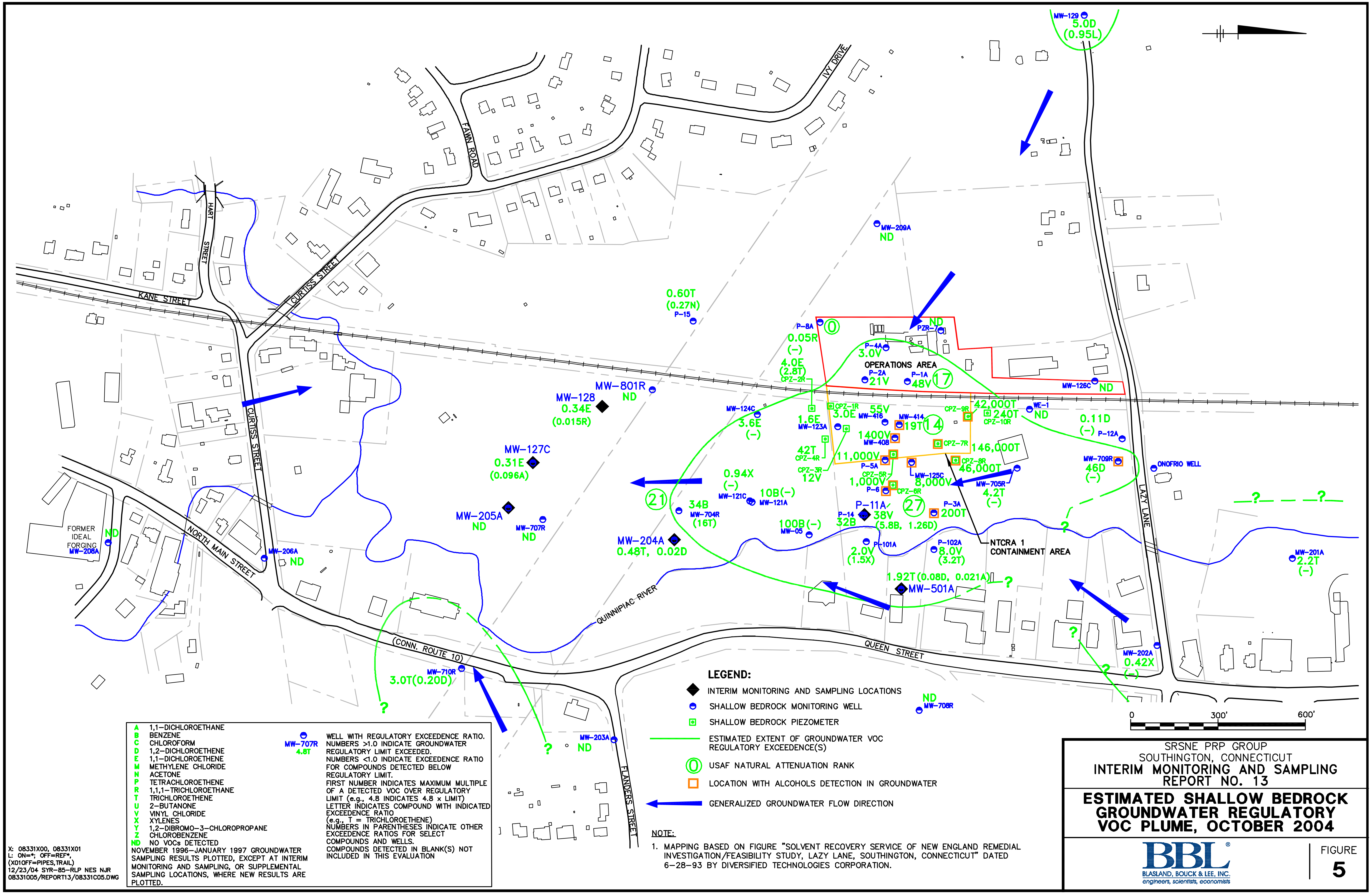
FIGURE
4



LEGEND:

- ◆ INTERIM MONITORING AND SAMPLING LOCATIONS
- ● SHALLOW BEDROCK MONITORING WELL
- ▣ SHALLOW BEDROCK PIEZOMETER
- — ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)
- ⓪ USAF NATURAL ATTENUATION RANK
- ☐ LOCATION WITH ALCOHOLS DETECTION IN GROUNDWATER
- ← GENERALIZED GROUNDWATER FLOW DIRECTION

A	1,1-DICHLOROETHANE
B	BENZENE
C	CHLOROFORM
D	1,2-DICHLOROETHENE
E	1,1-DICHLOROETHENE
M	METHYLENE CHLORIDE
N	ACETONE
P	TETRACHLOROETHENE
R	1,1,1-TRICHLOROETHANE
T	TRICHLOROETHENE
U	2-BUTANONE
V	VINYL CHLORIDE
X	XYLENES
Y	1,2-DIBROMO-3-CHLOROPROPANE
Z	CHLOROBENZENE
ND	NO VOCs DETECTED

NOVEMBER 1996–JANUARY 1997 GROUNDWATER SAMPLING RESULTS PLOTTED, EXCEPT AT INTERIM MONITORING AND SAMPLING, OR SUPPLEMENTAL SAMPLING LOCATIONS, WHERE NEW RESULTS ARE PLOTTED.

MW-707R
4.8T

WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUNDWATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 4.8 INDICATES 4.8 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS. COMPOUNDS DETECTED IN BLANK(S) NOT INCLUDED IN THIS EVALUATION

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

X: 08331X00, 08331X01
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(X01OFF=PIPES,TRAIL)
12/23/04 SYR-85-RLP NES NJR
08331005/REPORT13/08331C05.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

ESTIMATED SHALLOW BEDROCK GROUNDWATER REGULATORY VOC PLUME, OCTOBER 2004

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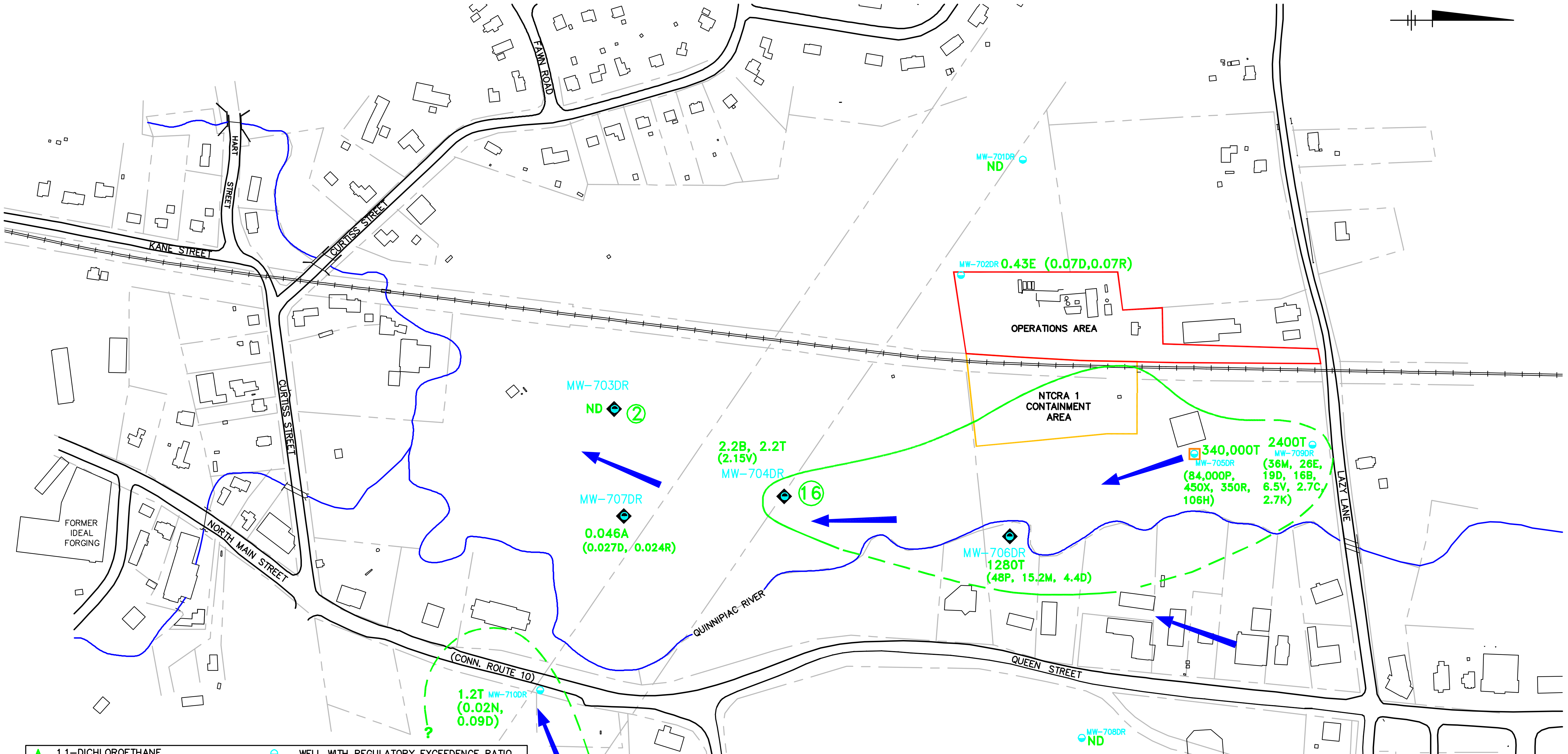
FIGURE
5



A 1,1–DICHLOROETHANE
B BENZENE
C CHLOROFORM
D 1,2–DICHLOROETHENE
E 1,1–DICHLOROETHENE
H ETHYLBENZENE
K 4–METHYL–2–PENTANONE (MIBK)
L TOLUENE
M METHYLENE CHLORIDE
N ACETONE
P TETRACHLOROETHENE
R 1,1,1–TRICHLOROETHANE
T TRICHLOROETHENE
U 2–BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED

NOVEMBER 1996–JANUARY 1997 GROUNDWATER SAMPLING RESULTS PLOTTED, EXCEPT AT INTERIM MONITORING AND SAMPLING, OR SUPPLEMENTAL SAMPLING LOCATIONS, WHERE NEW RESULTS ARE PLOTTED.

◒ MW–704DR 11T — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUNDWATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 11 INDICATES 11 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

COMPOUNDS DETECTED IN BLANK(S) OR IN SAMPLES WITH SURROGATE RECOVERY OUTSIDE QC LIMITS (*) NOT INCLUDED IN THIS EVALUATION.

LEGEND:

◆ INTERIM MONITORING AND SAMPLING LOCATIONS
◒ DEEP BEDROCK MONITORING WELL
— ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)
② USAF NATURAL ATTENUATION RANK
☐ LOCATION WITH ALCOHOLS DETECTION IN GROUNDWATER
← GENERALIZED GROUNDWATER FLOW DIRECTION

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6–28–93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

0 300' 600'

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P:SYR–BL1
12/20/04 SYR–85–RLP DMJ NES
08331005/REPORT13/08331C06.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

ESTIMATED DEEP BEDROCK GROUNDWATER REGULATORY VOC PLUME, OCTOBER 2004

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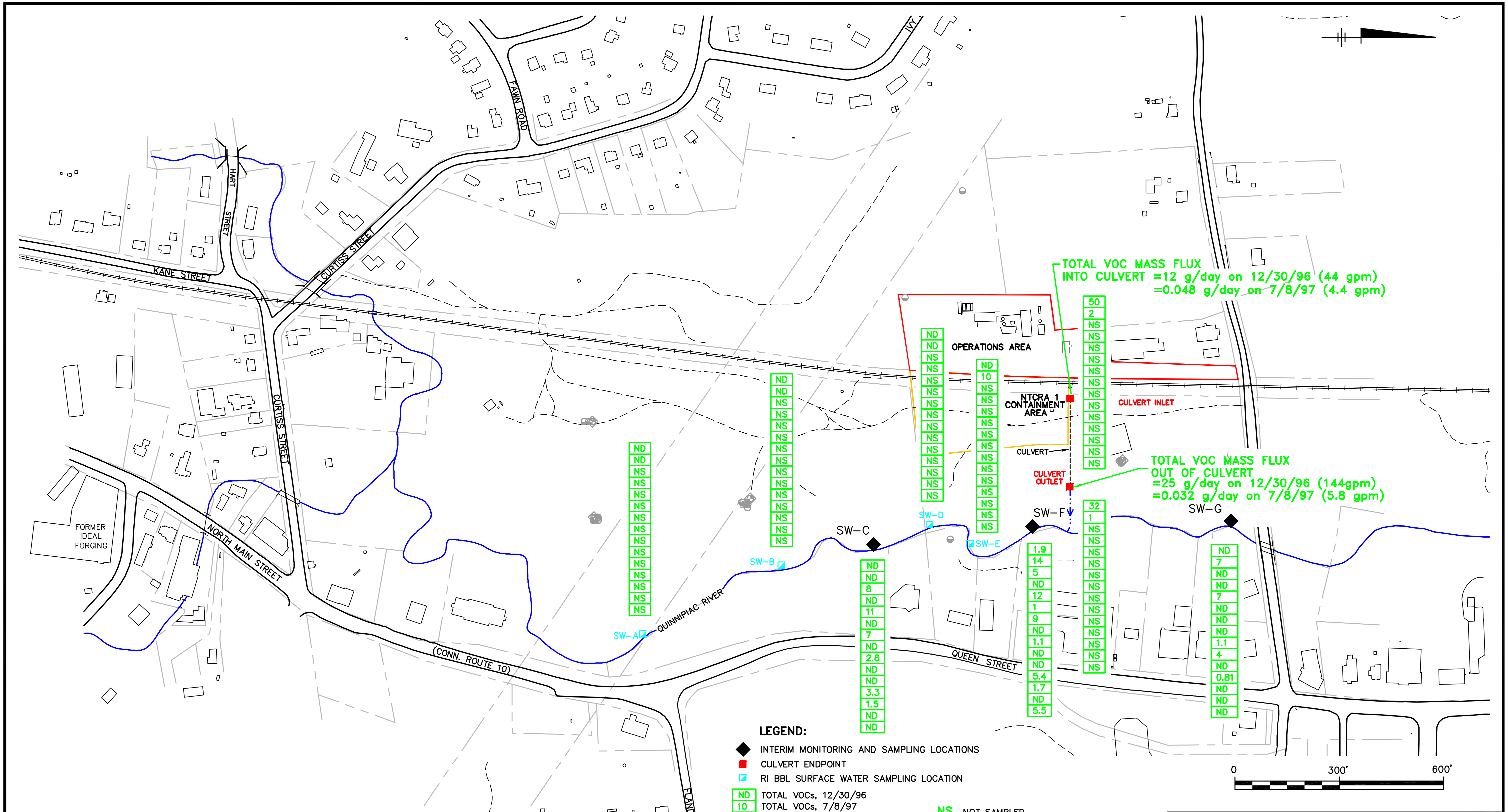
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
6



LEGEND:

◆ INTERIM MONITORING AND SAMPLING LOCATIONS

🟥 CULVERT ENDPOINT

◪ RI BBL SURFACE WATER SAMPLING LOCATION

ND	TOTAL VOCs, 12/30/96
10	TOTAL VOCs, 7/8/97
NS	TOTAL VOCs, 11/30/98
NS	TOTAL VOCs, 5/17/99
NS	TOTAL VOCs, 11/1/99
1	TOTAL VOCs, 4/24/00
7	TOTAL VOCs, 10/23/00
ND	TOTAL VOCs, 4/23/01
2.8	TOTAL VOCs, 10/22/01
ND	TOTAL VOCs, 4/22/02
ND	TOTAL VOCs, 10/21/02
33	TOTAL VOCs, 4/21/03
ND	TOTAL VOCs, 10/23/03
ND	TOTAL VOCs, 4/21/04
ND	TOTAL VOCs, 10/25/04

NS NOT SAMPLED
ND NONE DETECTED

NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. THESE RESULTS DO NOT INCLUDE ANALYTES DETECTED IN LAB BLANKS.

X: 08331X00, 08331X01
L: ON=*; OFF=REF*,(X01OFF=PIPES,TRAIL)
P: SYR-BL1
12/23/04 SYR-85-RLP NES NJR
08331005/REPORT13/08331C07.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

SUMMARY OF SURFACE-WATER SAMPLING RESULTS (ug/L), 12/30/96 THROUGH 10/25/04

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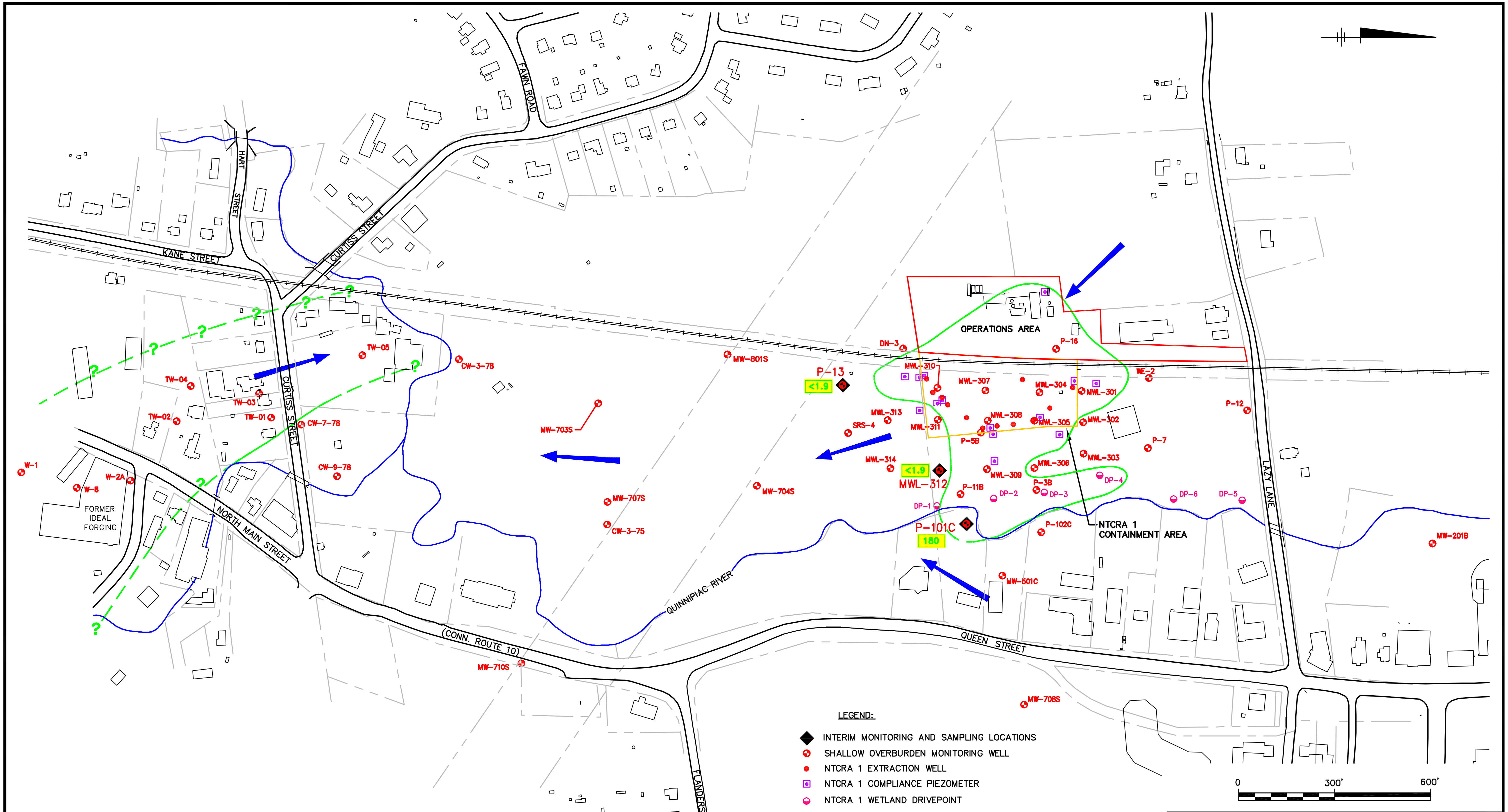
FIGURE
7



LEGEND:

- ◆ INTERIM MONITORING AND SAMPLING LOCATIONS
- ⊗ SHALLOW OVERBURDEN MONITORING WELL
- ● NTCRA 1 EXTRACTION WELL
- ▣ NTCRA 1 COMPLIANCE PIEZOMETER
- ◓ NTCRA 1 WETLAND DRIVEPOINT
- ── ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)
- ← GENERALIZED GROUNDWATER FLOW DIRECTION
- <1.9 1,4-DIOXANE CONCENTRATION IN GROUNDWATER (ug/L)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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P: SYR-BL1
12/20/04 SYR-85-RLP DMJ NES
08331005/REPORT13/08331C08.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

1,4-DIOXANE CONCENTRATIONS IN SHALLOW OVERBURDEN GROUNDWATER, OCTOBER 2004

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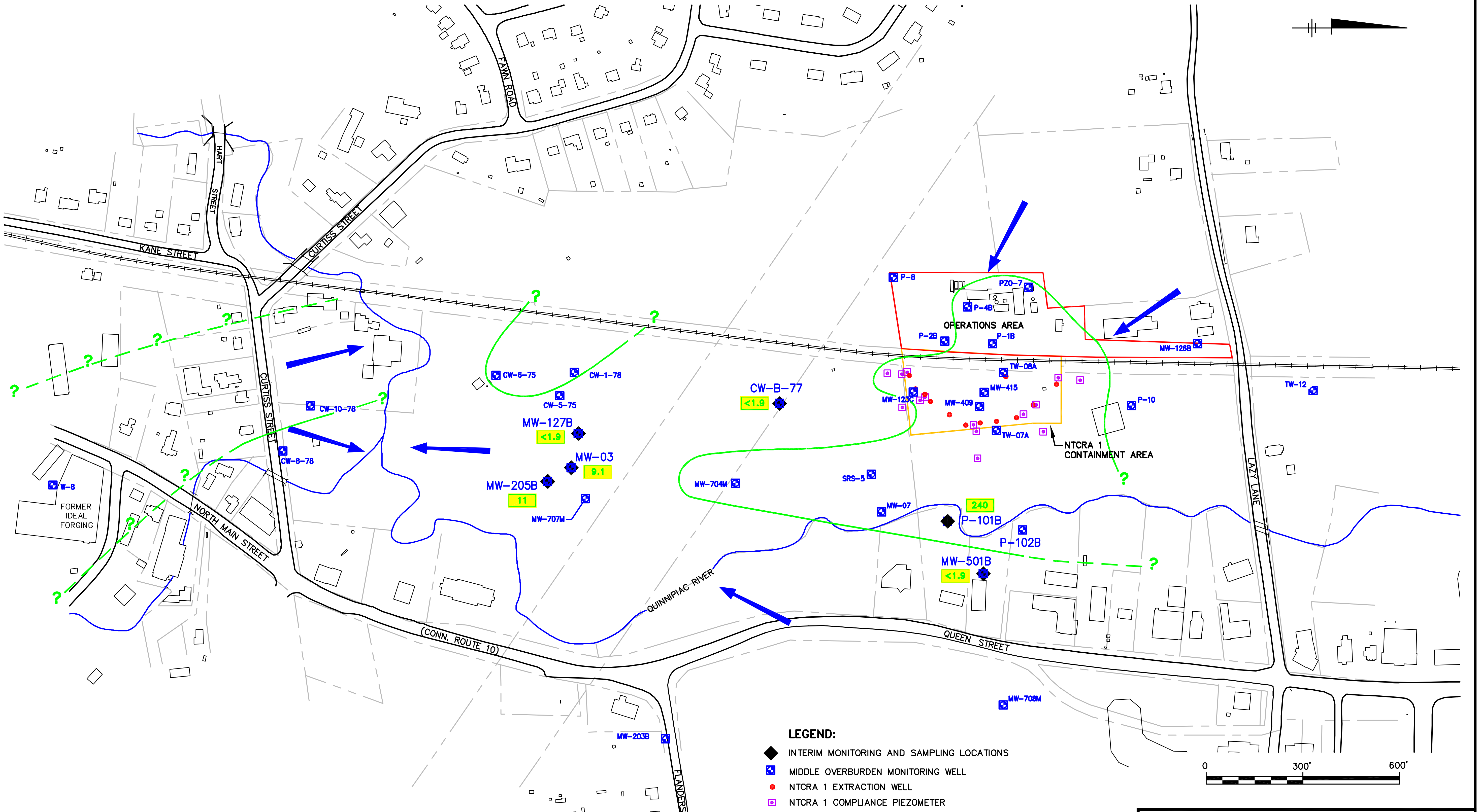
FIGURE
8



LEGEND:

◆ INTERIM MONITORING AND SAMPLING LOCATIONS

⊠ MIDDLE OVERBURDEN MONITORING WELL

● NTCRA 1 EXTRACTION WELL

⊡ NTCRA 1 COMPLIANCE PIEZOMETER

— ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)

← GENERALIZED GROUND-WATER FLOW DIRECTION

<1.9 1,4-DIOXANE CONCENTRATION IN GROUNDWATER (ug/L)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

X: 08331X00, 08331X01
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P: SYR-BL1
12/20/04 SYR-85-RLP DMJ NES
08331005/REPORT13/08331C09.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING REPORT NO. 13

1,4-DIOXANE CONCENTRATIONS IN MIDDLE OVERBURDEN GROUNDWATER, OCTOBER 2004

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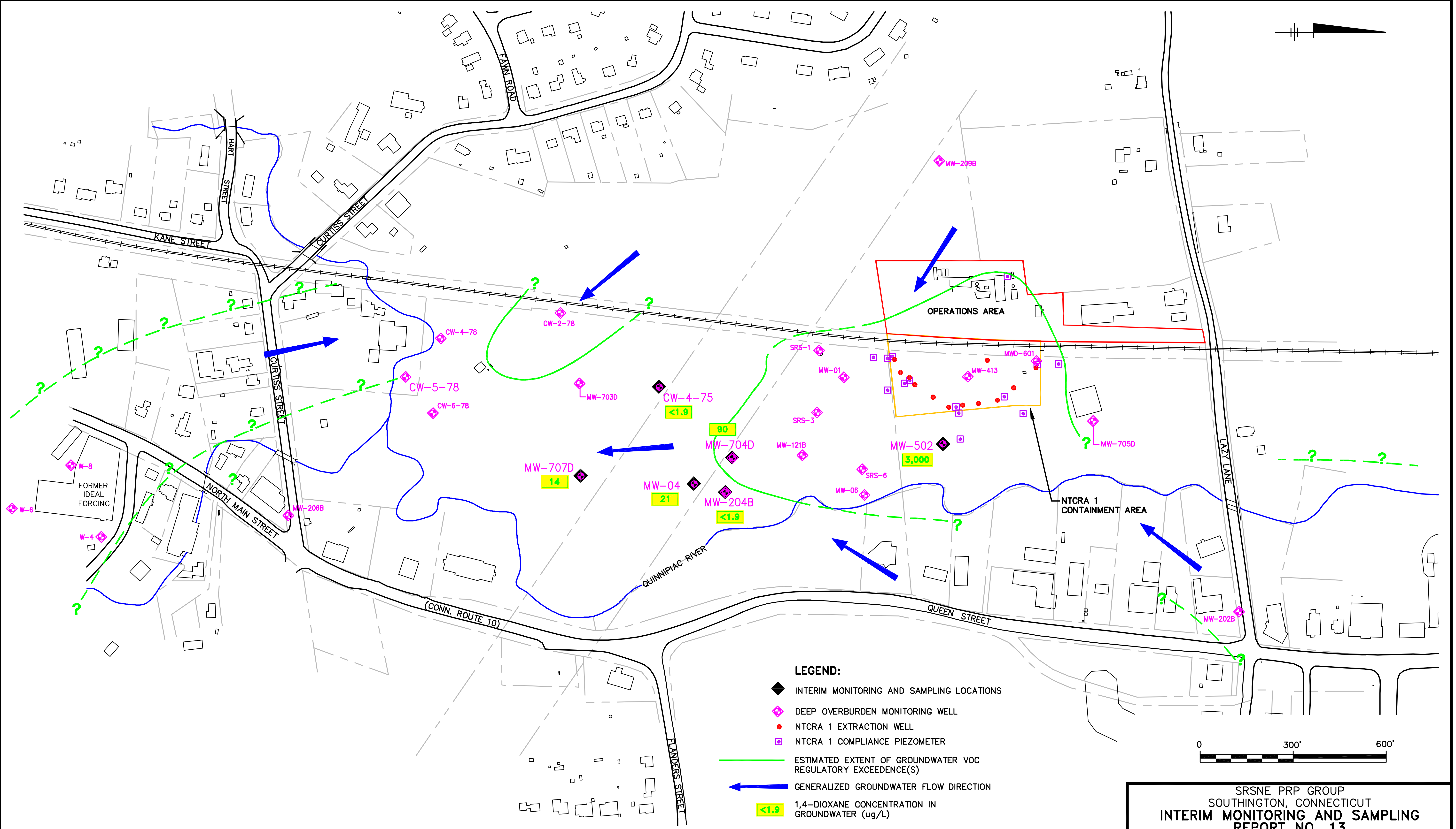
FIGURE
9



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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P: SYR-BL1
12/23/04 SYR-85-RLP NES NJR
08331005/REPORT13/08331C10.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

1,4-DIOXANE CONCENTRATIONS IN DEEP OVERBURDEN GROUNDWATER, OCTOBER 2004

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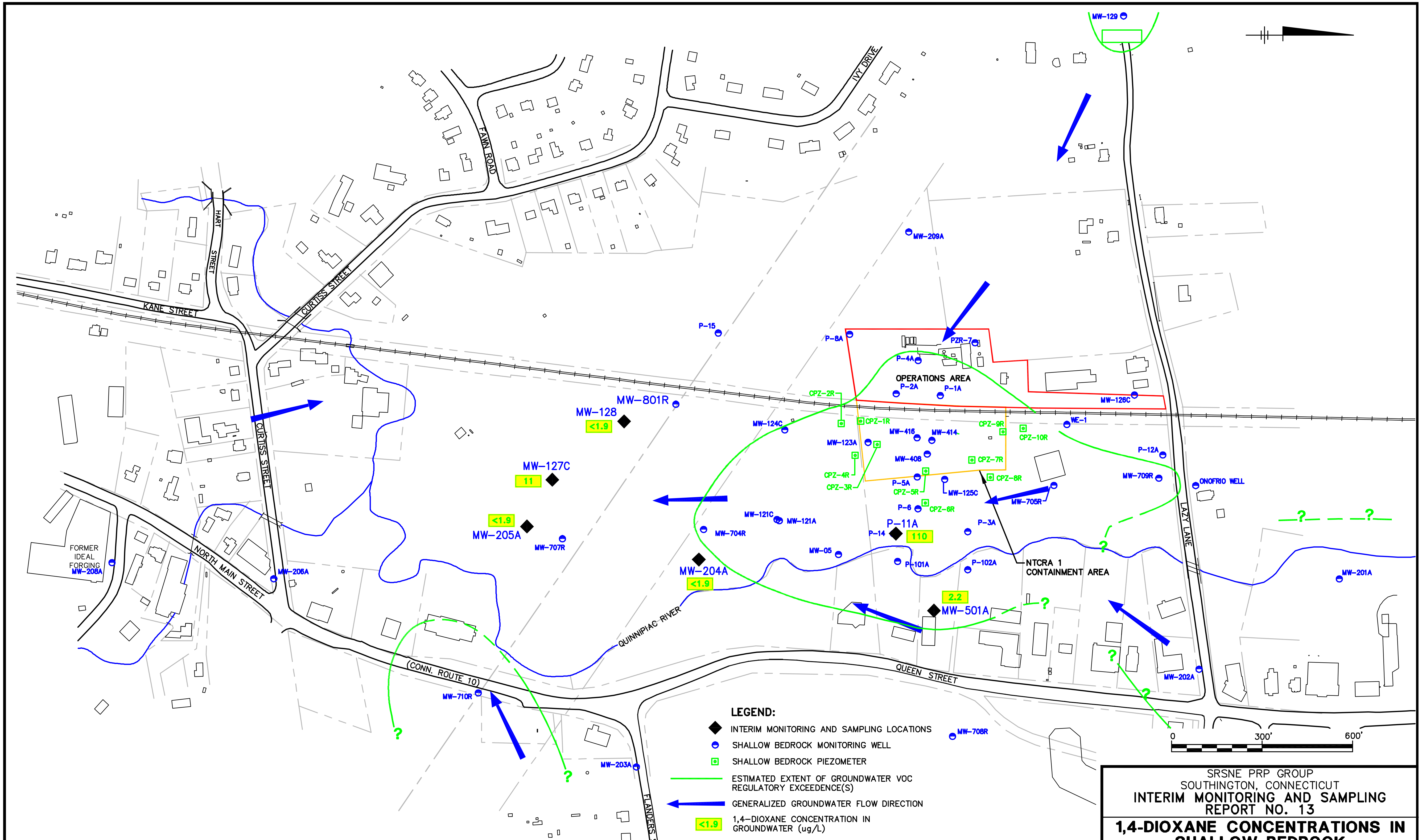
FIGURE
10



LEGEND:

- ◆ INTERIM MONITORING AND SAMPLING LOCATIONS
- ● SHALLOW BEDROCK MONITORING WELL
- ▣ SHALLOW BEDROCK PIEZOMETER
- ESTIMATED EXTENT OF GROUNDWATER VOC REGULATORY EXCEEDENCE(S)
- ← GENERALIZED GROUNDWATER FLOW DIRECTION
- <1.9 1,4-DIOXANE CONCENTRATION IN GROUNDWATER (ug/L)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

XREF: 08331X00, 08331X01.DWG
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12/20/04 SYR-85- PGL DMJ
NES08331005/REPORT13/08331C11.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

1,4-DIOXANE CONCENTRATIONS IN SHALLOW BEDROCK GROUNDWATER, OCTOBER 2004

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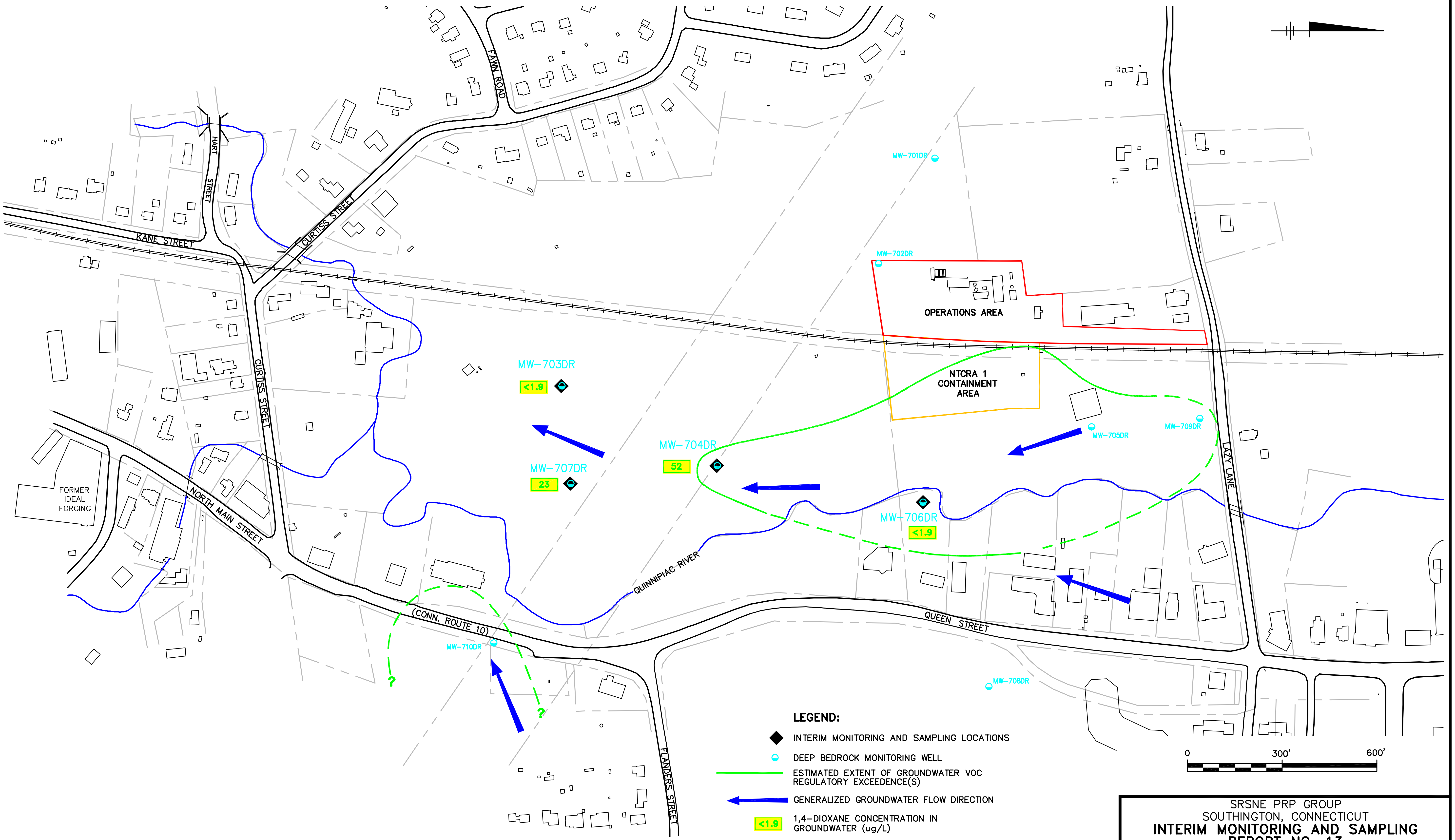
FIGURE
11



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

X: 08331X00, 08331X01.DWG
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P: SYR-BL1
12/20/04 SYR-85-RLP DMJ NES
08331005/REPORT13/08331C12.DWG

SRSNE PRP GROUP
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INTERIM MONITORING AND SAMPLING
REPORT NO. 13

1,4-DIOXANE CONCENTRATIONS IN DEEP BEDROCK GROUNDWATER, OCTOBER 2004

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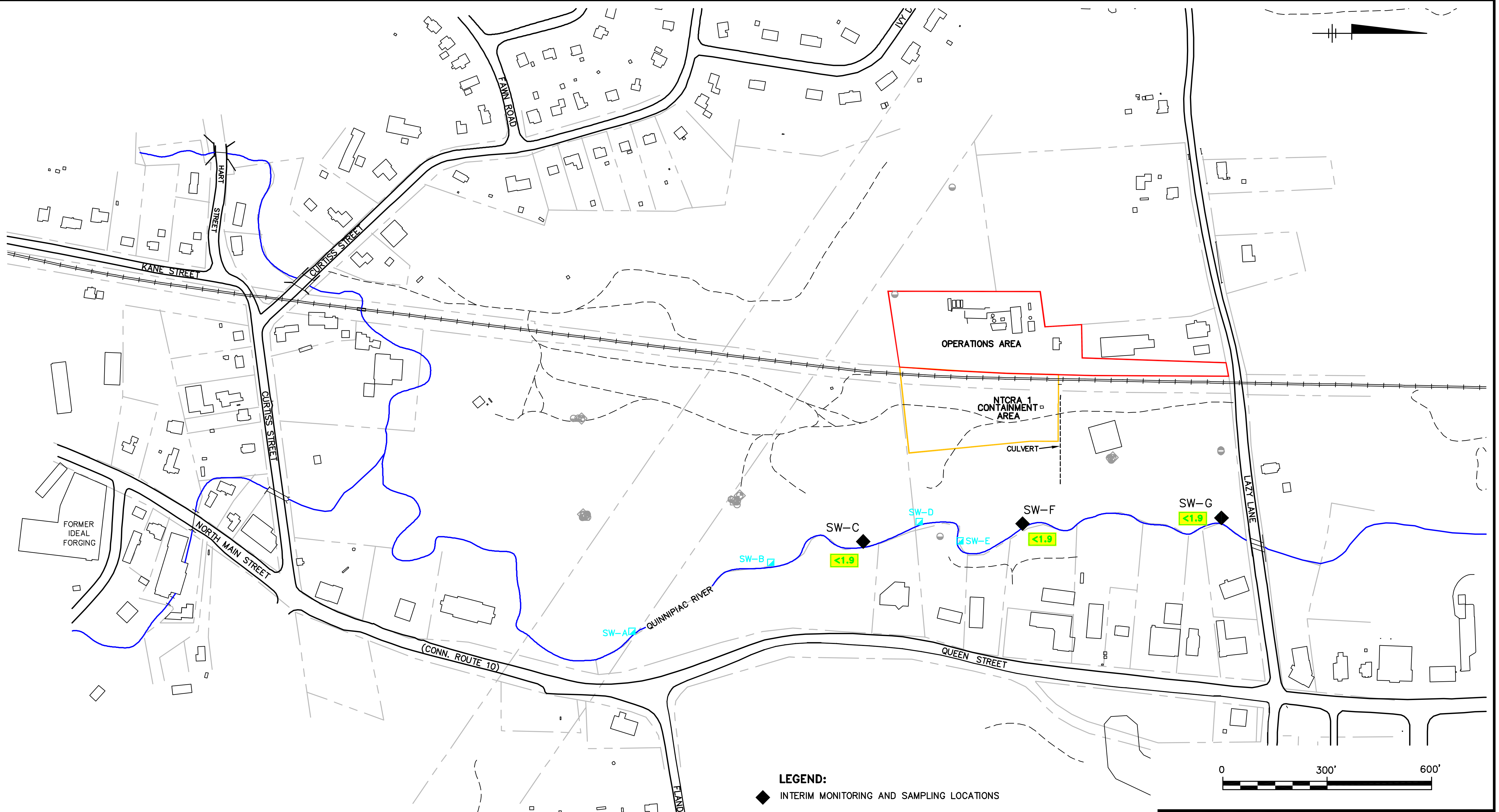
FIGURE
12



LEGEND:

◆ INTERIM MONITORING AND SAMPLING LOCATIONS

▨ RI BBL SURFACE WATER SAMPLING LOCATION

🟩 <1.9 1,4-DIOXANE CONCENTRATION IN SURFACE WATER (ug/L)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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P: SYR-BL1
12/20/04 SYR-85-RCB DMJ NES
08331005/REPORT13/08331C13.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
INTERIM MONITORING AND SAMPLING
REPORT NO. 13

SUMMARY OF 1,4-DIOXANE IN SURFACE WATER SAMPLES, OCTOBER 2004

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engineers, scientists, economists

FIGURE
13

Attachment 1

BLASLAND, BOUCK & LEE, INC.
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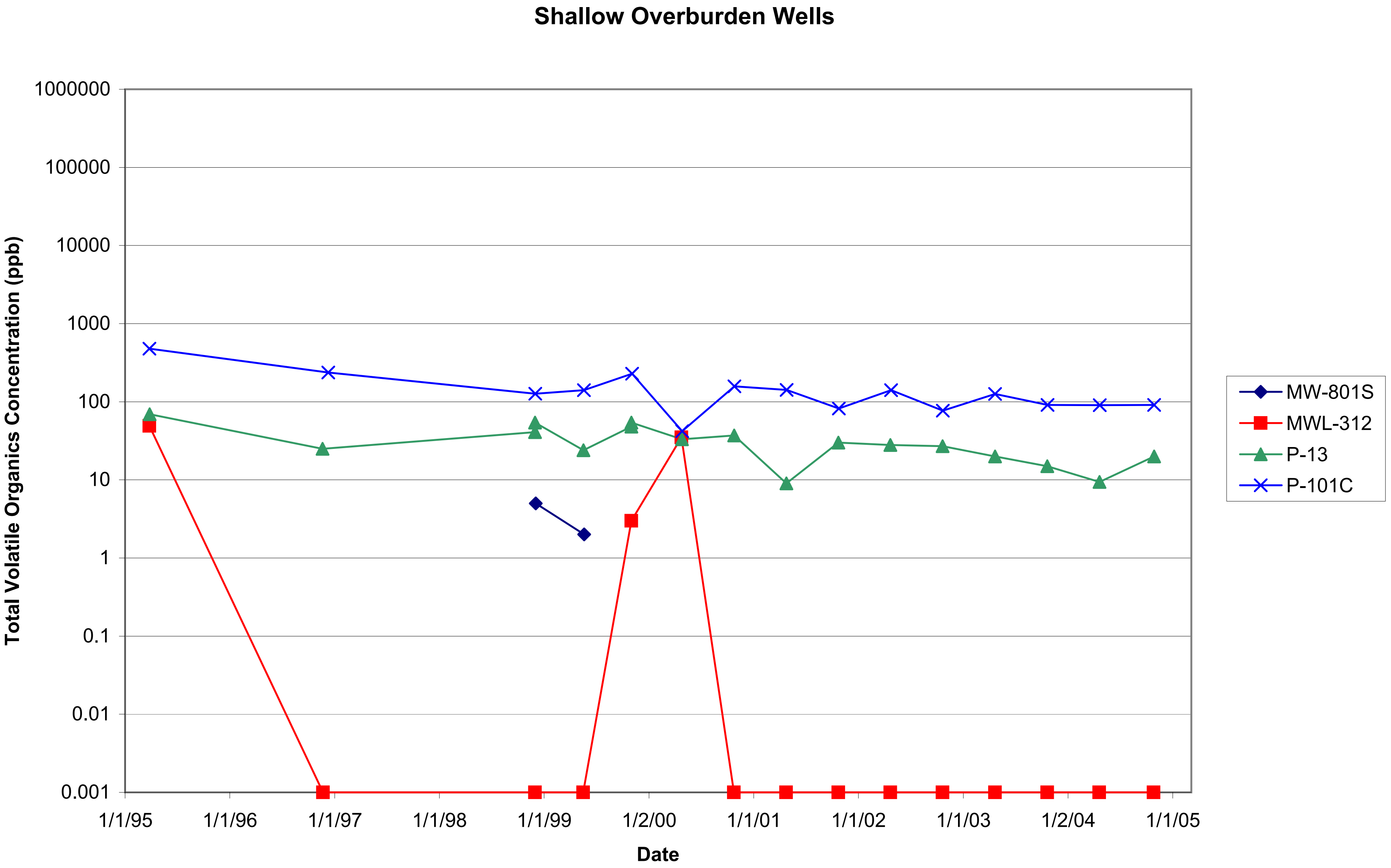
SRSNE
SOUTHINGTON, CONNECTICUT

TOTAL VOC CONCENTRATIONS OVER TIME



12/23/2004
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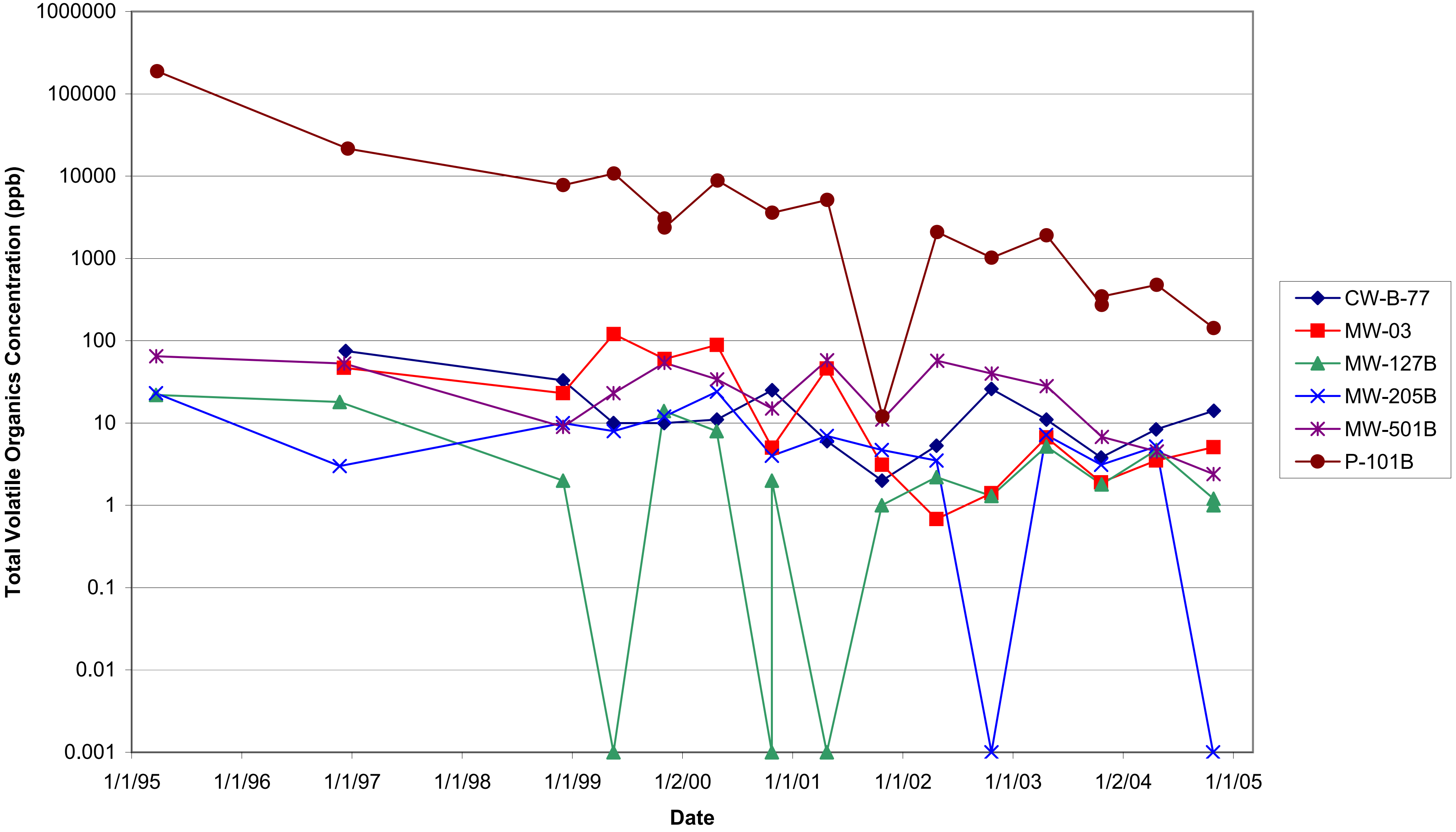
SRSNE
SOUTHINGTON, CONNECTICUT

TOTAL VOC CONCENTRATIONS OVER TIME

Middle Overburden Wells



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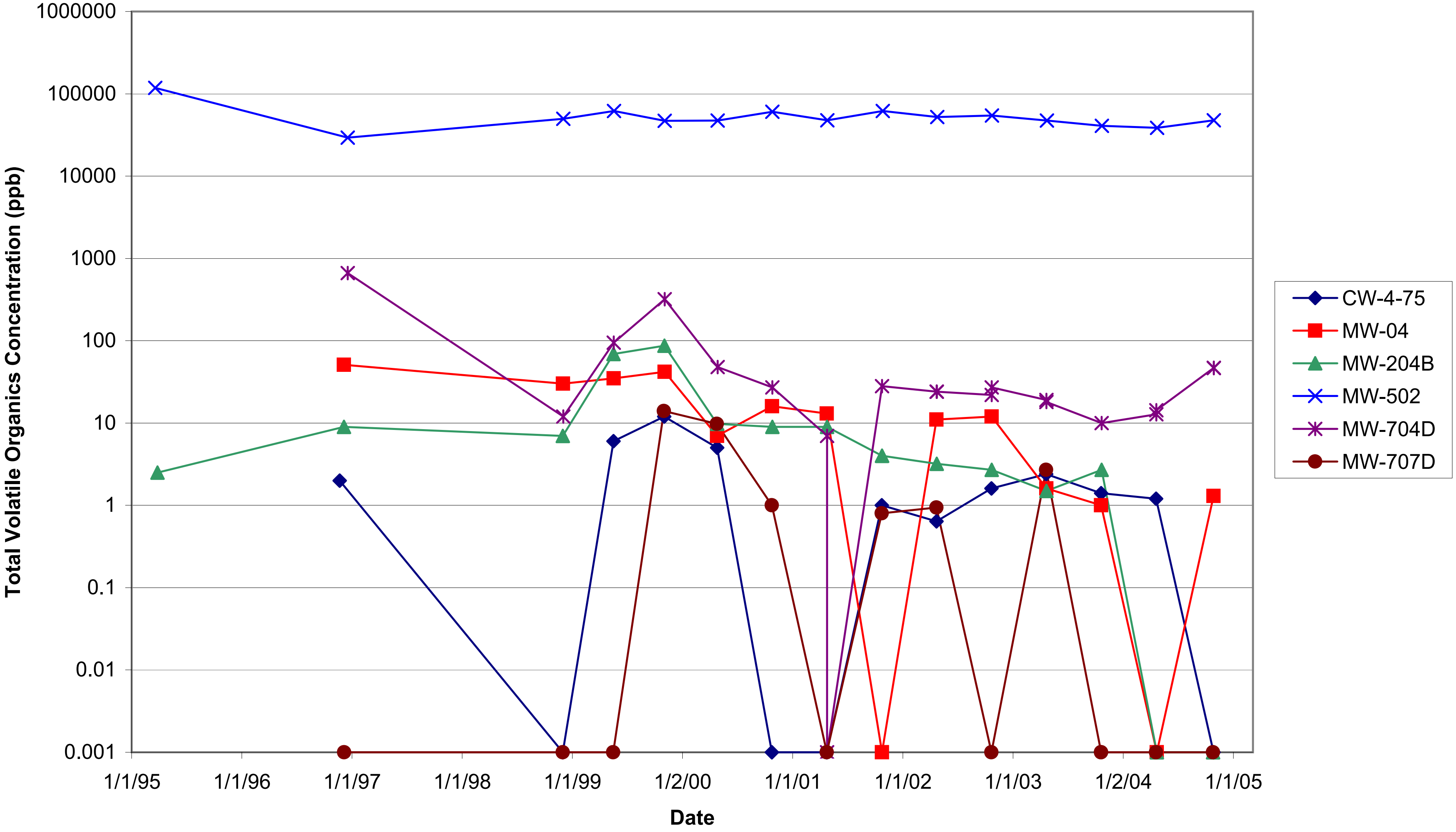
SRSNE
SOUTHINGTON, CONNECTICUT

TOTAL VOC CONCENTRATIONS OVER TIME

Deep Overburden Wells



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SRSNE
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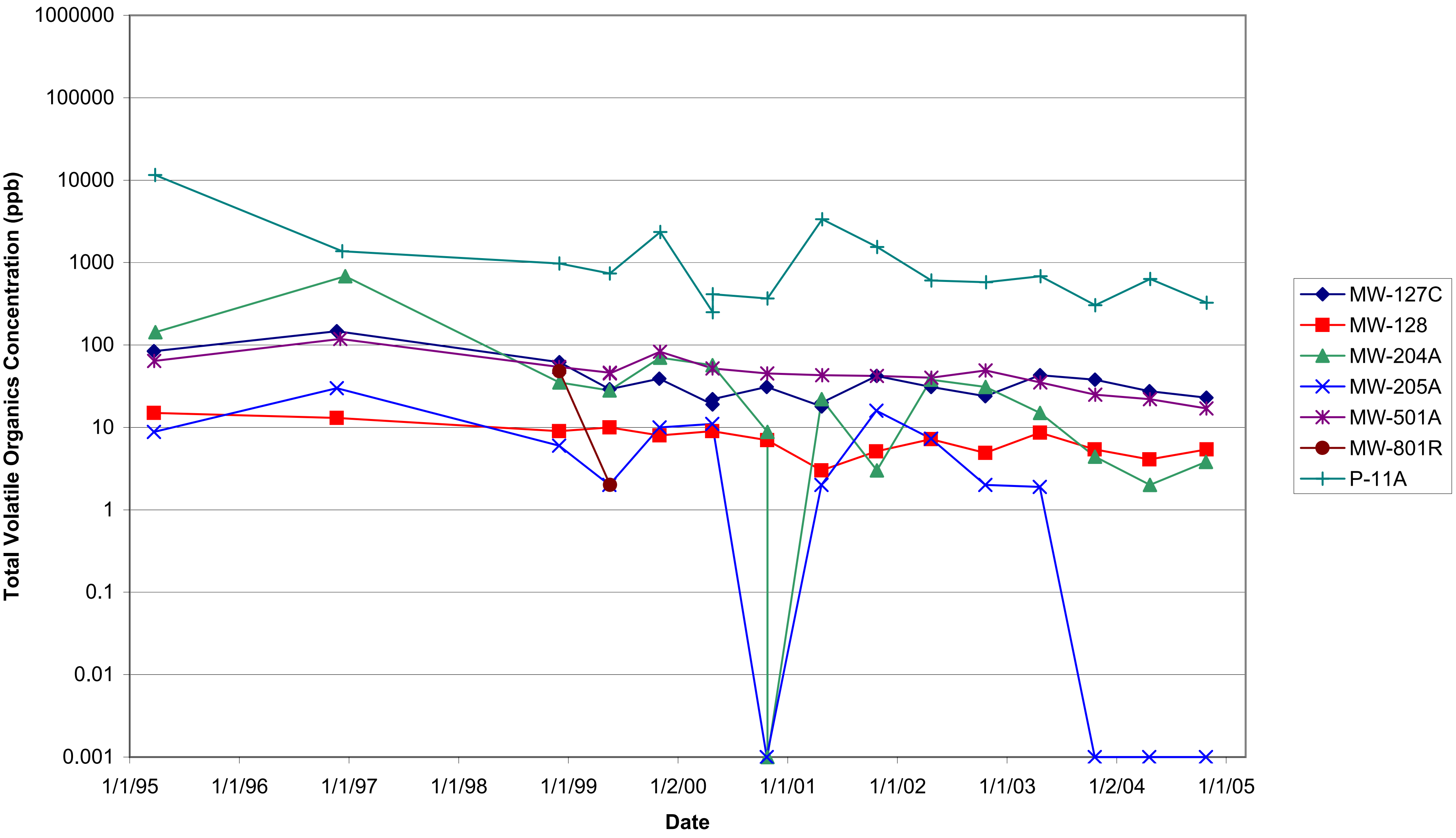
TOTAL VOC CONCENTRATIONS OVER TIME

Shallow Bedrock Wells



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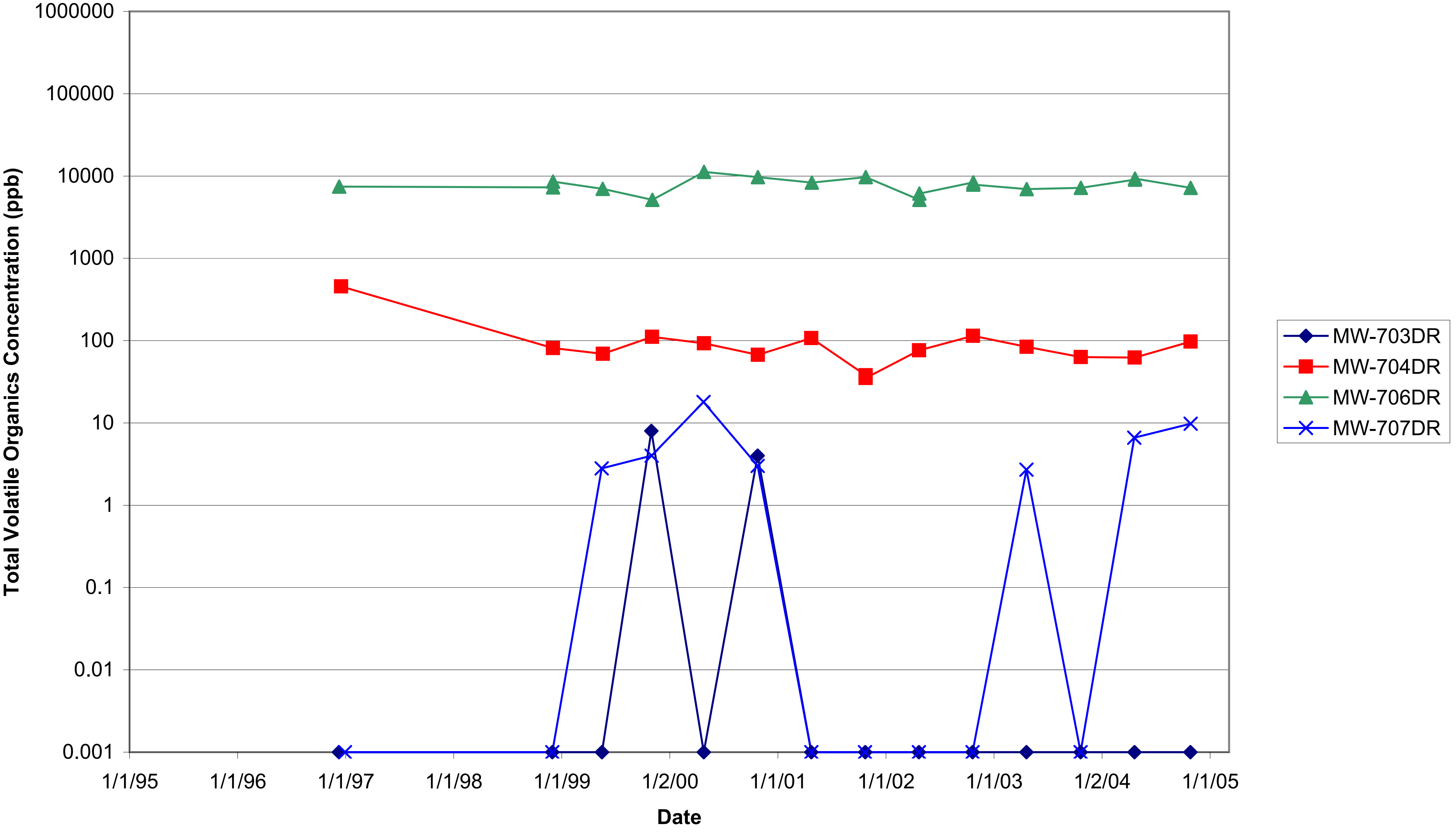
SRSNE
SOUTHINGTON, CONNECTICUT

TOTAL VOC CONCENTRATIONS OVER TIME

Deep Bedrock Wells



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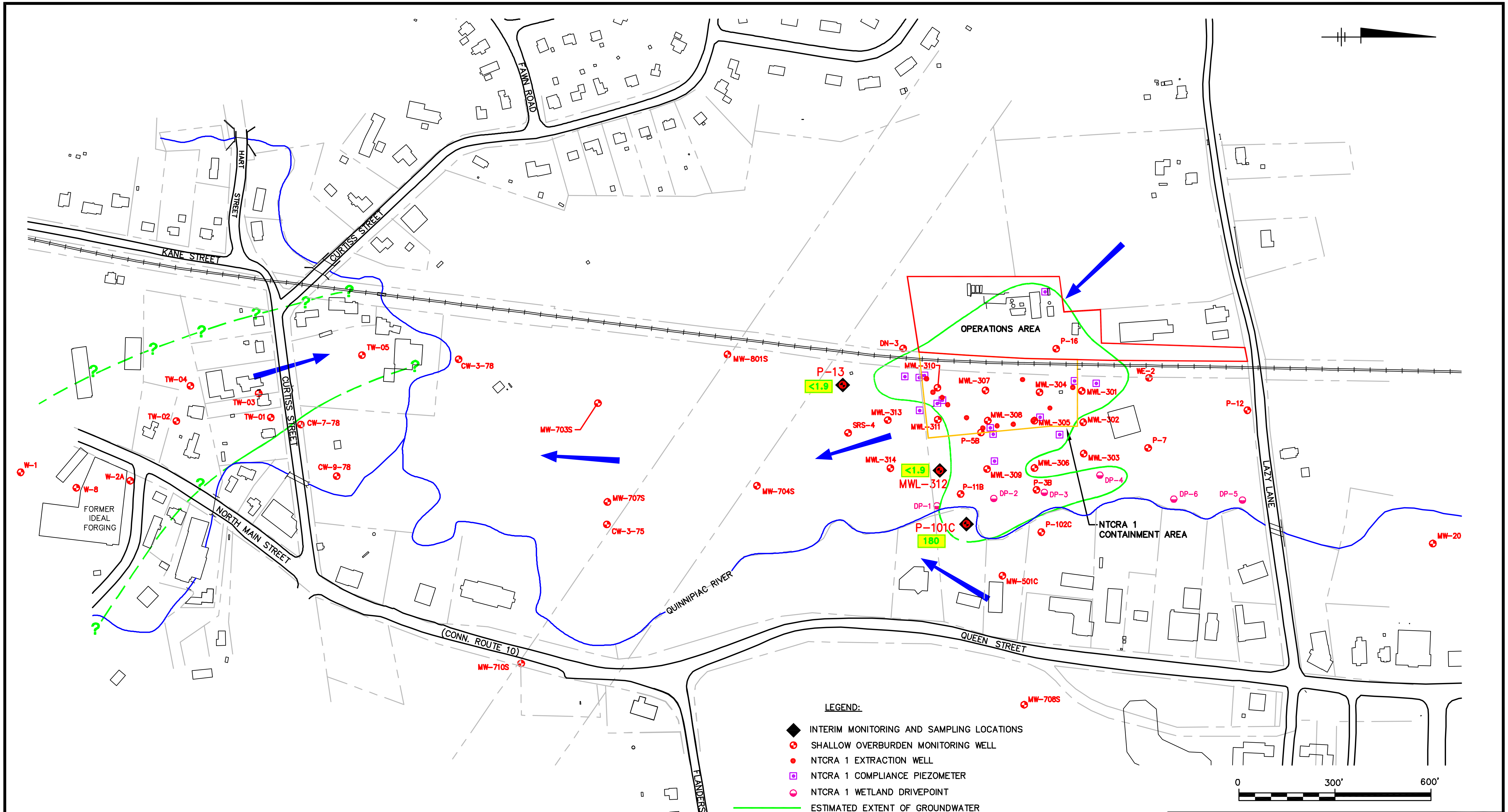
ATTACHMENT L – 2

1,4-Dioxane Sampling Results (April 2004)



LEGEND:

- ◆ INTERIM MONITORING AND SAMPLING LOCATIONS
- ⊕ SHALLOW OVERBURDEN MONITORING WELL
- ● NTCRA 1 EXTRACTION WELL
- ▣ NTCRA 1 COMPLIANCE PIEZOMETER
- ◓ NTCRA 1 WETLAND DRIVEPOINT
- 🟩 ESTIMATED EXTENT OF GROUNDWATER REGULATORY EXCEEDENCE(S)
- ← GENERALIZED GROUNDWATER FLOW DIRECTION
- <1.9 1,4-DIOXANE CONCENTRATION IN GROUNDWATER (ug/L)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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P: STD-BL
5/4/04 SYR-85-RLP NJR DMW
08331005/FS/08331C05.DWG

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FEASIBILITY STUDY

1,4-DIOXANE CONCENTRATIONS IN SHALLOW OVERBURDEN GROUNDWATER, APRIL 2004

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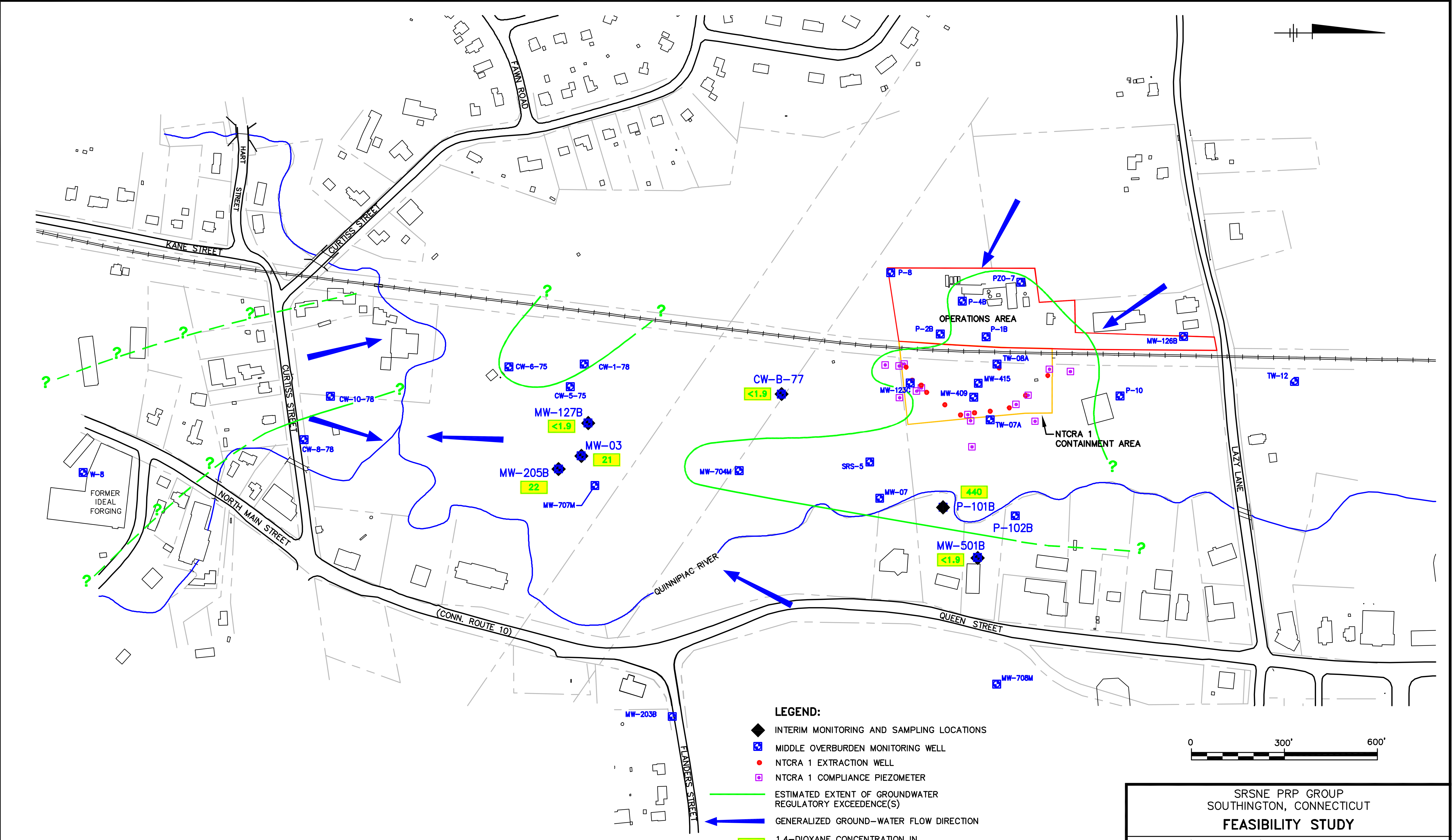
FIGURE
1



LEGEND:

◆ INTERIM MONITORING AND SAMPLING LOCATIONS

▣ MIDDLE OVERBURDEN MONITORING WELL

● NTCRA 1 EXTRACTION WELL

▣ NTCRA 1 COMPLIANCE PIEZOMETER

― ESTIMATED EXTENT OF GROUNDWATER REGULATORY EXCEEDENCE(S)

← GENERALIZED GROUND-WATER FLOW DIRECTION

<1.9 1,4-DIOXANE CONCENTRATION IN GROUNDWATER (ug/L)

NOTE:

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FEASIBILITY STUDY

1,4-DIOXANE CONCENTRATIONS IN MIDDLE OVERBURDEN GROUNDWATER, APRIL 2004

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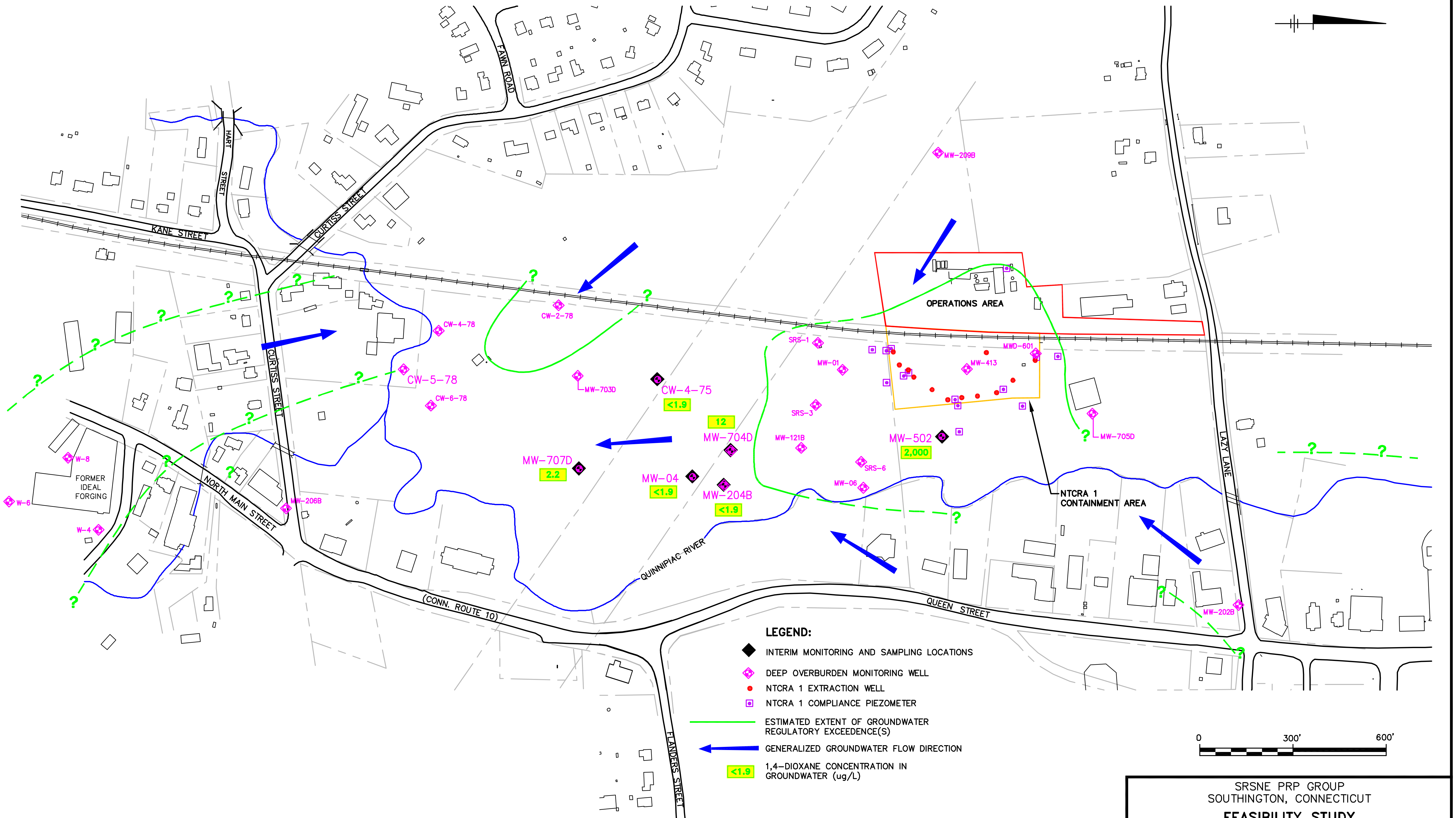
FIGURE
2



NOTE:
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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5/4/04 SYR-85-RLP NJR DMW
08331005/FS/08331C01.DWG

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FEASIBILITY STUDY

1,4-DIOXANE CONCENTRATIONS IN DEEP OVERBURDEN GROUNDWATER, APRIL 2004

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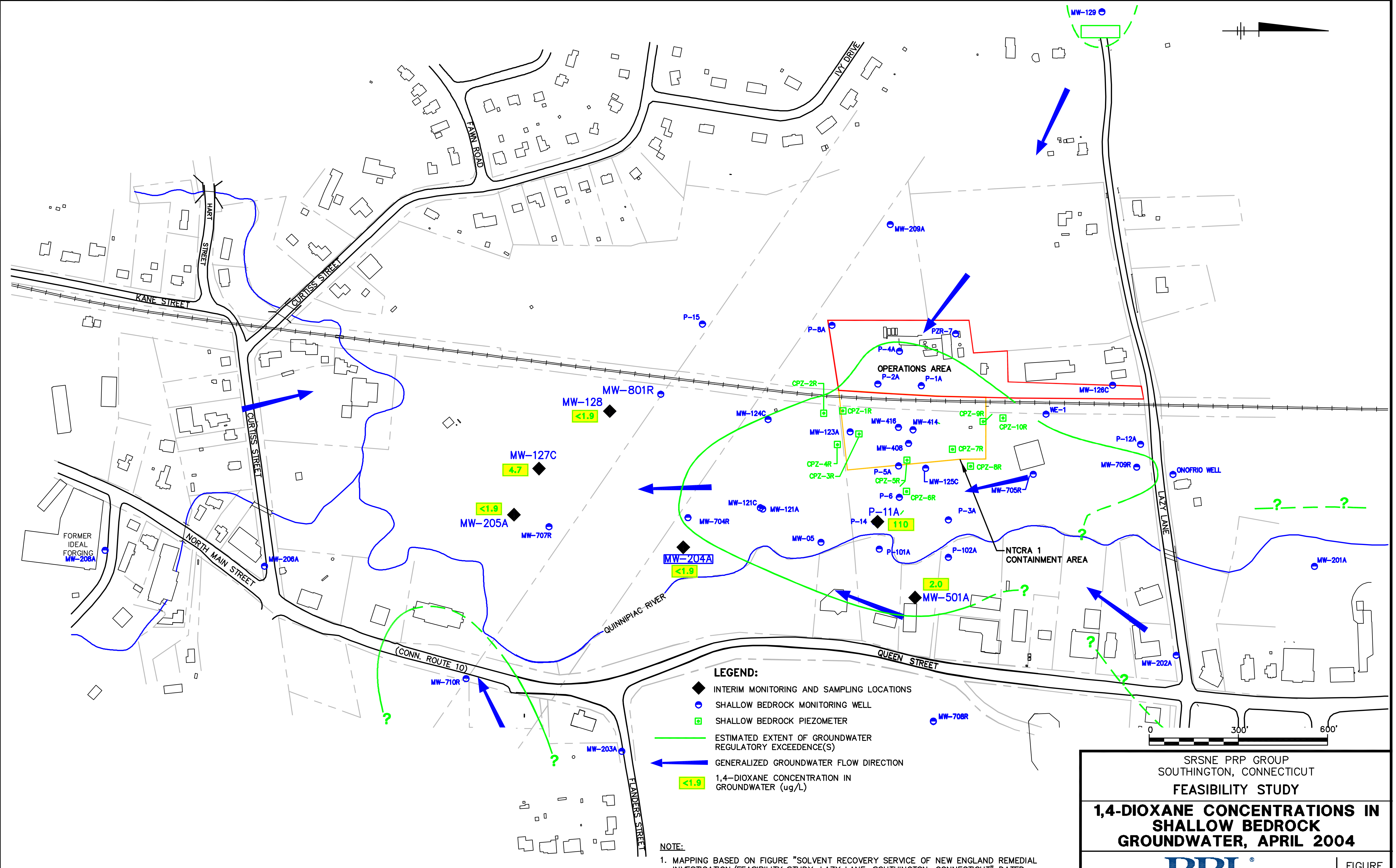
FIGURE
3



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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FEASIBILITY STUDY

1,4-DIOXANE CONCENTRATIONS IN SHALLOW BEDROCK GROUNDWATER, APRIL 2004

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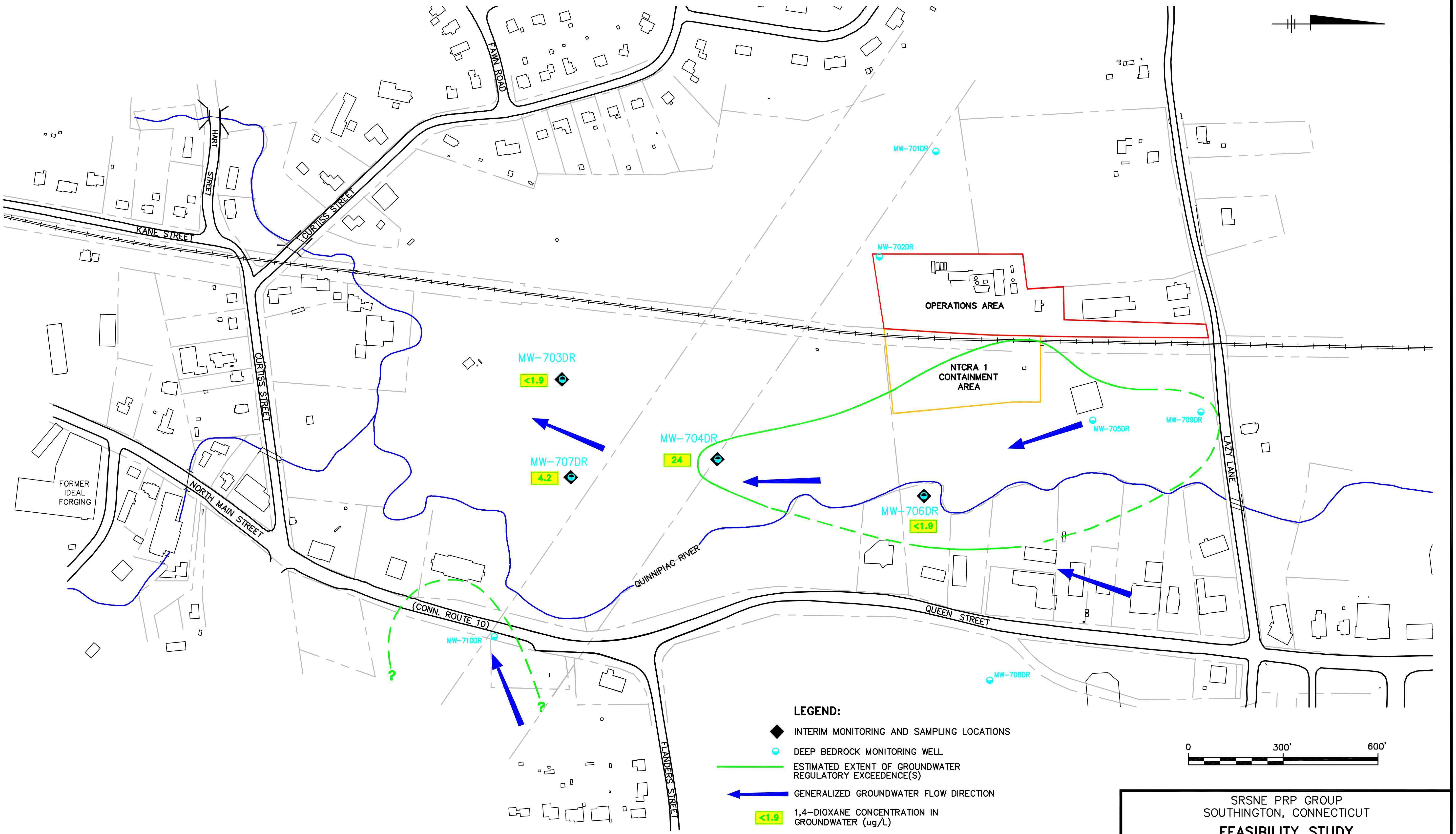
FIGURE
4



LEGEND:

◆ INTERIM MONITORING AND SAMPLING LOCATIONS

● DEEP BEDROCK MONITORING WELL

🟩 ESTIMATED EXTENT OF GROUNDWATER REGULATORY EXCEEDENCE(S)

← GENERALIZED GROUNDWATER FLOW DIRECTION

<1.9 1,4-DIOXANE CONCENTRATION IN GROUNDWATER (ug/L)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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P: STD-BL
5/4/04 SYR-85-RLP NJR DMW
08331005/FS/08331C03.DWG

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FEASIBILITY STUDY

1,4-DIOXANE CONCENTRATIONS IN DEEP BEDROCK GROUNDWATER, APRIL 2004

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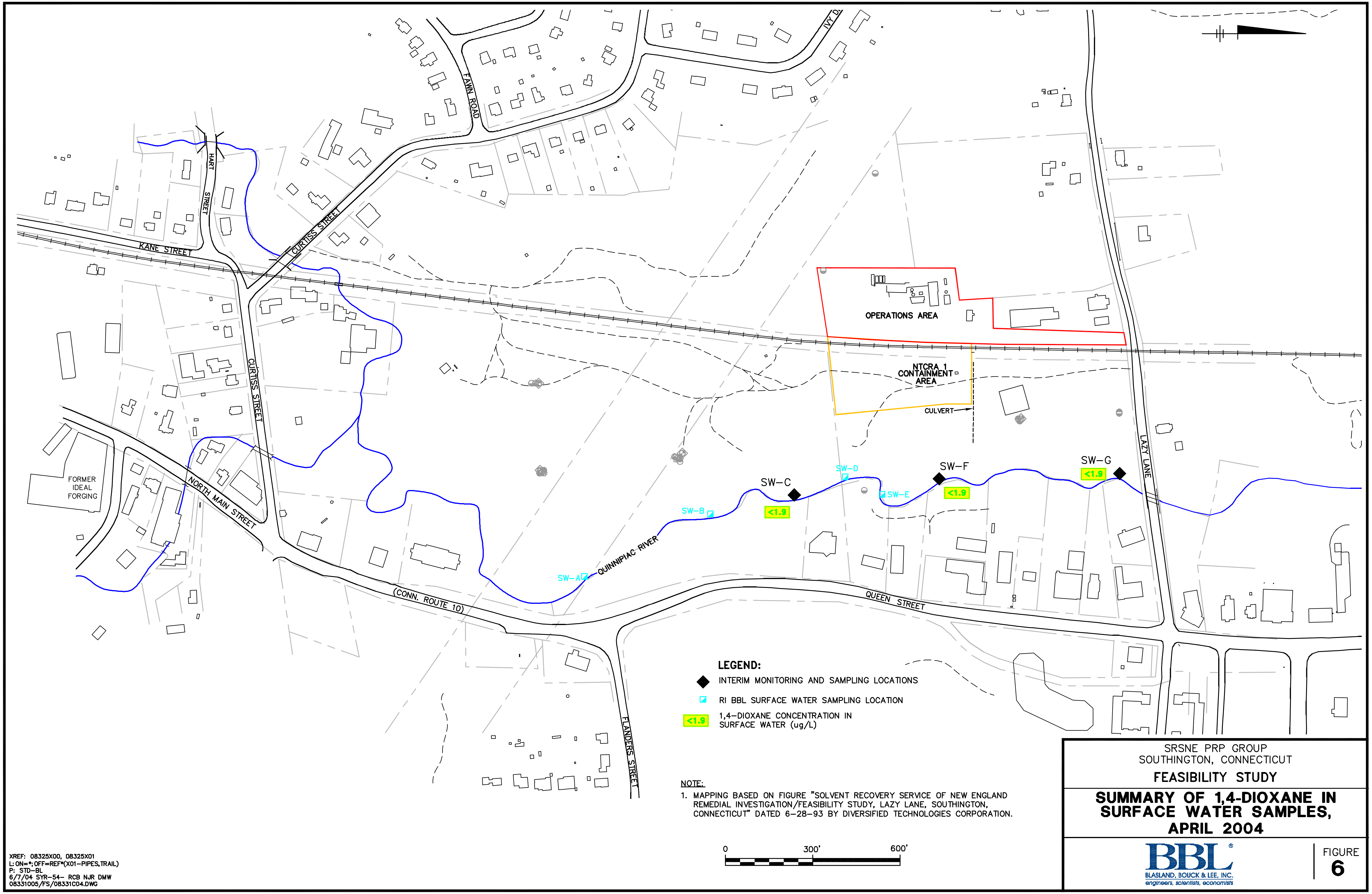
FIGURE
5



LEGEND:

◆ INTERIM MONITORING AND SAMPLING LOCATIONS

▨ RI BBL SURFACE WATER SAMPLING LOCATION

🟩 <1.9 1,4-DIOXANE CONCENTRATION IN SURFACE WATER (ug/L)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

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SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

FEASIBILITY STUDY

SUMMARY OF 1,4-DIOXANE IN SURFACE WATER SAMPLES, APRIL 2004

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FIGURE
6

Appendix M

Supplemental Soil Sampling

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Appendix M – Supplemental Soil Sampling

M.1 General

This appendix describes supplemental soil sampling performed by Blasland, Bouck & Lee, Inc. (BBL) on October 18 and 19, 1999, to support the completion of the Feasibility Study (FS) for the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. The initial work plan for supplemental soil sampling was submitted to the United States Environmental Protection Agency (USEPA) and the Connecticut Department of Environmental Protection (CT DEP) on August 27, 1999. Based on agency comments, subsequent revisions were made and submitted on September 27, 1999; September 29, 1999; October 5, 1999; and October 6, 1999. The final plan described herein was prepared to address CT DEP comments provided to BBL by telephone on October 14, 1999, and in the field on October 18, 1999.

M.2 Purposes for Supplemental Soil Sampling

Supplemental soil samples were obtained at the soil boring locations shown on Figure M-1. Figure M-1 also shows the pertinent areas of the site discussed in this appendix. Table M-1 summarizes the sample location coordinates and the depth, analysis, and geologic description of each soil sample. Tables M-2A through M-2E summarize the analytical results.

The supplemental soil-sampling program had three primary purposes, as summarized below.

- *Provide additional soil data to support the ongoing Risk Assessment (RA) Update for the former Cianci Property*

  Additional shallow soil samples were obtained at 12 locations in the northern area and 16 locations in the southern area of the former Cianci Property. These samples were analyzed for full TCL/TAL parameters to support the RA Update. In addition, the new analytical data were used to further evaluate CT DEP's Direct Exposure Criteria (DECs) for all analytes and Pollutant Mobility Criteria (PMCs) for volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). Appendix M presents the results of the soil data screening versus DECs.

- *Obtain leaching-based inorganics analytical data for vadose-zone soil to compare to CT DEP's PMCs.*

  Vadose-zone soil samples were obtained at eight locations in the southern portion of the former Cianci Property for analysis of inorganics by the Synthetic Precipitation Leaching Procedure (SPLP, SW-846 Method 1312). Contingent vadose-zone soil samples were also obtained at six locations in the northern portion of the former Cianci Property for potential analysis of inorganics by SPLP. The full TCL/TAL analytical data from the northern portion of the property were reviewed at a meeting in Hartford on November 30, 1999. The maximum potential leachate concentrations (mg/L) for inorganics can be estimated by dividing the soil concentrations (mg/kg) by 20. Thus, the vadose zone TAL inorganics data were divided by 20 to provide a conservative preliminary assessment of the maximum soil leaching potential for comparison with PMCs. Based on the review of the “divide by 20” rule of thumb as applied to the TAL inorganics data, two additional samples from the southern Cianci Property (SB-904[0.0-2.0] and SB-9100[.0-2.0]) were selected for SPLP analysis. In addition, six samples from the northern Cianci Property were selected for SPLP analysis based on the “divide by 20” rule of thumb, including: SB-917(0.0-1.7); SB-

922(0.0-3.1); SB-922(3.1-6.3); SB-926(0.0-1.4); SB-927(0.0-2.0); and SB-928(0.0-3.4). Whereas the mass/mass “divide by 20” rule of thumb suggested the potential for PMC exceedences in these samples, the SPLP data indicated no PMC exceedences. The results of all of the completed SPLP analyses are presented in this appendix. Appendix M presents the screening results versus PMCs.

- *Further characterize background soil quality.*

  Background soil samples were obtained at 10 locations to further characterize the background range of inorganics concentrations in soil based on mass/mass (TAL) and leaching (SPLP) methods. The new background soil data were added to the existing background soil data, and the complete background soil database was used to identify inorganics that may be attributed to the release(s) at the SRSNE Site. Soil inorganics detected above the background concentrations were subsequently screened versus CT DEP's PMCs and DECs.

M.3 Field Methods

Supplemental soil samples were obtained at the locations shown Figure M-1, including 10 background locations and 28 locations at the Former Cianci Property. Soil samples were managed and analyzed in accordance with the site-specific, USEPA-approved, Field Sampling Plan (FSP; BBL, August 1995), as modified by the supplemental soil sampling work plan and CT DEP comments received by telephone on October 14, 1999, and in the field on October 18, 1999.

The following soil samples were obtained for the following analytes.

- To further characterize the range of background inorganics concentrations, soil samples were obtained for analysis of TAL metals including cyanide and SPLP inorganics. The background soil samples were obtained from the depth interval of 0to 4 feet below grade at 10 locations (SB-929 through SB-938).

- To support the on-going RA Update and the evaluation of CT DEP’s PMCs and DECs, 28 surficial soil samples were obtained for analysis of full TCL/TAL analysis. These samples were obtained at a rectangular grid of 12 locations (spaced approximately every 100 feet) in the northern portion of the former Cianci Property, and 16 locations (spaced approximately every 150 feet along three parallel lines) in the southern portion of the former Cianci Property. Based on the supplemental soil sampling work plan, the surficial soil samples were to be obtained from the vadose zone at a depth interval from ground surface to either 2 feet below grade or the depth of the water table, whichever was shallower. The water table depth at each sampling location was determined based on a pre-sampling survey of the ground surface elevation at each sampling point (Table M-1), and the interpolated elevation of the water table (Figure M-2). However, as CT DEP requested in the field on October 18, 1999, the soil sampling approach was again modified such that the majority of the surface soil samples were obtained at the depth interval from ground surface to 2 feet below grade, regardless of the water table depth. The only exceptions were those surficial soil samples that BBL had already been obtained on October 18, 1999 per the supplemental soil sampling work plan prior to CT DEP’s request for a change in the field.

  (The change in ground surface elevation due to wetland mitigation activities in the northern portion of the Cianci Property was taken into account in calculating the water-table depth at the boring locations. During wetland mitigation activities, an “oxbow” was excavated adjacent to the Quinnipiac River, near soil borings SB-926 through 928 as shown on Figure M-1. The excavated soil was used as fill over the remainder of the northern Cianci Property. The associated ground-surface elevation increase in the filled area was approximately 0.0 to 3.5 feet. Because of its nearby origin, the fill soil is very similar to the underlying soil.)

- To further evaluate CT DEP's PMCs, vadose-zone soil samples were obtained from the ground surface to the depth of the seasonal high water table for analysis of SPLP inorganics. According to the work plan, these samples were supposed to be obtained at eight (odd-numbered) locations in the southern portion of the former Cianci Property. However, upon review of the new survey data and interpolated water table elevations, it became evident that the seasonal high water table is at ground surface at soil boring locations SB-901, SB-907, SB-913, and SB-915, rendering these locations inappropriate for PMC characterization. Therefore, with the concurrence of CT DEP, the field decision was made on October 18, 1999 to obtain vadose-zone SPLP samples from the following adjacent soil borings, respectively: SB-902, SB-906, SB-912, and SB-914.

  In addition, contingent vadose-zone soil samples were obtained from the ground surface to the depth of the seasonal high water table for potential future analysis of SPLP inorganics at six (even-numbered) locations in the northern portion of the former Cianci Property. At locations where the high water table was no more than 4 feet below the ground surface, a single composite soil sample was obtained. At locations were the high water table was greater than 4 feet below ground surface, two samples were obtained to span the depth to the water table.

- To further evaluate CT DEP's DECs, eight subsurface soil samples were obtained at odd-numbered locations in the southern portion of the former Cianci Property for full TCL/TAL analysis. Also, six subsurface soil samples were obtained at even-numbered locations in the northern portion of the former Cianci Property for analysis of full TCL/TAL. These subsurface soil samples were obtained from the depth of the bottom of the surficial soil sample to 4 feet below grade. The subsurface soil samples that were unsaturated were also compared to CT DEP's PMCs.

In addition, the following Quality Assurance/Quality Control (QA/QC) samples were obtained:

- TCL Methods (VOCs, SVOCs, and PCBs): rinse blanks, duplicates, matrix spikes (MSs), and matrix spike duplicates (MSDs) (three each);

- TAL Methods (inorganics including cyanide): rinse blanks, duplicates, matrix spikes (MSs), and matrix spike duplicates (MSDs) (three each); and

- SPLP (inorganics): duplicate, MS, and MSD (two each).

The majority of the soil samples were obtained using 4-foot-long, 1.5-inch-diameter soil core barrel lined with new, dedicated, disposable Lexan™ sleeves, and driven by a tractor-mounted Geoprobe™ device. Manual sampling equipment (e.g., hand shovel and trowel) was also used at some locations where only a surficial sample was required. To minimize the potential for cross-contamination, disposable or decontaminated equipment was used to collect the soil sample at each sampling location. At the request of USEPA, soil samples for VOC analysis were obtained using new EnCore™ samplers in accordance with SW-846 Method 5035 (Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples). The soil samples were managed in accordance with the existing FSP.

A BBL geologist described the soil samples in the field with respect to color, texture, and relative moisture content, as summarized in Table M-1. The supplemental soil samples were similar throughout the sampling area, and generally consisted of fine-to-coarse sand with varying amounts of silt, and minor gravel.

Decontamination waste liquids (consisting of alconox solution, hexane, nitric acid, potable water, and distilled water) were treated at the existing NTCRA 1 groundwater treatment system. Soil sampling activities were performed in accordance with the existing Health and Safety Plan (BBL, August 1996).

Each soil boring location were staked, labeled, and surveyed by Conklin and Soroka, Inc., of Cheshire, Connecticut.

M.4 Sample Analysis and Data Management

Laboratory analytical methods were as follows:

- TCL VOCs by SW-846 Method 5035/8260;
- TCL SVOCs by SW-846 Method 8270;
- PCBs by SW-846 Method 8082;
- TAL Metals by SW-846 Methods 6010/7000;
- Cyanide by SW-846 Method 9010; and
- Inorganics by SW-846 Methods 1312 (SPLP)/6010/7000.

Galson provided standard turnaround for these samples, and prepared validatable data packages. The analytical data were incorporated into the existing soil database for the site, and the updated soils database was queried to complete the RA Update and screening versus PMCs and DECs to complete the FS.

M.5 Results

Tables M-2A through M-2E present the analytical results from the supplemental soil samples. Appendix M to this FS summarizes the results of the database screening with respect to DECs and PMCs.

TABLES

Table M-1
Summary of Supplemental Soil Samples
SRSNE Site
Southington, Connecticut

Boring Number	Northing	Easting	Ground Surface Elev. (ft)	Calc. High Water-Table Elevation (ft)	Depth to High Water Table (ft)	Sample Depths (ft)	TCL/TAL Sample	SPLP Sample	Soil Description
SB-901	286207.9	565229.5	156.4	157.3	**-0.9**	0.0 - 2.0	X		0-4': Brown fine-medium sand, little silt, trace coarse sand, moist to wet.
						2.0 - 4.0	X		
SB-902	286332.9	565229.5	158.8	157.4	**1.4**	0.0 - 1.4		X	0-2': Brown-black fine sand and silt, trace medium-coarse sand, loose, damp.
						0.0 - 2.0	X		
SB-903	286457.9	565229.5	162.3	157.9	**4.4**	0.0 - 2.0	X		0-4.4': Brown-black fine sand, some silt, trace medium-coarse sand and fine gravel, damp.
						2.0 - 4.0	X		
						0.0 - 2.2		X	
						2.2 - 4.4		X	
SB-904	286580.9	565229.5	158.3	157.6	**0.7**	0.0 - 2.0	X	Z	0-2': Reddish brown fine-medium sand, some coarse sand, little fine gravel and silt, loose.
SB-905	286695.5	565259.8	160.2	158.3	**2.0**	0.0 - 2.0	X	X	0-2': Brown fine sand and silt, trace medium-coarse sand and fine gravel, damp, loose, moist.
						2.0 - 4.0	X		2-4': Brown fine to medium sand, trace silt, loose, moist.
SB-906	286188.6	565382.6	155.3	153.4	**2.0**	0.0 - 2.0	X	X	0-2': Orange-brown to red fine sand, some silt and medium sand, trace little sand to fine gravel, damp, firm.
SB-907	286308.6	565382.6	155.4	155.7	**-0.3**	0.0 - 2.0	X		0-2': Brown fine sand and silt, trace medium-coarse sand and fine gravel, damp to moist, firm.
						2.0 - 4.0	X		2-4': Brown fine sand and silt, little medium-coarse sand, trace fine gravel, firm, wet, trace ashes and cinders.
SB-908	286428.6	565382.6	157.3	156.1	**1.3**	0.0 - 2.0	X		0-1': Crushed stone.
									1-2': Red fine sand, some medium-coarse sand, little silt, trace fine gravel, damp.
SB-909	286548.6	565382.6	157.7	155.3	**2.4**	0.0 - 2.0	X		0-4': Reddish brown fine sand, some silt, little medium-coarse sand, little fine gravel and silt, loose, moist.
						2.0 - 4.0	X		
						0.0 - 2.4		X	
SB-910	286668.6	565382.6	160.4	156.2	**4.2**	0.0 - 2.0	X	Z	0-1': Crushed stone. 1-2': Red fine-medium sand, little coarse sand and fine gravel, trace silt, loose, damp.
SB-911	286788.6	565382.6	162.6	157.5	**5.1**	0.0 - 2.0	X		0-1': Crushed stone, geotextile fabric.
						2.0 - 4.0	X		
						0.0 - 2.5		X	1-5.1': Red fine-coarse sand, little silt and fine-coarse gravel, loose, wet.
						2.5 - 5.1		X	
SB-912	286216.4	565525.9	153.4	150.7	**2.7**	0.0 - 2.0	X		0-2.7': Reddish brown fine-medium sand, some coarse sand, little fine gravel and silt, dense.
						0.0 - 2.7		X	
SB-913	286341.4	565521.2	150.4	151.3	**-0.8**	0.0 - 2.0	X		0-4': Red silt, trace fine sand, firm, wet.
						2.0 - 4.0	X		
SB-914	286466.4	565516.6	153.3	151.0	**2.4**	0.0 - 2.0	X		0-2.4': Brown silt, little fine-medium sand, trace coarse sand, chunks of asphalt, firm, damp.
						0.0 - 2.4		X	
SB-915	286584.4	565498.9	149.9	150.4	**-0.6**	0.0 - 2.0	X		0-2': Brown fine sand and silt, wet, loose.
						2.0 - 4.0	X		2-4': Brown-black silt, some fine sand, loose, wet, organic odor.
SB-916	286716.4	565507.3	151.3	151.2	**0.0**	0.0 - 2.0	X		0-2': Brown to orange-brown fine to medium sand, some silt, trace coarse sand, loose, wet.
SB-917	286868.4	565246.3	160.4	158.7	**1.7**	0.0 - 1.7	X	Z	0-1.7': Brown fine sand, little medium sand, trace silt, moist, loose.
SB-918	286968.4	565246.3	161.4	159.2	**2.2**	0.0 - 2.0	X		0-4': Brown fine-medium sand, trace silt, loose, moist to wet.
						2.0 - 4.0	X		
						0.0 - 2.2		Y	

Table M-1
Summary of Supplemental Soil Samples
SRSNE Site
Southington, Connecticut

Boring Number	Northing	Easting	Ground Surface Elev. (ft)	Calc. High Water-Table Elevation (ft)	Depth to High Water Table (ft)	Sample Depths (ft)	TCL/TAL Sample	SPLP Sample	Soil Description
SB-919	287068.4	565241.3	162.1	159.4	**2.8**	0.0 - 2.0	X		0-2': Brown-red fine sand, little medium sand, trace silt and fine gravel, loose, damp.
SB-920	286867.3	565346.3	162.6	153.4	**9.2**	0.0 - 2.0	X		0-4': Reddish brown fine-coarse sand, little silt, trace fine gravel, loose, moist.
						2.0 - 4.0	X		
						0.0 - 4.6		Y	4-9.5': Red silt, little fine-coarse sand, trace fine gravel, hard, dense.
						4.6 - 9.2		Y	
SB-921	286968.4	565346.3	163.6	154.7	**8.9**	0.0 - 2.0	X		0-2': Reddish brown fine-medium sand, trace silt, coarse sand, and fine gravel, damp, loose.
SB-922	287068.4	565346.3	162.9	156.6	**6.3**	0.0 - 2.0	X		0-6.3': Reddish brown fine sand and silt, moist to wet, trace coarse sand and gravel, firm.
						2.0 - 4.0	X		
						0.0 - 3.1		X	
						3.1 - 6.3		X	
SB-923	286868.4	565446.3	159.1	150.7	**8.5**	0.0 - 2.0	X		0-2': Reddish brown fine sand, some medium sand, trace coarse sand and fine gravel, loose, damp.
SB-924	286968.4	565441.3	157.1	148.8	**8.3**	0.0 - 2.0	X		0-5.9': Brown fine-medium sand, little coarse sand, trace silt and fine gravel, loose, damp.
						2.0 - 4.0	X		
						0.0 - 4.1		Y	5.9-8.3': Red fine sand and silt, firm, damp.
						4.1 - 8.3		Y	
SB-925	287068.4	565446.3	160.4	150.9	**9.4**	0.0 - 2.0	X		0-2': Reddish brown fine sand, some medium sand, trace coarse sand and fine gravel, loose, damp.
SB-926	286868.4	565546.3	148.8	147.4	**1.4**	0.0 - 1.4	X	X	0-4': Reddish brown fine sand, some medium sand, trace silt and coarse sand, moist to wet, loose.
						1.4 - 4.0	X		
SB-927	286968.4	565546.3	153.1	147.5	**5.6**	0.0 - 2.0	X	Z	0-2': Reddish brown fine-medium sand, little coarse sand, trace silt, damp to moist, loose.
SB-928	287068.4	565546.3	150.8	147.4	**3.4**	0.0 - 2.0	X		0-4': Reddish brown to dark brown fine sand, little silt, trace medium-coarse sand, loose, damp.
						2.0 - 4.0	X		
						0.0 - 3.4		X	
SB-929	285783.7	564887.1	178.4	167	**11**	0.0 - 4.0	X	X	0-4': Reddish brown fine sand and silt, trace medium-coarse sand, loose, moist.
SB-930	285866.1	564764.3	181.4	172	**9**	0.0 - 4.0	X	X	0-4': Reddish brown fine sand and silt, trace medium-coarse sand, loose, moist.
SB-931	285937.6	564653.3	191.4	178	**13**	0.0 - 4.0	X	X	0-4': Reddish brown, fine-medium sand, trace silt, coarse sand and fine gravel, loose, damp.
SB-932	286102.5	564507.3	201.2	183	**18**	0.0 - 4.0	X	X	0-4': Red fine-medium sand, some silt, coarse sand, and fine gravel, loose, damp.
SB-933	286251.8	564573.2	196.6	182	**15**	0.0 - 4.0	X	X	0-4': Brown-red fine sand and silt, moist.
SB-934	287390.1	565408.9	176.7	155.0	**22**	0.0 - 4.0	X	X	0-4': Brown fine sand, little medium sand, trace silt and coarse sand, loose, damp.
SB-935	287515.6	565420.3	174.8	154.6	**20**	0.0 - 4.0	X	X	0-4': Red fine-medium sand, some coarse sand, trace fine gravel, loose, damp.
SB-936	287341.8	565474.5	167.1	153.2	**14**	0.0 - 4.0	X	X	0-4': Red fine sand, some silt, trace coarse sand, moist.
SB-937	287462.4	565470.2	172.0	153.3	**19**	0.0 - 4.0	X	X	0-4': Red fine-medium sand, little coarse sand, trace fine gravel, loose, damp.

Table M-1
Summary of Supplemental Soil Samples
SRSNE Site
Southington, Connecticut

Boring Number	Northing	Easting	Ground Surface Elev. (ft)	Calc. High Water-Table Elevation (ft)	Depth to High Water Table (ft)	Sample Depths (ft)	TCL/TAL Sample	SPLP Sample	Soil Description
SB-938	287560.7	565471.7	168.9	153.2	**16**	0.0 - 4.0	X	X	0-4': Red fine-medium sand, little coarse sand, trace fine gravel, loose, damp.

Notes:
1) BBL obtained these samples October 18 through 19, 1999.
2) Survey data for boring locations and ground-surface elevations provided by Conklin & Soroka of Cheshire, Connecticut.
3) High water table elevation for most locations calculated based on contouring and interpolation using highest historical water-level measurements at shallow overburden monitoring wells, and estimated concurrent surface-water elevation. High water table elevation at SB-929 through SB-933 estimated based on high water levels at deep overburden wells on hill west of site.
4) Locations with negative depth to water table are interpreted as saturated to ground surface during high water-table conditions.
X - Sample obtained and analyzed for specified parameters. (TCL/TAL includes VOCs, SVOCs, PCBs, and inorganics; SPLP includes only inorganics).
Y - Contingency sample obtained for SPLP, but not analyzed.
Z - Sample obtained for TCL/TAL, but also analyzed for SPLP following initial evaluation of TCL/TAL data.

TABLE M-2A

VOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-901	SB-901	SB-902	SB-902	SB-903	SB-903	SB-904	SB-905	SB-905	SB-906	SB-907
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	31	14	6.0 U	24	7.3 U	1.2 J	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
1,1,2,2-Tetrachloroethane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
1,1,2-Trichloroethane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
1,1-Dichloroethane	12	18	6.0 U	4.0 J	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
1,1-Dichloroethene	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
1,2-Dichlorobenzene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
1,2-Dichloroethane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
1,2-Dichloropropane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
1,3-Dichlorobenzene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
1,4-Dichlorobenzene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2-Butanone	11 U	11 U	21	12 J	15 U	17	15	9.4 J	10 U	12	8.8 J
2-Hexanone	11 U	11 U	15 U	13 U	15 U	11 U	11 U	11 U	10 U	11 U	11 U
4-Methyl-2-pentanone	11 U	11 U	15 U	13 U	15 U	11 U	11 U	11 U	10 U	11 U	11 U
Acetone	53	30	260	150	200	220	150	120	12 J	110	85
Benzene	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Bromodichloromethane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Bromoform	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Bromomethane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	1.1 J	5.4 U
Carbon disulfide	11 U	11 U	15 U	13 U	15 U	11 U	11 U	11 U	10 U	11 U	11 U
Carbon tetrachloride	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Chlorobenzene	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Chlorodibromomethane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Chloroethane	1.7 J	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Chloroform	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Chloromethane	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
cis-1,2-Dichloroethene	36	9.8	6.0 U	23	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	2.1 J	1.6 J
cis-1,3-Dichloropropene	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Ethylbenzene	14	5.3 U	6.0 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	2.3 J
M,P-Xylene	6.8	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	1.7 J
Methylene chloride	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	1.1 J	1.7 J
O-Xylene	3.2 J	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Styrene	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Tetrachloroethene	5.4 U	5.3 U	7.3 U	1.5 J	7.3 U	5.7 U	1.4 J	5.6 U	5.0 U	5.3 U	1.1 J
Toluene	35	1.8 J	3.6 J	2.1 J	7.3 U	5.7 U	3.6 J	3.3 J	5.0 U	2.4 J	5.4 J
trans-1,2-Dichloroethene	5.4 U	5.3 U	6.0 U	1.5 J	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
trans-1,3-Dichloropropene	5.4 U	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U
Trichloroethene	5.4 U	5.3 U	6.0 U	1.9 J	7.3 U	5.7 U	2.0 J	5.6 U	5.0 U	1.2 J	2.7 J
Vinyl chloride	1.1 J	5.3 U	7.3 U	6.4 U	7.3 U	5.7 U	5.3 U	5.6 U	5.0 U	5.3 U	5.4 U

See Notes on Page 5.

TABLE M-2A

VOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-907	SB-908	SB-909	SB-909	SB-910	SB-911	SB-911	SB-912	SB-913	SB-913	SB-914
Depth Interval	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
1,1,2,2-Tetrachloroethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
1,1,2-Trichloroethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
1,1-Dichloroethane	3.7 J	5.0 U	4.8 U	2.2 J	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
1,1-Dichloroethene	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
1,2-Dichlorobenzene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
1,2-Dichloroethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
1,2-Dichloropropane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
1,3-Dichlorobenzene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
1,4-Dichlorobenzene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2-Butanone	92	10 J	7.9 J	520 J	17	4.0 J	5.3 J	7.7 J	7.4 J	9.9 U	7.4 J
2-Hexanone	12 U	9.9 U	9.7 U	12 U	12 U	12 U	11 U	12 U	11 U	9.9 U	12 U
4-Methyl-2-pentanone	20	9.9 U	9.7 U	19	12 U	12 U	11 U	12 U	11 U	9.9 U	12 U
Acetone	300 J	60	90	150	92	70	45	120	79	20 U	86
Benzene	8.4	5.0 U	4.8 U	1.4 J	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Bromodichloromethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Bromoform	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Bromomethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Carbon disulfide	1.7 J	9.9 U	9.7 U	12 U	12 U	12 U	11 U	12 U	11 U	9.9 U	12 U
Carbon tetrachloride	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Chlorobenzene	24	0.99 J	4.8 U	18	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Chlorodibromomethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Chloroethane	10	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Chloroform	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Chloromethane	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
cis-1,2-Dichloroethene	14	5.0 U	4.8 U	10	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
cis-1,3-Dichloropropene	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Ethylbenzene	13,000	3.8 J	4.8 U	1,400	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
M,P-Xylene	5,300	2.2 J	4.8 U	2,300	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Methylene chloride	5.1 J	5.0 U	4.8 U	2.7 J	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
O-Xylene	1,400	5.0 U	4.8 U	520 J	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Styrene	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Tetrachloroethene	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Toluene	430 J	5.0 U	1.0 J	140 J	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	1.4 J
trans-1,2-Dichloroethene	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
trans-1,3-Dichloropropene	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Trichloroethene	5.9 U	5.0 U	4.8 U	6.2 U	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U
Vinyl chloride	5.9 U	5.0 U	4.8 U	2.4 J	5.8 U	6.1 U	5.6 U	5.9 U	5.3 U	4.9 U	6.2 U

See Notes on Page 5.

TABLE M-2A

VOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-915	SB-915	SB-916	SB-917	SB-918	SB-918	SB-919	SB-919	SB-920	SB-920	SB-921
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.7')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS
1,1,1-Trichloroethane	1.4 J	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
1,1,2,2-Tetrachloroethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
1,1,2-Trichloroethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
1,1-Dichloroethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
1,1-Dichloroethene	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
1,2-Dichlorobenzene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
1,2-Dichloroethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
1,2-Dichloropropane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
1,3-Dichlorobenzene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
1,4-Dichlorobenzene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2-Butanone	20	62	11 U	3.4 J	3.9 J	5.2 J	6.6 J	6.4 J	7.1 J	7.5 J	5.5 J
2-Hexanone	14 U	8.1 J	11 U	9.4 U	10 U	11 U	9.6 U	9.7 U	11 U	9.4 U	10 U
4-Methyl-2-pentanone	14 U	20 U	11 U	9.4 U	10 U	11 U	9.6 U	9.7 U	11 U	9.4 U	10 U
Acetone	270	370	72	27	25	36	48	44	44	46	45
Benzene	7.0 U	2.5 J	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Bromodichloromethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Bromoform	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Bromomethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Carbon disulfide	14 U	20 U	11 U	9.4 U	10 U	11 U	9.6 U	9.7 U	11 U	9.4 U	10 U
Carbon tetrachloride	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Chlorobenzene	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Chlorodibromomethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Chloroethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Chloroform	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Chloromethane	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
cis-1,2-Dichloroethene	4.1 J	4.2 J	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
cis-1,3-Dichloropropene	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Ethylbenzene	2.5 J	6.5 J	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
M,P-Xylene	2.9 J	11	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Methylene chloride	1.7 J	3.7 J	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
O-Xylene	7.0 U	8.8 J	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Styrene	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Tetrachloroethene	3.4 J	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Toluene	5.3 J	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
trans-1,2-Dichloroethene	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
trans-1,3-Dichloropropene	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Trichloroethene	6.6 J	6.2 J	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U
Vinyl chloride	7.0 U	10 U	5.3 U	4.7 U	5.1 U	5.3 U	4.8 U	4.8 U	5.4 U	4.7 U	5.2 U

See Notes on Page 5.

TABLE M-2A

VOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-922	SB-922	SB-923	SB-924	SB-924	SB-925	SB-926	SB-926	SB-927	SB-928	SB-928
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.4')	(1.4 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')
Sample Date	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,1,1-Trichloroethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
1,1,2,2-Tetrachloroethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
1,1,2-Trichloroethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
1,1-Dichloroethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
1,1-Dichloroethene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
1,2-Dichlorobenzene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
1,2-Dichloroethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
1,2-Dichloropropane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
1,3-Dichlorobenzene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
1,4-Dichlorobenzene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2-Butanone	11 U	8.0 J	10 U	5.7 J	11 U	10 U	3.9 J	8.9 J	11	10 J	3.5 J
2-Hexanone	11 U	10 U	10 U	11 U	11 U	10 U	12 U	13 U	11 U	10 U	11 U
4-Methyl-2-pentanone	11 U	10 U	10 U	11 U	11 U	10 U	12 U	13 U	11 U	10 U	11 U
Acetone	66	58	45	68	34	57	25	55	110	100	23
Benzene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Bromodichloromethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Bromoform	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Bromomethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Carbon disulfide	11 U	10 U	10 U	11 U	11 U	10 U	12 U	13 U	11 U	10 U	11 U
Carbon tetrachloride	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Chlorobenzene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Chlorodibromomethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Chloroethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Chloroform	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Chloromethane	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
cis-1,2-Dichloroethene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	4.1 J	5.1 U	5.3 U
cis-1,3-Dichloropropene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Ethylbenzene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
M,P-Xylene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Methylene chloride	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
O-Xylene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Styrene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Tetrachloroethene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Toluene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	2.5 J	1.5 J	5.3 U
trans-1,2-Dichloroethene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
trans-1,3-Dichloropropene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U
Trichloroethene	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	2.3 J	5.1 U	5.3 U
Vinyl chloride	5.6 U	5.0 U	5.2 U	5.5 U	5.5 U	5.0 U	5.8 U	6.5 U	5.4 U	5.1 U	5.3 U

See Notes on Page 5.

TABLE M-2A

VOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

NOTES:

1) Concentrations given in micrograms per kilogram (ug/kg); equivalent to parts per billion (ppb).
3) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
4) U - The compound was anlayzed for but not detected. The associated value is the compound quantitation limit.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-901	SB-901	SB-902	SB-902	SB-903	SB-903	SB-904	SB-905	SB-905	SB-906	SB-907
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS
1,2,4-Trichlorobenzene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2,2'-oxybis(dichloropropane)	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2,4,5-Trichlorophenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2,4,6-Trichlorophenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2,4-Dichlorophenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2,4-Dimethylphenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2,4-Dinitrophenol	920 U	940 U	1,100 U	990 U	1,000 U	940 U	940 U	920 U	930 U	930 U	1,000 U
2,4-Dinitrotoluene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2,6-Dinitrotoluene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2-Chloronaphthalene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2-Chlorophenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2-Methylnaphthalene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2-Methylphenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
2-Nitroaniline	920 U	940 U	1,100 U	990 U	1,000 U	940 U	940 U	920 U	930 U	930 U	1,000 U
2-Nitrophenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
3,3'-Dichlorobenzidine	740 U	750 U	900 U	790 U	820 U	750 U	750 U	730 U	750 U	740 U	810 U
3-Nitroaniline	920 U	940 U	1,100 U	990 U	1,000 U	940 U	940 U	920 U	930 U	930 U	1,000 U
4,6-Dinitro-2-methylphenol	920 U	940 U	1,100 U	990 U	1,000 U	940 U	940 U	920 U	930 U	930 U	1,000 U
4-Bromophenyl phenyl ether	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
4-Chloro-3-methylphenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
4-Chloroaniline	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
4-Chlorophenyl phenyl ether	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
4-Methylphenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
4-Nitroaniline	920 U	940 U	1,100 U	990 U	1,000 U	940 U	940 U	920 U	930 U	930 U	1,000 U
4-Nitrophenol	920 U	940 U	1,100 U	990 U	1,000 U	940 U	940 U	920 U	930 U	930 U	1,000 U
Acenaphthene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Acenaphthylene	370 U	380 U	410 U	54 J	410 U	42 J	380 U	370 U	370 U	370 U	400 U
Anthracene	370 U	380 U	410 U	51 J	410 U	370 U	380 U	370 U	370 U	370 U	56 J
Benzo(a)anthracene	370 U	380 U	410 U	220 J	66 J	88 J	380 U	370 U	370 U	370 U	160 J
Benzo(a)pyrene	370 U	380 U	410 U	260 J	77 J	120 J	380 U	370 U	370 U	38 J	180 J
Benzo(b)fluoranthene	370 U	380 U	410 U	400	99 J	180 J	380 U	370 U	370 U	54 J	220 J
Benzo(g,h,i)perylene	370 U	380 U	410 U	180 J	410 U	97 J	380 U	370 U	370 U	370 U	180 J
Benzo(k)fluoranthene	370 U	380 U	450 U	110 J	56 J	69 J	380 U	370 U	370 U	370 U	76 J

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-901	SB-901	SB-902	SB-902	SB-903	SB-903	SB-904	SB-905	SB-905	SB-906	SB-907
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS
Benzyl alcohol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
bis(2-Chloroethoxy)methane	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
bis(2-Chloroethyl)ether	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
bis(2-Ethylhexyl)phthalate	73 JB	58 JB	410 U	130 JB	410 U	190 J	70 JB	370 U	370 U	73 JB	830 B
Butyl benzyl phthalate	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Chrysene	370 U	380 U	410 U	240 J	84 J	120 J	43 J	370 U	370 U	370 U	160 J
Di-n-butyl phthalate	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Di-n-octyl phthalate	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Dibenz(a,h)anthracene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Dibenzofuran	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Diethyl phthalate	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Dimethyl phthalate	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Fluoranthene	370 U	380 U	410 U	420	120 J	170 J	60 J	370 U	370 U	45 J	210 J
Fluorene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Hexachlorobenzene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Hexachlorobutadiene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Hexachlorocyclopentadiene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Hexachloroethane	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Indeno(1,2,3-cd)pyrene	370 U	380 U	410 U	160 J	410 U	76 J	380 U	370 U	370 U	370 U	140 J
Isophorone	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
N-Nitroso-di-n-propylamine	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
N-Nitrosodimethylamine	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
N-Nitrosodiphenylamine	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Naphthalene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Nitrobenzene	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Pentachlorophenol	920 U	940 U	1,100 U	990 U	1,000 U	940 U	940 U	920 U	930 U	930 U	1,000 U
Phenanthrene	370 U	380 U	410 U	270 J	100 J	110 J	40 J	370 U	370 U	370 U	200 J
Phenol	370 U	380 U	450 U	400 U	410 U	370 U	380 U	370 U	370 U	370 U	400 U
Pyrene	370 U	380 U	410 U	590	230 J	330 J	82 J	370 U	370 U	46 J	360 J

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-907	SB-908	SB-909	SB-909	SB-910	SB-911	SB-911	SB-912	SB-913	SB-913	SB-914
Depth Interval	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,2,4-Trichlorobenzene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2,2'-oxybis(dichloropropane)	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2,4,5-Trichlorophenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2,4,6-Trichlorophenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2,4-Dichlorophenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2,4-Dimethylphenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2,4-Dinitrophenol	1,000 U	900 U	890 U	1,100 U	980 U	1,100 U	1,100 U	1,000 U	1,000 U	980 U	1,100 U
2,4-Dinitrotoluene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2,6-Dinitrotoluene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2-Chloronaphthalene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2-Chlorophenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2-Methylnaphthalene	2,500	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2-Methylphenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
2-Nitroaniline	1,000 U	900 U	890 U	1,100 U	980 U	1,100 U	1,100 U	1,000 U	1,000 U	980 U	1,100 U
2-Nitrophenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
3,3'-Dichlorobenzidine	800 U	720 U	710 U	870 U	780 U	890 U	880 U	820 U	800 U	780 U	910 U
3-Nitroaniline	1,000 U	900 U	890 U	1,100 U	980 U	1,100 U	1,100 U	1,000 U	1,000 U	980 U	1,100 U
4,6-Dinitro-2-methylphenol	1,000 U	900 U	890 U	1,100 U	980 U	1,100 U	1,100 U	1,000 U	1,000 U	980 U	1,100 U
4-Bromophenyl phenyl ether	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
4-Chloro-3-methylphenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
4-Chloroaniline	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
4-Chlorophenyl phenyl ether	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
4-Methylphenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
4-Nitroaniline	1,000 U	900 U	890 U	1,100 U	980 U	1,100 U	1,100 U	1,000 U	1,000 U	980 U	1,100 U
4-Nitrophenol	1,000 U	900 U	890 U	1,100 U	980 U	1,100 U	1,100 U	1,000 U	1,000 U	980 U	1,100 U
Acenaphthene	960	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Acenaphthylene	1,700	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	98 J
Anthracene	2,000	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	110 J
Benzo(a)anthracene	5,600 D	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	240 J
Benzo(a)pyrene	3,100	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	230 J
Benzo(b)fluoranthene	5,100 D	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	400 J
Benzo(g,h,i)perylene	2,600	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	210 J
Benzo(k)fluoranthene	700	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-907	SB-908	SB-909	SB-909	SB-910	SB-911	SB-911	SB-912	SB-913	SB-913	SB-914
Depth Interval	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Benzyl alcohol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
bis(2-Chloroethoxy)methane	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
bis(2-Chloroethyl)ether	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
bis(2-Ethylhexyl)phthalate	400 U	64 JB	350 U	440 U	390 U	440 U	440 U	410 U	55 JB	67 JB	450 U
Butyl benzyl phthalate	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Chrysene	5,200 D	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	240 J
Di-n-butyl phthalate	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Di-n-octyl phthalate	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Dibenz(a,h)anthracene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Dibenzofuran	1,200	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Diethyl phthalate	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Dimethyl phthalate	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Fluoranthene	9,400 D	360 U	57 J	440 U	390 U	440 U	440 U	410 U	400 U	390 U	480
Fluorene	3,400	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Hexachlorobenzene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Hexachlorobutadiene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Hexachlorocyclopentadiene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Hexachloroethane	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Indeno(1,2,3-cd)pyrene	1,900	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	160 J
Isophorone	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
N-Nitroso-di-n-propylamine	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
N-Nitrosodimethylamine	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
N-Nitrosodiphenylamine	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Naphthalene	2,000	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Nitrobenzene	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Pentachlorophenol	1,000 U	900 U	890 U	1,100 U	980 U	1,100 U	1,100 U	1,000 U	1,000 U	980 U	1,100 U
Phenanthrene	20,000 D	360 U	38 J	440 U	390 U	440 U	440 U	410 U	400 U	390 U	600
Phenol	400 U	360 U	350 U	440 U	390 U	440 U	440 U	410 U	400 U	390 U	450 U
Pyrene	18,000 D	360 U	76 J	440 U	390 U	440 U	440 U	410 U	400 U	390 U	740

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-915	SB-915	SB-916	SB-917	SB-918	SB-918	SB-919	SB-919	SB-920	SB-920	SB-921
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.7')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS
1,2,4-Trichlorobenzene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2,2'-oxybis(dichloropropane)	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2,4,5-Trichlorophenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2,4,6-Trichlorophenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2,4-Dichlorophenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2,4-Dimethylphenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2,4-Dinitrophenol	1,200 U	1,600 U	930 U	920 U	930 U	920 U	900 U	910 U	930 U	900 U	890 U
2,4-Dinitrotoluene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2,6-Dinitrotoluene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2-Chloronaphthalene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2-Chlorophenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2-Methylnaphthalene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2-Methylphenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
2-Nitroaniline	1,200 U	1,600 U	930 U	920 U	930 U	920 U	900 U	910 U	930 U	900 U	890 U
2-Nitrophenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
3,3'-Dichlorobenzidine	930 U	1,200 U	740 U	740 U	750 U	740 U	720 U	730 U	740 U	720 U	710 U
3-Nitroaniline	1,200 U	1,600 U	930 U	920 U	930 U	920 U	900 U	910 U	930 U	900 U	890 U
4,6-Dinitro-2-methylphenol	1,200 U	1,600 U	930 U	920 U	930 U	920 U	900 U	910 U	930 U	900 U	890 U
4-Bromophenyl phenyl ether	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
4-Chloro-3-methylphenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
4-Chloroaniline	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
4-Chlorophenyl phenyl ether	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
4-Methylphenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
4-Nitroaniline	1,200 U	1,600 U	930 U	920 U	930 U	920 U	900 U	910 U	930 U	900 U	890 U
4-Nitrophenol	1,200 U	1,600 U	930 U	920 U	930 U	920 U	900 U	910 U	930 U	900 U	890 U
Acenaphthene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Acenaphthylene	64 J	78 J	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	46 J
Anthracene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	79 J
Benzo(a)anthracene	180 J	110 J	370 U	370 U	370 U	370 U	39 J	360 U	370 U	360 U	220 J
Benzo(a)pyrene	190 J	170 J	370 U	370 U	370 U	370 U	65 J	360 U	370 U	360 U	260 J
Benzo(b)fluoranthene	300 J	300 J	370 U	370 U	370 U	370 U	66 J	360 U	370 U	360 U	250 J
Benzo(g,h,i)perylene	190 J	270 J	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	170 J
Benzo(k)fluoranthene	62 J	120 J	370 U	370 U	370 U	370 U	50 J	360 U	370 U	360 U	270 J

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-915	SB-915	SB-916	SB-917	SB-918	SB-918	SB-919	SB-919	SB-920	SB-920	SB-921
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.7')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS
Benzyl alcohol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
bis(2-Chloroethoxy)methane	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
bis(2-Chloroethyl)ether	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
bis(2-Ethylhexyl)phthalate	1,000 B	1,100 B	61 JB	120 JB	190 JB	110 JB	170 JB	140 JB	130 JB	120 JB	160 JB
Butyl benzyl phthalate	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Chrysene	200 J	210 J	370 U	370 U	370 U	370 U	47 J	360 U	370 U	360 U	240 J
Di-n-butyl phthalate	460 U	630 U	370 U	370 U	370 U	39 J	360 U	360 U	370 U	360 U	360 U
Di-n-octyl phthalate	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Dibenz(a,h)anthracene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Dibenzofuran	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Diethyl phthalate	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Dimethyl phthalate	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Fluoranthene	260 J	170 J	370 U	370 U	370 U	370 U	77 J	360 U	370 U	360 U	460
Fluorene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	42 J
Hexachlorobenzene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Hexachlorobutadiene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Hexachlorocyclopentadiene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Hexachloroethane	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Indeno(1,2,3-cd)pyrene	140 J	210 J	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	150 J
Isophorone	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
N-Nitroso-di-n-propylamine	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
N-Nitrosodimethylamine	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
N-Nitrosodiphenylamine	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Naphthalene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Nitrobenzene	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Pentachlorophenol	1,200 U	1,600 U	930 U	920 U	930 U	920 U	900 U	910 U	930 U	900 U	890 U
Phenanthrene	190 J	120 J	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	410
Phenol	460 U	630 U	370 U	370 U	370 U	370 U	360 U	360 U	370 U	360 U	360 U
Pyrene	500	480 J	370 U	370 U	370 U	370 U	120 J	360 U	370 U	360 U	670

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-922	SB-922	SB-923	SB-924	SB-924	SB-925	SB-926	SB-926	SB-927	SB-928	SB-928
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.4')	(1.4 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')
Sample Date	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
1,2,4-Trichlorobenzene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2,2'-oxybis(dichloropropane)	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2,4,5-Trichlorophenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2,4,6-Trichlorophenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2,4-Dichlorophenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2,4-Dimethylphenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2,4-Dinitrophenol	960 U	980 U	950 U	920 U	910 U	930 U	1,000 U	1,000 U	960 U	970 U	930 U
2,4-Dinitrotoluene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2,6-Dinitrotoluene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2-Chloronaphthalene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2-Chlorophenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2-Methylnaphthalene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2-Methylphenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
2-Nitroaniline	960 U	980 U	950 U	920 U	910 U	930 U	1,000 U	1,000 U	960 U	970 U	930 U
2-Nitrophenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
3,3'-Dichlorobenzidine	770 U	780 U	760 U	740 U	720 U	740 U	820 U	840 U	770 U	780 U	740 U
3-Nitroaniline	960 U	980 U	950 U	920 U	910 U	930 U	1,000 U	1,000 U	960 U	970 U	930 U
4,6-Dinitro-2-methylphenol	960 U	980 U	950 U	920 U	910 U	930 U	1,000 U	1,000 U	960 U	970 U	930 U
4-Bromophenyl phenyl ether	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
4-Chloro-3-methylphenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
4-Chloroaniline	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
4-Chlorophenyl phenyl ether	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
4-Methylphenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
4-Nitroaniline	960 U	980 U	950 U	920 U	910 U	930 U	1,000 U	1,000 U	960 U	970 U	930 U
4-Nitrophenol	960 U	980 U	950 U	920 U	910 U	930 U	1,000 U	1,000 U	960 U	970 U	930 U
Acenaphthene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Acenaphthylene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Anthracene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Benzo(a)anthracene	48 J	390 U	43 J	370 U	360 U	370 U	96 J	420 U	380 U	65 J	370 U
Benzo(a)pyrene	380 U	390 U	380 U	370 U	360 U	370 U	130 J	420 U	380 U	73 J	370 U
Benzo(b)fluoranthene	68 J	390 U	55 J	370 U	360 U	370 U	110 J	420 U	380 U	85 J	370 U
Benzo(g,h,i)perylene	380 U	390 U	380 U	370 U	360 U	370 U	69 J	420 U	380 U	52 J	370 U
Benzo(k)fluoranthene	81 J	390 U	72 J	370 U	360 U	370 U	150 J	420 U	380 U	58 J	370 U

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-922	SB-922	SB-923	SB-924	SB-924	SB-925	SB-926	SB-926	SB-927	SB-928	SB-928
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.4')	(1.4 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')
Sample Date	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Benzyl alcohol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
bis(2-Chloroethoxy)methane	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
bis(2-Chloroethyl)ether	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
bis(2-Ethylhexyl)phthalate	160 JB	130 JB	180 JB	370 U	120 JB	130 JB	230 JB	420 U	140 JB	150 JB	130 JB
Butyl benzyl phthalate	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Chrysene	69 J	390 U	55 J	370 U	360 U	370 U	130 J	420 U	380 U	74 J	370 U
Di-n-butyl phthalate	380 U	390 U	38 J	370 U	360 U	370 U	52 J	420 U	380 U	390 U	370 U
Di-n-octyl phthalate	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Dibenz(a,h)anthracene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Dibenzofuran	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Diethyl phthalate	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Dimethyl phthalate	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Fluoranthene	83 J	390 U	86 J	370 U	360 U	370 U	150 J	420 U	62 J	110 J	370 U
Fluorene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Hexachlorobenzene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Hexachlorobutadiene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Hexachlorocyclopentadiene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Hexachloroethane	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Indeno(1,2,3-cd)pyrene	380 U	390 U	380 U	370 U	360 U	370 U	63 J	420 U	380 U	46 J	370 U
Isophorone	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
N-Nitroso-di-n-propylamine	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
N-Nitrosodimethylamine	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
N-Nitrosodiphenylamine	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Naphthalene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Nitrobenzene	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Pentachlorophenol	960 U	980 U	950 U	920 U	910 U	930 U	1,000 U	1,000 U	960 U	970 U	930 U
Phenanthrene	61 J	390 U	53 J	370 U	360 U	370 U	75 J	420 U	380 U	87 J	370 U
Phenol	380 U	390 U	380 U	370 U	360 U	370 U	410 U	420 U	380 U	390 U	370 U
Pyrene	180 J	390 U	130 J	370 U	360 U	370 U	240 J	420 U	80 J	210 J	370 U

See Notes, Page 9.

TABLE M-2B

SEMIVOLATILE ORGANIC COMPOUNDS IN SOILS

SRSNE
SOUTHINGTON, CT

NOTES:

1) Concentrations given in micrograms per kilogram (ug/kg); equivalent to parts per billion (ppb).
2) B - The compound has been found in the sample as well as its associated blank, its presence in the sample may be suspect.
3) D - Concentration is based on a diluted sample analysis.
4) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
5) U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE M-2C

POLYCHLORINATED BIPHENYLS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-901	SB-901	SB-902	SB-902	SB-903	SB-903	SB-904	SB-905	SB-905	SB-906	SB-907
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS
Aroclor-1016	18 U	18 U	22 U	20 U	21 U	19 U	19 U	18 U	18 U	18 U	20 U
Aroclor-1221	18 U	18 U	22 U	20 U	21 U	19 U	19 U	18 U	18 U	18 U	20 U
Aroclor-1232	18 U	18 U	22 U	20 U	21 U	19 U	19 U	18 U	18 U	18 U	20 U
Aroclor-1242	18 U	18 U	22 U	20 U	21 U	19 U	19 U	18 U	18 U	18 U	20 U
Aroclor-1248	18 U	18 U	22 U	20 U	21 U	19 U	19 U	18 U	18 U	18 U	20 U
Aroclor-1254	18 U	18 U	21 U	200	53	56	19 U	18 U	18 U	18 U	50
Aroclor-1260	18 U	18 U	21 U	220	26	19 U	19 U	18 U	18 U	18 U	51
PCBs, Total	ND	ND	ND	420	79	56	ND	ND	ND	ND	101

See Notes, Page 4.

TABLE M-2C

POLYCHLORINATED BIPHENYLS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-907	SB-908	SB-909	SB-909	SB-910	SB-911	SB-911	SB-912	SB-913	SB-913	SB-914
Depth Interval	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Aroclor-1016	20 U	18 U	18 U	22 U	20 U	22 U	21 U	21 U	20 U	20 U	26 U
Aroclor-1221	20 U	18 U	18 U	22 U	20 U	22 U	21 U	21 U	20 U	20 U	26 U
Aroclor-1232	20 U	18 U	18 U	22 U	20 U	22 U	21 U	21 U	20 U	20 U	26 U
Aroclor-1242	20 U	18 U	18 U	22 U	20 U	22 U	21 U	21 U	20 U	20 U	26 U
Aroclor-1248	20 U	18 U	18 U	22 U	20 U	22 U	21 U	21 U	20 U	20 U	26 U
Aroclor-1254	20 U	18 U	18 U	22 U	20 U	22 U	21 U	21 U	20 U	20 U	32
Aroclor-1260	20 U	18 U	18 U	22 U	20 U	22 U	21 U	21 U	20 U	20 U	34
PCBs, Total	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	66

See Notes, Page 4.

TABLE M-2C

POLYCHLORINATED BIPHENYLS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-915	SB-915	SB-916	SB-917	SB-918	SB-918	SB-919	SB-919	SB-920	SB-920	SB-921
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.7')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS
Aroclor-1016	230 UD	32 U	18 U	18 U	19 U	19 U	18 U	18 U	18 U	18 U	18 U
Aroclor-1221	230 UD	32 U	18 U	18 U	19 U	19 U	18 U	18 U	18 U	18 U	18 U
Aroclor-1232	230 UD	32 U	18 U	18 U	19 U	19 U	18 U	18 U	18 U	18 U	18 U
Aroclor-1242	230 UD	32 U	18 U	18 U	19 U	19 U	18 U	18 U	18 U	18 U	18 U
Aroclor-1248	230 UD	32 U	18 U	18 U	19 U	19 U	18 U	18 U	18 U	18 U	18 U
Aroclor-1254	1,100 D	310	18 U	18 U	19 U	19 U	18 U	18 U	18 U	18 U	120
Aroclor-1260	1,100 D	260	18 U	18 U	19 U	19 U	18 U	18 U	18 U	18 U	92
PCBs, Total	2,200	570	ND	ND	ND	ND	ND	ND	ND	ND	212

See Notes, Page 4.

TABLE M-2C

POLYCHLORINATED BIPHENYLS IN SOILS

SRSNE
SOUTHINGTON, CT

Location	SB-922	SB-922	SB-923	SB-924	SB-924	SB-925	SB-926	SB-926	SB-927	SB-928	SB-928
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.4')	(1.4 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')
Sample Date	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Aroclor-1016	19 U	20 U	19 U	18 U	18 U	19 U	21 U	20 U	19 U	19 U	19 U
Aroclor-1221	19 U	20 U	19 U	18 U	18 U	19 U	21 U	20 U	19 U	19 U	19 U
Aroclor-1232	19 U	20 U	19 U	18 U	18 U	19 U	21 U	20 U	19 U	19 U	19 U
Aroclor-1242	19 U	20 U	19 U	18 U	18 U	19 U	21 U	20 U	19 U	19 U	19 U
Aroclor-1248	19 U	20 U	19 U	18 U	18 U	19 U	21 U	20 U	19 U	19 U	19 U
Aroclor-1254	19 U	20 U	19 U	18 U	18 U	51	21 U	20 U	90	19 U	19 U
Aroclor-1260	19 U	20 U	19 U	18 U	18 U	41	21 U	20 U	110	19 U	19 U
PCBs, Total	ND	ND	ND	ND	ND	92	ND	ND	200	ND	ND

NOTES:

1) Concentrations given in micrograms per kilogram (ug/kg); equivalent to parts per billion (ppb).
2) D - Concentration is based on a diluted sample analysis.
3) ND - The compound was not detected.
4) U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE M-2D

INORGANICS IN SOILS (MASS/MASS)

SRSNE
SOUTHINGTON, CT

Location	SB-901	SB-901	SB-902	SB-902	SB-903	SB-903	SB-904	SB-905	SB-905	SB-906	SB-907
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	DUP	FS	FS	FS	FS	FS	FS	FS	FS
Aluminum	6,560	3,420	8,500	7,980	9,900	13,300	7,850	4,770	4,160	8,630	9,000
Antimony	0.45 UN	0.45 UN	0.54 UN	0.48 UN	0.51 UN	0.47 UN	0.44 UN	0.45 UN	0.44 UN	0.44 UN	0.49 UN
Arsenic	1.3	1.2	2.1	1.8	2.6	2.8	1.1	1.2	0.62 B	1.6	2
Barium	55	23 B	28	114	94	84	45	21 B	16 B	62	91
Beryllium	0.31 B	0.26 B	0.44 B	0.42 B	0.49 B	0.59 B	0.40 B	0.25 B	0.22 U	0.51 B	0.58 B
Cadmium	0.23 B	0.11 U	0.13 U	1	0.25 B	0.12 U	0.11 U	0.11 U	0.11 U	0.11 U	1.6
Calcium	642	952	718	1,040	735	910	727	463 B	518 B	1,200	2,110
Chromium	7.4	4.6	5.9	10	13	15	11	5.6	4.8	11	14
Cobalt	3.0 B	2.9 B	4.0 B	3.9 B	5.1 B	7	5.7	3.0 B	3.4 B	5.2 B	6.1 B
Copper	6.1	5.2	8.9	9.6	11	14	8.6	6.5	6.2	8.1	14
Cyanide, Total	0.55 U	0.50 U	0.65 U	0.58 U	0.62 U	0.57 U	0.43 U	0.53 U	0.55 U	0.56 U	0.59 U
Iron	8,800	6,740	7,350	10,300	11,300	14,900	11,200	6,940	6,280	12,700	14,500
Lead	7.8	2.1	9.4 *N	18	17 *N	17 *N	15	7.6 *N	2.1 *N	8.2	28
Magnesium	1,140	728	1,530	1,410	1,900	2,990	2,730	1,340	1,390	2,160	2,620
Manganese	81	60	266 *N	296	299 *N	539 *N	245	81 *N	83 *N	293	498
Mercury	0.06 U	0.06 U	0.07 U	0.08 B	0.07 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	1.3
Nickel	5.6	5.6	7	6.1	8.6	11	10	7.4	5.5	7.8	9.8
Potassium	360 B	303 B	543 B	472 B	483 B	762	1,000	453 B	477 B	823	967
Selenium	0.45 U	0.45 U	0.54 U	0.81	0.51 U	0.47 U	0.59	0.45 U	0.44 U	0.48 B	0.49 U
Silver	0.23 U	0.23 U	0.27 U	0.24 U	0.26 U	0.24 U	0.22 U	0.23 U	0.22 U	0.22 U	0.24 U
Sodium	53 U	53 U	63 U	56 U	60 U	55 U	52 U	53 U	51 U	51 U	85 B
Thallium	0.80 B	0.45 U	0.54 U	0.48 U	0.51 U	0.85 B	0.44 U	0.45 U	0.44 U	0.81 B	0.61 B
Vanadium	19	14	22	21	25	27	20	12	9.3	23	28
Zinc	16	11	27	25	35	41	26	17	13	25	36

See Notes, Page 6.

TABLE M-2D

INORGANICS IN SOILS (MASS/MASS)

SRSNE
SOUTHINGTON, CT

Location	SB-907	SB-908	SB-909	SB-909	SB-910	SB-911	SB-911	SB-912	SB-913	SB-913	SB-914
Depth Interval	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Aluminum	7,300	11,600	8,630	11,400	11,200	11,700	13,000	9,460	9,800	10,600	11,000
Antimony	0.48 UN	0.45 UN	0.44 UN	0.54 UN	0.49 UN	0.55 UN	0.53 UN	0.52 UN	0.49 UN	0.48 UN	0.57 UN
Arsenic	1.2 B	2.8	2.1	2	0.82 B	1.7	2.3	1.3 B	1.8	2.3	3.1
Barium	103	39	80	81	52	73	101	50	68	108	141
Beryllium	0.35 B	0.39 B	0.64	0.53 B	0.45 B	0.54 B	0.65 B	0.39 B	0.57 B	0.72	0.67 B
Cadmium	0.12 U	0.11 U	0.11 U	0.14 U	0.12 U	0.14 U	0.13 U	0.13 U	0.12 U	0.12 U	2.8
Calcium	1,860	9,630	1,940	718	4,620	1,070	1,070	273 B	954	1,750	4,210
Chromium	9.6	7.6	13	10	9.9	11	12	12	15	18	22
Cobalt	5.8 B	11	5.9	4.3 B	12	4.9 B	6.0 B	6.5 B	10	8.1	9.8
Copper	11	35	9.9	6.7	28	7	11	8.5	12	12	34
Cyanide, Total	0.57 U	0.54 U	0.51 U	0.67 U	0.61 U	0.64 U	0.65 U	0.62 U	0.53 U	0.46 U	0.69 U
Iron	14,300	21,600	14,100	14,800	19,000	13,100	15,500	12,600	18,300	20,300	19,400
Lead	14	5.4	9.2 *N	9.3 *N	4.9 *N	8.8 *N	14 *N	5.2 *N	6.9	7.6	55 *N
Magnesium	1,770	5,220	2,740	1,350	5,170	1,850	2,420	2,870	4,090	4,420	4,950
Manganese	265	368	550 *N	219 *N	462 *N	286 *N	349 *N	233 *N	293	230	411 *N
Mercury	0.06 U	0.05 U	0.06 U	0.07 U	0.06 U	0.07 U	0.07 U	0.07 U	0.06 U	0.06 U	0.07 U
Nickel	7.6	8.8	8.6	6.5	14	23	10	12	13	15	20
Potassium	505 B	573	1,000	394 B	1,410	497 B	452 B	1,050	1,410	2,150	2,180
Selenium	0.48 U	0.45 U	0.44 U	0.54 U	0.49 U	0.55 U	0.53 U	0.52 U	0.64	0.48 U	0.57 U
Silver	0.24 U	0.23 U	0.22 U	0.27 U	0.24 U	0.27 U	0.26 U	0.26 U	0.25 U	0.24 U	0.29 U
Sodium	69 B	509 B	55 B	63 U	302 B	64 U	62 B	61 U	63 B	56 U	67 U
Thallium	0.48 U	0.50 B	0.90 B	0.54 U	0.74 B	0.55 U	0.70 B	0.52 U	0.49 U	0.94 B	1.3 B
Vanadium	28	51	28	25	38	23	31	21	42	42	41
Zinc	24	30	24	29	34	27	39	26	32	37	67

See Notes, Page 6.

TABLE M-2D

INORGANICS IN SOILS (MASS/MASS)

SRSNE
SOUTHINGTON, CT

Location	SB-915	SB-915	SB-916	SB-917	SB-918	SB-918	SB-919	SB-919	SB-920	SB-920	SB-921
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.7')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	DUP	FS	FS	FS	FS
Aluminum	10,800	15,400	7,320	4,650	6,940	2,990	8,300	7,340	6,270	6,200	7,640
Antimony	0.55 UN	0.77 UN	0.45 UN	0.45 UN	0.45 UN	0.45 UN	0.44 UN	0.44 UN	0.44 UN	0.45 UN	0.44 UN
Arsenic	4.2	2.7	0.46 B	0.98 B	1.2	0.88 B	1.4	1.5	1.4	1.8	2.4
Barium	163	215	20 B	18 B	28	16 B	37	33	33	31	46
Beryllium	0.65 B	0.87 B	0.29 B	0.23 B	0.25 B	0.22 U	0.36 B	0.34 B	0.33 B	0.34 B	0.42 B
Cadmium	7.7	8	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Calcium	1,890	3,090	271 B	318 B	256 B	356 B	1,260	771	410 B	569	1,020
Chromium	32	47	7.8	5.6	6.8	4.4	9.6	9.4	9.9	8.6	9.8
Cobalt	9	6.6 B	3.7 B	2.8 B	3.2 B	2.9 B	6	4.9 B	4.9 B	4.4 B	6.9
Copper	30	40	4.6	4.7	4.1	5.2	10	8.2	6.6	9	15
Cyanide, Total	0.64 U	0.73 U	0.51 U	0.56 U	0.52 U	0.54 U	0.48 U	0.51 U	0.56 U	0.52 U	0.50 U
Iron	16,300	12,700	9,290	7,060	8,110	7,100	13,500	11,100	11,700	11,700	15,300
Lead	51	49	3.1	3.9 N	4.0 N	3.2 N	9.3 N	7.6 N	5.6 N	5.2 N	8.7 N
Magnesium	2,990	2,730	1,360	1,080	1,150	846	2,660	2,100	1,990	1,970	2,620
Manganese	1,080	224	110	71 N	65 N	151 N	213 N	149 N	211 N	174 N	294 N
Mercury	0.26	0.25	0.06 U	0.06 U	0.06 U	0.06 B	0.06 U	0.08 B	0.06 U	0.06 U	0.06 U
Nickel	20	20	5.3	4.7	4.9	4.8	8.9	8.2	8.2	7.8	7.8
Potassium	766	591 B	354 B	423 B	372 B	393 B	867	696	806	975	730
Selenium	1.1	1.8	0.45 U	0.45 U	0.45 U	0.45 U	0.44 U	0.44 U	0.44 U	0.45 U	0.44 B
Silver	1.7	3.3	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U	0.22 U
Sodium	81 B	117 B	52 U	52 U	52 U	52 U	69 B	51 U	52 U	52 U	52 U
Thallium	1.8	0.77 U	0.45 U	1.0 B	0.45 U	0.45 U	0.44 U	0.67 B	0.55 B	0.45 U	0.44 U
Vanadium	39	51	15	11	13	11	23	19	20	18	31
Zinc	52	57	15	13	17	9.5	26	22	17	24	25

See Notes, Page 6.

TABLE M-2D

INORGANICS IN SOILS (MASS/MASS)

SRSNE
SOUTHINGTON, CT

Location	SB-922	SB-922	SB-923	SB-924	SB-924	SB-925	SB-926	SB-926	SB-927	SB-928	SB-928
Depth Interval	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 1.4')	(1.4 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')
Sample Date	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Aluminum	8,690	12,200	7,680	7,630	8,110	7,050	7,580	5,980	8,180	7,870	11,800
Antimony	0.46 UN	0.48 UN	0.46 UN	0.44 UN	0.43 UN	0.45 UN	0.50 UN	0.50 UN	0.45 UN	0.47 UN	0.46 UN
Arsenic	2	3.3	1.6	1.5	2	1.4	0.94 B	1.2 B	2.7	3.3	1.4
Barium	47	119	44	36	38	36	36	31	63	66	81
Beryllium	0.46 B	0.76	0.42 B	0.35 B	0.34 B	0.30 B	0.35 B	0.37 B	0.48 B	0.38 B	0.63
Cadmium	0.11 U	0.12 U	0.11 U	0.11 U	0.11 U	0.11 U	0.48 B	0.12 U	0.96	0.12 U	0.12 U
Calcium	547 B	1,760	657	522 B	405 B	446 B	447 B	473 B	794	673	574 B
Chromium	13	22	12	9.4	7.8	7.6	14	9.8	11	9	22
Cobalt	5.0 B	13	5.0 B	4.7 B	3.5 B	3.5 B	5.7 B	5.0 B	6.6	3.4 B	8.6
Copper	10	14	8.9	8.8	5.2	5.1	12	6.6	8.4	7.7	10
Cyanide, Total	0.57 U	0.58 U	0.52 U	0.55 U	0.52 U	0.54 U	0.60 U	0.62 U	0.47 U	0.58 U	0.54 U
Iron	12,300	24,500	12,000	11,400	9,320	9,680	13,300	12,100	14,000	10,600	21,100
Lead	15 N	11 N	9.7 N	9.2 N	8.8 N	5.6 N	9.9 N	5.7 N	13 N	16 N	9.9 N
Magnesium	2,090	6,470	2,150	2,160	1,230	1,420	2,850	2,640	2,250	1,600	4,650
Manganese	259 N	906 N	256 N	173 N	147 N	169 N	202 N	334 N	698 N	136 N	224 N
Mercury	0.09 B	0.17	0.07 B	0.07 B	0.10 B	0.08 B	0.11 B	0.06 U	0.06 U	0.08 B	0.11 B
Nickel	9.5	20	9	8.2	6.1	6.2	12	9.5	8.7	6.4	15
Potassium	807	2,210	830	759	403 B	493 B	1,140	1,150	866	465 B	1,400
Selenium	0.49 B	0.48 U	0.46 U	0.44 U	0.43 U	0.45 U	0.50 U	0.50 U	0.68	0.47 U	0.68
Silver	0.23 U	0.24 U	0.23 U	0.22 U	0.22 U	0.22 U	0.25 U	0.25 U	0.22 U	0.23 U	0.23 U
Sodium	53 U	89 B	54 U	52 U	54 B	52 U	82 B	119 B	52 U	62 B	54 U
Thallium	0.73 B	1.2 B	0.54 B	0.47 B	0.48 B	0.45 U	0.79 B	0.50 U	1.2	0.47 U	1.0 B
Vanadium	23	46	23	19	15	17	22	20	27	21	40
Zinc	26	53	25	25	21	18	33	21	28	31	37

See Notes, Page 6.

TABLE M-2D

INORGANICS IN SOILS (MASS/MASS)

SRSNE
SOUTHINGTON, CT

Location	SB-929	SB-930	SB-931	SB-932	SB-933	SB-934	SB-935	SB-936	SB-937	SB-938
Depth Interval	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')
Sample Date	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Aluminum	9,450	8,180	12,100	9,520	12,000	6,540	13,200	8,740	10,900	14,300
Antimony	0.48 UN	0.49 UN	0.52 UN	0.45 UN	0.47 UN	0.42 UN	0.44 UN	0.47 UN	0.45 UN	0.45 UN
Arsenic	1.9	2.2	1.8	1.6	2.5	2.8	1.8	2.1	1.4	1.8
Barium	64	50	57	35	42	36	76	38	64	65
Beryllium	0.35 B	0.54 B	0.67	0.42 B	0.46 B	0.39 B	0.6	0.52 B	0.66	0.77
Cadmium	0.12 U	0.12 U	0.13 U	0.11 U	0.12 U	0.11 U	0.11 U	0.12 U	0.11 U	0.11 U
Calcium	468 B	684	519 B	335 B	214 B	342 B	1,040	293 B	740	379 B
Chromium	8.4	13	23	14	15	7.4	22	13	21	22
Cobalt	2.5 B	6.3	9.3	7.5	7.2	3.8 BE	13 E	6.2 E	11 E	11 E
Copper	8.2 E*	9.9 E*	14 E*	12 E*	10 E*	7.3	20	7.9	12	14
Cyanide, Total	0.57 U	0.55 U	0.65 U	0.56 U	0.55 U	0.53 U	0.55 U	0.57 U	0.49 U	0.53 U
Iron	8,360	15,500	20,500	14,400	17,800	8,680	23,300	13,500	23,200	23,600
Lead	12 E*	17 E*	9.0 E*	6.3 E*	6.2 E*	9.5 *	8.6 *	6.4 *	9.5 *	11 *
Magnesium	995	3,640	5,020	3,740	2,820	1,580	7,120	3,190	5,850	6,310
Manganese	276	315	561	349	193	169 *	539 *	222 *	437 *	506 *
Mercury	0.06 B	0.06 U	0.06 U	0.06 U	0.09 B	0.05 U	0.08 B	0.06 U	0.05 U	0.05 U
Nickel	5.3	11	18	13	10	6.6	23	11	19	22
Potassium	389 B	1,720	2,180	1,460	835	570	2,190	1,110	2,290	2,360
Selenium	0.73	0.65	0.76	0.52 B	0.47 U	0.42 U	0.44 U	0.7	0.63	0.79
Silver	0.24 U	0.25 U	0.26 U	0.22 U	0.23 U	0.21 U	0.22 U	0.24 U	0.22 U	0.22 U
Sodium	56 U	58 U	98 B	81 B	54 U	70 B	106 B	55 U	59 B	111 B
Thallium	0.48 U	0.49 U	0.52 U	0.45 U	0.47 U	0.75 B	0.49 B	0.47 U	0.49 B	0.45 U
Vanadium	14	30	35	26	36	18 *	40 *	27 *	36 *	37 *
Zinc	25	33	39	28	26	23 *	47 *	33 *	44 *	54 *

See Notes, Page 6.

TABLE M-2D

INORGANICS IN SOILS (MASS/MASS)

SRSNE
SOUTHINGTON, CT

NOTES:

1) Concentrations given in micrograms per kilogram (ug/kg); equivalent to parts per billion (ppb).
2) B - The reported value was obtained from a reading less than the contract required detection limit (CRDL) but greater than or equal to the instrument detection limit (IDL).
3) E - The reported value is estimated due to the presence of interference.
4) N - Spiked sample recovery not within control limits.
5) U - The analyte was analyzed for but not detected. The associated value is the analyte instrument detection limit.
6) * - Duplicate analysis not within control limits.

TABLE M-2E

INORGANICS IN SOILS (SPLP)

SRSNE
SOUTHINGTON, CT

Location	SB-902	SB-903	SB-903	SB-904	SB-905	SB-905	SB-905	SB-906	SB-909	SB-910	SB-911
Depth Interval	(0.0 - 1.4')	(0.0 - 2.2')	(2.2 - 4.4')	(0.0 - 2.0')	(0.0 - 2.0')	(0.0 - 8.5')	(0.0 - 9.5')	(0.0 - 2.0')	(0.0 - 2.4')	(0.0 - 2.0')	(0.0 - 2.5')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999
Sample Type	FS	FS	FS	FS	FS	DUP	DUP	FS	FS	FS	FS
Antimony	4.0 UN	4.0 UN	4.0 UN	4.1 BN	4.0 UN	60 UN	4.0 UN	4.0 UN	4.0 UN	60 UN	4.0 UN
Arsenic	4.0 U	4.0 U	4.0 U	4.9 B	4.0 U	10 U	4.0 U	4.0 U	4.0 U	4.5 B	4.0 U
Barium	294	190 B	271	11 BE	174 B	15 BE	257	247	440	8.6 BE	425
Beryllium	2.0 U	2.0 U	2.0 U	5.0 U	2.0 U	5.0 U	2.0 U	2.0 U	2.0 U	5.0 U	2.0 U
Cadmium	1.3 B	1.0 U	1.0 U	5.0 U	1.0 U	5.0 U	1.0 U	1.0 U	1.0 U	5.0 U	1.0 U
Chromium	4.0 B	2.0 U	2.0 U	4.0 B	7.2 B	3.4 B	2.0 U	3.4 B	2.0 U	2.8 B	2.0 U
Copper	6.4 B	2.4 B	11 B	25 U	17 B	25 U	3.7 B	3.7 B	4.9 B	25 U	6.2 B
Lead	14 *	2.0 U*	11 *	5.0 B	50 *	16 B	2.9 B*	4.9 *	3.0 B*	4.3 B	3.6 *
Mercury	0.10 U	0.10 U	0.10 U	0.20 U	0.10 U	0.20 U	0.10 U	0.10 U	0.10 U	0.20 U	0.10 U
Nickel	3.0 U	3.0 U	3.0 U	40 U	3.6 B	40 U	3.0 U	3.0 U	3.0 U	40 U	3.0 U
Selenium	4.0 U	4.0 U	4.0 U	5.0 U	4.0 U	5.0 U	4.0 U	4.0 U	4.0 U	5.0 U	4.0 U
Silver	2.0 U	2.0 U	2.0 U	10 U	2.0 U	10 U	2.0 U	2.0 U	2.0 U	10 U	2.0 U
Thallium	5.0 U	5.0 U	5.0 U	10 U	5.0 U	10 U	5.0 U	5.0 U	5.0 U	10 U	5.0 U
Vanadium	2.8 B	3.2 B	5.4 B	3.1 B	31 B	6.0 B	3.0 B	3.0 B	3.7 B	4.8 B	3.2 B
Zinc	36	25	22	20 U	54	6.7 B	36	13 B	18 B	20 U	12 B

See Notes, Page 4.

TABLE M-2E

INORGANICS IN SOILS (SPLP)

SRSNE
SOUTHINGTON, CT

Location	SB-911	SB-912	SB-914	SB-917	SB-922	SB-922	SB-926	SB-927	SB-929	SB-930	SB-931
Depth Interval	(2.5 - 5.1')	(0.0 - 2.7')	(0.0 - 2.4')	(0.0 - 1.7')	(0.0-3.1)	(3.1-6.3)	(0.0 - 1.4')	(0.0 - 2.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')
Sample Date	10/19/1999	10/19/1999	10/19/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS
Antimony	4.0 UN	4.0 UN	4.0 UN	60 UN	60 UN	60 UN	60 UN	60 UN	4.0 UN	4.0 UN	4.0 UN
Arsenic	4.0 U	4.0 U	4.0 U	10 U	10 U	10 U	10 U	10 U	4.0 U	4.0 U	4.0 U
Barium	132 B	59 B	1,010	2.7 BE	7.0 BE	75 BE	2.7 BE	5.4 BE	138 B	9.4 B	2.7 B
Beryllium	2.0 U	2.0 U	2.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	2.0 U	2.0 U	2.0 U
Cadmium	1.0 U	1.0 U	1.2 B	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	1.0 U	1.0 U	1.0 U
Chromium	2.0 U	2.0 U	5.1 B	10 U	2.7 B	12 B	2.5 B	8.5 B	2.0 U	2.0 U	2.0 U
Copper	2.0 U	2.0 U	14 B	25 U	25 U	8.5 B	25 U	25 U	2.0 U	2.3 B	2.0 U
Lead	2.0 U*	2.0 U*	15 *	3.2 B	3.1 B	4.8 B	2.5 B	3.0 B	2.0 U*	2.0 U*	2.0 U*
Mercury	0.10 U	0.10 U	0.10 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.10 U	0.10 U	0.10 U
Nickel	3.0 U	3.0 U	3.0 U	40 U	4.7 B	9.0 B	40 U	4.8 B	3.0 U	3.0 U	3.0 U
Selenium	4.0 U	4.0 U	4.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	4.0 U	4.0 U	4.0 U
Silver	2.0 U	2.0 U	2.0 U	10 U	10 U	10 U	10 U	10 U	2.0 U	2.0 U	2.0 U
Thallium	5.0 U	5.0 U	5.0 U	10 U	10 U	10 U	10 U	10 U	5.0 U	5.0 U	5.0 U
Vanadium	2.0 U	2.0 U	16 B	50 U	50 U	18 B	50 U	50 U	2.0 U	3.2 B	2.0 U
Zinc	5.8 B	5.2 B	30	4.9 B	20 U	16 B	20 U	20 U	14 B	3.1 B	3.0 U

See Notes, Page 4.

TABLE M-2E

INORGANICS IN SOILS (SPLP)

SRSNE
SOUTHINGTON, CT

Location	SB-932	SB-933	SB-934	SB-935	SB-936	SB-937	SB-938
Depth Interval	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')	(0.0 - 4.0')
Sample Date	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type	FS	FS	FS	FS	FS	FS	FS
Antimony	4.0 UN	4.0 UN	4.0 UN	4.3 BN	4.0 UN	4.0 UN	4.0 UN
Arsenic	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Barium	101 B	81 B	120 B	102 B	66 B	165 B	128 B
Beryllium	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cadmium	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium	2.0 U	2.0 U	3.6 B	2.0 U	2.0 U	2.0 U	2.0 U
Copper	2.0 U	2.0 U	4.0 B	2.0 U	2.0 U	2.9 B	2.2 B
Lead	2.0 U*	2.0 U*	8.8	2.0 U	2.0 U	2.0 U	2.0 U
Mercury	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.10 U
Nickel	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
Selenium	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U	4.0 U
Silver	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Thallium	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Vanadium	2.0 U	2.0 U	3.0 B	3.0 B	2.0 U	3.4 B	3.4 B
Zinc	8.5 B	17 B	16 B	13 B	7.9 B	8.8 B	9.3 B

See Notes, Page 4.

TABLE M-2E

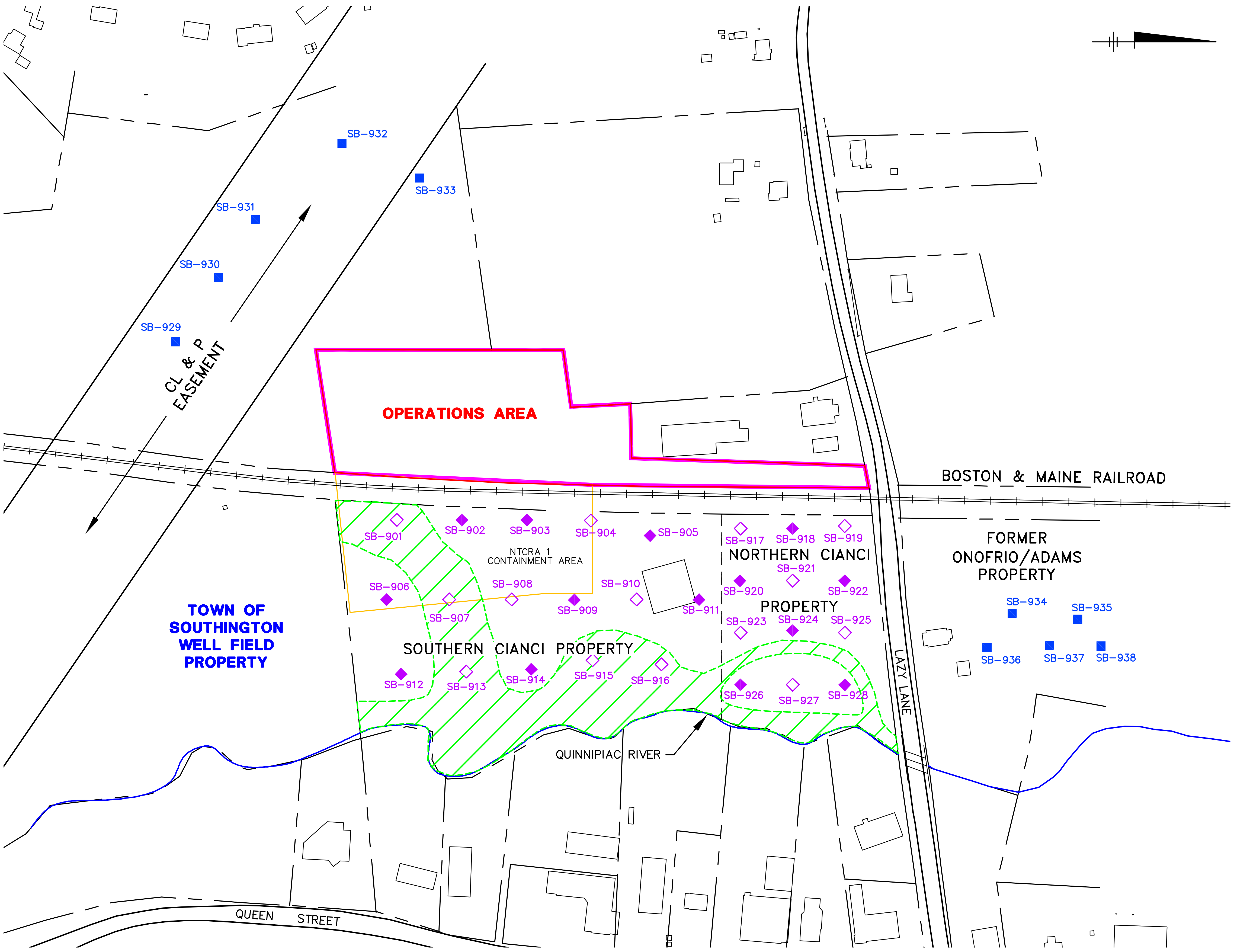
INORGANICS IN SOILS (SPLP)

SRSNE
SOUTHINGTON, CT

NOTES:

1) Concentrations given in micrograms per liter (ug/L); equivalent to parts per billion (ppb).
2) B - The reported value was obtained from a reading less than the contract required detection limit (CRDL) but greater than or equal to the instrument detection limit (IDL).
3) E - The reported value is estimated due to the presence of interference.
4) N - Spiked sample recovery not within control limits.
5) U - The analyte was analyzed for but not detected. The associated value is the analyte instrument detection limit.
6) * - Duplicate analysis not within control limits.

FIGURES



LEGEND:

SB–901 ◇	SUPPLEMENTAL SOIL SAMPLING LOCATIONS
SB–934 ■	SUPPLEMENTAL BACKGROUND SOIL SAMPLING LOCATION
■ ◆	SPLP SAMPLING LOCATIONS
— — —	APPROXIMATE PROPERTY LINE
▭	EXISTING BUILDING
▨	ESTIMATED AREA SEASONALLY SATURATED TO GROUND SURFACE IN CIANCI PROPERTY

NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6–28–93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. PROPOSED SOIL SAMPLING LOCATIONS ARE APPROXIMATE AND MAY BE ADJUSTED, AS NECESSARY, BASED ON ACCESSIBILITY AND UTILITY LOCATIONS.
3. ALL SITE FEATURES ARE APPROXIMATE.

0 200' 400'
GRAPHIC SCALE

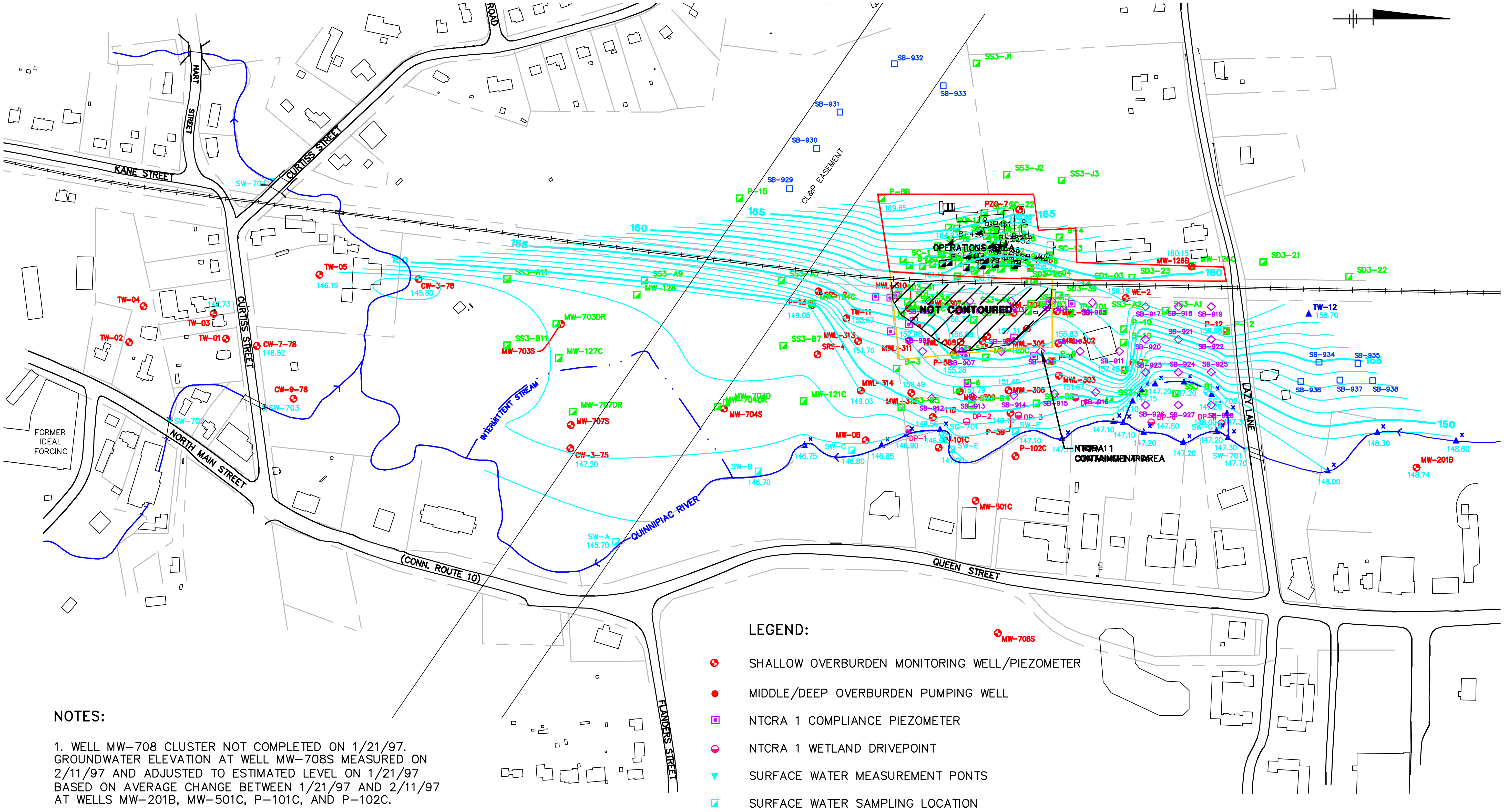
X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_M/08331B06.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

POLLUTANT MOBILITY CRITERIA SCREENING RESULTS

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
M-1



LEGEND:

⊗ SHALLOW OVERBURDEN MONITORING WELL/PIEZOMETER

● MIDDLE/DEEP OVERBURDEN PUMPING WELL

⊡ NTCRA 1 COMPLIANCE PIEZOMETER

⊖ NTCRA 1 WETLAND DRIVEPOINT

▼ SURFACE WATER MEASUREMENT PONTS

◩ SURFACE WATER SAMPLING LOCATION

⊕ STREAM GAUGE

◩ HISTORICAL SOIL SAMPLE LOCATIONS

▲ LOCATIONS WITH ESTIMATED WATER TABLE ELEVATIONS

157.5 GROUNDWATER ELEVATION (FT)

165 —— GROUNDWATER ELEVATION CONTOUR (FT), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

NOTES:

1. WELL MW-708 CLUSTER NOT COMPLETED ON 1/21/97. GROUNDWATER ELEVATION AT WELL MW-708S MEASURED ON 2/11/97 AND ADJUSTED TO ESTIMATED LEVEL ON 1/21/97 BASED ON AVERAGE CHANGE BETWEEN 1/21/97 AND 2/11/97 AT WELLS MW-201B, MW-501C, P-101C, AND P-102C.

2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

3. QUINNIPIAC RIVER AND MITIGATION WETLAND SURFACE WATER ELEVATIONS ESTIMATED.

0 300' 600'

GRAPHIC SCALE

X: 08331X00.DWG, X01.DWG
L: ON=*,OFF=REF
P: PAGESET/PLT-BL1
6/8/04 SYR-85-LJP
08331009/SRSNE04/APPENDIX/APPEND_M/08331B01.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW OVERBURDEN GROUNDWATER CONTOURS 3/20/95

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
M-2

Appendix N

Soil and Groundwater Database Regulatory Screening Results

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Appendix N – Soil and Groundwater Database Regulatory Screening Results

N.1 General

This appendix presents the results of database screening performed by Blasland, Bouck & Lee, Inc. (BBL) to support the completion of the Feasibility Study (FS) for the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. BBL compiled comprehensive soil and groundwater databases in MS-Access™ format and then performed queries to sort the data and identify the locations of soil and groundwater samples that exceeded respective regulatory criteria. Summary tables and figures were prepared from digital files produced from the queries.

The soil database was queried to identify exceedences of the soil Direct Exposure Criteria and Pollutant Mobility Criteria. These criteria are described in the Connecticut Department of Environmental Protection's (CT DEP's) Remediation Standard Regulations (RSRs) dated January 1996, as updated by the list of Approved Criteria for Additional Polluting Substances dated April 30, 1999.

The groundwater database was queried to identify exceedences of United States Environmental Protection Agency (USEPA) Maximum Contaminant Levels (or Goals) (MCL/MCLGs) for groundwater and Connecticut Department of Environmental Protection (CT DEP) Groundwater Protection Criteria. The groundwater data were also evaluated with respect to the CT DEP's Volatilization Criteria and Surface-Water Protection Criteria.

The results of these evaluations are summarized below. These results were used to identify the constituents of concern in each medium, and the areas of the site for which remedial alternatives were evaluated in this FS Report.

N.2 Soil Data Screening

All soil and onsite "sediment" data (i.e., from the railroad grade, onsite wetlands, or floodplain of the Quinnipiac River, but not within the river channel) were sorted using the site-specific relational database to identify soil samples that exceeded applicable soil regulatory criteria. The data set includes samples obtained at the site before the Remedial Investigation (RI), during the first three phases of the RI (HNUS, May 1994), the completion of the RI (BBL, June 1998), and supplemental soil sampling (this document, see Appendix M). The DEC soil screening included samples obtained from soil depth intervals up to and including four feet below ground surface or the bottom of the surface water body. Vadose zone soil samples were evaluated with respect to CT DEP's Pollutant Mobility Criteria (PMCs). In addition, the soil and sediment data were used to update the human health and ecological risk assessments for the site.

River sediment data obtained in the Quinnipiac River by HNUS (May 1994) and BBL (this document, see Appendix K) are not directly applicable for comparison to CT DEP's Direct Exposure Criteria (DECs) for residential soil. However, alternative river-sediment DECs were calculated to reflect an estimated river-sediment exposure period of 36.5 days per year (rather than 365 days per year as assumed for soil), for comparison to river sediment data.

The initial step in the screening process was to calculate representative background concentrations for the inorganic analytes detected in soil. This exercise identified no background inorganics detections above the applicable DEC or PMC, thus the background soil screening process did not provide a mechanism to reduce the scope of regulatory soil data screening. As CT DEP stated in a telephone conversation with BBL on April 25, 2000, however, the following metals were not considered, as they do not pose health threats: aluminum, calcium, iron, magnesium, potassium, and sodium. With the exception of these metals, all soil (and sediment) analytical data were evaluated with respect to applicable CT DEP regulatory criteria.

The soil data regulatory screening process and results are summarized below.

- **CT DEP Direct Exposure Criteria –** The DEC screening identified 22 analytes detected above residential DECs, as listed on Tables N-1A and N-1B. The highest concentrations of most of these chemicals were generally detected within the Operations Area. BBL calculated DEC values for three detected analytes that were not listed in the RSRs or Approved Criteria for Additional Polluting Substances dated April 30, 1999, as shown on Table N-2. Of these, only manganese was detected above the calculated value (Table N-1). Six other non-RSR-listed analytes were also detected at locations with no known exceedence of a listed analyte. DEC values were not calculated for these analytes, nor were they evaluated further because: 1) they are within the Operations Area and, therefore, will be remedied via a cap or excavation; and/or 2) they are inorganics that were not part of the release associated with the site (Table N-3).

  Figure N-1 summarizes the status of each soil sampling location with respect to Residential DECs, and shows that the majority of the exceedence locations are within the former SRSNE Operations Area or the Boston and Maine railroad easement. Another cluster of exceedences was identified near the outfall of an underground culvert that crosses the southern Cianci Property from the railroad easement to the western floodplain of the Quinnipiac River. The culvert discharges near sampling locations SB-915, SS3-B3, SD1-05, SD3-34, SD3-35 and SD3-36. Other isolated exceedences were also noted in the southern Cianci Property. No DEC exceedences were identified in soil in the Town of Southington Well Field Property, the northern Cianci Property, or background areas. Alternative, site-specific river-sediment DECs were calculated to reflect an estimated river-sediment exposure period of 36.5 days per year (rather than 365 days per year assumed for soil), for comparison to river sediment data. This "sediment" alternative DEC estimation procedure yields a ten-fold increase over the soil DEC value. No exceedences of the resulting alternative, site-specific DECs were identified in the Quinnipiac River sediment, including locations upstream, adjacent to, and downstream of the site. Sediment sampling results are discussed further in Appendix K.

- **CT DEP Pollutant Mobility Criteria –** The PMC screening identified 20 analytes detected above Class GA/GAA PMCs, as listed on Tables N-4A and N-4B. The highest concentrations of most of these chemicals were generally detected within the Operations Area. Three non-RSR-listed analytes were also detected, but BBL did not calculate PMC values for these analytes because they are within the Operations Area and, therefore, will be remedied via a cap or excavation (Table N-5).

  Figure N-2 summarizes the status of each vadose zone soil sampling location with respect to Class GA/GAA PMCs, and shows that the majority of the exceedence locations are within the former SRSNE Operations Area or the Boston and Maine railroad easement. Other isolated exceedences were also noted in the southern Cianci Property, although these are minor exceedences within a factor of one to three times the listed PMC. No PMC exceedences were identified in soil in the Town of Southington Well Field Property, the northern Cianci Property, or background areas.

N.3 Groundwater Data Screening

Groundwater quality data included in the site-specific relational database include samples obtained during the first three phases of the Remedial Investigation (RI; HNUS, May 1994), supplemental groundwater sampling events (ENSR, November 1994 and June 1995), the completion of the RI (BBL, June 1998), and Interim Monitoring and Sampling (up through and including the October 2003 sampling event for volatile organic compounds [VOCs; BBL, January 2004] and the April 2004 Interim Monitoring and Sampling [IMS] event for 1,4-dioxane). This database was queried to identify each well or piezometer where groundwater quality exceeded applicable groundwater regulatory criteria. All of the groundwater data were evaluated with respect to Federal MCL/MCLGs and CT DEP Groundwater Protection Criteria. The CT DEP Volatilization Criteria screening included only groundwater samples obtained from wells and piezometers up to 15 feet deep. Surface Water Protection Criteria were evaluated with respect to only the shallowest overburden wells located adjacent to the Quinnipiac River. Each of these evaluations considered the most recent analytical result for each analyte at each respective sampling location.

The initial step in the groundwater data screening process was to calculate representative background concentrations for the inorganic analytes. For the USEPA screening process, the inorganics data from the following background wells were used to identify a representative range of background concentrations: middle overburden well TW-12, and shallow bedrock wells TW-9, TW-10, MW-129, and MW-209A. These USEPA background wells were identified based on telephone discussions between BBL and USEPA's hydrogeologic consultant, TetraTech NUS. For the CT DEP screening process, the inorganics data from middle overburden well TW-12 were used to identify the representative background concentration. As stated in the RSRs, one background well is to be used to identify background groundwater quality. Inorganic analytes detected below background for CT DEP, or below the high end of the range of USEPA background, respectively, were not considered further in CT DEP or USEPA regulatory screening. In addition, as CT DEP stated in a telephone conversation with BBL on April 25, 2000, the following metals were not considered, as they do not pose health threats: aluminum, calcium, iron, magnesium, potassium, and sodium.

The groundwater data regulatory screening process and results are summarized below.

- **Federal MCL/MCLGs and CT DEP Groundwater Protection Criteria** – The groundwater data screening process was performed in two separate steps to identify two separate lists of analytes exceeding groundwater regulatory criteria. Specifically, the two groups of wells located inside or outside the NTCRA 2 capture zone were evaluated separately. The NTCRA 2 capture zone for either overburden and bedrock groundwater is depicted on FS Figures 2-4 and 2-5, respectively. This process resulted in four summary tables. Table N-6 identifies 31 analytes detected above Federal MCL/MCLGs within the NTCRA 2 capture zone. Table N-7 presents the 69 analytes detected above CT DEP background within the NTCRA 2 capture zone. Table N-8 lists one analyte detected above Federal MCL/MCLGs outside the NTCRA 2 capture zone. Table N-9 shows the 12 analytes detected above CT DEP background outside the NTCRA 2 capture zone. Tables N-6 and N-7 indicate the analytes detected within the NTCRA 2 capture zone. Tables N-8 and N-9 indicate the analytes detected in the remainder of the groundwater plumes, which will be evaluated with respect to groundwater remedial alternatives in the FS. Some of the inorganic analytes listed in Table N-9 ultimately may not need to (or may not be able to) be remedied. Inorganics concentrations in the area outside the NTCRA 2 capture zone will be monitored and evaluated further following the attenuation of the VOCs outside the NTCRA 2 capture zone.

  Figures N-3 through N-7 summarize the status of each groundwater sampling location with respect to Federal MCL/MCLGs and CT DEP Groundwater Protection Criteria (i.e., background), and depict the resulting regulatory plumes in the shallow, middle and deep overburden, and shallow and deep bedrock. In addition to the concentrations of chemicals detected in groundwater samples, groundwater hydraulics and quality data obtained during the RI (groundwater flow directions and concentration gradients) were considered in delineating the regulatory plumes shown on Figures N-3 through N-7. The solid and dashed lines on these maps delineate plumes associated with releases at the former SRSNE Operations Area. Locations with exceedences located outside of these plumes are related to other known sources and/or are distinguished as separate from the SRSNE-related plumes on the basis of groundwater flow directions, changes in chemistry, and/or concentration gradient reversals.

The SRSNE-related plumes generally extend southward into the Town of Southington Well Field Property. The hydraulic influence of the river was characterized in the RI as a zone of hydraulic convergence (groundwater discharge boundary) throughout the monitored thickness of the geologic section within the study area. Thus, the SRSNE-related plumes do not extend south of the bend in the Quinnipiac River near Curtiss Street. However, due to the presence of dense, non-aqueous phase liquids and the eastward dip of the geologic strata at the site, the SRSNE-related plumes are interpreted as extending slightly past the Quinnipiac River in the area due east of the site. In general, the only wells exhibiting SRSNE-Site-related MCL/MCLG or CT DEP Groundwater Protection Criteria exceedences outside of the NTCRA 2 Capture zone are those within the SRSNE plumes in the southern portion of the Town of Southington Well Field Property.

- **CT DEP Volatilization Criteria –** During the initial process of evaluating CT DEP Volatilization Criteria, three non-listed analytes (cis-1,2-dichloroethene; carbon disulfide; and tetrahydrofuran) were detected in areas outside of the former Operations Area. As required by the RSRs, BBL calculated Volatilization Criteria for these three substances using CT DEP's default soil physical parameters, water-table depth, and Target Indoor Air Concentration values suggested in a CT DEP letter dated March 2, 2000. The resulting Volatilization Criteria (with a maximum accepted value of 50,000 ug/L) are summarized in Attachment N-1. The groundwater quality data from wells and piezometers installed to depths of up to 15 feet below ground surface were screened versus the Volatilization Criteria Listed in Attachment N-1, and 10 parameters were identified above the criteria (see Table N-10).

  It should be noted that 1,4-dioxane was also sampled for in April 2004 and was detected outside of the Operations Area. As 1,4-dioxane does not have a CT DEP Target Indoor Air Value, no volatilization criterion was calculated for 1,4-dioxane. However, 1,4-dioxane is miscible in water and has a very low Henry's Law constant (4 orders of magnitude lower than the Henry's Law constant of 1,1,1-TCA, and over 2 orders of magnitude lower than that of TCE). Thus, it is reasonable to expect that the risk of volatilization associated with 1,4-dioxane in groundwater is very low.

  Figure N-8 summarizes the status of the appropriate groundwater sampling locations with respect to the established or calculated Volatilization Criteria. This map shows that the locations exceeding the Volatilization Criteria are within the former SRSNE Operations Area, former Cianci Property, and immediately east of the Quinnipiac River. These locations are or will be subject to deed restrictions precluding the construction of new buildings. In addition, the locations near the Quinnipiac River are within the flood plain of the river and would not be a favorable building location due to risk of flooding. No Volatilization Criteria were exceeded at the well situated closest to the nearest occupied buildings, which are located immediately north of the Operations Area along Lazy Lane (see well MW-126B on Figure N-8).

- **CT DEP Surface-Water Protection Criteria –** During the process of evaluating CT DEP Surface-Water Protection Criteria, no exceedences of listed criteria were identified. However, 11 non-listed analytes were detected at shallow overburden wells located nearest to the Quinnipiac River, as listed on Table N-11. As required by the RSRs, BBL attempted to calculate Surface-Water Protection Criteria for these substances, to the extent that applicable surface-water quality goals could be obtained. The results of this site-specific calculation process are summarized in Table N-11. For five of the six analytes for which surface water quality goals or aquatic toxicity values were available (1,1-dichloroethane, 1,2-dichloroethene, 1,4-dioxane, total xylenes, and isophorone), no exceedences were detected. Carbon disulfide was detected slightly above the alternate surface water protection criterion at shallow drivepoint DP-5 in December 1996, but this compound has not been detected in surface water in the Quinnipiac River during thirteen semiannual surface-water sampling events at IMS locations along the river adjacent to the former Cianci Property. Thus, no substantive exceedences of Surface Water Protection Criteria have been identified. CT DEP has indicated that no further evaluation is required with respect to the remaining analytes listed on Table N-11.

Tables

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

TABLE N-1A

SRSNE
SOUTHINGTON, CT

SUMMARY OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Chemical Class	CAS Registry Number	Chemical Name	Units	Direct Exposure Criteria	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
OV	75-35-4	1,1-Dichloroethene	mg/kg	1	4.2	SC-19	1/1/1985
OV	100-41-4	Ethylbenzene	mg/kg	500	720	SC-6	1/1/1985
OV	127-18-4	Tetrachloroethene	mg/kg	12	1,200	B-479	3/10/1994
OV	79-01-6	Trichloroethene	mg/kg	56	430	SC-9	1/1/1985
OV	75-01-4	Vinyl chloride	mg/kg	0.32	0.4 J	B-484	3/10/1994
OV	1330-20-7	Xylenes, Total	mg/kg	500	1,200 E	B-477	3/4/1994
OSV	56-55-3	Benzo(a)anthracene	mg/kg	1	5.6 D	SB-907	10/19/1999
OSV	50-32-8	Benzo(a)pyrene	mg/kg	1	3.8	SD3-23	12/12/1991
OSV	BBL-BK	Benzo(b&k)fluoranthene	mg/kg	1	4.6 J	SD1-14	5/14/1990
OSV	205-99-2	Benzo(b)fluoranthene	mg/kg	1	5.8	SD3-23	12/12/1991
OSV	117-81-7	bis(2-Ethylhexyl)phthalate	mg/kg	44	900	SD1-04	5/16/1990
OSV	193-39-5	Indeno(1,2,3-cd)pyrene	mg/kg	1	2.3 J	SD3-23	12/12/1991
OPCB	11097-69-1	Aroclor-1254	mg/kg	1	16 J	SD3-25	12/19/1991
OPCB	11096-82-5	Aroclor-1260	mg/kg	1	7.5 J	SD3-25	12/19/1991
OPCB	1336-36-3	PCBs, Total	mg/kg	1	42	SD1-04	5/16/1990
I	7440-36-0	Antimony	mg/kg	27	27.3	SD3-25	12/12/1991
I	7440-38-2	Arsenic	mg/kg	10	73.2	SD3-25	12/12/1991
I	7440-41-7	Beryllium	mg/kg	2	2.2	SD3-36	12/11/1991
I	7440-43-9	Cadmium	mg/kg	34	817	SD3-25	12/12/1991
I	7440-47-3	Chromium	mg/kg	100	1,940	SD3-25	12/12/1991
I	7439-92-1	Lead	mg/kg	500	3,910 J	SD3-25	12/12/1991
I	7439-96-5	Manganese*	mg/kg	1,400	4,360 J	SD1-04	5/16/1990

Notes:

1) These data based on samples less than or equal to four feet deep.
2) D - Concentration is based on a diluted sample analysis.
3) E - The compound was quantitated above the calibration range.
4) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
* Residential Direct Exposure criterion for manganese not listed in Remediation Standard Regulations, but calculated (see Table M-2).

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**CIANCI PROPERTY**								
Location ID:	**Direct**	**B-10**	**MW-123C**	**MW-123C**	**SB-701**	**SB-702**	**SB-702**	**SB-702**	**SB-702**	**SB-703**
Depth Interval:	**Exposure**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(2.0 - 4.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(2.0 - 4.0')**	**(2.0 - 4.0')**
Date Sampled:	**Criteria**	**4/5/1991**	**4/12/1991**	**4/12/1991**	**8/27/1996**	**8/27/1996**	**8/27/1996**	**8/27/1996**	**8/27/1996**	**8/28/1996**
Sample Type:	**(mg/kg)**	**S**	**S**	**D**	**S**	**S**	**D**	**S**	**D**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.006 U	0.006 U	0.006 U	0.011 U	--	--	0.012 U	0.011 U	0.012 U
Ethylbenzene	**500**	0.006 U	**0.013**	0.006 U	**0.34 D**	--	--	**0.83 D**	**2.9 D**	**0.007 J**
Tetrachloroethene	**12**	0.006 U	0.006 U	0.006 U	0.011 U	--	--	0.012 U	0.011 U	0.012 U
Trichloroethene	**56**	0.006 U	0.006 U	0.006 U	0.011 U	--	--	0.012 U	0.011 U	0.012 U
Vinyl chloride	**0.32**	0.011 U	0.011 U	0.011 U	0.011 U	--	--	0.012 U	0.011 U	0.012 U
Xylenes, Total	**500**	0.006 U	0.009 U	0.006 U	**0.032**	--	--	**0.099 D**	**0.11**	**0.037**
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	0.73 U	0.37 U	0.73 U	--	--	--	--	--	--
Benzo(a)pyrene	**1**	0.73 U	0.37 U	0.73 U	--	--	--	--	--	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	0.73 U	0.37 U	0.73 U	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	**44**	0.73 U	0.37 U	0.73 U	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	**1**	0.73 U	0.37 U	0.73 U	--	--	--	--	--	--
PCBs (mg/kg)										
Aroclor-1254	**1**	0.36 U	0.36 U	0.36 U	--	--	--	--	--	--
Aroclor-1260	**1**	0.36 U	0.36 U	0.36 U	--	--	--	--	--	--
PCBs, Total	**1**	ND	ND	ND	--	--	--	--	--	--
Inorganics (mg/kg)										
Antimony	**27**	12 UJ	12 UJ	12 UJ	--	--	--	--	--	--
Arsenic	**10**	**1**	**0.71 J**	**0.96**	--	--	--	--	--	--
Beryllium	**2**	**0.44 J**	**0.32 J**	**0.32 J**	--	--	--	--	--	--
Cadmium	**34**	1 U	1 U	1 U	--	--	--	--	--	--
Chromium	**100**	**18.1**	**6.5**	**6.4**	--	--	--	--	--	--
Lead	**500**	5.5 UJ	2.4 UJ	3 UJ	--	--	--	--	--	--
Manganese	**1400**	**412 J**	**91.7 J**	**88.7 J**	--	--	--	--	--	--

See Notes, Page 21.

See Notes on Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential Direct Exposure Criteria (mg/kg)**	**CIANCI PROPERTY**								
Location ID:		**SB-901**	**SB-901**	**SB-902**	**SB-902**	**SB-903**	**SB-903**	**SB-904**	**SB-905**	**SB-905**
Depth Interval:		**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 1.5')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**
Date Sampled:		**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**
Sample Type:		**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.0054 U	0.0053 U	0.0073 U	0.0064 U	0.0073 U	0.0057 U	0.0053 U	0.0056 U	0.005 U
Ethylbenzene	**500**	**0.014**	0.0053 U	0.006 U	0.0064 U	0.0073 U	0.0057 U	0.0053 U	0.0056 U	0.005 U
Tetrachloroethene	**12**	0.0054 U	0.0053 U	0.0073 U	**0.0015 J**	0.0073 U	0.0057 U	**0.0014 J**	0.0056 U	0.005 U
Trichloroethene	**56**	0.0054 U	0.0053 U	0.006 U	**0.0019 J**	0.0073 U	0.0057 U	**0.002 J**	0.0056 U	0.005 U
Vinyl chloride	**0.32**	**0.0011 J**	0.0053 U	0.0073 U	0.0064 U	0.0073 U	0.0057 U	0.0053 U	0.0056 U	0.005 U
Xylenes, Total	**500**	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	0.37 U	0.38 U	0.41 U	**0.22 J**	**0.066 J**	**0.088 J**	0.38 U	0.37 U	0.37 U
Benzo(a)pyrene	**1**	0.37 U	0.38 U	0.41 U	**0.26 J**	**0.077 J**	**0.12 J**	0.38 U	0.37 U	0.37 U
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	0.37 U	0.38 U	0.41 U	**0.4**	**0.099 J**	**0.18 J**	0.38 U	0.37 U	0.37 U
bis(2-Ethylhexyl)phthalate	**44**	**0.073 JB**	**0.058 JB**	0.41 U	**0.13 JB**	0.41 U	**0.19 J**	**0.07 JB**	0.37 U	0.37 U
Indeno(1,2,3-cd)pyrene	**1**	0.37 U	0.38 U	0.41 U	**0.16 J**	0.41 U	**0.076 J**	0.38 U	0.37 U	0.37 U
PCBs (mg/kg)										
Aroclor-1254	**1**	0.018 U	0.018 U	0.021 U	**0.2**	**0.053**	**0.056**	0.019 U	0.018 U	0.018 U
Aroclor-1260	**1**	0.018 U	0.018 U	0.021 U	**0.22**	**0.026**	0.019 U	0.019 U	0.018 U	0.018 U
PCBs, Total	**1**	ND	ND	ND	**0.42**	**0.079**	**0.056**	ND	ND	ND
Inorganics (mg/kg)										
Antimony	**27**	0.45 UN	0.45 UN	0.54 UN	0.48 UN	0.51 UN	0.47 UN	0.44 UN	0.45 UN	0.44 UN
Arsenic	**10**	**1.3**	**1.2**	**2.1**	**1.8**	**2.6**	**2.8**	**1.1**	**1.2**	**0.62 B**
Beryllium	**2**	**0.31 B**	**0.26 B**	**0.44 B**	**0.42 B**	**0.49 B**	**0.59 B**	**0.4 B**	**0.25 B**	0.22 U
Cadmium	**34**	**0.23 B**	0.11 U	0.13 U	**1**	**0.25 B**	0.12 U	0.11 U	0.11 U	0.11 U
Chromium	**100**	**7.4**	**4.6**	**5.9**	**10**	**13**	**14.6**	**10.6**	**5.6**	**4.8**
Lead	**500**	**7.8**	**2.1**	**9.4 *N**	**17.7**	**16.9 *N**	**16.5 *N**	**14.6**	**7.6 *N**	**2.1 *N**
Manganese	**1400**	**81.4**	**59.8**	**266 *N**	**296**	**299 *N**	**539 *N**	**245**	**81.2 *N**	**83 *N**

See Notes, Page 21.

See Notes on Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential Direct Exposure Criteria (mg/kg)**	**CIANCI PROPERTY**								
Location ID:		**SB-906**	**SB-907**	**SB-907**	**SB-908**	**SB-909**	**SB-909**	**SB-910**	**SB-911**	**SB-911**
Depth Interval:		**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**
Date Sampled:		**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**
Sample Type:		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.0053 U	0.0054 U	0.0059 U	0.005 U	0.0048 U	0.0062 U	0.0058 U	0.0061 U	0.0056 U
Ethylbenzene	**500**	0.0053 U	**0.0023 J**	**13**	**0.0038 J**	0.0048 U	**1.4**	0.0058 U	0.0061 U	0.0056 U
Tetrachloroethene	**12**	0.0053 U	**0.0011 J**	0.0059 U	0.005 U	0.0048 U	0.0062 U	0.0058 U	0.0061 U	0.0056 U
Trichloroethene	**56**	**0.0012 J**	**0.0027 J**	0.0059 U	0.005 U	0.0048 U	0.0062 U	0.0058 U	0.0061 U	0.0056 U
Vinyl chloride	**0.32**	0.0053 U	0.0054 U	0.0059 U	0.005 U	0.0048 U	**0.0024 J**	0.0058 U	0.0061 U	0.0056 U
Xylenes, Total	**500**	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	0.37 U	**0.16 J**	**5.6 D**	0.36 U	0.35 U	0.44 U	0.39 U	0.44 U	0.44 U
Benzo(a)pyrene	**1**	**0.038 J**	**0.18 J**	**3.1**	0.36 U	0.35 U	0.44 U	0.39 U	0.44 U	0.44 U
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	**0.054 J**	**0.22 J**	**5.1 D**	0.36 U	0.35 U	0.44 U	0.39 U	0.44 U	0.44 U
bis(2-Ethylhexyl)phthalate	**44**	**0.073 JB**	**0.83 B**	0.4 U	**0.064 JB**	0.35 U	0.44 U	0.39 U	0.44 U	0.44 U
Indeno(1,2,3-cd)pyrene	**1**	0.37 U	**0.14 J**	**1.9**	0.36 U	0.35 U	0.44 U	0.39 U	0.44 U	0.44 U
PCBs (mg/kg)										
Aroclor-1254	**1**	0.018 U	**0.05**	0.02 U	0.018 U	0.018 U	0.022 U	0.02 U	0.022 U	0.021 U
Aroclor-1260	**1**	0.018 U	**0.051**	0.02 U	0.018 U	0.018 U	0.022 U	0.02 U	0.022 U	0.021 U
PCBs, Total	**1**	ND	**0.101**	ND	ND	ND	ND	ND	ND	ND
Inorganics (mg/kg)										
Antimony	**27**	0.44 UN	0.49 UN	0.48 UN	0.45 UN	0.44 UN	0.54 UN	0.49 UN	0.55 UN	0.53 UN
Arsenic	**10**	**1.6**	**2**	**1.2 B**	**2.8**	**2.1**	**2**	**0.82 B**	**1.7**	**2.3**
Beryllium	**2**	**0.51 B**	**0.58 B**	**0.35 B**	**0.39 B**	**0.64**	**0.53 B**	**0.45 B**	**0.54 B**	**0.65 B**
Cadmium	**34**	0.11 U	**1.6**	0.12 U	0.11 U	0.11 U	0.14 U	0.12 U	0.14 U	0.13 U
Chromium	**100**	**11**	**14.2**	**9.6**	**7.6**	**12.7**	**10**	**9.9**	**11**	**12.1**
Lead	**500**	**8.2**	**27.9**	**14.2**	**5.4**	**9.2 *N**	**9.3 *N**	**4.9 *N**	**8.8 *N**	**13.9 *N**
Manganese	**1400**	**293**	**498**	**265**	**368**	**550 *N**	**219 *N**	**462 *N**	**286 *N**	**349 *N**

See Notes, Page 21.

See Notes on Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	Residential	CIANCI PROPERTY								
Location ID:	Direct	SB-912	SB-913	SB-913	SB-914	SB-916	SB-917	SB-918	SB-918	SB-919
Depth Interval:	Exposure	(0.0 - 2.0')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 2.0')	(0.0 - 2.0')	(0.0 - 1.7')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 1.5')
Date Sampled:	Criteria	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/19/1999	10/18/1999	10/18/1999	10/18/1999	10/18/1999
Sample Type:	(mg/kg)	S	S	S	S	S	S	S	S	D
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.0059 U	0.0053 U	0.0049 U	0.0062 U	0.0053 U	0.0047 U	0.0051 U	0.0053 U	0.0048 U
Ethylbenzene	**500**	0.0059 U	0.0053 U	0.0049 U	0.0062 U	0.0053 U	0.0047 U	0.0051 U	0.0053 U	0.0048 U
Tetrachloroethene	**12**	0.0059 U	0.0053 U	0.0049 U	0.0062 U	0.0053 U	0.0047 U	0.0051 U	0.0053 U	0.0048 U
Trichloroethene	**56**	0.0059 U	0.0053 U	0.0049 U	0.0062 U	0.0053 U	0.0047 U	0.0051 U	0.0053 U	0.0048 U
Vinyl chloride	**0.32**	0.0059 U	0.0053 U	0.0049 U	0.0062 U	0.0053 U	0.0047 U	0.0051 U	0.0053 U	0.0048 U
Xylenes, Total	**500**	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	0.41 U	0.4 U	0.39 U	**0.24 J**	0.37 U	0.37 U	0.37 U	0.37 U	**0.039 J**
Benzo(a)pyrene	**1**	0.41 U	0.4 U	0.39 U	**0.23 J**	0.37 U	0.37 U	0.37 U	0.37 U	**0.065 J**
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	0.41 U	0.4 U	0.39 U	**0.4 J**	0.37 U	0.37 U	0.37 U	0.37 U	**0.066 J**
bis(2-Ethylhexyl)phthalate	**44**	0.41 U	**0.055 JB**	**0.067 JB**	0.45 U	**0.061 JB**	**0.12 JB**	**0.19 JB**	**0.11 JB**	**0.17 JB**
Indeno(1,2,3-cd)pyrene	**1**	0.41 U	0.4 U	0.39 U	**0.16 J**	0.37 U	0.37 U	0.37 U	0.37 U	0.36 U
PCBs (mg/kg)										
Aroclor-1254	**1**	0.021 U	0.02 U	0.02 U	**0.032**	0.018 U	0.018 U	0.019 U	0.019 U	0.018 U
Aroclor-1260	**1**	0.021 U	0.02 U	0.02 U	**0.034**	0.018 U	0.018 U	0.019 U	0.019 U	0.018 U
PCBs, Total	**1**	ND	ND	ND	**0.066**	ND	ND	ND	ND	ND
Inorganics (mg/kg)										
Antimony	**27**	0.52 UN	0.49 UN	0.48 UN	0.57 UN	0.45 UN	0.45 UN	0.45 UN	0.45 UN	0.44 UN
Arsenic	**10**	**1.3 B**	**1.8**	**2.3**	**3.1**	**0.46 B**	**0.98 B**	**1.2**	**0.88 B**	**1.4**
Beryllium	**2**	**0.39 B**	**0.57 B**	**0.72**	**0.67 B**	**0.29 B**	**0.23 B**	**0.25 B**	0.22 U	**0.36 B**
Cadmium	**34**	0.13 U	0.12 U	0.12 U	**2.8**	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U
Chromium	**100**	**12.3**	**14.6**	**17.6**	**21.7**	**7.8**	**5.6**	**6.8**	**4.4**	**9.6**
Lead	**500**	**5.2 *N**	**6.9**	**7.6**	**55 *N**	**3.1**	**3.9 N**	**4 N**	**3.2 N**	**9.3 N**
Manganese	**1400**	**233 *N**	**293**	**230**	**411 *N**	**110**	**71.1 N**	**65 N**	**151 N**	**213 N**

See Notes, Page 21.

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TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**CIANCI PROPERTY**								
Location ID:	**Direct**	**SB-919**	**SB-920**	**SB-920**	**SB-921**	**SB-922**	**SB-922**	**SB-923**	**SB-924**	**SB-924**
Depth Interval:	**Exposure**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**
Date Sampled:	**Criteria**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U	0.0052 U	0.0055 U	0.0055 U
Ethylbenzene	**500**	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U	0.0052 U	0.0055 U	0.0055 U
Tetrachloroethene	**12**	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U	0.0052 U	0.0055 U	0.0055 U
Trichloroethene	**56**	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U	0.0052 U	0.0055 U	0.0055 U
Vinyl chloride	**0.32**	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U	0.0052 U	0.0055 U	0.0055 U
Xylenes, Total	**500**	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	0.36 U	0.37 U	0.36 U	**0.22 J**	**0.048 J**	0.39 U	**0.043 J**	0.37 U	0.36 U
Benzo(a)pyrene	**1**	0.36 U	0.37 U	0.36 U	**0.26 J**	0.38 U	0.39 U	0.38 U	0.37 U	0.36 U
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	0.36 U	0.37 U	0.36 U	**0.25 J**	**0.068 J**	0.39 U	**0.055 J**	0.37 U	0.36 U
bis(2-Ethylhexyl)phthalate	**44**	**0.14 JB**	**0.13 JB**	**0.12 JB**	**0.16 JB**	**0.16 JB**	**0.13 JB**	**0.18 JB**	0.37 U	**0.12 JB**
Indeno(1,2,3-cd)pyrene	**1**	0.36 U	0.37 U	0.36 U	**0.15 J**	0.38 U	0.39 U	0.38 U	0.37 U	0.36 U
PCBs (mg/kg)										
Aroclor-1254	**1**	0.018 U	0.018 U	0.018 U	**0.12**	0.019 U	0.02 U	0.019 U	0.018 U	0.018 U
Aroclor-1260	**1**	0.018 U	0.018 U	0.018 U	**0.092**	0.019 U	0.02 U	0.019 U	0.018 U	0.018 U
PCBs, Total	**1**	ND	ND	ND	**0.212**	ND	ND	ND	ND	ND
Inorganics (mg/kg)										
Antimony	**27**	0.44 UN	0.44 UN	0.45 UN	0.44 UN	0.46 UN	0.48 UN	0.46 UN	0.44 UN	0.43 UN
Arsenic	**10**	**1.5**	**1.4**	**1.8**	**2.4**	**2**	**3.3**	**1.6**	**1.5**	**2**
Beryllium	**2**	**0.34 B**	**0.33 B**	**0.34 B**	**0.42 B**	**0.46 B**	**0.76**	**0.42 B**	**0.35 B**	**0.34 B**
Cadmium	**34**	0.11 U	0.11 U	0.11 U	0.11 U	0.11 U	0.12 U	0.11 U	0.11 U	0.11 U
Chromium	**100**	**9.4**	**9.9**	**8.6**	**9.8**	**12.9**	**22.3**	**12**	**9.4**	**7.8**
Lead	**500**	**7.6 N**	**5.6 N**	**5.2 N**	**8.7 N**	**15.3 N**	**10.9 N**	**9.7 N**	**9.2 N**	**8.8 N**
Manganese	**1400**	**149 N**	**211 N**	**174 N**	**294 N**	**259 N**	**906 N**	**256 N**	**173 N**	**147 N**

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TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**CIANCI PROPERTY**								
Location ID:	**Direct**	**SB-925**	**SB-926**	**SB-926**	**SB-927**	**SB-928**	**SB-928**	**SD-04**	**SD-04**	**SD-05**
Depth Interval:	**Exposure**	**(0.0 - 2.0')**	**(0.0 - 1.4')**	**(1.4 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0-0.5)**	**(0.5-2.0)**	**(0-0.5)**
Date Sampled:	**Criteria**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/29/1999**	**10/29/1999**	**10/29/1999**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.005 U	0.0058 U	0.0065 U	0.0054 U	0.0051 U	0.0053 U	--	--	--
Ethylbenzene	**500**	0.005 U	0.0058 U	0.0065 U	0.0054 U	0.0051 U	0.0053 U	--	--	--
Tetrachloroethene	**12**	0.005 U	0.0058 U	0.0065 U	0.0054 U	0.0051 U	0.0053 U	--	--	--
Trichloroethene	**56**	0.005 U	0.0058 U	0.0065 U	**0.0023 J**	0.0051 U	0.0053 U	--	--	--
Vinyl chloride	**0.32**	0.005 U	0.0058 U	0.0065 U	0.0054 U	0.0051 U	0.0053 U	--	--	--
Xylenes, Total	**500**	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	0.37 U	**0.096 J**	0.42 U	0.38 U	**0.065 J**	0.37 U	**1**	**1.5**	**1.8**
Benzo(a)pyrene	**1**	0.37 U	**0.13 J**	0.42 U	0.38 U	**0.073 J**	0.37 U	**0.96**	**1.8**	**1.7**
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	0.37 U	**0.11 J**	0.42 U	0.38 U	**0.085 J**	0.37 U	**1.2**	**2.5**	**2.2**
bis(2-Ethylhexyl)phthalate	**44**	**0.13 JB**	**0.23 JB**	0.42 U	**0.14 JB**	**0.15 JB**	**0.13 JB**	**0.49**	**1**	**0.53 J**
Indeno(1,2,3-cd)pyrene	**1**	0.37 U	**0.063 J**	0.42 U	0.38 U	**0.046 J**	0.37 U	**0.62**	**1.2**	**1**
PCBs (mg/kg)										
Aroclor-1254	**1**	**0.051**	0.021 U	0.02 U	**0.09**	0.019 U	0.019 U	**0.041**	**0.11**	**0.039**
Aroclor-1260	**1**	**0.041**	0.021 U	0.02 U	**0.11**	0.019 U	0.019 U	0.02 U	0.032 U	0.026 U
PCBs, Total	**1**	**0.092**	ND	ND	**0.2**	ND	ND	--	--	--
Inorganics (mg/kg)										
Antimony	**27**	0.45 UN	0.5 UN	0.5 UN	0.45 UN	0.47 UN	0.46 UN	6 UN	6 UN	6 UN
Arsenic	**10**	**1.4**	**0.94 B**	**1.2 B**	**2.7**	**3.3**	**1.4**	**0.95 B**	**3.1**	**1.5 B**
Beryllium	**2**	**0.3 B**	**0.35 B**	**0.37 B**	**0.48 B**	**0.38 B**	**0.63**	0.5 U	**0.51 B**	0.5 U
Cadmium	**34**	0.11 U	**0.48 B**	0.12 U	**0.96**	0.12 U	0.12 U	**0.94**	**19.4**	**8.5**
Chromium	**100**	**7.6**	**14.4**	**9.8**	**11.3**	**9**	**22.3**	**11.9 E**	**86.4 E**	**25.5 E**
Lead	**500**	**5.6 N**	**9.9 N**	**5.7 N**	**12.8 N**	**15.8 N**	**9.9 N**	**48.4 N**	**126 N**	**35.3 N**
Manganese	**1400**	**169 N**	**202 N**	**334 N**	**698 N**	**136 N**	**224 N**	**67.6 N**	**179 N**	**136 N**

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TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**CIANCI PROPERTY**								
Location ID:	**Direct**	**SD-05**	**SD-06**	**SD-06**	**SD-06**	**SD-07**	**SD-07**	**SD-07**	**SD-08**	**SD-08**
Depth Interval:	**Exposure**	**(0.5-2.0)**	**(0-0.5)**	**(0.5-2.0)**	**(2.0-4.0)**	**(0-0.5)**	**(0.5-2.0)**	**(0.5-2.0)**	**(0-0.5)**	**(0.5-2.3)**
Date Sampled:	**Criteria**	**10/29/1999**	**10/29/1999**	**10/29/1999**	**10/29/1999**	**10/29/1999**	**10/29/1999**	**10/29/1999**	**10/29/1999**	**10/29/1999**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	--	--	--	--	--	--	--	--	--
Ethylbenzene	**500**	--	--	--	--	--	--	--	--	--
Tetrachloroethene	**12**	--	--	--	--	--	--	--	--	--
Trichloroethene	**56**	--	--	--	--	--	--	--	--	--
Vinyl chloride	**0.32**	--	--	--	--	--	--	--	--	--
Xylenes, Total	**500**	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	**0.54**	**1.4**	**0.32 J**	**0.046 J**	**0.66**	**0.12 J**	**0.35 J**	**0.063 J**	**0.6**
Benzo(a)pyrene	**1**	**0.6**	**1.5**	**0.31 J**	**0.048 J**	**0.72**	**0.16 J**	**0.26 J**	**0.073 J**	**0.58**
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	**0.84**	**2.2**	**0.42**	**0.069 J**	**1.2**	**0.21 J**	**0.37 J**	**0.12 J**	**0.82**
bis(2-Ethylhexyl)phthalate	**44**	**0.15 J**	**0.51 J**	0.41 U	**0.059 J**	**0.21 J**	**0.083 J**	**0.34 JB**	**0.06 J**	**0.26 J**
Indeno(1,2,3-cd)pyrene	**1**	**0.37 J**	**0.96**	**0.12 J**	0.4 U	**0.46**	**0.081 J**	**0.13 J**	0.41 U	**0.26 J**
PCBs (mg/kg)										
Aroclor-1254	**1**	**0.023**	**0.062**	0.021 U	0.02 U	**0.021**	0.02 U	0.021 U	0.02 U	0.022 U
Aroclor-1260	**1**	0.02 U	0.03 U	0.021 U	0.02 U	0.021 U	0.02 U	0.021 U	0.02 U	0.022 U
PCBs, Total	**1**	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)										
Antimony	**27**	6 UN	6 UN	6 UN	6 UN	**0.83 BN**	6 UN	6 U	6 UN	6 UN
Arsenic	**10**	**0.97 B**	**1.4 B**	**1 B**	**1.3**	**0.64 B**	**1.3**	**1.5**	**0.96 B**	**4.4**
Beryllium	**2**	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Cadmium	**34**	**7.7**	**7.9**	**1**	**0.14 B**	**2.4**	**3.8**	**4.1 ***	**2.7**	**2.6**
Chromium	**100**	**22.6 E**	**41.8 E**	**18.2 E**	**8.6 E**	**9.3 E**	**19.8 E**	**22 E*N**	**14.1 E**	**9.7 E**
Lead	**500**	**14 N**	**40 N**	**7.8 N**	**3 N**	**12.1 N**	**12 N**	**14 *N**	**15.4 N**	**6.4 N**
Manganese	**1400**	**36.2 N**	**83.4 N**	**90.7 N**	**67.7 N**	**42.5 N**	**83.4 N**	**83.5 *N**	**70.8 N**	**43.7 N**

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TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential Direct Exposure Criteria (mg/kg)**	**CIANCI PROPERTY**								
Location ID:		**SD1-08**	**SD1-08**	**SD1-08**	**SD1-08**	**SD1-10**	**SD1-16**	**SD3-26**	**SD3-26**	**SD3-26**
Depth Interval:		**(0.0 - 0.5')**	**(0.5 - 1.0')**	**(1.0 - 1.5')**	**(1.0 - 1.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**
Date Sampled:		**5/15/1990**	**5/15/1990**	**5/15/1990**	**5/16/1990**	**5/15/1990**	**5/16/1990**	**12/10/1991**	**12/10/1991**	**12/18/1991**
Sample Type:		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.01 U	0.012 U	--	0.024 U	0.008 U	0.006 U	0.012 U	0.012 U	--
Ethylbenzene	**500**	0.01 U	0.012 U	--	0.024 U	0.008 U	0.006 U	0.012 U	0.012 U	--
Tetrachloroethene	**12**	0.01 U	0.012 U	--	0.024 U	0.008 U	0.006 U	0.012 U	0.012 U	--
Trichloroethene	**56**	0.01 U	0.012 U	--	0.024 U	0.008 U	0.006 U	0.012 U	0.012 U	--
Vinyl chloride	**0.32**	0.02 U	0.024 U	--	0.048 U	0.016 U	0.013 U	0.012 U	0.012 U	--
Xylenes, Total	**500**	0.01 U	0.012 U	--	0.024 U	0.008 U	0.006 U	0.012 U	0.012 U	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	**1.3**	**1.2**	--	**0.95**	**1**	0.42 U	0.41 U	0.4 U	--
Benzo(a)pyrene	**1**	**1.1**	**1.2**	--	**0.87**	**0.3 J**	0.42 U	0.41 U	0.4 U	--
Benzo(b&k)fluoranthene *	**1**	**2.4 J**	**2.7 J**	--	**2 J**	**0.59 J**	0.42 U	--	--	--
Benzo(b)fluoranthene	**1**	--	--	--	--	--	--	0.41 U	0.4 U	--
bis(2-Ethylhexyl)phthalate	**44**	**0.75**	**0.6 J**	--	**0.32 J**	**0.19 J**	**0.088 J**	0.41 UJ	0.4 U	--
Indeno(1,2,3-cd)pyrene	**1**	**0.58 J**	**0.6 J**	--	**0.44 J**	**0.16 J**	0.42 U	0.41 U	0.4 U	--
PCBs (mg/kg)										
Aroclor-1254	**1**	0.32 U	0.38 U	0.31 U	--	0.26 U	0.2 U	--	--	0.041 UJ
Aroclor-1260	**1**	0.32 U	0.38 U	0.31 U	--	0.26 U	0.2 U	--	--	0.041 UJ
PCBs, Total	**1**	ND	ND	ND	--	ND	ND	--	--	ND
Inorganics (mg/kg)										
Antimony	**27**	16.7 U	12 UJ	--	12 UJ	12 UJ	7.8 U	10.6 UJ	11.4 UJ	--
Arsenic	**10**	**0.95**	**1.4**	--	**0.92**	2 U	**0.73**	**1.4 J**	**1.4 J**	--
Beryllium	**2**	0.84 U	1.3 U	--	0.81 U	0.53 U	0.61 U	0.22 UJ	0.24 UJ	--
Cadmium	**34**	**12 J**	**43.6 J**	--	**22.1 J**	**2.4 J**	1.8 U	0.67 U	0.73 U	--
Chromium	**100**	**58.7 J**	**125 J**	--	**68.1 J**	12.7 U	5.5 U	**14.4**	**16.9**	--
Lead	**500**	**77.6 J**	**161 J**	--	**71.8 J**	**14.9 J**	7.5 U	**5.3 J**	**7.2 J**	--
Manganese	**1400**	**476 J**	**205 J**	--	**320 J**	**138 J**	**81.5 J**	**570 J**	**579 J**	--

See Notes, Page 21.

See Notes on Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**CIANCI PROPERTY**								
Location ID:	**Direct**	**SD3-26**	**SD3-26**	**SD3-26**	**SD3-26**	**SD3-26**	**SD3-41**	**SD3-41**	**SD3-41**	**SD3-50**
Depth Interval:	**Exposure**	**(0.0 - 0.5')**	**(0.5 - 1.0')**	**(0.5 - 1.0')**	**(1.0 - 1.5')**	**(1.0 - 1.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.25)**
Date Sampled:	**Criteria**	**12/18/1991**	**12/10/1991**	**12/18/1991**	**12/10/1991**	**12/18/1991**	**12/16/1991**	**12/17/1991**	**12/22/1991**	**9/9/1993**
Sample Type:	**(mg/kg)**	**D**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	--	0.013 U	--	0.012 U	--	--	0.015 U	--	0.014 U
Ethylbenzene	**500**	--	0.013 U	--	0.012 U	--	--	0.015 U	--	0.014 U
Tetrachloroethene	**12**	--	0.013 U	--	0.012 U	--	--	0.015 U	--	0.014 U
Trichloroethene	**56**	--	0.013 U	--	0.012 U	--	--	0.015 U	--	0.014 U
Vinyl chloride	**0.32**	--	0.013 U	--	0.012 U	--	--	0.015 U	--	0.014 U
Xylenes, Total	**500**	--	0.013 U	--	0.012 U	--	--	0.015 U	--	0.014 U
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	--	0.42 U	--	0.4 UJ	--	--	**0.09 J**	--	**0.72**
Benzo(a)pyrene	**1**	--	0.42 U	--	0.4 UJ	--	--	**0.098 J**	--	**0.67 J**
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	--	0.42 U	--	0.4 UJ	--	--	**0.34 J**	--	**0.72 J**
bis(2-Ethylhexyl)phthalate	**44**	--	0.42 U	--	0.4 UJ	--	--	0.82 UJ	--	**0.34**
Indeno(1,2,3-cd)pyrene	**1**	--	0.42 U	--	0.4 UJ	--	--	**0.064 J**	--	**0.25 J**
PCBs (mg/kg)										
Aroclor-1254	**1**	0.04 UJ	--	0.042 UJ	--	0.039 UJ	--	--	0.049 UJ	**0.035 J**
Aroclor-1260	**1**	0.04 UJ	--	0.042 UJ	--	0.039 UJ	--	--	**0.03 J**	0.045 UJ
PCBs, Total	**1**	ND	--	ND	--	ND	--	--	**0.03**	**0.035 J**
Inorganics (mg/kg)										
Antimony	**27**	--	11.4 UJ	--	10.3 UJ	--	2.6 UJ	--	--	5 UJ
Arsenic	**10**	--	**1.3 J**	--	**1.1 J**	--	5.9 U	--	--	**1.1 J**
Beryllium	**2**	--	0.24 UJ	--	0.22 UJ	--	0.33 U	--	--	0.26 U
Cadmium	**34**	--	0.73 U	--	0.66 U	--	**19.6**	--	--	**2.4**
Chromium	**100**	--	**18.6**	--	**15.3**	--	**15.2**	--	--	**12.8**
Lead	**500**	--	**7 J**	--	**6.4 J**	--	**109 J**	--	--	**15.1 J**
Manganese	**1400**	--	**403 J**	--	**306 J**	--	**106**	--	--	**173 J**

See Notes, Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential Direct Exposure Criteria (mg/kg)**	**CIANCI PROPERTY**								
Location ID:		**SD3-50**	**SD3-51**	**SS3-A1**	**SS3-A2**	**SS3-A2**	**SS3-A3**	**SS3-A4**	**SS3-A5**	**SS3-B1**
Depth Interval:		**(0.25)**	**(0.25)**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**
Date Sampled:		**9/9/1993**	**9/9/1993**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**
Sample Type:		**D**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.014 U	0.023 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.014 U
Ethylbenzene	**500**	0.014 U	0.023 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.014 U
Tetrachloroethene	**12**	0.014 U	0.023 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.014 U
Trichloroethene	**56**	0.014 U	0.023 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.014 U
Vinyl chloride	**0.32**	0.014 U	0.023 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.014 U
Xylenes, Total	**500**	0.014 U	0.023 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.011 U	0.014 U
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	**0.76 J**	**1 J**	0.34 U	0.38 U	--	0.37 U	0.38 U	0.37 UJ	0.11 U
Benzo(a)pyrene	**1**	**0.67 J**	**1.3 J**	0.34 U	0.38 U	--	0.37 U	0.38 UJ	0.37 UJ	**0.077 J**
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	**0.74 J**	**1.8 J**	**0.058 J**	0.38 U	--	0.37 U	**0.14 J**	0.37 UJ	**0.37 J**
bis(2-Ethylhexyl)phthalate	**44**	0.43 UJ	**1.3 J**	0.34 U	0.38 U	--	0.37 U	0.38 U	0.37 UJ	0.46 U
Indeno(1,2,3-cd)pyrene	**1**	**0.26 J**	**0.66 J**	0.34 U	0.38 U	--	0.37 U	0.38 UJ	0.37 UJ	**0.088 J**
PCBs (mg/kg)										
Aroclor-1254	**1**	0.043 UJ	**0.17 J**	**0.029 J**	**0.039 J**	**0.087 J**	0.038 UJ	0.038 UJ	0.038 UJ	**0.19 J**
Aroclor-1260	**1**	0.043 UJ	0.067 UJ	0.035 UJ	**0.0065 J**	**0.024 J**	0.038 UJ	**0.014 J**	0.038 UJ	0.046 U
PCBs, Total	**1**	ND	**0.17 J**	**0.029**	**0.0455**	**0.111**	ND	**0.014**	ND	**0.19**
Inorganics (mg/kg)										
Antimony	**27**	5.3 UJ	7.8 UJ	R	R	R	R	R	R	R
Arsenic	**10**	**1.2 J**	**2.5 J**	**3.6**	**2.3**	**2.5**	**3.6**	**3**	**2.2**	**1.4**
Beryllium	**2**	0.28 U	**0.5 J**	0.21 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.22 UJ	0.23 UJ	0.3 UJ
Cadmium	**34**	**3.1**	**26.1**	0.63 UJ	**1.5**	1 U	0.67 UJ	0.66 UJ	0.68 UJ	**11.7**
Chromium	**100**	**15.2**	**92.4**	7.7 U	**11.1**	**12.7**	**10**	**10.9**	8.1 U	**55.5**
Lead	**500**	**17.6 J**	**93.7 J**	**24.5 J**	**25.6 J**	**15.8 J**	**10.8 J**	**8.2 J**	**7 J**	**82.6 J**
Manganese	**1400**	**204 J**	**660 J**	**296 J**	**318 J**	**592 J**	**323 J**	**298 J**	**513 J**	**327 J**

See Notes, Page 21.

See Notes on Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	Residential	CIANCI PROPERTY		CULVERT OUTFALL						
Location ID:	Direct	SS3-B2	SS3-B4	SB-915	SB-915	SD1-05	SD1-05	SD1-09	SD3-34	SD3-34
Depth Interval:	Exposure	(0.0 - 0.5')	(0.0 - 0.5')	(0.0 - 2.0')	(2.0 - 4.0')	(0.0 - 0.5')	(0.0 - 0.5')	(0.0 - 0.5')	(0.0 - 0.5')	(0.0 - 0.5')
Date Sampled:	Criteria	12/9/1991	12/9/1991	10/19/1999	10/19/1999	5/15/1990	5/15/1990	5/15/1990	12/11/1991	12/18/1991
Sample Type:	(mg/kg)	S	S	S	S	S	D	S	S	S
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.017 U	0.02 U	0.007 U	0.01 U	0.008 U	0.008 U	0.006 U	0.015 U	--
Ethylbenzene	**500**	0.017 U	0.02 U	**0.0025 J**	**0.0065 J**	0.008 U	0.008 U	0.006 U	0.015 U	--
Tetrachloroethene	**12**	0.017 U	0.02 U	**0.0034 J**	0.01 U	0.008 U	0.008 U	0.006 U	0.015 U	--
Trichloroethene	**56**	0.017 U	0.02 U	**0.0066 J**	**0.0062 J**	0.008 U	0.008 U	0.006 U	0.015 U	--
Vinyl chloride	**0.32**	0.017 U	0.02 U	0.007 U	0.01 U	0.016 U	0.016 U	0.013 U	0.015 U	--
Xylenes, Total	**500**	0.017 U	0.02 U	--	--	0.008 U	**0.002 J**	0.006 U	0.015 U	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	**0.25 J**	**0.49 J**	**0.18 J**	**0.11 J**	**0.39 J**	**0.29 J**	**1.8**	**0.21 J**	--
Benzo(a)pyrene	**1**	**0.059 J**	**0.74 J**	**0.19 J**	**0.17 J**	**0.31 J**	**0.2 J**	**1.4**	**0.2 J**	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	**0.57 J**	**0.39 J**	**2.8 J**	--	--
Benzo(b)fluoranthene	**1**	**1.3**	**1.8 J**	**0.3 J**	**0.3 J**	--	--	--	**0.38 J**	--
bis(2-Ethylhexyl)phthalate	**44**	0.56 U	0.65 UJ	**1 B**	**1.1 B**	**6.7 J**	**22 J***	**0.07 J**	**15 J**	--
Indeno(1,2,3-cd)pyrene	**1**	**0.36 J**	0.65 UJ	**0.14 J**	**0.21 J**	**0.12 J**	1 U	**0.61**	**0.086 J**	--
PCBs (mg/kg)										
Aroclor-1254	**1**	0.056 UJ	**0.87 J**	**1.1 D**	**0.31**	**0.87 J**	**1.9 J**	0.21 U	--	**5 J**
Aroclor-1260	**1**	0.056 UJ	**0.36 J**	**1.1 D**	**0.26**	0.25 U	1.2 U	0.21 U	--	**1.5 J**
PCBs, Total	**1**	ND	**1.23**	**2.2**	**0.57**	**0.87**	**1.9**	ND	--	**6.5**
Inorganics (mg/kg)										
Antimony	**27**	R	R	0.55 UN	0.77 UN	12 UJ	12 UJ	7.4 U	1.9 U	--
Arsenic	**10**	**5.4**	**9.7 J**	**4.2**	**2.7**	**4.2**	**4**	**0.48**	**1.8**	--
Beryllium	**2**	0.33 UJ	0.4 UJ	**0.65 B**	**0.87 B**	0.83 U	0.59 U	0.49 U	0.23 U	--
Cadmium	**34**	**17.4**	**45.3**	**7.7**	**8**	**12.1 J**	**7.9 J**	0.94 U	**12.1**	--
Chromium	**100**	**75.7**	**128**	**32**	**47.3**	19.7 U	10.4 U	4.2 U	**12.2**	--
Lead	**500**	**64 J**	**198 J**	**50.5**	**48.6**	**89.4 J**	**80.3 J**	**212 J**	**35.4 J**	--
Manganese	**1400**	**3760 J**	**1060 J**	**1080**	**224**	**113 J**	**72.5 J**	**115 J**	**96.8**	--

See Notes, Page 21.

See Notes on Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**CULVERT OUTFALL**								
Location ID:	**Direct**	**SD3-35**	**SD3-35**	**SD3-35**	**SD3-35**	**SD3-35**	**SD3-35**	**SD3-36**	**SD3-36**	**SS3-B3**
Depth Interval:	**Exposure**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.5 - 1.0')**	**(0.5 - 1.0')**	**(1.0 - 1.5')**	**(1.0 - 1.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**
Date Sampled:	**Criteria**	**12/11/1991**	**12/19/1991**	**12/11/1991**	**12/19/1991**	**12/11/1991**	**12/19/1991**	**12/11/1991**	**12/18/1991**	**12/9/1991**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.014 U	--	0.012 U	--	0.012 U	--	0.019 U	--	0.016 U
Ethylbenzene	**500**	0.014 U	--	0.012 U	--	0.012 U	--	0.019 U	--	0.016 U
Tetrachloroethene	**12**	0.014 U	--	0.012 U	--	0.012 U	--	0.019 U	--	0.016 U
Trichloroethene	**56**	0.014 U	--	0.012 U	--	0.012 U	--	0.019 U	--	0.016 U
Vinyl chloride	**0.32**	0.014 U	--	0.012 U	--	0.012 U	--	0.019 U	--	0.016 U
Xylenes, Total	**500**	0.014 U	--	0.012 U	--	0.012 U	--	0.019 U	--	0.016 U
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	**0.23 J**	--	0.39 UJ	--	0.39 UJ	--	**0.19 J**	--	**0.17 J**
Benzo(a)pyrene	**1**	**0.17 J**	--	0.39 UJ	--	0.39 UJ	--	0.62 U	--	**0.064 J**
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	**0.25 J**	--	0.39 UJ	--	0.39 UJ	--	**0.67**	--	**0.59**
bis(2-Ethylhexyl)phthalate	**44**	**10 J***	--	**0.1 J**	--	**0.49 J**	--	0.62 U	--	**1.6**
Indeno(1,2,3-cd)pyrene	**1**	**0.088 J**	--	0.39 UJ	--	0.39 UJ	--	**0.39 J**	--	**0.098 J**
PCBs (mg/kg)										
Aroclor-1254	**1**	--	**0.92 J**	--	0.04 UJ	--	**0.23 J**	--	**0.36 J**	**1.4 J**
Aroclor-1260	**1**	--	**0.23 J**	--	0.04 UJ	--	**0.061 J**	--	**0.14 J**	**0.8 J**
PCBs, Total	**1**	--	**1.15**	--	ND	--	**0.291**	--	**0.5**	**2.2**
Inorganics (mg/kg)										
Antimony	**27**	2 U	--	1.8 U	--	1.9 U	--	3.2 U	--	R
Arsenic	**10**	**2.5**	--	**1.9 J**	--	**2.2**	--	**4.8**	--	**5**
Beryllium	**2**	0.25 U	--	**0.42 J**	--	**0.43 J**	--	**2.2**	--	0.31 UJ
Cadmium	**34**	1.2 U	--	0.23 U	--	0.23 U	--	**9.8**	--	**7.6**
Chromium	**100**	**9.6**	--	**13**	--	**11.7**	--	**74.7**	--	**24.9**
Lead	**500**	**10 J**	--	**7.4 J**	--	**9.9 J**	--	**113 J**	--	**75.4 J**
Manganese	**1400**	**93.4**	--	**517**	--	**509**	--	**429**	--	**380 J**

See Notes, Page 21.

See Notes on Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**DRAINAGE DITCH**								
Location ID:	**Direct**	**SD1-03**	**SD3-22**	**SD3-22**	**SD3-22**	**SD3-22**	**SD3-22**	**SD3-24**	**SD3-24**	**SD3-24**
Depth Interval:	**Exposure**	**(0.0 - 0.5')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(1.0 - 2.0')**	**(1.0 - 2.0')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(1.0 - 2.0')**
Date Sampled:	**Criteria**	**5/16/1990**	**12/12/1991**	**12/19/1991**	**12/20/1991**	**12/12/1991**	**12/19/1991**	**12/11/1991**	**12/19/1991**	**12/11/1991**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.011 U	0.012 U	--	--	0.012 U	--	0.012 U	--	0.012 U
Ethylbenzene	**500**	0.011 U	0.012 U	--	--	0.012 U	--	**0.002 J**	--	**0.007 J**
Tetrachloroethene	**12**	0.011 U	0.012 U	--	--	0.012 U	--	0.012 U	--	0.012 U
Trichloroethene	**56**	0.011 U	0.012 U	--	--	0.012 U	--	**0.002 J**	--	**0.002 J**
Vinyl chloride	**0.32**	0.022 U	0.012 U	--	--	0.012 U	--	0.012 U	--	0.012 U
Xylenes, Total	**500**	0.011 U	0.012 U	--	--	0.012 U	--	**0.028**	--	**0.049**
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	**1.6**	**2.4 J**	--	--	**0.061 J**	--	2.1 UJ	--	4.1 UJ
Benzo(a)pyrene	**1**	**1.5**	**1.1 J**	--	--	**0.046 J**	--	2.1 UJ	--	4.1 UJ
Benzo(b&k)fluoranthene *	**1**	**1.5 J**	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	--	**2.3 J**	--	--	**0.11 J**	--	2.1 UJ	--	4.1 UJ
bis(2-Ethylhexyl)phthalate	**44**	**5.8**	**0.043 J**	--	--	**0.048 J**	--	**11 J**	--	**19 J**
Indeno(1,2,3-cd)pyrene	**1**	**0.65 J**	**0.99 J**	--	--	0.39 UJ	--	2.1 UJ	--	4.1 UJ
PCBs (mg/kg)										
Aroclor-1254	**1**	0.36 U	--	0.041 U	--	--	0.039 U	--	**1.5 J**	--
Aroclor-1260	**1**	0.36 U	--	0.041 U	--	--	0.039 U	--	**0.5 J**	--
PCBs, Total	**1**	ND	--	ND	--	--	ND	--	**2**	--
Inorganics (mg/kg)										
Antimony	**27**	18 U	--	--	1.7 UJ	1.8 U	--	11.8 UJ	--	10.9 UJ
Arsenic	**10**	**18.4**	--	--	**8.9**	**2**	--	**9.2 J**	--	**14.3 J**
Beryllium	**2**	1.3 U	--	--	**0.39**	**1.2**	--	0.25 UJ	--	0.7 U
Cadmium	**34**	**12.6 J**	--	--	0.22 U	0.22 U	--	**133**	--	**140**
Chromium	**100**	**32 J**	--	--	**7.4**	**13.8**	--	**51.1**	--	**45.8**
Lead	**500**	**263 J**	--	--	**17.2 J**	**10.9 J**	--	**158 J**	--	**257 J**
Manganese	**1400**	**1890 J**	--	--	**177**	**260**	--	**916 J**	--	**480 J**

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TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**DRAINAGE DITCH**								
Location ID:	**Direct**	**SD3-24**	**SD3-24**	**SD3-24**	**SD3-25**	**SD3-25**	**SD3-25**	**SD3-25**	**SD3-25**	**SD3-25**
Depth Interval:	**Exposure**	**(1.0 - 2.0')**	**(2.0 - 3.0')**	**(2.0 - 3.0')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(1.25 - 1.67')**	**(1.25 - 1.67')**	**(1.0 - 2.0')**	**(1.0 - 2.0')**
Date Sampled:	**Criteria**	**12/19/1991**	**12/11/1991**	**12/19/1991**	**12/12/1991**	**12/19/1991**	**12/12/1991**	**12/19/1991**	**12/12/1991**	**12/19/1991**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	--	0.012 U	--	**0.004 J**	--	4.1 U	--	11 U	--
Ethylbenzene	**500**	--	**0.011 J**	--	**0.15**	--	**4.1 J**	--	**29**	--
Tetrachloroethene	**12**	--	0.012 U	--	**5.2 J***	--	**66**	--	**170**	--
Trichloroethene	**56**	--	**0.003 J**	--	**0.061**	--	**11**	--	**27**	--
Vinyl chloride	**0.32**	--	0.012 U	--	**0.069**	--	4.1 U	--	11 U	--
Xylenes, Total	**500**	--	**0.11**	--	**3.5 J***	--	**4.2**	--	22 U	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	--	2 UJ	--	13 U	--	28 U	--	2.7 U	--
Benzo(a)pyrene	**1**	--	2 UJ	--	13 U	--	28 U	--	2.7 U	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	--	2 UJ	--	13 U	--	28 U	--	2.7 U	--
bis(2-Ethylhexyl)phthalate	**44**	--	**9.5 J**	--	**160 J***	--	**500 J***	--	2.7 U	--
Indeno(1,2,3-cd)pyrene	**1**	--	2 UJ	--	13 U	--	28 U	--	2.7 U	--
PCBs (mg/kg)										
Aroclor-1254	**1**	**1.8 J**	--	**1.5 J**	--	**13 J**	--	**7 J**	--	**16 J**
Aroclor-1260	**1**	**0.85 J**	--	**0.62 J**	--	**6.9 J**	--	**3.3 J**	--	**7.5 J**
PCBs, Total	**1**	**2.65**	--	**2.12**	--	**19.9**	--	**10.3**	--	**23.5**
Inorganics (mg/kg)										
Antimony	**27**	--	1.9 U	--	**27.3**	--	6.9 U	--	**14.7**	--
Arsenic	**10**	--	**14.1**	--	**46.6**	--	**64.4**	--	**73.2**	--
Beryllium	**2**	--	0.23 U	--	**0.48 J**	--	**0.67 J**	--	**0.58 J**	--
Cadmium	**34**	--	**64.6**	--	**786**	--	**94.7**	--	**817**	--
Chromium	**100**	--	**27.8**	--	**483**	--	**316**	--	**1940**	--
Lead	**500**	--	**148 J**	--	**3910 J**	--	**519 J**	--	**1750 J**	--
Manganese	**1400**	--	**222**	--	**214**	--	**117**	--	**574**	--

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TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**DRAINAGE DITCH**							**OPERATIONS AREA**	
Location ID:	**Direct**	**SD3-39**	**SD3-39**	**SD3-39**	**SD3-39**	**SD3-39**	**SD3-39**	**SS3-C1**	**B-1**	**B-5**
Depth Interval:	**Exposure**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(1.0 - 2.0')**	**(1.0 - 2.0')**	**(0.0 - 0.5')**	**(2)**	**(2)**
Date Sampled:	**Criteria**	**12/11/1991**	**12/11/1991**	**12/18/1991**	**12/18/1991**	**12/11/1991**	**12/18/1991**	**12/9/1991**	**4/30/1991**	**5/1/1991**
Sample Type:	**(mg/kg)**	**S**	**D**	**S**	**D**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.012 U	0.014 U	--	--	0.012 U	--	0.011 U	--	--
Ethylbenzene	**500**	0.012 U	0.014 U	--	--	0.012 U	--	0.011 U	--	--
Tetrachloroethene	**12**	0.012 U	0.014 U	--	--	0.012 U	--	0.011 U	--	--
Trichloroethene	**56**	0.012 U	0.014 U	--	--	0.012 U	--	0.011 U	--	--
Vinyl chloride	**0.32**	0.012 U	0.014 U	--	--	0.012 U	--	0.011 U	--	--
Xylenes, Total	**500**	0.012 U	0.014 U	--	--	0.012 U	--	0.011 U	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	**0.13 J**	**0.14 J**	--	--	0.4 UJ	--	0.38 UJ	--	--
Benzo(a)pyrene	**1**	0.47 U	**0.085 J**	--	--	0.4 U	--	0.38 UJ	--	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	**0.87**	**0.41 J**	--	--	0.4 U	--	0.38 UJ	--	--
bis(2-Ethylhexyl)phthalate	**44**	**1.2 J**	0.74 U	--	--	0.45 U	--	**2.7 J**	--	--
Indeno(1,2,3-cd)pyrene	**1**	**0.39 J**	**0.13 J**	--	--	0.4 U	--	0.38 UJ	--	--
PCBs (mg/kg)										
Aroclor-1254	**1**	--	--	**0.75 J**	**1.1 J**	--	**1.5 J**	**1.3 J**	--	--
Aroclor-1260	**1**	--	--	**0.12 J**	**0.16 J**	--	**0.26 J**	**0.27 J**	--	--
PCBs, Total	**1**	--	--	**0.87**	**1.26**	--	**1.76**	**1.57**	--	--
Inorganics (mg/kg)										
Antimony	**27**	12 U	--	--	--	11.5 UJ	--	R	--	--
Arsenic	**10**	2 U	--	--	--	**0.87 J**	--	**5.5**	--	--
Beryllium	**2**	1 U	--	--	--	0.74 U	--	0.33 UJ	--	--
Cadmium	**34**	1 U	--	--	--	0.74 U	--	**300**	--	--
Chromium	**100**	**16.2 J**	--	--	--	6.9 U	--	**49.9**	--	--
Lead	**500**	**2.8 J**	--	--	--	**11.4 J**	--	**1020 J**	--	--
Manganese	**1400**	**1.9 J**	--	--	--	**48.7 J**	--	**273 J**	--	--

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TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**OPERATIONS AREA**								
Location ID:	**Direct**	**B-7**	**B-8**	**B-14**	**B-14**	**B-17**	**B-18**	**B-477**	**B-479**	**B-480**
Depth Interval:	**Exposure**	**(2)**	**(1.0 - 3.0')**	**(2)**	**(2)**	**(1)**	**(1)**	**(0.5 - 1.0')**	**(2.0 - 3.0')**	**(3.5 - 4.0')**
Date Sampled:	**Criteria**	**5/1/1991**	**5/1/1991**	**5/2/1991**	**5/2/1991**	**5/2/1991**	**5/2/1991**	**3/4/1994**	**3/10/1994**	**3/10/1994**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	--	0.7 U	--	--	--	--	53 U	86 U	2.1 U
Ethylbenzene	**500**	--	**1.2**	--	--	--	--	**300**	86 U	**26**
Tetrachloroethene	**12**	--	**2.3**	--	--	--	--	**60**	**1200**	**0.84 J**
Trichloroethene	**56**	--	**0.38 J**	--	--	--	--	**58**	86 U	**0.28 J**
Vinyl chloride	**0.32**	--	1.4 U	--	--	--	--	53 U	86 U	2.1 U
Xylenes, Total	**500**	--	**2.8**	--	--	--	--	**1200 E**	86 U	**2.5**
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	--	0.74 UJ	--	--	--	--	--	--	--
Benzo(a)pyrene	**1**	--	0.74 UJ	--	--	--	--	--	--	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	--	0.74 UJ	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	**44**	--	**13 J**	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	**1**	--	0.74 UJ	--	--	--	--	--	--	--
PCBs (mg/kg)										
Aroclor-1254	**1**	--	**2 J**	--	--	--	--	--	--	--
Aroclor-1260	**1**	--	**2.2 J**	--	--	--	--	--	--	--
PCBs, Total	**1**	--	**4.42**	--	--	--	--	--	--	--
Inorganics (mg/kg)										
Antimony	**27**	--	12 UJ	--	--	--	--	--	--	--
Arsenic	**10**	--	**0.83**	--	--	--	--	--	--	--
Beryllium	**2**	--	0.46 U	--	--	--	--	--	--	--
Cadmium	**34**	--	**41.7**	--	--	--	--	--	--	--
Chromium	**100**	--	**13.4**	--	--	--	--	--	--	--
Lead	**500**	--	**17.5 J**	--	--	--	--	--	--	--
Manganese	**1400**	--	**214 J**	--	--	--	--	--	--	--

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SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	Residential	OPERATIONS AREA								
Location ID:	Direct	B-484	SC-1	SC-2	SC-3	SC-4	SC-5	SC-6	SC-7	SC-8
Depth Interval:	Exposure	(3.5 - 4.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')	(1.0 - 3.0')
Date Sampled:	Criteria	3/10/1994	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985	1/1/1985
Sample Type:	(mg/kg)	S	S	S	S	S	S	S	S	S
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	0.71 U	0.005 U	0.005 U	0.005 U	0.05 U	0.01 U	2 U	0.01 U	2 U
Ethylbenzene	**500**	**11**	0.005 U	**0.015**	**0.19**	**67.5**	**0.375**	**720**	**0.54**	**40**
Tetrachloroethene	**12**	**0.094 J**	**0.088**	**0.034**	**0.334**	**23.6**	**0.096**	**510**	**8.81**	**170**
Trichloroethene	**56**	**0.22 J**	**0.052**	**0.063**	**0.295**	**10.4**	**0.022**	**76**	**7.03**	**49**
Vinyl chloride	**0.32**	**0.4 J**	0.005 U	0.005 U	0.005 U	0.05 U	0.01 U	2 U	0.01 U	2 U
Xylenes, Total	**500**	**2.1**	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	**1**	--	--	--	--	--	--	--	--	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	**44**	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	**1**	--	--	--	--	--	--	--	--	--
PCBs (mg/kg)										
Aroclor-1254	**1**	--	--	--	--	--	--	--	--	--
Aroclor-1260	**1**	--	--	--	--	--	--	--	--	--
PCBs, Total	**1**	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)										
Antimony	**27**	--	--	--	--	--	--	--	--	--
Arsenic	**10**	--	--	--	--	--	--	--	--	--
Beryllium	**2**	--	--	--	--	--	--	--	--	--
Cadmium	**34**	--	--	--	--	--	--	--	--	--
Chromium	**100**	--	--	--	--	--	--	--	--	--
Lead	**500**	--	--	--	--	--	--	--	--	--
Manganese	**1400**	--	--	--	--	--	--	--	--	--

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SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**OPERATIONS AREA**								
Location ID:	**Direct**	**SC-9**	**SC-10**	**SC-11**	**SC-12**	**SC-13**	**SC-14**	**SC-15**	**SC-16**	**SC-17**
Depth Interval:	**Exposure**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**
Date Sampled:	**Criteria**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	**2.1**	2 U	2 U	2 U	0.005 U	0.005 U	2 U	0.005 U	0.01 U
Ethylbenzene	**500**	**45**	**50**	**58**	**200**	**0.156**	**0.15**	**150**	**0.483**	0.01 U
Tetrachloroethene	**12**	**120**	**160**	**15**	**570**	**0.106**	**3.57**	**94**	**0.806**	**0.036**
Trichloroethene	**56**	**430**	**170**	2 U	**35**	**0.022**	**0.53**	2 U	**0.019**	0.01 U
Vinyl chloride	**0.32**	2 U	2 U	2 U	2 U	0.005 U	0.005 U	2 U	0.005 U	0.01 U
Xylenes, Total	**500**	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	--	--	--	--	--	--	--	--	--
Benzo(a)pyrene	**1**	--	--	--	--	--	--	--	--	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	--	--	--	--
Benzo(b)fluoranthene	**1**	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	**44**	--	--	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	**1**	--	--	--	--	--	--	--	--	--
PCBs (mg/kg)										
Aroclor-1254	**1**	--	--	--	--	--	--	--	--	--
Aroclor-1260	**1**	--	--	--	--	--	--	--	--	--
PCBs, Total	**1**	--	--	--	--	--	--	--	--	--
Inorganics (mg/kg)										
Antimony	**27**	--	--	--	--	--	--	--	--	--
Arsenic	**10**	--	--	--	--	--	--	--	--	--
Beryllium	**2**	--	--	--	--	--	--	--	--	--
Cadmium	**34**	--	--	--	--	--	--	--	--	--
Chromium	**100**	--	--	--	--	--	--	--	--	--
Lead	**500**	--	--	--	--	--	--	--	--	--
Manganese	**1400**	--	--	--	--	--	--	--	--	--

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SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	**Residential**	**OPERATIONS AREA**								
Location ID:	**Direct**	**SC-18**	**SC-19**	**SC-20**	**SC-21**	**SC-22**	**SD1-04**	**SD1-15**	**SD3-23**	**SD3-23**
Depth Interval:	**Exposure**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**
Date Sampled:	**Criteria**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**5/16/1990**	**5/14/1990**	**12/12/1991**	**12/19/1991**
Sample Type:	**(mg/kg)**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1-Dichloroethene	**1**	2 U	**4.2**	2 U	0.005 U	0.005 U	**0.009 J**	0.006 U	0.014 U	--
Ethylbenzene	**500**	**20**	**57**	**74**	0.005 U	0.005 U	**0.3 J**	0.006 U	0.014 U	--
Tetrachloroethene	**12**	**22**	**820**	**77**	**0.01**	**0.29**	**0.007 J**	0.006 U	0.014 U	--
Trichloroethene	**56**	2 U	**52**	**19**	0.005 U	**0.064**	0.024 UJ	0.006 U	0.014 U	--
Vinyl chloride	**0.32**	2 U	2 U	2 U	0.005 U	0.005 U	**0.22 J**	0.012 U	0.014 U	--
Xylenes, Total	**500**	--	--	--	--	--	**23 J***	0.006 U	0.014 U	--
SVOCs (mg/kg)										
Benzo(a)anthracene	**1**	--	--	--	--	--	18 U	0.41 U	**3.9**	--
Benzo(a)pyrene	**1**	--	--	--	--	--	18 U	0.41 U	**3.8**	--
Benzo(b&k)fluoranthene *	**1**	--	--	--	--	--	18 U	0.41 U	--	--
Benzo(b)fluoranthene	**1**	--	--	--	--	--	--	--	**5.8**	--
bis(2-Ethylhexyl)phthalate	**44**	--	--	--	--	--	**900 ***	0.41 U	**0.97 J**	--
Indeno(1,2,3-cd)pyrene	**1**	--	--	--	--	--	18 U	0.41 U	**2.3 J**	--
PCBs (mg/kg)										
Aroclor-1254	**1**	--	--	--	--	--	**42**	0.2 U	--	0.048 U
Aroclor-1260	**1**	--	--	--	--	--	0.44 U	0.2 U	--	0.048 U
PCBs, Total	**1**	--	--	--	--	--	**42**	ND	--	ND
Inorganics (mg/kg)										
Antimony	**27**	--	--	--	--	--	37 U	12 UJ	2 U	--
Arsenic	**10**	--	--	--	--	--	**14.9**	**0.82**	**23**	--
Beryllium	**2**	--	--	--	--	--	2.1 U	0.64 U	0.25 U	--
Cadmium	**34**	--	--	--	--	--	**37.5 J**	1.3 U	**2.7**	--
Chromium	**100**	--	--	--	--	--	**99.3 J**	12.1 U	**8.2**	--
Lead	**500**	--	--	--	--	--	**77.5 J**	**66.4 J**	**28.5 J**	--
Manganese	**1400**	--	--	--	--	--	**4360 J**	**133 J**	**157**	--

See Notes, Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

Site Area:	Residential	OPERATIONS AREA		
Location ID:	Direct	SD3-23	SD3-23	SP-485
Depth Interval:	Exposure	(1.0 - 2.0')	(1.0 - 2.0')	(0.0 - 1.0')
Date Sampled:	Criteria	12/12/1991	12/19/1991	3/9/1994
Sample Type:	(mg/kg)	S	S	S
VOCs (mg/kg)				
1,1-Dichloroethene	**1**	0.012 U	--	15 U
Ethylbenzene	**500**	0.012 U	--	**84**
Tetrachloroethene	**12**	0.012 U	--	**8.1 J**
Trichloroethene	**56**	0.012 U	--	**3.7 J**
Vinyl chloride	**0.32**	0.012 U	--	15 U
Xylenes, Total	**500**	0.012 U	--	**320 E**
SVOCs (mg/kg)				
Benzo(a)anthracene	**1**	**0.14 J**	--	--
Benzo(a)pyrene	**1**	**0.075 J**	--	--
Benzo(b&k)fluoranthene *	**1**	--	--	--
Benzo(b)fluoranthene	**1**	**0.32 J**	--	--
bis(2-Ethylhexyl)phthalate	**44**	**0.058 J**	--	--
Indeno(1,2,3-cd)pyrene	**1**	0.4 U	--	--
PCBs (mg/kg)				
Aroclor-1254	**1**	--	0.04 U	--
Aroclor-1260	**1**	--	0.04 U	--
PCBs, Total	**1**	--	ND	--
Inorganics (mg/kg)				
Antimony	**27**	1.9 U	--	--
Arsenic	**10**	**6.7**	--	--
Beryllium	**2**	0.24 U	--	--
Cadmium	**34**	0.69 UJ	--	--
Chromium	**100**	**7.2**	--	--
Lead	**500**	**5.8 J**	--	--
Manganese	**1400**	**71.1**	--	--

See Notes, Page 21.

TABLE N-1B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP RESIDENTIAL DIRECT EXPOSURE CRITERIA

General Notes:

These data based on samples less than or equal to four feet deep.
* Residential Direct Exposure criterion for manganese not listed in Remediation Standard Regulations, but calculated (see Table M-2).
-- Indicates that the sample was not collected/analyzed for the listed analyte.

Data Qualifiers:

B = Indicates the analyte was found in the blanks as well as the sample. The data user should use caution when applying the results of this analyte.
D = All compounds identified in an analysis at a secondary dilution factor.
E = (Organics) Indicates that it exceeds calibration curve range.
  (Inorganics) Reported value is estimated because of the presence of interference.
J = The compound was analyzed for and determined to be present in the sample. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.
N = (Inorganics) Spiked sample recovery not within control limits.
ND = Not detected.
R = The sample results were rejected.
U = Indicates that the compound was analyzed for but not detected at the associated detection limit.
UJ = Indicates that the compound was analyzed for but not detected at the associated estimated detection limit.
* = Duplicate analysis not within control limits.

TABLE N-2

SRSNE
SOUTHINGTON, CT

SITE-SPECIFIC DIRECT EXPOSURE CRITERIA CALCULATION RESULTS FOR ADDITIONAL POLLUTING SUBSTANCES

Calculated CT Direct Exposure Criteria (DEC)			Residential		Industrial	
	Cancer SF	RfD	DEC Cancer (mg/kg)	DEC Noncancer (mg/kg)	DEC Cancer (mg/kg)	DEC Noncancer (mg/kg)
Chloroethane	0.0029	0.4	**2.1E+02**		**7.0E+02**	
Tetrahydrofuran	0.0076	0.2	**8.1E+01**		**2.7E+02**	
Manganese		0.02		**1.4E+03**		**3.5E+03**

USEPA Region 3 Risk Based Criteria (RBC)			Residential		Industrial	
	Cancer SF	RfD	Cancer (mg/kg)	Noncancer (mg/kg)	Cancer (mg/kg)	Noncancer (mg/kg)
Chloroethane	0.0029	0.4	2.2E+02		2.0E+03	
Tetrahydrofuran	0.0076	0.2	8.4E+01		7.5E+02	
Manganese		0.02		4.1E+04		3.9E+04

Notes:

1) Bold numbers indicate appropriate Direct Exposure Criteria for chloroethane, tetrahydrofuran, and manganese.
2) Residential DECs are used for SRSNE Site soil data screening.
3) USEPA Region 3 RBCs provided for comparison.
4) SF = slope factor
5) RfD = reference dose

TABLE N-3

SRSNE
SOUTHINGTON, CT

DETECTED COMPOUNDS WITHOUT DIRECT EXPOSURE CRITERIA

CAS Registry Number	Chemical Name	Minimum Detected Value	Maximum Detected Value	Location of Maximum Detection	Region 3 RBC	Maximum Fraction of RBC (%)	New Calculated Direct Exposure Criteria (Table M-2)	Rationale for No Further Assessment
Volatile Organic Compounds (ppm)								
107-02-8	Acrolein		0.048	SC-3	1.6E+03	0		A
75-69-4	Trichlorofluoromethane		0.014	SC-3	2.3E+04	0		A
Alcohols (ppm)								
67-63-0	Isopropanol		0.376	SC-2	not listed	NA		A
Dioxin/Furans (ppm)								
35822-46-9	1,2,3,4,6,7,8-HpCDD		0.00027 J	B-1	not listed	NA		A
3268-87-9	OCDDs, Total	0.00126	0.00282 J	B-1/B-14	not listed	NA		A
Inorganics (ppm)								
7440-48-4	Cobalt		13.7	B-10	4.7E+03	0		B

Notes:

This table includes only the analytes that were detected at locations lacking known DEC exceedences for RSR-listed analytes.

1. Region 3 RBCs for residential soils from EPA website, 11/99.
2. NA - not applicable.
3. J - Estimated concentration.

A = Within Operations Area, which is covered by asphalt/concrete and will be capped.

B = Not part of release associated with SRSNE operations.

TABLE N-4A

SRSNE
SOUTHINGTON, CT

SUMMARY OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Chemical Class	CAS Registry Number	Chemical Name	Sample Preparation	Units	Pollutant Mobility Criteria	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
OV	71-55-6	1,1,1-Trichloroethane	T	mg/kg	4	260	SC-19	1/1/1985
OV	79-34-5	1,1,2,2-Tetrachloroethane	T	mg/kg	0.01	0.022	SC-3	1/1/1985
OV	75-34-3	1,1-Dichloroethane	T	mg/kg	1.4	2.8 J	SP-485	3/9/1994
OV	75-35-4	1,1-Dichloroethene	T	mg/kg	0.14	4.2	SC-19	1/1/1985
OV	540-59-0	1,2-Dichloroethene, Total	T	mg/kg	1.4	35	SP-485	3/9/1994
OV	78-93-3	2-Butanone	T	mg/kg	8	44	SC-12	1/1/1985
OV	71-43-2	Benzene	T	mg/kg	0.02	2.9	SC-19	1/1/1985
OV	124-48-1	Chlorodibromomethane	T	mg/kg	0.01	0.027	SC-3	1/1/1985
OV	67-66-3	Chloroform	T	mg/kg	0.12	5.9	SC-19	1/1/1985
OV	100-41-4	Ethylbenzene	T	mg/kg	10.1	720	SC-6	1/1/1985
OV	75-09-2	Methylene chloride	T	mg/kg	0.1	7.4	SC-9	1/1/1985
OV	127-18-4	Tetrachloroethene	T	mg/kg	0.1	1200	B-479	3/10/1994
OV	108-88-3	Toluene	T	mg/kg	20	500	SC-19	1/1/1985
OV	79-01-6	Trichloroethene	T	mg/kg	0.1	430	SC-9	1/1/1985
OV	75-01-4	Vinyl chloride	T	mg/kg	0.04	0.4 J	B-484	3/10/1994
OV	1330-20-7	Xylenes, Total	T	mg/kg	19.5	1200 E	B-477	3/4/1994
OSV	205-99-2	Benzo(b)fluoranthene	T	mg/kg	1	1.8 J	SS3-B4	12/9/1991
OSV	207-08-9	Benzo(k)fluoranthene	T	mg/kg	1	1.8 J	SS3-B4	12/9/1991
OSV	117-81-7	bis(2-Ethylhexyl)phthalate	T	mg/kg	1	120 J*	B-15	5/3/1991
I	7439-92-1	Lead	P	mg/L	0.015	0.0503 *	SB-905	10/19/1999

Notes:

1) Sample Preparation: T = total (mass/mass), P = SPLP.
2) D - Concentration is based on a diluted sample analysis.
3) E - The compound was quantitated above the calibration range.
4) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
5) * - Duplicate analysis outside control limits.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT**	**CIANCI PROPERTY**									
Location ID:	**DEP**	**SB-902**	**SB-902**	**SB-903**	**SB-903**	**SB-903**	**SB-903**	**SB-905**	**SB-905**	**SB-905**	**SB-906**
Depth Interval:	**Pollutant**	**(0.0 - 1.4')**	**(0.0 - 1.5')**	**(0.0 - 2.0')**	**(0.0 - 2.2')**	**(2.0 - 4.0')**	**(2.2 - 4.4')**	**(0.0 - 2.0')**	**(0.0 - 8.5')**	**(0.0 - 9.5')**	**(0.0 - 2.0')**
Date Sampled:	**Mobility**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**
Sample Type:	**Criteria**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**D**	**D**	**S**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	--	0.006 U	0.0073 U	--	**0.0012 J**	--	0.0056 U	--	--	0.0053 U
1,1,2,2-Tetrachloroethane	**0.01**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
1,1-Dichloroethane	**1.4**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
1,1-Dichloroethene	**0.14**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
1,2-Dichloroethene, Total	**1.4**	--	--	--	--	--	--	--	--	--	--
2-Butanone	**8**	--	**0.021**	0.015 U	--	**0.017**	--	**0.0094 J**	--	--	**0.012**
Benzene	**0.02**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
Chlorodibromomethane	**0.01**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
Chloroform	**0.12**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
Ethylbenzene	**10.1**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
Methylene chloride	**0.1**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	**0.0011 J**
Tetrachloroethene	**0.1**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
Toluene	**20**	--	**0.0036 J**	0.0073 U	--	0.0057 U	--	**0.0033 J**	--	--	**0.0024 J**
Trichloroethene	**0.1**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	**0.0012 J**
Vinyl chloride	**0.04**	--	0.006 U	0.0073 U	--	0.0057 U	--	0.0056 U	--	--	0.0053 U
Xylenes, Total	**19.5**	--	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	--	0.41 U	**0.099 J**	--	**0.18 J**	--	0.37 U	--	--	**0.054 J**
Benzo(k)fluoranthene	**1**	--	0.41 U	**0.056 J**	--	**0.069 J**	--	0.37 U	--	--	0.37 U
bis(2-Ethylhexyl)phthalate	**1**	--	0.41 U	0.41 U	--	**0.19 J**	--	0.37 U	--	--	**0.073 JB**
Inorganics (SPLP, mg/L)											
Barium	**1**	**0.294**	--	--	**0.19 B**	--	**0.271**	**0.174 B**	**0.0145 BE**	**0.257**	**0.247**
Lead	**0.015**	**0.0137** *	--	--	0.002 U*	--	**0.0113** *	**0.0503** *	**0.0158 B**	**0.0029 B***	**0.0049** *

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT**	**CIANCI PROPERTY**									
Location ID:	**DEP**	**SB-909**	**SB-909**	**SB-910**	**SB-911**	**SB-911**	**SB-911**	**SB-911**	**SB-912**	**SB-912**	**SB-914**
Depth Interval:	**Pollutant**	**(0.0 - 2.0')**	**(0.0 - 2.4')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 2.5')**	**(2.0 - 4.0')**	**(2.5 - 5.1')**	**(0.0 - 2.0')**	**(0.0 - 2.7')**	**(0.0 - 2.0')**
Date Sampled:	**Mobility**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**	**10/19/1999**
Sample Type:	**Criteria**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
1,1,2,2-Tetrachloroethane	**0.01**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
1,1-Dichloroethane	**1.4**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
1,1-Dichloroethene	**0.14**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
1,2-Dichloroethene, Total	**1.4**	--	--	--	--	--	--	--	--	--	--
2-Butanone	**8**	**0.0079 J**	--	**0.017**	**0.004 J**	--	**0.0053 J**	--	**0.0077 J**	--	**0.0074 J**
Benzene	**0.02**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Chlorodibromomethane	**0.01**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Chloroform	**0.12**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Ethylbenzene	**10.1**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Methylene chloride	**0.1**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Tetrachloroethene	**0.1**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Toluene	**20**	**0.001 J**	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	**0.0014 J**
Trichloroethene	**0.1**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Vinyl chloride	**0.04**	0.0048 U	--	0.0058 U	0.0061 U	--	0.0056 U	--	0.0059 U	--	0.0062 U
Xylenes, Total	**19.5**	--	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	0.35 U	--	0.39 U	0.44 U	--	0.44 U	--	0.41 U	--	**0.4 J**
Benzo(k)fluoranthene	**1**	0.35 U	--	0.39 U	0.44 U	--	0.44 U	--	0.41 U	--	0.45 U
bis(2-Ethylhexyl)phthalate	**1**	0.35 U	--	0.39 U	0.44 U	--	0.44 U	--	0.41 U	--	0.45 U
Inorganics (SPLP, mg/L)											
Barium	**1**	--	**0.44**	**0.0086 BE**	--	**0.425**	--	**0.132 B**	--	**0.0589 B**	--
Lead	**0.015**	--	**0.003 B***	**0.0043 B**	--	**0.0036 ***	--	0.002 U*	--	0.002 U*	--

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT**	**CIANCI PROPERTY**									
Location ID:	**DEP**	**SB-914**	**SB-917**	**SB-918**	**SB-919**	**SB-919**	**SB-920**	**SB-920**	**SB-921**	**SB-922**	**SB-922**
Depth Interval:	**Pollutant**	**(0.0 - 2.4')**	**(0.0 - 1.7')**	**(0.0 - 2.0')**	**(0.0 - 1.5')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**
Date Sampled:	**Mobility**	**10/19/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**
Sample Type:	**Criteria**	**S**	**S**	**S**	**D**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
1,1,2,2-Tetrachloroethane	**0.01**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
1,1-Dichloroethane	**1.4**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
1,1-Dichloroethene	**0.14**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
1,2-Dichloroethene, Total	**1.4**	--	--	--	--	--	--	--	--	--	--
2-Butanone	**8**	--	**0.0034 J**	**0.0039 J**	**0.0066 J**	**0.0064 J**	**0.0071 J**	**0.0075 J**	**0.0055 J**	0.011 U	**0.008 J**
Benzene	**0.02**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Chlorodibromomethane	**0.01**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Chloroform	**0.12**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Ethylbenzene	**10.1**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Methylene chloride	**0.1**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Tetrachloroethene	**0.1**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Toluene	**20**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Trichloroethene	**0.1**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Vinyl chloride	**0.04**	--	0.0047 U	0.0051 U	0.0048 U	0.0048 U	0.0054 U	0.0047 U	0.0052 U	0.0056 U	0.005 U
Xylenes, Total	**19.5**	--	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	--	0.37 U	0.37 U	**0.066 J**	0.36 U	0.37 U	0.36 U	**0.25 J**	**0.068 J**	0.39 U
Benzo(k)fluoranthene	**1**	--	0.37 U	0.37 U	**0.05 J**	0.36 U	0.37 U	0.36 U	**0.27 J**	**0.081 J**	0.39 U
bis(2-Ethylhexyl)phthalate	**1**	--	**0.12 JB**	**0.19 JB**	**0.17 JB**	**0.14 JB**	**0.13 JB**	**0.12 JB**	**0.16 JB**	**0.16 JB**	**0.13 JB**
Inorganics (SPLP, mg/L)											
Barium	**1**	**1.01**	**0.0027 BE**	--	--	--	--	--	--	--	--
Lead	**0.015**	**0.0154 ***	**0.0032 B**	--	--	--	--	--	--	--	--

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT**	**CIANCI PROPERTY**									
Location ID:	**DEP**	**SB-923**	**SB-924**	**SB-924**	**SB-925**	**SB-926**	**SB-927**	**SB-928**	**SS3-A1**	**SS3-A2**	**SS3-A2**
Depth Interval:	**Pollutant**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(2.0 - 4.0')**	**(0.0 - 2.0')**	**(0.0 - 1.4')**	**(0.0 - 2.0')**	**(0.0 - 2.0')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**
Date Sampled:	**Mobility**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**10/18/1999**	**12/9/1991**	**12/9/1991**	**12/9/1991**
Sample Type:	**Criteria**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
1,1,2,2-Tetrachloroethane	**0.01**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
1,1-Dichloroethane	**1.4**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
1,1-Dichloroethene	**0.14**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
1,2-Dichloroethene, Total	**1.4**	--	--	--	--	--	--	--	0.011 U	0.011 U	0.011 U
2-Butanone	**8**	0.01 U	**0.0057 J**	0.011 U	0.01 U	**0.0039 J**	**0.011**	**0.01 J**	0.011 U	0.011 U	0.011 U
Benzene	**0.02**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
Chlorodibromomethane	**0.01**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
Chloroform	**0.12**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
Ethylbenzene	**10.1**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
Methylene chloride	**0.1**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.054 UJ	0.11 UJ	0.071 UJ
Tetrachloroethene	**0.1**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
Toluene	**20**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	**0.0025 J**	**0.0015 J**	0.011 U	0.011 U	0.011 U
Trichloroethene	**0.1**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	**0.0023 J**	0.0051 U	0.011 U	0.011 U	0.011 U
Vinyl chloride	**0.04**	0.0052 U	0.0055 U	0.0055 U	0.005 U	0.0058 U	0.0054 U	0.0051 U	0.011 U	0.011 U	0.011 U
Xylenes, Total	**19.5**	--	--	--	--	--	--	--	0.011 U	0.011 U	0.011 U
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	**0.055 J**	0.37 U	0.36 U	0.37 U	**0.11 J**	0.38 U	**0.085 J**	**0.058 J**	0.38 U	--
Benzo(k)fluoranthene	**1**	**0.072 J**	0.37 U	0.36 U	0.37 U	**0.15 J**	0.38 U	**0.058 J**	**0.058 J**	0.38 U	--
bis(2-Ethylhexyl)phthalate	**1**	**0.18 JB**	0.37 U	**0.12 JB**	**0.13 JB**	**0.23 JB**	**0.14 JB**	**0.15 JB**	0.34 U	0.38 U	--
Inorganics (SPLP, mg/L)											
Barium	**1**	--	--	--	--	**0.0027 BE**	**0.0054 BE**	--	--	--	--
Lead	**0.015**	--	--	--	--	**0.0025 B**	**0.003 B**	--	--	--	--

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT DEP Pollutant Mobility Criteria**	**CIANCI PROPERTY**				**DRAINAGE DITCH**				
Location ID:		**SS3-A3**	**SS3-A4**	**SS3-A5**	**SS3-B4**	**SD3-24**	**SD3-24**	**SD3-24**	**SD3-24**	**SD3-24**
Depth Interval:		**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 0.5')**	**(0.0 - 1.0')**	**(0.0 - 1.0')**	**(1.0 - 2.0')**	**(1.0 - 2.0')**	**(2.0 - 3.0')**
Date Sampled:		**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/9/1991**	**12/11/1991**	**12/19/1991**	**12/11/1991**	**12/19/1991**	**12/11/1991**
Sample Type:		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)										
1,1,1-Trichloroethane	**4**	0.011 U	0.011 U	0.011 U	0.02 U	**0.005 J**	--	**0.008 J**	--	**0.024**
1,1,2,2-Tetrachloroethane	**0.01**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
1,1-Dichloroethane	**1.4**	0.011 U	0.011 U	0.011 U	0.02 U	**0.001 J**	--	**0.003 J**	--	**0.005 J**
1,1-Dichloroethene	**0.14**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
1,2-Dichloroethene, Total	**1.4**	0.011 U	0.011 U	0.011 U	0.02 U	**0.007 J**	--	0.013 U	--	0.039 U
2-Butanone	**8**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
Benzene	**0.02**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
Chlorodibromomethane	**0.01**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
Chloroform	**0.12**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
Ethylbenzene	**10.1**	0.011 U	0.011 U	0.011 U	0.02 U	**0.002 J**	--	**0.007 J**	--	**0.011 J**
Methylene chloride	**0.1**	0.087 UJ	0.064 UJ	0.046 UJ	0.09 UJ	0.075 UJ	--	0.063 UJ	--	0.07 UJ
Tetrachloroethene	**0.1**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
Toluene	**20**	0.011 U	0.011 U	0.011 U	0.02 U	**0.002 J**	--	**0.019**	--	**0.015**
Trichloroethene	**0.1**	0.011 U	0.011 U	0.011 U	0.02 U	**0.002 J**	--	**0.002 J**	--	**0.003 J**
Vinyl chloride	**0.04**	0.011 U	0.011 U	0.011 U	0.02 U	0.012 U	--	0.012 U	--	0.012 U
Xylenes, Total	**19.5**	0.011 U	0.011 U	0.011 U	0.02 U	**0.028**	--	**0.049**	--	**0.11**
SVOCs (mg/kg)										
Benzo(b)fluoranthene	**1**	0.37 U	**0.14 J**	0.37 UJ	**1.8 J**	2.1 UJ	--	4.1 UJ	--	2 UJ
Benzo(k)fluoranthene	**1**	0.37 U	**0.14 J**	0.37 UJ	**1.8 J**	2.1 UJ	--	4.1 UJ	--	2 UJ
bis(2-Ethylhexyl)phthalate	**1**	0.37 U	0.38 U	0.37 UJ	0.65 UJ	**11 J**	--	**19 J**	--	**9.5 J**
Inorganics (SPLP, mg/L)										
Barium	**1**	--	--	--	--	--	--	--	--	--
Lead	**0.015**	--	--	--	--	--	--	--	--	--

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT**	**DRAINAGE DITCH**		**OPERATIONS AREA**							
Location ID:	**DEP**	**SD3-24**	**SS3-C1**	**B-1**	**B-5**	**B-7**	**B-8**	**B-14**	**B-14**	**B-15**	**B-17**
Depth Interval:	**Pollutant**	**(2.0 - 3.0')**	**(0.0 - 0.5')**	**(2')**	**(2')**	**(2')**	**(1.0 - 3.0')**	**(2')**	**(2')**	**(4.0 - 6.0')**	**(1')**
Date Sampled:	**Mobility**	**12/19/1991**	**12/9/1991**	**4/30/1991**	**5/1/1991**	**5/1/1991**	**5/1/1991**	**5/2/1991**	**5/2/1991**	**5/3/1991**	**5/2/1991**
Sample Type:	**Criteria**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**D**	**S**	**S**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	--	0.011 U	--	--	--	**0.92**	--	--	0.72 U	--
1,1,2,2-Tetrachloroethane	**0.01**	--	0.011 U	--	--	--	0.7 U	--	--	0.72 U	--
1,1-Dichloroethane	**1.4**	--	0.011 U	--	--	--	0.7 U	--	--	**0.11 J**	--
1,1-Dichloroethene	**0.14**	--	0.011 U	--	--	--	0.7 U	--	--	0.72 U	--
1,2-Dichloroethene, Total	**1.4**	--	0.011 U	--	--	--	**0.47 J**	--	--	0.72 U	--
2-Butanone	**8**	--	0.011 U	--	--	--	1.4 U	--	--	**1.5 J**	--
Benzene	**0.02**	--	0.011 U	--	--	--	0.7 U	--	--	**0.19 J**	--
Chlorodibromomethane	**0.01**	--	0.011 U	--	--	--	0.7 U	--	--	0.72 U	--
Chloroform	**0.12**	--	0.011 U	--	--	--	0.7 U	--	--	0.72 U	--
Ethylbenzene	**10.1**	--	0.011 U	--	--	--	**1.2**	--	--	**23 J**	--
Methylene chloride	**0.1**	--	0.044 UJ	--	--	--	0.7 U	--	--	0.72 U	--
Tetrachloroethene	**0.1**	--	0.011 U	--	--	--	**2.3**	--	--	**0.2 J**	--
Toluene	**20**	--	0.011 U	--	--	--	**46 ***	--	--	**18 J**	--
Trichloroethene	**0.1**	--	0.011 U	--	--	--	**0.38 J**	--	--	0.72 U	--
Vinyl chloride	**0.04**	--	0.011 U	--	--	--	1.4 U	--	--	1.4 U	--
Xylenes, Total	**19.5**	--	0.011 U	--	--	--	**2.8**	--	--	**150 ***	--
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	--	0.38 UJ	--	--	--	0.74 UJ	--	--	0.75 UJ	--
Benzo(k)fluoranthene	**1**	--	0.38 UJ	--	--	--	0.74 UJ	--	--	0.75 UJ	--
bis(2-Ethylhexyl)phthalate	**1**	--	**2.7 J**	--	--	--	**13 J**	--	--	**120 J***	--
Inorganics (SPLP, mg/L)											
Barium	**1**	--	--	--	--	--	--	--	--	--	--
Lead	**0.015**	--	--	--	--	--	--	--	--	--	--

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT**	**OPERATIONS AREA**									
Location ID:	**DEP**	**B-18**	**B-477**	**B-479**	**B-480**	**B-484**	**MW-488**	**SC-1**	**SC-2**	**SC-3**	**SC-4**
Depth Interval:	**Pollutant**	**(1')**	**(0.5 - 1.0')**	**(2.0 - 3.0')**	**(3.5 - 4.0')**	**(3.5 - 4.0')**	**(5.0 - 6.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**
Date Sampled:	**Mobility**	**5/2/1991**	**3/4/1994**	**3/10/1994**	**3/10/1994**	**3/10/1994**	**3/9/1994**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**
Sample Type:	**Criteria**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	--	**46 J**	86 U	**0.25 J**	**0.076 J**	**3.0 J**	**0.051**	**0.009**	**0.838**	**0.74**
1,1,2,2-Tetrachloroethane	**0.01**	--	53 U	86 U	2.1 U	0.71 U	5 U	0.005 U	0.005 U	**0.022**	0.005 U
1,1-Dichloroethane	**1.4**	--	53 U	86 U	2.1 U	0.71 U	**1.9 J**	0.005 U	0.005 U	**0.052**	0.05 U
1,1-Dichloroethene	**0.14**	--	53 U	86 U	2.1 U	0.71 U	5 U	0.005 U	0.005 U	0.005 U	0.05 U
1,2-Dichloroethene, Total	**1.4**	--	**10 J**	**12 J**	**1.1 J**	**0.34 J**	**20**	0.005 U	0.005 U	**0.31**	**1.56**
2-Butanone	**8**	--	53 U	86 U	2.1 U	4 U	5 U	0.01 U	**0.018**	0.01 U	**3.162**
Benzene	**0.02**	--	53 U	86 U	2.1 U	0.71 U	5 U	0.005 U	0.005 U	**0.019**	**0.031**
Chlorodibromomethane	**0.01**	--	53 U	86 U	2.1 U	0.71 U	5 U	0.005 U	0.005 U	**0.027**	0.005 U
Chloroform	**0.12**	--	53 U	86 U	2.1 U	0.71 U	**2.1 J**	0.005 U	**0.005**	**0.045**	**0.091**
Ethylbenzene	**10.1**	--	**300**	86 U	**26**	**11**	**34**	0.005 U	**0.015**	**0.19**	**67.5**
Methylene chloride	**0.1**	--	53 U	86 U	2.1 U	0.71 U	5 U	**0.03**	**0.105**	**0.553**	**0.49**
Tetrachloroethene	**0.1**	--	**60**	**1200**	**0.84 J**	**0.094 J**	**12**	**0.088**	**0.034**	**0.334**	**23.6**
Toluene	**20**	--	**230**	86 U	**3.2**	**1.6**	**88**	**0.072**	**0.023**	**0.372**	**6.69**
Trichloroethene	**0.1**	--	**58**	86 U	**0.28 J**	**0.22 J**	**12**	**0.052**	**0.063**	**0.295**	**10.4**
Vinyl chloride	**0.04**	--	53 U	86 U	2.1 U	**0.4 J**	5 U	0.005 U	0.005 U	0.005 U	0.05 U
Xylenes, Total	**19.5**	--	**1200 E**	86 U	**2.5**	**2.1**	**73**	--	--	--	--
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	**1**	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	**1**	--	--	--	--	--	--	--	--	--	--
Inorganics (SPLP, mg/L)											
Barium	**1**	--	--	--	--	--	--	--	--	--	--
Lead	**0.015**	--	--	--	--	--	--	--	--	--	--

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT**	**OPERATIONS AREA**									
Location ID:	**DEP**	**SC-5**	**SC-6**	**SC-7**	**SC-8**	**SC-9**	**SC-9**	**SC-10**	**SC-11**	**SC-12**	**SC-13**
Depth Interval:	**Pollutant**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(5.0 - 6.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**
Date Sampled:	**Mobility**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**
Sample Type:	**Criteria**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	0.01 U	**36**	**1.3**	**16**	**170**	**0.44**	**35**	**8.1**	**21**	**0.012**
1,1,2,2-Tetrachloroethane	**0.01**	0.01 U	2 U	0.01 U	2 U	2 U	0.02 U	2 U	2 U	2 U	0.005 U
1,1-Dichloroethane	**1.4**	0.01 U	2 U	0.01 U	2 U	2 U	0.02 U	2 U	2 U	2 U	0.005 U
1,1-Dichloroethene	**0.14**	0.01 U	2 U	0.01 U	2 U	**2.1**	0.02 U	2 U	2 U	2 U	0.005 U
1,2-Dichloroethene, Total	**1.4**	0.01 U	2 U	0.01 U	2 U	**2.3**	**0.29**	2 U	2 U	2 U	0.005 U
2-Butanone	**8**	**0.11**	**29**	**0.44**	**8.3**	**25**	**1.8**	**35**	**38**	**44**	0.01 U
Benzene	**0.02**	0.01 U	2 U	**0.013**	2 U	**2.6**	**0.03**	2 U	2 U	**2.1**	0.005 U
Chlorodibromomethane	**0.01**	0.01 U	2 U	0.01 U	2 U	2 U	0.02 U	2 U	2 U	2 U	0.005 U
Chloroform	**0.12**	**0.019**	2 U	**0.03**	2 U	**2.1**	0.02 U	2 U	2 U	2 U	0.005 U
Ethylbenzene	**10.1**	**0.375**	**720**	**0.54**	**40**	**45**	**3.63**	**50**	**58**	**200**	**0.156**
Methylene chloride	**0.1**	**0.096**	**2.7**	**0.069**	**3.5**	**7.4**	**1.68**	2 U	2 U	2 U	**0.023**
Tetrachloroethene	**0.1**	**0.096**	**510**	**8.81**	**170**	**120**	**5.1**	**160**	**15**	**570**	**0.106**
Toluene	**20**	**0.211**	**380**	**0.77**	**490**	**59**	**7.2**	**360**	**36**	**88**	**0.077**
Trichloroethene	**0.1**	**0.022**	**76**	**7.03**	**49**	**430**	**6.41**	**170**	2 U	**35**	**0.022**
Vinyl chloride	**0.04**	0.01 U	2 U	0.01 U	2 U	2 U	0.02 U	2 U	2 U	2 U	0.005 U
Xylenes, Total	**19.5**	--	--	--	--	--	--	--	--	--	--
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	**1**	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	**1**	--	--	--	--	--	--	--	--	--	--
Inorganics (SPLP, mg/L)											
Barium	**1**	--	--	--	--	--	--	--	--	--	--
Lead	**0.015**	--	--	--	--	--	--	--	--	--	--

See Notes on Page 10.

TABLE N-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

Area:	**CT DEP Pollutant Mobility Criteria**	**OPERATIONS AREA**									
Location ID:		**SC-14**	**SC-15**	**SC-16**	**SC-17**	**SC-18**	**SC-19**	**SC-20**	**SC-21**	**SC-22**	**SP-485**
Depth Interval:		**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(1.0 - 3.0')**	**(0.0 - 1.0')**
Date Sampled:		**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**1/1/1985**	**3/9/1994**
Sample Type:		**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
VOCs (mg/kg)											
1,1,1-Trichloroethane	**4**	**0.12**	2 U	**0.015**	**0.022**	**5.8**	**260**	**24**	0.005 U	**0.047**	**26**
1,1,2,2-Tetrachloroethane	**0.01**	0.005 U	2 U	0.005 U	0.01 U	2 U	2 U	2 U	0.005 U	0.005 U	15 U
1,1-Dichloroethane	**1.4**	0.005 U	2 U	0.005 U	0.01 U	2 U	2 U	2 U	0.005 U	0.005 U	**2.8 J**
1,1-Dichloroethene	**0.14**	0.005 U	2 U	0.005 U	0.01 U	2 U	**4.2**	2 U	0.005 U	0.005 U	15 U
1,2-Dichloroethene, Total	**1.4**	**0.21**	2 U	0.005 U	0.01 U	2 U	2 U	2 U	0.005 U	0.005 U	**35**
2-Butanone	**8**	0.01 U	2 U	0.01 U	0.01 U	**11**	**37**	**13**	0.01 U	0.01 U	15 U
Benzene	**0.02**	0.005 U	2 U	0.005 U	0.01 U	2 U	**2.9**	2 U	0.005 U	**0.009**	15 U
Chlorodibromomethane	**0.01**	0.005 U	2 U	0.005 U	0.01 U	2 U	2 U	2 U	0.005 U	0.005 U	15 U
Chloroform	**0.12**	0.005 U	2 U	**0.03**	**0.015**	**3.5**	**5.9**	2 U	0.005 U	0.005 U	15 U
Ethylbenzene	**10.1**	**0.15**	**150**	**0.483**	0.01 U	**20**	**57**	**74**	0.005 U	0.005 U	**84**
Methylene chloride	**0.1**	**0.013**	**3.7**	**0.02**	0.01 U	2 U	2 U	2 U	**0.015**	**0.24**	15 U
Tetrachloroethene	**0.1**	**3.57**	**94**	**0.806**	**0.036**	**22**	**820**	**77**	**0.01**	**0.29**	**8.1 J**
Toluene	**20**	**0.091**	**20**	**0.115**	**0.035**	**20**	**500**	**92**	**0.01**	0.005 U	**200**
Trichloroethene	**0.1**	**0.53**	2 U	**0.019**	0.01 U	2 U	**52**	**19**	0.005 U	**0.064**	**3.7 J**
Vinyl chloride	**0.04**	0.005 U	2 U	0.005 U	0.01 U	2 U	2 U	2 U	0.005 U	0.005 U	15 U
Xylenes, Total	**19.5**	--	--	--	--	--	--	--	--	--	**320 E**
SVOCs (mg/kg)											
Benzo(b)fluoranthene	**1**	--	--	--	--	--	--	--	--	--	--
Benzo(k)fluoranthene	**1**	--	--	--	--	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	**1**	--	--	--	--	--	--	--	--	--	--
Inorganics (SPLP, mg/L)											
Barium	**1**	--	--	--	--	--	--	--	--	--	--
Lead	**0.015**	--	--	--	--	--	--	--	--	--	--

See Notes on Page 10.

TABLE M-4B

SRSNE
SOUTHINGTON, CT

DETAILED LISTING OF ANALYTES DETECTED ABOVE CT DEP POLLUTANT MOBILITY CRITERIA

General Notes:

These data based on vadose zone samples only.
-- Indicates that the sample was not collected/analyzed for the listed analyte.

Data Qualifiers:

B = Indicates the analyte was found in the blanks as well as the sample. The data user should use caution when applying the results of this analyte.
D = All compounds identified in an analysis at a secondary dilution factor.
E = (Organics) Indicates that it exceeds calibration curve range.
(Inorganics) Reported value is estimated because of the presence of interference.
J = The compound was analyzed for and determined to be present in the sample. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.
N = (Inorganics) Spiked sample recovery not within control limits.
R = The sample results were rejected.
U = Indicates that the compound was analyzed for but not detected at the associated detection limit.
UJ = Indicates that the compound was analyzed for but not detected at the associated estimated detection limit.
* = Duplicate analysis not within control limits.

TABLE N-5

SRSNE
SOUTHINGTON, CT

DETECTED COMPOUNDS WITHOUT POLLUTANT MOBILITY CRITERIA

CAS Registry Number	Chemical Name	Minimum Detected Value	Maximum Detected Value	Location of Min/Max Detection	Depth of Maximum Detection
Dioxins/Furans (ppm)					
35822-46-9	1,2,3,4,6,7,8-HpCDD		0.00027 J	B-1	1.0 - 3.0'
BBL-TEQ	2,3,7,8-TCDD (TEQ)	0.000001 J	0.00001 J	B-14/B-1	1.0 - 3.0'
3268-87-9	OCDDs, Total	0.00126	0.00282 J	B-14/B-1	1.0 - 3.0'

Notes:

Above-listed results detected in the Operations Area, which is covered by asphalt/concrete and will be capped. Thus, Pollutant Mobility compliance will be achieved via engineered control.

TABLE N-6

SRSNE
SOUTHINGTON, CT

ANALYTES DETECTED ABOVE USEPA BACKGROUND AND MCL/MCLG WITHIN NTCRA 2 CAPTURE ZONE

Chemical Class	CAS Registry Number	Chemical Name	Units	MCL/MCLG	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
OV	71-55-6	1,1,1-Trichloroethane	ug/L	200	100,000	CPZ-9R	6/11/2003
OV	71-55-6	1,1,1-Trichloroethane	ug/L	200	100,000	P-4B	6/12/2003
OV	75-35-4	1,1-Dichloroethene	ug/L	7	10,000	CPZ-9R	6/11/2003
OV	107-06-2	1,2-Dichloroethane	ug/L	5	43	CPZ-3R	12/19/1996
OV	71-43-2	Benzene	ug/L	5	190	P-3A	12/20/1996
OV	56-23-5	Carbon tetrachloride	ug/L	5	57	P-1A	12/18/1996
OV	108-90-7	Chlorobenzene	ug/L	100	104	MWL-307	6/11/2003
OV	156-59-2	cis-1,2-Dichloroethene	ug/L	70	630,000	CPZ-9R	6/11/2003
OV	100-41-4	Ethylbenzene	ug/L	700	86,000	CPZ-7R	6/12/2003
OV	75-09-2	Methylene chloride	ug/L	5	28,000	CPZ-9R	6/11/2003
OV	100-42-5	Styrene	ug/L	100	4,000	CPZ-9R	6/11/2003
OV	127-18-4	Tetrachloroethene	ug/L	5	70,000	CPZ-9R	6/11/2003
OV	108-88-3	Toluene	ug/L	1000	240,000	CPZ-7R	6/12/2003
OV	79-01-6	Trichloroethene	ug/L	5	590,000	CPZ-9R	6/11/2003
OV	75-01-4	Vinyl chloride	ug/L	2	100,000	CPZ-7R	6/12/2003
OV	1330-20-7	Xylenes, Total	ug/L	10000	107,000	CPZ-7R	6/12/2003
OPCB	11097-69-1	Aroclor-1254	ug/L	0.5	180	P-1A	12/4/1992
OPCB	11096-82-5	Aroclor-1260	ug/L	0.5	104 J	P-1B	12/4/1992
I	7429-90-5	Aluminum	ug/L	50	430,000	P-11A	8/26/1991
I	7440-38-2	Arsenic	ug/L	50	63 J	P-1B	12/4/1992
I	7440-39-3	Barium	ug/L	2000	20,000	DN-2	6/28/1990
I	7440-41-7	Beryllium	ug/L	4	52	P-11A	8/26/1991
I	7440-43-9	Cadmium	ug/L	5	87	P-1B	12/4/1992
I	7440-47-3	Chromium	ug/L	100	760	P-11A	8/26/1991
I	7440-50-8	Copper	ug/L	1300	1,600 J	P-2A	8/16/1991
I	7439-89-6	Iron	ug/L	300	690,000	P-11A	8/26/1991
I	7439-92-1	Lead	ug/L	15	190	WE-1	6/26/1990
I	7439-96-5	Manganese	ug/L	50	43,000 J	P-12A	8/13/1991
I	7440-02-0	Nickel	ug/L	100	790 J	P-11A	8/26/1991
I	7440-28-0	Thallium	ug/L	2	13 J	TW-04	6/27/1990
I	7440-66-6	Zinc	ug/L	5000	12,000	WE-2	6/26/1990

Notes:
1) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
2) Data based on sampling completed as of October 2003, except April 2004 for 1,4-dioxane.

TABLE N-7

SRSNE
SOUTHINGTON, CT

ANALYTES DETECTED IN GROUNDWATER ABOVE CT DEP BACKGROUND WITHIN NTCRA 2 CAPTURE ZONE

Chemical Class	CAS Registry Number	Chemical Name	Units	CT DEP Background	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
OV	630-20-6	1,1,1,2-Tetrachloroethane	ug/L	ND	1.8 J	P-2A	8/16/1991
OV	71-55-6	1,1,1-Trichloroethane	ug/L	ND	100,000	CPZ-9R	6/11/2003
OV	71-55-6	1,1,1-Trichloroethane	ug/L	ND	100,000	P-4B	6/12/2003
OV	75-34-3	1,1-Dichloroethane	ug/L	ND	30,000	MW-413	6/11/2003
OV	75-35-4	1,1-Dichloroethene	ug/L	ND	10,000	CPZ-9R	6/11/2003
OV	95-50-1	1,2-Dichlorobenzene	ug/L	ND	5	P-6	12/10/1996
OV	107-06-2	1,2-Dichloroethane	ug/L	ND	43	CPZ-3R	12/19/1996
OV	540-59-0	1,2-Dichloroethene, Total	ug/L	ND	660,000	P-1B	12/18/1996
OV	123-91-1	1,4-Dioxane	ug/L	ND	2,000	MW-502	4/23/2004
OV	78-93-3	2-Butanone	ug/L	ND	130,000	CPZ-7R	6/12/2003
OV	591-78-6	2-Hexanone	ug/L	ND	1,600 J	CPZ-6R	12/20/1996
OV	108-10-1	4-Methyl-2-pentanone	ug/L	ND	150,000	CPZ-7R	6/12/2003
OV	67-64-1	Acetone	ug/L	ND	230,000	CPZ-7R	6/12/2003
OV	71-43-2	Benzene	ug/L	ND	190	P-3A	12/20/1996
OV	75-15-0	Carbon disulfide	ug/L	ND	25	MW-704R	12/17/1996
OV	56-23-5	Carbon tetrachloride	ug/L	ND	57	P-1A	12/18/1996
OV	108-90-7	Chlorobenzene	ug/L	ND	104	MWL-307	6/11/2003
OV	75-00-3	Chloroethane	ug/L	ND	2,900	CPZ-3	6/10/2003
OV	75-00-3	Chloroethane	ug/L	ND	2,900	RW-8	6/10/2003
OV	67-66-3	Chloroform	ug/L	ND	16	MW-709DR	12/12/1996
OV	156-59-2	cis-1,2-Dichloroethene	ug/L	ND	630,000	CPZ-9R	6/11/2003
OV	100-41-4	Ethylbenzene	ug/L	ND	86,000	CPZ-7R	6/12/2003
OV	BBL-MPX	M,P-Xylene	ug/L	ND	77,000	CPZ-7R	6/12/2003
OV	75-09-2	Methylene chloride	ug/L	ND	28,000	CPZ-9R	6/11/2003
OV	95-47-6	O-Xylene	ug/L	ND	30,000	CPZ-7R	6/12/2003
OV	100-42-5	Styrene	ug/L	ND	4,000	CPZ-9R	6/11/2003
OV	127-18-4	Tetrachloroethene	ug/L	ND	70,000	CPZ-9R	6/11/2003
OV	109-99-9	Tetrahydrofuran	ug/L	ND	160,000	CPZ-7R	6/12/2003
OV	108-88-3	Toluene	ug/L	ND	240,000	CPZ-7R	6/12/2003
OV	156-60-5	trans-1,2-Dichloroethene	ug/L	ND	35	TW-11	12/13/1990
OV	79-01-6	Trichloroethene	ug/L	ND	590,000	CPZ-9R	6/11/2003
OV	75-01-4	Vinyl chloride	ug/L	ND	100,000	CPZ-7R	6/12/2003
OV	1330-20-7	Xylenes, Total	ug/L	ND	107,000	CPZ-7R	6/12/2003
OSV	120-82-1	1,2,4-Trichlorobenzene	ug/L	ND	2 J	MW-121C	12/9/1992

See Notes, Page 3.

TABLE N-7

SRSNE
SOUTHINGTON, CT

ANALYTES DETECTED IN GROUNDWATER ABOVE CT DEP BACKGROUND WITHIN NTCRA 2 CAPTURE ZONE

Chemical Class	CAS Registry Number	Chemical Name	Units	CT DEP Background	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
OSV	105-67-9	2,4-Dimethylphenol	ug/L	ND	230 J	P-1B	12/4/1992
OSV	91-57-6	2-Methylnaphthalene	ug/L	ND	6 J	MW-123C	8/28/1991
OSV	95-48-7	2-Methylphenol	ug/L	ND	140 J	P-1B	12/4/1992
OSV	106-44-5	4-Methylphenol	ug/L	ND	1,100	P-101B	12/8/1992
OSV	65-85-0	Benzoic Acid	ug/L	ND	910	TW-08A	6/28/1990
OSV	117-81-7	bis(2-Ethylhexyl)phthalate	ug/L	ND	3 J	TW-03	6/27/1990
OSV	84-74-2	Di-n-butyl phthalate	ug/L	ND	2 J	P-1A	12/4/1992
OSV	117-84-0	Di-n-octyl phthalate	ug/L	ND	5 J	P-1A	12/4/1992
OSV	84-66-2	Diethyl phthalate	ug/L	ND	2 J	MW-203B	12/10/1992
OSV	78-59-1	Isophorone	ug/L	ND	120 J	P-1B	12/4/1992
OSV	91-20-3	Naphthalene	ug/L	ND	52	P-4B	12/3/1992
OSV	108-95-2	Phenol	ug/L	ND	2,800	P-1B	12/4/1992
OPCB	11097-69-1	Aroclor-1254	ug/L	ND	180	P-1A	12/4/1992
OPCB	11096-82-5	Aroclor-1260	ug/L	ND	104 J	P-1B	12/4/1992
OPCB	1336-36-3	PCBs, Total	ug/L	ND	180	P-1A	12/4/1992
OP	72-54-8	4,4'-DDD	ug/L	ND	0.17	P-3A	8/29/1991
OP	309-00-2	Aldrin	ug/L	ND	0.07	P-3A	8/29/1991
OP	58-89-9	gamma-BHC (Lindane)	ug/L	ND	0.05 J	MW-121A	12/10/1992
OL	64-19-7	Acetic Acid	ug/L	ND	200,000	MW-125C	6/11/2003
OL	64-17-5	Ethanol	ug/L	ND	3,400	MWL-307	12/16/1996
OL	67-63-0	Isopropanol	ug/L	ND	250,000	CPZ-7R	6/12/2003
OL	67-56-1	Methanol	ug/L	ND	9,500	P-5A	12/13/1996
OL	79-09-4	Propionic acid	ug/L	ND	16,000	MW-125C	6/11/2003
OL	78-92-2	Sec-Butanol	ug/L	ND	19,000	P-5A	12/13/1996
I	7440-38-2	Arsenic	ug/L	19	63 J	P-1B	12/4/1992
I	7440-39-3	Barium	ug/L	955	20,000	DN-2	6/28/1990
I	7440-41-7	Beryllium	ug/L	6.9	52	P-11A	8/26/1991
I	7440-47-3	Chromium	ug/L	140	760	P-11A	8/26/1991
I	7440-48-4	Cobalt	ug/L	122.5	390 J	P-2A	8/16/1991
I	7440-50-8	Copper	ug/L	145	1,600 J	P-2A	8/16/1991
I	7439-92-1	Lead	ug/L	21.5	190	WE-1	6/26/1990
I	7439-96-5	Manganese	ug/L	4550	43,000 J	P-12A	8/13/1991
I	7440-02-0	Nickel	ug/L	145	790 J	P-11A	8/26/1991
I	7440-22-4	Silver	ug/L	16.3	40	DN-2	6/28/1990

See Notes, Page 3.

TABLE N-7

SRSNE
SOUTHINGTON, CT

ANALYTES DETECTED IN GROUNDWATER ABOVE CT DEP BACKGROUND WITHIN NTCRA 2 CAPTURE ZONE

Chemical Class	CAS Registry Number	Chemical Name	Units	CT DEP Background	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
I	7440-62-2	Vanadium	ug/L	295	1,300 J	P-11A	8/26/1991
I	7440-66-6	Zinc	ug/L	420	12,000	WE-2	6/26/1990
GAS	74-85-1	Ethene	ug/L	ND	920	MW-125C	6/11/2003

Notes:

1) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
2) Data based on sampling completed as of October 2003, except April 2004 for 1,4-dioxane.

TABLE N-8

SRSNE
SOUTHINGTON, CT

ANALYTES DETECTED ABOVE USEPA BACKGROUND AND MCL/MCLG OUTSIDE NTCRA 2 CAPTURE ZONE

Chemical Class	CAS Registry Number	Chemical Name	Units	USEPA MCL/MCLG	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
I	7440-28-0	Thallium	ug/L	2	3.8	MW-127C	12/2/1992

Note:
1) Data based on sampling completed as of October 2003, except April 2004 for 1,4-dioxane.

TABLE N-9

SRSNE
SOUTHINGTON, CT

ANALYTES DETECTED IN GROUNDWATER ABOVE CT DEP BACKGROUND OUTSIDE NTCRA 2 CAPTURE ZONE

Chemical Class	CAS Registry Number	Chemical Name	Units	Background *	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
OV	71-55-6	1,1,1-Trichloroethane	ug/L	1	17	MW-02	12/5/1996
OV	75-34-3	1,1-Dichloroethane	ug/L	1	5	CW-3-78	11/20/1996
OV	75-35-4	1,1-Dichloroethene	ug/L	1	2	MW-02	12/5/1996
OV	540-59-0	1,2-Dichloroethene, Total	ug/L	2	6	MW-02	12/5/1996
OV	123-91-1	1,4-Dioxane	ug/L	2	21	MW-03	4/20/2004
OV	67-64-1	Acetone	ug/L	5	8	CW-3-75	11/21/1996
OV	75-00-3	Chloroethane	ug/L	1	2	MW-707M	12/5/1996
OV	156-59-2	cis-1,2-Dichloroethene	ug/L	1	6	MW-02	12/5/1996
OV	79-01-6	Trichloroethene	ug/L	1	2	MW-707S	12/5/1996
OSV	117-84-0	Di-n-octyl phthalate	ug/L	10	1 J	MW-127C	12/2/1992
I	7440-50-8	Copper	ug/L	145	433	MW-205A	12/2/1992
I	7439-92-1	Lead	ug/L	21.5	38.4	MW-205A	12/2/1992

Notes:

1) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
2) * Background expressed as detection limits for organics based on CLP-RAS analysis for VOCs, SW-846 Method 8270 for SVOCs, and SW-846 Method 8270C for 1,4-dioxane.
3) For inorganics, background is concentration detected at CT DEP-approved background monitoring well TW-12.
4) Data based on sampling completed as of October 2003, except April 2004 for 1,4-dioxane.

TABLE N-10

SRSNE
SOUTHINGTON, CT

GROUNDWATER ANALYTES EXCEEDING THE VOLATILIZATION CRITERIA

Chemical Class	CAS Registry Number	Chemical Name	Units	GW Volatilization Criteria	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date
OV	71-55-6	1,1,1-Trichloroethane	ug/L	20,400	100,000	P-4B	6/12/2003
OV	75-35-4	1,1-Dichloroethene	ug/L	1	104	MWL-307	6/11/2003
OV	540-59-0	1,2-Dichloroethene, Total	ug/L	2,740	120,000 D	TW-08A	12/16/1996
OV	75-00-3	Chloroethane	ug/L	63	2,500	MWL-307	6/11/2003
OV	156-59-2	cis-1,2-Dichloroethene	ug/L	3,370	63,000	TW-08A	6/11/2003
OV	127-18-4	Tetrachloroethene	ug/L	1,500	5,100	P-4B	6/12/2003
OV	109-99-9	Tetrahydrofuran	ug/L	1,760	1,800 D	MWL-309	12/6/1996
OV	108-88-3	Toluene	ug/L	23,500	61,000	P-4B	6/12/2003
OV	79-01-6	Trichloroethene	ug/L	219	15,000	P-4B	6/12/2003
OV	75-01-4	Vinyl chloride	ug/L	2	10,000	MWL-308	12/12/1996

Notes:

1) D - Concentration is based on a diluted sample analysis.
2) Data based on sampling completed as of October 2003, except April 2004 for 1,4-dioxane.

TABLE N-11

SRSNE
SOUTHINGTON, CT

COMPOUNDS DETECTED IN SHALLOW OVERBURDEN GROUNDWATER ADJACENT TO QUINNIPIAC RIVER WITH NO ESTABLISHED SURFACE-WATER PROTECTION CRITERIA

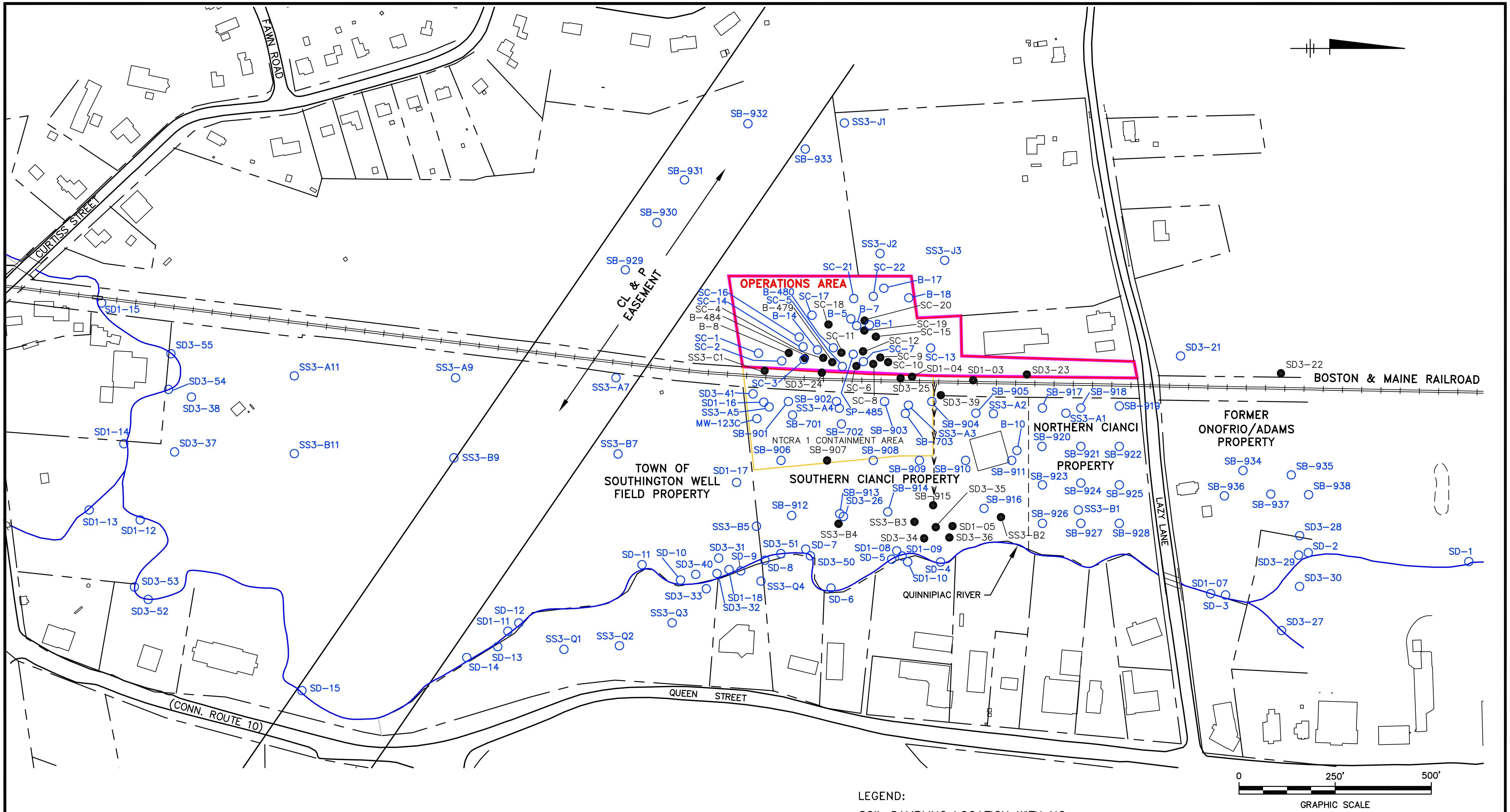
Chemical Class	CAS Registry Number	Chemical Name	Units	Maximum Detected Concentration	Maximum Conc. Location	Max. Conc. Sampling Date	Low SW Criteria	Reference	Alternate Surface Water Protection Criteria
OV	75-34-3	1,1-Dichloroethane	ug/L	22	DP-3	12/19/1996	47	3	470
OV	540-59-0	1,2-Dichloroethene, Total	ug/L	29	DP-3	12/19/1996	140,000	2	1,400,000
OV	123-91-1	1,4-Dioxane	ug/L	170	P-101C	4/22/2004	1,489,000	4	14,890,000
OV	75-15-0	Carbon disulfide	ug/L	11	DP-5	12/3/1996	0.92	3	9.2
OV	75-00-3	Chloroethane	ug/L	22	DP-4	12/19/1996			
OV	156-59-2	cis-1,2-Dichloroethene	ug/L	29	DP-3	12/19/1996			
OV	BBL-MPX	M,P-Xylene	ug/L	8	DP-4	12/19/1996			
OV	95-47-6	O-Xylene	ug/L	1	DP-4	12/19/1996			
OV	109-99-9	Tetrahydrofuran	ug/L	110	DP-2	12/19/1996			
OV	1330-20-7	Xylenes, Total	ug/L	10	DP-4	12/19/1996	13	3	130
OSV	78-59-1	Isophorone	ug/L	1 J	P-11B	8/27/1991	2,600	2	26,000

Notes:

1) J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
2) Connecticut Department of Environmental Protection, Water Quality Standards, Surface-Water Quality Standards Effective December 17, 2002; Ground Water Quality Standards Effective April 12, 1996.
3) Suter, G.W., and C.L. Tsao, 1996 (revision), Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota, Oak Ridge National Laboratories (as provided by CT DEP, November 10, 1999).
4) April 2004 telephone discussion between de maximis and Tracy Iott (CTDEP), who indicated a 1,4-dioxane aquatic toxicity value of 1,489 ppm.
5) Data based on sampling completed as of October 2003, except April 2004 for 1,4-dioxane.

Low SW CRIT = Lowest identified surface water quality criterion.

Figures



LEGEND:

SD3-53 ○ SOIL SAMPLING LOCATION WITH NO EXCEEDANCES OF RESIDENTIAL DEC

SD3-52 ● SOIL SAMPLING LOCATION WITH EXCEEDANCE OF RESIDENTIAL DEC

— — — — APPROXIMATE PROPERTY LINE

▭ EXISTING BUILDING

-->--->--->-- UNDERGROUND CULVERT

NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED
2. 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

ALL SITE FEATURES ARE APPROXIMATE.

X: NONE
P: PAGESET/PLT-BL
L: ON=*; OFF=REF*
6/14/04 SYR-54-YCC RCA DMJ
08331009/FEASIBILITY/08331C09.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

RESIDENTIAL DIRECT EXPOSURE CRITERIA SCREENING RESULTS

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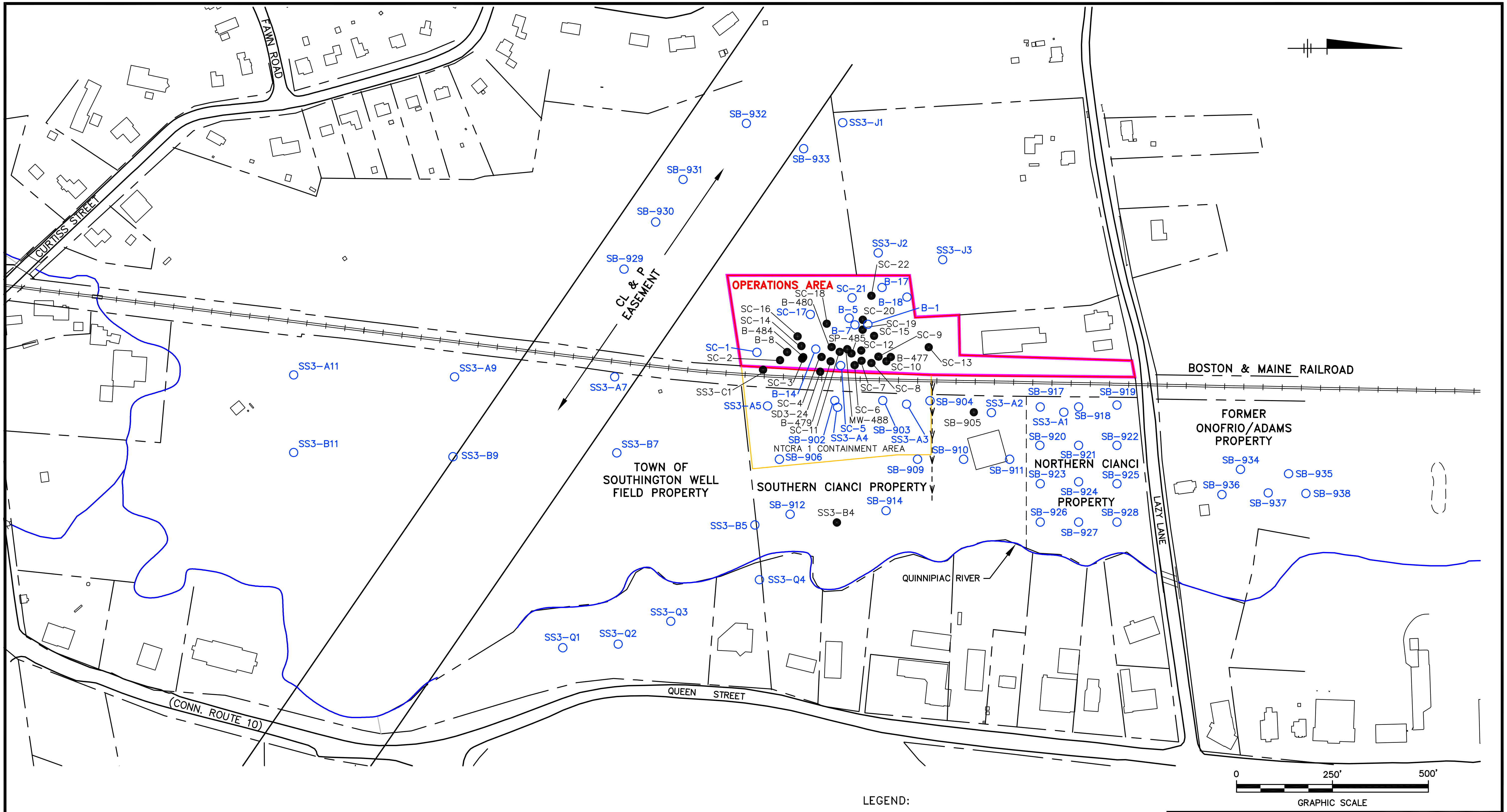
FIGURE
N-1



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. ALL SITE FEATURES ARE APPROXIMATE.

LEGEND:

SB-906 ○	SOIL SAMPLING LOCATION WITH NO EXCEEDANCES OF CLASS GA/GAA PMS
SS3-B4 ●	SOIL SAMPLING LOCATION WITH EXCEEDANCE OF CLASS GA/GAA PMC
— — —	APPROXIMATE PROPERTY LINE
▭	EXISTING BUILDING
-->-->-->--	UNDERGROUND CULVERT

X: NONE
P: PAGESET/PLT-BL
L: ON= *; OFF=REF*
6/14/04 SYR-54-YCC RCA DMJ
08331009/FEASIBILITY/08331C10.DWG

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FEASIBILITY STUDY

POLLUTANT MOBILITY CRITERIA SCREENING RESULTS

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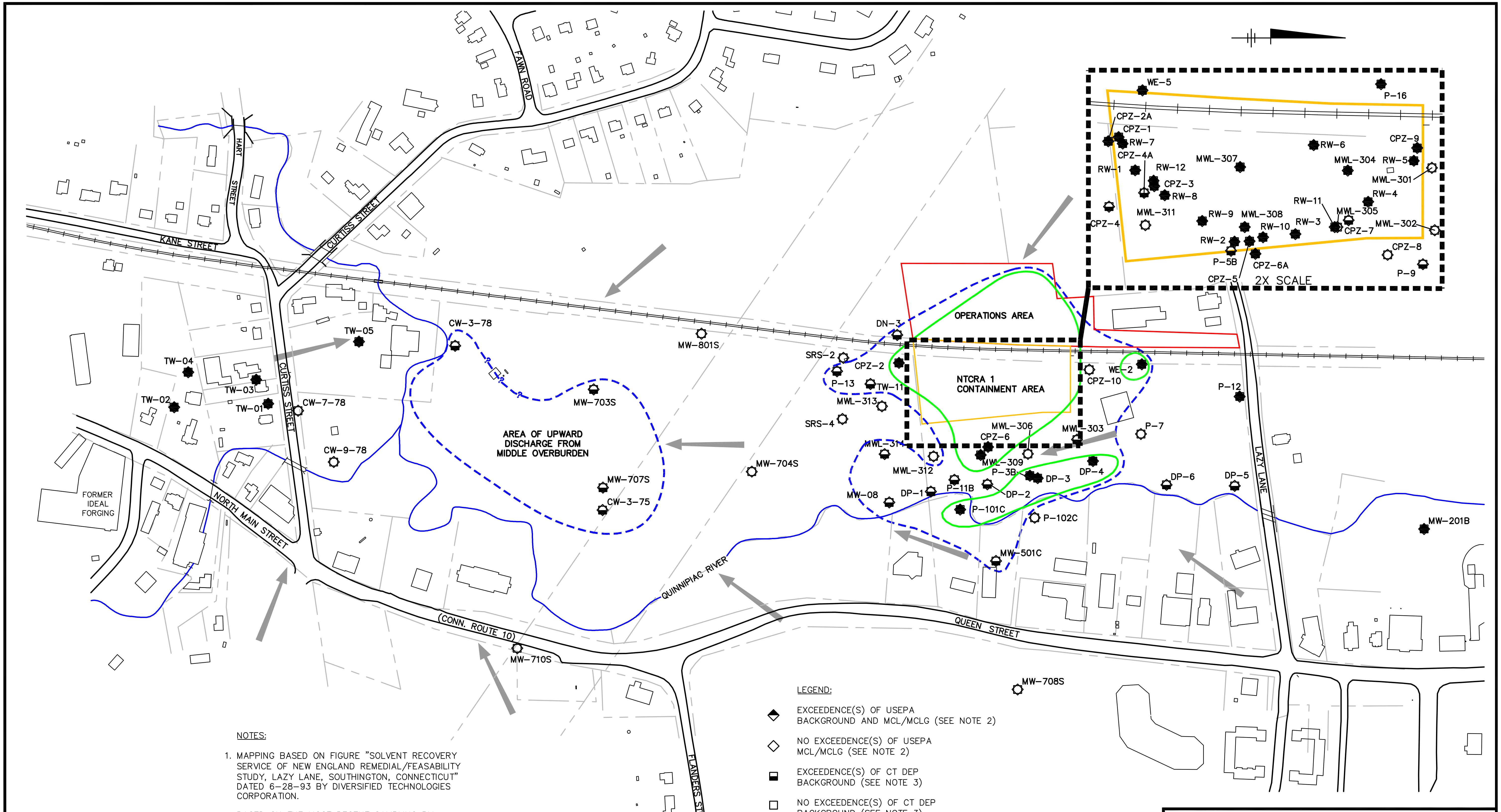
FIGURE
N-2



LEGEND:

⬘	EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
⬓	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
□	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
—	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
←	GENERALIZED GROUND-WATER FLOW DIRECTIONS

NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BASED ON THE MOST RECENT SAMPLING BY HNUS, ENSR, OR BBL (VOCs THROUGH 2003 AND 1,4-DIOXANE IN APRIL 2004).
3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

X: 08331X00, 08331X06
L: ON=*; OFF=*REF*
P: SYR-BL1
6/14/04 SYR-85-RLP RCA DMJ
08331009/FEASIBILITY/08331W01.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW OVERBURDEN GROUND-WATER QUALITY SCREENING RESULTS

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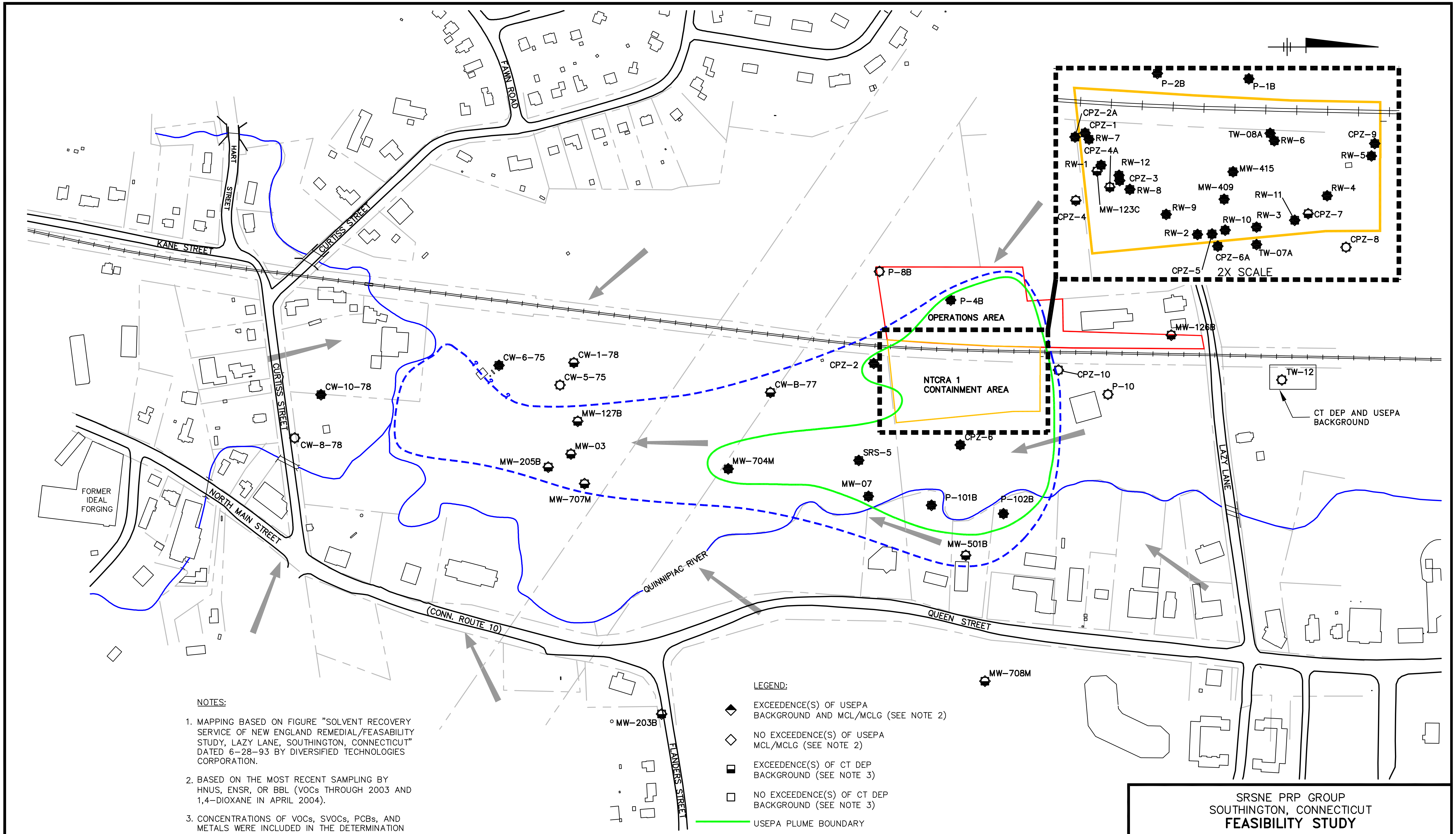
FIGURE
N-3



NOTES:

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3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

◆ EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇ NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
■ EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
☐ NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
— USEPA PLUME BOUNDARY
- - - CT DEP PLUME BOUNDARY (SEE NOTE 4)
← GENERALIZED GROUND-WATER FLOW DIRECTIONS

0 300' 600'
GRAPHIC SCALE

X: 08331X00, 08331X06
L: ON=*; OFF=*REF*
P: SYR-BL1
6/14/04 SYR-85-RLP RCA DMJ
08331009/FEASIBILITY/08331W02.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

MIDDLE OVERBURDEN GROUND-WATER QUALITY SCREENING RESULTS

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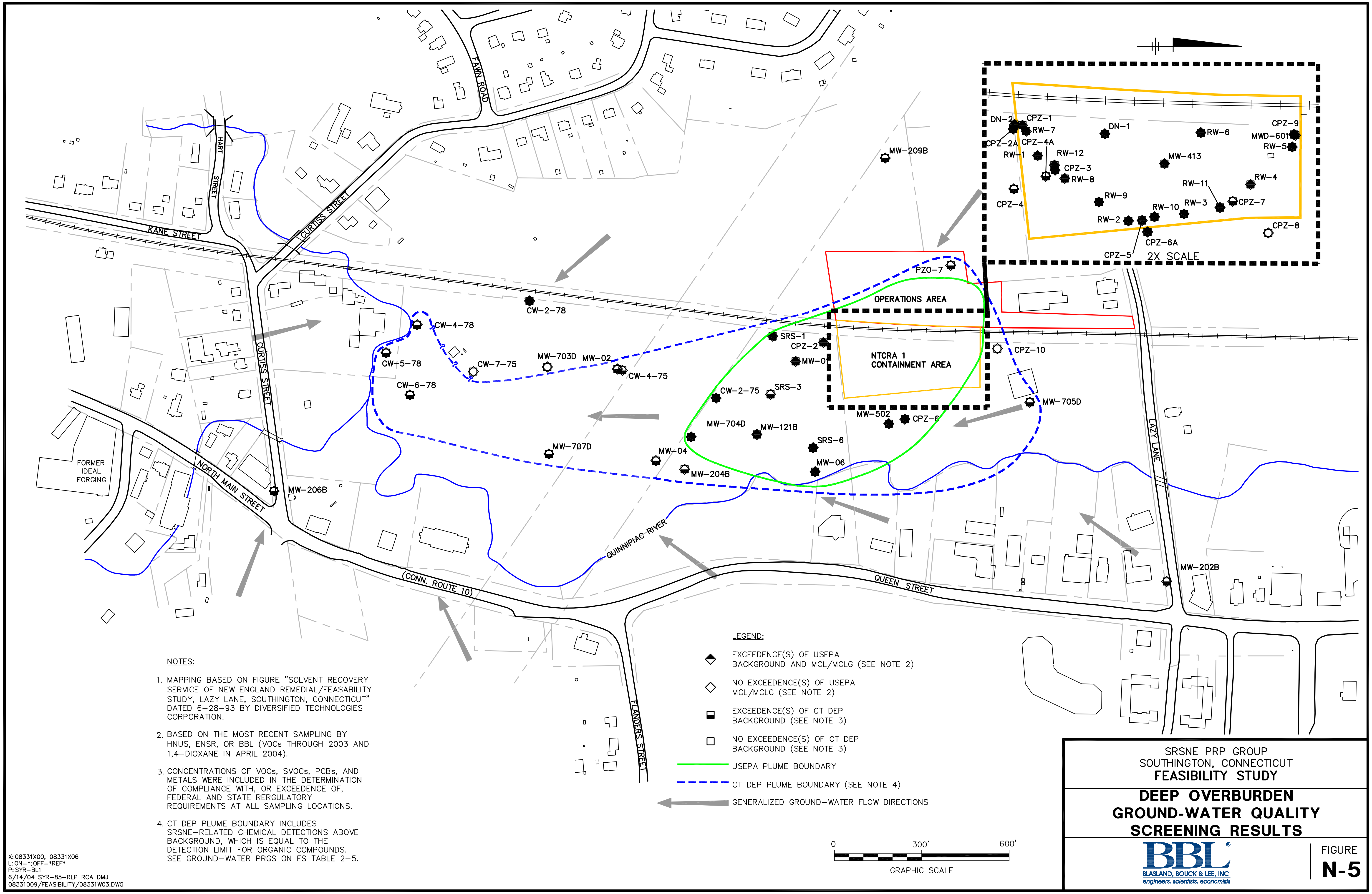
FIGURE
N-4



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
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3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

⬘	EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
⬓	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
☐	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
━━	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
←	GENERALIZED GROUND-WATER FLOW DIRECTIONS

X: 08331X00, 08331X06
L: ON=*; OFF=*REF*
P: SYR-BL1
6/14/04 SYR-85-RLP RCA DMJ
08331009/FEASIBILITY/08331W03.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

DEEP OVERBURDEN GROUND-WATER QUALITY SCREENING RESULTS

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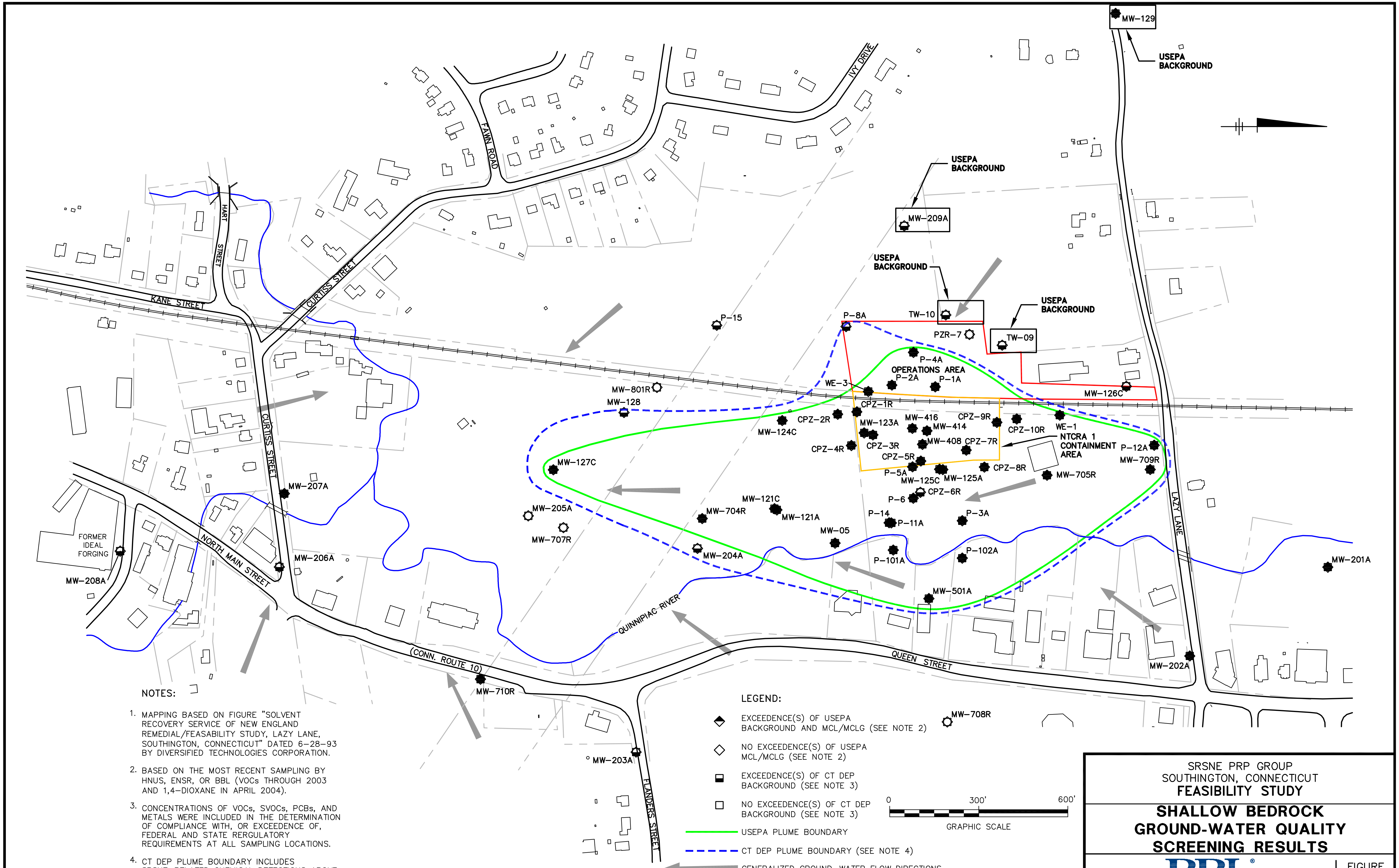
FIGURE
N-5



NOTES:

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4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

⬙	EXCEEDENCE(S) OF USEPA BACKGROUND AND MCL/MCLG (SEE NOTE 2)
◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
⬓	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
☐	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
🟩	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
←	GENERALIZED GROUND-WATER FLOW DIRECTIONS

X: 08331X00, 08331X06
L: ON=*; OFF=*REF*
P: SYR-BL1
6/14/04 SYR-85-RLP RCA DMJ
08331009/FEASIBILITY/08331W04.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SHALLOW BEDROCK GROUND-WATER QUALITY SCREENING RESULTS

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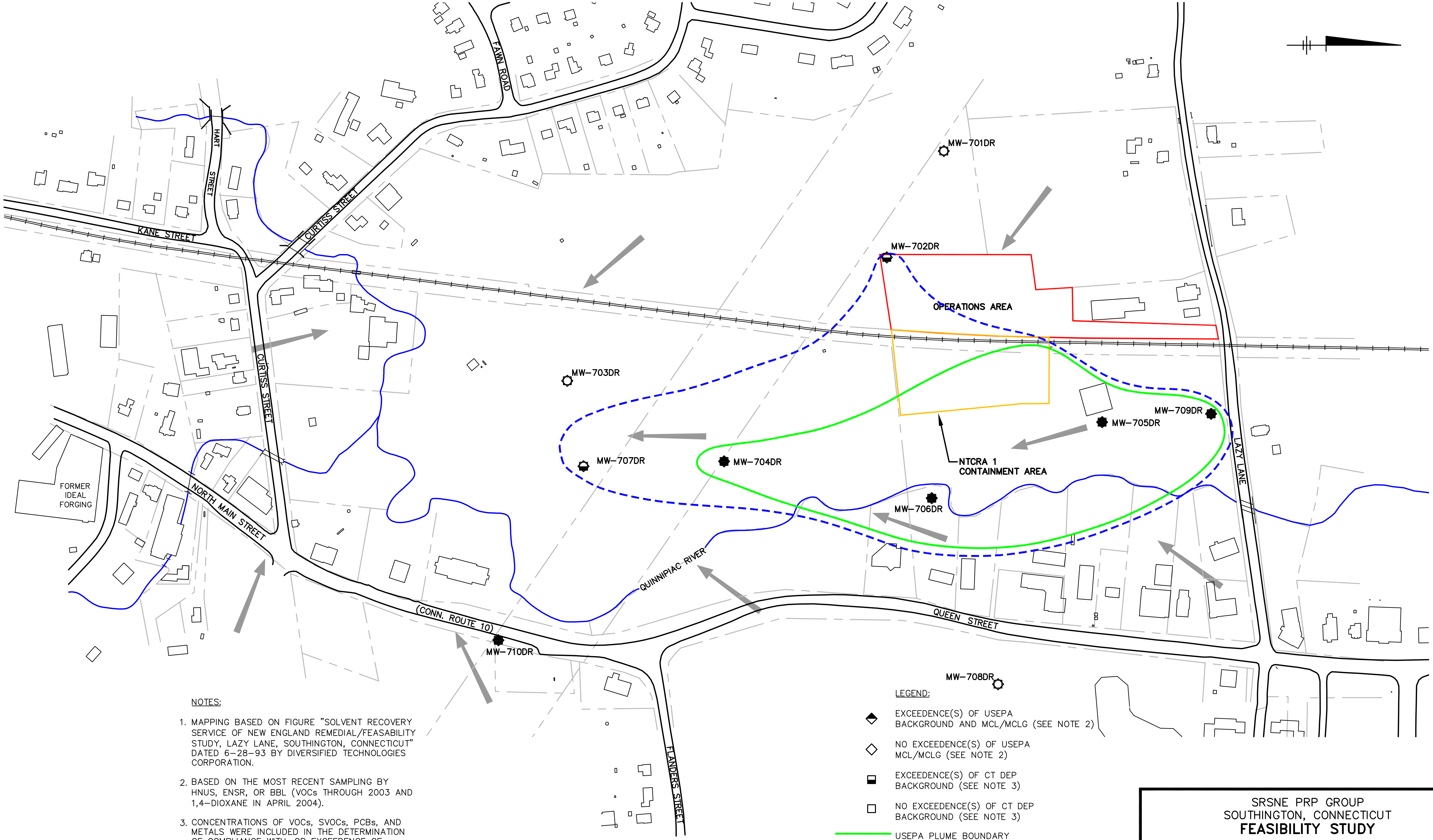
FIGURE
N-6



NOTES:

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3. CONCENTRATIONS OF VOCs, SVOCs, PCBs, AND METALS WERE INCLUDED IN THE DETERMINATION OF COMPLIANCE WITH, OR EXCEEDENCE OF, FEDERAL AND STATE RERGULATORY REQUIREMENTS AT ALL SAMPLING LOCATIONS.
4. CT DEP PLUME BOUNDARY INCLUDES SRSNE-RELATED CHEMICAL DETECTIONS ABOVE BACKGROUND, WHICH IS EQUAL TO THE DETECTION LIMIT FOR ORGANIC COMPOUNDS. SEE GROUND-WATER PRGS ON FS TABLE 2-5.

LEGEND:

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◇	NO EXCEEDENCE(S) OF USEPA MCL/MCLG (SEE NOTE 2)
■	EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
□	NO EXCEEDENCE(S) OF CT DEP BACKGROUND (SEE NOTE 3)
—	USEPA PLUME BOUNDARY
- - -	CT DEP PLUME BOUNDARY (SEE NOTE 4)
←	GENERALIZED GROUND-WATER FLOW DIRECTIONS

0 300' 600'
GRAPHIC SCALE

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

DEEP BEDROCK GROUND-WATER QUALITY SCREENING RESULTS

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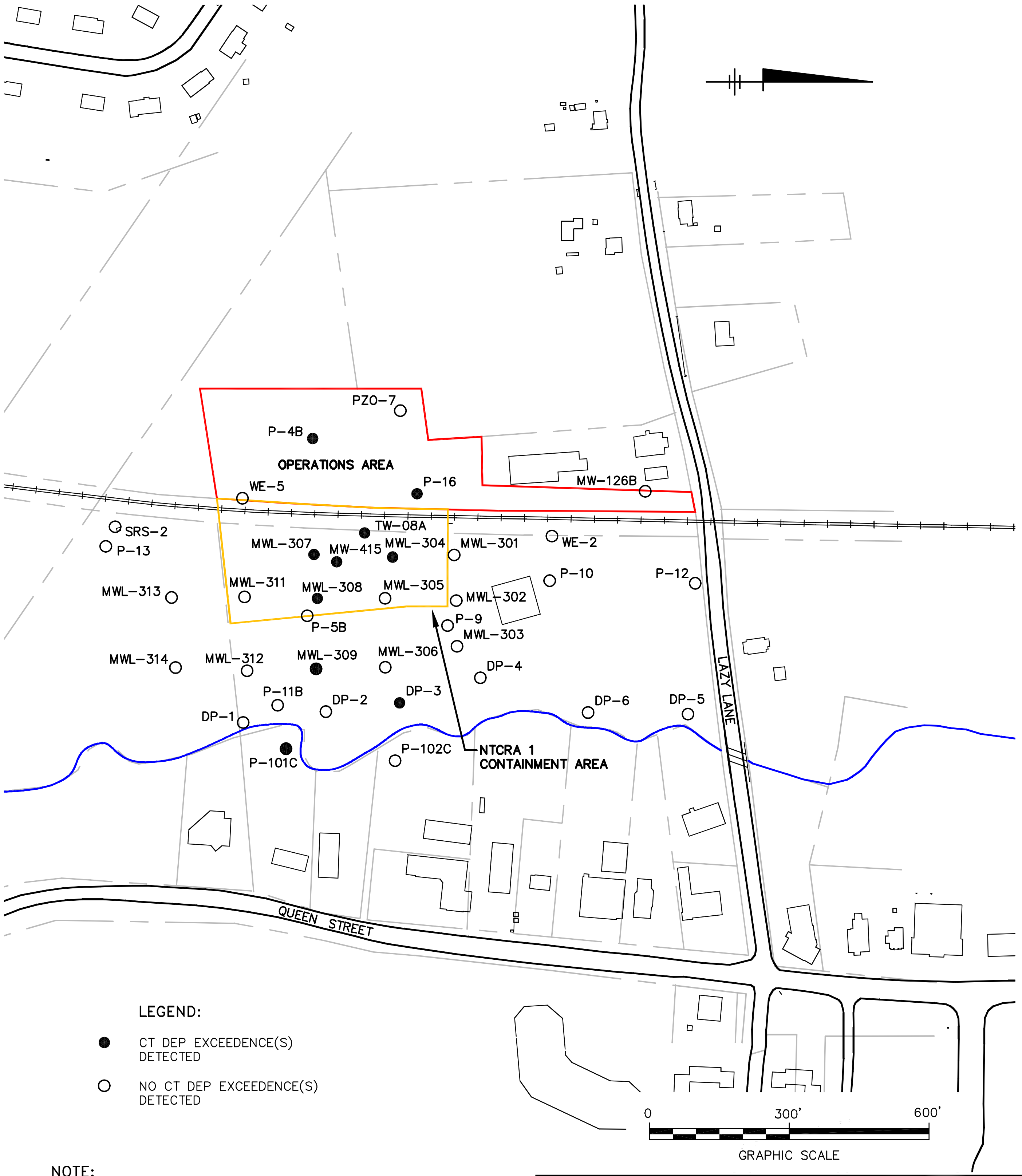
FIGURE
N-7

X: 08331X00, 08331X06
L: ON=*;OFF=*REF*
P: SYR-BL1
6/14/04 SYR-85-RLP RCA DMJ
08331009/FEASIBILITY/08331W05.DWG



NOTE:

MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL/FEASABILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

X: 08331X06.DWG
L: ON=*;OFF=*REF*
P: PAGESET/PLT-AP
6/8/04 SYR-54-RLP, RCB RCA
08331009/FEASIBILITY/08331C08.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

RESIDENTIAL VOLATILIZATION CRITERIA SCREENING RESULTS

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FIGURE
N-8

Attachment N-1

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Attachment N-1

Volatilization Criteria

SITE-SPECIFIC WORKSHEET FOR VOLATILIZATION CRITERIA FOR GROUNDWATER FOR RESIDENTIAL SITES

Site Specific Constants

Term	Units	Value	Description
Oas	unitless	0.26	Volumetric air content in vadose zone
Ows	unitless	0.12	Volumetric water content in vadose zone
Ot	unitless	0.38	Total soil porosity
Oacrack	unitless	0.26	Volumetric air content in foundation/wall cracks
Owcrack	unitless	0.12	Volumetric water content in foundation /wall cracks
Oacap	unitless	0.04	Volumetric air content in capillary fringe soils
Owcap	unitless	0.34	Volumetric water content in capillary fringe soils
Lbr	cm	200	Residential enclose-space volume/area ratio
hcap	cm	5	Thickness of capillary fringe
hv	cm	295	Thickness of vadose zone
Lcrack	cm	15	Enclosed space foundation or wall thickness
n	unitless	0.01	Areal fraction of cracks in foundation/walls
ERr	1/s	0.00014	Residential enclosed space air exchange rate

Compound Specific Constants

Term	Units	Value	Description
Dair	cm^2/s	8.40E-02	Diffusion coefficient in air
Dwater	cm^2/s	1.00E-05	Diffusion coefficient in water

Exposure Parameters

Term	Units	Value	Description
ATc	yrs	70	Averaging time for carcinogens
ATn	yrs	30	Averaging time for non-carcinogens
BW	kg	70	Adult body weight
ED	yrs	30	Exposure duration
EF	days/years	350	Exposure frequency
IRair - indoor	m^3/day	15	Daily indoor inhalation rate
THQ	unitless	1	Target hazard quotient for individual constituents
TR	unitless	1.00E-06	Target excess individual lifetime cancer risk

Recommended values taken from ASTM ES 38-94.

SITE-SPECIFIC WORKSHEET FOR VOLATILIZATION CRITERIA FOR GROUNDWATER FOR RESIDENTIAL SITES

Term Definitions

Term	Units	Value	Description
RfDi	ug/m^3	compound specific	Inhalation chronic reference dose
SFi	$1/(ug/m^3)$	compound specific	Inhalation cancer slope factor
H	cm^3-H_2O/cm^3-air	compound specific	Henry's law constant
MW	g/mole	compound specific	Molecular weight
Koc	cm^3-H_2O/g-C	compound specific	Carbon-water sorption coefficient
S	mg/L-H2O	compound specific	Pure component solubility in water
Dair	cm^2/s	calc.	Diffusion coefficient in air
Dwat	cm^2/s	calc.	Diffusion coefficient in water
Deff, s	cm^2/s	calc.	Effective diffusion through soil (in vapor phase)
Deff, crack	cm^2/s	calc.	Effective diffusion through foundation cracks
Deff,ws	cm^2/s	calc.	Effective diffusion coefficient between ground water and soil surface
TAC	ug/m^3-air	calc.	Target indoor air concentration
VFgw	$(mg/m^3$-a)/(mg/L-w)	calc.	Ground water volatilization factor
GWC	ug/L	calc.	Ground water volatilization criteria

SITE-SPECIFIC WORKSHEET FOR VOLATILIZATION CRITERIA FOR GROUNDWATER FOR RESIDENTIAL SITES

Compound	**H** [cm3-H2O/cm3-air]	**MW** [g/mole]	**Koc** [cm3-H2O/g-C]	**S** [mg/L-H2O]	**Dair** [cm2/s]	**Dwat** [cm2/s]
Acetone	1.75E-03	5.80E+01	5.40E+00	1.00E+06	8.40E-02	1.00E-05
Benzene	2.26E-01	7.80E+01	8.30E+01	1.78E+03	8.40E-02	1.00E-05
Bromoform	2.18E-02	2.53E+02	1.10E+02	3.20E+03	8.40E-02	1.00E-05
2-Butanone (MEK)	1.12E-03	7.20E+01	3.50E+00	2.75E+05	8.40E-02	1.00E-05
Carbon tetrachloride	1.20E+00	1.54E+02	1.10E+02	8.00E+02	8.40E-02	1.00E-05
Chlorobenzene	1.61E-01	1.13E+02	3.30E+02	4.88E+02	8.40E-02	1.00E-05
Chloroform	1.39E-01	1.19E+02	3.10E+01	9.30E+03	8.40E-02	1.00E-05
1,2-Dichlorobenzene	7.95E-02	1.47E+02	1.70E+03	1.45E+02	8.40E-02	1.00E-05
1,3-Dichlorobenzene	1.08E-01	1.47E+02	1.70E+03	1.45E+02	8.40E-02	1.00E-05
1,4-Dichlorobenzene	1.12E-01	1.47E+02	1.80E+03	7.90E+01	8.40E-02	1.00E-05
1,1-Dichloroethane	2.23E-01	9.90E+01	5.80E+01	5.50E+03	8.40E-02	1.00E-05
1,2-Dichloroethane	4.51E-02	9.90E+01	1.40E+01	8.69E+03	8.40E-02	1.00E-05
1,1-Dichloroethylene	6.11E-01	9.70E+01	6.50E+01	2.10E+02	8.40E-02	1.00E-05
1,2-Dichloropropane	1.16E-01	1.13E+02	4.70E+01	2.70E+03	8.40E-02	1.00E-05
1,3-Dichloropropene	1.44E-01	1.11E+02	2.60E+01	2.70E+03	8.40E-02	1.00E-05
Ethyl benzene	1.41E-01	1.06E+02	5.70E+02	1.61E+02	8.40E-02	1.00E-05
Ethylene dibromide (EDB)	2.76E-02	1.88E+02	4.40E+01	4.30E+03	8.40E-02	1.00E-05
Methyl-tert-butyl-ether	2.42E-02	8.80E+01	2.70E+01	4.80E+04	8.40E-02	1.00E-05
Methyl isobutyl ketone	5.66E-03	1.00E+02	3.10E+00	1.91E+04	8.40E-02	1.00E-05
Methylene chloride	1.31E-01	8.50E+01	8.80E+00	1.67E+04	8.40E-02	1.00E-05
Styrene	1.07E-01	1.04E+02	3.10E+00	3.00E+02	8.40E-02	1.00E-05
1,1,1,2-Tetrachloroethane	4.51E-01	1.68E+02	5.40E+01	2.00E+02	8.40E-02	1.00E-05
1,1,2,2-Tetrachloroethane	1.56E-02	1.68E+02	4.60E+01	2.90E+03	8.40E-02	1.00E-05
Tetrachloroethylene	8.36E-02	1.66E+02	4.70E+02	2.00E+02	8.40E-02	1.00E-05
Toluene	2.74E-01	9.20E+01	2.70E+02	5.35E+02	8.40E-02	1.00E-05
1,1,1 Trichloroethane	9.47E-01	1.33E+02	1.60E+02	7.30E+02	8.40E-02	1.00E-05
1,1,2-Trichloroethane	3.73E-02	1.33E+02	3.10E+02	4.50E+03	8.40E-02	1.00E-05
Trichloroethylene	3.74E-01	1.31E+02	1.20E+02	1.10E+03	8.40E-02	1.00E-05
Vinyl chloride	1.14E+00	6.30E+01	9.80E+01	1.10E+00	8.40E-02	1.00E-05
Xylenes	2.16E-01	1.06E+02	3.00E+02	1.71E+02	8.40E-02	1.00E-05
Trans-1,2-dichloroethylene	0.22	96.94			8.40E-02	1.00E-05
Chloroethane	6.15E-01	6.45E+01			8.40E-02	1.00E-05
Trichlorofloromethane	4.72	137.40			8.40E-02	1.00E-05
1,2 - Dichloroethylene (total)	0.17	97.00			8.40E-02	1.00E-05
Cis-1,2-Dichloroethylene	0.14	96.94	31.62	3.50E+03	8.40E-02	1.00E-05
Tetrahydrofuran	4.47E-03		1.78	3.00E+05	8.40E-02	1.00E-05
Carbon disulfide	0.42				8.40E-02	1.00E-05

SITE-SPECIFIC WORKSHEET FOR VOLATILIZATION CRITERIA FOR GROUNDWATER FOR RESIDENTIAL SITES

Deff, s [cm2/s]	**Deff, crack** [cm2/s]	**Deff, cap** [cm2/s]	**Deff, ws** [cm2/s]	**SFi** [1/(ug/m3)]	**RfDi** [ug/m3]	**RBSLair** [ug/m3-air]
6.59E-03	6.59E-03	1.10E-03	6.09E-03		8.00E+02	
6.56E-03	6.56E-03	2.13E-05	1.07E-03	8.30E-06	9.00E+00	2.93E-01
6.56E-03	6.56E-03	1.00E-04	3.16E-03	1.10E-06		2.21E+00
6.61E-03	6.61E-03	1.71E-03	6.31E-03		1.00E+03	
6.56E-03	6.56E-03	1.45E-05	7.68E-04	1.50E-05	4.30E+02	1.62E-01
6.56E-03	6.56E-03	2.47E-05	1.21E-03		2.00E+01	
6.56E-03	6.56E-03	2.66E-05	1.29E-03	2.30E-05	6.60E+02	1.06E-01
6.56E-03	6.56E-03	3.68E-05	1.66E-03		2.00E+02	
6.56E-03	6.56E-03	3.06E-05	1.44E-03		2.00E+02	
6.56E-03	6.56E-03	3.00E-05	1.42E-03		8.00E+02	
6.56E-03	6.56E-03	2.14E-05	1.08E-03		5.00E+02	
6.56E-03	6.56E-03	5.51E-05	2.21E-03	2.60E-05	5.50E+01	9.36E-02
6.56E-03	6.56E-03	1.60E-05	8.39E-04	5.00E-05	5.00E+00	4.87E-02
6.56E-03	6.56E-03	2.94E-05	1.39E-03	1.90E-05	4.00E+00	1.28E-01
6.56E-03	6.56E-03	2.62E-05	1.27E-03	3.70E-05	2.00E+01	6.58E-02
6.56E-03	6.56E-03	2.64E-05	1.28E-03		1.00E+03	
6.56E-03	6.56E-03	8.20E-05	2.83E-03	2.20E-04	2.00E-01	1.11E-02
6.56E-03	6.56E-03	9.16E-05	3.01E-03		5.00E+02	
6.57E-03	6.57E-03	3.50E-04	5.07E-03		8.00E+01	
6.56E-03	6.56E-03	2.74E-05	1.32E-03	4.70E-07	3.00E+03	5.18E+00
6.56E-03	6.56E-03	3.07E-05	1.44E-03	5.70E-07	1.00E+03	4.27E+00
6.56E-03	6.56E-03	1.71E-05	8.89E-04	7.40E-06		3.29E-01
6.56E-03	6.56E-03	1.35E-04	3.66E-03	5.80E-05	9.30E+01	4.20E-02
6.56E-03	6.56E-03	3.57E-05	1.62E-03	5.20E-07	4.60E+03	4.68E+00
6.56E-03	6.56E-03	1.98E-05	1.01E-03		4.00E+02	
6.56E-03	6.56E-03	1.49E-05	7.87E-04		1.00E+03	
6.56E-03	6.56E-03	6.40E-05	2.44E-03	1.60E-05	7.40E+01	1.52E-01
6.56E-03	6.56E-03	1.80E-05	9.28E-04	1.70E-06	1.80E+02	1.43E+00
6.56E-03	6.56E-03	1.45E-05	7.72E-04	8.40E-05	1.70E+01	2.90E-02
6.56E-03	6.56E-03	2.17E-05	1.09E-03		3.00E+02	
6.56E-03	6.56E-03	2.16E-05	1.09E-03		3.50E+02	
6.56E-03	6.56E-03	1.60E-05	8.38E-04		1.33E+04	
6.56E-03	6.56E-03	1.33E-05	7.11E-04		9.33E+02	
6.56E-03	6.56E-03	2.43E-05	1.20E-03		4.20E+01	
6.56E-03	6.56E-03	2.67E-05	1.29E-03			
6.57E-03	6.57E-03	4.39E-04	5.33E-03			
6.56E-03	6.56E-03	1.74E-05	9.03E-04		700.00	

SITE-SPECIFIC WORKSHEET FOR VOLATILIZATION CRITERIA FOR GROUNDWATER FOR RESIDENTIAL SITES

RBSLair [ug/m3-air]	**Air Conc.** [ug/m3-air]	**TAC** [ug/m3-air]	**VFgw** [(mg/m3-a)/(mg/L-w)]	**GWC** **[ug/L]**
8.34E+02	6.00E+00	8.34E+02	2.25E-04	**3704547.40**
9.39E+00	3.25E+00	3.25E+00	1.58E-02	**205.14**
		2.21E+00	2.41E-03	**918.98**
1.04E+03	4.20E+01	1.04E+03	1.46E-04	**7137629.94**
4.48E+02	1.00E+00	1.00E+00	6.92E-02	**14.44**
2.09E+01	1.00E+01	2.09E+01	1.21E-02	**1726.18**
6.88E+02	3.00E+00	3.00E+00	1.07E-02	**279.16**
2.09E+02	1.00E+00	2.09E+02	6.94E-03	**30070.99**
2.09E+02		2.09E+02	8.80E-03	**23695.16**
8.34E+02	5.00E-01	8.34E+02	9.04E-03	**92313.98**
5.21E+02		5.21E+02	1.57E-02	**33158.27**
5.74E+01		9.36E-02	4.42E-03	**21.18**
5.21E+00		4.87E-02	3.72E-02	**1.31**
4.17E+00		1.28E-01	9.30E-03	**13.78**
2.09E+01		6.58E-02	1.10E-02	**5.97**
1.04E+03	2.20E+00	1.04E+03	1.08E-02	**96146.90**
2.09E-01		1.11E-02	2.94E-03	**3.76**
5.21E+02		5.21E+02	2.64E-03	**197861.51**
8.34E+01	2.00E+00	8.34E+01	7.02E-04	**118792.51**
3.13E+03	4.50E+01	4.50E+01	1.02E-02	**4393.19**
1.04E+03	5.00E+00	5.00E+00	8.75E-03	**571.44**
		3.29E-01	2.84E-02	**11.56**
9.70E+01	1.00E-02	4.20E-02	1.79E-03	**23.43**
4.80E+03	1.10E+01	1.10E+01	7.21E-03	**1524.67**
4.17E+02	9.60E-01	4.17E+02	1.86E-02	**22431.62**
1.04E+03	3.00E+01	1.04E+03	5.55E-02	**18801.51**
7.72E+01	3.00E+01	3.00E+01	3.79E-03	**7924.18**
1.88E+02	5.00E+00	5.00E+00	2.42E-02	**206.72**
1.77E+01		2.90E-02	6.59E-02	**0.44**
3.13E+02	4.85E+00	3.13E+02	1.53E-02	**20447.23**
3.65E+02		7.30E+01	1.54E-02	**4734.47**
1.39E+04		2.20E+01	3.74E-02	**587.91**
9.73E+02		7.00E+02	2.59E-01	**2701.46**
4.38E+01		3.30E+01	1.24E-02	**2650.78**
		3.50E+01	1.07E-02	**3280.97**
		9.90E-01	5.61E-04	**1765.50**
7.30E+02		5.00E+01	2.67E-02	**1870.23**

Appendix P

Application of Cosolvent Extraction for DNAPL Removal at the SRSNE Site, Southington, CT

Application of Cosolvent Extraction for DNAPL Removal at the SRSNE Site, Southington, CT

May 10, 2004

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de maximis, inc.

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Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Executive Summary

Cosolvent extraction, also referred to as alcohol flushing, is an emerging technology with application for mass removal at the SRSNE Superfund Site located in Southington, CT. Although there has not been a full-scale implementation of this technology for environmental applications, field-scale pilot testing and laboratory bench-scale studies suggest that significant quantities of contaminant mass can be removed from the ‘observed NAPL in overburden groundwater unit’ (ONOGU) using the technology. It is concluded that cosolvent extraction would meet the overburden remedial action objectives (RAOs) in that significant quantities of contaminant mass would be removed such that (i) the time frame that groundwater standards are exceeded would be reduced, (ii) the size of the groundwater plume would be reduced, (iii) groundwater contaminant concentrations would be reduced, and (iv) mobile NAPL would be removed.

Preliminary analysis suggests that approximately 918,000 gallons of the primary alcohol will need to be injected at a concentration of approximately 90% by volume. To reduce cost and arrive at smaller treatment volumes, however, the technology can be applied in ‘modules’ with recycling of the alcohol. If four modules were utilized, for example, approximately 250,000 gallons of the primary alcohol would need to be purchased, rather than 918,000 gallons. The alcohol would need to be recycled following use in one module prior to injection into a subsequent module. Field trials published in the literature have successfully utilized recycling of alcohol solutions to reduce the capital cost of implementing this technology.

Blending agents to create a neutral density flushing solution will also be required, along with additives to bring about DNAPL density modification such that the threat of vertical DNAPL mobilization is reduced. It is estimated that the alcohol injection for each module will require approximately 21 days, followed by 90 days of clean water injection (polymer assisted) to displace residual alcohol and contaminants. Utilizing four modules in sequence would therefore require a total treatment period of approximately 444 days, but this could be reduced recognizing the fact that the majority of the alcohol to be recycled would be recovered within the first 21 days from each module. The particular alcohol formulation to be employed has not been selected at this time, but literature studies suggest that ethanol may be a suitable candidate for the primary alcohol given the high PCE and TCE content of the target DNAPL. Because cosolvent flushing is an emerging technology with limited application at real sites, it will be necessary to perform laboratory bench-scale and field pilot-scale tests prior to full-scale implementation at SRSNE.

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Figures

1.0 - Introduction

Cosolvent flushing is an innovative technology capable of extracting dense, non-aqueous phase liquids (DNAPLs) from the subsurface. For the purposes of this report, the cosolvents of interest will be water soluble alcohols such as methanol and ethanol. In the most general sense, however, there are a variety of compounds in addition to alcohols that are capable of cosolving with DNAPLs (e.g., acetic acid, acetone, other DNAPLs, etc.). Because the cosolvents of interest in this study are alcohols, the terms cosolvent flushing and alcohol flushing will be used interchangeably throughout this report.

The use of alcohol flushing to remove NAPLs from the subsurface was first investigated as an enhanced oil recovery technique by the petroleum industry in the late 1950s and early 1960s. Gatlin and Slobod (1960) recovered nearly 100% of the initial oil in place from a core using 0.13 pore volumes of 2-propanol (IPA). They suggested that the complete elimination of NAPL-water interfacial tension associated with the high IPA concentrations resulted in piston displacement of NAPL from the core. Subsequent studies (e.g., Taber et al., 1961) found that complete oil recovery was often not achieved in such experiments, and that the displacement process should be viewed as a ‘leaky piston’. These early investigators were finding that the degree of NAPL extraction was dependent on the type of alcohol being utilized for the particular type of NAPL being extracted. Further studies carried out in the 1960s focused on relating extraction efficiency to alcohol slug size and ternary phase behaviour (e.g., Farouq Ali and Stahl, 1962; Taber and Meyer, 1964; Sandrea and Stahl, 1965).

While petroleum industry investigators examined alcohol flushing as an oil extraction technology, researchers in the field of chemical engineering studied the partitioning of chlorinated solvent compounds between water and alcohol. Colburn and Phillips (1944), for example, measured the partitioning of ethanol between water and trichloroethylene (TCE). Other notable studies include Sorenson and Arlt (1979) who examined methanol partitioning between TCE and water, Macedo and Rasmussen (1987) who examined 1-propanol and 1-butanol partitioning between TCE and water as well as methanol partitioning between dichloromethane (DCM) and water, and Bergelin et al. (1942) who examined isopropanol partitioning between tetrachloroethylene (PCE) and water. The results of these studies, in conjunction with the petroleum industry work, clearly showed that a wide range of organic compounds could be solubilized by a variety of alcohols in the presence of water.

With respect to environmental applications, early studies examined the influence of relatively low alcohol concentrations on the enhancement of NAPL solubility in groundwater and the desorption of organic compounds from soil grains (e.g., Nkeddi Kizza, 1987; Rao et al., 1991; Peters and Luthy, 1993; Imhoff et al., 1995). These studies generally employed lower alcohol concentrations than one would utilize for cosolvent flushing applications, and partitioning of the alcohol into the NAPL phase was generally ignored.

With respect to utilizing alcohol flushing as a DNAPL extraction technology, one of the first applications was presented by Boyd (1991) in which residual TCE DNAPL was extracted from water saturated columns using IPA floods. The results of this study demonstrated that extraction efficiency was dependent on alcohol concentration and flood orientation. Brandes and Farley (1993) extended the work of Boyd (1991) by conducting one-dimensional upward flow experiments using IPA and tert-butanol (TBA) for the recovery of residual TCE and PCE DNAPL from porous media columns. This work illustrated that some alcohols will preferentially partition into the DNAPL phase, bringing about DNAPL swelling and an associated reduction in DNAPL density. Falta (1998) discusses the need to inject a sufficient concentration of alcohol in order to achieve miscible extraction in the context of ternary phase diagrams. Reitsma and Kueper (1998a,b) discuss the implications of non-equilibrium alcohol partitioning.

The above referenced environmental studies were performed in one-dimensional sand columns and therefore were not designed to examine hydrodynamic instability issues. Lunn and Kueper (1997) performed two-dimensional laboratory experiments in which ethanol and 1-propanol were used to extract pooled PCE DNAPL from a heterogeneous sand pack. This study showed that hydrodynamic instabilities and dispersion caused alcohol slug deterioration, and that consideration should be given to the use of polymers to stabilize the displacement. The Lunn and Kueper (1997) study also showed that while both of the employed alcohols led to a progressive lowering of DNAPL-water interfacial tension with increasing alcohol concentration, this potential increased vertical mobility of the DNAPL was off-set in the 1-propanol system as a result of preferential partitioning of the alcohol into the DNAPL. The preferential partitioning resulted in a reduction of DNAPL density from an initial value of 1.62 g/cc to approximately 1.04 g/cc prior to achieving full miscibility.

The idea that alcohols could potentially bring about a reversal in NAPL density, thereby causing DNAPLs to become LNAPLs, was further explored by Lunn and Kueper (1999a). Aqueous solutions of 10% isobutanol and 90% water were flushed through pools of PCE DNAPL, followed by extraction with a solution of 90% 1-propanol and 10% water. Measurements showed that the DNAPL-water interfacial tension was approximately 4 mN/m upon achieving neutral buoyancy between phases. Measurement of the effluent phase from two-dimensional flushing experiments showed that for all two-phase samples collected, the NAPL phase was less dense than the aqueous phase.

Lunn and Kueper (1999b) recognized that the density of the alcohol flushing solution itself may need to have a neutral density in many applications (e.g., horizontal flushing scenarios) in order to prevent gravity over-ride during delivery. They investigated using a 65% ethylene glycol – 35% 1-propanol main flood in conjunction with a polymer post-flood to achieve 99.8% PCE DNAPL removal with a 0.45 pore volume alcohol slug. The composite alcohol flushing solution (ethylene glycol – 1-propanol mixture) had a measured density of 1.004 g/cc (Lunn and Kueper, 1999b). The fact that slight variations in the amount of ethylene glycol (alcohol more dense than water) relative to the amount of 1-propanol (alcohol less dense than water) allowed engineering of a tailored flushing solution density provides the opportunity to create an alcohol slug density with floating, neutral, or sinking tendencies. In this particular set of experiments, the composite alcohol flushing solution was preceded by a 10% isobutanol flood that brought about PCE DNAPL swelling and a reduction in PCE density from 1.62 g/cc to approximately 1.0 g/cc.

The topic of density manipulation during alcohol flushing was also explored by Roeder et al. (1996) who present data and numerical simulations suggesting that TCE DNAPL may be recovered as an LNAPL using a combined methanol – 1 butanol flood. Falta et al. (1997) discuss the importance of density manipulation for both alcohol delivery in horizontal systems, and to prevent downward DNAPL mobilization in response to a lowering of interfacial tension. Roeder et al. (2001) present the hypothesis that the additional dense additive that remains preferentially in the aqueous phase widens the choice of alcohols that can be used to achieve phase density differences. The study by Roeder et al. (2001) created dense alcohol solutions through the use of both glycerol (density by itself of 1.26 g/cc) and sugar (density by itself of 1.59 g/cc) as additives to tert-butanol. Two-dimensional sand box experiments showed that gravity under-ride of the dense alcohol solution assisted in removing PCE DNAPL pools from the base of the sand pack.

With respect to field applications, Rao et al. (1997) present the results of an alcohol flushing field pilot test conducted in a sand-gravel-cobble aquifer at Hill Air Force Base located north of Salt Lake City, UT. The target contaminant was a multi-component NAPL containing a variety of chlorinated solvent and fuel related compounds. The injected alcohol solution was composed of 70% ethanol, 12% n-pentanol, and 18% water. The authors report that on average, greater than 85% by mass of several target contaminants was removed. The fact that the injected alcohol solution was less dense than water (no attempt was made to create a neutral density injection solution) likely resulted in some gravity over-ride during flushing.

Falta et al. (1999) present the results of a second field pilot test conducted at Hill Air Force Base. The target contaminant was described as a multicomponent LNAPL consisting of a complex mixture of aromatic and aliphatic hydrocarbons, chlorinated solvents, and other compounds. The injection solution consisted of a mixture of 80% tert-butanol, 15% n-hexanol, and 5% water. The results of pre- and post-flood partitioning tracer tests indicated nearly 80% removal of the total NAPL initially in place in the test cell. Soil coring indicated greater than 90% removal of the more soluble components of the NAPL (e.g., BTEX, chlorinated solvents, naphthalene) and 70% to 80% removal of the less soluble components (e.g., decane, undecane).

Jawitz et al. (2000) present the results of a pilot-scale in-situ alcohol flush at a former dry cleaner site located in Jacksonville, FL. PCE DNAPL was located below the watertable in localized, discontinuous distributions. The injected solution consisted of a 95% ethanol – 5% water mixture. Soil core data and partitioning tracer test results from before and after the alcohol flush indicated that between 62% and 65% of the initial PCE in place was removed. No attempt was made to create a neutral density injection solution.

Brooks et al. (2004) discuss the results of an alcohol flushing field trial conducted at the Dover National Test Site (DNTS) located at Dover Air Force Base in Dover, Delaware. The target DNAPL, PCE, was released under controlled conditions into a 3.0 m by 4.6 m by approximately 4 m thick saturated sand aquifer contained by steel sheet piling. The aquifer is described as containing alternating layers of silty sand, poorly sorted sand, and well sorted sand overlying a clay aquitard. The injected alcohol solution consisted of 95% ethanol and 5% water. The extracted alcohol solution was recycled (i.e., reinjected) following treatment by either activated carbon or air stripping. Of the estimated 84 liters of DNAPL initially in place, investigators estimate that 64% was removed by alcohol flushing. The investigators also report that pre and post flushing partitioning tracer tests both missed significant amounts of PCE present, likely due to inaccessibility of the PCE.

2.0 - Technology Description

2.1 - Ternary Phase Behaviour

Alcohol flushing involves the delivery of an alcohol solution to the subsurface through a series of injection wells. The alcohol solution, often referred to as the alcohol ‘slug’, flows through the DNAPL impacted zone (also known as the ‘target zone’) towards recovery wells under the influence of a hydraulic gradient. The hydraulic gradient is controlled by the fluid levels and/or pumping rates in the injection and recovery wells. Depending on the type of alcohol used, and the concentration of alcohol employed, any of the following four DNAPL removal mechanisms can take place:

1) enhanced DNAPL dissolution into the aqueous phase,
2) DNAPL mobilization resulting from DNAPL swelling,
3) DNAPL mobilization resulting from interfacial tension reduction,
4) complete miscible DNAPL extraction resulting from complete elimination of interfacial tension.

The fundamental pre-requisite to determining which of the above four removal mechanisms will take place, and to what degree, is the ternary phase diagram. Figure 1 presents a water/ethanol/aroclor 1242 ternary phase diagram that was measured by Gauthier and Kueper (2004) as part of a screening study to evaluate the use of alcohol flushing to remove PCB DNAPL from fractured bedrock at an industrial site in the U.S.A. The three apexes of the triangle represent composition end-points for the three-component system. It is common to represent the NAPL endpoint (aroclor 1242 in this case) by a single component, even for multicomponent systems. In such cases, the endpoint component is referred to as a pseudocomponent, and its behaviour is taken be representative of the NAPL mixture as a whole. This assumption is commonly adopted in the petroleum industry (Lake, 1989), and is an approach taken largely out of necessity for complex NAPLs.

The envelope of points towards the top of the ternary phase diagram in Figure 1 is referred to as the miscibility envelope (or binodal curve). Above the miscibility envelope, DNAPL-water interfacial tension has been completely eliminated and all system compositions result in one fluid phase. The density of this single fluid phase will depend primarily on the type of alcohol chosen and the initial density of the DNAPL. It is generally desirable to match the alcohol solution to the DNAPL such that this single fluid phase is less dense than water. The viscosity of this single fluid phase is also of interest. If the fluid is more viscous than water, a hydrodynamically stable displacement will occur at the leading edge enroute to the recovery wells.

Below the miscibility envelope, all system compositions result in two fluid phases (the water rich phase, and the DNAPL rich phase). Within this region the alcohol is partitioned into both the DNAPL and water phases. The straight lines that appear in Figure 1 below the miscibility envelope are called ‘tie lines’. Although only six tie lines are shown in Figure 1 (E0 through E5), there are an infinite number of tie lines below the miscibility envelope to cover all possible system compositions. If the tie lines slope down towards the DNAPL component apex (as they do in Figure 1), the alcohol is preferentially soluble in the water rich phase. If the tie lines slope down towards the water end point, the alcohol is preferentially soluble in the DNAPL phase and will bring about DNAPL swelling (reduction in DNAPL density).

Any system composition below the miscibility envelope will fall on a tie line. Point E3, for example, represents a system composition of 40% PCB, 30% water, and 30% ethanol. This overall system composition is distributed amongst the two fluid phases (PCB rich phase, water rich phase). The composition of the PCB rich phase is represented where the right hand end of the tie line intercepts the miscibility envelope, while the composition of the water rich phase is represented where the left hand end of the tie line intercepts the miscibility envelope. All overall system compositions falling on this tie line will have phase compositions given by these tie line end points. For the ternary phase diagram illustrated in Figure 1, all system compositions falling on the tie line labeled E3 will have a DNAPL rich phase composed of approximately 99% PCB, 0.5% water, and 0.5% ethanol. The water rich phase will be composed of approximately 1% PCB, 49.5% water, and 49.5% ethanol. The position of the tie line endpoints therefore provides a quantitative measure of the amount of DNAPL solubility enhancement that will occur upon exposure to alcohol. It is clear upon inspection of the tie lines in Figure 1 that ethanol provides only a weak enhancement of PCB solubility in water.

In addition to the phase compositions, the position of the overall system composition on the tie line provides a measure of the relative volume of each of the two phases in the system. For an overall system composition given by E3, for example, the DNAPL rich phase will occupy a volume fraction given by the distance from E3 to the left hand end of the tie line divided by the total length of the tie line. The volume fraction of the water rich phase is given by the distance from point E3 to the right hand end of the tie line divided by the total length of the tie line. For an overall system composition given by E3, the water rich phase would therefore occupy 60% of the mixture, while the DNAPL rich (i.e., PCB rich) phase would occupy 40% of the mixture. This information is useful in estimating the volume fraction of both the water rich phase and the DNAPL rich phase that will be produced in recovery wells for alcohol flushing systems operated below the miscibility envelope.

The ternary phase diagram is also a convenient tool for presenting changes in phase viscosity, density, and DNAPL-water interfacial tension that occur below the miscibility envelope. Figure 2, for example, presents DNAPL-water interfacial tension for a series of tie-lines in the ethanol/water/aroclor 1242 system. All system compositions falling along a particular tie line will give rise to two phases having a particular DNAPL-water interfacial tension. Figure 2 shows that as ethanol concentration is increased, DNAPL-water interfacial tension is decreased. If a DNAPL mobilization flush were desired in the absence of complete elimination of interfacial tension, the information provided in Figure 2 could be used to select the concentration of ethanol that should be injected to bring about the desired lowering of interfacial tension. Similar diagrams can be plotted to examine changes in DNAPL density and phase viscosity contrast as a function of alcohol content below the miscibility envelope (see, for example, Gauthier and Kueper, 2004).

2.2 - Transient Produced Fluids History

The expected produced fluids history for recovery wells will be dependent on the type of removal mechanism desired. If a simple enhancement in DNAPL solubility is desired, an alcohol can be selected that minimizes interfacial tension reduction and is preferentially soluble in the aqueous phase. The alcohol (and associated density modifiers to avoid gravity over-ride) would be injected at relatively low concentrations (typically less than 30% by volume) and would not be expected to mobilize significant quantities of DNAPL. The produced fluids stream in such an application would consist of a single fluid phase composed primarily of water, with moderate concentrations of the target contaminant and alcohol concentrations less than 30%.

If the desired removal mechanism is DNAPL mobilization through DNAPL swelling, a relatively high molecular weight alcohol (and associated density modifiers to avoid gravity over-ride) that is preferentially soluble in the DNAPL phase would be injected. The alcohol would be expected to bring about DNAPL swelling, a moderate reduction in DNAPL-interfacial tension, and a small increase in DNAPL solubility in water. The produced fluids stream would consist of a NAPL-water mixture with high concentrations of alcohol present in the NAPL phase. The NAPL may have a density less than that of water depending on the type of alcohol solution utilized. Given the fact that sweep efficiency will likely be less than 100% in field applications, moderate concentrations of the alcohol may also be present in the recovered water phase.

If the desired removal mechanism is DNAPL mobilization through interfacial tension reduction in the absence of DNAPL swelling, an alcohol (along with density modifiers to avoid gravity over-ride) that is preferentially soluble in the water would be injected at relatively high concentrations below the miscibility envelope. The recovered fluids stream would consist of two fluid phases (DNAPL and water) with relatively high concentrations of alcohol in the water phase, and relatively low concentrations of alcohol in the DNAPL phase.

If the desired removal mechanism is complete miscible extraction of the DNAPL through complete elimination of interfacial tension, a suitable alcohol (and density modifiers to avoid gravity over-ride) would be injected at high concentration (e.g., 90% to 95% by volume). The produced fluids stream would first consist of a mobilized NAPL bank taking the form of a two-phase NAPL-water mixture, followed by a single phase fluid high in contaminant and alcohol concentrations.

In all of the above applications, the last component in the recovery stream would be any polymer that may have been used to stabilize the alcohol injection at the back end of the injected alcohol slug.

2.3 - Technical Considerations

The successful operation of an alcohol flushing system must consider a number of technical issues. The particular issues will depend, in part, on the desired removal mechanism. For the list of technical issues to consider that is presented below, it is assumed that the desired removal mechanism will be complete miscible extraction of DNAPL through elimination of interfacial tension. This is the most aggressive of the four removal mechanisms, and is expected to lead to the maximum amount of DNAPL recovery.

1) **Position of miscibility envelope:** miscible extraction requires that alcohol concentrations remain above the miscibility envelope. A low miscibility envelope (in the ternary system) is desired for economic reasons, and is necessary to provide tolerance to the diluting effects of slug deterioration (brought about by dispersion).
2) **Gravity over-ride of injected solution:** in order to ensure that the injected alcohol solution will not rise towards the watertable during injection, a neutral density alcohol solution is desired. This can be achieved through the addition of density modifiers, and/or incorporation of high molecular weight alcohol.
3) **Concentration of alcohol:** The concentration of alcohol must remain above the miscibility envelope to achieve miscible extraction. Dispersion will result in slug deterioration. The combination of alcohol concentration and slug size must therefore offset the diluting influence of dispersion.
4) **Slug size:** The volume of injected alcohol must be large enough to provide miscible extraction for the volume of DNAPL in place. The initial volume of DNAPL in place is therefore a critical design parameter. The slug must also be of sufficient size to provide tolerance to slug deterioration resulting from dispersion mechanisms. The amount of alcohol that needs to be purchased will depend on whether the entire target zone is to be treated at one time, or if alcohol recycling will be employed to allow injection into discrete modules operated in series.

5) **Hydrodynamic stability of leading edge of alcohol slug:** The leading edge of the alcohol slug should be hydrodynamically stable in order to maximize sweep efficiency. For a horizontally flowing system, this implies that the injected alcohol solution should be more viscous than both the groundwater, and the DNAPL initially in place.

6) **Hydrodynamic stability of back end of alcohol slug:** The back end of the alcohol slug should be hydrodynamically stable since the alcohol injection will likely be followed by clean water injection to continue to drive the alcohol slug towards the recovery wells. If excess alcohol were used (i.e., injecting a larger alcohol slug than required), this requirement would be eliminated, but the resulting system would likely not be economically favourable. The use of a polymer solution (e.g., xanthum gum) to drive the alcohol slug can provide the necessary stability.

7) **Vertical mobilization of DNAPL:** In order to avoid undesirable vertical mobilization of DNAPL, a swelling alcohol can be employed that partitions favourably into the DNAPL phase.

8) **Produced fluids treatment:** a miscible extraction alcohol flush will produce an effluent stream composed of a two phase NAPL-water mixture followed by a single phase fluid slug containing high concentrations of both alcohol and contaminant. The range of compositions in the extracted fluid stream can be reasonably well predicted. Storage and conveyance systems will need to be put in place. If the application involves injecting alcohol into discreet modules in a sequenced fashion, recycling of the alcohol for reinjection will be required.

9) **Injection and recovery well design:** A system of injection and recovery wells will be required to deliver and recover fluids in the subsurface. The injection and recovery well locations, spacing, screened depths, and flowrates/pressures need to be selected to provide uniform delivery of injected fluids throughout the target zone. Storage containers and mixing vessels will be required to prepare the injected solution.

10) **Health and Safety:** The injection of high concentrations of alcohol may require that attention be given to specific health and safety issues that are outside the realm of those considered for other types of remedies (e.g., handling large volumes of flammable liquids).

11) **Permitting:** Injecting alcohol solutions, density modifiers, and polymer solutions may require specialized permits from regulatory agencies. Attention will likely be given to the fate of residual fluids in the subsurface at the completion of remedial activities (e.g., fate of low concentrations of alcohol in groundwater, and impact on subsequent pump-and-treat operations).

12) **Likelihood of meeting remedial action objectives:** The use of alcohol flushing to remove DNAPL from the subsurface is an innovative, emerging technology that has shown favourable results in laboratory, numerical, and field pilot scale studies. There is no proven track record for this technology with respect to full-

scale applications, which implies that uncertainty may exist with respect to predicting the volumes of contaminant to be extracted.

13) **Cost:** The primary cost component in an alcohol flush is typically the capital cost of the alcohol. Other significant costs may include produced fluids treatment, and well infrastructure. Recycling of the alcohol solution for reinjection, and performing the treatment in modules, would reduce the capital cost of alcohol.

3.0 - Screening for Use at SRSNE and Description of Required Design Process

3.1 – Composition, Spatial Extent, and Volume of Target

Past investigations conducted at the SRSNE site have determined that the DNAPL present in overburden is a multicomponent organic fluid composed of several constituents. Table 1 provides a summary of the DNAPL component compositions measured from three samples. Of note in Table 1 is the fact that the component compositions do not add to 100%, implying that compounds not on the laboratory target analyte list may be present in the DNAPL in unknown concentrations. A second possibility is that laboratory error, known to be influenced by dilutions when analyzing NAPL samples, accounts for a portion of the missing mass fractions. Of particular note also is the fact that the SVOC content of the three DNAPL samples was measured to be non-detect. This fact, in conjunction with the relatively low viscosity of the DNAPL samples, suggests that the missing mass fractions are not high molecular weight compounds, but rather low molecular weight compounds simply not present on the target analyte list. Examination of Table 1 shows that the two most prevalent measured compounds in the DNAPL are TCE and PCE. The DNAPL samples are characterized by relatively low densities (1.11 g/cc), relatively low viscosities (similar to that of water), and relatively low interfacial tensions (3.1 and 7.8 mN/m).

DNAPL delineation activities summarized in BBL (1998) indicated that DNAPL is present in overburden throughout the site operations area (west of railway tracks) as well as within the NTCRA1 containment area (east of railway tracks). This delineation has been confirmed through visual observation of DNAPL in monitoring wells in both of these areas (e.g., in wells MWD-601 and RW-5 east of the railway tracks; in former on-site interception wells west of the railway tracks). Recent boring activities conducted at the site during the week of November 3rd, 2003 further confirmed the occurrence of DNAPL west of the railway tracks (BBL, 2003). The field program was a focused effort designed to visually identify DNAPL in borings extracted from a selected number of locations.

On the basis of recent discussions between U.S.E.P.A., CT.D.E.P, regulatory oversight consultants, and the PRP group and its consultants, an ‘observed NAPL in overburden groundwater unit’ (ONOGU) has been identified for evaluation in the Feasibility Study. The ONOGU is the volume of overburden considered here for application of alcohol flushing. Because this area of the site is characterized by a relatively shallow watertable, this evaluation is restricted to the saturated zone. BBL (2004) report that the ONOGU has a total saturated volume (from the top of bedrock to the seasonal high watertable as represented by March, 1995 data) of 31,840 cubic yards. Using an effective porosity of 0.25 (total porosity has been measured to be 0.275), this corresponds to a total fluid pore volume of 1,607,920 U.S. gallons.

The 2003 boring program results presented by BBL (2003) distinguished between observations of residual NAPL and pooled NAPL. Using the relationship between capillary pressure and fluid saturation, measured DNAPL and porous media properties for the site, and the observed occurrences of NAPL at the site, BBL (2004) estimate that the ONOGU contains approximately 121,000 gallons of DNAPL (96,000 gallons pooled + 25,000 gallons at residual saturation). This corresponds to an overall average DNAPL saturation of 7.5% of pore space. As discussed in BBL (2004), however, the DNAPL is distributed unevenly within the ONOGU, with approximately 70% of all the DNAPL present in what has been defined as Zone 2 within the overall ONOGU. BBL (2004) also estimate that 80% of the pooled DNAPL is present within Zone 2.

Table 1 – Measured Component Composition of DNAPL From Overburden Visible NAPL Unit

Component	Molecular Weight (g/mole)	Aqueous[4] Solubility (mg/l)	MWD-601 (mg/l)	RW-5 (mg/l)	IW-23 (mg/l)
1,1-DCE	97[1]	3350[1]	187	126	418
DCM	84.9[1]	20000[1]	ND	60	50
1,1-DCA	99[1]	5100[1]	12.8	ND	38
Cis-1,2-DCE	97[1]	3500[1]	443.6	1321	1254
Chloroform	119.4[1]	8000[1]	14	16	ND
1,1,1-TCA	133.4[1]	1300[1]	4433	2313	1834
Benzene	78.1[2]	1755[2]	49.8	70	11
1,2-DCA	99[1]	8500[1]	9	ND	ND
TCE	131.5[1]	1100[1]	163000	57371	19019
MIBK	100.2[3]	17000[3]	ND	75	ND
Toluene	92.1[2]	500[2]	45104	15007	6636
1,1,2-TCA	133.4[1]	4400[1]	5.8	ND	ND
PCE	165.8[1]	200[1]	46470	12866	15052
Ethylbenzene	106.2[2]	175[2]	5239	3781	3891
p/m xylenes	106.2[2]	180[2]	12061	3629	5512
O xylene	106.2[2]	200[2]	4210	2569	2727
styrene	104.5[2]	300[2]	1056	643	784
PCB-1254	328[2]	0.04[2]	ND	300	0.730
PCB-1260	374[2]	0.025[2]	419	ND	ND
SVOCs			ND	ND	ND

TOTAL			282714	100147	57227
Density (g/cc)			1.11 (15.6C)	1.11 (10C)	NA
Viscosity (cS)			1.12 (20C)	1.23 (8.5C)	NA
IFT (mN/m)			7.8	3.1	NA

NOTES: 1 – Pankow and Cherry, 1996
2 – Mackay et al., 1992
3 – Verschueren, 1983
4 – Single component aqueous solubilities

3.2 – Technical Considerations

The basic sequence of steps leading towards implementation of alcohol flushing at the SRSNE site would be (i) measure ternary phase diagrams for a variety of alcohol formulations using DNAPL obtained from the site, (ii) measure the relationships between alcohol concentration and DNAPL density, DNAPL viscosity, and DNAPL-water interfacial tension, (iii) measure the density and viscosity of various alcohol formulations to arrive at a neutral density injection solution, (iv) conduct bench-scale column flushing experiments to assess produced fluids composition and compatibility between alcohol formulation and selected polymer, (v) perform numerical modeling of injection/withdrawal well system using a variable density, variable viscosity miscible displacement model, (vi) design and evaluate necessary produced fluids treatment facilities, including recycling options for the alcohol, (vii) conduct a field pilot test, (viii) construct full-scale produced fluids treatment facilities, and (ix) carry out full scale implementation. To reduce capital cost, it is assumed here that the technology will be applied in four separate modules, with recycling of extracted alcohol prior to reinjection into a subsequent module. The four modules would therefore be carried out in series.

To allow screening of alcohol flushing as part of the feasibility study process, the following can be considered at this time:

1) Position of miscibility envelope: Past studies indicate that it should be relatively straight forward to identify an alcohol capable of achieving full miscibility for a DNAPL composed primarily of TCE and PCE. Although not carried out as part of this feasibility study evaluation, ternary phase diagrams should be measured using DNAPL from the site to establish the exact position of the miscibility envelope and tie line behaviour. Past studies involving TCE and PCE have shown that a variety of alcohols are capable of completely eliminating DNAPL-water interfacial tension for DNAPLs rich in chlorinated solvents. Figure 3, for example, presents a methanol/TCE/water ternary phase diagram from Lunn (1998) that shows a maximum alcohol content along the miscibility envelope of approximately 60% volume. Figure 4 presents an ethanol/TCE/water ternary phase diagram from Lunn (1998) that shows a similarly placed miscibility envelope. Figure 5 presents a 1-propanol/PCE/water ternary phase diagram from Lunn and Kueper (1997) that shows a large miscible region similar to those illustrated in Figures 3 and 4.

2) Gravity over-ride of injected alcohol slug: Because residual and pooled DNAPL are present throughout the vertical profile of the saturated overburden unit, it will be necessary to design a neutrally buoyant alcohol solution in order to perform a horizontal alcohol flush (the geology does not lend itself to a vertical flushing scenario). Candidates for alcohol density modification include sugar, ethylene glycol, glycerol, and other alcohol soluble fluids more dense than water. The exact type of density modifier and required concentration will need to be determined during design studies in conjunction with selecting the main alcohol.

3) Concentration of alcohol: In order to provide tolerance to slug deterioration stemming from dispersion, it will likely be necessary to formulate the primary alcohol slug at concentrations on the order of 90% to 95% by volume.

4) Slug size: An estimate of the volume of alcohol required to flush the ONOGU can be provided here given the following assumptions (i) the target will contain 68,000 gallons of DNAPL following application of hydraulic displacement (see hydraulic displacement white paper for details), (ii) equilibrium partitioning between water/alcohol/DNAPL, (iii) 25% of the post hydraulic displacement DNAPL in place (17,000 gallons) will be removed at the leading edge of the alcohol slug as a result of mobilization through swelling and interfacial tension reduction, (iv) the remainder of the DNAPL (51,000 gallons) will be removed through miscible extraction within the alcohol slug, and (v) peak concentrations in the alcohol slug should be maintained at 90% volume. Given these assumptions (design activities would provide a more accurate estimate), the required alcohol slug would be 918,000 gallons (i.e., 1 part water to 1 part DNAPL to 18 parts alcohol). This is equivalent to approximately 57% of the pore volume of the ONOGU. If the technology is to be applied in four modules with recycling of alcohol between applications, the required alcohol volume would be approximately 250,000 gallons.

5) Hydrodynamic stability at leading edge of alcohol slug: The viscosity values presented in Table 1 indicate that the target DNAPL has a viscosity similar to that of water. Alcohols which may be considered for the flush include ethanol (viscosity = 1.13 cP at 22°C), isobutanol (viscosity = 3.91 cP at 25°C), 1-propanol (viscosity = 2.26 cP at 20°C), and ethylene glycol (viscosity = 19.9 cP at 20°C). These values indicate that it should be relatively straight forward, through either the primary alcohol selection or small amounts of blending, to achieve a hydrodynamically stable displacement at the leading edge of the alcohol slug (i.e., alcohol displacing DNAPL, and alcohol displacing water).

6) Hydrodynamic stability of back end of alcohol slug: The selected alcohol will likely need to be chased with a polymer-water solution in order to provide a stable displacement. If ethanol is selected, stability control may not be required. If the viscosity of the alcohol slug is greater than that of water, however, then polymer will likely be required. The exact composition of the alcohol slug will need to determined as part of design activities. With respect to polymer choices, Gauthier et al. (2004) present the viscosity of various xanthum gum solution concentrations as a function of hydraulic gradient (xanthum gum is a shear thinning fluid). The work by Gauthier et al. (2004) suggests that a viscosity of approximately 10 cP can be obtained using 1000 ppm xanthum gum solutions for hydraulic gradients less than 0.5. Assuming that the polymer slug would be 10% of the pore volume in size, this would require 160,780 gallons at a concentration of 1000 ppm (total amount of required xanthum gum, assuming no recycling between modules, would therefore be 608 kg).

7) Vertical mobilization of DNAPL: The target zone contains DNAPL having a measured density of 1.11 g/cc. Because the alcohol flush will likely result in a mobilized DNAPL bank ahead of the miscible zone, it will be necessary to select a swelling alcohol that will provide density modification of the DNAPL. This can likely be achieved by blending a high molecular weight alcohol such as 1-propanol with the main alcohol. Bench-scale tests will need to be performed to optimize the formulation required for density modification.

8) Produced fluids treatment: The produced fluids will consist of separate phase DNAPL followed by a miscible slug containing high concentrations of alcohol with entrained contaminants. It is reasonable to assume, at this point in time, that close to 80% of the volume of injected alcohol will be recovered as part of the miscible slug, and that the remaining 20% will be entrained in the DNAPL slug that is recovered ahead of the main alcohol slug. Brooks et al. (2004) report the use of both activated carbon and air stripping to allow recycling and reinjection of ethanol. Hayden et al. (2001) discuss the use of activated carbon to treat cosolvent solutions.

9) Injection and recovery well design: Given the distribution of DNAPL within the target zone, it will be necessary to utilize fully screened injection and recovery wells. Injection wells should be placed hydraulically upgradient with respect to ambient flow conditions. Injection and withdrawal wells can be placed to provide a line-drive configuration provided that the lateral spacing of the wells is sufficiently small to provide complete coverage of the target zone with the injected alcohol. Given the fact that the NTCRA1 pumping system is located hydraulically downgradient of the target zone, there may not be a need to significantly over-pump recovery wells in an effort to reduce the risk of having alcohol and mobilized contaminants escape the line-drive injection-withdrawal system. If it is decided to apply alcohol flushing in modules within the overall target zone, the western most modules (hydraulically upgradient with respect to ambient flow directions) should be applied first. With respect to injection pressures, these should be selected using a numerical model that is capable of simulating variable density and variable viscosity fluid displacements. At this point in time, it is not envisioned that a multiphase flow model will be required; however, a single-phase variable density and variable viscosity model is recommended (such models are commercially available). With respect to duration, preliminary groundwater modeling performed by BBL (2004) indicates that total injection rates on the order of 30 gpm may be achievable using 100 ft well spacings. Assuming that 918,000 gallons of alcohol needs to be injected (and ignoring viscosity and density effects), the alcohol injection period would last approximately 21 days. This would likely be followed by approximately 90 days of clean water injection to displace residual alcohol and contaminants. If the application is to be carried out in modules, the length of injection would depend on whether the choice of modules leads to a closer well spacing, or simply less lateral sweep than a full-scale application. For screening purposes, it will be assumed that injection into modules will also require 21 days of operation followed by 90 days of clean water injection.

10) Health and Safety: The specific health and safety concerns will need to be addressed once alcohol selection has been carried out.

11) Permitting: Specific permitting requirements will need to be addressed once alcohol selection has been carried out.

12) Likelihood of meeting remedial action objectives: The use of alcohol flushing at the SRSNE site is likely to remove significant quantities of contaminant mass from the subsurface such that (i) the time frame that groundwater standards are exceeded would be reduced, (ii) the size of the groundwater plume would be reduced, (iii) groundwater contaminant concentrations would be reduced, and (iv) mobile NAPL would be removed.

13) Costs: For costing purposes at this time, it is reasonable to assume that 250,000 gallons of commercial grade ethanol will need to be purchased, along with 608 kg of xanthum gum polymer. An additional 20% cost should be applied for the purchase of possible blending and density modification agents. Additional significant costs will be the injection/withdrawal well system, pilot test, fluid conveyance and storage systems, and produced fluids treatment facilities including recycling of the alcohol to allow reinjection.

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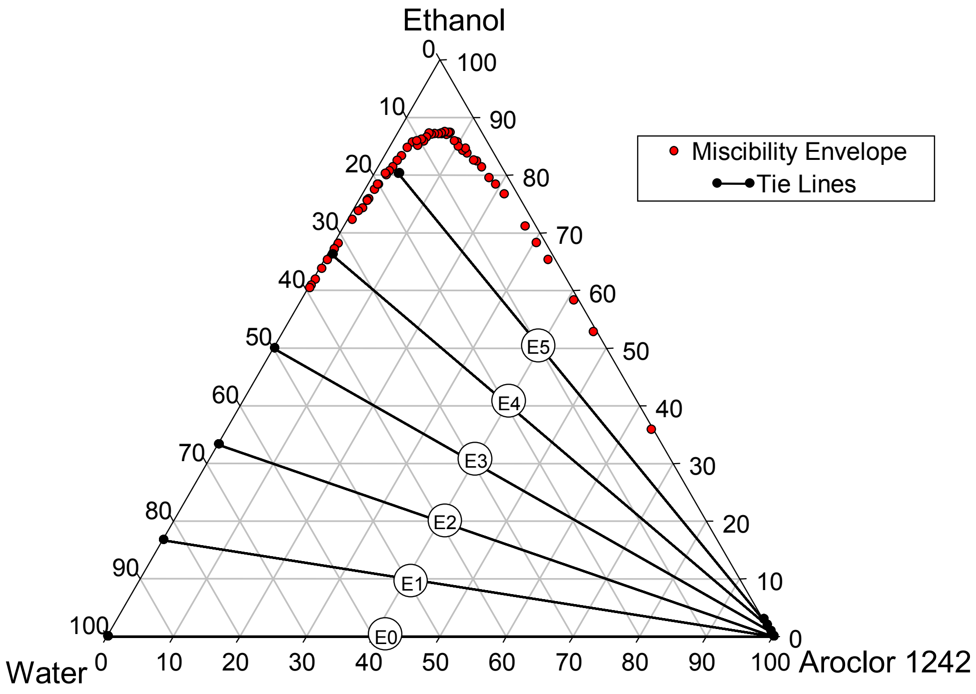

Figure 1 – Ethanol/water/aroclor 1242 ternary phase diagram (Gauthier and Kueper, 2004)

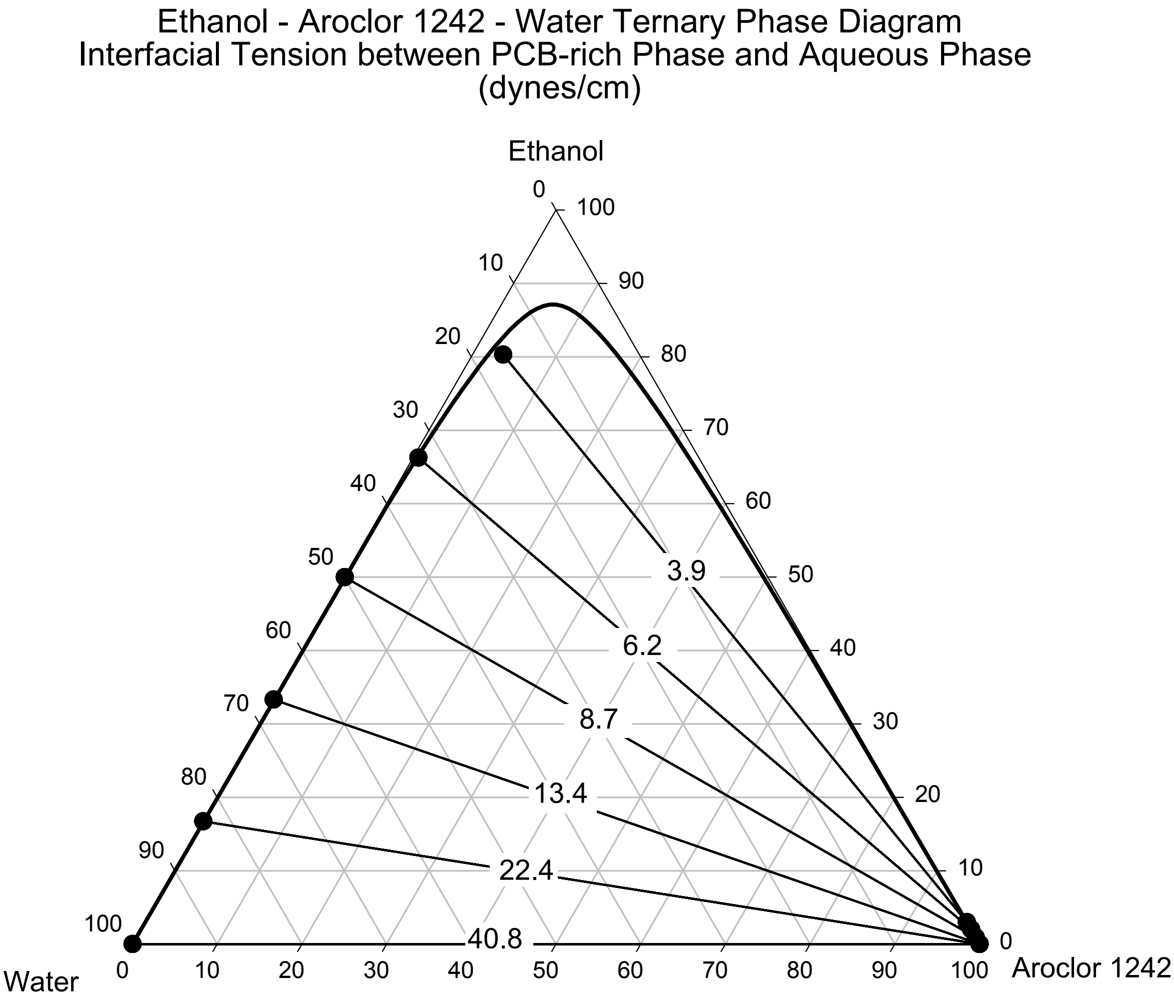

Figure 2 – Variation of DNAPL-water interfacial tension between tie lines (Gauthier and Kueper, 2004)

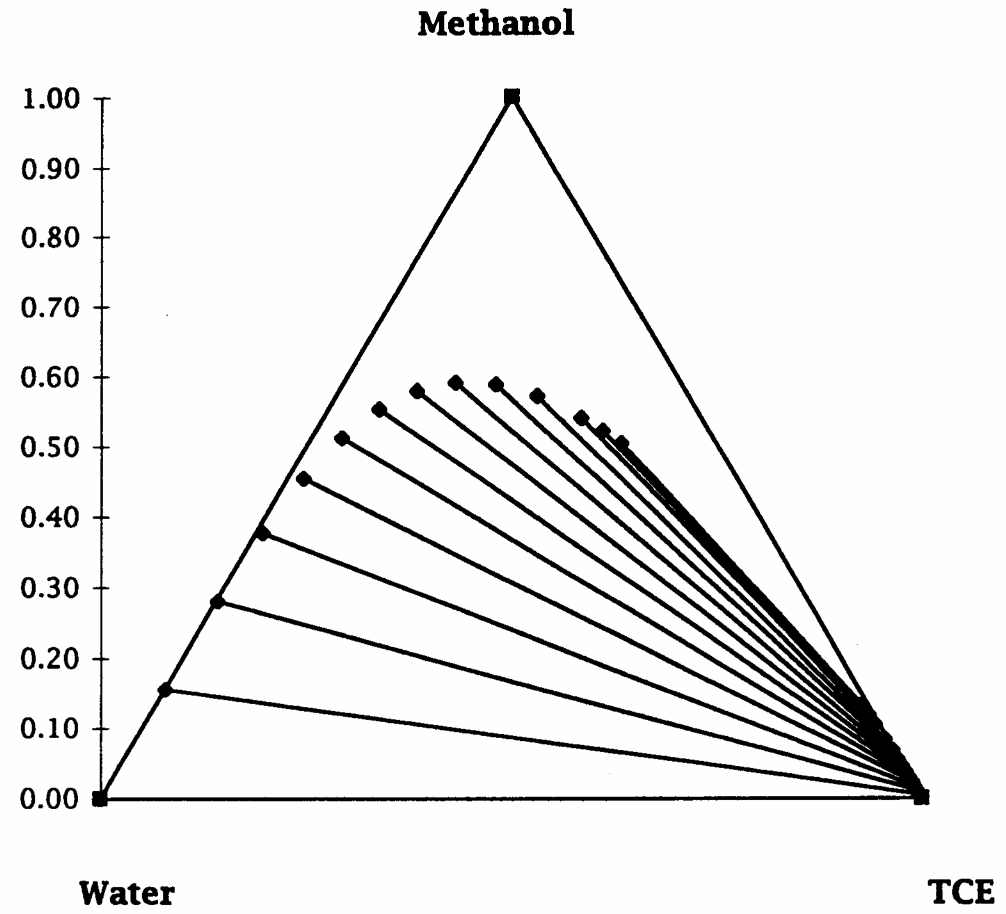

Figure 3 – Methanol, water, trichloroethylene (TCE) ternary phase diagram (Lunn, 1998)

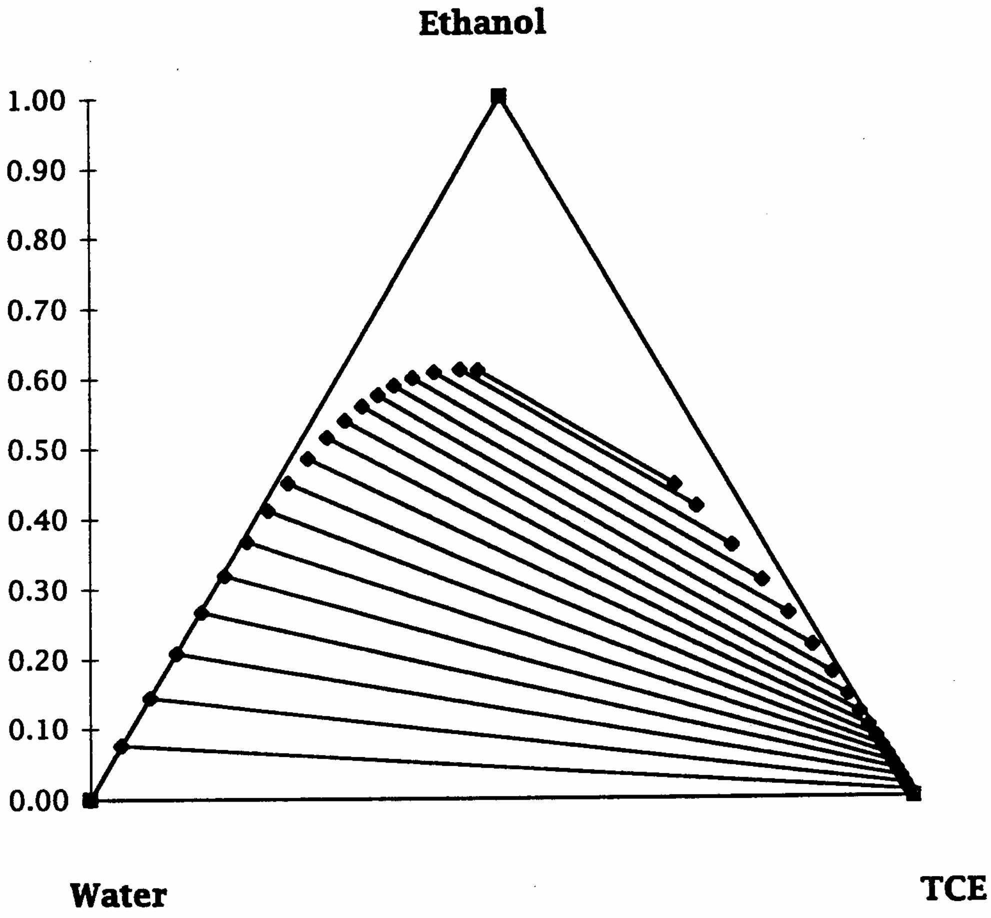

Figure 4 – Ethanol, water, trichloroethylene (TCE) ternary phase diagram (Lunn, 1998)

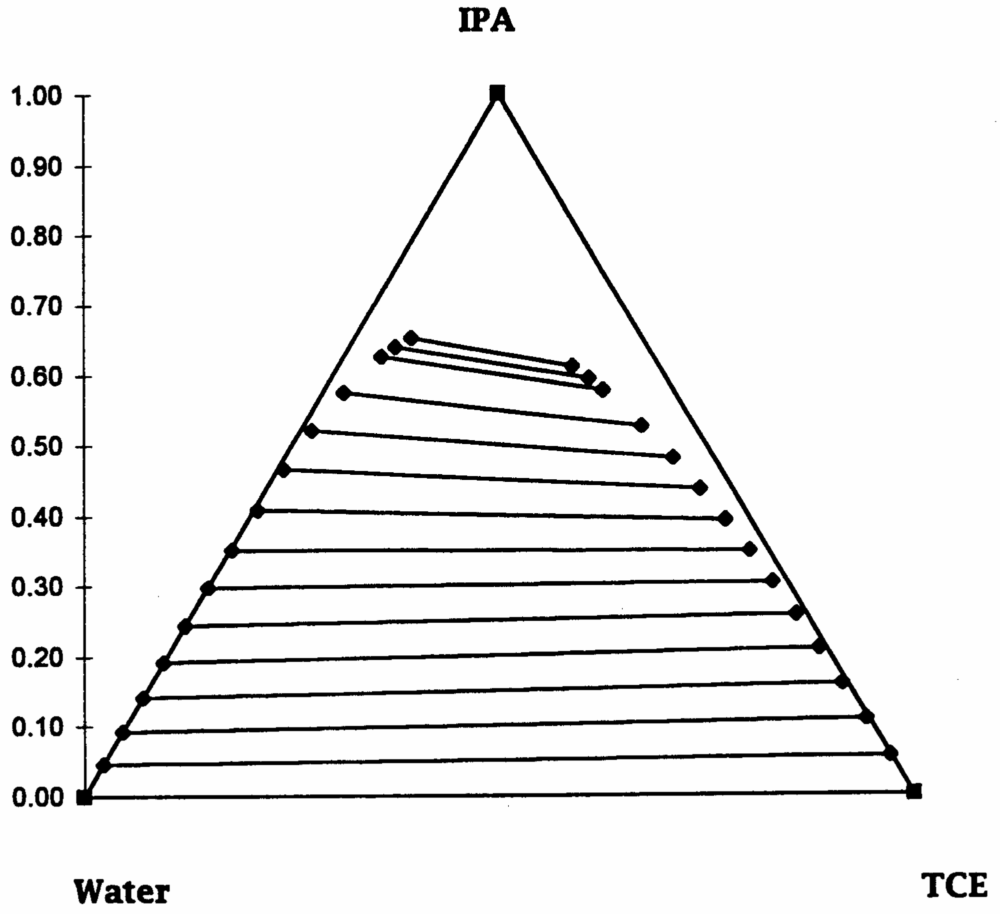

Figure 5 – Isopropanol (IPA), water, trichloroethylene (TCE) ternary phase diagram (Lunn, 1998)

Appendix Q

SRSNE Feasibility Study Water Treatment System Alternatives Evaluation

SOLVENTS RECOVERY SERVICES NEW ENGLAND
FEASIBILITY STUDY
WATER TREATMENT SYSTEM ALTERNATIVES EVALUATION

Prepared for:

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18 June 2004

W.O. No. 13056.001.004

Disclaimer

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LIST OF ACRONYMS

1,1,1-TCA	1,1,1-trichloroethane
APV	Invensys APV Systems
BBL	Blasland, Bouck & Lee, Inc.
CCC	Calgon Carbon Corporation
CFE	Critical Fluid Extraction
CPVC	chlorinated polyvinyl chloride
DNAPL	Dense Non-aqueous Phase Liquid
EPA	U.S. Environmental Protection Agency
ESTCP	Environmental Security Technology Certification Program
ft	foot/feet
GAC	Granular Activated Carbon
gpd	gallons per day
gpm	gallons per minute
GWTF	Ground Water Treatment Facility
IPA	Isopropyl alcohol
kW	kilowatt
LEL	lower explosive limits
MEUF	micellar-enhanced ultrafiltration
mg/L	milligrams per liter
MPPE	Macro Porous Polymer Extraction
NANSI	Naval Air Station North Island
NTCRA	Non-Time Critical Removal Action
O&M	Operation and Maintenance
ONOGU	Observed NAPL in the Overburden Groundwater Unit
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
PPC	Process Control Panel
PPE	personal protection equipment
ppm	parts per million
Site	Solvents Recovery Services New England Site
SRSNE	Solvents Recovery Services New England
TSS	total suspended solids
UV	ultraviolet
VOC	volatile organic compound

LIST OF ACRONYMS
(continued)

VSEP	Vibratory Shear Enhanced Process
WESTON®	Weston Solutions, Inc.
Zenon	Zenon Environmental, Inc.

SECTION 1

INTRODUCTION

1. INTRODUCTION

At the request of *de maximis, inc*. and the Solvents Recovery Services New England (SRSNE) Site Group, Weston Solutions, Inc. (WESTON®) has evaluated water treatment technologies in support of the feasibility study for the SRSNE Site (the Site). WESTON's analysis included evaluation of water treatment technologies for the following three source control remedial alternatives associated with Observed NAPL in the Overburden Groundwater Unit (ONOGU):

- Hydraulic Displacement.
- Cosolvent Extraction (Hydraulic Displacement followed by Ethanol Flooding).
- Excavation and off-site disposal of dense non-aqueous phase liquid (DNAPL) contaminated soils.

Detailed analyses of water treatment technologies, including costs and approaches to implementation, for each of the three source control alternatives are presented in Sections 2, 3, and 4, respectively, of this report.

For each source control alternative listed above, WESTON estimated the characteristics of the resulting influent to the water treatment system, and then screened methods to treat the anticipated water/fluid matrix. The surface water discharge limits for the existing Non-Time Critical Removal Action (NTCRA)-1 & 2 groundwater treatment facility (GWTF) were used to determine the level of water treatment required for each source control alternative. During this analysis, WESTON determined that several compounds present in the DNAPL source at the Site are not included in the current list of discharge limits for the Site. It is likely that permit limits will be established for these additional compounds prior to implementation of the source control remedy. In addition, the discharge flow allowed by the permit will need to be increased which may affect the discharge limits. WESTON has assumed that the treatment processes implemented to meet the current permit limits will be sufficient to meet limits established in the future for additional compounds. This assumption is based on the similarities between the types of compounds on the current list and the compounds not on the current list of discharge limits.

The objective of this report is to sufficiently screen treatment methods such that a sound technical approach can be developed and implemented to meet water treatment design criteria for the Site. Based on the analyses presented herein, reasonable capital and operating cost estimates have been developed to assist with evaluation of the source control alternatives, and to provide a basis for future allocation of funding to perform the detailed design, implementation, and operation of each alternative.

SECTION 2

HYDRAULIC DISPLACEMENT

2. HYDRAULIC DISPLACEMENT

The objective of the hydraulic displacement source control remedy is to recover pooled DNAPL by injection and flushing of a large volume of water through the source area. This flushing action will mobilize pooled DNAPL. A portion of the pooled DNAPL will then be extracted by a series of wells downgradient of the injection system.

2.1 WATER TREATMENT DESIGN CRITERIA

The following describes the general design criteria used to evaluate water treatment alternatives and costs associated with hydraulic displacement of DNAPL:

▪ Design Injection Rate	100 gallons per minute (gpm)
▪ Design Extraction Rate	100 gpm
▪ Minimum Duration	90 days
▪ Maximum Duration	180 days
▪ Percentage of DNAPL Removed	30 to 50%
▪ Mass of Contaminants Removed	300,000 to 500,000 pounds
▪ Influent Contaminant Concentrations	Refer to Table 2-1 and Table 2-2
▪ Maximum Day Contaminant Loading (initial)	5 times average day

The estimated influent water quality characteristics are based on DNAPL and associated groundwater samples collected by Blasland, Bouck & Lee, Inc. (BBL) from six monitoring wells at the Site. The results are presented in Table 2-1.

During source area flushing, the water and DNAPL contaminant concentrations are expected to peak shortly after start-up of the hydraulic displacement process, and trend downward throughout the flushing period as the source area is depleted of pooled DNAPL. The estimated contaminant concentrations in the extracted groundwater, based on the DNAPL contaminant matrix and the estimated water quality design criteria for the water treatment system, are presented in Table 2-2.

Table 2-1
SRSNE Site
Southington, CT
NAPL and Assocated Groundwater Characterization Data[1]

	Sample											Summary			
	*MWD-601		**RW-5		IW-23	***MW-705DR		CPZ-8R		P-4B		DNAPL		Aqueous Phase	
Characterization Parameter	DNAPL	Water	DNAPL	Water	DNAPL/Grout	DNAPL	Water	DNAPL	Water	DNAPL	Water	Average	Maximum	Average	Maximum
VOCs, mg/L (Method 8240 or Modified 8260)															
Vinyl Chloride	-	-	-	0.35	-	-	-	-	3.6	-	-	-	-	2.0	3.6
1,1-Dichloroethylene	187	1.12	126	-	418	-	2.6	-	-	-	-	243.7	418.0	1.9	2.6
Methylene Chloride	-	-	60	-	50	-	18	-	-	-	-	55.0	60.0	18.0	18.0
1,1-Dichloroethane	12.8	0.44	-	0.081	38	-	38	-	-	-	-	25.4	38.0	12.8	38.0
cis-1,2-Dichloroethylene	443.6	10.64	1321	0.932	1254	-	12	11000	83	-	25	3,505	11,000	26.3	83.0
Chloroform	14	-	16	-	-	-	-	-	-	-	-	15.0	16.0	-	-
2-Butanone (MEK)	-	-	-	-	-	-	32	-	-	-	-	-	-	32.0	32.0
1,1,1-Trichloroethane	4433	14.6	2313	0.103	1834	29000	33	6200	5	11000	100	9,130	29,000	30.5	100.0
Benzene	49.8	0.72	70	-	11	-	-	-	-	-	-	43.6	70.0	0.7	0.7
1,2-Dichloroethane	9	-	-	-	-	-	-	-	-	-	-	9.0	9.0	-	-
Trichloroethylene	163000	348	57371	0.66	19019	550000	780	220000	140	5600	15	169,165	550,000	256.7	780.0
4-Methyl-2-pentanone (MIBK)	-	1.44	75	-	-	-	50	-	-	-	-	75.0	75.0	25.7	50.0
2-Hexanone	NA	NA	NA	NA	NA	-	50	-	-	-	-	NA	NA	50.0	50.0
Toluene	45104	48.4	15007	-	6636	81000	42	64000	27	120000	61	55,291	120,000	44.6	61.0
1,1,2-Trichloroethane	5.8	-	-	-	-	-	-	-	-	-	-	5.8	5.8	-	-
Tetrachloroethylene	46470	16.28	12866	0.286	15052	160000	31	180000	16	38000	5.1	75,398	180,000	13.7	31.0
Ethylbenzene	5239	8.64	3781	-	3891	21000	2.8	30000	3.3	18000	2.8	13,652	30,000	4.4	8.6
P/M Xylenes	12061	8.67	3629	-	5512	46000	5.1	65000	6.6	38000	5	28,367	65,000	6.3	8.7
O Xylene	4210	5.76	2569	0.084	2727	12000	1.6	20000	-	8600	1.3	8,351	20,000	2.2	5.8
Styrene	1056	0.43	643	-	784	-	-	-	-	-	-	828	1,056	0.4	0.4
TOTAL VOCs	282,000	465	99,800	2.5	57,200	899,000	1,100	596,200	284.5	239,200	215.2	362,233	899,000	413	1,100
TCL SVOCs (Modified Methods 8270/8040)															
SVOCs	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	ND	ND	ND	ND
PCBs/Pesticides, mg/L (Method 8080)															
PCB-1254	-	-	300	-	0.730	NA	NA	1600	NA	NA	NA	950	1,600	NA	NA
PCB-1260	419	0.061	-	-	-	NA	NA	660	NA	NA	NA	540	660	NA	NA
Density, g/cm^3 (ASTM D-4052)															
@ 10 degrees Celsius			1.1136			1.23		1.068				1.1	1.2	NA	NA
@ 15.6 degrees Celsius	1.1093	Not Analyzed		Not Analyzed	Not Analyzed		Not Analyzed		Not Analyzed	Not Analyzed		1.1	1.1	NA	NA
@ 20.0 degrees Celsius	1.1005											1.1	1.1	NA	NA
@ 25.0 degrees Celsius	1.0963											1.1	1.1	NA	NA
@ 38.0 degrees Celsius	1.0855											1.1	1.1	NA	NA
Viscosity, centistokes (ASTM D-445)															
@ 8.5 degrees Celsius			1.23									1.2	1.2	NA	NA
@ 10 degrees Celsius				Not Analyzed	Not Analyzed	0.993	Not Analyzed	5.59	Not Analyzed	Not Analyzed		3.3	5.6	NA	NA
@ 20.0 degrees Celsius	1.12											1.1	1.1	NA	NA
@ 25.0 degrees Celsius	1.049											1.0	1.0	NA	NA
@ 38.0 degrees Celsius	0.901											0.9	0.9	NA	NA
Interfacial Tension, dynes/cm (ASTM D-971)															
@ 10 degrees Celsius								8.67	NA	NA	NA	8.7	8.7	NA	NA
@ 20.0 degrees Celsius	7.8	NA	3.1	NA	NA	9.0	NA					6.6	9.0	NA	NA

Notes:

(1) NAPL and Associated Groundwater Characterization Data - Obtained from BB&L - Feasibility Study

VOCs analyzed by Method 8240 except for samples from well MW-705DR and CPZ-8R, analyzed by modified Method 8260.

* Well MWD-601 installed with 5-foot long screen in 6.7-foot long sand pack.

** Well RW-5 installed with 10-foot long screen in 17-foot long saturated sand pack; ground-water sample obtained from RW-5 during NTCRA 1 system operation.

*** Well MW-705DR installed with 10-foot long screen in 12-foot long sand pack.

\- Below detection level.

ND - Analyzed, but none detected.

mg/L - milligrams per Liter.

Table 2-2
Hydraulic Displacement
Estimated Water Quality Design Data
SRSNE Site
Southington, CT

Design Data	**Units**	**Max**	**Min**	**Max Day**
Hydraulic Displacement Duration	days	90	180	1
Approximate Design Flow	gpm	100	100	100
Total lbs VOC Mass	lbs	500,000	300,000	27,780
Estimated Gallons of DNAPL (1)	gallons	50,000	30,000	2,778

	Groundwater Quality DNAPL Phase		**Estimated Influent Water Quality to Preliminary Treatment (100 gpm)**						**Groundwater Quality Aqueous Phase**	**Estimated Effluent Water Quality from Preliminary Treatment (100 gpm)**		**Suggested Preliminary Treatment Effluent Design Criteria** (3)	**Regulatory Limit for Combined Effluent**(4) **(NTCRA-1/2 + HD GWTF) 45 to 175 gpm**
	Average (2)		**Max Avg. Day** (2)		Min Average Day		Max Day (SF-5) (1)		Max (2)	2X - Max		**Aqueous**	**Aqueous**
Characterization Parameter	mg/L	%	**total lbs**	**mg/L**	total lbs	mg/L	lbs/day	mg/L	mg/L	mg/L	% of Sol	**mg/L**	**mg/L**
VOCs, mg/L (Method 8240 or Modified 8260)													
Vinyl Chloride	-	0.0%	**-**	**-**	-	-	-	-	3.6	7.2	NA	**7.20**	**4.50**
1,1-Dichloroethylene	244	0.1%	**335**	**3.1**	201	0.9	19	15.5	2.6	5.2	0.2%	**5.20**	**0.06**
Methylene Chloride	55	0.02%	**76**	**0.7**	45	0.2	4	3.5	18	36	NA	**0.70**	**15.00**
1,1-Dichloroethane	25	0.01%	**35**	**0.3**	21	0.1	2	1.6	38	76	1.5%	**0.32**	**No Limit**
cis-1,2-Dichloroethylene	3,505	1.0%	**4,812**	**44.5**	2,887	13.4	267	222.6	83	166	4.7%	**44.5**	**5.00**
Chloroform	15	0.004%	**21**	**0.2**	12	0.1	1	1.0	-	-	0.0%	**0.19**	**No Limit**
2-Butanone (MEK)	-	-	**-**	**-**	-	-	-	-	32	64	NA	**64**	**10.00**
1,1,1-Trichloroethane	9,130	2.5%	**12,536**	**116.0**	7,521	34.8	696	579.9	100	200	15.4%	**200**	**4.00**
Benzene	44	0.01%	**60**	**0.6**	36	0.2	3	2.8	0.7	1.4	0.1%	**0.55**	**No Limit**
1,2-Dichloroethane	9	0.002%	**12**	**0.1**	7	0.0	1	0.6	-	-	0.0%	**0.11**	**0.25**
Trichloroethylene	169,165	46.5%	**232,268**	**2,148.9**	139,361	644.7	12,904	10,744.6	780	780	70.9%	**780**	**0.97**
4-Methyl-2-pentanone (MIBK)	75	0.02%	**103**	**1.0**	62	0.3	6	4.8	50	100	0.6%	**0.95**	**2.00**
2-Hexanone	-	-	**-**	**-**	-	-	-	-	50	100	NA	**100**	**No Limit**
Toluene	55,291	15.2%	**75,916**	**702.4**	45,550	210.7	4,218	3,511.8	61	122	24.4%	**122**	**4.00**
1,1,2-Trichloroethane	6	0.002%	**8**	**0.1**	5	0.0	0	0.4	-	-	0.0%	**0.07**	**0.25**
Tetrachloroethylene	75,398	20.7%	**103,524**	**957.8**	62,114	287.3	5,751	4,788.9	31	62	31.0%	**62**	**0.11**
Ethylbenzene	13,652	3.7%	**18,744**	**173.4**	11,247	52.0	1,041	867.1	8.6	17.3	9.9%	**17.3**	**1.00**
Xylene (total)	36,718	10.1%	**50,449**	**466.7**	30,269	140.0	2,803	2,333.7	14.5	28.9	14.4%	**28.9**	**0.50**
Styrene	828	0.2%	**1,136**	**10.5**	682	3.2	63	52.6	0.4	0.9	0.3%	**0.86**	**0.50**
Chloroethane (5)	-	-	**-**	**-**	-	-	-	-	-	-	-	**0.94**	**No Limit**
Tetrahydrofuran (6)	-	-	**-**	**-**	-	-	-	-	-	-	-	**3**	**0.50**
TOTAL VOCs	364,159	100.0%	**500,000**	**4,626.2**	300,000	1,387.9	27,780	23,131.2	1,100	2200	-	**1438**	**-**
TCL SVOCs (Modified Methods 8270/8040)													
SVOCs	-	-	**-**	**-**	-	-	-	-	-	-	-	**-**	**No Limit**
PCBs/Pesticides, mg/L (Method 8080)													
PCB-1254	950	63.8%	**1304**	**12**	913	4	72	60.3	-	-	-	**0.06**	**No Limit**
PCB-1260	540	36.2%	**741**	**7**	519	2	41	34.3	-	-	-	**0.12**	**No Limit**
Total PCB's - Based on data received	1490	100.0%	**2045**	**19**	1432	7	114	95	-	-	-	**0.18**	**No Limit**
Discharge Permit Listed Alcohols (not listed above)													
Ethanol (6)	-	-	**-**	**-**	-	-	-	-	-	-	-	**21.37**	**20.00**
Isopropanol (6)	-	-	**-**	**-**	-	-	-	-	-	-	-	**0.2**	**10.00**
Methanol (6)	-	-	**-**	**-**	-	-	-	-	-	-	-	**16.00**	**30.00**
sec-butanol (6)	-	-	**-**	**-**	-	-	-	-	-	-	-	**11.00**	**10.00**
Discharge Permit Listed Ketones (not listed above)													
Acetone (6)	-	-	**-**	**-**	-	-	-	-	-	-	-	**5.80**	**35.00**
Methyl ethyl ketone (MEK) (6)	-	-	**-**	**-**	-	-	-	-	-	-	-	**7.00**	**10.00**

Notes

(1) - For preliminary design purposes, all Mass (lbs) and gallon estimates are based on DNAPL weight of 10 lbs/gallon.

(2) - Maximum average day and Max day with SF of 5 shall be used for GWTF Process Design Basis. Average and Max DNAPL/Aqueous phase results are based on BB&L data presented in Table 2-1.

(3) - Estimated Preliminary Treatment Effluent results are based on 2x-Max results for aqueous phase and notes 5, and 6.

(4) - Regulatory limit for combined NTCRA 1/2 and Hydrauic Displacement (HD) Groundwater Treatment Facility (GWTF) effluent is based on current plant discharge permit, which will likely be modified for a discharge rate >100gpm.

(5) - Bases on BB&L groundwater sample results for June 2003. No NTCRA-1 data available.

(6) - Assumed max detected value of NTCRA-1 influent sampling between July 1995 and March 2004.

mg/L - milligrams per Liter

gpm - gallons per minute

These data have been used to evaluate potential water treatment approaches, including estimated capital and operating costs, for the hydraulic displacement source removal alternative.

2.2 GROUNDWATER INJECTION AND EXTRACTION SYSTEMS

A preliminary Site Plan of the hydraulic displacement groundwater injection and extraction system has been provided to WESTON by BBL (Figure 1, Appendix A). The proposed system consists of approximately 38 injection wells and 43 extraction wells. Each well is 6 inches in diameter with an average depth of 19 feet (ft) and a screen length of approximately 10 ft. In addition, each well is equipped with a 2-ft-deep sump at the bedrock interface to ensure capture of the DNAPL. Based on preliminary material analysis and compatibility with the DNAPL matrix, grade 304 stainless steel is recommended for injection/extraction well screens, sumps, and risers.

Each injection well will likely be equipped with both flow and level monitoring to enable proper management of the injected fluid and optimization of the hydraulic displacement remedy performance. Each extraction well will be equipped with either a pneumatic submersible or other acceptable extraction well pump, which will extract water and mobilized DNAPL downgradient from the injection wells. There is the potential for well headspace vapors to exceed the lower explosive limit (LEL), because of the high volatile organic compounds (VOC) concentrations present in the groundwater and DNAPL fluid matrix. This will require all in-well equipment subject to vapor exposure to be suitable for installation in a hazardous atmosphere. The groundwater extraction wells will be designed to maintain an adjustable level set-point in order to control the groundwater hydraulic gradient during hydraulic displacement. Each extraction well will be designed to operate between 0 and 5 gpm, with an average extraction rate of approximately 2.5 gpm.

Groundwater injection and conveyance piping may be installed above or below ground surface. The method selected will be determined during detailed design and will take into consideration long-term use and accessibility requirements. Above ground conveyance piping will require freeze protection and provisions for maintaining access to the wells for maintenance. Underground lines will require provisions for accessibility for process line maintenance.

2.3 HYDRAULIC DISPLACEMENT WATER TREATMENT ALTERNATIVES

2.3.1 Evaluation of Potential Use of Existing NTCRA-1 and 2 GWTF

During hydraulic displacement operations, the NTCRA-1 and 2 extraction systems and GWTF will continue to operate. Projected flow ranges for the existing system are presented in Table 2-3, based on current and projected operating flows:

Table 2-3
Projected Flow Ranges for NTCRA-1 & 2

Description	Average Flow (gpm)	Maximum Flow (gpm)
NTCRA-1 – (RW-1 through 12)	15	40
NTCRA-2 (RW-13, 1R and proposed new RW-14)	30	35
Existing NTCRA-1 and 2 GWTF	45	75

Although the existing NTCRA-1 & 2 GWTF has a design maximum hydraulic capacity of approximately 100 gpm, the existing metals treatment unit processes are unlikely to provide effective treatment at influent flows greater than 75 gpm. Each of the two existing ultraviolet (UV) systems has sufficient capacity to treat the projected NTCRA-1 & 2 influent streams with approximately four operating lamps [(120 kilowatts (kW)]. For each UV unit to treat greater than 75 gpm, the existing 2-inch influent and effluent control valves and associated piping would require replacement with larger diameter piping and fittings. Flows greater than 75 gpm could also be treated by operating the two UV systems in parallel.

WESTON evaluated potential expansion and use of the existing NTCRA-1 & 2 GWTF to treat the additional water and DNAPL extracted during hydraulic displacement. This evaluation assumed that separate pre-treatment (phase separation) and treated water injection facilities would be required, and expansion of the existing facility would be limited to the metals and organic compound treatment components only. This analysis was based on the following conditions:

- NTCRA-1 & 2 plant effluent could be used as a water supply for the hydraulic displacement injection.

- Un-treated NTCRA-2 water would not be used as a water supply for the hydraulic displacement injection. *Note*: Even if this water was used for injection, it would not likely impact the outcome of this evaluation.

- Hydraulic displacement would be conducted in a single event throughout the source area and not in a modular fashion under which the injection and extraction rates could be reduced.

- The design flow for the NTCRA-1 & 2 system would be increased from the predicted 45 gpm average and 75 gpm maximum to a 145 gpm average and 175 gpm maximum to treat the additional water generated by the hydraulic displacement activities.

The results of this analysis indicate that use of the existing NTCRA-1 & 2 GWTF for metals and organic treatment of the full flow generated by the hydraulic displacement remedial alternative is unlikely to be the most cost-effective water treatment approach. The primary reasons for this conclusion are as follows:

1. The capacity of the existing system would need to be approximately doubled in order to treat the higher hydraulic loading rate. It is very unlikely that the existing building could accommodate the additional and larger equipment without expansion.

2. Given the short duration of the hydraulic displacement remedy (approximately 6 months) it appears more appropriate to construct a separate temporary GWTF to pre-treat this concentrated waste stream.

3. Based on a process evaluation conducted by Calgon Carbon Corporation (CCC), the manufacturer of the existing UV systems, the increased organic loading from the hydraulic displacement would exceed the capacity of the existing UV system. Therefore, additional organic removal processes would be required in order to meet the projected effluent discharge limits. The estimated organic loading is orders of magnitude greater than the capacity of the current UV system, even if both units are operated at full power.

4. There is the potential for tank headspaces to exceed the LEL during treatment of the highly contaminated liquids generated by the hydraulic displacement activities. An analysis of potential tank headspace vapor concentrations is presented in Table 2-4. The existing NTCRA-1 & 2 GWTF is not designed for hazardous conditions. Consequently, it is likely that at least the process tank interiors and envelopes would require a hazardous electrical classification of Class I-Division I, and Class I-Division II, respectively. In addition, LEL monitoring would be necessary when a tank is opened for maintenance or inspection. Although further detailed design analysis and/or implementation of additional controls could potentially reduce or prevent explosive conditions from occurring, it is appropriate at this point to assume that explosion-proof construction would be required for tank interiors. This issue will need to be further addressed during remedial design.

Table 2-4
Post Phase Separator - Vapor Phase Concentration Analysis
SRSNE - Southington CT

Hydraulic Displacement	Phase Separator Effluent
Groundwater Flow Rate (gpm)	100
Groundwater Flow Rate (L/day)	544,320

	Following Phase Separation													
VOCs, mg/L	**Aqueous Phase Concentration (mg/L)**	**Percent**	**Mass (grams/day)**	**MW grams/mole**	**#moles**	**mole fraction**	**Pure VP @20degC (mmHg)**	**^{1}Partial Pressure (mmHg)**	**Aqueous Solubility (mg/L)**	**Henry's Law Constant**	**Vapor Phase mg/L**	**% in Vapor Phase**	**LEL %**	**UEL %**
1,1,1-Trichloroethane^2	200.00	13.4%	108,864	133.4	816.1	0.113	100	11.3	1,300	0.06	12.67	7.8%	7.5%	15.0%
1,1,2-Trichloroethane	0.07	0.005%	38	133.40	0.3	0.000	19	0.0008	4,000	0.00	0.00	0.000%	6.0%	15..5%
1,1-Dichloroethane	0.32	0.02%	174	99.0	1.8	0.000	182	0.04	6,000	0.00	0.00	0.0%	5.6%	11.4%
1,1-Dichloroethylene	5.20	0.3%	2,830	98.0	28.9	0.004	500	2.0	2,500	0.00	0.02	0.0%	7.3%	16.0%
1,2-Dichloroethane	0.11	0.01%	60	98.0	0.6	0.000	64	0.01	8,700	0.00	0.00	0.00%	6.2%	15.9%
2-Butanone - MEK	64.00	4.3%	34,836	72.1	483.2	0.067	71	4.74	290,000	0.00	0.00	0.0%	1.8%	10.1%
2-Hexanone	100.00	6.7%	54,432	100.2	543.5	0.075	11	0.83	14,000	0.00	0.03	0.0%	1.3%	8.1%
4-Methyl-2-pentanone (MIBK)	0.95	0.1%	517	100.0	5.2	0.001	15	0.011	19,100	0.00	0.00	0.00%	1.1%	7.5%
Benzene	0.55	0.0%	299	78.1	3.8	0.001	75	0.04	1,750	0.000	0.00	0.00%	1.2%	7.8%
Chloroethane	0.94	0.1%	512	64.5	7.9	0.001	993	1.09	5,740	0.00	0.00	0.0%	3.8%	15.4%
Chloroform	0.19	0.01%	103	119.4	0.9	0.000	160	0.02	8,000	0.00	0.00	0.00%	NA	NA
cis-1,2-Dichloroethylene	44.52	3.0%	24,233	97.0	249.8	0.035	160	5.5	3,500	0.01	0.37	0.2%	5.6%	12.8%
Ethylbenzene	17.28	1.2%	9,406	106.2	88.6	0.012	7	0.1	150	0.00	0.06	0.0%	0.8%	6.7%
Methylene Chloride	0.70	0.05%	381	84.9	4.5	0.001	350	0.2	13,000	0.00	0.00	0.0%	13.0%	23.0%
Styrene	0.86	0.1%	468	104.2	4.5	0.001	5	0.0	300	0.00	0.00	0.0%	0.9%	6.8%
Tetrachloroethylene	62.00	4.2%	33,748	165.8	203.5	0.028	13	0.4	150	0.02	1.37	0.8%	NA	NA
Tetrahydrofuran^3	2.50	0.2%	1,361	72.0	18.9	0.003	129	0.3	1,000,000	0.00	0.00	0.0%	1.5%	12.0%
Toluene	122.00	8.2%	66,407	92.1	721.0	0.100	21	2.1	515	0.02	2.50	1.5%	1.1%	7.1%
Trichloroethylene	780.00	52.3%	424,570	131.4	3,231.1	0.447	58	25.9	1,000	0.19	145.32	89.3%	8.0%	10.5%
Vinyl Chloride	7.20	0.5%	3,919	62.5	62.7	0.009	2,580	22.4	2,670	0.03	0.21	0.1%	3.6%	33.0%
Xylenes-Total	28.86	1.9%	15,709	106.2	147.9	0.020	9	0.2	200	0.01	0.15	0.1%	1.1%	7.0%
TCL SVOCs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA	NA	N/A	N/A	N/A
PCBs/Pesticides, mg/L														
PCB-1254	0.06	0.0%	33	327	0.1	0.000	N/A	N/A	0.06	NA	NA	N/A	N/A	N/A
PCB-1260	0.12	0.0%	65	372	0.2	0.000	N/A	N/A	0.08	NA	NA	N/A	N/A	N/A
Permit Listed Alcohols														
Ethanol^3	21.37	1.4%	11,632	46.1	252.3	0.035	44	1.5	1,000,000	0.00	0.00	0.0%	3.3%	24.5%
Isopropanol^3	0.20	0.0%	109	60.1	1.8	0.000	33	0.01	1,000,000	0.00	0.00	0.0%	2.0%	12.0%
Methanol^3	16.00	1.1%	8,709	32	272.2	0.038	128	4.82	1,000,000	0.00	0.00	0.0%	6.0%	31.0%
sec-butanol	11.00	0.7%	5,988	74	80.9	0.011	12.5	0.14	160,000	0.00	0.00	0.0%	1.7%	9.8%
Permit Listed Ketones														
Acetone^3	5.80	0.4%	3,157	58.1	54.3	0.008	184.5	1.39	1,000,000	0.00	0.00	0.0%	2.5%	12.8%
Grand Total	**1,493**	**100%**	**809,404**	**-**	**7,232**	**1.0**	**-**	**-**			**163**	**100%**	**-**	**-**

Notes:

1. Partial Pressure calculated using Raoult's Law ($P_i = X_i P_i^o$)
2. Aqueous solubility from *Hydraulic Displacement of DNAPL* (Kueper, 2004a).
3. Compound is 100% soluble (i.e. 100mg/100mL of H_2O).

mg/L - milligrams per Liter

LEL - lower explosive limit

UEL - upper explosive limit

mmHg - milimeters of mercury

If a separate organics treatment process is employed, there will be excess UV system capacity at the existing NTCRA-1 & 2 GWTF. Therefore, potential use of some or all of this UV capacity will be retained for further evaluation during the detailed analysis of a separate treatment system to treat the groundwater for hydraulic displacement..

2.3.2 Evaluation of a Separate GWTF for Hydraulic Displacement

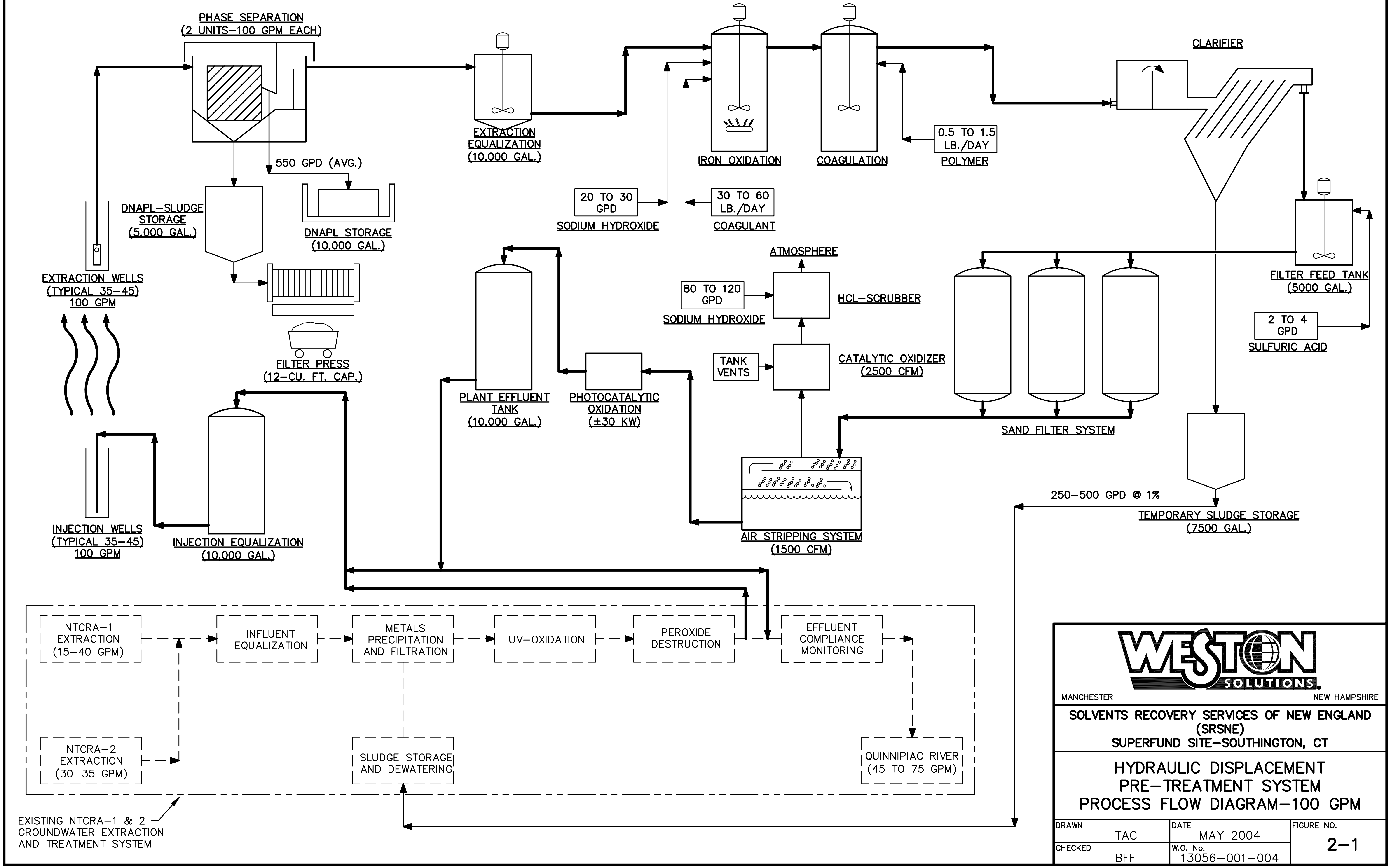
Based on the analysis of the existing NTCRA-1 & 2 GWTF presented in Subsection 2.3.1, WESTON recommends that a separate temporary GWTF be constructed for treatment of fluids extracted during hydraulic displacement. By implementing this approach, the extracted groundwater could be treated to achieve the current discharge criteria for the Site, and the treated effluent could then be used as the primary injection source water during hydraulic displacement. Excess effluent water from the hydraulic displacement treatment system would be combined with the existing NTCRA-1 & 2 GWTF effluent prior to discharge. Additional provisions could also be made for use of effluent from the existing NTCRA-1 and 2 GWTF during initial hydraulic displacement operations, and if supplemental injection capacity is needed.

Equipment for the hydraulic displacement GWTF would be housed on-site in a temporary building constructed on a reinforced concrete slab. The concrete slab would be equipped with secondary containment and a central floor sump. The foundation would also have equipment pads as necessary to properly support all equipment. The temporary building would likely be installed adjacent the existing NTCRA-1 & 2 GWTF. Portions of the building and treatment systems would be rated for Class I, Division II hazardous conditions.

2.3.3 Hydraulic Displacement Groundwater Treatment Facility Process Overview

The major unit processes for the proposed hydraulic displacement GWTF are listed below, and a process flow diagram for the system is shown in Figure 2-1.

- Preliminary Treatment – Phase separation, DNAPL storage, DNAPL sludge dewatering, and extraction equalization.
- Metals Pre-Treatment – Iron oxidation, coagulation, clarification, filtration and supplemental sludge handling.



WESTON SOLUTIONS.
MANCHESTER NEW HAMPSHIRE

SOLVENTS RECOVERY SERVICES OF NEW ENGLAND
(SRSNE)
SUPERFUND SITE-SOUTHINGTON, CT

HYDRAULIC DISPLACEMENT
PRE-TREATMENT SYSTEM
PROCESS FLOW DIAGRAM-100 GPM

DRAWN	DATE	FIGURE NO.
TAC	MAY 2004	2-1
CHECKED	W.O. No.	
BFF	13056-001-004	

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- Organics Treatment – Air stripping/catalytic oxidation and advanced photocatalytic oxidation.
- Effluent storage and injection system recirculation.

Detailed analyses of each major unit process listed above are presented in the following subsections.

2.3.3.1 Preliminary Treatment

Phase Separation

All extracted fluids from the hydraulic displacement wells will initially be processed through a phase separator. Because of the high volume of DNAPL expected, WESTON recommends that a minimum of two phase separators be provided, each conservatively sized for a minimum of 100 gpm capacity. Although the separators will be configured in parallel, and both units will be operated simultaneously, each unit should be sized to handle the full flow to allow for periodic cleaning and maintenance (sludge removal). Each unit should be equipped with an automatic DNAPL/water interface metering device to monitor and control equipment operation, and ensure satisfactory DNAPL separation and recovery.

DNAPL Storage

Approximately 52,800 gallons of DNAPL will be recovered during the hydraulic displacement remedial action based on a paper entitled *Hydraulic Displacement of DNAPL for Application at the SRSNE Site, Southington, CT* (Kueper, 2004a). The DNAPL extraction rate is expected to peak at approximately 3,000 gallons per day (gpd) during the initial phase of hydraulic displacement. This peak loading rate was calculated based on a 90-day hydraulic displacement operating period. The average DNAPL recovery rate for a 90 day operating period is estimated to be 587 gpd. A minimum of 10,000 gallons of on-site DNAPL storage capacity is recommended in order to provide at least 3 to 4 days storage at the initial DNAPL extraction rate, and approximately 2 weeks of storage following the initial high loading period. This tank should have a double wall design, or have integral secondary containment. Provisions for bulk tanker access to the DNAPL storage tank are necessary to facilitate off-site DNAPL disposal.

Sludge Handling and Dewatering

Water extracted during hydraulic displacement is anticipated to contain high concentrations of iron, manganese and solids. As a result, sludge is expected to accumulate in the coalescing media and DNAPL chambers in the phase separators. Consequently, frequent cleaning of the phase separators will likely be necessary in order to maintain effective DNAPL/water separation.

The periodic cleaning of the phase separators will likely generate sludge that contains high concentrations of DNAPL constituents. This sludge will likely require a disposal method that is different from the method currently used for the non-hazardous sludge generated by the NTCRA-1 & 2 GWTF. As a result, WESTON recommends that a separate sludge holding tank be provided in order to enable draining and cleaning of the phase separators. A separate filter press is also recommended for dewatering these solids separately from the NTCRA-1 & 2 sludge. The sludge holding tank should have a minimum capacity of 5,000 gallons and be equipped with a conical bottom and decant valves to further separate the sludge and DNAPL. The filter press should have a minimum capacity of 12 cubic feet.

Equalization

An equalization tank will be necessary to collect effluent from the phase separators and transfer process forward flow to the metals pre-treatment system. This equalization tank should be provided with a conical or dished bottom to capture any DNAPL that may pass through the phase separators. The equalization transfer pumps will be equipped with variable speed control in order to adequately control the level of the equalization tank, and to regulate process flows through the metals precipitation system. This equalization tank will also receive backwash water from the metals pre-treatment sand filter system.

Other Provisions

As previously discussed, all Preliminary Treatment process equipment and surrounding facilities should be designed for Class 1, Division II conditions. All process tanks and equipment will be vented to a catalytic oxidizer. The tank ventilation system will maintain a negative pressure on the tanks in order to prevent vapor emissions. It is likely that maintenance activities such as filter press operation, and cleaning of the phase separators will require Level B personal protection equipment (PPE) as well as work space air monitoring.

2.3.3.2 Metals Treatment

The hydraulic displacement GWTF will be designed to include metals treatment that can process a maximum of 100 gpm of forward flow. The metals treatment process in the proposed system will be similar to the one in the existing NTCRA-1 & 2 GWTF, which comprises the following unit processes: metals oxidation, coagulation, clarification, and sand filtration. Based on the estimated influent chemistry shown in Table 2-2, metals treatment will be designed to reduce the iron content in the influent from 10 milligrams per Liter (mg/L) to less than 1 mg/L prior to the organic treatment process.

As described above, metals treatment will be comprised of chemical precipitation followed by sand filtration. The chemical precipitation process will include the following:

- Aeration or mixing and adjustment of the pH to approximately 10 to oxidize and precipitate the metals. Sodium hydroxide will be used to elevate the pH.
- Coagulant and polymer addition to enhance flocculation and settling.
- Settling in an inclined plate clarifier.
- Neutralization of the pH, using sulfuric acid, to approximately 7.0 in preparation for sand filtration.
- Sludge storage, thickening and dewatering.

Approximate chemical usage and sludge generation estimates are shown in Figure 2-1. All chemicals will be delivered in drums and stored on secondary containment spill pallets, with exception of the sodium hydroxide, which will be stored in a tank with a minimum capacity of 1,500 gallons.

A temporary holding tank will be used to store sludge pumped from the settling chamber in the bottom of the clarifier, and to allow draining of the clarifier for periodic cleaning. It is expected that the sludge generated by this pre-treatment process will be compatible with, and similar to, the sludge generated by the existing NTCRA-1 & 2 GWTF. Therefore, the sludge will be transferred to the NTCRA-1 & 2 treatment system for dewatering.

The sand filter could either be a continuous backwashing type system similar to that in the existing NTCRA-1 & 2 GWTF, or a standard multi-media pressure filter system. For this evaluation, a multi-media pressure filtration system has been included in the estimated costs, because it is available on a temporary basis and a rental system has been included in the estimated. A triplex system is recommended with 4 to 5-ft-diameter columns in order to adequately filter solids and metals from the process water.

Similar to provisions for the preliminary treatment process components, all metals treatment processes will be designed for hazardous conditions. The headspaces of all process tanks and equipment will be maintained at a negative pressure in order to capture vapors for treatment prior to discharge.

2.3.3.3 Organics Treatment Alternatives

WESTON performed a preliminary screening of technologies for removal/destruction of the organic contaminants in the water extracted during the hydraulic displacement source control option. These technologies include the following:

1. Air stripping with treatment of the vapor phase exhaust.
2. Ultraviolet oxidation with hydrogen peroxide.
3. Ultraviolet oxidation with hydrogen peroxide and ferrous iron (Fenton’s Reaction)
4. Ultraviolet oxidation with titanium dioxide catalyst and possibly hydrogen peroxide as required (photocatalytic oxidation).
5. Liquid phase carbon adsorption.
6. A combination of the treatment technologies in Items 1 through 5.

The organics treatment process will be designed to remove/destroy the organic contaminants in the process water to levels less than the current site discharge limits. The design criteria and discharge limits for this evaluation are included in Table 2-2.

In addition to reliable and cost-effective attainment of the discharge limits, another factor considered during screening of the organics treatment technologies is the long-term water treatment strategy for the Site. Equipment used for treatment during hydraulic displacement can be reused as part of the long-term water treatment approach, which will likely reduce long-term costs. The organics treatment process used during the source control remedial action may be suitable for replacement of the existing aging UV-peroxide systems.

Of the five alternative organics treatment technologies identified above, initial screening results demonstrated that liquid phase carbon adsorption would not be suitable to treat organic contaminants during source control activities. The estimated carbon usage rate exceeds 20,000 pounds per day, resulting in extremely high operating costs. Liquid-phase carbon could be retained and evaluated only as a polishing process for other treatment technologies. The initial screening analysis revealed that all other alternative processes identified could be retained and further evaluated.

Air Stripping

Air stripping uses air to transfer VOCs from process water to the air stream. Air stripping has been successfully implemented in contaminated groundwater applications for many years and does not warrant a technical overview. Two primary types of air strippers available are low profile (tray) and packed column (tower) designs. Other alternative designs are also available including, but not limited to, induced cavitation technology which utilizes high pressure pumps and air eductors to aerate the water. For the basis of this analysis, WESTON evaluated tray-type air strippers, which are relatively economical to procure and operate.

The advantages of air stripping include the following:

- Economical removal of many volatile contaminants from water to acceptable levels.
- Low capital and operating costs.
- Relatively simple to operate.

The disadvantages of air stripping include the following:

- Unable to independently meet the discharge limits for all organic contaminants of concern at the SRSNE site including 2-Butanone, polychlorinated biphenyl (PCBs), tetrahydrafurans, acetone, alcohols, and 1,4-dioxane.
- Does not destroy contaminants. Supplemental air treatment is required and air emissions are a potential community concern.
- Metals removal is required prior to air stripping for successful long-term performance.

The preliminary conclusions from the initial screening of air stripping include the following:

1. Air stripping cannot independently treat the contaminated groundwater to acceptable levels. Supplemental treatment will be required.
2. If air stripping technology is evaluated as the primary VOC removal process, air emissions treatment will be required. Because of significant VOC loadings in the air stream, vapor phase carbon will not be suitable for treatment of this concentrated air stream. Thermal air treatment will be warranted, likely using catalytic oxidation. Because the influent to the oxidizer will have a high concentration of chlorinated organics, a caustic scrubber will be necessary to neutralize the resulting hydrochloric acid in the oxidizer exhaust.
3. If air stripping is evaluated as the polishing process for organics treatment, then thermal treatment of the stripper exhaust may not be necessary, and vapor phase carbon could be considered to reduce costs.

Ultraviolet Light with Hydrogen Peroxide

Ultraviolet (UV) light with hydrogen peroxide is another proven process capable of destroying VOC compounds present in contaminated groundwater. The UV/hydrogen peroxide technology is currently employed at the existing NTCRA-1 & 2 GWTF. This existing system is comprised of two separate 360 kW units that are controlled by a single control system. Current influent concentrations from the NTCRA-1 & 2 extraction system require 120 kW of power (1/3 capacity of one unit) with a relatively low hydrogen peroxide dose (20 mg/L) for attainment of the discharge limits.

WESTON consulted the existing UV system manufacturer, CCC, to evaluate the capacity of the existing UV system, and applicability to treatment of contaminated water generated by the hydraulic displacement remedy. CCC evaluated the projected influent concentrations and effluent discharge limits and advised WESTON that the existing on-site units (720 kW total) could not adequately treat the process water without pre-treatment. CCC suggested that the existing UV-peroxide equipment be considered for polishing only. Hydroxyl Systems (another vendor of UV-peroxide systems) also recommended that UV-peroxide not be further considered for the primary organics treatment process. They also suggested that UV-peroxide be considered for polishing only. However, Hydroxyl Systems indicated that their estimated UV demand for UV-peroxide treatment of the groundwater extracted by hydraulic displacement would be in the range of 250 to 350 kW, significantly less than power requirement suggested by CCC. This leaves some uncertainty in evaluating the capacity of the existing UV units. Hydroxyl Systems recommended the polishing approach because they are required to furnish a new system with this capacity, which would not be economical. If CCC had arrived at similar electrical demands, the potential use of one of the existing UV units would be more economical.

Preliminary conclusions from for initial screening of UV-peroxide include the following:

1. UV-peroxide should only be considered for polishing treatment, based on CCC recommendations.
2. Use of one of the two existing UV systems appears viable in a polishing treatment application. However, if one existing unit is dedicated for polishing treatment of hydraulic displacement, no redundant equipment will be available at the NTCRA-1 & 2 treatment system, further increasing the potential for hydraulic containment loss of compliance.
3. Use of a new UV-peroxide system for polishing would not be cost effective, and this analysis should be refined to consider the available on-site equipment.

Catalytic UV-Fenton-Peroxide

WESTON evaluated two photocatalytic advanced oxidation processes: UV-fenton and UV-Titanium Dioxide. These processes employ catalysts to enhance the production of hydroxyl radicals, and therefore have the potential for lower treatment costs in comparison to UV-peroxide alone. The first process discussed herein is the catalytic UV-fenton-peroxide process. This process utilizes either natural or supplemental (ferrous sulfate) iron catalyst to enhance the production of hydroxyl radicals and promote destruction of organic contaminants. In addition to the lower operating costs that these systems offer in comparison to UV-peroxide, they also can treat groundwater without metals pre-treatment. This can be accomplished because the pH of process water is reduced to approximately 3 prior to photocatalytic treatment, thereby maintaining metals such as iron and manganese in the dissolved state. Even so, metals removal would still be required in order to meet the effluent discharge limits for the Site, and to prevent fouling of the hydraulic displacement injection wells. Furthermore, either natural or supplemental iron will be discharged from the UV-fenton-peroxide process. This supplemental iron would require removal prior to discharge. As a result, the UV-fenton-peroxide process is primarily applicable for VOC destruction only during hydraulic displacement, and must be followed by a metals removal system. Hydroxyl Systems did not recommend UV-fenton-peroxide as the primary organics treatment process, and suggested that it only be considered for polishing. Other potential primary VOC treatment processes such as air stripping, require pretreatment for removal of metals. The low level of iron in the effluent from the primary organics treatment process would complicate use of the UV-fenton-peroxide process for polishing in this application. In addition, supplemental metals removal would be required prior to discharge and/or re-use of the water for injection. Consequently, this process has been eliminated from further consideration.

It should be noted that the manufacturer of the second photocatalytic advanced technology evaluated (Purifics – Photo-Cat®) did suggest that their process be considered for either primary VOC treatment or polishing. It is likely that both processes have similar capabilities. Therefore, this process could be re-evaluated during detailed design, prior to selection and implementation of the organics treatment process.

Preliminary conclusions from for initial screening of UV-fenton-peroxide include the following:

1. Because downstream metals removal would be necessary resulting in higher treatment costs and complexity, this process has been eliminated from future consideration.
2. Detailed design analysis may consider reevaluating this process if other advanced oxidation processes (Photo-Cat®) are considered to provide primary organics treatment, because of similar performance capabilities of the two technologies. However, Hydroxyl suggested that UV-fenton-peroxide would not be an economical solution for primary organics destruction.

Ultraviolet Oxidation with Titanium Dioxide Catalyst (Photo-Cat®)

Photo-Cat is a patented advanced oxidation process that employs a titanium dioxide slurry-based catalyst. Organic contaminants are destroyed when they are mixed with the titanium dioxide slurry and exposed to UV light in the reactor. This process can be enhanced with hydrogen peroxide to increase performance capabilities for high strength waste streams. One distinct difference between the Photo-Cat process and the UV-fenton process discussed previously is that the titanium dioxide is recoverable and recyclable, and downstream removal of excess catalyst is not necessary. The Photo-Cat process captures titanium dioxide downstream of the UV reactor, and recycles this slurry back to the process inlet.

Purifics, the manufacturer of the Photo-Cat process, reviewed the estimated water chemistry (Table 2-2) and determined that this process could provide either primary or polishing treatment for this application. If employed as the primary VOC treatment process, polishing would still be required by air stripping to remove 1,1,1-trichloroethane (1,1,1-TCA), which is resistant to oxidation by hydroxyl radicals. Assuming that downstream polishing of 1,1,1-TCA is used, the Photo-Cat process would require approximately 110 kW of power, and hydrogen peroxide addition at approximately 1,000 mg/L.

If the Photo-Cat process was employed for polishing following air stripping, Purifics estimated that approximately 28 kW would be necessary to treat air stripper effluent, and no hydrogen peroxide addition would be required because of the relatively low contaminant concentrations in the air stripper effluent.

Preliminary conclusions from for initial screening of Photo-Cat include the following:

1. Photo-Cat could either provide water treatment following air stripping, or provide primary treatment, with polishing of Photo-Cat effluent by air stripping.
2. This process is amenable to long-term groundwater treatment at the Site, following completion of the source removal remedial action. Replacement of one of the of the existing UV systems in with the Photo-Cat system would reduce long-term operation and maintenance (O&M) costs. The Photo-Cat system provided for either primary or polishing treatment could likely meet long-term operating requirements.

2.3.4 Process Evaluation Summary and Screening

WESTON has selected and compared the three most likely water treatment alternatives that could be implemented for the hydraulic displacement remedy. The three selected alternatives are as follows:

1. Air Stripping/Thermal Oxidation followed by Photocatalytic Polishing.
2. Air Stripping/Thermal Oxidation followed by existing UV-Peroxide System
3. Photocatalytic Oxidation followed by Air stripping with Vapor Phase Carbon.

A detailed cost comparison for the alternatives listed above is presented in Table 2-5. This cost comparison assumed that all equipment is new, and would be procured for the project.

The purpose of this evaluation is not to select the unit processes required for treatment of groundwater. This will be determined during detailed design should the hydraulic displacement remedy be selected for source control at the Site. During detailed design, this information will be revisited in support of the final process selection. The purpose of this analysis is to evaluate costs and budget appropriate funds to install and operate an acceptable water treatment process. Based on a comparison of the alternatives, Option No. 1 (Air Stripping/Thermal Oxidation followed by Photocatalytic Polishing) will be used in support of estimating overall water treatment system costs. Option No. 1 provides effective treatment of the groundwater contaminants and has the lowest combined capital and operating costs of all three alternatives evaluated.

2.4 CAPITAL AND OPERATING COST ESTIMATES FOR HYDRAULIC DISPLACEMENT

WESTON has prepared capital and operating cost estimates for implementation of the hydraulic displacement remedy. These cost estimates are included in Appendix B of this report and do not take into consideration additional costs associated with enhanced in situ bioremediation, which may be implemented following completion of the hydraulic displacement phase of the source control remedial action. In order to improve the accuracy of the estimate, WESTON prepared equipment lists and take-offs during development of the costs. Although a substantial amount of detail has been assembled in support of these estimates, they are still preliminary and a contingency of at least 20% is recommended.

TABLE 2-5
SRSNE SITE
Hydraulic Displacement - 100 GPM, Organics Treatment Alternative Analysis

Option 1 - Air Stripping/Thermal Oxidation Followed by Photocatalytic Polishing

Capital Costs		
Air Stripper	$18,679	Shallow Tray - 6-stage -900 to 1500 CFM
Thermal Oxidizer - HCL Scrubber	$340,500	2500 CFM - Catalytic, HCL Scrubber and Filter Bed
Bulk Caustic Storage Facility	$20,000	Estimate
Photocatalytic Oxidation	$250,000	28 kW - Purfics estimate
Peroxide Destruction	$0	Not Required
Total Estimated Capital	**$629,179**	
Operating Costs - 180 days		
Air Stripper	$3,564	7.5 kW
Thermal Oxidizer	$42,120	Nat.gas - $7.5/Million BTU - 1.3 Million BTU/Hr
	$7,128	Electricity - 15 KW/Hr
	$86,400	Caustic Soda - 50 lbs/hr
Photocatalytic Oxidation	$13,306	28 kW - 0 ppm H2O2 - Using Purifics Estimate
Peroxide Destruction	$0	Not Required
Maintenance of all equipment	$31,459	5% Capital
Total Estimated Operating - 180 days	**$183,977**	
Total Cost - 180 days	**$813,156**	

Option 2 - Air Stripping/Thermal Oxidation Followed by Existing UV-Peroxide System

Capital Costs		
Air Stripper	$18,679	Shallow Tray - 6-stage -900 CFM
Catalytic Oxidizer - HCL Scrubber	$340,500	2000 CFM - Catalytic, HCL Scrubber and Filter Bed
Bulk Caustic Storage Facility	$20,000	Estimate
Existing UV -2 Improvements	$100,400	New Ballasts, Lamps, and Control System
Peroxide Destruciton	$100,000	300 ppm residual - estimate
Peroxide Storage	$20,000	Based on Totes (no tank)
Total Estimated Capital	**$599,579**	
Operating Costs - 180 days		
Air Stripper	$3,564	7.5 kW
Thermal Oxidizer	$42,120	Nat.gas - $7.5/Million BTU - 1.3 Million BTU/Hr
	$7,128	Electricity - 15 KW/Hr
	$86,400	Caustic Soda - 50 lbs/hr
UV System	$114,048	Electricity - 240 KW/Hr
	$77,822	H2O2-150 gal/day (50%) - 600 mg/L dose
Peroxide Destruciton	$0	Assume no changeouts required
Maintenance of all equipment	$29,979	5% Capital
Total Estimated Opterating - 180 days	**$331,082**	
Total Cost - 180 days	**$930,661**	

Option - 3 Photocatalytic Oxidation - Followed by Air Stripping/Vapor Phase Carbon

Capital Costs		
Photocatalytic Oxidation	$590,000	110 KW - 1000 ppm system
Peroxide Storage	$20,000	Based on Totes (no tank)
Peroxide Destruction	$50,000	50 ppm residual
Air Stripping	$18,679	Shallow Tray - 6-Stage (maybe smaller)
Vapor Phase Carbon System	$40,000	Estimate - No Quote - Could Rent easily
Total Estimated Capital	**$718,679**	
Operating Costs - 180 days		
Photocatalytic Oxidation	$52,272	Electricity - 110 KW/Hr
	$129,600	H2O2-240 gal/day (50%) - 1000 mg/L dose
Air Stripping	$3,240	7.5 kW
Vapor Phase Carbon-Usage	$50,000	275 lb Carbon/day @ $1/lb
Peroxide Destruciton	$0	Assume no changeouts required
Maintenance of all equipment	$35,934	5% Capital
Total Estimated Opterating - 180 days	**$235,112**	
Total Cost - 180 days	**$953,791**	

Costing Assumptions

1. Gas - $7.5/Million BTU Energy
2. Electricity - Average cost per KWH = $0.11
3. Hydrogen Peroxide Cost = $3/gallon
4. Sodium Hydroxide = $0.40/lb
5. Vapor Phase Carbon = $1/lb (includes replacement and reactivation)
6. Annual Maintenance - 5% of Capital Costs
7. All Equipment is new and procurred for this project.

The estimated costs and major technical costing assumptions used to develop the capital and operating costs for the hydraulic displacement remedy are presented in Subsections 2.4.1 and 2.4.2, respectively.

2.4.1 Cost Estimate and Major Technical Cost Assumptions – Capital Costs

The estimated capital cost to design, construct and implement the hydraulic displacement system is approximately $4,720,000 based on the following assumptions

1. Systems and associated costs were included for implementation of the hydraulic displacement remedy only. No costs were included for potential subsequent enhanced in situ bioremediation activities. Others are evaluating additional capital costs for implementation of that remedy.
2. WESTON assumed that the systems would be temporary. However, costs were included for equipment procurement with exception to the sand filter system and catalytic oxidizer, which is budgeted to be rented. It may be possible to rent additional equipment and further reduce overall costs, but given the uncertainties at this time, costs were maintained to procure the remaining equipment.
3. WESTON only considered costs for construction of new systems required to successfully treat water for the hydraulic displacement remedy. Costs for potential improvements to the existing NTCRA-1 and 2 extraction and treatment systems, with the exception of integrating the proposed new treatment system into the existing system operations, have not been included. Such additional costs include interlocking alarms and a common effluent monitoring station.
4. WESTON did not include costs for the potential relocation of the communications cable installed along the former rail road right of way.
5. WESTON has included $200,000 for decommissioning the temporary treatment system as completion of the work in the construction costs.
6. It is likely that the proposed temporary GWTF will be located near the existing NTCRA 1 & 2 GWTF; however, final site selection would be determined during detailed design. Relocation costs for the existing systems and utilities that maybe required to adequately site the new systems have not been evaluated.
7. Other cost assumptions are provided in the attached estimate. These cost assumptions are preliminary and warrant contingency of at least 20%, which has not been included in any of the estimates.

2.4.2 Operating Cost Estimate and Major Technical Cost Assumptions

The estimated operating cost during hydraulic displacement is approximately $1,313,000. The major technical cost assumptions used to determine the operating costs of the hydraulic displacement system are as follows

1. On-going operating costs for the existing NTCRA-1 & 2 systems have not been included in the attached estimates. Operational costs only considered costs applicable to the treatment system for the hydraulic displacement remedy.

2. WESTON assumed that the hydraulic displacement injection, extraction and treatment systems would operate for 180 days. No costs have been included for operating the system for greater than 180 days, and if less than 180 days are not required, then costs may be lower.

3. WESTON assumed that the initial 21 days of operation will require full time on-site operations staff. Typically full time on-site supervision is provided during initial operations of any new treatment system. Because of the extremely high volume of DNAPL expected to be recovered during the initial phase of hydraulic displacement, WESTON has included additional labor to ensure appropriate operations staff are available. Estimated personnel requirements during the initial 21 days include two full time staff during the day and one full time staff at night performing monitoring only.

4. For the remainder of the 180 day period following the initial 21 days of operation, WESTON has budgeted one full time operator, and 38 hours per week of additional operations and maintenance support. Maintenance activities will likely warrant increased levels of PPE.

5. Additional cost assumptions are identified in the attached estimate (Appendix B). As previously stated, these cost assumptions are preliminary and warrant contingency of at least 20%, which has not been included in any of the estimates.

SECTION 3

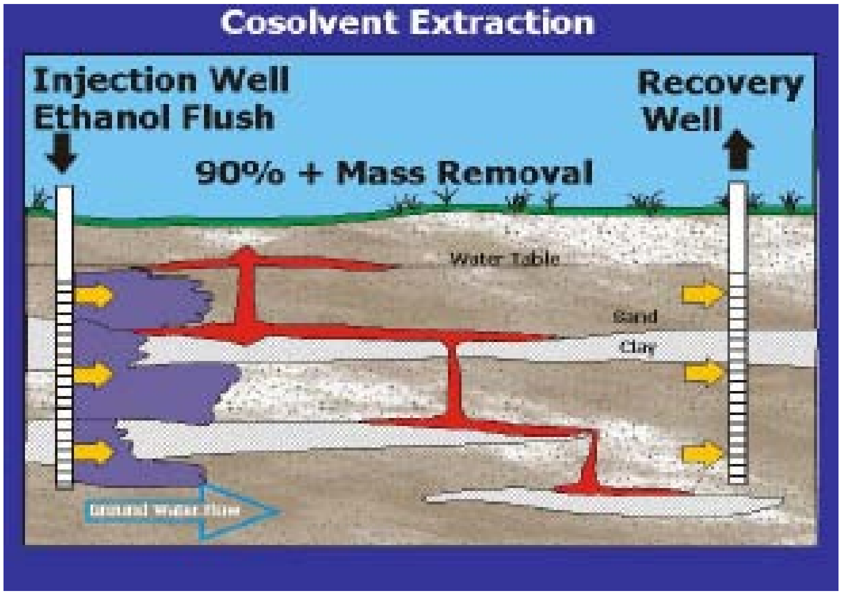
COSOLVENT EXTRACTION (HYDRAULIC DISPLACMENT WITH ETHANOL FLUSHING

3. COSOLVENT EXTRACTION (HYDRAULIC DISPLACEMENT WITH ETHANOL FLUSHING)

3.1 COSOLVENT EXTRACTION PROCESS OVERVIEW

Cosolvent extraction is an in situ remediation technology that involves flushing a water-soluble alcohol solution (i.e., ethanol) through a non-aqueous phase liquid-impacted groundwater zone in an effort to mobilize and recover the contaminant source. Both laboratory and field scale studies have demonstrated the ability of alcohol solutions to significantly increase the solubility of chlorinated solvents in the aqueous phase, thereby significantly increasing the rate at which chlorinated solvents can be extracted from adjacent groundwater recovery wells. A simplified cosolvent injection/extraction system is shown in Figure 3-1.

Figure 3-1 Simplified Cosolvent Injection/Extraction System



http://www.epa.gov/ada/research/waste/research_26.pdf

Mravik, et al. (2004)

3.2 TECHNICAL APPROACH FOR EVALUATING COSOLVENT WATER TREATMENT ALTERNATIVES

It has been proposed in the paper entitled, *“Application of Cosolvent Extraction for DNAPL Removal at the SRSNE Site, Southington, CT”* (Kueper, 2004b) that approximately 918,000 gallons of 90-95% ethanol be injected into the subsurface to treat the DNAPL-contaminated zone at the Site. Ethanol injection would be preceded by a 90-day period of treatment by hydraulic displacement (as described in Section 2) to remove pooled DNAPL from the subsurface. Following the ethanol injection, the source area would be flushed with clean water amended with polymer to displace residual alcohol and contaminants from the subsurface.

The following two alternative approaches for ethanol injection have been proposed (Kueper, 2004b):

1. Treat the entire source area using a single 918,000-gallon dose of ethanol solution.
2. Divide the Site into discrete zones, and treat each of these zones separately and sequentially (modular approach).

Treating separate areas of the Site sequentially would potentially allow ethanol to be recovered during treatment of each preceding zone. This recovered alcohol would be separated from the DNAPL constituents and water, and then reinjected for treatment of subsequent zones. If 50% of the injected ethanol could be recovered and reinjected, the cost of alcohol procured would be reduced by a minimum of $1 million. In addition, recycling the ethanol on-site would reduce the volume of liquids for off-site disposal, resulting in a potential saving of several million dollars. A limiting factor in evaluating ethanol recovery and recycling is that technologies for the separation of alcohol from DNAPL constituents are not well established, and could be very costly to implement. The uncertainty and costs associated with ethanol/DNAPL/water separation could outweigh the potential savings associated with recovering the ethanol.

The implementability, effectiveness, and costs associated with water treatment for both of the proposed cosolvent flooding approaches (Kueper, 2004b) have been analyzed by WESTON. The objective of this analysis is to propose the most cost-effective and reliable approach for treatment and disposal of produced fluids following cosolvent flooding. Results of this analysis will provide a reasonable basis for comparison of cosolvent flooding with the other source control remedial alternatives proposed for the Site. The evaluation of water treatment alternatives for the cosolvent flooding approach is presented as follows:

- Subsection 3.3: Analysis of a single 918,000-gallon ethanol injection (+20% for blending additives), with off-site transportation and disposal of the concentrated ethanol/DNAPL/water mixture recovered from the subsurface.
- Subsection 3.4: Analysis of a sequenced (modular) approach where injected ethanol is recovered and reinjected during each subsequent phase of treatment. This analysis includes a detailed evaluation of several technologies for separating ethanol from DNAPL constituents and water.
- Subsection 3.5: A comparison of the costs associated with each approach and discussion of the recommended approach for implementation of this remedy.

3.3 SINGLE ETHANOL INJECTION AND OFF-SITE FLUIDS DISPOSAL

For this approach, the entire source area would be flooded with a single dose of approximately 918,000 gallons of ethanol at an injection rate of 30 gpm. The injection period would last 21 days, and a follow-up polymer assisted water flush would be performed for an additional 90 days. The ethanol/DNAPL/water mixture would be extracted from the subsurface at approximately 30 to 45 gpm throughout the flooding process. It has been suggested that fluids recovered during the ethanol flood will occur as two distinct ‘slugs’: a DNAPL slug followed by a miscible alcohol slug (Kueper, 2004b). The initial DNAPL slug will contain approximately 20% (180,000 gallons) of the original volume of injected ethanol and approximately 17,000 gallons of DNAPL. The second miscible slug will contain the remaining 80% of injected ehtanol, and the equivalent of approximately 51,000 gallons of DNAPL. In comparison with the initial slug, the miscible slug will be a relatively uniform solution, with minimal separate phase DNAPL. In addition, WESTON has assumed that some residual water will also be present in the extraction fluid from both slugs. The estimated fluid quality during the initial DNAPL slug, intermediate ethanol slug and follow-up polymer-assisted water flush are presented in Table 3-1. It has been assumed that residual levels of both ethanol and DNAPL will be detected in the water extracted during the follow-up 90-day polymer assisted water injection.

Table 3-1 Water Treatment Design Criteria

Design Data	Units	Initial DNAPL Slug	Intermediate Ethanol Slug	Polymer Assisted Water Slug
Estimated Slug Duration	days	7	14	90
Estimated Total Volume of DNAPL removed	gal	17,000	51,000	Residual
Total Volume of Ethanol	gal	183,600	734,400	Residual
DNAPL Mass Flow	gpm	1.7	2.5	NA
Ethanol Flow	gpm	18	36	NA
[1]Approximate Water Flow	gpm	25	6	30
[2]Influent Design Flow (ethanol+DNAPL)	**gpm**	**20**	**39**	**0**
Influent Design Flow (DNAPL+ethanol+H20)	**gpm**	**45**	**45**	**0**

Notes:

1. Quantity of water added is an assumption used for analysis, to ensure capture of alcohol and DNAPL.
2. Influent design flow is the anticipated flow rate to the aboveground fluids handling and/or water treatment system

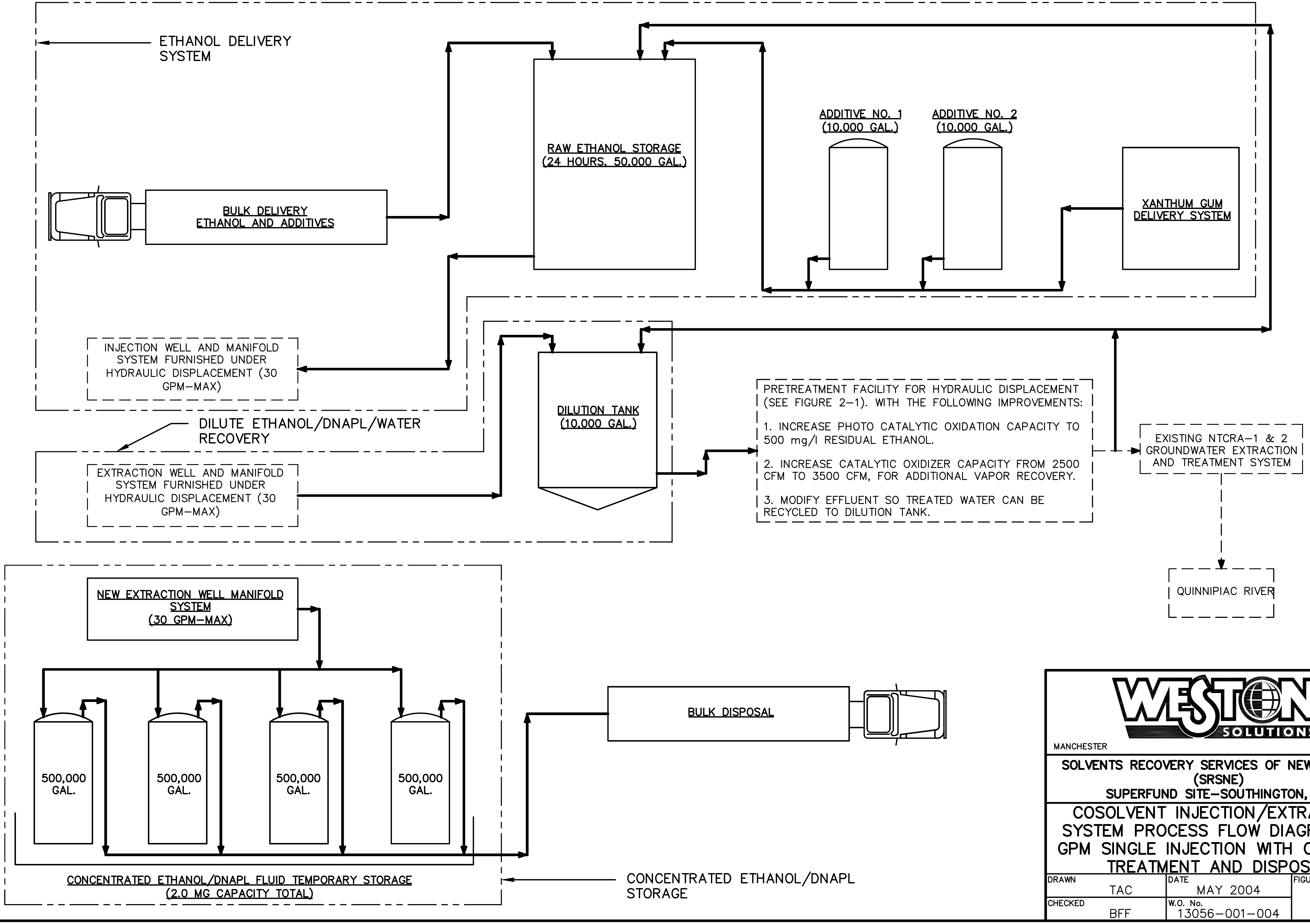
In summary, approximately one million gallons of DNAPL and ethanol are expected to be recovered over a 3-week period from the single injection approach. A preliminary process flow diagram of the single dose cosolvent injection/extraction system is presented in Figure 3-2. The process requirements and associated cost estimates for recovery and off-site disposal of the ethanol/DNAPL/water matrix were based on the following assumptions:

1. The alcohol injection system would be designed for an ethanol injection rate of 30 gpm. The total amount of ethanol required is 918,000 gallons plus an additional 20% (183,600 gallons) due to uncertainty and costs associated with blending and density modifying agents (Kueper, 2004b).

2. Ethanol will be delivered in bulk tanker trucks. The delivery schedule is unknown at this time; however, WESTON suggests that sufficient raw ethanol storage be provided for at least one full day of injection. Based on an estimated daily ethanol dose of 43,200 gallons at 30 gpm, WESTON has estimated that a minimum storage capacity of 50,000 gallons will be required.

3. It is anticipated that blending and density modifying agents will be required (Keuper, 2004b). Selection of appropriate density modifiers will be determined during detailed design. The conceptual design includes two 10,000-gallon storage tanks, and associated pumps and appurtenances, for density modifying agents.

4. Provisions for wetting, mixing and dosing a Xanthum gum polymer solution to the injection water will be required following the ethanol flush.



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WESTON SOLUTIONS.
MANCHESTER NEW HAMPSHIRE

SOLVENTS RECOVERY SERVICES OF NEW ENGLAND (SRSNE)
SUPERFUND SITE–SOUTHINGTON, CT

COSOLVENT INJECTION/EXTRACTION SYSTEM PROCESS FLOW DIAGRAM–30 GPM SINGLE INJECTION WITH OFF–SITE TREATMENT AND DISPOSAL

DRAWN	DATE	FIGURE NO.
TAC	MAY 2004	3–2
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5. It is recommended that on-site storage be provided for 2 million gallons of the concentrated ethanol/DNAPL/water mixture that will be extracted from the subsurface during cosolvent flushing. The basis for this recommendation is the uncertainty of predicting when alcohol concentrations will be sufficiently low enough (<500 mg/L ethanol and DNAPL) to treat the extracted ethanol/DNAPL/water mixture using the modified hydraulic displacement GWTF described in Paragraph 7 below. At an estimated extraction rate ranging between 30 to 45 gpm, 2 million gallons of on-site storage will store between 31 and 46 days of concentrated ethanol/DNAPL/water. Two million gallons of on-site storage should provide sufficient capacity for collection of the concentrated ethanol/DNAPL/water fluid until ethanol and contaminant concentrations in the extracted groundwater have decreased to acceptable treatment levels.

6. To reduce potential costs for off-site disposal of the concentrated ethanol/DNAPL/water fluid, WESTON suggests the following two enhancements to the fluids extraction system provided for the hydraulic displacement phase (refer to Subsection 2.2):

    a. Installation of a second, parallel, extraction well manifold that would discharge directly to the temporary storage tanks. This would enable each individual well to pump to either the storage tanks or the treatment process. Therefore, only the wells producing fluids that could not be treated on-site would pump directly to the storage tanks. All other wells would pump to the treatment facility for on-site treatment.

    b. As previously described, the hydraulic displacement GWTF will be designed to process 100 gpm. The design flow for cosolvent extraction is only 30 gpm. Therefore, WESTON recommends incorporating an internal influent dilution system to dilute the concentrated ethanol/DNAPL mixture. This would allow treatment of additional liquids on-site, and reduce the volume of liquids to be disposed off-site.

    The objective of the two system enhancements described above is to maximize the volume of liquids treated on-site, thereby minimizing the volume that must be shipped off-site for disposal.

7. For treatment of water containing 500 mg/L of ethanol and DNAPL, the hydraulic displacement GWTF described in Section 2 would require the following enhancements:

    a. The photo-catalytic system suggested for VOC polishing would need to be increased in size from 28 kW to approximately 110 kW in order to process the increased concentration of organics.

    b. A hydrogen peroxide metering system would be required in order to inject approximately 1,000 mg/L of hydrogen peroxide into the process water upstream of the photocatalytic system. A hydrogen peroxide destruction system (such as catalytic carbon) would also be required to remove residual hydrogen peroxide prior to discharge or re-injection.

   c. The capacity of the catalytic oxidizer would need to be increased from 2,500 to approximately 3,500 cfm in order to treat the higher levels of contaminants in the air stripper exhaust, and to control vapor emissions from the additional process storage tanks.

8. Approximately 2 million gallons of fluids containing ethanol and contaminants, which exceed the proposed on-site GWTF capabilities, will be collected and disposed off-site. Polychlorinated biphenyls (PCBs) are likely to be present in the fluids; therefore, disposal procedures and costs should be based on shipment of the liquids to one of two approved PCB waste receiving facilities located in Texas.

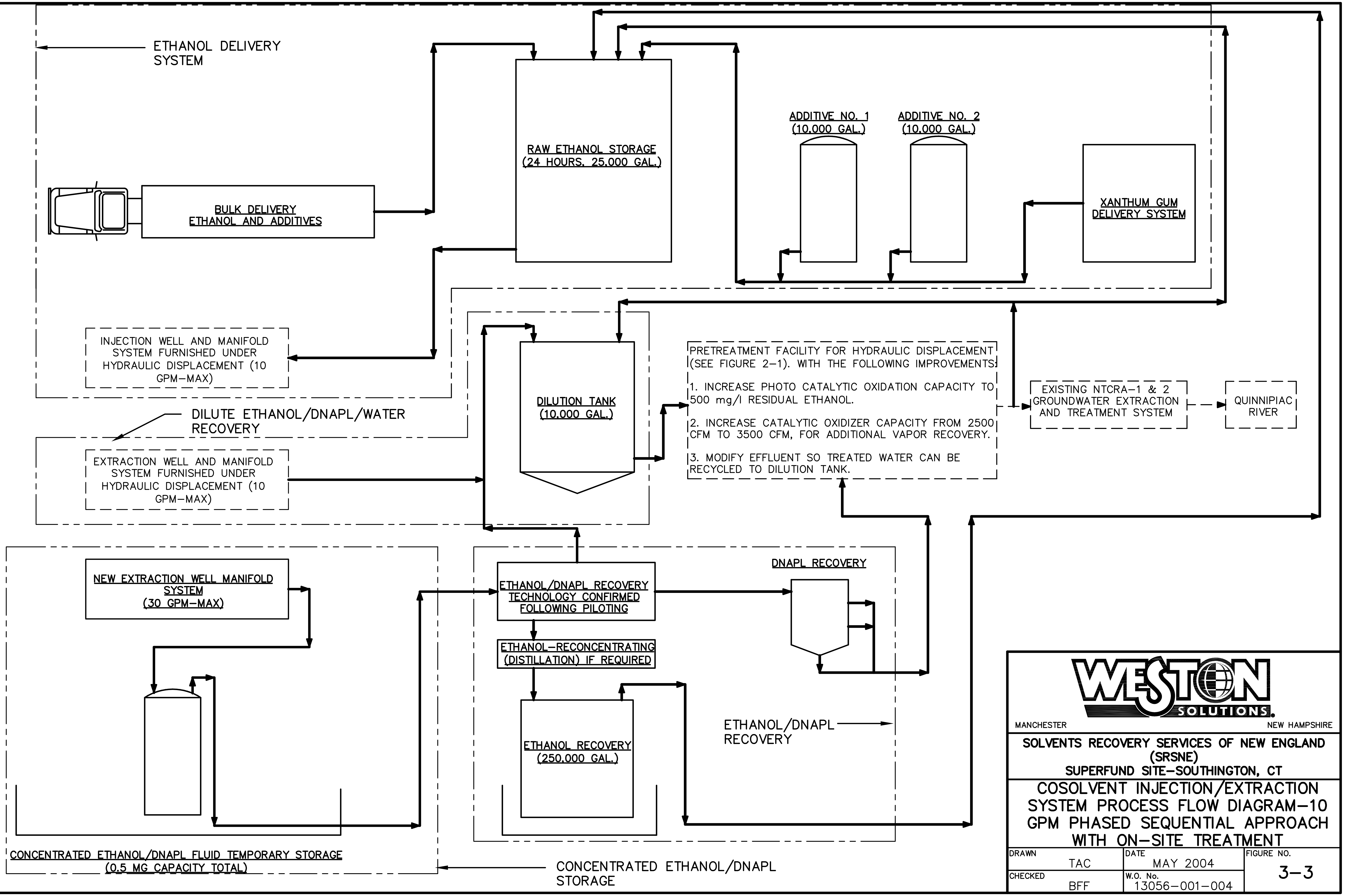
9. The total time to complete the cosolvent flooding remedy is approximately 4 months.

A summary of costs associated with implementing single dose cosolvent flushing with off-site disposal of produced fluids is summarized in Subsection 3.5

3.4 WATER TREATMENT ALTERNATIVES FOR A PHASED, SEQUENTIAL COSOLVENT FLOODING APPROACH

Rather than flooding the entire DNAPL zone with a single cosolvent injection event (as described in Subsection 3.3), it has been proposed that discrete portions (modules) of the DNAPL zone could be flooded with ethanol using separate sequential injections (Kueper, 2004b). The potential advantages of a phased (modular) approach to cosolvent flooding include, cost savings resulting from ethanol recycling and reinjection during subsequent injection phases, and reduced on-site storage requirements for the extracted ethanol/DNAPL/water fluids. Recycling the injected ethanol would reduce the volume of alcohol to be purchased, and would also reduce the volume of concentrated contaminated liquids to be disposed off-site.

As previously described, the alcohol extracted from the subsurface would be mixed with DNAPL constituents and water. Consequently, in order for the modular approach to be advantageous, a reliable, cost-effective procedure must be implemented for separating the alcohol from the DNAPL constituents to prevent reinjection of contaminants to the subsurface. A preliminary process flow diagram for cosolvent injection/extraction, using the modular approach, is presented in Figure 3-3.



WESTON SOLUTIONS

MANCHESTER NEW HAMPSHIRE

SOLVENTS RECOVERY SERVICES OF NEW ENGLAND (SRSNE)
SUPERFUND SITE-SOUTHINGTON, CT

COSOLVENT INJECTION/EXTRACTION SYSTEM PROCESS FLOW DIAGRAM-10 GPM PHASED SEQUENTIAL APPROACH WITH ON-SITE TREATMENT

DRAWN TAC	DATE MAY 2004	FIGURE NO. 3-3
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The following technical assumptions were used to determine the process requirements and estimated costs for the modular cosolvent flooding approach:

1. The modular approach will be implemented in a series of four modules (Kueper, 2004b). The total amount of ethanol budgeted per injection event is 250,000 gallons plus an additional 20% for blending additives, for a total of approximately 300,000 gallons. Assuming 80% alcohol recovery between modules, approximately 60,000 gallons of make-up ethanol will be required for each subsequent module for a total ethanol requirement of 480,000 gallons. As a result, treating the Site in four modules with alcohol recycling produces more than a 50% reduction in alcohol required for purchase in comparison with the single dose injection, which requires a one time purchase of approximately one million gallons of ethanol (refer to Subsection 3.3) The injection system will be designed to inject alcohol at a maximum rate of 10 gpm.

2. Ethanol will be delivered in bulk tanker trucks. Due to the reduced injection rate (10 gpm maximum), the bulk storage tank requirements will not be as large in comparison to storage requirements for single dose injection (Subsection 3.3). It is estimated that bulk storage capacity requirements could be reduced from 50,000 to 25,000 gallons.

3. It is anticipated that blending and density modifying agents will be required (Kueper, 2004b). Selection of the appropriate blending and density modifiers will be determined during detailed design; therefore, the conceptual design maintains two 10,000-gallon storage tanks, and associated pumps and appurtenances, for density modifying agents.

4. Wetting, mixing, and dosing a Xanthum gum polymer solution into the injection water will be required following the ethanol flush (Kueper, 2004b). It is assumed that the cost for this process will be the same for both the single dose and modular approaches to cosolvent flooding.

5. Alcohol separation/recovery will occur during and between the four injection modules. Therefore, the on-site storage capacity for the concentrated ethanol/DNAPL/water fluid could be reduced from 2 million gallons to approximately 500,000 gallons; 1/4th the recommended storage capacity for the single dose injection approach.

   Preliminary results of the technology screening process indicate that prior to commitment to a modular injection approach with alcohol recycling, site-specific pilot testing of the ethanol/DNAPL/water separation process will be required. As previously noted, the alcohol separation process will need to remove all dissolved contaminants from the alcohol prior to reinjecting the alcohol to the subsurface during subsequent injection phases. An evaluation of potential ethanol/DNAPL/water separation and recovery technologies is presented in Subsections 3.4.1 through 3.4.8. The separation process will not be considered effective unless the pilot testing demonstrates that the recycled alcohol is free of contaminants, and safe for reinjection to the subsurface.

6. A 250,000-gallon storage tank will be added to store recovered alcohol.
7. For the modular injection approach, the GWTF system proposed for the hydraulic displacement phase will require the same modifications as those previously presented in Subsection 3.3 for the single dose injection approach.
8. The quantity of fluids for off-site disposal will likely be reduced to approximately 250,000 gallons of ethanol, and approximately 50,000 gallons of DNAPL. For estimating purposes, WESTON has assumed that the recovered alcohol will require off-site disposal at completion of the remedy at the same disposal location. However, depending on the quality of alcohol recovered, it could have a more beneficial reuse resulting in additional cost-saving benefits that are not accounted for in this analysis.
9. The estimated operating time to complete the modular approach is 16 months for four modules.

The following six technologies were evaluated by WESTON for potential recovery of ethanol from the ethanol/DNAPL/water mixture extracted form the subsurface:

- Critical Fluid Extraction (CFE)
- Macro-Porous Polymer Extraction (MPPE)
- Pervaporation
- Liquid Phase Granular Activated Carbon (GAC)
- Air Stripping
- Membrane Filtration - Vibratory Shear Enhanced Process (VSEP)

All of the technologies listed above have bench or pilot scale performance data, but none of the technologies evaluated have full-scale performance demonstrated for similar applications. None of these technologies could be considered for implementation without further screening and pilot testing to confirm effectiveness and operating costs for site-specific conditions.

3.4.1 Critical Fluid Extraction

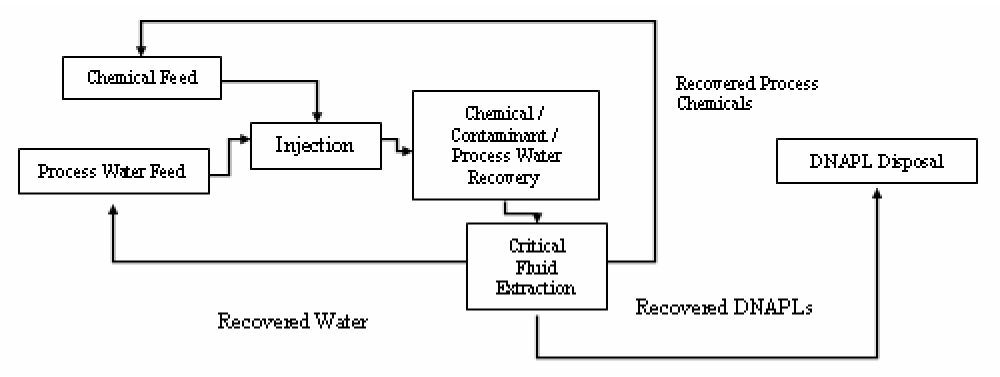
Critical fluid extraction uses a dense gas (i.e., carbon dioxide) above its critical temperature and pressure (31 °C and 73 atm, respectively) to treat and recover chemicals from process effluent. Above its critical temperature and pressure, the fluid density of carbon dioxide approaches that of a liquid, while its viscosity is similar to that of gas. This combination creates a powerful solvent with low surface tension and high interfacial surface area that increases.

Process Description

The CFE process shown in Figure 3-4 invoices passing fluid through a chemical/contaminant/water recovery process where a series of extraction columns selectively remove and recover dissolved components within the fluid stream.

Figure 3-4 CFE Chemical Recovery/Recycle

(CF Technologies, Inc.)



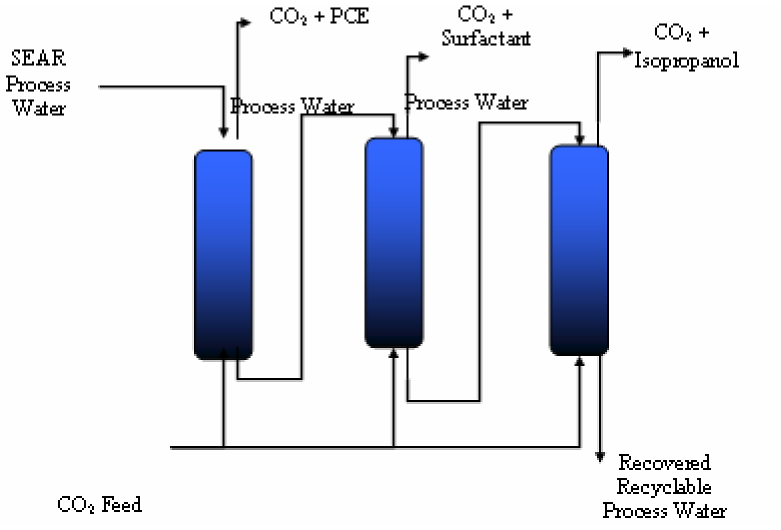
The CFE system shown in Figure 3-5 was designed for a tetrachloroethylene (PCE)/surfactant/Isopropyl alcohol (IPA)/water fluid mixture. This system could be modified to accommodate a DNAPL/ethanol/water fluid mixture at the SRSNE Site.

Applicability to SRSNE

A bench-scale study was conducted at the Idaho National Environmental Engineering Laboratory where supercritical carbon dioxide was used to extract PCE, IPA, and surfactant from an aqueous solution. Results of this study showed 99.8% removal of the PCE (from 3,000 parts per million (ppm) down to 5 ppm), and the IPA and surfactant were recovered from solution and recycled (McMurtrey, et al., 2004).

Figure 3-5 CFE System

(CF Technologies, Inc.)



CF Technologies, Inc., supplier of Critical Fluid Technology equipment, reviewed the estimated SRSNE fluid matrix (Table 3-1). They estimate this technology could separate the fluid matrix as follows:

- DNAPL – With approximately 50% alcohol.
- Alcohol – With approximately 10% water, and perhaps less than 500 ppm total VOC's.
- Water – with less than 2% alcohol, and less than 10 ppm total VOCs.

CF Technologies, Inc. indicated that this technology will potentially be more cost effective if IPA alcohol was used in lieu of ethanol. Budgetary pricing information provided by CF Technologies, Inc. includes the following:

- Bench scale treatability testing - $10,000 plus analytical costs.
- On-site pilot scale testing 0.05 to 1.0 gpm for two weeks - $75,000 plus analytical costs.
- On-site demonstration testing 0.5 to 2.0 gpm, continuous for 45 days - $450,000.

- Full scale capital and operating cost for ethanol based system– 10 gpm for 180 days – $3,900,000.
- Full scale capital and operating cost for IPA based system – 15 gpm for 120 days - $1,600,000.

The CFE technology may be applicable to the SRSNE Site following pilot testing. Of the six technologies evaluated by WESTON, CFE is the only technology that can potentially recover and concentrate ethanol within a single process. Based on the preliminary fluid separation estimates offered by CF Technologies, Inc. supplemental alcohol polishing would be necessary to remove DNAPL contaminants prior to reinjecting the ethanol to the subsurface.

3.4.2 Macro Porous Polymer Extraction

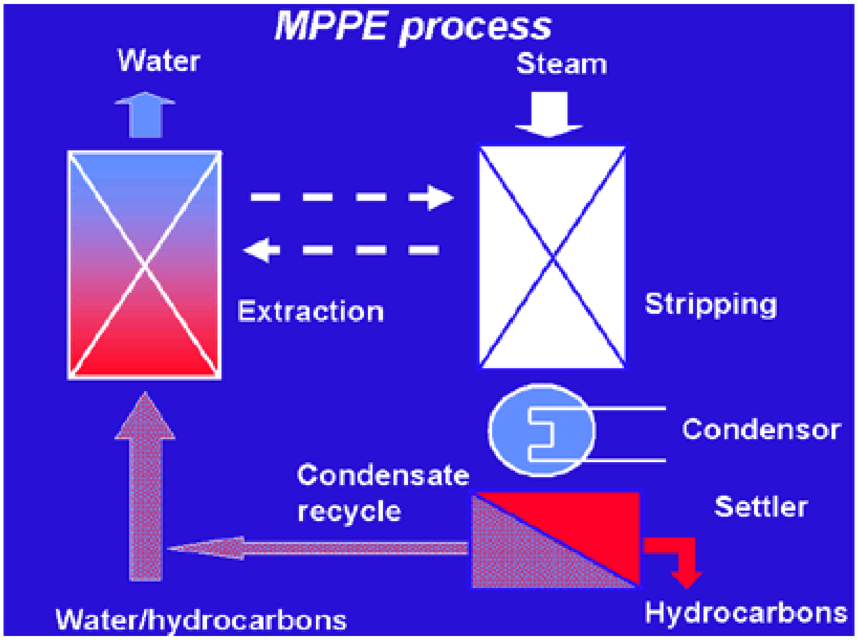
Macro Porous Polymer Extraction is a process that separates hydrocarbons from water by a patented liquid-liquid extraction process developed by Akzo Nobel. The extraction fluid is contained within a porous polymer that has a strong affinity for hydrocarbon compounds. Once the extraction fluid reaches its hydrocarbon loading limit, low pressure steam is used to strip the hydrocarbons from the column and regenerate the polymer.

Process Description

Hydrocarbon-contaminated water is passed through a column packed with MPPE particles. An extraction liquid immobilized within the MPPE matrix removes hydrocarbons from the water in a single pass, and the purified water passes out of the column for reuse or discharge. Periodic regeneration of the MPPE particles is accomplished using steam stripping. During regeneration, volatile hydrocarbons are removed from the particles while immobilized non-volatile hydrocarbons are retained in the pores of the polymer. Following condensation of the vapor phase, both an organic and an aqueous phase are obtained in the gravity separator. The hydrocarbon phase is recovered and the water phase is recycled to the system. Regeneration of the extraction liquid containing MPPE particles is accomplished in-situ with low pressure steam. The system is equipped with two columns to allow continuous operation with simultaneous regeneration.

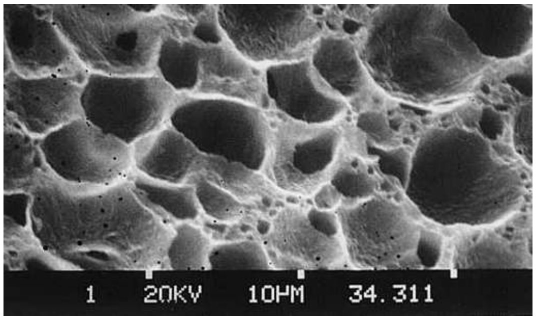
The MPPE Process Flow Diagram is shown in Figure 3-6, and a Macro Porous Polymer is shown in Figure 3-7.

Figure 3-6 Marcro Porous Polymer Extraction Process Diagram



Akzo Nobel (2004)
www.akzonobelmppsystems.com

Figure 3-7 SEM Picture of Macro Porous Polymer



Akzo Nobel (2004)
www.akzonobelmppsystems.com

Applicability to SRSNE

An Akzo Nobel MPPE system was used in conjunction with an air-stripping tower to treat extracted liquid during pilot scale testing of ethanol flushing at the Former Sages Dry Cleaner Site in Jacksonville, Florida. The MPPE System reduced the PCE concentration in the extracted groundwater fluid from 1 gram per Liter to 1 microgram per Liter for a removal efficiency of 99.999% (Jawitz, et al., 2000 and F.R. Levine Fricke, 1998). This removal efficiency was achieved while the concentration of ethanol was approximately 25 to 30% by volume.

In a separate pilot study, the MPPE technology was used in conjunction with surfactant flushing to remove trichloroethylene from groundwater at the Former Alameda Naval Air Station in California. At this site, surfactant was injected in the groundwater to solubilize the DNAPL. The groundwater was then pumped from recovery wells to the MPPE unit to remove the chlorinated organics from the surfactant solution. The surfactant was subsequently re-injected to the groundwater. Results of the study indicated that over 99% of the DNAPL was removed from the contaminated zone and the MPPE system consistently removed the chlorinated hydrocarbons to below effluent quality criteria (Azko Nobel, 2004).

Technical discussions with representatives of Akzo Nobel to determine applicability of the MPPE technology for the SRSNE Site revealed that the equipment has potential compatibility issues with concentrations of ethanol greater than 5% by volume. These compatibility concerns were based on evaluation of the MPPE column following the pilot work at the Former Sages Dry Cleaner site described above. During this study, degradation of the column media resulted following treatment of a highly concentrated ethanol/DNAPL/water mixture. At the SRSNE Site, dilution of the produced fluids to less than 5% ethanol by volume would greatly increase the amount of water required for treatment, and would also dramatically increase the cost to reconcentrate the recovered ethanol. Since dilution is required, it is unlikely that the MPPE technology will be cost effective. However, the potentially lower cost for this system when compared to other technologies may off-set additional costs associated with reconcentrating the ethanol. The following budgetary pricing information was supplied by Akzo Nobel for implementation of the MPPE system at the Site:

- On-site pilot test - $14,000 plus $7000 per week of testing not including analytical and expenses.
- Full Scale 100 gpm system - $759,000 with approximate annual operating cost of $107,000/year.

3.4.3 Pervaporation

Pervaporation is a membrane-based technology that removes VOCs from aqueous matrices [U.S. Environmental Protection Agency (EPA), 1995]

Process Description

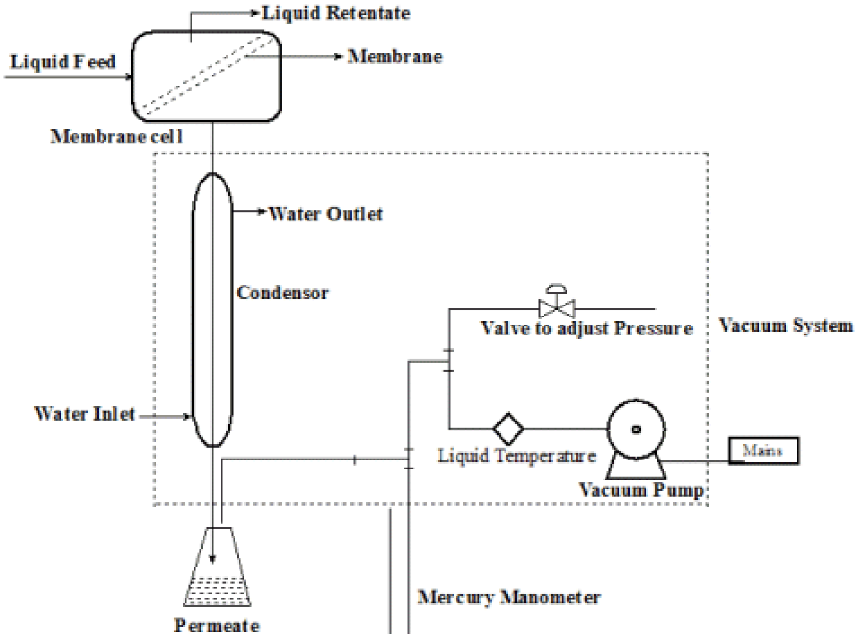
The cross-flow pervaporation technology was developed by Zenon Environmental, Inc. (Zenon). The pervaporation process uses an organophilic membrane made of nonporous silicone rubber to remove VOCs from aqueous matrices. The composition of the membrane causes organics in solution to adsorb to it. The organics then diffuse through the membrane by a vacuum and condense into a highly concentrated liquid that separates into aqueous and organic phases. The aqueous phase is sent back through the pervaporation unit for retreatment. Pervaporation is best utilized as a pretreatment for reducing high concentrations of VOCs prior to conventional treatment [i.e., GAC]. The number of membranes used in a particular system depends on the expected flow rates, and target concentrations for the contaminants in the treated water.

In a field application contaminated water is pumped from an equalization tank through a 200-micron pre-filter to remove debris and silt particles, and then into a heat exchanger that raises the water temperature to a maximum of 165 ºF. The heated contaminated water then flows through the pervaporation module where organics and small amounts of water are extracted from the contaminated solution and the treated water is discharged from the system. The organics and small quantity of water extracted from the contaminated mixture are drawn into a condenser where it separates into aqueous and organics phases. The organic phase is pumped from the condenser for disposal, while the aqueous phase can be returned to the pervaporation module for additional treatment. A pilot-scale pervaporation system is shown in Figure 3-8 and a typical pervaporation system layout is show in Figure 3-9.

Figure 3-8 Pilot-Scale Cross-Flow Pervaporation System

(http://www.akzonobelmppsystems.com/mppe_process.htm)

Figure 3-9 Typical Pervaporation System



(http://www.cheresources.com/pervaporation.shtml)

Applicability to SRSNE

In 1998, the EPA initiated research on a new pervaporation module for surfactant recovery during a surfactant-enhanced DNAPL removal project at Marine Corps Base Camp Lejeune. The above-ground surfactant recovery system was comprised of two membrane separation units and micellar-enhanced ultrafiltration (MEUF). The information presented herein is a summary of information obtained from the *Cost Performance Report – Surfactant Enhanced DNAPL Removal* [U.S. Department of Defense, Environmental Security Technology Certification Program (ESTCP), August 2001]. The fluid mixture injected into the DNAPL source included surfactant, IPA, and calcium chloride. The extraction well effluent contained a maximum of 900 mg/L PCE, 1.2 wt% surfactant, and 4.1 wt% IPA. The pervaporation process achieved 95% removal of the extracted DNAPL mass, and the MEUF recovered and reconcentrated approximately 77% of the diluted surfactant. Neither the pervaporation process nor the MEUF were able to extract the IPA during this pilot study. It was concluded that effective removal by a non-porous process such as pervaporation requires a thicker more hydrophilic membrane. Minimal fouling was observed despite high levels of calcium and iron in the extracted fluids.

In an attempt to follow-up with Zenon to discuss the applicability of this technology for SRSNE, WESTON learned that Zenon no longer markets this technology for this application. Research to see if other potential vendors could offer pervaporation technology was unsuccessful. Since this technology was not proven to recover alcohol and may no longer be available, it is unlikely that this technology could be considered for SRSNE.

3.4.4 Liquid Phase Granular Activated Carbon

Liquid phase GAC is used in water and wastewater treatment primarily as an adsorbent for the removal of relatively low levels of organic and inorganic contaminants via transfer from the dissolved phase to the solid carbon surface.

Process Description

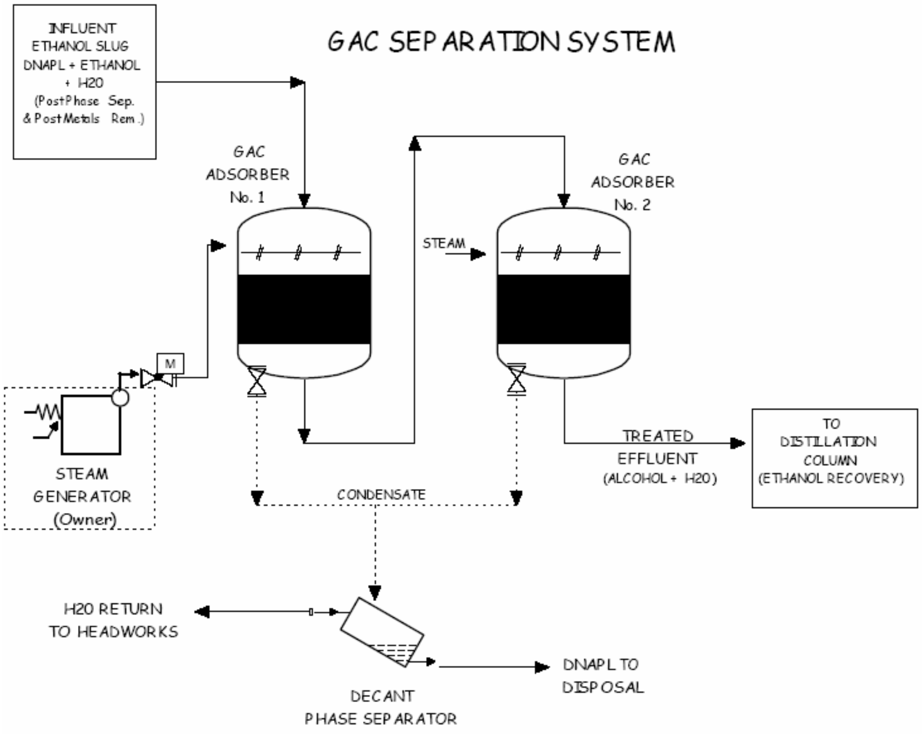
Liquid phase GAC treatment includes pumping groundwater through one or more vessels containing activated carbon. Contaminants are removed from the fluid matrix by activated carbon particles that attract and adsorb organic constituents, as well as some metals and inorganics. As the GAC particles become saturated with the groundwater contaminants, the column is removed from service, and the carbon is regenerated through steam stripping. The process design shown in Figure 3-10 was proposed by CCC for application at the SRSNE Site.

Applicability to SRSNE

A laboratory scale study was conducted by Hayden, et al. (2001) to investigate the ability of GAC to remove chlorinated compounds from alcohol solutions. Results of the study demonstrated that as solubility of organic compounds increases, carbon adsorbability decreases. Consequently, GAC alone may not be economically feasible for recovery of alcohol from highly concentrated organic mixtures. In contrast, GAC provides high recovery capacity of alcohol from low concentrations of organic mixtures when the fluid is run through multiple GAC columns in series (Hayden, et al., 2001).

Figure 3-10 Calgon GAC Process Diagram

(Calgon Carbon USA, 2004)



A field-scale pilot study using GAC was conducted during ethanol flooding at the Dover Air Force Base in Dover, Delaware (Hayden et al., 2001). Lower concentrations of a PCE/alcohol mixture were treated using up to three GAC drums in series. Higher concentrations were treated using a combination of GAC and air stripping. The recycled ethanol was augmented with a 95% ethanol solution and re-injected to the groundwater. Concentrations of PCE in the recycled alcohol ranged from 1 to 3 mg/L. It was concluded that for high concentrations of PCE, it would be more cost effective to implement other technologies such as air stripping or MPPE prior to GAC (Hayden, et al., 2001).

WESTON looked at using carbon as the primary treatment process for separating the ethanol/DNAPL/water mixture at the Site. Preliminary GAC usage, not even considering reduced GAC adsorption in higher concentrations of ethanol, indicated that carbon usage would exceed 80,000 pounds per day at a process flow rate of 15 gpm. This excessive carbon usage rate indicates that Carbon is not feasible even if on-site steam regeneration is considered. The use of GAC as a polishing step to remove residual contaminants from recovered ethanol may be both beneficial and required depending on the capabilities of other technologies evaluated.

3.4.5 Air Stripping

Air stripping was demonstrated to be an effective treatment for removal of VOCs from ethanol, in conjunction with MPPE, during cosolvent pilot testing at the Former Sages Dry Cleaning Site (Jawitz, et al., 2000). Air stripping was also suggested for use in combination with GAC for ethanol recovery following pilot testing of GAC during cosolvent flushing at the Dover Air Force Base (Hayden, et al., 2001). Although air stripping has shown promising results at the pilot scale, its applicability for full scale application is unclear, because the effectiveness of air stripping VOCs from a concentrated alcohol solution is unknown. Pilot testing would be required to establish the effectiveness of air stripping for treatment of the fluids extracted during cosolvent flooding at the SRSNE Site. If air stripping was considered as a treatment option, it is anticipated that the air emissions generated from treatment of the highly concentrated ethanol/DNAPL/water fluid would require aggressive thermal treatment. Alternatively, dilution of the extracted fluids stream could improve the effectiveness of air stripping, but dilution would result in increased distillation costs. Regardless of potential dilution considerations, distillation would be required following air stripping to reconcentrate recovered ethanol.

3.4.6 Ultrafiltration (VSEP) for Ethanol Recovery

The VSEP uses a membrane module for separating solids from ethanol.

Process Description

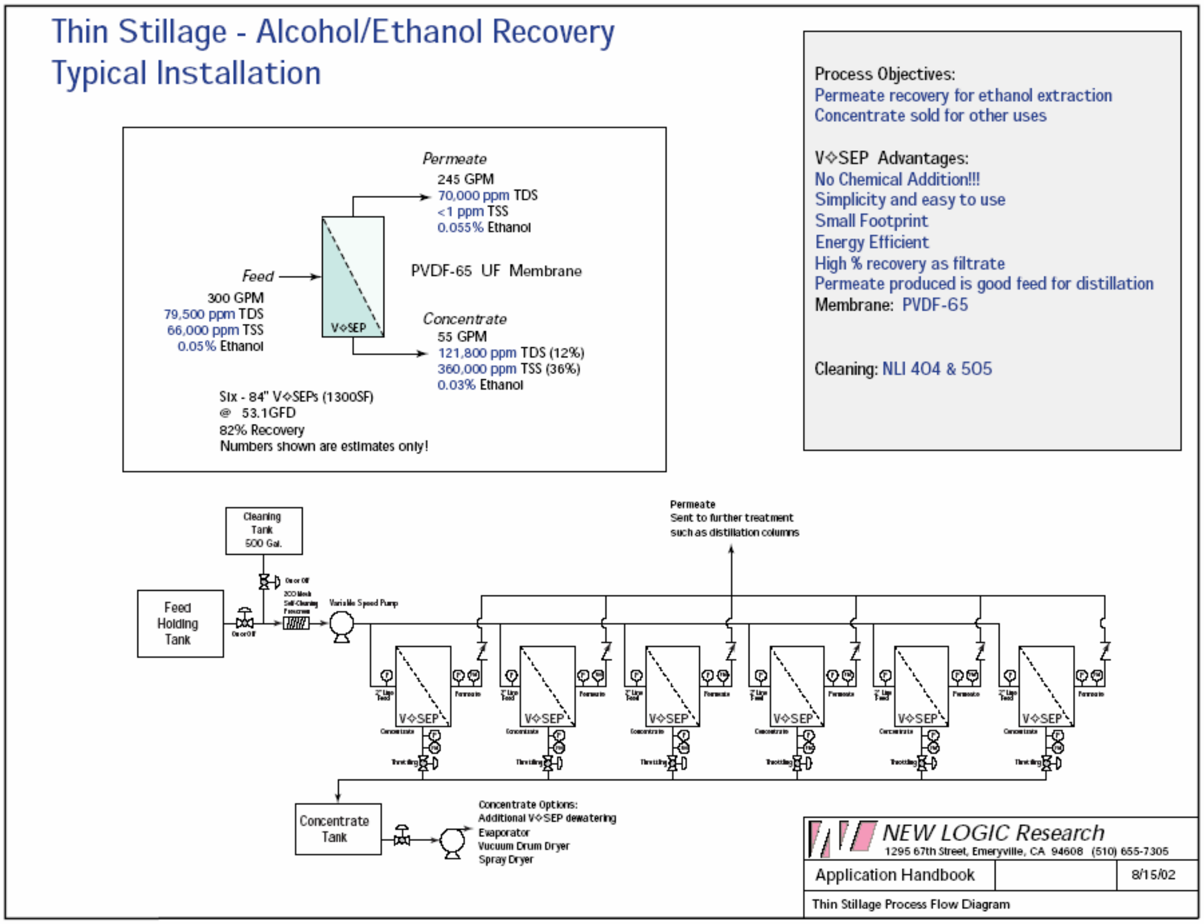
The VSEP technology is a membrane filtration system used for liquid-solid separation. The unit is comprised of several sheets of membrane arrayed in parallel disks and separated by gaskets. The disk stack is contained within a fiberglass reinforced plastic cylinder. The unit vibrates in torsional oscillation, producing tens times greater shear than conventional cross flow filtration. A process diagram of a typical VSEP system for ethanol recovery is shown in Figure 3-11.

Applicability to SRSNE

Neither bench scale nor pilot scale testing have been conducted using VSEP technology for separating DNAPL and ethanol/water. The VSEP technology has been used successfully for removing solids and contaminants from ethanol manufacturing processes prior to distillation. This process would not concentrate the ethanol, but could potentially remove DNAPL from the ethanol/water fluid matrix. Distillation would be required following the VSEP application to reconcentrate the alcohol. The effectiveness of VSEP may be limited in the presence of iron, manganese and other potential solids that could cause membrane fouling. To prevent membrane fouling, initial advanced filtration systems may be required to enable effective operation of the VSEP system. This process could not be considered further without treatability testing. The preliminary costing information received from VSEP is as follows:

- Bench scale testing: $1,000 plus analytical.
- Pilot Scale testing - $6,000 per month plus operations and analytical.
- Full scale 15 gpm system - $272,000 per module. Two modules at a minimum would likely be required.

Figure 3-11 VSEP Process Diagram
(New Logic Research, 2002)



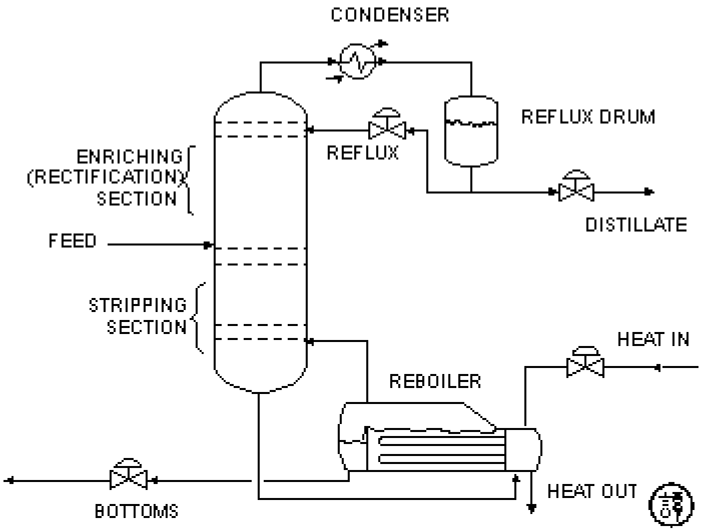
3.4.7 Distillation for Ethanol Recovery/Concentration

Direct distillation of the extracted ethanol/DNAPL/water fluids can not be considered for ethanol recovery at the SRSNE Site. Many of the DNAPL constituents form low boiling azeotropes with ethanol, and therefore, cannot be separated from liquid ethanol through boiling in a distillation column. Consequently, distillation would only be applicable for reconcentrating ethanol following separation from the DNAPL constituents.

Process Description

During the distillation process, the influent feed is introduced to the system near the middle of the distillation column. The vapor moves up the column, and as it exits the top of the unit, it is cooled by a condenser. The condensed liquid that is removed from the system as distillate. A typical distillation system is shown in Figure 3-12.

Figure 3-12 Typical Distillation Process Diagram



(http://lorien.ncl.ac.uk/ming/distil/distileqp.htm)

Applicability to SRSNE

A distillation process could be employed at the SRSNE site as a means of reconcentrating the ethanol following its separation from the DNAPL constituents through one of the technologies presented in Subsections 3.4.2 through 3.4.6 (note, excluding CFE).

Preliminary costs to distill pre-treated alcohol were obtained from Invensys APV Systems (APV). Technical representatives from APV estimated that a 15 gpm distillation system, assuming an average influent ethanol concentration of 30%, could be concentrated to 90% ethanol using a packed column at atmospheric pressure. The cost for this distillation system would be approximately $750,000. The distillation system would use approximately 2,750 pounds per hour of steam, and 2.3 MM Btu/hr of condensing duty. If the influent ethanol concentration was less than 30%, a larger distillation system would be required.

3.4.8 SUMMARY OF ETHANOL/DNAPL RECOVERY TECHNOLOGIES

The advantages, disadvantages, and feasibility (both technical and economical) of the ethanol/DNAPL recovery technologies discussed in the preceding subsections are summarized in Table 3-2.

3.5 COSOLVENT COST SUMMARY

3.5.1 Cost Comparison of a Single Dose Cosolvent Application with Off-Site Fluids Treatment Versus a Modular Injection Approach with On-Site Ethanol Recovery

The technology screening presented in Subsection 3.4 demonstrated that several possible technologies could be considered for full scale application; however, no process has demonstrated performance at full scale. None of the technologies could be considered without site-specific pilot testing. Based on uncertainties associated with all of the identified process technologies, it is likely that multiple systems would need to be further screened and piloted prior to consideration for implementation. Due to uncertainties associated with the performance of the different technologies analyzed, selection of the appropriate technology is beyond the scope of this level of feasibility analysis.

Given these potential treatment applicability concerns, the following approach was used for evaluating the potential benefit of on-site alcohol recovery. In comparing costs of the two approaches the following budgetary cost assumptions were used:

- Allocate $50,000 to further screen and select treatment processes that should be considered for on-site pilot testing.
- Allocate $500,000 to perform alternative pilot testing work on two or three of the promising alcohol recovery technologies.
- Allocate $4 to $7 million to construct and operate the selected alcohol recovery process, which will reduce the quantity of ethanol procured for injection and fluids requiring off-site treatment and disposal.

Table 3-2. Summary of Potential Ethanol Recovery Technologies

Technology	Estimated Full Scale Construction and Operating Costs	Advantages	Disadvantages
Critical Fluids Extraction (CFE)	$4,000,000 to $7,000,000	1. Minimal air emissions 2. Capable of ethanol recovery/reconcentration in one unit process. Distillation/concentration of ethanol not required.	1. No pilot scale testing experience. Only bench scale testing applicability. 2. Extremely high capital costs. 3. May be more effective with IPA instead of ethanol. 4. Vendor estimated additional polishing will be required to remove residual DNAPL constituents and improve the quality of recovered ethanol. 5. Vendor estimated water quality following CFE will exceed the capability of the proposed amendments to the hydraulic displacement GWTF (i.e. ethanol >500ppm)
Macro Porous Polymer Extraction (MPPE)	$2,500,000 to $4,000,000 (including distillation)	1. Minimal air emissions 2. Technology has pilot scale experience (Sages Dry Cleaner Site), with documented ability for ethanol recovery	1. Vendor has ethanol compatibility concerns and suggests maximum ethanol concentration of 5%, which will require significant dilution of the produced fluids. 2. Fouling is a concern from inorganics and metals. 3. Distillation will be required to reconcentrate the ethanol. Distillation costs will be higher for the more dilute ethanol. 4. Quality of recovered ethanol has not been determined (i.e. quantity of residual DNAPL constituents).
Pervaporation	Unknown	1. Can treat concentrated waste streams, with minimal impact from dissolved metals.	1. Vendor no longer markets this technology. 2. No field experience for operations with ethanol. 3. Process should not undergo further analyses.
Granular Activated Carbon (GAC)	$7,000,000 to $12,000,000	1. Carbon effectiveness has been demonstrated in both lab and pilot scale tests.	1. Carbon only applicable for more dilute waste streams. Excessive carbon usage required for highly concentrated ethanol/DNAPL/water mixture is not practical for full-scale implementation. 2. Carbon is more applicable as a polishing stage in conjunction with other technologies. 3. Distillation will be required to reconcentrate the ethanol. 4. Not effective for water soluble contaminants.
Air Stripping	Unknown	1. Has pilot scale experience	1. Effectiveness is unknown for high ethanol concentrations. 2. Air treatment costs would be extremely high. 3. Dilution likely required for effective treatment.
Vibratory Shear Enhanced Process VSEP	$2,000,000 to $4,000,000	1. Dilution of ethanol is not required. 2. Potentially lower capital and operating costs. 3. Minimal air emissions	1. No pilot or bench scale testing experience. Unproven performance. 2. Fouling is a concern from inorganics and metals; therefore, pretreatment will likely be required. 3. Distillation will be required to reconcentrate the recovered ethanol. 4. Quality of recovered ethanol has not been determined (i.e. quantity of residual DNAPL constituents). 5. Alcohol polishing likely required.
All Technologies	**Budget $4 to $7 Million**	**1. Reduced off-site disposal costs.**	**1. On-site pilot testing required to confirm applicability and costs under site-specific conditions** **2. Risk of reinjection of contaminants to subsurface if DNAPL constituents are not fully removed from the ethanol.** **3. Multiple processes required; therfore, there is increased complexity of operations and increased potential for downtime/failure.**

Tables 3-3 and 3-4 provide separate estimates to compare the costs for off-site disposal with potential benefits offered by on-site ethanol recovery. It should be noted that these costs do not represent the total cost of the cosolvent flooding remedial alternative, and are only applicable for comparing off-site fluids disposal with on-site treatment. Overall technical cost assumptions and recommendations are presented in Subsection 3.5.2, and cost estimates are presented in Appendix C. A comparison of costs presented in Tables 3-3 and 3-4 reveals that on-site ethanol recovery could potentially reduce the overall remedial cost by $2.5 to $5.5 million. Because of the potential savings offered by on-site ethanol recovery, WESTON recommends that costs be allocated in the overall budget for additional process screening and pilot testing.

Table 3-3
Single Injection Module, and Off-Site Fluids Disposal Comparison Costs Summary

Description	Unit	Qty	Unit Cost	Total Cost	Assumptions
Alcohol Cost	Gallon	1,101,600	$2.50	$2,754,000	918,000 gallons + 20%
Alcohol Storage Tank - 50,000 gallon	ea	1	$57,500	$57,500	Estimate
Alcohol Tank Mixer	ea	1	$23,000	$23,000	Estimate
Alcohol/DNAPL/Storage Tanks - 500,000 gallon	ea	4	$316,250	$1,265,000	Estimate
Alcohol/DNAPL/Storage Tank Mixers	ea	4	$92,000	$368,000	Estimate
Tank Foundations & Secondary Containment System	LS	1	$233,871	$233,871	Estimate
Alcohol/DNAPL/Water-Disposal	lb	16,680,000	$0.75	$12,510,000	2,000,000 gallons @ weight of water
O&M Cost	Mo	4	$275,000	$1,100,000	Estimate
Total				**$18,311,371**	

Table 3-4
Phased Sequential Operation, with On-Site Ethanol Recovery Comparison Cost Summary

Description	Unit	Qty	Unit Cost	Total Cost	Assumptions
Alcohol Cost	Gallon	480,000	$2.50	$1,200,000	Assumes 250,000 gallons (+20%) purchased initially and 80% Alcohol recovery per batch
Additional Technology Screening and Pilot selection	LS	1	$50,000	$50,000	Estimate
Piloting of Technology	LS	1	$500,000	$500,000	Estimate
Minimum Assumed Alcohol Recovery Technology Capital and Operating Cost	LS	1	$4,000,000	$4,000,000	Estimated Minimum
Maximum Alcohol Recovery Capital and Operating Cost	LS	1	$7,000,000	$7,000,000	Estimated Maximum
Alcohol Storage Tank - 25,000 gallon	Ea	1	$28,750	$28,750	Estimate
Alcohol Tank Mixer	Ea	1	$11,500	$11,500	Estimate
Alcohol/DNAPL/Storage Tanks - 500,000 gallon	Ea	1	$316,250	$316,250	Estimate
Alcohol/DNAPL/Storage Tank Mixers	Ea	1	$92,000	$92,000	Estimate
Tank Found & Secondary Containment System	LS	1	$116,935	$116,935	Estimate
Alcohol Disposal	lb	2,085,000	$0.75	$1,563,750	Quote - Assumes weight of water- and 250,000 gallons
DNAPL Disposal	lb	500,000	$0.75	$375,000	Quote - Assumes 50,000 gallons @ 10 lb/gallon
O&M Cost	Mo	16	$275,000	$4,400,000	Estimate
Estimated Minimum Total				**$12,654,185**	
Estimated Maximum Total				**$15,654,185**	

3.5.2 Overall Cosolvent Construction and Operations Costs

Capital and operating cost estimates for implementation of the cosolvent flushing remedial alternative are included in Appendix C of this report. These costs do not take into consideration costs for hydraulic displacement (Section 2 of this report) or additional costs associated with enhanced in-situ bioremediation, which would be implemented following completion of the cosolvent remedial action. Similar to estimates prepared for hydraulic displacement, WESTON prepared equipment lists and take-offs during development of the costs. For costs assembled herein, there is a high level of uncertainty in determining all process requirements to inject, extract, and dispose or possibly recover the cosolvent. Due to these uncertainties, WESTON recommends a minimum contingency of 25% be applied when comparing remedial alternatives with cosolvent flushing, even though conservative costing assumptions were used in developing the cost estimate.

The following summarizes the major costing assumptions utilized to develop the estimate:

- WESTON assumed that the remedy would be implemented in a single injection/recovery approach and all concentrated fluids (2,000,000 gallons of ethanol/DNAPL/water) would be temporarily stored and treated and disposed of off-site. WESTON has also assumed that the off-site treatment and disposal will be required at one of the two Texas facilities, which are permitted to treat PCB contaminated wastes.

- Costs were maintained for further screening and piloting of alternative technologies, ($50,000 for screening, and $500,000 for piloting). However potential benefits and cost savings of implementing one of the technologies were not included in the overall estimate. If piloting confirmed a technology was applicable for the ethanol recovery, a reduction in costs between 2.5 and 5.5 million dollars costs could potentially be realized. Piloting would confirm the accuracy of the potential cost benefits.

- In addition to piloting of fluids treatment, WESTON allocated $500,000 for piloting performance of the cosolvent remedial alternative prior to full-scale implementation.

- WESTON allocated $75,000 towards obtaining flammable liquids storage tank permits for the ethanol and ethanol/DNAPL/water storage tanks. We also assumed that the Site could accommodate the additional storage tanks and treatment system components.

- Other cost assumptions used for both the capital and operating costs are highlighted in Subsection 3.3, which listed additional pricing assumptions for the single module approach and off-site fluids disposal. Additional cost assumptions are shown in the estimate, included in Appendix C.

In summary the total estimated capital and operating costs (not including the minimum 25% recommended contingency) for implementation of the cosolvent remedy are $6,760,000 and

$16,460,000, respectively. The resulting combined cost is approximately $23,220,000. These costs assume that all fluids (alcohol/DNAPL) are treated off-site, and on-site treatment will not be implemented. In addition, these costs do not include implementation costs associated with the hydraulic displacement remedial alternative presented in Appendix B.

SECTION 4

EXCAVATION AND OFF-SITE DISPOSAL

4. EXCAVATION AND OFF-SITE DISPOSAL

4.1 WATER TREATMENT DESIGN CRITERIA

WESTON evaluated treatment requirements for fluids extracted during soil excavation and preparation for shipment off-site. Table 4-1 summarizes the general design criteria and assumptions used for this analysis.

Table 4-1

Water Treatment Design Criteria During Excavation and Off-Site Soil Disposal

Description	Assumption
Average Fluids Excavation Rate during Soil Removal Work	20 gpm
Maximum Fluids Extraction Rate during Soil Removal Work	50 gpm
Estimated Duration of Soil Excavation and Backfill Work	1 Year
Method of Fluids Extraction	Well Point System or other method that will minimize extraction of suspended and settleable solids above 50 mg/L

To evaluate the water treatment requirements for this alternative, WESTON assumed that the extracted groundwater quality will be similar to the influent water quality determined for the hydraulic displacement alternative discussed in Section 2 of this report.

4.2 EXCAVATION WATER PRE-TREATMENT REQUIREMENTS

Extracted fluids are expected to contain both DNAPL and silt particles; therefore, pre-treatment to remove these components prior to downstream metals and organics treatment will be necessary. Although the well point system will minimize extraction of solids, it is likely that some silts associated with soil excavation activities will remain in the fluid matrix. To minimize impact to the downstream water treatment process, settling tanks will likely be necessary to allow initial settling of incoming silts. These settling tanks will also inherently trap DNAPL present in the extracted fluids, which will require periodic removal. It is likely that multiple settling tanks will be necessary in order to achieve required settling criteria, as well as allow for periodic cleaning of the tanks, including DNAPL and solids removal. During operation, these settling tanks will periodically be taken out of service so that fluids can be decanted from the tanks, and trapped solids removed and re-mixed with excavated soils or bulking agent. Decanted process fluids will be treated by the downstream water pre-treatment process.

Following initial settling and bulk solids separation, fluids extracted during soil excavation activities will be processed through a pre-treatment facility, which will be similar to the preliminary treatment process discussed in Subsection 2.3 – for the hydraulic displacement alternative. Influent flows to the treatment system during excavation activities will be less than design flows for the hydraulic displacement alternative; therefore, the size of each phase separator could be reduced by 50%, from 100 gpm to 50 gpm capacity. In addition, excavation activities will also likely increase the solids loading to pre-treatment. To handle the higher solids loading, it is recommended that the pre-treatment filter press capacity be increased from 12 to a minimum of 24 cubic feet.

4.3 EVALUATION OF POTENTIAL USE OF EXISTING NTCRA-1 AND 2 GWTF

During soil excavation activities, the NTCRA-1 & 2 extraction systems and GWTF will continue to operate. Projected ranges for the combined influent flows are presented in Table 4-2, based on current and projected operating flows.

Table 4-2

Projected Combined Influent Flow During Soil Excavation

Description	Average Flow (gpm)	Maximum Flow (gpm)
NTCRA-1 (RW-1 to 12)	15	40
NTCRA-2 (RW-13, 1R and proposed new RW-14)	30	35
Soil Excavation Groundwater	20	50
Total Flow	**65**	**125**

During soil excavation activities, the estimated average water treatment flow rate is 65 gpm, and the maximum flow rate is 125 gpm (i.e, during peak wet weather periods). The estimated maximum flow exceeds the 100 gpm design capacity of the existing NTCRA-1 & 2 GWTF. It may be possible, however, to modify the existing facility such that it can be used for treatment of the combined flows from excavation dewatering and the NTCRA-1 & 2 wells.

The combined influent water quality to the NTCRA-1 & 2 GWTF from all three water sources (NTCRA-1, NTCRA-2, and Soil Excavation Pretreatment effluent) was estimated for both the average and maximum estimated flow conditions. The estimated influent concentrations are presented in Table 4-3 along with current facility effluent requirements.

It was assumed that the effluent water quality for the pretreatment system would be similar to the water quality predicted for the hydraulic displacement remedial alternative presented in Section 2. These data have been used to evaluate the improvements required for the existing NTCRA-1 & 2 GWTF in order to treat the additional process flows and loadings associated with the soil excavation remedy.

4.3.1 Recommended NTCRA-1 GWTF Improvements

The recommended NTCRA-1 & 2 GWTF improvements have been segregated into three categories: General Process Improvements: Water Treatment Process Equipment Improvements: and Non-Process Improvements. These are discussed in Subsections 4.3.1.1, through 4.3.1.3, respectively. These recommendations are preliminary and require further evaluation prior to implementation.

4.3.1.1 General Process Improvements

The following general process-related improvements will be required in order to treat the higher flow and loadings using the NTCRA-1 & 2 GWTF during the soil excavation remedy.

1. **Electrical Classification Modifications:** As previously discussed in Section 2, the potential exists for tank headspace vapors to exceed the LEL downstream of the pre-treatment process. Consequently, the interior of all process tanks upstream of the

TABLE 4-3
SRSNE SITE SOUTHINGTON, CT
ESTIMATED GROUNDWATER QUALITY
EXCAVATION AND OFF-SITE DISPOSAL

	Average Influent Water Flow and Estimated Influent Water Quality			Design Maximum Influent Water Flow and Estimated Influent Water Quality			Facility Effluent
Contaminated Water Source	Suggested Pre-Treatment System Effluent Design Criteria from Excavation Pre-Treatment System (1)	Average Influent Groundwater From NTCRA-1 and 2 (7-95 to 9-03) (2)	**Combined Influent (NTCRA-1/2 & Excavation Pre-Treatment Effluent) Groundwater Quality during Soil Excavation Work**	Suggested Pre-Treatment System Effluent Design Criteria from Excavation Pre-Treatment System (1)	Average Influent Groundwater From NTCRA-1 and 2 (7-95 to 9-03) (2)	**Combined Influent (NTCRA-1/2 & Excavation Pre-Treatment Effluent) Groundwater Quality during Soil Excavation Work**	Current Plant Discharge Criteria (3)
Assumed Flow Rate - GPM	20	45	**65**	50	75	**125**	100
Characterization Parameter	mg/L	mg/L	**mg/L**	mg/L	mg/L	**mg/L**	mg/L
VOCs, mg/L							
Vinyl Chloride	7.20	1.23	**3.07**	7.20	1.23	**3.62**	4.50
1,1-Dichloroethylene	5.20	0.09	**1.66**	5.20	0.09	**2.14**	0.06
Methylene Chloride	0.70	0.29	**0.41**	0.70	0.29	**0.45**	15.00
1,1-Dichloroethane	0.32	NA	**0.10**	0.32	NA	**0.13**	**No Limit**
cis-1,2-Dichloroethylene	44.52	4.86	**17.07**	44.52	4.86	**20.73**	5.00
Chloroform	0.19	NA	**0.06**	0.19	NA	**0.08**	**No Limit**
2-Butanone (MEK)	64.00	1.28	**20.58**	64.00	1.28	**26.37**	10.00
1,1,1-Trichloroethane	200.00	0.91	**62.17**	200.00	0.91	**80.55**	4.00
Benzene	0.55	NA	**0.17**	0.55	NA	**0.22**	**No Limit**
1,2-Dichloroethane	0.11	0.57	**0.43**	0.11	0.57	**0.38**	0.25
Trichloroethylene	780.00	0.10	**240.07**	780.00	0.10	**312.06**	0.97
4-Methyl-2-pentanone (MIBK)	0.95	0.50	**0.64**	0.95	0.50	**0.68**	2.00
2-Hexanone	100.00	NA	**30.77**	100.00	NA	**40.00**	**No Limit**
Toluene	122.00	3.98	**40.29**	122.00	3.98	**51.19**	4.00
1,1,2-Trichloroethane	0.07	0.33	**0.25**	0.07	0.33	**0.23**	0.25
Tetrachloroethylene	62.00	0.11	**19.15**	62.00	0.11	**24.87**	0.11
Ethylbenzene	17.28	1.31	**6.22**	17.28	1.31	**7.70**	1.00
Xylenes-Total	28.86	0.96	**9.54**	28.86	0.96	**12.12**	0.50
Styrene	0.86	0.25	**0.44**	0.86	0.25	**0.49**	0.50
Chloroethane	0.94	NA	**0.29**	0.94	NA	**0.38**	**No Limit**
Tetrahydrofuran	2.50	0.41	**1.06**	2.50	0.41	**1.25**	0.50
PCBs/Pesticides, mg/L (Method 8080)							
PCB-1254	0.06	NA	**0.02**	0.00	NA	**0.00**	**No Limit**
PCB-1260	0.12	NA	**0.04**	0.12	NA	**0.05**	**No Limit**
Discharge Permit Listed Alcohols (not listed above)							
Ethanol	21.37	3.24	**8.82**	21.37	3.24	**10.49**	20.00
Isopropanol	0.20	0.20	**0.20**	0.20	0.20	**0.20**	10.00
Methanol	16.00	7.99	**10.45**	16.00	7.99	**11.19**	30.00
sec-butanol	11.00	4.91	**6.78**	11.00	4.91	**7.35**	10.00
Discharge Permit Listed Ketones (not listed above)							
Acetone	5.80	0.81	**2.34**	5.80	0.81	**2.81**	35.00
Methyl ethyl ketone (MEK)	7.00	1.28	**3.04**	7.00	1.28	**3.57**	10.00

(1) - Estimated Phase separator effluent based on Hydraulic Displacement Analysis - Discussed In Section 2 and Presented in Table 2-2

(2) - Average Influent Data based on NTCRA-1/2 GWTF Influent Sampling for period noted.

(3) Plant Effluent Impacts -Current Plant Discharge Permit will likely require modification to increase allowable discharge rate above 100 gpm, and establish limits for contaminants which currently have no discharge limit.

organics treatment system(s) must be designed for hazardous atmospheres. It is likely that the tank internals will require an electrical hazardous classification of Class I-Division I, and the envelopes around these tanks will be classified as Class I-Division II. This electrical reclassification will require replacement or upgrade of process equipment and electrical systems in the impacted areas.

2. **Process Control System Improvements:** The existing GWTF Main Process Control Panel (PCP) is located in the main process treatment area. This location adds significant complications to safe and efficient monitoring and control of the treatment process. Therefore, the PCP should be relocated to the facility electrical room concurrently with expansion of the treatment system. In addition, a Human Machine Interface computer should be provided to improve on-site interface capabilities, enable storage, display, and reporting of system operations data, and to allow for remote (off-site) monitoring, control, and troubleshooting of the treatment system. This enhancement will improve system operability and reduce short-term and long-term operating costs.

3. **Process Piping Improvements:** The NTCRA-1 & 2 GWTF piping is mostly comprised of chlorinated polyvinyl chloride (CPVC) piping. Manufacturers do not recommend use of either CPVC or PVC for groundwater with concentrations of organic solvents in the range expected during excavation dewatering at the SRSNE site. In addition to the high concentrations of organic solvents anticipated in the process water during excavation, larger piping systems will be required to handle the increased flow from the combined influent streams. It is recommend that all new pipe systems used to convey groundwater upstream of the organics treatment process be constructed of stainless steel or other approved material that is compatible with the groundwater contaminants. For piping systems that do not require to be increased in size, an allocation is recommended for future replacement of existing CPVC piping systems that are damaged as a result of the contaminated groundwater. This cost allocation would be a contingency to ensure funds were available to replace these pipe systems in the event that the existing piping systems fail or have a reduced operating life.

4.3.1.2 Water Treatment Process Equipment Enhancements

1. **Supplemental Influent Equalization:** To address the need for additional influent equalization for the increased flow, supplemental equalization will be provided as part of the soil excavation pretreatment system. No changes are recommended for the existing Influent Equalization Tank except for those necessary to convert the tank level controls, and other associated process equipment, to use in Class I-Division I conditions (tank internals), and/or Class I-Division II conditions (equipment immediately outside of the tank).

2. **Iron Oxidation Tank:** The existing Iron Oxidation (Clarifier Feed) Tank and operating configuration has an operating capacity of approximately 750 gallons. At estimated maximum influent flows of 125 gpm, the retention time will be

approximately 5 minutes, which is too short to ensure effective oxidation of iron and manganese. The capacity of the Iron Oxidation Tank should be increased to provide a minimum of 20 minutes retention. It is recommended that this tank be replaced with a new 3000-gallon tank and associated elevated support system. This tank will require a new mixer and provisions for oxidant and coagulant addition in order to optimize iron and manganese removal.

3. **Caustic Feed System Improvements:** The existing caustic feed system is sized for a maximum process forward flow of approximately 50 gpm. At flows greater than 50 gpm, the caustic feed system cannot maintain the target pH of 10, which is necessary for sufficient oxidation of iron and manganese. The chemical transfer pumps should be increased to approximately 1.5 gallons per hour, which is approximately three times their current capacity. In addition, a 1500 gallon minimum capacity bulk caustic storage tank should be considered to replace the existing drum storage system. Adding a caustic storage tank will reduce labor costs and reduce safety concerns associated with frequent changeout of caustic drums.

4. **Flash Mix and Flocculation Tank Improvements:** Currently these two tanks operate at approximately 50% capacity because of the piping arrangement. The flash mix tank size is adequately sized; however, the flocculation tank is a concern. The flocculation tank capacity is approximately 450 gallons at the reduced level. The capacity of this tank could be increased to approximately 700 gallons by modifications to the piping system. This would provide retention time of approximately 5 minutes at maximum flows, which is less than optimal. Field testing should be considered along with clarifier performance testing at the estimated maximum influent flow rate to determine if additional flocculation tank capacity is warranted. Because of these uncertainties, WESTON suggests that a second parallel flash mix/flocculation tank be budgeted at this time.

5. **Inclined Plate Clarifier:** The performance of the inclined plate clarifier is also a concern at the projected maximum influent flow rate of 125 gpm. Performance of the clarifier at higher flows may be sufficient if the following enhancements are implemented: modify the sludge piping such that automatic wasting can be implemented; increase the flocculation tank capacity; and add oxidization and coagulant aids to improve metals precipitation and settling, and overall metals removal. Because of these performance uncertainties, WESTON recommends that a second parallel clarifier be budgeted in order to maintain acceptable hydraulic conditions through the existing clarifier. This second clarifier should be equipped with integral flash mix and flocculation tanks to jointly address the sizing concerns for those vessels as previously described in Item 4, above. Prior to proceeding with implementation of a larger clarifier, field trials should be performed to evaluate clarifier performance at higher flows, and confirm if supplemental clarifier capacity is warranted.

6. **Access Catwalk:** An access catwalk should be provided between the elevated process equipment to improve safety when maintaining this equipment. The catwalk

will also allow access to the elevated process pipelines, which currently require a man lift to service.

7. **Sludge Handling Improvements:** The sludge wasting piping from the clarifier to the sludge holding tank requires replacement in order to prevent sludge from siphoning out of the clarifier, and to allow proper control of automatic sludge wasting.

8. **Process Pumps:** The process forward flow pumps are currently limited to approximately 100 to 120 gpm. It is likely that larger motors and impellers will be necessary for each forward flow pump in order to process the increased flows. In some cases the existing pumps may be acceptable provided the related process piping sizes are increased to accommodate the higher flow rates.

9. **Process Piping:** Portions of the process piping will likely require replacement in order to process the maximum expected influent flow rate of 125 gpm.

10. **Sand Filter:** The performance of the sand filter system at flows greater than 70 gpm has never been tested. At current system operating flows (30 to 70 gpm), the sand filter provides reliable filtration provided the wash water return rate is greater than 15 gpm. This is a higher wash water return rate than the filter internals manufacturer (Parkson) typically recommends. However, this higher rate may be necessary because the Parkson internals have been retrofitted inside a Lighthouse filter tank, and clearances for the sand lift system are different than for standard Parkson tanks. Parkson recommends obtaining total suspended solids (TSS) samples during high flow testing to confirm that sand filter influent water quality can be maintained below 30 mg/L. If a maximum of 30 mg/L of TSS can be maintained in the filter influent (clarifier effluent), then Parkson recommends a maximum surface loading rate of 4 gpm per square foot, which is equal to 150 gpm. If improvements to the metals upstream metals precipitation system are implemented such 30 mg/L of TSS can be maintained in the filter influent, then the existing sand filter will be satisfactory for the flow rates estimated from excavation dewatering activities.

11. **Compressor System:** The capacity of the existing compressed air system should be increased to handle the additional diaphragm pumps operating on compressed air. In addition, a common air dryer system is recommended to dry the compressed air, and thereby reduce the maintenance for, and improve reliability of, the air operated equipment.

12. **Transducers for Extraction Wells:** The existing NTCRA-1 & 2 extraction wells are controlled using conductivity-type level probes, which foul rapidly and require significant maintenance. It is recommended that pressure transducers with local controllers be provided for the 13 extraction wells in the NTCRA-1 & 2 well fields.

13. **Organics Treatment:** For the excavation dewatering alternative, it is expected that the concentrations of organic contaminants in the treatment system influent will be similar to the concentrations estimated in Section 2 for the Hydraulic Displacement

alternative. Therefore, WESTON recommends that, for excavation dewatering, the same organics treatment processes be budgeted as for the Hydraulic Displacement alternative. These processes consist of air stripping with catalytic oxidation and caustic scrubbing off-gas, followed by photocatalytic oxidation. At least one, or possibly both, of the existing UV units could be retained as back-up for the photocatatlytic system. The only difference in cost, when compared to the costs for the organics treatment process proposed for Hydraulic Displacement are as follows:

- The excavation dewatering activities are expected to have a duration of 12 months. Therefore, purchase of a catalytic oxidizer and scrubber system in lieu of renting this equipment would be more cost-effective
- WESTON has included cost to decommission at least one of the UV Systems currently operating at the facility.

4.3.1.3 Other Potential Non-Process Improvements

To accommodate the increased flow from excavation dewatering, other long-term enhancements that should be considered for the NTCRA-1 & 2 GWTF upgrade and expansion include the following:

1. **New Gas-Fired Boiler and Hot Water Heating System:** Given the long-term operating costs of heating the existing, and potentially expanded, building, conversion of the existing electrical heating system to a gas fired boiler system will offer significantly lower operating costs. The system will be comprised of a gas-fired boiler, hydronic unit heaters, and a tempered ventilation system to improve the indoor air quality for the facility.
2. **Fire Suppression, Fire Detection and Security System Improvements:** Expansion of the existing treatment systems building will require upgrades of the fire suppression and detection system, and the security system.

4.4 ESTIMATED CAPITAL AND OPERATING COSTS

Capital and operating cost estimates for implementation of water treatment systems required for the soil excavation and disposal remedy are included in Appendix D of this report. Detailed technical assumptions have been used in preparing the estimates, however, no design activities or detailed take-offs have been completed to date. Although conservative costing assumptions were used to develop the costs summarized herein, WESTON recommends a minimum 20% contingency be applied to the estimate. The major capital and operating cost assumptions used to develop the cost estimates are as follows:

Capital Cost Estimate Assumptions

- WESTON assumed that others were estimating the capital and operating costs for actual soil excavation and groundwater extraction components; therefore, the costs included herein only address water treatment systems.
- WESTON assumed that the existing NTCRA-1 & 2 GWTF will be expanded in order to treat the additional process water. It may be possible to consider temporary buildings in lieu of permanent construction, but estimated costs were allocated for permanent facilities.
- WESTON assumed that the costs presented in Appendix B for DNAPL Pre-Treatment, Primary VOC Treatment, and Polishing VOC Treatment will be approximately the same for the excavation dewatering alternative. The only exception is for cost associated with purchase of a catalytic oxidizer and hydrochloric acid scrubber for treatment of the excavation process fluids.
- Refer to the cost estimate in Appendix D for additional technical assumptions.

Operating Cost Estimate Assumptions

- WESTON assumed that the remedy would be completed over a 1 year period.
- On-going costs for operating the existing NTCRA-1 & 2 groundwater extraction and treatment systems have not been included in the attached estimate. Costs associated with operating the expanded systems have been included.
- WESTON assumed an additional 40 hours of operations labor and 20 hours of technical and management support will be required each week to operate the expanded treatment system.
- Refer to the cost estimate in Appendix D for additional technical assumptions.

In summary the estimated capital and operating costs (not including the recommended 20% contingency) for construction and operation of water treatment systems associated with the soil excavation and disposal alternative are $3,817,000 and $1,222,000, respectively. The resulting estimated combined cost is $5,039,000.

SECTION 5

REFERENCES

5. REFERENCES

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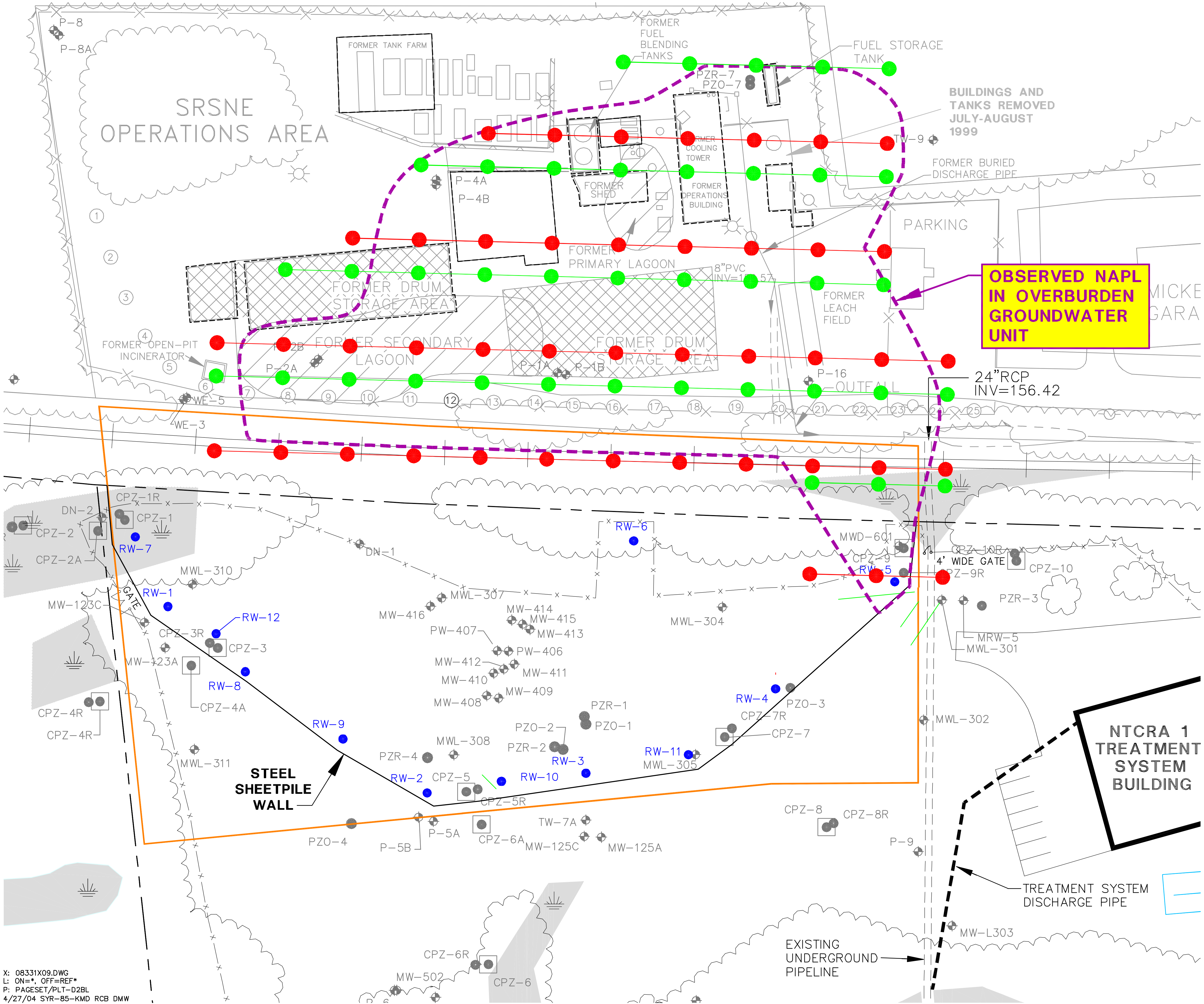
APPENDIX A

BBL FIGURE 1 – CONCEPTUAL HYDRALIC DISPLACEMENT SYSTEM



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L: ON=*, OFF=REF*
P: PAGESET/PLT-D2BL
4/27/04 SYR-85-KMD RCB DMW
08331003/08331B07.DWG

— — — —	PROPERTY LINE
- - - - - - -	EXISTING CONCRETE PAD
▨	WETLAND
▭	NTCRA 1 CONTAINMENT AREA
⊓	EXISTING STRUCTURE
—X—X—	FENCE
⊕ P-10	MONITORING WELL
● PZR-3	NTCRA 1 PIEZOMETER
▣ CPZ-10	NTCRA 1 COMPLIANCE PIEZOMETER
● RW-1	NTRCA 1 OVERBURDEN EXTRACTION WELL
⑫	FORMER ON-SITE INTERCEPTOR INTERCEPTOR SYSTEM EXTRACTION WELL
🟢	PROPOSED INJECTION WELL
🔴	PROPOSED EXTRACTION WELL

NOTES:

1. SITE PLAN TAKEN FROM DIVERSIFIED TECHNOLOGIES CORP., 556 WASHINGTON AVE., NORTH HAVEN, CT, DATED 6/93. TOPOGRAPHY REPORTED TO HAVE BEEN DIGITIZED FROM TOWN OF SOUTHINGTON TOPOGRAPH MAPS G-7, G-8, G-9; PHOTOGRAPHY DATED NOV. 1978, SCALE: 1"=100'. PROPERTY LINES REPORTED TO HAVE BEEN DIGITIZED AND LOT NUMBERS TAKEN FROM "PROPERTY MAP, TOWN OF SOUTHINGTON" MAPS 134 & 147, SCALE: 1"=100' BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. BENCHMARK #1 IS AT ELEVATION 164.03. PK NAIL; S'LY.
3. THE LOCATIONS OF EXISTING DRIVE POINTS, WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.
4. LOCATIONS OF PTB BORINGS AND CONCRETE PADS SURVEYED BY CONKLIN & SOROKA, NOVEMBER 2003.

0 30' 60'
GRAPHIC SCALE

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

FEASIBILITY STUDY

CONCEPTUAL HYDRAULIC DISPLACEMENT SYSTEM

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE
1

APPENDIX B

HYDRAULIC DISPLACEMENT CAPITAL AND OPERATIONS COST ESTIMATES

Project: SRSNE- Superfund Site
Southington, CT

Appendix B
Hydraulic Displacement
Capital Cost Estimate

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location or Comment
I	**FACILITY DESIGN AND COORDINATION**					**$ 378,319**	
a	Finalize Design Basis and Detailed Facility Design	1	10%	$ 378,319	$ 378,319		Estimate Only
II	**CONSTRUCTION**					**$ 3,783,187**	
1	**Mobilization and Demobilization**					**$ 25,000**	
a	Mobilization and Demobilizatior	1	LS	$ 25,000	$ 25,000		Estimate Only
2	**Access Restrictions**					**$ 8,600**	
a	Fencing	5000	LS	$ 1	$ 5,000		Estimate Only
b	Gate, Double Leaf	2	EA	$ 1,250	$ 2,500		Estimate Only
c	Safety Signage	15	EA	$ 40	$ 600		Estimate Only
d	Locks (all wells)	100	EA	$ 5	$ 500		Estimate Only
3	**Site Work**					**$ 21,544**	
a	Clear and Grub, and Site Prep	1	LS	$ 21,544	$ 21,544		Site Work Summary
b	Well Access Roads - Required for Installation	1	LS	$ -	$ -		Covered-Under Cap Construction - Estimated by Others
c	Potential Wetlands Mitigation?	1	LS	$ -	$ -		Covered Under Cap Construction - Estimated by Others
4	**Groundwater Injection System**					**$ 576,971**	
a	Injection Well Equipment	1	LS	$ 43,677	$ 43,677		GW Injection Summary
b	Injection Well Instruments	1	LS	$ 76,935	$ 76,935		GW Injection Summary
c	Injection Well Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		GW Injection Summary
d	Injection Well Mechanical Installation	1	LS	$ 9,150	$ 9,150		Mechanical Summary
e	Injection Well Electrical Installation	1	LS	$ 32,674	$ 32,674		Electrical Summary
f	Injection Well Piping	1	LS	$ 44,554	$ 44,554		Mechanical Piping Summary
g	Injection Well Insulation and Heat Trace	1	LS	$ 50,000	$ 50,000		Estimate
h	Injection Well Installation and Development	1	EA	$ 255,662	$ 255,662		Well Installation and Development Summary
i	Injection Well Installation and Development Oversight	1	LS	$ 54,320	$ 54,320		Well Installation Oversight
5	**Groundwater Extraction System**					**$ 877,580**	
a	Extraction Well Equipment	1	LS	$ 174,225	$ 174,225		GW Extraction Summary
b	Extraction Well Instruments	1	LS	$ 56,609	$ 56,609		GW Extraction Summary
c	Extraction Well Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		GW Extraction Summary
d	Extraction Well Mechanical Installation	1	LS	$ 70,147	$ 70,147		Mechanical Summary
e	Extraction Well Electrical Installation	1	LS	$ 32,674	$ 32,674		Electrical Summary
f	Extraction Well Piping	1	LS	$ 184,371	$ 184,371		Mechanical Piping Summary
g	Extraction Well Insulation and Heat Trace	1	LS	$ -	$ -		Assume - System will be installed and operated in warm weather
h	Extraction Well Installation and Development	1	LS	$ 288,299	$ 288,299		Well Installation and Development Summary
i	Extraction Well Installation and Development Oversight	1	LS	$ 61,255	$ 61,255		

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location or Comment
6	**DNAPL Pretreatment**					**$ 415,300**	
a	DNAPL Pretreatment Equipment	1	LS	$ 199,272	$ 199,272		DNAPL Pretreatment Summary
b	DNAPL Pretreatment Instruments	1	LS	$ 20,298	$ 20,298		DNAPL Pretreatment Summary
c	DNAPL Pretreatment Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		DNAPL Pretreatment Summary
d	DNAPL Pretreatment Mechanical Installation	1	LS	$ 46,511	$ 46,511		Mechanical Summary
e	DNAPL Pretreatment Electrical Installation	1	LS	$ 49,011	$ 49,011		Electrical Summary
f	DNAPL Pretreatment Piping	1	LS	$ 90,209	$ 90,209		Mechanical Piping Summary
7	**Metals Treatment**					**$ 407,255**	
a	Metals Treatment Equipment	1	LS	$ 228,208	$ 228,208		Metals Treatment Summary
b	Metals Treatment Instruments	1	LS	$ 14,634	$ 14,634		Metals Treatment Summary
c	Metals Treatment Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		Metals Treatment Summary
d	Metals Treatment Mechanical Installation	1	LS	$ 39,649	$ 39,649		Mechanical Summary
e	Metals Treatment Electrical Installation	1	LS	$ 49,011	$ 49,011		Electrical Summary
f	Metals Treatment Piping	1	LS	$ 65,754	$ 65,754		Mechanical Piping Summary
8	**Primary VOC Treatment**					**$ 335,903**	
a	Primary VOC Treatment Equipment	1	LS	$ 210,680	$ 210,680		Primary VOC Treatment Summary
b	Primary VOC Treatment Instruments	1	LS	$ 11,845	$ 11,845		Primary VOC Treatment Summary
c	Primary VOC Treatment Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		Primary VOC Treatment Summary
d	Primary VOC Treatment Mechanical Installation	1	LS	$ 41,936	$ 41,936		Mechanical Summary
e	Primary VOC Treatment Electrical Installation	1	LS	$ 32,674	$ 32,674		Electrical Summary
f	Primary VOC Treatment Piping	1	LS	$ 28,768	$ 28,768		Mechanical Piping Summary
9	**Polishing**					**$ 347,881**	
a	Polishing Equipment	1	LS	$ 287,500	$ 287,500		Polishing Summary
b	Polishing Instruments	1	LS	$ 5,750	$ 5,750		Polishing Summary
c	Polishing Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		Polishing Summary
d	Polishing Mechanical Installation	1	LS	$ 4,765	$ 4,765		Mechanical Summary
e	Polishing Electrical Installation	1	LS	$ 32,674	$ 32,674		Electrical Summary
f	Polishing Piping	1	LS	$ 7,192	$ 7,192		Mechanical Piping Summary
10	**Effluent**					**$ 110,995**	
a	Effluent Equipment	1	LS	$ 31,625	$ 31,625		Effluent Summary
b	Effluent Instruments	1	LS	$ 9,200	$ 9,200		Effluent Summary
c	Effluent Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		Effluent Summary
d	Effluent Mechanical Installation	1	LS	$ 10,675	$ 10,675		Mechanical Summary
e	Effluent Electrical Installation	1	LS	$ 16,337	$ 16,337		Electrical Summary
f	Effluent Piping	1	LS	$ 33,158	$ 33,158		Mechanical Piping Summary

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location or Comment
11	**NTCRA 1/2 Integration**					**$ 85,357**	
a	NTCRA 1/2 Integration Equipment	1	LS	$ 11,500	$ 11,500		NTCRA 1/2 Summary
b	NTCRA 1/2 Integration Instruments	1	LS	$ 5,750	$ 5,750		NTCRA 1/2 Summary
c	NTCRA 1/2 Integration Process Instrumentation and Controls	1	LS	$ 15,000	$ 15,000		NTCRA 1/2 Summary
d	NTCRA 1/2 Integration Mechanical Installation - Estimate	1	LS	$ 15,000	$ 15,000		Mechanical Summary
e	NTCRA 1/2 Integration Electrical Installation	1	LS	$ 20,000	$ 20,000		Electrical Summary
f	NTCRA 1/2 Integration Piping	1	LS	$ 18,107	$ 18,107		Mechanical Piping Summary
12	**Groundwater Treatment Plant Building**					**$ 570,801**	
a	Building foundation and site prep	1	LS	$ 15,446	$ 15,446		Building Foundation Summary
b	Building Concrete Slab with Secondary Containment	1	LS	$ 140,152	$ 140,152		Building Foundation Summary
c	Building Foundation Frost Wall	1	LS	$ -	$ -		Estimate Only
d	Reinforced Concrete Pads (10%-Building Concrete)	1	10%	$ 14,015	$ 14,015		Estimate Only
e	Temporary Building - 60 x 100 (+-6000 sq.ft.)	1	LS	$ 174,000	$ 174,000		Quote
f	Temporary Heating System - 2 indirect fired heaters	2	LS	$ 5,000	$ 10,000		Estimate Only
g	Temporary Electric Building and Control System	1	LS	$ 15,000	$ 15,000		Estimate Only - Electrical Summary
h	Building Electrical Service (High Voltage)	1	LS	$ 25,000	$ 25,000		Estimate Only - Electrical Summary
i	Building Lighting and Power Distribution- XP - ESTIMATE	1	LS	$ 81,684	$ 81,684		Estimate Only - Electrical Summary
j	Building Gas Service	500	LS	$ 75	$ 37,500		Estimate Only
k	Building Water Service & Utility Trenching	1	LS	$ 23,003	$ 23,003		Mechanical Piping Summary
l	Building Fire Suppression/Detection System - Assumed not required	1	LS	$ -	$ -		Estimate Only
m	Plant Control and Monitoring System	1	LS	$ 30,000	$ 30,000		Estimate Only
n	Utility Water System	1	LS	$ 5,000	$ 5,000		Estimate Only
III	**CONSTRUCTION MANAGEMENT AND ADMINISTRATION, and PERMITS**					**$ 358,739**	Estimate Only
a	Construction Mangagement	1	5%	$ 189,159	$ 189,159		Estimate
b	Construction Administration	1	2.5%	$ 94,580	$ 94,580		Estimate
c	Permits - (Discharge, Air, and Construction)	1	LS	$ 50,000	$ 50,000		Estimate
d	O&M Manual/SOP's	1	LS	$ 25,000	$ 25,000		Estimate
					$ -		
					$ -		
IV	**DECOMMISSION - % OF CONST.**	**1**	**LS**	**$ 200,000**	**$ 200,000**	**$ 200,000**	Estimate
	Total - Design, Construction and Decommisioning					**$ 4,720,244**	
V	**ESTIMATED O&M COST 180 DAY - See Separate Sheet**					**$ 1,312,870**	
	GRAND TOTAL - CONSTRUCTION AND 180 DAY O&M					**$ 6,033,114**	

Task	Units	Est. Qty.	Unit Cost	Total Cost	Assumptions
Vendor Inspections and Training				**$ 8,900.00**	**Vendor Costs included in equipment pricing**
Lead Operator - Labor	Hrs	40	$ 85.00	$ 3,400.00	40 Hours/week
Project Engineer - Labor	Hrs	40	$ 100.00	$ 4,000.00	40 Hours/week
Travel & Expenses	LS	1	$ 1,500.00	$ 1,500.00	Estimate
Whitewater Checkout				**$ 11,900.00**	**Estimate 1-week to complete**
Lead Operator - Labor	Hrs	40	$ 85.00	$ 3,400.00	40 Hours/week
Support Operator - Labor	Hrs	40	$ 75.00	$ 3,000.00	40 Hours/week
Project Engineer - Labor	Hrs	40	$ 100.00	$ 4,000.00	40 Hours/week
Travel & Expenses	LS	1	$ 1,500.00	$ 1,500.00	Estimate
Operations and Maintenance				**$ 794,320.00**	**Full time staff for first 21 days - 12 hours/day for remainder of 180 day period**
Health and Safety Plan	LS	1	$ 20,000.00	$ 20,000.00	Estimate
Lead Operator - Labor	Hrs	2,160	$ 85.00	$ 183,600.00	12 hours/day for 180 days
Support Operator 1 Labor	Hrs	912	$ 75.00	$ 68,400.00	12 Hours/day for first 21 days, 30 hours/week for remainder of O&M
Support Operator 2 - Labor	Hrs	428	$ 75.00	$ 32,100.00	12 Hours/day for first 21 days, 8 hours/week for remainder of O&M
Project Engineer - Labor	Hrs	312	$ 100.00	$ 31,200.00	12 Hours/week
Project Management/QA/Tech Support	Hrs	208	$ 125.00	$ 26,000.00	8 Hours/Week
O&M Travel & Expenses - 180 days	day	180	$ 100.00	$ 18,000.00	Estimate
Electrical Power	KW	864,000	$ 0.11	$ 95,040.00	200 KW/Hr - Continuous
Water	LS	1	$ 5,000.00	$ 5,000.00	Estimate
Natural Gas - (Therms = 100 Cu.Ft. = 100,000 BTU)	Therms	64,800.0	$ 0.75	$ 48,600.00	1,500,000 BTU/HR - Continuous
Caustic Soda	lb	410,400	$ 0.20	$ 82,080.00	3 times average NTCRA-1/2 usage, plus 80 lb/hr (AVG) for HCL scrubber
Polymer	gal	30	$ 60.00	$ 1,800.00	1 mg/L dose continuously
Sulfuric Acid	lb	5,000	$ 0.20	$ 1,000.00	3 times average NTCRA-1/2 usage
Hydrogen Peroxide	lb	0	$ 0.40	$ -	Assume None Required
Coagulant Aid (Aluminum Chlorhydrate)	gal	900	$ 10.00	$ 9,000.00	30 mg/L dose
Recovery Well Development	day	43	$ 2,500.00	$ 107,500.00	1-complete round on all injection wells @ 1day/well
Preventive and Corrective Maintenance	LS	1	$ 25,000.00	$ 25,000.00	Estimate
Tools, Monitoring Equipment, Misc. Supplies and Expenses	LS	1	$ 20,000.00	$ 20,000.00	Estimate
Safety Supplies	LS	1	$ 20,000.00	$ 20,000.00	Assume Breathing air equipment maintained on-site for maintenance activities.

Appendix B
Hydraulic Displacement
Operations, Maintenance, and Monitoring Cost Estimate

Task	Units	Est. Qty.	Unit Cost	Total Cost	Assumptions
Disposal				**$ 393,750.00**	
DNAPL - Bulk Disposal	kg	200,000	$ 1.65	$ 330,000.00	Assumes Incineration @ approved Off-Site Facility
PCB - Sludge Disposal - Drums	ea	75	$ 600.00	$ 45,000.00	Estimate
Non-PCB Sludge Disposal - Drums	ea	50	$ 200.00	$ 10,000.00	Estimate
PPE Disposal - Drums PCB Contaminated	ea	25	$ 350.00	$ 8,750.00	Estimate
Analytical				**$ 59,000.00**	
DNAPL Sampling	ea	2	$ 2,000.00	$ 4,000.00	2 in 6-months
PCB - Sludge Sampling	ea	2	$ 2,000.00	$ 4,000.00	2 in 6-months
Non-PCB Sludge Sampling	ea	2	$ 2,000.00	$ 4,000.00	2 in 6-months
PPE Sampling	ea	2	$ 2,000.00	$ 4,000.00	2 in 6-months
Process Influent and Effluent Sampling	ea	100	$ 300.00	$ 30,000.00	Assume 5 24-TAT during first week, and weekly for the first month and monthly thereafter on influent and effluent. Assume 50 Intra-process. VOC, Alcohol, TSS, Metals
Dioxin/Furan Sampling	ea	7	$ 1,000.00	$ 7,000.00	Assume 1 on first week and then monthly
Supplemental Toxicity	ea	6	$ 1,000.00	$ 6,000.00	Assume Monthly toxicity Required during O&M
Reporting and Monitoring				**$ 45,000.00**	
Operations Summary Reports	LS	9	$ 5,000.00	$ 45,000.00	Weekly for first month, and Monthly thereafter
Final Completion Report	LS	1	$ -	$ -	Client to determine Scope and associated costs
Hydro-geological Hydraulic Displacement - Analysis	LS	1	$ -	$ -	Client to determine Scope and associated costs
Owner Representative Oversight and Project Coordination	LS	1	$ -	$ -	Client to determine Scope and associated costs
Grand Total				**$ 1,312,870.00**	

APPENDIX C

COSOLVENT EXTRACTION CAPITAL AND OPERATING COST ESTIMATES

Project: SRSNE- Superfund Site
Southington CT.

Appendix C
Cosolvent Flooding
Capital Cost Estimate

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location
I	**Cosolvent Treatment Facility Design & Coord.**					**$ 1,516,237**	
a	Additional Facility Design Basis and Design	1	10%	$ 466,237	$ 466,237		Estimate Only
f	Screen alternative Ethanol Recovery Processes	1	LS	$ 50,000	$ 50,000		Estimate Only
g	Pilot Cosolvent Remedy - Effectiveness	1	LS	$ 500,000	$ 500,000		Estimate Only
h	Pilot Alternative Ethanol Recovery Equipment	1	LS	$ 500,000	$ 500,000		Estimate Only
II	**CONSTRUCTION**					**$ 4,662,375**	
1	**Mobilization and Demobilization**	1	LS			**$ 25,000**	
a	Additional Mobilization and Demobilizatior	1	LS	$ 25,000	$ 25,000		
2	**Additional Site Work**					**$ 4,700**	
a	Additional Fencing	1000	LS	$ 1	$ 1,000		Estimate Only
b	Additional Gate, Double Leaf	2	EA	$ 1,250	$ 2,500		Estimate Only
c	Additional Safety Signage	30	EA	$ 40	$ 1,200		Estimate Only
3	**Site Work**					**$ 311,930**	
a	Clear and Grub , and Site Preparation	1	LS	$ 103,535	$ 103,535		Site Work
b	Secondary Containment Tank Berms & Liner	1	LS	$ 208,395	$ 208,395		Site Work
4	**GW Extraction/Injection Improvements and Dilution System**					**$ 511,194**	
a	Upgraded Injection System Piping, Added Extraction Well Manifold and Dilution Equipment	1	LS	$ 102,925	$ 102,925		Extraction and Dilution Summary
b	Upgraded Injection System Piping, Added Extraction Well Manifold and Dilution Instruments	1	LS	$ 45,684	$ 45,684		Extraction and Dilution Summary
c	Upgraded Injection System Piping, Added Extraction Well Manifold and Dilution Instrumentation and Control	1	LS	$ 25,000	$ 25,000		Extraction and Dilution Summary
d	Upgraded Injection System Piping, Added Extraction Well Manifold and Dilution Mechanical Installation	1	LS	$ 40,000	$ 40,000		Estimate
e	Upgraded Injection System Piping, Added Extraction Well Manifold and Dilution Electrical Installation	1	LS	$ 58,164	$ 58,164		Estimate - Electrical Summary
f	Upgraded Injection System Piping, Added Extraction Well Manifold and Dilution Piping (upgrade injection to Stainless Steel and add second extractions system manifold to enable selection of dilute or concentrated process fluid line)	1	LS	$ 209,421	$ 209,421		CoSolvent Piping Summary
g	Well Manifold Insulation and Heat Trace	1	LS	$ 30,000	$ 30,000		Estimate
5	**Ethanol Delivery System**					**$ 441,136**	
a	Ethanol Delivery System Equipment	1	LS	$ 187,450	$ 187,450		Ethanol Delivery Summary
b	Ethanol Delivery System Instruments	1	LS	$ 20,700	$ 20,700		Ethanol Delivery Summary
c	Ethanol Delivery System Process Instrumentation and Controls	1	LS	$ 25,000	$ 25,000		Ethanol Delivery Summary
d	Ethanol Delivery System Mechanical Installation	1	LS	$ 60,000	$ 60,000		Estimate
e	Ethanol Delivery System Electrical Installation	1	LS	$ 58,164	$ 58,164		Estimate - Electrical Summary
f	Ethanol Delivery System Piping	1	LS	$ 89,822	$ 89,822		Cosolvent Piping Summary

Appendix C
Cosolvent Flooding
Capital Cost Estimate

Project: SRSNE- Superfund Site
Southington CT.

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location
6	**Temporary Storage (Ethanol/DNAPL)**					**$ 2,095,561**	
a	Temporary Storage Equipment	1	LS	$ 1,646,800	$ 1,646,800		Temporary Storage Summary
b	Temporary Storage Instruments	1	LS	$ 14,950	$ 14,950		Temporary Storage Summary
c	Temporary Storage Process Instrumentation and Controls	1	LS	$ 25,000	$ 25,000		Temporary Storage Summary
d	Temporary Storage Mechanical Installation	1	LS	$ 50,000	$ 50,000		Estimate
e	Temporary Storage Electrical Installation	1	LS	$ 58,164	$ 58,164		Estimate - Electrical Summary
f	Temporary Storage Piping	1	LS	$ 66,775	$ 66,775		Cosolvent Piping Summary
g	Ethanol Storage Tank Foundations and Berms	1	LS	$ 233,871	$ 233,871		Tank Foundation Summary
7	**Ethanol/DNAPL Separation and Recovery**					**$ -**	
a	Ethanol/DNAPL Separation and Recovery Equipment	CONSTRUCTION COSTS FOR ETHANOL SEPARATION AND RECOVERY HAVE BEEN ELIMINATED FROM ESTIMATE. THE APPROXIMATE COSTS FOR ETHANOL RECOVERY COULD BE AS HIGH AS $6,000,000. BECAUSE OF UNCERTAINTIES ASSOCIATED WITH ETHANOL RECOVERY, COSTS FOR OFF-SITE FLUID TREATMENT AND DISPOSAL HAVE BEEN INCLUDED IN SEPARATE O&M ESTIMATE. SEE SHEET 7 FOR ESTIMATED ETHANOL/DNAPL SEPARATION EQUIPMENT COSTS. BECAUSE ETHANOL RECOVERY HAS THE POTENTIAL TO REDUCE OVERALL IMPLEMENTATION COSTS, PART (I) OF THIS ESTIMATE HAS BUDGETED COSTS FOR ADDITIONAL PROCESS SCREENING AND PILOTING OF ALTERNATIVE TREATMENT PROCESSES, THAT HAVE THE POTENTIAL TO EXTRACT ETHANOL AND REDUCE DISPOSAL COSTS.					
b	Ethanol/DNAPL Separation and Recovery Instruments						
c	Ethanol/DNAPL Separation and Recovery Process Instrumentation and Controls						
d	Ethanol/DNAPL Separation and Recovery Mechanical Installation						
e	Ethanol/DNAPL Separation and Recovery Electrical Installation						
f	Ethanol/DNAPL Separation and Recovery Piping						
8	**Hydraulic Displacement Facility Upgrades**					**$ 666,500**	
a	Hydraulic Displacement Facility Upgrades Equipment	1	LS	$ 557,750	$ 557,750		Hyd. Displ. Upgrades Summary
b	Hydraulic Displacement Facility Upgrades Instruments	1	LS	$ 28,750	$ 28,750		Hyd. Displ. Upgrades Summary
c	Hydraulic Displacement Facility Upgrades Process Instrumentation and Controls	1	LS	$ 25,000	$ 25,000		Hyd. Displ. Upgrades Summary
d	Hydraulic Displacement Facility Upgrades Mechanical Installation	1	LS	$ 25,000	$ 25,000		Estimate
e	Hydraulic Displacement Facility Upgrades Electrical Installation	1	LS	$ 5,000	$ 5,000		Estimate - Electrical Summary
f	Hydraulic Displacement Facility Upgrades Piping	1	LS	$ 25,000	$ 25,000		Estimate
9	**NTCRA-1/2 Facility Upgrades**					**$ 51,500**	
a	NTCRA-1/2 Facility Upgrades Equipment	1	LS	$ 5,750	$ 5,750		NTCRA 1/2 Upgrade Summary
b	NTCRA-1/2 Facility Upgrades Instruments	1	LS	$ 5,750	$ 5,750		NTCRA 1/2 Upgrade Summary
c	NTCRA-1/2 Facility Upgrades Process Instrumentation and Controls	1	LS	$ 25,000	$ 25,000		NTCRA 1/2 Upgrade Summary
d	NTCRA-1/2 Facility Upgrades Mechanical Installation	1	LS	$ 5,000	$ 5,000		Estimate
e	NTCRA-1/2 Facility Upgrades Electrical Installation	1	LS	$ 5,000	$ 5,000		Estimate - Electrical Summary
f	NTCRA-1/2 Facility Upgrades Piping	1	LS	$ 5,000	$ 5,000		Estimate

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location
10	**Cosolvent Flood Additional Temporary Building**					**$ 554,854**	
a	Additional Building foundation and site prep	1	LS	$ 15,446	$ 15,446		Building Foundation Summary
b	Additional Building Concrete Slab with Secondary Containment	1	LS	$ 140,152	$ 140,152		Building Foundation Summary
c	Additional Building Foundation Frost Wall	1	LS	$ 70,076	$ 70,076		Estimate
d	Reinforced Concrete Pads (10%-Building Concrete)	1	10%	$ 14,015	$ 14,015		Estimate
e	Increased Pre-Engineered Metal Building - 40 x 60 (+- 2400 sq.ft.)	2400	SF	$ 55	$ 132,000		Estimate
f	Additional Building HVAC System - XP Ventilation	1	LS	$ 75,000	$ 75,000		Estimate
g	Additional Building Electrical Room	1	LS	$ 5,000	$ 5,000		Estimate - Electrical Summary
h	Increased Building Electrical Service (High Voltage)	1	LS	$ 5,000	$ 5,000		Estimate - Electrical Summary
i	Additional Building Lighting and Power Distribution- XP - ESTIMATE	1	LS	$ 58,164	$ 58,164		Estimate - Electrical Summary
j	Additional Building Gas Service	1	LS	$ -	$ -		No Change assumed
k	Additional Building Water Service & Utility Trenching	1	LS	$ -	$ -		No Change assumed
l	Additional Building Fire Suppression/Detection System	1	LS	$ 25,000	$ 25,000		Estimate
m	Additional Plant Control and Monitoring System	1	LS	$ 10,000	$ 10,000		Estimate
n	Additional Utility Water System	1	LS	$ 5,000	$ 5,000		Estimate
III	**CONSTRUCTION MANAGEMENT AND ADMINISTRATION and Permits (% of Construction)**	**1**	**7.5%**	**$ 349,678**	**$ 349,678**	**$ 349,678**	
IV	**DECOMMISSION (% of Construction)**	**1**	**5%**	**$ 233,119**	**$ 233,119**	**$ 233,119**	
	Overall Design and Construction Total					**$ 6,761,409**	
V	**Estimated O&M Cost for 1 Module Ethanol Injection and Off-Site Fluids Disposal - 4 Month Period of Operation**					**$ 16,463,705**	
	Grand Total Construction, and O&M - Not Including Costs for Hydraulic Displacement or on-going costs for NTCRA-1/2 Systems					**$ 23,225,114**	

Task	Units	Est. Qty.	Unit Cost	Total Cost	Assumptions
Vendor Inspections and Training				**$ 17,300.00**	**Vendor Costs included in equipment pricing**
Lead Operator - Labor	Hrs	80	$ 85.00	$ 6,800.00	40 Hours/week
Project Engineer - Labor	Hrs	80	$ 100.00	$ 8,000.00	40 Hours/week
Travel & Expenses	LS	1	$ 2,500.00	$ 2,500.00	Estimate
Whitewater Checkout				**$ 23,300.00**	**Estimate 2-weeks to complete**
Lead Operator - Labor	Hrs	80	$ 85.00	$ 6,800.00	40 Hours/week
Support Operator - Labor	Hrs	80	$ 75.00	$ 6,000.00	40 Hours/week
Project Engineer - Labor	Hrs	80	$ 100.00	$ 8,000.00	40 Hours/week
Travel & Expenses	LS	1	$ 2,500.00	$ 2,500.00	Estimate
Operations and Maintenance				**$ 989,080.00**	**Full time staff for first 60 days - 12 hours/day for remainder of 120 day period - 4 Months**
Health and Safety Plan	LS	1	$ 20,000.00	$ 25,000.00	Estimate
Lead Operator - Labor	Hrs	1,440	$ 85.00	$ 122,400.00	12 hours/day 120 days
Support Operator 1 Labor	Hrs	1,170	$ 80.00	$ 93,600.00	12 Hours/day for first 60 days, 50 hours/week for final 60 days
Support Operator 2 - Labor	Hrs	900	$ 80.00	$ 72,000.00	12 Hours/day for first 60 days, 20 hours/week for final 60 days
Project Engineer - Labor	Hrs	540	$ 100.00	$ 54,000.00	30 Hours/week - 18 Weeks
Project Management/QA/Tech Support	Hrs	540	$ 125.00	$ 67,500.00	30 Hours/week - 18 Weeks
O&M Travel & Expenses - 180 days	day	120	$ 100.00	$ 12,000.00	Estimate
Electrical Power	KW	864,000	$ 0.11	$ 95,040.00	300 KW/Hr - Continuous - 18 weeks
Water	LS	1	$ 5,000.00	$ 5,000.00	Estimate
Natural Gas - (Therms = 100 Cu.Ft. = 100,000 BTU)	Therms	57,600.0	$ 0.75	$ 43,200.00	2,000,000 BTU/HR - Continuous
Caustic Soda	lb	331,200	$ 0.20	$ 66,240.00	3 times average NTCRA-1/2 usage, plus 100 lb/hr for HCL scrubber
Polymer	gal	20	$ 60.00	$ 1,200.00	1 mg/L dose continuously
Sulfuric Acid	lb	4,000	$ 0.20	$ 800.00	3 times average NTCRA-1/2 usage
Hydrogen Peroxide	lb	144,000	$ 0.40	$ 57,600.00	1000 ppm dose - continuous for 18 weeks
Coagulant Aid (Aluminum Chlorhydrate)	gal	600	$ 10.00	$ 6,000.00	30 mg/L dose
Recovery Well Development	day	43	$ 2,500.00	$ 107,500.00	1-complete round on all injection wells @ 1day/well
Preventive and Corrective Maintenance	LS	1	$ 75,000.00	$ 75,000.00	Estimate
Tools, Monitoring Equipment, Misc. Supplies and Expenses	LS	1	$ 60,000.00	$ 60,000.00	Estimate
Safety Supplies	LS	1	$ 25,000.00	$ 25,000.00	Assume Breathing air equipment maintained on-site for maintenance activities.

Appendix C
Cosolvent Operations, Maintenance, and Monitoring Cost Estimate

Task	Units	Est. Qty.	Unit Cost	Total Cost	Assumptions
Cosolvent Remedy Fluids				**$ 2,760,075.00**	Performed in one Module
Ethanol Cost	gal	1,101,600	$ 2.50	$ 2,754,000.00	918,000 gallons with 20% additional for density modifiers
Xanthum Gum Cost	lb	1,350	$ 4.50	$ 6,075.00	
Disposal				**$ 12,553,750.00**	
DNAPL/Ethanol/Water Fluid - Bulk Disposal	lb	16,680,000	$ 0.75	$ 12,510,000.00	Estimate 2,000,000 gallons total @ $0.75/lb and 8.34 lbs/gallon - Assumes incineration at one of the two Texas facilities that can take PCB contaminated materials.
PCB - Sludge Disposal - Drums	ea	50	$ 600.00	$ 30,000.00	Estimate
Non-PCB Sludge Disposal - Drums	ea	25	$ 200.00	$ 5,000.00	Estimate
PPE Disposal - Drums PCB Contaminated	ea	25	$ 350.00	$ 8,750.00	Estimate
Analytical				**$ 85,200.00**	
DNAPL/Alcohol Sampling	ea	18	$ 2,000.00	$ 36,000.00	1 per week for 18 weeks
PCB - Sludge Sampling	ea	2	$ 2,000.00	$ 4,000.00	2 in 4-months
Non-PCB Sludge Sampling	ea	2	$ 2,000.00	$ 4,000.00	2 in 4-months
PPE Sampling	ea	2	$ 2,000.00	$ 4,000.00	2 in 4-months
Process Influent and Effluent Sampling	ea	94	$ 300.00	$ 28,200.00	Assume 5 24-TAT during first week, and weekly thereafter on influent and effluent. Assume 50 Intra-process. VOC, Alcohol, TSS, Metals
Dioxin/Furan Sampling	ea	5	$ 1,000.00	$ 5,000.00	Assume 1 on first week and then monthly
Supplemental Toxicity	ea	4	$ 1,000.00	$ 4,000.00	Assume Monthly toxicity Required during O&M
Reporting and Monitoring				**$ 35,000.00**	
Operations Summary Reports	LS	7	$ 5,000.00	$ 35,000.00	Weekly for first month, and Monthly thereafter
Final Completion Report	LS	1	$ -	$ -	Client to determine Scope and Associated Costs
Hydro-geological Hydraulic Displacement - Analysis	LS	1	$ -	$ -	Client to determine Scope and Associated Costs
Owner Representative Oversight and Project Coordination	LS	1	$ -	$ -	Client to determine Scope and Associated Costs
Grand Total				**$ 16,463,705.00**	

APPENDIX D

SOIL EXCAVATION AND OFF-SITE DISPOSAL CAPITAL AND OPERATING COST ESTIMATES

Project: SRSNE- Superfund Site
Southington CT.

Appendix D
Soil Excavation and Off-Site Disposal
Capital Cost Estimate

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location	Percent of TOTAL Cost - Excluding O&M
I	**FACILITY DESIGN AND COORDINATION**					**$ 303,415**		**7.95%**
a	Finalize Design Basis and Detailed Facility Design	1	10%	$ 303,415	$ 303,415		10% Construction Total	
II	**CONSTRUCTION**					**$ 3,034,155**		**79.49%**
1	**Mobilization and Demobilization**					**$ 25,000**		0.65%
a	Mobilization and Demobilization	1	LS	$ 25,000	$ 25,000		Estimate Only	
2	**Access Restrictions**					**$ 8,100**		0.21%
a	Fencing	5000	LS	$ 1	$ 5,000		Estimate Only	
b	Gate, Double Leaf	2	EA	$ 1,250	$ 2,500		Estimate Only	
c	Safety Signage	15	EA	$ 40	$ 600		Estimate Only	
3	**Site Work**					**$ 117,500**		3.08%
a	General Clear and Grub, and Site Prep	1	LS	$ 25,000	$ 25,000		Estimate Only	
b	Building Foundation Expansion	6000	Sq.Ft.	$ 5	$ 30,000		Estimate Only	
c	Tank Farm/Frac Tank Pad	2500	Sq.Ft.	$ 5	$ 12,500		Estimate Only	
d	Relocation of Underground Utilities as necessary for Building Expansion	1	LS	$ 50,000	$ 50,000		Estimate Only	
4	**NTCRA-1 GWTF Foundation and Building Expansion**					**$ 515,000**		13.49%
a	Sediment Facilities Foundation	2500	Sq.Ft.	$ 20	$ 50,000		Assumption: Total GWTF Expansion - 6000 sq.ft. - with foundation @ $20/sq.ft. and Blg/internal building work @ $55/sq.ft. - Likely add minimum of one bay to each end of building for req'd expansion.	
b	Sedimentation Facilities Temporary Building	2500	Sq.Ft.	$ 30	$ 75,000			
c	Sediment Facility Temporary Heating for 1 Full Season	1	LS	$ 15,000	$ 15,000			
d	DNAPL Pretreatment Foundation Expansion	2000	Sq.Ft.	$ 20	$ 40,000			
e	DNAPL Pretreatment Building Expansion	2000	Sq.Ft.	$ 55	$ 110,000			
f	Metals Pre-Treatment Foundation Expansion	1000	Sq.Ft.	$ 20	$ 20,000			
g	Metals Pre-Treatment Building Expansion	1000	Sq.Ft.	$ 55	$ 55,000			
h	Organics and Polishing Treatment Foundation Expansion	500	Sq.Ft.	$ 20	$ 10,000			
i	Organics and Polishing Treatment Building Expansion	500	Sq.Ft.	$ 55	$ 27,500			
j	Boiler Room, Electric, Control and Storage Foundation Expansion	1500	Sq.Ft.	$ 20	$ 30,000			
k	Boiler Room, Electric, Control and Storage Building Expansion	1500	Sq.Ft.	$ 55	$ 82,500			
5	**Silts and Sediment Pre-Treatment**					**$ 141,330**		3.70%
a	Sediment Equipment - Tanks and Pumps	1	LS	$ 96,968	$ 96,968		Includes Rental of Frac Tanks for 13 Months	
b	Sediment Instruments	1	LS	$ 4,140	$ 4,140		Estimate	
c	Sediment Instrumentation and Controls	1	LS	$ 10,000	$ 10,000		Estimate	
d	Sediment Mechanical Installation	1	LS	$ 5,055	$ 5,055		5% Equipment & Inst	
e	Sediment Electrical Installation	1	LS	$ 5,055	$ 5,055		5% Equipment & Inst	
f	Sediment Piping	1	LS	$ 10,111	$ 10,111		10% Equipment & Inst	
g	Sediment Insulation and Heat Trace	1	LS	$ 10,000	$ 10,000		Estimate	

Appendix D
Soil Excavation and Off-Site Disposal
Capital Cost Estimate

Project: SRSNE- Superfund Site
Southington CT.

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location	Percent of TOTAL Cost - Excluding O&M
6	**DNAPL Pretreatment**					**$ 415,301**		10.88%
a	DNAPL Pretreatment Equipment	1	LS	$ 199,272	$ 199,272		Assumed Same Costs as Hydraulic Displacement	
b	DNAPL Pretreatment Instruments	1	LS	$ 20,298	$ 20,298			
c	DNAPL Pretreatment Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000			
d	DNAPL Pretreatment Mechanical Installation	1	LS	$ 46,511	$ 46,511			
e	DNAPL Pretreatment Electrical Installation	1	LS	$ 49,011	$ 49,011			
f	DNAPL Pretreatment Piping	1	LS	$ 90,209	$ 90,209			
7	**NTCRA-1 GWTF Metals Treatment Improvements**					**$ 234,500**		6.14%
a	Replace Equalization Tank Mixer Motor, and non-XP wiring.	1	LS	$ 5,000	$ 5,000		Estimate	
b	Replace and Upgrade Iron Oxidation Tank, and Mixing Equipment including demolition and installation of a new larger tank.	1	LS	$ 25,000	$ 25,000		Estimate	
c	Provide Bulk Caustic Storage System and larger Caustic Feed Pumps	1	LS	$ 8,000	$ 8,000		Estimate	
d	Coagulant Feed Pumps, drum storage, and Secondary Containmnent	1	LS	$ 4,000	$ 4,000		Estimate	
e	Oxidant Feed Pumps, drum storage, and Secondary Containment	1	LS	$ 7,500	$ 7,500		Estimate - Use existing H2O2	
f	Parallel Inclinded Plate Clarifier, Flash Mix Flocculation Tank and Sludge Transfer Pumps	1	LS	$ 85,000	$ 85,000		Estimate	
g	Raised Catwalk for improved access and safety	1	LS	$ 30,000	$ 30,000		Estimate	
h	Sludge Hanlding Improvements (Prevent syphoning)	1	LS	$ 5,000	$ 5,000		Estimate	
i	Process Piping Replacement (S.S. or Equal)	1	LS	$ 50,000	$ 50,000		Estimate	
j	New Magnetic Flow Meters (NTCRA-1 Influent, NTCRA-2 Infl, and Clarifier Feed)	3	Ea	$ 5,000	$ 15,000		Estimate	
8	**NTCRA-1 Primary VOC Treatment System - Air Stripper, Oxidizer, Scrubber and appurtenanaces**					**$ 540,543**		14.16%
a	Primary VOC Treatment Equipment	1	LS	$ 375,230	$ 375,230		Assumed Same Costs as Hydraulic Displacement - Except Permanent Oxidizer/scrubber	
b	Primary VOC Treatment Instruments	1	LS	$ 11,845	$ 11,845			
c	Primary VOC Treatment Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000			
d	Primary VOC Treatment Mechanical Installation	1	LS	$ 41,936	$ 41,936			
e	Primary VOC Treatment Electrical Installation	1	LS	$ 32,764	$ 32,764			
f	Primary VOC Treatment Piping	1	LS	$ 28,768	$ 28,768			
g	Abandon Existing UV System	1	LS	$ 40,000	$ 40,000			
9	**NTCRA-1 Polishing VOC Treatment System - Photocatalytic System**					**$ 347,881**		9.11%
a	Polishing Equipment	1	LS	$ 287,500	$ 287,500		Assumed Same Costs as Hydraulic Displacement	
b	Polishing Instruments	1	LS	$ 5,750	$ 5,750			
c	Polishing Process Instrumentation and Controls	1	LS	$ 10,000	$ 10,000			
d	Polishing Mechanical Installation	1	LS	$ 4,765	$ 4,765			
e	Polishing Electrical Installation	1	LS	$ 32,674	$ 32,674			
f	Polishing Piping	1	LS	$ 7,192	$ 7,192			

Appendix D
Soil Excavation and Off-Site Disposal
Capital Cost Estimate

Project: SRSNE- Superfund Site
Southington CT.

Item	Description	Unit Quantity	Unit	Unit Cost	Total Cost	Subtotal	Cost Backup Location	Percent of TOTAL Cost - Excluding O&M
10	**Misc. NTCRA-1 GWTF Improvements**					**$ 304,000**		7.96%
a	Increase Existing Process Forward Flow Pump Capacity - XP Motors	6	LS	$ 2,500	$ 15,000		Estimate	
b	Upgrade Misc. Piping to SS or Equal - Allocation	1	LS	$ 50,000	$ 50,000		Estimate	
c	Increase Compressed Air System Capacity - Add Air Drying System	1	LS	$ 15,000	$ 15,000		Estimate	
d	New Extraction Well Transducer Controls	13	LS	$ 3,000	$ 39,000		Estimate	
e	Revise Electrical so meets XP, where required	1	LS	$ 50,000	$ 50,000		Estimate	
e	New Power Distribution and Relocated Control Panel - Electrical Work	1	LS	$ 60,000	$ 60,000		Estimate	
f	New Power Distribution and Relocated Control Panel - I&C Work	1	LS	$ 50,000	$ 50,000		Estimate	
g	SCADA Monitoring System	1	LS	$ 25,000	$ 25,000		Estimate	
11	**NTCRA 1 - Building Improvements**					**$ 385,000**		10.09%
a	New Boiler and Hydronic Heating System	1	LS	$ 200,000	$ 200,000		Estimate	
b	Process area Ventilation Systems	1	LS	$ 100,000	$ 100,000		Estimate	
c	Fire Suppression System Expansion	1	LS	$ 50,000	$ 50,000		Estimate	
d	Fire Detection System Expansion	1	LS	$ 25,000	$ 25,000		Estimate	
e	Security System Expansion	1	LS	$ 10,000	$ 10,000		Estimate	
III	**CONSTRUCTION MANAGEMENT AND ADMINISTRATION, and PERMITS**					**$ 327,562**	Estimate Only	8.58%
a	Construction Mangagement	1	5%	$ 151,708	$ 151,708		Estimate	
b	Construction Administration	1	2.5%	$ 75,854	$ 75,854		Estimate	
c	Permits - (Discharge, Air, and Construction)	1	LS	$ 50,000	$ 50,000		Estimate	
d	O&M Manual/SOP's	1	LS	$ 50,000	$ 50,000		Estimate	
					$ -			
					$ -			
IV	**DECOMMISSION - % OF CONST.**	**1**	**5%**	**$ 151,708**	**$ 151,708**	**$ 151,708**	Estimate Only	3.97%
	OVERALL DESIGN AND CONSTRUCTION TOTAL					**$ 3,816,839**		**100.00%**
V	**ESTIMATED O&M COST - 1 Year**					**$ 1,222,578**		
	GRAND TOTAL - CONSTRUCTION AND O&M					**$ 5,039,417**		

Major Assumptions

1 Assumed others providing costs for new Groundwater Extraction (well Point) costs.

2 Costs only consider NTCRA-1 GWTF Water Treatmnet system improvements

3 Costs do not consider soil excavation and disposal work.

Task	Units	Est. Qty.	Unit Cost	Total Cost	Assumptions
Vendor Inspections and Training				**$ 16,300**	**Vendor Costs included in equipment pricing**
Lead Operator - Labor	Hrs	80	$ 85.00	$ 6,800	Estimate
Project Engineer - Labor	Hrs	80	$ 100.00	$ 8,000	Estimate
Travel & Expenses	LS	1	$ 1,500.00	$ 1,500	Estimate
Whitewater Checkout				**$ 12,900**	**Estimate 1-week to complete**
Lead Operator - Labor	Hrs	40	$ 85.00	$ 3,400	40 Hours/week
Support Operator - Labor	Hrs	40	$ 75.00	$ 3,000	40 Hours/week
Project Engineer - Labor	Hrs	40	$ 100.00	$ 4,000	40 Hours/week
Travel & Expenses	LS	1	$ 2,500.00	$ 2,500	Estimate
Operations and Maintenance				**$ 739,258**	**Full time staff for first 7 days - 40 additional hours/week for remainder of 1 year period**
Health and Safety Plan	LS	1	$ 20,000.00	$ 20,000	Estimate
Lead Operator - Labor	Hrs	900	$ 85.00	$ 76,500	NTCRA-1 Lead Operator to 12 Hours/day for first 7 days, and 16 additional Hours/Week above existing NTCRA-1/2 O&M for remainder of year.
Support Operator 1 Labor	Hrs	900	$ 75.00	$ 67,500	12 Hours/day for first 7 days, 16 hours/week for remainder of O&M
Support Operator 2 - Labor	Hrs	492	$ 75.00	$ 36,900	12 Hours/day for first 7 days, 8 hours/week for remainder of O&M
Project Engineer - Labor	Hrs	520	$ 100.00	$ 52,000	10 Hours/week
Project Management/QA/Tech Support	Hrs	520	$ 125.00	$ 65,000	10 Hours/Week
O&M Travel & Expenses - 1-Year	day	365	$ 100.00	$ 36,500	Estimate
Electrical Power	KW	438,000	$ 0.11	$ 48,180	50 KW/Hr - Additional Demand over current system
Water	LS	0	$ 5,000.00	$ -	No Additional Charges
Natural Gas - (Therms = 100 Cu.Ft. = 100,000 BTU)	Therms	131,400.0	$ 0.75	$ 98,550	1,500,000 BTU/HR - Continuous
Caustic Soda	lb	525,600	$ 0.20	$ 105,120	2 times average NTCRA-1/2 usage, plus 50 lb/hr for HCL scrubber
Polymer	gal	18	$ 60.00	$ 1,104	Assume Double current usage
Sulfuric Acid	lb	18,480	$ 0.20	$ 3,696	Assume Double current usage
Hydrogen Peroxide	lb	10,520	$ 0.40	$ 4,208	Assume 20 mg/L dosed for Iron Oxidation
Coagulant Aid (Aluminum Chlorhydrate)	gal	900	$ 10.00	$ 9,000	30 mg/L dose
Recovery Well Development	day	0	$ -	$ -	No additional wells for this alternative
Preventive and Corrective Maintenance	LS	1	$ 50,000.00	$ 50,000	Estimate
Tools, Monitoring Equipment, Misc. Supplies and Expenses	LS	1	$ 40,000.00	$ 40,000	Estimate
Safety Supplies	LS	1	$ 25,000.00	$ 25,000	Assume Breathing air equipment maintained on-site for maintenance activities.

Project: SRSNE Superfund Site
Southington CT

Appendix D
Soil Excavation and Off-Site Disposal
Operations, Maintenance, and Monitoring Cost Estimate

Task	Units	Est. Qty.	Unit Cost	Total Cost	Assumptions
Disposal				**$ 390,700**	
DNAPL - Bulk Disposal	kg	200,000	$ 1.65	$ 330,000	Same Assumption as Hydraulic Displacement
PCB - Sludge Disposal - Drums	ea	78	$ 600.00	$ 46,800	DNAPL Sludge Disposal - Assume 1.5 drums/week
Non-PCB Sludge Disposal - Drums	ea	52	$ 200.00	$ 10,400	Assume Additional Metals Sludge Disposal - 1 drum/week
PPE Disposal - Drums PCB Contaminated	ea	10	$ 350.00	$ 3,500	Estimate
Analytical				**$ 37,500**	
DNAPL Sampling	ea	2	$ 2,000.00	$ 4,000	2 in 6-months
PCB - Sludge Sampling	ea	2	$ 2,000.00	$ 4,000	2 in 6-months
Non-PCB Sludge Sampling	ea	2	$ 2,000.00	$ 4,000	2 in 6-months
PPE Sampling	ea	2	$ 2,000.00	$ 4,000	2 in 6-months
Process Sampling	ea	1	$ 21,500.00	$ 21,500	Additional Analytical Sampling - Assume that additional sampling costs equal current permit sampling costs.
Reporting and Monitoring				**$ 25,920**	
Supplemental WTF Effort for Reporting	LS	1	$ 25,920.00	$ 25,920	Assume Reporting costs will double current reporting costs.
Final Water Treatment Completion Report	LS	1	$ -	$ -	Client to determine Scope and Associated Costs
Owner Representative Oversight and Project Coordination	LS	1	$ -	$ -	Client to determine Scope and Associated Costs
Grand Total				**$ 1,222,578**	

Appendix R

Quantitative Assessment of Groundwater Remedial Alternatives

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Appendix R - Quantitative Assessment of Groundwater Remedial Alternatives

R.1 General

This appendix presents a quantitative assessment of potential groundwater remedial alternatives and results of groundwater flow modeling performed by Blasland, Bouck & Lee, Inc. (BBL), in support of the Feasibility Study (FS) for the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. The existing regional groundwater flow model, which was developed for bedrock groundwater containment design as part of Non-Time Critical Removal Action No. 2 (NTCRA 2), was used to simulate potential groundwater remedial alternatives as presented in this appendix.

As described in the Remedial Investigation Report, the plumes of dissolved VOCs associated with the SRSNE site have resulted from the partial (and ongoing) dissolution of non-aqueous phase liquids (NAPLs) within the saturated overburden and bedrock formations. The NTCRA 2 ground water extraction wells were installed at a safe distance downgradient (southeast) of the interpreted NAPL zones in the overburden and bedrock to avoid remobilizing NAPL. NTCRA 2 has contained the flow of ground water migrating through the NAPL zones, allowing the downgradient portions of the plumes, beyond the NTCRA 2 capture zone, to attenuate below Federal Maximum Contaminant Levels (MCLs) and Connecticut (CT) Class GA Groundwater Protection Criteria. The current NTCRA 2 groundwater extraction system is equivalent to groundwater Remedial Alternative 3A.

A successful groundwater remedy would need to address, via hydraulic containment and/or natural attenuation, the ground water that exceeds regulatory criteria for volatile organic compounds (VOCs) related to the SRSNE Site. The portion of the plume that is not controlled by pumping would be allowed to naturally attenuate to meet ARARs within a reasonable time frame. The portion of the VOC plume downgradient of the NTCRA 2 capture zone has already attenuated to below drinking water standards. Thus, continued operation of NTCRA 2 can be considered a feasible remedy for dissolved phase VOCs in groundwater unless (and until) the Town of Southington reactivates Production Wells No. 4 and 6. At the request of the Connecticut Department of Environmental Protection (CT DEP), this appendix includes groundwater flow simulations to help identify a contingent remedial alternative to contain the groundwater VOCs related to the SRSNE Site in the event that Production Wells No. 4 and 6 are reactivated (Remedial Alternative 4). Attachments R-1 through R-5 present graphical results of the simulations discussed in this appendix.

R.2 Overview of MODFLOW Groundwater Flow Model

A regional MODFLOW (McDonald & Harbaugh, 1988) groundwater flow model was developed as described in the NTCRA 2 Design and Study Work Plan (DSWP; BBL, August 1996) to represent overburden and bedrock groundwater flow on a regional and site-specific scale, with model grid refinement in the vicinity of the SRSNE Site. The NTCRA 2 Interim Technical Memorandum (BBL, September 1997), which described the general setup and the preliminary results from the MODFLOW model, is presented in Attachment R-6 to this appendix.

The NTCRA 2 MODFLOW model domain encompasses a five-square-mile section of the regional Quinnipiac River drainage basin centered about the SRSNE Site. The model includes two overburden layers (outwash and till) and five bedrock layers. The total saturated thickness of the overburden ranges from zero feet at the edges of bedrock hills to approximately 130 feet near the southern end of the model. The total saturated thickness of the bedrock in the model is 600 feet.

The model domain extends outward to the locations of regional surface-water features (ponds, streams, and canals) where the shallow overburden hydraulic head is known. The regional scale of the MODFLOW model allows simulation of groundwater extraction by the existing Non-Time Critical Removal Action No. 1 (NTCRA 1) overburden groundwater extraction wells, potential groundwater containment alternatives, and Town of Southington's Production Wells No. 4 and/or 6 with little impact of the pumping stresses at model boundaries.

The measured horizontal hydraulic conductivity values for overburden Layers 1 and 2 within the Remedial Investigation (RI; BBL, June 1998) study area were contoured to create a smooth distribution within Layers 1 and 2, with hydraulic conductivity values ranging from <1 to >1,000 ft/day. The horizontal hydraulic conductivity of the bedrock in Layers 3 through 7, 0.35 ft/day, is the geometric mean value from packer-tests, slug-tests, and specific capacity tests at bedrock wells in the study area.

The vertical anisotropy factors (horizontal to vertical hydraulic conductivity ratio) for the bedrock was estimated as 200:1 based on specific capacity test results (BBL, June 1998). Based on the time-drawdown data obtained during the overburden pumping test (see Appendix A to this FS Report), BBL estimated that the horizontal to vertical anisotropy of the overburden in the Town Well Field is slightly less than 10:1. The ratio of 10:1 was assumed representative, and this change was made to the regional model prior to performing the simulations presented in this appendix. A horizontal anisotropy factor (ratio of north-south to east-west hydraulic conductivity) of 4:1 was estimated for the overburden layers based on drawdown ellipses observed during a specific capacity test and the overburden pumping test. Horizontal anisotropy for the bedrock was calculated as approximately 20:1 based on the regional, approximately 20°, eastward dip of the bedrock strata and associated bedding plane fractures using a technique presented by Anderson and Woessnor (1992). Horizontal anisotropy was found to be necessary to match simulated groundwater flow directions with the known shapes of the regulatory plumes in the overburden and bedrock, as determined during model calibration. The assumed anisotropy, however, increases the potential that simulated pumping from Town Production Wells No. 4 and 6 would predict groundwater flow from the SRSNE Site to either production well.

In the areas beyond the RI Study Area, the model geometry (outwash and till thickness, top of bedrock and surface water elevations, etc.) and hydraulic parameters were digitized based on numerous publications, which are cited in Section R.3 of this appendix.

The model was calibrated to potentiometric heads measured January 21, 1998 and all predictive simulations were run assuming steady-state ("long-term average") head and flow conditions. Model calibration results were discussed in the Interim Technical Memorandum (BBL, November 1997) and the NTCRA 2 Technical Memorandum (BBL, November 1998).

R.3 Summary of Simulations and Results

To evaluate groundwater remedial alternatives in this FS, several remedial scenarios were simulated using the regional NTCRA 2 MODFLOW model. The remainder of this appendix describes simulated remedial alternatives in term of groundwater containment effectiveness, estimated groundwater extraction rates by various hydraulic stress centers (e.g., remedial pumping wells, constructed wetlands, Town Production Wells), and VOC attenuation calculations, as appropriate.

R.3.1 Remedial Alternative 2A (Simulation No. R-1; See Attachment R-1)

VOC plume containment using a constructed wetland in the area north of the MW-704 cluster without the Town of Southington Production Wells operating

A constructed wetland option was originally considered for the overburden and bedrock groundwater units in an earlier stage of the FS process. The constructed wetland option was evaluated as a potential means to extract and treat groundwater within the VOC plume downgradient of the NTCRA 1 Containment Area. The constructed wetland was removed from consideration in the final FS because of potential complications in constructing a wetland in the proposed location (within a portion of the Quinnipiac River floodplain) and questions regarding hydraulic effectiveness in controlling the VOC plumes. The quantitative analysis of this alternative, described in this subsection, was retained to memorialize the groundwater hydraulics information that suggested this approach may not be feasible.

Because constructed treatment wetlands do not have a long history of proven success in terms of passive groundwater *containment* effectiveness (e.g., in comparison to pumping wells), the constructed wetland option was evaluated using two groundwater flow models to determine if natural flow would provide sufficient capture of the SRSNE plumes.

- Since vertical flow of ground water to a wetland would largely control its groundwater containment effectiveness, a Conceptual Wetland Model was developed using MODFLOW to support an earlier draft of the FS. The Conceptual Wetland Model contained seven overburden and eight bedrock layers to more accurately estimate the vertical extent of groundwater containment that may be achieved by a constructed wetland.

- The regional, NTCRA 2 MODFLOW model was used to assess the potential horizontal extent of groundwater containment, and accounts for the lateral heterogeneity of the overburden and the influence of the Quinnipiac River as a boundary within the shallow overburden. These results are discussed below.

Description of Model Setup: In Simulation R-1, a hypothetical constructed wetland was simulated in the northern portion of the Town Well Field Property using the regional, NTCRA 2 MODFLOW model. The simulated constructed wetland occupies an area of 1.6 acres along the northern boundary of the Connecticut Power and Light (CP&L) easement. The wetland was simulated using the MODFLOW drain package. The reference head of the drain was set at 0.1 feet above the modeled stage of the adjacent Quinnipiac River, or 145.3 feet. An average drain conductance was calculated and used in each wetland drain cell based on the average vertical hydraulic conductivity of the Layer 1 cells underlying the footprint of the wetland, and the average Layer 1 half-thickness between the node in each wetland cell and the base of the simulated wetland. Reverse-tracked particles were used to delineate groundwater flow lines collected by the wetland and depict the groundwater capture zone dimensions (See Attachment R-1)

Hydraulic Containment Effectiveness: The simulated wetland creates a substantial capture zone in the overburden and bedrock, covering most of the Operations Area and extending east of the Quinnipiac River (Attachment R-1). A similar capture zone was predicted for the shallow bedrock. However, the extent of capture downgradient of the wetland is limited, and does not contain overburden nor bedrock ground water at the MW-704 well cluster. Also, the simulated wetland creates a drawdown of approximately 1.6 feet at the NTCRA 1 sheet pile wall. In addition, the Conceptual Level Wetland Model presented in an earlier draft of the FS predicted no bedrock containment by the simulated wetland. The Conceptual Level Wetland model included seven overburden model layers to simulate the vertical extent of capture in detail, and is considered more reliable in estimating the vertical extent of groundwater capture associated with a wetland. Thus, it appears that a constructed wetland operating alone may not effectively contain the overburden and bedrock plumes.

Estimated Groundwater Extraction Rates: The simulated discharge rate of the wetland was 28 gpm, which is higher than the rate of 15.1 gpm predicted by the Conceptual Level Wetland Model. This discrepancy may explain, in part, why the regional model predicted a deeper capture zone than predicted by the Conceptual Level Wetland Model. The lower rate estimated by the Conceptual Level Wetland Model is considered more reliable, because it contains more model layers representing the overburden and, therefore, provides better resolution of vertical groundwater discharge to the simulated wetland.

R.3.2 Remedial Alternative 2B

VOC plume containment using a constructed wetland in the area north of the MW-704 cluster and pumping at another location further downgradient to potentially expedite the cleanup of the leading edge of the overburden and bedrock VOC plumes without the Town of Southington Production Wells operating.

The results of Simulation R-1 (described above) and the conceptual level wetland model indicated that a constructed wetland operating alone may not hydraulically contain the dissolved VOC plumes associated with the SRSNE Site in the overburden nor bedrock in the northern portion of the Town Well Field Property. Thus, simulation of Remedial Alternative 2B was not considered necessary. Without cutting off the SRSNE-related plume in the overburden and bedrock, dissolved VOCs would continue to migrate toward the downgradient pumping well from the northern portion of the Town Well Field Property for the foreseeable future; downgradient pumping would not expedite cleanup of the downgradient portion of the plume.

R.3.3 Remedial Alternative 3A (Simulation No. R-2; See Attachment R-2)

Overburden VOC plume containment by pumping in the vicinity of the MW-704 cluster without the Town of Southington Production Wells operating.

Description of Model Setup: In Simulation R-2, existing middle/deep overburden pumping well RW-13 is simulated as pumping 22.5 gpm, which was the pumping rate during an actual one-week, steady-state pumping test performed as part of the overburden investigation. (See Appendix A to this FS Report for a detailed discussion of the well RW-13 pumping test results). Simulation R-2 was performed for comparison with the actual pumping test results, which provide an empirical demonstration of the groundwater containment effectiveness of overburden groundwater extraction in the northern portion of the Town of Southington Well Field Property.

Hydraulic Containment Effectiveness: The empirical and simulated hydraulic containment effectiveness of Remedial Alternative 3A is shown on the hydraulic head contour maps and capture zone figures in Appendix A to this FS Report (Figures 7 through 11). Figure 12 in Appendix A also shows the empirical capture zone in cross section. These results demonstrate that well RW-13 operating at a rate of approximately 22.5 gpm is capable of hydraulically controlling the majority of the overburden and bedrock groundwater regulatory plumes. The actual capture zones extend downgradient (southward) into the CL&P easement, and encompass the Operations Area and the area immediately east of the Quinnipiac River. Only the portions of the plumes situated south of the CL&P easement are outside of the estimated capture zone established by well RW-13. Under Remedial Alternative 3A, the portions of the plumes south of the CL&P easement would be addressed via monitored natural attenuation.

Attachment R-2 presents output figures for this simulation. The model prediction of the overburden drawdown at the NTCRA 1 sheetpile wall, 0.2 feet, was similar to the results seen during the actual pumping test. However, the model slightly underestimated the magnitude of drawdown within the cone of depression, and the extent of groundwater containment, as observed during the actual RW-13 pumping test results. On this basis, the model is considered a reasonable, but conservative tool for use in predicting groundwater containment alternatives. This remedial alternative is considered feasible for containing the overburden and bedrock plumes under the scenario where Town Production Wells No. 4 and 6 are not re-activated.

<u>Groundwater Extraction Rates:</u> In this remedial alternative, the pumping test rate of 22.5 gpm was simulated at extraction well RW-13, which was estimated as its sustainable yield based on the results of pumping tests. RW-13 was activated as a component of the NTCRA 2 groundwater containment system in August 1998. Although its actual long-term operating rate (approximately 15 gpm) is lower than originally expected, the portion of the VOC plume beyond the CL&P power line easement has attenuated to below MCLs and CT Class GA Groundwater Protection Criteria, as discussed below.

<u>Fate of Downgradient Portion of Plume</u>: At the stagnation point of the NTCRA 2 capture zone, near the CL&P power line easement, the overburden and shallow bedrock VOC plumes were bifurcated. The downgradient portions of the overburden or bedrock plumes that were not within the capture zone of NTCRA 2 pumping wells RW-13 and RW-1R were allowed to continue to migrate as a "slug". Following the RI, only two monitoring wells south of the CL&P easement contained VOCs above MCLs or CT Class GA Groundwater Protection Criteria – middle overburden well MW-3 and shallow bedrock well MW-127C. Earlier drafts of the FS Report predicted that the VOCs at monitoring wells MW-127C and MW-3 would degrade to below these regulatory criteria within a few years following NTCRA 2 startup.

The NTCRA 2 system started pumping in August 1998. Consistent with previous estimates of severed VOC plume attenuation, the VOCs at monitoring wells MW-127C and MW-3 degraded to below regulatory criteria by May 1999 and October 2001, respectively. After these dates, monitoring wells MW-127C and MW-3 have met MCLs and CT Class GA Groundwater Protection Criteria during semiannual sampling event through October 2003 (10 sampling events and 5 sampling events, respectively). These findings indicate that the NTCRA 2 system has effectively cut off the VOC plume and allowed the severed portion of the plume to attenuate. Appendix L to this FS presents the most recent available groundwater quality data produced by the Interim Monitoring and Sampling program.

Table R-1 summarizes the estimated time required for the downgradient portion of the overburden and bedrock VOC plumes to attenuate to the proposed Preliminary Remediation Goals (PRGs) listed in FS Table 2-4. The PRGs are more stringent than MCLs or CT Class GA Groundwater Protection Criteria in that the PRGs are background concentrations. For VOCs, the PRGs are equivalent to the detection level obtained by Method 10/92 - Low Concentration Organics in Water.

Table R-1 lists the maximum value of the compounds that were detected above PRGs in the area downgradient of the well RW-13 capture zone (i.e., outside of the NTCRA 2 capture zone). Compounds are not listed if a more recent sampling event at the same well indicated that the concentration had degraded to below the PRG. Based on the mean published degradation half lives, the time for individual VOCs to degrade to PRGs ranged from approximately 1.2 years for acetone to 10 years for 1,4-dioxane. Table R-1 also lists estimated VOC concentrations at 5-year time increments following the specified sampling dates. Attachment R-2 includes a travel-time analysis from the approximate stagnation point location of the NTCRA 2 system to the downgradient discharge point at the Quinnipiac River, with an estimated travel time of 22 years. Thus, it appears that the severed plume outside of the NTCRA 2 capture zone would likely degrade before completely flushing to the river via groundwater flow. CT DEP RSRs provide for an exemption from the requirement to restore ground water to background quality if remediation has proceeded to the point where Groundwater Protection Criteria have been satisfied, and achieving background levels is deemed technically impracticable.

The estimated natural attenuation time frames discussed above do not account for other natural attenuation factors processes recognized by the United States Environmental Protection Agency (USEPA) as components of natural attenuation, including dispersion, dilution, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants (USEPA, OSWER Directive 9200.4-17, November 1997). Thus, these time frames provide a conservative basis to assess potential attenuation rates for the downgradient portions of the overburden and bedrock plumes. Actual attenuation time frames are expected to be shorter than those estimated herein.

R.3.4 Remedial Alternative 3B

Overburden VOC plume containment by pumping in the vicinity of the MW-704 cluster and at another location further downgradient to potentially expedite the cleanup of the leading edge of the overburden VOC plume without the Town of Southington Production Wells operating.

As discussed above, the NTCRA 2 system has effectively cut off the VOC plume; the downgradient portion of the plume beyond the NTCRA 2 capture zone has attenuated to below MCLs and CT Class GA Groundwater Protection Criteria. Thus, although previous drafts of the FS report included simulation of Remedial Alternative 3B, it was not considered necessary for the Final FS Report.

R.3.5 Remedial Alternative 4 and Supplemental Simulations with Town of Southington Production Wells No. 4 and/or 6 Operating (Simulations No. R-3, R-4 and R-5)

VOC plume containment using groundwater extraction wells, as necessary, with Town of Southington Production Wells No. 4 and 6 operating at their registered capacities (740 and 1,150 gpm, respectively).

Remedial Alternative 4 is a contingent remedy that would apply in the event that the Town of Southington reactivates Production Wells No. 4 and 6. As requested by CT DEP, this Remedial Alternative was evaluated under the conservative assumption that both production wells could operate concurrently at their registered capacities of 740 and 1,150 gpm, or a combined rate of 1,890 gpm. According to the Town of Southington Water Department's records, this condition apparently has never occurred. Production Wells No. 4 and 6 are approximately 1,800 and 1,400 feet south of the former SRSNE Operations Area, respectively.

<u>Description of Model Setup</u>: To identify a potential contingency measure to cut off the SRSNE-related VOC plume between the site and Production Wells No. 4 and 6, BBL performed additional MODFLOW simulations. In addition, comparative simulations were performed to: 1) evaluate the influence of the existing NTCRA 2 system in the event of production well reactivation; and 2) calculate groundwater travel times to the production wells to support screening level calculations of potential VOC concentrations at the production wells.

Three simulations were performed, as listed below. In each of these model runs, Production Wells No. 4 and 6 were simulated as operating at their registered capacities of 740 and 1,150 gpm, or a combined rate of 1,890 gpm, in steady state:

- Simulation R-3: NTCRA 2 extraction wells RW-13 and RW-1R operating at their representative sustainable rates of 15 gpm and 0.25 gpm, respectively – this simulation illustrated that effect of the existing NTCRA 2 system in containing the SRSNE-related VOC plume;

- Simulation R-4 (Groundwater Remedial Alternative 4): 4 groundwater extraction wells with a combined rate of 55 gpm to cut off the SRSNE-related VOC plume – in this simulation, NTCRA 2 pumping well RW-13 and RW-1R was excluded because they did not improve the overall plume containment capability provided by the other simulated extraction wells; and

- Simulation R-5: no extraction wells to cut off the SRSNE-related VOC plume – this simulation was performed to calculate the groundwater travel times from overburden monitoring wells with elevated concentrations to the production wells.

For each of these simulations, BBL inserted simulated groundwater particle pathlines every 100 feet along a "flux cross section" drawn across the footprint of the potential SRSNE-related VOC plume. The simulated particles were tracked forward and, for the portions of the cross section from which particles migrated to Production Well No. 6, the flux was calculated through the cross section. The results for Model Layers 1 and 2 were used to estimate the total combined flow rate to Production Well 6 from the overburden portion of the potential SRSNE VOC plume. The results from Model Layers 3 through 5 were used to estimate the total combined flow rate to Production Well 6 from the portion of the potential SRSNE VOC plume within the top 100 feet of bedrock. A similar flux cross section was inserted into the model at the location of the Ideal Forging Site, which is situated approximately 600 and 1,200 feet south Production Wells No. 4 and 6, respectively.

Particle tracking was also performed from the locations of monitoring wells with elevated VOC concentrations related to the SRSNE site and the Ideal Forging site to support screening-level calculations of the potential concentrations of VOCs at the production wells.

Hydraulic Containment Effectiveness: The results of Simulation R-3, presented in Attachment R-3, show that the existing NTCRA 2 extraction system (in its current configuration) would be relatively ineffective at containing the portion of the SRSNE-related VOC plume beyond the NTCRA 1 sheet-pile wall in the event that the Town of Southington Production wells are reactivated at their full registered capacity. The total groundwater flow rates to Production Well 6 through the overburden and bedrock portions of the flux cross section were calculated as approximately 44.7 gpm and 2.4 gpm, respectively (Attachment R-3).

Simulation R-4 evaluated Groundwater Remedial Alternative 4. As shown in Attachment R-4, the model predicted the that SRSNE-related VOC plume can be contained by pumping from 4 new overburden extraction wells in the area downgradient of the site. Existing extraction wells RW-13 and RW-1R were not necessary to achieve plume containment under this scenario. Attachment R-4 also includes particle tracking results illustrating that the groundwater containment system considered in Simulation R-4 cuts off flow lines from key monitoring wells with elevated VOC concentrations situated near the SRSNE Site. The total combined pumping rate of the containment wells in Simulations R-4 was approximately 55 gpm. Thus, Simulation R-4 suggests that Groundwater Remedial Alternative 4 is feasible from a plume containment standpoint, and can be implemented using readily available technologies.

The results of Simulation R-5, which are presented in Attachment R-5, evaluated the groundwater flux and travel times to the production wells under the hypothetical scenario where Production Wells No. 4 and 6 are reactivated in the absence of a groundwater containment system for the SRSNE VOC plume. This simulation provides an assessment of the potential for the SRSNE-related VOC plume to impact Production Well No. 6 based on conservative assumptions regarding potential pumped VOC concentrations (erring toward higher VOC concentration estimates). The total groundwater flow rates through the overburden and bedrock portions of the flux cross section to Production Well 6 were calculated as approximately 42.2 gpm and 3.0 gpm, respectively (Attachment R-5). Travel times for SRSNE monitoring wells with elevated VOC concentrations outside of the NTCRA 1 capture zone are illustrated in Attachment R-5 and discussed further below. The total overburden groundwater flow rate to Production Well No. 4 through the flux cross section at the Ideal Forging site was estimated as approximately 124 gpm (56 gpm in the top 56 feet, and 69 gpm in the bottom 36 feet of the saturated overburden). The minimum travel time between the Ideal Forging Site and Production Well No. 4 in Simulation R-5 was 139 days, calculated for a particle pathline that originates in the middle of the flux section near the former Ideal Forging dry well.

Simulation R-5 predicted approximately half of the combined pumping rate (1,890 gpm) from Production Wells No. 4 and 6 would be drawn from surface-water features near the production wells, principally the Quinnipiac River.

Estimated Groundwater Extraction Rates: The extraction rates in Simulation R-3 were 15 gpm at overburden well RW-13 and 0.25 gpm at bedrock well RW-1R.

The estimated groundwater extraction rates from the 5 extraction wells simulated to contain the SRSNE-related VOC plumes in the overburden and bedrock north of the CL&P easement in Simulation R-4 were 3.9 (#1), 8.0 (#2), 11.0 (#3) , and 32.4 (#4) gpm, with a total combined pumping rate of 55 gpm.

The simulated pumping rates at Production Wells No. 4 and 6 were 740 and 1,150 gpm, respectively, in Simulations R-3, R-4, and R-5.

Fate of SRSNE-Related VOC Plume: The results of Simulation R-3 indicate that, if Production Wells No. 4 and 6 were activated at their registered capacities in steady state with NTCRA 2 operating, approximately 47.1 gpm of the 1,150 gpm (4%) pumped by Production Well No. 6 would be "pulled past" the NTCRA 2 capture zone within the area of the SRSNE-related VOC plume (Attachment R-3). The NTCRA 2 system was predicted to be relatively ineffective at containing the SRSNE-related VOC plume. The flow contribution from the SRSNE-related bedrock VOC plume represents only 2.4 gpm, or 0.2% of the simulated flow to Production Well No. 6.

The results of Simulation R-4 (Groundwater Remedial Alternative 4) indicated that the SRSNE-related VOC plume can be cut off using 5 groundwater extraction wells at a combined pumping rate of 56 gpm (Attachment R-4). Thus, under this remedial alternative, the total steady-state groundwater flow to Production Well No. 6 from the SRSNE-related plume would be negligible.

Simulation R-5 was performed to support screening-level calculations regarding the potential fate of the overburden VOCs related to the SRSNE Site (Attachment R-5). This simulation assumed no groundwater extraction for plume containment. Groundwater travel times were calculated from the locations of key overburden monitoring wells to the production wells. The results of Simulation R-5 indicated that, if Production Wells No. 4 and 6 were activated at their registered capacities in steady state, approximately 44.2 gpm of the 1,150 gpm (3.8%) pumped by Production Well No. 6 would be "pulled through" the SRSNE-related overburden VOC plume. The flow contribution from the SRSNE-related bedrock VOC plume represents only 3.0 gpm, or 0.26% of the simulated flow to Production Well No. 6. The bedrock groundwater flow is considered negligible compared to the potential overburden flow contribution to Production Well No. 6. The overburden pathway was evaluated further to assess the potential "endpoint" VOC concentrations (before dilution via pumping) and also the pumped VOC concentrations that may occur in steady state at Production Well No. 6.

Table R-2 summarizes the fate of VOCs tracked forward from overburden monitoring wells MW-502 and P-101B, and MW-121B. Monitoring well MW-502 has the highest concentrations of VOCs outside of the interpreted NTCRA 1 capture zone, and the VOC concentrations at well MW-502 have remained consistently high throughout 6 years of semiannual sampling as part of the Interim Monitoring and Sampling program. Wells P-101B and MW-121B have relatively high concentrations of benzene at locations further from the SRSNE Operations Area, and were also considered in this evaluation. Other monitoring wells with elevated VOC concentrations in the Operations Area or immediately outside of the NTCRA 1 sheet pile wall were also evaluated by particle tracking, but found to be within the simulated NTCRA 1 capture zone based on Simulation R-5 results (Attachment R-5). The VOCs considered in this evaluation were reported above MCLs and/or CT Class GA Groundwater Protection Criteria during the most recent sampling events at these wells (in October 2003). Although elevated concentrations of VOCs exist at these wells, the calculations summarized in Table R-2 indicate that retardation and degradation processes would render the endpoint VOC concentrations near or below MCLs and/or CT Class GA Groundwater Protection Criteria upon arrival at Production Well No. 6. Also, it is important to note that the water that may migrate to Production Well No. 6 from the overburden within the SRSNE-related plume in Simulation R-5 amounts to a maximum of only 3.8% of the registered capacity of Production Well No. 6. Thus, in the absence of any other VOC sources, the calculations suggest that the water pumped by Production Well No. 6 would be below MCLs and/or CT Class GA Groundwater Protection Criteria for all VOCs.

These screening-level calculations suggest that, even without a downgradient contingency remedy to contain the SRSNE-related VOC plume, it is unlikely that the SRSNE plume would adversely impact the use and value of the groundwater that would be pumped from Production Well No. 6, operating at its full registered capacity of 1,150 gpm. It is important to note that the Town of Southington would still need to implement wellhead treatment relative to the production wells to render the pumped water potable; because other VOC sources (notably including the Ideal Forging Site) have been documented in closer proximity to the production wells (BBL, June 1998).

Fate of Ideal Forging-Related VOC Plume: The same screening-level calculation process described above was used to evaluate the fate of the VOCs within the plume downgradient of the Ideal Forging Site, which is situated 600 feet southeast of Town of Southington Production Well No. 4. VOC plume maps included in the Final RI Report showed an interpreted VOC plume extending northwestward from the Ideal Forging property (BBL, June 1998). The Ideal Forging VOC plume depicted in the RI was interpreted based on groundwater samples obtained at the Ideal Forging property by Clarence Welti and Associates (CWA, July 1981; October 1981), and groundwater sampling results obtained between the Ideal Forging property and the Quinnipiac River by BBL in 1996. More recent groundwater analytical results for the Ideal Forging Property were reported in a document titled *Groundwater/Non-Aqueous Phase Liquid (NAPL) Extraction Workplan* (Retec, May 2002). Specifically, groundwater samples obtained in October 1999 indicated similar constituents and concentrations as previously reported at the Ideal Forging Property by CWA, including up to: 46,000 ug/L of PCE; 1,000 ug/L of TCE; 7,800 ug/L of cis-1,2-DCE; 12,000 ug/L of 1,1,1-TCA; 1,000 ug/L of 1,1-DCA; and other VOCs. The wells where these concentrations were detected are situated near a former dry well. In addition, Retec used UV fluorescence to assist in identifying NAPL in soil samples, and interpreted that NAPL was present in soil near the former dry well. This information, combined with the elevated VOC concentrations in groundwater, indicates a significant continuing VOC source at the Ideal Forging Site. The dry well was located near the inside bend in the outline of the former Ideal Forging Building. The Ideal Forging Company has filed for bankruptcy. The current status of further investigation and/or remediation of the Ideal Forging Site is unknown.

Table R-3 summarizes the estimated fate of VOCs tracked forward from the Ideal Forging Site to Production Well No. 4. The five VOCs considered in this evaluation were reported above 1,000 ug/L based on the most recent available data (October 1999 sampling results; Retec, May 2002). As summarized on Table R-3, degradation would reduce the VOC concentrations between the Ideal Forging Site and Production Well No. 4. The endpoint VOC concentrations, however, may be significantly above MCLs and/or CT Class GA Groundwater Protection Criteria upon arrival at Production Well No. 4. The water that may migrate to Production Well No. 4 from the overburden within the Ideal Forging-related VOC plume amounts to a maximum of 17% of the registered capacity of Production Well No. 4. Following dilution, however, the estimated maximum pumped concentrations are still predicted to be above regulatory standards. Production Well No. 4 historically operated from 1966 through 1977 at a long-term average rate of 385 gpm. A groundwater sample obtained from Production Well No.4 in early 1980, over two years after water-supply pumping was discontinued, contained the five analytes listed in Table R-3 at concentrations up to 150 ug/L (USEPA, April 1980).

Another simulation was performed to evaluate the potential for groundwater flow from the Ideal Forging Site to Production Well No. 6. Following the shut-down of Production Well No. 4 in 1977, Production Well No. 6 operated from 1978 to early 1980 at a long-term average rate of 100 gpm. Attachment R-5 includes a particle tracking simulation with Production Well No. 4 inactive and Production Well No. 6 operating at 100 gpm. The particle tracking results suggest that the majority of the overburden groundwater within the Ideal Forging plume would discharge at Production Well No. 6 rather than the Quinnipiac River. The calculated groundwater travel times to Production Well No. 6 were 0.3 years from the area beneath the Quinnipiac River, 1 year from the location of Production Well No. 4, and 2 years from the Ideal Forging Site. The only compounds reported at Production Well No. 6 in early 1980 were 1,1-dichloroethane, 1,1,1-trichloroethane, and trichloroethene. These are three of the five compounds that were also detected at Production Well No. 4 during the same sampling event (USEPA, April 1980) and in groundwater at the Ideal Forging Site at concentrations above 1,000 ug/L (Retec, May 2002).

<u>Implications of Drawdown Associated with Remedial Alternative 4:</u> The results of Simulation R-4 (Groundwater Remedial Alternative 4) indicated that the SRSNE-related VOC plume can be hydraulically controlled by a system of 5 extraction wells operating at a combined rate of 56 gpm. However, the total combined drawdown produced by this system and the Town of Southington Production Wells No. 4 and 6 was predicted to be approximately 2 feet immediately outside the NTCRA 1 sheetpile wall. This situation could create an outward hydraulic gradient across some of the NTCRA 1 sheet-pile wall. The NTCRA 1 compliance criteria, which require an inward hydraulic gradient across the sheet-pile wall, will no longer apply following the issuance of the ROD. If outward leakage occurs through the sheet-piling as a result of reactivating the production wells, it is likely to be at a low rate due to the low permeability of the sheet piling. Assuming the drawdown caused by the production wells creates an *outward* hydraulic gradient with an average head difference of 1 foot at the sheetpile wall, given a sheet-piling permeability of approximately 1E-7 cm/sec, sheet-pile length of approximately 700 ft, 25 ft average saturated thickness, and wall thickness 0.375 inches, the total flow through the wall is estimated as approximately 0.8 gpm. This rate of leakage is considered negligible, and it would be readily contained by groundwater extraction and/or natural attenuation further downgradient.

The Simulation R-4 results predicted little drawdown in the overburden within the NTCRA 1 sheet-pile wall, but over three feet within the shallow bedrock in the same area. It is presumed that a remedial measure of some type would be appropriate to mitigate the risk of downward NAPL remobilization from overburden to bedrock. Several remedial alternatives are currently being evaluated in the FS to address potentially mobilizable (pooled) NAPL within the Observed NAPL in Overburden Groundwater Unit, which encompasses most of the former Operations Area and a small portion of the NTCRA 1 Containment Area. Following implementation of a remedy to address pooled NAPL in this area, Production Well No. 4 or 6 could be reactivated without significant risk of adverse NAPL remobilization at the SRSNE Site. Wellhead treatment would still be need to render the pumped water potable due to the presence of other VOC sources in closer proximity to the production wells (BBL, June 1998).

Consistent with NCP requirements, a No Action alternative is also being considered for the Observed NAPL in Overburden Groundwater Unit. In the event that the No Action alternative is selected for the Observed NAPL in Overburden Groundwater Unit and the Town of Southington elects to reactivate Production Well No. 4 or 6, contingency measures prior to reactivation may entail implementing a voluntary remedy to remove pooled NAPL in the overburden at the SRSNE Site, and installing an enhanced groundwater extraction system to cut off the SRSNE-related VOC plume downgradient of the site. These actions would be implemented within the same timeframe during which the town designs and constructs a wellhead treatment system for the production well(s).

<u>Groundwater Flow Directions and Travel Times from other VOC Sources:</u> A final simulation was performed to evaluate groundwater flow directions and travel times to discharge points from the SRSNE Site and 10 other known or suspected VOC source areas in the region surrounding Production Wells No. 4 and 6 (Attachment R-5). The known or potential VOC sources included in this simulation were discussed in the Final RI Report (BBL, June 1998). In this simulation, Production Wells No. 4 and 6 were simulated as running at their registered capacities and the NTCRA 1 containment system was simulated as operating. The simulation results indicate that groundwater from several of these areas would migrate to Production Well No. 4 or 6.

R.3.6 Overburden VOC Plume Containment

Overburden VOC plume containment using a constructed wetland north of the MW-704 cluster and overburden groundwater extraction wells, as necessary, with the Town of Southington Production Wells operating at their full registered capacities.

Given the results of Simulation R-1 described above, which indicated that a constructed wetland operating alone would not hydraulically contain the dissolved VOC plumes associated with the SRSNE Site in the overburden nor bedrock in the northern portion of the Town Well Field Property, this simulation was not considered necessary.

R.4 References

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Tables

TABLE R-1

SRSNE SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

TIME REQUIRED FOR SEVERED VOC PLUME (OUTSIDE OF NTCRA 2 CAPTURE ZONE) TO DEGRADE TO PRELIMINARY REMEDIATION GOALS (BACKGROUND)

Compound	**Degradation Half Life (days)**				**PRG**	**Maximum Initial "Slug"**			**Time to Degrade to PRG**		**Estimated Concentrations at Various Times Indicated Sampling Dates (Years)**			
	Low	**High**	**Mean**	**Ref.**	**(ug/L)**	**Conc (ug/L)**	**Well**	**Date**	**(# Half-Lives)**	**Years (Mean)**	**5**	**10**	**15**	**20**
1,1,1-trichloroethane	73	730	402	b	1	20	MW-127C	10/22/03	4.3	4.8	0.9	0.0	0.0	0.0
1,1-dichloroethane	490	650	570	d	1	8.1	MW-127C	10/22/03	3.0	4.7	0.9	0.1	0.0	0.0
1,1-dichloroethene	10	2100	1055	a	1	2.9	MW-127C	10/22/03	1.5	4.4	0.9	0.3	0.1	0.0
acetone	15	150	83	c	5	190	P-15	12/4/96	5.2	1.2	0.0	0.0	0.0	0.0
cis-1,2-dichloroethene	10	2100	1055	a	1	6.6	MW-127C	10/22/03	2.7	7.9	2.0	0.6	0.2	0.1
tetrahydrofuran	183	1460	821	e	1	5 U	MW-3	10/21/03	2.3	5.2	1.1	0.2	0.0	0.0
trichloroethene	70	700	385	a	1	3	P-15	12/04/96	1.6	1.7	0.1	0.0	0.0	0.0
1,4-dioxane	365	1825	1095	e	2	22	MW-205B	04/04/04	3.5	10.4	6.9	2.2	0.7	0.2

Notes:

1) "Mean" half life is the average of the low and high ends of the range. Half-life references:
   a. Newell, C.J. , Rifai, H.S, Wilson, J.T., Connor, J.A., Aziz, J.A., and M.P. Saurez. 2002. Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies. EPA 540-S-02/500.
   b. Remediation Technology Development Forum. 2002. RTDF Teaching Practice Manual.
   c. Keith, N.G., et al. 2003. Design, Construction and operation of a sulfate biobarrier to treat chlorinated and non-chlorinated VOCs. In V.S. Magar and M.E. Kelley (Eds)., Proceedings of the Seventh International In Situ and On Site Bioremediation Symposium (Orland FL June 2003). Paper K-07 (with sulfate present in groundwater)
   d. Ravi, V., Chen, J. S., Wilson, J. T., Johnson, J. A., Gierke, W., and L. Murdie. 1998. Evaluation of Natural Attenuation of Benzene and Dichlorethanes at the KL Landfill. Bioremediation Jour., 2(3&4):239-258.
   e. Sock, S. M. 1993. A comprehensice evaluation of biodegradtion as a treatment alternative for the removal of 1,4-dioxane. MS Thesis. Clemson University.
2) Tetrahydrofuran not detected outside NTCRA 2 capture zone during last sampling using modified Method 8260B. Calculations performed for detection-level concentration.
3) PRG = Preliminary Remedial Goal, listed in FS Table 2-5.

TABLE R-2

SRSNE SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SOLUTE DEGRADATION DOWNGRADIENT OF THE SRSNE SITE AND PROJECTED MAXIMUM SRSNE-RELATED VOC CONCENTRATION AT PRODUCTION WELL NO. 6

OVERBURDEN WELL MW-502

Compound	R	Degradation Half Life (days)				GW Reg. Criteria		Starting Conc. (ug/L)	GW Trav. Time (Years)	Compound Travel Time (Years)	# of Half Lives (Mean)	Endpoint Conc. (ug/L)	Minimum Dilution Factor	Maximum Pumped Conc. (ug/L)
		Low	High	Mean	Ref.	CT DEP 1/96	EPA MCL 10/96							
2-butanone	1.11	30	150	90	b	400	NA	12,000	8.6	9.5	38.5	0.0	26	0.0
4-methyl-2-pentanone	1.61	30	150	90	b	350	NA	2,500	8.6	13.8	55.8	0.0	26	0.0
acetone	1.01	30	150	90	b	700	NA	12,000	8.6	8.6	35.0	0.0	26	0.0
benzene	2.65	70	700	385	a	1	5	160	8.6	22.7	21.5	0.0	26	0.0
xylenes	7.07	70	700	385	a	530	10,000	1,410	8.6	60.5	57.3	0.0	26	0.0

OVERBURDEN WELL P-101B

Compound	R	Degradation Half Life (days)				GW Reg. Criteria		Starting Conc. (ug/L)	GW Trav. Time (Years)	Compound Travel Time (Years)	# of Half Lives (Mean)	Endpoint Conc. (ug/L)	Minimum Dilution Factor	Maximum Pumped Conc. (ug/L)
		Low	High	Mean	Ref.	CT DEP 1/96	EPA MCL 10/96							
benzene	2.65	70	700	385	a	1	5	24	5.2	13.6	12.9	0.0	26	0.0

OVERBURDEN WELL MW-121B

Compound	R	Degradation Half Life (days)				GW Reg. Criteria		Starting Conc. (ug/L)	GW Trav. Time (Years)	Compound Travel Time (Years)	# of Half Lives (Mean)	Endpoint Conc. (ug/L)	Minimum Dilution Factor	Maximum Pumped Conc. (ug/L)
		Low	High	Mean	Ref.	CT DEP 1/96	EPA MCL 10/96							
benzene	2.65	70	700	385	a	1	5	52	1.7	4.5	4.3	2.7	26	0.1

Notes:

1) R = retardation factor. Retardation numbers calculated by BBL (June 1998; Table 10).
2) Starting concentrations based on latest sampling results at listed wells (MW-502 and P-101B, October 2003; MW-121B, June 2003).
3) "Mean" half life is the average of the low and high ends of the range. Half-life references:
   a. Newell, C.J. Et al. 2002. Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies. EPA 540-S-02/500.
   b. Keith, N.G., and others. 2003. Design, Construction and operation of a sulfate biobarrier to treat chlorinated and non-chlorinated VOCs. In V.S. Magar and M.E. Kelley (Eds)., Proceedings of the Seventh International In Situ and On Site Bioremediation Symposium (Orland FL June 2003). Paper K-07 (with sulfate present in groundwater)
4) Minimum Dilution Factor = (Prod. Well No. 6 Capacity of 1,150 gpm) / (Est. Flow of 44.7 gpm through SRSNE-Overburden Plume, from Simulation R-5) = 26. This dilution factor is considered a minimum because only a fraction of flow through the plume originates at the specified starting concentration.
5) Maximum pumped concentration = Endpoint Concentration / Minimum Dilution Factor.

TABLE R-3

SRSNE SITE
SOUTHINGTON, CONNECTICUT
FEASIBILITY STUDY

SOLUTE DEGRADATION DOWNGRADIENT OF THE IDEAL FORGING SITE AND PROJECTED MAXIMUM IDEAL FORGING-RELATED VOC CONCENTRATION AT PRODUCTION WELL NO. 4

OVERBURDEN WELL MWC-405A

Compound	R	Degradation Half Life (days)				GW Reg. Criteria		Starting Conc. (ug/L)	GW Trav. Time (Years)	Compound Travel Time (Years)	# of Half Lives (Mean)	Endpoint Conc. (ug/L)	Minimum Dilution Factor	Maximum Pumped Conc. (ug/L)
		Low	High	Mean	Ref.	CT DEP 1/96	EPA MCL 10/96							
1,1-DCA	1.76	490	650	570	c	70	NA	1,000	0.38	0.67	0.4	743	6	124
cis-1,2-DCE	1.81	10	2100	1055	a	70	70	7,800	0.38	0.69	0.2	6612	6	1102
1,1,1-TCA	4.82	73	730	402	b	200	200	12,000	0.38	1.84	1.7	3775	6	629

OVERBURDEN WELL ASC-409B

Compound	R	Degradation Half Life (days)				GW Reg. Criteria		Starting Conc. (ug/L)	GW Trav. Time (Years)	Compound Travel Time (Years)	# of Half Lives (Mean)	Endpoint Conc. (ug/L)	Minimum Dilution Factor	Maximum Pumped Conc. (ug/L)
		Low	High	Mean	Ref.	CT DEP 1/96	EPA MCL 10/96							
PCE	10.21	58	365	212	b	5	5	46,000	0.38	3.89	6.7	440	6	73
TCE	4.19	70	700	385	a	5	5	1,000	0.38	1.60	1.5	351	6	58

OVERBURDEN WELL MW-409C

Compound	R	Degradation Half Life (days)				GW Reg. Criteria		Starting Conc. (ug/L)	GW Trav. Time (Years)	Compound Travel Time (Years)	# of Half Lives (Mean)	Endpoint Conc. (ug/L)	Minimum Dilution Factor	Maximum Pumped Conc. (ug/L)
		Low	High	Mean	Ref.	CT DEP 1/96	EPA MCL 10/96							
PCE	10.21	58	365	212	b	5	5	2,900	0.38	3.89	6.7	28	6	5

OVERBURDEN WELL MW-307A

Compound	R	Degradation Half Life (days)				GW Reg. Criteria		Starting Conc. (ug/L)	GW Trav. Time (Years)	Compound Travel Time (Years)	# of Half Lives (Mean)	Endpoint Conc. (ug/L)	Minimum Dilution Factor	Maximum Pumped Conc. (ug/L)
		Low	High	Mean	Ref.	CT DEP 1/96	EPA MCL 10/96							
cis-1,2-DCE	1.81	10	2100	1055	a	70	70	19,000	0.38	0.69	0.2	16106	6	2684

Notes:

1) R = retardation factor. Retardation numbers calculated by BBL (June 1998; Table 10).

2) Starting concentrations based on latest sampling results at listed wells (October 1999; Retec, 2002).

3) "Mean" half life is the average of the low and high ends of the range. Half-life references:

a. Newell, C.J. Et al. 2002. Calculation and Use of First Order Rate Constants for Monitored Natural Attenuation Studies. EPA 540-S-02/500.

b. Remediation Technology Development Forum. 2002. RTDF Teaching Practice Manual.

c. Ravi, V., Chen, J. S., Wilson, J. T., Johnson, J. A., Gierke, W., and L. Murdie. 1998. Evaluation of Natural Attenuation of Benzene and Dichlorethanes at the KL Landfill. Bioremediation Jour., 2(3&4):239-258.

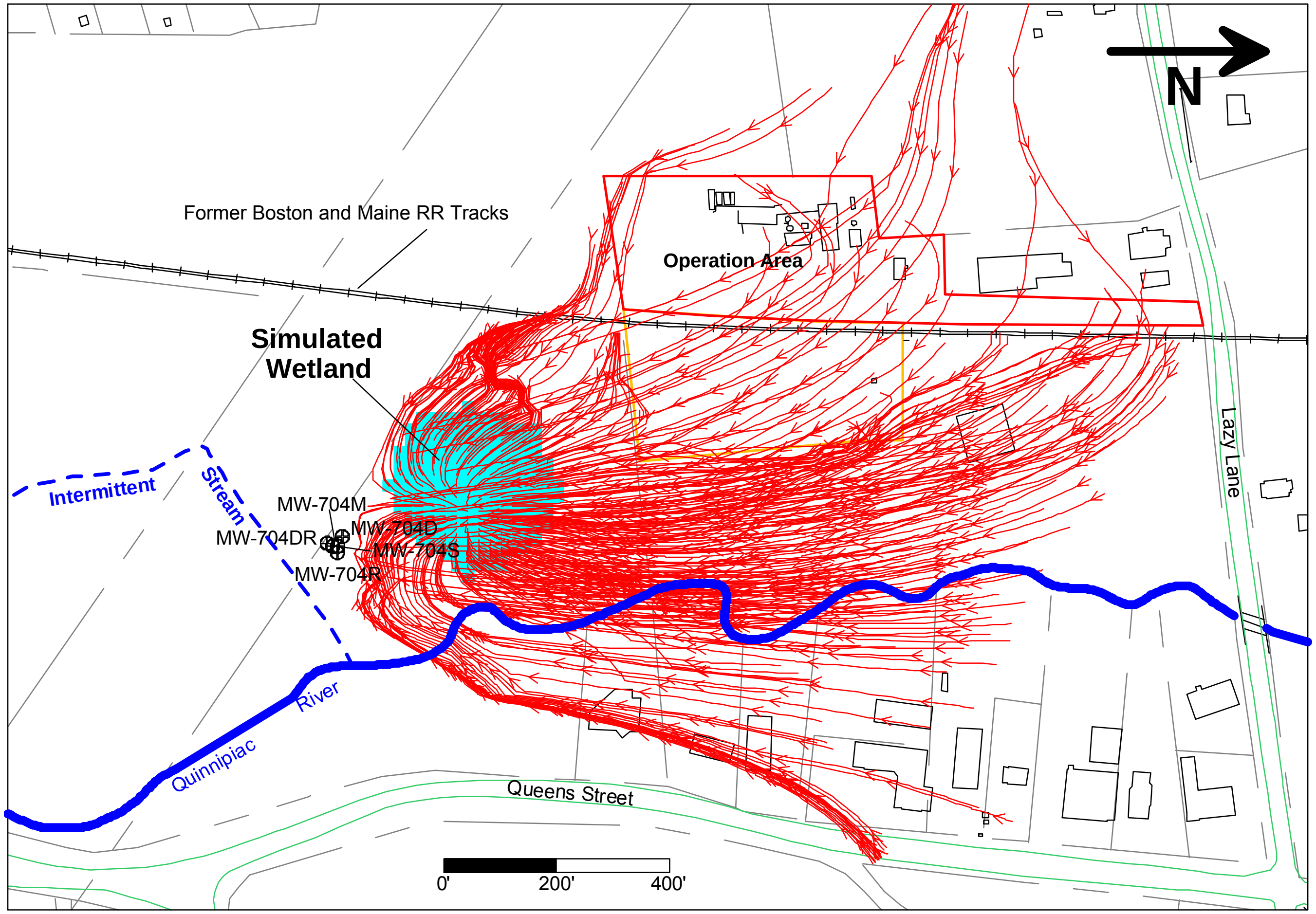
3) Minimum Dilution Factor = (Prod. Well No. 4 Capacity of 740 gpm) / (Est. Flow of 124 gpm through Ideal Forging Overburden Plume, from Simulation R-5) = 15. This dilution factor is considered a minimum because only a fraction of flow through the plume originates at the specified starting concentration.

4) Maximum pumped concentration = Endpoint Concentration / Minimum Dilution Factor.

Attachments

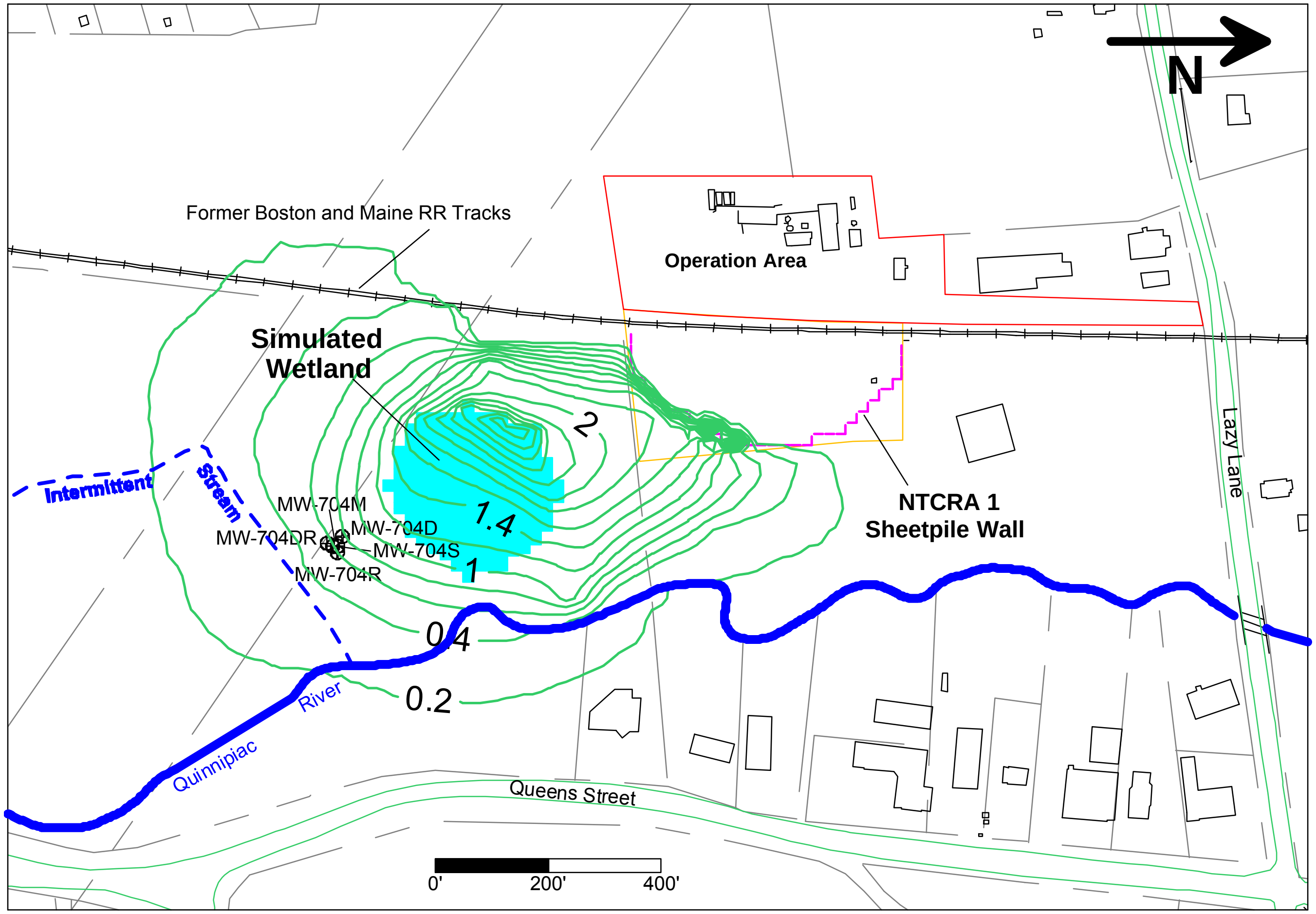
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Attachment R-1



Groundwater Remedial Alternative 2A (Simulation R-1)

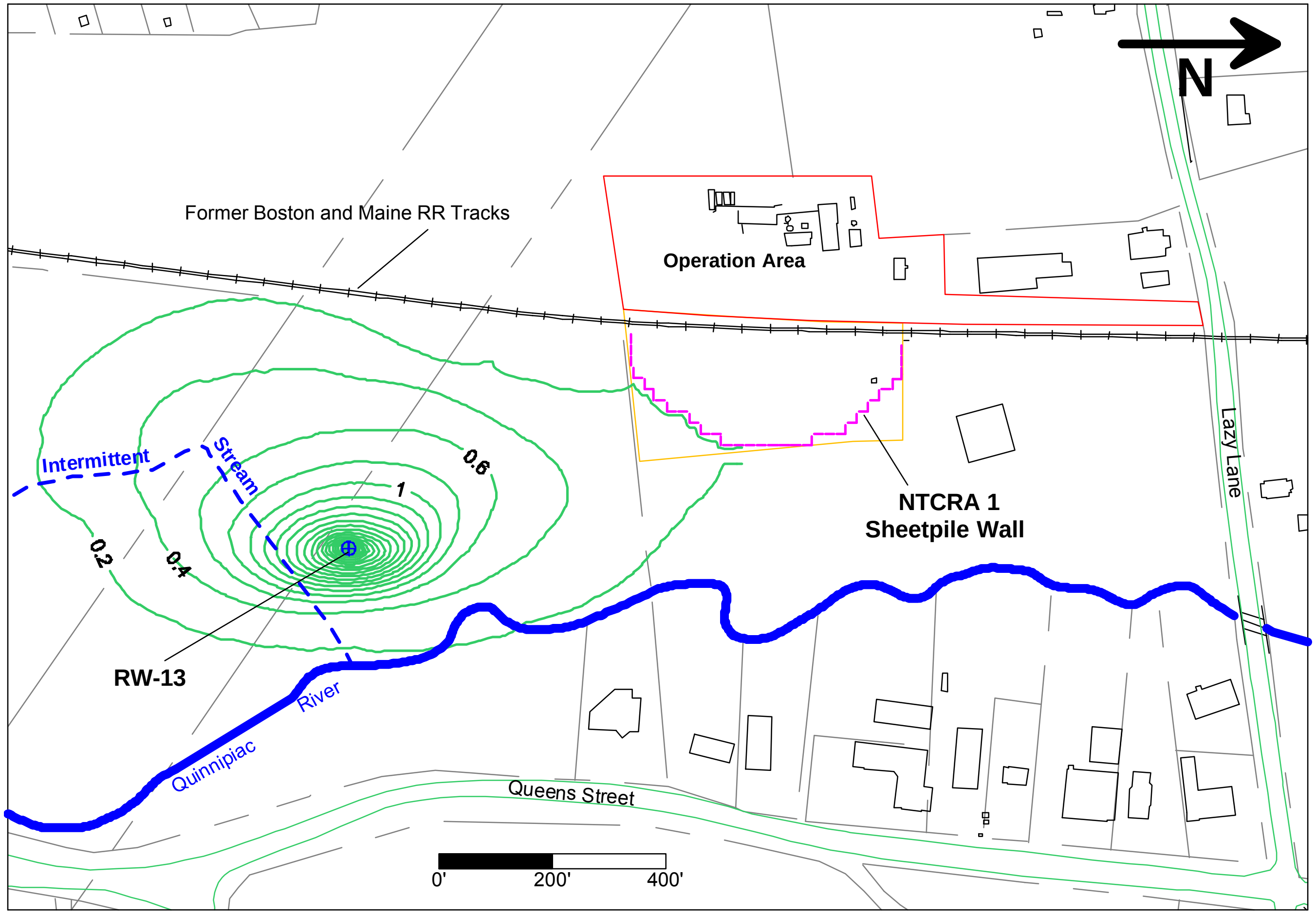
Simulated reverse-tracked particles showing steady-state capture zone with constructed wetland (groundwater discharge to wetland = 28 gpm).



Groundwater Remedial Alternative 2A (Simulation R-1)

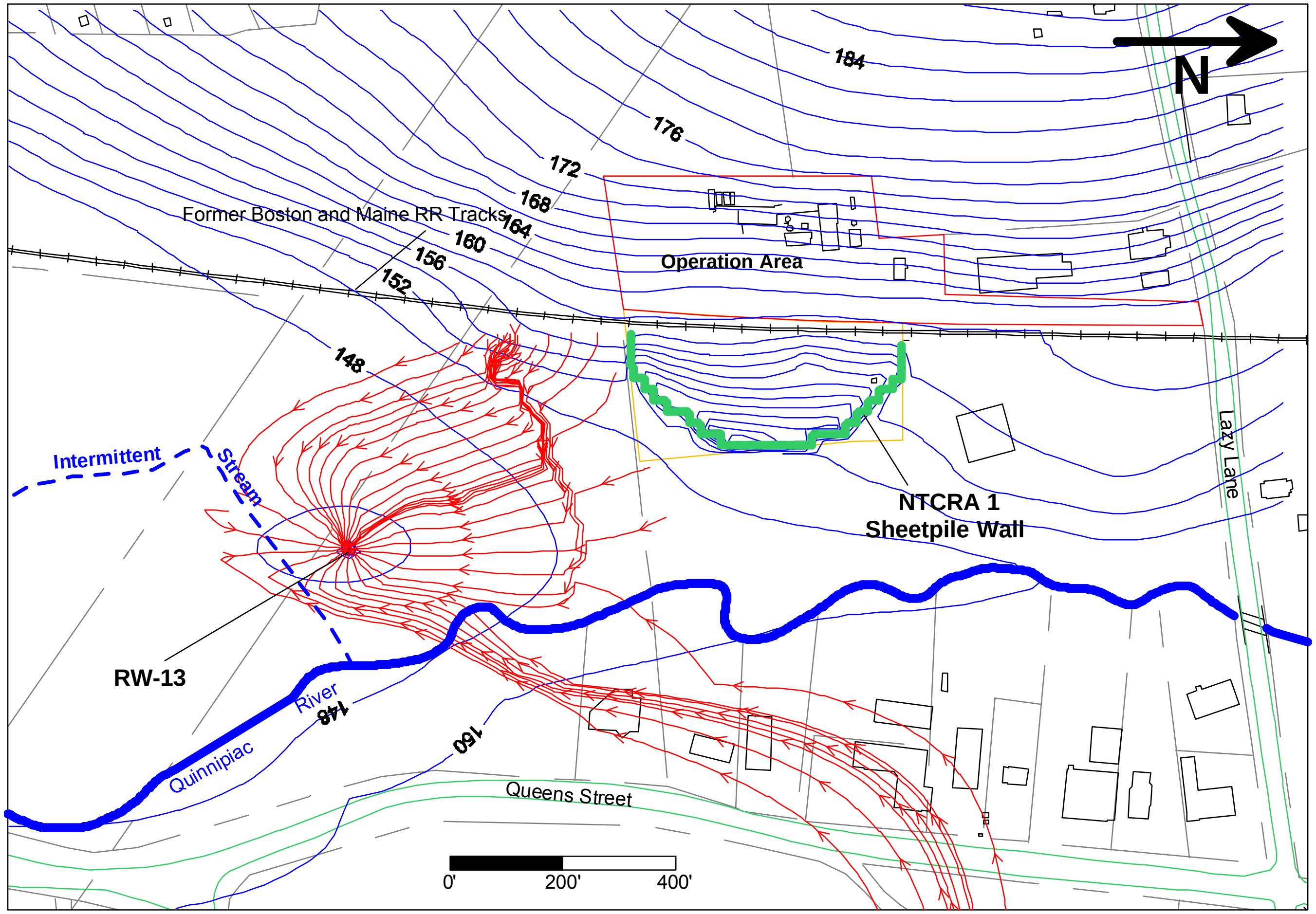
Simulated steady-state drawdown contours (feet) in overburden with constructed wetland. Contour interval = 0.2 feet.

Attachment R-2



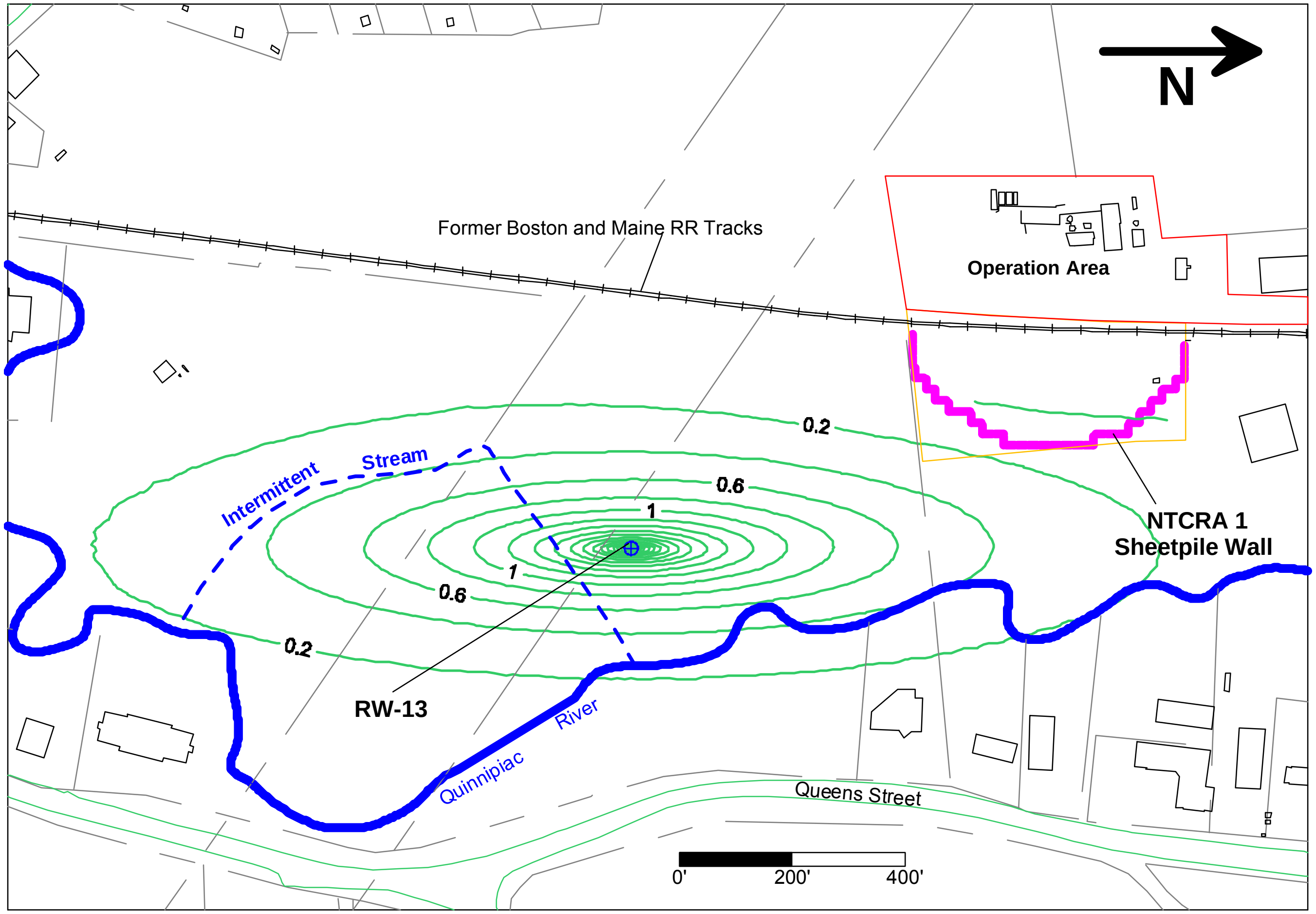
Groundwater Remedial Alternative 3A (Simulation R-2)

Simulated steady-state drawdown contours (feet) in overburden (RW-13 pumping at 22.5 gpm). Contour interval = 0.2 feet.



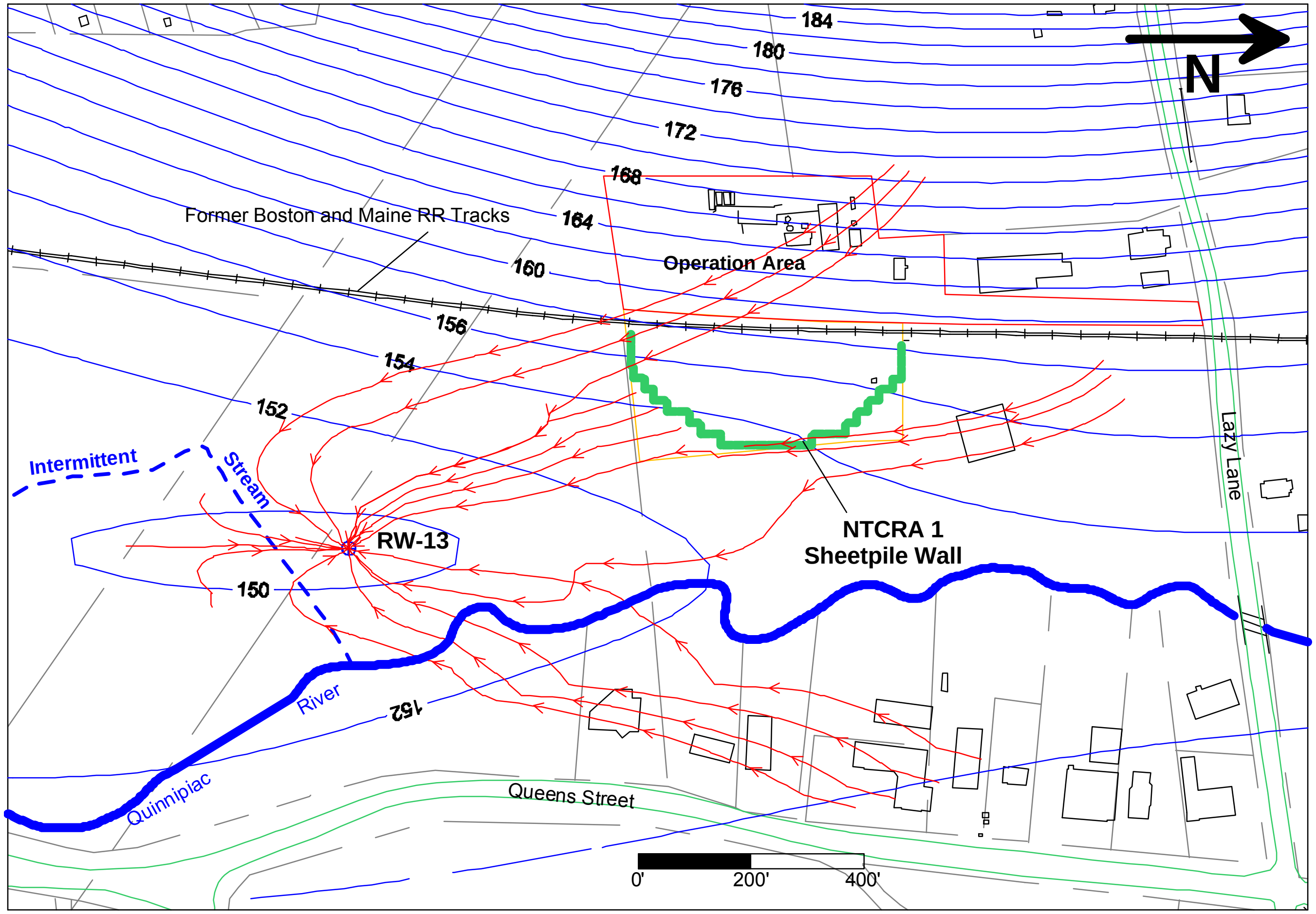
Groundwater Remedial Alternative 3A (Simulation R-2)

Simulated steady-state head contours (feet) and capture zone in overburden (RW-13 pumping at 22.5 gpm). Contour interval = 2 feet.



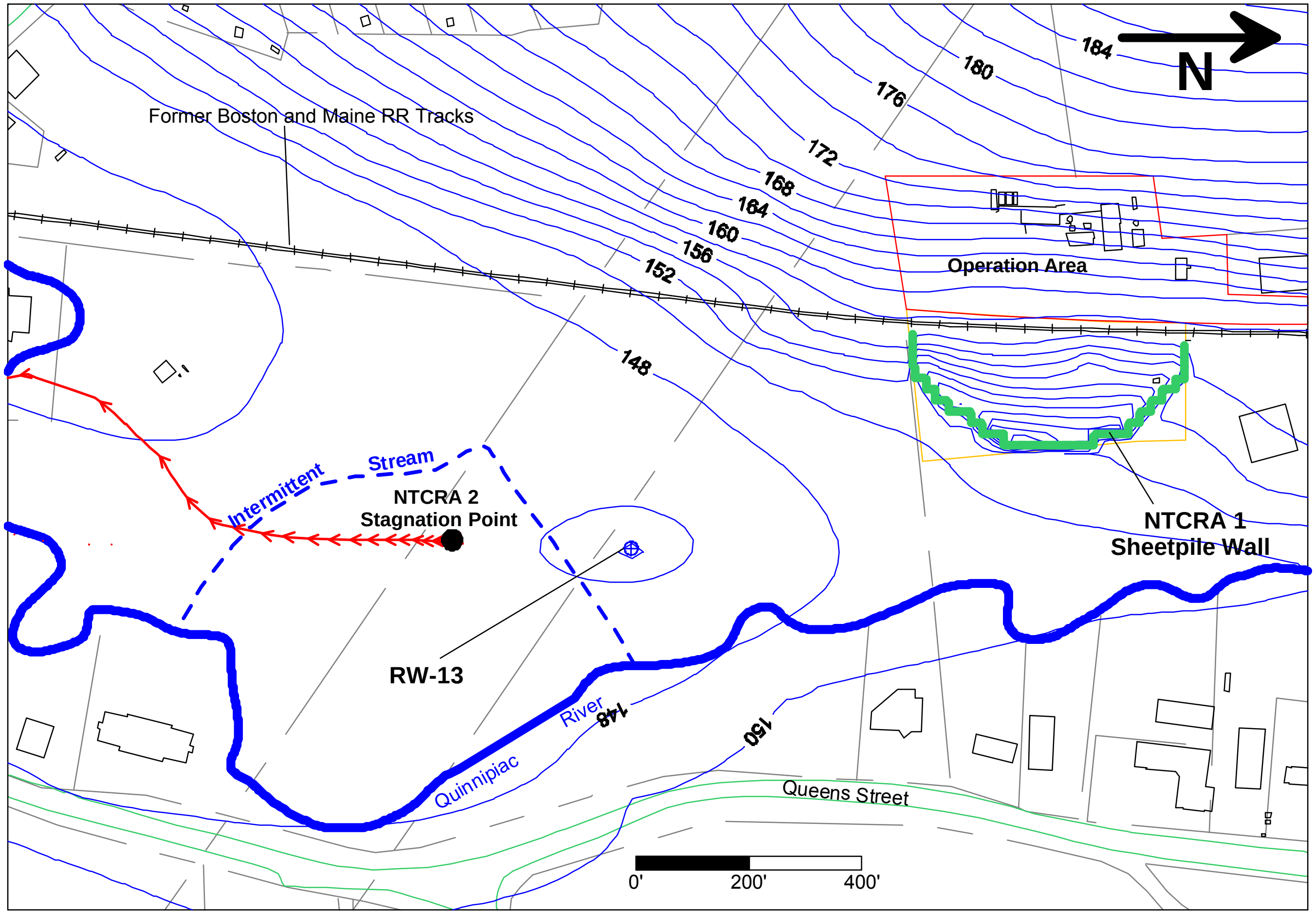
Groundwater Remedial Alternative 3A (Simulation R-2)

Simulated steady-state drawdown contours (feet) in shallow bedrock (RW-13 pumping at 22.5 gpm). Contour interval = 0.2 feet.



Groundwater Remedial Alternative 3A (Simulation R-2)

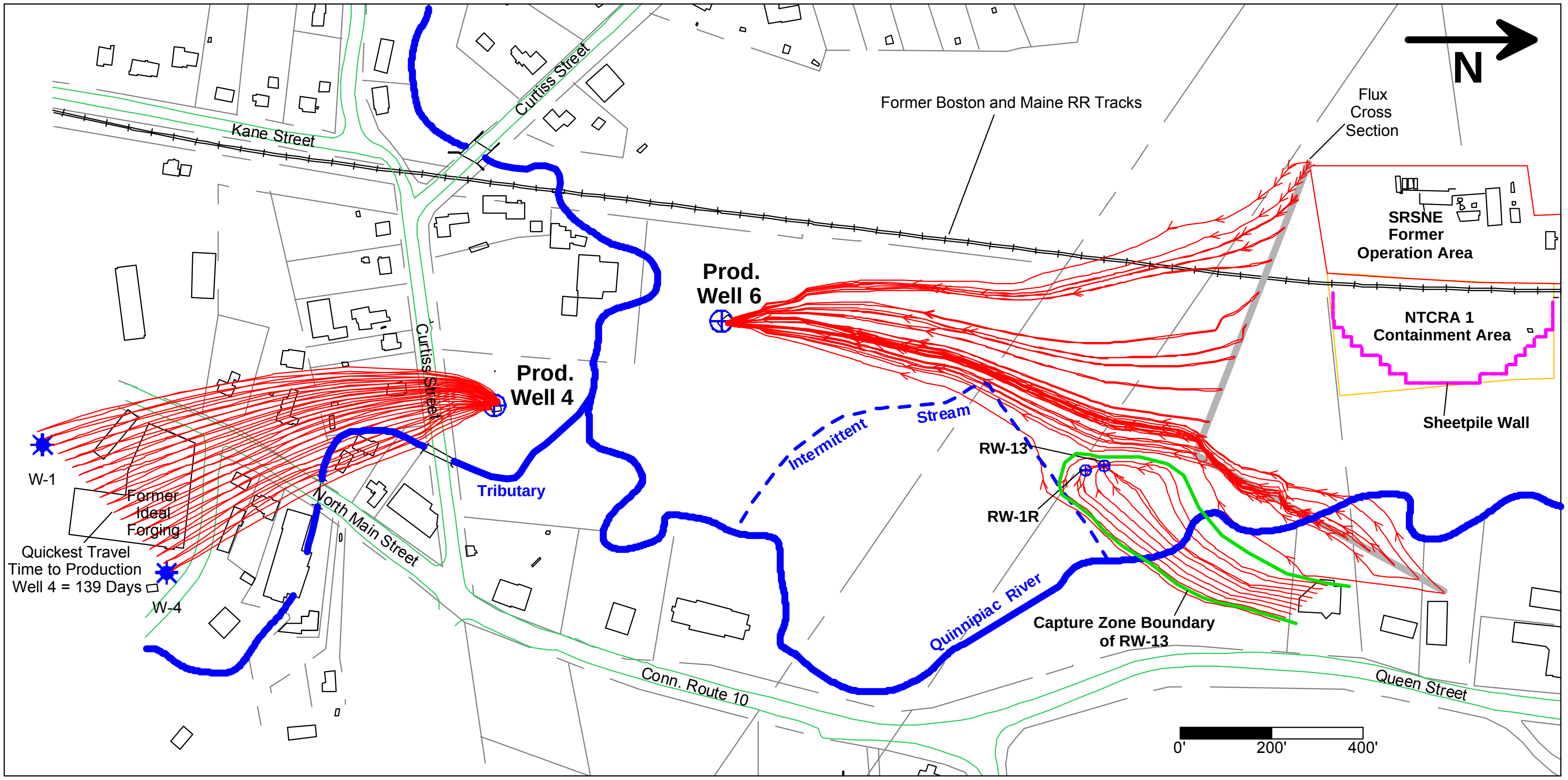
Simulated steady-state head contours (feet) and capture zone in shallow bedrock (RW-13 pumping at 22.5 gpm). Contour interval = 2 feet. Particles were originated in middle of layer 3 (forward particle tracking).



Groundwater Remedial Alternative 3A (Simulation R-2)

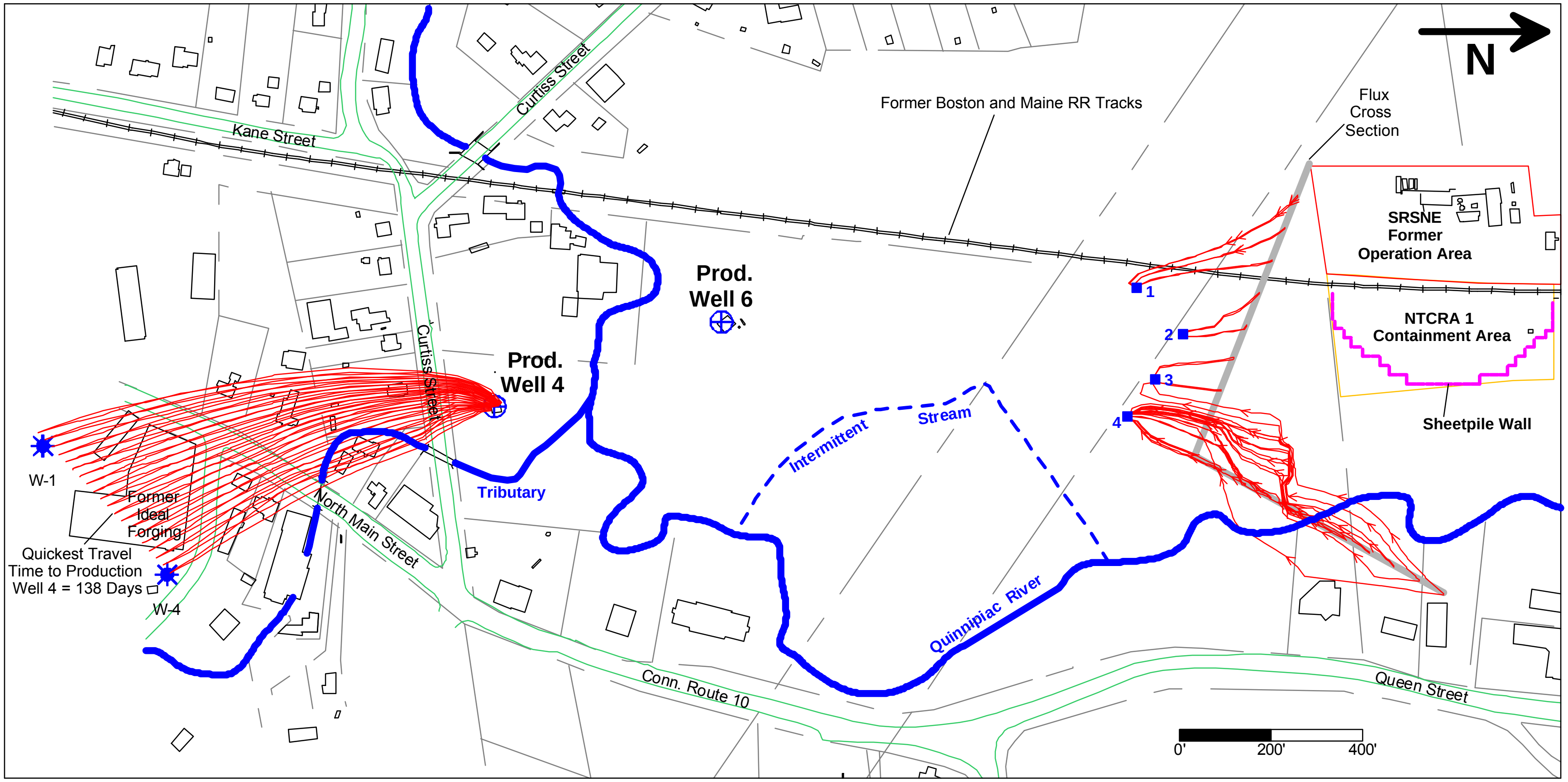
Simulated overburden particle track showing flow path from NTCRA 2 overburden stagnation point to discharge point at Quinnipiac River (RW-13 pumping at 22.5 gpm). Travel time = 7875 days or 21.6 years.

Attachment R-3

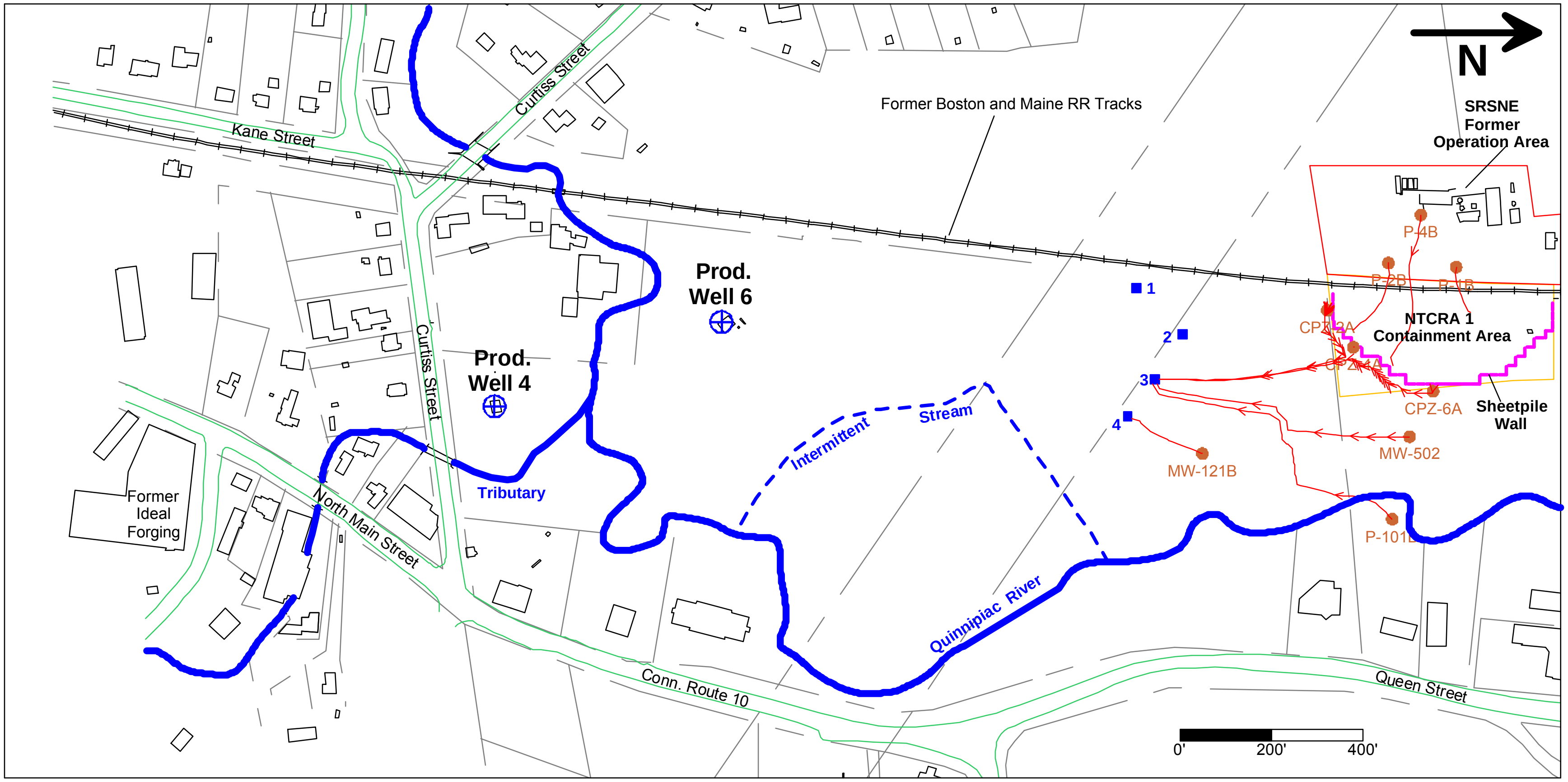


<u>Attachment R-3, Figure A.</u> Forward-tracked particle pathlines. The particles originate in overburden (Model Layers 1 and 2). The arrow-to-arrow interval is 365 days. Production Wells 4 and 6 are simulated as pumping at 740 gpm and 1150 gpm, respectively. Wells RW-13 and RW-1R (NTCRA2) are simulated as pumping at 15 gpm and 0.25 gpm, respectively. Total flows across the cross section near the SRSNE Site to Production Well 6 through overburden and bedrock are calculated as approximately 44.7 gpm and 2.4 gpm, respectively. Total flow from the Ideal Forging Site to Production Well 4 through overburden between wells W-1 and W-4 is calculated as approximately 118.3 gpm.

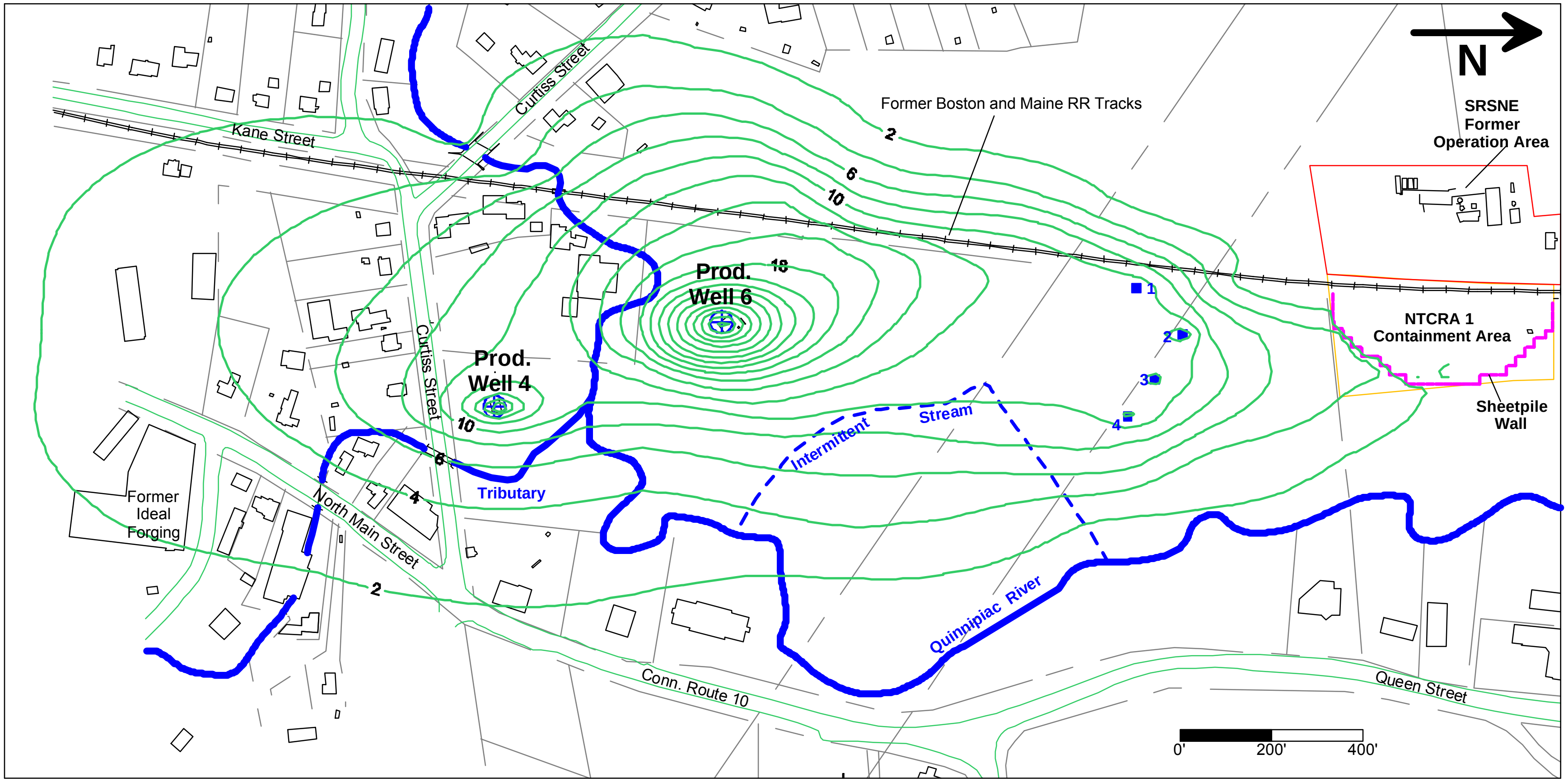
Attachment R-4



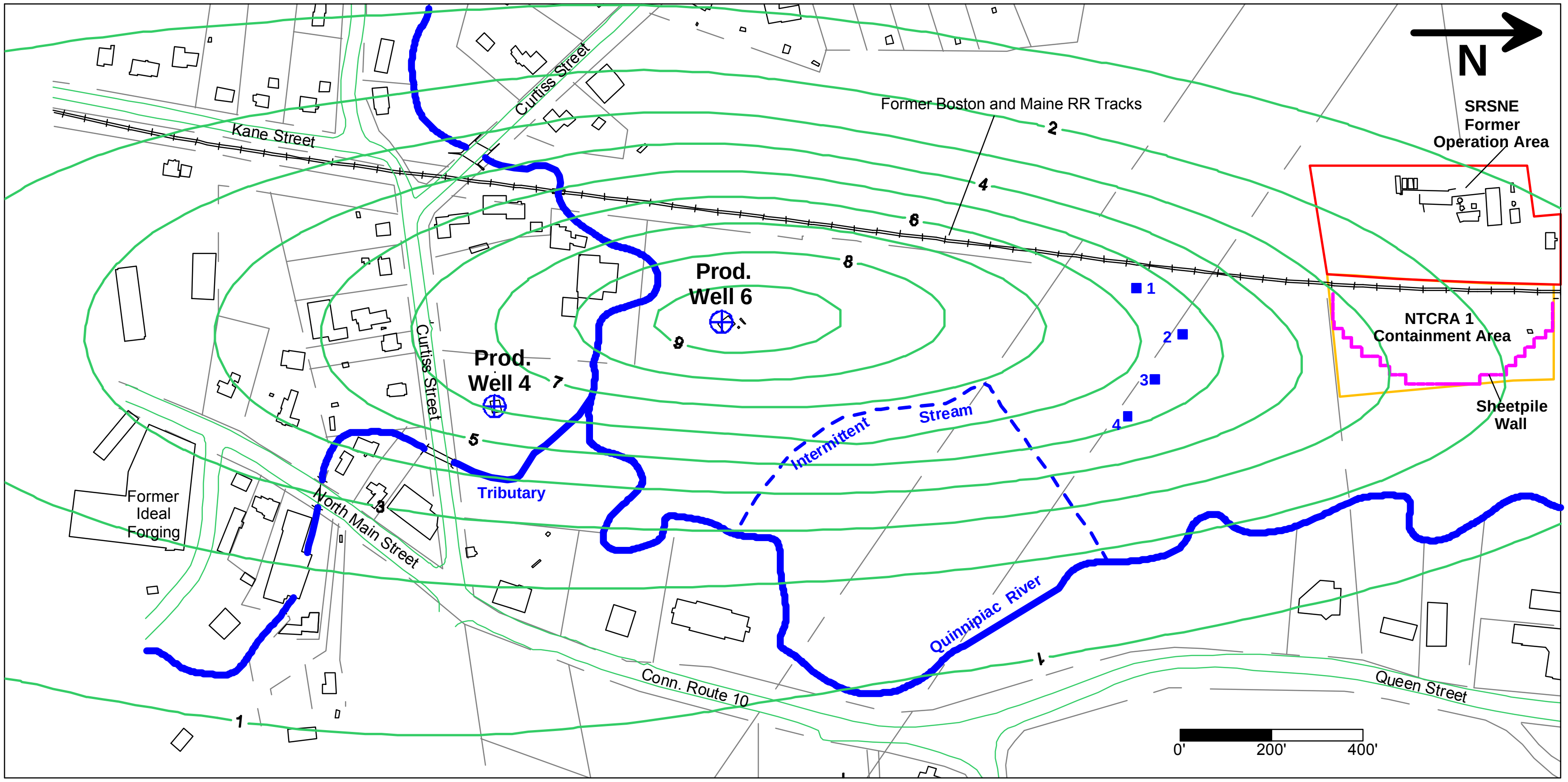
Attachment R-4, Figure A. Forward-tracked water particle pathlines. The particles originate in the overburden (Model Layers 1 and 2). The arrow-to-arrow interval is 365 days. Production Wells 4 and 6 are simulated as pumping at 740 gpm and 1150 gpm, respectively. New extraction wells are represented by blue squares (numbered 1 through 4), with a combined pumping rate of 55.4 gpm. New wells 1, 2, 3, and 4 are simulated as pumping at 3.9 gpm, 8.0 gpm, 11.0 gpm and 32.4 gpm, respectively. Total flow from the Ideal Forging Site to Production Well 4 through the overburden between wells W-1 and W-4 is calculated as approximately 131 gpm.



Attachment R-4, Figure B. Forward-tracked particle pathlines. The particles originate in the overburden from the middle of the screens of the following wells P-1B, P-2B, P-4B, CPZ-2A, CPZ-4A, CPZ-6A, MW-502 and P-101B. The arrow-to-arrow interval is 365 days. Pumping rates are as specified above in Figure A.

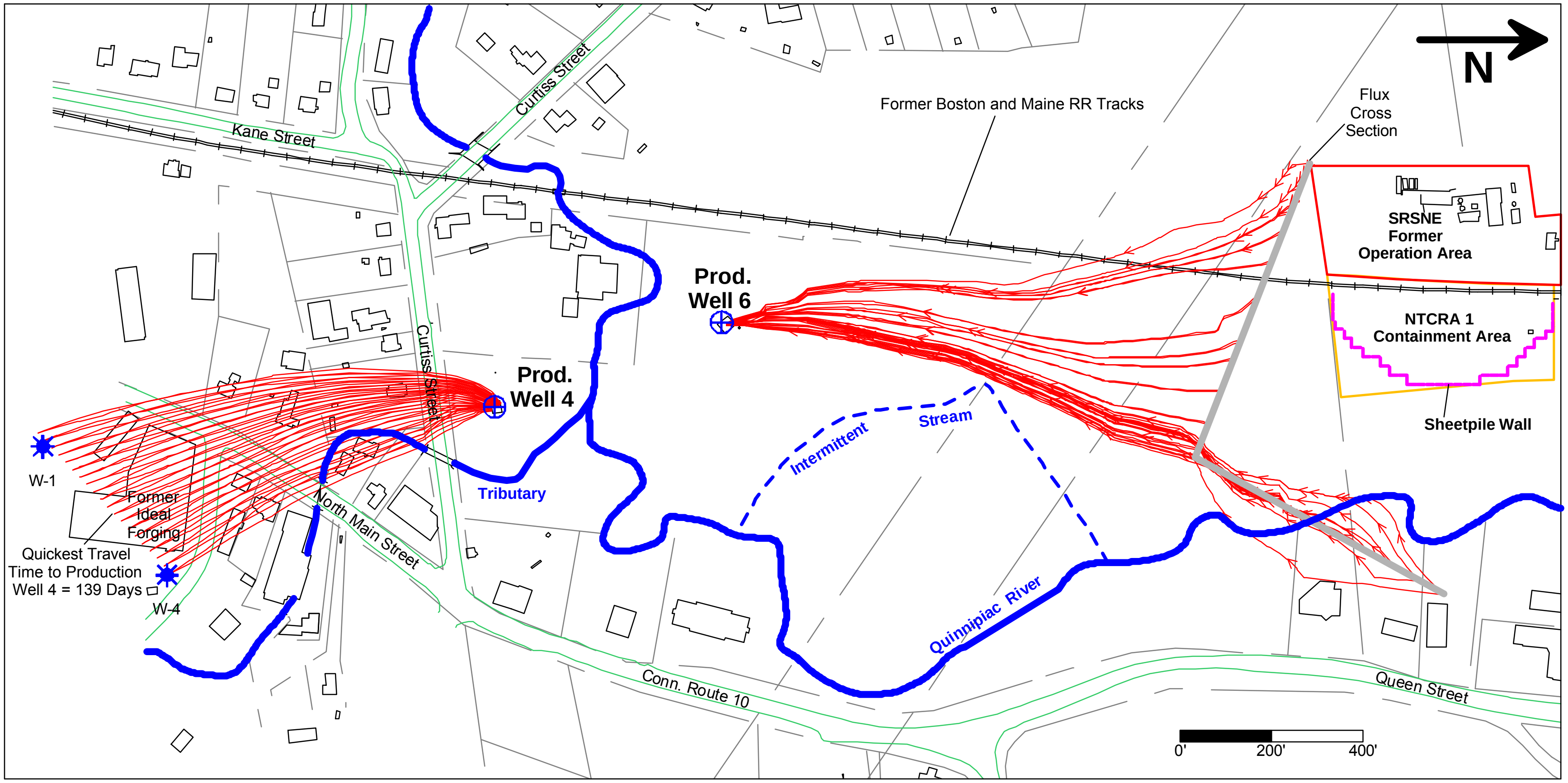


<u>Attachment R-4, Figure C</u>. Simulated steady-state drawdown contours (feet) in overburden. Contour interval = 2 feet. Pumping rates are as specified above in Figure A.

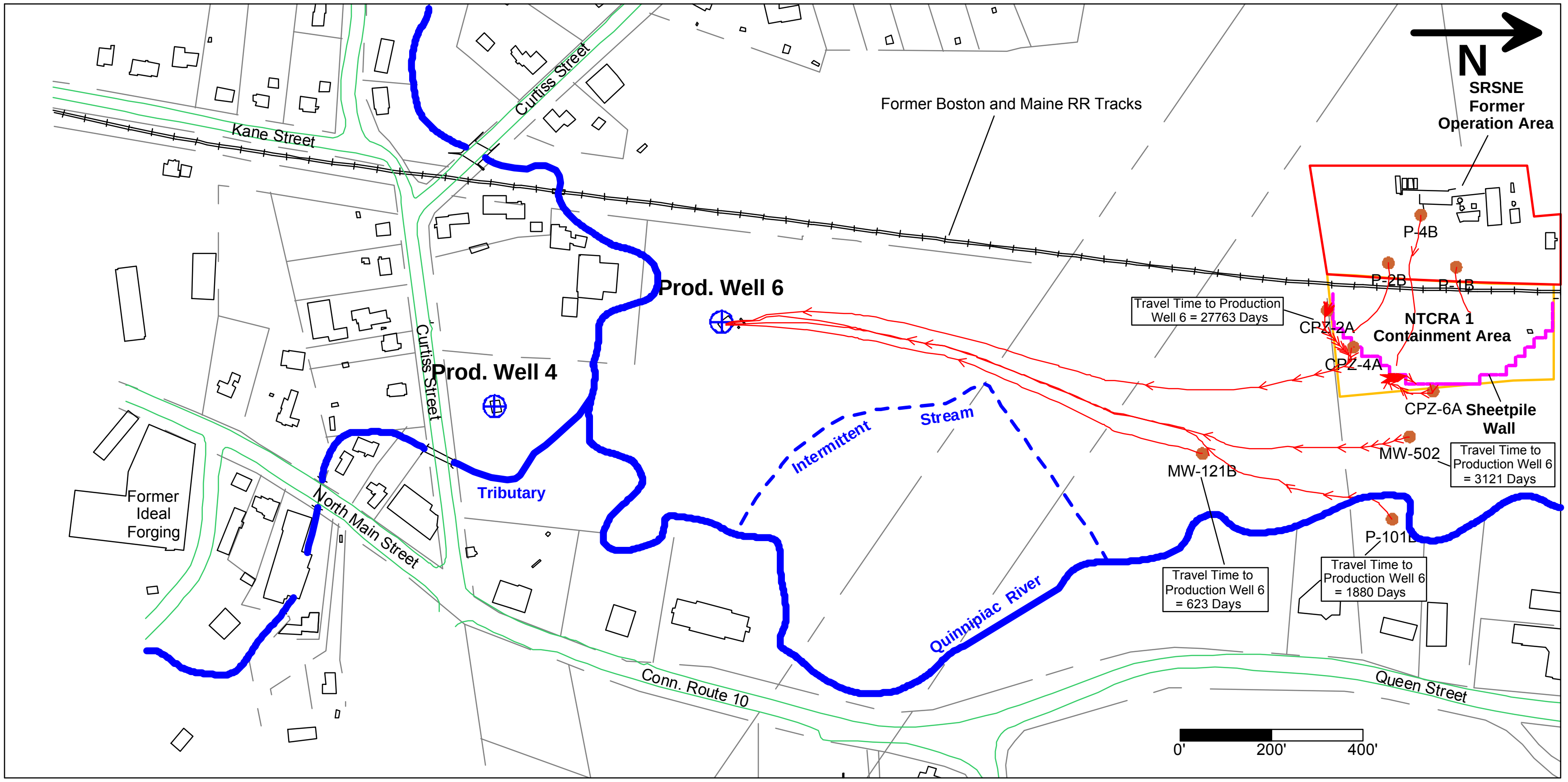


Attachment R-4, Figure D. Simulated steady-state drawdown contours (feet) in shallow bedrock. Contour interval = 1 foot. Pumping rates are as specified above in Figure A.

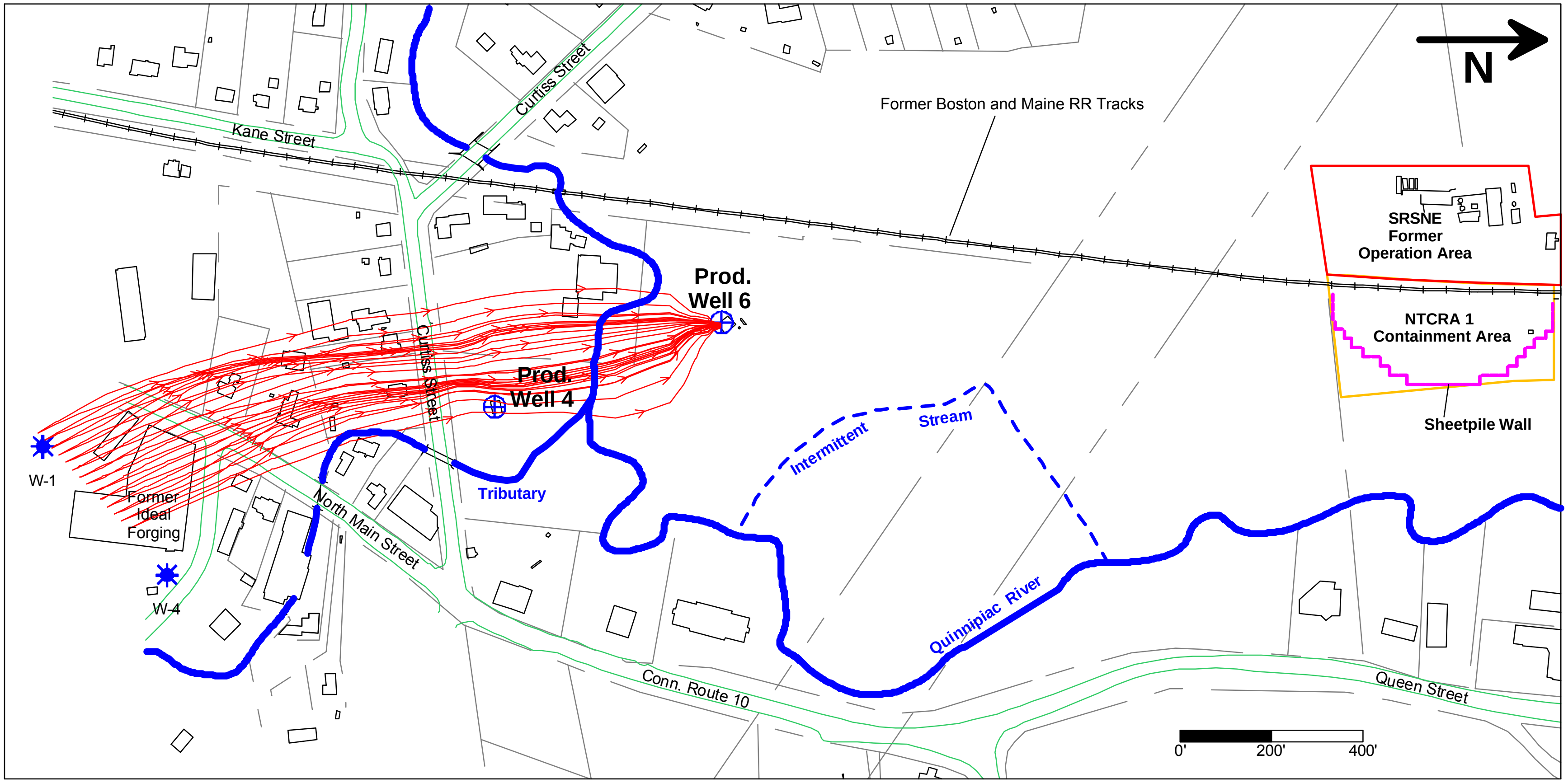
Attachment R-5



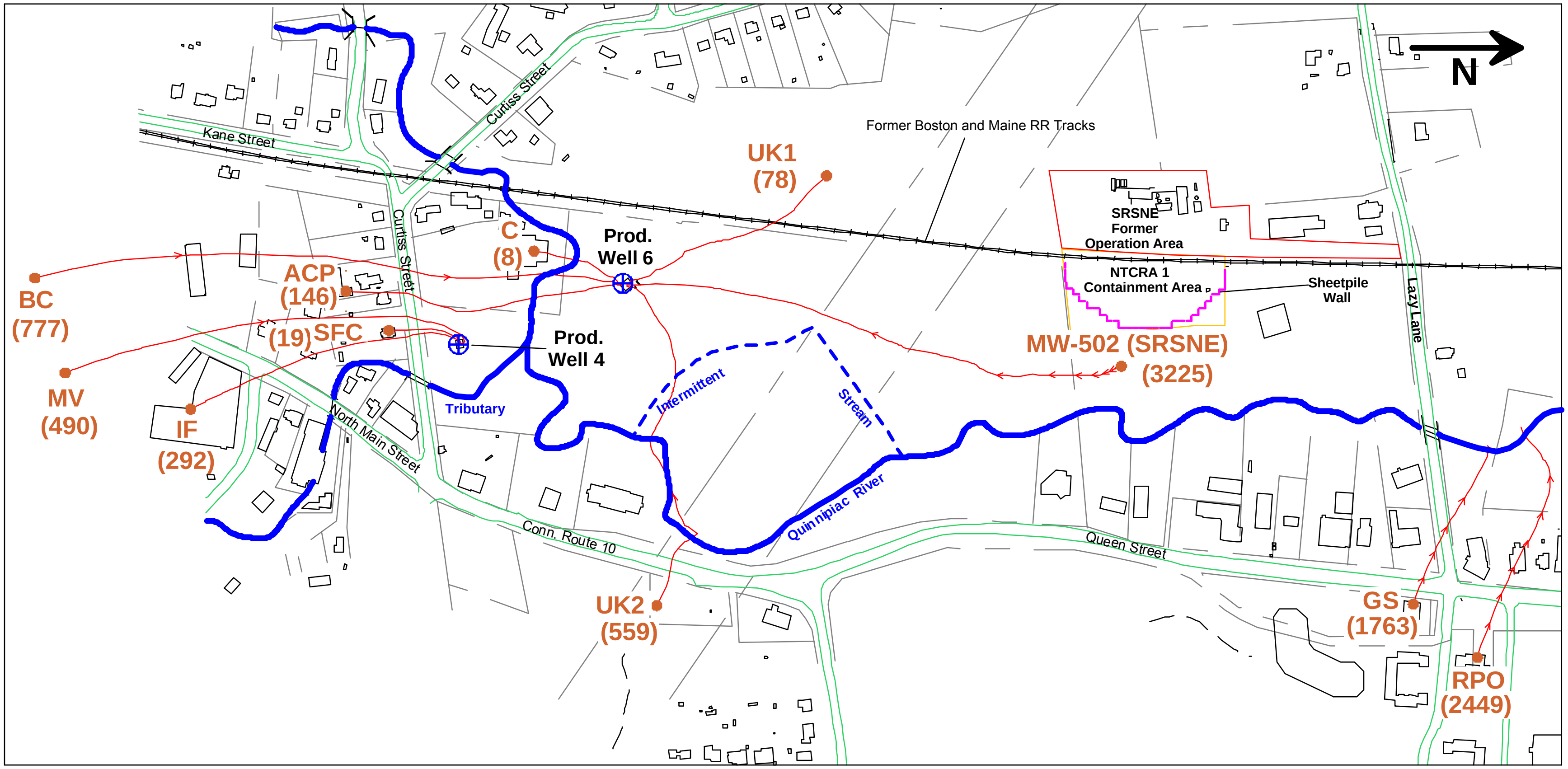
Attachment R-5, Figure A. Forward-tracked particle pathlines. The particles originate in the overburden (Model Layers 1 and 2), with 40 particles along the cross section near the SRSNE site and 40 particles at the Ideal Forging Site. The arrow-to-arrow interval is 365 days. Production Wells 4 and 6 are simulated as pumping at 740 gpm and 1150 gpm, respectively. Total flows across the cross section in the SRSNE Site to Production Well 6 through overburden and bedrock are calculated as approximately 42.2 gpm and 3.0 gpm, respectively. Total flow from the Ideal Forging Site to Production Well 4 through overburden between wells W-1 and W-4 is calculated as approximately 124.3 gpm (55.6 gpm in Layer 1 and 68.7 gpm in Layer 2). Simulated travel time from Ideal Forging to Production Well No. 4 is approximately 139 days.



Attachment R-5, Figure B. Forward-tracked water particle pathlines. The particles originate in overburden from middle screens of the following wells P-1B, P-2B, P-4B, CPZ-2A, CPZ-4A, CPZ-6A, MW-502 and P-101B. Pumping rates are as specified above in Figure A. The groundwater travel time from wells CPZ-2A, MW-502 and P-101B to Production Well 6 are calculated as 27763, 3121 and 1880 days, respectively. Groundwater at P-1B, P-2B, P-4B, CPZ-4A and CPZ-6A are extracted by NTCRA1 pumping wells.



Attachment R-5, Figure C. Forward-tracked water particle pathlines. The particles originate in the overburden (Model Layers 1 and 2), with 40 particles at the Ideal Forging Site. The arrow-to-arrow interval is 365 days. Production Well 4 is simulated as inactive. Production Well 6 is simulated as pumping at 100 gpm. Wells RW-13 and RW-1R simulated as inactive. Seventy percent of the particles discharge at Production Well No. 6, with a minimum travel time of 758 days. The travel time from Production Well 4 to Productions Well 6 is 418 days. The travel time from beneath the river to Production Well 6 is 123 days.



<u>Attachment R-5, Figure D</u>. Forward-tracked water particle pathlines. The particles originate in Model Layer 1 at the approximate locations of 11 known or suspected VOC source areas. The arrow-to-arrow interval is 365 days. Production Wells 4 and 6 are simulated as pumping at 740 and 1150 gpm, respectively. NTCRA 1 system is simulated as operating. The groundwater travel times to calculated discharge points are posted in parentheses (in days). VOC sources are as follows: ACP = Abandoned Chrome Plating Facility; BC = Beaton & Corbin; C = Caldwell Property; GS = Gasoline Station; IF = Former Ideal Forging; MV = Marek/Vojtila Property; RPO = R.P. Olson & Son; SFC = Southington Form Construction Company; UK1 and UK2 = Unknown sources of VOCs.

Attachment R-6

MEMORANDUM

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

To: Sheila Eckman, USEPA Region I

Date: September 25, 1997

From: Michael J. Gefell

cc: M. Beskind (CT DEP), L. Chu (HNUS), SRSNE Technical Committee, B.R. Thompson, B.H. Kueper, G.R.Cameron, D.F.Sauda

Re: NTCRA 2 Pumping Well and Piezometers, SRSNE Site, Southington, Connecticut

NTCRA 2
INTERIM TECHNICAL MEMORANDUM

This Interim Technical Memorandum was prepared by Blasland, Bouck & Lee, Inc. (BBL), to present preliminary numerical ground-water flow (MODFLOW) modeling results and describe the proposed design for a bedrock pumping well and piezometer network downgradient of the Solvents Recovery Service of New England (SRSNE) Site, located in Southington, Connecticut (Figure 1). These activities are consistent with the Non-Time Critical Removal Action No. 2 (NTCRA 2) design and study process, which will provide bedrock ground-water containment in the area downgradient of the SRSNE Site Operations Area (Figure 2). The NTCRA 2 design and study process was described in the Design and Study Work Plan (DSWP) (BBL, August 1996), which was submitted to the United States Environmental Protection Agency (USEPA) on August 30, 1996. USEPA conditionally approved the DSWP, with comments, in a letter to the SRSNE Potentially Responsible Party (PRP) Group dated October 23, 1996. To address USEPA's comments, BBL prepared a DSWP Addendum No. 1, which was submitted to USEPA on November 13, 1996.

Background

The fundamental purpose for NTCRA 2 is to minimize, to the extent reasonably practicable, the flow of ground water within the fractured bedrock from the Operations Area of the Site. However, due to the presence of non-aqueous phase liquids (NAPLs) in the bedrock immediately east (immediately downgradient) of the Operations Area (BBL, November 1995), bedrock ground water containment will be targeted in the area further downgradient (southeast) of the Operations Area to avoid remobilizing NAPL. The flow of bedrock ground water from the Operations Area can be safely contained by intercepting the ground water within the bedrock VOC plumes downgradient of the potential bedrock NAPL zone. The appropriate ground-water extraction location, therefore, will be downgradient of the potential bedrock NAPL zone, and within the off-site plumes of volatile organic compounds (VOCs) detected above regulatory criteria in shallow bedrock (Figure 3) or deep bedrock (Figure 4) ground water.

A regional MODFLOW ground-water flow model was developed as described in the DSWP (BBL, August 1996) to represent overburden and bedrock ground-water flow on a regional and site-specific scale, with model grid refinement in the vicinity of the SRSNE Site (Figure 2). The model provides the basis to complete the design for the bedrock pumping well and the network of bedrock piezometers that will be used in NTCRA 2. This Interim Deliverable describes the general setup and the preliminary results from the MODFLOW model, including the estimated pumping rate required to hydraulically control bedrock ground-water migrating downgradient of the Operations Area of the site. In addition, simulated hydraulic gradient changes were characterized to assess the potential for NAPL mobilization and to estimate the influence on NTCRA 1 Demonstration of Compliance.

As specified in the USEPA-approved DSWP, the model was used to identify the number, location, depth, diameter, and intake length of the NTCRA 2 bedrock ground-water extraction well(s), and the appropriate locations for bedrock piezometers. These construction specifications will provide the basis for the installing a bedrock pumping well and a network of bedrock piezometers during the NTCRA 2 Design Investigation. The extraction well and piezometer network will be used in a bedrock pumping test to evaluate bedrock ground-water hydraulics in the area downgradient of the site, and empirically assess the bedrock ground-water containment effectiveness of the pumping well.

Based on the pumping test results, the MODFLOW model will be refined and used for additional simulations to identify the final design for the NTCRA 2 ground-water extraction system. A detailed discussion of the NTCRA 2 MODFLOW Model design and calibration will be presented in the NTCRA 2 Technical Memorandum. The NTCRA 2 Technical Memorandum will also summarize the findings of the Design Investigation.

The remainder of this Interim Technical Memorandum presents:

- An overview of the MODFLOW ground-water flow model;
- Preliminary model results;
- A preliminary assessment of the potential for NAPL mobilization due to bedrock ground-water extraction;
- An evaluation of the potential influence of the NTCRA 2 bedrock pumping well on the NTCRA 1 Demonstration on Compliance requirements for overburden ground-water containment; and
- The proposed pumping well design and piezometer locations.

Overview of MODFLOW Ground-Water Flow Model

Ground-water flow modeling was performed using the pre/post-processor Groundwater Vistas (Rumbaugh, 1996) to facilitate the use of the United State Geological Survey (USGS) MODFLOW model (McDonald and Harbaugh, 1988). MODFLOW is a modular, three-dimensional, block-centered, finite-difference steady-state or transient flow model. A detailed discussion of the MODFLOW model, including setup, calibration, and simulation results, will be presented in the NTCRA 2 Technical Memorandum, which will be prepared after the Design Investigation. The sections below provide a brief overview of the model setup and simulation results that affect the forthcoming Design Investigation.

Model Domain

The NTCRA 2 MODFLOW model domain encompasses a section of the regional Quinnipiac River drainage basin, covering a total area of 5 square miles. The model grid dimensions are 10,800 feet (ft) (2 miles) in the east-west direction and 13,300 ft, (2.5 miles) in the north-south direction (Figure 5). The model domain is approximately centered about the SRSNE Site, and extends outward to the locations of regional surface-water features (ponds, streams, and canals) where the shallow overburden hydraulic head is known. The regional scale of the MODFLOW model allows simulation of ground-water extraction by the existing NTCRA 1 overburden ground-water extraction wells, potential NTCRA 2 bedrock ground-water extraction alternatives, or Town of Southington's Production Wells No. 4 and/or 6 with little or no impact of the pumping stresses on model boundaries.

Model Grid and Layer Structure

The model grid is rectilinear in plan view, such that the columns are oriented north to south and the rows are oriented east to west (Attachment 1). The model domain was discretized by a rectilinear, three-dimensional, block-centered finite difference model grid, consisting of 158 non-uniformly spaced rows, and 116 non-uniformly spaced columns (18,328 cells per layer). The grid in the vicinity of the SRSNE site was discretized down to cells dimensions of approximately 20 ft by 20 ft in plan view. At the periphery of the model, at a distance from the site, the grid coarsens to cells up to approximately 500 ft by 500 ft.

The model layer configuration is summarized on a schematic cross section in Attachment 1. The model grid is vertically discretized into seven layers with non-uniform interface elevations, which were defined based on geology or depth below the top of bedrock. Layers 1 and 2 represent the overburden and Layers 5 through 7 represent the bedrock. The total saturated thickness of the model ranges from approximately 600 to 720 feet and, therefore, extends to a substantial depth below the currently monitored geologic section, which extends to a maximum depth of approximately 270 feet below grade. The substantial vertical extent of the model allows the simulation of pumping wells within the overburden or the monitored portion of the bedrock with upward ground-water flow from below the simulated pumping system(s).

Portions of the hills west and northeast of the site where the water table is believed to be within the bedrock (Mazzaferro et al., 1979) were assigned as inactive cells in Layers 1 and 2.

Recharge

The recharge to ground water due to infiltration was defined for the uppermost active model layer throughout the model domain based on data reported in the literature. While reported recharge rates range from 6 to 26 inches across Connecticut (USGS, 1995), more recharge is anticipated in valley areas underlain by saturated stratified drift than in hilly areas underlain by till or bedrock (Mazzaferro, et al., 1979). Consistent with the available published information, the recharge rates identified through model calibration are generally 22 inches per year for the valleys and 6 to 9 inches per year for the hills. Other recharge rates were used to reflect anthropogenic influences on recharge, including paved areas where recharge was set to zero, areas with private septic systems where recharge was increased based on estimated domestic water use, and outflow points of storm-water culverts with well-defined catchment areas.

Regional Boundary Conditions

The regional boundary conditions for the MODFLOW model were located using USGS topographic map data for the New Britain, Meriden, and Southington quadrangles (USGS, 1992) and the Bristol quadrangle (USGS, 1984). Constant head conditions were specified in Layer 1 and Layer 2 at the periphery of the model domain approximately 5600 ft north, 5900 south, 5100 east, and 4500 west of the site. River cells were used in Layer 1 for the Quinnipiac River, associated tributaries, and other surface water features. Surface-water elevations were estimated based on USGS topographic maps. A general head boundary was used at the eastern edge of the model domain in the bottom layer of the model (Layer 7) to represent the potential regional influence of the Connecticut River on deep bedrock ground-water flow.

Private domestic wells on the hill west of the site and along Lazy Lane were simulated as a pumping rate of 450 gallons per day per well from Layer 5 (Mazzaferro et al., 1979). A hydraulic drain condition was used to simulate a submerged sanitary sewer pipe south of the site along Queen Street (Town of Southington, June 1979).

Near-Site Hydraulic Stresses

The NTCRA 1 overburden ground-water extraction system was modeled using MODFLOW drain cells and the associated sheet pile wall modeled using MODFLOW's horizontal flow barrier (HFB) package. The 30-inch underground culvert that crosses east-west beneath the former Cianci Property was simulated using MODFLOW drain cells. A zone of high hydraulic conductivity (estimated as 100 ft/day) was used to simulate the influence of the gravel-filled, force-main trench associated with the an Off-Site Interceptor System in the north portion of the Town Well Field (Loureiro, 1984). Also, the gravel-filled ditches along the railroad tracks, which commonly contain standing water and extend to the location of two ponds north of Lazy Lane, were simulated as river cells.

Hydraulic Parameters

The horizontal hydraulic conductivity values for Layers 1 and 2 within the RI study area were defined based on the existing hydrogeologic database for the site. Individual hydraulic conductivity values measured at overburden wells and piezometers were contoured to create a smooth distribution within Layers 1 and 2. The resulting grids of hydraulic conductivity data were digitally imported to define the hydraulic conductivity at each model cell in Layers 1 and 2 within the study area, with hydraulic conductivity values ranging from < 1 to >1000 ft/day. The regional hydraulic conductivity of Layers 1 and 2 beyond the study area the were estimated based on well yields reported in the literature, and were refined through calibration to final values ranging from 6 to 400 ft/day. The horizontal hydraulic conductivity of the bedrock in Layers 3 through 7, 0.35 ft./day, is the geometric mean value from packer-tests, slug-tests, and specific capacity tests at bedrock wells in the study area. This conductivity estimate is consistent with a reported value of 0.31 ft./day based on specific capacity testing of 401 wells installed in sedimentary rock units in Connecticut (USGS, 1995).

Vertical anisotropy factors (horizontal to vertical hydraulic conductivity ratios) were estimated as 100:1 for the overburden and 200:1 for the bedrock based on Neuman-Witherspoon (1972) analysis of specific capacity tests performed in either formation. In addition, a horizontal anisotropy factor (ratio of north-south to east-west hydraulic conductivity) of 4:1 was estimated for the overburden layers based on a drawdown ellipse observed during a specific capacity test (Kruseman and de Ridder, 1990). Horizontal anisotropy for the bedrock was simulated as 20:1 due to the regional, approximately 20°, eastward dip of the bedrock strata and associated bedding plane fractures (Anderson and Woessner, 1992). Horizontal anisotropy was found to be necessary to match simulated ground-water flow directions with the known shapes of the regulatory plumes in the shallow and deep bedrock, as determined during model calibration.

Model Calibration

The NTCRA 2 MODFLOW model calibration process and results will be discussed in detail in the NTCRA 2 Technical Memorandum. Attachment 2 to this Interim Technical Memorandum, however, presents a summary plot for the calibrated versus target head values. The target heads included measured or reported head values from 195 wells and piezometers in the study area and surrounding region, and ranged from approximately 140 to 265 feet elevation. During the calibration process, the residuals (difference between model heads and target heads) were reduced to <5 ft for 88% of the targets and <2 ft for 66% of the targets.

The simulated total combined flow rate of 21 gpm from the NTCRA 1 overburden ground-water extraction wells compares favorably to the historical average of 20 gpm. Also, the simulated ground-water discharge rate into the Quinnipiac River without the NTCRA 1 system operating was 33 gpm, which is reasonably consistent with the September 1992 measurement of 48 gpm (HNUS, May 1994).

The main parameters varied during model calibration to target head values were recharge, vertical hydraulic conductivity, and hydraulic stresses associated with sewers, trenches and domestic wells/leach fields. However, even after achieving a reasonable match to target heads, ground-water flow directions downgradient of the site did adequately not match the known extent and shapes of the off-site VOC plumes. Therefore, near the end of the model calibration process, directional differences in horizontal hydraulic conductivity (anisotropic conditions) were also evaluated. The effective horizontal hydraulic conductivity (geometric mean of major and minor horizontal conductivities) remained fixed throughout the anisotropy evaluation. Without anisotropy (horizontal conductivity the same in all directions), and without the NTCRA 1 system operating, simulated ground-water flow originating from the Operations Area (and the overburden and bedrock NAPL zones) discharges into the Quinnipiac River north of the Connecticut Power and Light (CL&P) easement (Figure 2). Thus, in the absence of horizontal anisotropy, the southern portions of the regulatory plumes believed to be related to the SRSNE Site can not be explained in terms of ground-water flow from the site. Particle tracking was used to compare ground-water flow paths to the observed regulatory plumes in the overburden and in the shallow and deep bedrock and evaluate the effect of horizontal anisotropy.

Through the particle tracking process, BBL interpreted that horizontal anisotropy values of approximately 4:1 in the overburden and 20:1 in the bedrock were necessary to match the observed southward extent of the plumes in the overburden and bedrock. These factors were calculated based on measured hydraulic responses in the overburden (Kruseman and de Ridder, 1990) and published methods of estimating horizontal anisotropy of dipping bedrock strata (Anderson and Woessner, 1992). Using the anisotropy factors of 4:1 in the overburden and 20:1 in the bedrock, ground-water particle path lines tracked in reverse from key bedrock wells with regulatory exceedences in shallow and deep bedrock match the interpreted regulatory plumes, as shown on Figures 6 and 7. These results indicate that the simulated bedrock ground-water flow directions in the calibrated model are consistent with the shapes of the regulatory plumes.

The potential influence of horizontal anisotropy will be clarified based on the results of the bedrock pumping test that will be performed during the Design Investigation. For the purposes of bedrock ground-water pumping simulations,

Preliminary Model Results

Following calibration, predictive simulations were run to simulate bedrock ground-water flow conditions during ground-water extraction. Several containment scenarios were run to identify optimal locations and pumping rates for a NTCRA 2 bedrock ground-water extraction well to contain the regulatory VOC plume in the bedrock. To assess the simulated capture zone affected by pumping, simulated head distributions were contoured and forward particle tracking was performed in the bedrock zone(s) requiring hydraulic control.

The results of these simulations indicated that a single extraction well pumping at a rate of approximately 18 gpm in Layers 3, 4, and 5 (shallow, middle, and deep bedrock) should contain the shallow and deep bedrock ground-water within the regulatory plume downgradient of the Operations Area of the site. Figure

8 shows the resulting, simulated containment of ground-water particle paths tracked forward from key wells with ground-water regulatory exceedences in shallow and deep bedrock. Attachment 3 presents the pumping-induced head distribution in Layers 3 through 5, respectively.

It should be noted that the simulated capture zones and drawdown distributions are considered preliminary estimates of the actual pumping response that will be observed at the site. Fractured bedrock ground-water hydraulic conditions can be extremely complicated and are dominated by the spacing and connectedness of groups of fractures. The effectiveness of a ground-water extraction system in fractured media is strongly controlled, therefore, by the number of fractures intercepted by a pumping system, e.g., a well or group of wells. At the SRSNE Site, the bedrock fractures are primarily parallel to the gently eastward-dipping bedding, and therefore several water-bearing fractures should be intercepted by the proposed vertical pumping well. Nevertheless, the bedrock fracture characteristics vary from location to location. In practice, the hydraulic effectiveness of the proposed pumping well will need to be evaluated in the field during the Design Investigation. In the event that the NTCRA 2 pumping well is not found to provide sufficient bedrock ground-water containment during the design investigation, the NTCRA 2 design will be enhanced prior to NTCRA 2 implementation to improve the connection to the fractured bedrock. Potential design enhancements may include hydrofracting the pumping well borehole, installing additional bedrock extraction wells, and/or installing a fractured bedrock trench.

Assessment of NAPL Remobilization Potential and Influence on NTCRA 1 Compliance

The simulated vertical and horizontal hydraulic gradients near the downgradient border of the estimated potential NAPL zones in overburden and bedrock were evaluated to estimate the relative NAPL remobilization potential due to the proposed NTCRA 2 bedrock pumping well. Critical hydraulic gradients required to mobilize NAPL were estimated by Dr. Bernie Kueper using the measured physical characteristics of NAPL samples obtained at the site (BBL, November 1995) and the till and bedrock physical characteristics, which were quantified during the RI. These data were used to calculate: 1) the downward gradient required for a hypothetical NAPL pool to exceed the displacement pressure for the till layer overlying the bedrock, and 2) the horizontal gradient required for a hypothetical NAPL pool currently in the bedrock fractures to exceed the displacement pressure for the fracture and migrate laterally along the fracture.

Table 1 presents the pre-pumping horizontal and vertical hydraulic gradients and the estimated pumping hydraulic gradients based on the results of the MODFLOW model. To estimate the gradients that would result during bedrock ground-water pumping, the simulated head changes caused by pumping were superimposed on observed, pre-pumping head values measured at specific pairs of wells/piezometers. Thus, the MODFLOW model was used to estimate the change in heads (drawdown values) during pumping. The pre-pumping heads were selected to represent the strongest horizontal or downward hydraulic gradient, or the weakest historical upward gradient. As shown in Table 1, the estimated pumping gradients are similar to the observed pre-pumping gradients. None of the existing upward gradients are expected to reverse to a downward component due to the proposed bedrock pumping well (20 gpm near the MW-704 cluster). Based on the simulated gradient changes, we do not anticipate horizontal or vertical NAPL mobilization during pumping at the proposed pumping well (Kueper, pers. com. with M.J. Gefell, September 1997). Dr. Kueper's NAPL mobilization assessment will be presented as part of the NTCRA 2 Technical Memorandum.

In addition, BBL evaluated he simulated drawdown in the overburden adjacent to the south side of the

NTCRA 1 sheet-pile wall to assess the potential influence on NTCRA 1 Demonstration of Compliance. The NTCRA 1 compliance requirements require an inward head differential of at least 0.3 feet as measured at pairs of overburden compliance piezometers situated on either side of the sheet-pile wall. Assuming a bedrock ground-water extraction rate of 18 gpm at the location shown on Figure 8, the simulated drawdown in the overburden outside the sheet-pile wall are estimated as approximately 0.18 feet at piezometer CPZ-2 and 0.47 feet at piezometer CPZ-4. Simulated drawdowns inside the sheetpile wall were 0.05 feet at piezometer CPZ-1 and 0.03 feet at piezometer CPZ-3. While these results indicate a decrease in the inward head differential of approximately 0.13 feet at the CPZ-1/2 pair and 0.44 feet at the CPZ-3/4 pair, the typical head differences observed at these piezometer pairs are greater >0.8 feet and >2.5 feet, respectively. These modeling results suggest that the drawdown due to bedrock pumping should not affect the ability to demonstrate compliance with the NTCRA 1 reversal of gradient requirements.

Proposed NTCRA 2 Pumping Well Design and Piezometer Network

Pumping Well Design

The bedrock ground-water pumping well will be installed to extract bedrock ground water at the approximate location shown on Figure 8. Given the recognition of VOCs in the deep bedrock during the completion of the Remedial Investigation, BBL proposes to modify the pumping well design from the preliminary design considered in the Design and Study Work Plan (BBL, August 1996). In particular, the pumping well will need to extend approximately 90 feet into the bedrock (rather than the initially assumed depth of approximately 30 feet into rock) to contain deep bedrock ground-water. Given the increased depth and cost of installing the bedrock pumping well, a 12-inch, rather than 14-inch diameter pumping well borehole will be installed. A permanent, 12-inch diameter black steel casing will be grouted approximately 3 feet into the top of competent bedrock to seal off the overburden formation, and the 12-inch diameter extraction well borehole will be advanced to a depth of approximately 95 feet below the top of bedrock (approximately 170 feet total depth). This depth and diameter are consistent with the pumping well design simulated in the NTCRA 2 ground-water flow model. The depth to the top of bedrock will be verified during drilling based on the characteristics of the air-rotary drill cuttings. Drilling mud will not be used during the drilling of the pumping well borehole(s). The extraction well will be constructed as an open bedrock well, with an intake section extending from the bottom of the permanent 12-inch casing to the bottom of the bedrock borehole.

The proposed open bedrock design is consistent with the design of private bedrock wells in the region, and is considered appropriate for the NTCRA 2 pumping well. (The former Cianci Water Supply well, which was used to obtain bedrock fracture and ground-water quality data during the RI, had an open-bedrock intake section that extended from the top of bedrock to a depth of approximately 100 feet below the top of bedrock.) The open-bedrock pumping well design is fundamentally the same as the design presented in the Design and Study Work Plan (BBL, August 1996) except that, due to the substantial increase in depth, no well screen or riser will be installed in the pumping well borehole during the Design Investigation.

Bedrock Piezometer Network

The basic design of the NTCRA 2 piezometers was presented in the USEPA-approved DSWP.
Five shallow bedrock and two deep bedrock piezometers will be installed at the approximate locations shown on Figure 9 to provide hydraulic response data during the pumping test activities and NTCRA 2 implementation. These locations were selected to fill data gaps in the bedrock monitoring array,

particularly in the area downgradient of the proposed pumping well location, where the extent of the capture zone will be evaluated. In combination with the existing bedrock monitoring wells in the area, the proposed piezometer locations will provide an appropriate network to characterize the hydraulic response to bedrock pumping and the shape of the resulting capture zone. Shallow and deep bedrock piezometers will be installed to a depth of approximately 25 feet and 90 feet below the top of bedrock, respectively. Each new bedrock piezometer will be constructed with a 20-feet long, 2-inch diameter, 0.010-inch slot, Schedule 40 PVC screen and riser pipe. A Morie No. 0 or equivalent filter pack will be placed in the well/borehole annulus from the bottom of the piezometer screen to approximately two feet above the top of the screen, and the remainder of the annulus will be filled with bentonite to ground surface. The new bedrock pumping well and piezometers will be located by survey with respect to the existing site coordinate system established during the initial phases of the RI completed on behalf of USEPA (HNUS, May 1994). Vertical survey control will also be established for the ground surface and the top of riser at each new bedrock pumping well and piezometer.

The proposed locations for several piezometers are within the CL&P easement that crosses the Town Well Field Property (Figure 9). Access to these locations for drilling purposes will be subject to OSHA requirements regarding safe clearance from overhead, high-tension power lines. In addition, wet, soft ground conditions along the intermittent stream that crossed the Well Field will pose access limitations associated with rig mobility. Therefore, the proposed locations should be considered approximate only, and will need be verified in the field based on actual field conditions.

Summary

This Technical Memorandum provides the basis for the NTCRA 2 Design Investigation described in the USEPA-approved DSWP. Preliminary modeling results indicate that a bedrock ground-water extraction well with a 90-foot long open-bedrock interval pumping at approximately 18 gpm may be sufficient to intercept the plumes of dissolved VOCs downgradient of the Operations Area of the site, with minimal potential for NAPL remobilization and minimal influence on NTCRA 1 Demonstration of Compliance. The modeling results provide an understanding of the bedrock ground-water capture zone and the basis for the proposed bedrock piezometer network, which will be installed in the area around the proposed pumping well during the forthcoming Design Investigation. The results of the Design Investigation and a detailed discussion of the NTCRA 2 MODFLOW model design and calibration will be presented in the NTCRA 2 Technical Memorandum.

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TABLES

TABLE 1

SRSNE SITE
NTCRA 2

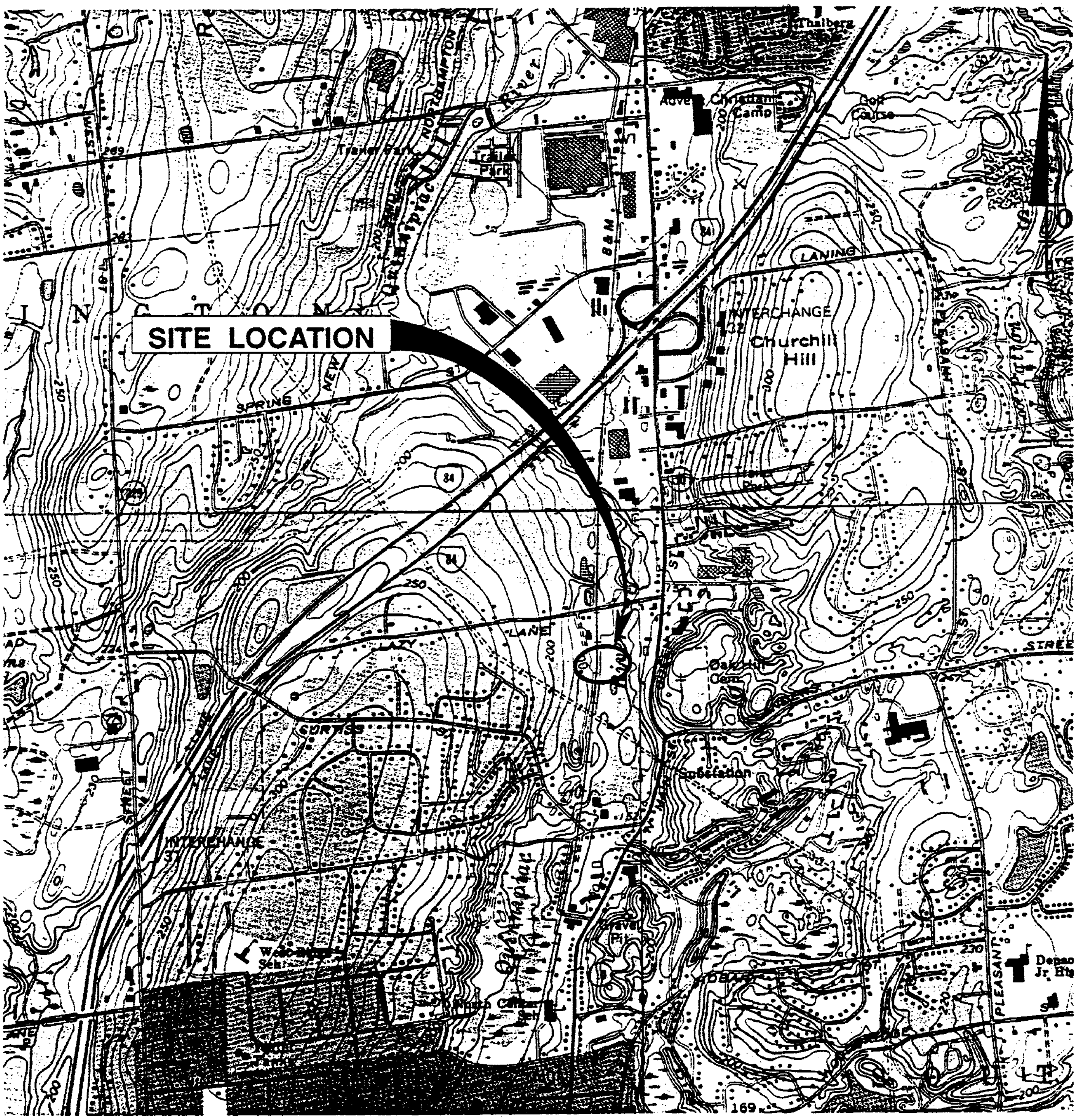
NAPL MOBILITY ASSESSMENT DUE TO SIMULATED PUMPING STRESSES

Well I.D.	Date	Observed Prepumping Head (ft AMSL)	A – B Distance (ft AMSL)	Observed Prepumping Gradient**	Simulated Prepumping Head (ft AMSL)	Simulated Pumping Head (ft AMSL)	Simulated Drawdown (ft)	Estimated* Pumping Heads (ft AMSL)	Estimated Pumping Gradient**
Bedrock Horizontal Gradient Assessment									
P-6	3/20/95	152.09	111.2	0.017	149.38	148.95	0.430	151.66	0.016
P-11A	3/20/95	150.19			148.61	148.25	0.360	149.83	
CPZ-3R	7/7/97	152.30	81.4	0.018	147.13	146.96	0.172	152.13	0.021
CPZ-4R	7/7/97	150.85			148.97	148.55	0.420	150.43	
Overburden/Bedrock Interface Vertical Gradient Assessment									
P-11B (OVB)	3/20/95	149.56	51.9	0.012	148.41	148.11	0.300	149.26	0.007
P-11A (Shall. Rock)	3/20/95	150.19			148.55	148.01	0.542	149.65	
MW-413 (OVB)	1/21/97	155.10	22.4	-0.151	148.42	148.39	0.028	155.07	-0.158
MW-414 (Shall. Rock)	1/21/97	151.72			148.70	148.52	0.183	151.54	
CPZ-4 (OVB)	1/21/97	151.20	40.0	0.055	150.54	150.07	0.470	150.73	0.042
CPZ-4R (Shall. Rock)	1/21/97	153.39			149.12	148.65	0.468	152.92	

Kv range for K1: 0.03 to 0.20 ft/day (Kv for deep overburden from model, KH/100).
Kv range for K2: 0.0018 to 0.0034 ft/day (from till sample vertical permeability results).
Kv for K3: 0.0018 ft/day (Kv for bedrock from model, KH/200).

Notes
This table reflects head conditions before and after pumping at a rate of approximately 20 gpm in Layers 3, 4, and 5 adjacent to bedrock wells MW-704R and MW-704DR.
* Estimated pumping heads determined by subtracting the simulated drawdown change from the observed prepumping heads.
** "-" indicates downward vertical gradient; vertical positive gradients are upward in this analysis.
Simulated drawdown during bedrock pumping estimated at key NTCRA 1 compliance piezometers include:
CPZ-1: 0.05 feet;
CPZ-2: 0.18 feet;
CPZ-3: 0.03 feet;
CPZ-4: 0.47 feet.
Therefore, the resulting changes in head differentials are estimated as -0.13 feet at the CPZ-1/CPZ-2 compliance pair, and -0.44 feet at the CPZ-3/CPZ-4 compliance pair.
These minor changes should not impact NTCRA 1 Demonstration of Compliance.

FIGURES



REFERENCE:
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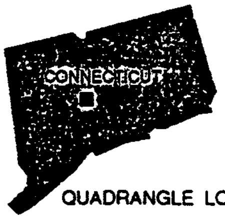
NEW BRITIAN, CONN. USGS QUAD. 1966 PR 1984, & BRISTOL, CONN. USGS QUAD 1967 PR 1984

APPROX. SCALE: 1" = 2000'



QUADRANGLE LOCATION

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NTCRA 2

SITE LOCATION MAP

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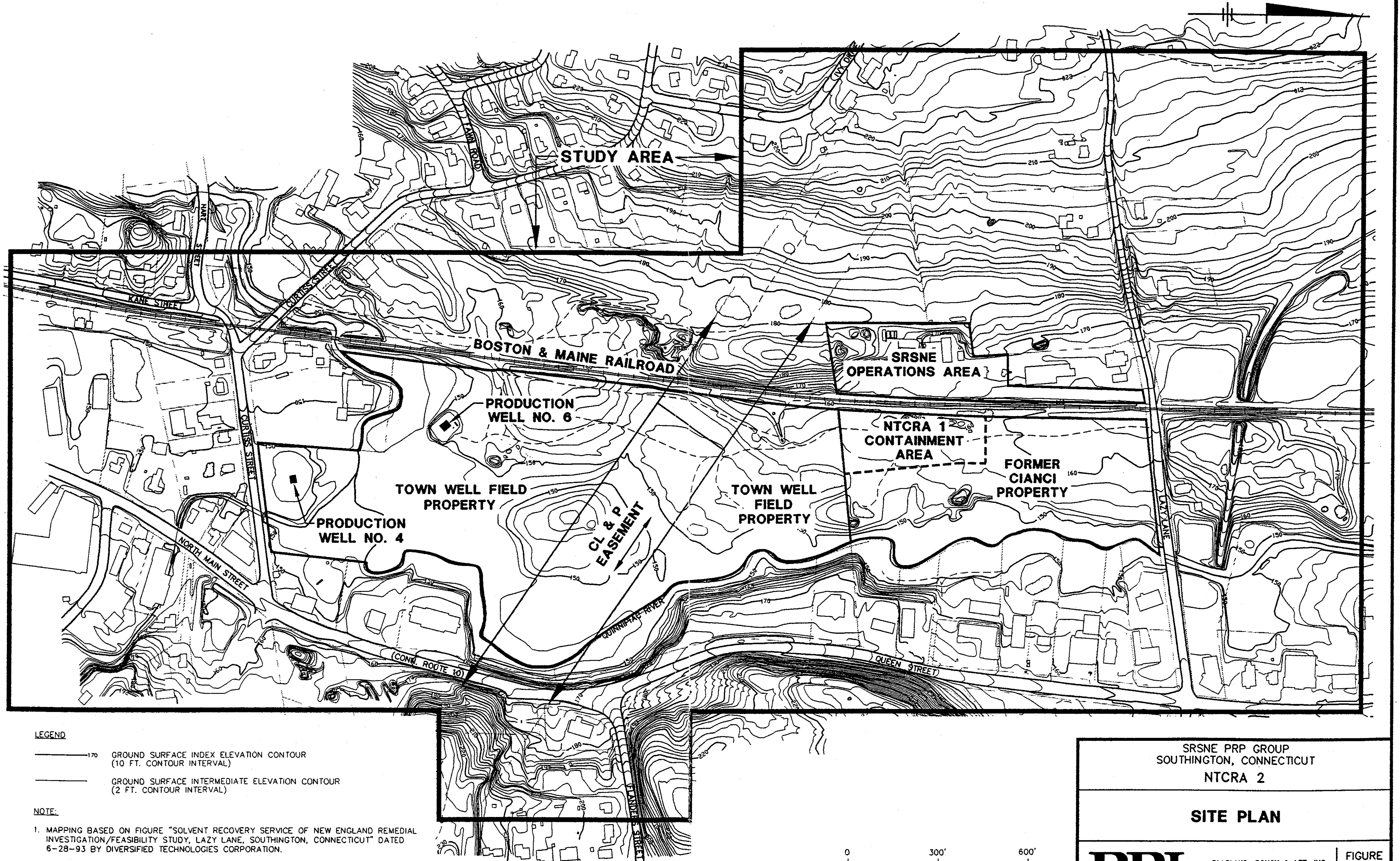
FIGURE
1

8/96 SYR D54-JVM PMC
08331096/08331N02.cdr



LEGEND

170 GROUND SURFACE INDEX ELEVATION CONTOUR (10 FT. CONTOUR INTERVAL)

GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

DJB08REF.PCP
X: 08325X00,08325X01:L: OFF: REF•,(XREF X01:PIPES)
8/12/96 SYR-54-DMW
08331011/08331G01.DWG

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SOUTHINGTON, CONNECTICUT
NTCRA 2

SITE PLAN

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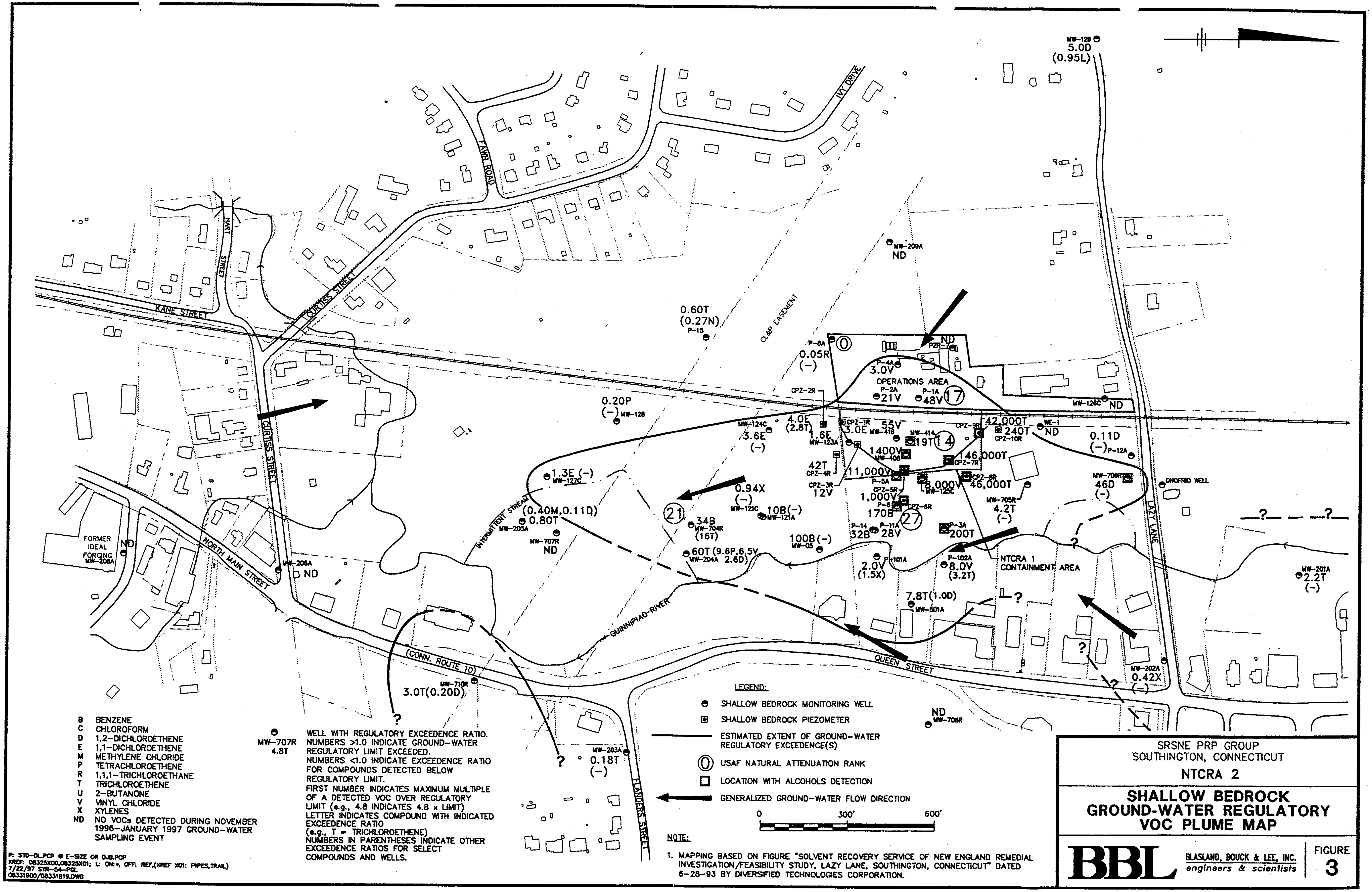
FIGURE
2



B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
M METHYLENE CHLORIDE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT

● MW-707R 4.8T — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 4.8 INDICATES 4.8 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

LEGEND:

● SHALLOW BEDROCK MONITORING WELL
▣ SHALLOW BEDROCK PIEZOMETER
— ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
⓪ USAF NATURAL ATTENUATION RANK
☐ LOCATION WITH ALCOHOLS DETECTION
← GENERALIZED GROUND-WATER FLOW DIRECTION

0 300' 600'

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

P: STD-DL.PCP @ E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01; L: ON:*, OFF: REF,(XREF X01: PIPES,TRAIL)
7/22/97 SYR-54-PGL
08331900/08331B19.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

SHALLOW BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP

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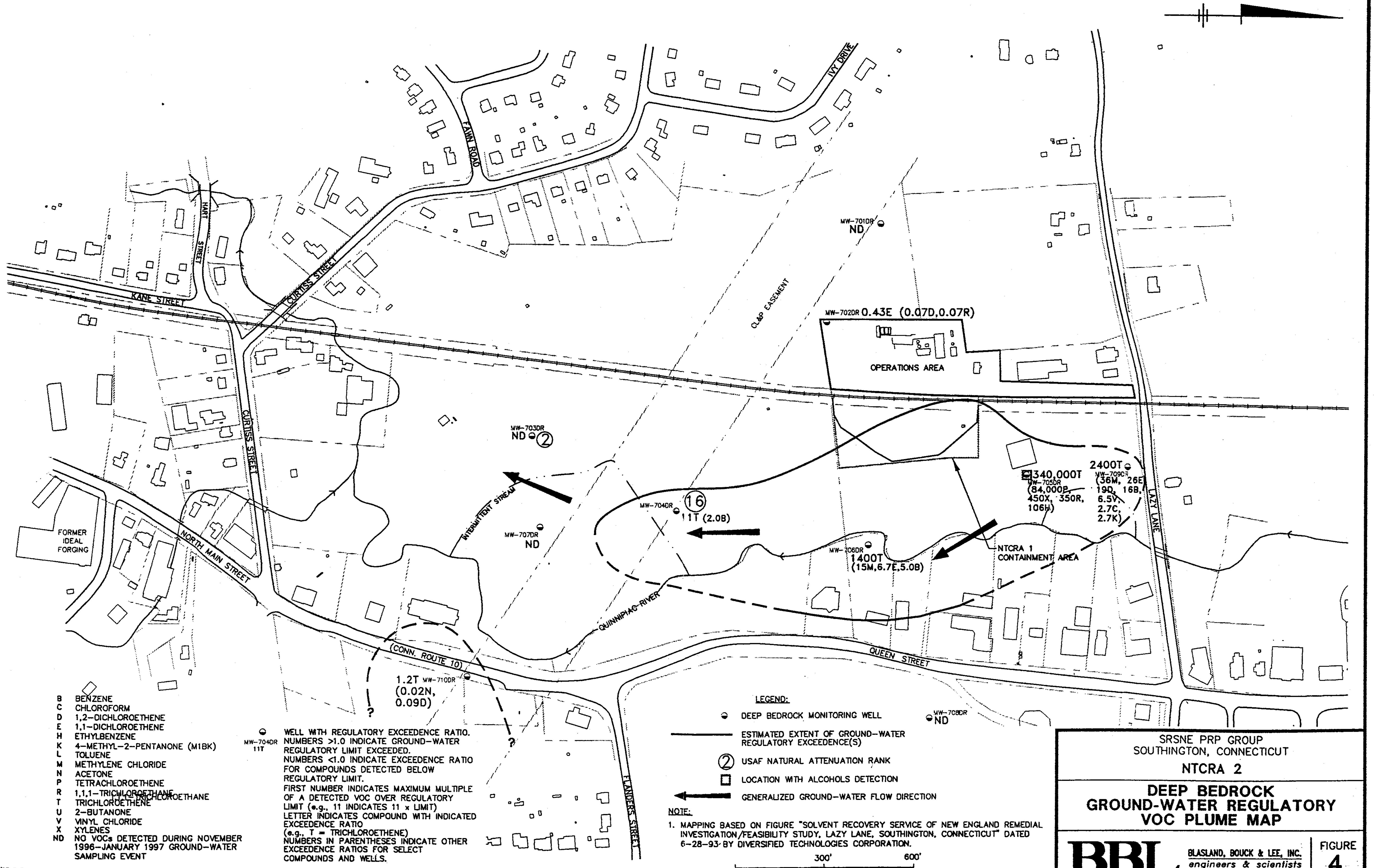
FIGURE
3



B	BENZENE
C	CHLOROFORM
D	1,2-DICHLOROETHENE
E	1,1-DICHLOROETHENE
H	ETHYLBENZENE
K	4-METHYL-2-PENTANONE (M1BK)
L	TOLUENE
M	METHYLENE CHLORIDE
N	ACETONE
P	TETRACHLOROETHENE
R	1,1,1-TRICHLOROETHANE
T	TRICHLOROETHENE
U	2-BUTANONE
V	VINYL CHLORIDE
X	XYLENES
ND	NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT

◒ MW-704DR 11T — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 11 INDICATES 11 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

LEGEND:

◒	DEEP BEDROCK MONITORING WELL
———	ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
②	USAF NATURAL ATTENUATION RANK
☐	LOCATION WITH ALCOHOLS DETECTION
◀━━	GENERALIZED GROUND-WATER FLOW DIRECTION

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

300' 600'

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NTCRA 2

DEEP BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP

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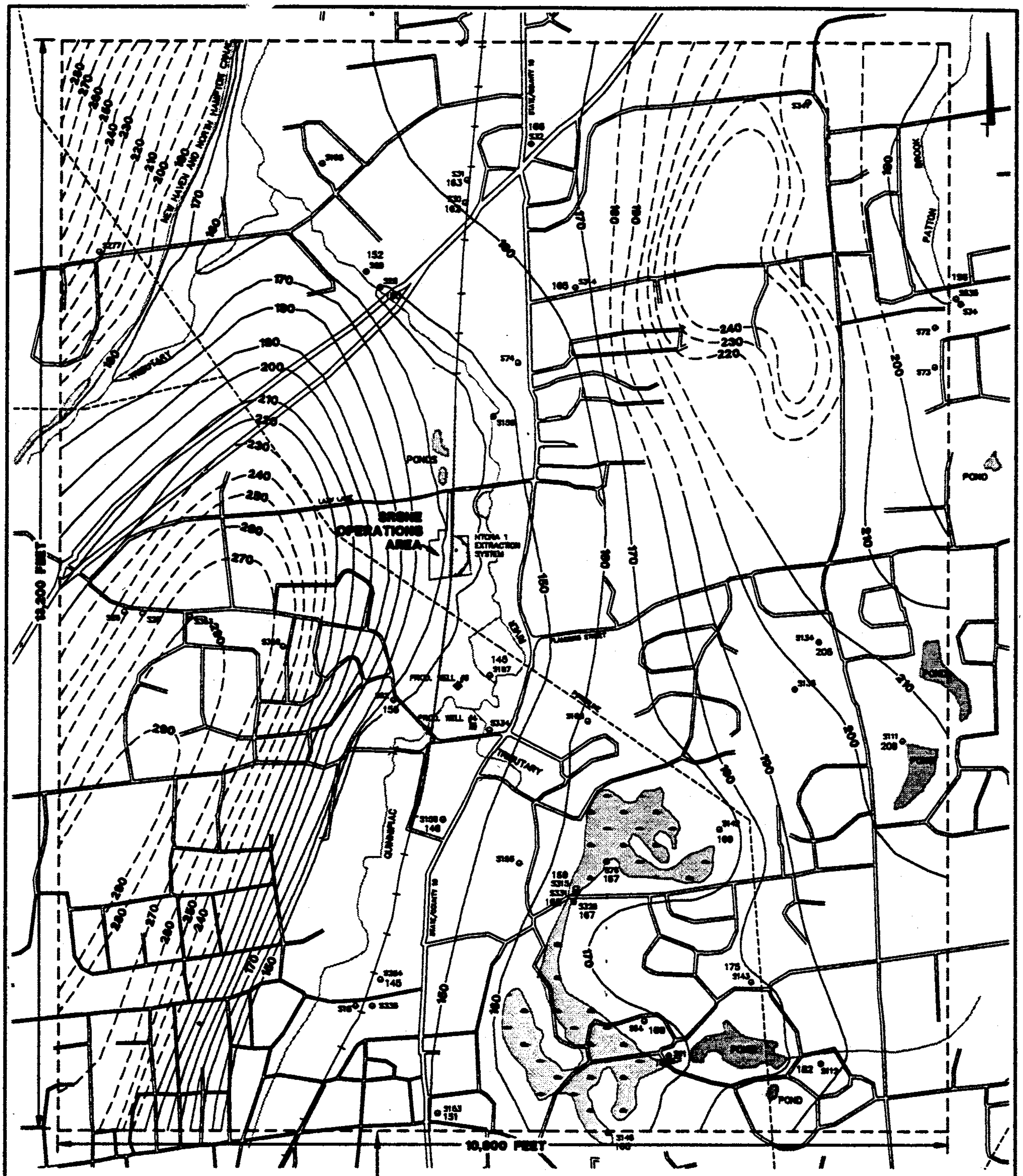
FIGURE 4

7/22/97 SYR-54-RLP,PGL X: 08325X00,08325X01.DWG
08331900/08331821.DWG P: STD-DL.PCP ● E-SIZE OR DJB.PCP



LEGEND

═══	STREET
───	RIVER OR STREAM
▨	POND
⬭	WETLAND
●	REGIONAL WELL/BORING
●	PRODUCTION WELL
•	NTCRA 1 RECOVERY WELL
182	WATER TABLE ELEVATION AT REGIONAL WELL (FT, AMSL)
170 ───	WATER TABLE ELEVATION CONTOUR LINE (FT, AMSL), 10-FOOT CONTOUR INTERVAL, DASHED WHERE INFERRED

0 1000' 2000'

GRAPHIC SCALE

EXTENT OF NTCRA 2 MODFLOW MODEL DOMAIN

NOTES:

1. BACKGROUND MAPPING COPYRIGHT 1995 AMERICAN DIGITAL CARTOGRAPHY, INC. BASED ON 1:100000 SCALE DIGITAL DATA AVAILABLE FROM THE US GEOLOGICAL SURVEY AND MEETS MAP ACCURACY STANDARDS FOR 1:100000 SCALE MAPS.
2. ALL WELL LOCATIONS ARE APPROXIMATE.
3. RI DATA MEASURED JANUARY 21, 1997 WERE USED TO INTERPRET THE WATER TABLE ELEVATION IN THE RI STUDY AREA.
4. REGIONAL WATER LEVEL DATA OBTAINED FROM MAZZAFERRO (1973) AND HAENI & ANDERSON (1980).

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NTCRA 2

MODEL DOMAIN AND MEASURED/ ESTIMATED REGIONAL WATER TABLE

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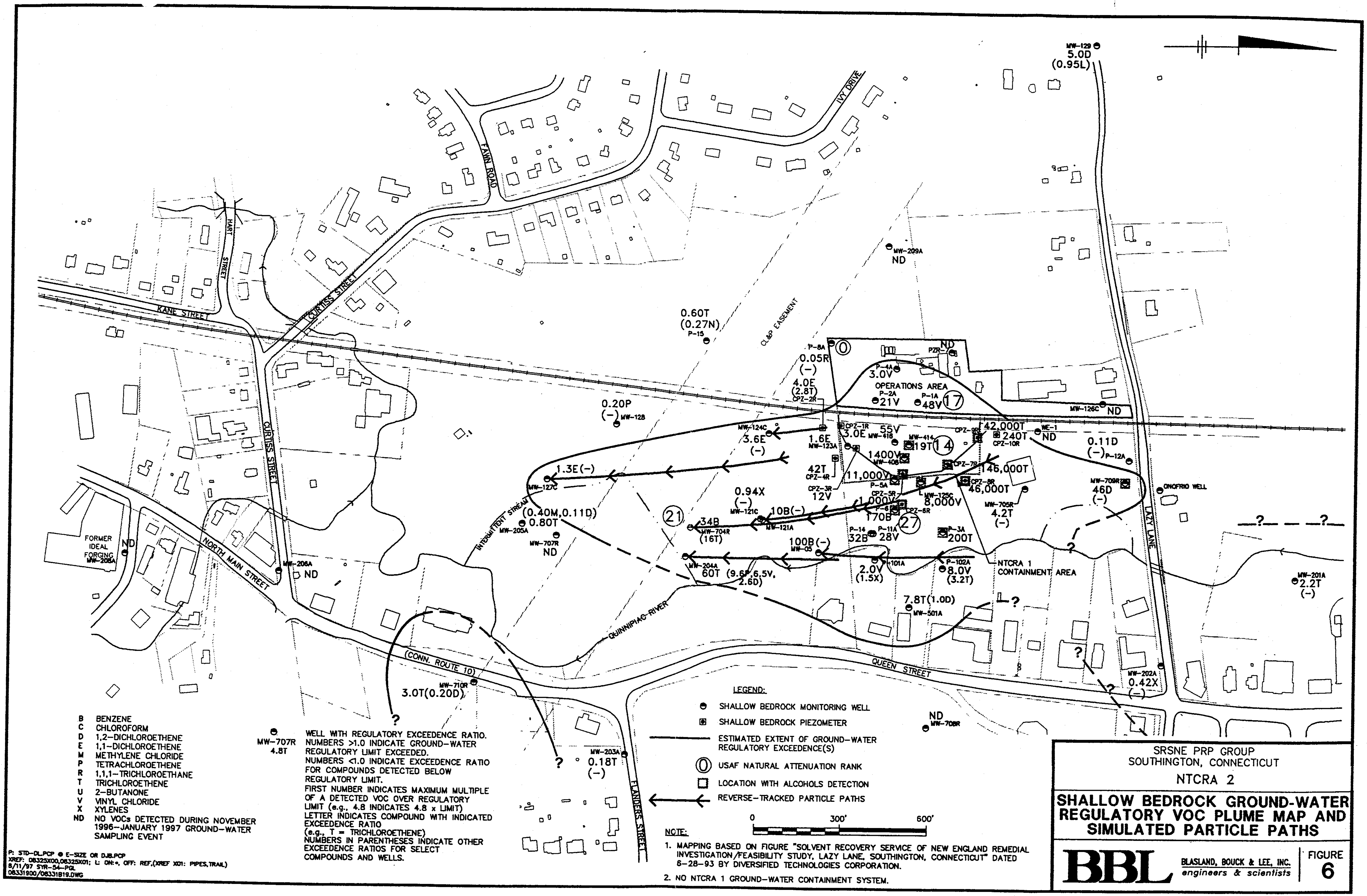
FIGURE
5

X: [illegible]
P: [illegible]
6/22/97 [illegible]
[illegible]



B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
M METHYLENE CHLORIDE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT

MW-707R
4.8T

WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 4.8 INDICATES 4.8 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

P: STD-DL.PCP ● E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01; L: ON:*, OFF: REF,(XREF X01: PIPES,TRAIL)
8/11/97 SYR-54-PGL
08331900/08331B19.DWG

LEGEND:

●	SHALLOW BEDROCK MONITORING WELL
▣	SHALLOW BEDROCK PIEZOMETER
───	ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
(0)	USAF NATURAL ATTENUATION RANK
☐	LOCATION WITH ALCOHOLS DETECTION
←─<	REVERSE-TRACKED PARTICLE PATHS

0 300' 600'

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. NO NTCRA 1 GROUND-WATER CONTAINMENT SYSTEM.

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

SHALLOW BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP AND SIMULATED PARTICLE PATHS

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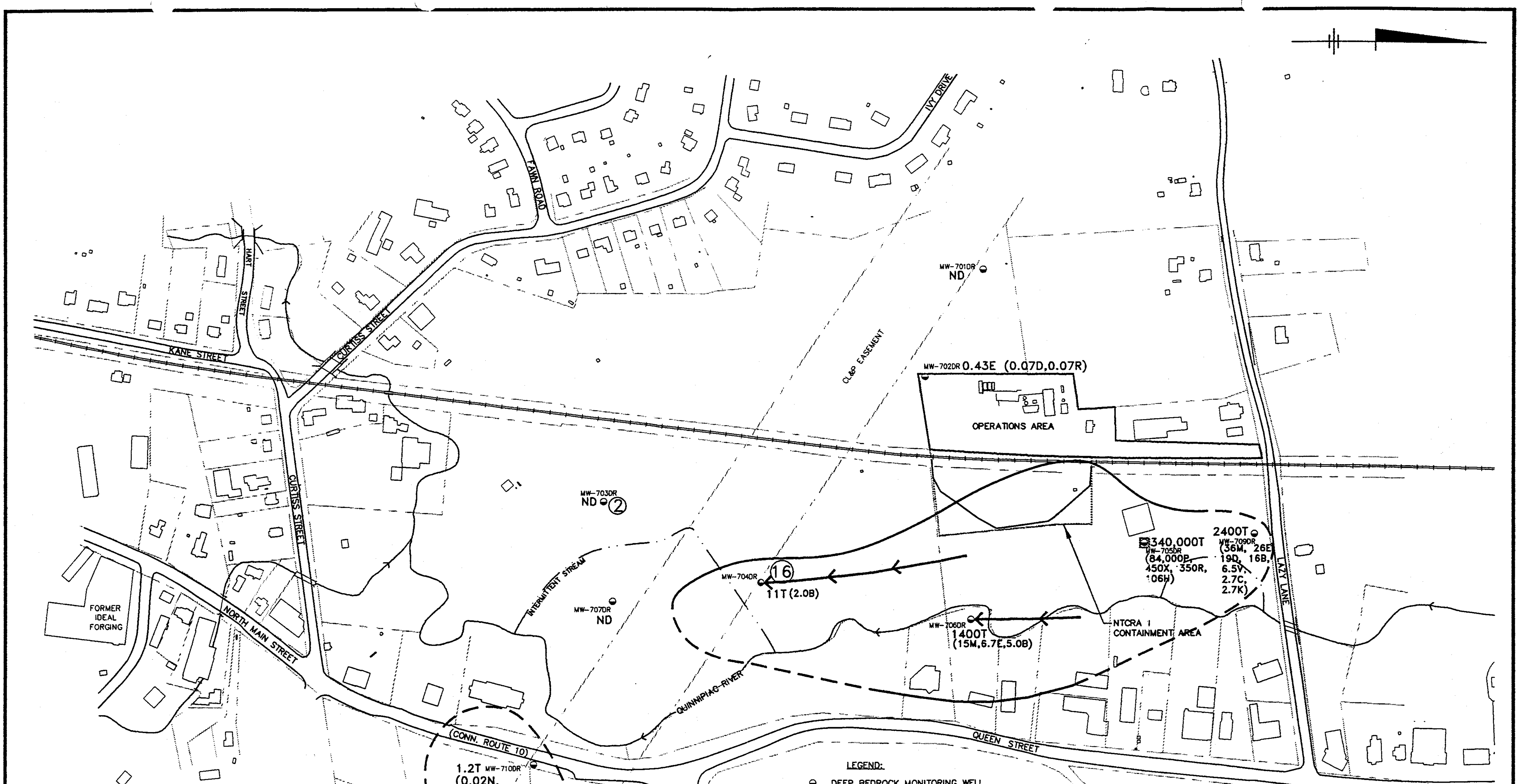
FIGURE
6



B	BENZENE
C	CHLOROFORM
D	1,2-DICHLOROETHENE
E	1,1-DICHLOROETHENE
H	ETHYLBENZENE
K	4-METHYL-2-PENTANONE (M1BK)
L	TOLUENE
M	METHYLENE CHLORIDE
N	ACETONE
P	TETRACHLOROETHENE
R	1,1,1-TRICHLOROETHANE
T	TRICHLOROETHENE
U	2-BUTANONE
V	VINYL CHLORIDE
X	XYLENES
ND	NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT

◓ MW-704DR 11T — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 11 INDICATES 11 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

LEGEND:

- ◓ DEEP BEDROCK MONITORING WELL
- ——— ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
- ② USAF NATURAL ATTENUATION RANK
- ☐ LOCATION WITH ALCOHOLS DETECTION
- ←—— REVERSE-TRACKED PARTICLE PATHS

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. NO NTCRA 1 GROUND-WATER CONTAINMENT SYSTEM.

0 300' 600'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

DEEP BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP AND SIMULATED PARTICLE PATHS

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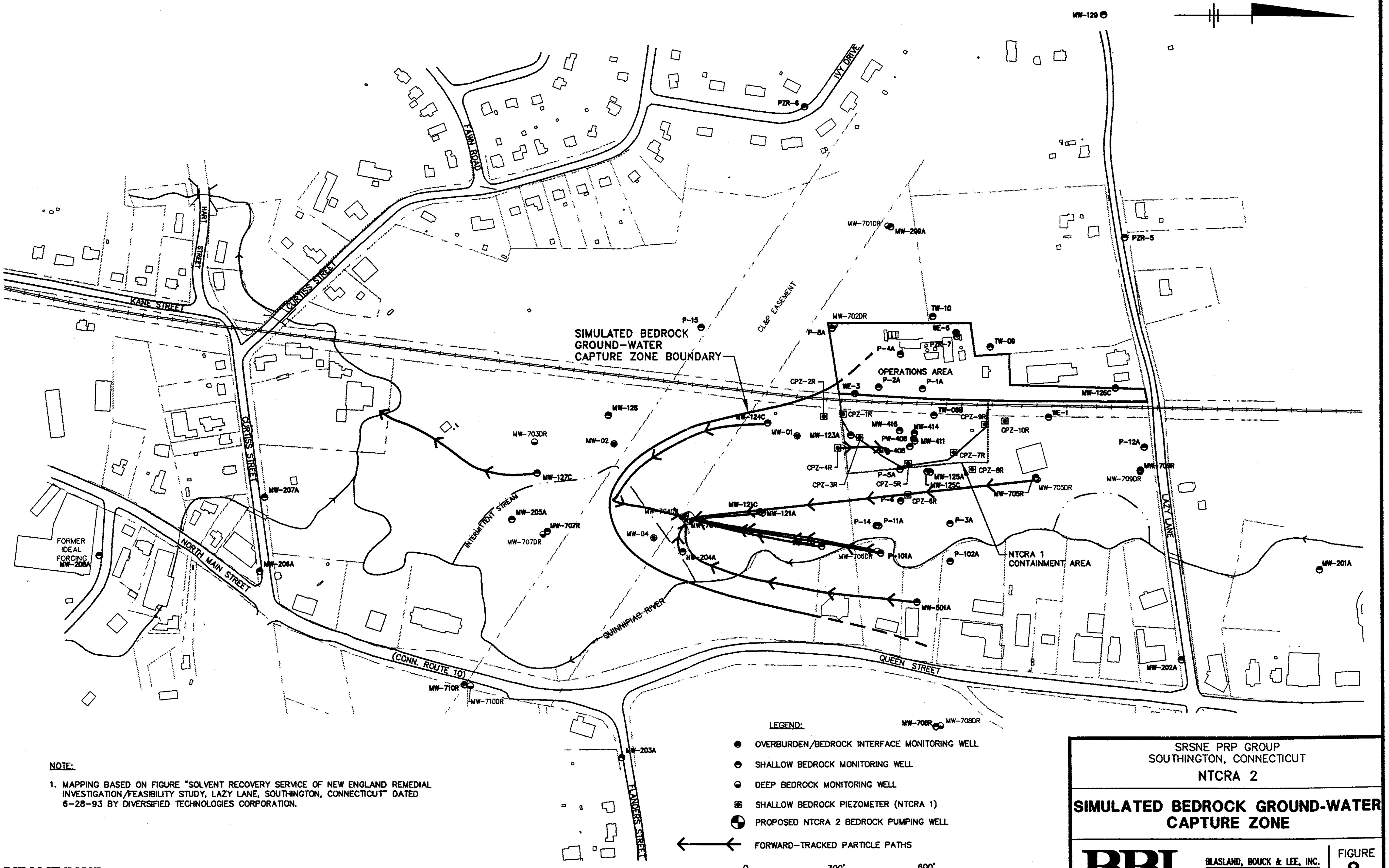
FIGURE
7

8/11/97 SYR-54-RLP.PGL X: 08325X00,08325X01.DWG
08331900/08331B21.DWG P: STD-DL.PCP ● E-SIZE OR DJB.PCP



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

SIMULATED BEDROCK GROUND-WATER CAPTURE ZONE

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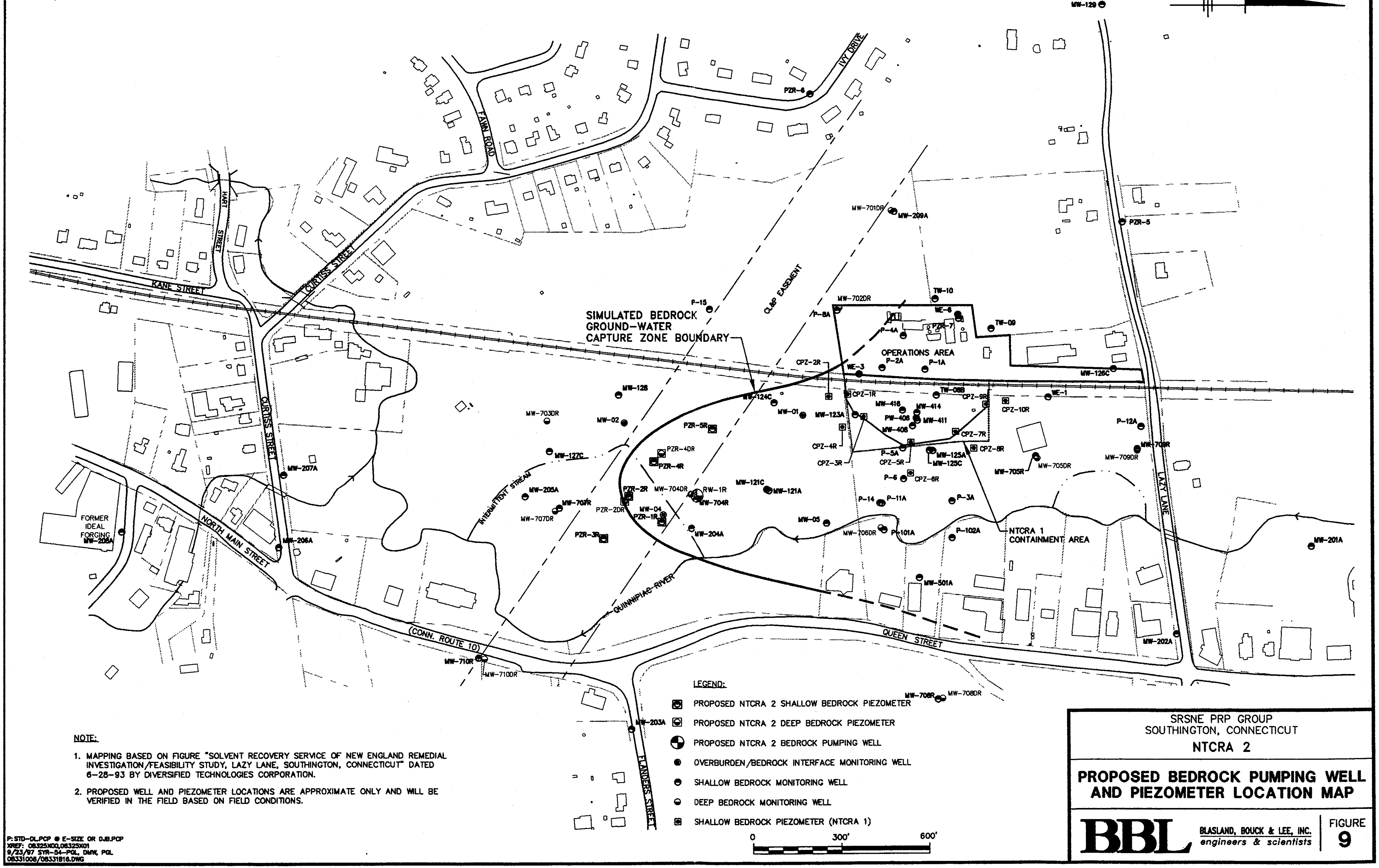
FIGURE
8

P:STD-DL.PCP ● E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01
9/22/97 SYR-54-PGL, DMW, PGL
08331008/08331B15.DWG



LEGEND:

- ◙ PROPOSED NTCRA 2 SHALLOW BEDROCK PIEZOMETER
- ◙ PROPOSED NTCRA 2 DEEP BEDROCK PIEZOMETER
- ◕ PROPOSED NTCRA 2 BEDROCK PUMPING WELL
- ● OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
- ● SHALLOW BEDROCK MONITORING WELL
- ◒ DEEP BEDROCK MONITORING WELL
- ◙ SHALLOW BEDROCK PIEZOMETER (NTCRA 1)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. PROPOSED WELL AND PIEZOMETER LOCATIONS ARE APPROXIMATE ONLY AND WILL BE VERIFIED IN THE FIELD BASED ON FIELD CONDITIONS.

P:STD-DL.PCP ● E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01
9/23/97 SYR-54-PGL, DMW, PGL
08331008/08331B16.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

PROPOSED BEDROCK PUMPING WELL AND PIEZOMETER LOCATION MAP

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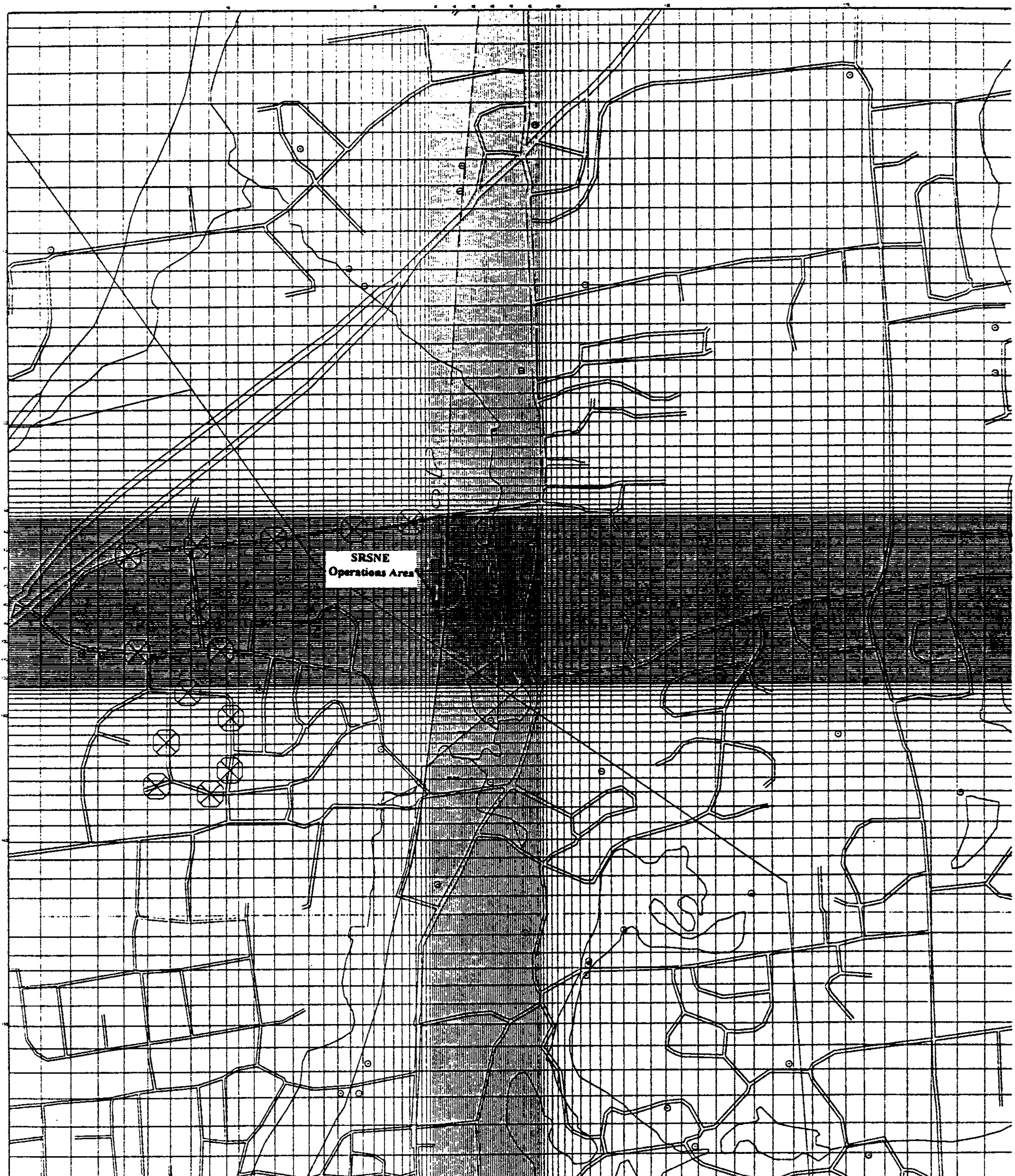
FIGURE
9

ATTACHMENT 1

PLAN VIEW AND SCHEMATIC CROSS-SECTION OF MODEL GRID

Plan View of the Model Grid



SRSNE SITE
SOUTHINGTON, CONNECTICUT
NTCRA2 MODFLOW MODEL
MODEL LAYER STRUCTURE

Layer 1 (Outwash)

- unconfined
- estimated saturated thickness: 0 to 120 ft.
- designated inactive where saturated thickness equals 0 ft.
- heterogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 2 (Till and Coarse Drift)

- confined/unconfined (convertible)
- estimated saturated thickness: 0 to 50 ft.
- designated inactive where saturated thickness equals 0 ft.
- heterogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 3 (Shallow Bedrock)

- confined/unconfined (convertible)
- uniform thickness: 30 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 4 (Middle Bedrock)

- confined/unconfined (convertible)
- uniform thickness: 30 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 5 (Deep Bedrock)

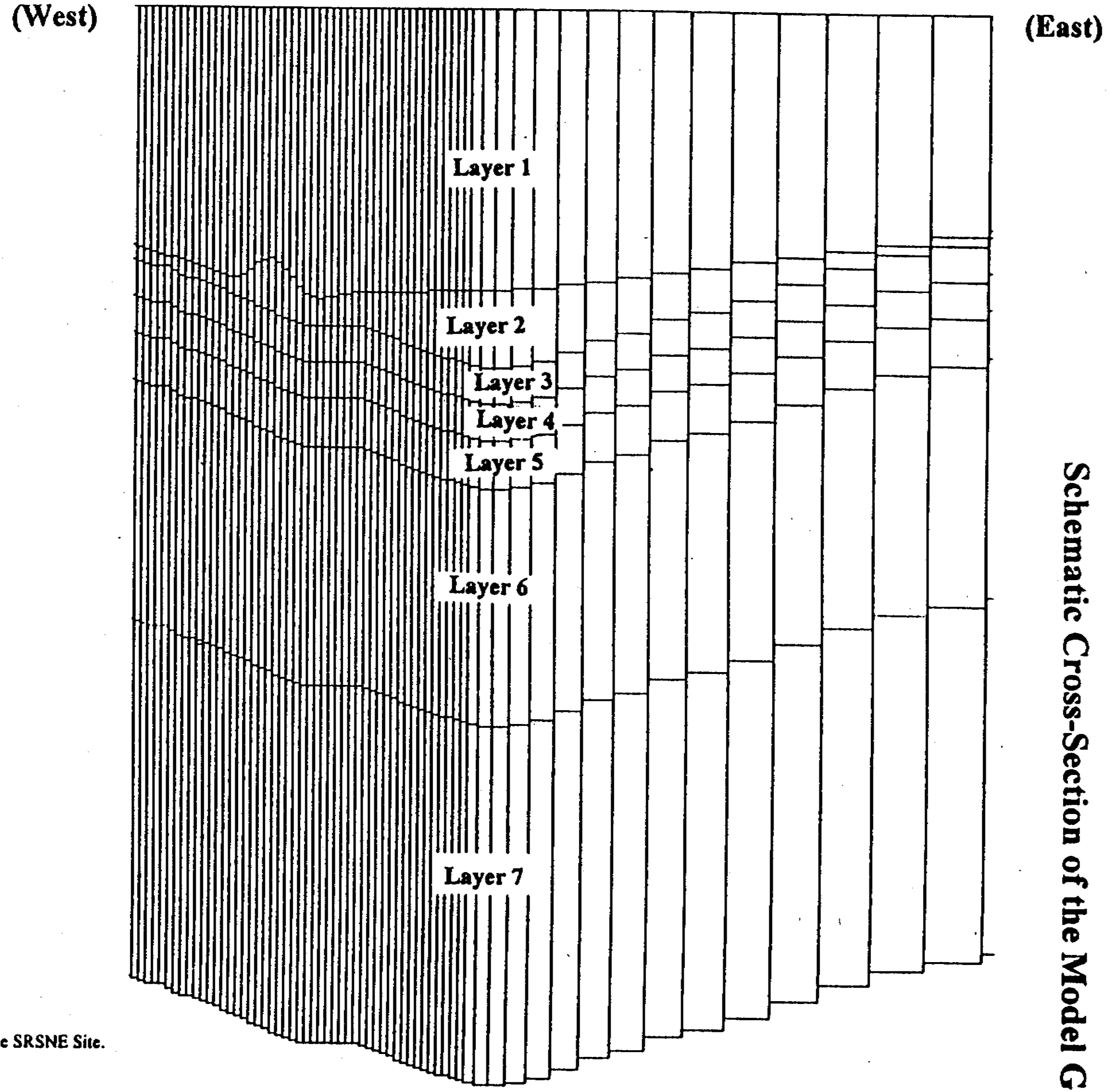
- confined/unconfined (convertible)
- uniform thickness: 40 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 6 (Deeper Bedrock)

- confined/unconfined (convertible)
- uniform thickness: 200 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 7 (Deeper Bedrock)

- confined/unconfined (convertible)
- uniform thickness: 300 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

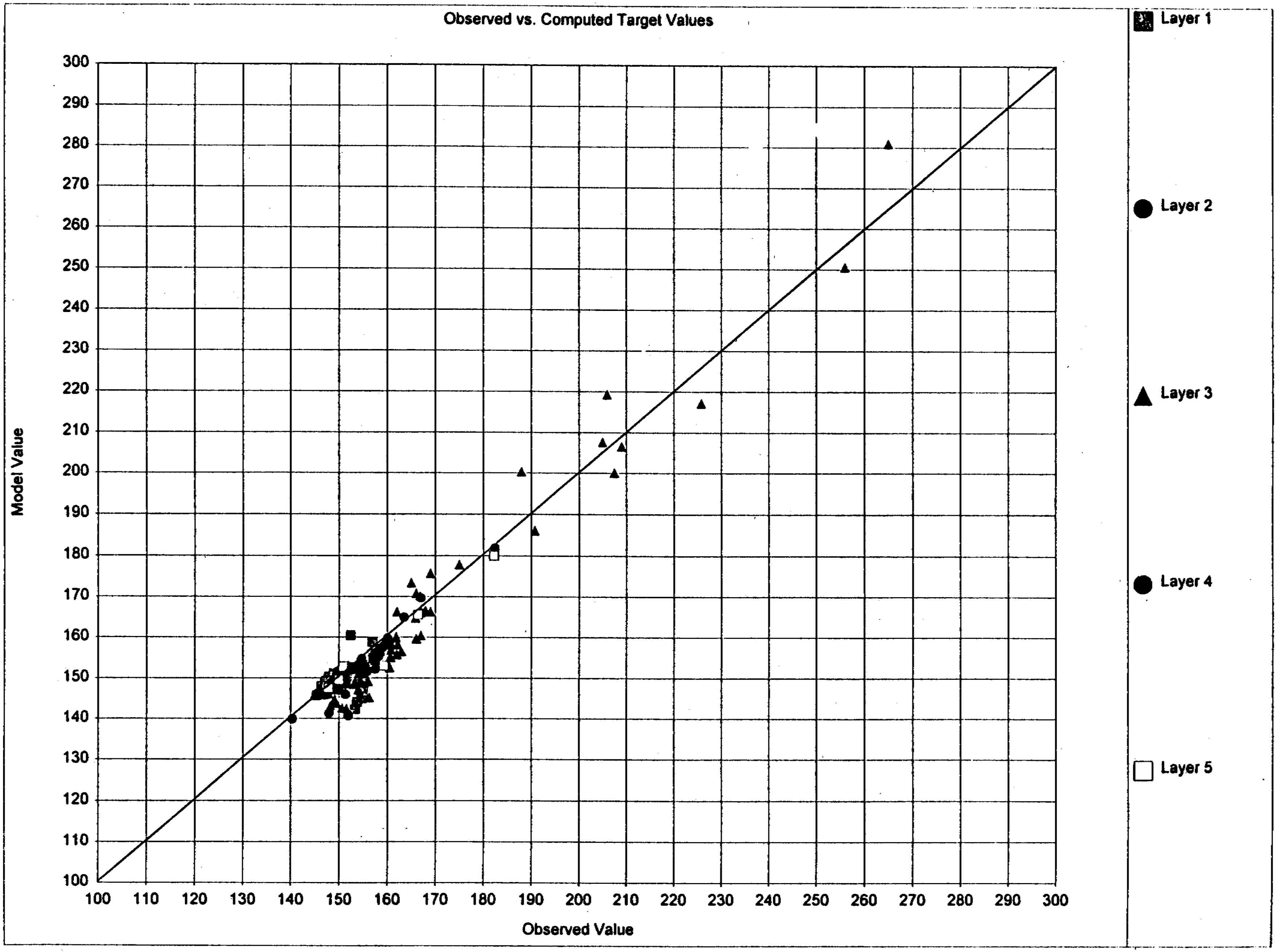


Schematic Cross-Section of the Model Grid

Note: Figure represents the central position of the model grid in east-west cross-section through the SRSNE Site.

ATTACHMENT 2

CALIBRATION SUMMARY PLOT

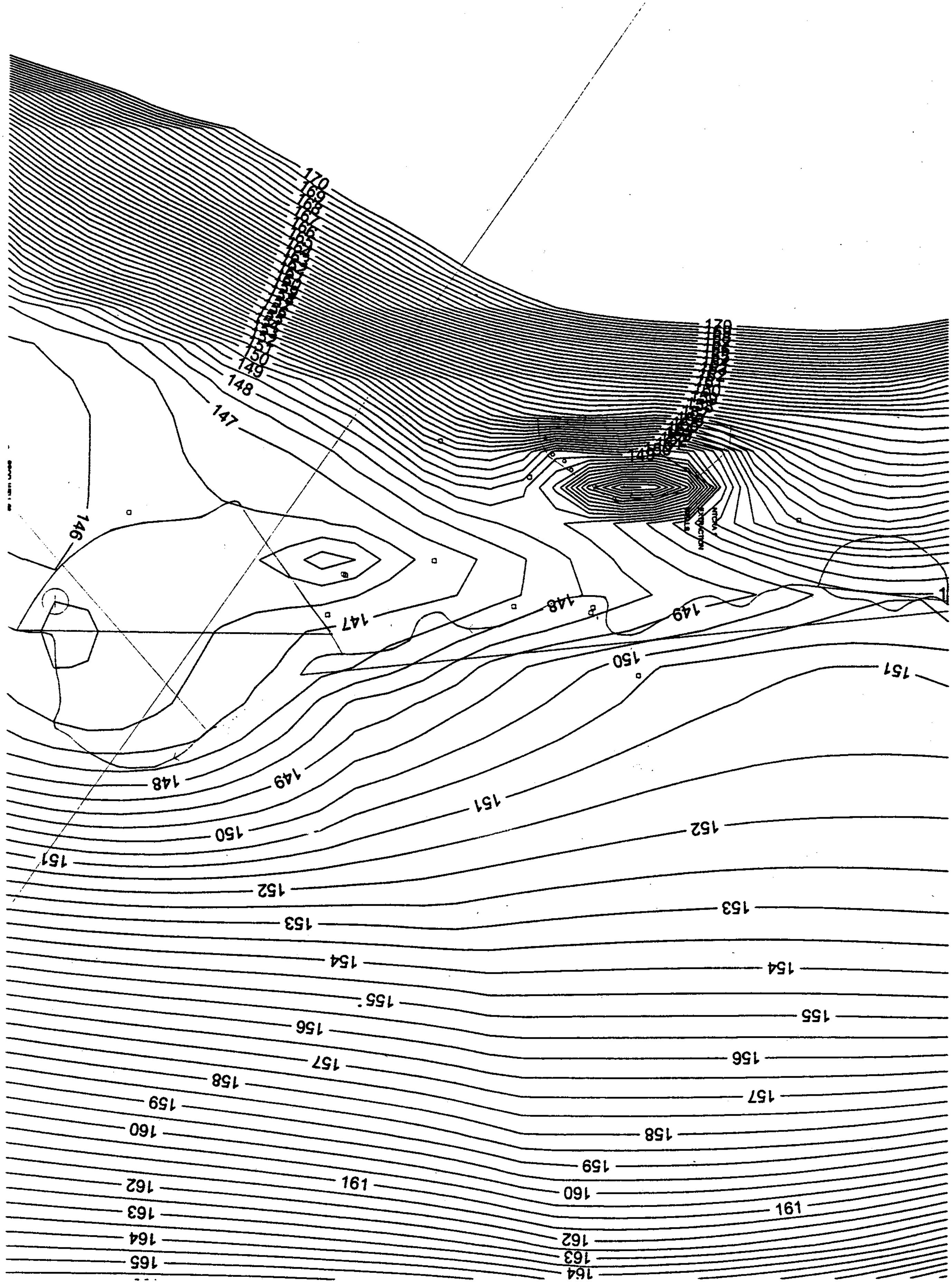


Calibration Summary Plot

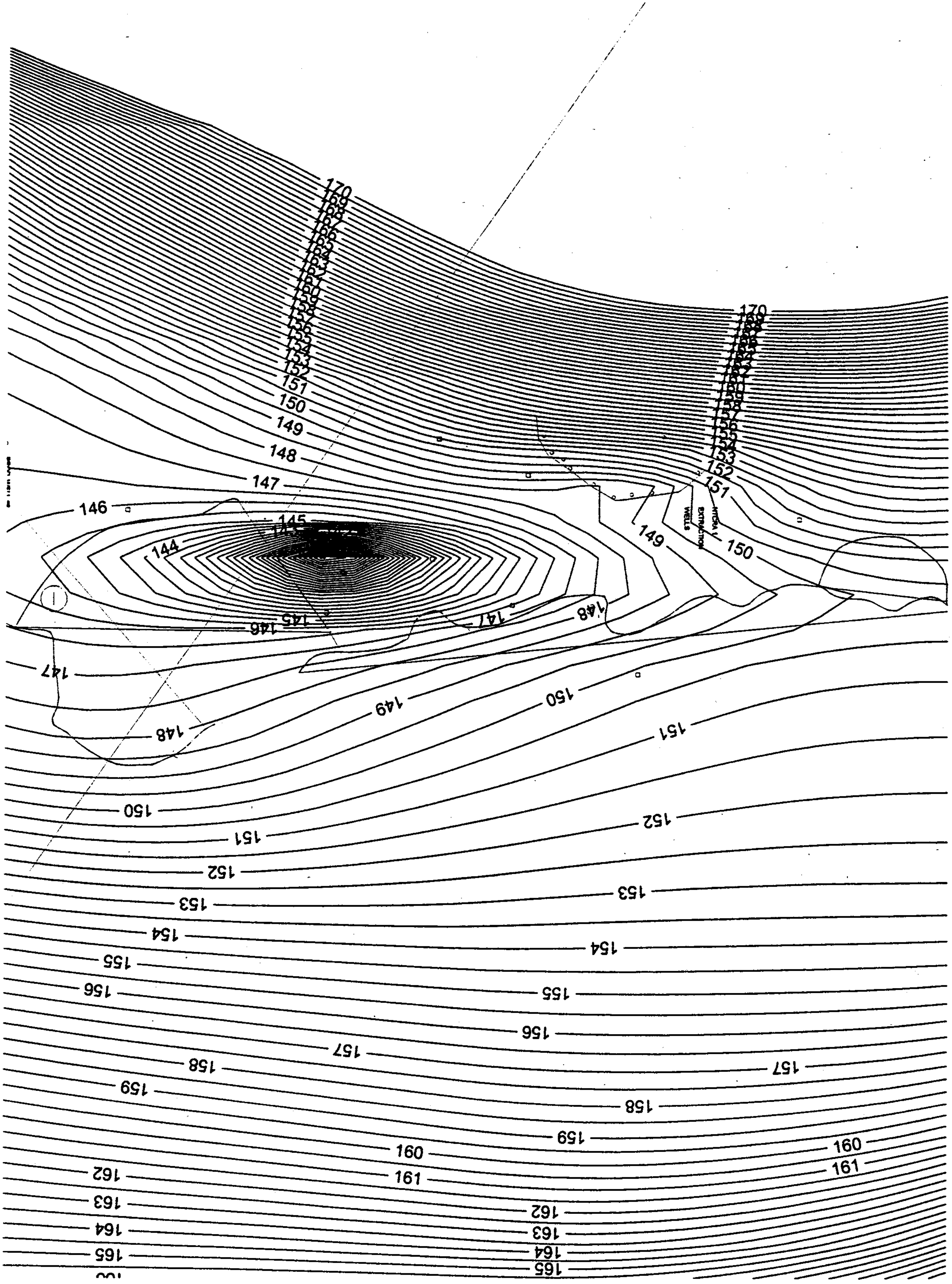
ATTACHMENT 3

SIMULATED HEADS IN LAYER 3 THROUGH 5

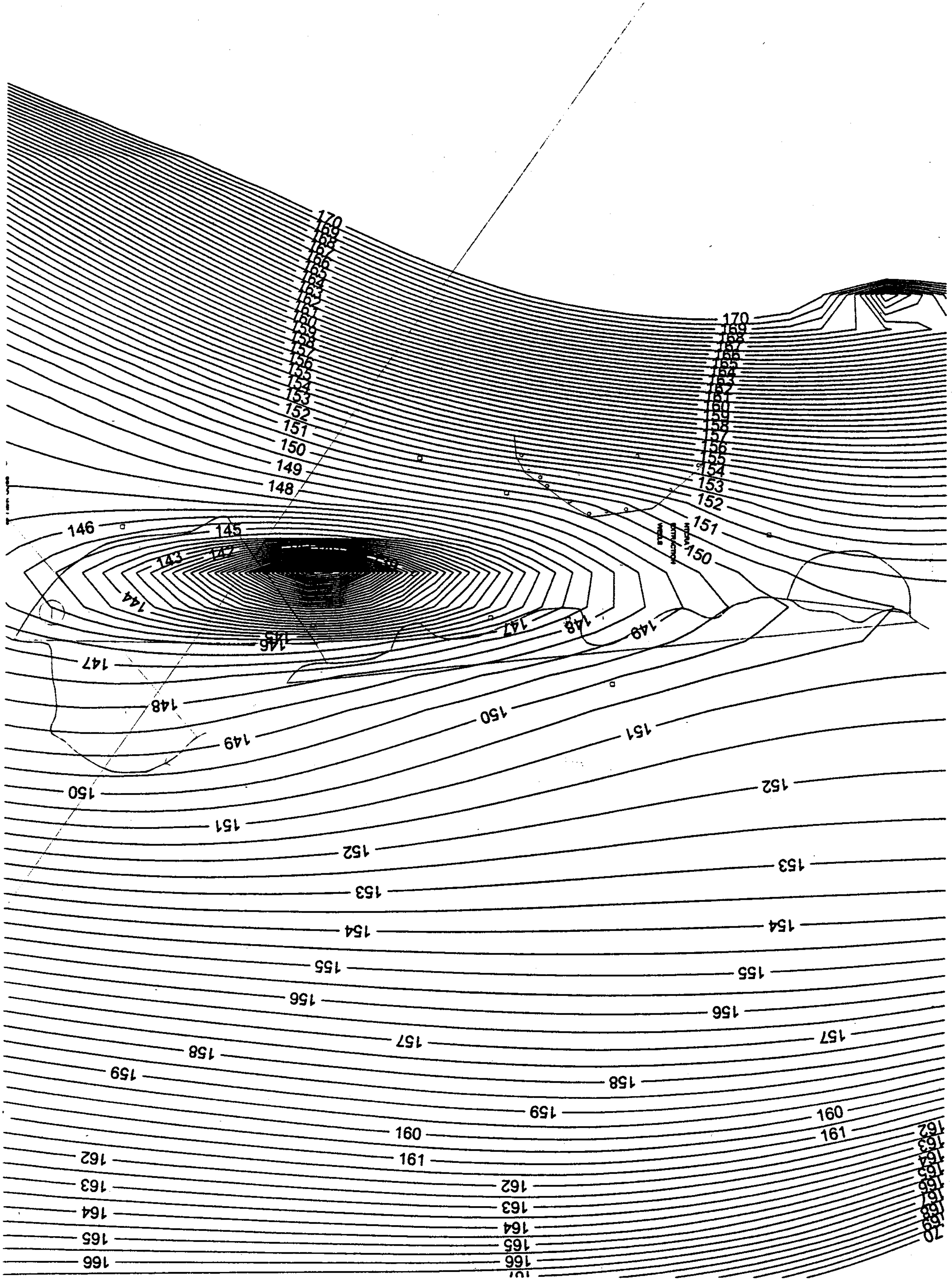
Simulated Layer 3 Heads



Simulated Layer 4 Heads



Simulated Layer 5 Heads



Appendix S

Evaluation of Potential Biological Impacts of Enhanced In Situ Bioremediation Following Hydraulic Displacement

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DRAFT

EVALUATION OF POTENTIAL BIOLOGICAL IMPACTS OF ENHANCED IN SITU BIOREMEDIATION FOLLOWING HYDRAULIC DISPLACEMENT

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC., SUPERFUND SITE SOUTHINGTON, CT

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GeoSyntec Project Number TR0119
22 June 2004

Disclaimer

This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

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1. INTRODUCTION

This remedial alternative for the Observed Non-aqueous Phase Liquid (NAPL) in Overburden Groundwater Unit (Alternative ONOGU-3) involves the sequential application of hydraulic displacement and enhanced in situ bioremediation (EISB) as the proposed remedial option at the Solvents Recovery Service of New England Inc., (SRSNE) Superfund Site in Southington, CT (the Site). This proposed remedial alternative involves the use of hydraulic displacement as the primary treatment step to extract some mobile dense non-aqueous phase liquid (DNAPL) and to convert the rest to residual, immobile form. Appendix I describes the proposed implementation of hydraulic displacement at the Site. The application of hydraulic displacement would take approximately 180 days to complete. It is assumed that the initial treatment technologies will remove any pooled NAPL mass and that only residual NAPL will remain for enhanced in situ bioremediation (EISB) treatment. This appendix presents how EISB would be applied for Alternative ONOGU-3, specifically, how hydraulic displacement may improve the effectiveness of a subsequent application of EISB. Appendix G (EISB) provides a review of the applicability of EISB as a remedial technology for the Site and Appendix H (Biodegradation Mechanisms) provides a review of the common microbial processes that can result in biodegradation of select Site chemicals.

The use of hydraulic displacement is expected to remove as much as 44% of the DNAPL mass from the ONOGU. Hydraulic displacement is, therefore, expected to be applied as a partial mass removal technology with EISB used as a polishing step to cost-effectively treat the remaining residual DNAPL.

The remainder of this section presents a brief description of the hydraulic displacement technology (Section 2), a review of the impact of hydraulic displacement on microorganisms (Section 3) and a review of the site specific technical considerations as they apply to the Site (Section 4).

2. SUMMARY OF HYDRAULIC DISPLACEMENT AS A REMEDIAL TECHNOLOGY

As discussed in detail in Appendix I (Hydraulic Displacement), the application of hydraulic displacement as a means to recover NAPL is an established technology. Displacement options include bailing or pumping of single wells to large extraction systems designed to extract large volumes. The effectiveness of removal is increased if water can be injected and differential gradient pressures used to accelerate pool movement and recovery. The objective of the application of hydraulic displacement is to remove some pooled NAPL, and convert the remaining NAPL pools to small, immobile droplets (residual NAPL) as a means to reduce NAPL mass and eliminate NAPL mobility. In essence, this technology is very similar to pump and treat technology applications. After the hydraulic displacement treatment is complete, there will only be residual NAPL remaining.

The basic physical properties and calculations required to mobilize NAPL are provided in Appendix I. The hydraulic displacement treatment step will involve injecting and extracting water at a rate of approximately 100 gallons per minute for a period of approximately 180 days to create a head differential and cause displacement of pooled NAPL remaining in the subsurface. After the hydraulic displacement process is complete, the ONOGU will be monitored until it stabilizes with respect to groundwater chemical concentrations and hydraulic gradients. After the stabilization period, the level of bioremediation that is occurring will be evaluated.

3. IMPACTS OF HYDRAULIC DISPLACEMENT ON BIOREMEDIATION

The application of hydraulic displacement is unlikely to cause significant or permanent lasting effects on the indigenous microbial populations at the Site. In fact, the removal of pooled NAPL and conversion to residual will most likely increase the natural degradation rate, by significantly increasing the surface area of the remaining NAPL within the ONOGU. Hydraulic displacement that uses highly aerobic water could negatively impact the application of EISB by temporarily raising the reduction–oxidation potential and by the introduction of oxygen. The halorespiring microorganisms generally require reduced conditions to function, and their exposure to oxygen will cause their death. However, the negative impacts of raised oxidation potential and oxygen levels should be short-term effects.

As indicated in Appendix G (EISB), specific halorespiring microorganisms are required to carry out complete dechlorination of the chlorinated ethenes to ethene, in the presence of a suitable electron donor (e.g., ketones, TEX [toluene, ethylbenzene, xylenes] and alcohols). Several field demonstrations have shown the utility of bioaugmentation to improve the application of EISB technology (Ellis et al., 2000; Lendvay et al., 2003; Major et al., 2002). Bioaugmentation can significantly reduce the time to reestablish activity (from years to weeks) and, therefore, reduce the flux from any remaining NAPL phases. It is assumed for this option that bioaugmentation will be applied to the Site.

4. PROPOSED APPLICATION OF EISB AS PART OF ALTERNATIVE ONOGU-3

The information presented in Appendix G (EISB) demonstrates that under the current Site conditions (up to June 2003), without the addition of supplemental electron donors, there is evidence that biological degradation of the Site chemicals is promoting the enhanced dissolution of DNAPLs over what would be expected based solely on abiotic dissolution mechanisms. Therefore, it is reasonable to expect that the dissolution rate can be maintained, and potentially be enhanced by adding additional suitable electron donors to the groundwater, and that EISB can be used as a follow on remedial technology to continue the enhanced removal of NAPL residuals that remain after the application of hydraulic displacement.

As described in Appendix I (Hydraulic Displacement) the water flooding will involve the addition of water to create gradients sufficient to displace all NAPL pools greater than 1 meter. After the hydraulic displacement is complete, the ONOGU will be monitored until it stabilizes with respect to groundwater chemical concentrations and hydraulic gradients.

The infrastructure installed as part of the hydraulic displacement option will be used for EISB. Additional wells may need to be added to optimize the distribution of electron donor and bacterial cultures. The electron donor and bacterial culture will be diluted and dispersed into the treatment area via the extraction and re-injection of Site groundwater using the extraction and injection well networks.

Excess donor is delivered initially to provide appropriate coverage of the ONOGU treatment area. The total volume of the treatment zone requiring re-amendment with oil is expected to decrease substantially after year five. Additionally, biomass that has built up in the first five years will decay and serve as an electron donor.

The principal cost of EISB is the electron donor as it will be added periodically. The selected electron donor will be emulsified soybean oil (oil), and it will be added so that 1% (on average) of the effective pore volume within the ONOGU treatment area will contain oil. The amount of electron donor, in this case, emulsified soybean oil, is based on the likely range of biodegradation rates and their impact on the enhanced loading rate of the Site chemicals during the application of EISB, the stoichiometric amount of oil required to meet the loading rate of Site chemicals to promote their complete dechlorination, and a safety factor to account for loss of electron donor to competing microbial processes (i.e., less than 100% of the electron donor is used during the reduction of chlorinated solvents). As discussed in Appendix G (EISB), additional electron donor injection wells may be added to achieve a more uniform electron donor distribution, but this will be part of the detailed design process. For the purposes of evaluation, an initial application of 1% oil to the ONOGU treatment area would be applied for all EISB options, regardless of initial starting mass variations. This application would be repeated in years three and five. Amounts and distribution of any subsequent application would be adjusted based on consumption rates and after any review of any observed distribution of chlorinated volatile organic compounds (cVOCs) in the ONOGU that may be present after year seven. Table 1 summarizes the major costs associated with the EISB component of Alternative ONOGU-3.

The following sections review factors that might affect the performance of the proposed technology design (Sections 4.1 through 4.5).

4.1 Technology Demonstrations at Comparable Sites or Scale

The information provided in Appendix G (EISB) clearly identify that EISB is likely already occurring on a large scale at the Site. These lines of evidence support the application of EISB as a component of the Site remedy. As noted above, EISB at the Site is intended to act as follow on treatment process.

4.2 Risks and/or Benefits of Implementation

The risks and benefits of implementing EISB are summarized below.

Risks:

- Once EISB is established there may be an increase in the dissolution rate. This rate may overwhelm the ability of microorganisms to completely dechlorinate the Site chemicals until their population densities increase. This could result in the short-term production of intermediate degradation compounds like vinyl chloride. However, this risk is mitigated by bioaugmentation to increase cell densities of key halorespiring microorganisms, and by use of the non-time critical removal action (NTCRA-2) containment system.

- Methane will be produced as a by-product of microbial activity. Systems will need to be designed to ensure methane is handled appropriately. Methane production (methanogenesis) is not typically associated with NAPL residuals of chlorinated ethenes as elevated concentrations of chlorinated ethenes inhibit methanogenesis.

- EISB may not enhance current degradation rates. There are already reliable indications that enhanced degradation is occurring. So, at minimum, electron donor addition is expected to sustain the current degradation process. Lack of enhancing (increasing) the degradation rate would, therefore, has little impact other than extending remedial time frames.

- Biofouling of wells may occur. This could lead to increased costs associated with well rehabilitation.

- Mobilization of metals may occur. Once the Site is returned to anaerobic conditions, possible secondary water impacts, such as an increase in the mobilization of reduced metals may occur.

Benefits:

- Increase in dissolution rate of residual NAPLs can shorten overall time frame for remediation. This will make the remedy less expensive to achieve the overall remedial goal.

- Technology is capable of complete detoxification in situ. At some point this may eliminate the need for ex situ treatment systems.

- If degradation rates are sufficiently fast, then “biocontainment” (i.e., where the natural attenuation capacity of the system equals the dissolution rate) of dissolved phases may be sufficient to contain the aqueous phase plume, and eliminate the need for further groundwater extraction and treatment in the future.

- Creation of larger ‘smear’ zones from superseding technologies (i.e., hydraulic displacement) which make the VOCs more available for biodegradation than large pools.

- Addition of bacteria culture and/or oil has a very low risk of causing adverse effects to human health or the environment.

4.3 Cost Sensitivity

The factors most affecting the application cost of EISB include:

- Achieved rate of degradation and the resultant impact on the loading of chemicals from the residual NAPL to dissolved phases.

- Unit cost of electron donors. The major cost of EISB is electron donor and the change in costs may be substantial based on changes in electron donor types.

- Variable residual NAPL distribution that does not allow for optimized donor addition, causing increased usage and donor cost.

- Ability to distribute oil. Although the oil estimates presented in Table 1 are based on the stoichiometric requirements, the delivery of the oil will also affect the total amount of oil that needs to be delivered yearly to obtain adequate oil coverage to the target areas. As an electron donor is added, it is also consumed during its travel. Assuming that the time to degrade one half the electron donor mass is 10 days, and it takes 30 days for oil to be advected between an injection and target location, then approximately six times more donor would need to be added at the injection well to achieve the required concentration of oil near the target location. However, increasing the number of injection wells so there is only 10 days of travel time between injection and target locations would require only injecting three times the required mass. There is a trade off between increasing the number of injection locations and total donor required. For longer term cleanups, the increase in cost for additional permanent injection locations is saved through overall decrease in electron donor costs. The detailed design process would evaluate the optimization of wells and electron donor cost.

4.4 Endpoints and How is Performance Measured/Quantified

The performance of EISB is assessed through:

- Increase in flux of parent and degradation products (chlorinated, non-chlorinated and inorganic compounds). This measurement provides an indication of mass removed and enhancement of dissolution rates, and is obtained by use of flux meters or simple measurement of the concentration of target chemicals and using groundwater flow velocities to calculate fluxes;
- Calculation of degradation rates using changes in concentrations of parent and degradation products along defined flow paths; and
- Increase in abundance and distribution of key microbial species or their activities.

Application of EISB would be expected to improve the attainment of ONOGU Remedial Action Objectives (RAOs). While hydraulic displacement would eliminate the mobility of NAPL, and meet that RAO, application of EISB would be expected to shorten the time frame that groundwater standards are exceeded, shrink the aqueous phase VOC plume, and further reduce groundwater contaminant concentrations.

4.5 Scale-Up and Potential for Implementation of the Technology

EISB is scaleable to the Site through the addition of electron donor to existing or added wells. Factors to consider during scale up may include:

- Control of Intermediary Chlorinated Volatile Organic Compounds (cVOCs) – Due to the confined nature of the treatment zone at the Site (underlying confining layer, downgradient sheet pile wall and hydraulic controls) the possible formation of degradation intermediates (cis-1,2-dichloroethene [cDCE], vinyl chloride [VC]) is not a concern.

- Supplemental Addition of Electron Donor – The existing system of injection and extraction wells installed for the hydraulic displacement application are believed to be sufficient for the addition of electron donor and bacterial culture, if required. Additional injection points or wells may need to be installed to provide adequate coverage for electron donor addition; however, the optimization of well and mass of electron donor will be finalized during the design stage.

- Permitting –Permits for bioaugmentation with bacterial culture may be required.

- Biofouling controls – The specific biofouling controls will need to be addressed when the final well configuration has been designed.

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TABLE 1
ALTERNATIVE ONOGU-3 COSTS: EISB FOLLOWING HYDRAULIC DISPLACEMENT
Solvents Recovery Service of New England Superfund Site, Southington, CT

Description	Cost
1. Enhanced In-Situ Bioremediation Design	
i) Enhanced In-Situ Bioremediation Design Cost	$202,500
ii) Microcosm Studies	$100,000
iii) Column Studies	$150,000
iv) System Infrastructure Installation	$110,000
Total Estimated EISB Design Costs	**$562,500**
2. Enhanced In-Situ Bioremediation O&M Costs (3 injections over 5 years)	
i) EISB Injection O&M	
a. Bioaugmentation with Dehalococcoides	$250,000
b. System Infrastructure shake down	$3,750
c. Oil for 3 injections	$900,000
d. Labor for 3 injections	$180,000
ii) EISB Well Maintenance O&M	$45,000
Total Estimated EISB O&M Costs for 5 Years	**$1,378,750**
Total Estimated Cost for 5 Years of EISB following Hydraulic Displacement	**$1,941,250**

Appendix T

White Paper for In-Situ Chemical Oxidation

WHITE PAPER FOR IN-SITU CHEMICAL OXIDATION

Solvents Recovery Service of New England, Inc. Superfund Site, Southington, CT

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Disclaimer

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1.0 INTRODUCTION

This white paper was prepared to identify and evaluate a potential remedial approach, using in-situ chemical oxidation (ISCO), for constituents of concern (COCs) present in overburden soil and groundwater at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund site in Southington, Connecticut (site). Remedial alternatives for the COCs, which exist as a non-aqueous phase liquid (NAPL), in the Observed NAPL in Overburden Groundwater Unit (ONOGU) are under evaluation within the Feasibility Study being prepared for the site. Preliminary screening of potentially applicable technologies to address the NAPL has identified ISCO in combination with Hydraulic Displacement (Hydraulic Displacement is discussed in Appendix I of the Feasibility Study) as one remedial approach that merits further consideration. The NAPL mass in the ONOGU at the site is composed of a combination of chlorinated and non-chlorinated volatile organic compounds (VOCs) and polychlorinated biphenyls (PCB's), the primary VOCs present in the NAPL are: tetrachloroethylene (PCE), trichloroethylene (TCE), dichloroethylene (DCE) (combined 1,1-DCE and 1,2-DCE isomers), trichloroethane (TCA) (combined 1,1,1-TCA and 1,1,2-TCA isomers), dichloroethane (DCA) (combined 1,1-DCA and 1,2-DCA isomers), benzene, toluene, ethylbenzene, xylene isomers (BTEX), methylene chloride, chloroform, 4-methyl-2-pentanone (MIBK), styrene. The mixture of COCs present can act as a light or dense NAPL dependent on the constituent composition at any given location.

1.1 OBJECTIVES

The objective of this white paper is to present an evaluation of available ISCO technologies and to outline a conceptual design for the most appropriate ISCO technology to remediate the NAPL in the ONOGU at the SRSNE site. The evaluation also includes a feasibility study level cost for application of the approach and a discussion on the uncertainties / risks / potential limitations and the expected results of applying the remedial approach at the site.

1.2 CONTENTS

This white paper is structured as follows:

Section 2	In-Situ Chemical Oxidation Technologies: provides an overview of the available chemical oxidation technologies and discusses the applicability of these technologies in the context of the SRSNE site. The recommended chemical oxidation technology approach for the site is described.
Section 3	Technical Approach for the SRSNE Site: presents the recommended ISCO approach in more detail and a conceptual design for the application of the technology at the site. Uncertainties, risks and potential limitations associated

with the approach are identified and discussed, as well as the expected results from application of the approach at the site. A review of related literature and experience with the recommended approach is provided.

Section 4 Costs: provides feasibility study level costs for application of the recommended ISCO approach for the SRSNE site.

2.0 IN-SITU CHEMICAL OXIDATION TECHNOLOGIES

This section provides an overview of the available chemical oxidation technologies and discusses the applicability of these technologies in the context of the SRSNE site. Further, a specific ISCO technology approach is recommended and discussed.

2.1 AVAILABLE TECHNOLOGIES OVERVIEW

In-situ chemical oxidation relies on the oxidative potential and stability of an oxidant to transport in the subsurface and to breakdown target COCs. Table 2-1 presents the most common, commercially available oxidants and an overview of the oxidant potential and relative stabilities. The stability or persistence of an oxidant in the subsurface will provide prolonged treatment times to allow for desorption / dissolution of low solubility compounds such as polynuclear aromatic hydrocarbons (PAHs). Oxidant stability also allows for transport of the oxidant in the subsurface, which allows for less injection locations for a given target treatment volume.

Table 2-1: Commonly Available Oxidants

Oxidant	**Potential (V)**	**Form**	**Stability**
Fenton's Reagent (OH•)	2.8	Liquid	**Low (seconds)**
Perozone (O_3 + OH•)	2.8	Gas/Liquid	**Low(seconds)**
Catalyzed Persulfate ($SO_4^{-}\bullet$)	2.6	Salt/Liquid	**Low(seconds)**
Ozone (O_3)	2.42 2.07	Gas	**Low(hours)**
Persulfate ($S_2O_8^{2-}$)	2.01	Salt/Liquid	**Moderate (few months)**
Hydrogen Peroxide (H_2O_2)	1.78	Liquid	**Low (hours)**
Permanganate (MnO_4^{-})	1.68	Salt Liquid	**High (several months +)**

The most common oxidants considered for full-scale application at sites of the size and with the mixture of NAPL constituents present at the SRSNE site are Fenton's reagent (Fe^{2+}/H_2O_2), sodium persulfate (NaS_2O_8) and potassium permanganate ($KMnO_4$). There is a theoretical basis for and some experimental validation of NAPL degradation by ISCO, primarily through enhanced mass transfer of NAPL to the aqueous phase, with subsequent destruction of the COCs in the aqueous phase (Urynowicz 2000; Nelson et al., 2001; Marley et. al. 2003). The effective application of ISCO for in situ remediation of NAPL sites involves a complex set of interacting processes at the micro- and macro-scale as illustrated in Figure 2-1. At field sites, the effective application of ISCO is highly dependent on the ability to deliver the active oxidant so it contacts the NAPL in the subsurface. Oxidant delivery at NAPL sites is complicated and challenging due to subsurface physical heterogeneity, complex NAPL distribution, and the oxidant consumption caused by reactions between the oxidant and the reduced organic and inorganic phases (NOM) within the natural aquifer matrix.

Fundamental and applied laboratory research has elucidated many aspects of the stoichiometry, degradation pathways, and kinetics for Fenton's reagent, potassium permanganate and to a lesser degree sodium persulfate reacting with NAPL organics in aqueous systems as well as the effects of temperature, pH, and matrix composition. Pilot-scale demonstrations and full-scale applications have attempted in-situ treatment of chlorinated solvents, BTEX and PAHs in soil and groundwater and to a lesser degree, NAPLs, using oxidant delivery by injection probes, deep soil mixing, hydraulic fracturing, and vertical or horizontal groundwater wells (Section 3.1.2 presents a literature / experience review).

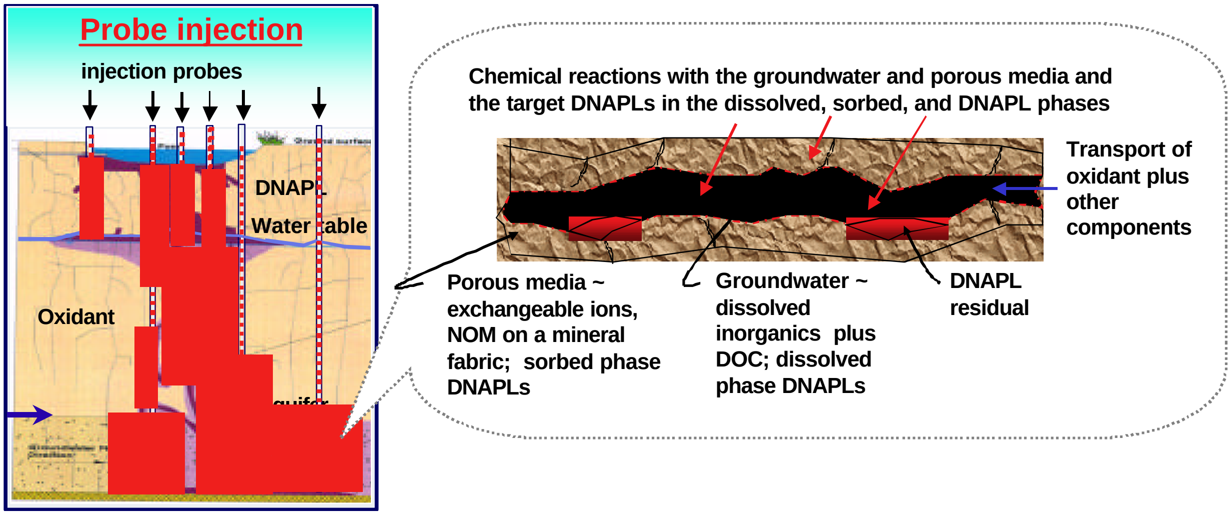


Figure 2-1: Macro- and micro-scale features of in situ chemical oxidation for NAPL sites (from Crimi et. al. 2003).

Oxidation reactions are usually highly energetic and contaminants are broken down quickly. Another benefit is that ISCO does not produce a large volume of waste material (ITCR, 2004).

In many cases a number of oxidation / reduction steps are required to reach the innocuous end products and not all reaction intermediates have been identified.

There are many factors (including stoichiometry, kinetics and thermodynamics) that influence how an oxidant chemical will react with a contaminant. Kinetics, or reaction rates, is dependant on a number of factors, such as temperature, pH, and concentrations of reactants, catalysts, reaction by-products and system impurities. The stoichiometry of the reaction describes the relative quantities of the reactants and products required for a balanced reaction, and thermodynamics describes the flow of heat and energy in the reaction.

The following three oxidants were selected for potential application at the SRSNE site and are described in the following subsections:

- Permanganate
- Persulfate
- Hydrogen Peroxide

2.1.1 PERMANGANATE

Two common forms of permanganate are potassium permanganate ($KMnO_4$) and sodium permanganate ($NaMnO_4$). Potassium permanganate is a crystalline solid and therefore, transportation hazards are minimized. Aqueous solutions of a desired concentration (up to several percent solutions) can be prepared on site using groundwater or tap water. Sodium permanganate ($NaMnO_4$) is usually supplied as a concentrated liquid (40%), but it can be diluted on-site and applied at lower concentrations. Higher concentrations of sodium permanganate solutions give more flexibility in the design of the injection volume and, because it is in liquid form, the dusting hazards associated with dry potassium permanganate solids are eliminated. However, due to the cost of sodium permanganate relative to potassium, potassium permanganate is more typically applied to larger sites. Both forms of permanganate are strong oxidizing agents with an affinity for oxidizing organic compounds containing carbon-carbon double bonds, aldehyde groups or hydroxyl groups (ITRC, 2004). However, permanganate's effectiveness for oxidizing chlorinated methanes and ethanes and for benzene is very limited.

Oxidation by permanganate involves direct electron transfer. Contaminant degradation rates are easily influenced by the presence of competing species, such as naturally occurring organic matter or reduced mineral species. Permanganate is a very stable oxidant and can persist for several months or longer in the subsurface, this makes it a good choice for subsurface applications and typically will require substantially fewer injections and wells to treat the target COCs than the other available oxidants. This is a significant advantage for the SRSNE site as it is intended that the ISCO process will follow a Hydraulic Displacement treatment of the NAPL and, for cost effectiveness, it is expected that the ISCO approach will utilize, to the extent feasible, the infrastructure developed for the Hydraulic Displacement treatment. However, permanganate also forms a manganese oxide precipitant which, for applications requiring heavy oxidant use, may cause a significant reduction in the hydraulic conductivity of the porous media around the injection points in particular. Pretreatment with Hydraulic Displacement is intended to reduce the volume of contaminant requiring oxidation, and therefore to reduce the potential for reduced hydraulic conductivity. In addition, there are a number of trace metal impurities within commercially available permanganate. At the scale of application of the SRSNE site the mass and potential impacts of these metal impurities added to the subsurface will need evaluation, this is discussed further in Section 3.2.2.

2.1.2 PERSULFATE

Persulfate salts are available in three forms: ammonium persulfate, sodium persulfate and potassium persulfate. Ammonium persulfate may lead to the generation of ammonia and the solubility of potassium persulfate is too low for ISCO; therefore, sodium persulfate is the most common persulfate salt used for ISCO. Persulfate salts disassociate in water to form persulfate anions ($S_2O_8\ ^{2?}$). The persulfate anion ($S_2O_8^{2-}$) is the most powerful oxidant of the peroxygen family of compounds, and is among the strongest oxidants commonly used for water and wastewater treatment. Sodium persulfate can be catalyzed (i.e., activated) by transition metal ions such as naturally occurring or externally supplemented ferrous iron (Fe^{2+}) to produce a powerful oxidant known as the sulfate free radical ($SO_4\bullet$).

In most persulfate applications oxidation involves free radical processes. Free radicals are molecular fragments that have an unpaired electron, which causes them to be highly reactive and short-lived. Decomposition reactions vary with concentration, pH, and oxygen, and hydrogen peroxide, superoxides and/or peroxymonosulfate can be produced (Cooper et. al. 1998). Persulfate is a relatively strong oxidant on its own and can degrade many COCs including BTEX. However, in order for persulfate to be used alone and to be effective for some of the chlorinated VOCs at the site, an activator must be distributed and transported with the persulfate. The addition of low levels of heat (around 40 ^{o}C) or a ferrous salt (Fe^{2+}) will dramatically increase the oxidative strength of persulfate. The use of chelating agents aid in maintaining the ferrous iron solubility is common. An elevated pH can also activate the sulfate radical.

Persulfate is a reasonably stable oxidant and can persist for a few months in the subsurface and as with permanganate this makes it a good choice for subsurface applications and it typically will require fewer injections and wells to treat the target COCs than peroxide. This again is a significant advantage for the SRSNE site as it is intended that the ISCO process will follow a Hydraulic Displacement treatment of the NAPL and, for cost effectiveness, the ISCO treatment is expected to use the infrastructure for the Hydraulic Displacement treatment. However, persulfate applications for in-situ remediation of the scale of the SRSNE site are limited at this time, and the optimization of the reaction with the added catalysts is still under refinement.

2.1.3 HYDROGEN PEROXIDE

Hydrogen peroxide (H_2O_2) by itself is a fairly strong oxidant, but at low concentrations it is not kinetically fast enough to degrade most COCs before decomposition of the peroxide occurs. As explained previously, peroxide in-situ is very unstable and typically only persists for time periods on the order of a few hours to a day or two. It is due to this lack of stability that most peroxide applications require closely spaced injection wells on the order of ten feet.

For peroxide to be effective on a wide range of COCs an iron catalyst is typically used to dramatically increase its oxidative strength through the production of hydroxyl radicals ($OH^{\bullet}$). The hydroxyl radical, a relatively non-specific oxidant that reacts with most organic compounds at near diffusion-controlled rates, readily attacks the target COCs. Therefore, Fenton's reagent (a term commonly used to describe the combination of peroxide with an iron catalyst) is usually modified for ISCO by using higher concentrations of hydrogen peroxide and varying the type of catalyst (i.e., iron (III), iron chelates, or iron oxyhydroxide minerals).

All transformations by Fenton's reagent have traditionally been attributed to a hydroxyl radical mechanism. However, at least two other reactive species are generated by the catalyzed decomposition of hydrogen peroxide. The other reactive species that are formed are superoxides and hydroperoxides. Superoxide anion ($O_2{\bullet}^-$) is a reductant and a weak nucleophile. Hydroperoxide (HO_2^-) is reductant and a strong nucleophile.

Modified Fenton's reagent has been applied at tens of sites over the past few years. Practitioners have used a range of catalysts with and without acid addition (acidic conditions maintain the solubility of the iron catalyst). Results from Fenton's ISCO applications have been mixed: soluble, sorbed, and NAPL COCs have been destroyed at some sites, while minimal treatment has been found at other sites. The common practice in the field has been to increase the concentration of hydrogen peroxide when treatment has been unsuccessful. This practice often enhances treatment effectiveness, which is likely related to driving propagation reactions that form the other reactive transient oxygen species other than just or predominantly hydroxyl radicals.

The combination of hydroxyl radicals, superoxide, and hydroperoxide anions is believed most capable for desorbing and disrupting NAPLs; furthermore, they can oxidize reduced compounds and reduce oxidized compounds, increasing the likelihood of mineralization of recalcitrant COCs.

However, as peroxide is an unstable oxidant and cannot persist for more than a day or two in the subsurface, this makes Fenton's reagent a poor choice for the proposed treatment train for the SRSNE site. Fenton's reagent would require more subsurface applications and many more injection locations to treat the target COCs than needed for permanganate or persulfate. Again, this is a significant disadvantage for the SRSNE site as it is intended that the ISCO process will follow a Hydraulic Displacement treatment of the NAPL and, for cost effectiveness, the selected

ISCO process would make use of the infrastructure developed for the Hydraulic Displacement treatment.

2.2 SUITABLE ISCO APPROACH FOR THE SRSNE SITE

In the following sections the suitability of permanganate, persulfate and peroxide for the SRSNE site is discussed in more detail. The four most critical factors for the success of ISCO at the SRSNE site are 1) effective distribution of the reagents in the target treatment zone, 2) the integration of the oxidant into the proposed overall treatment train, 3) the reactivity of the oxidant with the COCs, and 4) the prior success at other sites in applying the technology at a scale that is representative of the SRSNE site.

2.2.1 PERMANGANATE

Important considerations for the application of permanganate at the SRSNE site with respect to the above critical factors are the rate and methods of application, the balance of the total mass of permanganate introduced with the amount of oxidizable material present in the subsurface, and the reactivity of permanganate with the target COCs. Additional considerations for the injection of permanganate include: the potential reduction in soil permeability from the precipitation of manganese oxides, the addition to the site of the trace metal impurities in the permanganate and the potential mobilization of metals in the treatment zone from Eh - pH changes due to the oxidation reactions and due to the Enhanced In Situ Biodegradation (EISB) polishing step proposed for the site following the ISCO application.

Permanganate application using the infrastructure proposed for the Hydraulic Displacement treatment at the site is viable, based on the stability of the permanganate. Large volumes of permanganate would be required because of the significant mass of COCs and potential Natural Organic Matter (NOM) that is present at the site; if the Hydraulic Displacement infrastructure is used alone to apply the permanganate this may cause issues with excessive precipitation of manganese oxides in the soil pores in the vicinity of the injection wells and a subsequent reduction in hydraulic conductivity and therefore an undesirable change to the groundwater flow regime in the target treatment area. However, this potential issue may be reduced by converting all of the Hydraulic Displacement wells into injection wells and by adding some additional injection wells to provide better distribution of the oxidant.

There are a number of trace metal impurities within commercially available permanganate. At the scale of application of the SRSNE site the mass and potential impacts of these metal impurities added to the subsurface will need evaluation, this is discussed further in Section 3.2.2.

While the natural buffering capacity of the native soils is unknown, experience at ISCO sites has shown that Eh - pH changes and associated metals mobilization is typically measured only in the immediate area of the oxidant addition, and geochemical conditions revert rapidly to background conditions outside the target treatment area. However, as an EISB polishing step is proposed following ISCO for the site, and the EISB approach involves the addition of electron donor to create reducing conditions in the treatment area (Appendix U), the potential for manganese (and associated trace metals) dissolution and associated downgradient migration would need to be considered in the overall system design. At the SRSNE site, the existing downgradient overburden groundwater capture system provides a mechanism to capture and treat any undesirable groundwater quality changes that could result from the ISCO followed by EISB approach; however, the existing groundwater treatment system will likely require upgrading to deal with the more complex groundwater metals geochemistry resulting from the ISCO / EISB approach.

Permanganate is not an effective oxidant for degradation of chlorinated alkanes, such as 1,1,1-trichloroethane (1,1,1-TCA), saturated aliphatic compounds and PCBs. However, the application of permanganate as an ISCO treatment for the NAPL in Overburden Groundwater at the SRSNE site is considered appropriate; as the predominant COCs present in the NAPL (tetrachloroethylene (PCE), trichloroethylene (TCE), and toluene, ethylbenzene, xylene isomers) are treatable by permanganate. Further, a review of relevant case studies (Section 3.1.3) indicates that to date, permanganate has been applied at relatively large scale sites with reasonable success but not at the scale required for the SRSNE site.

2.2.2 PERSULFATE

Important considerations for the application of persulfate at the SRSNE site with respect to the stated critical factors are the rate and methods of application, the balance of the total mass of persulfate or catalyzed persulfate introduced with the amount of oxidizable material present in the subsurface, and the reactivity of persulfate with the target COCs. Additional considerations for the injection of persulfate include: the potential mobilization of metals in the treatment zone from pH changes due to the oxidation / reduction reactions.

Persulfate application using the infrastructure proposed for the Hydraulic Displacement treatment at the site is viable, based on the stability of the persulfate. Large volumes of persulfate would be required because of the significant mass of COCs and potential NOM that is present at the site (although the persulfate - NOM demand is typically much less for high NOM sites than for permanganate – NOM demand, Marley et. al. 2003). Further, while uncatalyzed persulfate will destroy the TEX portion of the COCs and meet the NOM demand, catalyzation of the persulfate will be required and can destroy the remaining significant COCs mass. Catalyzation of the persulfate would require the addition of catalysts and may require closer well spacing, than the current Hydraulic Displacement system design, to ensure proper mixing of the reagents with the persulfate. Further, at this time there have been no recorded applications of catalyzed persulfate at the scale of the SRSNE site.

While the natural buffering capacity of the native soils is unknown, experience at ISCO sites has shown that pH changes and associated metals mobilization is typically measured only in the immediate area of the oxidant addition, and geochemical conditions revert rapidly to background conditions outside the target treatment area. Further, at the SRSNE site the existing downgradient overburden groundwater capture system provides a mechanism to capture and treat any undesirable groundwater quality issues associated with the ISCO approach that would migrate significantly from the target treatment area.

2.2.3 HYDROGEN PEROXIDE

Important considerations for the application of hydrogen peroxide at the SRSNE site include the incompatibility of the technology with the Hydraulic Displacement infrastructure (instability of oxidant), generation of heat from the use of a strong (>10%) peroxide solution, generation of significant volumes of oxygen gas from the dissociation of the peroxide which may cause stripping of VOC's and a decrease in pH that can cause an increase in dissolved metal concentrations in groundwater.

As peroxide is an unstable oxidant and cannot persist for more than a day or two in the subsurface more subsurface applications and many more injection locations (likely on the order of 10 feet on center) would be required to implement the ISCO approach than are needed for permanganate or persulfate applications. With respect to the SRSNE site, this means that the use of peroxide as an oxidant could not effectively use the Hydraulic Displacement treatment infrastructure. While the application of hydrogen peroxide as an in-situ chemical oxidant can benefit from the exothermic (heat generating) nature of the reaction of peroxide (the heat can enhance the dissorption and dissolution of sorbed and NAPL mass), peroxide's exothermic and oxygen gas production properties may cause volatile compounds to be released to subsurface air and possibly into the vadose zone, these vapors may then require capture and treatment. Catalyzed peroxide is capable of destructing the COCs at the SRSNE site and has been used previously on relatively large scale projects with reasonable success.

While the natural buffering capacity of the native soils is unknown, experience at ISCO sites has shown that pH changes and associated metals mobilization is typically measured only in the immediate area of the oxidant addition, and geochemical conditions revert rapidly to background conditions outside the target treatment area. Further, at the SRSNE site the existing downgradient overburden groundwater capture system provides a mechanism to capture and treat any undesirable groundwater quality issues associated with the ISCO approach.

2.3 RECOMMENDED ISCO TECHNOLOGY APPROACH FOR SRSNE SITE

Based on the discussions provided in Sections 2.1 and 2.2 above, Fenton's reagent is not recommended for application at the SRSNE site. Both permanganate and persulfate could be used and integrated into the overall proposed treatment train, which will use Hydraulic Displacement of the NAPL as the first phase of the process and will have an EISB polishing step. Both permanganate and persulfate have potential limitations with respect to the SRSNE site as discussed in Section 2.2 above. Based on the lack of experience in applying persulfate at the scale of the SRSNE site, and the current potential refinements ongoing with respect to catalyst optimization, permanganate is recommended as the ISCO approach for feasibility study level evaluation at the site. If selected, design level analysis will further consider the best oxidant or combination of oxidants to be used.

3.0 TECHNICAL APPROACH FOR SRSNE SITE

This section provides a conceptual ISCO design for a permanganate ISCO application for the SRSNE site. The conceptual design was developed based on XDD's ISCO experience and research work and on available related published experiences. Uncertainties, risks and potential limitations associated with this approach are identified and discussed, as well as the expected results from the technology application. The review of related literature and experience is also included in this section.

3.1 CONCEPTUAL DESIGN

After the Hydraulic Displacement operational period is completed, the ISCO application will be initiated. The conceptual design for the ISCO approach includes the addition of 37 new injection wells to supplement the 78 wells that are incorporated into the Hydraulic Displacement system design. The ISCO approach would be designed to integrate with the injection/extraction wells (or trench) and manifold network used for the Hydraulic Displacement system. Following the additional well installations, potassium permanganate will be injected into all 115 wells to treat the predominant COCs, during several injection events, over a period of approximately 12 to 15 months. During the injection period extraction and recirculation of groundwater will not be implemented, and therefore there will be no need for above-ground water treatment / disposal.

3.1.1 MAJOR DESIGN ASSUMPTIONS

Based on the available site data, the following major design assumptions have been made for the development of the ISCO approach for the SRSNE site:

- Volume of ONOGU soil to be treated ~ 31,840 cubic yards (yd^3) (volume within target treatment zone below seasonal high water table elevation)

- Calculated pore volume (porosity of 27.5%) of the target treatment zone ˜ 6,700,000 liters (L) ˜ 1,770,000 gallons (gal)
- Total mass of NAPL in target treatment zone ˜ 460,000 kilograms (kg) or 120,000 gallons
- Mass of NAPL assumed to be removed by hydraulic displacement = 43.3%; remaining mass on NAPL after hydraulic displacement = 68,000 gallons (per Dr. Kueper's Hydraulic Displacement White Paper (Appendix I))
- NAPL mass not treatable by permanganate = 3%
- 85 percent destruction of the remaining NAPL by ISCO is assumed
- NOM (typical range for silty sands: 3 to 5 g/kg of soil) = 4 g/kg of soil is assumed
- Quantity of oxidants required to satisfy the NOM: estimated at 170,000 kg of permanganate
- Calculated quantity of permanganate required for the ISCO approach (stoichiometric requirement for NAPL + NOM) ˜ 1,450,000 kg
- Permanganate injection concentration = ~40 g/L
- Volume of permanganate solution ˜ 36,250,000 L ˜ 9,580,000 gal
- Total number of pore volumes exchanged ˜ 5
- Injection flow rate per well ~1.5 gallons per minute (gpm)
- A total of approximately 15 months of system operation, assuming 6 to 8 hours per day of oxidant injection

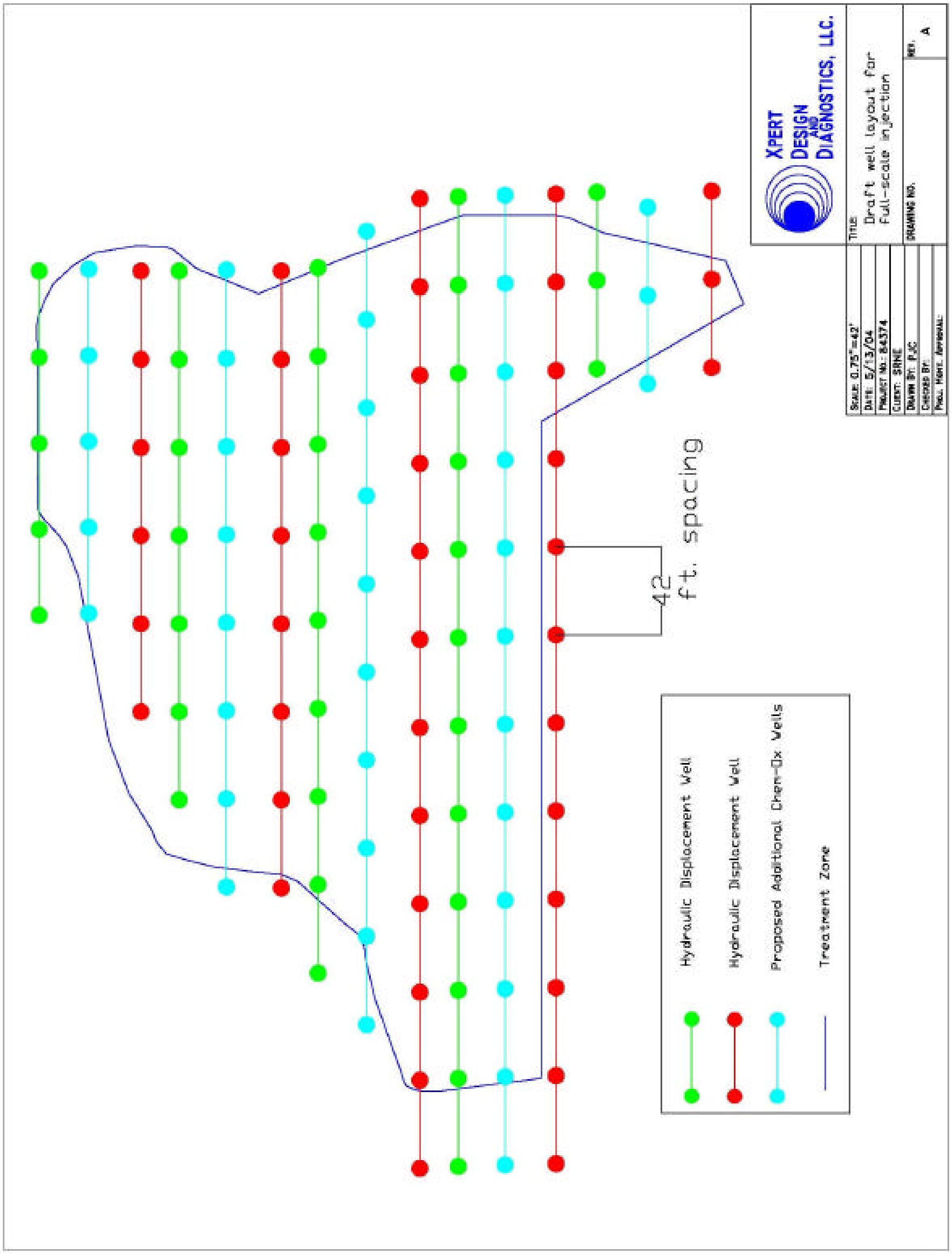
3.1.2 IMPLEMENTATION APPROACH

Based on a stoichiometric balance on the treatable NAPL mass remaining after the hydraulic displacement of NAPL, a total of approximately 1,450,000 kg or 3,190,000 pounds (lb) of potassium permanganate dissolved in approximately 9,580,000 gallons of site groundwater will be injected into the target treatment zone. For the conceptual design, the oxidant loading was calculated based on the stoichiometric requirement for complete mineralization of the NAPL constituents. Bench- and pilot- scale testing, which are recommended for the site prior to full-scale implementation, would provide a refined estimate on the oxidant loading for optimal NAPL treatment at the site.

For this conceptual design, a total of 1,450,000 kg of potassium permanganate will be injected at a concentration of 40 g/L. A total of approximately 9,580,000 gallons (approximately five times the pore volume of the target treatment zone) of permanganate solution will be injected over a period of 12 to 15 months. The permanganate application will treat the dominant chlorinated ethenes within the NAPL, the TEX and NOM. Based on the NAPL description provided in the

Feasibility Study, approximately 3 percent of the NAPL (the saturated chlorinated hydrocarbons) will not react significantly with the permanganate; however, those compounds are subject to biodegradation.

Figure 3-1 present a schematic of the injection field layout. Figure 3-2 shows the above ground components of a typical dual-oxidant ISCO application process. Figures 3-3 and 3-4 show pictures of the above ground components of an ISCO approach used by XDD at a site impacted with NAPL consisting predominantly of chlorinated hydrocarbons similar to the SRSNE site.


XPERT DESIGN AND DIAGNOSTICS, LLC.
TITLE:
Draft well layout for Full-scale injection
DRAWING NO.
REV. A
SCALE: 0.75"=42'
DATE: 5/13/04
PROJECT NO.: 84374
CLIENT: SRNE
DRAWN BY: PJC
CHECKED BY:
PROJ. MGMT. APPROVAL:
42 ft. spacing
Hydraulic Displacement Well
Hydraulic Displacement Well
Proposed Additional Chem-Ox Wells
Treatment Zone

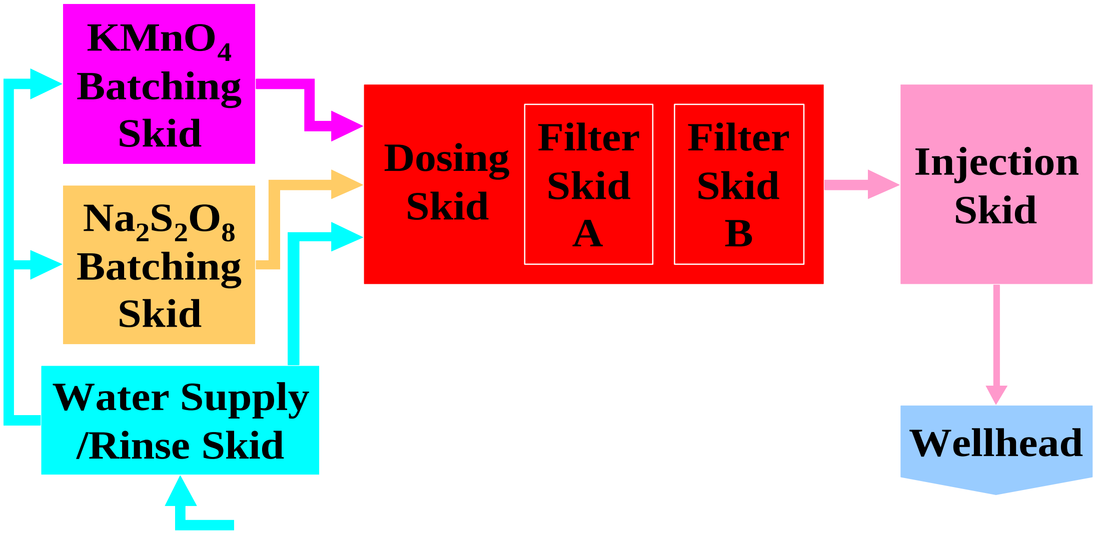


Figure 3-2: Schematic of Typical ISCO Oxidant Application Process (Marley et. al 2003)

Figure 3-3: Picture Shows Oxidant Batching Tanks and Associated Piping for Oxidant Application (Marley et. al. 2003)

Figure 3-4: Picture Shows Dosing and Filtration Skids and Associated Piping for Oxidant Application (Marley et. al. 2003)

As shown in Figures 3-2 through 3-4, the above-ground ISCO equipment will primarily consist of oxidant batching skids, a dosing solution preparation skid, a solution filtration skid and associated injection pumps and ancillary equipment. As previously stated the ISCO process equipment would be tied into the exiting injection/extraction well and manifold network that will be used in the hydraulic displacement phase of the overall treatment process. The details on the equipment to be used for the hydraulic displacement phase and for integration with the ISCO phase is described in Appendix I of the Feasibility Study and is not repeated herein.

3.1.3 RELATED LITERATURE / EXPERIENCE

Based on the scale of the application of ISCO at the SRSNE site it is considered important that success in applying ISCO at comparable sites be incorporated into the decision of selecting an appropriate remedial approach for the site. A personal communication with a Carus Chemical Company representative, a major provider of permanganate in the United States, indicates that the largest application, for which they supplied permanganate, was on the order of 300,000 pounds (an order of magnitude less than the mass of permanganate projected for the SRSNE site).

A review of the available literature was performed to provide a global overview of the potential success of ISCO using permanganate for the COCs present at the site and to find case studies that may be comparable to this proposed application. The summary of the relevant literature search is provided in the following paragraphs.

Assessing the Feasibility of DNAPL Source Zone Remediation: Review of Case Studies - (GeoSyntec Consultants, 2004)

Of 118 sites reviewed, a total of 25 used chemical oxidation (15 used permanganate, 9 used Fenton's Reagent and 1 used Ozone). Of these 25 sites 84% reported that the target organics was dominated by chlorinated ethenes. Eighty seven percent ranked the technology as being a success or a fair success (of 16 sites). In assessing overall technology performance, there were only two sites (one used permanganate) that met the most stringent criteria of greater than 80% mass removal AND a greater than 61% reduction in mass flux AND no observed rebound AND a perceived success; this application was a pilot scale test in a sandy aquifer.

Cape Canaveral, FL (IT Corporation, 2000)

A permanganate application in a sand aquifer contaminated with TCE DNAPL was performed at the Launch Complex 34 facility at Cape Canaveral Air Force Station in Florida. Several injections of permanganate were delivered into the source zone through drive-point injection. The reduction in DNAPL mass resulting from oxidant injection was estimated to be 84%, with mass reduction estimates in the groundwater ranging from 83% to 95%. At this site, no evidence of permeability reductions resulting from precipitated MnO_2 in the matrix was observed.

Industrial Facility, Joplin, MO (Crawford, et al., 2002)

A multi-dose full-scale ISCO treatment using potassium permanganate was implemented at an industrial facility impacted with chlorinated volatile organic compounds, primarily TCE with measured DNAPL. The area of concern was a utility trench approximately 550 feet long by 10 feet deep. The target compounds were distributed in highly variable hydrogeological conditions with low permeability. A total of approximately 25,000 gallons of 30 grams per liter (g/L) permanganate solution was injected during four dosing events. Elevated concentrations of oxidant remaining in the trench will promote diffusion into the impacted silty clay soils and will continue to treat the remaining impacts. The DNAPL in the trench was destroyed. The site has since been closed and no further action is required by the state of Missouri.

Former Commercial Property, Rockville, MD (Werner, P.G., 2002)

ISCO using permanganate was used to treat an aquifer contaminated primarily with PCE and its associated degradation byproducts. The impacted area encompassed approximately 4,800 cubic yards consisting primarily of saturated fine-grained soils. A total of 2,200 gallons of a 20 percent solution of sodium permanganate was injected under both low-pressure and manual addition (gravity feed) conditions into more than 50 locations in a grid pattern. This treatment resulted in an 85 percent reduction of the original PCE mass. To address the remaining PCE, a supplementary treatment was implemented in which 75 gallons of a more dilute solution of permanganate was injected over 4 monthly events. Post-injection monitoring indicated that the original PCE mass was reduced by greater than 95 percent.

Canadian Forces Base (CFB) Borden, Toronto, Ontario (Schnarr and Farquhar, 1992; Schnarr et al. 1998)

The application of potassium permanganate was implemented at the Canadian Forces Base (CFB) Borden near Toronto, Ontario. The source zone was estimated to encompass an area of approximately 26,900 ft^2 within a 13-foot thick sandy aquifer. It was estimated that the DNAPL source zone was impacted with an average of 1,200 mg/Kg of PCE and 6,700 mg/Kg of TCE. A double-walled sheet pile cell was utilized to isolate the treatment zone from the surrounding aquifer. Two oxidant injections were first performed in the early 1990's. The first injection of oxidant, which evaluated permanganate oxidation of residual PCE, illustrated that rapid removal of residual DNAPL could be achieved. A second injection evaluated permanganate oxidation of a multi-component TCE/PCE DNAPL distributed as both pooled and residual DNAPL. The results of the second demonstration showed that the rate of degradation of pooled DNAPL was limited by the low surface area to volume ratio. In 1996, an 8 g/L solution of $KMnO_4$ was flushed into the DNAPL source zone for approximately 500 days. Post-injection analyses indicated a 99 percent reduction in peak concentrations for both PCE and TCE.

3.1.4 BENCH- AND FIELD-SCALE STUDIES

Due to the scale and complexity of the SRSNE site, it is recommended that the conceptual approach provided herein be validated through both bench and field-pilot studies prior to implementation of a full-scale ISCO application at the site. The primary objective of the bench and pilot studies will be to refine the estimated loadings of the oxidants required to achieve an optimal, cost effective NAPL treatment for the site.

The bench-scale study would be performed first to evaluate laboratory derived optimal oxidant loadings for the site soils and NAPL. Based on the bench-scale study results appropriate oxidant loadings will be determined for the field-scale study. The duration of the bench-scale study is approximately one month.

The field-scale study will be designed to meet the following additional objectives:

- The achievable levels of NAPL removal under field conditions
- Injection pressure and injection/extraction flow rate requirements to effectively distribute the oxidants throughout the target treatment area
- The time required for the oxidation process to meet the overall project objectives
- The refined costs to apply the full-scale ISCO approach for the site

A three-month field-pilot study is recommended. The study would be performed using a set of four injection wells. The study would include two months of permanganate injection, followed by a reaction and sampling period totaling one month. Assuming a couple months of internal / regulatory reviews of the documentation, a total duration of approximately eight to ten months is estimated from the beginning of a bench-scale study work plan preparation to a field-pilot study completion report.

3.2 UNCERTAINTIES/POTENTIAL LIMITATIONS

The application of an ISCO approach at the SRSNE site has a number of potential uncertainties, risks and potential limitations that need to be considered. A number of the major uncertainties / risks / limitations are: the potential for incomplete distribution of the oxidants in the target treatment area; the addition of a significant mass of metal impurities to the site based on the projected large mass of permanganate required for source treatment; the potential effects of the ISCO approach on the site geochemistry and hydraulic conductivity, and the impact on microorganisms present at the site, that are likely required to provide polishing of the remaining NAPL that may not be treated through the ISCO approach; and cost sensitivities. Further, being a strong oxidizer, there are health and safety concerns in handling large volumes of permanganate.

3.2.1 OXIDANT DISTRIBUTION

Subsurface heterogeneities or preferential flow paths can cause an uneven distribution of the oxidant and result in areas that do not get adequately treated or are not treated at all. Following appropriate oxidant selection for a given application, poor performance of an ISCO approach is often attributed to poor uniformity of oxidant delivery, mostly as a result of site-specific heterogeneities.

The data available for this site and for the majority of sites is not amenable to making a very accurate estimate of the potential soil volume that may not be effectively treated. The results of the field-pilot testing of the ISCO approach and results from any field testing of the Hydraulic Displacement approach will provide the best insight into this site-specific issue.

3.2.2 ADDITION OF METAL IMPURITIES

There are a number of trace metal impurities within commercially available permanganate. Carus Chemical Company provided technical specifications on the two commercially available forms (Technical grade and USP Code F) of potassium permanganate; the specifications are included as Appendix A of this white paper. The difference in the forms of permanganate is that a free flow additive is present in the Technical grade. The specifications are based on the analysis of 20 lot composites, which they perform a couple of times annually. While Carus Chemical Company do manufacture a remediation grade of permanganate with reduced metal impurities, a personal communication with the company representative indicated that to manufacture 1,450,000 kg (amount projected for the SRSNE site) of remediation grade potassium permanganate would take a number of years and is therefore not considered feasible for the SRSNE site.

Based on the specifications provided in Appendix A of this white paper, the mass of each metal impurity that would be added to the site during the ISCO application was calculated. Table 3.1 presents the calculated amounts of the added metal impurities. For the SRSNE site it is most likely that Technical grade potassium permanganate would be used to enable easier handling of the large volumes of oxidant required for the site. An additional concern with adding the metal impurities at the site is that, during the EISB polishing step proposed to follow ISCO, the addition of electron donor will create reducing conditions in the treatment area (Appendix U), the potential for manganese (and associated trace metals) dissolution and associated downgradient migration will need to be considered in the overall system design. Further, a number of these metals may exceed drinking water criteria during the oxidant injection and / or during the changing redox conditions created form the ISCO and EISB processes. Potential metals of concern include: Aluminum, antimony, arsenic, chromium, lead, molybdenum, thallium, and vanadium. At the SRSNE site, the existing downgradient overburden groundwater capture system provides a mechanism to capture and treat any undesirable groundwater quality changes that could result from the ISCO followed by EISB approach; however, the existing groundwater treatment system will likely require upgrading to deal with the more complex groundwater metals geochemistry resulting from the ISCO / EISB approach.

TABLE 3.1
SUMMARY OF MASS OF METAL ADDED TO SOIL THROUGH INJECTION OF PERMANGANATE

Parameter	Mass of Metal Added to Soil (lbs) [a]	
	USP Code F Grade	Technical Grade
Aluminum	117	230
Antimony	0.34 *	0.34 *
Arsenic	3	6
Barium	25	17
Beryllium	0.16 *	0.16 *
Boron	0.40 *	0.40 *
Cadmium	0.03 *	0.03 *
Calcium	82	74
Chromium	0.05 *	15
Cobalt	0.03 *	0.05 *
Copper	0.05 *	0.11 *
Iron	0.11 *	0.02 *
Lead	0.34 *	1.69
Lithium	0.06 *	0.06 *
Mercury	n/a	0.03
Molybdenum	0.06 *	0.05 *
Nickel	0.06 *	0.06 *
Selenium	0.06	0.0003 *
Silicon	n/a	529
Silver	0.08 *	0.08 *
Sodium	661	1716
Strontium	0.90	0.36
Thallium	1.7 *	1.7 *
Vanadium	11	28
Zinc	4	3

Note: * - concentration in permanganate reported as less than (<) the detection limit; therefore, a value equal to ½ the detection limit was assumed for the calculation.

n/a – concentrations not available; therefore, calculation not completed.

a - $$M_{metal}\text{lbs} = C_{perm}\frac{\text{mg metal}}{\text{kg perm}} \times M_{perm}\text{kg perm} \times \frac{2.2\text{x}10^{-6}\text{ lbs}}{1\,\text{mg}}$$

C_{perm} values were obtained from Carus Chemical Company for USP Code F Grade and Technical Grade Potassium Permanganate. Concentrations were assumed to be on a dry weight basis.

M_{perm} was assumed to be 1,450,000 kg.

3.2.3 EFFECT ON SITE GEOCHEMISTRY AND MICROORGANISMS

The potential impact of an ISCO approach, using permanganate, on the site geochemistry and the microorganisms present at the site is contained within a separate white paper developed by GeoSyntec Consultants (Appendix U of the Feasibility Study). A brief summary of the white paper is provided in the following paragraphs.

Following the application of ISCO, impacts resulting from residual permanganate in groundwater are likely minor, since permanganate is readily decomposed by the natural reduction capacity present in many groundwater systems, and over the longer-term, the most significant groundwater impacts are likely to be associated with the presence of the manganese dioxide precipitates and metal impurities, which may significantly impact post-treatment groundwater quality.

Due to the expected significant change in redox in the treatment area as a result of ISCO, it is probable that the redox conditions will need to be manipulated to create reduced conditions after ISCO and before the EISB polishing. Under oxic conditions, manganese is essentially insoluble; however, as an anaerobic biodegradation polishing step is proposed for the site following ISCO, the anaerobic conditions typically associated with biodegradation of chlorinated ethenes favor manganese-reduction and the mobilization of soluble Manganese (II) through reductive dissolution. Simultaneously, it is likely manganese mobilization will result in concurrent mobilization of any metals adsorbed on the manganese dioxide surface or co-precipitated within the manganese dioxide structure. The elevated manganese levels will be expected to migrate downgradient until the groundwater geochemistry becomes sufficiently oxic to precipitate the manganese on to the soils. The extent of the downgradient migration is therefore linked to the geochemical changes to the groundwater projected for the post-ISCO biodegradation polishing step (Appendix U).

To date, a limited number of laboratory investigations have evaluated the impacts of ISCO using permanganate on microbial populations and dechlorinating activity. While permanganate may result in large reductions in microbial populations, there is at least limited microcosm evidence to suggest that ISCO does not intrinsically inhibit the dechlorinating activity of the microbial population.

3.2.4 COST SENSITIVITIES

The projected cost to apply the ISCO approach at the site is provided in Section 4. From the cost estimate, the chemical costs make up approximately 76 percent of the total cost of a full-scale application. Therefore the actual / optimal oxidant demands will have a significant impact on the final cost to apply the technology. The oxidant demand and therefore oxidant costs are directly related to the actual amount of NAPL present within the target treatment zone and to the amount of NAPL that will be removed by the Hydraulic Displacement process. The amount of oxidant is also directly, but to a lesser degree than for the NAPL, related to the actual NOM of the porous media. The contingency provided in the Feasibility Study should reflect this uncertainty.

3.2.5 HANDLING PERMANGANATE

Potassium permanganate is a relatively safe chemical when handled and stored according to the manufacture's guidelines. However, as with the handling and storage of any oxidizing chemical, appropriate care should be taken, and the MSDS's always consulted prior to use. Skin and eye contact with oxidizing chemicals should be avoided, and special care should be taken to avoid breathing the chemicals in the form of a dust or mist. Consequently, proper personal protective equipment should be employed as per the manufacturer's MSDS. Also, oxidizing chemicals should never be stored or directly mixed with combustible materials (such as fuels, paper, or solvents) or reducing agents (such as metals or sulfites). Complete familiarization with the safe handling and storage practices of these oxidants, and proper use of personal protective equipment, is strongly recommended to avoid incident or injury. National Fire Prevention Association (NFPA) guidelines should be followed when storing significant quantities of an oxidizer.

3.3 EXPECTED RESULTS AND PERFORMANCE EVALUATION

3.3.1 EXPECTED RESULTS

Based on site-specific conditions, the ISCO approach discussed in Sections 2 and 3, and the related published experience obtained for comparable sites (Section 3.1.3), the following general statement about the expected treatment results is provided:

- With the proposed permanganate - ISCO approach, it is feasible to integrate the ISCO phase with the Hydraulic Displacement phase to more effectively treat the NAPL present in the target treatment zone of the site. It is estimated that approximately 3 percent of the NAPL mass is not treatable by permanganate and it is recognized that there are likely to be areas of the site that do not get adequate permanganate distribution. Therefore, while the maximum possible percent removal by ISCO at the site is 97 percent, based on the review of the available literature, assuming a destruction effectiveness between 60 and 97 percent would not be unreasonable. For the purposes of this Feasibility Study, a reasonable expectation would be to assume that 85 percent of the NAPL remaining after the Hydraulic Displacement process will be destroyed with the ISCO approach.
- Application of ISCO would be expected to improve the attainment of ONOGU Remedial Action Objectives (RAOs). While hydraulic displacement would eliminate the mobility of NAPL, and meet that RAO, application of ISCO would be expected to further shorten

the time frame that groundwater standards are exceeded, further shrink the aqueous phase VOC plume, and further reduce groundwater contaminant concentrations.

3.3.2 PERFORMANCE EVALUATION

The success of the ISCO approach at the site is highly dependent on the actual mass of NAPL present in the target treatment volume and the ability to distribute the oxidant to contact the NAPL. The current NAPL mass estimate is based on a comprehensive sampling program and sound scientific principles; the amount of oxidant required is based on stoichiometry for the NAPL and an assumed NOM demand. The results of bench and pilot scale testing will help refine the estimates of the NAPL and NOM demand, the mass of NAPL present in the target soil volume is not likely to ever be known. It is currently projected that the end-point of the active ISCO approach will be when the calculated amount of oxidant (following refinement of mass of oxidant required, resulting from pilot testing) has been added into the target treatment soil volume.

Given that the true mass of NAPL in the target treatment volume is not definitive, the effectiveness of the ISCO approach would be monitored primarily through monitoring of active permanganate and associated field parameters (e.g. ORP) within the target treatment zone and an engineering mass balance on the chloride produced from the destruction of the unsaturated chlorinated hydrocarbons that are the dominant COCs in the NAPL. Additionally, monitoring of the mass flux of COCs from the target soil volume and rebound in the groundwater concentrations of the COCs in the target soil volume will provide data to further evaluate the ISCO effectiveness. These techniques can also be used to identify locations within the target volume that may require additional doses of oxidant (no active permanganate relative to other areas) during the treatment period or for which oxidant distribution is less effective. Further, based on the concerns on metals mobility a comprehensive suite of metals should be monitored for during both the ISCO and EISB polishing applications.

4.0 COSTS

This section provides feasibility study level costs for application of the ISCO approach for the SRSNE site. The costs were derived by XDD, a company that regularly designs, costs and performs ISCO applications using permanganate, persulfate and peroxide as oxidants. Given that the ISCO approach would be complete within a two year period, a net present worth analysis was not performed.

4.1 BENCH AND FIELD PILOT STUDIES

The cost of a bench-scale ISCO study for the SRSNE site will range from $10,000 to $20,000.

The cost estimate to design, install, operate and monitor, demobilize and report on an ISCO pilot study, as described in Section 3.1.4, would be in the range of $300,000. The unit costs for pilot testing are typically considerably higher than for a full-scale application due to the effect of fixed costs associated with design, reporting, procurement, mobilization, and operation (i.e., costs that are relatively independent of the scale of the project).

4.2 FULL-SCALE SYSTEM

This section describes the costs associated with the application of the full-scale ISCO approach following implementation of the Hydraulic Displacement process at the SRSNE site. The total estimated cost for a full-scale ISCO application (not including Hydraulic Displacement process costs) at the site is $7.2 million. The chemical cost is approximately $5.5 million.

The following is an estimated cost breakdown for implementation of the full-scale ISCO approach:

- Project coordination, meetings, detailed design and implementation plans: $200,000
- Fabrication & system mobilization: $300,000
- Additional 34 wells: $100,000
- System installation and start-up: $150,000
- Operation and maintenance: $675,000 (two people on-site full time + maintenance, material handling, reporting & related costs)
- Oxidant costs: $5,450,000 (shipping & tax included)
- Groundwater monitoring - analytical costs: $100,000
- Demobilization and related post-operational activities: $200,000

Costs are not included for injection/extraction well abandonment.

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Appendix A

Specifications for Commercially Available Potassium Permanganate

CAIROX$^{\text{O}}$ POTASSIUM PERMANGANATE

GRADE: USP CODE F

COMPOSITE ANALYSIS

(Based on June-December 2003 20 Lot Composite)

PARAMETER	SPECIFICATION	COMPOSITE ANALYSIS
Assay, % $KMnO_4$	≥99.0	99.38
Insolubles, %	≤0.2	0.020
Wt. Loss (over silica gel), %	≤0.5	0.005
Sieve Analysis, % on: U.S. Std. No. 30 (590µm)	≤5.0	0.0

By: Keith Kujawa

Keith Kujawa
Quality Assurance Manager
815-224-6871

Note: Material conforms to ANSI/NSF Standard 60.

CAIROX^{O} POTASSIUM PERMANGANATE

GRADE: USP CODE F

COMPOSITE ANALYSIS

(Based on June-December 2003 20 Lot Composite)

PARAMETER	COMPOSITE ANALYSIS
Wt. Loss (105°C), %	0.05
pH, 5% Solution	9.20
Chloride, %	0.0075
Sulfate, %	0.0040
Nitrogen, %	0.0020
Sieve Analysis, % on:	
U.S. Std. No. 30 (590µm)	0.0
U.S. Std. No. 40 (420µm)	0.0
U.S. Std. No. 60 (250µm)	22.7
U.S. Std. No. 80 (177µm)	43.0
U.S. Std. No. 100 (149µm)	7.7
U.S. Std. No. 140 (105µm)	20.3
U.S. Std. No. 200 (74µm)	4.3
U.S. Std. No. -200 (74µm)	2.0

Metals (mg/Kg):

Aluminum	36.6	Lithium	<0.04
Antimony	<0.21	Mercury	
Arsenic	0.88	Molybdenum	<0.04
Barium	7.9	Nickel	<0.04
Beryllium	<0.10	Selenium	0.02
Boron	<0.25	Silver	<0.05
Cadmium	<0.02	Sodium	206.70
Calcium	25.6	Strontium	0.3
Chromium	<0.03	Thallium	<1.04
Cobalt	<0.02	Vanadium	3.6
Copper	<0.03	Zinc	1.2
Iron	<0.07		
Lead	<0.21		

Note: Material conforms to ANSI/NSF Standard 60.

CAIROX® POTASSIUM PERMANGANATE

GRADE: TECHNICAL

COMPOSITE ANALYSIS

(Based on November 2003 20 Lot Composite)

PARAMETER	SPECIFICATION	COMPOSITE ANALYSIS
Assay, % KMnO4	≥98.0	99.7
Sieve Analysis, % on:		
U.S. Std. No. 40 (420µm)	≤20.0	0.2
U.S. Std. No. -200 (74µm)	≤7.0	2.2

Note: Material conforms to ANSI/NSF Standard 60.

CAIROX® POTASSIUM PERMANGANATE

GRADE: TECHNICAL

COMPOSITE ANALYSIS

(Based on November 2003 20 Lot Composite)

PARAMETER	COMPOSITE ANALYSIS
Insolubles, %	0.08
Wt. Loss (105° C), %	0.08
Water Tolerance, %	0.1
pH, 5% Solution	10
Chloride, %	0.0750
Sulfate, %	0.0162
Nitrogen, %	0.0019
Sieve Analysis, % on:	
U.S. Std. No. 40 (420µm)	0.2
U.S. Std. No. 60 (250µm)	27.9
U.S. Std. No. 80 (177µm)	39.3
U.S. Std. No. 100 (149µm)	15.4
U.S. Std. No. 140 (105µm)	10.6
U.S. Std. No. 200 (74µm)	4.4
U.S. Std. No. -200 (74µm)	2.2

Metals (mg/Kg):

Aluminum	72.1	Lithium	<0.04
Antimony	<0.21	Mercury	0.01
Arsenic	2.0	Molybdenum	<0.03
Barium	5.4	Nickel	<0.04
Beryllium	<0.10	Selenium	<0.0002
Boron	<0.25	Silicon	165.4
Cadmium	<0.02	Silver	<0.05
Calcium	23.0	Sodium	536.8
Chromium	4.8	Strontium	0.1
Cobalt	<0.03	Thallium	<1.04
Copper	<0.07	Vanadium	8.7
Iron	<0.01	Zinc	1.0
Lead	0.5		

Note: Material conforms to ANSI/NSF Standard 60.

Appendix U

Evaluation of Enhanced In Situ Bioremediation After In Situ Chemical Oxidation

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EVALUATION OF ENHANCED IN SITU BIOREMEDIATION AFTER IN SITU CHEMICAL OXIDATION

SOLVENTS RECOVERY SERVICE OF NEW ENGLAND, INC., SUPERFUND SITE SOUTHINGTON, CT

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GeoSyntec Project Number TR0119
22 June 2004

Disclaimer

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1. INTRODUCTION

This remedial alternative for the Observed Non-aqueous Phase Liquid (NAPL) in Overburden Groundwater Unit (Alternative ONOGU-4) involves the sequential application of hydraulic displacement, in situ chemical oxidation (ISCO) and enhanced in situ bioremediation (EISB) as the proposed remedial option at the Solvents Recovery Service of New England Inc., (SRSNE) Superfund Site in Southington, CT (the Site). Hydraulic displacement is proposed as a means to extract some mobile dense non-aqueous phase liquid (DNAPL) mass from the ONOGU, and to convert the rest to residual, immobile form. The application of hydraulic displacement would take approximately 180 days to complete. Appendix I describes the proposed implementation of hydraulic displacement at the Site. ISCO is proposed as a secondary treatment for the Site as a means to destroy additional dense DNAPL mass from the ONOGU. The application of ISCO would take approximately two years. Appendix S describes how hydraulic displacement would improve subsequent application of EISB. Appendix T provides a detailed description of the ISCO technology and the proposed application scenario of Alternative ONOGU-4 as the remedial option for the Site. It is assumed that the initial treatment technologies will remove any pooled NAPL mass and that only residual NAPL will remain for EISB. This appendix presents how EISB would be applied for Alternative ONOGU-4, specifically, how ISCO may impact the subsequent application of EISB. Appendix G (EISB) provides a review of the applicability of EISB as a remedial technology for the Site and Appendix H (Biodegradation Mechanisms) provides a review of the common microbial processes that can result in biodegradation of select compounds.

The use of ISCO is expected to remove as much as 85% of the chemical mass remaining after hydraulic displacement. ISCO is expected to be applied as a partial mass removal technology. Bioremediation would then be used as a polishing step to cost-effectively remove remaining residual DNAPL.

This remainder of this section presents a brief description of the ISCO technology (Section 2), a review of the impact of ISCO on microorganisms (Section 3) and a review of the site specific technical considerations as they apply to the Site (Section 4).

2. OVERVIEW OF IN SITU CHEMICAL OXIDATION

Various oxidants have been used in laboratory and field applications to aggressively destroy tetrachloroethene (PCE) and trichloroethene (TCE) DNAPLs, including permanganate (MnO_4^-) and Fenton's reagent (hydrogen peroxide [H_2O_2] and a ferrous iron catalyst). Of these, permanganate offers significant advantages because it is: i) less reactive with aquifer solids, resulting in improved oxidant delivery to target contaminants; ii) typically more stable and safer to handle than Fenton's reagent; iii) does not require pH adjustment with concentrated acid; and iv) produces less heat and insoluble gas in the treatment zone.

The reaction between permanganate and chlorinated ethenes involves an electrophilic attack on the ethene's Carbon-Carbon double bond and the formation of a cyclic hypomanganate ester. Rapid hydrolysis of the cyclic ester results in the production of carbon dioxide (CO_2). The stoichiometric reactions describing the oxidation of TCE and PCE by MnO_4^- is given by Yan and Schwartz (1999),

$$C_2Cl_3H + 2MnO_4^- \rightarrow 2CO_2(g) + 2MnO_2(s) + 3Cl^- + H^+ \qquad (1)$$

$$3C_2Cl_4 + 4MnO_4^- + 4H_2O \rightarrow 6CO_2(g) + 4MnO_2(s) + 12Cl^- + 8H^+ \qquad (2)$$

where, TCE and PCE are presented by their chemical formulae C_2Cl_3H and C_2Cl_4, respectively. This reaction indicates that oxidation of these compounds by MnO_4^- is accompanied by the production of manganese dioxide (MnO_2) solid, CO_2 gas, hydrogen ion (H^+) and chloride (Cl^-).

2.1 Case Studies of DNAPL Source Zone Remediation using Permanganate

Successful destruction of both dissolved phase volatile organic compounds (VOCs) and pure-phase DNAPL has been demonstrated using MnO_4^- oxidation in both porous and fractured media. While it is estimated that ISCO using either Fenton's reagent or MnO_4^- has been applied at some 300 sites (R. Siegrist, personal communication, 2001), few rigorous studies of the performance of ISCO have been reported in the scientific literature. Several key demonstrations are highlighted below.

The first significant field evaluations of ISCO using MnO_4^- were conducted in a sand aquifer at Canadian Forces Base (CFB) Borden near Toronto, Ontario (Schnarr and Farquhar, 1992; Schnarr et al. 1998). These field demonstrations were conducted within a double-walled sheetpile cell (3.0 meters (m) x 2.5 m x 1.0 m) that isolated the treatment zone from the surrounding aquifer. The first demonstration evaluated MnO_4^- oxidation of a residual PCE source while the second demonstration evaluated MnO_4^- oxidation of a multi-component TCE/PCE DNAPL distributed as both pooled and residual DNAPL. The results of the first demonstration illustrated that rapid removal of residual DNAPL could be achieved. However, the rate of degradation of pooled DNAPL in the second demonstration was limited by the low surface area to volume ratio. A field study conducted by Hood et al. (1997) in the sandy aquifer at CFB Borden confirmed the conclusions of Schnarr et al. (1998) and Schnarr and Farquhar (1992), namely that DNAPL residuals (consisting of PCE, TCE, and trichloromethane [TCM]) can be rapidly remediated using MnO_4^-.

Subsequent to these initial investigations, a MnO_4^- flush in a sand aquifer contaminated with a substantial quantity of TCE DNAPL was performed at the Launch Complex 34 facility at Cape Canaveral Air Force Station in Florida (IT Corporation, 2000). Pulses of MnO_4^- were delivered into the source zone through drive-point injection. The reduction in DNAPL mass resulting from oxidant injection was estimated to be 84%, with mass reduction estimates in the groundwater ranging from 83% to 95%. At this site, no evidence of permeability reductions resulting from precipitated MnO_2 in the matrix was observed. Hydraulic conductivity measurements performed after oxidant injections were either comparable to or slightly higher than pre-test measurements, a result which is consistent with theoretical calculations reported by Hood (2000).

2.2 Geochemical Impacts

Permanganate can result in impacts to groundwater quality through a wide range of geochemical reactions. In addition to reactions with the target contaminant, permanganate can oxidize constituents of the uncontaminated porous media, including natural organic carbon, sulfides and minerals containing reduced forms of either iron or manganese (Barcelona and Holm, 1991). The reduction of permanganate results in the precipitation of Mn(IV) manganese oxides (generally δ-MnO_2) as brown-black precipitates, which are capable of oxidizing a wide range of organic compounds (Stone, 1984) and possess significant cation exchange properties (e.g., Stumm and Morgan, 1970).

In buffered aquifers where relatively small amounts of contaminant are present, short-term groundwater quality impacts of permanganate are characterized by an increase in pH (7.5-9.5) resulting from the slow oxidation of water accompanied by an increase in the concentration of some dissolved cations (calcium [Ca^{2+}], magnesium [Mg^{2+}], sodium [Na^{+}]) as they are displaced from cation-exchange sites by potassium [K^{+}]) (Nelson et al., 2001). The occurrence of reducing conditions increases manganese solubility, although this is generally limited to concentrations less than 20 milligrams per liter (mg/L) due to precipitation of $MnCO_3$ and MnS (Stumm and Morgan, 1970). In data from a US EPA survey of groundwater sources of municipal drinking water, Mn was detected in 64% of these source waters at concentrations exceeding the reporting limit (0.001 mg/L) and was present in source water at a median concentration of 0.005 mg/L with 99% of source waters at a concentration less than 2.9 mg/L (USEPA, 2002), indicating that solubility controls on Mn limit its mobility in most geochemical environments. Mn is a regulated contaminant with a secondary maximum contaminant level (MCL) of 0.05 mg/L (www.epa.gov/safewater/mcl.html).

Oxidation of constituents of the aquifer matrix can produce soluble products. Sulfide minerals may be oxidized to produce sulfate (Nelson et al., 2001) while fractions of the insoluble organic carbon content is likely only partially oxidized to carboxylic acids and aldehydes (Hayes, 1989), possibly accounting for increases in dissolved organic carbon concentrations observed at some field sites (Droste et al., 2000; Siegrist, personal communication).

In aquifers where significant contaminant mass is present, relatively significant groundwater impacts can result. Oxidation of chloroethenes such as PCE or TCE by permanganate results in the production of CO_2(g), MnO_2 (MnIV), Cl^-, and H^+ (Equations 1 and 2). As a result of the high oxidation rates, extremely acidic pH conditions have been observed in some laboratory models adjacent to DNAPL zones (e.g., MacKinnon and Thomson, 2002). The production of acidic conditions may impact contaminant degradation in addition to groundwater geochemistry. Under near-neutral conditions, Mn(VII)->Mn(IV) is the predominant redox couple; however, under acidic conditions this may shift to the Mn(VII)->Mn(II) couple resulting in the formation of soluble Mn(II), although there is only limited laboratory evidence of this effect (Schroth et al., 2001). In carbonate buffered aquifer systems, the acidity results in a buffering response that increases the solubility of carbonate minerals. Further oxidation of sulfide minerals may occur, resulting in the production of soluble sulfate (SO_4^{2-}). Depending upon the carbonate mineralogy, groundwater quality impacts in buffered aquifers may be characterized by slightly acidic pH (5.5-6.5) and elevated concentrations of Cl^-, Mg^{2+}, Ca^{2+} and SO_4^{2-} (Nelson et al., 2001). In the Borden aquifer (calcium carbonate content of 15.4%, Ball et al., 1990), calcite dissolution resulting from acidity produced by PCE oxidation produced an observed Ca:Cl molar ratio of 5:12, consistent with stoichiometric predictions (Nelson et al., 2001). The decrease in pH may be readily countered if carbonate minerals are present, limiting the zone of lowered pH to the area immediately surrounding the DNAPL (Nelson et al., 2001).

Metals present in permanganate or mobilized as a result of the shift in redox conditions are of concern during ISCO. For example, metal constituent impurities in permanganate, including aluminum (Al), antimony (Sb), arsenic (As), chromium (Cr), molybdenum (Mo), thallium (Tl), and vanadium (V), can exceed drinking water criteria in permanganate solutions in excess of 4% (FDEP, 2000), while the solubility of trace minerals in aquifer materials containing Cr, mercury (Hg), and ruthenium (Ru) is reported to increase during permanganate addition (Li and Schwartz, 2002). Of these metals, Cr has been the principal focus of attention (e.g., Chambers et al., 2000a; Allen et al., 2002). In groundwater environments where either natural or anthropogenic sources of Cr mineral phases are present, oxidation of Cr(III) to more soluble Cr(VI) can occur, resulting in Cr concentrations exceeding regulatory criteria (Chambers et al., 2000b), although there is evidence to suggest that Cr is readily attenuated once any residual permanganate is depleted from solution through the natural oxidant demand of soil (Chambers et al., 2000a). A similar effect on metal solubility may occur during ISCO if reduced forms of Hg (e.g., Hg^0, $HgCH_3$) are present (GeoSyntec, unpublished data).

Following the application of ISCO, impacts resulting from residual MnO_4^- in groundwater are likely minor, since permanganate is readily decomposed by the natural reduction capacity present in many groundwater systems, and over the longer-term, the most significant groundwater impacts are likely to be associated with the presence of MnO_2, which may significantly impact post-treatment groundwater quality. Sorption processes on MnO_2 surfaces or co-precipitation with the MnO_2 structure is reported to attenuate the transport of a wide range of dissolved metals, including Al, Ba, Ca, cadmium (Cd), cobalt (Co), copper (Cu), Cr, Mg, Mn, nickel (Ni), strontium (Sr), uranium (U) and zinc (Zn) (e.g., Jenne, 1968; Stumm and Morgan, 1970; Fu et al., 1991; Nelson et al., 2001; Siegrist et al., 2001). While colloidal particles of MnO_2 are mobile in groundwater (e.g., Siegrist et al., 2001), it is likely that most MnO_2 is deposited on the soil grains. In the post-treatment groundwater, the sorptive capacity of MnO_2 (either produced during treatment or naturally-occurring) may significantly limit Cr(VI) mobility through similar attenuating processes (Siegrist et al., 2001). Under oxic conditions, manganese is essentially insoluble; however, the anaerobic conditions typically associated with biodegradation of chlorinated ethenes favor Mn-reduction and the mobilization of soluble Mn(II) through reductive dissolution (Stone, 1984). Simultaneously, it is likely Mn mobilization will result in concurrent mobilization of other metals adsorbed on the MnO_2 surface or co-precipitated within the MnO_2 structure.

2.3 Microbiological Impacts

To date, a limited number of laboratory investigations have evaluated the impacts of ISCO using permanganate on microbial populations and dechlorinating activity. As an oxidizing agent, contact with permanganate adversely impacts microorganisms present in groundwater, although complete sterilization of the microbial population is generally considered unlikely to occur. In a study evaluating the impact of permanganate addition on indigenous microorganisms, reductions in the populations of aerobic and anaerobic heterotrophs, nitrate, nitrite and sulfate reducers, and methanogens following treatment ranged from 47-99.95% (Klens et al., 2001). Replicate samples collected six months after treatment suggested that the population of heterotrophic aerobic microorganisms rebounded although enumeration of anaerobic heterotrophic microorganisms indicated that only minimal recovery of these microorganisms had occurred. While permanganate may result in large reductions in microbial populations, there is at least limited microcosm evidence to suggest that ISCO does not permanently destroy the dechlorinating activity of the microbial population (Rowland et al., 2001; GeoSyntec, unpublished data). However, the data does show that key dechlorinating populations can be decimated and the recovery rate is likely linked to transport of microorganisms into the treated area, or from growth over time of surviving bacteria.

Other investigators have evaluated the impact of ISCO using permanganate on microbial populations in the field. Of particular interest are the results from an ISCO demonstration at LC34, where aerobic and anaerobic plate counts were taken from samples collected pre-demonstration, and at 1, 9 and 13 months post-demonstration (Battelle, 2001). At one month the anaerobic populations were virtually eliminated in some parts of the test plot, but these populations had reestablished at the 9 and 13 month post-demonstration points. While these results indicate that the general population of anaerobic microorganisms rapidly reestablished following ISCO, it provides only limited insight into any changes in the dominant microorganisms and their phenotypic expression of degradation activity by the microbial community.

Although data from groundwater systems is limited, the application of permanganate as a drinking water disinfectant provides insight into acute impacts of this oxidant on the microorganisms in groundwater environments. Potassium permanganate is an effective disinfectant for both bacteria and viruses (USEPA, 1999). At very low doses (1 to 6 mg/L), complete removal of coliform bacteria was achieved with contact times of up to 30 minutes (Hazen and Sawyer, 1992). Similar results were achieved for a surrogate virus (MS-2 bacteriophage), with 2-log inactivation occurring after a contact time of 52 minutes at a permanganate residual of 0.5 mg/L (Yahya et al., 1989). The rapid disinfection reported in these studies suggest that comparable removals at the permanganate concentrations typically used in field applications (e.g., 2%) requires contact times of less than one second.

3. IMPACTS OF CHEMICAL OXIDATION ON BIOREMEDIATION

Taken in conjunction with ongoing data collected as part of Department of Defense Environmental Security Technology Certification Program (ESTCP) project number

CU-0116 (*Sequential Application of Chemical Oxidation and Bioaugmentation*), these studies provide a framework for understanding the impact of permanganate on microbial populations and their activity. Given the disinfectant properties of permanganate, it seems likely that the in situ addition of a concentrated permanganate solution will significantly reduce the indigenous microbial population and inhibit further microbial activity as long as residual permanganate is present in the groundwater.

Once the residual permanganate is depleted, groundwater flow into the oxidized zone (i.e., the immediate volume of the aquifer containing significant quantities of manganese oxides) containing microorganisms can reestablish an active microbial population, likely favoring those microorganisms with rapid growth rates and unique characteristics that enable them to effectively exploit the environmental conditions (e.g., manganese-reducing bacteria such as *Geobacter metallireducens*; Nealson and Saffarini, 1994). To achieve a transition to a microbial population dominated by degradative microorganisms (e.g., *Dehalococcoides*), however, may require a significant shift in redox conditions. As Mn-reduction is thermodynamically favorable relative to reductive dechlorination, the establishment of dechlorinating populations may only be possible in anaerobic niches where MnO_2 has been completely removed (Sleep and Hrapovic, 2003, research report in progress).

As indicated in Appendix G (EISB), specific halorespiring microorganisms are required to carry out complete dechlorination of the chlorinated ethenes to ethene, in the presence of a suitable electron donor. The extent that the oxidants will decimate the population of dechlorinating microorganisms is unknown but it will likely be sufficient to reduce biodegradation rates for a lengthy period of time. Although the clean water flushing stage of ISCO will reduce the residual oxidant concentrations, repopulation with the requisite halorespiring microorganisms will be required before EISB will become effective. Repopulation could involve:

1) bioaugmentation with commercial cultures;

2) waiting a significant period of time for surviving microorganisms to regrow to appropriate cell densities; or

3) waiting for the transport of microorganisms upgradient back into the treatment area.

Options 2 and 3 above assume that surviving or transported microorganisms have the same capabilities compared to those that have developed over time within the source area. Bioaugmentation avoids the need to rely on that assumption and would provide more rapid and predictable response and, therefore, is the option of choice. This is particularly true after ISCO because the introduced microorganisms will grow and thrive more rapidly in an environment that has become relatively free of competition from native microorganisms. Several field demonstrations have shown the utility of bioaugmentation to improve the application of EISB technology (Ellis et al., 2000; Lendvay et al., 2003; Major et al., 2002).

After the ISCO application, the redox conditions would need to be changed from oxidizing to reducing. Pretreatment of the area with electron donor would be completed to: 1) reduce any residual oxidant remaining in the ONOGU, and 2) promote anaerobic conditions prior to bioaugmentation to ensure that conditions are appropriate for the microbial community.

The addition of an electron donor will drive the system anoxic, favoring the activity of anaerobic microorganisms. The presence of an electron donor will favor the activity of manganese-reducing bacteria (likely including Geobacter species, the same organisms responsible for iron reduction in the environment), solubilizing more dissolved Mn and other co-precipitated metals that may have been present in the commercial source of permanganate. The mobility of dissolved Mn (and many other metals) is limited by the presence of Mn-dioxide, which is a excellent cation exchange surface. If microorganisms capable of partial dechlorination are present, electron donor addition may enhance the production of cDCE; however, competitive donor demand processes (e.g., Mn-reduction) may limit the availability of electron donors for dechlorination.

Further there is substantial evidence indicating that the deposition of Mn-dioxide severely reduces the permeability of porous media containing significant DNAPL. This may reduce VOC mass transfer from the DNAPL and will certainly impede the delivery of electron donors to the DNAPL:water interface, suggesting the efforts to mobilize Mn-dioxide through electron donor addition may have limited success. If true this would suggest that the design of post-treatment bioremediation strategies should focus on providing containment of the remaining VOC plume, rather than enhancing dissolution of the remaining DNAPL.

The impact of bioaugmentation after ISCO is not well-understood even after treatment zones are returned to anaerobic conditions based on limited studies; however, it is evident that there are some significant effects. Bioaugmentation with cultures containing species of Geobacter is likely to facilitate Mn-reduction and the formation of highly reduced niches in the subsurface capable of supporting reductive dechlorination. Bioaugmented dechlorinating microorganisms may colonize these niches where Mn-dioxide has been depleted; however, the extent of recolonization possible where Mn-dioxide remains present is not well-understood and there is some evidence to suggest that these zones will not support the growth of Dehalococcoides-like microorganisms.

4. PROPOSED APPLICATION OF EISB AS PART OF ALTERNATIVE OGU-4

The information presented in Appendix G (EISB) demonstrates that under the current Site conditions (up to June 2003), without the addition of supplemental electron donors, there is evidence that biological degradation of the Site chemicals is promoting the enhanced dissolution of DNAPLs over what would be expected based solely on abiotic dissolution mechanisms. Therefore, it is reasonable to expect that the dissolution rate can be maintained and potentially be enhanced by adding additional suitable electron donors to the groundwater, and that EISB can be used as a follow-on remedial technology to continue the enhanced removal of NAPL residuals that remain after the application of hydraulic displacement.

As described in Appendix T (ISCO), the ISCO treatment step will involve the addition of approximately 1.45 million kilograms of potassium permanganate. The proposed design for ISCO at the Site consists of approximately 12-15 months of oxidant addition, followed by several months of clean water flushing and oil injection to change the redox conditions back to reducing (Appendix T [ISCO]). After the oxidant application and follow-up water flush are complete, the treatment zone will be monitored until it stabilizes with respect to groundwater chemical oxidant concentrations and hydraulic gradients. After the stabilization period, the level of bioremediation that is occurring will be evaluated (see Appendix S). Bioaugmentation will be required to re-establish the activity of key halorespiring populations after application of ISCO.

The infrastructure installed as part of the hydraulic displacement and/ or ISCO options will be used for EISB. Additional wells may need to be added to optimize the distribution of electron donor and cultures. The electron donor and bacterial culture will be diluted and dispersed into the treatment area via the extraction and re-injection of Site groundwater using the extraction and injection well networks.

The principal cost of EISB is the electron donor as it will be added periodically. The selected electron donor will be emulsified soybean oil (oil), and it will be added so that 1% (on average) of the effective pore volume within the treatment area will contain oil. The annual amount of electron donor, in this case, emulsified soybean oil, is based on the likely range of biodegradation rates and their impact on the enhanced loading rate of the Site chemicals during the application of EISB, the stoichiometric amount of oil required to meet the loading rate of Site chemicals to promote their complete dechlorination, and a safety factor to account for loss of electron donor to competing microbial processes (i.e., less than 100% of the electron donor is used during the reduction of chlorinated solvents). Additional electron donor injection wells may be added to achieve a more uniform electron donor distribution, but this will be part of the detailed design process. For the purposes of evaluation, an initial application of 1% oil to the ONOGU would be applied for all EISB options, regardless of initial starting mass variations. After this, applications would be based on consumption throughout the ONOGU. This application would be repeated in years three and five. Amounts and distribution of any subsequent application would be adjusted based on consumption rates and after any review of any observed distribution of chlorinated volatile organic compounds (cVOCs) in the ONOGU that may be present after year seven. Table 1 summarizes the major costs associated with the EISB component of Alternative ONOGU-4.

The following sections review factors that might affect the performance of the proposed technology design (Sections 4.1 through 4.5).

4.1 Technology Demonstrations at Comparable Sites or Scale

As identified in Sections 2 and 3 both laboratory and field investigations have indicated EISB following ISCO can occur. Similarly the information provided in Appendix G and in Section 4 clearly identifies that bioremediation is already occurring on a large scale at the Site. These lines of evidence support the application of EISB as a component of the Site remedy. As noted above, EISB at the Site is intended to act as follow on treatment process.

4.2 Risks and/or Benefits of Implementation

The risks and benefits of implementing EISB after ISCO are summarized below.

Risks:

- Impact of ISCO application on dehalogenating microbial populations. ISCO will substantially reduce the microbial diversity and amount of biomass in the subsurface. Bioaugmentation will be required to re-establish the requisite microbial populations.

- ISCO may reduce the permeability of the formation and reduce the distribution of electron donor. Additional injection points may be required to provide appropriate distribution of added oil and cultures.

- Residual concentration of oxidant. Residual permanganate will continue to inhibit the re-establishment of the microbial activity.

- Once EISB is established there may be an increase in the dissolution rate. This rate may overwhelm the ability of microorganisms to completely dechlorinate the Site chemicals until their population densities increase. This could result in the production of intermediate degradation compounds like vinyl chloride. However, this risk is mitigated by bioaugmentation to increase cell densities of key halorespiring microorganisms and by utilization of the non-time critical removal action (NTCRA-1) containment system.

- Methane will be produced as a by-product of microbial activity. Systems will need to be designed to ensure methane is handled appropriately. Methane production (methanogenesis) is not typically associated with NAPL residuals of chlorinated ethenes as elevated concentrations of chlorinated ethenes inhibit methanogenesis.

- EISB may not enhance current degradation rates, as there are already indications that enhanced degradation is occurring. However, this will have little impact other than extending remedial time frames.

- Biofouling, of wells may occur. This could lead to increased costs associated with well rehabilitation.

- Mobilization of metals may occur. Once the Site is returned to anaerobic conditions, possible secondary water impacts, such as an increase in the mobilization of reduced metals may occur, particularly those associated with manganese oxides.

Benefits:

- Increase in dissolution rate of residual NAPLs can shorten overall time frame for remediation. This will make the remedy less expensive to achieve overall remedial goal.

- Technology is capable of complete detoxification in situ. At some point this may eliminate the need for ex situ treatment systems.

- If degradation rates are sufficiently fast, then “biocontainment” (i.e., where the natural attenuation capacity of the system equals the dissolution rate) of dissolved phases may be sufficient to contain the aqueous phase plume, and eliminate the need for further groundwater extraction and treatment in the future.

- Creation of larger 'smear' zones from superseding technologies (e.g., hydraulic displacement) which make the VOCs more available for biodegradation than large pools.

- Addition of bacteria culture and/or oil has a very low risk of causing adverse effects to human health or the environment.

4.3 Cost Sensitivity

The factors most affecting the application cost of EISB after ISCO include:

- Achieved rate of degradation and the impact this has on the loading of chemicals from the residual NAPL to dissolved phases.

- Unit cost of electron donors. The major cost of EISB is electron donor and the change in costs may be substantial based on changes in electron donor types.

- Ability to distribute oil. Although the oil estimates presented in Tables 1 are based on the stoichiometric requirements, the delivery of the oil will also affect the total amount of oil that needs to be delivered yearly to obtain adequate oil coverage to the target areas. As an electron donor is added, it is also consumed during its travel. Assuming that the time to degrade one half the electron donor mass is 10 days, and it takes 30 days for oil to be advected between an injection and target location, then approximately six times more donor would need to be added at the injection well to achieve the required concentration of oil near the target location. However, increasing the number of injection wells so there is only 10 days of travel time between injection and target locations would require only injecting three times the required mass. There is a trade off between increasing the number of injection locations and total donor required. For longer term cleanups, the increase in cost for additional permanent injection locations is saved through overall decrease in electron donor costs. The detailed design process would evaluate the optimization of wells and electron donor cost.

4.4 Endpoints and How is Performance Measured/Quantified

The performance of EISB is assessed through:

- Increase in flux of parent and degradation products (chlorinated, non-chlorinated and inorganic compounds). This measurement provides an indication of mass removed and enhancement of dissolution rates, and is obtained by use of flux meters or simple measurement of the concentration of target analytes and using groundwater flow velocities to calculate fluxes;
- Calculation of degradation rates using changes in concentrations of parent and degradation products along defined flow paths; and
- Increase in abundance and distribution of key microbial species or their activities.

Application of EISB would be expected to improve the attainment of ONOGU Remedial Action Objectives (RAOs). While hydraulic displacement would eliminate the mobility of NAPL, and meet that RAO, application of EISB would be expected to shorten the time frame that groundwater standards are exceeded, shrink the aqueous phase VOC plume, and further reduce groundwater contaminant concentrations.

4.5 Scale-Up and Potential for Implementation of the Technology

EISB is readily scaleable to the Site through the addition of electron donor to existing or added wells. Factors to consider during scale up may include:

- Control of Intermediary Chlorinated Volatile Organic Compounds (cVOCs). Due to the confined nature of the treatment zone at the Site (underlying confining layer, downgradient sheet pile wall and hydraulic controls) the possible formation of degradation intermediates (cis-1,2-dichlroethene [cDCE], and vinyl chloride[VC]) is not a concern.

- Supplemental Addition of Electron Donor. The existing system of injection and extraction wells installed for the ISCO application are believed to be sufficient for the addition of electron donor and bacterial culture, if required. If the groundwater extraction is no longer ongoing, additional injection points or wells may need to be installed to provide adequate coverage for electron donor addition.

- Permitting. If bioaugmentation with bacterial culture is deemed to be necessary, than a permit may be required.

- Biofouling controls. The specific biofouling controls will need to be addressed when the final well configuration has been designed.

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TABLE 1
ALTERNATIVE ONOGU-4 COSTS: EISB FOLLOWING HYDRAULIC DISPLACEMENT AND ISCO
Solvents Recovery Service of New England Superfund Site, Southington, CT

Description	**Cost**
1. Enhanced In-Situ Bioremediation Design	
i) Enhanced In-Situ Bioremediation Design Cost	$202,500
ii) Microcosm Studies	$100,000
iii) Column Studies	$150,000
iv) System Infrastructure Installation	$110,000
Total Estimated EISB Design Costs	**$562,500**
2. EISB O&M Costs (1 injection for pre-treatment, 3 injections over 5 years)	
i) EISB Injection O&M	
a. Bioaugmentation with Dehalococcoides	$450,000
b. System Infrastructure shake down	$3,750
c. Oil for 4 injections	$1,200,000
d. Labor for 4 injections	$225,000
ii) EISB Well Maintenance O&M	$22,500
Total Estimated EISB O&M Costs for 5 Years	**$1,901,250**
Total Estimated Cost for 5 Years of EISB following Hydraulic Displacement and ISCO	**$2,463,750**

Appendix V

White Paper for Thermal Technologies

WHITE PAPER FOR THERMAL TECHNOLOGIES

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Disclaimer

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Appendix A: Results of Thermal Modeling by Dr. Sleep
Appendix B: Analysis of Air Emissions ARARs

1.0 INTRODUCTION

This white paper was prepared to identify and evaluate a potential remedial approach, using thermal technologies, for constituents of concern (COCs) present in overburden soil and groundwater at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund site in Southington, Connecticut (site). Remedial alternatives for the COCs, which exist as a non-aqueous phase liquid (NAPL) in the Observed NAPL in Overburden Groundwater Unit (ONOGU) are under evaluation within the Feasibility Study being prepared for the site. Preliminary screening of potentially applicable technologies to address the NAPL has identified thermal technologies as one remedial approach that merits further consideration. The NAPL mass in the ONOGU at the site is composed of a combination of chlorinated and non-chlorinated volatile organic compounds (VOCs) and polychlorinated biphenyls (PCBs). The primary VOCs present in the NAPL are: tetrachloroethylene (PCE), trichloroethylene (TCE), dichloroethylene (DCE) (combined 1,1-DCE and 1,2-DCE isomers), trichloroethane (TCA) (combined 1,1,1-TCA and 1,1,2-TCA isomers), dichloroethane (DCA) (combined 1,1-DCA and 1,2-DCA isomers), benzene, toluene, ethylbenzene, xylene isomers (BTEX), methylene chloride, chloroform, 4-methyl-2-pentanone (MIBK) and styrene. The mixture of COCs present can act as a light or dense NAPL depending on the constituent composition at any given location. At other sites, thermal remediation technologies have been shown to effectively remove similar NAPL phases and reduce soil and groundwater concentrations substantially for similar contaminants. However, no site treated to date has had the combined challenges of the SRSNE Site with respect to the large VOC mass located in a significant volume of saturated overburden, over a fractured bedrock zone.

1.1 OBJECTIVE

The objectives of this white paper are to present an evaluation of available thermal technologies and outline a conceptual design for the most appropriate thermal technology to remediate the NAPL in the ONOGU at the SRSNE site. The evaluation also includes an estimate of the energy requirements, a feasibility study level cost for application of the approach and a discussion on the uncertainties / risks / potential limitations and the expected results of applying the remedial approach at the site.

1.2 CONTENTS

This white paper is structured as follows:

Section 2	Thermal Technologies: provides an overview of the effects of thermal technologies on NAPL remediation and discusses available thermal technologies and their applicability in the context of the SRSNE site. The potential for downward migration of the NAPL into the underlying bedrock is evaluated and discussed, and the recommended thermal technology approach for the site is described.

Section 3	Technical Approach for the SRSNE Site: presents the results of thermal modeling simulations performed to assist in the design of the thermal remedy. A conceptual design for the application of the recommended thermal technology approach for the site is described. Uncertainties, risks and potential limitations associated with the approach are identified and discussed, as well as the expected results from application of the approach at the site. A review of relevant literature and experience with the recommended approach is provided.
Section 4	Energy Balance: provides an estimate of the energy requirements to implement the recommended approach at the site. The energy requirements were developed based on a simple energy balance equation and from the output of the thermal modeling of the site.
Section 5	Costs: provides feasibility study level costs for application of the thermal technology approach for the site. The costs were derived from a thermal vendor, as amended by the thermal modeling results and experiences gained from previous site activities.

2.0 THERMAL TECHNOLOGIES

This section provides an overview of the potential effects of thermal technologies on NAPL remediation / recovery and discusses the commercially available thermal technologies and their applicability in the context of the SRSNE site. The potential for downward migration of the NAPL into the underlying bedrock and the implications to the thermal remedy approach for the site was evaluated by Dr. Sleep (University of Toronto, Canada) and Dr. Kueper (Queen's University, Canada) in a separate appendix to the Feasibility Study (Appendix W) and the results of the analysis are briefly summarized in this section. Further, a site-specific thermal technology approach, which minimizes the risk of NAPL mobilization while achieving a high degree of mass removal, is recommended and briefly described.

2.1 THERMAL EFFECTS ON NAPL REMEDIATION

Generally, COCs present as NAPL are difficult to remediate due to relatively low aqueous solubility and relatively high octanol-water partition coefficients. A low aqueous solubility does not allow for significant mass removal through dissolution into groundwater. A high octanol-water partition coefficient results in preferential partitioning of COCs to organic matter in the subsurface, rather than to groundwater, and this makes the COCs more difficult to extract. Heating the subsurface to temperatures around the boiling point of water can lead to significant changes in the thermodynamic conditions in the subsurface and can make NAPL more mobile / removable. The potential for increased accumulation and mobility of the NAPL can also negatively impact the environmental conditions at a site (through downward migration beyond the Target Treatment Zone (TTZ), and must be considered in the remedial approach evaluation and design.

The major effects of heating are:

- The vapor pressure of the NAPL increases markedly with temperature. As the subsurface is heated from ambient temperature to temperatures in the range of 100 ^oC, the vapor pressure of the NAPL constituents will typically increase by between 10 and 30-fold (Udell 1996).
- Adsorption coefficients are reduced moderately during heating, leading to an increased rate of desorption of COCs from the soil (Heron et al. 1998).
- Viscosity of NAPL is reduced by heating. The higher the initial viscosity, the higher the reduction. For TCE and other chlorinated solvents, the viscosity typically is reduced by about a factor of 2.
- NAPL-water interfacial tensions are lowered by as much as 2-fold. However, for DNAPLs this can be a significant negative effect if downward migration of the DNAPL is a site-specific concern.
- Boiling of NAPL at temperatures below the boiling point of water (DeVoe et al. 1998). For the SRSNE site, with TCE and Toluene being dominant NAPL constituents, an estimated boiling point for the NAPL is between 80 and 85 ^oC at the in-situ pressure, which is a function of depth below the water table. At modest depths such as those at this site, heating the subsurface to above 85 ^oC will make the NAPL thermodynamically unstable, causing it to boil and convert to a vapor.

These physical effects can lead to improved NAPL remediation:

- By displacement of the NAPL phase for potential extraction with pumped fluids (If groundwater is pumped).
- By vaporization and extraction in the vapor phase.
- By volatilization, migration in a steam phase, and condensation in water for potential extraction with pumped fluids.
- By dissolution and desorption and potential extraction with pumped fluids.

For chlorinated solvents such as TCE and PCE, vaporization is the most important removal / remediation mechanism. Therefore, there is no extraction of fluids in the approach proposed for SRSNE.

In addition to the physical removal described above, biological and chemical degradation mechanisms may occur during and after thermal remediation. These mechanisms may include:

- Thermal destruction by oxidation and pyrolysis near heating elements (for thermal conductive heating) at temperatures around 400 ^oC (Baker and Kuhlman 2002).
- Post-thermal treatment microbial mineralization of NAPL components, dependent on the rebound of the microbial communities (discussed further in Section 3.3.2).
- Hydrous Pyrolysis Oxidation, an aqueous-phase oxidation reaction initiated by the introduction of excess oxygen to a previously heated subsurface.

- Hydrolysis at elevated temperature. This is particularly relevant for chemicals with short hydrolysis half-lives such as Methylene Chloride and 1,1,1-TCA (Jeffers et al. 1989).

Since the chosen strategy involves mobilization of the NAPL by vaporization, the capture and control of the generated vapors is essential for successful remediation.

2.2 AVAILABLE TECHNOLOGIES OVERVIEW

Commercially available thermal technologies (U.S. EPA 2004) considered for application at the SRSNE site include:

- Steam Enhanced Extraction (SEE)
- Electrical Resistive Heating (ERH)
- Thermal Conductive Heating (TCH)
- Radio Frequency Heating (RFH)

These thermal technologies are discussed briefly in the following sections.

2.2.1 STEAM ENHANCED EXTRACTION (SEE)

SEE involves the injection of steam into the TTZ to dissolve, vaporize, mobilize and displace contaminants for recovery with standard vapor and liquid extraction equipment. After extraction, vapors and liquids are treated using conventional aboveground treatment technologies, such as condensation, air stripping, carbon adsorption and thermal oxidation. SEE was first used by the petroleum industry for enhanced recovery of oil from deep formations by lowering the viscosity of heavy oils and increasing the volatility of light oils.

2.2.2 ELECTRICAL RESISTIVE HEATING (ERH)

ERH involves the application of electrical current to the TTZ, which results in the generation of heat. Heat is generated from the natural electrical resistance within the subsurface and energy is dissipated through resistive loss. As the subsurface temperature increases, steam is generated from the pore water or saturated media in the treatment zone. The steam dissolves, vaporizes, mobilizes and displaces contaminants for recovery with standard vapor and liquid extraction equipment. Conventional above ground treatment technologies similar to those used with SEE are usually required.

2.2.3 THERMAL CONDUCTIVE HEATING (TCH)

TCH involves the application of heat and vacuum to the TTZ using vertical heater/vacuum wells. Heat is transferred from the heating element to the subsurface via thermal conduction and radiant heat transport. Convective heat transfer occurs during the formation of steam from pore water. TCH is considered to also provide a degree of in situ contaminant destruction, since the potential elevated soil temperatures (greater than 500°C near the heater borings, with 100°C in the majority of the treatment volume) can cause organic contaminants to either oxidize or pyrolize. Conventional above ground process and treatment technologies, similar to those employed with SEE and ERH, are also required to treat captured fluids.

2.2.4 RADIO FREQUENCY HEATING (RFH)

RFH is a method that uses radio-frequency transmissions to increase temperatures in the subsurface and evaporate contaminants for capture in installed wells. The technology can be applied to horizontal or vertical boreholes in the TTZ and the heating pattern can be controlled by varying the operating frequency, electrical phasings, and antenna length and position. Conventional above ground process and treatment technologies are required for the extracted fluids.

2.3 SUITABLE TECHNOLOGIES FOR SRSNE SITE

The commercial equipment available for RFH is limited to several 10 and 20 Kilowatt (kW) units that are only suitable for small treatment volumes on the order of several hundred to a couple of thousand cubic yards. Given the scale of the required application for the SRSNE site, RFH was not considered further for application at the site.

The following sections discuss the suitability of SEE, ERH and TCH at the site. These thermal technologies have demonstrated varying degrees of success in mass removal and in remediation of chlorinated solvents, as well as other VOCs and semi-volatile organic compounds (SVOCs), under a range of site conditions (Sleep 1995; U.S. EPA 2004).

The following generalized site-specific conditions have been assumed for the discussions on the suitability of SEE, ERH and TCH for the site:

- The site geology consists of silty fine to medium sand with minor amounts of gravel that extends to an approximate depth of 16 feet, and is underlain, in part of the target treatment area, by an approximately 3 to 6 feet thick till consisting of fine to medium sand with silt, which rests on several feet of weathered bedrock.
- The COCs are primarily chlorinated solvents, BTEX and PCBs; TCE, PCE, Toluene, and Xylenes are the dominant constituents present.
- The TTZ for application of the thermal technologies is defined as from the land surface to the base of the till layer (the interface between the till and the bedrock). This interface occurs at depths around 20 feet below grade.
- Treatment shall occur both above and below the water table, presently located about 6 to 10 feet below grade.
- NAPL exists across the TTZ, and at greater depth beneath the designated TTZ.
- The target treatment volume is approximately 47,000 cubic yards, with about 32,000 cubic yards being below the water table.

- Saturated hydraulic conductivities in the soils above the till range from $3x10^{-4}$ to $1x10^{-2}$ cm/sec, with a geometric mean value of $2x10^{-3}$ cm/sec. The estimated geometric mean saturated hydraulic conductivity value for the thin discontinuous till layer is $6x10^{-4}$ cm/sec. The soil porosity is assumed at 27.5%.

It is understood that the objective of the thermal technology is not complete site restoration, since NAPL is known to have migrated deeper than the identified TTZ depth. The objective is to cost-effectively remove sufficient mass to meet the performance standards, without negatively impacting current environmental conditions.

2.3.1 STEAM ENHANCED EXTRACTION (SEE)

The mechanisms operative in SEE include volatilization of water and organic fluids, formation of a steam zone, and accumulation and hydraulic displacement of organic compounds in front of the steam zone. The relative importance of these mechanisms depends on the nature of the organic compounds present and on the distribution of these compounds in the soil.

The effectiveness of SEE relies on the ability of steam to enter the pore space of soils. Sleep and McClure (2001) showed that the effectiveness of contaminant removal (VOCs and SVOCs) by steam flushing is not only rate-limited (affected by the persistence of the residual organic phase, desorption, and channeling), but also limited by the soil permeability. In low permeability areas, steam cannot enter the pore space and the resulting heat loss can lead to an inability to completely heat the TTZ. SEE is typically considered a favorable treatment technology when the bulk hydraulic conductivity is moderate to high (greater than 1×10^{-4} cm/sec; the SRSNE site hydraulic conductivity is within this range), low permeability layers are less than two meters in thickness, and for deeper depths of remediation. Coupling SEE with other technologies, such as ERH and TCH, has been considered / applied to improve the treatment of heterogeneous sites with both high and low permeability zones (US DOE 2003). Air in combination with SEE has been introduced as a theoretical concept to reduce the risk of downward DNAPL mobilization at the condensation front (Kaslusky and Udell 2002), and used in the field for this purpose (Integrated Water Resources 2003).

The heterogeneity of the ONOGU at the SRSNE site could make it difficult to ensure that steam will effectively contact the NAPL. Additionally, due to its buoyancy, steam injected in the unconfined overburden deposits will quickly travel upwards into the unsaturated zone. Therefore, the shallow application at the SRSNE site would require closely spaced SEE wells and a surface cover to ensure good aerial distribution and level of heating and capture of the volatilized COCs. The low permeability of the till layer may lead to steam override, and difficulty in heating to the top of bedrock. Further, the potential for NAPL accumulation and downward migration is of particular concern at the SRSNE site due to the relatively moderate permeability and discontinuity of the till and the proximity of the NAPL to the underlying fractured bedrock. This and other potential technology limitations will be discussed further in Sections 2.4.1 and 3.3. The heterogeneities of the ONOGU and the potential for downward

NAPL migration suggest that SEE should be coupled with either TCH or ERH, if applied at the SRSNE site.

2.3.2 ELECTRICAL RESISTIVE HEATING (ERH)

ERH is suited for the treatment of NAPL located in a variety of geological settings, with special efficacy in low-permeability layers where fluid-delivery based methods are challenged. The site is heated gently by passing current through the formation between electrodes, and vapors are extracted from screened wells. For sites with complex geology and layers with moderate to high permeability materials, a combination of ERH and SEE has been used to address the entire TTZ. SEE is applied primarily to the permeable zones, and besides treatment of the high permeability zones can be used to build a high-pressure steam-filled zone that reduces the water flow into the TTZ by reducing or negating the inward hydraulic gradients and by reducing the relative permeability of water within the steam saturated soils (as demonstrated by SteamTech at the Young-Rainey STAR Center; US DOE 2003). Alternatively, a hydraulic barrier can be installed to control groundwater flow through the site.

Although the natural resistance of soil to electrical current flow is the cause of heat, ERH requires the presence of water to conduct the current away from the electrodes. Therefore, water must be present at saturations of at least three percent, which may require wetting of the area around the electrodes (Davis 2003). Since typical ERH electrode assemblies have diameters greater than 6 in (15 cm), and the number of electrodes needed would be in the range of 300-500, their installation may present a greater risk of creating vertical permeability than technologies that employ either much fewer, or smaller diameter borings, and ERH would be expected to generate a greater volume of contaminated cuttings.

ERH is deemed to be applicable to the ONOGU for the removal of NAPL in the saturated zone, including the lower permeability till. It would require a system to limit horizontal groundwater flow, for instance a hydraulic barrier around the TTZ. However, it is not clear that ERH could be used to effectively heat the water which flows vertically upward during remediation, as a drawdown is established by vaporizing water within the TTZ. Since the bedrock will have a higher electrical resistivity than the overburden (lower porosity and clay content), preferential current flow above the bedrock interval would likely limit the heat delivery at depth. Therefore, the ERH alternative could suffer from significant cooling by inflowing water from the bedrock.

Overall, ERH is deemed to be applicable for heating the saturated fraction of the TTZ at SRSNE. The vendors have overcome the logistical limitations at several other sites. It is likely that ERH could be successfully used to clean the vadose zone as well, as the generated steam would sweep upward and heat this zone. However, the Thermal Conductive Heating method described below was deemed to be more robust for this site, since it also heats the vadose zone directly and the top of the bedrock using the same, simple borings. Also, the larger boreholes and the associated volume of cuttings reduce the attractiveness of ERH at this site.

2.3.3 THERMAL CONDUCTIVE HEATING (TCH)

TCH is suited for treating NAPL under varied hydrogeologic conditions. TCH differs from SEE and ERH because it does not rely only on steam as a heat source or water as a conductive path (U.S. EPA 2004). TCH can achieve soil temperatures greater than 500°C that may be effective for the removal of SVOCs, such as PCBs, PAHs, pesticides and herbicides (Stegemeier and Vinegar 2001). However, for VOC sites, the TCH target temperature is typically 100°C, which is sufficient to effectively vaporize all NAPL phases for recovery as a vapor (LaChance et al. 2004). The thermal conductivity of soil is directly related to moisture content, with conductivity decreasing as moisture content decreases. As soils become dry, higher temperature gradients are required to transfer energy through the treatment area. At high temperatures, clayey soils can shrink and crack, increasing their permeability and potentially enhancing transport of the COCs. Such elevated temperatures and drying typically occur only in the immediate proximity to TCH wells, while the intervening soil remains moist even while achieving target temperatures of 100°C.

As the heat travels horizontally away from the heater borings, vapors are generated by in-situ boiling of groundwater and NAPL. The generated vapors travel towards the heaters, and upward along the heater borings where increased gas phase permeability is created by the drying in the vicinity of each heater. The vapors are captured and extracted by vapor collectors located in the vadose zone. This continuous removal of VOC mass, starting a few hours after the onset of heating, is key for minimizing the potential for forming NAPL condensation zones

Application of TCH to the ONOGU for the removal of NAPL sequestered in the discontinuous till and to prevent downward NAPL migration is likely a necessary part of a successful thermal technology approach at the SRSNE site. However, similar to ERH, a limitation of TCH alone is the ability to effectively treat moderate to high permeability zones that can transmit cold ground water in and out of the TTZ. The flux of water into the treatment zone must be controlled to a moderate level, so it does not continuously cool the treatment volume. Therefore, hydraulic containment must be achieved, either by a carefully implemented a perimeter pumping system, perimeter steam injection to form a barrier to water inflow, or by placement of a hydraulic barrier around the treatment zone. For the SRSNE site, a combination of TCH and hydraulic isolation may be used to address the concern of a water cooling effect, and to allow for heating of the entire TTZ to the target temperature of 100°C.

The application of TCH to the ONOGU for the removal of NAPL at the site has the potential to produce a significant mass reduction of the COCs in the TTZ. TCH is a better choice than ERH as a heating method at the SRSNE site, as the effectiveness of TCH to heat the upper portion of the low porosity bedrock to a temperature sufficient to vaporize NAPL is deemed feasible, even though applications of this approach for a similar site have not been found in the available literature (see Section 3.3.1). The thermal conductivity of the bedrock will be at least as high as that of the overburden, allowing TCH to heat the rock relatively easily. In contrast, ERH would suffer by the higher resistance of the bedrock, and the power would flow preferentially in the porous zone where higher water contents lower the resistance.

2.4 RECOMMENDED THERMAL TECHNOLOGY APPROACH FOR SRSNE SITE

2.4.1 POTENTIAL OF DOWNWARD NAPL MIGRATION

A review of the relevant available thermal remediation literature (Section 3.3.1) indicates that for DNAPL sites the potential for downward NAPL migration has been controlled by the existence of either an aquitard or aquiclude below the target treatment area. At the SRSNE site the site conceptual model is significantly different. The hydrogeologic data indicate that the till underlying the silty-sand overburden materials and overlying the bedrock, in the TTZ, is discontinuous and has a permeability that is not significantly different than the overlying silty-sand materials. Therefore, it is not reasonable to expect the till to act as an aquitard to prevent the potential of downward migration of mobilized DNAPL, and a carefully designed thermal technology is needed to minimize the risk of downward NAPL migration.

The potential to mobilize DNAPL into the underlying bedrock is a significant concern with respect to negatively impacting current environmental conditions at the SRSNE site, and therefore to the evaluation of remedial alternatives for the ONOGU. Dr. Sleep of the University of Toronto and Dr. Kueper of Queen's University together performed an evaluation of the potential for downward migration of DNAPL resulting from the application of a thermal remediation remedy at the site. The evaluation is titled "Risks of Vertical Mobilization of DNAPL during Thermal Remediation" and is provided as Appendix W of the Feasibility Study for the site.

In the analysis, Dr. Sleep and Dr. Kueper evaluated the potential for downward migration of the DNAPL into the underlying bedrock at the SRSNE site. Further, they evaluated the potential of adding air or using supplemental heating using a 'hot plate' concept below the target overburden materials to mitigate the DNAPL migration. The following summarizes the conclusion of the evaluation report:

"There is significant risk of adverse downward mobilization of DNAPL at SRSNE in connection with applying steam flooding, thermal conduction heating, or electrical resistance heating. The risk of mobilization stems from a number of mechanisms including DNAPL bank formation as a result of condensation, lowering of porous media and fracture entry pressures as a result of heating, and displacement of DNAPL pools in response to increased vertical components of the hydraulic gradient. Creation of a hot floor in the upper bedrock may reduce the risk of downward mobilization of the DNAPL. However, using thermal conduction heating to create a hot floor requires extension of heater wells into the bedrock. The feasibility of placing thermal conduction heater wells in the bedrock to create a hot floor below DNAPL has not yet been demonstrated at any sites similar to SRSNE. The impact of site heterogeneities on performance of the thermal conductive heating system, which relies on vacuum extraction wells to capture volatilized fluids is also difficult to predict. "

The thermal design presented in Section 3 was carefully chosen to minimize the risks discussed above, considering all the possible mechanisms for DNAPL mobilization. It avoids the steam drive situation, instead it uses a constant depletion approach where DNAPL bank formation is prevented or minimized.

It has also been proposed (Kaslusky and Udell 2002) that co-injection of air may reduce the potential for DNAPL bank formation with steam flooding by providing enough air to prevent DNAPL condensation at the steam front. The analysis presented in Kaslusky et al. (2002) suggests for the SRSNE site that an air to steam mass ratio of approximately 8:1 would be required if the DNAPL saturation were limited to no higher than 25% of pore space and the DNAPL were composed entirely of TCE. In some areas, the NAPL saturation exceeds 25% of pore space, and the SRSNE NAPL is not pure TCE, being comprised of many different VOCs, which would lead to higher air-steam ratios. Using the 8:1 ratio, the high air content of the injected stream would correspond to a reduced energy content and an approximately 80% reduction in the temperature front velocity. This in turn will significantly increase operational time and costs. If higher vapor pressure compounds are present in the DNAPL (as is the case at SRSNE), even higher air to steam ratios are required. In this case, the thermal remediation system essentially becomes a heated air sparging system, and therefore the approach is not considered applicable for the SRSNE site.

2.4.2 RECOMMENDED APPROACH

Based on the site-specific geology, hydrogeology, and NAPL distribution and the potential for downward DNAPL migration, a combination of TCH and hydraulic control is recommended as the thermal technology approach for this feasibility study level evaluation at the SRSNE site.

TCH heater borings equipped with vapor collectors will be placed approximately 15 feet on center within and slightly beyond the limits of the target treatment area. At each TCH well location, a small-diameter vapor collector will extend from the ground surface to approximately 8 feet below grade and be screened from just below ground surface to the top of the water table.

Around the perimeter of the treatment zone, a low-permeability barrier will be installed from land surface to the top of the competent bedrock. This barrier can be either a slurry wall, a sheet-pile wall, or a low-permeability zone created by reworking the soil and sediment and mixing in fines, a slurry, or grout. The purpose of this barrier is to reduce groundwater inflow during heating, when a draw-down of a few feet is expected inside the treatment zone. The wall needs to reduce the inflow by a minimum of 10-fold to effectively reduce the cooling effect of inflowing water.

A schematic of the heating approach is provided in Figure 2-1. The design eliminates screened sections and sand packs below the water table, through grouting the heater casing/can immediately after placement in the hole, as the drilling equipment is retracted. In addition, the simple, small-diameter heater borings allow for use of drilling methods with minimal risk of creating vertical permeability due to the drilling method itself.

During operation, the zone immediately adjacent to the heater heats to above 100^{o}C, as the soil there dries. The pores of this zone are filled with vapor, predominantly steam. Due to the drying, the soils have increased vapor phase permeability, enabling this zone to serve as a preferred pathway through which the generated steam and VOC vapors will escape to shallower depth, without a significant pressure build-up. As water and DNAPL are heated and vaporize, a volume increase of about 1,000 to 1,600-fold occurs (expansion from liquid to vapor). The path of least resistance for this large volume of vapor to escape is towards the boring, then up along it to the shallow vapor collector shown on Figure 2-1.

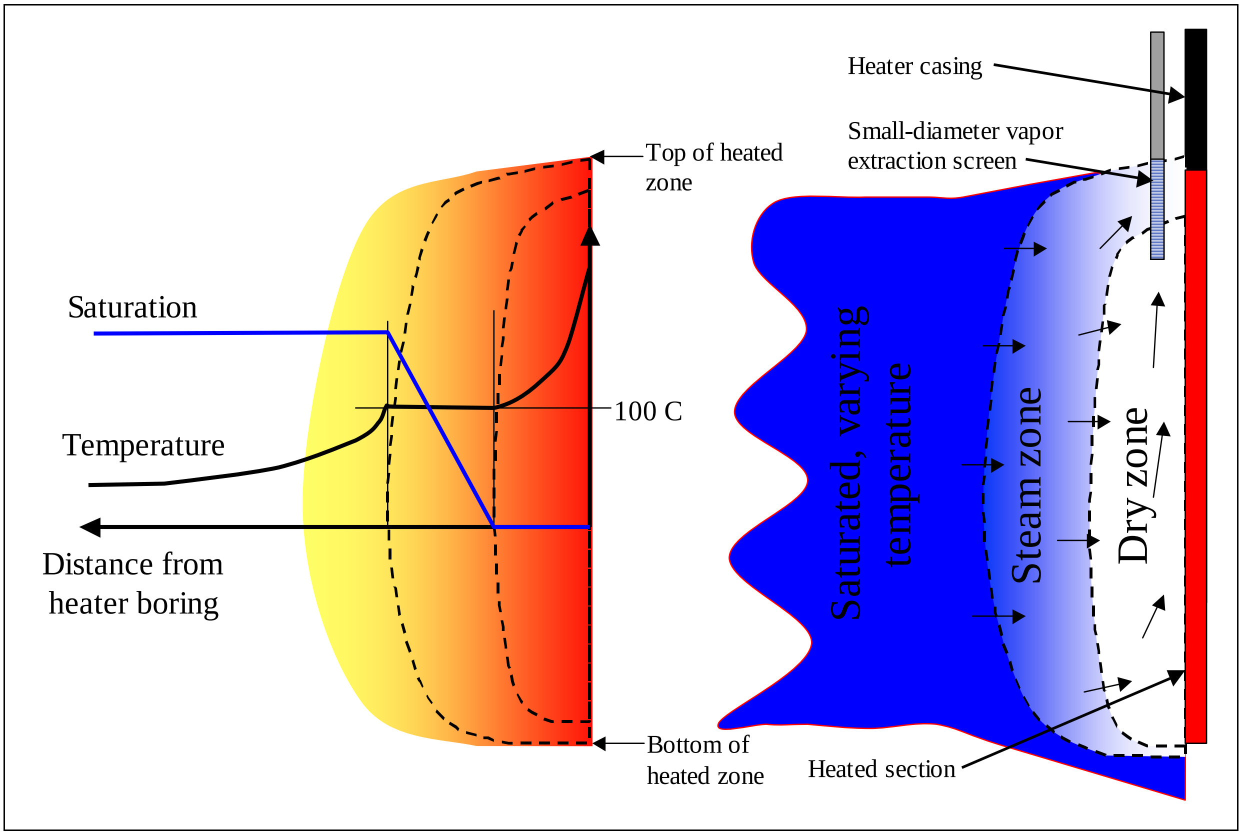

Figure 2-1: Schematic of TCH boring design and vapor recovery method. The arrows on the right side indicate vapor flow directions.

It is crucial to understand that the boiling of liquids in the steam zone leads to production of several hundred pore-volumes of vapor. Since these vapors are extracted at each heater location, they do not migrate horizontally away from the heaters, as would happen during steam injection. The vapors are constantly extracted, meaning that the mass of VOCs in the subsurface decreases immediately after onset of heating. In addition, any contaminant vapors that are not removed and are pushed outwards, encounter cooler regions immediately adjacent to the region at steam temperature and condense just a short distance away. As the heat front steadily advances, these regions are subsequently heated and the condensed contaminants are re-vaporized, with a portion or all of the contaminant mass removed. This depletion process occurs progressively and on a small scale, not all of a sudden over large portions of the subsurface as in a steam drive.

Therefore, DNAPL saturations decrease immediately upon the start of heating, and significant banks of condensate are not formed. This is key to minimizing the risk of DNAPL mobilization.

While locations close to TCH heaters may achieve temperatures well above the boiling point of water (up to 500 °C, based on the thermal modeling presented in Appendix A), locations between heaters need only achieve 100°C to accomplish steam distillation for effective removal of the COCs. Further, mixtures of chlorinated solvents and water boil at temperatures less than the boiling point of individual constituents. For example, a mixture of PCE and water will boil at 88°C at 1 atm pressure, more than 30°C less than the 121°C boiling point of pure PCE. Therefore, boiling off all the soil water is not necessary.

In general, the vacuum applied to the vapor collectors will draw the vapors through the hot soil around each heater boring. Oxidation, hydrolysis and pyrolysis reactions can occur in the hot soil in proximity to the TCH heater wells. This can result in a degree of in-situ destruction of the COCs in the vicinity of the heater wells. Vapor treatment is completed within an Air Quality Control (AQC) unit. Vapors exiting the AQC system typically consist of water vapor, air with reduced concentrations of oxygen, low concentrations of carbon dioxide (less than 2.0%), low levels of carbon monoxide (less than 100 ppm), and low total hydrocarbon (THC) levels, compliant with emission standards.

3.0 TECHNICAL APPROACH FOR SRSNE SITE

The following section provides a conceptual design for the application of the TCH technology for the SRSNE site. The conceptual design was developed from discussions with both TerraTherm, Inc. a recognized thermal technologies vendor (providing both SEE and TCH services) and from thermal modeling performed by Dr. Brent Sleep of the University of Toronto. Uncertainties, risks and potential limitations associated with the approach are identified and discussed in this section, as well as the expected results from application of the approach at the site. A brief review of related published literature on the recommended technology approach is also provided.

3.1 MODEL SIMULATIONS

Dr. Brent Sleep of the University of Toronto performed thermal modeling to further evaluate the potential application of SEE, ERH and TCH technologies to remediate the TTZ at the SRSNE site. The report produced by Dr. Sleep is attached as Appendix A.

A series of simulations were conducted to investigate the potential behavior of various thermal remediation strategies for the shallow groundwater system representative of the SRSNE site. Several cases were simulated, including steam flushing, electrical resistance heating, and conductive heating. The impacts of well spacing and ground surface boundary conditions were examined.

In summary, Dr. Sleep’s analysis presents the following relevant conclusions:

- Any thermal technology approach will require a surface cover to control potential emissions and to control surface energy losses that would negatively impact the treatment effectiveness.
- Steam injection / extraction wells in the overburden materials would need to be closely spaced, on the order of 15 to 20 ft to ensure the required heat distribution throughout the TTZ.
- During steam injection, steam over-ride would likely occur due to heat losses to the bedrock, without supplemental heating of the bedrock.
- If a hot plate were to be created, TCH well spacing in the shallow bedrock would need to be closely spaced, on the order of 10 feet (this hot plate was considered to be unnecessary by the EPA reviewers, and is not included in the Conceptual Design).
- Due to potential quenching from cold gas and groundwater influxes, TCH could not be used alone but would need to be supplemented with a technique that minimizes water inflow.

The modeling results suggest a potential thermal technology approach that is consistent with the conceptual approach recommended in Section 2.4.2 above for the SRSNE site.

3.2 CONCEPTUAL DESIGN

3.2.1 BORING DESIGN AND MINIMIZATION OF RISK OF DNAPL MOBILIZATION DURING DRILLING

Due to the possibility of encountering pooled and mobile DNAPL during installation of the 450 TCH wells and an estimated 75 temperature monitoring wells (Section 3.2.6), a careful review of the potential for spreading DNAPL to greater depth during the installation phase was conducted. The TCH heater borings will extend from the ground surface to approximately 4 feet into bedrock.

Figure 3-1 shows a sketch of the heater boring design. The thermal conduction heaters are extended about 3-4 ft deeper than the target treatment depth (top of bedrock), to allow for some heat losses at depth without sacrificing the ability to achieve desired temperatures in the target volume. The heaters each have a stainless steel casing, which will be grouted into place immediately after placing the casing in the hole. A grout that hardens in less than 12 hours will be used, which will minimize the risk of DNAPL migration vertically along the heater casing. The grout will be selected with special focus on compatibility with the COCs present at SRSNE.

A shallow vapor collector will be installed next to each heater boring to capture the steam and DNAPL vapors as boiling around the heaters generates them. Each vapor collector will apply a slight vacuum around the heater and beneath the vapor cap, minimizing the risk of escape of steam, and the associated potential odors. By having one vapor collector per heater, the need to rely on sufficient vapor flow connection across the vadose zone is eliminated. Since the vapor collectors do not penetrate the water table, they will not provide a significant pathway for

DNAPL to migrate to greater depth during the period between drilling and onset of thermal operation.

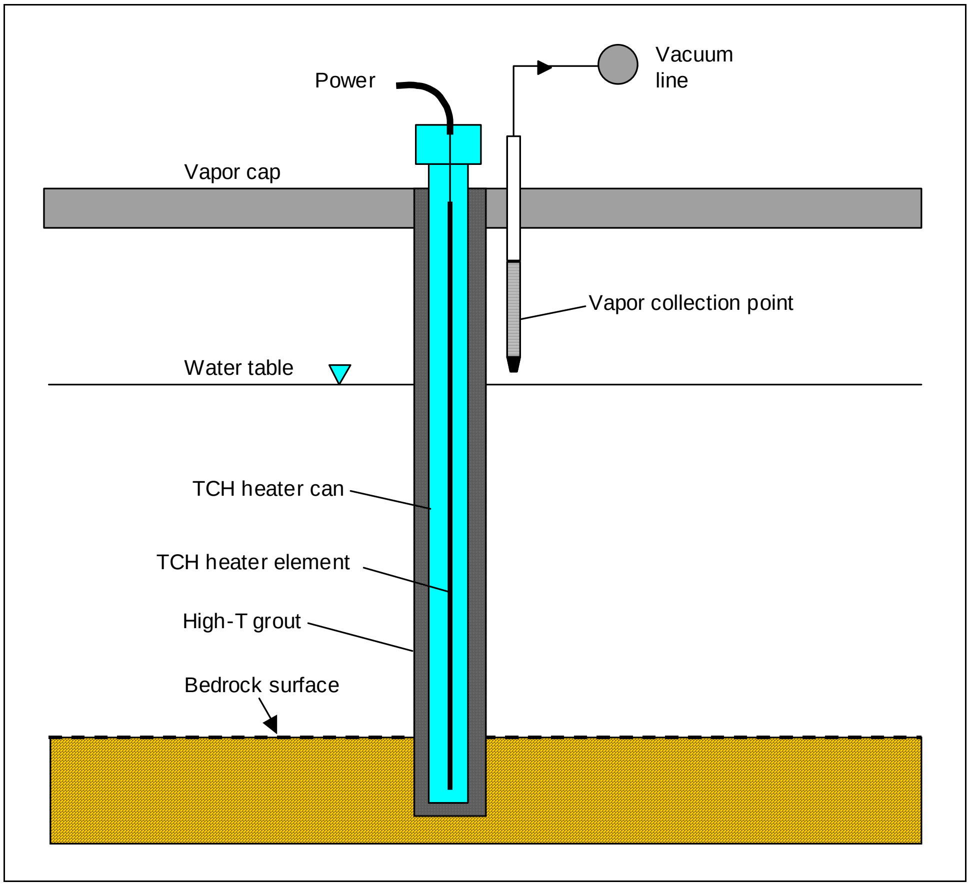

Figure 3-1. Thermal Conduction Heater boring, showing heater extending below the target treatment depth, and the associated shallow vapor collector and vapor cap.

Following completion of the drilling and installation phase, the heater wells will be furnished with heater elements and made ready for heating.

Each heater boring consists of a simple, 3-inch (7.6 cm) diameter stainless steel pipe (termed a “heater can”) housing a thermal conduction heater. Each heater can contains a simple stainless steel heater element (Figure 3-2).

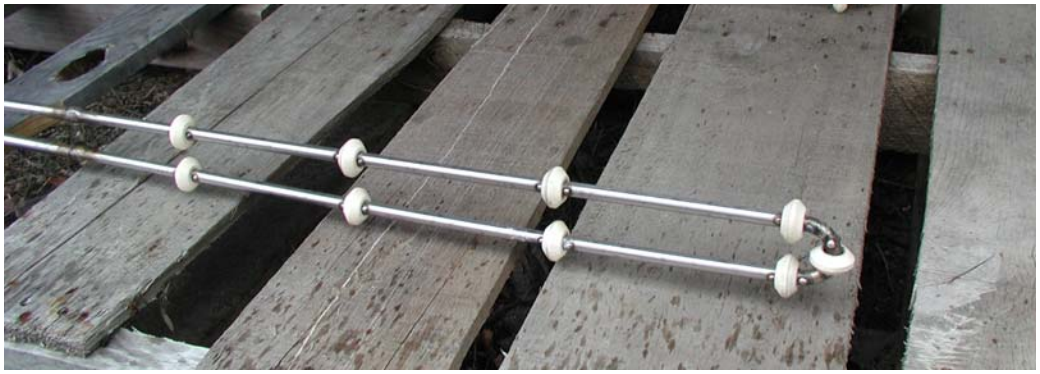

Figure 3-2. Proprietary TerraTherm heater element used inside each thermal conduction heater boring. The metal rod has a diameter of approximately 0.5 inches (1.3 cm). The white beads are ceramic isolators. Electric power flows through the steel rod, causing it to heat resistively. Covered by one or more of the following: U.S. Patent Nos. 5,190,405, 5,318,116, 6,485,232 and 6,632,047.

3.2.2 WELL LAYOUT

After onset of the heating, the site would be heated to the boiling point of water, mobile NAPL removed by vaporization, and thermal treatment continued to reduce both soil and groundwater COCs concentrations. The proposed TCH approach is not the “traditional high-temperature” TCH approach for soil treatment (where temperatures in excess of 300 ^{o}C are used to desorb and destroy high-boiling point COCs). It is a milder treatment approach where TCH is used to heat the TTZ, allowing the majority of the groundwater to stay in place, since it is not boiled off. However, as steam temperatures are reached, in-situ boiling is induced by the continued input of heat, which leads to steam formation and steam stripping of the COCs.

While the target temperature for heating the TTZ is the boiling point of water, the TCH approach will achieve higher than boiling-point temperatures in close proximity (within 1-2 ft) of the TCH heater borings. Additionally, the TCH well design includes heating of the top of the bedrock to mitigate heat losses, and to allow for heating of the entire treatment interval from the land surface to the top of bedrock. In the target treatment area, the upper 5 feet of rock is described as highly weathered and fractured. The TCH heaters will extend approximately 4 ft into rock, thereby heating the upper weathered rock zone as well as some of the deeper, more competent bedrock. The bottom 5-10 ft of the heaters will be boosted, meaning that they will have heater elements capable of delivering approximately 30 to 50% more heat per unit length (e.g., 400 W/ft) than the heater elements above (e.g., 300 W/ft). This, combined with the lower porosity (8%) and associated higher thermal conductivity of the bedrock, is projected to result in significantly faster heating of the bedrock compared to the overburden. This will heat the groundwater flowing upward from the bedrock, providing enough energy to heat the water to boiling, and vaporize a minimum of 30 percent of it. This means that when water flows upward into the TTZ, it will be heated to boiling, and a large volume of steam will be formed, pushing upward into the TTZ. This leads to treatment by steam stripping of the water influx, and removes the potential for the base of the overburden to cool due to the upward flow.

The site will be heated using a network of heater wells arranged in a hexagonal pattern, with a spacing of 15 feet (4.6 m) between neighboring heaters.

Each TCH well will be surrounded by six others in a regular pattern across the site. With a well spacing of 15 ft (4.6 m) between them, an estimated total of 450 heater borings will be required. A schematic of the well field layout for the thermal remedy approach is provided in Figure 3-3 below. This figure also shows the slurry wall that will be installed to minimize horizontal groundwater flow during the heating period. Note that the wall ties into the existing sheet-pile wall, and therefore provides hydraulic isolation of the treatment area, and the area south of it between the thermal treatment area and the existing sheet-pile wall.

Below are several necessary actions, which would be performed prior to drilling and well installation:

- The proposed treatment zone has significant relief, and would require some grading work prior to drilling and installation of the perimeter barrier wall. There are concrete foundation materials and walls on the west side of the Operations Area, and roughly a 10’ drop between the Operations Area and the railroad grade. Some grading would be required to flatten out the western side of the treatment zone (the former tank farm area), as well as to smooth out the slope along the railroad grade.
- It will be necessary to remove a small fraction of the ballast stone along the eastern edge of the treatment zone in the railroad grade to allow for the barrier wall installation.
- The eastern tip of the treatment zone is within the Non-Time Critical Removal Action (NTCRA) area. It is assumed that several wells (including RW-5) within this zone will be abandoned, and that relocation of the HDPE force main for the rest of the NTCRA system would be necessary.
- Thermal treatment would need to be integrated with the remedies being considered for the Operations Area and Railroad Grade soils and the Cianci Property soils and sediments. Portions of these remedies will need to be implemented prior to thermal treatment, such as the drainage re-routing and culvert replacement for flow along the ditches along the railroad grade, and NTCRA system changes in the treatment area.
- The buried fiber optic cable on the east side of the railroad grade will need to be relocated.

Costs for this work are not estimated in this analysis, but are included in the FS cost estimates for thermal treatment and for remediation of other media.

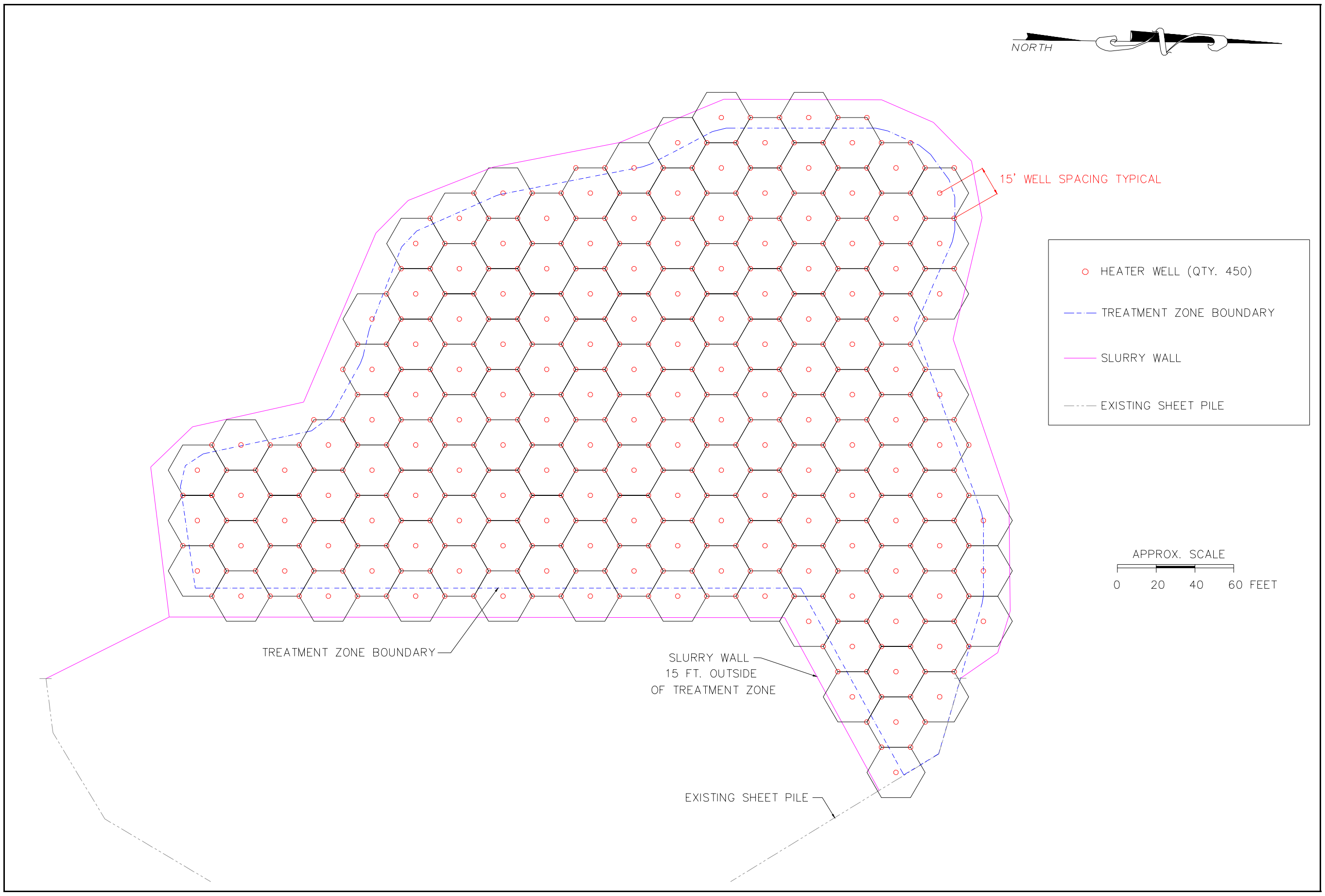

Figure 3-3. Conceptual well field layout. Note that the slurry wall will tie into the existing sheet-pile wall.

Note that the 450 vapor extraction wells, and 75 temperature and pressure monitoring locations are not shown on Figure 3-3. The monitoring locations would be selected during the detailed design stage, to complement the sampling and analysis plan.

Figure 3-4 shows a sketch of how the heater borings follow the undulating surface of the bedrock, ensuring that each heater penetrates a minimum of 3-4 ft into the rock. This allows heat to be directed into the top of the bedrock, with the following positive impacts:

1. Heating 3 to 4 ft below the target treatment depth reduces the treatment time by compensating for heat losses to depth.
2. The rock immediately surrounding each heater boring would heat up rapidly compared to the zone above it, due to the higher thermal conductivity of the rock relative to that of the soil. This ensures that steam vapors will sweep upward across the outside of the grout around the heater, creating an escape route for the generated vapors only a few hours after the onset of heating. This in turn ensures that the lower boundary of the TTZ will be adequately heated. The small amount of water that would migrate upward during thermal operation would be pre-heated when passing through the upper bedrock, thereby reducing its ability to quench and cool the materials in the overburden. The maximum upward flow rate across the entire treatment area was estimated at approximately 3 gpm. Enough energy would be deposited into the upper 3 ft of the bedrock to heat approximately 15 gpm of water to the boiling point (or to heat 3 gpm and boil off a minimum of 30% of this water).

Overall, the approach would lead to a predictable and safe heating process, whereby DNAPL mobilization is minimized by constantly extracting vapors at the locations where vapors are formed.

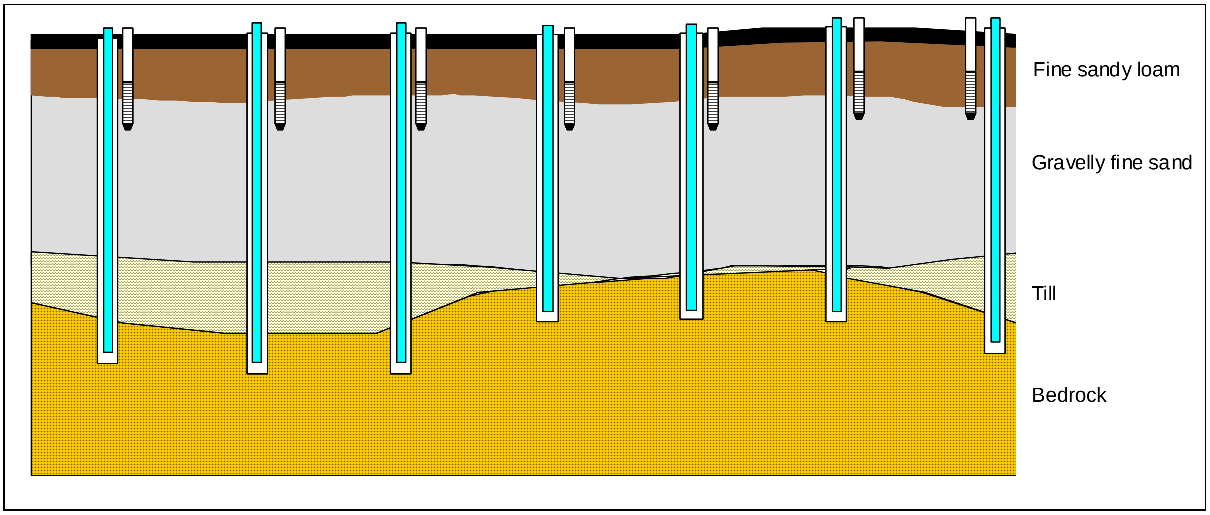

Figure 3-4. Conceptual cross-section showing heater borings relative to depth to bedrock.

3.2.3 GROUNDWATER FLUX MANAGEMENT DURING THERMAL CONDUCTION HEATING

Under existing conditions, groundwater moves through the TTZ predominantly due to horizontal fluxes from surrounding upslope/upgradient areas. There is also the potential for some vertical flow from the bedrock system up into the overburden system as a result of upward vertical gradients between portions of the bedrock and the overburden. In general, this flux is expected to be less than the horizontal flux due to the fact that the vertical hydraulic conductivity of the bedrock is on average one to two orders of magnitude lower than the horizontal hydraulic conductivity of the overburden.

Without pumping of the NTCRA wells and the existing NTCRA sheet pile wall, groundwater beneath the TTZ would be expected to discharge to the Quinnipiac River based on local and regional flow patterns (i.e., overburden and shallow and deep groundwater within the bedrock discharge to the river). Groundwater flow would be expected to be primarily horizontal within the overburden and both horizontal and vertical (depending on the location relative to the regional flow patterns) within the bedrock.

Pumping of the NTCRA wells results in capturing groundwater beneath the TTZ within the overburden and a portion of the bedrock and preventing the discharge of this water to the river. Natural and imposed (i.e., due to pumping of the NTCRA wells) hydraulic gradients and groundwater flow patterns result in upward gradients within the bedrock and between the bedrock and overburden, both beneath the TTZ and downgradient of the TTZ in the vicinity of the NTCRA extraction wells. Two key questions related to vertical gradients, are: 1) These upward gradients historically prevented some downward migration of DNAPL. An issue, is whether installation of a slurry wall downgradient of the TTX could cause mounding of overburden groundwater and reduce or reverse the present upward gradient between overburden and bedrock, creating a setting where the potential for further downward DNAPL mobilization is increased; and 2) whether the cut-off of overburden groundwater flowing into the western portion of around the TTZ by slurry wall installation, and/or removal of water from the TTZ due to heating and boiling, would lower the water table and enhance the upward vertical flow from the bedrock to an extent that hinders the ability of the ISTD system to reach the desired treatment temperature or necessitates modifications of the system in the field to reach the desired treatment temperature. Adverse changes to the vertical gradients (e.g., decreasing the magnitude of the upward gradients or creation of downward gradients) beneath the TTZ, could create a setting where the potential for further downward vertical DNAPL mobilization is increased. In addition, the ability of the ISTD system to tolerate the potential influx of water from the bedrock into the TTZ is of concern.

Once the slurry wall is installed around the entire perimeter of the TTZ, it will prevent horizontal fluxes through the TTZ, and hydraulic heads and the potentiometric surface within and around the TTZ will re-equilibrate The elevation of the potentiometric surface within the area enclosed by the slurry wall is expected to gradually decrease along the upgradient (western) side and increase along the downgradient (eastern) side of the slurry wall to off set or come into equilibrium with the hydraulic heads in the shallow bedrock. Following the equilibration period, vertical gradients between the TTZ and the underlying shallow bedrock will approach zero and groundwater flux into and out of the TTZ/slurry walled area are expected to become negligible (i.e., a stagnant zone will be created within the slurry walled area.). As discussed in detail below, once operation of the ISTD system begins, boiling will occur resulting in removal of water from the TTZ. Removal of water from the TTZ may result in a lowering of the water table immediately around heaters and/or throughout the TTZ. Such an effect may create upward hydraulic gradients and groundwater fluxes across the bedrock/overburden interface.

The overall impacts of the installation of the slurry wall and operation of the ISTD system on the local and regional hydraulic gradients need to be further assessed using a numerical groundwater flow model during detailed design to determine if there may be is an unacceptable increase in the potential for downward mobilization of DNAPL (i.e., reduction or reversal in the current upward gradient in the eastern portion of the proposed TTZ). A numerical flow model is required because of the complex interrelationships between the shallow and deep flow systems and the natural and manmade discharge locations (i.e., the river and NTCRA pumping wells, respectively). The groundwater flow model would be used to predict average and worse-case vertical gradients beneath the TTZ. A separate analysis would then be conducted to evaluate the magnitude of the potential risk of DNAPL mobilization due to the predicted changes in vertical hydraulic gradients.

One possible outcome of the analysis could be a design requiring extraction of groundwater from the downgradient (eastern) end of the TTZ. This would then be accomplished by the placement of five to ten extraction wells along the slurry wall. Each well would be paired with a bedrock well, both instrumented with pressure transducers. Then, the pumping rate for the upper well would be regulated such that a downward gradient was prevented and the historical minimum upward gradient preserved. Overall, the groundwater extraction rate to accomplish this control would be significantly less than the present pumping rates for the NTCRA wells. This is because the capture zone for the NTCRA wells would be fully enclosed by hydraulic barriers once the slurry wall is installed. Therefore, the existing water treatment plant would have sufficient capacity to receive both streams.

Another potential solution which would prevent mounding and formation of a downward gradient would be to remove the eastern part of the slurry wall from the design, and allow the NTCRA wells to capture groundwater that flowed east. This would effectively prevent water mounding within the TTZ. Again, the existing treatment system should likely have sufficient capacity, since the slurry wall would be tied into the sheet pile wall, reducing overall water flow to the pumping wells.

With the commencement of heating, groundwater fluxes into the TTZ would be primarily through the bedrock at the bottom of the TTZ and would be approximately equivalent to the amount of water removed or boiled-off from the TTZ. During the initial phases of TCH operation, most of the energy being delivered goes into satisfying the sensible heat requirements of the soil and water as the temperature is increased from ambient up to the boiling point. Some of the energy also goes into boiling of water immediately adjacent to the heaters.

As the temperature of the TTZ increases, the rate of conductive and convective heat loss also increases. As the TTZ gradually heats up, an increasingly larger portion of the power added to the subsurface will go to boiling/groundwater removal. Once the sensible heat to raise the temperature of all of the soil and groundwater within the TTZ to the boiling point of water is satisfied, the rate of heat loss will become constant. It is at this point that the maximum TTZ-wide boiling rate or groundwater extraction rate will be attained.

The amount of drawdown or dewatering that occurs around each heater will depend on the horizontal and vertical hydraulic conductivities of the soil and bedrock around and underneath each heater (i.e. the ability of the local soil and bedrock to allow water to flow to the heaters at the rate of removal or boiling). Local areas with low soil and bedrock conductivities will experience slightly more drawdown and upward gradients, whereas areas with higher conductivities (e.g., heaters overlying bedrock fracture zones) will experience less drawdown.

Areas in between the heaters will also eventually begin boiling and experience some drawdown or dewatering. The rate of boiling and amount of drawdown, however, will be significantly lower than the regions immediately around the heaters. This is because the amount of energy delivered to the interwell regions will be less than the amount delivered to the near well regions (i.e., the boiling rate is fastest near the heaters). Therefore, although the entire TTZ will eventually boil (i.e., water will be removed throughout the entire TTZ), the water removal rates will not be uniform and the groundwater system will respond as if water is primarily removed at each heater (i.e., as if each heater were a small groundwater extraction well).

Following installation of the slurry wall and infiltration cap, the flux rates towards the heaters, whether vertically through the bedrock or horizontally through the overburden, will never exceed the rate of boiling/water removal at each heater. The extent of the dry zone created around each heater (i.e., the cone of drawdown) will be a function of the water removal rate and the combination of horizontal and vertical hydraulic conductivities and specific yields of the overburden and bedrock formations.

The current design for the SRSNE site includes sufficient power to heat up the TTZ to the boiling point of water (100°C) and remove or boil off a total of 30% of the water within the TTZ. Given that the TTZ is approximately 1.5 ac in area, the average saturated thickness is 13.2 ft, and the effective porosity is 25%, the total volume of water within the TTZ is approximately 1,610,000 gals. If 30% of this is removed during ISTD treatment, that would be equal to 483,000 gals.

Assuming that the slurry wall is installed 15 ft outside the perimeter of the TTZ (resulting in an area of 73,330 ft^2, the total volume of water within the slurry walled area is 1,800,000 gals. Removing 483,000 gals from the slurry walled area would result in a 27% decrease in the potentiometric surface or approximately 3.6 feet of drawdown (this ignores fluxes into the TTZ from the shallow bedrock that would off-set the decrease in water level). Any additional decrease in water levels within the TTZ due to boiling/water removal during treatment, would result in further increases in the upward vertical gradients between the bedrock and overburden and provide added protection against potential vertical mobilization of DNAPL within the bedrock.

A conservative estimate of the flux into the bottom of the TTZ through the underlying bedrock during TCH treatment can be calculated using the assumed average drawdown calculated above (3.6 ft), the vertical hydraulic conductivity of the bedrock, and the area of the slurry wall. The vertical hydraulic conductivity of the bedrock (0.034 ft/d) was estimated from the measured horizontal conductivity of the bedrock (0.34 ft/d) and assuming an anisotropy ratio of 10:1 (i.e., the vertical horizontal conductivity is 0.1 of the horizontal conductivity). The vertical gradient (0.24) was calculated by dividing the 3.6 ft of drawdown by 15 feet. Using these estimates, the rate of groundwater flux into the bottom of the entire slurry walled area during the later stages of TCH treatment is expected to be approximately 3 gpm, assuming the overburden and bedrock heads are equal at the beginning of thermal treatment.

The capacity of the TCH system to heat up and boil off water can be calculated given the total number of heaters, the average length of each heater, and the power delivery rate. For the SRSNE site, 450 heater wells, with an average length of 17 ft and an average power application rate of 300 W/ft, is planned for the TTZ. Between 30 and 50% of the power applied is typically lost due to conductive and convective heat losses. If less power is lost, more water will be boiled. Thus, from the perspective of the ability of the TCH system to tolerate the flux into the bottom of the TTZ through the bedrock, it was assumed conservatively that 50% of the power will be lost. This results in a heating/boiling rate of approximately 8 gpm for the entire TTZ. Enough energy would be deposited into just the upper 3 ft of the bedrock to heat approximately 15 gpm of water to the boiling point.

Given the assumptions used above to estimate the flux rate into the bottom of the TTZ (3 gpm), the TCH system as currently designed (15 ft well spacing, 3-4 ft of heating into bedrock, and heater element power application rate of 300 W/ft for the upper, unboosted section, and 400 W/ft for the boosted bottom section) has sufficient capacity to handle fluxes of ambient water into the TTZ and still achieve the desired target treatment temperature. This inference is based on the assumption that the vertical flow upward from the bedrock is zero at the beginning of thermal treatment and is uniform across the base of the TTZ as the water table declines during treatment. The potential influence of heterogeneity on the ability to reach target temperatures throughout the TTZ will be evaluated using a numerical flow model during design, and possibly further evaluated with a pilot test of the technology.

If TCH is selected for implementation at the site, detailed numerical simulations could be conducted during the design phase to further evaluate the following:

- The ability of the TCH system to heat up the subsurface and tolerate influxes of water,
- The impact of the slurry wall, infiltration cap, and water removal during heating on the local and regional groundwater flow system (e.g., vertical gradients, groundwater flow directions, and flux rates),
- The sensitivity of the TCH system to variations in horizontal and vertical hydraulic conductivity within the overburden and bedrock.

The numerical simulations could also evaluate the time required to achieve the desired remedial goals and the rate, mass loading, and timing of off-gas emissions.

If more detailed analyses (e.g., the numerical simulations) indicate that there is a potential for unfavorable changes in the vertical gradients beneath portions of the TTZ due to the slurry wall, infiltration cap, and/or heating, one option would be to remove the downgradient portion of the slurry wall and tie the north and south sides of the slurry wall into the existing NTCRA sheetpile wall. Water levels in the downgradient (i.e., eastern) portion of the TTZ would not increase and the existing NTCRA groundwater extraction wells could be used to control the flux of water into the TTZ through the bedrock and prevent unwanted flux of water westward through the overburden into the TTZ.

Although the TCH system appears to be conservatively designed, if during implementation it is determined that additional energy is required to adequately heat and treat the site, there are several approaches that could be used:

- Extend the duration of heating,
- Change out the standard heaters (300 W/ft for the unboosted sections) for high output heaters (e.g., 400 W/ft along the entire length of the heater),
- Install additional heaters within the TTZ (i.e., decrease the spacing between heaters and increase the power input density), and/or
- Implement a combination of the above.

The cost estimate carries contingency to account for these possible adjustments to the current design.

3.2.4 VAPOR CAP

Based on the results of the thermal modeling performed for the site, and TerraTherm's experience from operation at several sites where treatment to the land surface was required, a low permeability cap will be required to control vapors developed in the subsurface as a result of the thermal remediation approach. A high-temperature resistant vapor cap will be constructed over the entire target treatment area, and 15 ft outside it where access makes this possible (the cap would extend out to the slurry wall). The well field would have approximately 525 borings (450 TCH heating wells each accompanied by a small-diameter vapor collection screen, and 75 monitoring wells). This large number of wells is made necessary by the substantial surface area of the TTZ. The vapor cap will likely be constructed of asphalt to provide a reasonable seal around the large number of wells and to make the cap installation logistically feasible. The existing asphalt cap would be left in place, with additional material placed over it.

An asphalt cap was deemed appropriate for this site based on the following:

- Asphalt vapor caps have been used successfully in the past for thermal projects, without substantial problems.
- The vapor cap for this site does not need to provide a thick layer of thermal insulation, since the COCs will stay in the vapor phase even if they cool to around 90 ^{o}C. Since the TCH heaters extend to right below the surface cover, the heat losses through the asphalt are deemed to be acceptable.

- The porous nature of asphalt, and the vacuum applied below it, would lead to a small downward leakage of atmospheric air into the TTZ. This leakage will ensure that any odors released from the asphalt as it heats up will be mitigated by the vacuum system.
- Asphalt caps are less expensive, and easier to maintain and dispose of than more advanced sandwiched caps consisting of materials such as insulation board and light aggregate concrete.

The asphalt cap would be installed prior to drilling. Holes would then be cut in the asphalt for installation of the wells. Each of the well penetrations will be sealed using high-temperature grout, as done at several other sites. Minor leaks and cracks are acceptable, since the wells will be under a vacuum and any such leakage will be downward toward the locations at negative pressure. If large cracks develop due to expansion and contraction, they are readily sealed using a small amount of grout or asphalt.

3.2.5 HEATING STRATEGY AND DURATION

The operations period would be as follows:

- After establishing hydraulic control (e.g., by installation of an encircling slurry wall) and pneumatic control (meaning extraction of vapors under vacuum such that the boundaries of the TTZ are under a lower pressure than the surrounding area), heat the site in one step by TCH. It is anticipated that a very significant fraction of the DNAPL will be recovered during this heat-up phase, which will last approximately 100 days.
- After achieving the target temperatures, continue thermal treatment until the target treatment goals are met. During this phase, the heating approach would be adjusted based on the observed heating and mass removal. The concentration of COCs in both off-gases (vapors) and extracted groundwater is expected to decline to low levels. Interim sampling will be used to verify the achieved soil concentrations. The heating will then be suspended. The estimated duration of this phase is 73 days, during which approximately 30% of the water in the treatment volume will be vaporized and removed.
- After cessation of heating, a period of cool-down will follow.

The effluent treatment plant will operate through all the operational phases.

The total estimated duration of field operations is 200 to 230 days.

3.2.6 EQUIPMENT

The necessary equipment includes:

- TCH electrical supply and power distribution equipment.
- Effluent treatment system.

The TCH heating equipment consists of a step-down transformer supplying 480 V, 3-phase power to the TCH system, a series of relays, switchboxes, and controllers, and the cables and wires for the individual heater elements located in each heater boring. A total of between 8 and 10 heaters will be controlled by each Silicon Controlled Rectifier (SCR), based on the measured temperature of the heater elements. SCRs are off-the-shelf units that operate very reliably. Should one fail, it can be replaced in a matter of hours. The TCH equipment is automated to safely shut down in case of overheating or failure of the vacuum system, using interlocks. The system is automated, and will not require continuous staffing to operate it. Generally, the operators watching the off-gas treatment system also monitor and maintain the TCH system.

Once the subsurface is heated, the vapors and steam are still produced for a period of time, even if the heaters are shut down. Therefore, a backup power source is used to operate the vapor recovery and treatment system in the event of power failure. The power generator needs to supply sufficient power for motor starters on the treatment system, and to run the treatment equipment. A 300 KVA diesel generator was selected. An automatic transfer switch will assure that the emergency generator is started within 5 minutes of a power outage, and that the pneumatic control will be maintained. A Programmable Logic Control (PLC) system will be used to stage the start of motors such that the load is distributed over time.

The effluent treatment system is shown on Figure 3-7. The effluent fluids are condensed before vapor treatment, and conventional vapor and water treatment technologies are used. The heat exchanger/condenser reduces the temperature of the extracted vapor, to remove steam, reduce the volume of the vapor load, and increase the efficiency of the water and vapor treatment. The fluids then are separated into liquids and vapors in a knock-out vessel, KO-1. The vapor treatment system consists of a vacuum blower, a thermal oxidizer with scrubber and quench, and an optional polishing step consisting of vapor phase granular activated charcoal (GAC) system. Condensate is treated by air stripping prior to treatment using the existing NTCRA water treatment plant. The air stripping pre-treatment step reduces the impact of large concentrations, and the magnitude of potential spikes during operation. The off-gas from the air stripper is treated along with the extracted non-condensable vapors in the thermal oxidizer.

The resulting sizing and capacity/rates for the process equipment are as follows:

- Vapor treatment system: 2,000 scfm (assumed 1,500 scfm from vapor points and 500 scfm from air stripper).
- Water treatment system: 11 gpm (condensate and entrained liquids).

As shown on Figure 3-7, the instantaneous water flow rate to the existing plant can be as high as 20 gpm, due to the periodic nature of pumping from GS-1 (pump P-2).

The total vapor extraction rate is approximately 2,900 scfm, consisting of about 1,400 scfm of steam (which is condensed before it reaches the oxidizer) and about 1,500 scfm of non-condensable gases (air). This means that 1,500 scfm of atmospheric air is entering the TTZ from the outside, by the following pathways:

- Leakage through the asphalt vapor cover due to the porous nature of the asphalt.
- Leakage through cracks in the sealed penetrations around the 450 heater borings, the 450 vapor collectors, and the 75 monitoring borings.
- Leakage through sheet-pile joints straddling the vadose zone.

The total flow is based on about 6 scfm per extraction point (2,900 scfm total from the subsurface, with about half of this being steam). While this would be a low rate from an SVE perspective, it is a sufficient flow from a TCH operations perspective, since the vapor flow during TCH projects is much slower than for typical SVE systems. The vapor extraction rates are kept as low as possible, but high enough that all generated and inflowing vapors are captured. In past projects, the extraction of 6 scfm per well, with about half of this being non-condensable air, has shown to be sufficient for COC capture and vapor control.

The following describes potential short-term operational problems/issues and their solutions:

- If an extraction manifold fails or begins to leak due to corrosion, valve failure, or other physical changes, leakage will be inward due to the vacuum. Typically, such leaks would develop slowly over time, and would be located by visual observation or by a noise caused by air flowing through a crack. Such leaks are routinely fixed by replacing sections of corroded pipe or valves. It can typically be performed by isolating the manifold leg by closing a valve closer to the treatment system. During the repair, the vacuum is still applied across the remainder of the site, and vapors generated near the failed location will be extracted by other wells.
- Should a vapor leak start to emerge, it is rapidly quenched by the injection of cold water into the subject wells. This serves to quench steam and COC-laden vapors by cooling the soils and vapors rapidly.
- Failure of the vacuum system for several days would be critical, since capture of the heated vapors must be achieved at all times. However, interlocks will ensure that a vacuum failure also leads to complete shutdown of the heating system. When everything is turned off, and the site cools slowly by the surface and perimeter heat losses, a slight vacuum is generated as the condensing steam creates a contraction of the vapors inside the TTZ. Therefore, the system can safely be off for several hours, without leakage of COC-laden vapors.
- The vacuum system is built with a minimum of one standby blower, ready to be turned on if the primary blower fails.

The condenser, HX-1, will be operated using cooling water from the cooling tower. The cooling tower uses a maximum of 10 gpm make-up water (this water is vaporized in the cooling tower). There is only a small flow of blow-down water (less than 0.5 gpm average) from the cooling tower.

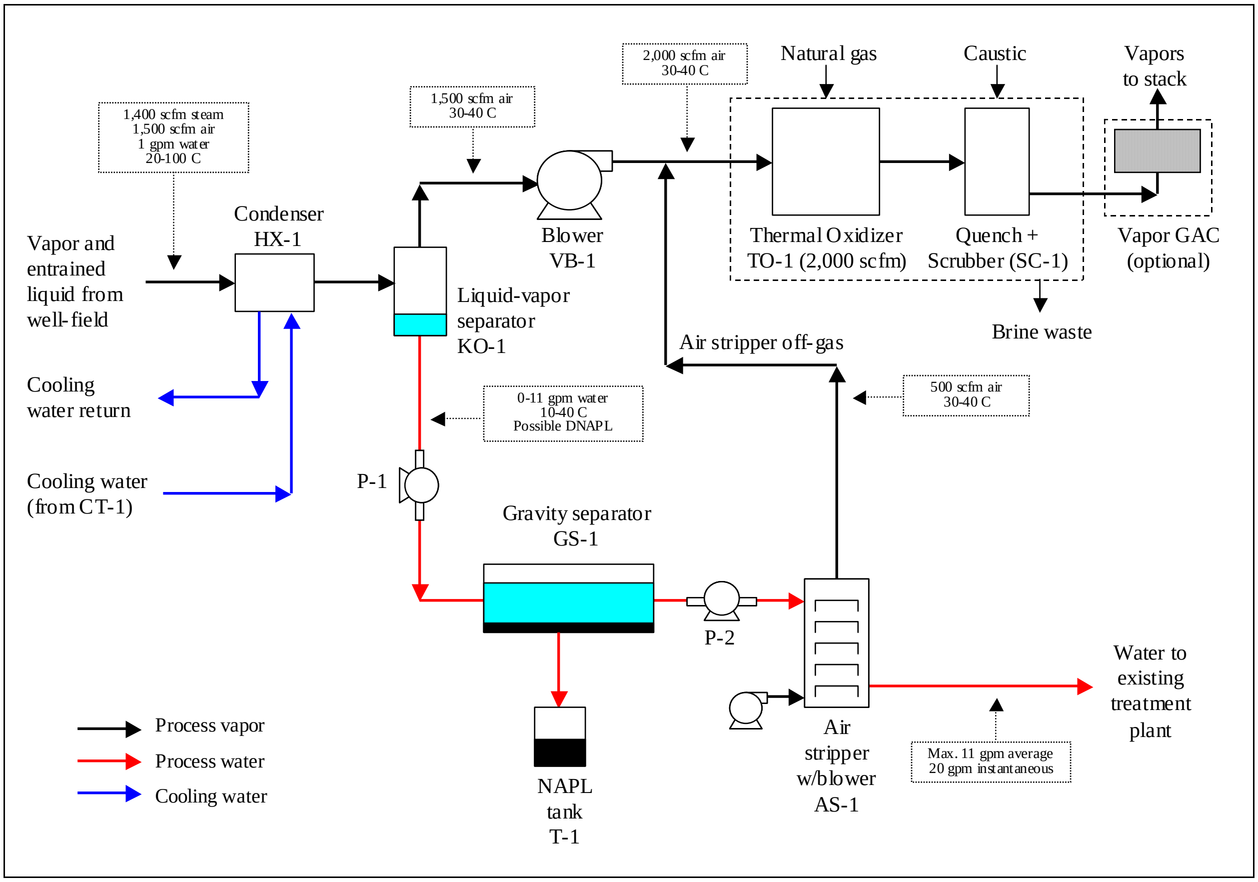

Figure 3-7 Effluent treatment system schematic with estimated flow rate and temperature specifications.

Since the extracted fluids include water, NAPL, air, and steam at varying temperatures and pressures, the treatment system is a robust combination of cooling, separation and treatment units previously proven to be effective in serving their functions. Similar units have been deployed at several sites of similar size. However, the large VOC mass at the SRSNE site has justified an analysis of the thermal oxidation capacity of available units. The uncertainty in the estimate of DNAPL mass at the site translates to similar uncertainty in the needed capacity of the thermal oxidizer. Therefore, a range of necessary units and vapor flow rates was assumed in the cost estimate.

A description of the applicable ARARs, and an analysis of the system as designed, is included in Appendix B. For the system shown in Figure 3-7 to meet all applicable standards (and demonstrate compliance with the CTDEP hazardous air pollutants regulations), a treatment efficiency of 99.8% is necessary for the worst-case scenario, assuming that 2,000,000 lbs of chemicals exists in the TTZ at the onset of operation. This is an achievable efficiency for the selected thermal oxidizer design, e.g. an Alzeta QR2000 Flameless Thermal Oxidizer, for which DREs on the order of 99.99% or better are reported for vapor concentrations as high as 30,000 ppmv (http://www.alzeta.com/products/edgeqr.asp).

Due to the potential in-situ destruction of chlorinated compounds around and near the heater borings, the extracted fluids may contain elevated concentrations of hydrochloric acid, HCl. Therefore, the pH of the extracted water and condensate can be low, and neutralization will be necessary prior to water treatment. The pH of the water will be measured on-site. The data will be used to calculate the necessary addition of lime or caustic to the water stream. This adjustment is very similar to the ones performed for the acid gas scrubber. The manpower needed for these adjustments is included in the operational staffing plan.

Cooling tower and acid gas scrubbers will be well-known, commercially available brands with standard size stacks. The effluent vapors will be clean and odorless.

The process equipment will be equipped with noise reduction features. The vacuum blowers, the thermal oxidizer, and the cooling tower will be the major sources of noise. The features (and the location of each of the most noisy units) will be selected to meet the site-specific noise requirements (typically a specific maximum dB level at the property line).

3.2.7 IN-SITU MONITORING

A preliminary approach for in situ temperature and pressure monitoring is as follows:

- Use thermocouples temperature sensors.
- Use vibrating wire pressure transducers to measure vacuum and water levels.
- Inside the TTZ, use approximately 50 boreholes for temperature monitoring selected as the most likely cool spots, representing the heating patterns, and focusing in areas of particular concern.
- Approximately 15 boreholes for temperature and pressure monitoring location located outside the TTZ, documenting control of the heat and fluids.
- Approximately 10 inside pressure monitoring boreholes for documentation of water levels (drawdown for hydraulic control) and applied vacuum (for documentation of pneumatic control).

3.2.8 LABORATORY TESTING AND MODELING TO OPTIMIZE DESIGN

Even though the conceptual design is very robust, and the individual elements have been tested and used in past projects, a pilot test would be useful, although not required, to demonstrate that this form of treatment is implementable and that it would achieve remedial goals. Several design assumptions and unit costs could be better defined by the following activities:

1. Laboratory scale experiments with different materials subjected to the DNAPL under elevated temperatures (for selection of the least expensive material that will tolerate the operating conditions). These tests would be used to minimize the expense of constructing the heater borings, well-heads, and manifold piping. The testing would include heater cans, the high-temperature grout, well-screens, and manifold piping and valves.

2. Field scale testing of materials of construction to verify the results of the laboratory testing and ensure that the well and piping materials are capable of withstanding the elevated temperatures and the degree of corrosivity likely to be encountered during full scale operation.
3. Numerical simulation and optimization of the design (refinement of process flow rates and maximum VOC removal rate). In particular, this task includes detailed modeling of the groundwater flow regime after installation of the barrier wall, and during operation.

These tasks could be completed in approximately 3 months.

If a larger pilot test was performed (e.g., say a 50 ft by 50 ft area), it could provide information on the following:

- Suitability of various materials of construction for heater wells and above ground piping,
- Degree of groundwater flux into the TTZ during heating and ability of the ISTD system to attain the target temperature (i.e., 100^{o}C),
- Heating duration and power usage,
- Amount of dewatering and the associated impacts to vertical gradients beneath the pilot test area,
- Off-gas treatment characteristics (flow rate, concentration, and pH), and
- Effectiveness at reducing contaminant concentrations.

A larger pilot test would require 10 to 12 months to design and implement, and would cost considerably more than the lab, field tests, and numerical modeling combined. Importantly, the pilot test may not provide an accurate indication of how the system will respond during full-scale implementation. For example, unless the pilot test was conducted directly over a till window and high permeability zone in the bedrock, the ability of the ISTD system to tolerate groundwater influx may not be fully demonstrated. A larger pilot test may provide information that can be more directly related to field-scale conditions, however, it may not provide a comprehensive understanding of how the full scale system will respond. It would, however, likely reveal whether there are unanticipated site conditions that could affect the success or cost of the remediation.

Analysis conducted by TerraTherm determined that a pilot test might have prevented the one “failure” to date of this technology, when unexpected corrosion caused the rapid failure of heaters and vapor piping during an attempted remediation of chlorinated pesticide wastes at the Rocky Mountain Arsenal (TerraTherm 2002).

3.3 UNCERTAINTIES / RISKS / LIMITATIONS

The application of a TCH approach at the SRSNE site has some potential uncertainties, risks or limitations that need to be considered. The uncertainties / risks / limitations are: the lack of comparable sites where TCH has been used in bedrock; effect on microorganisms within the treatment zone; potential for well corrosion; potential for DNAPL migration as a result of the high number of well installations; potential logistical limitations; and cost sensitivities. These are discussed in the following sections.

3.3.1 LITERATURE/EXPERIENCE

A comprehensive review of the available literature on thermal technologies was performed to develop data to support the potential success of the recommended TCH approach for the SRSNE site. While TerraTherm has substantial experience with TCH at complex sites, only a few publicly available references have been published. The following paragraphs briefly describe a few case studies for TCH that have significant relevance to the conditions / scale of the SRSNE site. These cases were selected because they each provide input on some of the TCH-related questions at the SRSNE site.

In-Situ Thermal Desorption (ISTD): Manufacturing Facility in Portland, IN (TerraTherm, 1997).

The first full-scale TCH implementation for CVOCs was conducted at an industrial facility in Portland, IN (Vinegar et al. 1999; USEPA 2003). The site consisted of heterogeneous unsaturated deposits of fill material, clays, and till, heavily contaminated with CVOCs, in particular PCE and TCE. Perched groundwater existed within the source zone. A total of 140 heater borings was used to a maximum depth of 18 ft. The surface area of each of the two TTZs was covered by an impermeable silicone rubber sheet to prevent fugitive emissions, beneath a thermally insulated mat and rain cover to minimize surface heat loss and infiltration of rainfall. Two distinct source areas comprising over 5,000 cy were treated in six months, while monitoring was conducted of subsurface temperatures at 91 centroid locations and of off-gas emissions from the thermal oxidizer. PCE concentrations in the soil were reduced from levels as high as 3,500 mg/kg to below 0.5 mg/kg in all soil samples collected after the remediation was complete, relative to a cleanup goal of 8 mg/kg. Significantly, COC reductions were seen even at a portion of the site where groundwater influx prevented achievement of treatment temperatures above 100°C, as had initially been intended (this site did not have a hydraulic barrier installed around the TTZ as does the SRSNE site; thus this cooling effect will be prevented at SRSNE). This was the first application of TCH at a CVOC site that demonstrated that target treatment temperatures greater than 100°C were not required to accomplish the remedial goals. No adverse impacts were noticed (either health and safety related or odors), and the site was closed based on soil sampling after thermal treatment. A no further action letter was provided by the State of Indiana in 2000 (http://www.terratherm.com/technical papers).

In-Situ Thermal Desorption: Active Manufacturing Facility, US (TerraTherm, 2004)

ISTD was used to treat three distinct CVOC source areas containing clay soils located above the regional water table but frequently inundated by perched water. The site was an active manufacturing facility in the Midwest US, with a total treatment volume of approximately 11,000 cubic yards. Interwell soil temperatures of 99 ^{o}C were achieved (the boiling point at the actual elevation). Initial TCE concentrations in soil of up to 4,130 mg/kg, indicative of the presence of DNAPL, were reduced to less than 1 mg/kg after 150 days of heating, based on the collection of 79 pre-treatment, 137 interim and 94 post-treatment soil samples.

The geology at the site consists of a silt and clay unit to approximately 18 feet overlying a sand and gravel unit to approximately 100 feet below grade. The regional water table was at about 30 feet below grade in the sand and gravel unit. A total of 206 wells were installed in the treatment area at a spacing of between 12 and 17 feet. The surface area of each of the three TTZs was covered by an impermeable vapor barrier to prevent fugitive emissions, beneath a thermally insulated mat and rain cover to minimize surface heat loss and infiltration of rainfall. 3 MW-hr of energy was utilized to heat the target soils over a 150 day period. Although one of the three treatment areas remained saturated with perched water throughout the treatment period, and all three treatment areas received infiltration of water via fractures in the till, the remedial goals, which included 1 mg/kg for TCE were met for all three areas. For the largest of the three TTZs, this conclusion was based on 54 randomly selected soil samples collected after treatment, the average TCE concentration of which was 0.07 mg/kg).

The turn-key project cost was reported as $1.5 million, equaling $136 per cubic yard. A technical paper presenting the results was presented at the 2004 Battelle conference in Monterey, CA (LaChance et al. 2004).

In brief, this case study shows that for CVOCs such as those present at the SRSNE site, very low concentrations can be achieved after about 180 days of heating, provided that there is not an excessive influx of groundwater to the TTZ. Furthermore, it illustrates that low-permeability saturated zones can be effectively treated using TCH.

In-Situ Thermal Desorption (ISTD): Commercial Client, Los Angeles, CA (TerraTherm, 2004).

At a site in Alhambra, California, TerraTherm has completed remediation of the first of two stages of treatment of a large former wood-treater site where a total of 785 heater borings were used simultaneously. The TTZ consists of 16,200 cy of heterogeneous soil contaminated to a depth of 105 ft bgs. While this is not a CVOC site, it demonstrates that installation and operation of several hundred heaters (almost twice as many as needed for the SRSNE site), and heating of large subsurface volumes is an achievable target. The TTZ included several large buried tanks containing creosote DNAPL. A total of about 1,000,000 lbs of COCs (PAHs, PCP and dioxins) were removed from the subsurface by vaporization in less than 1 year of operation, and the off-gases were treated by thermal oxidation followed by activated charcoal filtration. This is relevant to SRSNE, since a similar treatment of very high mass fluxes are necessary, and stringent off-gas treatment goals will have to be met as well. Also, a total of 785 thermal well penetrations were installed at this site, with minimal leakage of vapors through the cap being observed. This site utilizes an insulated and poured concrete cap with grouted seals around each well penetration. The first phase of this remediation project was published and reported by Bierschenk et al. (2004), with the results accepted by the California EPA Dept. of Toxic Substances Control.

Performance data included over 100 subsurface temperature and pressure monitoring points, a Continuous Emissions Monitoring system, and four source testing events conducted by an independent air monitoring firm. All emission standards were consistently met.

In summary, these full-scale TCH projects (comprising six separate source areas) above the water table (although some included areas of perched groundwater), all achieved complete DNAPL removal. All six source areas were remediated to the satisfaction of the clients and regulators. Unit costs varied from $136 to $400 per cubic yard (with the low cost representing CVOC sites, and the higher cost representing treatment of PAH and dioxin-laden soils to residential standards).

3.3.2 EFFECT ON MICROORGANISMS

The potential impact on the microorganisms present at the site through the application of a thermal technology approach was developed by GeoSyntec Consultants as a separate white paper that is attached as an appendix to the Feasibility Report (Appendix X). A summary of the relevant conclusions of the white paper are provided in the following paragraphs:

Typically, the application of heat-based remediation technologies will increase the subsurface soil and groundwater temperatures to above 65ºC for extended time periods (several months to a year), which will effectively sterilize the soil in the treatment area of dechlorinating organisms. Research recently conducted at the Technical University of Denmark using KB-1™, a culture known to contain several *Dehalococcoides* strains, found that TCE dechlorination ceased at temperatures above approximately 40ºC; even when the microcosms were returned to temperatures of about 25ºC dechlorination activity was not re-established (Friis et al., submitted). Additionally, heat will slowly dissipate in the treatment zone, which will impede the re-establishment of microbial degradation of untreated residuals by halo-respiring microorganisms that naturally migrate in to the area over time. However, for a period of time after sufficient cooling, microorganisms that migrate or are added to the thermally treated area could grow rapidly because there would be little competition for the space and residual nutrients (released from dead cell mass) present in the treatment zone.

The extent that the thermal technology will reduce the population of dechlorinating microorganisms is unknown, but likely it will be large. There will be a delay in the restart of the natural degradation processes while the soils cool and repopulate with degrading organisms. A period of monitored natural attenuation will be necessary after thermal treatment before risk-based concentrations are achieved. Natural degradation during and after cool-down will further reduce the soil and groundwater concentrations, and may reduce the re-contamination by groundwater migrating upward from the contaminated bedrock.

3.3.3 CORROSION OF WELLS

One of the potential concerns is corrosion of wells / piping, but under the relatively low-temperature operating conditions (i.e., consistent with steam distillation) that would prevail during the proposed TCH approach, the probability of corrosive failure of piping is considered to be modest. Unlike higher-temperature applications of TCH for treatment of SVOCs, which promote in-situ thermal destruction of a large fraction of the contaminant mass, the proposed TCH approach focuses on vapor-phase extraction of the COCs, with the expectation that relatively little HCl would be generated in-situ or in the aboveground piping leading to the treatment equipment; therefore, strongly acidic conditions are not expected. However, acidic corrosion caused the unexpected failure of a prior TCH remediation, although that project dealt with highly chlorinated pesticide residues (Hex Pit Remediation / Material Failure Report, TerraTherm 2002). The cost estimates assume use of series 304 or equivalent stainless steel wells, along with placement of a calcareous grout around the heaters, and that carbon steel will be used for the above ground piping. However, laboratory testing is described in Section 3.2.8 that will be used to select the most cost-effective compromise between corrosion resistance and price.

3.3.4 POTENTIAL FOR DNAPL MIGRATION DURING WELL INSTALLATIONS

It is currently projected that approximately 525 borings will need to be installed to the bedrock surface (a minimum of 450 of the borings to several feet into the bedrock) across the site. While it cannot be accurately predicted how many of the well installations will pass through an area of potentially mobile NAPL, it is highly probable that a significant number of wells will encroach upon the NAPL. While methods exist (e.g. positive water pressure) to control the flow of NAPL into the well bores, this will require extra precautions and therefore additional time and costs to perform the installations. As described in section 3.2.1, the borings will be grouted immediately after installation of the heater casing, using a high-temperature grout that hardens within a few hours. This will effectively minimize the risk of downward spreading of DNAPL associated with the drilling and well installation. In addition, the grout seals will make it unnecessary to pump water and NAPL in the period between drilling and thermal operation.

3.3.5 POTENTIAL LOGISTICAL LIMITATIONS

Based on the conceptual design for the application of the TCH approach for the site and the energy balance provided in Section 4 below, two potential logistical limitations require consideration; power and natural gas availability. From the energy evaluation provided in Section 4 below, the thermal remediation approach will require an electrical power source capable of providing 2,200 kW supply, and an anticipated total electrical usage over the seven-month operational period of 7.7 million kWh. In addition, approximately 8,000 million BTU of natural gas fuel value (or equivalent fuel) will be required. As the SRSNE site is within the Town of Southington, CT, the required electrical and natural gas sources are expected to be available; however, the costs for a short-term, high intensity usage period will need to be confirmed.

Other potential logistical limitations to the successful implementation of this system, along with potential mitigating approaches include:

- The wells can be installed by several drill-rigs operating at the same time, each installing wells along lines in the well-field. This has been done without logistical trouble for sites with a well spacing as close as 7 ft. Therefore, at SRSNE, there will be ample room for the drill rigs.
- The large number of wells, heaters, and thermocouples in the well-field. At past sites, including some with more wells, and some with smaller well spacing, this has been handled without safety issues for the personnel working at the site. Minor repairs during operations have not impacted the ability to keep the system operational.
- Interim and final soil sampling will be done by a compact drill-rig which can maneuver to the sampling locations in between the piping network. For some locations near the middle of the well-field, it will be lifted via a crane and lowered into place, a technique that has been implemented at previous sites without difficulty.

These and similar logistical limitations have been overcome several times in past projects.

3.3.6 COST SENSITIVITIES

The projected cost to apply the TCH approach at the site is provided in Section 5. From the estimate the operating costs make up approximately 30 percent of the total cost (without design or contingency). Therefore the time of required system operation vs. the predicted system operational time could have a significant impact on the final cost to apply the technology. The contingency provided in the Feasibility Study reflects this uncertainty.

3.4 EXPECTED RESULTS AND PERFORMANCE EVALUATION

3.4.1 EXPECTED RESULTS

Based on the site specifics, the mechanisms discussed in Sections 1 and 2, and the results obtained at comparable sites presented in Section 3.3.1, the following general statements about the expected treatment results are provided:

- With the TCH approach it is likely that the TTZ can be heated to above the in-situ boiling point of the primary NAPL constituents-water mixture of 80-90 ^{o}C at 1 atm pressure. A field target will be set for heating to 100 ^{o}C, which will ensure that the site is too hot to host DNAPL. This leads to complete removal of the DNAPL everywhere that those temperatures are achieved. The majority of the COCs will be extracted as a vapor, with the potential of some limited additional degree of in situ degradation. However, no site has yet been treated with a DNAPL mass as large as expected at the SRSNE site, or with a volume as large below the water table. Therefore, for the purposes of the Feasibility Study and based on the uncertainties relayed in Section 3.3 above, a removal effectiveness of at least 95 percent of the NAPL is set as a very realistic target.
- Both the adsorbed and dissolved COCs will be affected by the thermal treatment. Since the objective for application of the thermal technology approach in the TTZ is to provide cost-effective mass removal, it is anticipated that the thermal treatment will not be

operated long enough to reach MCL or similar low groundwater concentrations. Treating to such low standards would likely not make sense, since the upward gradient is expected to bring in contaminated groundwater from the bedrock once thermal remediation has been completed.

- Application of TCH would be expected to improve the attainment of ONOGU Remedial Action Objectives (RAOs). The thermal approach would be expected to eliminate the NAPL mobility and meet that RAO. Further, the approach would be expected to further shorten the timeframe that groundwater standards are exceeded, further shrink the aqueous phase VOC plume, and further reduce groundwater contaminant concentrations.

3.4.2 PERFORMANCE EVALUATION

It is expected that the thermal remediation approach will be successful in removing a significant amount of NAPL from the target treatment volume. For a full-scale application, typical approaches to monitor the effectiveness / end-point of the non-NAPL migration aspects of a thermal remedy include:

- The effluent treatment system would be designed so the following parameters could be measured:
    - NAPL volume recovered as a liquid by the treatment system (collected at the gravity separator).
    - COC mass removed in the water phase at the inlet to the air stripper.
    - COC mass removed in the non-condensable vapor stream based on vapor samples at the inlet to the thermal oxidizer. This data would also be used to verify the off-gas treatment efficiency.
- Screening of individual wells:
    - Each lateral discharge line would be screened for NAPL presence, order-of-magnitude COC vapor content, and visual parameters approximately once per month to track treatment performance across the well field.
    - During the latter half of the heating phase, individual extraction wells would be sampled for COC concentrations (vapor or liquid samples, or both) at selected times. This data would be used to focus the thermal treatment in areas that continue to release COCs, and to provide preliminary indications of the achieved COC reductions.
- Interim soil sampling.
    - Interim drilling and sampling events would be used to document remedial progress. Hot sampling techniques would be used to sample both zones that have achieved target temperatures and are expected to have been depleted in mobile NAPL, and zones that resist heating and may need additional focus.
    - When the operational data indicate that treatment is nearing completion in certain areas of the site, detailed sampling would be conducted to confirm whether thermal treatment can be suspended.

- Hot sampling techniques described and validated by Gabarell et al. (2002) will be used. Soil, sediment cores will be collected in sleeves, capped and cooled on ice before opening and sampling using standard methods.

Thermal treatment would be suspended when the well-field samples verify that individual sections of the site are depleted in extractable COCs (which would be measured by the mass removal rate from the well field, which should diminish to an asymptotic level), and the interim soil sampling indicates that COC concentrations are reduced sufficiently to allow for the beginning of the cooling and polishing phases.

4.0 ENERGY BALANCE

An energy balance provides an estimate of the energy requirements to implement the TCH approach at the site. The energy requirements were developed based on a simple energy balance equation, input from TerraTherm, and from the output of thermal modeling of the site, as performed by Dr. Sleep.

4.1 ESTIMATING THE ENERGY BUDGET

Analytical and numerical models are essential tools in predicting the heat required to achieve target temperatures at a given site, regardless of the method of heating. A simple box model can be used to readily estimate the duration of heating, as functions of energy input and well spacing, necessary to heat solid and liquid phases within a TTZ (Baker and Heron 2004). A multiplier can then be applied to factor in heat losses to the site’s surroundings. This procedure was used to estimate the energy budget for the SRSNE site. The treatment is in the shallower end of the optimal range for thermal technologies, which will require use of a vapor cap and typically results in an overall cost per unit volume that is high compared to deeper applications. The estimated treatment times are in the range suggested by the limited full-scale system data available for chlorinated NAPL sites, both for steam alone, and for TCH projects.

Table 4-1 presents the overall design parameters and estimates of energy / utility usage.

Table 4-1: Overall Design Parameters and Estimates for Utility Usage

Category	Parameter	Value	Unit
Volume and area	Heated zone depth (average)	18	ft
	Target zone area	71,000	ft^2
	Volume in heated zone	47,400	yd^3
Well-field	Spacing between heater wells	15	ft
	Number of heater wells w/ vacuum recovery screens	450	(-)
	Number of monitoring boreholes	75	(-)
Duration	Estimated duration, whole cleanup	203	days
	Heat-up phase duration	100	days
	Optimization phase duration	73	days
	Cool-down phase duration	30	days
Mass and energy	TCH power input rate, maximum for TCH wells	2,025	kW
	Estimated treatment system power usage, maximum	200	kW
	Total liquid treatment system capacity	11	gpm
	Vapor treatment system capacity and emission rate	2,000	scfm
System sizing	Power supply, maximum	2,200	kW
	Total cooling need, maximum	2	million BTU/hr
	Fresh water supply rate, instantaneous maximum	10	gpm
Utility needs	Total power usage	7,700,000	kWh
	Total natural gas usage	8,000	million BTU
	Total fresh water usage	1,000,000	gallons
	Total treated water discharge	600,000	gallons

Total power demand is estimated at 7.7 million kWh, which equals 160 kWh/yd^3. Approximately 0.6 million gallons of treated water (condensate) would be discharged. The cooling tower make-up water would total approximately 1 million gallons, supplied at a rate of up to 10 gpm, with an average flow rate of 4 gpm. The quantity of natural gas for the thermal oxidizer is estimated to total about 8,000 million BTU. The actual gas usage depends strongly on the VOC concentration, with more gas needed at times of low concentrations.

4.2 ENERGY BALANCE FROM THERMAL MODELING

The energy balance for the ten cases modeled by Dr. Sleep is presented in Table 4-3. Appendix A provides a description of the conditions modeled for each of the eight cases. Cases 4 and 9 are most representative of the projected combined approach for the SRSNE site. Scaling the well pattern modeled by the number of steam injection and TCH wells proposed for the SRSNE site indicates that for Case 4 the required energy input to approach the target temperature in the overburden soils above the 'hot plate' is approximately 7,000 MW.h; and for Case 9 the required energy input to create the 'hot plate' is approximately 2,000 MW.h. The total energy requirement to achieve the target temperature in the treatment zone is approximately 9,000 MW.h, which is relatively consistent with the energy calculations provided in Section 4.1 above.

Table 4-3: Energy Balance Derived From Thermal Modeling

Case	Heating Method	Treatment Volume (m^3)	Ground Surface	Energy Input Rate (kW)	Time Period (days)	Total Energy Input (MW-Hr)	Energy Change in System (MW-Hr)
1	Steam flushing	900	Open	420	80	800	216
2	Steam Flushing	200	Open	105	40	100	65
3	Steam Flushing	900	Closed	420	20	200	180
4	Steam Flushing	200	Closed	105	20	50	40
5	Electrical Resistance	900	Closed	89	100	214	192
6	Conductive Heating	900	Closed	88	100	212	190
7	Electrical Resistance	160	Closed	4	145	12.5	10
8	Conductive Heating	160	Closed	3	77	7	6
9	Conductive Heating	150	Closed	6	60	9	9
10	Conductive Heating	70	Closed	6	40	6	6

5.0 COSTS

This section provides feasibility study level costs for application of the TCH approach for the SRSNE site. The costs were derived in part from input from the thermal vendor, as amended by the thermal modeling results. Given that the thermal technology approach would be complete within a two year period, a net present worth analysis was not performed.

5.1 FULL-SCALE SYSTEM

Based on the preliminary conceptual design outlined in Section 3.2, the estimated costs for a full-scale treatment using TCH at the SRSNE site is summarized in Table 5.1 below. The total estimated full-scale project cost is $9.65 million. For an assumed treatment volume of 47,000 cubic yards, this equates to approximately $205 per cubic yard.

The following costs were not included:

- Contingency
- Project and Construction Management (of thermal contractor)
- Recovered NAPL disposal (which may contain PCBs)
- Water treatment, assumed to be discharged to the existing treatment system, with appropriate modifications to incorporate phase separation and higher influent VOC concentrations.
- Costs for interim soil sampling
- Closure of existing PVC monitoring wells within the treatment area
- Site preparation
- Abandonment of NTCRA system components within treatment area
- Relocation of fiber optic cable within treatment area
- Pilot Study, if needed to demonstrate treatability or costs.

Table 5-1: Cost Breakdown for TCH Approach for SRSNE Site

CAPITAL COSTS	
Design	**$ 355,000.00**
Conceptual Design	
Detail Design	
Permitting	
Design Review	
Pre Mobilization	**$ 350,000.00**
O & M Plan	
Procurement (includes pumps / piping)	
Primary Transformer	
Equipment Prep & Shipping	
Mobilization & Site Prep	**$ 68,000.00**
Personnel Mobilization	
Equipment Unloading	
Utilities Installation	
Facilities Setup	
Install Well Field	**$ 2,500,000.00**
Layout well field	
Drilling	
Well Installation	
Construct Cover	**$ 500,000.00**
Install Insulation	
Install Concrete Cap	
Well Field Piping	**$ 450,000.00**
Install Manifold Piping	
Install Well Head Connections	
Install Piping Insulation	
Electrical Installation	**$ 310,000.00**
Wire Well Heaters	
Install Instrumentation	
Wire Electrical Distribution Gear	
Wire Process Equipment	
Construct Off-Gas Treatment Systems	**$ 1,300,000.00**
Install Vapor Piping	
Install Condensate Piping	
Install Catalytic Oxidizer/Scrubber	
Install ancillary equipment	
Condensate Pumping and Separation	**$ 162,000.00**
Install Transfer Pumps	
Install Separators	
Install Neutralization System	
Install NAPL Storage Tank	
Shakedown Testing	**$ 45,000.00**
Field Piping Checks	
Electrical System Checks	
AQC System Checks	
Decommissioning	**$ 110,000.00**
Dismantle/Decon Process Equipment	
Dismantle Electrical Equipment	
Dismantle Decon Piping	
Remove Heaters	**$ 280,000.00**
Remove Wells and Heaters	
Remove and Dispose Cap Materials	
Site Restoration	**$ 19,000.00**
Re-grading, Misc. Restoration	
Site Clearance & Demob	**$ 50,000.00**
Disconnect Utilities	
Breakdown On-site Facilities	
Demob Equipment & Materials	
Demob Personnel	
Final Report	**$ 31,000.00**
Data Review	
Report Preparation	
Home Office Support	**$ 200,000.00**
Project Management	
Engineering Support / meetings	
TOTAL CAPITAL COST	**$ 6,730,000.00**

OPERATING COSTS	
ISTD Operation	**$ 2,500,000.00**
Operator Labor	
Equipment Rental	
Electricity Usage	
GAC Usage	
Air Monitoring	
Field Support	**$ 170,000.00**
Health and Safety Supplies	
Per Diem Expenses	
Equipment Rentals	
Home Office Support	**$ 250,000.00**
Project Management	
Engineering Support	
Project Meetings	
TOTAL OPERATING COSTS	**$ 2,920,000.00**
TOTAL PROJECT COST	**$ 9,650,000.00**
Cost per cubic yard (47,000 yd^3)	$205

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APPENDIX A

RESULTS OF THERMAL MODELING BY DR. SLEEP

Modeling of Thermal Remediation for Solvents Recovery Service of New England (SRSNE) Site

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May, 2004

Modeling of Thermal Remediation for Solvents Recovery Service of New England (SRSNE) Site

General

A series of simulations were conducted to investigate the potential behavior of various thermal remediation strategies for a shallow groundwater system representative of the shallow subsurface at the Solvents Recovery Service of New England (SRSNE) site. Several cases were simulated, including steam flushing, electrical resistance heating, and conductive heating (in situ thermal desorption). The impacts of well spacing and ground surface boundary conditions were also examined. The simulations were performed for illustrative rather than predictive purposes, as conditions at the SRSNE site might vary considerably from those employed in simulations, particularly with respect to variability of soil properties and DNAPL properties and distribution.

Methods

A three-dimensional thermal compositional model (Sleep and She, 1998) was used for all simulations. Three-dimensional simulations of steam movement were conducted in a domain that was 30 m by 30 m by 6.2 m deep, representing a possible treatment area at the site. The upper 4.2 m of the domain were assigned properties typical of the overburden soils at SRSNE (K = 2 x 10^{-3} cm/sec). The bottom 2 m of the domain was assigned a low hydraulic conductivity (5 x 10^{-8} cm/sec) to represent bedrock. The initial water table was set 1 m below the ground surface. Soil properties used are listed in Table 1. As no thermal properties were available for the site typical values from the literature were used.

For the simulations the vertical boundaries were treated as no flow boundaries, assuming that hydraulic controls, or the use of multiple treatment units (repeated patterns of extraction and injection wells for example). For some cases the ground surface was simulated as an open surface, by applying a boundary condition of atmospheric pressure, allowing vapor and energy to be transported to the atmosphere as a result of subsurface pressure buildup due to subsurface heating and steam generation. For other cases, the ground surface was modeled as an impermeable boundary, representing a situation where the ground surface was sealed from the atmosphere. Steam flushing, electrical resistance heating, and conductive heating were simulated. The cases simulated are listed in Table 2.

Results

Case 1

For Case 1, a three-dimensional domain 30 m by 30 m by 6.2 m deep was simulated to represent one isolated treatment area at the site. The upper 4.2 m were assigned properties typical of the overburden soils at SRSNE (K = 5.8 ft/day). The bottom 2 m of the domain was assigned a low permeability to represent bedrock. The initial water table was set 1 m below the ground surface. For the simulations the vertical boundaries were treated as no flow boundaries. The ground surface was simulated as an open surface, by applying a boundary condition of atmospheric pressure, allowing vapor and energy to be transported to the atmosphere as a result of subsurface pressure buildup due to steam injection.

For Case 1 a five-spot pattern was simulated, with four injector wells surrounding a central injection well (See Figure 1a). The wells are spaced 14 m apart, and they are each approximately 8 m from the extraction well. Steam was injected into each of the four wells at a rate of 150 kg/hr over an interval from 3.3 m bgs to 4.2 m bgs. A vacuum of 1 m H_2O was applied to the upper portion of the extraction well, and a prescribed water level of 2.85 m bgs was applied to the lower portion of the well to remove liquids from the saturated zone.

The temperature profiles produced by steam injection for Case 1 are shown in Figures 1a – 1d for 20, 40, 60, and 80 days. The results at 20 days show that injected steam rapidly breaks through to the ground surface. As the vacuum well is very close to the ground surface it has a small radius of influence, and does not capture the steam from the injection wells. The water saturations are shown in Figure 1e. The steam override as the steam moves upwards and towards the extraction well is evident. This is accentuated by the presence of the low permeability bedrock layer at the bottom of the system, as heat is lost to this layer as the steam zone expands outwards from the steam injection wells. In addition, the influx of air to the vacuum well produces cooling in the vadose zone around the extraction well. The pumping of water from the extraction well is not able to promote adequate horizontal expansion of the steam zone due to the shallow depth of the aquifer and the short circuiting of steam to the ground surface. The energy balance given in Table 2 indicates that about 75% of the energy input from steam injection was lost to the atmosphere and to fluid and vapor withdrawal by the extraction well.

Case 2

Case 2 investigates the impact of closer well spacing on steam movement at the site. The well spacing was reduced by 50% to 7 m between injector wells and 4 m between injector wells and the extractor well. The steam injection rate was also reduced by a factor of 4. The temperature profiles are indicated in Figure 2 a and 2b for 20 and 40 days of steam injection, respectively. At 10 days the steam has reached the ground surface, but it has not yet reached the extraction well. By 40 days the steam has reached the extraction well, and temperatures are above 100 C for most of the upper portion of the site. Some steam override is still evident, but it is less pronounced than in Case 1 with greater well spacing. However, with an open ground surface, a substantial amount of heat, steam and contaminant vapors are being lost to the atmosphere. The energy balance in Table 2 shows that about 65% of the energy input from steam injection remained in the system. The losses are reduced compared to Case 1, due to the closer well spacing and lower rates of steam input.

Case 3

Case 3 investigates the impact of sealing the ground surface on steam movement from steam flushing. The conditions are the same as for Case 1, except that the ground surface is modeled as an impermeable boundary to all flow. The temperature profiles for 10 and 20 days are shown in Figures 3a and 3b. At 10 days the steam zone has not yet reached the extraction well. Steam has reached the ground surface, but cannot escape due to the sealed ground surface. By 20 days the steam has reached the extraction well. As with Cases 1 and 2, there is some steam override. As steam flushing continues the steam override becomes less pronounced due to vertical heat conduction from the steam zone to the underlying region. To reduce the potential for downward mobilization of DNAPL that might occur with steam override closer well spacing would be required, or supplemental electrical heating would likely be necessary. With the sealed ground surface less than 10% of the energy added through steam injection is lost to the extraction well over the simulation period.

Case 4

For Case 4, the impact of closer well spacing on steam injection with a sealed ground surface was examined. The temperature profiles for 10 and 20 days of steam injection, plotted in Figures 4a and 4b, indicate similar results as Case 3, with less pronounced steam override due to the smaller distance between injection and extraction wells. Due to the lower steam injection rate, the average temperature at 20 days is lower than in Case 3, in which the steam injection rate was 4 times higher, and about 20% of the energy was lost to the extraction well.

Case 5

In Case 5, a uniform heat source is added across the site at a depth of 3 to 4.2 m bgs. This heat source is meant to simulate the heating produced by electrical resistance heating. It is assumed that a sufficient density of electrodes (3 phase or 6 phase) are installed at the site to provide this relatively uniform source. If the site soil is heterogeneous, with respect to electrical conductivities of the soil (which will not vary as much as hydraulic conductivities), the distribution of heat flux will be correspondingly variable. 25 vacuum extraction wells are modeled, at the locations shown in Figure 5a. The ground surface was assumed to be sealed. All soil properties and model dimensions are the same as Case 1.

The temperature profile for a heating rate of 100 W/m^3 is shown for 100 and 120 days in Figures 5a and 5b, respectively. At 100 days the maximum temperature is just over 90 C. By 120 days the lower portion of the site has reached 100 C and water boiling has started. It should be noted that the mixture of water and PCE will boil at just 87 C at atmospheric pressure, while TCE and water will boil at approximately 75 C.

Applying higher voltages to the electrodes would provide a greater rate of heating. However, the greater rates of heating would also lead to drying out of the soil and loss of electrical conductivity. As the electrodes and electrical processes were not directly simulated this process of changing electrical conductivity with changing soil moisture content was not simulated. The addition of water to prevent electrode overheating was also not simulated. This would tend to slow the rate of heating. Also, areas with lower water saturations due to the presence of high DNAPL saturation would have lower conductivities, and therefore have lower heating rates.

Case 6

In Case 6, conductive heating was modeled. A total of 441 heater wells, spaced approximately 4 m apart (See Figure 6a), extending from 1.5 m bgs to 4.2 m bgs, were simulated by prescribing heat fluxes equivalent to about 660 watts/m of heater (200 w/ft) for each heater well. A total of 25 vacuum extraction wells spaced 6 m apart were also simulated (see Figure 6a), some coinciding with heater well locations, and others located between heater wells. At 50 days heat conduction had produced spherical local heating zones around each of the heater wells, but temperatures between wells were still less than 50 C. By 100 days the zones of boiling temperature around each well had started to overlap the zones from neighboring wells (Figure 6b). The impact of heat loss to the bedrock layer is evident, as the lower portion of the system heats up more slowly than the shallower depths. The energy balance was similar to that of electrical resistance heating, but the heating pattern was less uniform due to the more localized form of heat addition.

Case 7

In this case electrical resistance heating was simulated for a two-dimensional domain. The domain was 30 m wide, and 6.2 m deep, and 2 m wide, with the same soil properties used in Case 1 and 4, with the same initial water table elevation. The ground surface was assumed to be sealed. In this simulation the infiltration, redistribution, and removal of PCE in the centre of the domain was also simulated. A total of 350 L of PCE were added over 2 days in the centre of the system, and allowed to redistribute for an additional 1000 days before heating began. A heat source of 100 W/m^3 was simulated for the depth of 3 to 4.2 m bgs, and an extraction well removing water and gas was modeled in the centre of the domain. The model included PCE movement as a DNAPL, as well as dissolution and volatilization, with temperature dependent densities, viscosities, vapor pressures, and solubilities.

The PCE DNAPL saturations are shown before heating, and after 122, 134, and 145 days in Figures 7a, 7b, and 7d, respectively. The temperature profile at 134 days is shown in Figure 7c. At the beginning of heating the PCE is distributed at residual saturation in the upper portion of the aquifer, and as a pool on the bedrock in the lower portion of the aquifer. The heating does not have much impact on PCE distribution until after 122 days of heating. At this point the top of the pool sitting on the bedrock has been volatilized, but there is still a pool of PCE remaining on the bedrock layer due to the lower temperatures in the overburden just above the bedrock. The temperatures are lower next to the bedrock due to heat loss to the bedrock.

By 134 days the PCE pool in the lower portion of the aquifer has been volatilized and moved upwards to the extraction well. A layer of PCE DNAPL remains at the top of the steam chamber that is produced from the heating below the water table. The temperature profile in Figure 7c shows the extent of this steam chamber, and comparing Figures 7b and 7c indicates that the PCE has been swept from the zone that has reached steam temperature. By 145 days a thin layer of PCE remains at the top of the steam chamber that is slowly expanding to the vadose zone.

Increasing the rate of heating by increasing the power input to the heated zone produced reductions in heating times and PCE removal that were slightly greater than what would be predicted due to simple proportional scaling, due to the lower relative impact of heat losses at higher power inputs. Heterogeneities in soil properties would produce less even heating, and also lead to more variability in flow rates of steam, contaminant vapors, and DNAPL. The potential for downward mobilization of DNAPL also exists, as the PCE-water interfacial tension decreases about 10% as the temperature is increased from 20 to 90 C (Sleep and Ma, 1997). She and Sleep (1998) found that PCE-water entry pressures for a silica sand decreased about 50% as the temperature was increased from 20 to 80 C.

Case 8

In Case 8 conductive heating was simulated in a two-dimensional domain, similar to that of Case 7. Heater wells were simulated by in the same manner as for Case 6, but with half the heater power to account for the reduction from three dimensions to two dimensions. For this simulation 4 heater wells were simulated, extending from a depth of 1.5 m to 4.2 m bgs, spaced 2 m apart.. An extraction well removing liquid and vapors was simulated between the two center wells. The ground surface was assumed to be sealed from the atmosphere. The PCE DNAPL saturations at the beginning of heating and after 77 days of heating are shown in Figures 8a and 8b, respectively. The corresponding temperature profile at 77 days is given in Figure 8c.

The PCE DNAPL profiles indicate that PCE DNAPL is removed from the zones that reach steam temperature, but PCE DNAPL remains in the cooler region between the central heater wells where the extraction well is located. Approximately 25% of the PCE was removed by 77 days. The simulations indicate that close heater well spacing is required to ensure that downward mobilization of PCE does not occur. Application of strong vacuum is also necessary to ensure that vapors are captured, rather than condensing at the edge of the heated zone.

Case 9

In Case 9 conductive heating was extended into the bedrock to attempt to simulate creation of a hot floor at the top of the bedrock. Four heater wells (2.4 m long) were simulated, each with energy inputs of 500 w/m of electrode. The heater wells extended from 0.9 m above the bedrock-overburden interface to 1.5 m below the bedrock-overburden interface, and were spaced a distance of 2.4 m apart. A vacuum extraction well was placed in the vadose zone centered between the heater wells, and a water extraction well was placed in the saturated zone just above the bedrock. The water level was maintained at the initial level (1 m bgs) in the extraction well.

The temperature profiles for 20, 40 and 60 days of heating are shown in Figures 9a – 9c. The horizontal plane plotted corresponds to the top of the bedrock. The results indicate that at 20 days of heating there is a small zone around each heater well in which the temperature is above 100 C. The highest temperature predicted at the heater wells is 150 C at 20 days. In the area between the heater wells the temperature is in the range of 50 – 70 C. At 40 days the temperature in the centre between the heater wells has reached 80 – 90 C, and at 60 days, it has reached 90-95 C. The highest temperature at the heater wells at 60 days is 162 C. The water saturation profiles for 60 days (Figure 9d) indicate that desaturation has occurred primarily around the heater wells, as the temperature in the central area between the wells is still below 100 C. As the boiling point for an a two-phase TCE-water system is approximately 74 C any TCE present at or just above the bedrock interface will be volatilized between 40 and 60 days. Injection of steam into the system at this point accelerate heating, and as the bedrock is above the boiling point of TCE and water, vertical remobilization of DNAPL above the bedrock would be minimized.

Doubling the power to the heater wells (1000 watts/m) increased the temperature in the region between above 100 C in 20 days (see Figure 9e). In this case, the temperatures at the heater wells at 20 days were approximately 200 C.

When the spacing between heater wells was increased to 3.2 m, the temperature in the region between the wells at the top of the bedrock had reached a temperature of 35 C after 20 days of heating and 65 C after 60 days of heating with the 500 watts/m applied to the heater wells (data not shown). Increasing the power to the heater wells to 1000 watts/m increased the temperature in the central region between the wells to 65 C at 20 days, 90 C after 40 days, and above 100 C in 60 days.

Case 10

In case 10, conditions were similar to Case 9, with the exception that the spacing between heater wells was decreased to 1.6 m. The temperature profiles for 20 and 40 days (with 500 watts/m applied to the heater wells) are given in Figure 10a and 10b. With closer well spacing the temperatures between the wells has reached 110 – 120 C at 20 days, and the highest temperature at the heater wells has reached 215 C. At 40 days the temperature in the central area between the wells exceeds 120 C. The temperature in the vadose zone at this time has reached 30 – 50 C.

The saturations at 20 and 40 days are plotted in Figures 10c and 10d. At 20 days there is a small region in the centre between the wells that has not yet desaturated, but by 40 days this has desaturated also. In the overburden, the regions between the wells are still saturated. Injection of steam and vapor extraction at this time would be expected to accelerate removal of water and contaminants from this zone.

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Sleep, B. E., and Y. Ma, Thermal variation of organic fluid properties and impact on thermal remediation feasibility, *J. Soil Contamination*, 6(3), 281-306, 1997.

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TABLES

Table 1: Soil Properties Used in Simulations

Property	Overburden	Bedrock
Hydraulic Conductivity (cm/sec)	2×10^{-3}	4.2×10^{-7}
Porosity	0.35	0.077
Residual Organic Saturation	0.1	0.1
Air Entry Pressure (m H_2O)	0.2	1.2
Heat Capacity (kJ/m^3-C)	2600	2600
Thermal Conductivity (W/m-C)	2.8	2.8

Table 2: Energy Balances for Simulations

Case	**Heating Method**	**Treatment Volume (m^3)**	**Ground Surface**	**Energy Input Rate (kW)**	**Time Period (days)**	**Total Energy Input (MW-Hr)**	**Energy Change in System (MW-Hr)**
1	Steam flushing	900	Open	420	80	800	216
2	Steam Flushing	200	Open	105	40	100	65
3	Steam Flushing	900	Closed	420	20	200	180
4	Steam Flushing	200	Closed	105	20	50	40
5	Electrical Resistance	900	Closed	89	100	214	192
6	Conductive Heating	900	Closed	88	100	212	190
7	Electrical Resistance	160	Closed	4	145	12.5	10
8	Conductive Heating	160	Closed	3	77	7	6
9	Conductive Heating	150	Closed	6	60	9	9
10	Conductive Heating	70	Closed	6	40	6	6

FIGURES

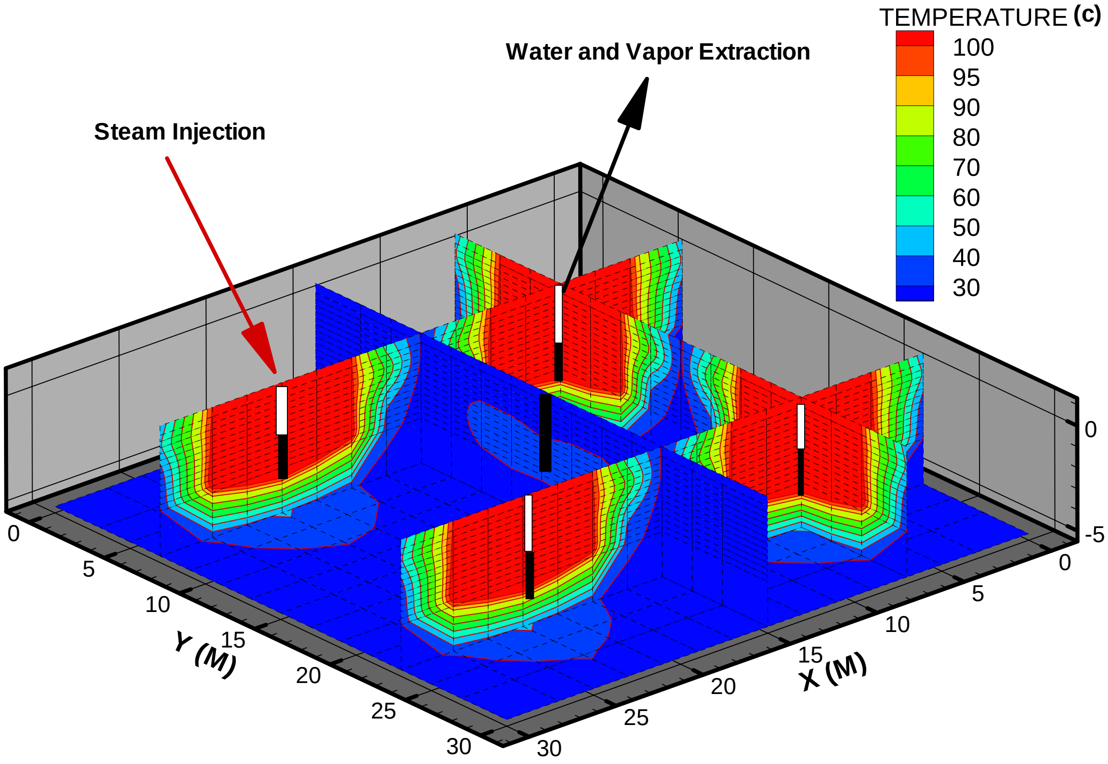

Figure 1a: Case 1, Temperatures After 20 days of steam flushing

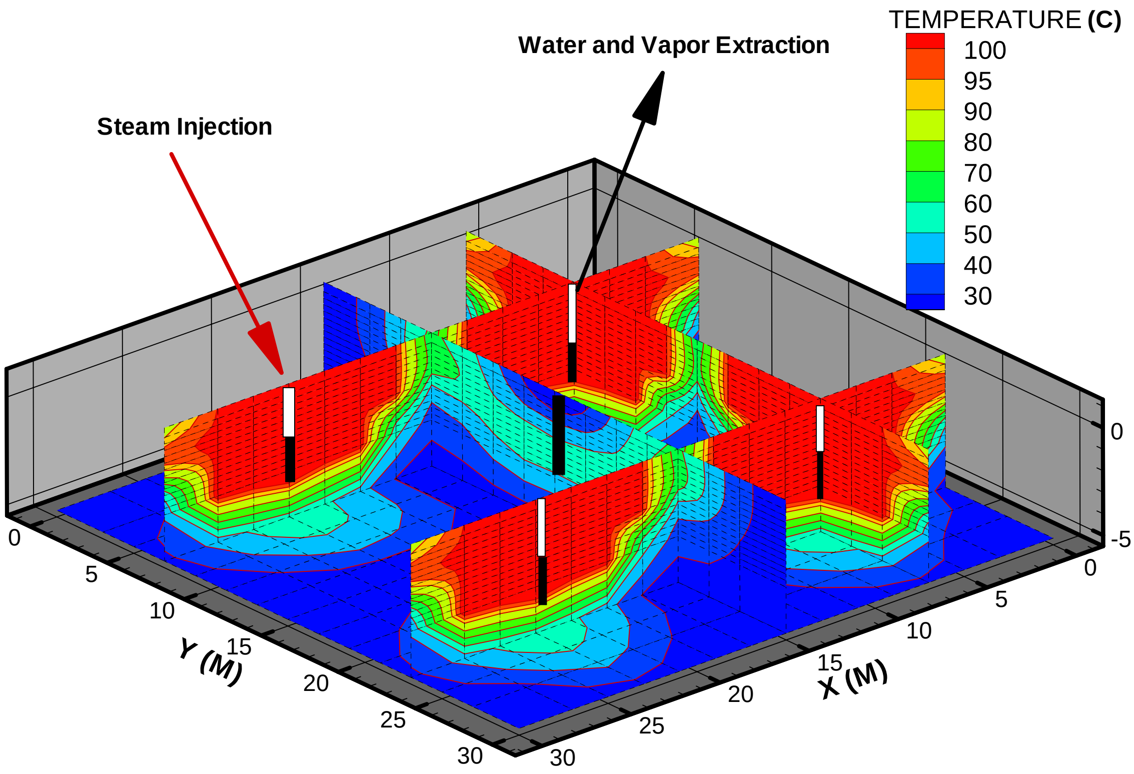

Figure 1b: Case 1, Temperatures After 40 Days of Steam Flushing

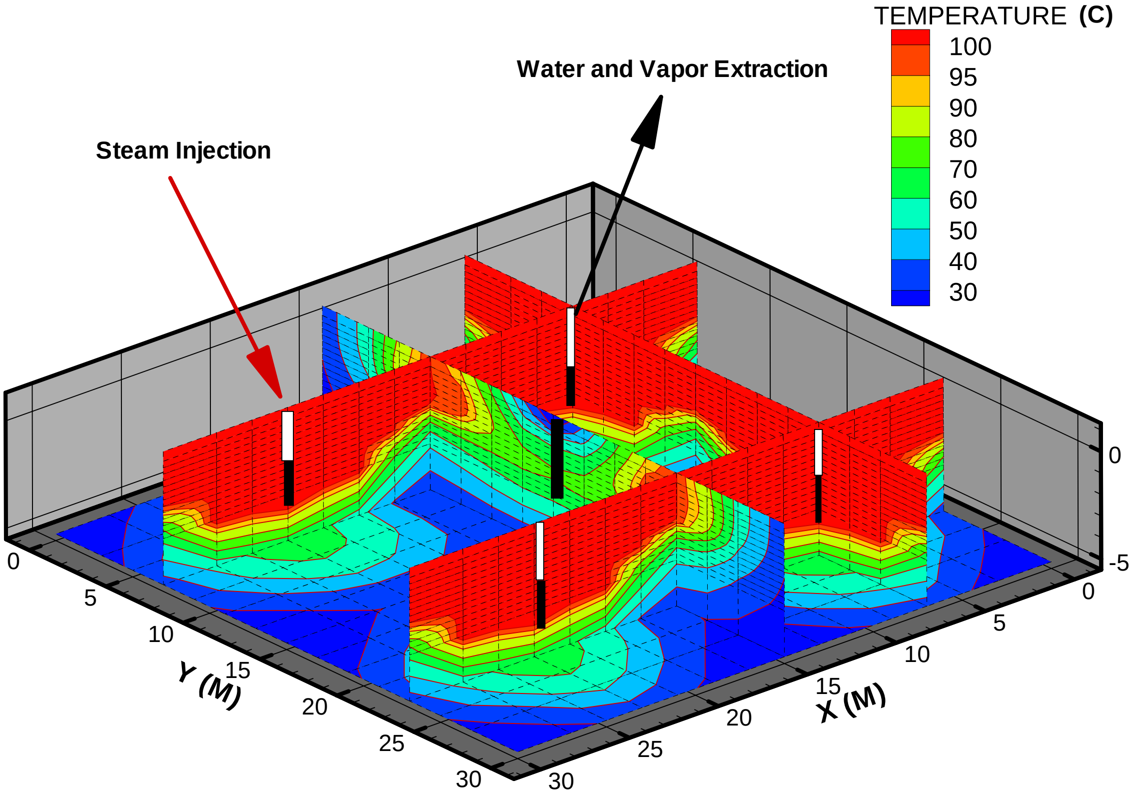

Figure 1c: Case 1, Temperatures After 60 Days of Steam Flushing

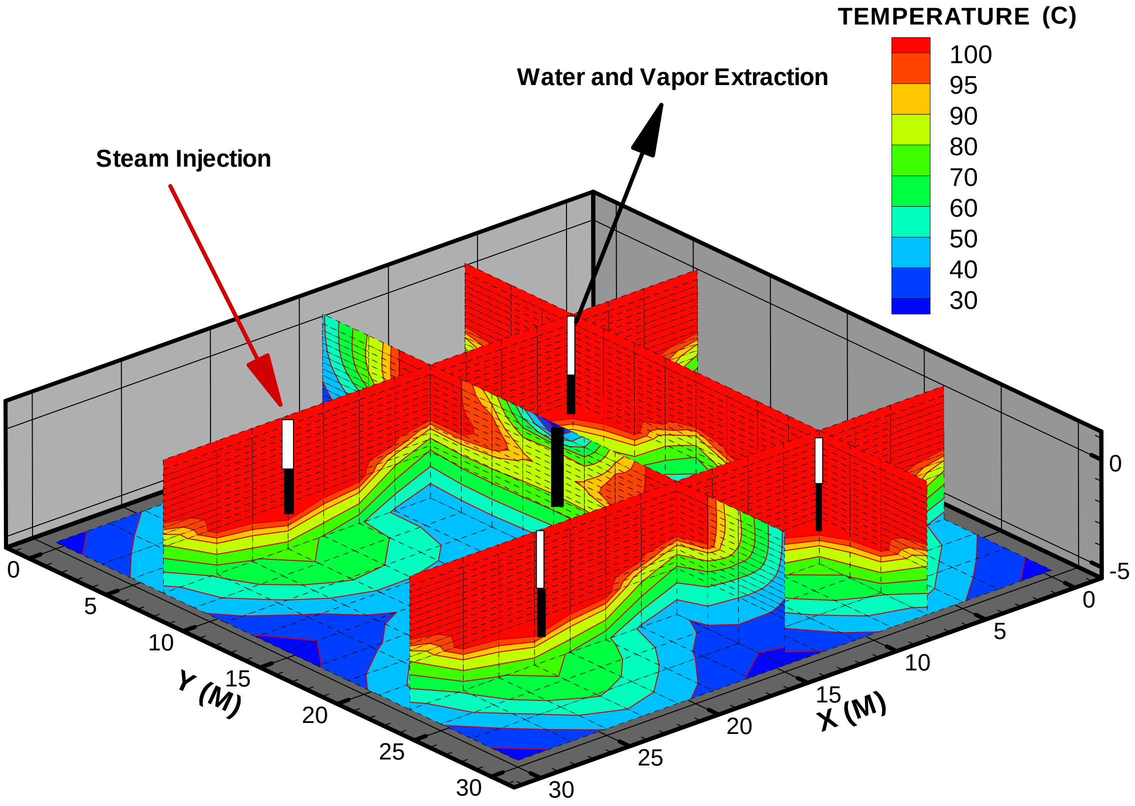

Figure 1d: Case 1, Temperatures After 80 Days of Steam Flushing

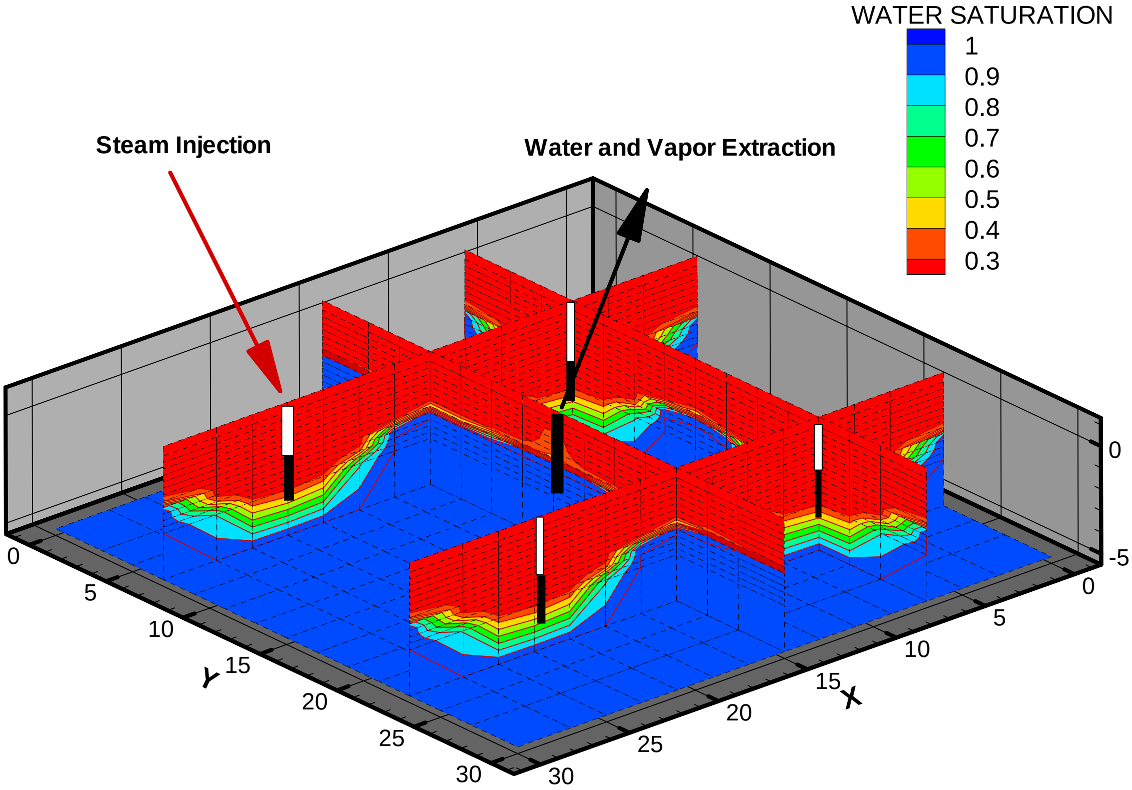

Figure 1c: Case 1, Water Saturations After 80 Days of Steam Flushing

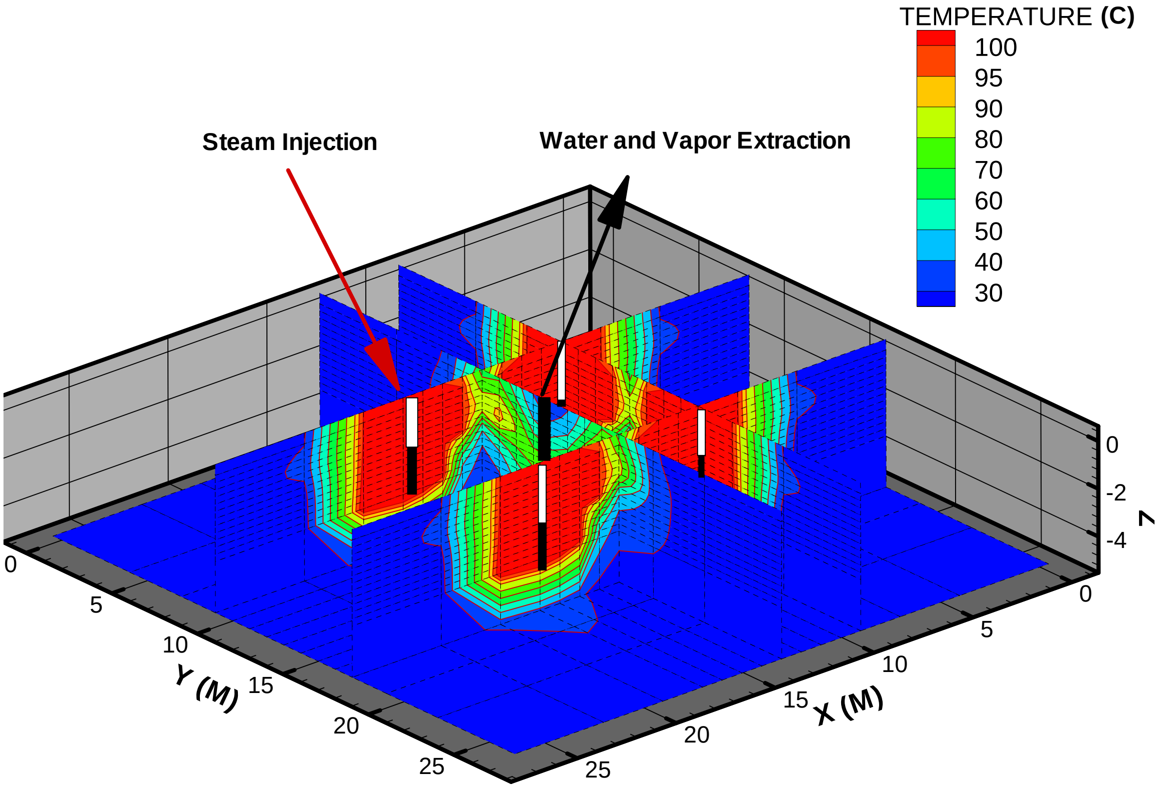

Figure 2a: Case 2, Temperatures After 20 Days of Steam Flushing

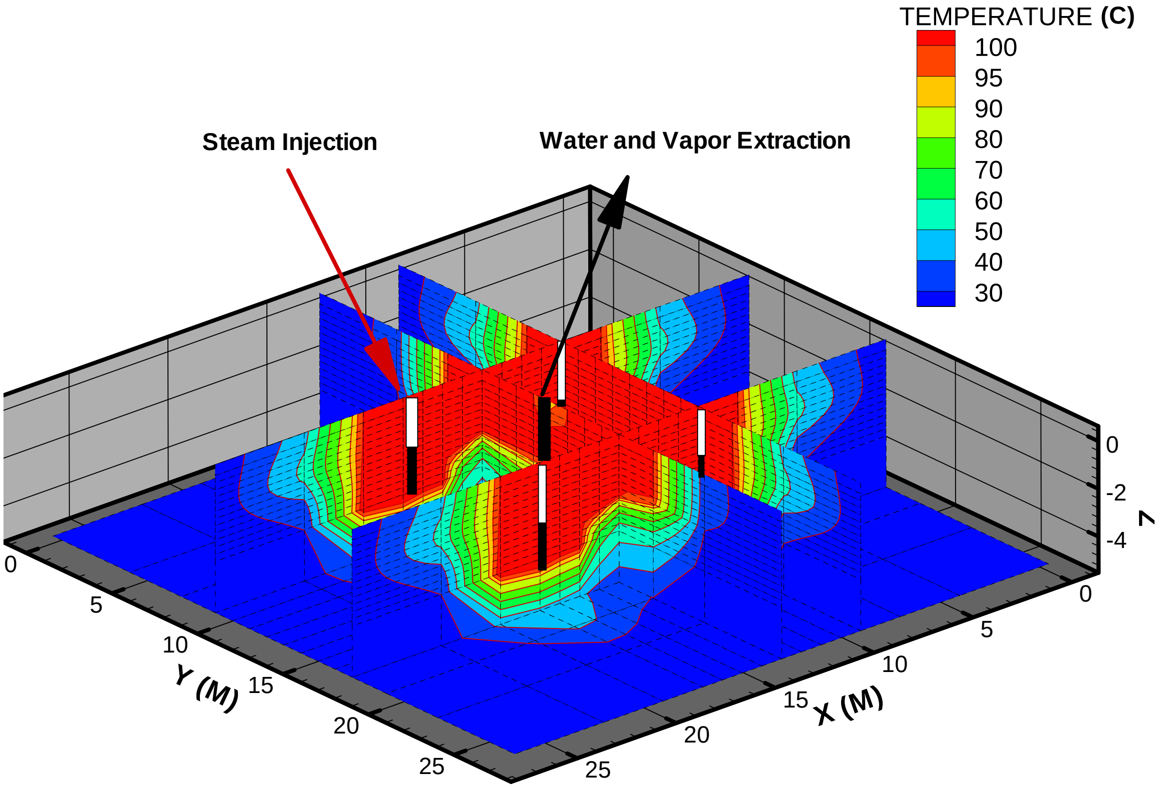

Figure 2b: Case 2, Temperatures After 40 Days of Steam Flushing

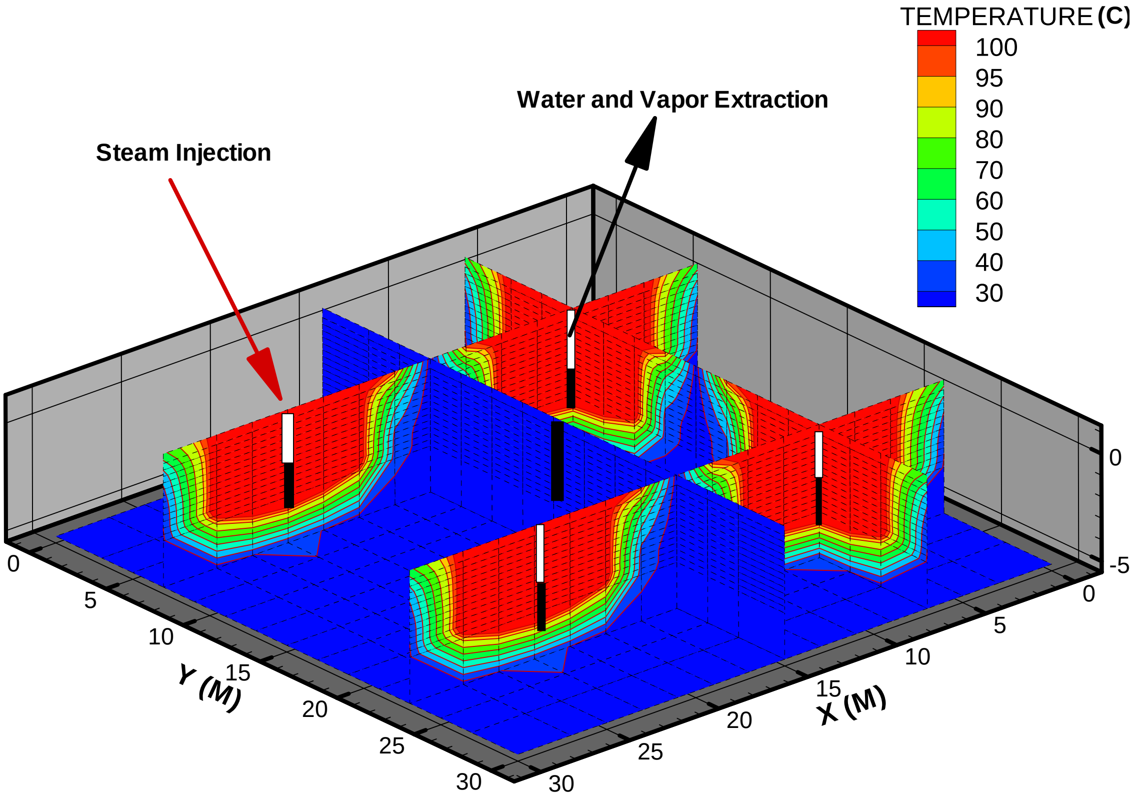

Figure 3a: Case 3, Temperatures After 10 Days of Steam Flushing

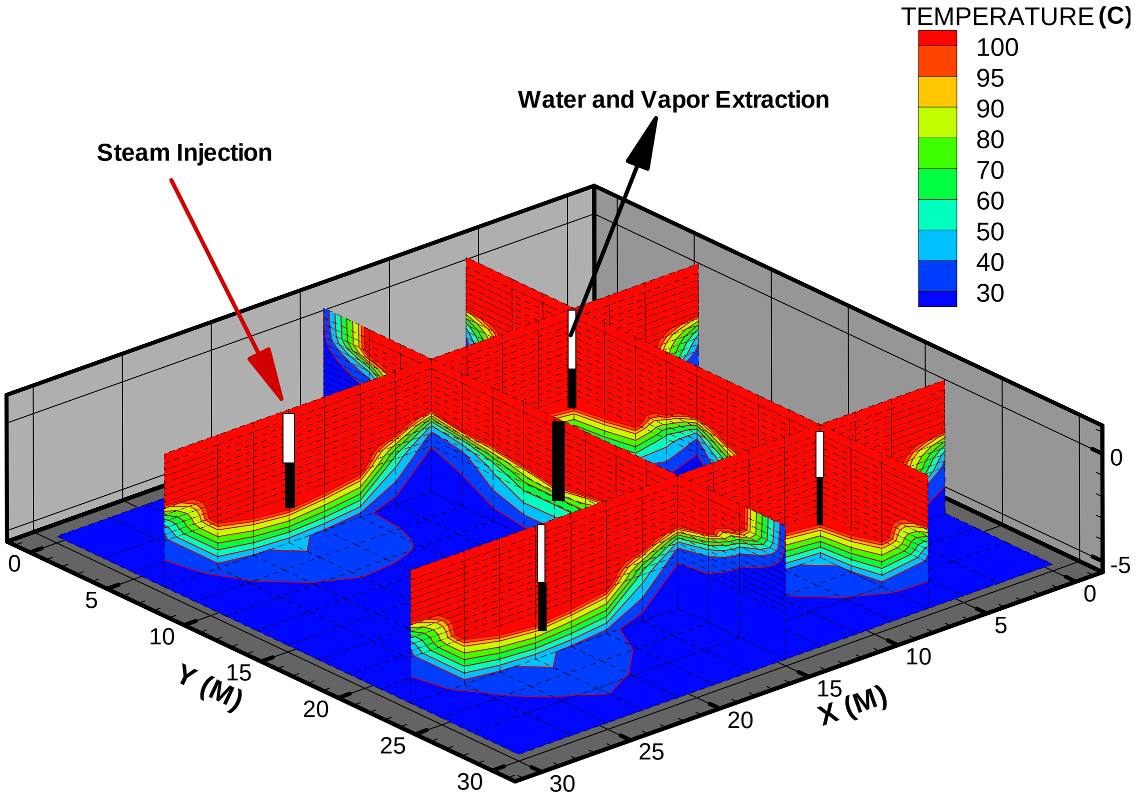

Figure 3a: Case 3, Temperatures After 20 Days of Steam Flushing

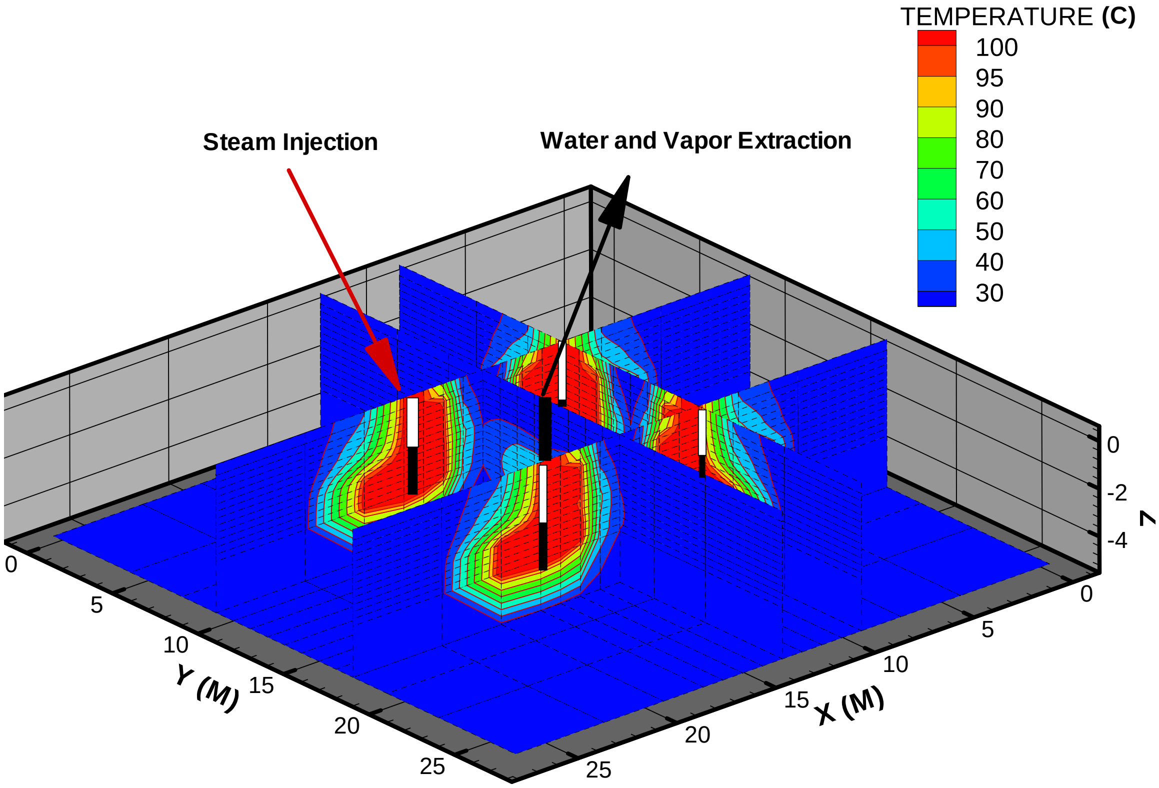

Figure 4a: Case 4, Temperatures After 10 Days of Steam Flushing

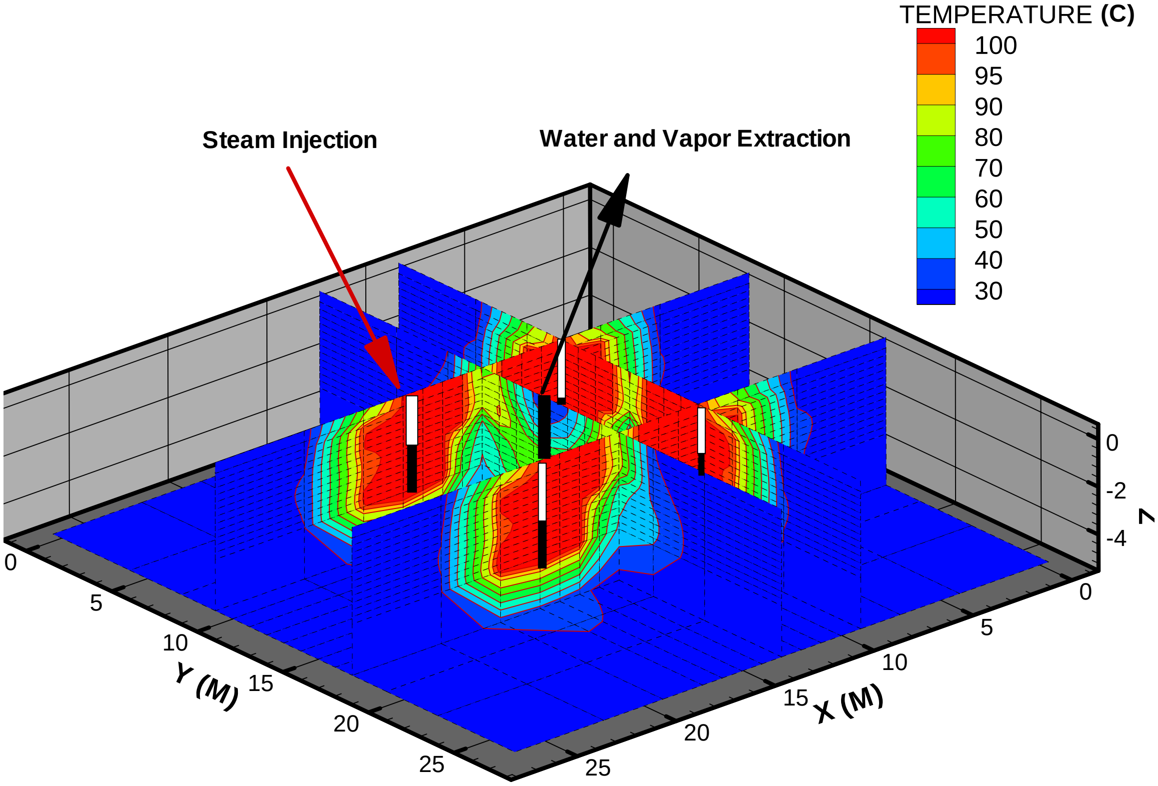

Figure 4b: Case 4, Temperatures After 20 Days of Steam Flushing

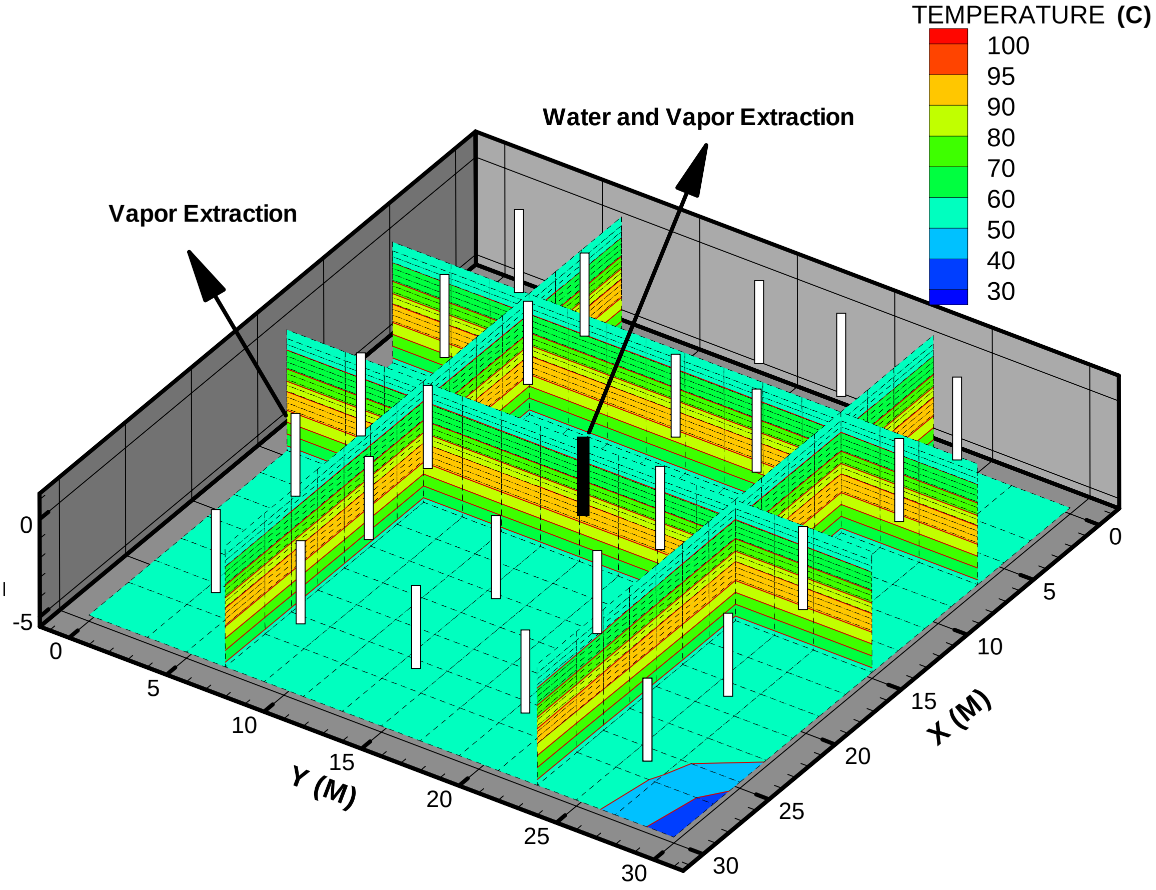

Figure 5a: Case 5, Temperatures After 100 Days of Electrical Resistance Heating

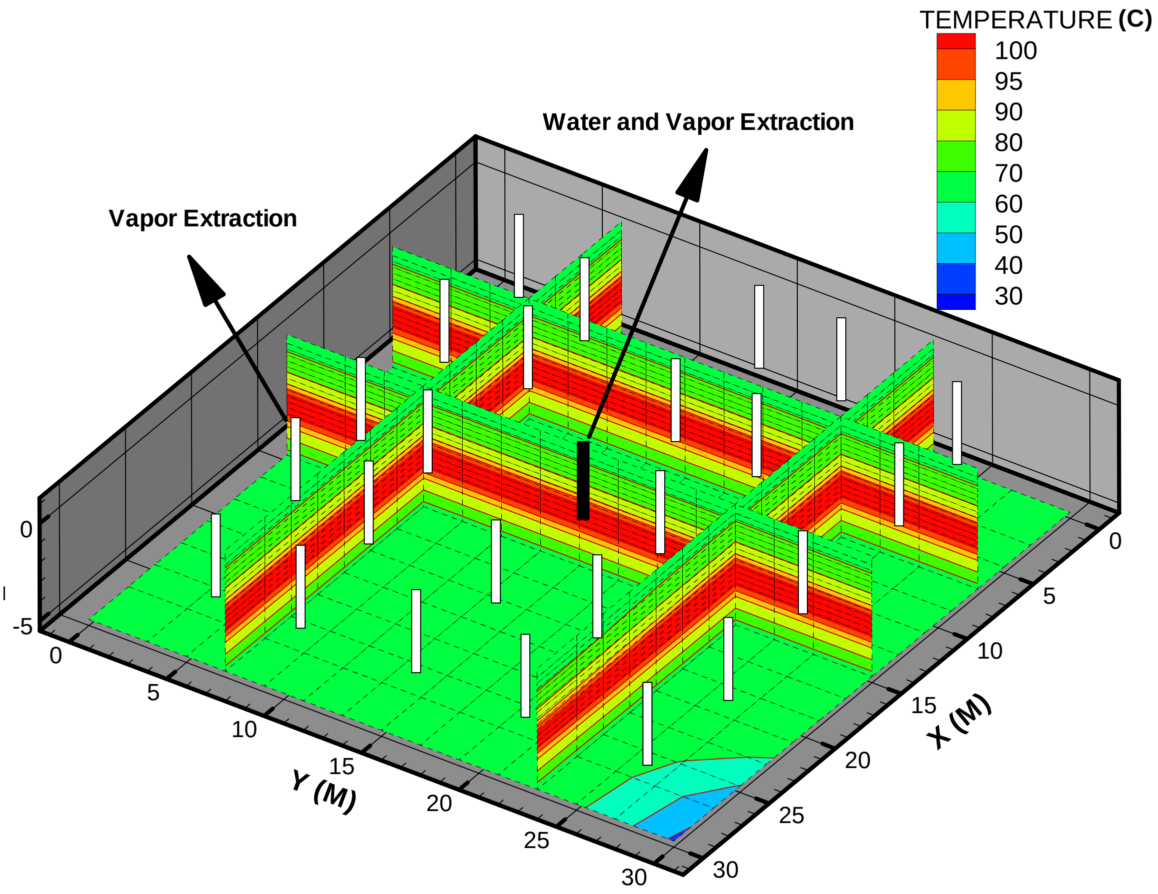

Figure 5b: Case 5, Temperatures After 120 Days of Electrical Resistance Heating

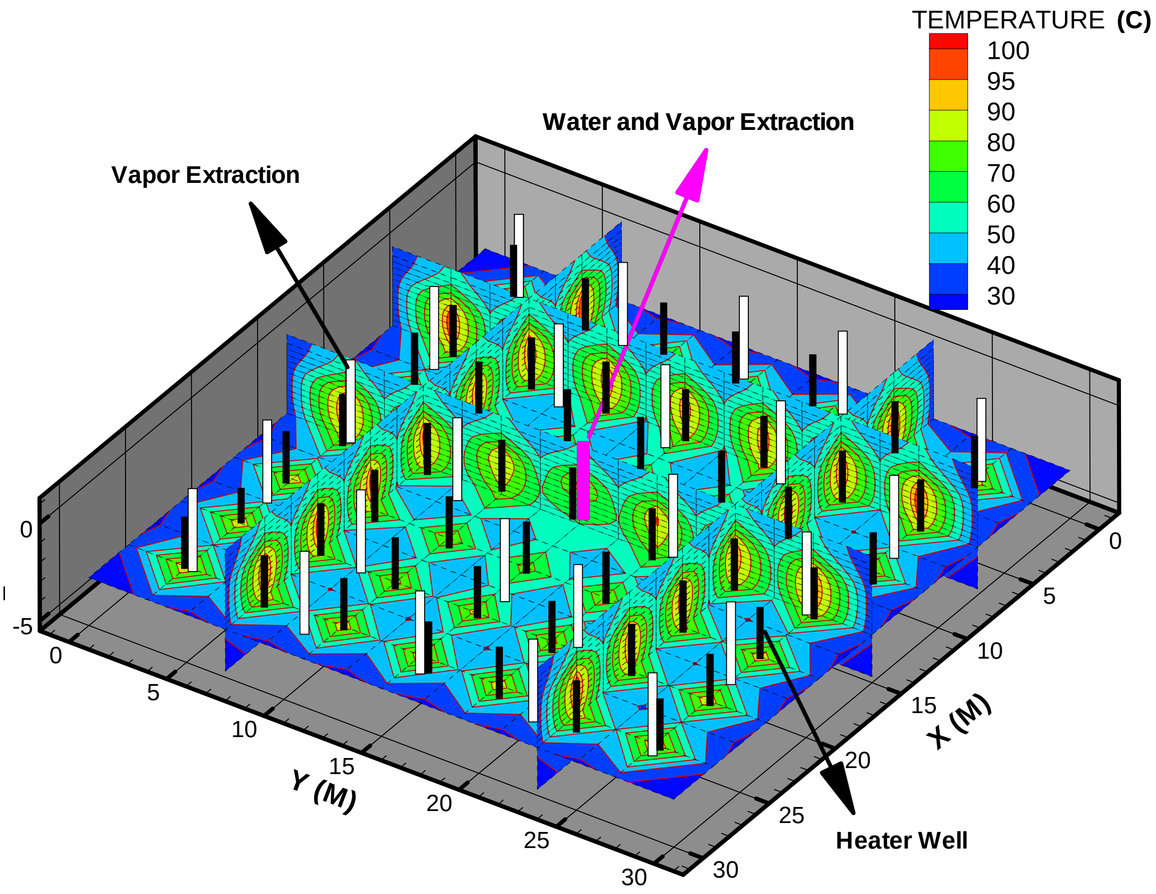

Figure 6a: Case 6, Temperatures After 50 Days of Conductive Heating

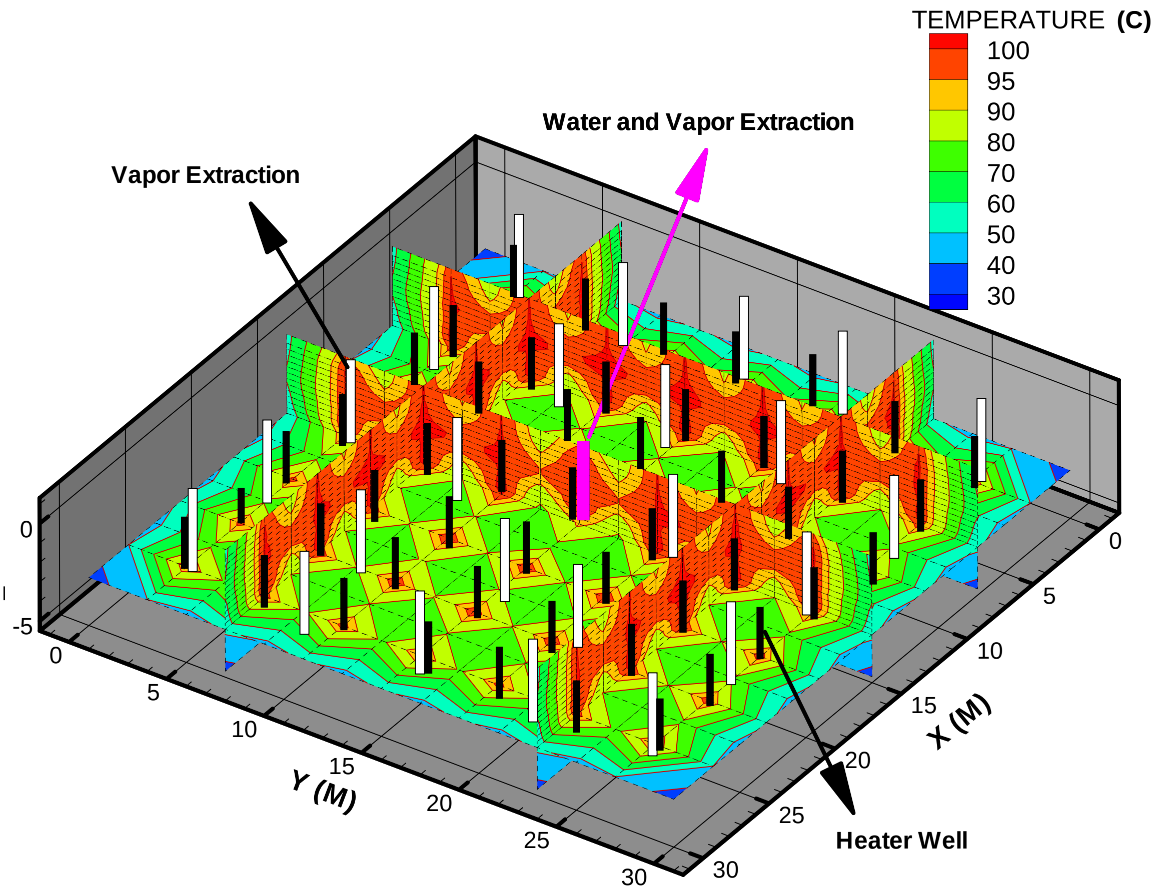

Figure 6b: Case 6, Temperatures After 100 Days of Conductive Heating

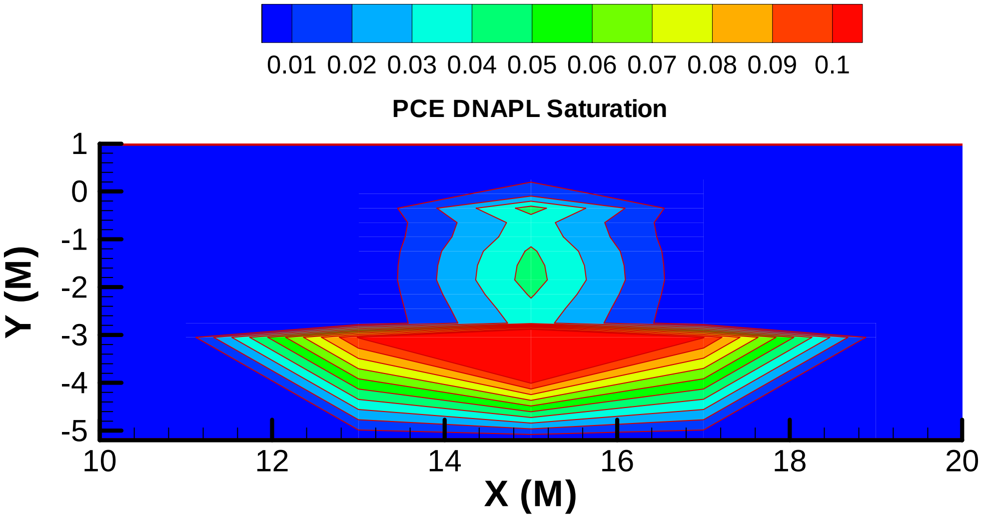

Figure 7a: Case 7, Initial PCE DNAPL Saturations Before Heating

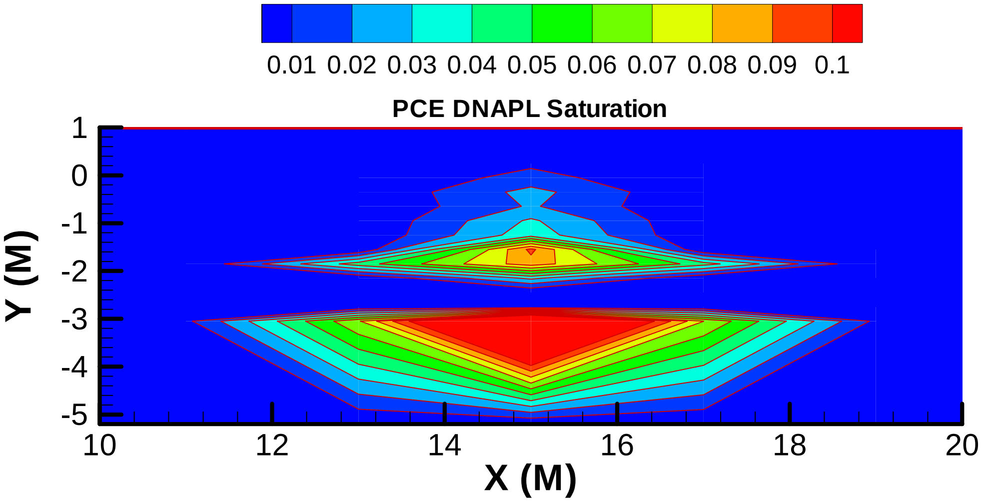

Figure 7b: Case 7, PCE DNAPL Saturations After 122 Days of Electrical Resistance Heating

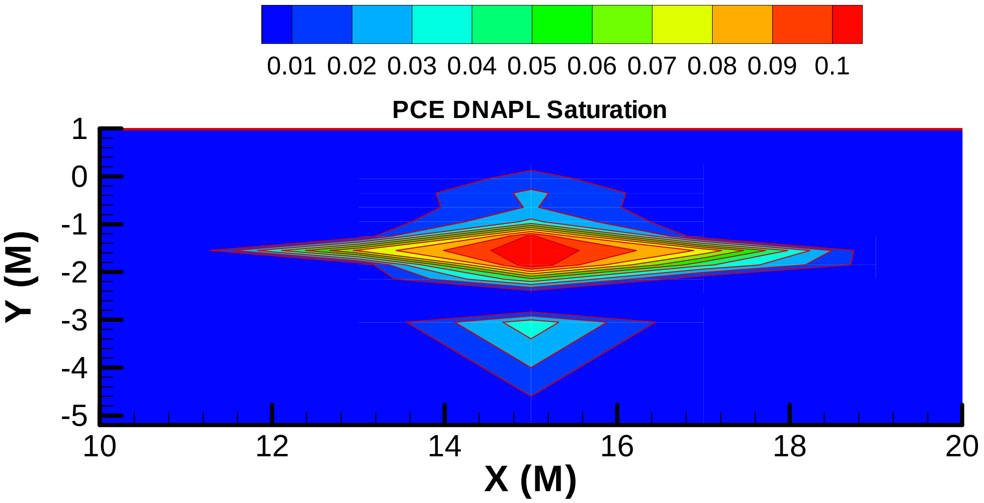

Figure 7c: Case 7, PCE DNAPL Saturations After 134 Days of Electrical Resistance Heating

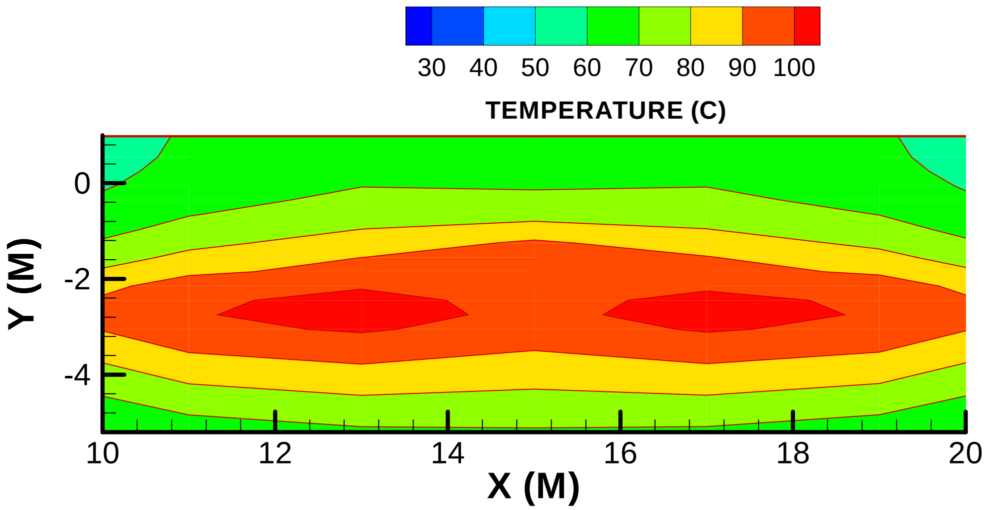

Figure 7d: Case 7, Temperatures After 134 Days of Electrical Resistance Heating

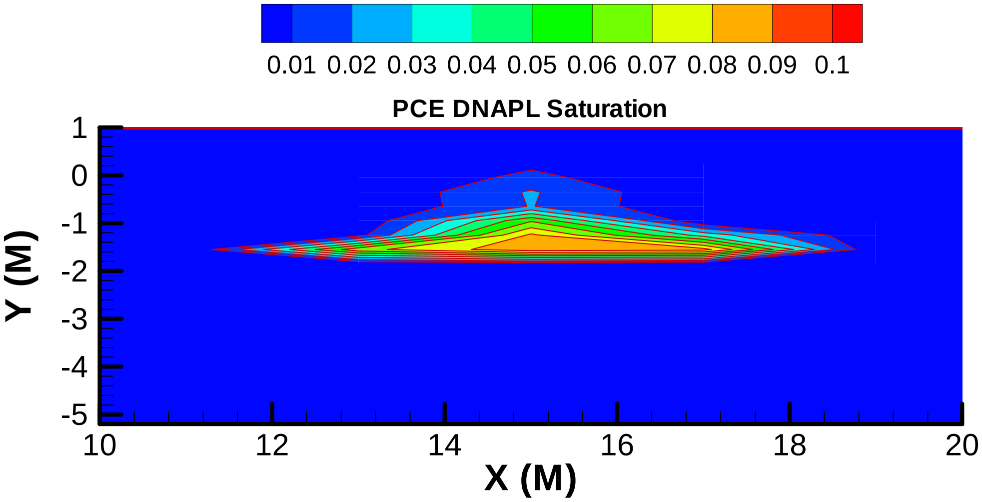

Figure 7e: Case 7, PCE DNAPL Saturations After 145 Days of Electrical Resistance Heating

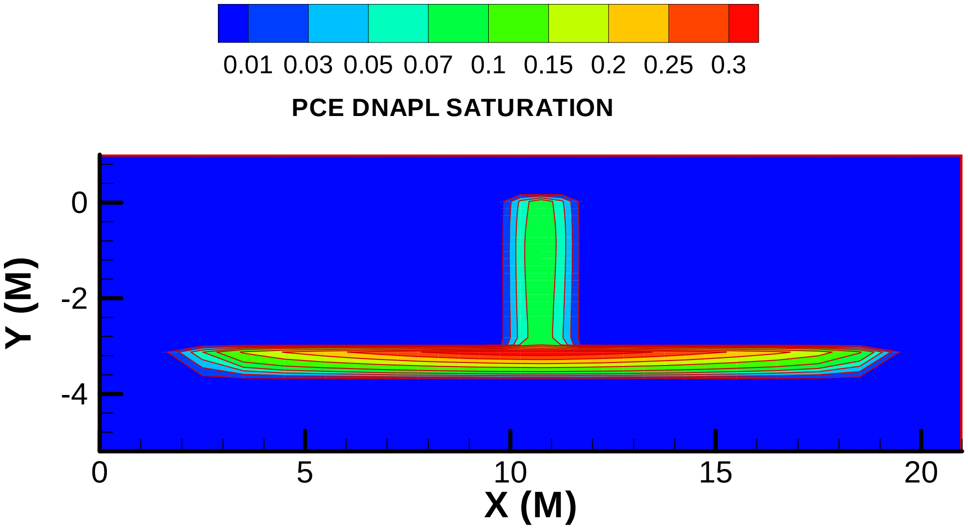

Figure 8a: Case 8, PCE DNAPL Saturations Before Conductive Heating

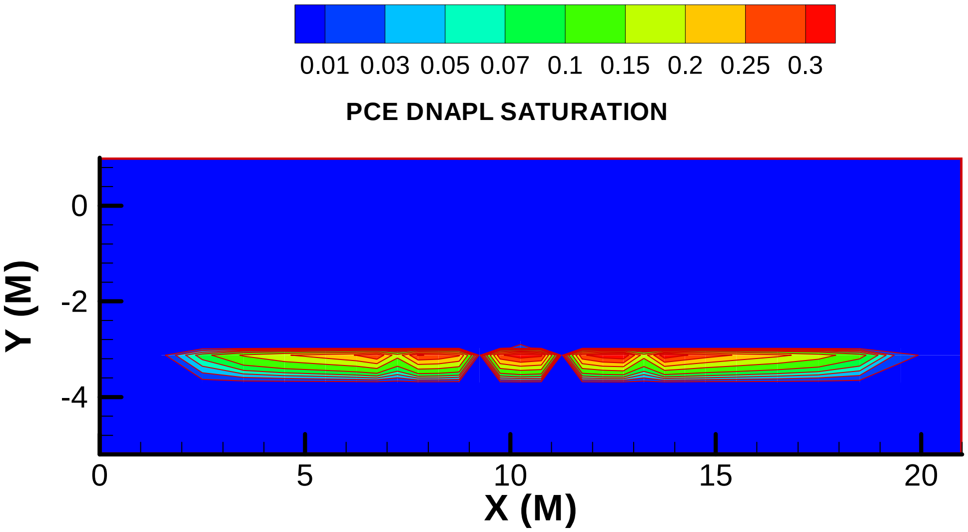

Figure 8b: Case 8, PCE DNAPL Saturations After 100 Days of Conductive Heating

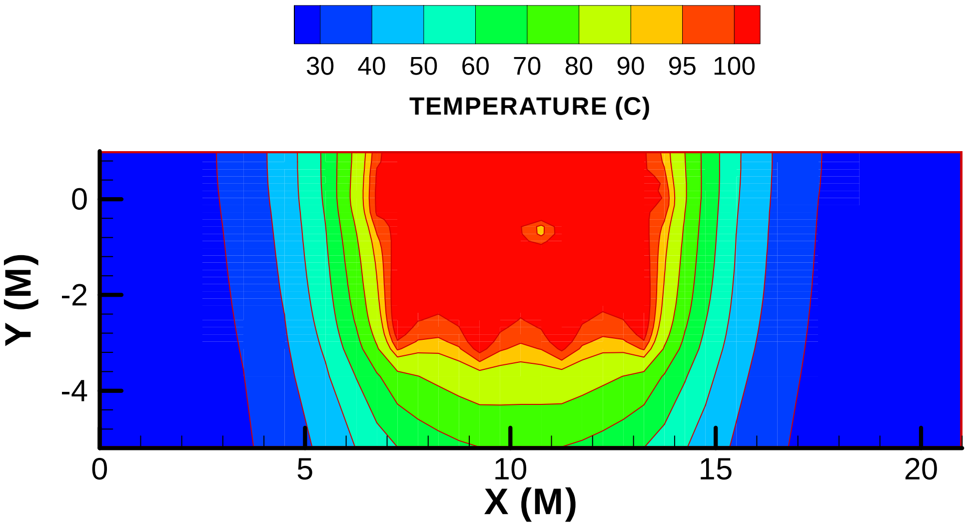

Figure 8c: Case 8, Temperatures After 100 Days of Conductive Heating

M.I. HOLZMAN
& ASSOCIATES, LLC

Environmental Engineering ■ Impact Assessment ■ Compliance Services

March 28, 2005

Haley & Aldrich
200 Town Centre Drive
Suite 2
Rochester, NY 14623-4264
Attn.: Denis Conley

Privileged and Confidential

Re: Identification and Evaluation of ARARs – Air Quality / Air Pollution Control SRSNE Superfund Site

Dear Mr. Conley:

Pursuant to your request, I have identified and evaluated applicable or relevant and appropriate requirements (ARARs), focusing on air quality or air pollution control requirements, that would potentially be applicable to the in-situ thermal desorption (ISTD) process being proposed by TerraTherm, Inc. for remediation of the Solvent Recovery Systems of New England (SRSNE) superfund site in Southington, CT. Table 1 of this letter summarizes the identified air quality ARARs and evaluates the potential for compliance of the ISTD process with the ARARs. ARARs were identified using the process utilized by EPA for CERCLA remedial actions. Although on-site response actions under CERCLA are exempted from administrative permit requirements, CERCLA remedial actions must be completed in such a manner as to achieve a level or standard of control which attains each legally applicable or relevant and appropriate standard, requirement, criterion, or limitation.

Assumptions

The identification and evaluation of air quality ARARs were based on the following design/operating assumptions and calculations provided by you or TerraTherm:

- The proposed remediation of SRSNE will be a CERCLA remedial action.
- The air pollution control system for the ISTD process, as described by TerraTherm, will consist of a non-contact quench/condenser, thermal oxidizer fueled with natural gas, sodium hydroxide-based acid gas scrubber, and activated carbon adsorber. The volumetric flow rate at the inlet of the air pollution control system is estimated at approximately 2,000 standard cubic feet per minute (scfm). The final exhaust stack will be less than 20 meter (m) in height, have a final volumetric rate of approximately 2,500 acfm, a temperature less than 100°F, and be located at least 50 feet from the nearest property line.
- Calculations estimating the composition and mass loading at the inlet and outlet of the air pollution control system are presented in Table 2 for a total 1,000,000 pounds total mass to be treated and in Table 3 for a total 2,000,000 pounds total mass. Outlet

emissions have been evaluated assuming a minimum 99.6% overall control for the 1,000,000 pounds total mass case (Table 2). As shown in Table 3, for the 2,000,000 pounds total mass case, a minimum 99.8% control efficiency is required to demonstrate compliance with CTDEP hazardous air pollutant regulations.

Identification and Evaluation of ARARs

Table 1 summarizes the results of my identification and evaluation of air quality ARARs for the proposed ISTD process at SRSNE. The table includes the regulatory level (Federal or State of CT), title and citation of the ARAR and whether it is relevant and appropriate or an applicable requirement. A synopsis of each of the identified ARAR is given and the results of the compliance evaluations are summarized. Based upon my review of the proposed ISTD process and the assumptions listed above, I believe compliance with each ARAR can be demonstrated.

Please feel free to contact me with any questions you may have on this evaluation.

Sincerely,

M.I. HOLZMAN & ASSOCIATES, LLC

Michael I. Holzman
President

Table 1
SRSNE Superfund Site

Evaluation of Air Quality ARARs – ISTD Alternative

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ ARAR?
Action-Specific	Federal	RCRA Air Emission Standards for Process Vents	40 CFR 264 Subpart AA	Relevant and Appropriate if threshold concentrations are met	▪ Standards for air emissions from process vents associated with treatment of hazardous wastes with organic concentrations of at least 10 ppmw. ▪ Total organic emissions from process vents at the facility must be reduced below 3 lb/hr and 3.1 TPY or reduced by 95%. ▪ Emissions or emissions reductions must be determined from engineering calculations or performance tests. ▪ A vapor incinerator shall be designed and operated to reduce organic emissions by 95% or greater; to achieve a total organic compound concentration of 20 ppmv @ 3% O_2; **or** to provide a minimum 0.5 seconds residence time at a minimum temperature of 760°C. ▪ The control device shall include monitoring of vent stream flow rate. ▪ The vapor incinerator shall be monitored for temperature w/ a continuous recorder. ▪ The carbon adsorber that is not regenerated on-site shall be monitored for the concentration of organic compounds in the	The proposed air pollution control system (APC) consisting of quench, thermal oxidizer, acid gas scrubber and carbon adsorption as described by TerraTherm will comply with the emissions reduction and design standards. Monitoring systems and operating procedures must be implemented to comply with relevant and appropriate requirements.	Y

Table 1 (Continued)
SRSNE Superfund Site

Evaluation of Air Quality ARARs – ISTD Alternative

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ ARAR?
					exhaust **or** the carbon should be replaced with fresh carbon at a regular, predetermined interval. ▪ Performance testing of emissions reduction or emission rates must be performed.		
Action-Specific	Federal	RCRA Air Emission Standards for Equipment Leaks	30 CFR 264 Subpart BB	Relevant and Appropriate if treatment involves groundwater with organic concentrations of at least 10% by weight.	Standards for air emissions for equipment that contains or contacts hazardous substances with organic concentrations of a least 10% by weight. Equipment that is in "Vacuum service" (> 5 kPa or 20 inch water column below ambient pressure) is excluded from requirements of these regulations, except for testing, recordkeeping and reporting requirements. Equipment not in vacuum service, such as pumps, compressors, pressure relief devices, sampling connection systems, valves, etc. must be periodically monitored and inspected for leaks.	▪ The ISTD with APC system must be designed to operate in "vacuum service" to be exempt from these standards. ▪ Equipment that can not be maintained at greater than 20 in. w.c. vacuum must meet applicable standards, which generally include periodic monitoring and inspections for leaks.	Y
Action-Specific	State of CT	Permit to Construct and Operate Stationary Sources	RCSA §22a-174-3a	Applicable	This section identifies sources subject to permits to construct and operate as well as requirements for evaluating air quality impacts, Best Available Control Technology (BACT), Prevention of Significant Deterioration (PSD), non-attainment New Source Review (NSR) and major sources of hazardous air pollutants (HAPs).	▪ Stripping facilities used to remove VOCs from contaminated groundwater or soil pursuant to an order by the commissioner are exempt from air permitting as long as the facility has a VOC control device with at least 95% removal	Y

Evaluation of Air Quality ARARs – ISTD Alternative

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ ARAR?
						efficiency. The control efficiency will exceed 95%. ▪ The proposed control system, consisting of quench, oxidizer, acid gas scrubber and carbon adsorption will exceed BACT criteria. ▪ Potential emissions after control (see Tables 2 and 3) are estimated to be less than major source thresholds. Therefore, PSD and non-attainment NSR requirements would not apply and the facility would not be considered a major source of HAPs.	
Action Specific	State of CT	Source Monitoring, Recordkeeping, Reporting	RCSA §22a-174-4	Applicable	This section identifies sources required to install continuous opacity monitors and gives the commissioner the discretion to determine if opacity or gaseous CEM equipment is reasonably available, technically feasible, economically feasible and necessary to evaluate compliance with chapter 446c of the Connecticut General Statutes and regulations promulgated thereunder.	▪ Continuous opacity monitoring is not required because the facility will not include any of the listed equipment categories. ▪ Gaseous CEMS are not required, but commissioner has discretion to require them. Parameter monitoring, such as oxidizer temperature and acid gas scrubber pressure drop are	Y

Table 1 (Continued)
SRSNE Superfund Site

Evaluation of Air Quality ARARs – ISTD Alternative

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ ARAR?
						typically used in lieu of CEMs for remediation APC systems.	
Action Specific	State of CT	Methods for sampling, emission testing, sample analysis and reporting	RCSA §22a-174-5	Applicable	Any sampling and/or emissions testing program must be performed in accordance with the methods specified or referenced in this section.	Sampling and emissions testing must be performed in accordance with required methods.	Y
Action Specific	State of CT	Air Pollution Emergency Episode Procedures	RCSA §22a-174-6	Not Applicable	Requires major sources to implement emergency shutdown procedures.	The facility will not have the potential to emit more than 100 TPY of any pollutant and is, therefore, not subject to this regulation.	NA
Action Specific	State of CT	Air pollution control equipment and monitoring equipment operation	RCSA §22a-174-7	Applicable	This section requires continuous operation of air pollution control and monitoring equipment and notification of any breakdowns, failure or deliberate shutdowns.	Appropriate management procedures must be implemented to comply with these requirements.	Y
Action Specific	State of CT	Compliance plans and schedules	RCSA §22a-174-8	Applicable	All new sources must comply with all regulations as of startup of operations.	Appropriate management procedures must be implemented to comply with these requirements.	Y
Action Specific	State of CT	Control of particulate matter and visible emissions	RCSA §22a-174-18	Applicable	▪ Any source of air pollution is subject to the visible emission standards in § 22a-174-18(b): 20% opacity within any 6-minute block average and 40% in any 1-minute block average (as determined by visual opacity observation – EPA Reference Method 9). ▪ § 22a-174-18(c) requires reasonable precautions to control airborne and fugitive	▪ Opacity observations must be used, as necessary to verify compliance with visible emission standards. ▪ Dust control measures must be implemented to comply with fugitive emissions requirements. ▪ Estimated particulate matter emissions, based	Y

Table 1 (Continued)
SRSNE Superfund Site

Evaluation of Air Quality ARARs – ISTD Alternative

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ ARAR?
					particulate matter from material transfer or construction activities. ▪ § 22a-174-18(d) requires incinerators to meet a 0.08 grains/dscf @ 12% CO_2 emission standard and unburned waste or ash particulate emissions must not be individually discernible by the human eye. ▪ § 22a-174-18(e) requires fuel burners in the oxidizer to meet the more stringent of a 0.1 lb/MMBtu emission standard or other applicable limitation.	on typical emissions factors, are expected to comply with applicable standards. If necessary, emissions testing will be performed to verify compliance.	
Action Specific	State of CT	Control of sulfur compound emissions	RCSA §22a-174-19	Applicable	Requires fuel users to combust fuel with less than 1% sulfur content.	Natural gas fuel to be used in oxidizer will contain significantly less than 1% sulfur.	Y
Action Specific	State of CT	Control of organic compound emissions	RCSA §22a-174-20	Applicable	▪ § 22a-174-20(f) requires any equipment with organics coming into contact with flame be limited to less than 8 lb/hr or 40 lb/day unless the discharge is reduced by 85% overall. ▪ § 22a-174-20(j) prohibits disposal of VOC solvents by evaporation.	▪ The APC system control efficiency must exceed 85%. ▪ Evaporated solvents must not be emitted to the atmosphere without at least 99% control.	Y
Action Specific	State of CT	Control of nitrogen oxides emissions	RCSA §22a-174-22, -22a, -22b	Not Applicable	These sections contain emissions standards, monitoring and recordkeeping requirements applicable to major sources of	The proposed facility will not be a major source of nitrogen oxides or a NO_X Budget Source.	NA

Table 1 (Continued)
SRSNE Superfund Site

Evaluation of Air Quality ARARs – ISTD Alternative

ARAR Category	Regulatory Level	Requirement	Citation	Status	Synopsis	Evaluation	Comply w/ ARAR?
					nitrogen oxides and NO_X Budget Sources.		
Action Specific	State of CT	Control of odors	RCSA §22a-174-23	Applicable	No person shall cause or permit the emission of any substance or combination of substances which creates or contributes to an odor, in the ambient air, that constitutes a nuisance.	The proposed facility's APC system must provide high-efficiency removal of potentially odorous compounds.	Y
Action Specific	State of CT	Hazardous Air Pollutants	RCSA §22a-174-29	Applicable	Requires compliance with Maximum Allowable Stack Concentrations (MASCs)	Compliance demonstration calculations summarized in Tables 2 and 3. For 1,000,000 lbs. total mass to be treated, 99.6% overall control is required to meet all MASCs. For 2,000,000 lbs. total mass to be treated, 99.8% overall control is required to meet all MASCs.	Y
Action Specific	State of CT	Reasonably Available Control Technology (RACT) for Volatile Organic Compounds	RCSA §22a-174-32	Not Applicable	VOC control requirements applicable to premises that are major stationary sources of VOCs.	The facility with proposed VOC controls will not be a major stationary source of VOCs.	NA
Action Specific	State of CT	Title V Sources	RCSA §22a-174-33	Not Applicable	Requirement to obtain a Title V Operating permit for major stationary sources.	The facility with proposed controls will not be a major stationary source for any pollutant.	NA

Table 2
Demonstration of Compliance With CTDEP Hazardous Air Pollutant Regulations (RCSA 22a-174-29)
Case 1: 1,000,000 lbs. Total Mass

Alternate Units:

6.1 = Stack Height (m)
15.2 = Property Line (m)
15.2 = Xmax (m)
1.18 = V_O, flow (acm/s)

20 = Stack Height (ft)
50 = Property Line (ft)
2,500 = Flow (acfm)

59.14 = unitless MASC

1,000,000 = total mass (lbs.)

DRE(%) = 99.6

Pollutant	Average Composition	Max. APC Inlet Loading @ 1 MM lb. Total Mass (lb/hr)[1]	Max. APC Inlet Loading @ 1 MM lb. Total Mass (TPY)[2]	Max. Controlled Emissions @99.6% DRE (lb/hr)	Max. Controlled Emissions @99.6% DRE (lb/hr)	HLV (µg/m^3)[3]	MASC (µg/m^3)[3]	ASC (µg/m^3)[3]	ASC < MASC?
Vinyl Chloride	1.4%	5.78	6.94	0.023	0.028	50	3.0E+03	2.5E+03	Yes
1,1-Dichloroethylene	0.1%	0.53	0.64	0.002	0.003	15800	9.3E+05	2.3E+02	Yes
Methylene Chloride	0.2%	0.65	0.78	0.003	0.003	7000	4.1E+05	2.8E+02	Yes
1,1-Dichloroethane	0.6%	2.60	3.12	0.010	0.012	8000	4.7E+05	1.1E+03	Yes
cis-1,2-Dichloroethylene	8.7%	36.24	43.49	0.145	0.174	15800	9.3E+05	1.5E+04	Yes
Chloroform	0.0%	0.01	0.01	0.0000	0.0000	250	1.5E+04	3.4E+00	Yes
2-Butanone	0.3%	1.10	1.32	0.004	0.005	11800	7.0E+05	4.7E+02	Yes
1,1,1-Trichloroethane	6.8%	28.20	33.84	0.113	0.135	38000	2.2E+06	1.2E+04	Yes
Benzene	0.02%	0.10	0.12	0.000	0.000	150	8.9E+03	4.2E+01	Yes
1,2-Dichloroethane	0.0%	0.0012	0.0014	0.00000	0.00001	20	1.2E+03	5.2E-01	Yes
Trichloroethylene	43.4%	180.88	217.06	0.724	0.868	1350	8.0E+04	7.7E+04	Yes
4-Methyl-2-pentanone (MIBK)	0.4%	1.72	2.07	0.007	0.008	4000	2.4E+05	7.4E+02	Yes
2-Hexanone	0.00%	0.00	0.00	0.000	0.000	400	2.4E+04	0.0E+00	Yes
Toluene	15.0%	62.35	74.83	0.249	0.299	7500	4.4E+05	2.7E+04	Yes
1,1,2-Trichloroethane	0.0002%	0.0008	0.0009	0.000	0.000	225	1.3E+04	3.3E-01	Yes
Tetrachloroethylene	13.2%	55.04	66.04	0.220	0.264	1700	1.0E+05	2.4E+04	Yes
Ethylbenzene	2.9%	12.09	14.51	0.048	0.058	8700	5.1E+05	5.2E+03	Yes
P/M Xylenes	5.1%	21.37	25.65	0.085	0.103	8680	5.1E+05	9.1E+03	Yes
O Xylene	2.0%	8.51	10.21	0.034	0.041	8680	5.1E+05	3.6E+03	Yes
Styrene	0.2%	0.94	1.13	0.004	0.005	4300	2.5E+05	4.0E+02	Yes
TOTAL VOCs	100%	418.13	501.76	1.67	2.01				

Notes:

1. Maximum estimted value, based on total mass of VOCs and 30% of total mass removed between days 61 and 90.

2. Assumes total mass removed in less than 1 year.

3. HLV = Hazard Limiting Value, per RCSA 22a-174-29, 8-hr average concentration
MASC = Maximum Allowable Stack Concentration, calculated per RCSA 22a-174-29, 8-hr. average concentration
ASC = Actual Stack Concentration

Table 3
Demonstration of Compliance With CTDEP Hazardous Air Pollutant Regulations (RCSA 22a-174-29)
Case 1: 2,000,000 lbs. Total Mass

Alternate Units:

6.1 = Stack Height (m) — 20 = Stack Height (ft)
15.2 = Property Line (m) — 50 = Property Line (ft)
15.2 = Xmax (m)
1.18 = V_O, flow (acm/s) — 2,500 = Flow (acfm)

59.14 = unitless MASC

2,000,000 = total mass (lbs.) — DRE(%) = 99.8

Pollutant	Average Composition	Max. APC Inlet Loading @ 2 MM lb. Total Mass (lb/hr)[1]	Max. APC Inlet Loading @ 2 MM lb. Total Mass (TPY)[2]	Max. Controlled Emissions @99.8% DRE (lb/hr)	Max. Controlled Emissions @99.8% DRE (lb/hr)	HLV (µg/m^3)[3]	MASC (µg/m^3)[3]	ASC (µg/m^3)[3]	ASC < MASC?
Vinyl Chloride	1.4%	11.56	13.88	0.023	0.028	50	3.0E+03	2.5E+03	Yes
1,1-Dichloroethylene	0.1%	1.06	1.27	0.002	0.003	15800	9.3E+05	2.3E+02	Yes
Methylene Chloride	0.2%	1.31	1.57	0.003	0.003	7000	4.1E+05	2.8E+02	Yes
1,1-Dichloroethane	0.6%	5.20	6.24	0.010	0.012	8000	4.7E+05	1.1E+03	Yes
cis-1,2-Dichloroethylene	8.7%	72.48	86.98	0.145	0.174	15800	9.3E+05	1.5E+04	Yes
Chloroform	0.0%	0.02	0.02	0.0000	0.0000	250	1.5E+04	3.4E+00	Yes
2-Butanone	0.3%	2.21	2.65	0.004	0.005	11800	7.0E+05	4.7E+02	Yes
1,1,1-Trichloroethane	6.8%	56.41	67.69	0.113	0.135	38000	2.2E+06	1.2E+04	Yes
Benzene	0.02%	0.20	0.24	0.000	0.000	150	8.9E+03	4.2E+01	Yes
1,2-Dichloroethane	0.0%	0.0024	0.0029	0.000	0.000	20	1.2E+03	5.2E-01	Yes
Trichloroethylene	43.4%	361.77	434.12	0.724	0.868	1350	8.0E+04	7.7E+04	Yes
4-Methyl-2-pentanone (MIBK)	0.4%	3.45	4.14	0.007	0.008	4000	2.4E+05	7.4E+02	Yes
2-Hexanone	0.00%	0.00	0.00	0.00	0.00	400	2.4E+04	0.0E+00	Yes
Toluene	15.0%	124.71	149.65	0.249	0.299	7500	4.4E+05	2.7E+04	Yes
1,1,2-Trichloroethane	0.0002%	0.0016	0.0019	0.00000	0.00000	225	1.3E+04	3.3E-01	Yes
Tetrachloroethylene	13.2%	110.07	132.09	0.220	0.264	1700	1.0E+05	2.4E+04	Yes
Ethylbenzene	2.9%	24.18	29.01	0.048	0.058	8700	5.1E+05	5.2E+03	Yes
P/M Xylenes	5.1%	42.74	51.29	0.085	0.103	8680	5.1E+05	9.1E+03	Yes
O Xylene	2.0%	17.02	20.42	0.034	0.041	8680	5.1E+05	3.6E+03	Yes
Styrene	0.2%	1.88	2.26	0.004	0.005	4300	2.5E+05	4.0E+02	Yes
TOTAL VOCs	100%	836.27	1003.52	1.67	2.01				

Notes:

1. Maximum estimted value, based on total mass of VOCs and 30% of total mass removed between days 61 and 90.

2. Assumes total mass removed in less than 1 year.

3. HLV = Hazard Limiting Value, per RCSA 22a-174-29, 8-hr average concentration
MASC = Maximum Allowable Stack Concentration, calculated per RCSA 22a-174-29, 8-hr. average concentration
ASC = Actual Stack Concentration, calculated per RCSA 22a-174-29, 8-hr. average concentration

Appendix W

Risks of Vertical Mobilization of DNAPL During Thermal Remediation

Risks of Downward Mobilization of DNAPL During Thermal Remediation

June 21, 2004

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demaximis, inc

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Disclaimer: This document has been prepared pursuant to a government administrative order (U.S. EPA Region 1 CERCLA Docket No. I-97-1000) and has not received final acceptance from the U.S. Environmental Protection Agency. The opinions, findings and conclusions expressed are those of the authors and not those of the U.S. Environmental Protection Agency.

Executive Summary

The application of either steam flooding, electrical resistance heating, or thermal conduction heating is likely to mobilize DNAPL into bedrock beneath the observed NAPL in overburden groundwater unit (ONOGU) at the SRSNE site. Although techniques exist to reduce this risk, they have limited applicability at the SRSNE site because of geological conditions and the extensive distribution of DNAPL within the target zone. In particular, the risk of downward DNAPL mobilization is high because (i) laterally continuous capillary barriers with sufficient entry pressure do not exist at the base of overburden, (ii) DNAPL is located immediately above bedrock, so that creation of a 'hot floor' below the DNAPL would require extensive placement of heater wells in the bedrock, (iii) the DNAPL in overburden has a relatively low interfacial tension (3.1 dynes/cm – 7.3 dynes/cm), and (iv) the DNAPL would be continuously distributed between injection/withdrawal wells and heater/vacuum wells. The feasibility of creation of a hot floor in rock at a DNAPL site has not been demonstrated at any site.

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1.0 - Introduction

A variety of thermal technologies are available in the marketplace to remove mass from NAPL source zones. Thermal technologies suited for mass removal at NAPL sites include steam flooding, thermal conduction heating (in situ thermal desorption), electrical resistance heating (three or six phase), radio frequency heating, microwave heating, in-situ vitrification, and hot water flushing. A number of these technologies were originally developed in the petroleum industry as a means of improving oil recovery from petroleum reservoirs. Steam injection, for example, was originally employed as a tertiary petroleum recovery technique in the early 1900's (White and Moss, 1983). More recently, electrical heating has been used for the recovery of heavy oil (Butler, 1991). In the last 15 -20 years, applications of thermal technologies to address NAPL contamination of groundwater have been investigated through laboratory studies, field studies, and numerical modeling (e.g., Hunt et al, 1988; Stewart and Udell, 1988; Falta et al, 1992; Sleep and Ma, 1997; She and Sleep, 1999; Kaslusky and Udell, 2002; Schmidt et al., 2002).

Thermal technologies have the potential to remove significant amounts of mass from NAPL source zones, but the mechanisms are complex involving interplay between fluid flow, heat transfer, phase change, and significant changes in fluid properties. Failure to properly consider the implications of these processes in a given hydrogeological setting can lead to failure of the technology. At sites where DNAPL is known to be present in the target zone, one of the most significant risks is downward mobilization of DNAPL, leading to increased groundwater contamination (She and Sleep, 1998; She and Sleep, 1999; Kaslusky and Udell, 2002; Schmidt et al, 2002).

The purpose of this paper is to provide background on the risks of downward remobilization of DNAPL during implementation of thermal technologies, with specific consideration given to the SRSNE site located in Southington, CT. The mechanisms involved with thermal technologies are briefly reviewed, and the conditions which may lead to downward remobilization are discussed. These risks are then discussed with respect to the SRSNE site. Focus is given to technologies that involve the injection and/or creation of steam in the subsurface (i.e., steam flooding, electrical resistance heating, thermal conduction heating).

2.0 - Mechanisms of Downward Mobilization of DNAPL by Thermal Technologies

Steam that is injected or created (through heating) in the subsurface will have a tendency to condense, giving up latent heat to the surrounding soil and fluids. This will raise the subsurface temperature in the vicinity of the steam injection and/or creation point. With continued steam injection or heating, subsurface temperatures will reach the boiling point of the subsurface fluids and a steam zone will form. This steam zone will expand outwards and upwards (see Figure 1) due to pressure gradients created by steam injection and expansion due to fluid vaporization (Hunt et al, 1988). Extraction wells need to be employed to capture the hot fluids and vapors that are created. In the case of steam injection and formation below the watertable, wells also need to be installed to pump water to capture heated fluids and promote horizontal expansion of the steam zone.

Both water and DNAPL that are volatilized within the steam zone will accumulate at the boundary of the expanding steam zone and condense due to contact with cooler fluids and soil at the steam zone boundary (see Figure 1). As the steam zone continues to expand through regions containing DNAPL, DNAPL will continue to accumulate in a bank at the leading edge of the steam zone. This leads to an increase in the DNAPL saturation in the DNAPL bank and an increase in capillary pressure at the base of the bank. Thus, even if the DNAPL was initially at residual saturation, a bank of mobile DNAPL may be created that has DNAPL saturations above the residual level. This DNAPL may then begin to move vertically downwards due to gravitational effects. This was illustrated very clearly in the laboratory tests of Schmidt et al (2002), the theoretical analysis by Kaslusky and Udell (2002), and is supported by the work of She and Sleep (1999).

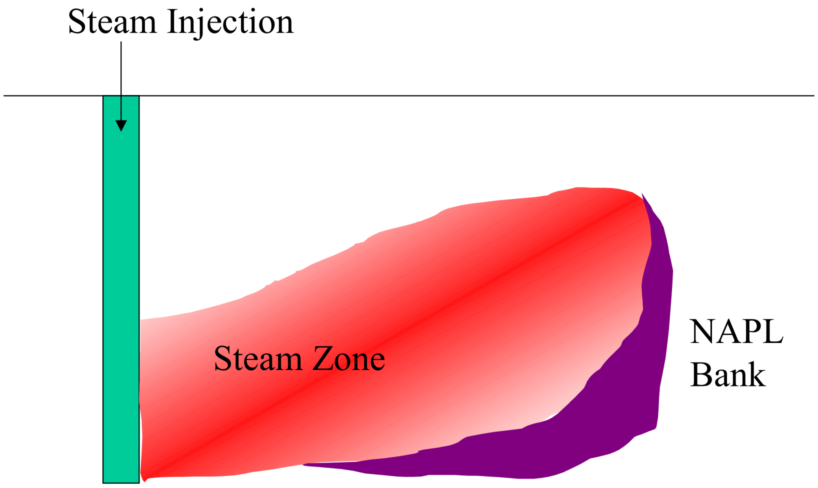

Figure 1: Steam zone expansion and DNAPL bank formation

When thermal technologies that inject or create steam are applied to sites having DNAPLs with much lower vapor pressures than water, water will be removed more rapidly than the organic, changing a two-phase DNAPL-water region to a three-phase DNAPL-water-gas region. In this situation, DNAPL is the wetting phase with respect to the gas phase. Therefore, fine grained layers which start to desaturate with respect to water will no longer act as capillary barriers to downward DNAPL movement (She and Sleep, 1999). This would not be a significant concern for DNAPLs such as TCE and PCE as these would likely be removed as rapidly as water by an advancing steam front.

In addition to changes in DNAPL mobility related to saturation changes, heating also increases the potential mobility of DNAPL through decreases in viscosity and interfacial tension with increasing temperature. Sleep and Ma (1997) found that PCE-water interfacial tension decreased about 10% as the temperature increased from 20 to 90 C. She and Sleep (1998) found that entry pressures decreased by about 50% as the temperature was raised from 20 to 80 C. Thus, DNAPL perched on fine-grained layers that are capillary barriers to downward DNAPL movement at ambient temperatures, may cease to be capillary barriers when temperatures are increased during application of thermal technologies. This is of particular concern in electrical resistance heating, and thermal conduction heating, where the heating raises temperatures substantially, but takes several weeks to reach boiling temperatures and the beginning of DNAPL volatilization and removal. With steam flooding, areas just beyond the steam zone may have raised temperatures due to heat conduction, but may not reach steam temperatures. This could occur in the case of steam flooding above low permeability layers, for example, as the steam would not likely flow through the low permeability layer, but the layer would be heated by conduction from the steam zone above.

The risk of downward mobilization of DNAPL by steam flooding can potentially be reduced by creating a steam zone that extends a significant distance below the bottom of the DNAPL zone, and by using closely spaced injection and extraction wells. This will ensure that the steam front will reach the extraction well before the DNAPL bank moves below the bottom of the steam zone. The tendency of steam to rise (steam override) as it moves away from steam injection well makes it difficult to maintain a deep steam zone, however, particularly in the case of shallow unconfined aquifers where steam may rapidly channel upwards to the vadose zone. It has also been proposed (Kaslusky and Udell, 2002; Schmidt et al, 2002) that co-injection of air can reduce the potential for DNAPL bank formation with steam flooding by providing enough air to prevent DNAPL condensation at the steam front. The specific air to steam ratio is dependent on the initial amount of DNAPL in place, and the volatility of the DNAPL. Higher initial DNAPL saturations require higher air to steam ratios to avoid the formation of a DNAPL bank at the steam front. This technique has only been analyzed for application in simplified systems, and has not been demonstrated in the field. The co-injection of air reduces the rate of heating substantially, and also has the potential to create significant channeling due to the low viscosity of air. It is not clear whether this technique could be applied to thermal conduction heating and electrical resistance heating systems where the steam is created in-situ, as opposed to injected externally.

When DNAPL is distributed as pools on low permeability aquitards or bedrock, heat loss to the underlying low permeability layer will contribute to the difficulty in maintaining a steam zone that extends below the DNAPL zone, particularly if the DNAPL is pooled on the low permeability layer. In DNAPL source zones underlain by low permeability units, it has been proposed that electrical resistance heating or thermal conduction heating be used to produce a hot floor. This may then ensure that DNAPL perched on the low permeability layer, or DNAPL vertically mobilized from higher elevations, will be volatilized and removed before it can breach the underlying low permeability layer. As clays typically have higher electrical conductivities than other soils, electrical resistance heating is well suited to the generation of hot floors at sites underlain by clay aquitards.

Rock typically has lower porosity than unconsolidated materials, and therefore would have a relatively low electrical conductivity compared to saturated soils. Thus, electrical resistance heating would not be expected to be effective in creating a hot floor at a site underlain by low porosity rock. It is possible that thermal conduction heating could be used to create a hot floor at these sites, but this would require placement of thermal conduction heater wells in the bedrock, and would require close heater well spacing, perhaps in the range of 10 ft or less. The use of thermal conduction heating to create hot floors in bedrock has not been implemented in the field and cannot yet be considered proven.

It can take several weeks to reach boiling temperatures with electrical resistance or thermal conduction heating. As temperatures are raised, DNAPL-water interfacial tensions and entry pressures will be reduced, perhaps by as much as 50% before DNAPL volatilization begins (Sleep and Ma, 1997, She and Sleep, 1998). In some cases the DNAPL pool height may be great enough that a reduction in entry pressure of the low permeability layer may allow the DNAPL to penetrate the layer and move downwards.

The downward mobilization of DNAPL in response to implementation of thermal technologies is of particular concern at sites where fractured aquitards or fractured bedrock underlie the source zone. This stems from the fact that small amounts of DNAPL mobilized down from porous media can travel a substantial distance in fractured media. This amplification of travel distance between porous and fractured media stems from the fact that the capacity of fractured media to retain DNAPL is typically orders of magnitude less than that of porous media. As a rule of thumb, the amplification factor is simply the ratio of overburden porosity to bedrock or aquitard fracture porosity.

3.0 - Potential for DNAPL Mobilization by Thermal Technologies at SRSNE

The surficial aquifer at the SRSNE site is shallow (8-15 ft bgs), with an average hydraulic conductivity of approximately 2 x 10^{-3} cm/sec. In some portions of the observed NAPL in overburden groundwater unit (ONOGU), till units with hydraulic conductivities an order of magnitude lower exist immediately above bedrock. In other regions of the ONOGU, a significantly lower permeability till is absent as evidenced by visual observation of the porous media fabric and the fact that residual DNAPL was observed immediately above bedrock in the 2003 soil boring program. DNAPL would not have penetrated to the top of rock if a substantial capillary barrier existed. The DNAPL is composed primarily of PCE, TCE, and toluene, with a specific gravity of 1.1 and a relatively low DNAPL-water interfacial tension that has been measured in overburden DNAPL samples to range from 3.1 to 7. 3 dynes/cm. DNAPL saturation in the surficial aquifer is variable, with some distributed at residual saturation, some as pools perched on basal till units, and some as pools on the bedrock surface. DNAPL is also known to be present in fractures in the bedrock.

Application of steam flooding at SRSNE would likely involve installation of injection and extraction wells screened over an interval that extends to the bedrock surface. Vacuum extraction wells would also likely be installed in the vadose zone to capture rising steam and vapors, and surface sealing would be employed to minimize losses to the atmosphere and enhance capture of vapors by vacuum extraction wells.

Steam injected into the shallow saturated zone at the SRSNE site is very likely to break through to the vadose zone before reaching extraction wells, even with distances between injection and extraction wells as small as 10-12 ft (see steam modeling appendix). This channeling to the vadose zone, and heat losses to the underlying bedrock, will accentuate steam override and therefore the potential for accumulation of condensed DNAPL vapors at the lower leading edge of the steam front as it moves towards extraction wells. The extent of this bank will depend on the initial DNAPL saturation and the initial vertical and horizontal extent of the DNAPL in the zone between injection and extraction wells, and the distance between injection and extraction wells. Spacing between injection and extraction wells is typically 10-20 ft, which is smaller than the typical horizontal extent of DNAPL zones at the SRSNE site (BBL, 2003). Therefore, it is reasonable to assume that the initial DNAPL zone will extend from injection to extraction well. The vertical extent of the DNAPL zone may vary from 2 to 4 ft, and initial DNAPL saturations may vary from 25 to 50% of the pore space (BBL, 2003).

Consider a scenario where a central extraction well is surrounded by steam injection wells, and the DNAPL zone is an aerially extensive cylindrical zone bounded by the injection wells, with the extraction well at the centre. To determine the height of DNAPL bank that may form from accumulation of DNAPL at the steam front, a DNAPL volume balance can be made for the time when the leading edge of the DNAPL bank just reaches the extraction well. With (i) an initial DNAPL saturation of S_i extending from injection wells to the extraction well, (ii) an initial DNAPL zone height of H_i, (iii) an injection-extraction well distance of L, (iv) a DNAPL bank of radius B formed around the extraction well, and (v) a DNAPL bank saturation of S_b, a volume balance leads to the potential height of such a bank (H_b) of:

$$H_b = (S_i/S_b)(L^2/B^2)H_i \qquad (1)$$

If (i) the initial DNAPL saturation is 25%, (ii) the initial DNAPL zone height is 2 ft, (iii) the injection-extraction well spacing is 15 ft, (iv) it is assumed that the DNAPL bank saturation is 50%, and (v) the DNAPL bank radius at arrival at the extraction well is 3 ft, then H_b is 25 ft. A well spacing of 10 ft gives a bank height of 11 ft. A well spacing of 5 ft gives a bank height of approximately 3 ft with a bank radius of 3 ft. However, as well spacing decreases DNAPL bank radius will also decrease, so the potential DNAPL bank height may be greater than 3 ft. Higher initial DNAPL saturations, or thicker initial DNAPL zones, lead to greater potential DNAPL bank heights. Thus, it is reasonable to assume that DNAPL bank height produced by steam flooding at the SRSNE site would extend from the watertable down to any capillary barrier below the initial DNAPL zone.

Whether or not the mobilized DNAPL will breach the capillary barrier will depend on the height of the DNAPL bank above the barrier, the density of the DNAPL, the DNAPL-water interfacial tension, and the entry pressure of the capillary barrier. Consider a bank of DNAPL with the top of the bank in a soil with an entry pressure of P_d^1, perched on a capillary barrier with an entry pressure P_d^2. The height of DNAPL that can be held up by the capillary barrier is given by:

$$H = [P_d^2 - P_d^1]/[(\rho_n - \rho_W)g] \qquad (2)$$

where ρ_n is the DNAPL density, ρ_w is water density, and g is 9.81 m/s^2.

For a till layer with a hydraulic conductivity of approximately 10^{-4} cm/sec and a DNAPL-water interfacial tension (IFT) of 3.1 dynes/cm, a conservative estimate of the entry pressure is approximately 1000 Pa. This value of the entry pressure is based on the data presented in Figure 2. The upper curve in this figure presents DNAPL-water entry pressures measured by Kueper and Frind (1991) for sands having a similar range in conductivity to those at SRSNE. It is well established that entry pressures can be scaled according to interfacial tension. The lower two curves in Figure 2 present scaled DNAPL-water entry pressures for interfacial tensions of 7.3 and 3.1 dynes/cm. Assuming that the DNAPL bank is under drainage conditions in a soil with a hydraulic conductivity of 2 x 10^{-3} cm/sec (entry pressure of 220 dynes/cm), this corresponds to a pool height of approximately 2.6 ft. For an IFT of 7.3 dynes/cm, this corresponds to a pool height of 6.1 ft. Thus, there is considerable potential for steam flooding at the SRSNE site to create DNAPL banks that can breach capillary barriers with hydraulic conductivities of 10^{-4} cm/sec.

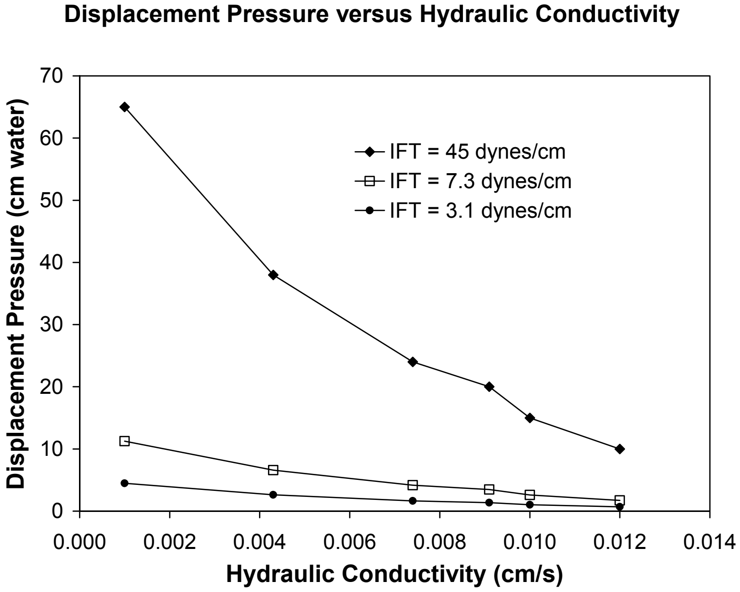

Figure 2 – Entry pressure (displacement pressure) versus hydraulic conductivity

The fact that a capillary barrier does not exist everywhere beneath the ONOGU must also be considered. In these regions, it can be assumed that any accumulated DNAPL bank will have the potential to enter bedrock. One method to evaluate the potential for DNAPL mobilization into bedrock as a result of applying steam flooding is to estimate the hydraulic conductivity of the capillary barrier that must exist to resist a given DNAPL bank height. A bank of DNAPL (density 1.1 g/cc, IFT 3.1 dynes/cm) extending 15 ft from the watertable to bedrock, with the bank under drainage conditions in soil with a hydraulic conductivity of 2 x 10^{-3} cm/sec, would create a capillary pressure at the bottom of the bank of 4700 Pa. In order for this bank to not be mobilized downwards, the capillary barrier would need to have an entry pressure of 4700 Pa or greater. For an IFT of 3.1 dynes/cm, this corresponds to a hydraulic conductivity of approximately 4.5 x 10^{-6} cm/sec (using Leverett, 1941 scaling). For an IFT of 7.3 dynes/cm this corresponds to a hydraulic conductivity of 2.3 x 10^{-5} cm/sec. If the DNAPL bank is located above fractures in the bedrock, the capillary pressures associated with a 15 ft high DNAPL bank correspond to fracture apertures of 0.7 and 1.5 microns, for IFTs of 3.1 and 7.3 dynes/cm, respectively (see Pankow and Cherry, 1996 for calculation procedure). Raising the DNAPL temperature would further decrease the DNAPL-water IFT and decrease the minimum fracture aperture that would be invaded by mobilized DNAPL.

With respect to injecting hot air to prevent the accumulation of condensed DNAPL banks at the edges of the steam zone, the analysis presented in Kaslusky et al. (2002) suggests that an air to steam mass ratio of approximately 8:1 would be required if the DNAPL saturation were limited to no higher than 25% of pore space and the DNAPL was composed entirely of TCE. The high air content of the injected stream would correspond to a reduced energy content and an approximately 80% reduction in the temperature front velocity. This in turn will increase operational time and costs. If higher vapor pressure compounds are present in the DNAPL (as is the case at SRSNE), even higher air to steam ratios are required. In this case, the thermal remediation system essentially becomes an air sparging system. It should also be pointed out that the study by Kaslusky et al. (2002) is based on theoretical considerations invoking a number of simplifying assumptions, and we are not aware of this technique having been applied in the field to sites such as SRSNE where significant quantities of a multicomponent DNAPL are present immediately above permeable bedrock. This technique has also not been applied with technologies such as thermal conduction and electrical resistance heating that create steam in-situ.

The creation of a hot floor below DNAPL source zones before starting steam injection has been proposed as a means to stop downward migration of DNAPL mobilized by steam flushing. It should be pointed out that because DNAPL has been observed directly upon bedrock, there does not exist an un-impacted zone of overburden beneath the DNAPL within which to create a hot floor. Creating a hot floor beneath the DNAPL source zone at the SRNSE site could only be accomplished by installing thermal conduction heater wells in the upper portion of the bedrock. As thermal conduction heating is focused around heater wells, and heat transfer is primarily by thermal conduction, close well spacing would be required to provide bedrock heating to steam temperatures in a timely manner.

Although it may be theoretically possible to create a hot floor by placing closely spaced heater wells in the upper bedrock at the SRSNE site, this approach has not been demonstrated at any other sites, and entails technical problems and uncertainties. Installing the heater wells would require drilling through DNAPL impacted soils into the bedrock. The impact of the initial heating period, before steam temperatures are reached, on DNAPL behavior is difficult to predict, particularly for the SRSNE site where DNAPL may be pooled on the bedrock, and the upper bedrock contains fractures. As the bedrock and adjacent overburden would be water-saturated, control of fluid movement would be difficult until a continuous steam zone was formed in the bedrock. Mobilization of DNAPL in bedrock would not only occur downwards, but would have a significant lateral component as well since bedrock bedding plane fractures are known to dip towards the east at an angle of approximately 22 degrees from horizontal.

4.0 - Conclusions

There is significant potential for adverse downward mobilization of DNAPL at SRSNE in connection with applying steam flooding, thermal conduction heating, or electrical resistance heating, particularly with injection-extraction well spacings exceeding 10 ft. Using either thermal conduction or electrical resistance heating to preferentially heat the lower portion of the aquifer to create a hot floor is not applicable at this site because of the fact that DNAPL is present immediately above bedrock. The feasibility of placing thermal conduction heater wells in the bedrock to create a hot floor in bedrock below DNAPL has not yet been demonstrated at any sites similar to SRSNE.

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Appendix X

Evaluation of Enhanced In Situ Bioremediation Following Steam Treatment

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EVALUATION OF ENHANCED IN SITU BIOREMEDIATION FOLLOWING THERMAL TREATMENT

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Disclaimer

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1. INTRODUCTION

This remedial alternative for the Observed Non-aqueous Phase Liquid (NAPL) in Overburden Groundwater Unit (Alternative ONOGU-5) involves the sequential application of thermal heating followed by enhanced in situ bioremediation (EISB) as the proposed remedial option at the Solvents Recovery Service of New England Inc., (SRSNE) Superfund Site in Southington, CT (the Site). There are a variety of thermal treatment options but the one proposed for the Site is steam enhanced extraction (SEE) coupled with either thermal conductive heating (TCH) as a means to extract additional dense non-aqueous phase liquid (DNAPL) mass from the treatment zone (defined as the Observed NAPL in Overburden Groundwater Unit or ONOGU). The application of thermal heating would take approximately one year to complete. Appendix V provides a detailed description of the thermal treatment technology and the proposed application scenario of Alternative OGNOGU-5 as the remedial option for the Site. It is assumed that the thermal treatment technology will remove any pooled NAPL mass and that only residual NAPL will remain for EISB treatment. This appendix presents how EISB would be applied for Alternative OGNOGU-5, specifically, how thermal treatment may impact the subsequent application of EISB. Appendix G provides a review of the applicability of EISB as a remedial technology for the Site and Appendix H provides a review of the common microbial processes that can result in biodegradation of select compounds.

The use of thermal heating is expected to remove as much as 85% of the DNAPL mass from the ONOGU. Thermal heating is therefore expected to be applied as a partial mass removal technology with EISB used as a polishing step to cost-effectively treat the remaining residual DNAPL.

The remainder of this appendix presents a brief description of the thermal heating technology (Section 2), a review of the impact of temperature on microorganisms (Section 3) and a review of the site specific technical considerations as they apply to this Site (Section 4).

2. SUMMARY OF THERMAL HEATING AS A REMEDIAL TECHNOLOGY

The thermal technologies that are most commonly applied for remediation of DNAPLs include SEE, electrical resistive heating (ERH) and TCH. While there are a number of other thermal technologies including in situ vitrification, radio frequency heating and hot-air injection, these are not commonly applied.

All thermal technologies involve increasing the soil and groundwater temperature in the target area. Heating can result in DNAPL remediation through enhancement of both extraction and in situ destruction processes (Udell & Stewart, 1998; Battelle, 2002; Stegemeier and Vinegar, 2001; Roote, 2003; US EPA, 1999). The mechanisms through which removal may occur include:

1) increasing vapor pressure and volatilization rates of low boiling point chemicals;

2) conversion of groundwater to steam and subsequent steam distillation of target chemicals;

3) desorption of target chemicals from sorption sites;

4) decreases in viscosity of separate phase chemicals which can increase mobility;

5) increases in soil permeability through partial (steam, ERH) or complete drying (TCH) of the soil matrix;

6) increases in both aqueous solubility and aqueous and gaseous molecular diffusion coefficients to increase dissolution and diffusion rates;

7) enhanced *in situ* biodegradation of target chemicals in the case of moderate (typically <100°C) temperature increases;

8) *in situ* thermal destruction of target chemicals through hydrous pyrolysis/oxidation, particularly when higher temperatures are applied (i.e., greater than 100°C); and

9) physical displacement of DNAPL mobilized by active flushing of the target zone due to the induced gradient from soil vapor extraction (SVE) and/or steam injection.

ERH and SEE rely on the water to transport heat, and therefore are only effective while soil moisture remains. In contrast, TCH is achieved through heating of the soil, and therefore can be applied at much higher temperatures to achieve DNAPL remediation (Roote, 2003; Stegemeier and Vinegar, 2001). TCH and ERH are suitable for application in both high and low permeability media (i.e. clays), as the thermal conductivity of soils tends to be fairly uniform as compared to hydraulic permeabilities. As steam flushing is reliant on hydraulic transport, it is less applicable to low permeability media. For all thermal technologies, groundwater influx into the treatment zone is a key factor in the successful application of the technology as this material needs to be heated to continue the remedial process. In cases where groundwater velocities or surface recharge is high, resulting in a high influx of unheated groundwater into the treatment zone, special controls (extraction wells) may be required so that the thermal technology can be effective in maintaining adequate heat in the treatment zone.

2.1 Review of Proposed Thermal Heating Application to the ONOGU

As described in Appendices V and W (Thermal Technologies and Risks of Vertical Migration of DNAPL), the proposed thermal treatment design will utilize both SEE and TCH at the Site. Briefly, the intent is applying steam to mobilize the NAPL and to create a “hot floor” within the first five feet of bedrock to reduce the potential downward migration of condensate and/ or pooled NAPL. SEE is used to heat the permeable zones; and build a high-pressure steam-filled zone that reduces the water flow into the target treatment zone by reducing or negating the inward hydraulic gradient and by reducing the relative permeability of water within the steam-saturated soils. For sites with high permeability layers located below the water table, water management is required to minimize the amount of energy expended to heat groundwater that enters from outside the target treatment zone (Appendix V).

The proposed thermal design for the Site would consist of 324 heater-only wells, 148 heater-extraction wells and 20 steam injection wells, located within the ONOGU. The program is to proceed in stages, with SEE beginning after the hot floor has been established. It will take approximately three months to create the hot floor. The target temperature for overburden soils is 100˚C for a period of four to six months (Appendix V).

3. IMPACT OF TEMPERATURE ON BIOREMEDIATION

The thermal technology application will significantly reduce the numbers and diversity of the microorganisms present in the treatment zone. As presented in Section 4 of Appendix G (EISB) the Site currently is actively dechlorinating and is producing complete degradation of many cVOCs. To assess the impacts of the proposed thermal treatment the following sections provide an overview of microbial growth at various temperatures (Section 3.1), cell death in response to temperatures and specifically the survival rate of one model organism under the temperatures proposed by this alternative (ONOGU-5) (Section 3.2), and a summary of published effects of thermal treatments on microbial survival and activity (Section 3.3).

3.1 Microbial Growth at Various Temperatures

Microorganisms can be classified as psychrophiles, mesophiles, thermophiles, and hyperthermophiles. Psychrophiles (cold-loving) can grow at 0^oC, with growth between -10 and 25^oC. Mesophiles optimal growth occurs over a moderate temperature range of between 20 to 45^oC. Thermophiles (heat-loving) can grow from a minimum of 20^oC to a maximum of 70^oC or more, with an optimum growth temperature of 50^oC. Hyperthermophiles have an optimum growth above 75^oC.

Every microorganism has an optimal temperature range and the further from this temperature an organism is the less productive (or more stressed) it is. Similarly if a temperature increases or decreased significantly (i.e., more than 10 to 15^oC) a shift in the dominant microbial populations may occur. Most subsurface soil microorganisms would be classified as psychrophiles or mesophiles. This is simply because subsurface soils and groundwater temperatures typically range from 0 to 25^oC, which does not favor microorganisms that would grow outside this range.

Temperatures above a microorganism’s maximum growth range will result in its death. Some microorganisms produce resistive resting stages, such as spores, that permit survival above the maximum temperature growth range, but even these stages have temperature limits.

3.2 Cell Death in Response to Temperature

The Decimal Reduction Time (D_T) is the amount of time at a given temperature needed to reduce the number of viable microorganisms by 90%. Plotting the D_T values from different temperatures can be used to construct a Thermal Death Time (TDT) curve (see Figure 1). TDT is the time required to kill a specified number of microorganisms. From the TDT curve, the z value is determined, which represents the temperature change required to change D_T by a factor of 10 while still achieving the same kill of viable microorganisms. Various factors affect D_T, such as the pH or if the environment is wet or dry (dry heating is less effective at sterilizing). Using D and z values it is possible to calculate the time needed to achieve sterilization at any temperature, or the Lethal Rate (Lv) for any microorganism. However, as the initial population size is unknown, the time required to achieve 12 Decimal reductions ($12D_T$) is commonly used in the food industry to calculate the time required to sterilize a product. The time required is calculated as shown below.

$$Lv = 10^{(T-T_{121})/z}$$

$$D_T = 12D_{121}/Lv$$

Clostridia botulinum is a pathogen, very difficult to kill, present in soils and is a good candidate to demonstrate the time required to sterilize soil that is heated to a moderate temperature. *C. botulinum* has D_{121} and z values of 12 seconds and 10°C, respectively. Assuming soil is heated to an average temperature of 65 °C, the time to achieve a 12 decimal reduction of the vegetative and spore forms of C. *botulinum* would be:

$$Lv=10^{(65-121)/10} = 2.5\text{x}10^{-6}$$

$$D65 = 12/2.5\text{x}10^{-6} = 4.7\text{x}10^{6} \text{ seconds} = 55 \text{ days}$$

The vast majority of common soil microorganisms have D values that are an order, or more, less than *C. botulinum* and, therefore, would be more rapidly killed during soil heating. Although TDT curves have not been constructed for halo-respiring bacteria, particularly for *Dehalococcoides* (DHC), these microorganisms are not spore-formers and will be similarly killed with a relatively small increase in temperature. The proposed thermal technology application would last for about four to six months (see Appendix V).

Complete sterilization (i.e., reduce a population to zero) is almost impossible to achieve in soils due to possible heat bypass and non-uniform heating creating lower temperature zones. However, there will be an exponential reduction in numbers of viable organisms. As an example, assuming the typical cell density reported for subsurface soils 10^6 dechlorinating cells per gram or 10^9 per kg, and just 4 decimal reductions (99.99% kill rate) was achieved, then only 100,000 cells per kg would survive. If the surviving cells had a doubling time of 5 days, then it would take approximately 200 days to reestablish the original population density (assuming no influx of cells from upgradient of the treatment zone). However, the reestablished population will not necessarily have the same microbial community composition and activity as pre-treatment.

3.3 Case Studies Assessing Bioactivity after Thermal Treatment

Dettmer (2002) discussed the effects of thermal remediation on microbial degradation processes and concluded that while thermal technologies had been applied in several locations for several target organic chemicals that there was not sufficient information on survival or impact of many organisms after thermal treatment. The concept of sequentially applying thermal and bioremediation was not a common treatment train. Of five case studies reviewed two showed signs of in situ biodegradation. However, petroleum hydrocarbons were the target compounds (not cVOCs) for treatment at these two sites. It is not surprising that both of these sites observed biodegradation of petroleum hydrocarbons during heating because thermophilic (heat loving) petrophilic bacteria are ubiquitous in the environment.

Richardson et al. (2002) looked at steam enhanced extraction effects on soil microbial activity, community structure and the potential for biodegradation of contaminants after SEE. They used direct epilfluorescent microscopy, and found that steamed soils, while hot did not have activity about their method detection limit. Those samples that were slowly cooled had some activity. Samples from a field site (Alameda NAS) where steam was applied for six weeks showed high levels of activity after cooling. This study does not report the maximum soil temperature achieved but when cores were collected soil was 50 to 55 ^{o}C. The researchers found that both bacteria and Archaea survived steam treatment but that Bacteria dominated the post-steam communities. Laboratory studies using thermally treated soils found aerobic phenanthrene biodegradation could be re-established.

Though not an evaluation of a thermal treatment technology for VOC remediation Ueki et al., (1997) evaluated the survival of methanogens from air dried rice paddy field soils and heat tolerance and found that methanogens survived, with 34% remaining after 4 months of aerobic storage. The methanogens surviving in the soils could withstand 105^{o}C for 10 hours and 140^{o}C for 30 minutes. The hydrogen producing bacteria in the air dried soils almost withstood the same level of heat treatment. This indicates that under the proposed treatment alternative where temperatures in excess of 65^{o}C will be applied for weeks that very few methanogens or hydrogen producing bacteria will remain.

4. PROPOSED APPLICATION OF EISB AS PART OF ALTERNATIVE ONOGU-5

The information presented in Appendix G (EISB) demonstrates that under the current Site conditions (up to June 2003), without the addition of supplemental electron donors, there is evidence that biological degradation of the Site chemicals is promoting the enhanced dissolution of DNAPLs over what would be expected based solely on abiotic dissolution mechanisms. Therefore, it is reasonable to expect that the dissolution rate can be maintained and enhanced by adding additional suitable electron donors to the groundwater, and that EISB can be used as a follow-on remedial technology to continue the enhanced removal of NAPL residuals that remain after the application of initial treatment technology. The proposed technology application for thermal at this site has a target groundwater temperature of about 65 to 100^{o}C for an extended period of time (several months). This therefore suggests that the area will be generally hostile to the re-growth of bacteria that survive the treatment and to bacteria that migrate into the treatment area, or are added (bioaugmented). This will impede the re-establishment of microbial degradation of untreated residuals by halo-respiring microorganisms that naturally migrate in to the area over time or through bioaugmentation with cultures containing DHC and other halo-respiring bacteria (e.g., KB-1™). However, for a period of time, microorganisms that migrate or are added to the sterilized area could grow rapidly because there would be little competition for the space and residual nutrients (released from dead cell mass) present in the treatment zone.

As described in Appendix V (Thermal Technologies), the thermal application would involve using SEE and TCH to increase the soil tempartures to levels that would transport the NAPL to surface for ex-situ treatment. After the thermal application is complete, the treatment zone will be monitored until it stabilizes with respect to groundwater chemical concentrations, temperatures and hydraulic gradients. After the stabilization period, the level of bioremediation that is occurring will be evaluated (see Appendix G (EISB).

At the Site, EISB will rely primarily on reductive dechlorination, the sequential replacement of chlorine atoms on the organic molecule by hydrogen atoms (described in more detail in Section 2.4 of Appendix H). Specific halorespiring microorganisms are required to carry out complete dechlorination of the chlorinated ethenes to ethene, in the presence of a suitable electron donor (e.g., alcohols). The extent that temperature will decimate the population of dechlorinating microorganisms is unknown, but likely large. Repopulation with the requisite halorespiring microorganisms will be required before EISB will become effective. Repopulation could involve:

- bioaugmentation with commercial cultures;
- waiting a significant period of time for surviving microorganisms to regrow to appropriate cell densities; or
- waiting for the transport of microorganisms upgradient back into the treatment area.

Options 2 and 3 above assumes that surviving or transported microorganisms have the same capabilities compared to those that have developed over time within the source area. Bioaugmentation negates that assumption and provides more rapid and predictable response. This is particularly true after thermal applications because the introduced microorganisms will grow and thrive more rapidly in an environment that has become relatively free of competition from indigenous microorganisms. Several field demonstrations have shown the utility of bioaugmentation to improve the application of EISB technology (Ellis et al., 2000; Lendvay et al., 2003; Major et al., 2002). It is assumed for this option that bioaugmentation will be applied to the Site to optimize degradation potential.

After the thermal treatment, the redox conditions would need to be changed from oxidizing to reducing. Pretreatment of the area with electron donor would be completed to promote anaerobic conditions prior to bioaugmentation to ensure that conditions are appropriate for the microbial community.

It is assumed that the thermal well network will be suitable for the application of electron donor to the Site. It is estimated that about 100 of the heater extraction wells could be used for EISB. There may be some additional infrastructure costs to re-plumb some lines and remove some injection/extraction wells. The electron donor and culture will be diluted and dispersed into the treatment area through the extraction and re-injection of Site groundwater via the extraction and injection well networks.

The principal cost of EISB is the electron donor as it will be added periodically. The selected electron donor will be emulsified soybean oil (oil), and it will be added so that 1% (on average) of the effective pore volume within the ONOGU will contain oil. The amount of electron donor, in this case, emulsified soybean oil, is based on the likely range of biodegradation rates and their impact on the enhanced loading rate of the Site chemicals during the application of EISB, the stoichiometric amount of oil required to meet the loading rate of Site chemicals to promote their complete dechlorination, and a safety factor to account for loss of electron donor to competing microbial processes (i.e., less than 100% of the electron donor is used during the reduction of chlorinated solvents). It is unlikely that any additional electron donor injection wells, beyond the proposed wells, will be required to achieve a uniform electron donor distribution, but this will be part of the detailed design process. For the purposes of evaluation, an initial application of 1% oil to the ONOGU would be applied for all EISB options, regardless of initial starting mass variations. After this applications would be based on consumption throughout the ONOGU. This application would be repeated in years three and five. Amounts and distribution of any subsequent application would be adjusted based on consumption rates and after any review of any observed distribution of chlorinated volatile organic compounds (cVOCs) in the ONOGU that may be present after year seven. Table 1 summarizes the major costs associated with the EISB component of Alternative ONOGU-5.

The following sections review factors that might affect the performance of the proposed technology design (Sections 4.1 through 4.5).

4.1 Technology Demonstrations at Comparable Sites or Scale

As identified in Section 3.3 there have been very few planned demonstrations to evaluate the impacts of microbial activity following steam treatments. There are also limited data sets to compare the relative impact of the various steam treatment technologies on microbial activity so there is little empirical data to assess if one steam treatment is less inhibitory to others. It would be expected that the microbial response to the steam treatment would be site dependent and be related to the target performance of the treatment (e.g., in partial treatment areas the deleterious effects of steam on microbial populations). The information provided in Appendix G (EISB) clearly identify that EISB is likely already occurring on a large scale at the Site. These lines of evidence support the application of EISB as a component of the Site remedy. As noted above, EISB at the Site is intended to act as follow on treatment process.

4.2 Risks and/or Benefits of Implementation

The risks and benefits of implementing EISB after thermal treatment are summarized below.

Risks:

- Impact of thermal heating on dehalogenating microbial populations. The elevated temperatures may substantially reduce the microbial diversity and amount of biomass in the subsurface. Bioaugmentation will be required to re-establish the requisite microbial populations.
- Residual temperature profiles. Monitoring will be required to determine when re-population through bioaugmentation would be warranted. It may take a substantial period of time for temperatures to return to suitable ranges for biodegradation to be established.
- Once EISB is established there may be an increase in the dissolution rate. This rate may overwhelm the ability of microorganisms to completely dechlorinate the Site chemicals until their population densities increase. This could result in the short-term production of intermediate degradation compounds like vinyl chloride. However, this risk is mitigated by bioaugmentation to increase cell

densities of key halorespiring microorganisms, and by use of the non-time critical removal action (NTCRA-2) containment system.

- Methane will be produced as a by-product of microbial activity. Systems will need to be designed to ensure methane is handled appropriately. Methane production (methanogenesis) is not typically associated with NAPL residuals of chlorinated ethenes as elevated concentrations of chlorinated ethenes inhibit methanogenesis.

- EISB may not enhance current degradation rates. There are already reliable indications that enhanced degradation is occurring. So, at minimum, electron donor addition is expected to sustain the current degradation process. Lack of enhancing (increasing) the degradation rate would, therefore, have little impact other than extending remedial time frames.

- Biofouling of wells may occur. This could lead to increased costs associated with well rehabilitation.

- Health and Safety. The handling of soils which remain hot will need to be addressed.

- Mobilization of metals may occur. Once the Site is returned to anaerobic conditions, possible secondary water impacts, such as increase in the mobilization of reduced metals may occur.

Benefits:

- Elevated soil temperatures in the 20-40 ^{o}C range may result in accelerated biodegradation.

- Increase in dissolution rate of residual NAPLs can shorten overall time frame for remediation. This will make the remedy less expensive to achieve overall remedial goal.

- <u>Technology is capable of complete detoxification in situ.</u> At some point this may eliminate the need for ex situ treatment systems.

- <u>If degradation rates are sufficiently fast,</u> then “biocontainment” (i.e., where the natural attenuation capacity of the system equals the dissolution rate) of dissolved phases may be sufficient to contain the aqueous phase plume, and eliminate the need for further groundwater extraction and treatment in the future.

- <u>Creation of larger ‘smear’ zones</u> from superseding technologies (i.e., hydraulic displacement) which make the VOCs more available for biodegradation than large pools.

- <u>Addition of bacteria and/or vegetable oil has a very low risk of causing adverse effects to human health or the environment.</u>

4.3 Cost Sensitivity

The factors most affecting the application cost of EISB after cosolvent flushing include:

- <u>Achieved rate of degradation and the impact this has on the loading of chemicals from the residual NAPL to dissolved phases.</u>

- <u>Unit cost of electron donors.</u> The major cost of EISB is electron donor and the change in costs may be substantial based on changes in electron donor types

- <u>Ability to distribute oil.</u> Although the oil estimates presented in Table 1 are based on the stoichiometric requirements, the delivery of the oil will also affect the total amount of oil that needs to be delivered yearly to obtain adequate oil coverage to the target areas. As an electron donor is added, it is also consumed during its travel. Assuming that the time to degrade one half the electron donor mass is 10 days, and it takes 30 days for oil to be advected between an injection and target location, then approximately six times more donor would need to be added at the injection well to achieve the required concentration of oil near the target location. However, increasing the number of injection wells so there is only 10 days of travel time between injection and target locations would require only injecting three times the required mass. There is a trade off between increasing the number of injection locations and total donor required. For longer term cleanups, the increase in cost for additional permanent injection locations is saved through overall decrease in electron donor costs. The detailed design process would evaluate the optimization of wells and electron donor cost.

4.4 Endpoints and How is Performance Measured/Quantified

The performance of EISB is assessed through:

- Increase in flux of parent and degradation products (chlorinated, non-chlorinated and inorganic compounds). This measurement provides an indication of mass removed and enhancement of dissolution rates, and is obtained by use of flux meters or simple measurement of the concentration of target analytes and using groundwater flow velocities to calculate fluxes;

- Calculation of degradation rates using changes in concentrations of parent and degradation products along defined flow paths; and

- Increase in abundance and distribution of key microbial species or their activities.

Application of EISB would be expected to improve the attainment of ONOGU Remedial Action Objectives (RAOs). While hydraulic displacement would eliminate the mobility of NAPL, and meet that RAO, application of EISB would be expected to shorten the time frame that groundwater standards are exceeded, shrink the aqueous phase VOC plume, and further reduce groundwater contaminant concentrations.

4.5 Scale-Up and Potential for Implementation of the Technology

EISB is readily scaleable to the Site through the addition of electron donor to existing or added wells. Factors to consider during scale up may include:

- Control of Intermediary Chlorinated Volatile Organic Compounds (cVOCs). Due to the confined nature of the treatment zone at the Site (underlying confining layer, downgradient sheet pile wall and hydraulic controls) the possible formation of degradation intermediates (cis-1,2-dichloroethene (cDCE), vinyl chloride (VC) is not a concern.

- Supplemental Addition of Electron Donor. The existing system of injection and extraction wells installed for the thermal application is believed to be sufficient for the addition of electron donor and bacterial culture, if required. Additional injection points or wells may need to be installed to provide adequate coverage for electron donor addition; however, the optimization of well and mass of electron donor will be finalized during the design stage.

- Permitting. Permit(s) may be required for bioaugmentation.

- Biofouling controls. The specific biofouling controls will need to be addressed when the final well configuration has been designed.

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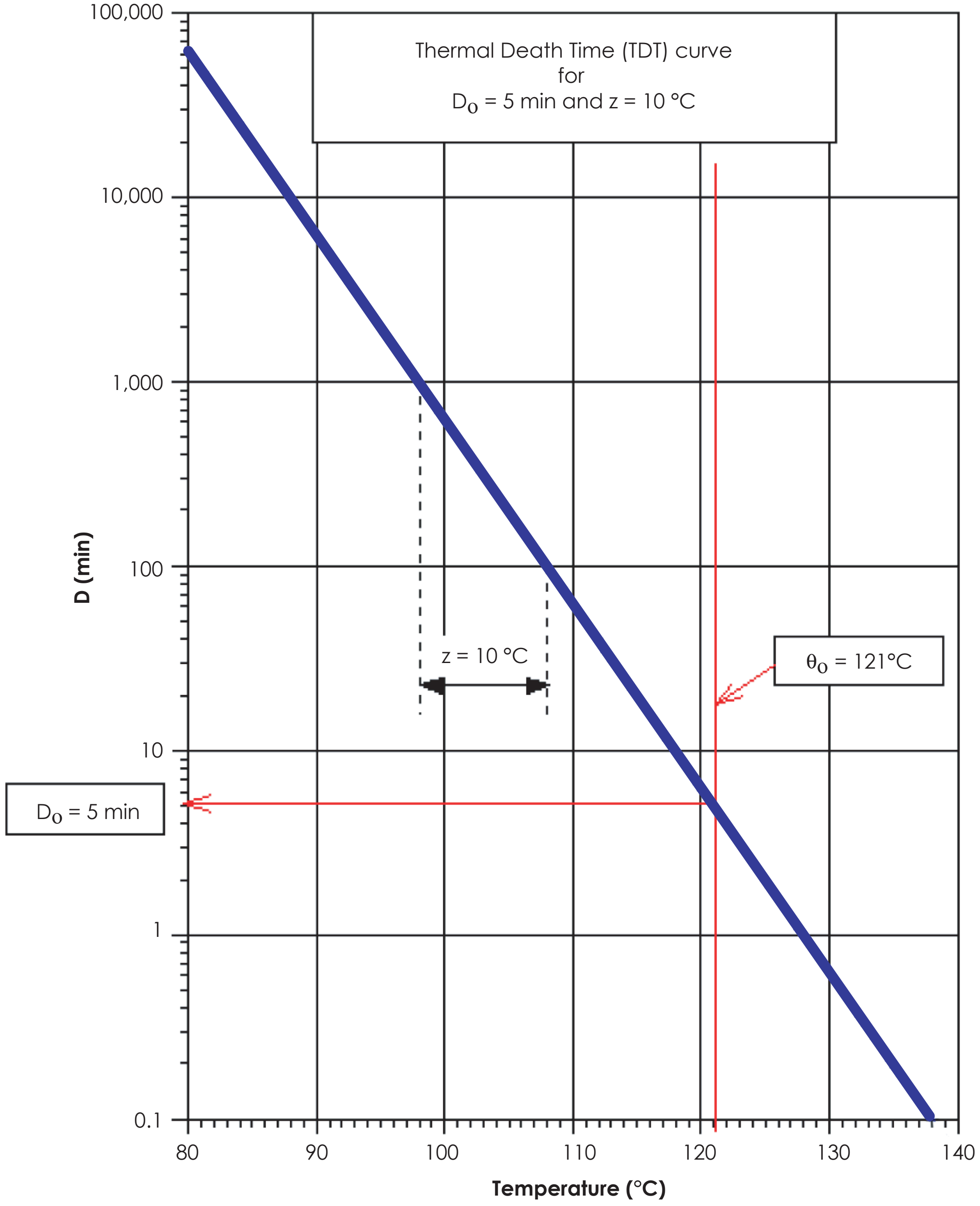
TABLE 1
ALTERNATIVE ONOGU-5 COSTS: EISB FOLLOWING THERMAL TREATMENT
Solvents Recovery Service of New England Superfund Site, Southington, CT

Description	Cost
1. Enhanced In-Situ Bioremedmdiation Design	
i) Enhanced In-Situ Bioremediation Design Cost	$202,500
ii) Microcosm Studies	$100,000
iii) Column Studies	$150,000
iv) System Infrastructure Installation	$110,000
Total Estimated EISB Design Costs	**$562,500**
2. EISB O&M Costs (1 injection for pre-treatment, 3 injections over 5 years)	
i) EISB Injection O&M	
a. Bioaugmentation with Dehalococcoides	$450,000
b. System Infrastructure shake down	$3,750
c. Oil for 4 injections	$1,200,000
d. Labor for 4 injections	$225,000
ii) EISB Well Maintenance O&M	$22,500
Total Estimated EISB O&M Costs for 5 Years	**$1,901,250**
Total Estimated Cost for 5 Years of EISB following Thermal Treatment	**$2,463,750**



D = "decimal reduction time"
time required for a 10-fold reduction in the population density at a given temperature

z = number of degrees required for one log cycle of deaths

θ_o = sterilization temperature of generic product

D_o = time required for sterilization at θ_o for thermal death curve

DRAFT

Thermal Death Time (TDT) Curve
Solvents Recovery Service of New England, Southington, CT

June 2004	Figure: **1**	GEOSYNTEC CONSULTANTS

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