REPORT

NON-TIME-CRITICAL REMOVAL ACTION 100% GROUND-WATER CONTAINMENT AND TREATMENT SYSTEM DESIGN REPORT

Solvent Recovery Services of New England Site
Southington, Connecticut

Prepared For:
SRSNE PRP Group

December 1994

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

Report

Non-Time-Critical Removal Action 100% Ground-Water Containment and Treatment System Design Report

Solvent Recovery Services of New England Site
Southington, Connecticut

Prepared For:
SRSNE PRP Group

December 1994

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

6723 Towpath Road
Syracuse, New York 13214
(315) 446-9120

Table of Contents

Appendices

Appendix A - Ground-Water Containment System Investigation Results
Appendix B - Ground-Water Containment System Modeling Results
Appendix C - Ground-Water Sampling and Treatability Testing Results
Appendix D - Draft Substantive Requirements for Pretreated Ground-Water Discharge to Quinnipiac River from Connecticut Department of Environmental Protection
Appendix E - Plans and Specifications
Appendix F - Key Design Calculations and Vendor Information
Appendix G - Demonstration of Compliance Plan

1.0 - Introduction

1.1 General

This report presents the 100% design for a Non-Time-Critical Removal Action (NTCRA) for ground-water containment and treatment at the Solvent Recovery Services of New England (SRSNE) Site in Southington, Connecticut (see Figure 1 for a site location map). This 100% design report was prepared on behalf of the SRSNE Potentially Responsible Party (PRP) Group.

On October 4, 1994, the SRSNE PRP Group entered into an Administrative Order on Consent (Consent Order) for a Removal Action with the United States Environmental Protection Agency (USEPA) for this NTCRA (Docket No. I-94-1045). Included as Appendix B of this Consent Order is a Statement of Work (SOW) that defines the response activities and deliverable obligations that the SRSNE PRP Group is obligated to perform pursuant to the Consent Order. The activities described in the SOW are based upon the USEPA Action Memorandum for the SRSNE Site signed by the acting USEPA Region I Administrator on April 1, 1993.

The NTCRA, as described in the SOW, consists of the following components:

1. The design and implementation of a ground-water containment and treatment system to prevent migration of overburden ground water from the SRSNE Site; and

2. The performance of soil studies to acquire information for the USEPA's use in planning and directing future response actions at the SRSNE Site.

This 100% design report, which specifically addresses the first component of the NTCRA, has been prepared in accordance with the requirements of the SOW.

1.2 Site Background

The SRSNE site is located on approximately 14 acres of land on Lazy Lane in the town of Southington, Connecticut. The current property was developed as two distinct areas with separate operating histories. A portion of the property was used as a hazardous waste treatment, storage and disposal facility (TSDF). This portion of the SRSNE Site is on the west side of the Boston and Maine (B&M) railroad tracks and is identified as the "Operations Area" throughout this document. The remaining portion of the SRSNE Site lying to the east of the railroad tracks and west of the Quinnipiac River was used by Cianci Construction Company for storage of construction equipment and for truck washing from 1969 to 1988. This area is identified as the "former Cianci property" throughout this document. Both of these areas are shown on the Site Plan (Figure 2).

In 1955, SRS, Inc. began operating a TSDF in the Operations Area. Starting in 1960, this facility was operated by SRSNE, Inc. From 1955 until 1988, the primary activities in the Operations Area were the distillation of spent solvents for recovery and resale. From 1988 until 1991, the primary activities in the Operations Area were fuel blending and waste transfer operations. In 1991, SRSNE, Inc. was forced to discontinue operating, because it failed to satisfy the conditions of its permit to operate a TSDF under the Resource Conservation and Recovery Act (RCRA).

From 1955 until 1991, waste materials in tanks, drums, and other containers were stored in the Operations Area. During this period, leaks and spills from these tanks, drums, and other containers allegedly contaminated the soil and ground water at the SRSNE Site. Between 1955 and 1967, waste materials were allegedly stored and/or disposed of in two unlined lagoons in the Operations Area. From about 1967 until 1974, an open-pit incinerator in the Operations Area was allegedly used to dispose of waste materials. Storm water, surface runoff, and water from cooling towers and from the distillation processes and drum-cleaning operations, which potentially contained waste materials, were allegedly discharged into a storm drain that ran easterly from the Operations Area and ultimately into the Quinnipiac River.

In 1977 and 1979, the town of Southington shut down two of its public drinking water wells due to the presence of elevated levels of organic compounds. These two wells are located approximately 1,900 and 1,300 feet south of the SRSNE facility.

In 1979, the USEPA filed suit against SRSNE, Inc. under RCRA for allegedly contaminating the two production wells and under the Clean Water Act for unpermitted discharge of pollutants into the Quinnipiac River. In 1983, SRSNE, Inc., the USEPA, and others entered into a Consent Decree which required SRSNE, Inc., among other things, to construct a network of wells (referred to herein as the "on-site interceptor system") along the eastern perimeter of the Operations Area in order to reduce the migration of potentially contaminated ground water from the site, and to construct a cooling tower/air stripper to remove organic compounds from ground water captured by the on-site interceptor system. The Consent Order also required SRSNE, Inc. to construct a second network of wells to the southwest of the Operations Area (referred to herein as the "off-site interceptor system") that was never used due to the failure of the Connecticut Department of Environmental Protection (CT DEP) to permit the system.

In 1983, the USEPA placed the SRSNE Site on the National Priorities List (NPL), making it eligible for federal assistance for study and cleanup under the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund. In 1986, SRSNE, Inc. began operating the on-site interceptor system and the associated cooling tower/air stripper treatment system. The cooling tower/air stripper treatment system was replaced in 1992 with an ultra-violet (UV)/oxidation (hereafter referred to as enhanced oxidation) treatment unit purchased from Vulcan Peroxidation Systems, Inc. (VPSI) that was operated by the CT DEP from June 1992 to October 1994.

In 1990, NUS Halliburton Corporation (HNUS) was retained by the USEPA to conduct a Remedial Investigation/Feasibility Study (RI/FS) to evaluate the extent of contamination, risks to human health and the environment, and alternatives for cleaning up the SRSNE Site. The RI was completed in May 1994, and the FS is currently underway.

Within the last several years, the USEPA has completed two Removal Actions in the Operations Area. The first was conducted in September 1992, during which the USEPA excavated and disposed of contaminated sediments from two catch basins; excavated and disposed of PCB-containing sediments from a drainage ditch; constructed covered drains in the ditch; erected fencing; and disposed of drums containing decontamination water from previous field investigations at the SRSNE Site. In January 1994, the USEPA performed a second Removal Action to dispose of waste chemicals from a building in the Operations Area, to prevent releases from drums and smaller containers.

Based on the on-going investigations at the SRSNE Site, the USEPA determined that the existing on-site interceptor system was not effectively preventing the continued migration of contaminants into the overburden aquifer. In 1992, the USEPA commenced an Engineering Evaluation/Cost Analysis (EE/CA) to evaluate potential alternatives that could be implemented as a NTCRA, meaning that the response action would have at least a six-month planning period after USEPA's decision to respond and prior to initiation of the action. After a public comment period, the USEPA issued an Action Memorandum for the SRSNE Site on April 1, 1993, which requires the implementation of a NTCRA. In January 1994, the PRP Group voluntarily began field work on the NTCRA in advance of the effective date of the Consent Order (October 4, 1994). Therefore, many of the requirements of the Consent Order described in the SOW have already been met.

1.3 Overview of Non-Time-Critical Removal Action

The SOW defines the response activities and deliverable obligations for the NTCRA that the PRP Group must perform pursuant to the Consent Order. The SOW sets the following specific activities for the NTCRA:

- Soil Studies of the Operations Area;
- Additional Studies;

- Design of a Ground-Water Containment System;
- Design of a Ground-Water Treatment System;
- Implementation of the Ground-Water Containment and Treatment System; and
- Completion of Ground-Water Containment and Treatment.

Reports covering the Operations Area soil studies and additional studies were submitted to the USEPA and CT DEP on June 15, 1994 and June 29, 1994, respectively, and are not addressed by this report.

This 100% design report is the third and final deliverable specified by the SOW for the design of the ground-water containment and treatment system. The first deliverable, entitled "Final Soil, Ground-Water and Additional Studies Work Plan for the SRSNE Superfund Site," was prepared by ENSR Consulting and Engineering (ENSR) on behalf of the SRSNE PRP Group and submitted to the USEPA and CT DEP on March 14, 1994. The second deliverable, also prepared by ENSR and entitled, "Ground-Water Technical Memorandum," was submitted to the USEPA and CT DEP on June 15, 1994.

The "Ground-Water Technical Memorandum" contained recommendations for the ground-water containment and treatment system as outlined below.

Ground-Water Containment System

- Wells should be screened across the outwash and till;
- Wells should be constructed of stainless steel, continuous-slot well screens, and stainless steel or polyvinyl chloride (PVC) riser pipe;
- Well screens should be sized and located to minimize the possibility of dewatering the well screen;

- Sand packs should be extended upward as high as feasible to facilitate collection of overburden ground water above the well screen and should be sized to minimize silt production;

- Individual pumps and controllers should be installed in each well; and

- All system components, including wells, valves, flow meters, pumps, and effluent piping, should be selected and designed to accommodate periodic operation and maintenance (O&M) activities.

Ground-Water Treatment System

- An equalization tank should be provided to dampen short-term variations in the flow and chemical loading to the treatment system;

- A metals/solids pretreatment system, including a clarifier and granular media filtration, should be provided to remove metals (particularly iron) and suspended solids prior to the enhanced oxidation treatment system;

- An enhanced oxidation treatment system manufactured by VPSI should be provided to treat organic compounds in the ground water;

- A liquid-phase granular activated carbon (GAC) treatment system should be provided to remove residual hydrogen peroxide following the enhanced oxidation treatment system;

- The treatment system should discharge to the Quinnipiac River; and

- The treatment system building should be located in the northwest quadrant of the former Cianci property adjacent to the Containment Area.

In a letter dated September 9, 1994, the USEPA approved the "Ground-Water Technical Memorandum" and established a submittal due date of December 15, 1994 for this 100% Design Report.

The NTCRA Containment Area, as established in the SOW, is shown on the Site Plan (Figure 2). This area is generally bordered as follows:

1) To the west by the Operations Area;
2) To the north by an existing underground 36-inch-diameter reinforced concrete pipe (RCP);
3) To the east by the "lower till window," where no basal till is found in the subsurface geology; and
4) To the south by the former Cianci property line.

The NTCRA consists of the following components:

- Withdrawal of ground water from the Containment Area;

- Treatment of the ground water using a metals pretreatment system, an enhanced oxidation treatment system, and a liquid-phase GAC treatment system;

- An air treatment system that utilizes a blower and vapor-phase GAC to collect and treat vapors from the ground-water treatment system; and

- Discharge to the Quinnipiac River in accordance with the discharge limitations to be determined by the CT DEP.

As specified in the SOW, this 100% Design Report contains the following:

- The basis of design and design bid package for the ground-water containment system;

- The basis of design and design bid package for the ground-water treatment system; and

- A Demonstration of Compliance Plan that describes how the performance standards listed in the SOW will be achieved, maintained, and demonstrated.

Once the USEPA approves this 100% Design Report, the SOW specifies that an implementation schedule be submitted to the USEPA and CT DEP. This implementation schedule must contain the following deadlines:

- Substantial completion of construction and initial start-up of the ground-water containment and treatment system within 90 days of USEPA approval of the 100% design report; and

- Completion of construction and achievement of the performance standards for the ground-water containment system contained in the SOW within 30 days of substantial completion of construction and initial system start-up.

1.4 Report Organization

Following this introductory section, Section 2.0 contains a description of the pre-design activities that were conducted to develop the necessary data for the ground-water containment and treatment system design. The supporting information for Section 2.0 is presented in Appendices A, B, C, and D. In Section 3.0, the ground-water containment and treatment system design is described, with supporting details contained in Appendices E and F. Appendix G contains the Demonstration of Compliance Plan, which describes how the performance standards listed in the SOW will be achieved, maintained, and demonstrated.

2.1 General

In order to develop the necessary data to complete the design for the ground-water containment and treatment system, Blasland, Bouck & Lee, Inc. (BB&L) completed a number of pre-design activities in September and October 1994. These activities included:

- Installation and development of five recovery wells, with associated piezometers;
- A ground-water pumping test consisting of a step-drawdown test, a constant-rate test, and a recovery test;
- Collection of ground-water samples during the recovery well development and pumping test to characterize the expected influent to the treatment system;
- A metals/suspended solids treatability test to define the requirements of the metals pretreatment system;
- An assessment of siting factors to determine the most appropriate location for the treatment system building; and
- Consideration of potential ground-water discharge limitations to be established by the CT DEP.

A more detailed description of these activities is provided below.

2.2 Ground-Water Containment System

A number of hydraulic tests were completed to develop the data necessary to complete the ground-water containment system design. The general purpose of the aquifer tests was to determine flow-system hydraulic coefficients, to characterize the physical system, and to construct a system-representative conceptual model to support numerical ground-water flow modeling. Following calibration of the numerical model to steady-state head conditions in the Containment Area, the model was used in a predictive mode to simulate and evaluate containment scenarios. Appendix A presents the results of ground-water investigations, while Appendix B presents the results of the modeling performed to identify an appropriate remedial design for containing overburden ground water.

2.2.1 Recovery Well Development and Hydraulic Evaluation

BB&L installed a total of five overburden recovery wells (RW-1 through RW-5) in the Containment Area during late September to early October 1994, as identified on Figure 2. (Note: Recovery Well RW-5 is shown as Monitoring Well MRW-5 on Figure 2 and all other figures in this report, since it is located outside the Containment Area and will not be used as part of the ground-water containment system). The recovery wells consisted of 6-inch-diameter well installed at a depth of approximately 25 to 30 feet below grade. Each of the wells was constructed of a 15-foot-long, 6-inch-diameter, continuous-wound, 0.020-inch stainless steel slot-screen set at the top of bedrock. A 6-inch-diameter Schedule 80 PVC riser pipe was installed to extend from the top of the screen to above ground surface. A filter pack consisting of Morie No. 0 sand was installed from the bottom of the screen to a depth of 5 feet below grade. The remaining depth was backfilled with a cement-bentonite grout mixture and an 8-inch-diameter steel protective casing with locking cap was installed around the recovery well.

Following the installation of recovery wells, the water levels were measured, and the wells were surged for approximately two hours. The wells were then pumped at a relatively constant rate for a period of approximately three to five hours to estimate the hydraulic coefficients of the surrounding formation.

2.2.2 Pumping Tests

A 48-hour constant-rate pumping test was conducted at Recovery Well RW-2 to further quantify the bulk hydrogeologic parameters (e.g., transmissivity and storativity) of the saturated zone in the Containment Area. A preliminary step-drawdown test of approximately 8 hours was implemented prior to the 48-hour constant-rate pumping test to identify a suitable pumping rate for the constant-rate test. Based on the results of the step-drawdown test, a pumping rate of 1.8 gallons per minute (gpm) was selected for the constant-rate test.

The constant-rate pumping test involved pumping ground water from RW-2 and measuring the change in water levels in the recovery well and other monitoring wells/piezometers proximate to RW-2. Following completion of the 48-hour constant-rate pumping test, a 24-hour recovery test was conducted.

2.2.3 Ground-Water Modeling

The objectives of the ground-water flow modeling were to:

1) Develop a three-dimensional, numerical ground-water flow model that represents ground-water flow conditions within and between the overburden and top of bedrock;

2) Use the model to simulate the steady-state overburden ground-water capture zone that may be achieved during simultaneous pumping of ground water in the Containment Area;

3) Augment the simulated pumping array to identify a remedial pumping scenario that, based upon steady-state flow simulation, appears to hydraulically control the overburden ground water within the Containment Area;

4) Produce simulated contour maps showing the pre-pumping ground-water elevations, and the pumping ground-water elevations and simulated ground-water flowlines within the overburden and the top-of-bedrock flow systems;

5) Provide cumulative and steady-state discharge estimates for the ground-water treatment system design; and

6) Identify key areas where hydraulic containment will need to be demonstrated during the Demonstration of Compliance, including stagnation points and ground-water flow divides.

The results of the ground-water modeling are presented in Appendix B. The ground-water containment system design that was developed based on the modeling results is described in detail in Section 3.0.

2.3 Ground-Water Sampling and Treatability Testing

In conjunction with the field activities for the containment system pre-design activities, BB&L collected samples of ground water to characterize the influent to the ground-water treatment system. Near the end of recovery well development, one round of ground-water samples was collected at each of the five recovery wells. The total pumping time, total volume pumped, and the average flow rate during development for each of the recovery wells are presented below.

Recovery Well	Total Pumping Time (Hours)	Total Volume Pumped (Gallons)	Average Flow Rate (gpm)
RW-1	4.9	835	2.8
RW-2	4.0	965	4.0
RW-3	2.7	365	2.3
RW-4	4.0	1,200	5.0
RW-5	7.0	480	1.1

Each of the collected samples was submitted to Upstate Laboratories, Inc. (Upstate) of Syracuse, New York for the following analyses:

Parameter	Method
Organic Compounds including Ketones	SW-846 8240
Alcohols	SW-846 8015
Total Suspended Solids (TSS)	USEPA 160.2
Total Iron	USEPA 200.7
Total Copper	USEPA 200.7
Total Lead	USEPA 239.2
Total Nickel	USEPA 200.7
Total Zinc	USEPA 200.7
Total Manganese	USEPA 200.7
Total Arsenic	USEPA 206.2
Total Cadmium	USEPA 200.7

Additionally, during the recovery well development process, field tests for pH, temperature, and conductivity were conducted. The results of the laboratory and field testing are summarized on Table 1, and the Laboratory Analytical Report is included in Appendix C.

In conjunction with the pumping test, one round of samples was also collected near the end of the pumping test at Recovery Well RW-2. The samples were collected after Recovery Well RW-2 had been pumped at an average flow rate of approximately 1.8 gpm for 48 hours, or after approximately 5,200 gallons had been pumped from the well. The samples were submitted to Upstate for analysis of the same parameters as the samples from the well development process. Additionally, field tests for pH, temperature, and conductivity were conducted during the pumping test. The analytical results from the pumping test are also summarized on Table 1, and the Laboratory Analytical Report is included in Appendix C.

BB&L also collected one gallon of ground water from each recovery well during the well development process, composited the samples, and submitted them to Parkson Corporation of Fort Lauderdale, Florida for treatability testing. The purpose of the treatability testing was to determine the most appropriate pretreatment system for removal of metals (specifically iron) and suspended solids from the pumped ground water. The treatability testing program was designed to determine the most effective pH, polymer flocculation agent, and solids loading to effectively pretreat the ground water to allow the enhanced oxidation system to effectively treat organic constituents in the ground water. The treatability testing results are presented in Appendix C. In summary, the treatability testing showed the following conditions to be the most effective:

- Addition of caustic soda to raise the pH of the ground water to approximately 9.0;
- Addition of approximately one milligram per liter (mg/l) of a non-ionic polymer to enhance flocculation;
- Recycle of approximately 7,200 mg/l of suspended solids to enhance overall solids precipitation and flocculation;
- Use of a Lamella® gravity settler with a surface loading rate of approximately 0.32 gpm per square foot of clarification area; and
- Use of a DynaSand® filter at a loading rate of approximately 3.94 gpm per square foot of filtration area.

The results of the treatability testing are summarized below.

Parameter	Influent	Lamella® Effluent	DynaSand Effluent
Total Iron (mg/l)	8.7	1.1	0.93
TSS (mg/l)	831	<20	<15

The total iron results are based on samples submitted by Parkson Corporation to Upstate, while the TSS results were obtained by Parkson during the treatability testing.

2.4 Ground-Water Treatment System Building Siting Assessment

An assessment was conducted to determine the most appropriate location for the treatment system building, the support facilities to be included within the building, and the utilities necessary to service the treatment system building. To minimize pumping and to facilitate discharge, the treatment system building will be located just north of the Containment Area (approximately 400 feet from Lazy Lane) and east of the existing dirt access road (towards the river). The existing dirt access road will be improved with 12 inches of gravel laid on a woven geotextile to ensure year-round access to the treatment system building. Parking and turnaround areas will be provided adjacent to the treatment system building. The building will be located outside of the 100-year flood limit and wetlands defined by the "SRSNE Site Remedial Investigation Report" (HNUS, May 1994).

All treatment equipment will be located inside of the building, and the treatment system will discharge to the existing underground 36-inch-diameter RCP that runs from the Operations Area to the Quinnipiac River. The treatment system building will not be designed to accommodate office space, drinking water, or sanitary facilities.

Electric service to the treatment system building will be provided by Connecticut Light and Power (CL&P). The required electric service is available from a power pole located on Lazy Lane. Based on CL&P's requirements, service from Lazy Lane to the treatment system building will be conducted via a buried electrical cable, and a pad-mounted electrical transformer will be constructed adjacent to the treatment system building.

Natural gas service is not available on Lazy Lane adjacent to the SRSNE Site and would need to be provided from approximately one mile away to the west or from the east side of the Quinnipiac River. Therefore, electric heat will be utilized to maintain the temperature in the treatment system building above freezing.

Potable water service is available on Lazy Lane adjacent to the SRSNE Site. However, there is no sanitary sewer service on Lazy Lane. Potable water service will be provided to the treatment system building for the purpose of providing wash water for the treatment process, an eyewash/safety shower, and a sink to be used for hand washing. The eyewash/safety shower and sink will discharge into the influent equalization tank of the treatment process.

2.5 Ground-Water Treatment System Effluent Limits

A September 30, 1994 meeting was held between the PRP Group, ENSR, and the CT DEP to discuss the effluent limits for the ground-water treatment system. As described in a letter dated October 3, 1994 to Mr. Ken Major of CT DEP from Mr. Anthony Silva, P.E., of ENSR, interim effluent limits for the ground-water treatment system will be established by the CT DEP for a period of time, until sufficient Containment Area ground-water treatment system flow and effluent data are available. The effluent limits contained in the Emergency Authorization for the on-site interceptor system will be utilized by CT DEP as the basis for establishing the interim effluent limits. Once the CT DEP determines that sufficient data is available from the ground-water treatment system, effluent limits for selected parameters will be evaluated and may be revised based on water quality and Best Available Technology Economically Achievable (BAT) criteria. At that time, these effluent limits will replace the interim effluent limits. A copy of the draft substantive requirements for the ground-water treatment system issued by CT DEP in mid-November 1994 is presented in Appendix D. The effluent limits contained in this document are summarized on Table 2.

3.1 General

This section outlines the basis of design of the NTCRA ground-water containment and treatment system. Included in this section is a description of the basis of key design conditions such as treatment system design flow rate, influent concentrations, and target effluent concentrations. Also included are detailed descriptions of all components of the ground-water containment and treatment system.

3.2 Ground-Water Influent Concentrations and Treatment Objectives

The treatment system design influent concentrations and the target effluent concentrations are presented on Table 2. The influent basis of design concentrations are based on the results of the pre-design sampling and analysis activities performed by BB&L in September and October 1994. As shown on Table 2, a range of treatment system influent concentrations was developed for both organic and inorganic parameters. To be conservative, the high end of the range of influent concentrations given were based on the highest detected concentrations from samples collected either during the recovery well development process or during the pumping test. The lower end of the range of influent concentrations were based on the average concentrations of samples obtained from each of the five recovery wells during the recovery well development process. The following are specific protocols used to develop the treatment system influent concentrations presented on Table 2.

1. The higher treatment system influent concentrations were based on the highest concentrations found during the recovery well development process and the pumping test at Recovery Well RW-2.

2. These higher concentrations were compared to the highest concentration obtained by ENSR during the pumping test conducted in April 1994, as reported in the "Ground-Water Technical

Memorandum." In all cases, the higher influent concentrations exceeded the highest concentrations obtained by ENSR.

3. For the purposes of calculating the lower treatment system influent concentrations, parameters reported as less than the detection limit at a particular recovery well were assumed to be equal to that detection level.

4. If detectable concentrations of a parameter were not found either during the recovery well development process or the pumping test, the treatment system influent concentrations were assumed to be equal to the numerical average of the detection limits of a particular parameter at each of the recovery wells.

The treatment system target effluent concentrations presented on Table 2 for organic parameters were developed by VPSI based on the range of influent concentrations developed by BB&L. VPSI developed these target effluent concentrations based on the enhanced oxidation treatability testing results presented in the "Ground-Water Technical Memorandum" and on operating data obtained from the enhanced oxidation treatment system used in conjunction with the on-site interceptor system in the Operations Area from June 1992 to October 1994. For comparison, the effluent limits issued by the CT DEP for the NTCRA treatment system are also presented on Table 2. As shown on Table 2, the treatment system target effluent concentrations for organic parameters are all at least a factor of 10 lower than the draft effluent limits. However, actual effluent concentrations may vary due to actual influent concentrations and field conditions.

The chemical compounds that limit the design of the enhanced oxidation treatment system are primarily acetone and 1,1,1-trichloroethane, and to a lesser extent 1,1-dichloroethane and methylene chloride. The 1,1,1-trichloroethane and 1,1-dichloroethane will be removed by the liquid-phase GAC treatment system that follows the enhanced oxidation treatment system. However, acetone and methylene chloride are not readily treated by liquid-phase GAC, so there will be no additional treatment of these parameters following the enhanced oxidation treatment system.

3.3 System Components

3.3.1 General

This section provides a detailed description and basis of design for all specified process equipment for the ground-water containment and treatment system. The general layout of the ground-water containment and treatment system is shown on Sheet 1 of the Design Drawings, which are provided in Appendix E. A process flow diagram, which shows the arrangement of various process equipment, is included on Sheet 2 of the Design Drawings. Additional equipment and design details related to implementation of the NTCRA are contained on the remaining sheets of the Design Drawings, Special Conditions, and Material and Performance Specifications (Appendix E).

3.3.2 Overview of Ground-Water Containment and Treatment System

The ground-water containment system for the NTCRA will consist of a series of 11 vertical recovery wells (including four existing recovery wells) and a downgradient hydraulic barrier (i.e., sheet-piling). The water collected from the Containment Area will be pumped to the ground-water treatment system located in a treatment system building. The water will first be collected in a 10,000-gallon flow equalization tank, from where it will be pumped through a metals pretreatment system to remove suspended solids and metals. Following metals pretreatment, the water will be treated to remove organic compounds using an enhanced oxidation treatment system, followed by a liquid-phase GAC treatment system to remove residual peroxide from the enhanced oxidation process to address potential aquatic toxicity. The treated water will be discharged to the Quinnipiac River through the existing 36-inch-diameter underground gravity discharge pipe located on the northern boundary of the Containment Area.

The ground-water treatment system will be designed for a flow rate of 100 gpm. This design flow rate has been developed in order to achieve the following:

- Contain ground water in the Containment Area based on the flow rates estimated using ground-water modeling presented in Appendix B;

- Provide sufficient capacity to accommodate increased pumping rates during the initial dewatering of the overburden ground water;

- Provide sufficient capacity to facilitate routine maintenance of process equipment, such as the enhanced oxidation treatment system, without completely shutting down the ground-water extraction system; and

- Provide sufficient capacity to treat additional ground water that may be generated on the site from such activities as monitoring well sampling.

3.3.3 Ground-Water Containment System

The ground-water containment system design is based upon the results of the ground-water modeling presented in Appendix B. The ground-water containment system consists of a series of 11 vertical recovery wells installed within the Containment Area, with submersible well pumps all connected to a common header leading to the ground-water treatment system. The containment system also includes a downgradient hydraulic barrier consisting of a steel sheet-pile wall that extends to bedrock.

The containment system design basically follows the recommendations contained within the "Ground-Water Technical Memorandum" regarding well construction and operation controls. The 11 vertical recovery wells will include the four recovery wells installed as part of the pre-design activities. The vertical recovery wells will be located immediately upgradient and along the sheet-pile wall and be spaced approximately 50-70 feet apart. Each recovery well will be designed to pump up to 9 gpm and will be activated based on the ground-water level in the well. A description of the ground-water containment system components is provided below.

Equipment

Well Pump

Quantity:	11
Manufacturer:	Grunfos
Type:	Submersible Environmental
Flow Rate:	9 gpm
Electrical:	230 volt, single-phase

Controls/Gauges/Alarms

A. Controls

1. Remote start/stop in treatment system building
2. Level controls to control pump operation

B. Gauges

None

C. Alarms

High level alarm in each well

3.3.4 Ground-Water Treatment System

The ground-water treatment system consists of a metals pretreatment system, enhanced oxidation treatment system, liquid-phase GAC treatment system and an air treatment system. The ground-water treatment system and all associated equipment will be housed in a treatment system building located adjacent to the Containment Area. The treatment system building, which will be approximately 80 feet by 80 feet in size, will be a pre-engineered metal building with a concrete floor slab, structural steel frame, and metal panels for the exterior and interior walls and roof. A description of the treatment system components is provided below.

3.3.4.1 Metals Pretreatment System

The influent from the ground-water containment system will be pumped to the metals pretreatment system. The metals pretreatment system is designed to operate at a flow rate of 100 gpm and to remove influent inorganics (primarily iron and suspended solids) to below the target effluent concentrations presented on Table 2.

The metals pretreatment system will consist of a 10,000-gallon flow equalization tank followed by a 1,000-gallon clarifier feed tank, where caustic soda will be added to adjust the pH from approximately 7.0 to 9.0. Water from the clarifier feed tank will flow to a rapid mix chamber, where polymer will be added; a slow mix chamber, where flocculation will occur; and then to a clarifier, where solids will settle out. The caustic soda will be stored in 55-gallon drums and added to the clarifier feed tank via one of two metering pumps. The polymer will be stored in 55-gallon drums and added to the rapid mix chamber via one of two metering pumps. Effluent from the clarifier will overflow by gravity to a sand filter and then to a 3,000-gallon oxidation feed tank, where sulfuric acid will be added to adjust the pH from approximately 9.0 to 7.0. The water will then be pumped to the enhanced oxidation treatment system. The sulfuric acid will be stored in 55-gallon drums and added to the oxidation feed tank via one of two metering pumps. Caustic soda and sulfuric acid addition will be controlled based upon pH. Polymer addition will be controlled based upon flow.

The sludge from the bottom of the clarifier will be pumped to a sludge thickener tank and then to a sludge dewatering filter press. A portion of the sludge from the bottom of the clarifier will be recycled back to the flow equalization tank to enhance precipitation and flocculation in the clarifier. The filter press will utilize the compaction pressure of the sludge pump to dewater sludge into filter cakes of 25 to 60 percent solids. The filter cake will be dropped into a collection hopper and transferred into containers for off-site disposal. Supernatant from the sludge thickener, filtrate from the filter press, continuous backwash from the sand filter, and any water collected in the treatment system building sump will be directed back to the equalization tank.

The equalization tank, clarifier feed tank, clarifier (including flash and slow mix chambers), sludge thickener, sand filter, and oxidation feed tank will all be equipped with covers and vented to a blower included as part of the air treatment system. Below is a list of preliminary equipment, controls, gauges, and alarms to be provided as part of the metals pretreatment system.

Equipment

1. Equalization Tank

Material:	Steel
Diameter:	14 feet
Height:	10 feet
Capacity:	10,000 gallons

2. Mixer for Equalization Tank

Quantity:	One
Manufacturer:	Lightning or equal
Motor Type:	TEFC
Horsepower:	4
Electrical:	230 volt, three-phase

3. Clarifier Feed Tank

Material:	Steel
Length:	6 feet
Width:	6 feet
Height:	5 feet
Capacity:	1,000 gallons

4. Caustic Metering Pumps

Quantity:	2
Manufacturer:	Pulsafeeder or equal
Capacity:	0.10 to 0.02 gallons per hour (gph)
Motor Type:	TEFC
Electrical:	115 volt, single-phase

5. Mixer for Clarifier Feed Tank

Quantity:	One
Manufacturer:	Lightning or equal
Motor Type:	TEFC
Horsepower:	½
Electrical:	230 volt, single-phase

6. Clarifier

Manufacturer:	Hoffland Environmental or equal
Model:	600/60/5B
Type:	Inclined plate
Weight:	37,150 pounds (operating)
Total Volume:	2,918 gallons
Rapid Mix Chamber Capacity:	67 gallons
Slow Mix Chamber Capacity:	270 gallons
Sludge Hopper Capacity:	1,550 gallons
Material:	A-36 carbon steel

7. Sand Filter

Manufacturer:	Parkson Corporation or equal
Model:	DSF-38
Inside Diameter:	7 feet
Top Height:	21 feet
Sand Required:	9.5 tons
Pressure Drop:	2 feet

8. Oxidation Feed Tank

Material:	Steel
Length:	8 feet
Width:	8 feet
Height:	8 feet
Capacity:	3,000 gallons

9. Mixer for Oxidation Feed Tank

Quantity:	One
Manufacturer:	Lightning or equal
Motor Type:	TEFC
Horse Power:	1½
Electrical:	230 volt, three-phase

10. Sludge Thickener Tank

Material:	Steel
Type:	Conical bottom
Diameter:	10 feet
Height:	11 feet
Capacity:	6,400 gallons

11. Flash Mixer for Clarifier

Quantity:	One
Manufacturer:	Lightning or equal
Motor type:	TEFC
Horsepower:	1/4
Electrical:	230 volt, single-phase

12. Slow Mixer for Clarifier

Quantity:	One
Manufacturer:	Lightning or equal
Motor type:	TEFC, 10.5 to 52 revolutions per minute (rpm), variable speed
Horsepower:	1/4
Electrical:	230 volt, single-phase

13. Polymer Metering Pumps

Quantity:	2
Manufacturer:	Pulsafeeder or equal
Capacity:	0.003 to 0.012 gph
Motor Type:	TEFC
Electrical:	115 volt, single-phase

14. Influent Transfer Pumps

Quantity:	2
Manufacturer:	Goulds Pumps, Inc. or equal
Motor Type:	TEFC
Drive:	VFD
Electrical:	230 volt, three-phase

15. Oxidation Feed Pumps

Quantity:	2
Manufacturer:	Goulds Pumps, Inc. or equal
Motor Type:	TEFC
Drive:	VFD
Electrical:	230 volt, three-phase

16. Acid Metering Pumps

Quantity:	2
Manufacturer:	Pulsafeeder or equal
Capacity:	0.009 - 0.036 gph
Motor type:	TEFC
Electrical:	115 volt, single-phase

17. Sludge Pumps (to Gravity Thickener)

Quantity:	2
Manufacturer:	Wilden Pumps or equal
Type:	Pneumatic

18. Sludge Pumps (to Filter Press)

Quantity:	2
Manufacturer:	Wilden Pumps or equal
Type:	Pneumatic

19. Filter Press

Manufacturer:	Hoffland Environmental or equal
Type:	Air-operated plate shifter
Capacity:	15 cubic feet
Height:	63 inches
Width:	41 inches
Length:	204 inches

20. Air Compressor

Quantity:	One
Manufacturer:	Speedaire or equal
Type:	Duplex design
Horsepower:	5 each
Tank Capacity:	120 gallons
Electrical:	230 volt, three-phase

21. Sump Pump

Quantity:	2
Manufacturer:	Goulds Pumps, Inc. or equal
Type:	Submersible
Casing Material:	316 stainless steel
Horsepower:	1/3
Electrical:	230 volt, single-phase

Controls/Gauges/Alarms

A. Controls

A complete programmable logic control (PLC) unit will be included for the metals pretreatment system to control pumping, mixing, chemical feed, sludge processing, and other processes. A description of each of these controls is as follows:

1. Level control in the equalization tank to control pumping and mixing. The level controls will be programmed to maintain a particular level in the equalization tank by varying the speed of the influent transfer pump drive.

2. Process and metering pumps to automatically switch over in case of failure.

3. Caustic and acid addition based upon pH measurement in clarifier feed tank and oxidation feed tank, respectively.

4. Polymer addition based upon flow into the clarifier feed tank.

5. Sludge transfer pumps to gravity thickener and sludge dewatering filter press based upon an adjustable timer.

6. Level control from the oxidation feed tank to control pumping and mixing. The level controls will be programmed to maintain a particular level in the oxidation feed tank by varying the speed of the oxidation feed pumps.

7. High pressure shut-off switch for the sludge transfer pumps to the filter press.

8. Air compressors to automatically switch over in case of failure.

9. Level control in the treatment system building sump and filter press room sump.

<u>B. Gauges</u>

1. Pressure gauges following all pumps.
2. Continuously recording flow measurement into the equalization tank.

3. Flow measurement into the clarifier feed tank.

C. Alarms

1. High and low level in the equalization tank.
2. High and low level in the oxidation feed tank.
3. Metering pump failure.
4. Mixer failure.
5. Air compressor failure.
6. Process pump failure.
7. High level in the treatment building sump and filter press room sump.
8. High discharge pressure on sludge pump.

3.3.4.2 Enhanced Oxidation Treatment System

Following pH adjustment to approximately 7.0 (neutral), the water from the oxidation feed tank metals will be pumped to the enhanced oxidation system. The enhanced oxidation system consists of two independent oxidation chambers each designed to accommodate a flow rate of 50 gpm, for a total flow of 100 gpm while removing organic compounds to meet the target effluent concentrations identified in Section 3.2. The enhanced oxidation process involves the use of high-powered lamps to emit UV radiation through a quartz sleeve onto a water stream, while an oxidizing agent, hydrogen peroxide is added and forms oxidizing radicals which destroy the organic compounds contained in the water. The organic compounds are removed from the water without the creation of vapor emissions. Below is a preliminary list of equipment, controls, gauges, and alarms to be provided as part of the enhanced oxidation system.

Equipment

1. Enhanced Oxidation System

Manufacturer:	Vulcan Peroxidation Systems, Inc. or equal
Model:	E-360
Number of Units:	2
Inlet/Outlet:	3-inch
Power Required:	360 kilowatts
Electrical:	480 volts, three-phase
Enclosure:	Nema 3R
Material (Wetted Parts):	Quartz, fluoropolymers
Material (External Parts):	Enameled steel
Shipping Weight:	12,500 pounds
Operating Weight:	13,800 pounds

2. Peroxide Storage Tank

Material:	Alloy 505A-H32
Diameter:	6 feet
Length:	16.5 feet
Capacity:	7,000 gallons
Operating Weight:	74,450 pounds

3. Peroxide Feed Pumps

Quantity:	2
Manufacturer:	Pulsafeeder or equal
Capacity:	As required by enhanced oxidation system
Motor Type:	TEFC
Electrical:	115 volt, single-phase

Controls/Gauges/Alarms

A. Controls

The enhanced oxidation system will be controlled via a touch-screen interface to a PLC. Controls will be provided to allow automatic operation of the following:

1. Individual UV lamps.
2. Chemical feed pumps.
3. Shut down of the enhanced oxidation system under certain alarm conditions.

4. Turn-on and shut-off of lamps with variations in flow.
5. Based upon an adjustable low-flow condition, the system will activate the opening and closing of a ball valve to recycle treated water back to the influent tank.
6. When the flow through the system is too low, a ball valve before the system will be activated to recycle flow back through to the equalization tank until the flow has built up sufficient volume for system operation.

B. Gauges

1. Temperature indicators.
2. Instantaneous and totalizing flow meters on each unit.

C. Alarms

1. High temperature in lamp drive enclosure.
2. Low water flow.
3. High water temperature.
4. Moisture in lamp and enclosure.
5. Access door opening.
6. Remote contact closure.
7. Low peroxide feed pressure.
8. Low peroxide splitter flow (if splitter is provided).
9. Overpressure relief flow.
10. Low oxidation chamber water level.
11. Tube cleaning system failure.
12. Lamp low current detection.
13. Lamp contactor failure.
14. Emergency stop.

15. Primary ground fault.

16. Secondary ground fault.

3.3.4.3 Liquid-Phase GAC Treatment System

The enhanced oxidation treatment system will discharge into a 3,000-gallon GAC feed tank and then will be pumped through two liquid-phase GAC units connected in series. Each liquid-phase GAC unit consists of two GAC vessels connected in parallel. The first GAC unit (No. 1) will be used to remove any organic compounds that may remain in the water following the enhanced oxidation treatment system. The treated water will then flow through a second GAC unit (No. 2) designed to remove any residual peroxide that remains in the water from the enhanced oxidation treatment system. GAC Unit No. 1 will be backwashable so that any accumulated solids can be backwashed to the equalization tank, as necessary.Each GAC unit is designed to operate at 50 gpm under normal operating conditions, but may operate at the design flow rate of 100 gpm during change-out of GAC in one of the units.

Equipment

1. Liquid-Phase GAC Unit No. 1

Manufacturer:	Calgon Carbon Corporation or equal
Model:	Model 4
Number of Units:	2
Carbon Capacity:	2,000 lbs. per adsorber
Carbon Type:	Fitrasorb 8 x 30 or equal
Diameter:	4 feet
Height:	11 feet
Skid Size:	7 feet x 9 feet, 3 inches
Operating Weight:	26,000 pounds

2. Liquid-Phase GAC Unit No. 2

Manufacturer:	Calgon Carbon Corporation or equal
Model:	Model 4
Number of Units:	2
Carbon Capacity:	1,000 lbs. per adsorber
Carbon Type:	Centaur 8 x 30 or equal

Diameter:	4 feet
Height:	11 feet
Skid Size:	7 feet x 9 feet, 3 inches
Skid Mounted Operating Weight:	26,000 pounds

3. GAC Feed Tank

Material:	Steel
Length:	8 feet
Width:	8 feet
Height:	8 feet
Capacity:	3,000 gallons

4. GAC Feed Pump

Quantity:	2
Manufacturer:	Goulds Pumps, Inc. or equal
Motor Type:	TEFC
Electrical:	230 volt, three-phase

Controls/Gauges/Alarms

A. Controls

1. Level control in the GAC feed tank to control pumping.
2. GAC feed pumps to automatically switch over in case of failure.

B. Gauges

1. Pressure gauges following pumps and each GAC unit.
2. Flow measurement into the GAC units.
3. Continuously recording flow measurement on effluent.
4. Continuously recording pH measurement on effluent.

C. Alarms

1. High and low level in GAC feed tank.
2. Pump failure.
3. Effluent pH out of range.
4. High GAC inlet pressure.

3.3.4.4 Air Treatment System

Volatilized organic compounds from process tanks and in the filter press room will be collected and treated by the air treatment system. All tanks, excluding the GAC feed tank, will be equipped with covers, with a vent that routes to the air treatment system consisting of a blower and vapor-phase GAC units. The blower will maintain the tanks at a slight negative pressure, which will prevent any fugitive emissions from entering the treatment building. The sludge dewatering filter press will be located in a separate room, which will be ventilated at a rate greater than the rest of the treatment system building. The entire filter press room will be vented to the same air treatment system. The blower discharge will pass through a set of two vapor-phase GAC units in parallel prior to entering the atmosphere. Additionally, there is an installed back-up blower that will automatically start-up should the primary blower go off-line. Organic compounds that may be present in the air treatment system will be removed in the vapor-phase GAC units and then discharged to the atmosphere.

Equipment

1. Blower

Quantity:	2
Manufacturer:	Hartzell or equal
Series:	052
Capacity:	700 cubic feet per minute (cfm) at 8 inches water column
Motor Type:	Explosion proof
Horsepower:	2
Electrical:	230 volt, three-phase

2. Vapor-Phase GAC Units

Quantity:	2
Manufacturer:	Carbtrol or equal
Model:	G-4
Carbon Capacity:	1,000 pounds
Diameter:	4 feet (approximate)
Inlet/Outlet:	4 inches

Control/Gauges/Alarms

A. Controls

Blowers to automatically switch over in case of failure.

B. Gauges

Differential pressure gauge.

C. Alarms

Blower failure (low discharge pressure).

3.3.5 Ground-Water Containment and Treatment System Operation

The operation of the ground-water containment and treatment system will be automated and controlled by instrumentation. The purpose of the controlling instrumentation is to provide a means for continuously monitoring the operation, recording key performance data, and initiating alarms in response to operational problems that could result in damage to facility equipment and/or the discharge of unacceptable effluent. To reduce the likelihood of these events, the system will be designed with alarms and sensors to minimize the degree of operator attention required. Major treatment process components are monitored by automated control instrumentation. The following alarm systems have been built into the instrumentation system:

Alarms		
A.	Ground-Water Containment System	
	High recovery well level	
B.	Metals Treatment System Alarms	
	1.	High and low level in equalization tank
	2.	High and low level in oxidation feed tank
	3.	Metering pump failure
	4.	Mixer failure
	5.	Air compressor failure
	6.	Process pump failure

Alarms		
	7.	High level in either treatment system building or filter press room sumps
	8.	High discharge pressure on sludge pumps
C.	Enhanced Oxidation System	
	1.	High temperature in lamp drive enclosure
	2.	Low water flow
	3.	High water temperature
	4.	Moisture in lamp and enclosure
	5.	Access door opening
	6.	Remote contact closure
	7.	Low peroxide feed pressure
	8.	Low peroxide splitter flow (if splitter is provided)
	9.	Overpressure relief flow
	10.	Low oxidation chamber water level
	11.	Tube cleaning system failure
	12.	Lamp low current detection
	13.	Lamp contactor failure
	14.	Emergency stop
	15.	Primary ground fault
	16.	Secondary ground fault
D.	Liquid-Phase GAC	
	1. High and low level in GAC feed tank	
	2. Pump Failure	
	3. Effluent pH out of range	
	4. High GAC inlet pressure	
E.	Air Treatment System	
	Blower failure (low discharge pressure)	
F.	Other	
	1.	Unauthorized access to treatment system building
2.	Power failure	

The intent of the above alarm systems is to detect conditions outside the range of routine activities and to notify the appropriate operating personnel via an autodialer notification system. The operating personnel will be responsible for responding appropriately to limit potential damage to facility equipment and to prevent discharge of unacceptable effluent.

Tables

Table 1

SRSNE Site
Southington, Connecticut

Ground Water Data Summary

Parameter	Recovery Well Development (mg/l)					Pumping Test (mg/l)
	RW-1	RW-2	RW-3	RW-4	RW-5	RW-2
A. Organic Parameters						
Volatile Organic Compounds						
Trichloroethene	<0.6	<1.5	<0.6	1.3	<0.03	<1.5
Benzene	<0.6	<1.5	<0.6	<0.15	<0.03	<1.5
Tetrachloroethene	<0.6	<1.5	<0.6	0.18	<0.03	<1.5
Toluene	10	16	6.4	3.1	0.17	15
Ethylbenzene	1.7	7.5	3.2	1.1	0.16	8.5
Total xylenes	0.6	2.0	1.4	1.2	0.06	2.5
Vinyl chloride	0.7	<1.5	<0.6	2.8	<0.03	<1.5
Chloroethane	2.8	<1.5	<0.6	<0.15	<0.03	<1.5
1,1-Dichloroethene	<0.6	<1.5	<0.6	<0.15	<0.03	<1.5
1,1-Dichloroethane	3.1	<1.5	<0.6	<0.15	<0.03	<1.5
Tetrahydrofuran	<0.6	5.5	<0.6	<0.15	<0.03	<1.5
cis-1,2-Dichloroethene	1.9	2.7	2.0	8.4	0.72	2.0
1,2-Dichloroethane	<0.6	<1.5	<0.6	<0.15	<0.03	<1.5
1,1,1-Trichloroethane	2.5	<1.5	<0.6	0.35	<0.03	<1.5
1,1,2-Trichloroethane	<0.6	<1.5	<0.6	<0.15	<0.03	<1.5
Methylene chloride	0.6	3.0	0.6	0.18	<0.03	2.5
Styrene	<0.6	<1.5	<0.6	<0.15	<0.03	<1.5
Alcohols						
Ethanol	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Methanol	1.0	<1.0	<1.0	<1.0	1.4	<1.0
2-Butanol (sec-Butanol)	<1.0	33	6.6	<1.0	<1.0	57
2-Propanol (Isopropanol)	<1.0	56	11	1.3	<1.0	89
Keytones						
Acetone	3.0	27	7.0	1.1	<0.1	36
2-Butanone (Methyl Ethyl Ketone)	10	24	5.0	<0.5	<0.03	40
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	<2.0	5.2	2.6	<0.5	<0.1	6.0

Table 1
(Cont'd)
SRSNE Site
Southington, Connecticut

Ground Water Data Summary

Parameter	Recovery Well Development (mg/l)					Pumping Test (mg/l)
	RW-1	RW-2	RW-3	RW-4	RW-5	RW-2
B. Inorganic Parameters						
Metals						
Arsenic, Total	0.003	0.007	0.002	0.003	0.006	0.004
Cadmium, Total	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper, Total	<0.02	<0.02	<0.02	<0.02	0.06	<0.02
Iron, Total	8.5	30	0.57	7.5	49	29
Lead, Total	0.003	0.022	0.082	0.002	0.018	0.003
Manganese, Total	3.8	3.1	<0.02	3.7	1.7	5.6
Nickel, Total	<0.03	0.05	<0.03	<0.03	0.07	<0.03
Zinc, Total	0.06	0.14	0.06	0.05	0.19	0.05
Other						
Total Suspended Solids (TSS)	180	1,200	35	64	2,400	42
pH (SU)	7.3	6.1	6.8	7.3	6.6	6.2
Conductivity (µmhos/cm)	660	1,660	755	335	560	1,765
Temperature (°F)	67	58	63	59	64	56

Notes:

1. mg/l = milligrams per liter.
2. SU = standard units.
3. µmhos/cm = microohms per centimeter.

Table 2

SRSNE Site
Southington, Connecticut

Treatment System Basis of Design

Parameter	Treatment System Influent Concentration (mg/l)	Treatment System Target Effluent Concentration (mg/l)	Substantive Requirements Effluent Limits (mg/l)
A. Organic Parameters			
Volatile Organic Compounds			
Trichloroethene	1.3 - 0.81	<0.005	3.0
Benzene	<0.58	<0.005	NL
Tetrachloroethene	0.58 - 0.18	<0.005	0.489
Toluene	16 - 7.1	<0.005	4.0
Ethylbenzene	8.5 - 2.7	<0.005	1.0
Total xylenes	2.5 - 1.0	<0.005	0.5
Vinyl chloride	2.8 - 1.1	<0.005	NL
Chloroethane	2.8 - 1.0	<0.005	NL
1,1-Dichloroethene	<0.58	<0.005	0.275
1,1-Dichloroethane	3.1 - 1.1	0.070	NL
Tetrahydrofuran	5.5 - 1.4	<0.020	0.5
cis-1,2-Dichloroethene	8.4 - 3.1	<0.005	5.0
1,2-Dichloroethane	<0.58	<0.007	0.25
1,1,1-Trichloroethane	2.5 - 1.0	0.26	4.0
1,1,2-Trichloroethane	<0.58	<0.014	0.25
Methylene chloride	3.0 - 0.88	0.095	15.0
Styrene	<0.58	<0.005	0.5
Alcohols			
Ethanol	<1.0	<1	20.0
Methanol	1.4 - 1.1	<1	30.0
2-Butanol (sec-Butanol)	57 - 8.5	<1	10.0
2-Propanol (Isopropanol)	89 - 14	<1	10.0
Keytones			
Acetone	36 - 7.6	0.63	35.0
2-Butanone (Methyl Ethyl Ketone)	40 - 7.9	<0.04	10.0
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	6 - 2.1	<0.02	2.0

Table 2
(Cont'd)
SRSNE Site
Southington, Connecticut

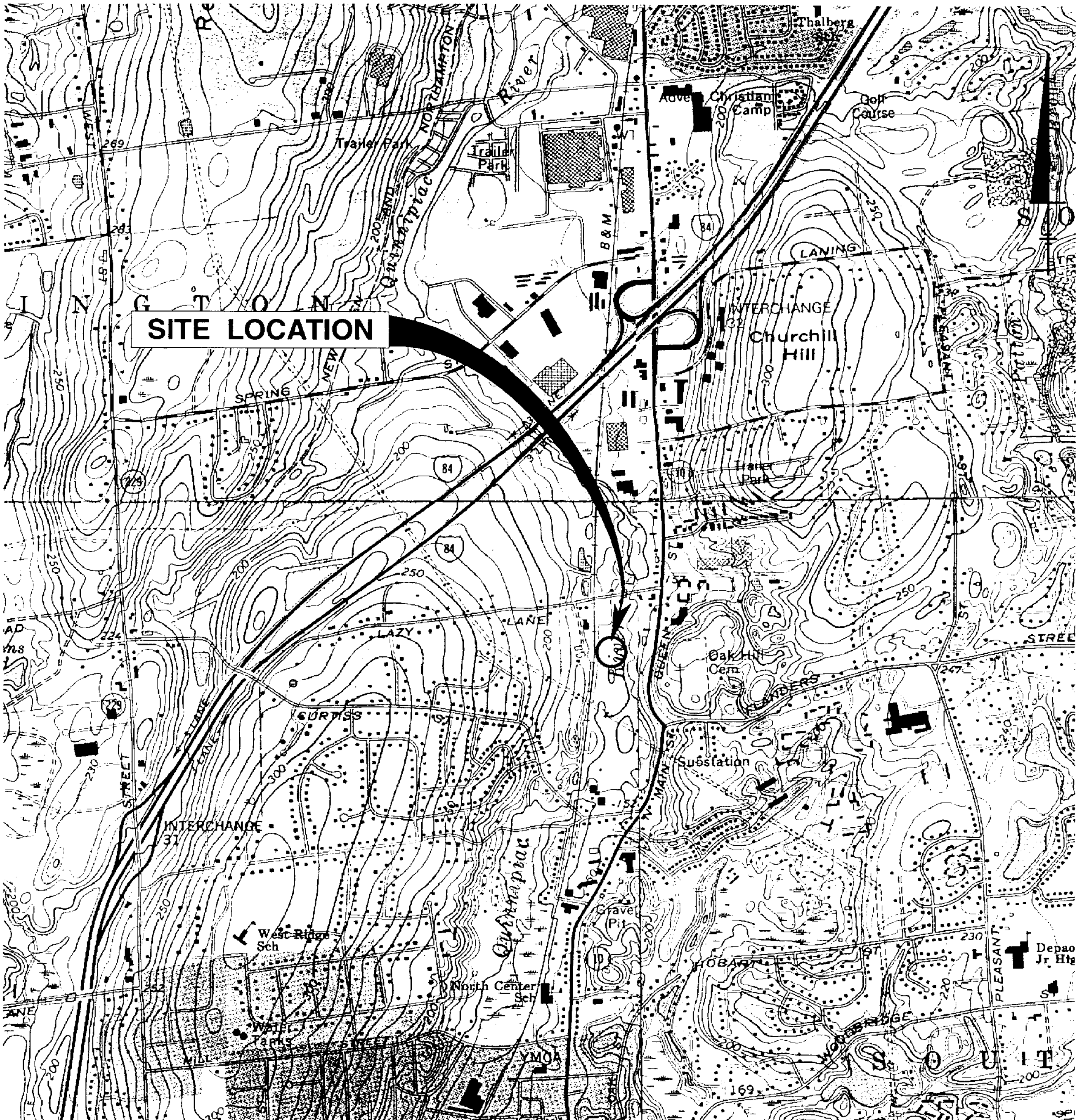
Treatment System Basis of Design

Parameter	Treatment System Influent Concentration (mg/l)	Treatment System Target Effluent Concentration (mg/l)	Substantive Requirements Effluent Limits (mg/l)
B. Inorganic Parameters			
Metals			
Copper, Total	0.06 - 0.005	<0.133	0.133
Iron, Total	49 - 24	<5.0	5.0
Lead, Total	0.082 - 0.025	<0.029	0.029
Nickel, Total	0.07 - 0.004	<0.5	0.5
Zinc, Total	0.19 - 0.011	<0.342	0.342
Other			
Total Suspended Solids (TSS)	--	<30	30.0
Peroxide	--	<3	6.0
pH (SU)	--	6.0 - 9.0	6.0 - 9.0

Notes:

1) mg/l = milligrams per liter.
2) SU = standard units.
3) NL = no limit.

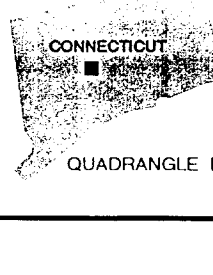
Figures



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

2000' 0 2000'

APPROX. SCALE: 1" = 2000'



QUADRANGLE LOCATION

11/94 D54-JVM
0832501/08325N01.cdr

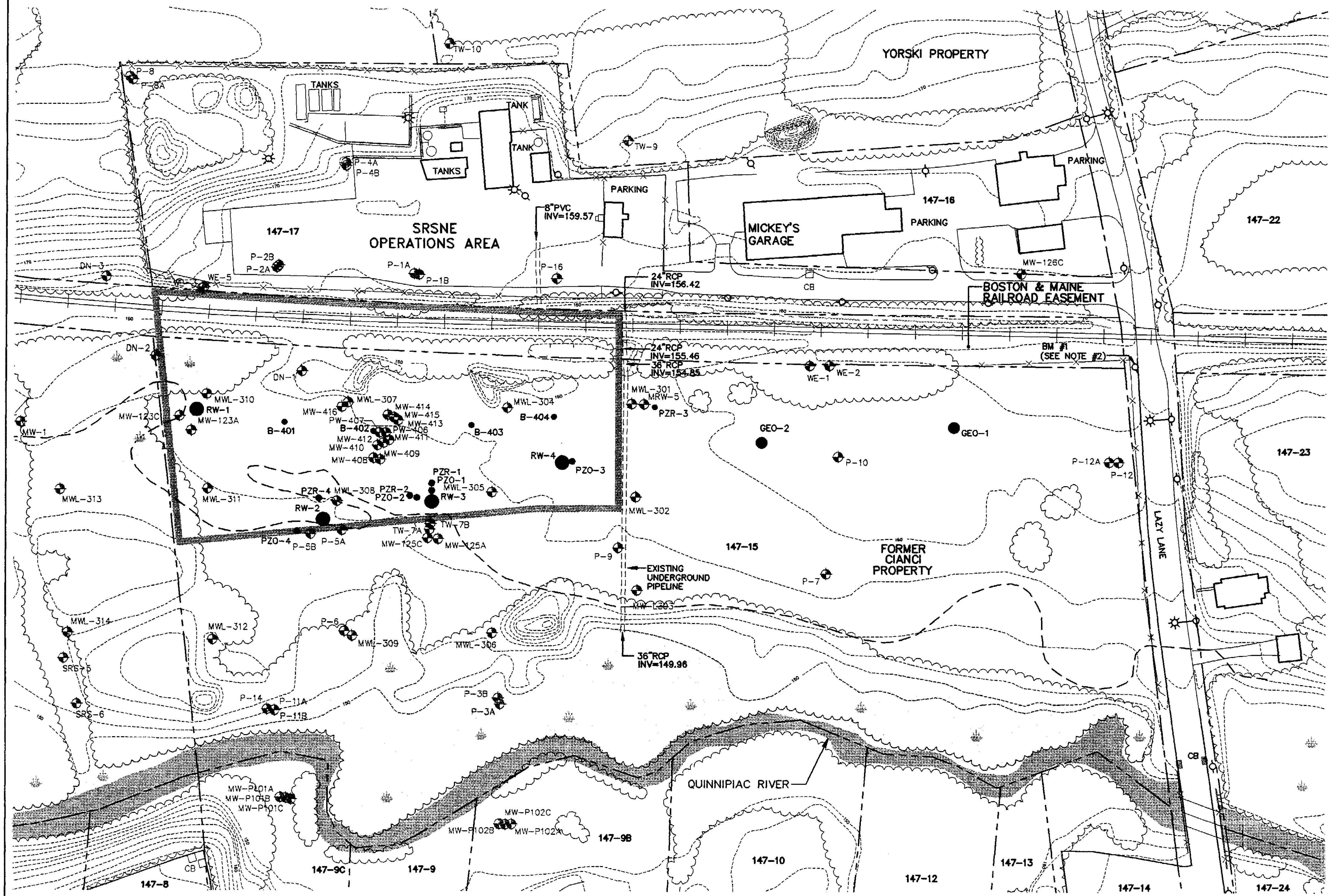
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NON-TIME-CRITICAL REMOVAL ACTION

SITE LOCATION MAP

FIGURE
1



LEGEND

- PROPERTY LINE
- 100-YEAR FLOOD LIMIT
- WATER
- RIVER
- WETLAND
- P-10 MONITORING WELL
- PZR-3 PIEZOMETER
- RW-5 RECOVERY WELL
- CONTAINMENT AREA
- 147-15 TAX MAP NUMBER
- EXISTING STRUCTURE
- VEGETATION
- EXISTING CONTOUR
- FENCE
- UTILITY POLE
- LIGHTING

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).
4. THE LOCATION OF EXISTING WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

VIEW: 50
LAYER: ON=*; OFF=G1,A1,REF
XREF: 08325X05
12/94-54 PMC AK
08325001/08325C19.DWG

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

No.	Date	Revisions	Init

In charge of ________
Designed by ________
Drawn by ________
Checked by ________

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS
SYRACUSE, NEW YORK

SRSNE PRP GROUP • SOUTHINGTON, CONNECTICUT

NON-TIME-CRITICAL REMOVAL ACTION
SRSNE SITE

EXISTING SITE PLAN

File Number 083.25
Date DECEMBER 1994

FIGURE 2

Appendices

Appendix A

Ground-Water Containment System Investigation Results

I. Introduction and Background

This appendix describes the implementation of and results from the NTCRA ground-water containment system design investigation for the SRSNE Site. This field investigation, performed by BB&L, included installation of five overburden ground-water recovery wells that will become part of an overburden ground-water containment system to be installed downgradient of the SRSNE Operations Area. This investigation also provided hydrogeologic data to supplement the relatively comprehensive pre-existing hydrogeologic database and to support numerical modeling of the containment system design.

Hydrogeologic data obtained at the former Cianci property by HNUS (May 1994) and ENSR (June 1994) include:

- Geologic data for the stratified overburden and weathered top of bedrock;
- Hydraulic conductivity based on slug and packer tests; and
- Ground-water and soil analytical results.

The geologic data base indicates that the overburden materials are texturally consistent, consisting of mainly red silty sand or sandy silt. Basal till may be distinguished from the overlying glacial outwash deposits primarily based on an increase in standard penetration blowcounts. The weathered, friable top of the New Haven Arkose bedrock is substantially decomposed, so that split-spoon samplers can be used to obtain samples of the weathered rock. The weathered rock can be distinguished from the overlying till by an additional increase in blowcounts, a higher mica content, and apparent relict fluvial bedding. The contacts between the outwash and the till, or the till and the weathered bedrock, are relatively non-distinct, however, and are subject to interpretation.

Overburden and bedrock hydraulic conductivities range by approximately three orders of magnitude each, and indicate moderately low overall permeability (HNUS, May 1994; ENSR, June 1994). The overburden hydraulic conductivity, based on slug test results, is highly variable, ranging from 95 to 0.04 feet per day (ft/d) [3×10^{-2} to 1×10^{-5} centimeter per second (cm/sec)], with a geometric mean of 1.8 ft/d (6×10^{-4} cm/sec). The bedrock conductivity, based on packer test results, ranges from 8 to 0.01 ft/d (3×10^{-3} to 4×10^{-6} cm/sec), with a geometric mean of 0.4 ft/d (1×10^{-4} cm/sec).

Ground-water and soil analytical results for samples obtained downgradient of the SRSNE Operations Area indicate detectible concentrations of organic compounds. An organic compound plume in the overburden has been interpreted as extending from the Operations Area eastward through the former Cianci property (HNUS, May 1994). Based on this interpretation, a Containment Area was delineated downgradient of the Operations Area. This appendix presents the Basis of Design for the containment system, which will be implemented within the Containment Area to hydraulically control overburden ground water migratiing eastward from the Operations Area.

The NTCRA field investigation, which was performed between September 20 and October 14, 1994, included the following activities:

- The installation of two geotechnical soil borings (GEO-1 and GEO-2) to characterize the unconsolidated deposits in the vicinity of the proposed treatment system building;

- The installation and development of five overburden ground-water recovery wells (RW-1 through RW-5), four overburden piezometers (PZO-1 through PZO-4), and four bedrock piezometers (PZR-1 through PZR-4); and

- The completion of a step-drawdown test and a constant-rate pumping test using new Recovery Well RW-2.

The locations of the soil borings, wells, and piezometers installed during the NTCRA field investigation are shown on Figure A-1 in this appendix and Figure 2 of this report. The implementation of and results from the field activities, as well as a description of the modeling process and results, are presented in detail below.

II. Soil Boring and Well Installation Activities

Two geotechnical borings, GEO-1 and GEO-2, were installed to assess the surface geotechnical conditions of the unconsolidated deposits in the vicinity of the proposed ground-water treatment system. These boring locations are shown on Figure 2 of this report. The geotechnical soil borings provided standard penetration test data (split-spoon blowcounts) to be used in the treatment system building design. These two borings were installed in accordance with the standard penetration test (ASTM D-1586) by BB&L's contractor, East Coast-Thomas Environmental of Wallingford, Connecticut, on September 21 and September 22, 1994. The overburden deposits, which consisted of red-brown, silty, sandy outwash and a slightly denser sandy silt unit interpreted as till, were comparable to the soil descriptions from previous field investigations at the site (HNUS, May 1994; ENSR, June 1994). Weathered bedrock fragments retained in the split-spoon sampler were composed of friable red sandstone. Detailed descriptions of the surface materials encountered at borings GEO-1 and GEO-2 are provided on the surface logs presented in Attachment A-1.

Other work elements performed during the NTCRA field investigation included the installation of five overburden ground-water recovery wells and eight piezometers to provide additional hydrogeologic data in the Containment Area. The additional hydrogeologic data were used to help design a numerical (MODFLOW) ground-water flow model, which was used to identify an appropriate remedial alternative for controlling overburden ground water within the Containment Area. Five recovery wells, RW-1 through RW-5, were installed by East Coast-Thomas Environmental between September 27 and October 5, 1994. The recovery well boreholes were advanced using 18-inch (RW-1, RW-2, RW-3, and RW-5) or 12-inch (RW-4) outside-diameter hollow-stem augers. The recovery wells were constructed with a 15-foot-long, 6-inch-diameter, continuous-wound, 0.020-inch-slot stainless steel screen set at or near the top of the weathered

New Haven Arkose bedrock. A 6-inch-diameter Schedule 80 PVC riser pipe was installed from the top of the screen to above ground surface. A Morie #0 filter pack was placed in the borehole annulus from the bottom of the screen to approximately 5 feet below ground surface. The remainder of the well construction consisted of a 2-foot-thick hydrated bentonite pellet seal placed above the filter pack and an 8-inch-diameter locking steel protective casing placed around the recovery, well set in a cement surface seal. Recovery Well RW-3 was installed in an area that may contain dense, non-aqueous phase liquids (DNAPLs) in the overburden, based on the results of previous investigations (ENSR, June 1994, Vol. III). Based on this interpretation, RW-3 was installed with a 4-foot-long stainless steel blank sump at the base of the 15-foot well screen and set 5 feet into the bedrock to promote the collection of DNAPL, if any, that may enter the filter pack during pumping. A calculated volume of neat cement was piped using the tremie method into the bottom of the borehole to completely surround the 4-foot-long sump, and a conical cement basket was installed at the top of the sump within the well-borehole annulus. Recovery well construction details are presented on the surface logs included in Attachment A-1.

Four overburden piezometers and four bedrock piezometers were installed by East Coast-Thomas at the locations shown on Figure A-1. These piezometers were installed to provide additional monitoring locations to measure hydraulic responses during pumping of the new recovery well(s). Each piezometer was constructed of 2-inch-diameter, Schedule 40 PVC, and a 5-foot-long, 0.010-inch-slot PVC screen. Overburden Piezometers PZO-1 through PZ0-4 were installed with the screened section placed approximately in the center of the overburden as measured from the water table to the top of bedrock. Bedrock Piezometers PZR-1 through PZR-4 were installed with the top of the screened section 5 feet below the top of the bedrock. Each piezometer was installed with a filter pack consisting of Morie #0 sand from the bottom of the screen to approximately one foot above the screen, a 2-foot-thick hydrated bentonite seal, and cement-bentonite grout in the remainder of the borehole annulus. Each piezometer was completed with a 4-inch-diameter, locking, steel protective casing set in a cement surface seal. Piezometer construction details are presented on the subsurface logs included in Attachment A-1. These piezometers were developed using a centrifical pump; ground water was purged from each piezometer until the water was relatively silt free. All purge water was discharged into an on-site liquid-waste containment tank.

III. Recovery Well Development and Hydraulic Evaluation

Recovery well development was conducted in two stages. The first stage of development consisted of surging the well with a 5-inch-diameter surge block for approximately two hours. The second stage of development consisted of a three- to five-hour hydraulic evaluation, during which the well was pumped at a relatively constant purge rate, and water levels were monitored at the piezometers and/or wells in the vicinity, as well as in the pumping well, to estimate the hydraulic coefficients of the surrounding formation. The pumping rate differed at each recovery well location from approximately one gpm at Well RW-5 to 5 gpm at RW-4. The discharge water was pumped directly into an on-site liquid-waste containment tank. Prior to the end of each test, a ground-water sample was collected from the discharge line and was submitted for laboratory analysis of total suspended solids and selected organic compounds, ketones, alcohols, and metals.

A tabulated and graphical summary of the recovery well development hydraulic evaluations at the five new recovery wells is presented in Attachment A-2. These evaluations provided an initial, order-of-magnitude estimate of the aquifer transmissivity (generally between 60 and 600 square feet per day) and the potential yield at each new recovery well (in the range of one to 5 gpm).

IV. Recovery Well RW-2 Pumping Tests

While Recovery Well RW-3 had initially been targeted for pump testing because of its central location within the Containment Area and the presence of several nearby existing observation wells, Well RW-3 yielded less flow than Well RW-2 (approximately 2 gpm, compared to 4 gpm) during development testing. Recovery Well RW-2 was selected for pumping during the 48-hour constant-rate pumping test, therefore, because of its higher yield, central location within the Containment Area, and the existing array of nearby monitoring wells.

Prior to the 48-hour test, an 8-hour step-drawdown test was performed at Well RW-2 to assess the sustainable pumping rate for the 48-hour test. The step-drawdown test was run in five stages at pumping rates increasing one gpm per stage, from one gpm through 5 gpm, for 1.5-hour periods. To provide a qualitative assessment of the hydraulic effect in the aquifer during the step test, drawdown data were monitored at the following locations: RW-2 (27.3 feet of total drawdown), P-5A (1.5 feet), P-5B (0.16 feet), PZO-1 (0.15 feet), PZR-1 (1.3 feet), PZO-2 (0.56 feet), PZR-2 (1.4 feet), PZO-4 (2.0 feet), PZR-4 (4.1 feet), and RW-3 (1.1 feet).

A graphical summary of the drawdown inside Well RW-2 during the step-drawdown test is provided in Attachment A-3. The drawdown versus time plot from Well RW-2 shows that, following an initially rapid drawdown response, the temporal drawdown trend during each pumping step became linear with respect to the logarithm of time. The linear drawdown versus time trend would be expected in any constant-rate discharge scenario in the absence of hydraulic boundaries or leakage. The linear slope of drawdown versus time became steeper and steeper with increasing discharge from Well RW-2. The straight-line trends in drawdown versus time provided a basis for assessing the temporal drawdown during long-term pumping from Well RW-2 for various rates of discharge between one and 5 gpm. The straight-line time-drawdown trend observed during pumping at 2 gpm (Step 2) suggested that, after 48 hours (2880 minutes) of pumping, the drawdown inside RW-2 (assuming no aquifer boundary conditions or leakage) would be expected to be approximately 20 to 25 feet. While this analysis suggests that a rate of 2 gpm may be sustainable at RW-2 through the duration of the 48-hour constant-rate test, a rate of 1.8 gpm was selected to be more conservative and allow greater confidence that the well would not be pumped dry during the test.

After the completion of the step-drawdown test, pressure transducers were installed at Wells RW-2, MW-125C, MWL-308, MWL-309, MW-408, MW-409, P-5A, and TW-7A, and at Piezometers PZO-2, PZR-2, PZO-4, and PZR-4, for use during the 48-hour constant-rate test. Prior to starting the constant-rate pumping test, manual water-level readings were measured at each of the transducer-monitored wells and at several wells selected for manual monitoring, including: MW-123C, MW-125A, MWL-307, MWL-311, MW-410, MW-411, MW-412, MW-416, TW-7B, P-2A, P-2B, P-5B, and P-16.

During the 48-hour constant-rate pumping test, Well RW-2 was pumped at a rate of approximately 1.8 gpm, which was monitored frequently using an in-line totalizing flow meter (Table A-1). The totalizer readings were confirmed by flow-rate measurements obtained using a calibrated bucket and stopwatch. On-site barometric pressure and cumulative precipitation measurements were also recorded at regular intervals throughout the test (Table A-2). Shortly prior to the termination of pumping, a ground-water sample was collected from the RW-2 discharge line and was mitted for analysis of total suspended solids and selected VOCs, ketones, alcohols, and metals. At the instant the pump was shut off in RW-2, recovery-phase data acquisition began. During the recovery phase, water levels were measured in the same wells monitored during the pumping phase. The recovery phase was terminated after 24 hours of recovery.

Drawdown/recovery hydrographs from wells and piezometers monitored manually, or with transducers and dataloggers are presented in Attachment A-4. These data show that drawdown/recovery responses were observed in the overburden as well as the bedrock during pumping from Well RW-2, which was installed to the top of bedrock to fully penetrate the overburden and the till. The drawdown responses suggest that ground water was being extracted from the overburden as well as from the bedrock, precluding a detailed quantification of the hydraulic coefficients of any individual zone. The hydraulic responses measured at the observation wells/piezometers do provide an empirical demonstration of the hydraulic effectiveness of a single, fully penetrating, vertical pumping well, and provide a basis for a semi-quantitative analysis of flow-system dynamics during pumping.

Drawdown/recovery responses can be separated into the following three groups, based on the magnitude of drawdown, which appears to be a function of the position of the well/piezometer within the hydrogeologic flow regime: 1) water-table zone; 2) lower outwash/till; and 3) bedrock (Attachment A-4). Distance-drawdown plots were also prepared to show the empirical configuration of the potentiometric cone-of-depression in each of these three zones within the flow system (Attachment A-5). The drawdown/recovery responses were reasonably systematic, with greater potentiometric response within each zone observed at wells/piezometers near Recovery Well RW-2, and lesser drawdown/recovery responses observed with increasing distance from Well RW-2. The magnitude of the drawdown/recovery response differed considerably at different depths within the saturated zone. At a distance of approximately 20 feet from Well RW-2, the drawdown after 48 hours of pumping was approximately 0.3 feet in the water-table zone (Well MWL-308), 2 feet in the lower outwash/till zone (Piezometer PZO-4), and 4.6 feet in the bedrock (Piezometer PZR-4).

The general lack of potentiometric drawdown in the uppermost portion of the saturated zone, near the water table, is interpreted as the result of the hydraulic interaction between the vertical orientation of Well RW-2 with the horizontally stratified overburden deposits. Following the dewatering of the uppermost permeable strata at the contact between the recovery well borehole and the formation, no additional drawdown can be established at the water table due to continued pumping and drawdown inside the recovery well. In contrast, the lower portions of the overburden and the bedrock do not dewater at the contact between the recovery well borehole and the formation, but continue to draw down potentiometrically as the water level declines in the recovery well.

While the simultaneous pumping from multiple stratigraphic units (the water table zone, lower outwash/till, and bedrock) precludes quantification of the hydraulic parameters of each individual unit, drawdown responses at select wells/piezometers relatively near Recovery Well RW-2 have been evaluated by the Jacob method (*in*, e.g., Kruseman and deRidder, 1990) to provide an estimate of the bulk transmissivity and average hydraulic conductivity of the entire water-bearing zone, including the saturated overburden and the upper portion of the bedrock (Attachment A-6). With the exception of Piezometer PZO-4 (which was within the distance range where partial penetration could affect the drawdown response), the transmissivity (T) values estimated from the Recovery Well RW-2 constant-rate test were within the range of 0.03 to 0.08 square feet per minute (40 to 120 square feet per day). Assuming the total thickness (B) of the waterbearing zone consisted of approximately 27 feet of saturated overburden and the top 30 feet of bedrock, the average conductivity ($K = T/B$) of this 57-foot-thick composite flow system is estimated as 0.7 to 2.1 ft/d (2×10^{-4} to 7×10^{-4} cm/sec). This range of K values is similar to the overall geometric mean K for overburden (1.8 ft/d, or 6×10^{-4} cm/sec) and bedrock (0.4 ft/d, or 1×10^{-4} cm/sec), based on previous investigations (Table A-4). These results suggest that Recovery Well RW-2 is installed in a zone of average permeability, in contrast to a more permeable zone interpreted in the center of the Containment Area (ENSR, June 1994).

Tables

TABLE A-1

PUMPING RATE DATA
RW-2 PUMPING TEST, OCTOBER 11-14, 1994

NTCRA BASIS OF DESIGN
SRSNE SITE - SOUTHINGTON, CONNECTICUT

Date	Time	Test Running Time (min)	Totalizer Reading (gal)	Interval Pumping Rate Rate (gpm)	Test Average Pumping Rate (gpm)
10/11/94	10:00:00	0	5730.4		
10/11/94	10:05:00	5	5740.1	1.94	1.94
10/11/94	10:10:00	10	5748.6	1.70	1.82
10/11/94	10:15:00	15	5757.6	1.80	1.81
10/11/94	10:20:00	20	5766.6	1.80	1.81
10/11/94	10:25:00	25	5775.4	1.76	1.80
10/11/94	10:30:00	30	5784.2	1.76	1.79
10/11/94	10:35:00	35	5792.9	1.74	1.79
10/11/94	10:40:00	40	5802.0	1.82	1.79
10/11/94	10:45:00	45	5810.9	1.78	1.79
10/11/94	10:50:00	50	5819.4	1.70	1.78
10/11/94	10:55:00	55	5828.0	1.72	1.77
10/11/94	11:00:00	60	5836.8	1.76	1.77
10/11/94	12:00:00	120	5941.4	1.74	1.77
10/11/94	13:00:00	180	6047.0	1.76	1.77
10/11/94	14:00:00	240	6152.5	1.76	1.77
10/11/94	15:00:00	300	6257.9	1.76	1.77
10/11/94	16:00:00	360	6363.0	1.75	1.77
10/11/94	17:00:00	420	6469.3	1.77	1.77
10/11/94	18:00:00	480	6574.4	1.75	1.77
10/11/94	19:00:00	540	6688.7	1.91	1.77
10/11/94	20:00:00	600	6782.7	1.57	1.76
10/11/94	21:00:00	660	6886.3	1.73	1.76
10/11/94	22:00:00	720	6991.0	1.75	1.76
10/11/94	23:00:00	780	7107.3	1.94	1.77
10/12/94	00:00:00	840	7201.7	1.57	1.76
10/12/94	01:00:00	900	7308.8	1.79	1.76
10/12/94	02:00:00	960	7416.3	1.79	1.76
10/12/94	03:00:00	1020	7522.1	1.76	1.76
10/12/94	04:00:00	1080	7629.8	1.80	1.76

TABLE A-1

PUMPING RATE DATA
RW-2 PUMPING TEST, OCTOBER 11-14, 1994

NTCRA BASIS OF DESIGN
SRSNE SITE - SOUTHINGTON, CONNECTICUT

Date	Time	Test Running Time (min)	Totalizer Reading (gal)	Interval Pumping Rate Rate (gpm)	Test Average Pumping Rate (gpm)
	05:00:00	1140	7736.2	1.77	1.76
10/12/94	06:00:00	1200	7842.2	1.77	1.76
10/12/94	07:00:00	1260	7948.9	1.78	1.77
10/12/94	08:00:00	1320	8053.0	1.74	1.76
10/12/94	09:00:00	1380	8159.1	1.77	1.76
10/12/94	10:00:00	1440	8264.8	1.76	1.76
10/12/94	11:00:00	1500	8371.2	1.77	1.76
10/12/94	12:00:00	1560	8482.5	1.86	1.77
10/12/94	13:00:00	1620	8590.0	1.79	1.77
10/12/94	14:00:00	1680	8706.7	1.95	1.77
10/12/94	15:00:00	1740	8803.3	1.61	1.77
10/12/94	16:00:00	1800	8919.5	1.94	1.77
10/12/94	17:00:00	1860	9024.8	1.76	1.77
10/12/94	18:00:00	1920	9129.2	1.74	1.77
10/12/94	19:00:00	1980	9222.9	1.56	1.77
10/12/94	20:00:00	2040	9326.5	1.73	1.77
10/12/94	21:00:00	2100	9430.1	1.73	1.76
10/12/94	22:00:00	2160	9533.7	1.73	1.76
10/12/94	23:00:00	2220	9637.4	1.73	1.76
10/13/94	00:00:00	2280	9741.0	1.73	1.76
10/13/94	01:00:00	2340	9844.3	1.72	1.76
10/13/94	02:00:00	2400	9947.6	1.72	1.76
10/13/94	03:00:00	2460	10051.6	1.73	1.76
10/13/94	04:00:00	2520	10155.5	1.73	1.76
10/13/94	05:00:00	2580	10259.6	1.74	1.76
10/13/94	06:00:00	2640	10363.7	1.74	1.76
10/13/94	07:00:00	2700	10468.1	1.74	1.76
10/13/94	08:00:00	2760	10571.5	1.72	1.76
10/13/94	09:00:00	2820	10675.0	1.73	1.76
10/13/94	10:00:00	2880	10778.6	1.73	1.76

Notes:

Pump on @ 10:00, October 11, 1994.
Pump off @ 10:00, October 13, 1994.

TABLE A–2

BAR]OMETRIC PRESSURE AND RAINFALL DATA
RW–2 PUMPING TEST, OCTOBER 11–14, 1994

NTCRA BASIS OF DESIGN
SRSNE SITE – SOUTHINGTON, CONNECTICUT

Date	Clock Time	Test Running Time (min)	Barometric Pressure (Hg) On–Site Readings (1)	Barometric Pressure (Hg) On–Site Readings (2)	Cumulative Precipitation
10/11/94	09:43:00	–17	30.28	30.28	0.0
10/11/94	12:10:00	130	30.28	30.19	0.0
10/11/94	14:00:00	240	30.26	30.05	0.0
10/11/94	16:00:00	360	30.28	30.10	0.0
10/11/94	19:10:00	550	30.34	30.26	0.0
10/12/94	00:28:00	868	30.36	30.39	0.0
10/12/94	02:30:00	990	30.37	30.44	0.0
10/12/94	06:30:00	1230	30.40	30.45	0.0
10/12/94	10:00:00	1440	30.49	30.03	0.0
10/12/94	14:00:00	1680	30.45	30.22	0.0
10/12/94	16:00:00	1800	30.41	30.39	0.0
10/12/94	22:00:00	2160	30.42	30.44	0.0
10/13/94	02:00:00	2400	30.34	30.40	0.0
10/13/94	06:00:00	2640	30.32	30.40	0.0
10/13/94	09:40:00	2860	30.38	30.30	0.0
10/13/94	13:23:00	3083	30.33	NA	0.0
10/13/94	14:00:00	3120	30.27	NA	0.0
10/14/94	08:16:00	4216	30.13	NA	0.0

barprep––DWL

TABLE A-3

SUMMARY OF HYDROGEOLOGIC DATABASE
NTCRA GROUND-WATER CONTAINMENT SYSTEM BASIS OF DESIGN
SRSNE SITE – SOUTHINGTON, CONNECTICUT

Location	Easting (X)	Northing (Y)	Ground Surface Elev.	Depth to Till	Depth to Rock	Till Elev.	Rock Elev.	Water Table 10/93	Rock Piez. Surf. 10/93	Water Table 5/93	Rock Piez. Surf. 5/93	MODFLOW Model Layer Data: Layer 1 Top	Layer 1 Bottom	Layer 2 Top	Layer 2	Layer 3 Top	Layer 3	Layer 4 Top	Layer 4 Bottom	Overburden Conductivity (ft/d)	Bedrock Conductivity (ft/d)	Well Depth	Well Formation
B-401	565281	286230	156.66	16	21	140.7	135.7					156.7					135.7	135.7	105.7				
B-402	565290	286324	157.7	17.5	20	140.2	137.7					157.7					137.7	137.7	107.7				
B-403	565283	286428	158.05	15	22	143.1	136.1					158.1			143.1	143.1	136.1	136.1	106.1				
B-404	565274	286515	158.81	19	20	139.8	138.8					158.8			139.8	139.8	138.8	138.8	108.8				
B-405	565304	286618	159.32	18.5	26	140.8	133.3					159.3			140.8	140.8	133.3	133.3	103.3				
PW-406	565291	286337	157.71		24		133.7					157.7					133.7	133.7				50.17	
PW-407	565291	286331	157.43									157.4										18	OW
MW-408	565318	286324	156.98	18.5	26.5	138.5	130.5					157			138.5	138.5	130.5	130.5	100.5	2.4		51.6	R
MW-409	565320	286332	157.14									157.1										16.7	OW
MW-410	565305	286329	157.04									157								13.6		12.1	OW
MW-411	565299	286341	157.22	15	24	142.2	133.2					157.2			142.2	142.2	133.2	133.2	103.2			51.3	R
MW-412	565302	286335	157.13									157.1								2.2		21.3	OW/T
MW-413	565278	286350	158									158								8.8		19.8	OW
MW-414	565273	286339	158.29	22.5	25.4	135.8	132.9					158.3			135.8	135.8	132.9	132.9	102.9			50.2	R
MW-415	565275	286346	158.15									158.2										11.8	OW
MW-416	565264	286291	157.42	18.5	25	138.9	132.4					157.4			138.9	138.9	132.4	132.4	102.4	0.18		49.4	R
B-1	565031	286419	166.92	7.5	13.5	159.4	153.4					166.9			159.4	159.4	153.4	153.4	123.4				
B-3	565436	286110	150.35		42		108.4					150.4					108.4	108.4	78.35				
B-4	565036	286607	167.08	13	16.3	154.1	150.8					167.1			154.1	154.1	150.8	150.8	120.8				
B-5	565015	286370	166.95	5		162						167			162	162							
B-7	565032	286386	166.89	7		159.9						166.9			159.9	159.9							
B-8	565103	286209	166.69	8.5	10.5	158.2	156.2					166.7			158.2	158.2	156.2	156.2	126.2				
B-11	565362	286586	157.78	26	30	131.8	127.8					157.8			131.8	131.8	127.8	127.8	97.78				
B-12	565455	286583	156.3	18	26	138.3	130.3					156.3			138.3	138.3	130.3	130.3	100.3				
B-13	565518	287127	154.82	22	33	132.8	121.8					154.8			132.8	132.8	121.8	121.8	91.82				
B-14	565095	286283	166.56	12	13	154.6	153.6					166.6			154.6	154.6	153.6	153.6	123.6				
B-16	565089	286347	166.51	9	15.5	157.5	151					166.5			157.5	157.5	151	151	121				
MW-121A	565539	285834	150.51									150.5									0.52	95	R
MW-121B	565532	285817	150.96	53	55	97.96	95.96	146.5		148.2		151	141.5	141.5	97.96	97.96	95.96	95.96	65.96			52	OW
MW-121C	565535	285826	151.12									151.1										68.7	R
MW-123A	565280	286128	156.33						155.9		158.5	156.3									0.7	85	R
MW-123C	565274	286126	156.72	16	32	140.7	124.7	152.9		155.4		156.7	147.9	147.9	140.7	140.7	124.7	124.7	94.72	0.24		15	OW
MW-124C	565238	285852	155.98	27.5	33	128.5	123		152.4		158.5	156			128.5	128.5	123	123	92.98		0.02	45.9	R
MW-125A	565403	286393	155.83	25	35	130.8	120.8		155.29		156.26	155.8			130.8	130.8	120.8	120.8	90.83		3	65	R
MW-125C	565402	286382	155.97									156										50.5	R
MW-126B	565124	287008	162.79							159.9		162.8								95		12.5	OW
MW-126C	565123	287011	162.78		21		141.8				161.82	162.8					141.8	141.8	111.8		3.5	34	R
MW-127B	565403	285087	147.86	47.5	90	100.4	57.86	146.1		147.1		147.9	141.1	141.1	100.4	100.4	57.86	57.86	27.86	59		47	OW
MW-127C	565404	285081	147.58									147.6									0.32	101.5	R
MW-128	565211	285319	155.43	38	52	117.4	103.4		146.45		148.71	155.4			117.4	117.4	103.4	103.4	73.43		0.016	65	R
MW-129	564223	287053	227.54	4.5	10.5	223	217	222.4	222.36	224.9	224.86	227.5	221	221	218.8	218.8	217	217	187		0.1	23.85	R
MW-201A	565732	287690	154.29						148.64		149.02	154.3									0.14	64	R
MW-201B	565737	287694	154.48	42.5	47.5	112	107	148.9		148.5		154.5	143.9	143.9	112	112	107	107	76.98			20	OW
MW-202A	566031	287225	156.25						148.02		150.41	156.3										129	R
MW-202B	566037	287225	156.28	79	114	77.28	42.28	148.2		149.8		156.3	143.2	143.2	77.28	77.28	42.28	42.28	12.28			92.5	OW
MW-203A	566355	285360	188.78						148.65		152.75	188.8										160	R
MW-203B	566351	285359	188.47	104	150	84.47	38.47	148.6		152.7		188.5	143.6	143.6	84.47	84.47	38.47	38.47	8.47			105	OW
MW-204A	565669	285566	148.83						146.64		148.41	148.8										114	R
MW-204B	565652	285569	148.74	79	84	69.74	64.74	146.4		148.2		148.7	141.4	141.4	69.74	69.74	64.74	64.74	34.74			78	OW
MW-205A	565559	284997	150.29						145.75		146.48	150.3									0.18	133.5	R
MW-205B	565551	284992	149.96	84	124	65.96	25.96	145.8		146.6		150	140.8	140.8	65.96	65.96	25.96	25.96				49	OW
MW-206A	565732	284158	153.13						146.23		146.75	153.1										125.5	R
MW-206B	565726	284159	153.2	99	116	54.2	37.2	146.3		146.7		153.2	141.3	141.3	54.2	54.2	37.2	37.2	7.2			89	OW
MW-207A	565484	284175	150.9	94	103	56.9	47.9					150.9			56.9	56.9	47.9	47.9	17.9			113	R
MW-208A	565678	283622	156.82	89	111	67.82	45.82		146.61		148.03	156.8			67.82	67.82	45.82	45.82	15.82		0.61	121	R

TABLE A-3

SUMMARY OF HYDROGEOLOGIC DATABASE
NTCRA GROUND-WATER CONTAINMENT SYSTEM BASIS OF DESIGN
SRSNE SITE - SOUTHINGTON, CONNECTICUT

Location	Easting (X)	Northing (Y)	Ground Surface Elev.	Depth to Till	Depth to Rock	Till Elev.	Rock Elev.	Water Table 10/93	Rock Piez. Surf. 10/93	Water Table 5/93	Rock Piez. Surf. 5/93	MODFLOW Model Layer Data: Layer 1 Top	Layer 1 Bottom	Layer 2 Top	Layer 2	Layer 3 Top	Layer 3	Layer 4 Top	Layer 4 Bottom	Overburden Conductivity (ft/d)	Bedrock Conductivity (ft/d)	Well Depth	Well Formation
MW-209A	564582	286263	196.13						172		174.32	196.1									2	38	R
MW-209B	564582	286258	195.81	2.5	18	193.3	177.8	181.4				195.8	180.2	180.2	179	179	177.8	177.8	147.8			15	OW
MWL-301	565261	286598	158.82					156.1		157		158.8	157	157						0.34		11	OW
MWL-302	565359	286603	159.15					155.1		155.9		159.2	156.4	156.4								11	OW
MWL-303	565457	286604	156.96					149.7		150.5		157	152.1	152.1								11	OW
MWL-304	565265	286466	157.96					156.1		157.5		158	156.7	156.7						5.7		11	OW
MWL-305	565354	286450	157.55					155.4		156.4		157.6	156.1	156.1						1.3		11	OW
MWL-306	565502	286450	153.8					150.1		149.9		153.8	151.4	151.4								11	OW
MWL-307	565259	286297	157.71					155.9		157.3		157.7	156.5	156.5								11	OW
MWL-308	565354	286304	155.88					155.2		156.7		155.9	155.4	155.4								11	OW
MWL-309	565505	286302	152.78					151.7		150.1		152.8	152.1	152.1								11	OW
MWL-310	565251	286147	157.34					154.5		156.3		157.3	155.5	155.5								10.5	OW
MWL-311	565351	286149	155.46					151.9		152.9		155.5	153.1	153.1						0.91		11	OW
MWL-312	565509	286154	153.75							150.3		153.8										11	OW
MWL-313	565352	285992	154.52					147		150.9		154.5	149.5	149.5								11	OW
MWL-314	565502	286001	153.68					146.6		148.8		153.7	148.9	148.9								11	OW
P-1A	565124	286367	166.2						156.8		161.52	166.2									4.5	36	R
P-1B	565125	286372	166.15	13.5	17	152.7	149.2	155.3		158.3		166.2	153.2	153.2	152.7	152.7	149.2	149.2	119.2			15.75	OW/T
P-2A	565118	286221	166.41						147.11		161.94	166.4									2	32	R
P-2B	565116	286223	166.41	12	21.5	154.4	144.9			160.7		166.4			154.4	154.4	144.9	144.9	114.9	5		16	OW/T
P-3A	565576	286459	148.2								150.1	148.2									0.14	64.5	R
P-3B	565570	286457	148.13	25	50	123.1	98.13					148.1			123.1	123.1	98.13	98.13	68.13	0.1		17	OW
P-4A	565008	286294	167.94						158.64		166.55	167.9									0.16	30	R
P-4B	565011	286294	167.6	11	17.5	156.6	150.1	160.7		164.3		167.6	157.2	157.2	156.6	156.6	150.1	150.1	120.1	0.78		14.8	OW
P-5A	565394	286291	155.33						151.23		153.22	155.3									0.09	52.5	R
P-5B	565391	286283	155.24	28	38	127.2	117.2	151.2		154.5		155.2	146.2	146.2	127.2	127.2	117.2	117.2	87.24	0.04		9	OW
P-6	565500	286294	152.74	26	39	126.7	113.7		149.62		151.46	152.7			126.7	126.7	113.7	113.7	83.74		1	57.5	R
P-7	565439	286805	158.06	27	47.5	131.1	110.6	155.7		157.2		158.1	150.7	150.7	131.1	131.1	110.6	110.6	80.56			16.5	OW
P-8	564918	286064	179.72	16	23.5	163.7	156.2	158.4				179.7	157.6	157.6	156.9	156.9	156.2	156.2	126.2	0.2		19.9	OW/T
P-8A	564921	286067	179.66								167.37	179.7									0.3	70	R
P-9	565412	286584	157.66	18	34	139.7	123.7	154.1		154.5		157.7	149.1	149.1	139.7	139.7	123.7	123.7	93.66			13	OW
P-10	565316	286803	160.84	12	27	148.8	133.8	156.5		158.4		160.8	151.5	151.5	148.8	148.8	133.8	133.8	103.8	48		13.95	OW/T
P-11A	565583	286220	151.8						147.7		149.88	151.8										68	R
P-11B	565583	286220	152.22	31	56	121.2	96.22	147.3		149.4		152.2	142.3	142.3	121.2	121.2	96.22	96.22	66.22	0.78		14	OW
P-12	565321	287115	161.27	21	31	140.3	130.3	155.8		158.6		161.3	150.8	150.8	140.3	140.3	130.3	130.3	100.3	0.53		14	OW
P-12A	565321	287105	161.21						155.37		158.3	161.2										50	R
P-13	565242	285851	155.88					147.1		148.7		155.9	150	150						0.12		14.9	OW
P-14	565582	286212	151.96						147.82		150.5	152									0.01	89	R
P-15	564917	285631	179.18	14	20.5	165.2	158.7					179.2			165.2	165.2	158.7	158.7	128.7		0.09	34	R
P-16	565129	286518	165.35	14		151.4		156.4		157.9		165.4	159.4	159.4	151.4	151.4				51		12.5	OW
P-101A	565674	286226	148.05						147.62		149.68	148.1									0.1	96	R
P-101B	565675	286232	148.19									148.2										44	OW
P-101C	565676	286238	148.34	51	64	97.34	84.34	147.5		146.9		148.3	142.5	142.5	97.34	97.34	84.34	84.34	54.34			13	OW
P-102A	565702	286458	148.77						147.63		149.85	148.8										91	R
P-102B	565702	286465	148.74									148.7										39	OW
P-102C	565702	286472	148.71	39	69	109.7	79.71	147.2		147.5		148.7	142.2	142.2	109.7	109.7	79.71	79.71	49.71			13	OW
CW-OBS-	565364	284416																					
CW-B-77	565309	285710																					
CW-2-75	565407	285677																					
CW-2-78	565073	285036						145.8		147.4			140.8										
CW-3-75	565678	285115																					
CW-3-78	565162	284652								145.2													
CW-4-75	565312	285355						146.4		147.9			141.4										
CW-4-78	565155	284650																					
CW-5-78	565251	284543																					

TABLE A-3

SUMMARY OF HYDROGEOLOGIC DATABASE
NTCRA GROUND-WATER CONTAINMENT SYSTEM BASIS OF DESIGN
SRSNE SITE – SOUTHINGTON, CONNECTICUT

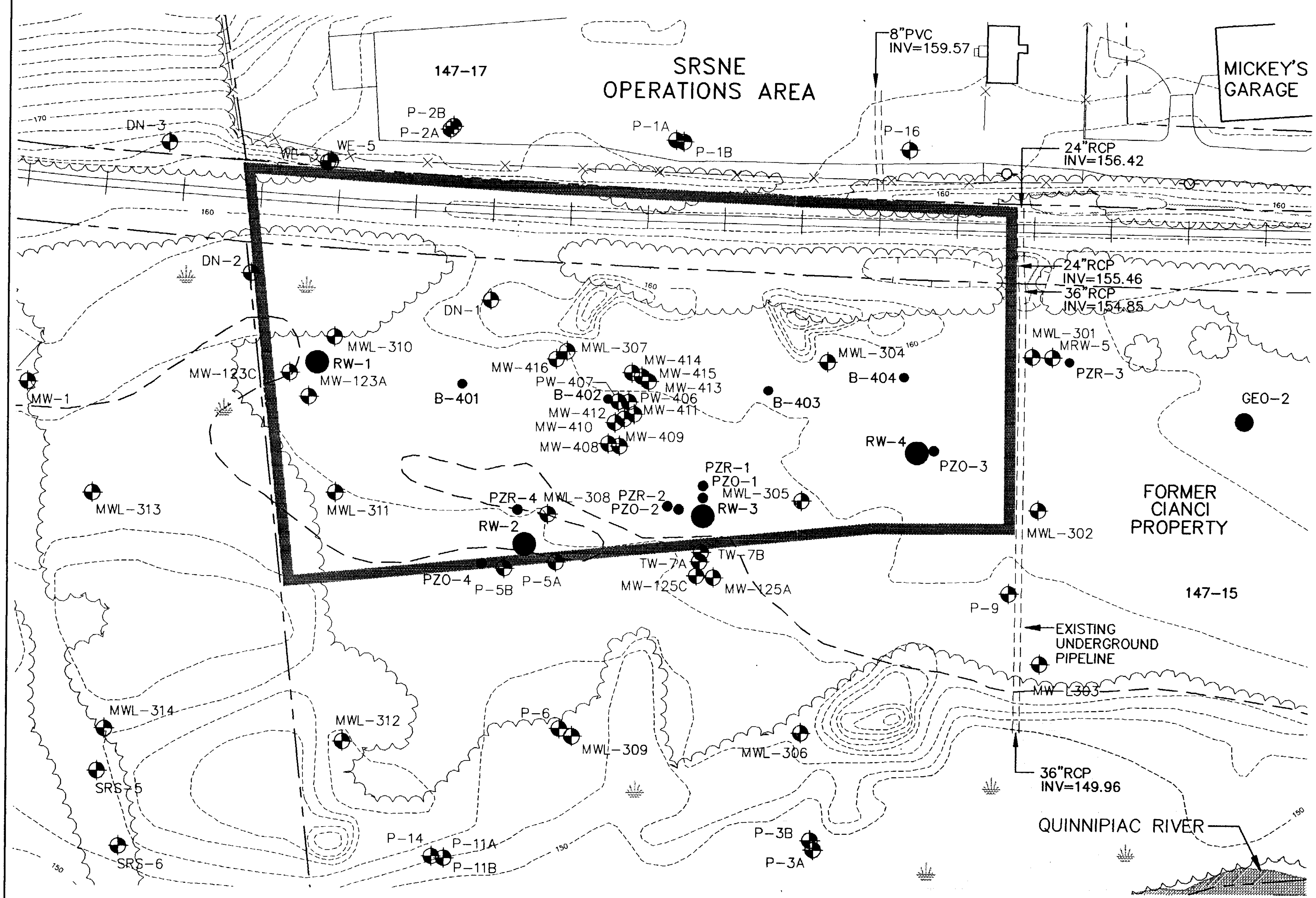
Location	Easting (X)	Northing (Y)	Ground Surface Elev.	Depth to Till	Depth to Rock	Till Elev.	Rock Elev.	Water Table 10/93	Rock Piez. Surf. 10/93	Water Table 5/93	Rock Piez. Surf. 5/93	MODFLOW Model Layer Data: Layer 1 Top	Layer 1 Bottom	Layer 2 Top	Layer 2	Layer 3 Top	Layer 3	Layer 4 Top	Layer 4 Bottom	Overburden Conductivity (ft/d)	Bedrock Conductivity (ft/d)	Well Depth	Well Formation
CW-6-75	565222	284832																					
CW-6-78	565396	284625																					
CW-7A	565314	284843																					
CW-7	565316	284843																					
CW-7-78	565366	284159																					
CW-8-78	565457	284171								146.2													
CW-9-78	565527	284271																					
CW-10-7	565317	284256																					
DN-1	565227	286248																					
DN-2	565211	286093						154		156.8			149							2.6			
DN-3	565128	286040																					
MW-1	565281	285950																					
MW-2	565307	285338																					
MW-3	565509	285065																					
MW-4	565622	285470																					
MW-5	565651	286030								149.4													
MW-6	565660	286017																					
MW-7	565646	286028																					
MW-8	565654	286015						149.6		151.8			144.6										
S6-1	565357	284465																					
SRS-1	565194	285871																					
SRS-2	565200	285871																					
SRS-3	565394	285864																					
SRS-4	565392	285868																					
SRS-5	565529	285996																					
SRS-6	565577	286010																					
TW-1	565344	284065								146.5										0.31			OB
TW-2	565355	283770								144.2													
TW-3	565269	284027								146.9										4.1			OB
TW-4	565245	283814																					
TW-5	565149	284350																					
TW-7B	565387	286385																					
TW-7A	565393	286384																		0.8			OB
TW-8A	565213	286406																		18			OB
	565213	286406																			0.6		R
TW-9	564984	286593																			1.4		R
TW-10	564882	286403																			8		R
TW-11	565282	285956																		17			OB
TW-12	565269	287366																		0.21			OB
WE-1	565220	286787																			0.4		R
WE-2	565220	286808																					
WE-3	565140	286142																					R
WE-4	565140	286142																		0.9			
WE-5	565139	286144																					
Geometric Mean Hydraulic Conductivity																				1.8	0.4	(feet/day)	
																				6E-04	1E-04	(cm/sec)	

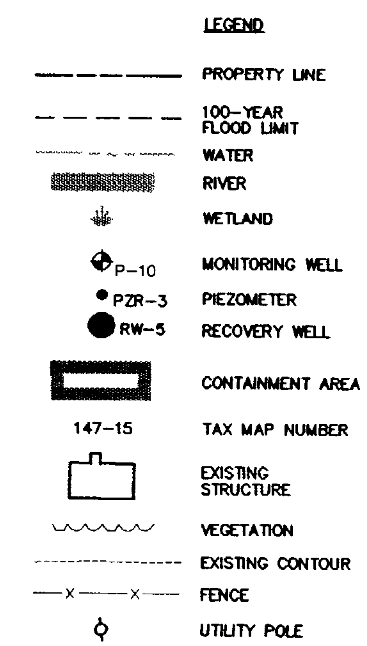
Notes: Data obtained from hydrogeologic data reports by HNUS (May 1994) and ENSR (June 1994). Some hydrogeologic contacts reinterpreted by BB&L.

Hydraulic conductivity data typically represent slug test results at overburden wells and packer test results at bedrock corehole intervals. Where multiple tests were performed, the higher value was selected.

MODFLOW model layer designations as follows: Layer 1 – upper 5 feet of saturated zone; Layer 2 – middle and deep portions of outwash; Layer 3 – till; and Layer 4 – upper 30 feet of bedrock.

Figures





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).
4. THE LOCATION OF EXISTING WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

VIEW: 30
LAYER: ON=*; OFF=G1,2,REF
XREF: 08325X05
12/94-54 PMC AK
08325001/08325C19.DWG

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

No.	Date	Revisions	Init

In charge of
Designed by
Drawn by
Checked by

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS
SYRACUSE, NEW YORK

SRSNE PRP GROUP • SOUTHINGTON, CONNECTICUT

NON-TIME-CRITICAL REMOVAL ACTION
SRSNE SITE

EXISTING SITE PLAN

File Number 083.25
Date DECEMBER 1994
FIGURE **A-1**

Attachment A-1
Subsurface Logs

Date Start/Finish: 09/21/94 - 09/21/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size :** 8.25-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 28 ft.
Ground Surface Elev.: NA

Geologist: David W. Lay

Boring No. GEO-1

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
	1		3 3 4 8	1.7	1.8		Brown fine subrounded SAND, some mica, little silt, loose, moist.	
	2		7 15 30 31	0.8	1.6		Red/Brown SILT, little fine to medium SAND, trace coarse sand and fine gravel, medium compact, wet.	
5	3		15 25 45 52	1.2	1.8			
	4		25 33 34 22	0.4	0.5			
	5		15 21 23 22	0.7	0.5		Grades to some fine to medium sand.	
10	6		7 24 24 22	0.8	1.6		Grades to little fine to coarse sand.	
	7		10 22 24 26	0.6	0.5			
15	8		10 23	0.6	0.5			

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Boring No. GEO-1

Borehole Depth = 28 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
	8		24 24	0.8	0.5		Red/Brown SILT, little fine to medium SAND, trace coarse sand and fine gravel, medium compact, wet.	
	9		11 22 23 29	0.9	0.5			
	9		15 30 43 100/.3	1.1	0.5		Red/Brown SILT, some fine to coarse sand, trace fine gravel, very compact, wet. (TILL).	
20	10		100/.2 25 43 43	1.1	0.5			
	11		25 26 27 29	1.0	0.5		Red/Brown fine to medium SAND, some silt, trace fine gravel, loose, wet.	
25	12		15 23 52 100/.3	1.5	0.5			
	13		15 52 92 100/.2	1.0	0.5		Red fine SAND, some medium sand and silt, trace coarse sand, mica matrix, dense, moist. (WEATHERED SANDSTONE).	
30							Bottom of boring at 28 feet.	
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25

Script: SRSNEbore
Date: 11/11/94

Date Start/Finish: 09/22/94 - 09/22/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size :** 8.25-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 27.5 ft.
Ground Surface Elev.: NA

Geologist: David W. Lay

Boring No. GEO-2

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
	1		4 4 4 7	1.6	2.4		Red/brown SILT, some fine to coarse sand, trace fine gravel, loose, moist. Brown fine SAND, some medium sand, little silt, trace fine gravel, loose, moist.	
	2		7 25 38 45	1.4	8.3		Grading wet. Red SILT, little fine to coarse sand, trace gravel, loose, moist.	
5	3		14 18 20 17	1.4	3.4		Red/brown fine SAND, some medium sand and silt, little coarse sand and fine gravel, medium compact, moist. Grades to little silt, trace fine gravel, wet.	
	4		7 8 7 6	0.9	12.2			
	5		5 6 10 15	1.3	15.1		Red/brown SILT, some fine to medium sand, little coarse sand, loose, wet.	
10	6		8 11 17 22	0.5	5.8			
	7		10 21 38 32	0.8	2.4			
15	8		10 21	0.8	2.4		Grading medium compact.	

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Boring No. GEO-2

Borehole Depth = 27.5 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
	8		19 21	0.8	2.4		Red/brown SILT, some fine to medium sand, little coarse sand, loose, wet.	
							Augered through cobbles 16-17' BGS.	
	9		23 16 15 33	1.2	3.4			
20	10		25 82 75 100/.3	0.8	7.3		Red/brown SILT, some fine gravel, little fine to coarse sand, very compact, wet (TILL). Sandstone cobbles.	
	11		100/.4	0.2	1.4			
	12		56 66 71 63	1.6	2.4		Grades to some fine to medium sand, trace fine gravel.	
25	13		7 9 33 29	0.8	0.4			
	14		100/0.5	0.5	0.4		Red/brown chips of SANDSTONE, shiny matrix, little silt and fine to coarse sand, mica, dense, moist (WEATHERED SANDSTONE). Bottom of boring at 27.5' BGS.	
30								
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25 Script: SRSNEbore Date: 11/11/94

Date Start/Finish: 09/27/94 - 09/27/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size** : 18.0-in. OD
Rig Type: CME 85
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 30.2 ft.
Ground Surface Elev.: NA

Geologist: David W. Lay

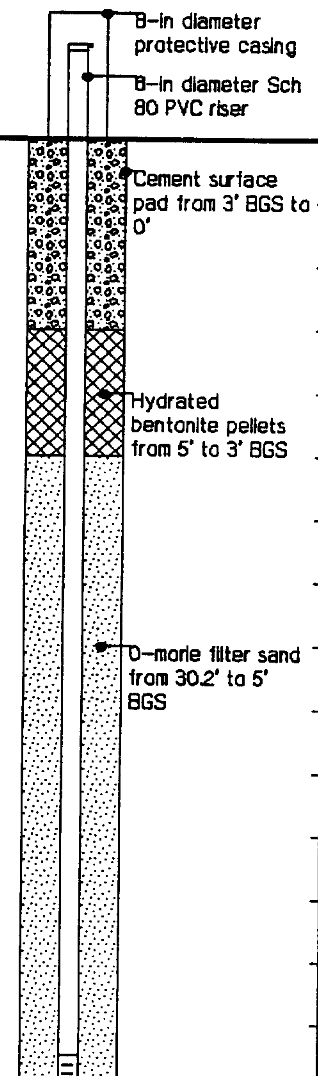
Well No. **RW-1**

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description
							GROUND SURFACE
	1		2 2 30 100/.3	0.8	2.5		Red/brown SILT, some fine to coarse sand (mica), little coarse sand, trace fine gravel, loose to medium loose, moist.
5	2		2 3 5 10	1.2	113.7		Grey/brown fine SAND, little medium sand, loose, wet (chemical odor) grading to medium sand, little fine sand.
10	3		20 15 11 7	0.2	110.8		Grey/red laminated SILT, trace sandstone gravel, loose, wet.
15							

Well Construction



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth

Project: 083.25

Script: SRSNEwell
Date: 11/18/94

Project: NTCRA 1-Phase I Field Investigation

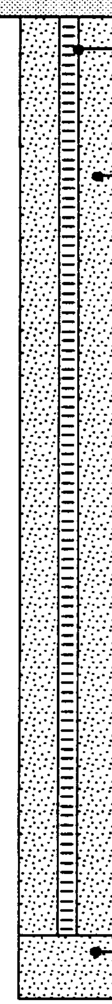
Site: SRSNE, Southington, CT

Well No. RW-1

Borehole Depth = 30.2 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description
	4		4 5 10 13	1.5	22.9		Red/brown fine to medium SAND, loose, wet. / Red/brown SILT, little fine to coarse sand (sandstone), medium loose, wet.
							Red/brown SILT, little to some fine to coarse sand, little fine gravel, compact, wet (TILL).
20	5		29 34 31 28	NR			
25	6		48 55 50 51	1.0	1.2		
30	7		45 33 100/.3	1.2	1.2		Red/brown WEATHERED SANDSTONE, dense, damp.
							Bottom of borehole at 30.2' BGS.
35							

Well Construction



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Date Start/Finish: 09/29/94 - 09/29/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size :** 18.0-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 34 ft.
Ground Surface Elev.: NA

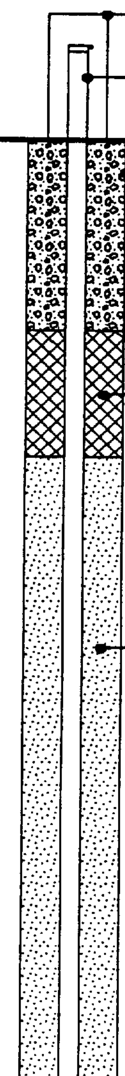
Geologist: David W. Lay

Well No. RW-2

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
							Geologic descriptions interpreted based on log of Well P-5B (HNUS, May 1984).	
5								
10								
15								



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

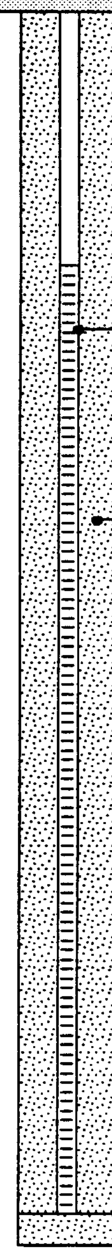
Project: NTCRA 1-Phase I Field Investigation

Well No. RW-2

Borehole Depth = 34 ft.

Site: SRSNE, Southington, CT

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Geologic descriptions interpreted based on log of Well P-5B (HNUS, May 1994).	
20								20-slot stainless steel well screen from 34' to 19' BGS
								0-morie filter sand from 34' to 5' BGS
25								
30								
	1		30 27 41 100/.3	1.3	180.2		Red brown SILT, some fine to coarse sand, medium compact to compact, wet (TILL), chemical odor.	
	2		100/.3	0.3	158.5		Red SANDSTONE, brittle, weathered, wet.	
35							Bottom of boring at 34.5' BGS.	



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

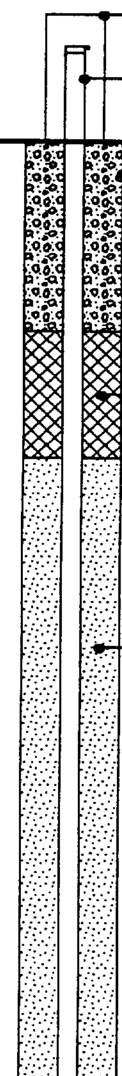
Remarks:

Water Levels

Date / Time	Elevation	Depth

Date Start/Finish: 10/05/94 - 10/05/94 **Drilling Company:** East Coast/Thomas Environmental **Driller's Name:** Brett Swiatek **Drilling Method:** Hollow Stem Auger **Bit Size:** N/A **Auger Size :** 18.0-in. OD **Rig Type:** CME 95 **Hammer Weight:** 140-lb **Height of Fall:** 30-in.	**Well Casing Elev.:** NA **Borehole Depth:** 37.0 ft. **Ground Surface Elev.:** NA **Geologist:** David W. Lay	**Well No.** RW-3 **Site:** SRSNE, Southington, CT **Project:** NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	8-in diameter protective casing 8-in diameter Sch 80 PVC riser
							Refer to piezometer log PZR-1 for geologic description.	Cement surface pad from 3' BGS to 0'
5								Hydrated bentonite pellets from 5' to 3' BGS
								0-morie filter sand from 33' to 5' BGS
10								
15								



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25
Script: SRSNEwell
Date: 11/18/94

Project:
NTCRA 1-Phase I Field Investigation

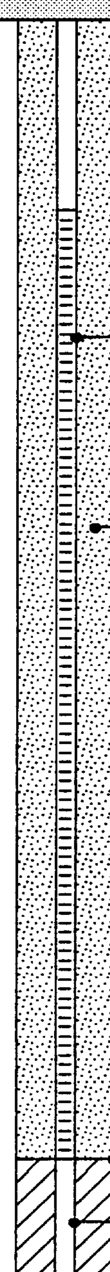
Site:
SRSNE, Southington, CT

Well No. RW-3

Borehole Depth = 37.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/8 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description
							Refer to piezometer log PZR-1 for geologic description.
20							
25	1		8 8 7 7	0.8	18.2		Brown SILT, some fine to coarse sand, little coarse sand, loose, wet.
30	2		3 12 100/.8	1.0	184		Red WEATHERED SANDSTONE, wet, chemical odor. Augered to 37.0' BGS to set well.
35							

Well Construction



Remarks:

Water Levels

Date / Time	Elevation	Depth

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Well No. RW-3

Borehole Depth = 37.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Red WEATHERED SANDSTONE.	Neat cement grout
							Bottom of boring at 37.0' BGS.	
40								
45								
50								
55								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth

Date Start/Finish: 09/27/94 - 09/27/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size :** 12.0-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 24.9 ft.
Ground Surface Elev.: NA

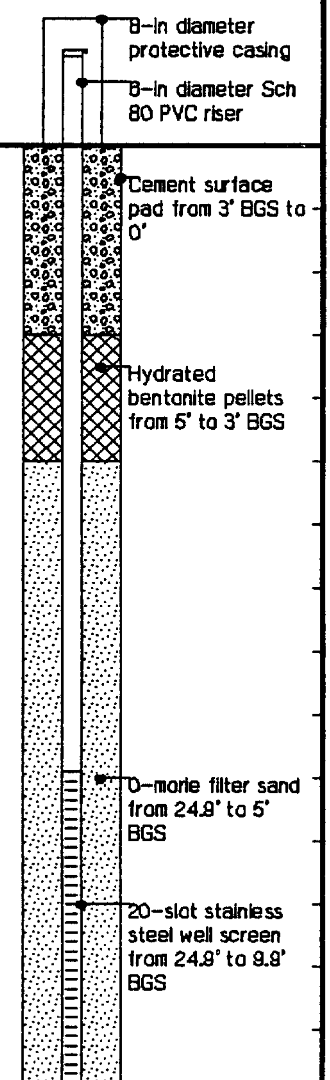
Geologist: David W. Lay

Well No. **RW-4**

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
							Refer to piezometer log PZO-3 for geologic description.	
5								
10								
15								



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Well No. RW-4

Borehole Depth = 24.9 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Refer to piezometer log PZO-3 for geologic description.	0-morie filter sand from 24.9' to 5' BGS; 20-slot stainless steel well screen from 24.9' to 9.9' BGS
20								
25	1		100/.3	0.3			Red/brown SANDSTONE chips, weathered, brittle.	
							Bottom of boring at 24.9' BGS.	
30								
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

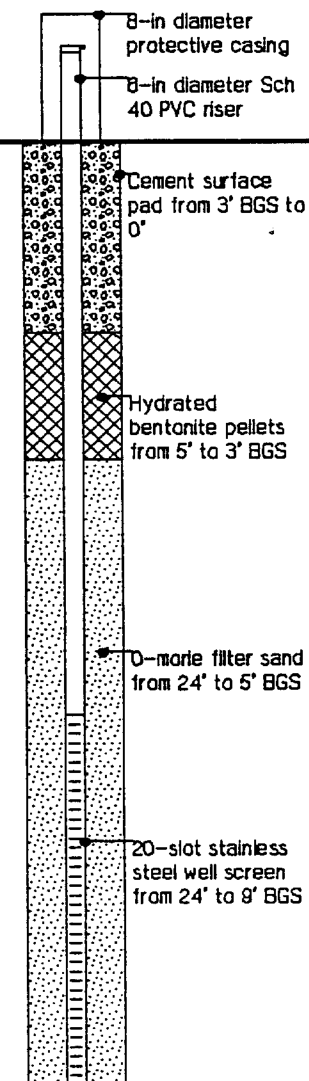
Remarks:

Water Levels

Date / Time	Elevation	Depth

Project: 083.25
Script: SRSNEwell
Date: 11/18/94

Date Start/Finish: 10/04/94 - 10/04/94 **Drilling Company:** East Coast/Thomas Environmental **Driller's Name:** Brett Swiatek **Drilling Method:** Hollow Stem Auger **Bit Size:** N/A **Auger Size** : 18.0-in. OD **Rig Type:** CME 95 **Hammer Weight:** 140-lb **Height of Fall:** 30-in.	**Well Casing Elev.:** NA **Borehole Depth:** 24 ft. **Ground Surface Elev.:** NA **Geologist:** David W. Lay	**Well No.** RW-6 **Site:** SRSNE, Southington, CT **Project:** NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
							Refer to piezometer log PZR-3 for geologic description.	
5								
10								
15								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

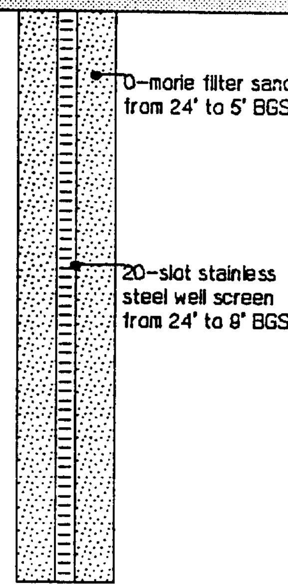
Project: NTCRA 1-Phase I Field Investigation

Site: SRSNE, Southington, CT

Well No. RW-5

Borehole Depth = 24 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Refer to piezometer log PZR-3 for geologic description.	
20								
							Bottom of boring at 24.0' BGS.	
25								
30								
35								

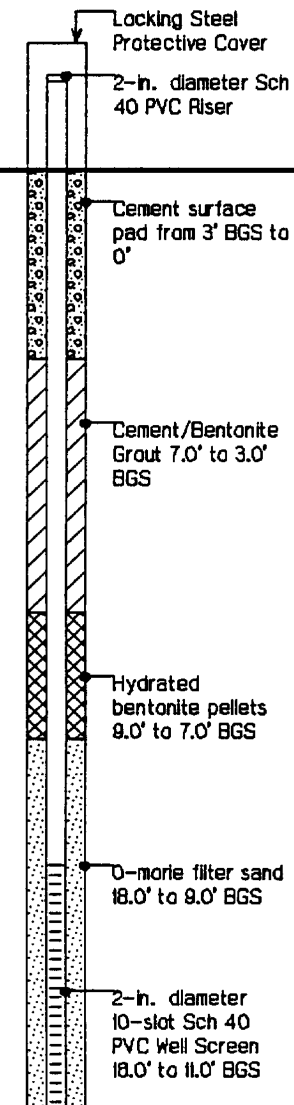


BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Date Start/Finish: 09/26/94 - 09/27/94 **Drilling Company:** East Coast/Thomas Environmental **Driller's Name:** Brett Swiatek **Drilling Method:** Hollow Stem Auger **Bit Size:** N/A **Auger Size** : 8.25-in. OD **Rig Type:** CME 95 **Hammer Weight:** 140-lb **Height of Fall:** 30-in.	**Well Casing Elev.:** NA **Borehole Depth:** 18.0 ft. **Ground Surface Elev.:** NA **Geologist:** David W. Lay	**Piezometer No. PZO-1** **Site:** SRSNE, Southington, CT **Project:** NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
5 10 15							Refer to piezometer PZR-1 for geologic description.	

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: NTCRA 1-Phase I Field Investigation

Site: SRSNE, Southington, CT

Piezometer No. PZO-1

Borehole Depth = 18.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Refer to piezometer PZR-1 for geologic description.	
							Bottom of boring at 18.0' BGS.	
20								
25								
30								
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25
Script: SRSNEpiez
Date: 11/18/94

Date Start/Finish: 09/27/94 - 09/27/94 **Drilling Company:** East Coast/Thomas Environmental **Driller's Name:** Brett Swiatek **Drilling Method:** Hollow Stem Auger **Bit Size:** N/A **Auger Size** : 8.25-in. OD **Rig Type:** CME 95 **Hammer Weight:** 140-lb **Height of Fall:** 30-in.	**Well Casing Elev.:** NA **Borehole Depth:** 18.0 ft. **Ground Surface Elev.:** NA **Geologist:** David W. Lay	**Piezometer No.** PZO-2 **Site:** SRSNE, Southington, CT **Project:** NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	Locking Steel Protective Cover 2-in. diameter Sch 40 PVC Riser
0–15 (5, 10, 15)							Refer to piezometer log PZR-1 for geologic decription.	Cement surface pad from 3' BGS to 0' Cement/Bentonite Grout 7.0' to 3.0' BGS Hydrated bentonite pellets 9.0' to 7.0' BGS 0-morie filter sand 18.0' to 9.0' BGS 2-in. diameter 10-slot Sch 40 PVC Well Screen 18.0' to 11.0' BGS

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Piezometer No. PZO-2

Borehole Depth = 18.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Refer to piezometer log PZR-1 for geologic decription.	
							Bottom of borehole at 18.0' BGS.	
20								
25								
30								
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Date Start/Finish: 09/22/94 – 09/22/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size :** 8.25-in. OD
Rig Type: CME 85
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 28.3 ft.
Ground Surface Elev.: NA

Geologist: David W. Lay

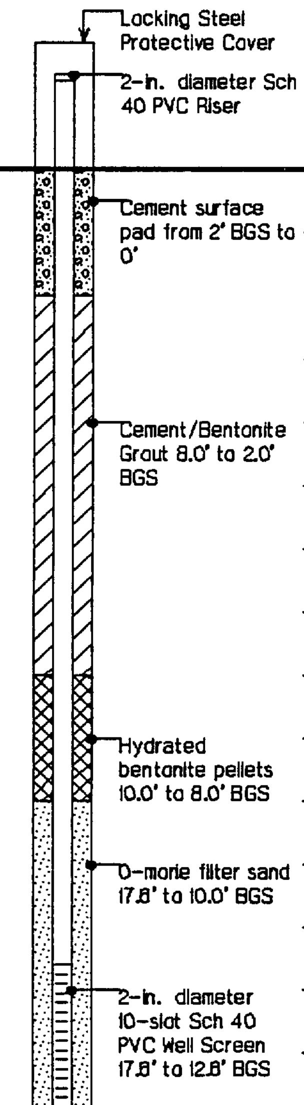
Piezometer No. PZO-3

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description
							GROUND SURFACE
	1		2 3 7 12	2.0	1.4		Brown SILT, some fine sand, little medium to coarse sand, trace fine gravel, loose, moist.
5	2		8 13 13 22	1.2	8.3		Brown SILT, some fine sand, little medium to coarse sand, little fine gravel, loose, moist. Grey/brown fine to medium SAND, little silt, loose, wet, chemical odor.
10	3		8 12 7 8	0.2	4.4		Red/brown SILT, little fine to coarse sand, semicompact, wet, slight chemical odor.
15							

Well Construction



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: NTCRA 1–Phase I Field Investigation

Site: SRSNE, Southington, CT

Piezometer No. PZO–3

Borehole Depth = 28.3 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 in.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
	4		4 8 12 13	1.7	29.9		Brown fine SAND, little silt, loose, wet, strong chemical odor.	
20								Sand backfill
	5		8 11 17 100/.3	1.4	86.1		Brown fine SAND, little silt and medium to coarse sand, loose, wet, strong chemical odor.	
							Red/brown SILT, little fine to coarse sand, trace fine gravel, compact, wet (TILL).	
25								
	6		100/.6	0.3	76.9		Red SILT, little fine sand, some red sandstone chips, compact, wet (WEATHERED SANDSTONE).	
	7		100/.3	0.3	42.6			
							Bottom of boring at 28.3' BGS.	
30								
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Date Start/Finish: 10/08/94 - 10/08/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size** : 8.25-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 20.0 ft.
Ground Surface Elev.: NA

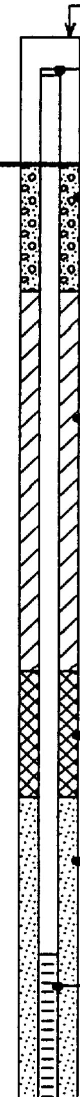
Geologist: David W. Lay

Piezometer No. PZO-4

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
5							Geologic descriptions interpreted based on log of Well P-5B (HNUS, May 1994).	
10								
15								



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Piezometer No. PZO-4

Borehole Depth = 20.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Geologic descriptions interpreted based on log of Well P-5B (HNUS, May 1994).	
20							Bottom of boring at 20.0' BGS.	
25								
30								
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25
Script: SRSNEplez
Date: 11/18/94

Date Start/Finish: 09/26/94 – 09/26/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size** : 8.25-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 37.0 ft.
Ground Surface Elev.: NA

Geologist: David W. Lay

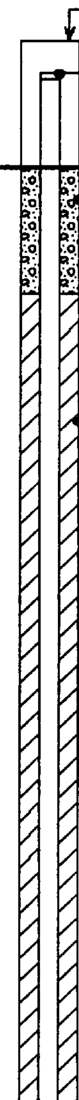
Piezometer No. PZR-1

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description
							GROUND SURFACE
	1		2 2 7 4	0.8	80		Red/brown fine to medium SAND with silt, some fine to medium gravel, chemical odor.
5	2		9 18 18 11	1.8	179		Grey to black fine to coarse SAND and fine to medium GRAVEL, some red/brown silt lenses. Chemical odor.
10	3		1 1 2 2	1.2	39		Red/brown SILT with some fine sand, wet, chemical odor.
15							

Well Construction



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: NTCRA 1-Phase I Field Investigation

Site: SRSNE, Southington, CT

Piezometer No. PZR-1

Borehole Depth = 37.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
	4		3 3 4 4	1.2	16		Red/brown SILT and fine to medium GRAVEL, wet. Chemical odor.	
20	5		7 16 31 100	1.0	88		Red/brown WEATHERED SANDSTONE, damp.	
25	6		46 82 67 38	0.7				Hydrated bentonite pellets 27.5' to 25.0' BGS
	7		100/.3	0.3				0-morie filter sand 37.0' to 27.5' BGS
30	8		100/.3	0.3				2-in. diameter 10-slot Sch 40 PVC Well Screen 34.5' to 29.5' BGS
	9		100/.3	0.3				
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth

Project: 083.25

Script: SRSNEpiez
Date: 11/18/94

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Piezometer No. PZR-1

Borehole Depth = 37.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Red/brown WEATHERED SANDSTONE, damp.	Sand backfill
							Bottom of borehole at 37.0' BGS.	
40								
45								
50								
55								

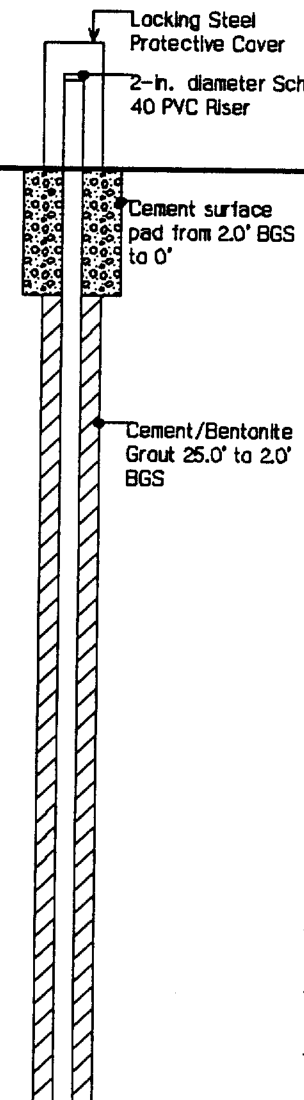
BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Date Start/Finish: 9/27/94 – 9/27/94 **Drilling Company:** East Coast/Thomas Environmental **Driller's Name:** Brett Swiatek **Drilling Method:** Hollow Stem Auger **Bit Size:** N/A **Auger Size :** 8.25-in. OD **Rig Type:** CME 95 **Hammer Weight:** 140-lb **Height of Fall:** 30-in.	**Well Casing Elev.:** NA **Borehole Depth:** 37.5 ft. **Ground Surface Elev.:** NA **Geologist:** David W. Lay	**Piezometer No.** PZR-2 **Site:** SRSNE, Southington, CT **Project:** NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
							Refer to Piezometer log PZR-1 for geologic description.	
5								
10								
15								



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Piezometer No. PZR-2

Borehole Depth = 37.5 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Refer to Piezometer log PZR-1 for geologic description.	
20								
25								Hydrated bentonite pellets 27.0' to 25.0' BGS
								0-morie filter sand 37.5' to 27.0' BGS
30								2-in. diameter 10-slot Sch 40 PVC Well Screen 34.0' to 29.0' BGS
35								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: NTCRA 1-Phase I Field Investigation

Site: SRSNE, Southington, CT

Piezometer No. PZR-2

Borehole Depth = 37.5 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Refer to Piezometer log PZR-1 for geologic description.	Sand backfill
							Bottom of boring at 37.5' BGS.	
40								
45								
50								
55								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25

Script: SRSNEpiez
Date: 11/18/94

Date Start/Finish: 09/28/94 - 09/28/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size**: 8.25-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 37.5 ft.
Ground Surface Elev.: NA

Geologist: David W. Lay

Piezometer No. PZR-3

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	Locking Steel Protective Cover; 2-in. diameter Sch 40 PVC Riser
	1		6 17 19 100/.3	1.2	0.0		Red/brown SILT, some sand, with fine to medium gravel. Sandstone cobble.	Cement surface pad from 3' BGS to 0'
5	2		3 4 6 9	0.6	5.0		Light brown fine to medium SAND, some silt, grades to wet.	Cement/Bentonite Grout 26.0' to 3.0' BGS
10	3		15 64 32 17	1.8	0.0		Fine to medium angular GRAVEL and SILT, loose, wet.	
15								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

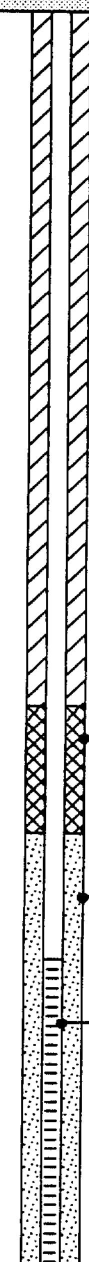
Site:
SRSNE, Southington, CT

Piezometer No. PZR-3

Borehole Depth = 37.5 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description
	4		11 10 7 5	0.1	0.0		Red/brown fine to medium GRAVEL and SILT, loose, wet.
20	5		5 5 11 11	1.8	0.0		Red/brown SILT with fine to medium sand and fine gravel, loose, wet.
							Red/brown fine to medium SAND with some silt and fine gravel, loose, wet.
							Red SILT, some fine to medium sand, compact (TILL).
25	6		23 50/.1	0.8	0.0		
							Red/brown WEATHERED SANDSTONE, dense, damp.
30							Augered to 37.5' BGS to set piezometer.
35							

Well Construction



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Piezometer No. PZR-3

Borehole Depth = 37.5 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Red/brown WEATHERED SANDSTONE, dense, damp.	Sand backfill
							Bottom of boring at 37.5' BGS.	
40								
45								
50								
55								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25
Script: SRSNEpiez
Date: 11/18/94

Date Start/Finish: 10/08/94 - 10/08/94
Drilling Company:
East Coast/Thomas Environmental
Driller's Name: Brett Swiatek
Drilling Method: Hollow Stem Auger
Bit Size: N/A **Auger Size :** 8.25-in. OD
Rig Type: CME 95
Hammer Weight: 140-lb
Height of Fall: 30-in.

Well Casing Elev.: NA
Borehole Depth: 38.0 ft.
Ground Surface Elev.: NA

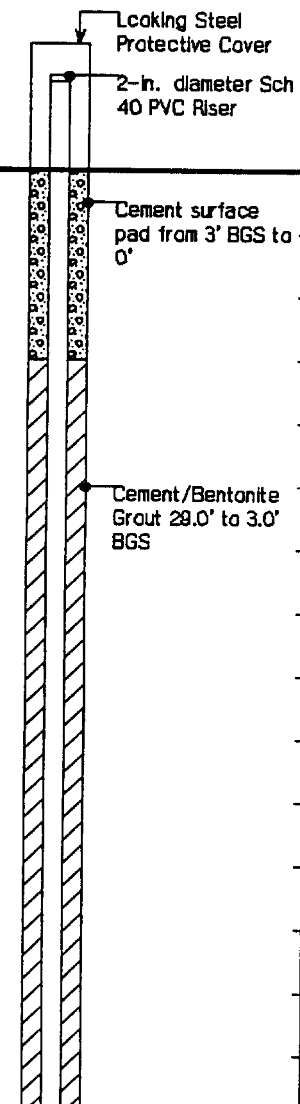
Geologist: David W. Lay

Piezometer No. PZR-4

Site:
SRSNE, Southington, CT

Project:
NTCRA 1-Phase I Field Investigation

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							GROUND SURFACE	
							Geologic descriptions interpreted based on log of Well P-5B (HNUS, May 1994).	
5								
10								
15								



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels

Date / Time	Elevation	Depth

Project: 083.25
Script: SRSNEpiez
Date: 11/18/94

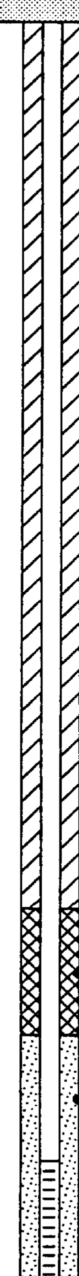
Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Piezometer No. PZR-4

Borehole Depth = 38.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Geologic descriptions interpreted based on log of Well P-5B (HNUS, May 1994).	
20								
25								
30								Hydrated bentonite pellets 31.0' to 29.0' BGS
								0-morie filter sand 38.0' to 31.0' BGS
35								



BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25

Script: SRSNEpiez
Date: 11/18/94

Project:
NTCRA 1-Phase I Field Investigation

Site:
SRSNE, Southington, CT

Piezometer No. PZR-4

Borehole Depth = 38.0 ft.

DEPTH BELOW GROUND SURFACE (ft.)	Sample Run Number	Sample/Int/Type	Blows/6 In.	Recovery (ft.)	PID (ppm) Headspace	Geologic Column	Stratigraphic Description	Well Construction
							Geologic descriptions interpreted based on log of Well P-5B (HNUS, May 1994).	2-in. diameter 10-slot Sch 40 PVC Well Screen 38.0' to 33.0' BGS
							Bottom of boring at 38.0' BGS.	
40								
45								
50								
55								

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Water Levels		
Date / Time	Elevation	Depth

Project: 083.25

Script: SRSNEpiez
Date: 11/18/94

Attachment A-2
Recovery Well Development Hydraulic Evaluation Results

SUMMARY OF RECOVERY WELL DEVELOPMENT
HYDRAULIC EVALUATIONS

SRSNE SITE -- SOUTHINGTON CONNECTICUT
NTCRA 1 GROUND-WATER CONTAINMENT DESIGN INVESTIGATION

==

Recovery Well RW-1

Test Date: September 30, 1994
Avg. Q (gpm): 1.9
H (feet): 26

Location	Formation	r ft	*s ft	t(0) min	T gpd/ft	T sqft/day	K ft/day	K cm/sec	S
MW-123C	OVBDN	11.75	0.37	4	1331	178	7	2E-03	0.008
MW-123A	BDRK		Flowing Artesian Well -- Drawdown Data Not Obtained						
MWL-310	WTR TBL		Negligible Response						

==

Recovery Well RW-2

Test Date: October 3, 1994
Avg. Q (gpm): 3.9
H (feet): 32

Location	Formation	r ft	*s ft	t(0) min	T gpd/ft	T sqft/day	K ft/day	K cm/sec	S
MWL-308	WTR TBL	26.5	0.40	60	2577	345	11	4E-03	0.046
P-5A	BDRK		Recovering from Transducer Removal -- No Usable Data						
P-5B	OVBDN		Recovering from Transducer Removal -- No Usable Data						

Test Date: October 4, 1994
Avg. Q (gpm): 3.9
H (feet): 32

Location	Formation	r ft	*s ft	t(0) min	T gpd/ft	T sqft/day	K ft/day	K cm/sec	S
MWL-308	WTR TBL	26.5	0.35	60	2945	394	12	4E-03	0.052
P-5A	BDRK	18.3		Substantial Response to Pumping					
P-5B	OVBDN	16.0		Recovering from Transducer Removal -- No Usable Data					

==

SUMMARY OF RECOVERY WELL DEVELOPMENT
HYDRAULIC EVALUATIONS

SRSNE SITE -- SOUTHINGTON CONNECTICUT
NTCRA 1 GROUND-WATER CONTAINMENT DESIGN INVESTIGATION

==

Recovery Well RW-3

Test Date: October 6, 1994
Avg. Q (gpm): 2.1
H (feet): 32

Location	Formation	r ft	*s ft	t(0) min	T gpd/ft	T sqft/day	K ft/day	K cm/sec	S
PZO-1	OVBDN	14.0	0.12	6	4516	604	19	7E-03	0.029
PZO-2	OVBDN	20.0	0.16	1.5	3387	453	14	5E-03	0.003
PZR-1	BDRK		Magnitude of Response Comparable to OVBDN and PZR-2						
PZR-2	BDRK		Magnitude of Response Comparable to OVBDN and PZR-1						

==

Recovery Well RW-4

Test Date: September 29, 1994
Avg. Q (gpm): 4.9
H (feet): 21

Location	Formation	r ft	*s ft	t(0) min	T gpd/ft	T sqft/day	K ft/day	K cm/sec	S
PZO-3	OVBDN	8.7	2.80	6	458	61	3	1E-03	0.008

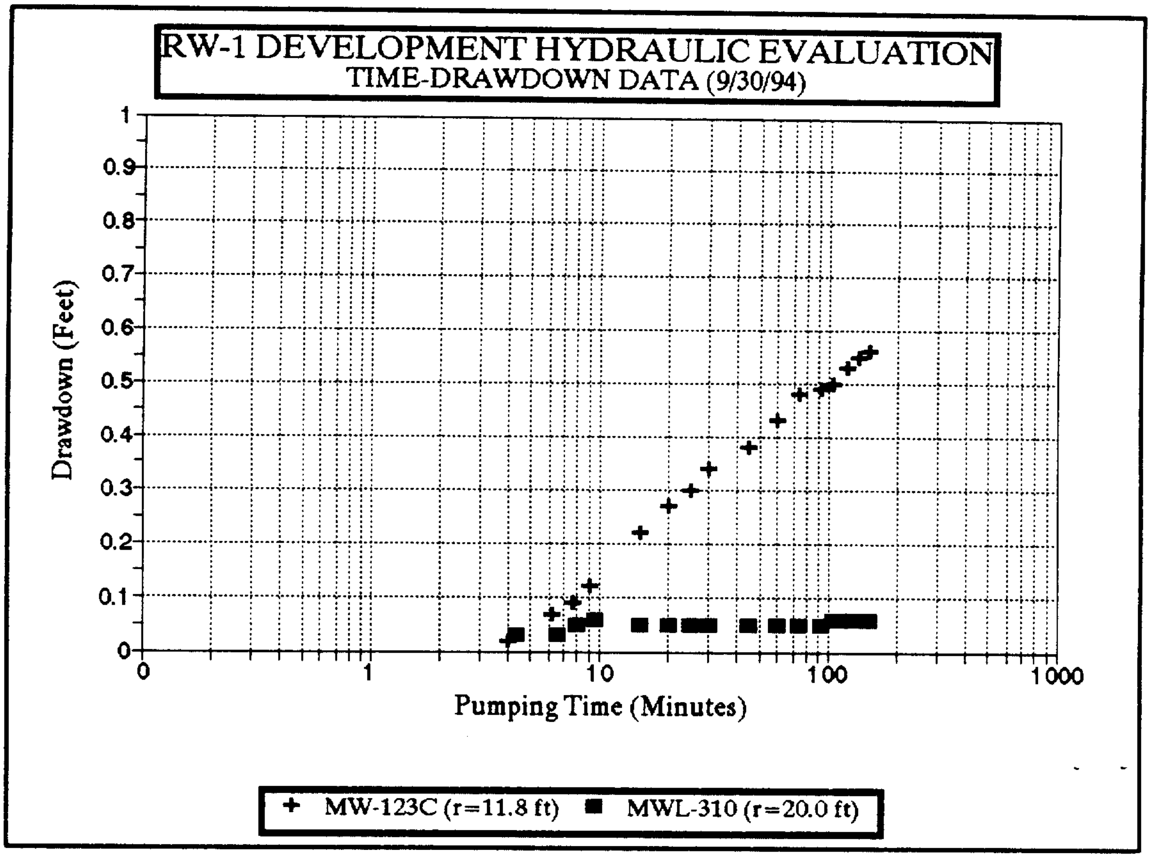
==

Recovery Well RW-5

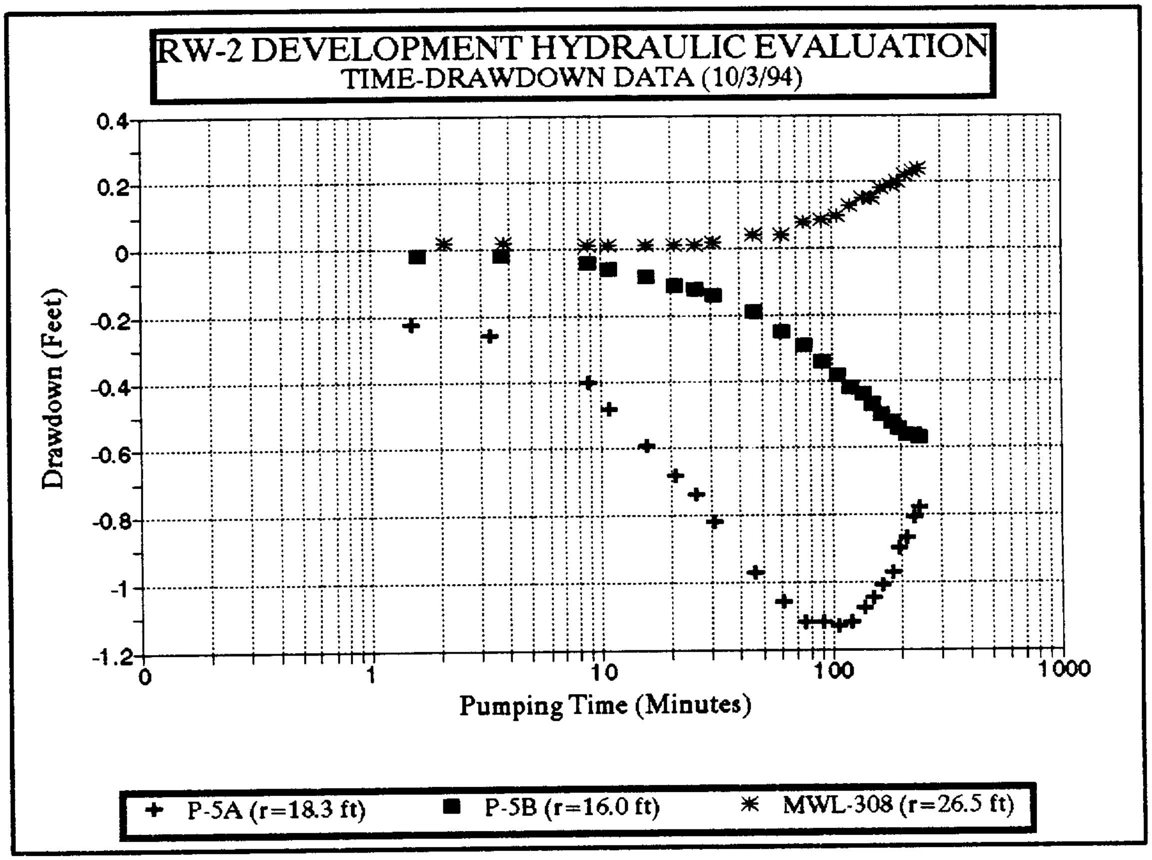
Test Date: October 4, 1994
Avg. Q (gpm): 1.1
H (feet): 22

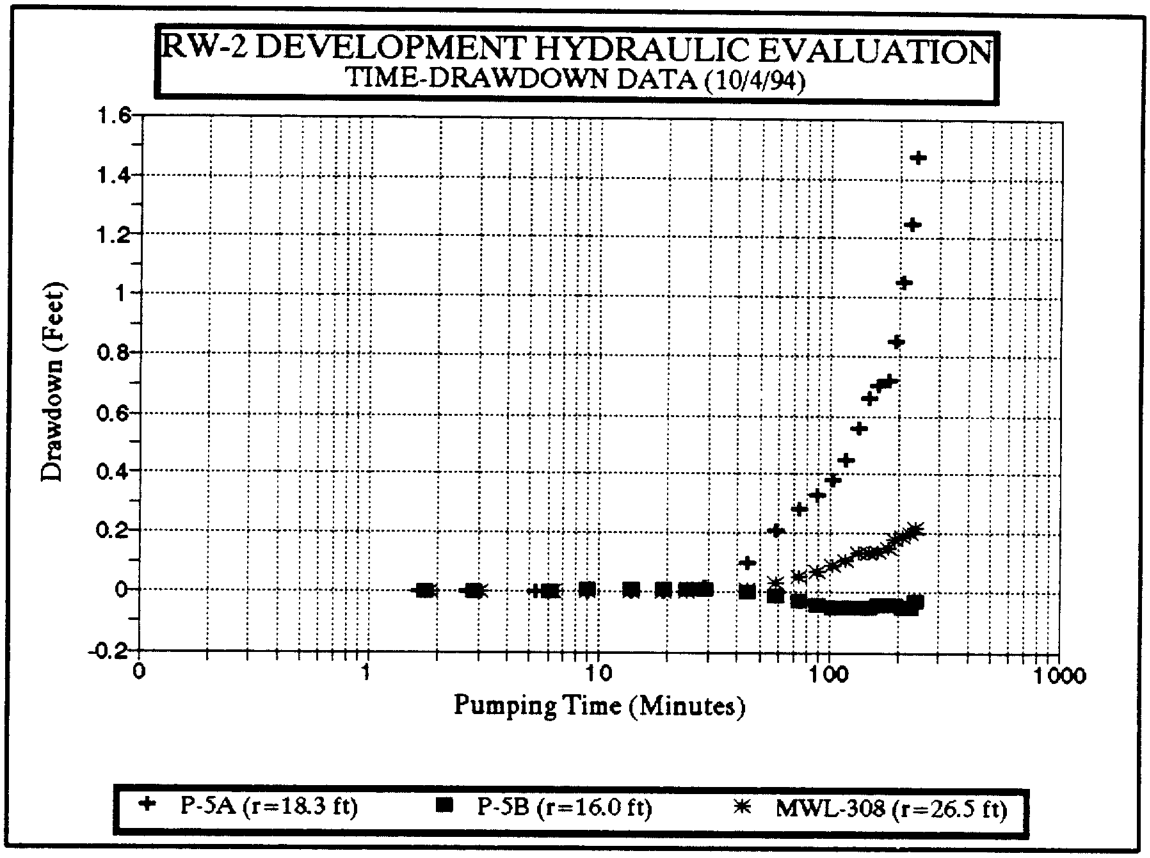
Location	Formation	r ft	*s ft	t(0) min	T gpd/ft	T sqft/day	K ft/day	K cm/sec	S
MWL-301 DDN	WTR TBL	12.0	0.03	0.5	11018	1473	67	2E-02	0.008
PZR-3	BDRK	9.0		Recovering from Development (10/3/94)					
MWL-301 RCV	WTR TBL	12.0	0.13	45	2288	306	14	5E-03	0.149

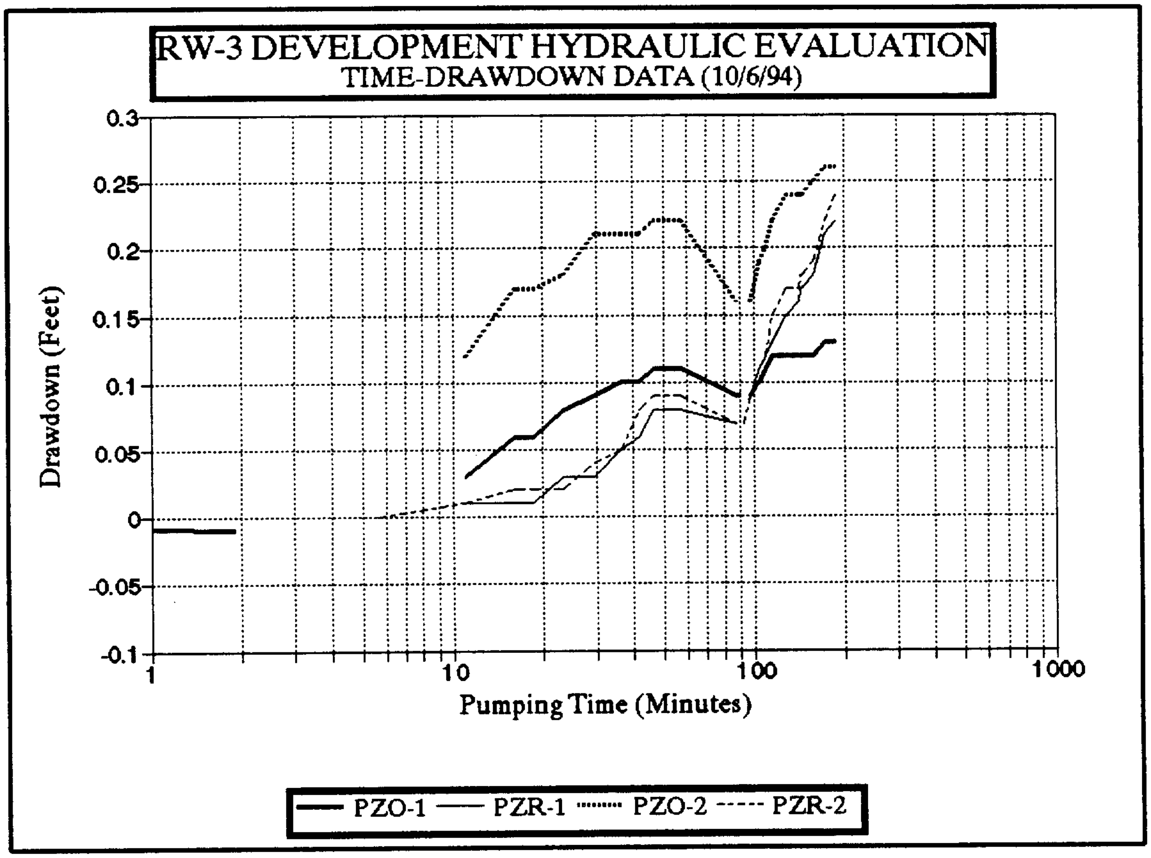
==

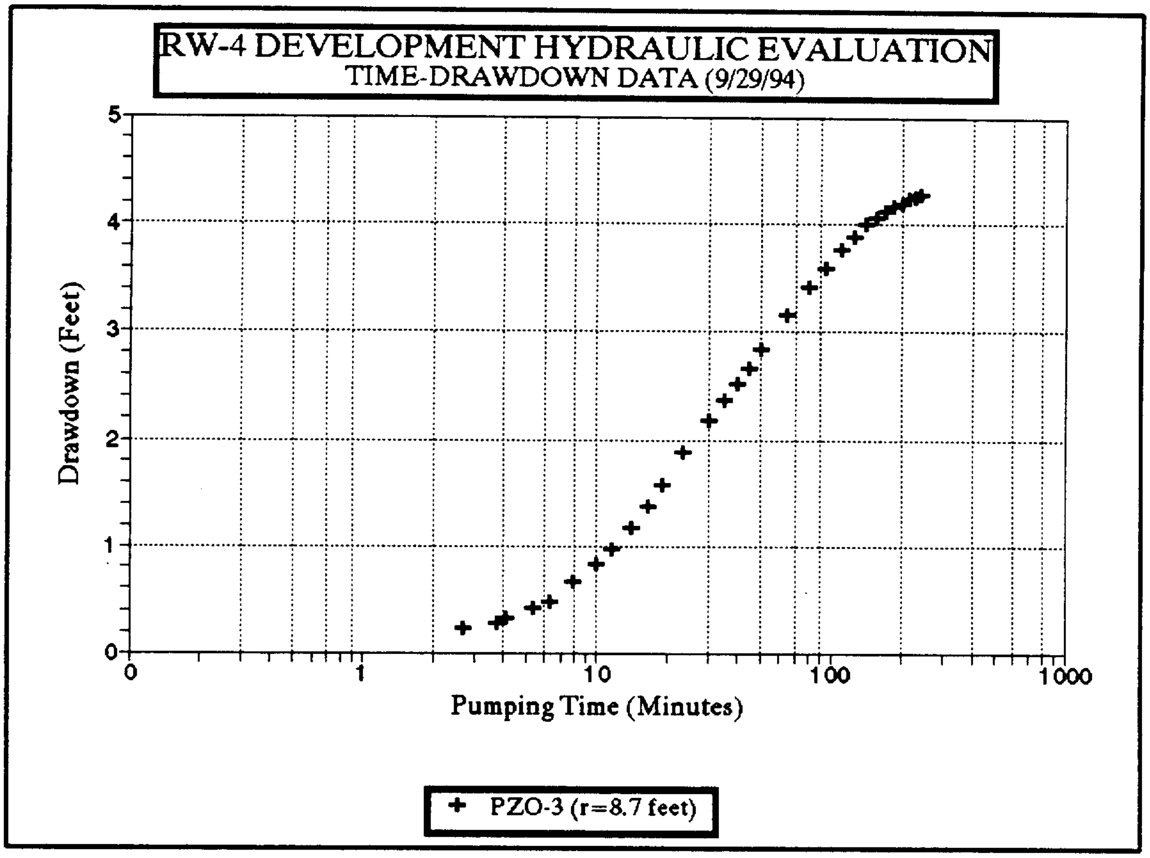


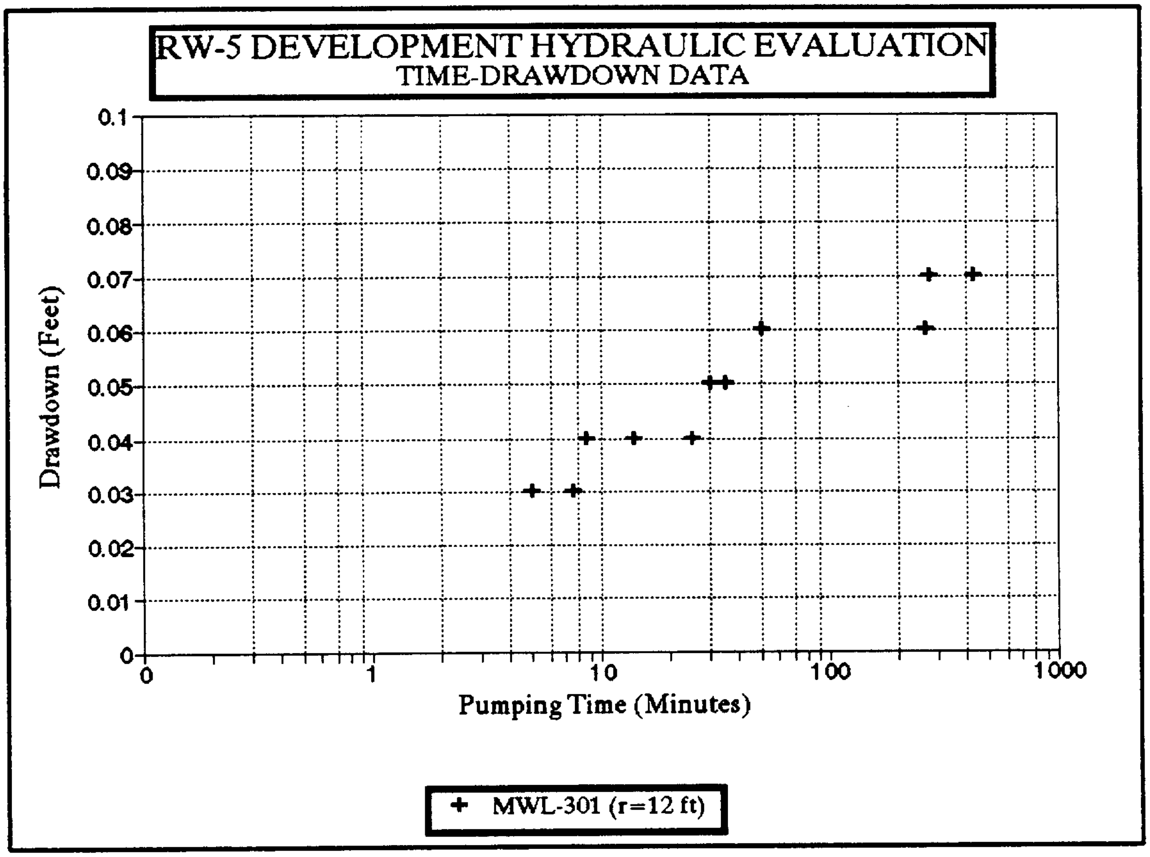
RW-1 DEVELOPMENT HYDRAULIC EVALUATION
TIME-DRAWDOWN DATA (9/30/94)
Drawdown (Feet)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
10
100
1000
Pumping Time (Minutes)
MW-123C (r=11.8 ft)
MWL-310 (r=20.0 ft)

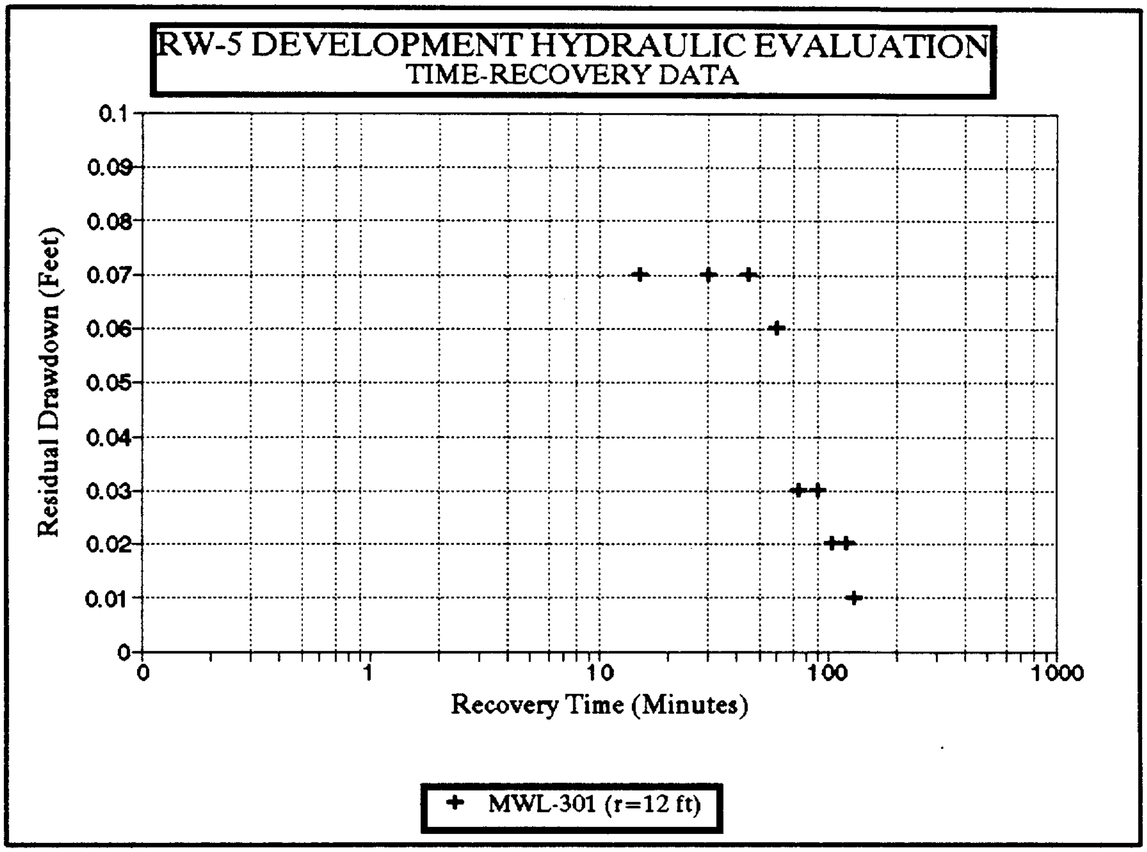

RW-2 DEVELOPMENT HYDRAULIC EVALUATION
TIME-DRAWDOWN DATA (10/3/94)
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
Drawdown (Feet)
0
1
10
100
1000
Pumping Time (Minutes)
P-5A (r=18.3 ft)
P-5B (r=16.0 ft)
MWL-308 (r=26.5 ft)


RW-2 DEVELOPMENT HYDRAULIC EVALUATION
TIME-DRAWDOWN DATA (10/4/94)
Drawdown (Feet)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
1
10
100
1000
Pumping Time (Minutes)
P-5A (r=18.3 ft)
P-5B (r=16.0 ft)
MWL-308 (r=26.5 ft)

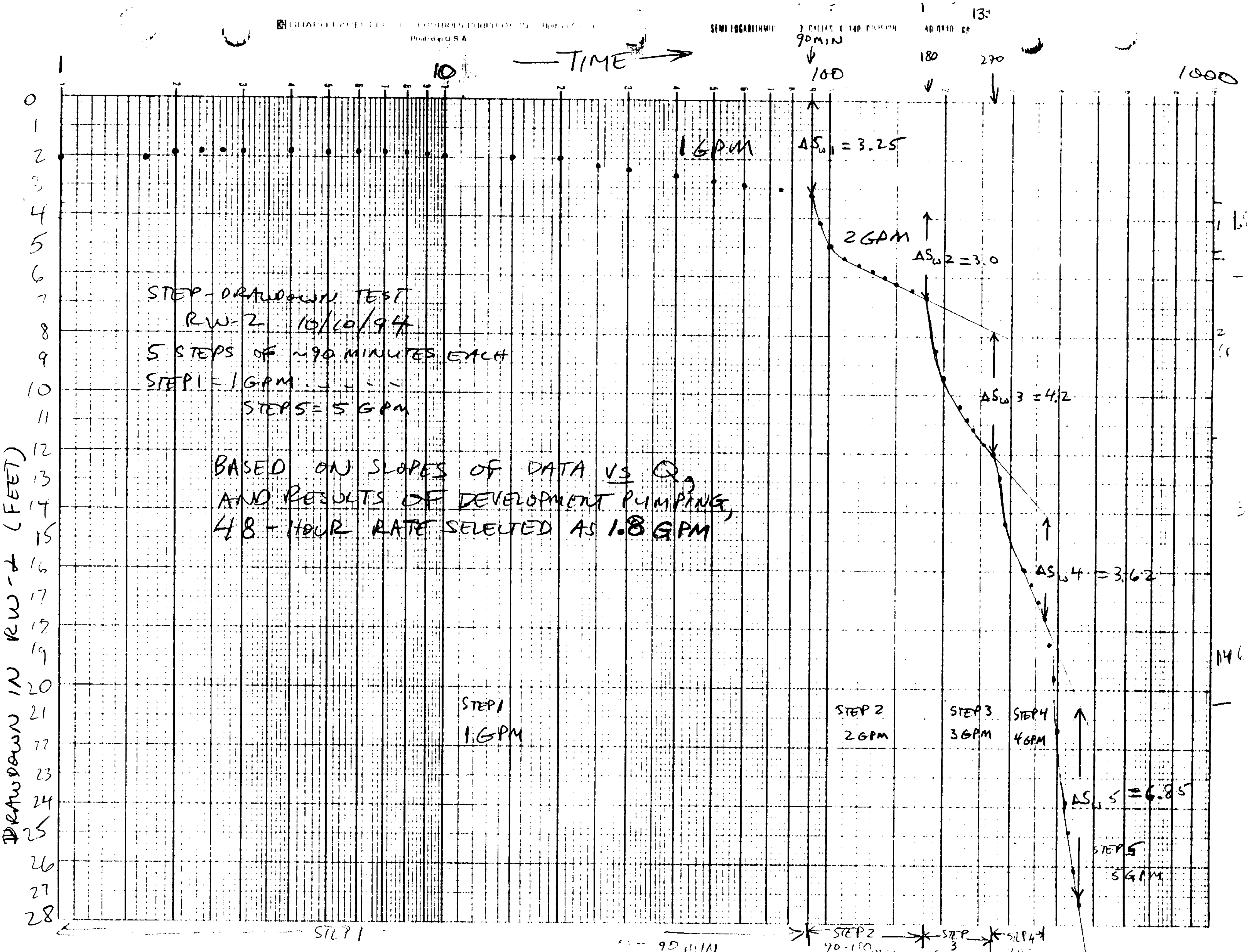

RW-3 DEVELOPMENT HYDRAULIC EVALUATION
TIME-DRAWDOWN DATA (10/6/94)
Drawdown (Feet)
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1
10
100
1000
Pumping Time (Minutes)
PZO-1
PZR-1
PZO-2
PZR-2


RW-4 DEVELOPMENT HYDRAULIC EVALUATION
TIME-DRAWDOWN DATA (9/29/94)
Drawdown (Feet)
5
4
3
2
1
0
0
1
10
100
1000
Pumping Time (Minutes)
PZO-3 (r=8.7 feet)


RW-5 DEVELOPMENT HYDRAULIC EVALUATION
TIME-DRAWDOWN DATA
Drawdown (Feet)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
1
10
100
1000
Pumping Time (Minutes)
MWL-301 (r=12 ft)

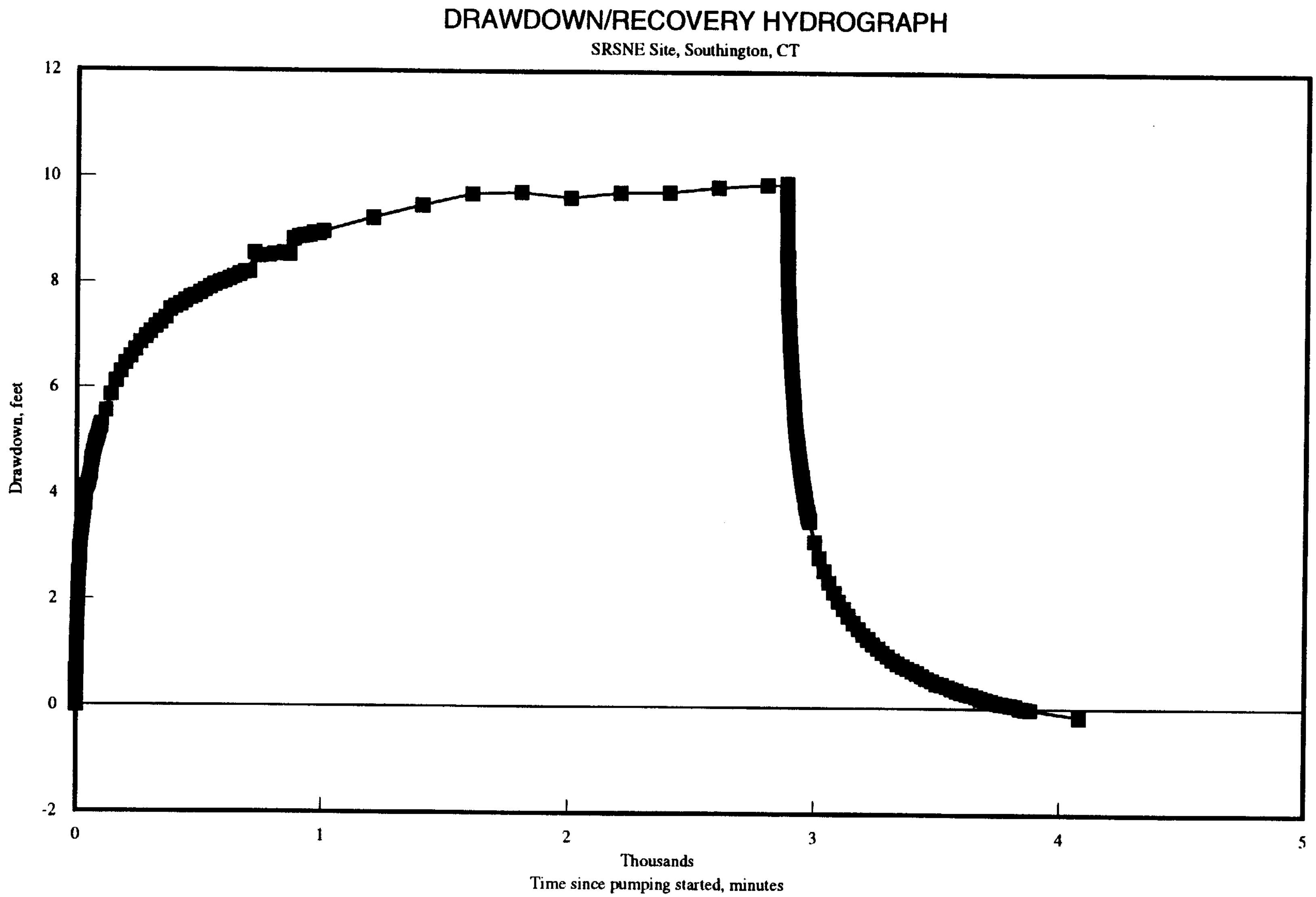

RW-5 DEVELOPMENT HYDRAULIC EVALUATION
TIME-RECOVERY DATA
Residual Drawdown (Feet)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
1
10
100
1000
Recovery Time (Minutes)
MWL-301 (r=12 ft)

Attachment A-3
RW-2 Step-Drawdown Test Data

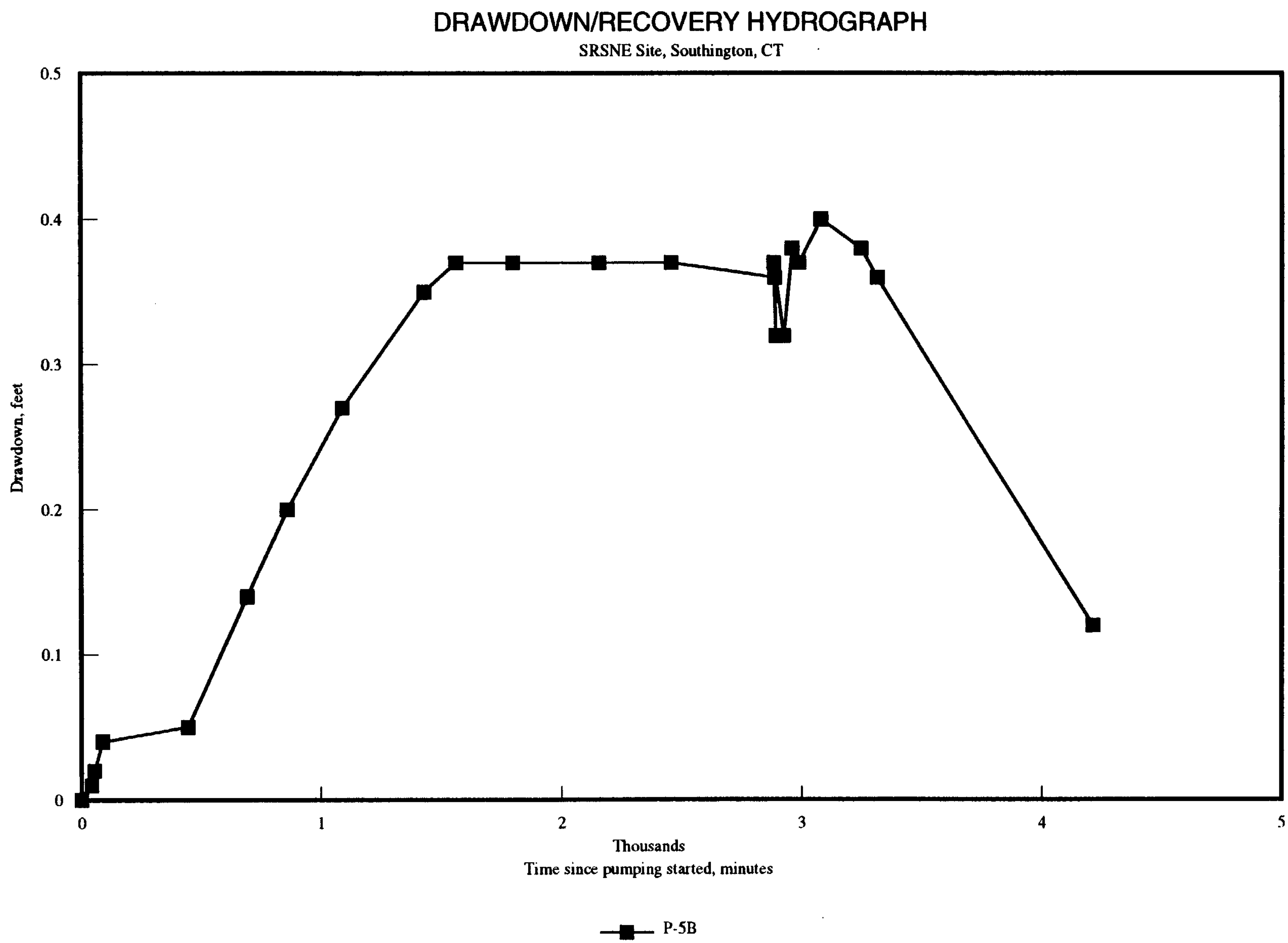


SEMI LOGARITHMIC
—TIME→
1
10
100
1000
90 MIN
180
270
DRAWDOWN IN RW-2 (FEET)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
1 GPM
$\Delta S_{w}1 = 3.25$
2 GPM
$\Delta S_{w}2 = 3.0$
$\Delta S_{w}3 = 4.2$
$\Delta S_{w}4 = 3.62$
$\Delta S_{w}5 = 6.85$
STEP-DRAWDOWN TEST
RW-2 10/10/94
5 STEPS OF ~90 MINUTES EACH
STEP 1 = 1 GPM
STEP 5 = 5 GPM
BASED ON SLOPES OF DATA vs Q, AND RESULTS OF DEVELOPMENT PUMPING, 48-HOUR RATE SELECTED AS 1.8 GPM
STEP 1
1 GPM
STEP 2
2 GPM
STEP 3
3 GPM
STEP 4
4 GPM
STEP 5
5 GPM
STEP 1
STEP 2
90-180
STEP 3
STEP 4

Attachment A-4
RW-2 Constant Rate Test
Drawdown/Recovery Hydrographs



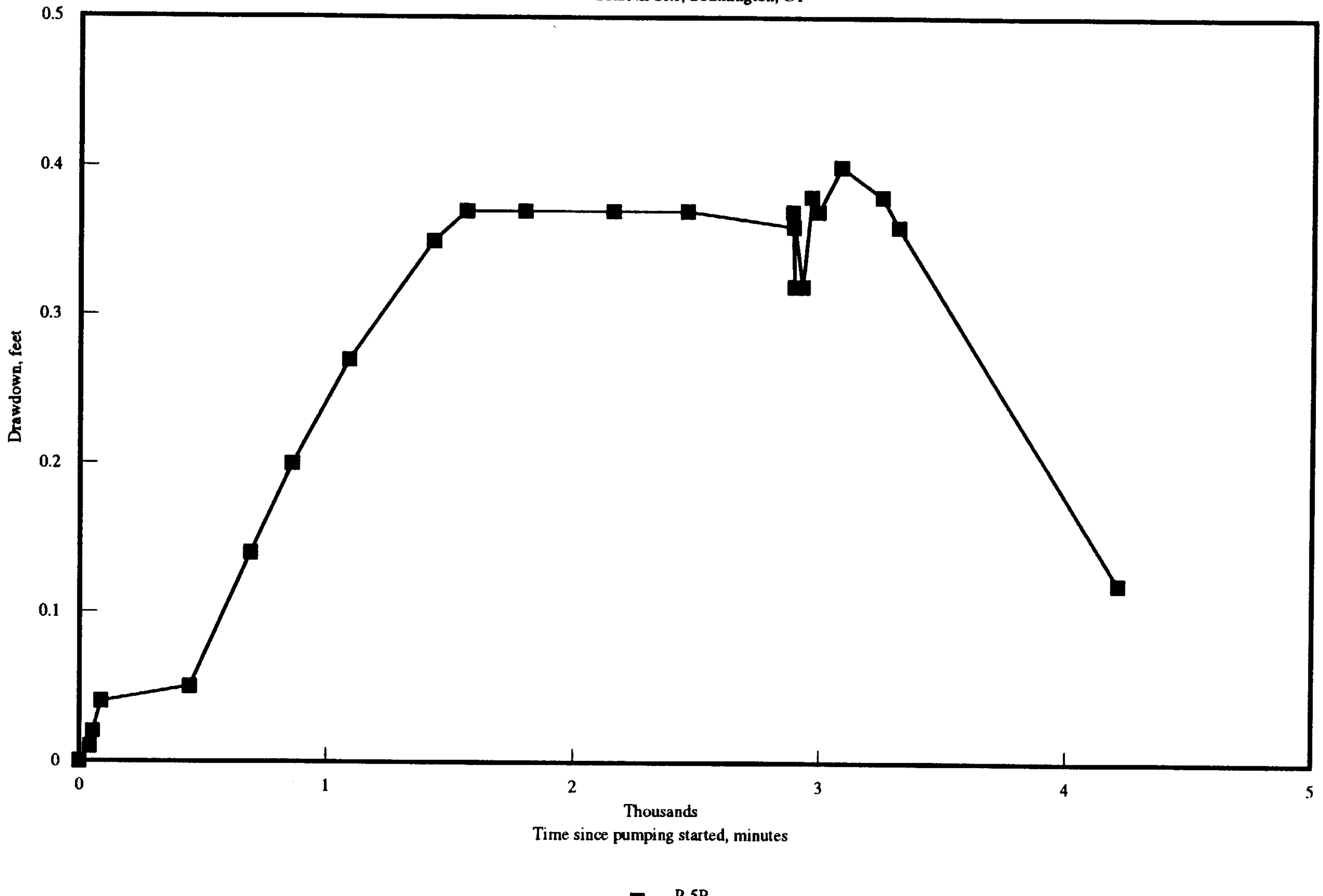
Outwash/Till/Bedrock
Distance to Pumping Well RW-2: 1 feet. Pump on at 0 minutes; off at 2880 minutes.



Water-Table
Distance to Pumping Well RW-2: 16 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

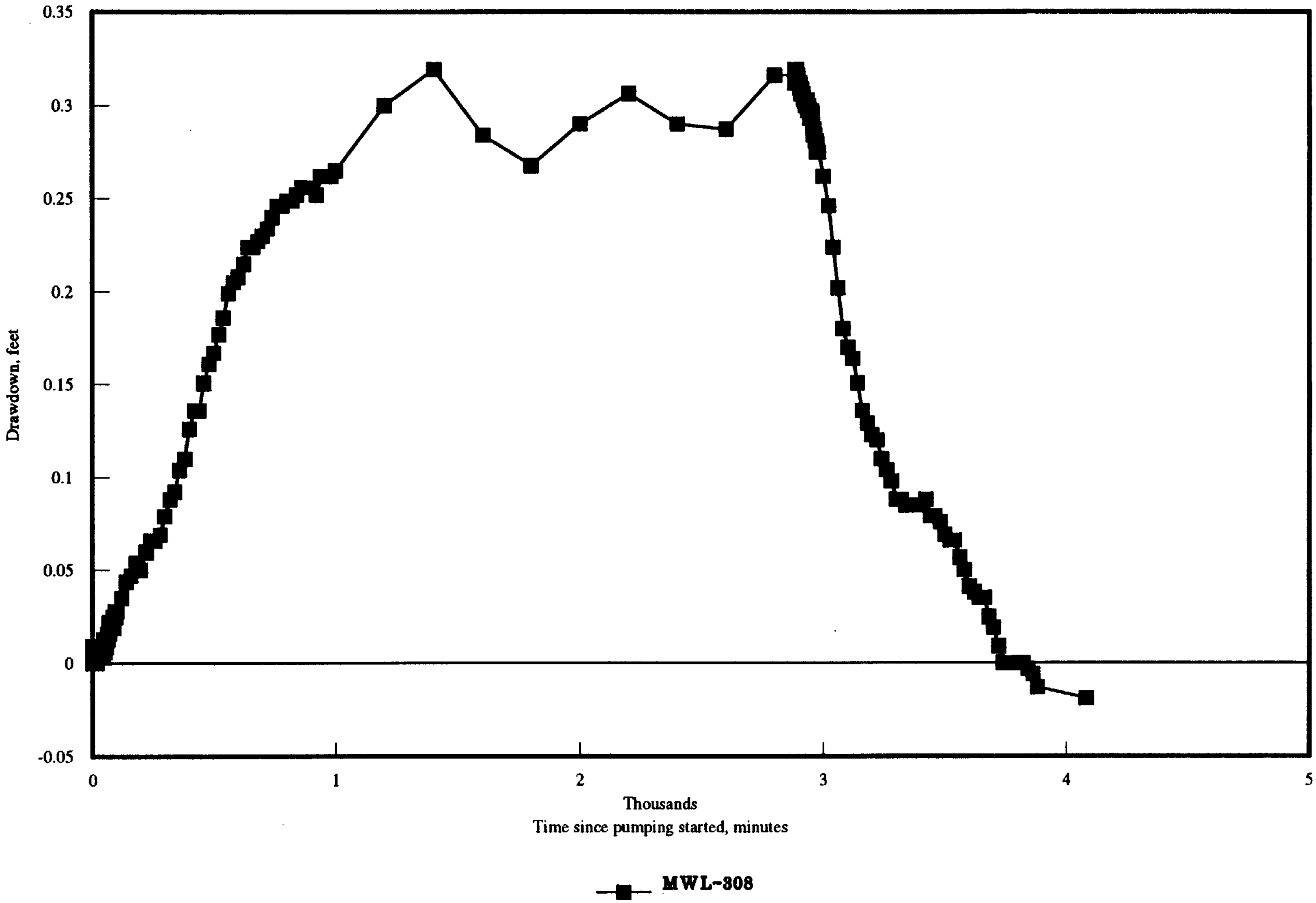


Water-Table

Distance to Pumping Well RW-2: 16 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

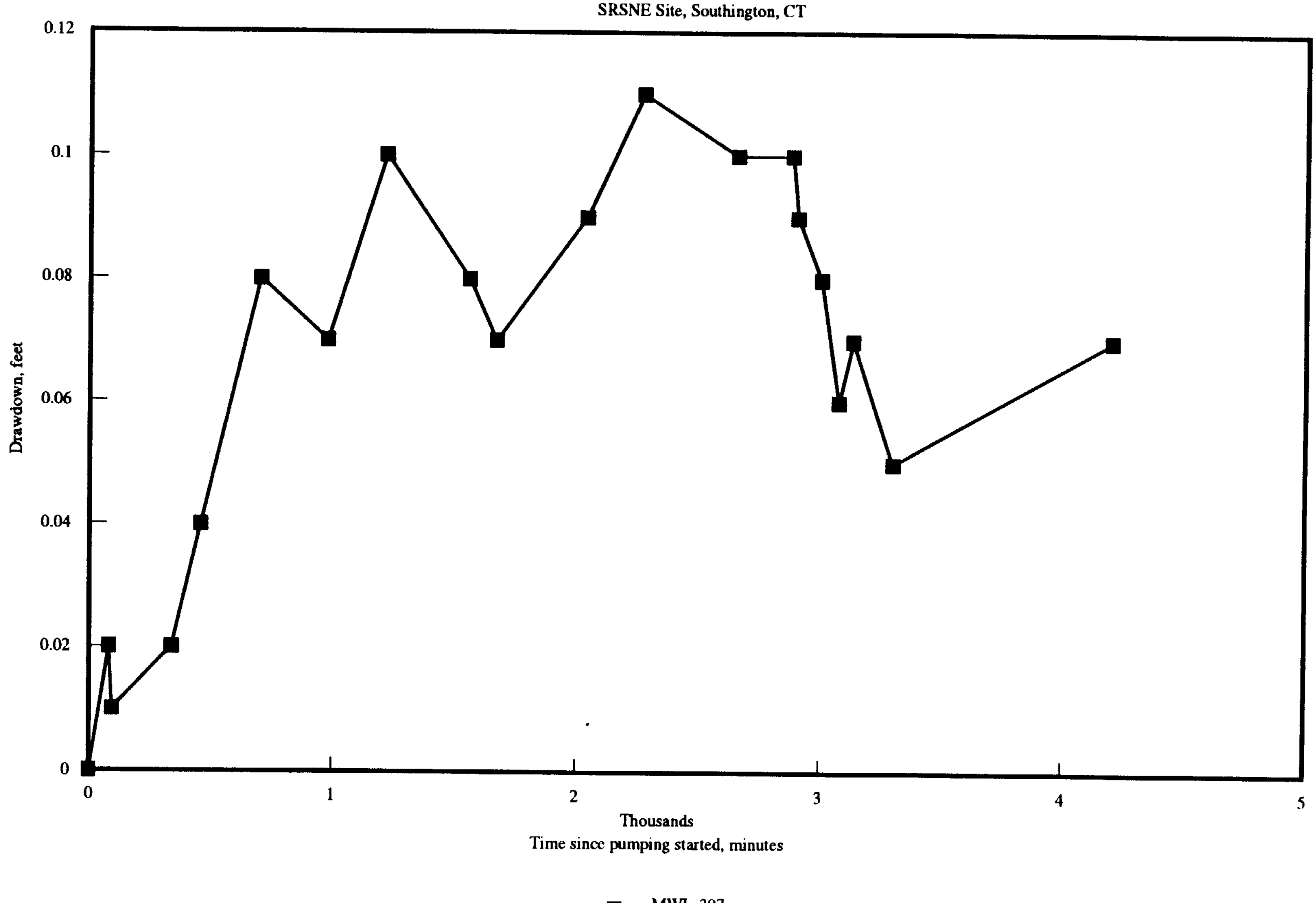


Water-Table

Distance to Pumping Well RW-2: 27 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

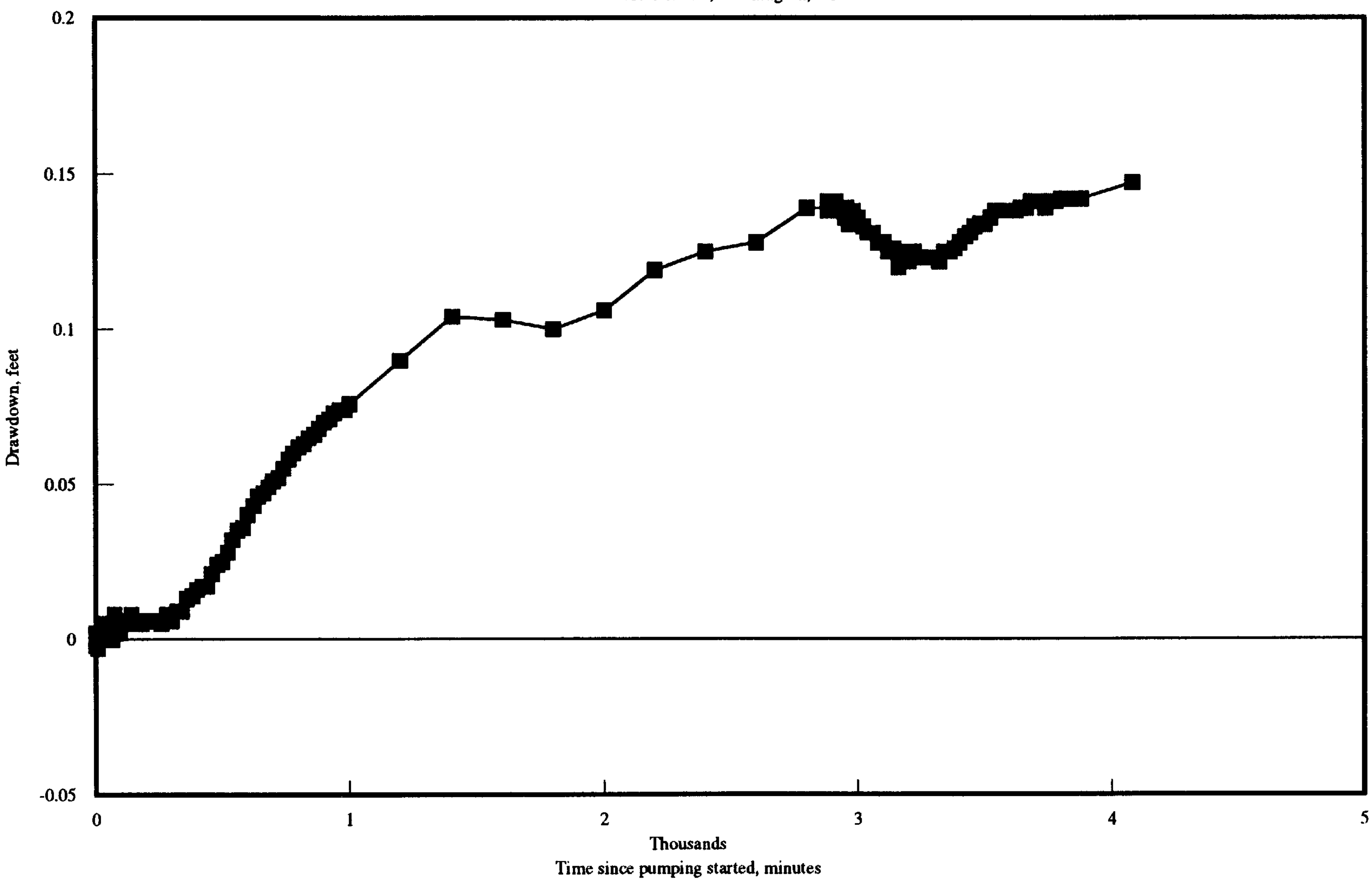


Water-Table

Distance to Pumping Well RW-2: 117 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

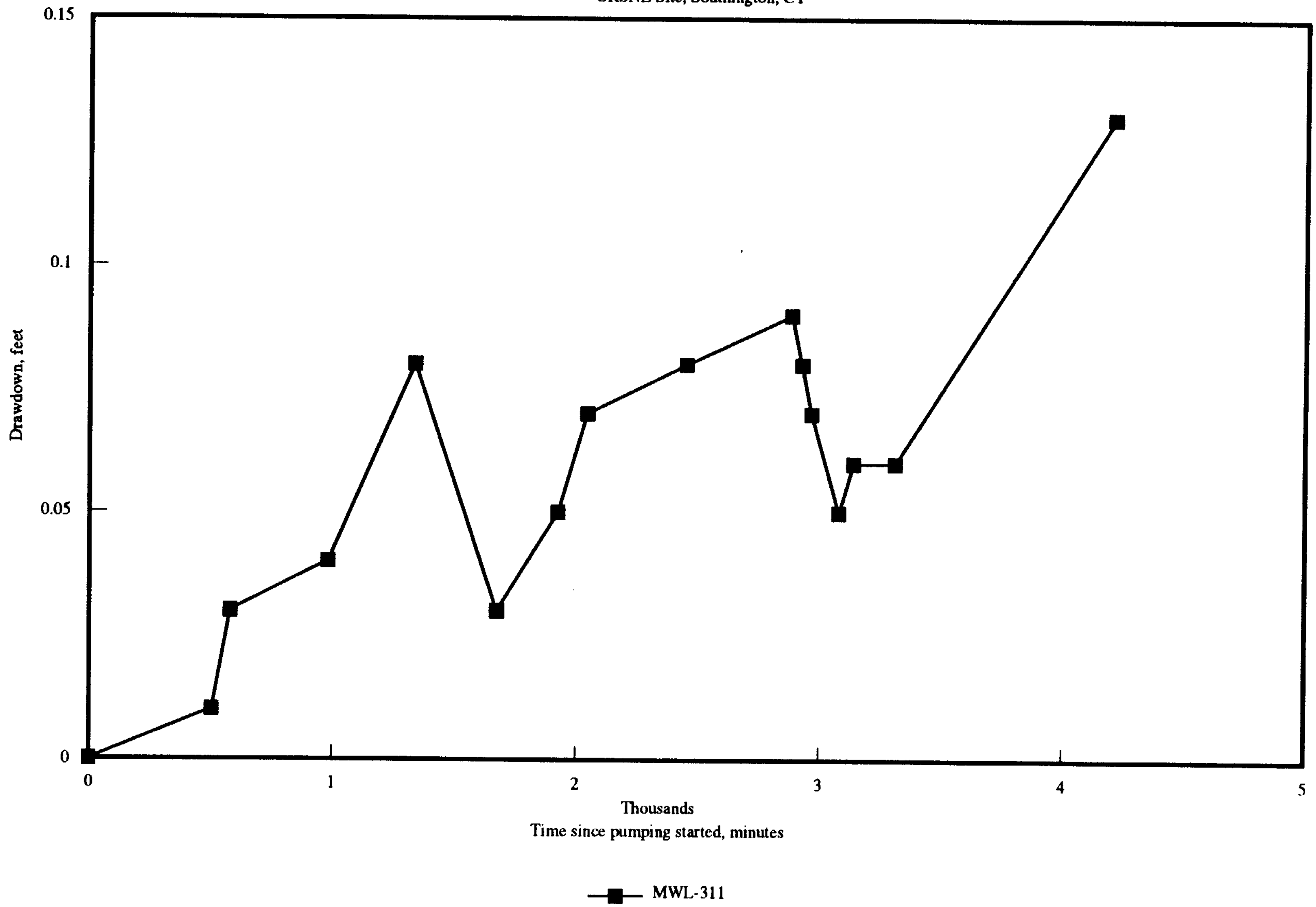


Water-Table

Distance to Pumping Well RW-2: 129 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

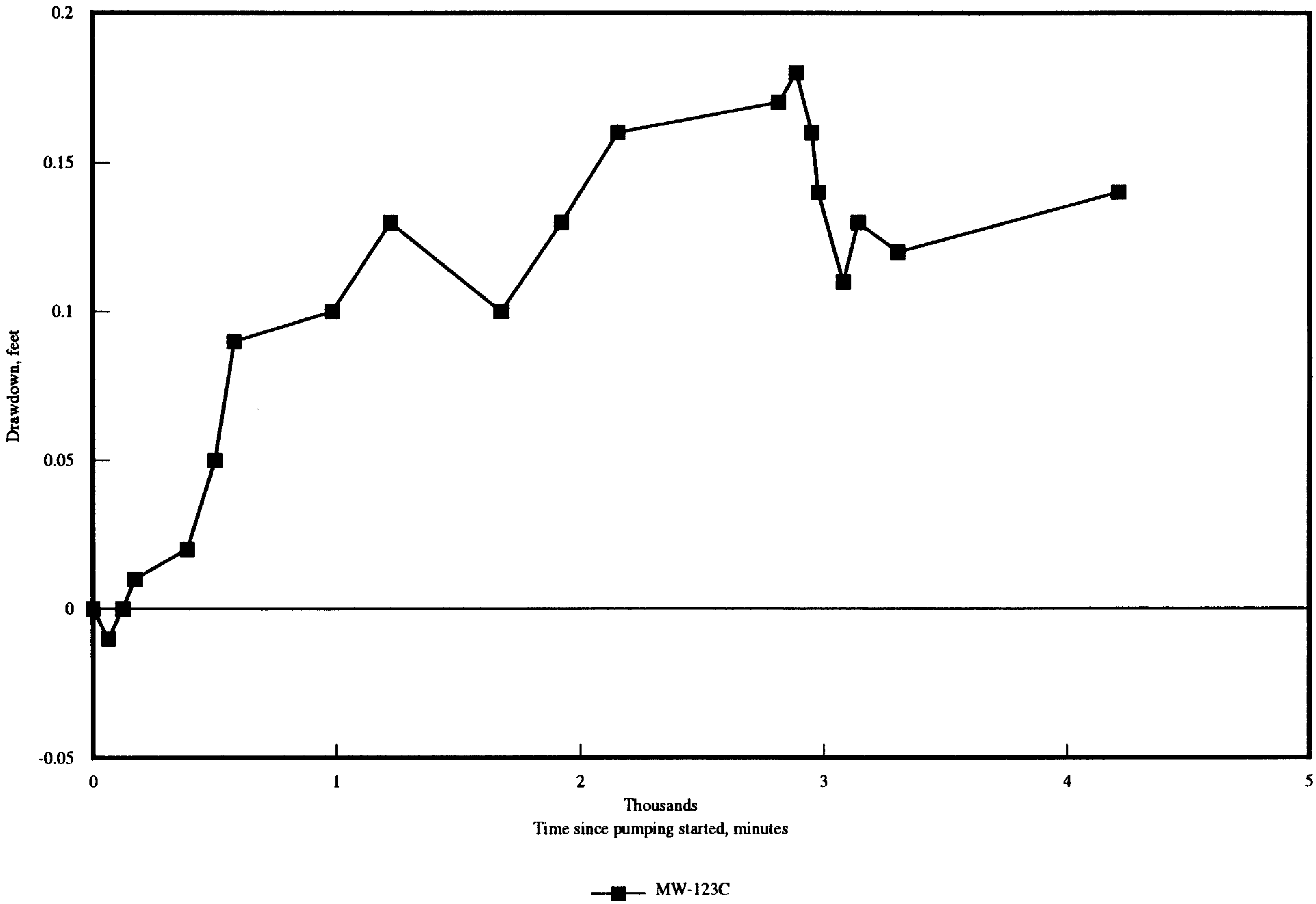


Water-Table

Distance to Pumping Well RW-2: 145 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

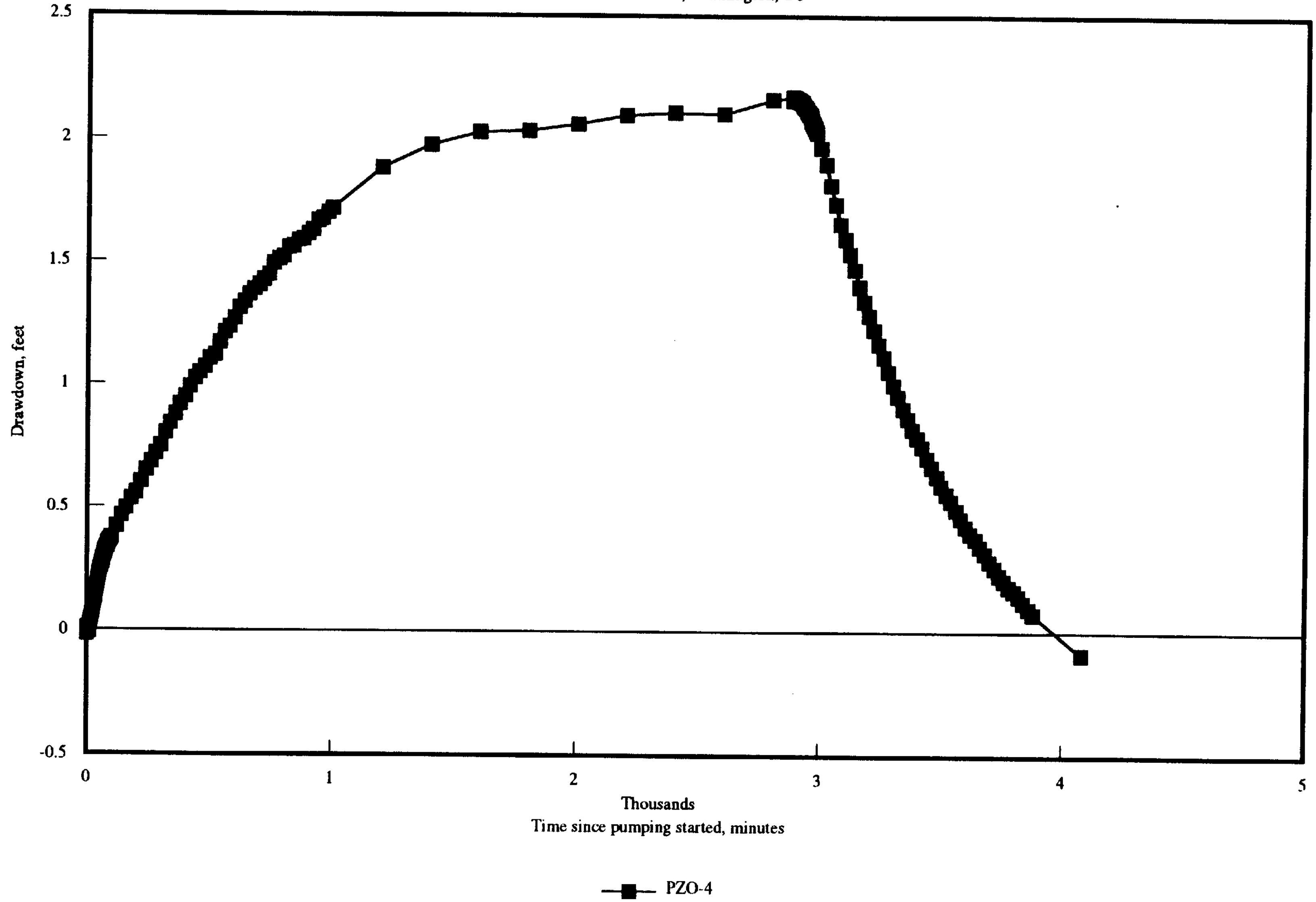
SRSNE Site, Southington, CT



Water-Table
Distance to Pumping Well RW-2: 190 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

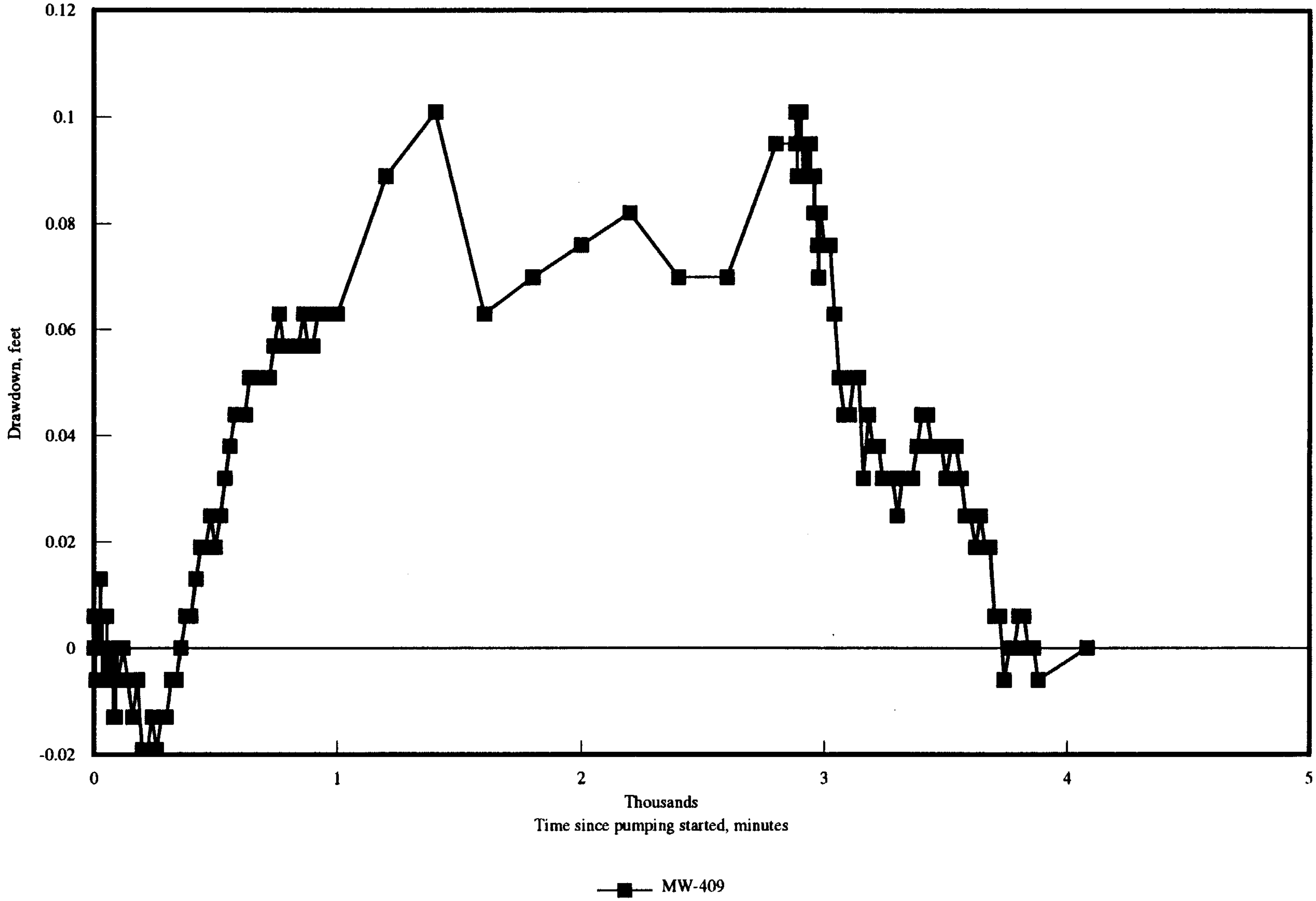


Lower Outwash +/- Till

Distance to Pumping Well RW-2: 27 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

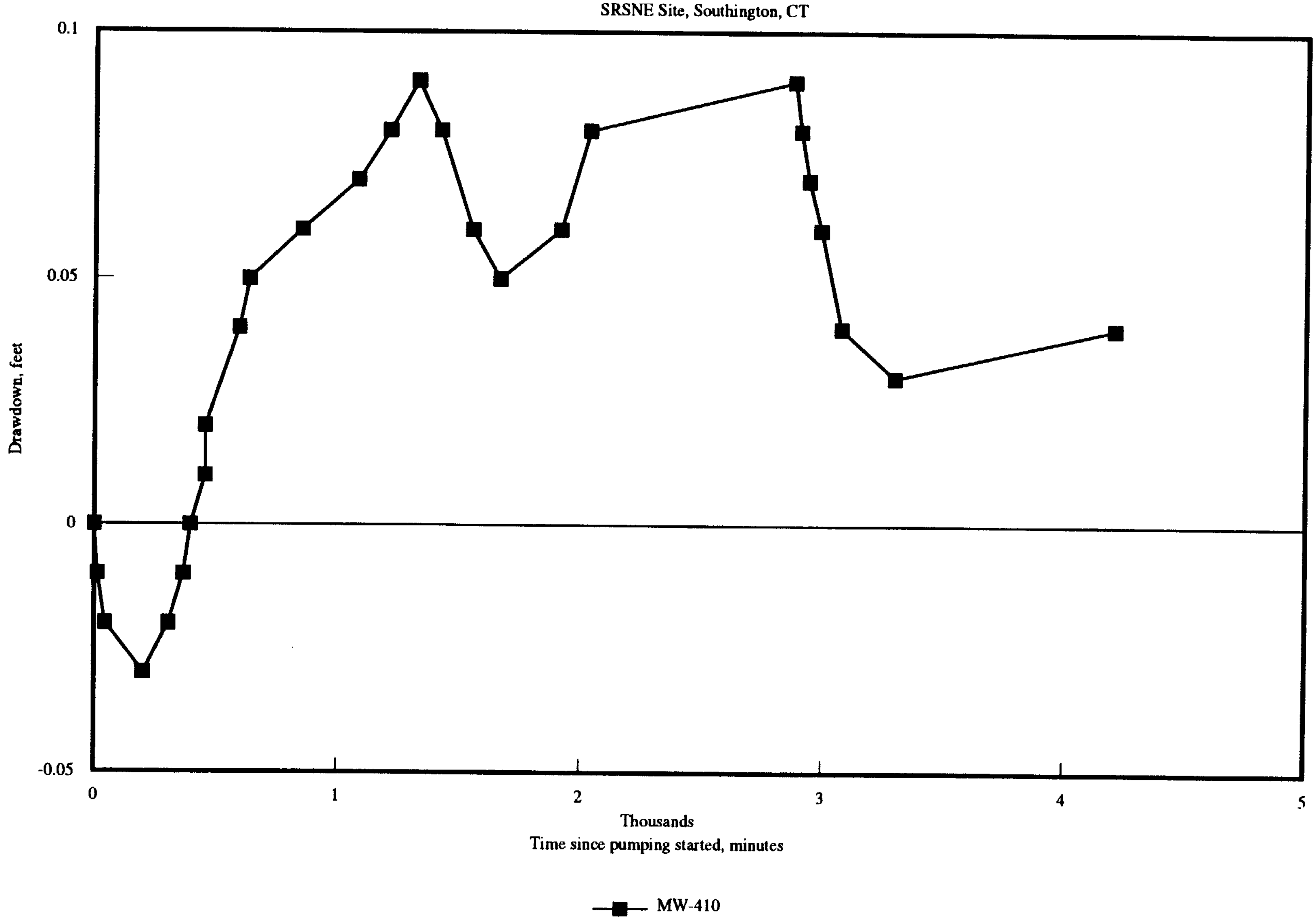


Lower Outwash +/- Till

Distance to Pumping Well RW-2: 71 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

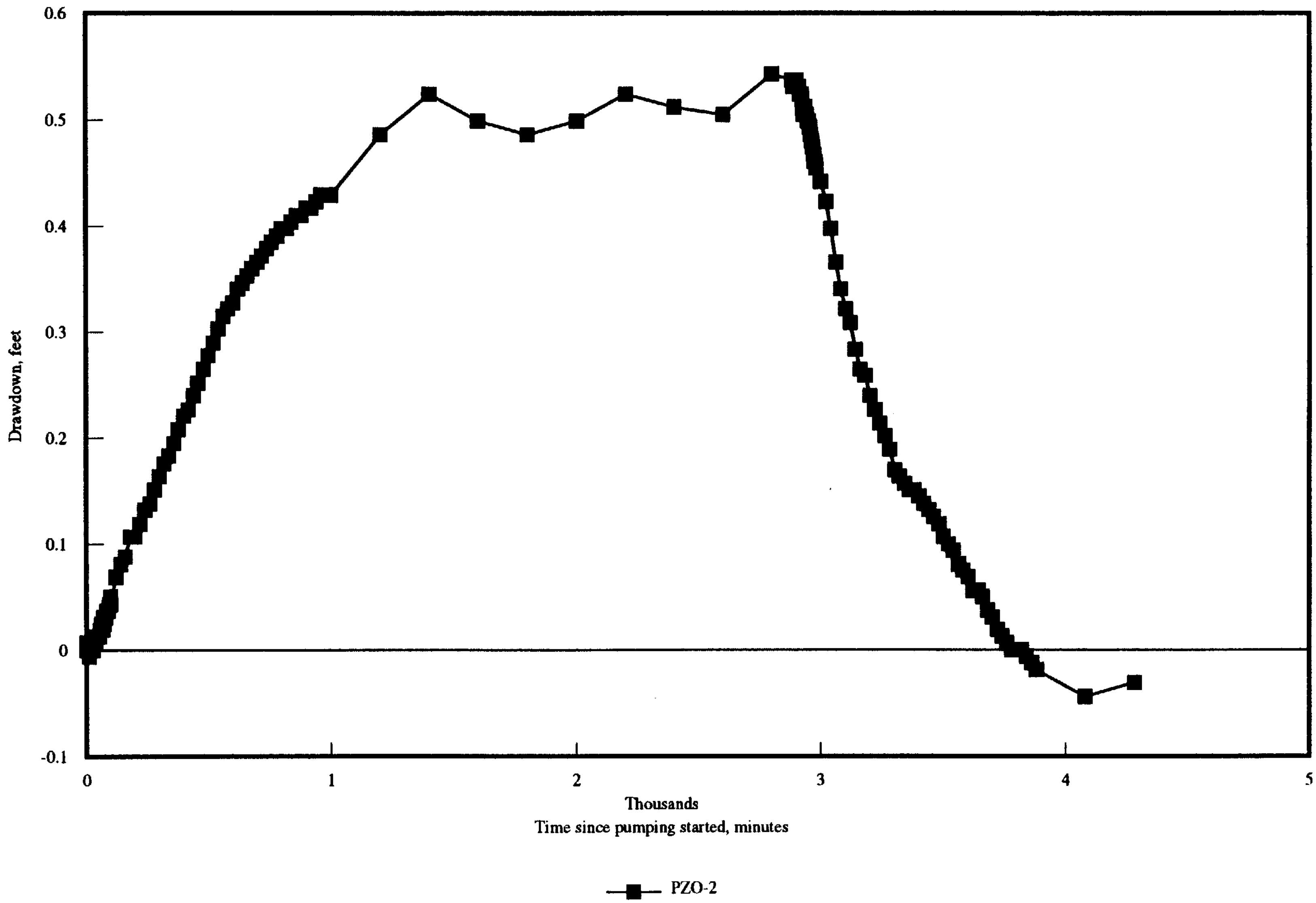


Lower Outwash +/- Till

Distance to Pumping Well RW-2: 82 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

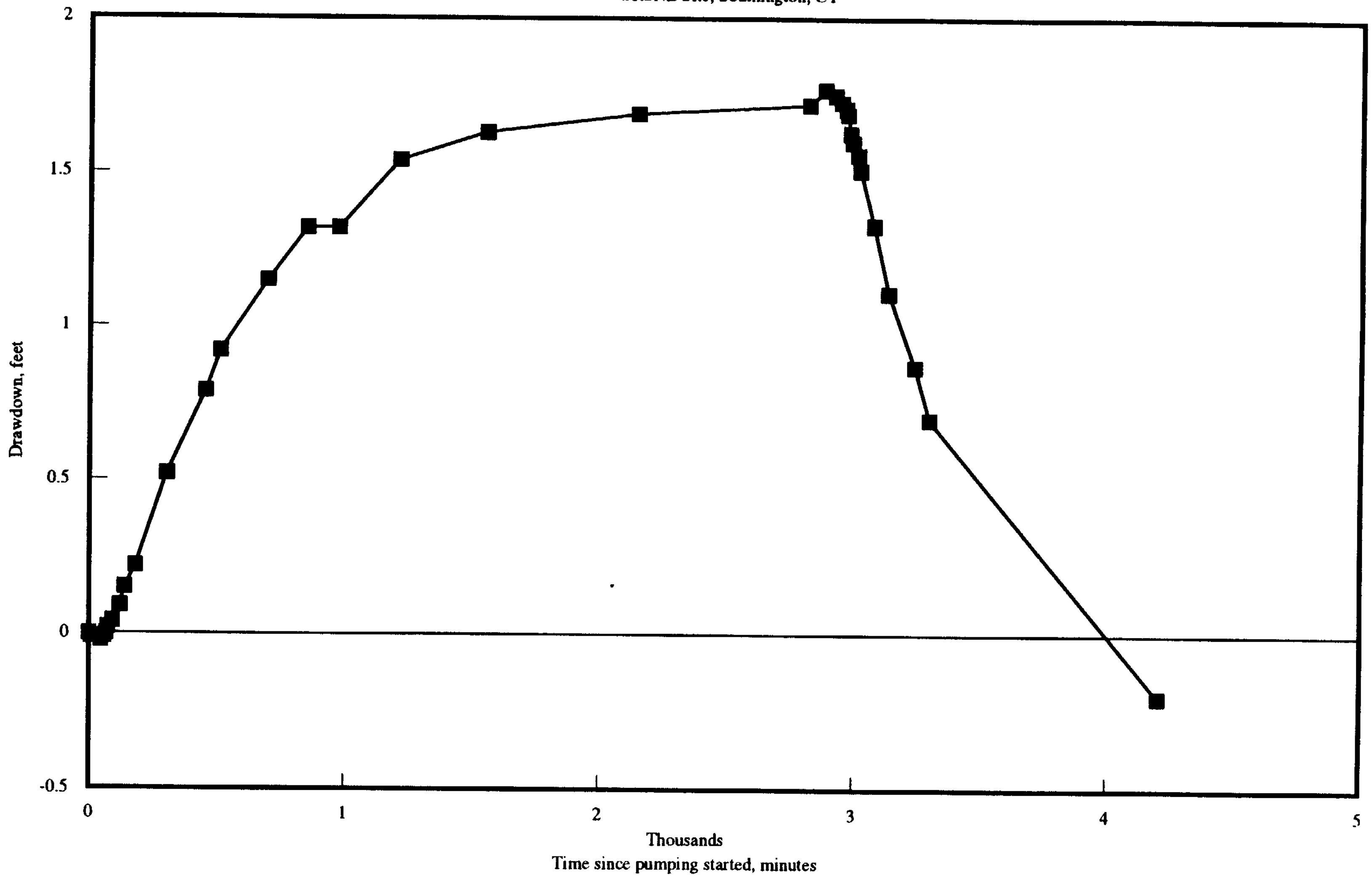


Lower Outwash +/- Till

Distance to Pumping Well RW-2: 86 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

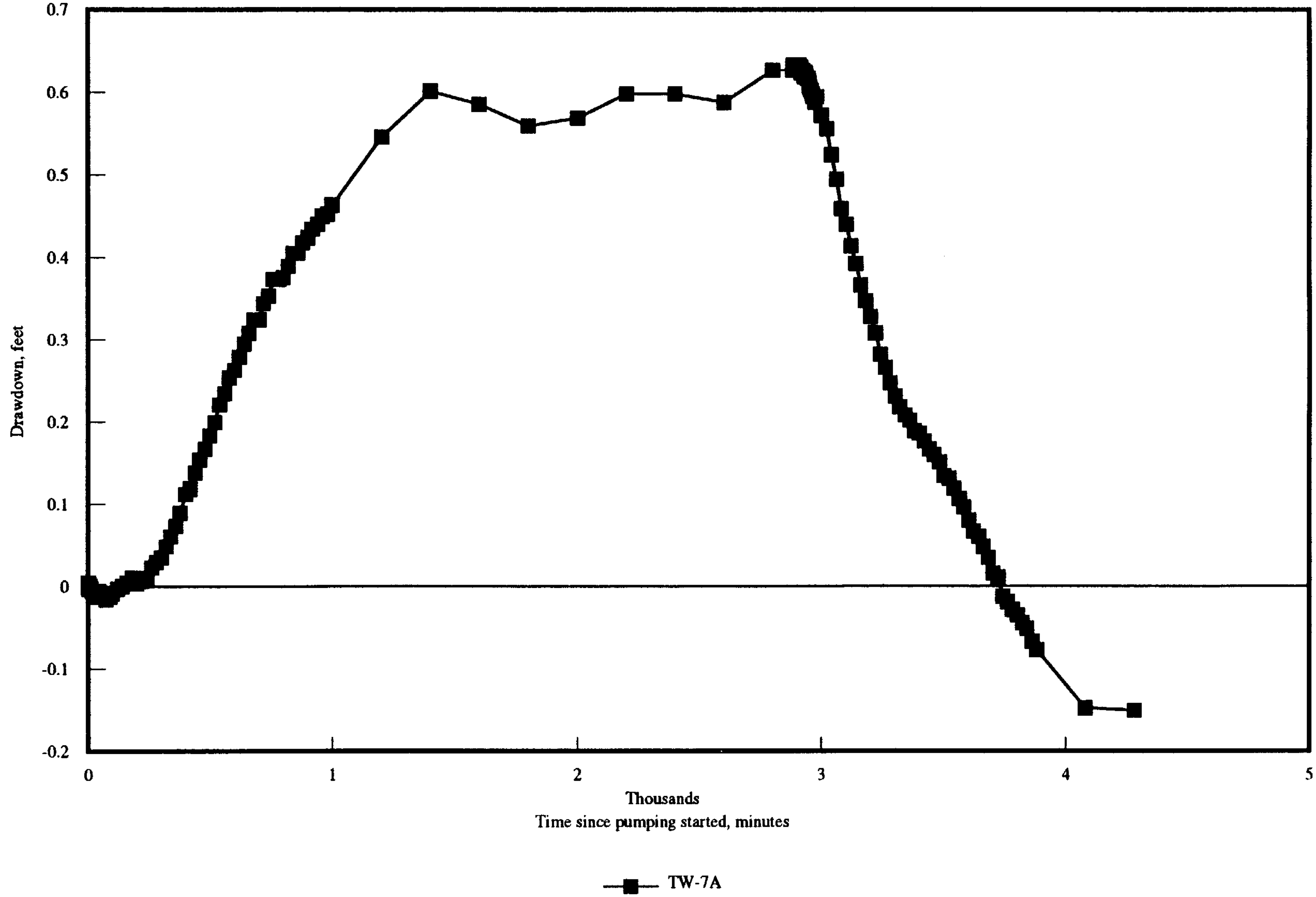


Lower Outwash +/- Till

Distance to Pumping Well RW-2: 87 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

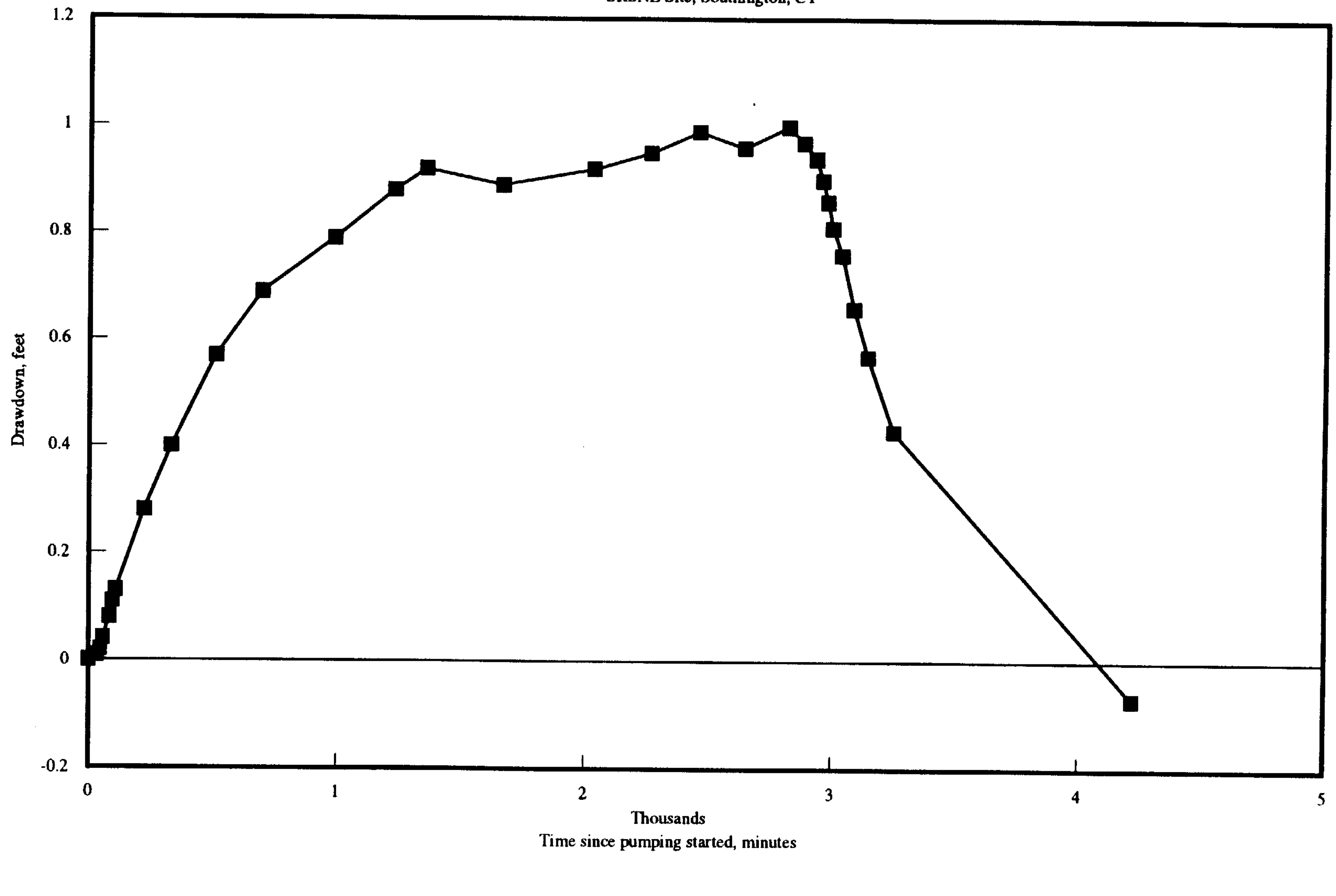


Lower Outwash +/- Till

Distance to Pumping Well RW-2: 97 feet. Pump on at 0 minutes; off at 2880 minutes.

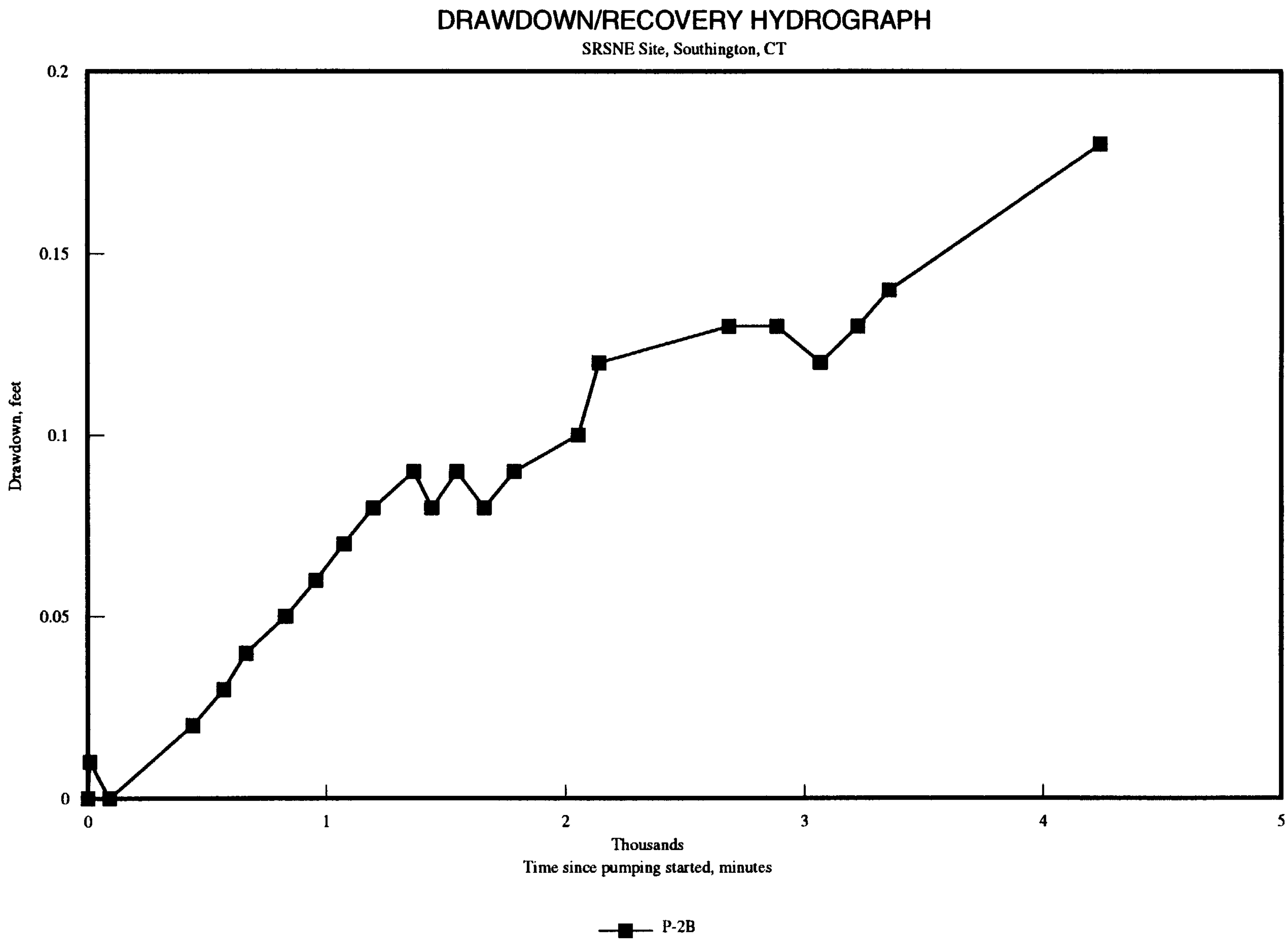
DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT



Lower Outwash +/- Till

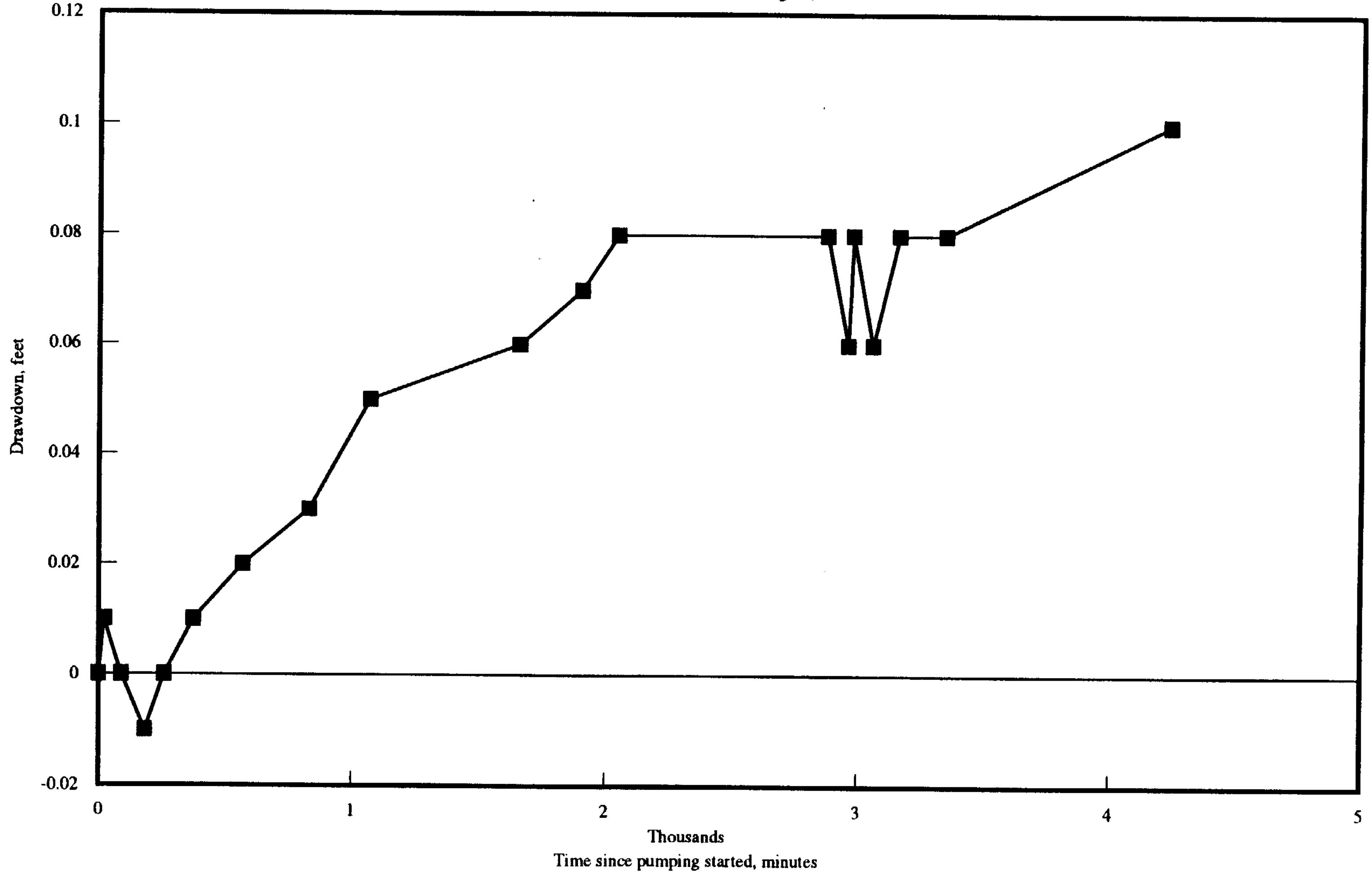
Distance to Pumping Well RW-2: 98 feet. Pump on at 0 minutes; off at 2880 minutes.



Lower Outwash +/- Till
Distance to Pumping Well RW-2: 265 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

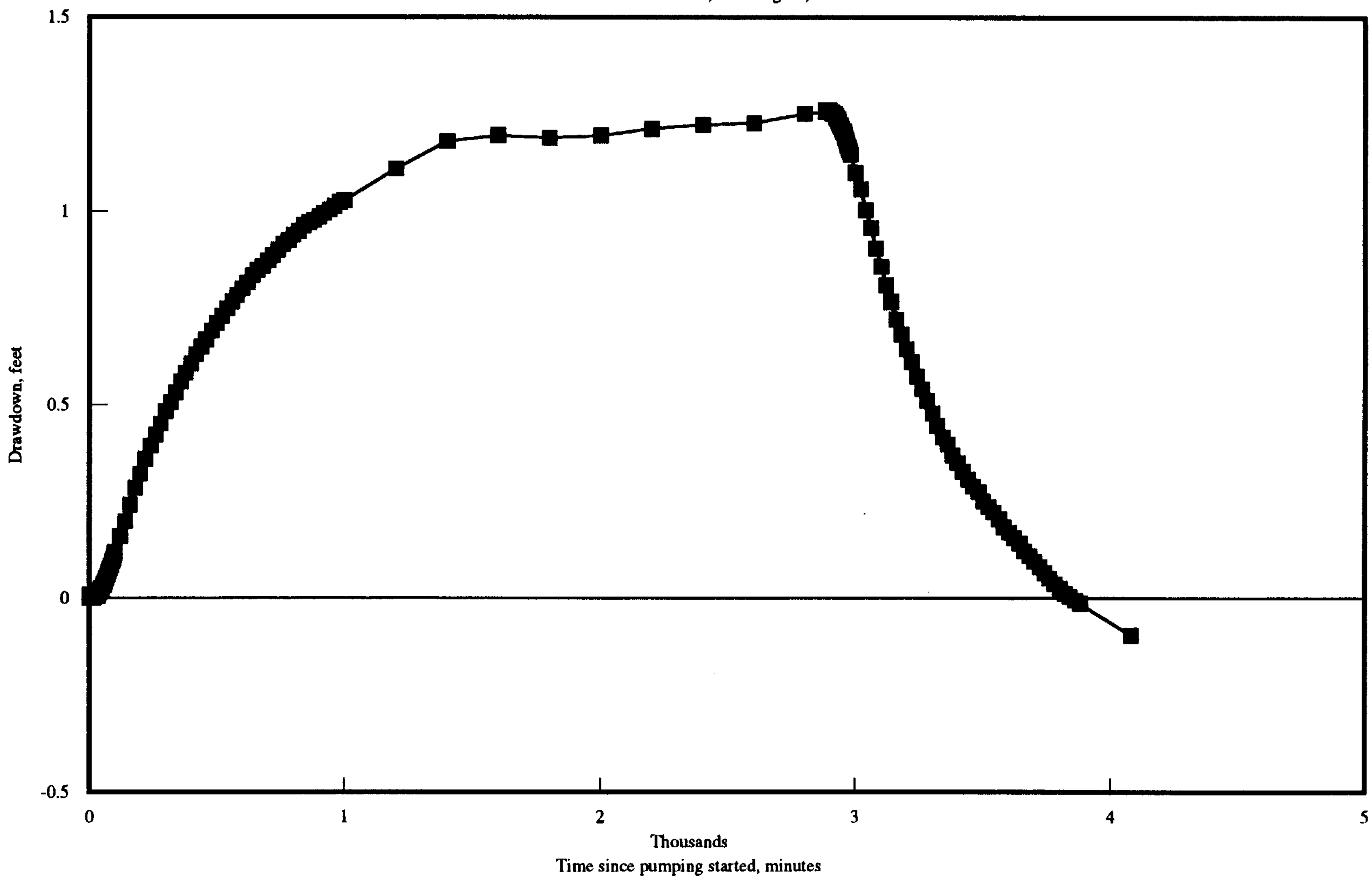


Lower Outwash +/- Till

Distance to Pumping Well RW-2: 330 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

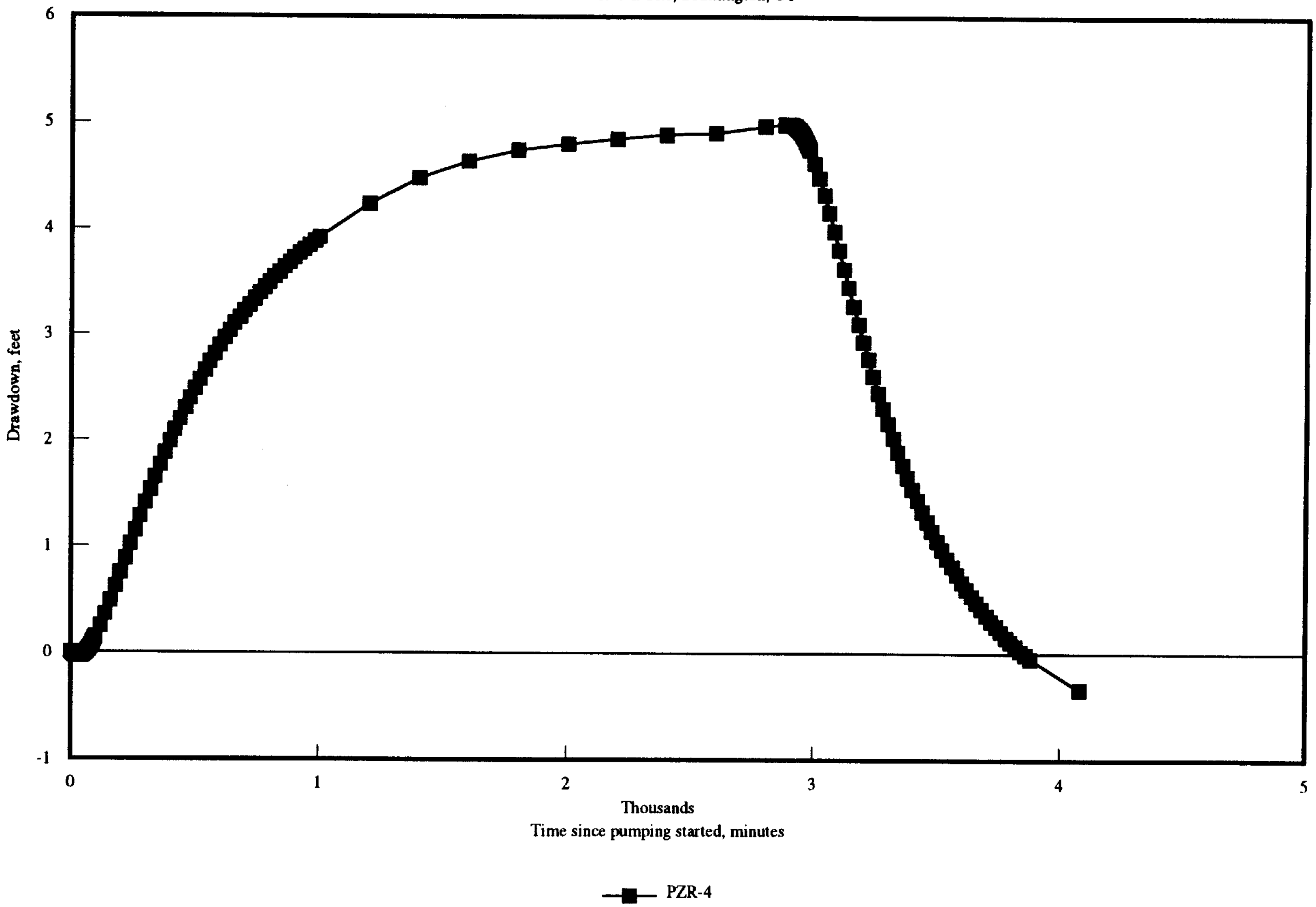


Bedrock

Distance to Pumping Well RW-2: 18 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

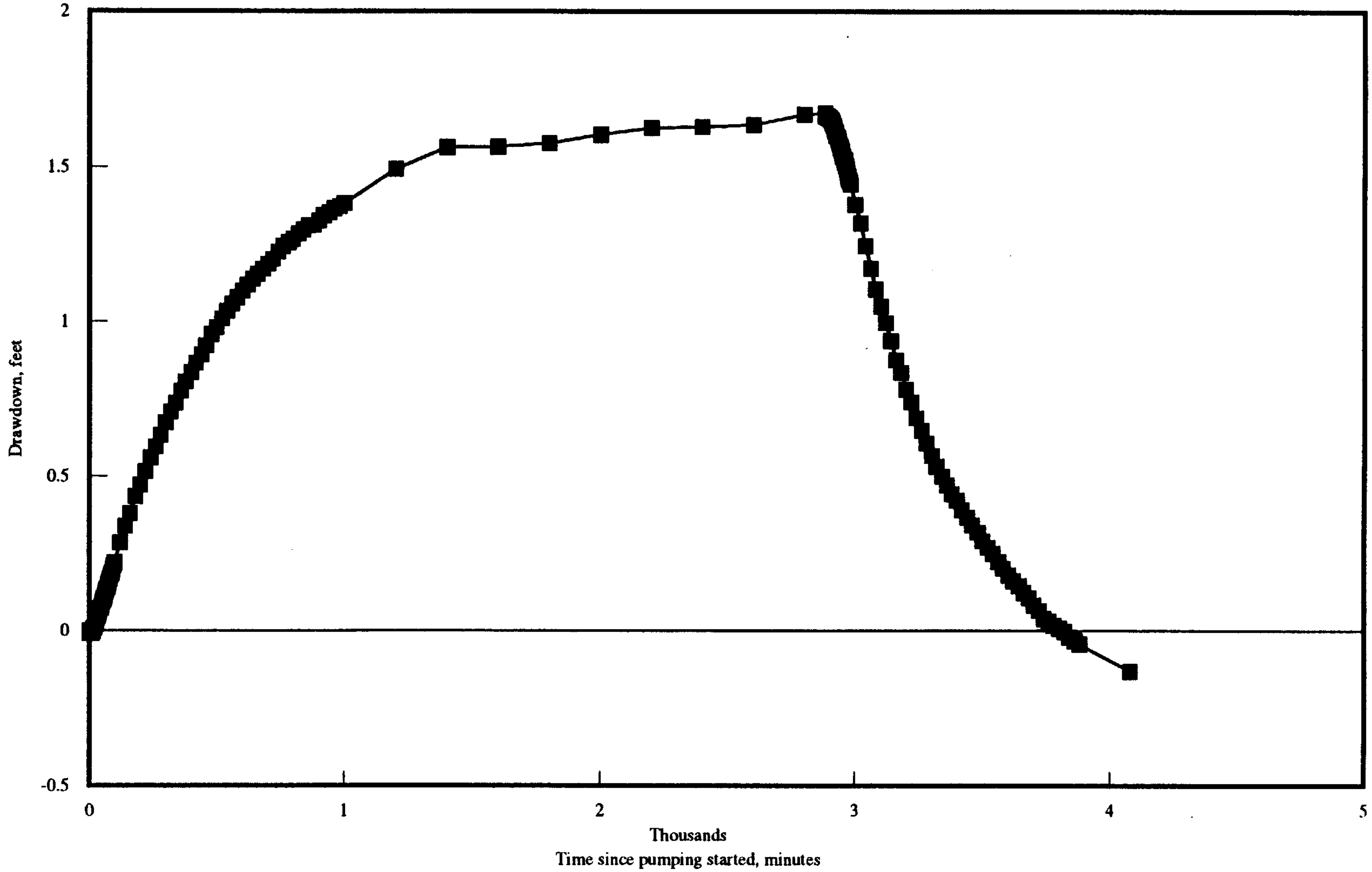


Bedrock

Distance to Pumping Well RW-2: 21 feet. Pump on at 0 minutes; off at 2880 minutes.

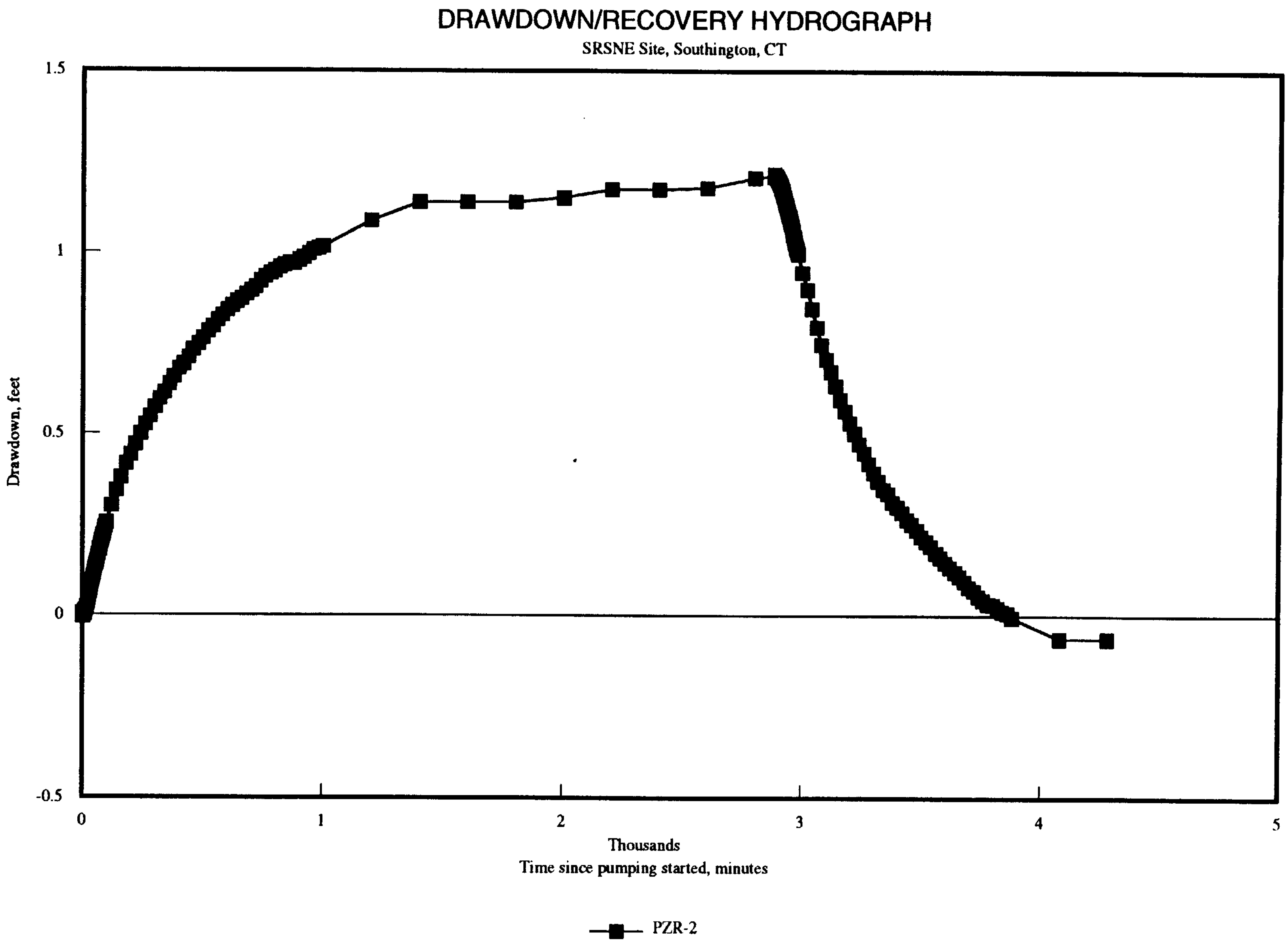
DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT



Bedrock

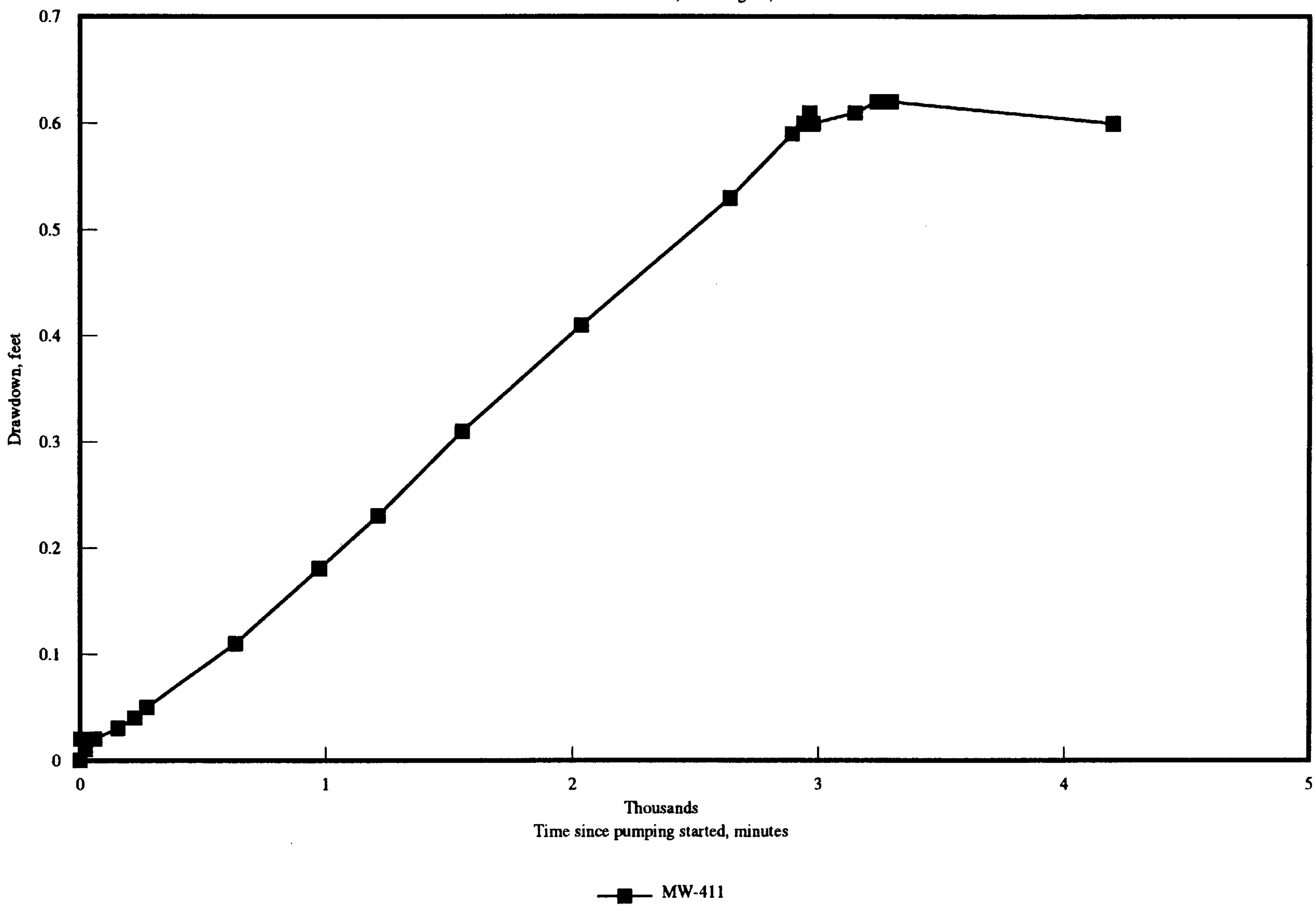
Distance to Pumping Well RW-2: 68 feet. Pump on at 0 minutes; off at 2880 minutes.



Bedrock
Distance to Pumping Well RW-2: 81 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

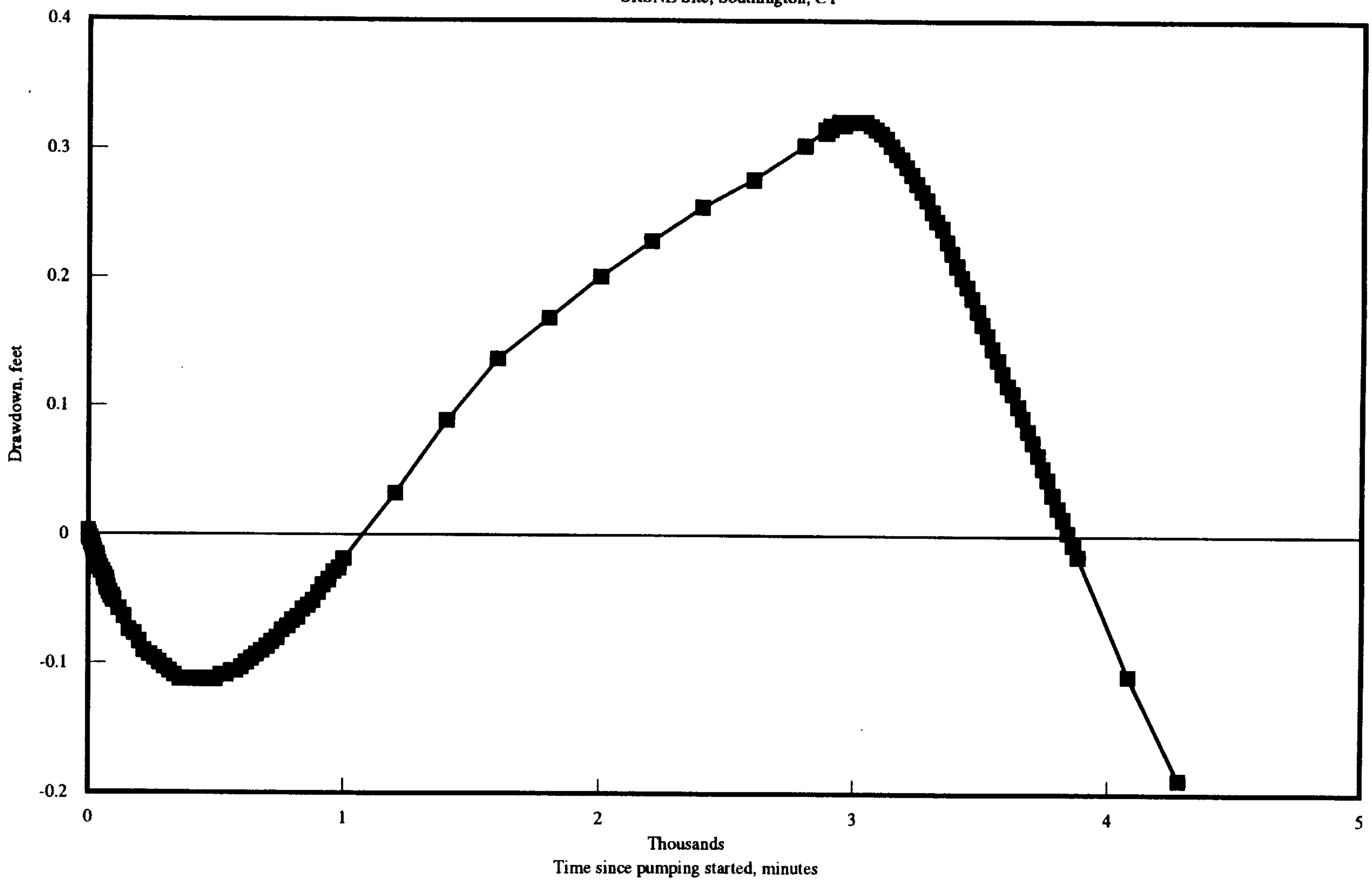


Bedrock

Distance to Pumping Well RW-2: 93 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

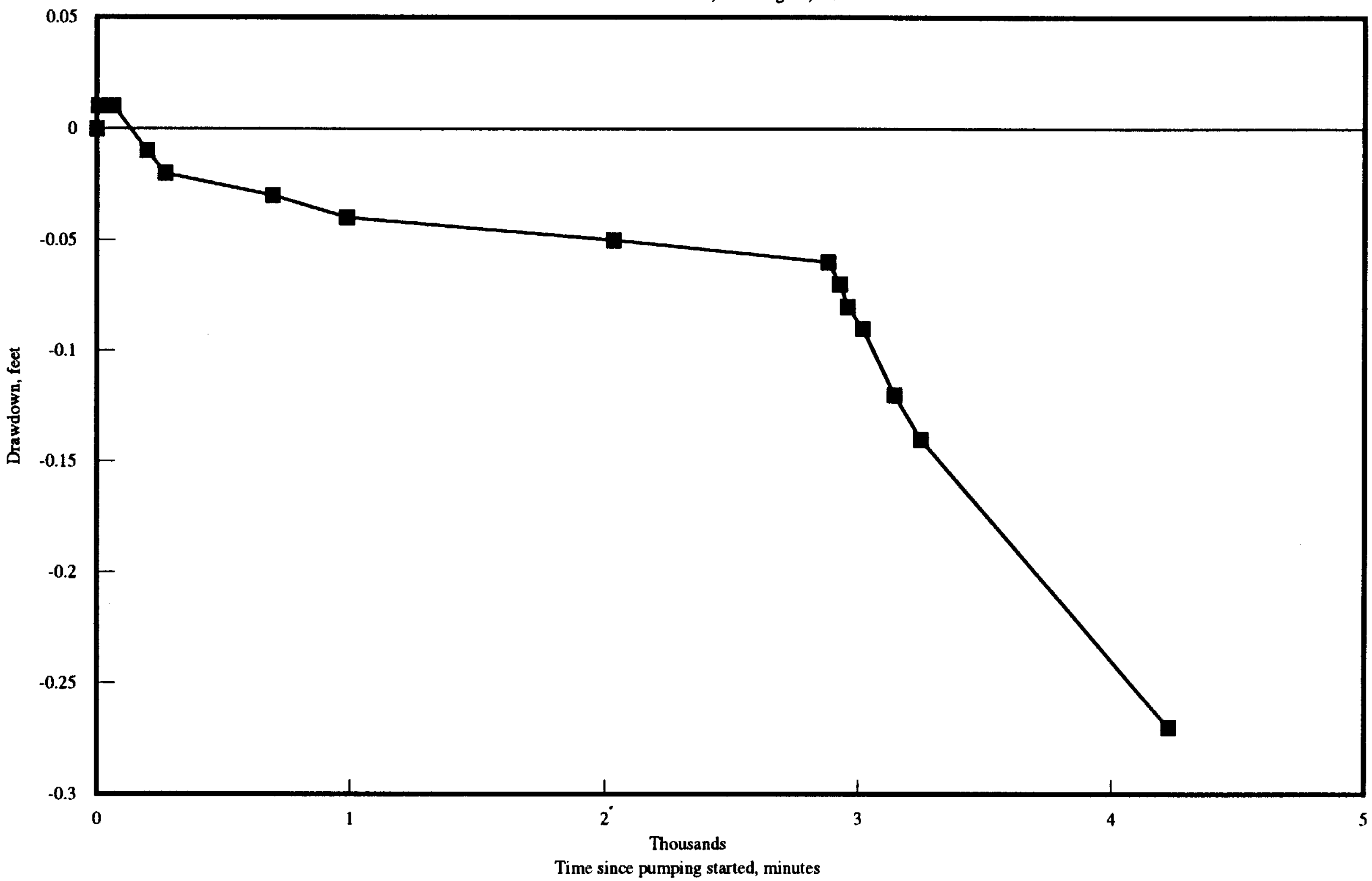


Bedrock

Distance to Pumping Well RW-2: 98 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

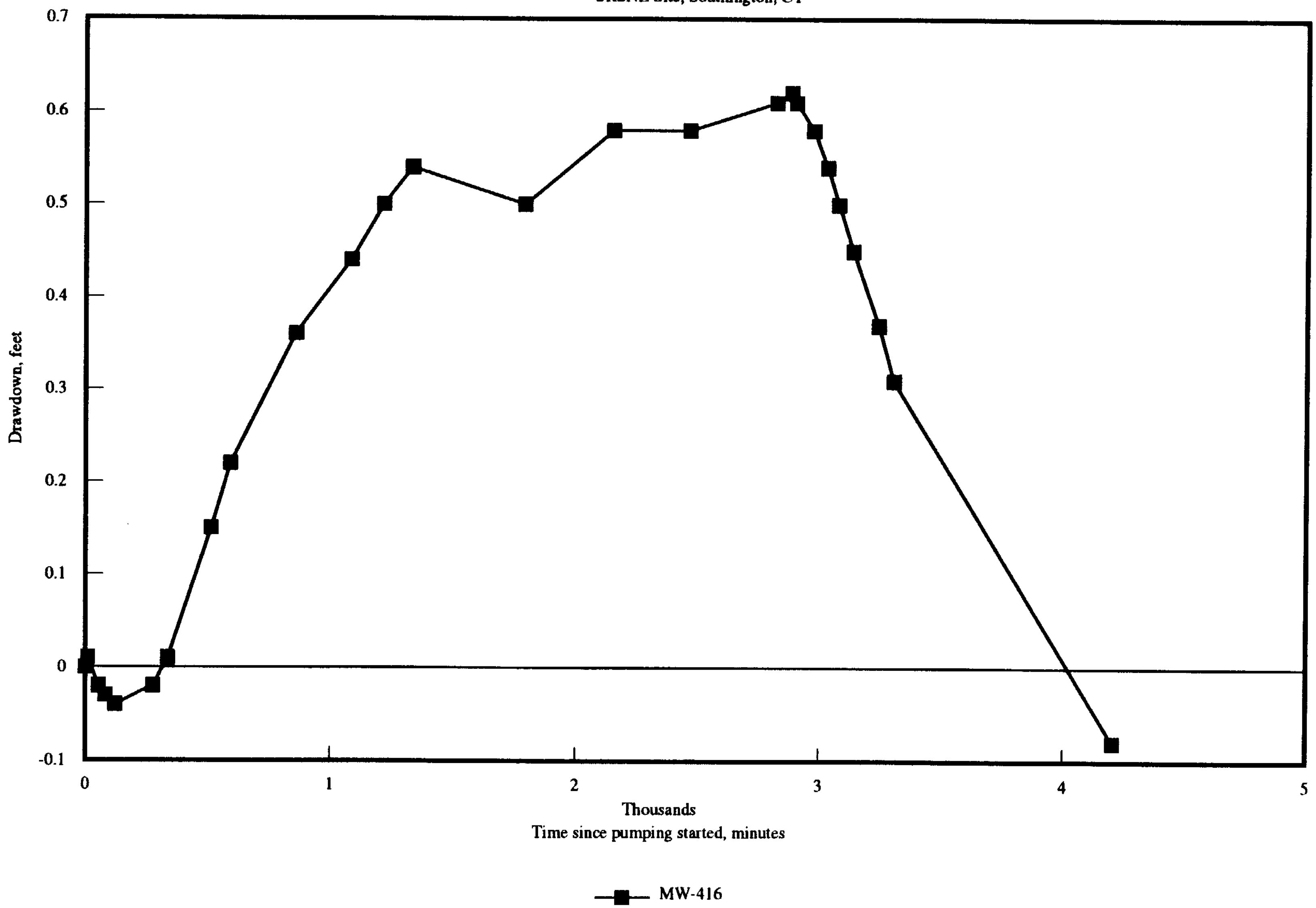


Bedrock

Distance to Pumping Well RW-2: 108 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT

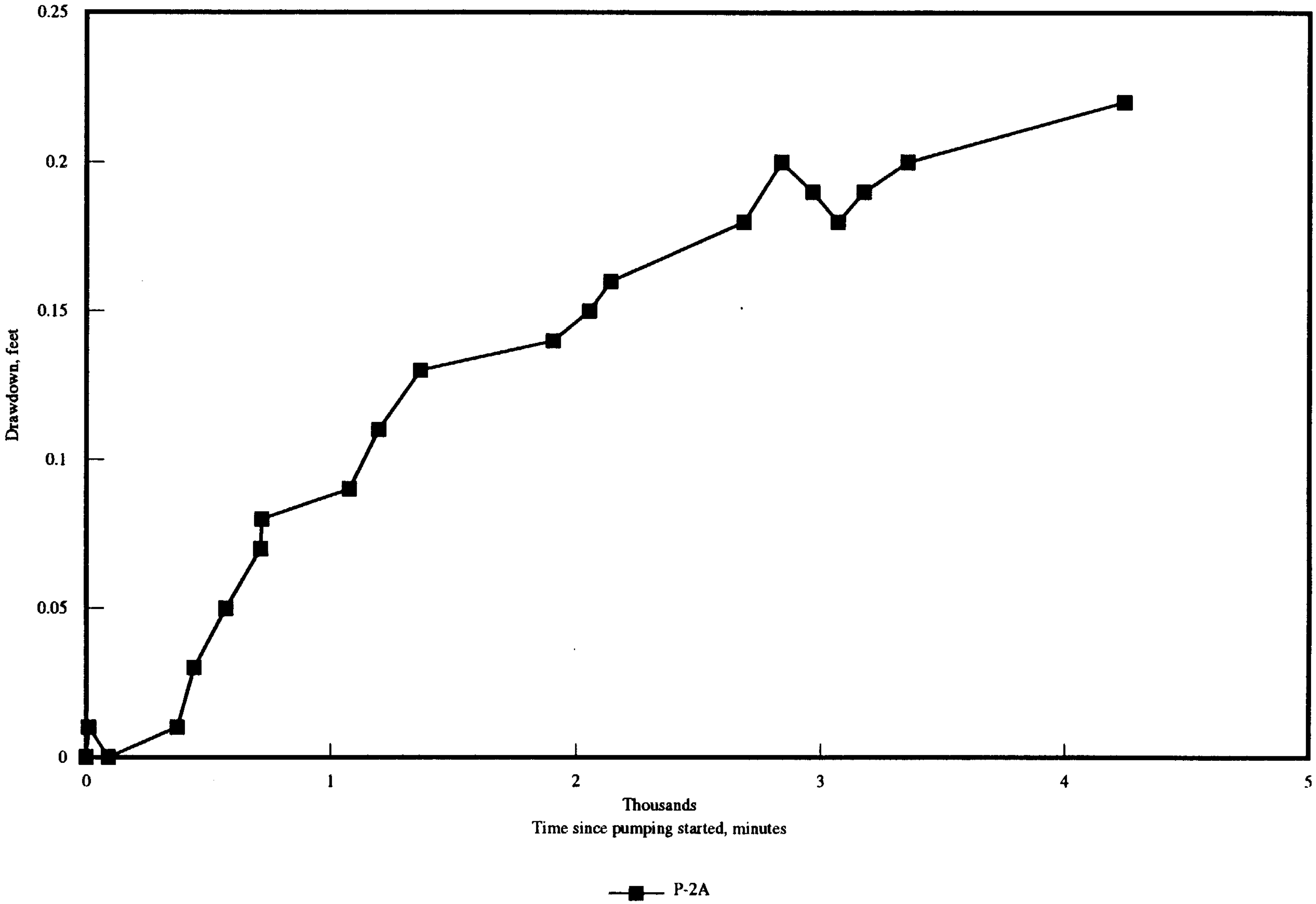


Bedrock

Distance to Pumping Well RW-2: 112 feet. Pump on at 0 minutes; off at 2880 minutes.

DRAWDOWN/RECOVERY HYDROGRAPH

SRSNE Site, Southington, CT



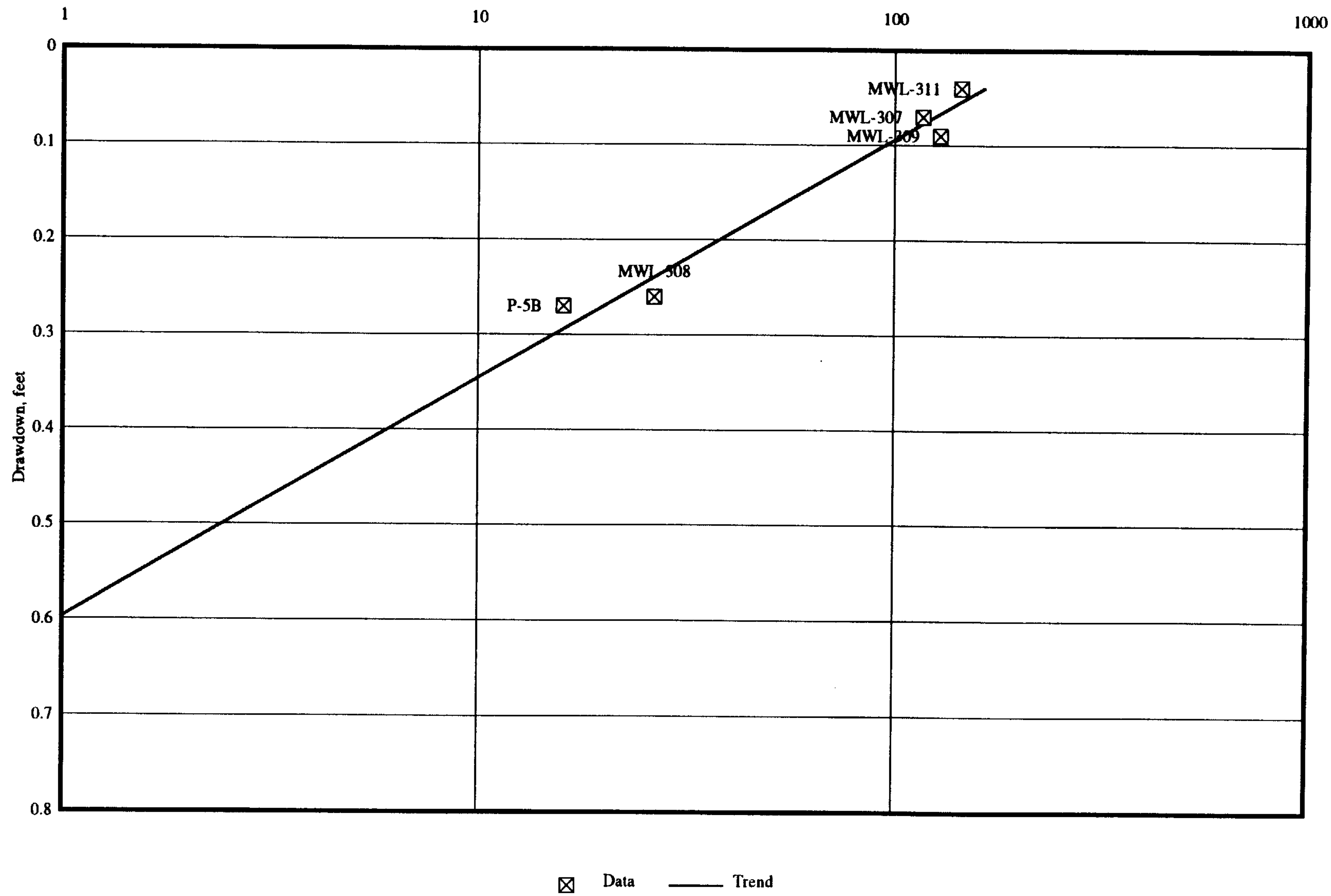
Bedrock

Distance to Pumping Well RW-2: 265 feet. Pump on at 0 minutes; off at 2880 minutes.

Attachment A-5
RW-2 Constant Rate Test
Distance-Drawdown Plots

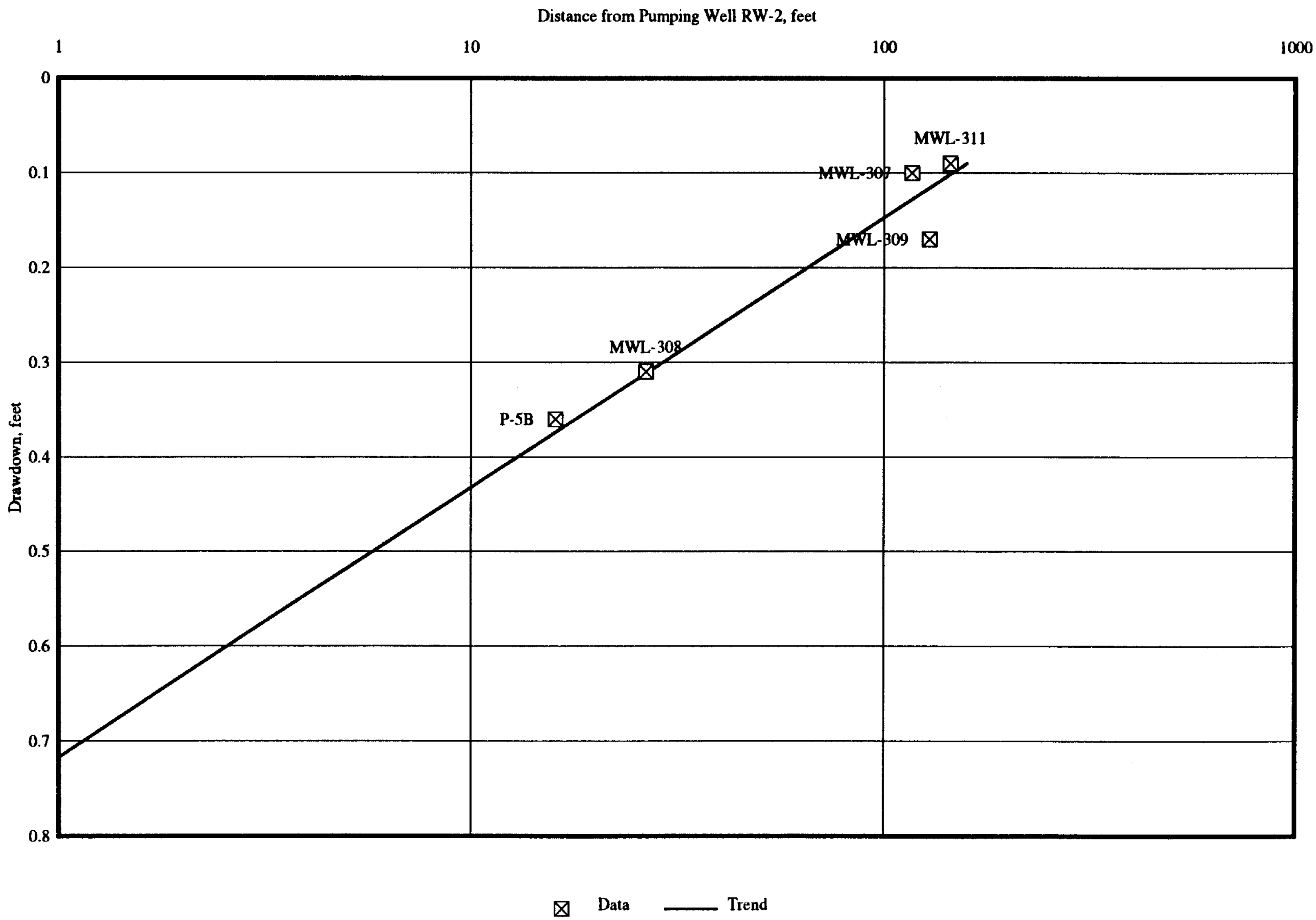
Water Table Zone Distance-Drawdown Relationship (1000 min)

SRSNE Site, Southington, CT



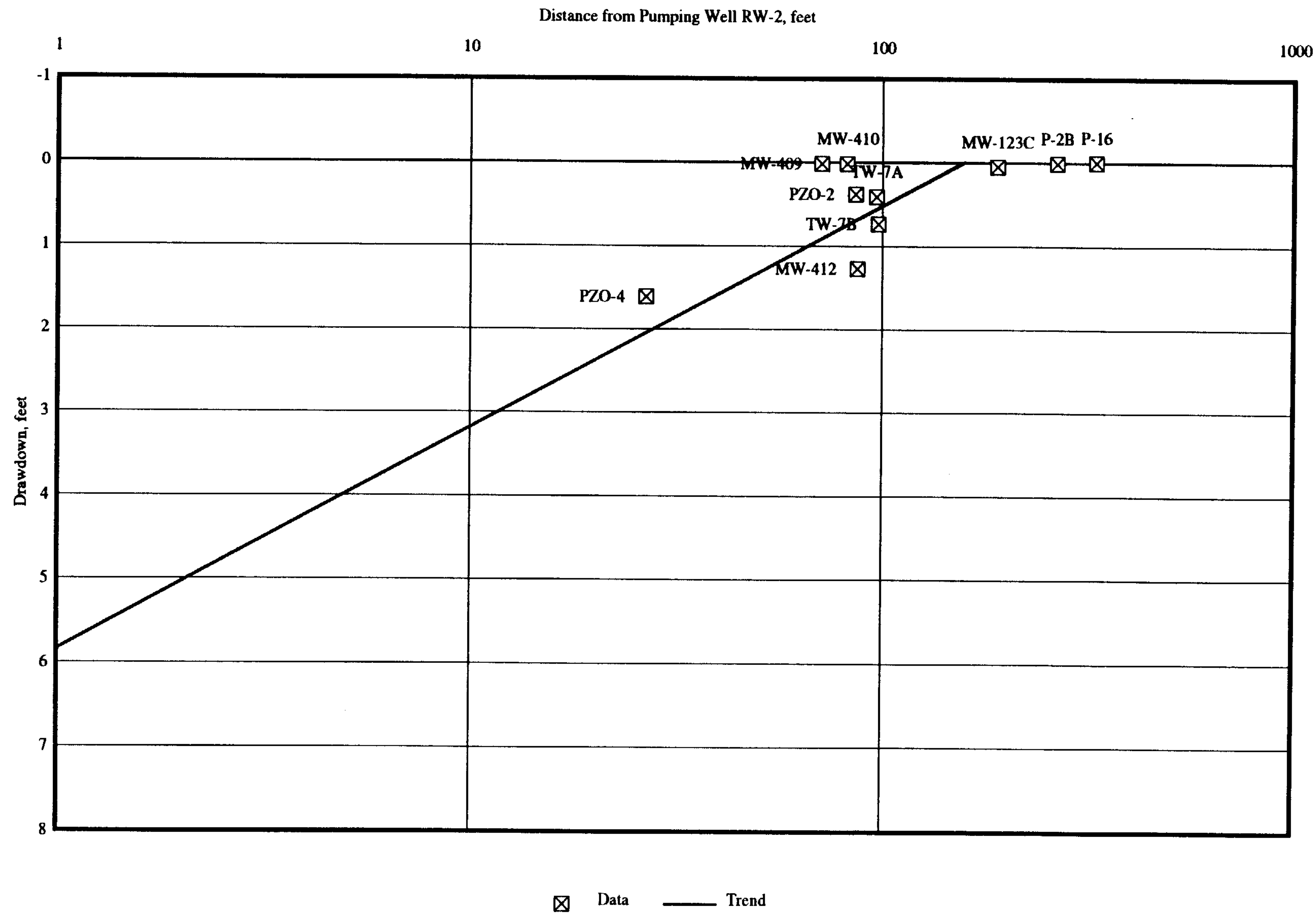
Water Table Zone Distance-Drawdown Relationship (2880 min)

SRSNE Site, Southington, CT



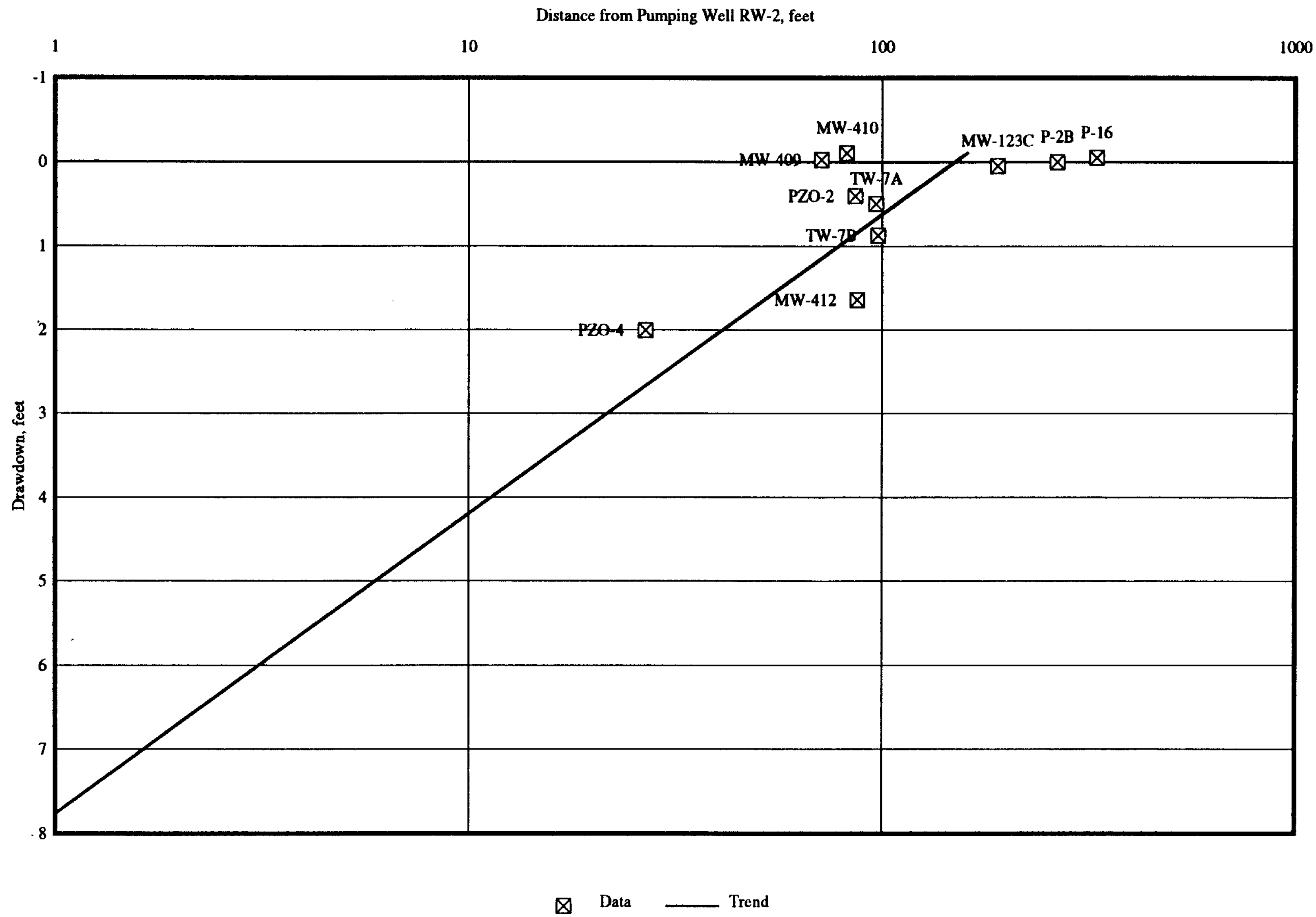
Outwash/Till Zone Distance-Drawdown Relationship (1000 min)

SRSNE Site, Southington, CT



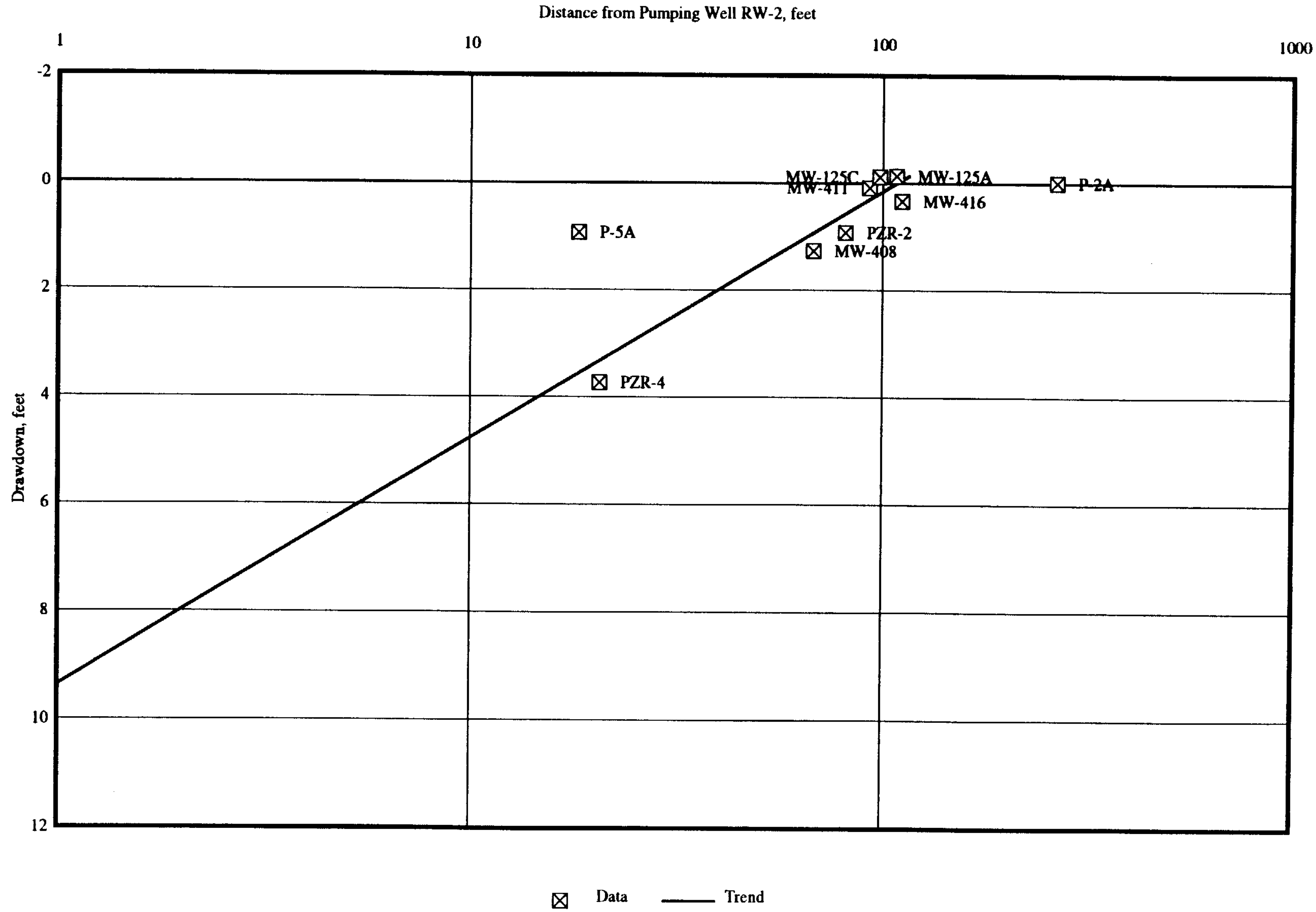
Outwash/Till Zone Distance-Drawdown Relationship (2880 min)

SRSNE Site, Southington, CT



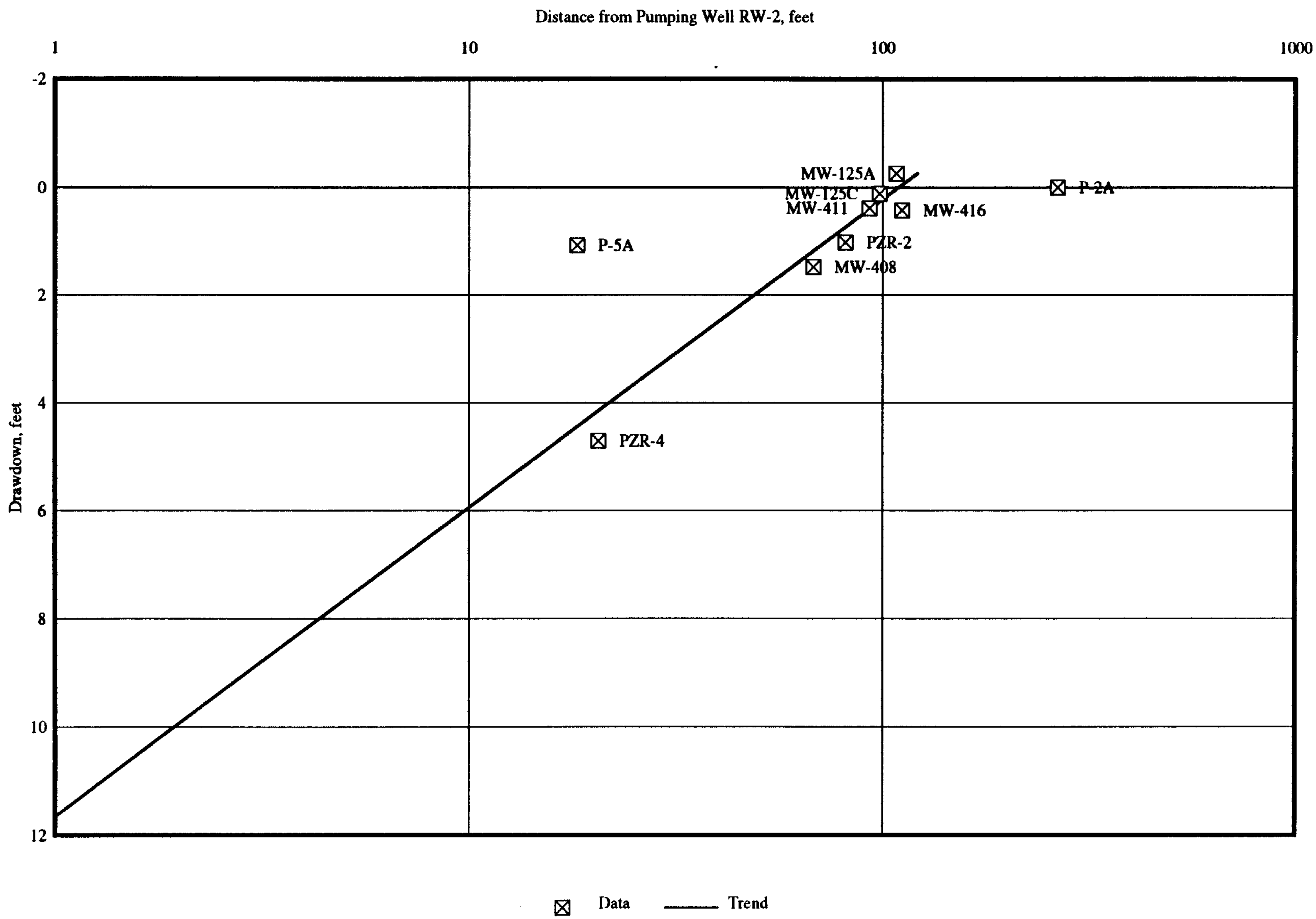
Bedrock Zone Distance-Drawdown Relationship (1000 min)

SRSNE Site, Southington, CT



Bedrock Zone Distance-Drawdown Relationship (2880 min)

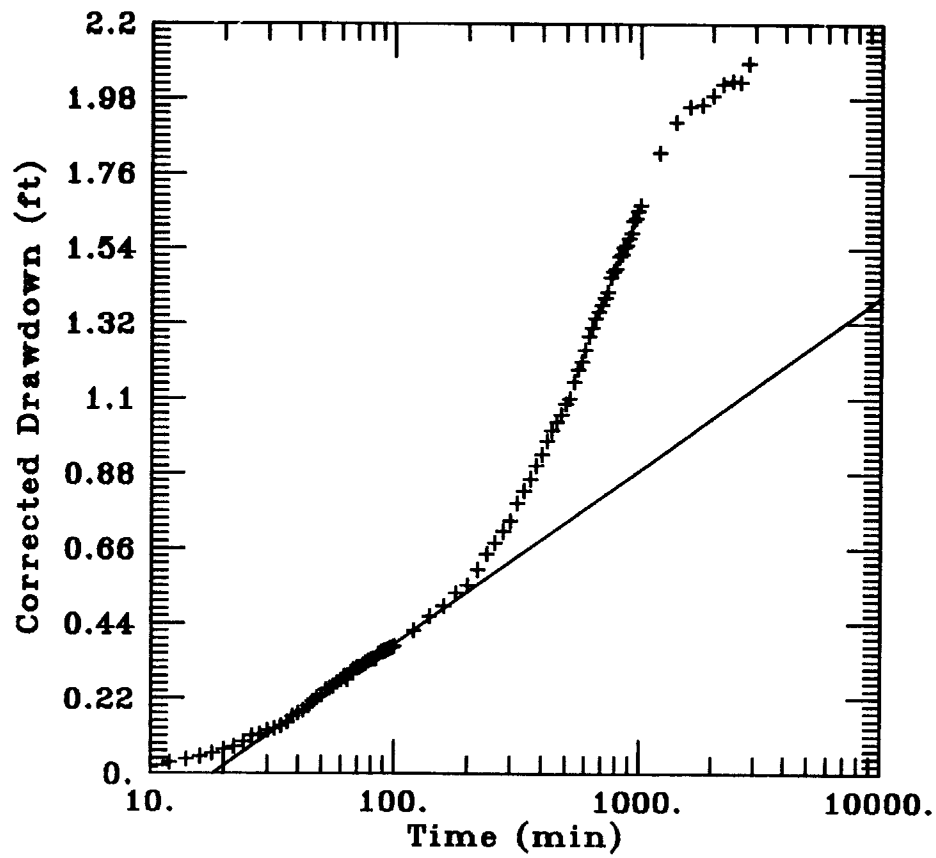
SRSNE Site, Southington, CT



Attachment A-6
RW-2 Constant Rate Test
Hydraulic Parameter Estimates

BB&L, INC.	Client: SRSNE Site
Project No.: 08325	Location: Southington, CT

PUMPING TEST ANALYSIS - WELL PZO-4



DATA SET:
pzo-4.prn
10/24/94

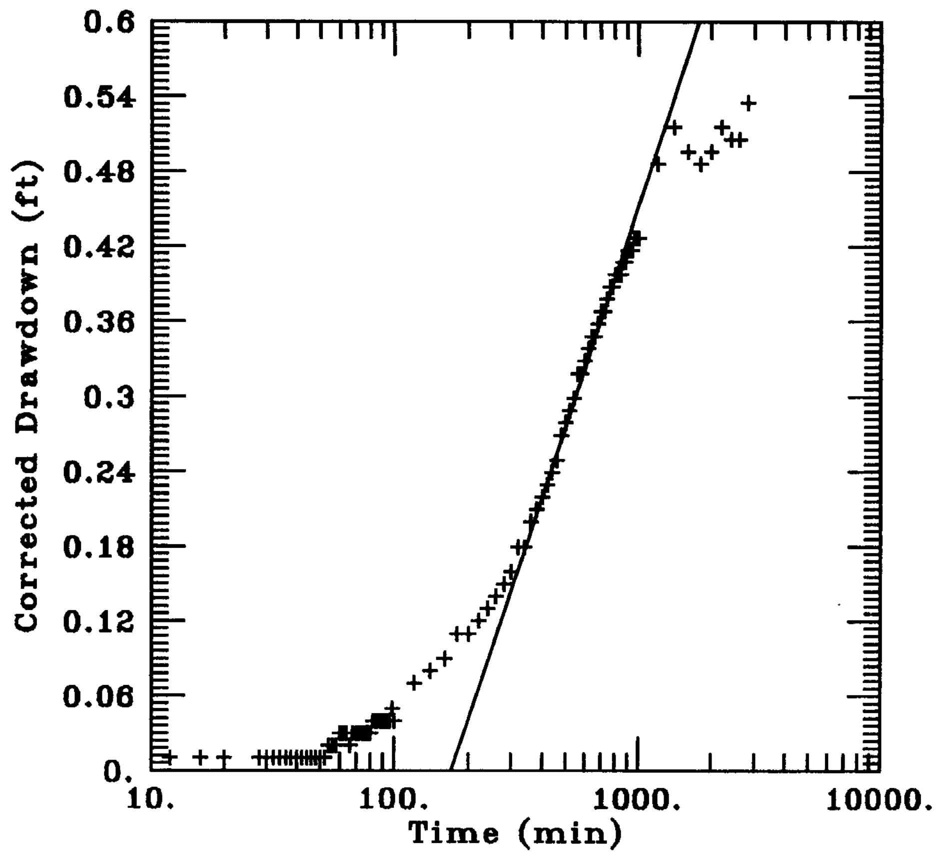
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
11-Oct-94
TEST WELL:
RW-2
OBS. WELL:
PZO-4

ESTIMATED PARAMETERS:
T = 0.08167 ft^2/min
S = 0.004636

TEST DATA:
Q = 0.2273 ft^3/min
r = 26.7 ft
rc = 0.75 ft
rw = 3000. ft
b = 30. ft

BB&L, INC.	Client: SRSNE Site
Project No.: 08325	Location: Southington, CT

PUMPING TEST ANALYSIS - WELL PZO-2



DATA SET:
pzo-2.prn
10/24/94

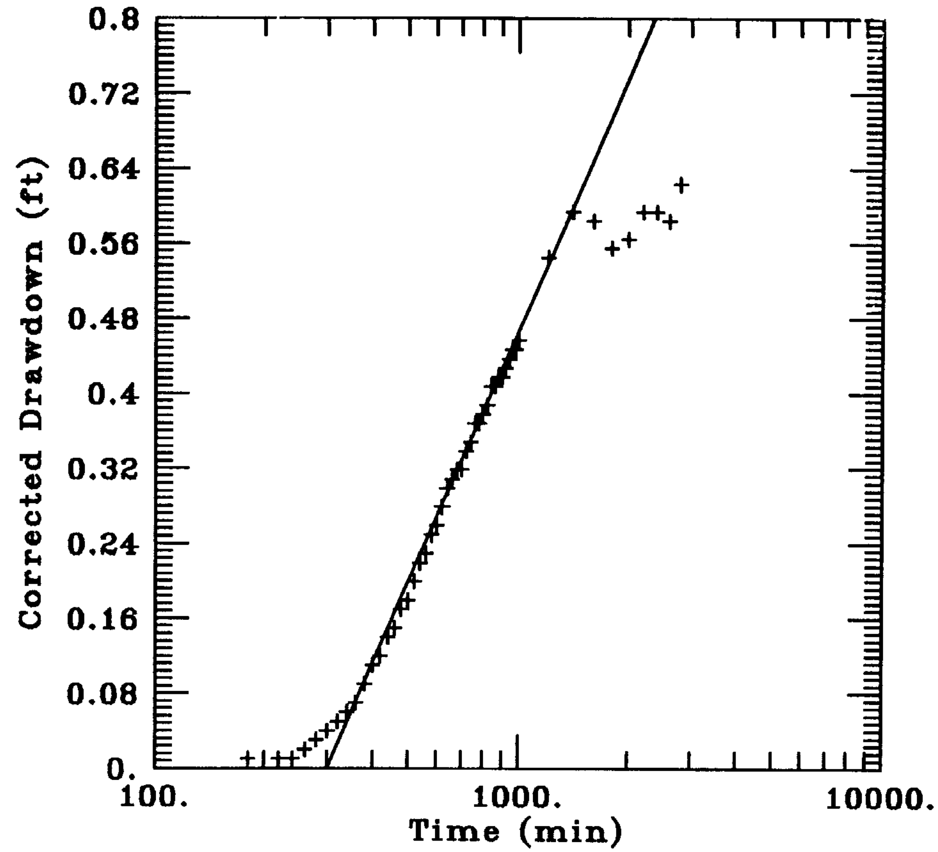
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
11-Oct-94
TEST WELL:
RW-2
OBS. WELL:
PZO-2

ESTIMATED PARAMETERS:
T = 0.07077 ft^2/min
S = 0.003656

TEST DATA:
Q = 0.2273 ft^3/min
r = 86. ft
rc = 0.75 ft
rw = 3000. ft
b = 30. ft

BB&L, INC.	Client: SRSNE Site
Project No.: 08325	Location: Southington, CT

PUMPING TEST ANALYSIS - WELL TW-7A



DATA SET:
tw-7a.prn
10/24/94

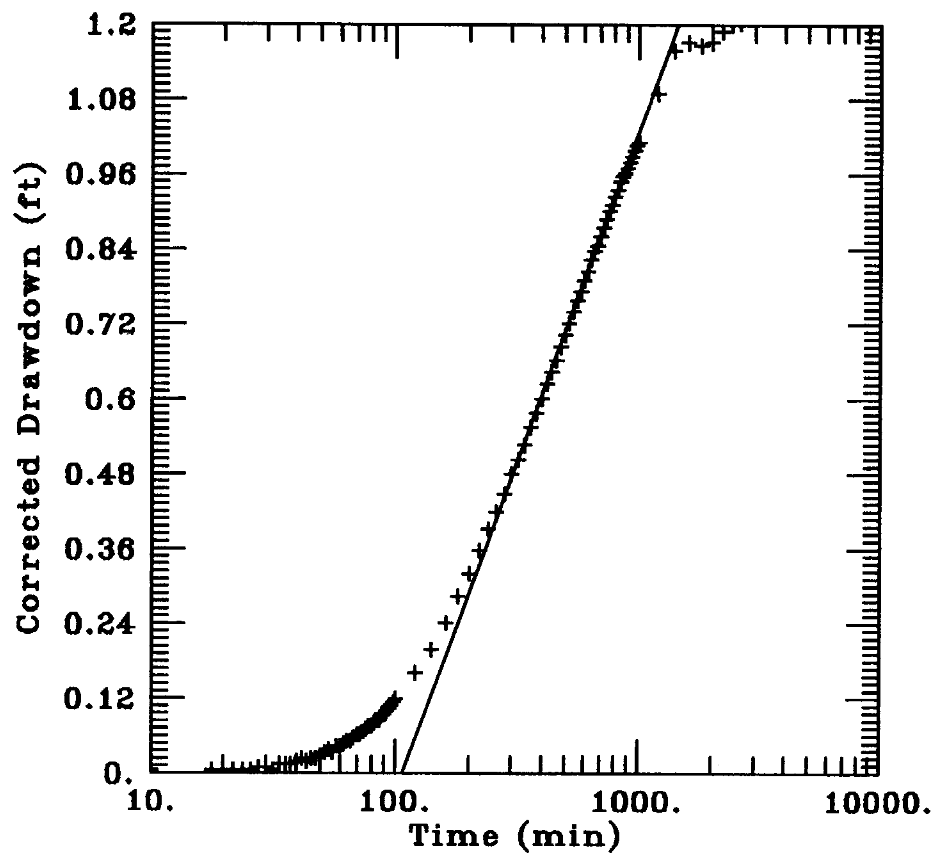
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
11-Oct-94
TEST WELL:
RW-2
OBS. WELL:
TW-7A

ESTIMATED PARAMETERS:
T = 0.04672 ft^2/min
S = 0.003356

TEST DATA:
Q = 0.2273 ft^3/min
r = 96.7 ft
rc = 0.75 ft
rw = 3000. ft
b = 30. ft

BB&L, INC.	Client: SRSNE Site
Project No.: 08325	Location: Southington, CT

PUMPING TEST ANALYSIS - WELL P-5A



DATA SET:
p-5a.prn
10/24/94

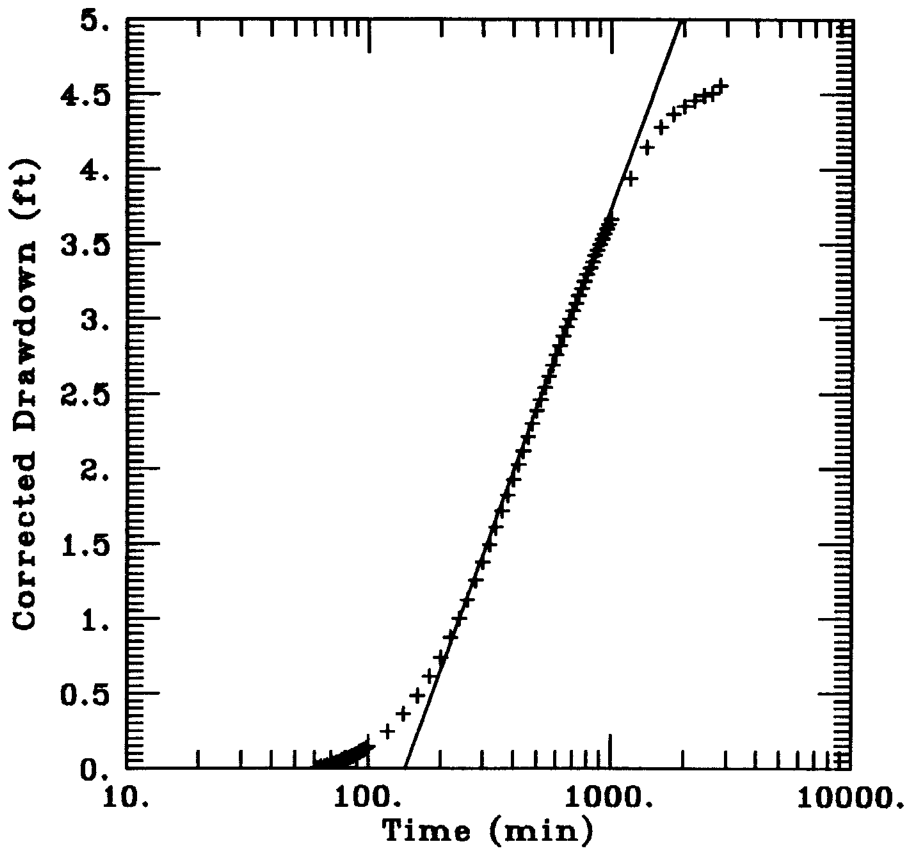
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
11-Oct-94
TEST WELL:
RW-2
OBS. WELL:
P-5A

ESTIMATED PARAMETERS:
T = 0.03931 ft^2/min
S = 0.02815

TEST DATA:
Q = 0.2273 ft^3/min
r = 18.3 ft
rc = 0.75 ft
rw = 3000. ft
b = 30. ft

BB&L, INC.	Client: SRSNE Site
Project No.: 08325	Location: Southington, CT

PUMPING TEST ANALYSIS - WELL PZR-4



DATA SET:
pzr-4.prn
10/24/94

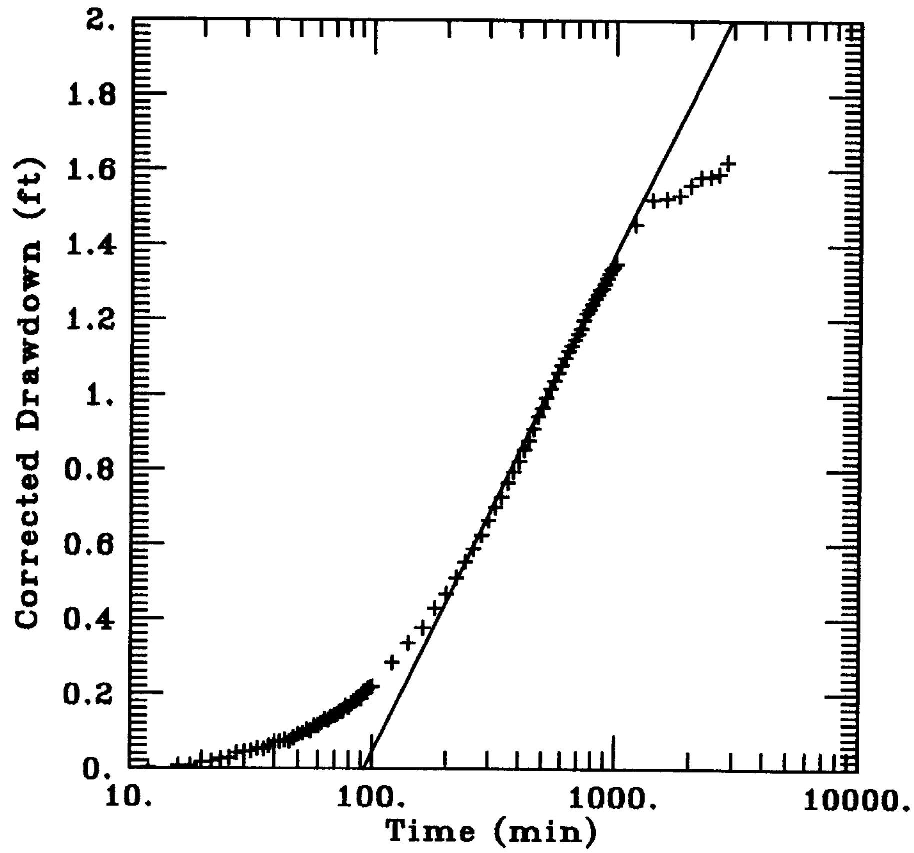
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
11-Oct-94
TEST WELL:
RW-2
OBS. WELL:
PZR-4

ESTIMATED PARAMETERS:
T = 0.009435 ft^2/min
S = 0.007117

TEST DATA:
Q = 0.2273 ft^3/min
r = 20.6 ft
rc = 0.75 ft
rw = 3000. ft
b = 30. ft

BB&L, INC.	Client: SRSNE Site
Project No.: 08325	Location: Southington, CT

PUMPING TEST ANALYSIS - WELL MW-408



DATA SET:
mw-408.prn
10/24/94

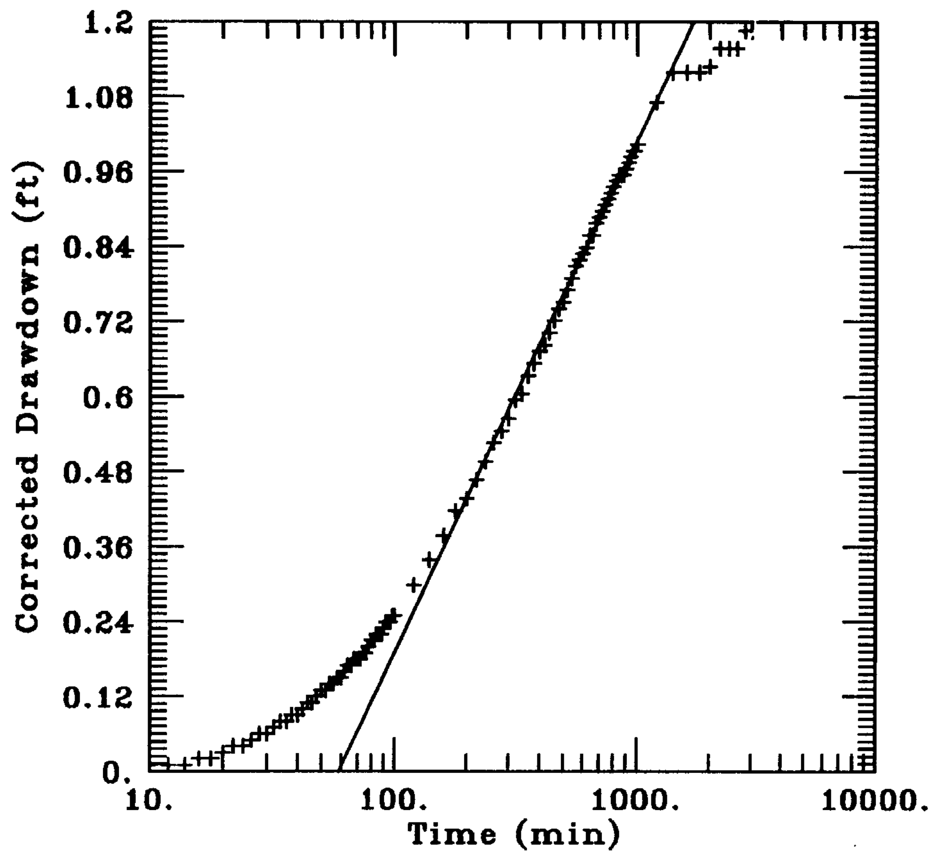
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
11-Oct-94
TEST WELL:
RW-2
OBS. WELL:
MW-408

ESTIMATED PARAMETERS:
T = 0.03124 ft^2/min
S = 0.001404

TEST DATA:
Q = 0.2273 ft^3/min
r = 68. ft
rc = 0.75 ft
rw = 3000. ft
b = 30. ft

BB&L, INC.	Client: SRSNE Site
Project No.: 08325	Location: Southington, CT

PUMPING TEST ANALYSIS - WELL PZR-2



DATA SET:
pzr-2.prn
10/24/94

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Cooper-Jacob
TEST DATE:
11-Oct-94
TEST WELL:
RW-2
OBS. WELL:
PZR-2

ESTIMATED PARAMETERS:
T = 0.05081 ft^2/min
S = 0.001012

TEST DATA:
Q = 0.2273 ft^3/min
r = 81.3 ft
rc = 0.75 ft
rw = 3000. ft
b = 30. ft

Appendix B

Ground-Water Containment System Modeling Results

I. Introduction

This appendix presents the results of ground-water modeling for the NTCRA ground-water containment system at the SRSNE Site in Southington, Connecticut. BB&L used both analytical and numerical techniques to model ground-water flow at the site, employing the analytical element model QuickFlow™ (Rumbaugh, 1991) for preliminary flow modeling and the United States Geological Survey (USGS) modular three-dimensional (3-D) numerical code developed by McDonald and Harbaugh (1988), referred to as MODFLOW, for detailed follow-up modeling. This modeling approach allows a "first-order" preliminary assessment of flow conditions and system responses to stresses (i.e., pumping wells) for use in the design of the numerical model.

II. QuickFlow™ Model Construction

The construction of the QuickFlow™ model involved the following steps:

1. Identification of system-representative horizontal hydraulic conductivity (K_h), horizontal hydraulic gradient (I_h), and saturated thickness in the Containment Area to "idealize" the flow system in the area of concern;

2. Simulation of the flow system under non-stressed (non-pumping) conditions to verify system-representative flow conditions in the Containment Area;

3. Addition of pumping wells in the Containment Area in the model; and

4. Simulation of flow-system responses to aquifer stresses (pumping wells).

The modeling processes and results are described below.

Flow-System Parameters

A review of the existing hydrogeologic data base indicated that system-representative K_h and I_h values in the Containment Area are 1.4 feet per day (ft/d) and 0.025, respectively (HNUS, 1994 and ENSR, 1994). The K_h of 1.4 represents the geometric mean value based upon slug tests performed at wells installed in the Operations and Containment Areas. The I_h value of 0.025 was selected as a representative but conservative gradient value from the historical range of approximately 0.01 to 0.03 in the Containment Area. The saturated thickness of the glacial outwash, which ranges from approximately 13 to 24 feet in the Containment Area, was initially set at a representative value of 20 feet in the QuickFlow™ model.

Flow-System Stresses

A varying number of simulated pumping-well arrays were used to evaluate the potential for hydraulic containment of all ground water entering the Containment Area from the Operations Area within the outwash deposits. Based upon the approximately 7-foot drawdown response observed in the outwash deposits during the 48-hour, constant-rate pumping test at Recovery Well RW-2, a drawdown value of 7 feet was established at the five simulated recovery wells. Thus, each well was modeled with a constant head corresponding to 7 feet of drawdown under steady-state conditions.

Model Results and Conclusions

QuickFlow™ simulations predicted that vertical recovery well arrays consisting of between 10 and 52 wells operating in the Containment Area, including the five existing recovery wells, would not hydraulically contain the ground water flowing through the Containment Area within the outwash deposits. The 52-well scenario simulated using QuickFlow™ predicted that approximately 14 percent of the flow would not be captured. Moreover, the 52-well simulation showed that the hydraulic gradient may not be reversed in the area downgradient of the pumping wells.

The analytical model results make "hydrogeologic" sense (confirm the conceptual model and the field conditions), because in flow systems where the geometry and hydraulic conditions result in a very low water-transmitting system, numerous vertical wells are needed in order to establish, if possible, overlapping capture zones to attain complete containment. Furthermore, the competition among large numbers of vertical wells to pump available ground water often causes the wells to be dewatered and renders them unable to achieve or maintain containment.

Based on the analytical modeling results and flow-system conceptualization, the remedial alternative was reassessed; it was determined that a remedial scenario consisting solely of vertical wells to create a hydraulic barrier is not viable. With respect to the MODFLOW model, QuickFlow™ results indicate that a MODFLOW model grid would require extremely small discretization (i.e., portioning of the flow system into parcels on the order of one-foot to 2-foot spacings in and around the Containment Area) to reproduce the QuickFlow™ (continuous flow system) results. This discretization scheme would, in turn, result in the design of an overly detailed (discretized) model grid to address an ineffective remedial scenario based on use of numerous vertical wells. Instead, a physical barrier (e.g., steel sheet pilings or a slurry wall) would require fewer vertical recovery wells upgradient of a physical barrier to eliminate migration of constituent-impacted ground water downgradient of the Containment Area. A highly discretized grid would not be necessary to simulate and evaluate the alternate remedial scenario; thus, the QuickFlow™ model also provided a tool to assist in the design and degree of discretization of the MODFLOW grid to a level that accurately simulates the physical barrier and wells scenario.

III. MODFLOW Model Construction

The construction of the MODFLOW model involved the following steps:

1. Construction of the finite-difference grid;
2. Definition and input of the boundary conditions and flow-system parameters;
3. Calibration of the model; and
4. Simulation of flow-system responses to aquifer stresses.

Each of these steps is described below.

Grid Construction

In MODFLOW, the numerical solution of the differential equations that describe ground-water flow is obtained though the finite-difference approach. The finite-difference approach involves replacing the continuous flow system by an equivalent set of discrete blocks, the flow system is discretized into parcels of uniform geometry and hydraulic condition which, when combined, are representative of the system as a whole. By varying the hydraulic conditions between blocks, system heterogeneity and anisotropy can be incorporated into the model to best represent field conditions. In the finite-difference approach, both space and time variables are treated as discrete parameters.

The spatial discretization of the flow system results in a finite-difference grid, or "mesh" composed of rows, columns, and layers parallel to the x, y, and z axes. The intersection of these rows, columns, and layers creates the parcels, or "nodes," of the mesh. Conceptually, each node represents the center point of a prism of aquifer material, or "cell." The hydraulic and geometric properties are constant throughout each cell (McDonald and Harbaugh, 1988). The numerical solver computes the head at each node in the finite-difference grid based upon the boundary conditions, stresses, and hydraulic parameters specified as input to the model.

The modeled area, which covers a 1600-foot by 2400-foot region in and around the site, was discretized into a finite-difference grid consisting of 120 rows and 88 columns (Figure B-1). The grid spacings along rows and columns varied between 10 and 95 feet. The smallest spacings are in the Containment Area, which was the focus of the modeling study (Figure B-2). The finite-difference grid spacing was systematically expanded to the north, south, east, and west of the site, where less detail was required. The purpose of extending the grid into these distant areas was to represent the regional flow system as a whole and to allow for underflow through the modeled domain. Moreover, because the number of recovery wells and total pumpage rate needed to contain and capture constituent-impacted ground water entering the Containment Area had not been determined, it was necessary to conservatively establish boundary conditions beyond the influence of these recovery wells. Without this boundary, pumping stresses at the Site would simulate non-field-representative head-and-flow system responses.

The model was also discretized vertically into four layers. These four layers depict the steeply eastward dipping geometry of the flow system (glacial outwash underlain by glacial till, underlain by bedrock). Thus, the vertical discretization resulted in a deformed grid, with the tops and bottoms of the four layers "stair-stepped" to represent subsurface conditions.

The glacial outwash was divided into two layers (Layers 1 and 2) to better represent ground-water/surface-water relationships between the water table and the Quinnipiac River, as well as to better represent the effects of pumping wells in the upper portion of the saturated zone. The till was represented by Layer 3, and the top 30 feet of the bedrock were represented by Layer 4.

Boundary Conditions

Boundary conditions incorporated into the MODFLOW model belong to one of three general categories:

1. When the ground-water elevation (head) is known for surfaces bounding the flow system (e.g., constant heads, variable heads);

2. When the flow is known across a surface bounding the flow region (e.g., constant flow, no flow); and

3. When a mixed condition (some combination of the first two categories of boundary conditions) exists for surfaces bounding the flow region (Wang and Anderson, 1982).

MODFLOW allows for the specification of boundary conditions in accordance with the three types itemized above. Specifically, each cell within the model can be identified as one in which the head varies with time (variable-head cell), one that is constant with time (constant-head cell), or one in which no flow occurs (no-flow cell), or the boundary package can be combined or modified depending upon the conditions of the system (McDonald and Harbaugh, 1988).

In the model, hydrologic features represented by modeled boundary conditions include the general west-to-east flow of ground water and recharge from precipitation. The western and eastern edges of the model (Columns 1 and 88, respectively) in all four layers are simulated as constant-head boundaries. In each constant-head boundary cell, the respective ground-water elevation (head) does not change with time. The head values assigned to these boundaries were interpolated from published water-level elevation data for the outwash, till, and bedrock (HNUS, 1994 and ENSR, 1994), and extrapolated to the upgradient (western boundary) and downgradient (eastern boundary) extent of the model.

These western and eastern boundaries are established beyond the influence of the recovery wells. If these constant-head boundaries were not established at a distance beyond the influence of the recovery wells, then the cones of depression from the recovery wells could have extended to and intercepted these boundaries. Because water levels in constant-head boundaries do not change with time, they represent a continuous source of inflow or outflow of water to or from the model. If the cones of drawdown from the recovery wells intercepted either of these boundaries, then the simulated heads would not have correctly represented the flow regime. The continuous source of water would have caused their cones of depression to stop expanding, because they would have intercepted an inexhaustible supply of water to satisfy the pumpage rates, which would have resulted in unrealistically small and skewed cones of drawdown, and in turn, improper simulated head-and-flow relationships and underestimated capture zones.

The northern and southern boundaries (Rows 1 and 122) are approximately parallel to regional ground-water flow and therefore, represent the approximate limiting flow lines for the system. (Limiting flow lines "separate" areas of ground-water flow, so that ground water on either "side" of the flow line remains on its respective "side." Ground water does not move across a limiting flow line [Rushton and Redshaw, 1979].) It is a common technique to use limiting flow lines to represent no-flow boundaries in a ground-water model area.

In reference to the site flow model, this condition established that no ground water can be drawn from beyond the northern and southern boundaries of the modeled area. If the northern and southern boundaries were not established at a distance beyond the influence of the recovery wells, then the cones of depression from the recovery wells could have extended to and intercepted these boundaries. Because no-flow boundaries prohibit ground water from entering or leaving the modeled domain, the simulated heads would not have correctly represented the flow regime and would have caused their cones of depression to expand in other directions in order to intercept sufficient water to satisfy the pumpage rates, which would have resulted in unrealistically extensive and skewed cones of drawdown, and in turn, improperly simulated head-and-flow relationships and exaggerated capture zones.

An attempt was made to determine the recharge rate based upon published information. An on-line, computer data base search was undertaken, and information pertaining to precipitation, evapotranspiration, and runoff in the area of the site was obtained from Mazzaferro, *et.al.* (1978). These data showed that of the 47 inches per year (in/yr) of precipitation, 21 in/yr are lost as a result of evapotranspiration, and 26 in/yr are lost via runoff. Thus, of the total amount of precipitation, none is reported to be available for recharge to the aquifer.

Based upon BB&L's experience working in the Quinnipiac River basin, approximately 15 to 50 percent of precipitation can recharge ground water. As a result of calibration and sensitivity simulations, model results indicated that an appropriate estimate for recharge in the area of the site is 8.76 in/yr, or about 20 percent of the precipitation rate. This recharge rate was applied uniformly throughout the model domain, with the exception of the following two areas:

- The SRSNE Operations Area; and

- The commercially developed area along Queen Street.

Recharge for both of these areas was eliminated (set to zero), because these areas are paved and/or covered with buildings.

A recharge rate of 8.76 in/yr, which represents the lower range of the percentage of precipitation available for recharge, fits with the field and conceptual models. Upgradient (west) of the Operations Area, the topography rises steeply at a rate of approximately 2 percent. This steep gradient fosters runoff of precipitation and reduces the amount of water (from precipitation) available to recharge the water table. The area in, around, and downgradient of the Containment Area is characterized by a relatively shallow depth to ground water (on the order of approximately 5 feet or less). The proximity of the water table to land surface promotes evapotranspiration, again reducing the amount of water (from precipitation) available to recharge the water table.

Flow-System Parameters

Data characterizing flow-system hydraulic coefficients and geometry were obtained from HNUS (1994), ENSR (1994), and BB&L's field investigation. These data are shown in Table B-1.

Hydraulic coefficient data were obtained from slug and pumping tests, and the thicknesses of the saturated glacial outwash and till were obtained from boring and well drilling activities.

Horizontal hydraulic conductivity values throughout the modeled domain range from 0.1 ft/d to 40 ft/d. Values within each of the model layers include the following:

- Layer 1 and 2 (glacial outwash) - 0.1 ft/d to 40 ft/d;
- Layer 3 (glacial till) - 0.1 ft/d to 40 ft/d; and
- Layer 4 (upper 30 feet of the bedrock) - 1.0 ft/d to 6.0 ft/d.

Horizontal hydraulic conductivity values within the Containment Area, where remedial activities will take place, range from 1.0 ft/d to 22 ft/d. Values within each of the model layers in the Containment Area include the following:

- Layer 1 and 2 (glacial outwash) - 1.0 ft/d to 22 ft/d;
- Layer 3 (glacial till) - 1.0 ft/d to 22 ft/d; and
- Layer 4 (upper 30 feet of the bedrock) - 1.0 ft/d to 6.0 ft/d.

Although the range of K_h values for the unconsolidated deposits is from 1.0 ft/d to 22 ft/d, the higher range of these values (10 ft/d and greater) is limited to the northwest portion of the Containment Area. The majority of the Containment Area is characterized by K_h values ranging from 1.0 ft/d to 4.0 ft/d, with the eastern portion of the containment area being characterized by K_h values ranging from 1.0 ft/d to 2.0 ft/d.

There are no data describing the anisotropy of the flow system. Specifically, no pumping tests were designed or performed for long enough periods of time to quantify the ratio and distribution between K_h and the vertical hydraulic conductivity (K_v). Published information indicates that the ratios of K_h to K_v generally range from 10 to 1, to 100 to 1 (Todd, 1980). The 10 to 1 ratio was applied throughout the model, as discussed in Section IV (MODFLOW Model Calibration).

Aquifer geometry, as it relates to saturated thickness, is accounted for in the model by designating top and bottom elevations for the individual layers of the model.

The elevations of the tops and bottoms of the four layers comprising the deformed grid throughout the modeled domain range from 65 feet to 190 feet, and 35 feet to 175 feet, respectively. Top and bottom elevation values for each of the model layers include the following:

- Layer 1 (the upper 5 feet of the saturated glacial outwash) - 150 feet to 190 feet, and 130 feet to 175 feet, respectively;

- Layer 2 (glacial outwash below the upper 5 feet of the glacial outwash [Layer 1]) - 130 feet to 175 feet, and 75 feet to 170 feet, respectively;

- Layer 3 (glacial till) - 75 feet to 170 feet, and 65 feet to 160 feet, respectively; and

- Layer 4 (upper 30 feet of the bedrock) - 65 feet to 160 feet, and 35 feet to 135 feet, respectively.

Elevations of the tops and bottoms of the four layers comprising the deformed grid in the Containment Area, where remedial activities will take place, range from 115 feet to 165 feet, and 85 feet to 150 feet, respectively. Top and bottom elevation values for each of the model layers include the following:

- Layer 1 (upper 5 feet of the glacial outwash) - 155 feet to 165 feet, and 145 feet to 150 feet, respectively;

- Layer 2 (glacial outwash below the upper 5 feet of the glacial outwash [Layer 1]) - 145 feet to 150 feet, and 130 feet to 140 feet, respectively;

- Layer 3 (glacial till) - 130 feet to 140 feet, and 115 feet to 135 feet, respectively; and

- Layer 4 (upper 30 feet of the bedrock) - 115 feet to 135 feet, and 85 feet to 105 feet, respectively.

IV. MODFLOW Model Calibration

The objective of model calibration is to compare the input data and the conceptual model of the aquifer to the real system. This is accomplished by iteratively running the model and modifying the model setup based upon the conceptual model of the aquifer, until the computed head-and-flow conditions compare favorably to observed head-and-flow conditions. Calibration was demonstrated by using the model to simulate a period where model outputs were compared to available field flow conditions in the Containment Area. When the difference between observed and computed flow conditions (K_h and I_h values) in the

Containment Area exceeded tolerable limits, the input data were modified to obtain the best representation of computed and observed data. However, these modifications were consistent with the geologic and hydrologic data base characterizing the flow system (i.e., the field condition, conceptual model, and numerical model made "hydrogeologic" sense). Thus, this iterative process continued until the model approximated flow conditions through the Containment Area while maintaining the geologic and hydrologic data base characteristic of the flow system.

May 1993 water-level elevation measurements were used for the calibration. Based upon the May 1993 ground-water elevation data, the direction of flow is east and southeast, and the I_h for the glacial outwash within the Containment Area ranged from 0.01 to 0.03 (HNUS, 1994). These flow directions and I_h values are illustrated in Figures B-3 and B-4 (Layer 1 - the upper 5 feet of the saturated glacial outwash and Layer 2 - the remaining portion of the saturated glacial outwash, respectively). Field flow directions and I_h values for the glacial till (Layer 3), which also range from 0.01 to 0.03, are also reproduced by the model, as illustrated in Figure B-5.

In addition to reproducing the I_h across the Containment Area, a comparison of simulated heads to field-measured heads was undertaken. This involved the use of observation wells as targets to which to compare the model-generated heads. This was accomplished by selecting targets to obtain comprehensive coverage of the site without clustering wells in any particular location (i.e., using too many wells in a specific area), which would bias the calibration procedure. However, as the majority of the wells are clustered in groups throughout the site, these targets were used to obtain qualitative and quantitative information regarding the calibration by performing a point-to-point analysis and a statistical analysis.

With the exception of Well P-2A, all wells with May 1993 heads were used. Well P-2A was eliminated from the target base, because a comparison of historical water-level elevations between respective wells indicated that all the wells, with the exception of Well P-2A, varied by similar levels. Well P-2A, on the other hand, showed a discrepancy on the order of 10 feet from past to current elevations. Because this difference in heads could not be accounted for, the water level was presumed to be non-system-representative, and well P-2A was eliminated from the target base.

Even with the inherent drawback from the clustering of the targets, the calibration resulted in a good match between field-measured and MODFLOW-simulated heads. A plot of the field-measured versus calibrated heads is shown in Figure B-6. It is important to note that not only are the majority of the values close to the theoretically ideal calibration line, but the array of values is well distributed on either side of the theoretical line (i.e., there is minimal clustering of the values on one side of the line relative to the other side of the line). Moreover, of the 55 targets throughout the model domain, 48 targets, or approximately 85 percent of the simulated heads, are within 3 feet of the measured heads (21 targets within one foot, 18 targets within 2 feet, and eight targets within 3 feet), while the remaining 15 percent of the simulated heads are within 6 feet of the measured heads (two targets within 4 feet, four targets within 5 feet, and two targets within 6 feet). Furthermore, the mean residual of -0.675 foot is close to zero, which is required for a good match. A residual mean close to zero signifies that neither positive nor negative residuals predominate and that the calibration is not biased.

The information obtained from the target and statistical analyses supports the information obtained by reproducing the I_h through the Containment Area, specifically, that a good calibration was produced and the model is suitable for predictive simulation for remedial system design.

V. MODFLOW Model Simulations

The calibrated MODFLOW model was used to simulate several remedial scenarios. Three simulations, presented below, predict the flow-system response to the pumpage of recovery wells, with two of the simulations including a proposed physical barrier. The first (the five existing wells) and second (the five existing wells plus a physical flow barrier) simulations predict that these design alternatives are inadequate for hydraulically containing the ground water within the outwash. These results are presented, however, because:

- Five recovery wells have been installed to date. It is important to demonstrate that these five wells alone neither hydraulically contain ground water nor reverse the hydraulic gradient within the outwash downgradient of the extraction system; and

- Preliminary QuickFlow$_{TM}$ modeling results suggested that a physical barrier would be needed in conjunction with recovery wells. It is important to demonstrate that these five wells, pumping in conjunction with a physical barrier, also neither hydraulically contain ground water nor reverse the hydraulic gradient within the outwash downgradient of the extraction system.

The third simulation is representative of a successful remedial scheme, with 11 recovery wells operating west (upgradient) of a physical barrier (steel wall) within the Containment Area.

<u>Simulation 1 - Five Recovery Wells</u>

Recovery Wells RW-1 through RW-5 were simulated using MODFLOW's drain package, based on information collected during BB&L's aquifer tests and the information obtained from the QuickFlow^{TM} model (discussed in Section II above). Simulating wells using the MODFLOW drain package eliminates guesswork about the sustainable pumping rate by allowing the model to calculate the inflow (pumping rate) to each well based upon the known reference head. At the location of each simulated well, drain conductance and reference head terms were input to Layers 1 through 3 of the model, as outlined in Table B-2. At the wells, dynamic (pumping) heads were set in Layers 1 through 3, based upon observed drawdowns during the Recovery Well RW-2 pumping test (see Appendix A).

Head-and-flow relationships determined by the five-well pumping stress for Layers 1, 2, and 3 of the model are illustrated in Figures B-7, B-8, and B-9, respectively. Figure B-7 shows that Layer 1 of the model (the initial upper 5 feet of the saturated glacial outwash) becomes dewatered in the area around the wells due to the vertical flow of ground water downward in response to the five-well pumping stress in Layer 2 and the thin saturated thickness of Layer 1.

Figures B-8 and B-9 show that, although capture zones are predicted in proximity to Recovery Wells RW-1 through RW-5 in the remainder of the glacial outwash (Layer 2) and glacial till (Layer 3), respectively, ground water is able to migrate between these wells and their respective capture zones, and there is no downgradient reversal of the I_h.

Simulation 2 - Five Recovery Wells and Steel Sheet-Piling Wall

The simulation involving five recovery wells and a steel sheet-piling wall was identical to the one described above; however, a 2.5-inch-thick, horse-shoe-shaped steel piling wall was included within the Containment Area. The wall is located adjacent to and immediately downgradient of the existing recovery wells.

The steel wall was simulated with a thickness of 2.5 inches and an extremely low K_h ($1.0x10^{-16}$ ft/d). The purpose of simulating the steel wall in this manner, as opposed to using a no-flow boundary (barrier), was to simulate the wall under conservative conditions. That is, in the event that the wall is not completely impervious, an ample ground-water depression behind the wall would create a I_h into the Containment Area. Thus, ground water immediately downgradient of the wall could only flow between "seams" in the wall into the Containment Area.

Head-and-flow relationships in response to the five-well pumping stress and the steel wall for Layers 1, 2, and 3 of the model are illustrated in Figures B-10, B-11, and B-12, respectively. Figure B-10 shows that Layer 1 of the model (the initial upper 5 feet of the glacial outwash) becomes dewatered in the area around the wells. As in the previous simulation, this is due to the vertical flow of ground water downward in response to the five-well pumping stress in Layer 2 and the thin saturated thickness of Layer 1.

Figures B-11 and B-12 show enhanced capture zones near Recovery Wells RW-1 through RW-5 in Layer 2 and Layer 3 due to the presence of the steel wall. The steel wall prohibits each well's cone of influence from extending downgradient and causing it to spread in the upgradient and crossgradient directions to intercept sufficient ground water to satisfy its pumping needs. However, ground water is able to migrate around the ends of the steel walls, and there is no downgradient reversal of the I_h. Thus, there is incomplete containment of constituent-impacted ground water flowing from the Operations Area through the Containment Area.

Simulation 3 - Eleven Recovery Wells and Steel Sheet-Piling Wall

To completely contain constituent-impacted ground water flowing from the Operations Area through the Containment Area, six additional wells were simulated, along with existing Recovery Wells RW-1 through RW-5. All 11 wells were simulated at locations west (upgradient) of the steel wall.

Head-and-flow relationships in response to the 11-well pumping stress and the steel wall for Layers 1, 2, and 3 of the model are illustrated in Figures B-13, B-14, and B-15, respectively. Figure B-13 shows that Layer 1 of the model (the initial upper 5 feet of the glacial outwash) becomes dewatered in the area around the wells. As in the previous simulations, this is due to the vertical flow of ground water downward in response to the pumping stress in Layer 2 and the limited saturated thickness of Layer 1.

Figures B-14 and B-15 show enhanced capture zones near existing Recovery Wells RW-1 through RW-5 and the six additional wells Layers 2 and Layer 3. This enhancement is caused by the increased pumping stress in the presence of the steel wall. The steel wall prohibits each well's cone of influence from extending downgradient, causing it to spread in the upgradient and crossgradient directions, creating well interference as each well intercepts sufficient ground water to satisfy its pumping needs. Thus, the combination of the 11 pumping wells (an increased pumping stress) and the steel wall create a ground-water depression on the upgradient side of the wall (Figures B-14 and B-15), and ground water cannot migrate around the ends of the steel walls (i.e., ground-water containment is achieved and maintained). Moreover, a stagnation area (ground-water divide) is established across the wall where the I_h within the Containment Area is toward and into the pumping wells; the I_h immediately downgradient of and adjacent to the wall is toward the wall; and the I_h further downgradient of the wall continues in an easterly direction. Consequently, there is complete containment of constituent-impacted ground water flowing from the Operations Area through the Containment Area.

Model results indicate that, in the presence of the wall, the total rate of ground-water withdrawal to attain the containment described above is approximately 20 gpm.

VI. Wetlands

The State of Connecticut has identified concerns regarding the effects of the remedial program upon two wetlands areas. The locations of these two wetlands are as follows:

- An area immediately south of the Containment Area, part of which straddles the Containment Area property line; and

- An area east of the Containment Area bordering and west of the Quinnipiac River.

Based upon the simulated remedial alternative (11 pumping wells and the steel wall), the decline in ground-water elevations (drawdown) in the glacial outwash with respect to each wetlands area is as follows:

- Drawdown ranging from 5 to 7 feet (Figure B-4 compared to Figure B-14) is likely to occur in the wetlands area immediately south of the Containment Area; and

- Drawdown ranging from one foot to 5 feet (Figure B-4 compared to Figure B-14) is likely to occur in the wetlands area east of the Containment Area bordering and west of the Quinnipiac River.

VII. MODFLOW Model Results and Conclusions

Both Simulation 1 and Simulation 2 proved inadequate in containing constituent-impacted ground water flowing from the Operations Area through and downgradient of the Containment Area.

Simulation 3 proved adequate in containing constituent-impacted ground water flowing from the Operations Area through and downgradient of the Containment Area. Moreover, a stagnation area is established across the wall where the I_h within the Containment Area is toward and into the pumping wells; the I_h immediately downgradient of and adjacent to the wall is toward the wall; and the I_h further downgradient of the wall continues in an easterly direction. Thus, there is complete containment of constituent-impacted ground water flowing from the Operations Area through the Containment Area; constituent-impacted ground water cannot flow downgradient of the Containment Area.

Drawdown in the wetlands area immediately south of the Containment Area, part of which straddles the Containment Area property line, is likely to range from 5 feet to 7 feet. The wetlands area east of the Containment area bordering west of the Quinnipiac River is likely to experience drawdown ranging from one foot to 5 feet.

References

ENSR Consulting & Engineering. "Groundwater Technical Memorandum, Soils Study Report, and Additional Studies Report for the SRSNE Superfund Site, Volume III - Additional Studies Report." Draft, June 1994.

Halliburton NUS Environmental Corporation. "Final Remedial Investigation Report." Solvent Recovery Services of New England, Inc. Site, May 1994.

Mazzaferro, D.L., E.H. Handman, and M.P. Thomas. "Water Resources Inventory of Connecticut." Part 8, Quinnipiac River Basin, Water Resources Division. Connecticut Water Resources Bulletin No. 27. Geological Survey, Hartford, Connecticut, 1978.

McDonald, M.G. and A.W. Harbaugh. "A Modular Three-Dimensional Finite-Difference Groundwater Flow Model." Techniques of Water-Resources Investigations of the United Geological Survey. Book 6, Chapter A1, 1988.

Rumbaugh III, J.O. QuickFlow™ Analytical Ground-Water Flow Model. Geraghty & Miller, Inc. Modeling Group. Reston, Virginia, 1991.

Rumbaugh III, J.O. ModelCad386™. Geraghty & Miller, Inc. Modeling Group. Reston, Virginia, 1993.

Rushton, K.R. and S.C. Redshaw. Seepage and Groundwater Flow, Numerical Analysis by Analog and Digital Methods. John Wiley and Sons: New York, New York, 1979.

Rushton, K.R. and S.C. Redshaw. Seepage and Groundwater Flow, Numerical Analysis by Analog and Digital Methods. John Wiley and Sons: New York, New York, 1979.

Todd, D.K. Groundwater Hydrology. 2nd Edition. John Wiley & Sons: New York, New York, 1980.

Wang, H.F. and M.P. Anderson. Introduction to Groundwater Modeling, Finite-Difference and Finite-Element Methods. W.H. Freeman and Company: San Francisco, California, 1982.

Tables

TABLE B-1

SUMMARY OF HYDROGEOLOGIC DATABASE
NTCRA GROUND-WATER FLOW MODEL
SRSNE SITE - SOUTHINGTON, CONNECTICUT

Location	Easting (X)	Northing (Y)	Ground Surf. Elev.	Depth to Till	Depth to Bedrock	Till Elevation	Bedrock Elevation	Water Table 10/93	Bedrock Piez. Surface 10/93	Water Table 5/93	Bedrock Piez. Surface 5/93	MODFLOW Model Layer Data: Layer 1 Top	Layer 1 Bottom	Layer 2 Top	Layer 2 Bottom	Layer 3 Top	Layer 3 Bottom	Layer 4 Top	Layer 4 Bottom	Overburden Conductivity (ft/d)	Bedrock Conductivity (ft/d)	Well Depth	Well Formation
B-401	565281	286230	156.66	16	21	140.66	135.66					156.66					135.66	135.66	105.66				
B-402	565290	286324	157.7	17.5	20	140.2	137.7					157.7					137.7	137.7	107.7				
B-403	565283	286428	158.05	15	22	143.05	136.05					158.05			143.05	143.05	136.05	136.05	106.05				
B-404	565274	286515	158.81	19	20	139.81	138.81					158.81			139.81	139.81	138.81	138.81	108.81				
B-405	565304	286618	159.32	18.5	26	140.82	133.32					159.32			140.82	140.82	133.32	133.32	103.32				
PW-406	565291	286337	157.71		24		133.71					157.71					133.71	133.71				50.17	
PW-407	565291	286331	157.43									157.43										18	OW
MW-408	565318	286324	156.98	18.5	26.5	138.48	130.48					156.98			138.48	138.48	130.48	130.48	100.48	2.4		51.6	R
MW-409	565320	286332	157.14									157.14										16.7	OW
MW-410	565305	286329	157.04									157.04								13.6		12.1	OW
MW-411	565299	286341	157.22	15	24	142.22	133.22					157.22			142.22	142.22	133.22	133.22	103.22			51.3	R
MW-412	565302	286335	157.13									157.13								2.2		21.3	OW/T
MW-413	565278	286350	158									158								8.8		19.8	OW
MW-414	565273	286339	158.29	22.5	25.4	135.79	132.89					158.29			135.79	135.79	132.89	132.89	102.89			50.2	R
MW-415	565275	286346	158.15									158.15										11.8	OW
MW-416	565264	286291	157.42	18.5	25	138.92	132.42					157.42			138.92	138.92	132.42	132.42	102.42	0.18		49.4	R
B-1	565031	286419	166.92	7.5	13.5	159.42	153.42					166.92			159.42	159.42	153.42	153.42	123.42				
B-3	565436	286110	150.35		42		108.35					150.35					108.35	108.35	78.35				
B-4	565036	286607	167.08	13	16.3	154.08	150.78					167.08			154.08	154.08	150.78	150.78	120.78				
B-5	565015	286370	166.95	5		161.95						166.95			161.95	161.95							
B-7	565032	286386	166.89	7		159.89						166.89			159.89	159.89							
B-8	565103	286209	166.69	8.5	10.5	158.19	156.19					166.69			158.19	158.19	156.19	156.19	126.19				
B-11	565362	286586	157.78	26	30	131.78	127.78					157.78			131.78	131.78	127.78	127.78	97.78				
B-12	565455	286583	156.3	18	26	138.3	130.3					156.3			138.3	138.3	130.3	130.3	100.3				
B-13	565518	287127	154.82	22	33	132.82	121.82					154.82			132.82	132.82	121.82	121.82	91.82				
B-14	565095	286283	166.56	12	13	154.56	153.56					166.56			154.56	154.56	153.56	153.56	123.56				
B-16	565089	286347	166.51	9	15.5	157.51	151.01					166.51			157.51	157.51	151.01	151.01	121.01				
MW-121A	565639	285834	150.51									150.51									0.52	95	R
MW-121B	565532	285817	150.96	53	55	97.96	95.96	146.54		148.24		150.96	141.54	141.54	97.96	97.96	95.96	95.96	65.96			52	OW
MW-121C	565535	285826	151.12									151.12										68.7	R
MW-123A	565280	286128	156.33						155.9		158.5	156.33									0.7	85	R
MW-123C	565274	286126	156.72	16	32	140.72	124.72	152.86		155.39		156.72	147.86	147.86	140.72	140.72	124.72	124.72	94.72	0.24		15	OW
MW-124C	565238	285852	155.98	27.5	33	128.48	122.98		152.4		158.5	155.98			128.48	128.48	122.98	122.98	92.98		0.02	45.9	R
MW-125A	565403	286393	155.83	25	35	130.83	120.83		155.29		156.26	155.83			130.83	130.83	120.83	120.83	90.83		3	65	R
MW-125C	565402	286382	155.97									155.97										50.5	R
MW-126B	565124	287008	162.79							159.93		162.79								95		12.5	OW
MW-126C	565123	287011	162.78		21		141.78				161.82	162.78					141.78	141.78	111.78		3.5	34	R
MW-127B	565403	285087	147.86	47.5	90	100.36	57.86	146.09		147.14		147.86	141.09	141.09	100.36	100.36	57.86	57.86	27.86	59		47	OW
MW-127C	565404	285081	147.58									147.58									0.32	101.5	R
MW-128	565211	285319	155.43	38	52	117.43	103.43		146.45		148.71	155.43			117.43	117.43	103.43	103.43	73.43		0.016	65	R
MW-129	564223	287053	227.54	4.5	10.5	223.04	217.04	222.36	222.36	224.86	224.86	227.54	221	221	218.81	218.81	217.04	217.04	187.04		0.1	23.85	R
MW-201A	565732	287690	154.29						148.64		149.02	154.29									0.14	64	R
MW-201B	565737	287694	154.48	42.5	47.5	111.98	106.98	148.94		148.47		154.48	143.94	143.94	111.98	111.98	106.98	106.98	76.98			20	OW
MW-202A	566031	287225	156.25						148.02		150.41	156.25										129	R
MW-202B	566037	287225	156.28	79	114	77.28	42.28	148.19		149.83		156.28	143.19	143.19	77.28	77.28	42.28	42.28	12.28			92.5	OW
MW-203A	566355	285360	188.78						148.65		152.75	188.78										160	R
MW-203B	566351	285359	188.47	104	150	84.47	38.47	148.63		152.71		188.47	143.63	143.63	84.47	84.47	38.47	38.47	8.47			105	OW
MW-204A	565669	285566	148.83						146.64		148.41	148.83										114	R
MW-204B	565652	285569	148.74	79	84	69.74	64.74	146.41		148.23		148.74	141.41	141.41	69.74	69.74	64.74	64.74	34.74			78	OW
MW-205A	565559	284997	150.29						145.75		146.48	150.29									0.18	133.5	R
MW-205B	565551	284992	149.96	84	124	65.96	25.96	145.84		146.58		149.96	140.84	140.84	65.96	65.96	25.96	25.96				49	OW
MW-206A	565732	284158	153.13						146.23		146.75	153.13										125.5	R
MW-206B	565726	284159	153.2	99	116	54.2	37.2	146.3		146.71		153.2	141.3	141.3	54.2	54.2	37.2	37.2	7.2			89	OW
MW-207A	565484	284175	150.9	94	103	56.9	47.9					150.9			56.9	56.9	47.9	47.9	17.9			113	R
MW-208A	565678	283622	156.82	89	111	67.82	45.82		146.61		148.03	156.82			67.82	67.82	45.82	45.82	15.82		0.61	121	R
MW-209A	564582	286263	196.13						172		174.32	196.13									2	38	R
MW-209B	564582	286258	195.81	2.5	18	193.31	177.81	181.4				195.81	180.2	180.2	179.01	179.01	177.81	177.81	147.81			15	OW
MWL-301	565261	286598	158.82					156.13		156.97		158.82	157.03	157.03						0.34		11	OW
MWL-302	565359	286603	159.15					155.06		155.87		159.15	156.42	156.42								11	OW
MWL-303	565457	286604	156.96					149.71		150.54		156.96	152.13	152.13								11	OW
MWL-304	565265	286466	157.96					156.06		157.48		157.96	156.69	156.69						5.7		11	OW
MWL-305	565354	286450	157.55					155.39		156.37		157.55	156.11	156.11						1.3		11	OW
MWL-306	565502	286450	153.8					150.13		149.88		153.8	151.35	151.35								11	OW

TABLE B-1

SUMMARY OF HYDROGEOLOGIC DATABASE
NTCRA GROUND-WATER FLOW MODEL
SRSNE SITE - SOUTHINGTON, CONNECTICUT

Location	Easting (X)	Northing (Y)	Ground Surf. Elev.	Depth to Till	Depth to Bedrock	Till Elevation	Bedrock Elevation	Water Table 10/93	Bedrock Piez. Surface 10/93	Water Table 5/93	Bedrock Piez. Surface 5/93	MODFLOW Model Layer Data: Layer 1 Top	Layer 1 Bottom	Layer 2 Top	Layer 2 Bottom	Layer 3 Top	Layer 3 Bottom	Layer 4 Top	Layer 4 Bottom	Overburden Conductivity (ft/d)	Bedrock Conductivity (ft/d)	Well Depth	Well Formation
MWL-307	565259	286297	157.71					155.93		157.25		157.71	156.52	156.52								11	OW
MWL-308	565354	286304	155.88					155.16		156.7		155.88	155.4	155.4								11	OW
MWL-309	565505	286302	152.78					151.7		150.12		152.78	152.06	152.06								11	OW
MWL-310	565251	286147	157.34					154.53		156.28		157.34	155.47	155.47								10.5	OW
MWL-311	565351	286149	155.46					151.88		152.87		155.46	153.07	153.07						0.91		11	OW
MWL-312	565509	286154	153.75							150.25		153.75										11	OW
MWL-313	565352	285992	154.52					146.96		150.93		154.52	149.48	149.48								11	OW
MWL-314	565502	286001	153.68					146.57		148.82		153.68	148.94	148.94								11	OW
P-1A	565124	286367	166.2						156.8		161.52	166.2									4.5	36	R
P-1B	565125	286372	166.15	13.5	17	152.65	149.15	155.25		158.27		166.15	153.22	153.22	152.65	152.65	149.15	149.15	119.15			15.75	OW/T
P-2A	565118	286221	166.41						147.11		161.94	166.41									2	32	R
P-2B	565116	286223	166.41	12	21.5	154.41	144.91			160.7		166.41			154.41	154.41	144.91	144.91	114.91	5		16	OW/T
P-3A	565576	286459	148.2								150.1	148.2									0.14	64.5	R
P-3B	565570	286457	148.13	25	50	123.13	98.13					148.13			123.13	123.13	98.13	98.13	68.13	0.1		17	OW
P-4A	565008	286294	167.94						158.64		166.55	167.94									0.16	30	R
P-4B	565011	286294	167.6	11	17.5	156.6	150.1	160.72		164.34		167.6	157.18	157.18	156.6	156.6	150.1	150.1	120.1	0.78		14.8	OW
P-5A	565394	286291	155.33						151.23		153.22	155.33									0.09	52.5	R
P-5B	565391	286283	155.24	28	38	127.24	117.24	151.23		154.47		155.24	146.23	146.23	127.24	127.24	117.24	117.24	87.24	0.04		9	OW
P-6	565500	286294	152.74	26	39	126.74	113.74		149.62		151.46	152.74			126.74	126.74	113.74	113.74	83.74		1	57.5	R
P-7	565439	286805	158.06	27	47.5	131.06	110.56	155.67		157.18		158.06	150.67	150.67	131.06	131.06	110.56	110.56	80.56			16.5	OW
P-8	564918	286064	179.72	16	23.5	163.72	156.22	158.35				179.72	157.64	157.64	156.93	156.93	156.22	156.22	126.22	0.2		19.9	OW/T
P-8A	564921	286067	179.66								167.37	179.66									0.3	70	R
P-9	565412	286584	157.66	18	34	139.66	123.66	154.05		154.49		157.66	149.05	149.05	139.66	139.66	123.66	123.66	93.66			13	OW
P-10	565316	286803	160.84	12	27	148.84	133.84	156.52		158.35		160.84	151.52	151.52	148.84	148.84	133.84	133.84	103.84	48		13.96	OW/T
P-11A	565583	286220	151.8						147.7		149.88	151.8										68	R
P-11B	565583	286220	152.22	31	56	121.22	96.22	147.34		149.41		152.22	142.34	142.34	121.22	121.22	96.22	96.22	66.22	0.78		14	OW
P-12	565321	287115	161.27	21	31	140.27	130.27	155.75		158.56		161.27	150.75	150.75	140.27	140.27	130.27	130.27	100.27	0.53		14	OW
P-12A	565321	287105	161.21						155.37		158.3	161.21										50	R
P-13	565242	285851	155.88					147.06		148.74		155.88	150	150						0.12		14.9	OW
P-14	565582	286212	151.96						147.82		150.5	151.96									0.01	89	R
P-15	564917	285631	179.18	14	20.5	165.18	158.68					179.18			165.18	165.18	158.68	158.68	128.68		0.09	34	R
P-16	565129	286518	165.35	14		151.35		156.35		157.92		165.35	159.35	159.35	151.35	151.35				51		12.5	OW
P-101A	565674	286226	148.05						147.62		149.68	148.05									0.1	96	R
P-101B	565675	286232	148.19									148.19										44	OW
P-101C	565676	286238	148.34	51	64	97.34	84.34	147.49		146.92		148.34	142.49	142.49	97.34	97.34	84.34	84.34	54.34			13	OW
P-102A	565702	286458	148.77						147.63		149.85	148.77										91	R
P-102B	565702	286465	148.74									148.74										39	OW
P-102C	565702	286472	148.71	39	69	109.71	79.71	147.22		147.49		148.71	142.22	142.22	109.71	109.71	79.71	79.71	49.71			13	OW
CW-OBS-	565364	284416																					
CW-B-77	565309	285710																					
CW-2-75	565407	285677																					
CW-2-78	565073	285036						145.8		147.41			140.8										
CW-3-75	565678	285115																					
CW-3-78	565162	284652								145.23													
CW-4-75	565312	285355						146.4		147.85			141.4										
CW-4-78	565155	284650																					
CW-5-78	565251	284543																					
CW-6-75	565222	284832																					
CW-6-78	565396	284625																					
CW-7A	565314	284843																					
CW-7	565316	284843																					
CW-7-78	565366	284159																					
CW-8-78	565457	284171								146.23													
CW-9-78	565527	284271																					
CW-10-7	565317	284256																					
DN-1	565227	286248																					
DN-2	565211	286093						153.99		156.83			148.99							2.6			
DN-3	565128	286040																					
MW-1	565281	285950																					
MW-2	565307	285338																					
MW-3	565509	285065																					
MW-4	565622	285470																					
MW-5	565651	286030								149.38													

TABLE B-1

SUMMARY OF HYDROGEOLOGIC DATABASE
NTCRA GROUND-WATER FLOW MODEL
SRSNE SITE - SOUTHINGTON, CONNECTICUT

Location	Easting (X)	Northing (Y)	Ground Surf. Elev.	Depth to Till	Depth to Bedrock	Till Elevation	Bedrock Elevation	Water Table 10/93	Bedrock Piez. Surface 10/93	Water Table 5/93	Bedrock Piez. Surface 5/93	MODFLOW Model Layer Data: Layer 1 Top	Layer 1 Bottom	Layer 2 Top	Layer 2 Bottom	Layer 3 Top	Layer 3 Bottom	Layer 4 Top	Layer 4 Bottom	Overburden Conductivity (ft/d)	Bedrock Conductivity (ft/d)	Well Depth	Well Formation
MW-6	565660	286017																					
MW-7	565646	286028																					
MW-8	565654	286015						149.6		151.76			144.6										
S6-1	565357	284465																					
SRS-1	565194	285871																					
SRS-2	565200	285871																					
SRS-3	565394	285864																					
SRS-4	565392	285868																					
SRS-5	565529	285996																					
SRS-6	565577	286010																					
TW-1	565344	284065								146.46										0.31			OB
TW-2	565355	283770								144.23													
TW-3	565269	284027								146.92										4.1			OB
TW-4	565245	283814																					
TW-5	565149	284350																					
TW-7B	565387	286385																					
TW-7A	565393	286384																		0.8			OB
TW-8A	565213	286406																		18			OB
	565213	286406																			0.6		R
TW-9	564984	286593																			1.4		R
TW-10	564882	286403																			8		R
TW-11	565282	285956																		17			OB
TW-12	565269	287366																		0.21			OB
WE-1	565220	286787																			0.4		R
WE-2	565220	286808																					
WE-3	565140	286142																					R
WE-4	565140	286142																		0.9			
WE-5	565139	286144																					

Notes: Data obtained from hydrogeologic data reports by HNUS (May 1994) and ENSR (June 1994). Some hydrogeologic contacts reinterpreted by BB&L based on comparisons to soil samples obtained during the NTCRA Phase 1 field investigation.

Hydraulic conductivity data typically represent slug test results at overburden wells and packer test results at bedrock corehole intervals. Where multiple tests were performed, the higher value was selected.

TABLE B-2

CALCULATION OF HEAD AND CONDUCTANCE FOR SIMULATION OF RECOVERY WELLS AS DRAINS
NTCRA GROUND-WATER FLOW MODEL
SRSNE SITE - SOUTHINGTON, CONNECTICUT

	RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9	RW-10	RW-11
Model Row (Y-Coordinate)	85	69	59	45	37	57	80	75	64	52	41
Model Column (X-Coordinate)	36	45	43	40	35	31	39	42	44	42	38

LAYER 1	RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9	RW-10	RW-11
Initial Head Elevation (ft)	154	154	154	154	154	157	154	154	154	154	154
Bottom Elevation (ft)	150	150	150	150	150	150	150	150	150	150	150
Available Drawdown (ft)	4	4	4	4	4	7	4	4	4	4	4
Estimated Well Efficiency	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Effective Drawdown (ft)	2	2	2	2	2	3.5	2	2	2	2	2
Effective Head at Well (ft)	152	152	152	152	152	153.5	152	152	152	152	152
Hydraulic Conductivity (ft/day)	1.2	1.2	1.9	1.7	2	14	1	1	1.7	2	1.4
Calc. Drain Conductance (sqft/day)	21	21	34	30	35	432	18	18	30	35	25

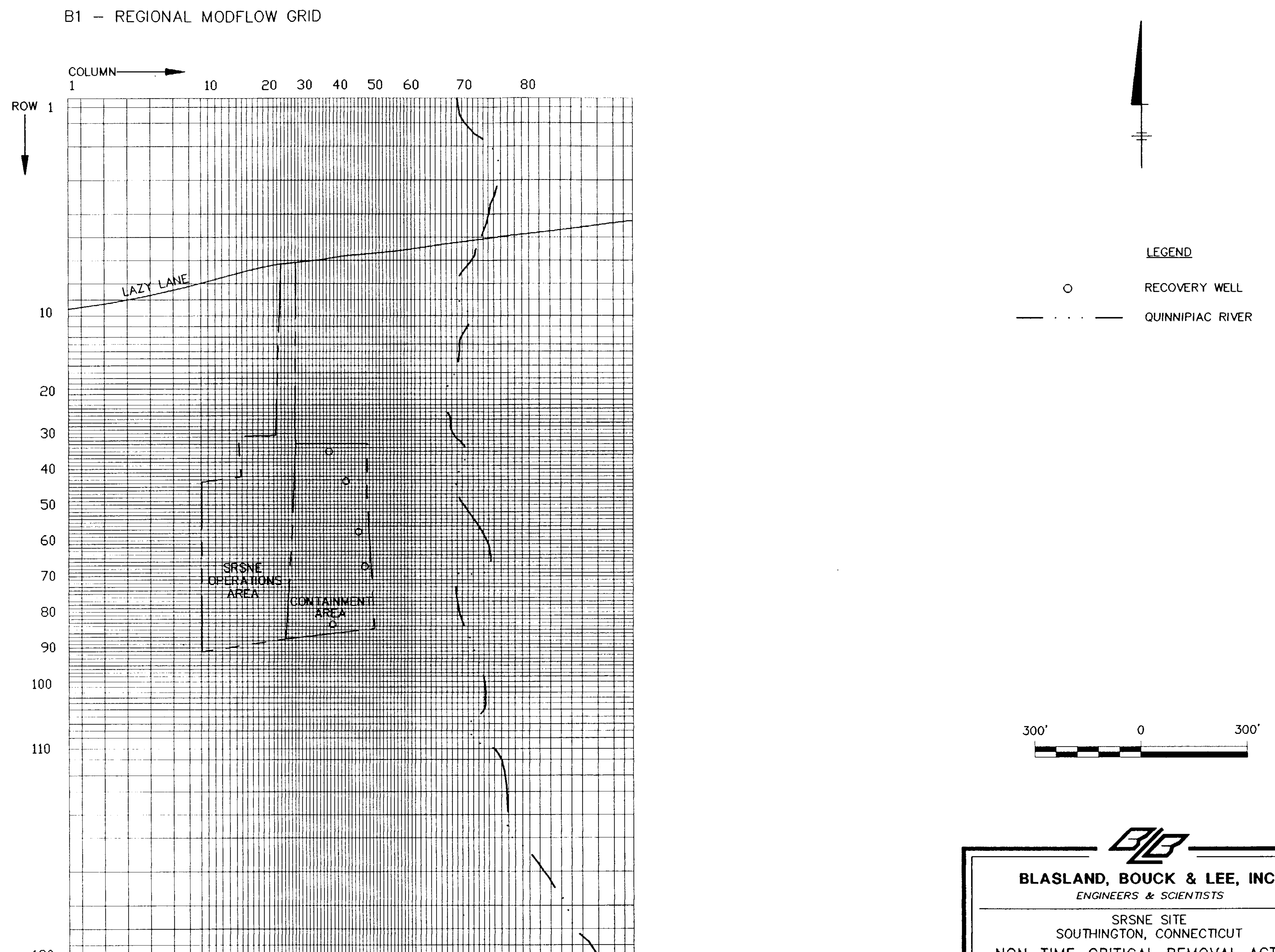
LAYER 2	RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9	RW-10	RW-11
Initial Head Elevation (ft)	154	154	154	154	154	157	154	154	154	154	154
Top Elevation (ft)	150	150	150	150	150	150	150	150	150	150	150
Bottom Elevation (ft)	137.5	130	130	135	135	135	135	130	130	135	135
Available Drawdown (ft)	16.5	20	20	19	19	20	19	20	20	19	19
Estimated Well Efficiency	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Effective Drawdown (ft)	8.25	10	10	9.5	9.5	10	9.5	10	10	9.5	9.5
Effective Head at Well (ft)	145.75	144	144	144.5	144.5	147	144.5	144	144	144.5	144.5
Hydraulic Conductivity (ft/day)	1.2	1.2	1.9	1.7	2	14	1	1	1.7	2	1.4
Calc. Drain Conductance (sqft/day)	66	106	168	112	132	926	66	88	150	132	93

LAYER 3	RW-1	RW-2	RW-3	RW-4	RW-5	RW-6	RW-7	RW-8	RW-9	RW-10	RW-11
Initial Head Elevation (ft)	154	154	154	154	154	157	154	154	154	154	154
Top Elevation (ft)	137.5	130	130	135	135	135	135	130	130	135	135
Bottom Elevation (ft)	122.5	115	120	120	120	125	120	120	120	120	120
Available Drawdown (ft)	20	20	20	20	20	20	20	20	20	20	20
Estimated Well Efficiency	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Effective Drawdown (ft)	10	10	10	10	10	10	10	10	10	10	10
Effective Head at Well (ft)	144	144	144	144	144	147	144	144	144	144	144
Hydraulic Conductivity (ft/day)	1.2	1.2	1.9	1.7	2	14	1	1	1.7	2	1.4
Calc. Drain Conductance (sqft/day)	79	79	84	112	132	617	66	44	75	132	93

LAYER 4	RW-1	RW-2	RW-3	RW-4	RW-5
Initial Head Elevation (ft)	154	154	154	154	154
Top Elevation (ft)	122.5	115	120	120	120
Bottom Elevation (ft)	92.5	85	90	90	90
Available Drawdown (ft)	20	20	20	20	20
Estimated Well Efficiency	0.5	0.5	0.5	0.5	0.5
Effective Drawdown (ft)	10	10	10	10	10
Effective Head at Well (ft)	144	144	144	144	144
Hydraulic Conductivity (ft/day)	1.1	1.1	1.7	1.3	1.3
Calc. Drain Conductance (sqft/day)	146	146	225	172	172

Note: Drain conductance term based on Prickett (1967), calculated as C = 2K(3.14)B/ln(x/4.81r), where C is the drain conductance, K is the horizontal conductivity, B is the layer thicknness, x is the numerical model grid spacing, and r is the well radius (approx. 0.5 feet).

Figures



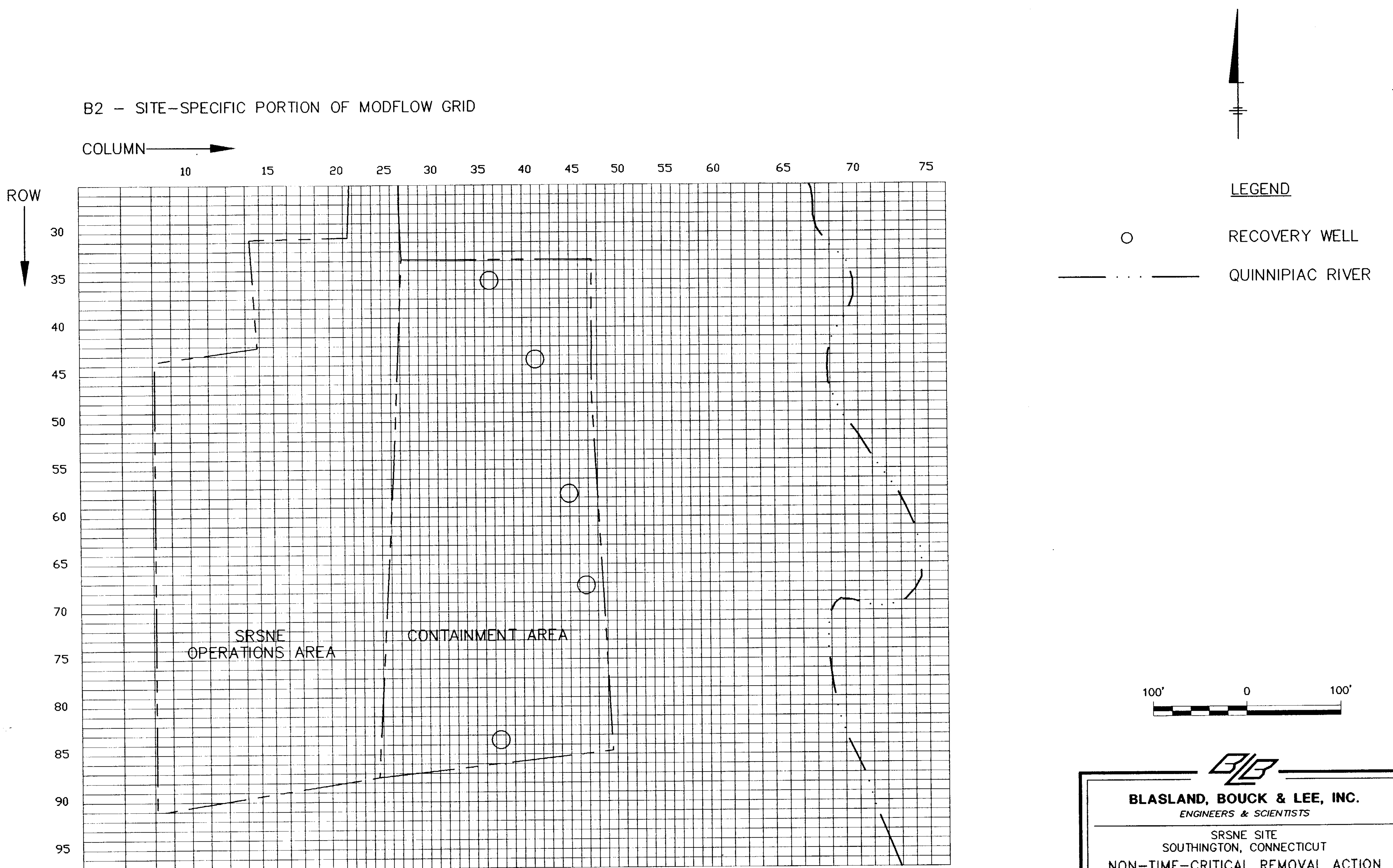
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION

FIGURE B1

OPTIONAL L: OR X:
12/94 54-PMC,DMW
08325001/08325G13.DWG

B2 - SITE-SPECIFIC PORTION OF MODFLOW GRID



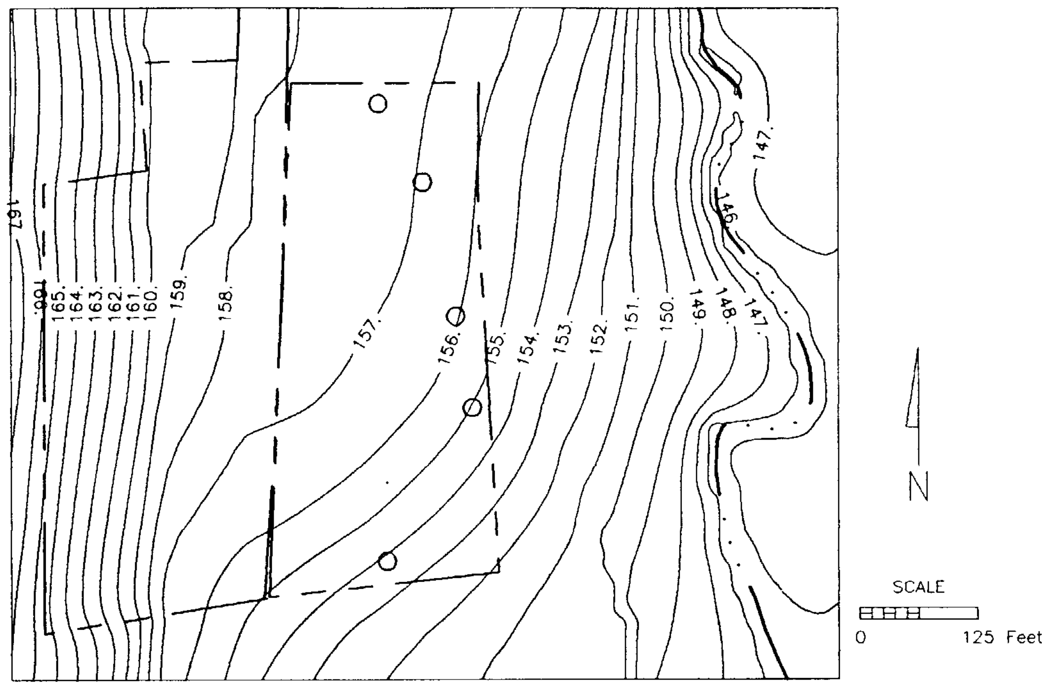
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION

FIGURE B2

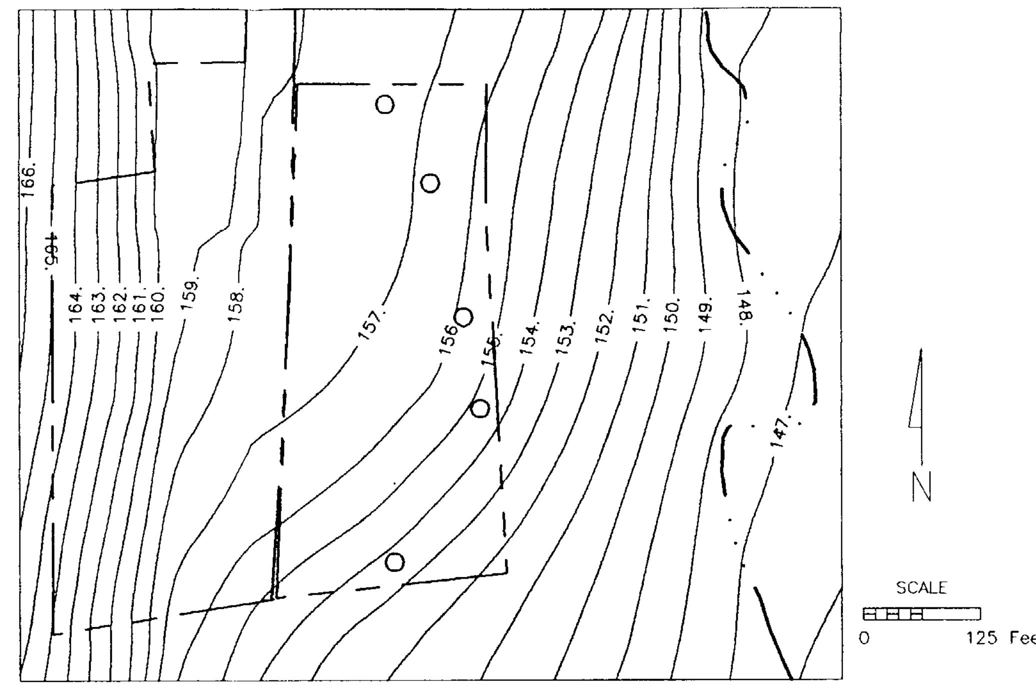
OPTIONAL L: OR X:
12/94 54-PMC.DMW
08325001/08325G15.DWG

B3 – CALIBRATED WATER-TABLE (LAYER 1) ELEVATION MAP



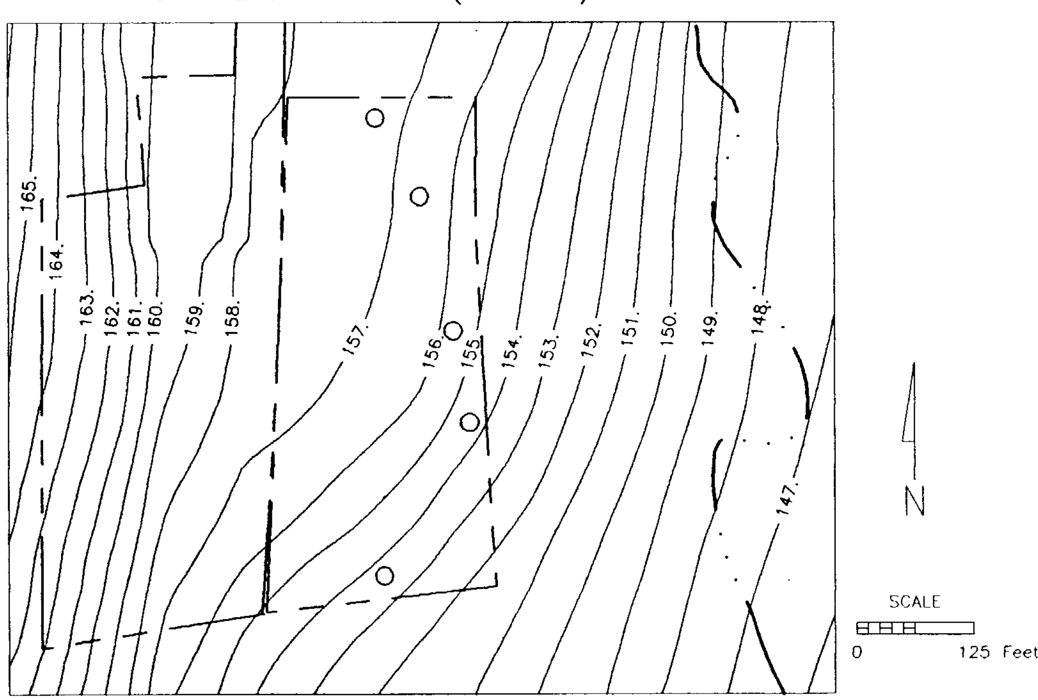
SCA2L1ST

B4 – CALIBRATED POTENTIOMETRIC SURFACE MAP
OF THE GLACIAL OUTWASH (LAYER 2)



SCA2L2ST.DXF

B5 – CALIBRATED POTENTIOMETRIC SURFACE MAP
OF THE GLACIAL TILL (LAYER 3)



SCA2L3ST.DXF

LEGEND

148 — LINE OF EQUAL GROUND-WATER ELEVATION, FEET RELATIVE TO MEAN SEA LEVEL

○ RECOVERY WELL

— · · · — QUINNIPIAC RIVER

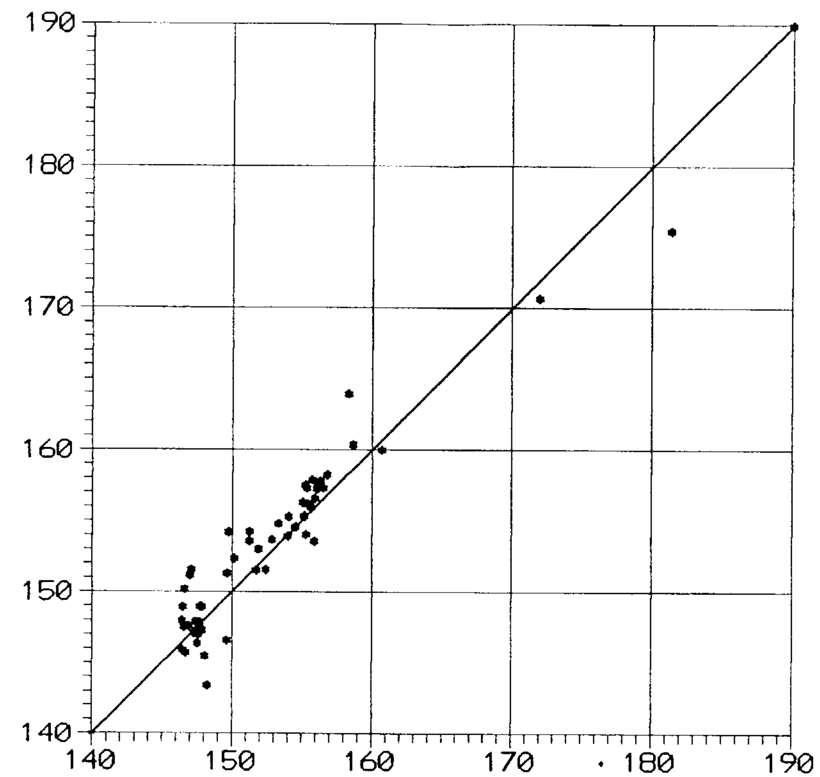
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION

FIGURES B3, B4 & B5

OPTIONAL L: OR X:
12/94 54-PMC.DMW
08325001/08325G10.DWG

B6 – OBSERVED VERSUS CALCULATED HEADS



LEGEND

• CALIBRATION DATA

THEORETICAL PERFECT CALIBRATION LINE

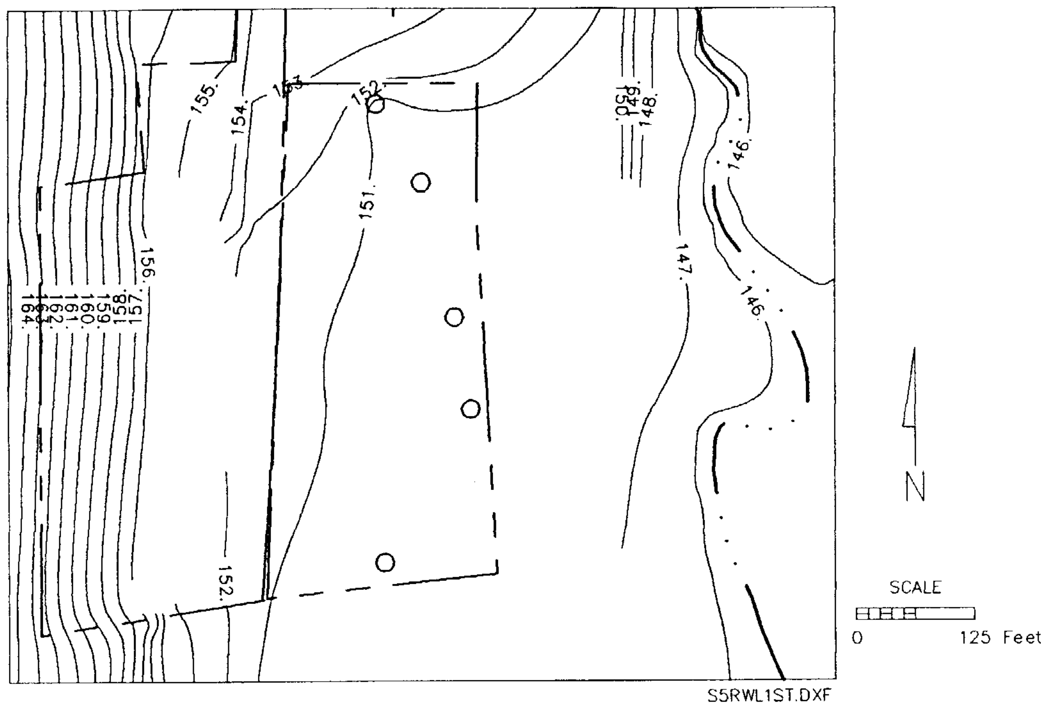
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION

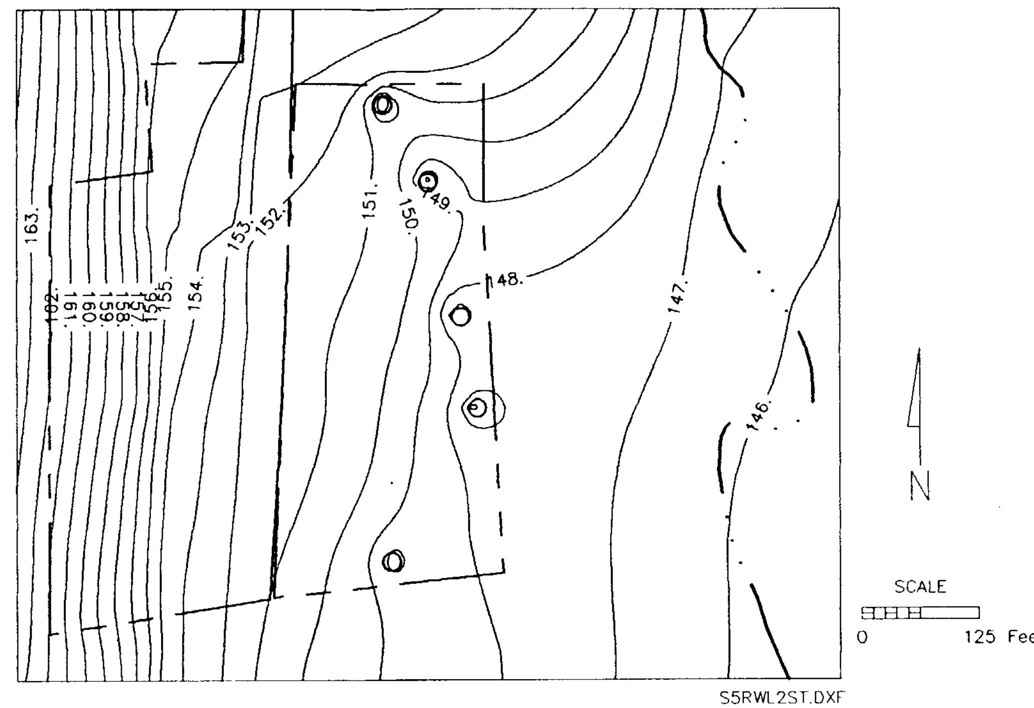
FIGURE B6

OPTIONAL L: OR X:
12/94 54-PMC
06325001/06325G16.DWG

B7 – SIMULATED WATER-TABLE (LAYER 1) ELEVATION MAP WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING



B8 – SIMULATED POTENTIOMETRIC SURFACE MAP OF THE GLACIAL OUTWASH (LAYER 2) WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING



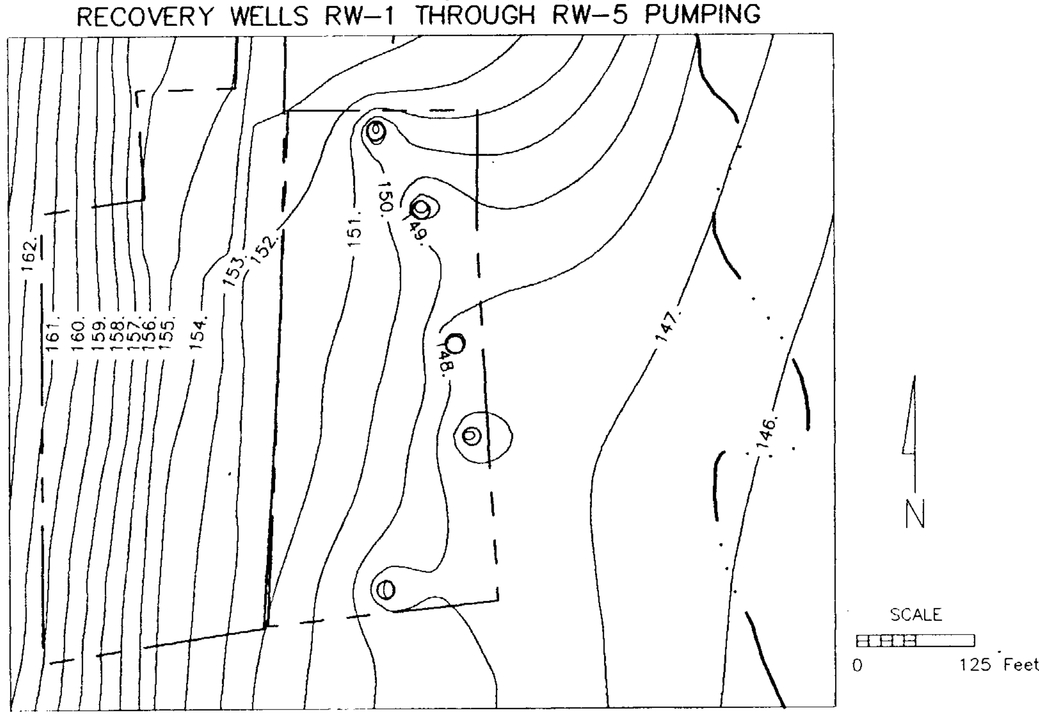
LEGEND

148 — LINE OF EQUAL GROUND-WATER ELEVATION, FEET RELATIVE TO MEAN SEA LEVEL

○ RECOVERY WELL

— · · · — QUINNIPIAC RIVER

B9 – SIMULATED POTENTIOMETRIC SURFACE MAP OF THE GLACIAL TILL (LAYER 3) WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING



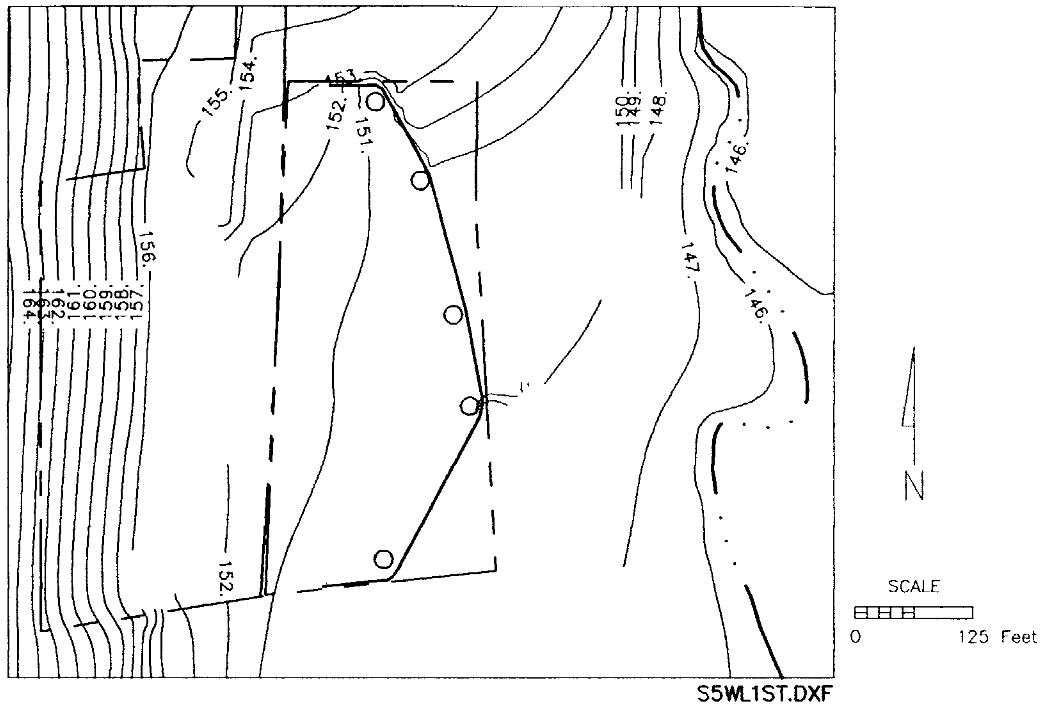
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION

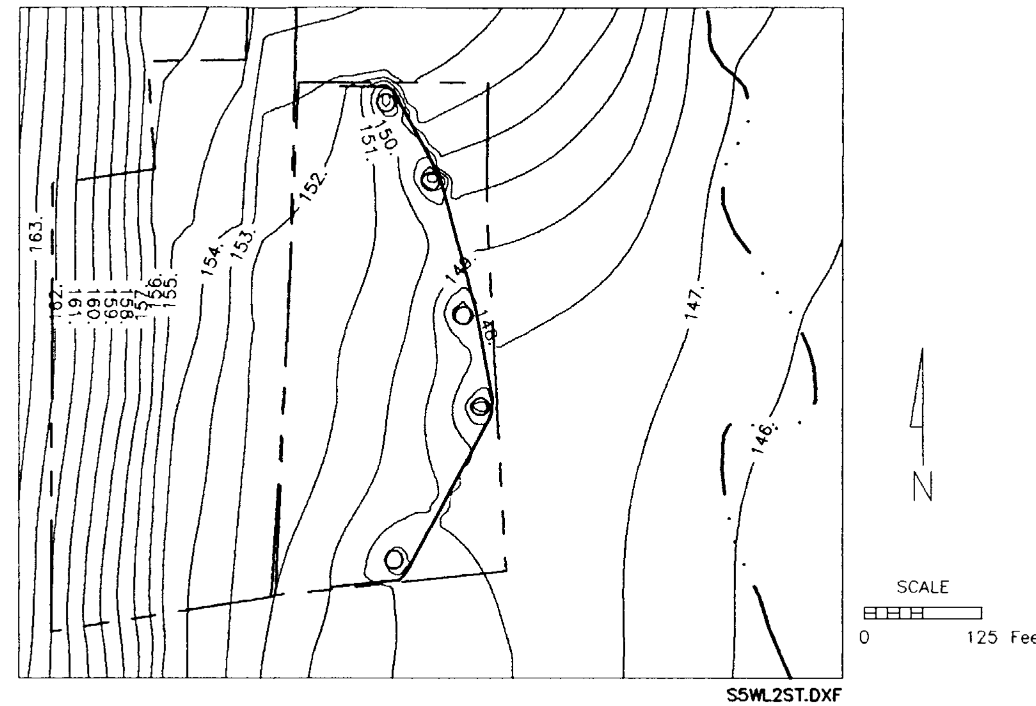
FIGURES B7, B8 & B9

OPTIONAL L: OR X:
12/94 54-PMC,DMW
08325001/08325G08.DWG

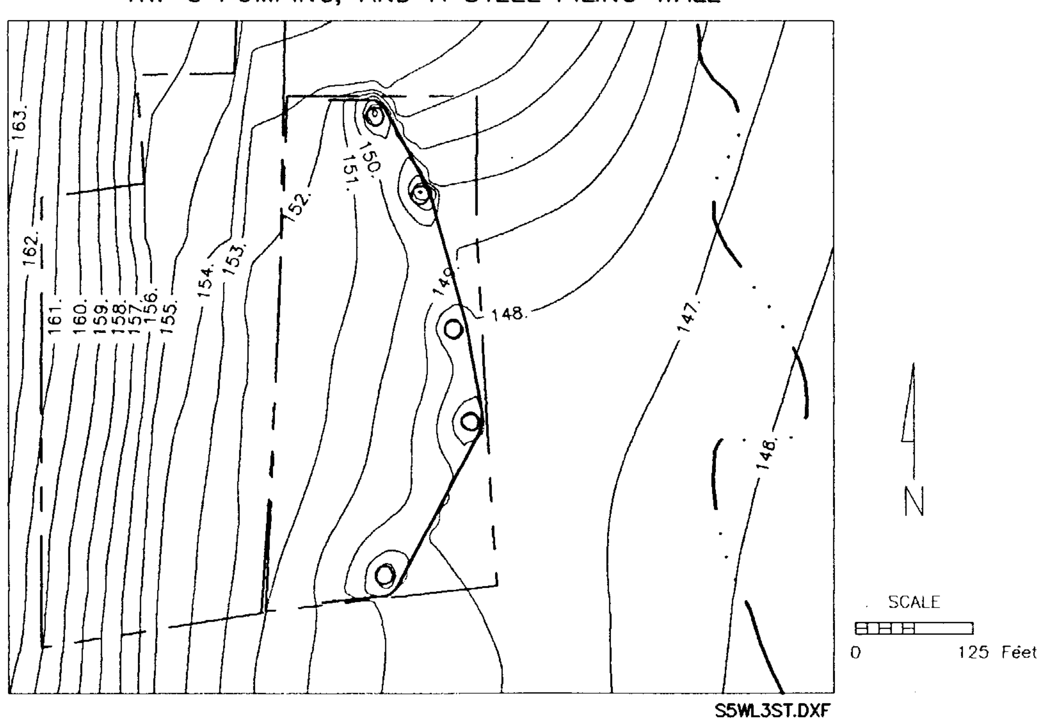
B10 – SIMULATED WATER-TABLE (LAYER 1) ELEVATION MAP WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING, AND A STEEL PILING WALL



B11 – SIMULATED POTENTIOMETRIC SURFACE MAP OF THE GLACIAL OUTWASH (LAYER 2) WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING, AND A STEEL PILING WALL



B12 – SIMULATED POTENTIOMETRIC SURFACE MAP OF THE GLACIAL TILL (LAYER 3) WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING, AND A STEEL PILING WALL



LEGEND

—— 148 ——	LINE OF EQUAL GROUND WATER ELEVATION, FEET RELATIVE TO MEAN SEA LEVEL
O	RECOVERY WELL
— · · · —	QUINNIPIAC RIVER
————	STEEL PILING WALL

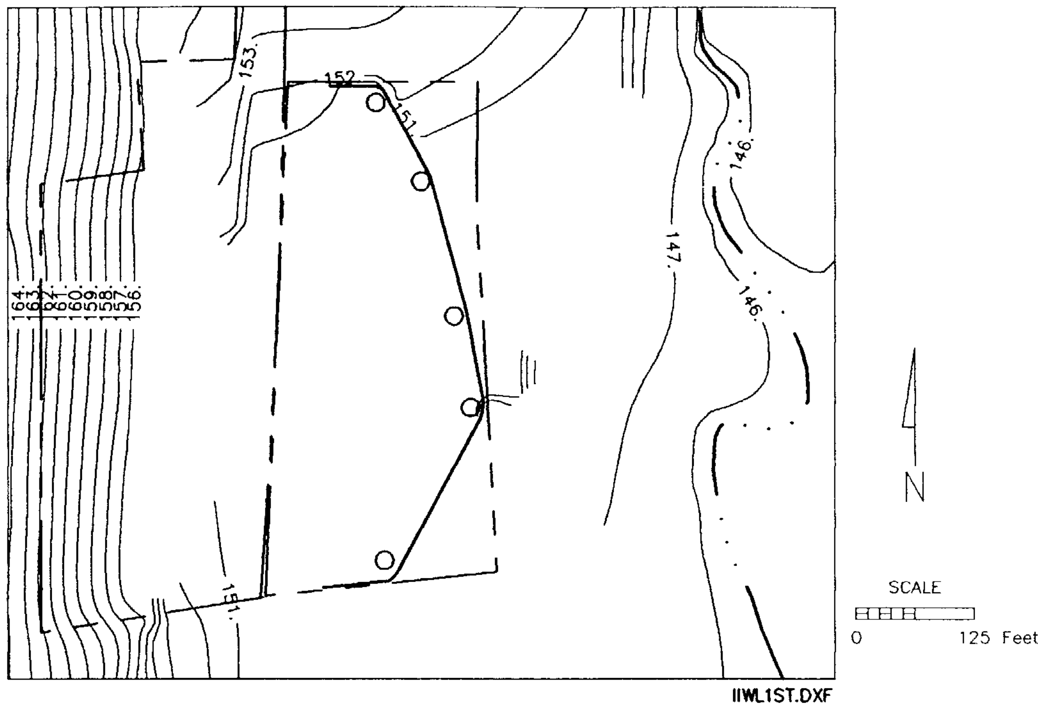
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION

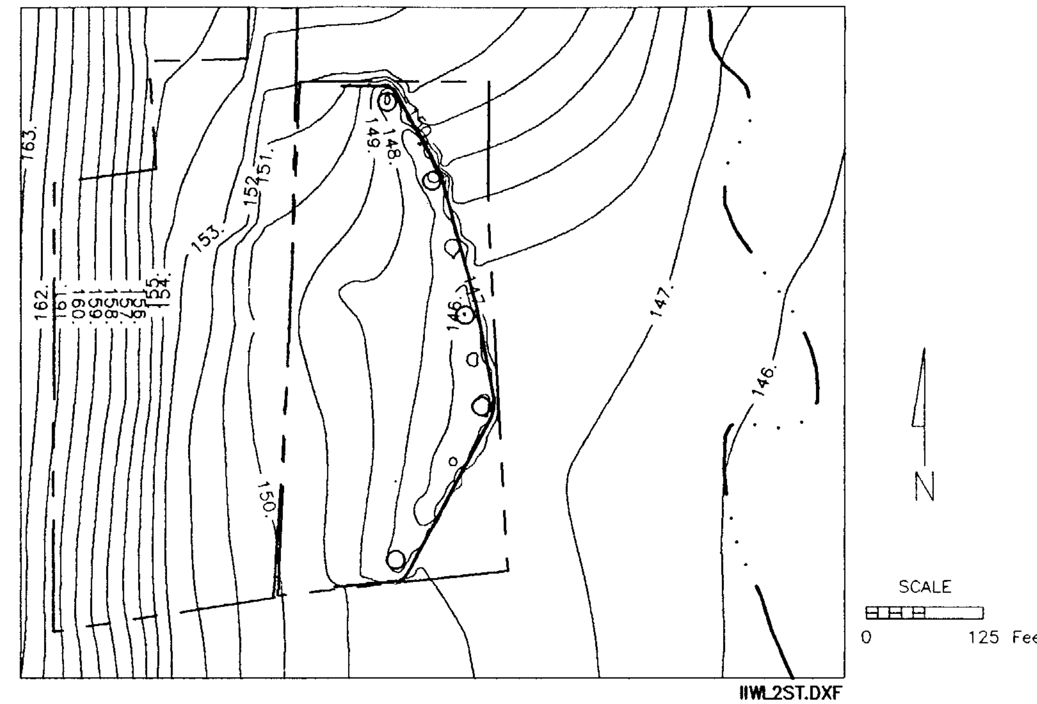
FIGURES B10, B11 & B12

OPTIONAL L: OR X:
12/94 54-PMC,DMW
08325001/08325G09.DWG

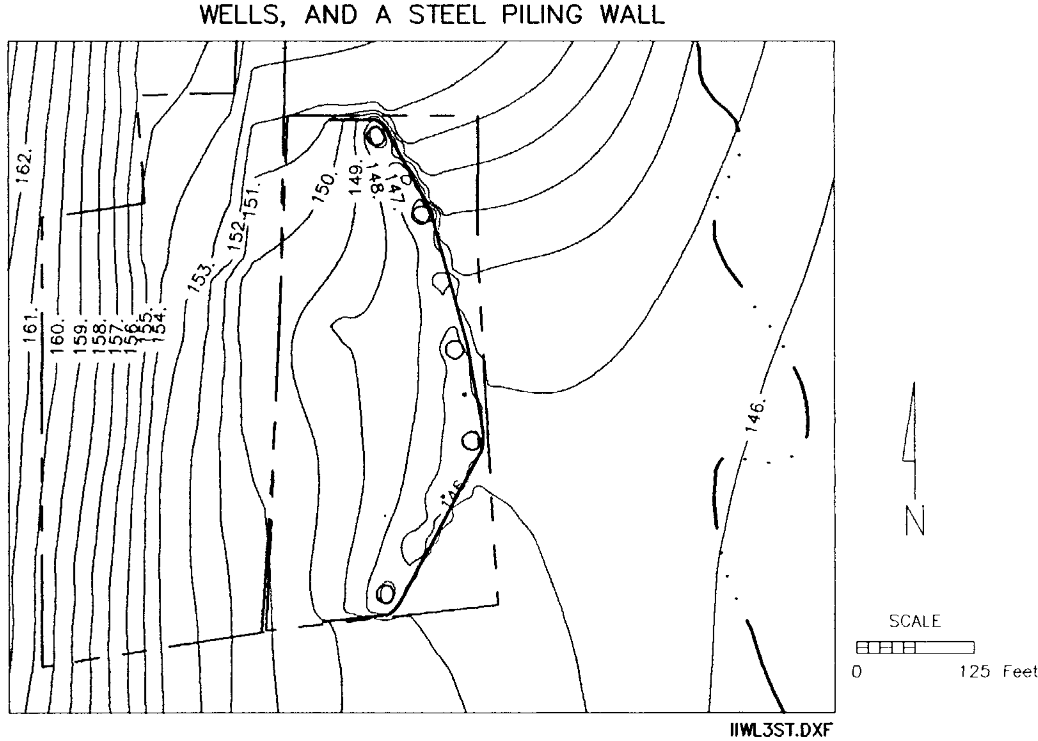
B13 – SIMULATED WATER-TABLE (LAYER 1) ELEVATION MAP WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING, SIX ADDITIONAL PUMPING WELLS, AND A STEEL PILING WALL



B14 – SIMULATED POTENTIOMETRIC SURFACE MAP OF THE GLACIAL OUTWASH (LAYER 2) WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING, SIX ADDITIONAL PUMPING WELLS, AND A STEEL PILING WALL



B15 – SIMULATED POTENTIOMETRIC SURFACE MAP OF THE GLACIAL TILL (LAYER 3) WITH RECOVERY WELLS RW-1 THROUGH RW-5 PUMPING, SIX ADDITIONAL PUMPING WELLS, AND A STEEL PILING WALL



LEGEND

—— 148 ——	LINE OF EQUAL GROUND-WATER ELEVATION, FEET RELATIVE TO MEAN SEA LEVEL
○	RECOVERY WELL
—— · · · ——	QUINNIPIAC RIVER
————	STEEL PILING WALL

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION

FIGURES B13, B14 & B15

OPTIONAL L: OR X:
12/94 54-PMC.DMW
08325001/08325G03.DWG

Appendix C

Ground-Water Sampling and Treatability Testing Results

Upstate Laboratories inc.

Shipping: 6034 Corporate Dr. • E. Syracuse, NY 13057 • (315) 437-0255 • Fax (315) 437-1209
Mailing: Box 289 • Syracuse, NY 13206
Albany (518) 459-3134
Binghamton (607) 724-0478
Buffalo (716) 662-2118
Rochester (716) 436-9070
New Jersey (201) 703-1324

November 8, 1994

Mr. Don Sauda
Project Engineer
Blasland, Bouck & Lee, Inc.
6723 Towpath Rd.
P.O. Box 66
Syracuse, NY 13214-0066

Re: Analysis Report #28394084 - 083.25.01 Solvent Recovery System (SRS)
Northeast Site

Dear Mr. Sauda:

Please find enclosed the results for your samples which were received on October 10, 14 and 31, 1994.

We have included the Chain of Custody Record as part of your report. You may need to reference this form for a more detailed explanation of your sample. Samples will be disposed of approximately one month from final report date.

Should you have any questions, please feel free to give us a call.

Thank you for your patronage.

Sincerely,

UPSTATE LABORATORIES, INC.

Anthony J. Scala
Director

AJS/sl

Enclosure: report

cc/enc: N. Scala, ULI
file

Note: Faxed results were given to your office on 10/24, 10/26, 10/28 and 11/1/94. AJS

Disclaimer: The test results and procedures utilized, and laboratory interpretations of data obtained by ULI as contained in this report are believed by ULI to be accurate and reliable for sample(s) tested. In accepting this report, the customer agrees that the full extent of any and all liability for actual and consequential damages of ULI for the services performed shall be equal to the fee charged to the customer for the services as liquidated damages.

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.
Sampled by: Client

APPROVAL: _____
QC: PFF
Lab I.D.: 10170
08325 SOLVENT
RECOVERY SYSTEM SRS-092994-RW4 1910H 09/29/94 G

ULI I.D.: 28394084 Matrix: Water

PARAMETERS		RESULTS	KEY	FILE#
	Total Suspended Solids	64mg/l		WA5601
Total	Arsenic by furnace method	0.003mg/l		MA2358
Total	Cadmium	<0.005mg/l		MA2326
Total	Copper	<0.02mg/l		MA2326
Total	Iron	7.5mg/l		MA2326
Total	Lead by furnace method	0.002mg/l		MA2328
Total	Manganese	3.7mg/l		MA2326
Total	Nickel	<0.03mg/l		MA2326
Total	Zinc	0.05mg/l		MA2326
	TCL Volatiles by EPA Method 8240			
	Chloromethane	<150ug/l	05	VM0347
	Bromomethane	<150ug/l	05	VM0347
	Vinyl Chloride	2800ug/l		VM0347
	Chloroethane	<150ug/l	05	VM0347
	Methylene Chloride	180ug/l		VM0347
	Acetone	1100ug/l		VM0347
	Carbon Disulfide	<150ug/l	05	VM0347
	1,1-Dichloroethene	<150ug/l	05	VM0347
	1,1-Dichloroethane	<150ug/l	05	VM0347
	trans-1,2-Dichloroethene	<150ug/l	05	VM0347
	cis-1,2-Dichloroethene	8400ug/l		VM0347
	Chloroform	<150ug/l	05	VM0347
	1,2-Dichloroethane	<150ug/l	05	VM0347
	2-Butanone	<500ug/l	05	VM0347
	1,1,1-Trichloroethane	350ug/l		VM0347
	Carbon Tetrachloride	<150ug/l	05	VM0347
	Bromodichloromethane	<150ug/l	05	VM0347
	1,2-Dichloropropane	<150ug/l	05	VM0347
	cis-1,3-Dichloropropene	<150ug/l	05	VM0347
	Trichloroethene	1300ug/l		VM0347
	Dibromochloromethane	<150ug/l	05	VM0347
	1,1,2-Trichloroethane	<150ug/l	05	VM0347
	Benzene	<150ug/l	05	VM0347
	trans-1,3-Dichloropropene	<150ug/l	05	VM0347
	Bromoform	<150ug/l	05	VM0347
	4-Methyl-2-pentanone	<500ug/l	05	VM0347
	2-Hexanone	<500ug/l	05	VM0347
	Tetrachloroethene	180ug/l		VM0347
	1,1,2,2-Tetrachloroethane	<150ug/l	05	VM0347
	Toluene	3100ug/l		VM0347
	Chlorobenzene	<150ug/l	05	VM0347

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC. 08325 SOLVENT RECOVERY SYSTEM SRS-092994-RW4 1910H 09/29/94 G
Sampled by: Client

APPROVAL: [signature]
QC: PEF
Lab I.D.: 10170

ULI I.D.: 28394084 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Ethylbenzene	1100ug/l		VM0347
Styrene	<150ug/l	05	VM0347
m-Xylene and p-Xylene	890ug/l		VM0347
o-Xylene	320ug/l		VM0347
Other Compounds by EPA Method 8240			
Tetrahydrofuran	<150ug/l	05	VM0347
Compounds By EPA Method 8015			
Methanol	<1mg/l		PA1126
Ethanol	<1mg/l		PA1126
Isopropanol	1.3mg/l		PA1126
sec-Butanol	<1mg/l		PA1126

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC. 08325 SOLVENT RECOVERY SYSTEM SRS-100394-RW1 1415H 10/03/94 G
Sampled by: Client

APPROVAL: _____
QC: _PFF_
Lab I.D.: 10170

ULI I.D.: 28394085 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	Total Suspended Solids	180mg/l		WA5601
Total	Arsenic by furnace method	0.003mg/l		MA2358
Total	Cadmium	<0.005mg/l		MA2326
Total	Copper	<0.02mg/l		MA2326
Total	Iron	8.5mg/l		MA2326
Total	Lead by furnace method	0.003mg/l		MA2328
Total	Manganese	3.8mg/l		MA2326
Total	Nickel	<0.03mg/l		MA2326
Total	Zinc	0.06mg/l		MA2326
	TCL Volatiles by EPA Method 8240			
	Chloromethane	<600ug/l	05	VM0347
	Bromomethane	<600ug/l	05	VM0347
	Vinyl Chloride	700ug/l		VM0347
	Chloroethane	2800ug/l		VM0347
	Methylene Chloride	600ug/l		VM0347
	Acetone	3000ug/l		VM0347
	Carbon Disulfide	<600ug/l	05	VM0347
	1,1-Dichloroethene	<600ug/l	05	VM0347
	1,1-Dichloroethane	3100ug/l		VM0347
	trans-1,2-Dichloroethene	<600ug/l	05	VM0347
	cis-1,2-Dichloroethene	1900ug/l		VM0347
	Chloroform	<600ug/l	05	VM0347
	1,2-Dichloroethane	<600ug/l	05	VM0347
	2-Butanone	10,000ug/l		VM0347
	1,1,1-Trichloroethane	2500ug/l		VM0347
	Carbon Tetrachloride	<600ug/l	05	VM0347
	Bromodichloromethane	<600ug/l	05	VM0347
	1,2-Dichloropropane	<600ug/l	05	VM0347
	cis-1,3-Dichloropropene	<600ug/l	05	VM0347
	Trichloroethene	<600ug/l	05	VM0347
	Dibromochloromethane	<600ug/l	05	VM0347
	1,1,2-Trichloroethane	<600ug/l	05	VM0347
	Benzene	<600ug/l	05	VM0347
	trans-1,3-Dichloropropene	<600ug/l	05	VM0347
	Bromoform	<600ug/l	05	VM0347
	4-Methyl-2-pentanone	<2000ug/l	05	VM0347
	2-Hexanone	<2000ug/l	05	VM0347
	Tetrachloroethene	<600ug/l	05	VM0347
	1,1,2,2-Tetrachloroethane	<600ug/l	05	VM0347
	Toluene	10,000ug/l		VM0347
	Chlorobenzene	<600ug/l	05	VM0347

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC. 08325 SOLVENT RECOVERY SYSTEM SRS-100394-RW1 1415H 10/03/94 G
Sampled by: Client

APPROVAL:
QC: PFF
Lab I.D.: 10170

ULI I.D.: 28394085 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Ethylbenzene	1700ug/l		VM0347
Styrene	<600ug/l	05	VM0347
m-Xylene and p-Xylene	600ug/l		VM0347
o-Xylene	<600ug/l	05	VM0347
Other Compounds by EPA Method 8240			
Tetrahydrofuran	<600ug/l	05	VM0347
Compounds By EPA Method 8015			
Methanol	1.0mg/l		PA1126
Ethanol	<1mg/l		PA1126
Isopropanol	<1mg/l		PA1126
sec-Butanol	<1mg/l		PA1126

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC. 08325 SOLVENT RECOVERY SYSTEM SRS-100394-RW2 1830H 10/03/94 G
Sampled by: Client

APPROVAL: ___
QC: PFF
Lab I.D.: 10170

ULI I.D.: 28394086 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Total Suspended Solids	1200mg/l		WA5601
Total Arsenic by furnace method	0.007mg/l		MA2358
Total Cadmium	<0.005mg/l		MA2326
Total Copper	<0.02mg/l		MA2326
Total Iron	30mg/l		MA2326
Total Lead by furnace method	0.022mg/l		MA2328
Total Manganese	3.1mg/l		MA2326
Total Nickel	0.05mg/l		MA2326
Total Zinc	0.14mg/l		MA2326
TCL Volatiles by EPA Method 8240			
Chloromethane	<1500ug/l	05	VM0351
Bromomethane	<1500ug/l	05	VM0351
Vinyl Chloride	<1500ug/l	05	VM0351
Chloroethane	<1500ug/l	05	VM0351
Methylene Chloride	3000ug/l		VM0351
Acetone	27,000ug/l		VM0351
Carbon Disulfide	<1500ug/l	05	VM0351
1,1-Dichloroethene	<1500ug/l	05	VM0351
1,1-Dichloroethane	<1500ug/l	05	VM0351
trans-1,2-Dichloroethene	<1500ug/l	05	VM0351
cis-1,2-Dichloroethene	2700ug/l		VM0351
Chloroform	<1500ug/l	05	VM0351
1,2-Dichloroethane	<1500ug/l	05	VM0351
2-Butanone	24,000ug/l		VM0351
1,1,1-Trichloroethane	<1500ug/l	05	VM0351
Carbon Tetrachloride	<1500ug/l	05	VM0351
Bromodichloromethane	<1500ug/l	05	VM0351
1,2-Dichloropropane	<1500ug/l	05	VM0351
cis-1,3-Dichloropropene	<1500ug/l	05	VM0351
Trichloroethene	<1500ug/l	05	VM0351
Dibromochloromethane	<1500ug/l	05	VM0351
1,1,2-Trichloroethane	<1500ug/l	05	VM0351
Benzene	<1500ug/l	05	VM0351
trans-1,3-Dichloropropene	<1500ug/l	05	VM0351
Bromoform	<1500ug/l	05	VM0351
4-Methyl-2-pentanone	5200ug/l		VM0351
2-Hexanone	<5000ug/l	05	VM0351
Tetrachloroethene	<1500ug/l	05	VM0351
1,1,2,2-Tetrachloroethane	<1500ug/l	05	VM0351
Toluene	16,000ug/l		VM0351
Chlorobenzene	<1500ug/l	05	VM0351

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.
Sampled by: Client

APPROVAL: [signature]
QC: PEF
Lab I.D.: 10170

08325 SOLVENT
RECOVERY SYSTEM SRS-100394-RW2 1830H 10/03/94 G

ULI I.D.: 28394086 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Ethylbenzene	7500ug/l		VM0351
Styrene	<1500ug/l	05	VM0351
m-Xylene and p-Xylene	2000ug/l		VM0351
o-Xylene	<1500ug/l	05	VM0351
Other Compounds by EPA Method 8240			
Tetrahydrofuran	5500ug/l		VM0351
Compounds By EPA Method 8015			
Methanol	<1mg/l		PA1126
Ethanol	<1mg/l		PA1126
Isopropanol	56mg/l		PA1126
sec-Butanol	33mg/l		PA1126

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.
Sampled by: Client

APPROVAL:
QC: PFF
Lab I.D.: 10170

08325 SOLVENT
RECOVERY SYSTEM SRS-100594-RW5 1415H 10/05/94 G

ULI I.D.: 28394087 Matrix: Water

PARAMETERS		RESULTS	KEY	FILE#
	Total Suspended Solids	2400mg/l		WA5601
Total	Arsenic by furnace method	0.006mg/l		MA2358
Total	Cadmium	<0.005mg/l		MA2326
Total	Copper	0.06mg/l		MA2326
Total	Iron	49mg/l		MA2326
Total	Lead by furnace method	0.018mg/l		MA2328
Total	Manganese	1.7mg/l		MA2326
Total	Nickel	0.07mg/l		MA2326
Total	Zinc	0.19mg/l		MA2326

TCL Volatiles by EPA Method 8240

Chloromethane	<30ug/l	05	VM0351
Bromomethane	<30ug/l	05	VM0351
Vinyl Chloride	<30ug/l	05	VM0351
Chloroethane	<30ug/l	05	VM0351
Methylene Chloride	<30ug/l	05	VM0351
Acetone	<100ug/l	05	VM0351
Carbon Disulfide	<30ug/l	05	VM0351
1,1-Dichloroethene	<30ug/l	05	VM0351
1,1-Dichloroethane	<30ug/l	05	VM0351
trans-1,2-Dichloroethene	<30ug/l	05	VM0351
cis-1,2-Dichloroethene	720ug/l		VM0351
Chloroform	<30ug/l	05	VM0351
1,2-Dichloroethane	<30ug/l	05	VM0351
2-Butanone	<30ug/l	05	VM0351
1,1,1-Trichloroethane	<30ug/l	05	VM0351
Carbon Tetrachloride	<30ug/l	05	VM0351
Bromodichloromethane	<30ug/l	05	VM0351
1,2-Dichloropropane	<30ug/l	05	VM0351
cis-1,3-Dichloropropene	<30ug/l	05	VM0351
Trichloroethene	<30ug/l	05	VM0351
Dibromochloromethane	<30ug/l	05	VM0351
1,1,2-Trichloroethane	<30ug/l	05	VM0351
Benzene	<30ug/l	05	VM0351
trans-1,3-Dichloropropene	<30ug/l	05	VM0351
Bromoform	<30ug/l	05	VM0351
4-Methyl-2-pentanone	<100ug/l	05	VM0351
2-Hexanone	<100ug/l	05	VM0351
Tetrachloroethene	<30ug/l	05	VM0351
1,1,2,2-Tetrachloroethane	<30ug/l	05	VM0351
Toluene	170ug/l		VM0351
Chlorobenzene	<30ug/l	05	VM0351

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC. 08325 SOLVENT
Sampled by: Client RECOVERY SYSTEM SRS-100594-RW5 1415H 10/05/94 G

APPROVAL: [signature]
QC: PFF
Lab I.D.: 10170

ULI I.D.: 28394087 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Ethylbenzene	160ug/l		VM0351
Styrene	<30ug/l	05	VM0351
m-Xylene and p-Xylene	64ug/l		VM0351
o-Xylene	<30ug/l	05	VM0351
Other Compounds by EPA Method 8240			
Tetrahydrofuran	<30ug/l		VM0351
Compounds By EPA Method 8015			
Methanol	1.4mg/l		PA1126
Ethanol	<1mg/l		PA1126
Isopropanol	<1mg/l		PA1126
sec-Butanol	<1mg/l		PA1126

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC. 08325 SOLVENT RECOVERY SYSTEM SRS-100694-RW3 1700H 10/06/94 G
Sampled by: Client

APPROVAL: _____
QC: PFF
Lab I.D.: 10170

ULI I.D.: 28394088 Matrix: Water

	PARAMETERS	RESULTS	KEY	FILE#
	Total Suspended Solids	35mg/l		WA5601
Total	Arsenic by furnace method	0.002mg/l	28	MA2358
Total	Cadmium	<0.005mg/l		MA2326
Total	Copper	<0.02mg/l		MA2326
Total	Iron	0.57mg/l		MA2326
Total	Lead by furnace method	0.082mg/l		MA2328
Total	Manganese	<0.02mg/l		MA2326
Total	Nickel	<0.03mg/l		MA2326
Total	Zinc	0.06mg/l		MA2326
	TCL Volatiles by EPA Method 8240			
	Chloromethane	<600ug/l	05	VM0347
	Bromomethane	<600ug/l	05	VM0347
	Vinyl Chloride	<600ug/l	05	VM0347
	Chloroethane	<600ug/l	05	VM0347
	Methylene Chloride	600ug/l		VM0347
	Acetone	7000ug/l		VM0347
	Carbon Disulfide	<600ug/l	05	VM0347
	1,1-Dichloroethene	<600ug/l	05	VM0347
	1,1-Dichloroethane	<600ug/l	05	VM0347
	trans-1,2-Dichloroethene	<600ug/l	05	VM0347
	cis-1,2-Dichloroethene	2000ug/l		VM0347
	Chloroform	<600ug/l	05	VM0347
	1,2-Dichloroethane	<600ug/l	05	VM0347
	2-Butanone	5000ug/l		VM0347
	1,1,1-Trichloroethane	<600ug/l	05	VM0347
	Carbon Tetrachloride	<600ug/l	05	VM0347
	Bromodichloromethane	<600ug/l	05	VM0347
	1,2-Dichloropropane	<600ug/l	05	VM0347
	cis-1,3-Dichloropropene	<600ug/l	05	VM0347
	Trichloroethene	<600ug/l	05	VM0347
	Dibromochloromethane	<600ug/l	05	VM0347
	1,1,2-Trichloroethane	<600ug/l	05	VM0347
	Benzene	<600ug/l	05	VM0347
	trans-1,3-Dichloropropene	<600ug/l	05	VM0347
	Bromoform	<600ug/l	05	VM0347
	4-Methyl-2-pentanone	2600ug/l		VM0347
	2-Hexanone	<2000ug/l	05	VM0347
	Tetrachloroethene	<600ug/l	05	VM0347
	1,1,2,2-Tetrachloroethane	<600ug/l	05	VM0347
	Toluene	6400ug/l		VM0347
	Chlorobenzene	<600ug/l	05	VM0347

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.   08325 SOLVENT
RECOVERY SYSTEM SRS-100694-RW3 1700H 10/06/94 G
Sampled by: Client

APPROVAL: [signature]
QC: PFF
Lab I.D.: 10170

ULI I.D.: 28394088   Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Ethylbenzene	3200ug/l		VM0347
Styrene	<600ug/l	05	VM0347
m-Xylene and p-Xylene	1400ug/l		VM0347
o-Xylene	<600ug/l	05	VM0347
Other Compounds by EPA Method 8240			
Tetrahydrofuran	<600ug/l	05	VM0347
Compounds By EPA Method 8015			
Methanol	<1mg/l		PA1126
Ethanol	<1mg/l		PA1126
Isopropanol	11mg/l		PA1126
sec-Butanol	6.6mg/l		PA1126

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.
Sampled by: Client

APPROVAL: _ _
QC: PFF
Lab I.D.: 10170
SRSNE
SRS-101394-RW2-PT 0830H 10/13/94 G

ULI I.D.: 28794159 Matrix: Water

PARAMETERS		RESULTS	KEY	FILE#
	Total Suspended Solids	42mg/l		WA5658
Total	Arsenic by furnace method	0.004mg/l		MA2398
Total	Cadmium	<0.005mg/l		MA2354
Total	Copper	<0.02mg/l		MA2354
Total	Iron	29mg/l		MA2354
Total	Lead by furnace method	0.003mg/l		MA2408
Total	Manganese	5.6mg/l		MA2366
Total	Nickel	<0.03mg/l		MA2354
Total	Zinc	0.05mg/l		MA2354
TCL Volatiles by EPA Method 8240				
	Chloromethane	<1500ug/l	05	VM0388
	Bromomethane	<1500ug/l	05	VM0388
	Vinyl Chloride	<1500ug/l	05	VM0388
	Chloroethane	<1500ug/l	05	VM0388
	Methylene Chloride	2500ug/l		VM0388
	Acetone	36,000ug/l		VM0388
	Carbon Disulfide	<1500ug/l	05	VM0388
	1,1-Dichloroethene	<1500ug/l	05	VM0388
	1,1-Dichloroethane	<1500ug/l	05	VM0388
	trans-1,2-Dichloroethene	<1500ug/l	05	VM0388
	cis-1,2-Dichloroethene	2000ug/l		VM0388
	Chloroform	<1500ug/l	05	VM0388
	1,2-Dichloroethane	<1500ug/l	05	VM0388
	2-Butanone	40,000ug/l		VM0388
	1,1,1-Trichloroethane	<1500ug/l	05	VM0388
	Carbon Tetrachloride	<1500ug/l	05	VM0388
	Bromodichloromethane	<1500ug/l	05	VM0388
	1,2-Dichloropropane	<1500ug/l	05	VM0388
	cis-1,3-Dichloropropene	<1500ug/l	05	VM0388
	Trichloroethene	<1500ug/l	05	VM0388
	Dibromochloromethane	<1500ug/l	05	VM0388
	1,1,2-Trichloroethane	<1500ug/l	05	VM0388
	Benzene	<1500ug/l	05	VM0388
	trans-1,3-Dichloropropene	<1500ug/l	05	VM0388
	Bromoform	<1500ug/l	05	VM0388
	4-Methyl-2-pentanone	6000ug/l		VM0388
	2-Hexanone	<4500ug/l	05	VM0388
	Tetrachloroethene	<1500ug/l	05	VM0388
	1,1,2,2-Tetrachloroethane	<1500ug/l	05	VM0388
	Toluene	15,000ug/l		VM0388
	Chlorobenzene	<1500ug/l	05	VM0388

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.
Sampled by: Client

APPROVAL:
QC: PFF
Lab I.D.: 10170

SRSNE
SRS-101394-RW2-PT 0830H 10/13/94 G

ULI I.D.: 28794159 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Ethylbenzene	8500ug/l		VM0388
Styrene	<1500ug/l	05	VM0388
m-Xylene and p-Xylene	2500ug/l		VM0388
o-Xylene	<1500ug/l	05	VM0388
Other Compounds by EPA Method 8240			
Tetrahydrofuran	<1500ug/l	05	VM0388
Compounds By EPA Method 8015			
Methanol	<1mg/l		PA1126
Ethanol	<1mg/l		PA1126
Isopropanol	89mg/l		PA1126
sec-Butanol	57mg/l		PA1126

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC. SRSNE
Sampled by: Client ULI TRIP BLANK 10/13/94

APPROVAL: [signature]
QC: PFF
Lab I.D.: 10170

ULI I.D.: 28794160 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
TCL Volatiles by EPA Method 8240			
Chloromethane	<3ug/l		VM0388
Bromomethane	<3ug/l		VM0388
Vinyl Chloride	<3ug/l		VM0388
Chloroethane	<3ug/l		VM0388
Methylene Chloride	3ug/l	44	VM0388
Acetone	<10ug/l		VM0388
Carbon Disulfide	<3ug/l		VM0388
1,1-Dichloroethene	<3ug/l		VM0388
1,1-Dichloroethane	<3ug/l		VM0388
trans-1,2-Dichloroethene	<3ug/l		VM0388
cis-1,2-Dichloroethene	<3ug/l		VM0388
Chloroform	<3ug/l		VM0388
1,2-Dichloroethane	<3ug/l		VM0388
2-Butanone	<10ug/l		VM0388
1,1,1-Trichloroethane	<3ug/l		VM0388
Carbon Tetrachloride	<3ug/l		VM0388
Bromodichloromethane	<3ug/l		VM0388
1,2-Dichloropropane	<3ug/l		VM0388
cis-1,3-Dichloropropene	<3ug/l		VM0388
Trichloroethene	<3ug/l		VM0388
Dibromochloromethane	<3ug/l		VM0388
1,1,2-Trichloroethane	<3ug/l		VM0388
Benzene	<3ug/l		VM0388
trans-1,3-Dichloropropene	<3ug/l		VM0388
Bromoform	<3ug/l		VM0388
4-Methyl-2-pentanone	<10ug/l		VM0388
2-Hexanone	<10ug/l		VM0388
Tetrachloroethene	<3ug/l		VM0388
1,1,2,2-Tetrachloroethane	<3ug/l		VM0388
Toluene	<3ug/l		VM0388
Chlorobenzene	<3ug/l		VM0388
Ethylbenzene	<3ug/l		VM0388
Styrene	<3ug/l		VM0388
m-Xylene and p-Xylene	<3ug/l		VM0388
o-Xylene	<3ug/l		VM0388
Other Compounds by EPA Method 8240			
Tetrahydrofuran	<3ug/l		VM0388

DATE: 11/08/94

Upstate Laboratories, Inc. APPROVAL: [signature]
Analysis Results QC: PFF
Report Number: 28394084 Lab I.D.: 10170
Client I.D.: BLASLAND, BOUCK & LEE, INC. 083.25.01 SRS
Sampled by: Client NORTHEAST SITE FEED 10/31/94 G

ULI I.D.: 30494101 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Total Iron	8.7mg/l		MA2402

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.
Sampled by: Client

APPROVAL:
QC: PFF
Lab I.D.: 10170

083.25.01 SRS
NORTHEAST SITE LAMELLA EFF 10/31/94 G

ULI I.D.: 30494102 Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Total Iron	1.1mg/l		MA2402

DATE: 11/08/94

Upstate Laboratories, Inc.
Analysis Results
Report Number: 28394084
Client I.D.: BLASLAND, BOUCK & LEE, INC.
Sampled by: Client

APPROVAL: [signature]
QC: PFF
Lab I.D.: 10170
083.25.01 SRS
NORTHEAST SITE DYNASAND EFF 10/31/94 G

ULI I.D.: 30494103

Matrix: Water

PARAMETERS	RESULTS	KEY	FILE#
Total Iron	0.93mg/l		MA2402

KEY PAGE

1 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS
2 MATRIX INTERFERENCE
3 PRESENT IN BLANK
4 ANALYSIS NOT PERFORMED BECAUSE OF INSUFFICIENT SAMPLE
5 THE PRESENCE OF OTHER TARGET ANALYTE(S) PRECLUDES LOWER DETECTION LIMITS
6 BLANK CORRECTED
7 HEAD SPACE PRESENT IN SAMPLE
8 BDL(BELOW DETECTION LIMITS)
9 MDL(METHOD DETECTION LIMITS)
10 ADL(AVERAGE DETECTION LIMITS)
11 PQL(PRACTICAL QUANTITATION LIMIT)
12 SAMPLE ANALYZED OVER HOLDING TIME
13 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL DUE TO CONTAMINATION FROM THE FILTERING PROCEDURE
14 SAMPLED BY ULI
15 DISSOLVED VALUE MAY BE HIGHER THAN TOTAL; HOWEVER, THE VALUES ARE WITHIN EXPERIMENTAL ERROR
16 SUBCONTRACTED
17 PARAMETER NOT ANALYZED WITHIN 15 MINUTES OF SAMPLING
18 DEPENDING UPON THE INTENDED USE OF THIS TEST RESULT, CONFIRMATION BY GC/MS OR DUAL COLUMN CHROMATOGRAPHY MAY BE REQUIRED
19 CALCULATION BASED ON DRY WEIGHT
20 INDICATES AN ESTIMATED VALUE, DETECTED BUT BELOW THE PRACTICAL QUANTITATION LIMIT
21 UG/KG AS REC.D / UG/KG DRY WT
22 MG/KG AS REC.D / MG/KG DRY WT
23 INSUFFICIENT SAMPLE PRECLUDES LOWER DETECTION LIMITS
24 SAMPLE DILUTED/BLANK CORRECTED
25 ND(NON-DETECTED)
26 MATRIX INTERFERENCE PRECLUDES LOWER DETECTION LIMITS/BLANK CORRECTED
27 SPIKE RECOVERY ABNORMALLY HIGH/LOW DUE TO MATRIX INTERFERENCE
28 POST-DIGESTION SPIKE FOR FURNACE AA ANALYSIS IS OUTSIDE OF THE CONTROL LIMITS (85-115%); HOWEVER, THE SAMPLE CONCENTRATION IS BELOW THE PQL
29 ANALYZED BY METHOD OF STANDARD ADDITIONS
30 METHOD PERFORMANCE STUDY HAS NOT BEEN COMPLETED/ND(NON-DETECTED)
31 FIELD MEASURED PARAMETER TAKEN BY CLIENT
32 TARGET ANALYTE IS BIODEGRADED AND/OR ENVIRONMENTALLY WEATHERED
33 NON-POTABLE WATER SOURCE
34 INDIVIDUAL AROCLORS DO NOT CARRY A DETECTION LIMIT BUT ARE INCLUSIVE TO THE TOTAL PCB CONTENT
35 THE HYDROCARBONS DETECTED IN THE SAMPLE DID NOT CROSS-MATCH WITH COMMON PETROLEUM DISTILLATES
36 MATRIX INTERFERENCE CAUSING SPIKES TO RESULT IN LESS THAN 50.0% RECOVERY
37 MILLIGRAMS PER LITER (MG/L) / POUNDS (LBS) PER DAY
38 MILLIGRAMS PER LITER (MG/L) OF RESIDUAL CHLORINE (CL2) / POUNDS (LBS) PER DAY OF CL2
39 MICROGRAMS PER LITER (UG/L) / POUNDS (LBS) PER DAY
40 MILLIGRAMS PER LITER (MG/L) LINEAR ALKYL SULFONATE (LAS) / POUNDS (LBS) PER DAY LAS
41 RESULTS ARE REPORTED ON AN AS REC.D BASIS
42 THE SAMPLE WAS ANALYZED ON A TOTAL BASIS; THE TEST RESULT CAN BE COMPARED TO THE TCLP REGULATORY CRITERIA BY DIVIDING THE TEST RESULT BY 20, CREATING A THEORETICAL TCLP VALUE
43 METAL BY CONCENTRATION PROCEDURE
44 POSSIBLE CONTAMINATION FROM FIELD/LABORATORY

Upstate Laboratories inc.

Shipping: 6034 Corporate Drive • East Syracuse, New York 13057 • (315) 437-0255
Mailing: Box 289 • Syracuse, New York 13206
Southern Region (607) 724-0478
Western Region (716) 436-9070
Eastern Region (518) 459-3134
N. Jersey Region (201) 703-1324

INFORMATION REGARDING YOUR CHAIN OF CUSTODY RECORD

Any information on the Chain of Custody Record that appears in parentheses may be information that did not originally appear, and was later added by ULI personnel.

Please let one of our Environmental Project Coordinators (EPC) know if we could provide you with a typed Chain of Custody Record for this or any of our projects. This typed Chain of Custody Record may facilitate a faster turnaround time of your project through our laboratory.

Thank you.

BLASLAND & BOUCK ENGINEERS, P.C.
6723 Towpath Road, Box 66
Syracuse, New York 13214-0066 (315) 446-9120
FAX: (315) 449-0017

30494101-103

Rush
24 Hr. Turnaround 11/1 HDD
(Set up with Pete Fricano)

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME
083.25.04	SRS Northeast Site

LAB ID	CUSTODY TAPE NUMBER	DATE	TIME	COMP.	GRAB	SAMPLE TYPE: SOLID	SAMPLE TYPE: WIPE	SAMPLE TYPE: WATER	NO. OF CONTAINERS	Total Iron (ICP)					REMARKS
Feed		10/31/94	—		X			X	1	✓					Acidify Upon Receipt (if not already)
Lamella Effluent		↓	—		X			X	1	✓					↓
DynaSand Effluent		↓	—		X			X	1	✓					↓

SAMPLED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
Parkson Corp.		Don Sauda	Don Sauda	10/31/94 3:00 pm	Wayne DeCarr

RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
Wayne DeCarr	10/31/94 1640				

RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED FOR LABORATORY BY: (SIGNATURE)	DATE/TIME	REMARKS
		C. Nufjdek	10/31/94 1640	Fax Results To Don Sauda @ 445-9161

Upstate Laboratories, Inc.
6034 Corporate Drive E. Syracuse New York 13057
(315) 437 0255 Fax 437 1209

Chain Of Custody Record

Client:		Project # / Project Name	
Blasland Bouck & Lee Inc.		SRSNE	
Client Contact: DON SAUDA ~~Mike Gefell~~	Phone # 315-446-9120	Location (city/state) Address: Southington, CT	

Sample ID	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
SRS-101394-RW2-PT	10-13-94	0830	Aqueous	Grab	28704159	6	1	1	2	2							
(ULI TRIP BLANK) (CN)	(10/13/94)		WATER		160	1			(x)								
STOGGLES																	

parameter and method	sample bottle: type	size	pres.
1) TSS (METHOD 160.2) All GATERATE FED OR ON	PLASTIC	250ml	NONE
2) ICP METALS: CU, FE, ~~PB~~, MN, NI, ZN, CD (METHOD 200.7) *	PLASTIC	500ml	HNO3
3) EPA 8240 (MEK, MIBK, ACETONE, STYRENE, TETRAHYDROFURAN) **	GLASS	40ml	1:1HCL
4) EPA 8015 (METHANOL, ETHANOL, ISOPROPANOL, SEC-BUTANOL)	GLASS	40ml	1:1HCL
5)			
6)			
7) * + PB BY METHOD 239.2, AS BY METHOD			
8) 206.2			
9) ** FULL SCAN INCLUDING THESE COMPOUNDS			
10) AND cis- and trans-1,2-DICHLOROETHENE			

Note: The numbered columns above cross reference with the numbered columns in the upper right hand corner.

Sampled by: (Print) Brian W Lovgren (BB&L)

Company:

Name of Courier (if used)

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
[signature]	10-13-94	0900	[signature]
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
[signature]	10/14/94	1620	
Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
	10/14/94	1620	[signature]

ost I bor ori I

6034 Corporate Drive E. Syracuse New York 13057

(315) 437 0255 Fax 437 1209

Chain Of Custody Record

11 '11

Client:	Phone #	Project # / Project Name			
Blasland Bouck + Lee Inc		08325 Solvent Recovery Service (SRS)			
Client Contact: Don Sanda [redacted]	315-446-9120	Location (city/state) Address: Southington, CT 06489			

Sample ID	Date	Time	Matrix	Grab or Comp.	ULI Internal Use Only	No. of Containers	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	Remarks
SRS-092994-RW4	9-29-94	1910	Aqueous	Grab	28394084	6	1	1	2	2							
SRS-100394-RW1	10-3-94	1415	Aqueous	Grab	85	5	1	1	2	1							
SRS-100394-RW2	10-3-94	1830	Aqueous	Grab	86	6	1	1	2	2							
SRS-100594-RW5	10-5-94	1415	Aqueous	Grab	87	6	1	1	2	2							
SRS-100694-RW3	10-6-94	1700	Aqueous	Grab	88	6	1	1	2	2							

parameter and method (sample bottle:)	type	size	pres.
1) TSS (Method 160.2)	PLASTIC	250ml	NONE
2) ICP METALS: CU,FE,CD,MN,NI,ZN (Method 200.7) *	PLASTIC	500ml	HNO3
3) EPA 8240 (MEK,MIBK,ACETONE,STYRENE,TETRAHYDROFURAN) **	GLASS	40ml	1:1HCL
4) EPA 8005 (METHANOL,ETHANOL,ISOPROPANOL,SEC-BUTANOL)	GLASS	40ml	1:1HCL
5) :			
6)			
7) * plus PB* by 239.2, AG* by 206.2			
8) :			
9) ** Full Scan including these compounds and			
10) cis + trans - 1,2 - Dichloroethene			

Note: The numbered columns above cross reference with the numbered columns in the upper right hand corner.

Sampled by:(Print) Brian Lovgren

Company: Blasland Bouck + Lee Inc

Name of Courier (If used)

Relinquished by: (Signature)	Date	Time	Received by: (Signature)
[signature]	10-6-94	1830	[signature]
Relinquished by: (Signature)	Date	Time	Received by: (Signature)
[signature]	10-11-94	1445	
Relinquished by: (Signature)	Date	Time	Rec'd for Lab by: (Signature)
	10/11/94	0945	[signature]

PARKSON CORPORATION

M E M O R A N D U M

TO: Mr. Donald Sauda
Blasland, Bouck & Lee
6723 Towpath Road
Box 66
Syracuse, NY 13214

FROM: Miguel Gutierrez, Applications Manager

DATE: November 4, 1994

RE: Lab Test Summary for Blasland, Bouck & Lee
for the Lamella® Gravity Settler and DynaSand® Filter

CC: PPS, MAG, BJH, MGS, File: English Project .

Thomas English & Associates

Enclosed you will find our Laboratory Summary for the test work conducted on the recently submitted samples.

The received sample contained 831 ppm suspended solids at a pH of 7.77.

The best results were obtained with the addition of pH adjustment, sludge recycle, followed with 1.0 ppm of a non-ionic polymer followed by one minute of flocculation. The test indicated that an effluent containing less than 20 ppm suspended solids can be produced from the Lamella® Gravity Settler.

Also enclosed you will find a drawing depicting the recommended equipment for this application. At a flow rate of GPM and a loading rate of 0.32 GPM/sq.ft., the suggested equipment is **one Model LGS-570/55 with a size "C" flash-mixer/ flocculator.**

Should there be additional questions regarding the recommendations, feel free to contact **Mike Schill.** If there are questions concerning the test work, materials of construction, etc., please contact me.

Enclosures as noted

LAMELLA® GRAVITY SETTLER

Date Tested: 10/30/94 Customer Sample Number: 9803

LABORATORY SETTLING TEST SUMMARY
for the
LAMELLA GRAVITY SETTLER/THICKENER (LGST)

For: Blasland, Bouck & Lee, Syracuse, N. Y.

Application: GROUND WATER (METAL HYDROXIDE - IRON)

FEED AS RECEIVED:
Suspended Solids: 831.00 PPM pH: 7.77

FEED PRETREATMENT:

Chemicals Used:	ppm
SODIUM HYDROXIDE	40
SLUDGE RECYCLE	6329

New Suspended Solids Level: 7160.00 ppm
New pH: 9.00
Temperature: Ambient

FLOCCULATING AIDS:

Manufacturer	Polymer	Dosage ppm	Flash sec	Flocc. min
AMERICAN C	MAGNIFLOC 1906N	1.00	10	1

OUR RECOMMENDATIONS:

Based on a maximum feed rate of 150 GPM, we recommend the use of: 1 Model 570/55 LGS / 1 Model 620/55 LGST. Each unit has 456 sq.ft. (LGS) / 496 sq.ft. (LGST) of clarification area and 114 sq.ft. (LGS) / 124 sq.ft. (LGST) of thickening area. At the maximum feed rate, the surface loading rate is 0.32 GPM/sq.ft. (LGS)/ 0.30 GPM/sq.ft. (LGST). At this loading rate, the unit will produce an effluent containing less than 20 ppm suspended solids and an underflow containing at least .5 - 1 %(LGS)/1 TO 2 %(LGST) suspended solids, if attainable in static settling tests.

Date Tested: 10/30/94 Customer Sample Number: 9803

COMMENTS:

The sample received for testing was pH adjusted with sodium hydroxide to pH 9.0 for metals precipitation. Bench top flocculation was performed to determine if anionic, cationic or nonionic polymer would work best. The nonionic polymer produced the best flocculation and fastest solids settling rate. When sludge recycle was used, the effluent clarity was greatly improved.

REPORTED BY: Barbara J. Hill, Laboratory Manager BJH

REPORT DATE: 10/27/94

BJH:gjp

PARKSON CORPORATION

LABORATORY SUMMARY

DYNASAND® FILTER

Date Tested: 10/26/94 Customer Sample Number: 9803C

For: Blasland, Bouck & Lee , Syracuse, N. Y.

Application: GROUND WATER (METAL HYDROXIDE - IRON)
LAMELLA EFFLUENT

FEED AS RECEIVED:
Suspended Solids: 36.00 PPM pH: 9.00

OUR RECOMMENDATIONS:

Flow Rate	Qty Units	Model	Loading Rate	Effluent S. S. ppm	Units
150	1	DSF-38	3.94	15 TO 20	

COMMENTS:
A simulated Lamella effluent was filtered through the regular laboratory sand filter column at a loading rate of 3.94 gpm/ft.sq. The sand used was 1.3 - 1.4 mm effective size. No additional chemical pretreatment was used.

REPORTED BY: Barbara J. Hill, Laboratory Manager

REPORT DATE: 10/27/94

2727 N.W. 62nd Street
P.O. Box 408399
Fort Lauderdale, Florida 33340-8399
Telephone: 305 974-6610
FAX: 305 974-6182

Appendix D

Draft Substantative Requirements for Pretreated Ground-Water Discharge to Quinnipiac River from Connecticut Department of Environmental Protection

STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

SUBSTANTIVE REQUIREMENTS

I. The Substantive Requirements presented in this document specifically allow XXXXXXXXXXXXXX to discharge 43,200 gallons per day of pretreated groundwater from a recovery system located at 114 Lazy Lane, Southington, CT to the Quinnipiac River.

II. The Substantive Requirements presented in this document shall become effective on the date they are issued, and may be revised to reflect actual treatment performance upon receipt and review of effluent analytical data.

III. The Substantive Requirements presented in this document are based upon the following information:

A) Analysis results from previous groundwater pretreatment system located at 114 Lazy Lane, Southington, CT.

B) Treatment system plans and specifications submitted by XXXX and received by the Department on XXX.

C) Spill control plan submitted by XXXX and received by the Department on XXX.

IV. A. SPECIAL CONDITIONS

1) DISCHARGE LIMITS: The discharge shall not exceed at any time and shall otherwise conform to the following conditions and limitations and shall be monitored in accordance with the sampling frequency listed in sections IV.A.3)(a) and (b).

(a) pH

For discharges to a surface water. The pH of the discharge shall not be less than 6.0 or greater than 9.0 at any time, unless the discharge is into the same water body from which the test water is drawn, and the pH of the source water is less than 6.0 or greater than 9.0, in which case the pH of the discharge shall be no more than 0.5 standard pH units greater or less than the source water.

(b) Monitoring Site No. 001-A (Pretreatment influent)

Pollutant Parameters	Sample Type
1,2 Dichloroethane	Grab
1,1,1 Trichloroethane	Grab
1,1,2 Trichloroethane	Grab
1,1 Dichloroethylene	Grab
1,2 Dichloroethylene	Grab
Ethyl Benzene	Grab
Methylene Chloride	Grab
Tetrachloroethylene	Grab
Toluene	Grab
Trichloroethylene	Grab
Methyl Ethyl Ketone	Grab
Methanol	Grab
Ethanol	Grab
Acetone	Grab
Styrene	Grab
Methyl Isobutyl Ketone	Grab
Xylenes	Grab
Isopropanol	Grab
Sec-Butanol	Grab
Tetrahydrofuran	Grab
Iron-Total	Grab
Copper-Total	Grab
Lead-Total	Grab
Nickel-Total	Grab
Zinc-Total	Grab

(c) Discharge Serial No. 001-1 (Pretreated groundwater effluent)
Maximum Daily Flow - 43,200 gallons per day

Pollutant Parameters	Limits	Sample Type
pH	See paragraph IV.A.1)(a)	Instantaneous
1,2 Dichloroethane	0.25 mg/l	Grab
1,1,1 Trichloroethane*	4.0 mg/l	Grab
1,1,2 Trichloroethane	0.25 mg/l	Grab
1,1 Dichloroethylene*	0.275 mg/l	Grab
1,2 Dichloroethylene*	5.0 mg/l	Grab
Ethyl Benzene*	1.0 mg/l	Grab
Methylene Chloride	15.0 mg/l	Grab
Tetrachloroethylene*	0.489 mg/l	Grab
Toluene*	4.0 mg/l	Grab
Trichloroethylene*	3.0 mg/l	Grab
Methyl Ethyl Ketone	10.0 mg/l	Grab
Methanol	30.0 mg/l	Grab
Ethanol	20.0 mg/l	Grab
Acetone	35.0 mg/l	Grab

DRAFT

Styrene	0.5 mg/l	Grab
Methyl Isobutyl Ketone	2.0 mg/l	Grab
Xylenes	0.5 mg/l	Grab
Isopropanol	10.0 mg/l	Grab
Sec-Butanol	10.0 mg/l	Grab
Tetrahydrofuran	0.5 mg/l	Grab
Iron-Total	5.0 mg/l	Grab
Copper-Total	0.133 mg/l	Grab
Lead-Total	0.029 mg/l	Grab
Nickel-Total	0.50 mg/l	Grab
Zinc-Total	0.342 mg/l	Grab
Total Suspended Solids	30.0 mg/l	Grab
Peroxide	6.0 mg/l	Grab
PCB(s), Total	See paragraph IV.A.1)(d) below	Grab
Dioxins	See paragraph IV.A.1)(e) below	Grab
Furans	See paragraph IV.A.1)(e) below	Grab
Acute Toxicity	See paragraph IV.A.1)(f) below	
Chronic Toxicity	See paragraph IV.A.1)(g) below	

*** : Limit for chemical parameters will be reevaluated, and may be revised, when analytical data from actual discharge is obtained and reviewed by the Department.**

(d) The analytical method used to determine the concentration of total PCB(s) shall be EPA Method 608.

(e) The analytical method used to determine the concentration of Dioxins and Furans shall be EPA Method 1613 : all isomers of Dioxins and Furans by Isotope Dilution HRGC/HRMS.

(f) A Grab sample of Discharge Serial No. 001-1 (pretreated groundwater effluent) shall not exhibit acute toxicity in the receiving waterbody.

(1) Dilution equivalent to 14,811 gallons per hour (gph) is allocated to a zone of influence for assimilation of toxicity. This allocation shall be used to calculate the instream waste concentration (IWC) according to the formula:

$$IWC = \frac{\text{average daily flow}}{\text{(average daily flow + allocated zone of influence flow)}} \times 100$$

(2) Acute toxicity is demonstrated, and the Substantive Requirements presented in this document are violated when the LC_{50} value for the effluent is less than three (3) times the IWC.

DRAFT

(3) Monitoring to determine compliance with this limit shall be performed quarterly (January, April, July, October) following the toxicity testing protocol for static acute toxicity tests in "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms: (EPA 600/4-85/013) with the following specifications:

(i) Neonatal _Daphnia pulex_ (less than 24 hours old) and juvenile _Pimephales promelas_ (30 +/- 5 days old) shall be used as test organisms.

(ii) Synthetic freshwater prepared as described in EPA 600/4-85/013 and adjusted to a hardness of 50 +/-5 mg/l as $CaCo_3$ shall be used as dilution water in the tests.

(iii) Test duration shall be 48 hours for _Daphnia pulex_ and 96 hours for _Pimephales promelas_

(g) A Grab sample of Discharge Serial No. 001-1 (pretreated groundwater effluent) shall not exhibit chronic toxicity in the receiving waterbody.

(1) Dilution equivalent to 14,811 gallons per hour (gph) is allocated to a zone of influence for assimilation of toxicity. This allocation shall be used to calculate the instream waste concentration (IWC) according to the formula:

$$IWC = \frac{\text{average daily flow}}{(\text{average daily flow + allocated zone of influence flow})} \times 100$$

(2) Chronic toxicity is demonstrated, and the Substantive Requirements presented in this document are violated when the LC_{50} value for effluent is less than twenty (20) times the IWC.

(3) Monitoring to determine compliance with this limit shall be performed quarterly (January, April, July, October) following the toxicity testing protocol for static acute toxicity tests in "Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms: (EPA 600/4-85/013) with the following specifications:

(i) Neonatal _Daphnia pulex_ (less than 24 hours old) and juvenile _Pimephales promelas_ (30 +/- 5 days old) shall be used as test organisms.

(ii) Synthetic freshwater prepared as described in EPA 600/4-85/013 and adjusted to a hardness of 50 +/-5 mg/l as $CaCo_3$ shall be used as dilution water in the tests.

(iii) Test duration shall be 48 hours for _Daphnia pulex_ and 96 hours for _Pimephales promelas_

DRAFT

(4) In determining LC_{50} values, five (5) test concentrations, in duplicate, shall be utilized.

(5) The LC_{50} value shall be determined by the computational method (Binomial Distribution, Probit Analysis, Moving Average Angle, Spearman-Karber) which yields the smallest 95% confidence interval and LC_{50} value which is consistent with the dose-response data.

(6) Any test in which the survival of test organisms is less than ninety (90) percent in each replicate control test chamber or failure to achieve test conditions as specified in Section 22a-430-3(j)(7)(A) of the Regulations of Connecticut State Agencies, such as maintenance of appropriate environmental controls, constitutes an invalid test and the WMB shall immediately retest using the procedures described herein. Failure to submit suitable valid test results constitutes a violation.

(7) Results of the toxicity tests required as part of this condition shall be entered on the Discharge Monitoring Report (DMR) for the month in which it was performed, using the appropriate parameter code. Additionally, complete and accurate test data, including all supporting chemical/physical measurements performed in association with the toxicity tests, as well as dose/response data shall be entered on the Aquatic Toxicity Monitoring Report form (ATMR). Analytical results for the following parameters shall be included in these reports: pH, copper, hydrogen peroxide, lead, nickel, zinc, iron, total suspended solids, sulfate, ammonia, oil and grease, methyl tertiary butyl ether, dibromoethane, MBAS, EPA 601 and 602 compounds, benzene, toluene, ethylbenzene, xylene, and vinyl chloride. The ATMR shall be sent to the following address:

Lee Dunbar
Water Toxics Program
Connecticut Department of Environmental Protection
Water Management Bureau (WMB)
79 Elm Street
Hartford, CT 06106-5127

(8) If any test result indicates that the maximum daily toxicity limit for the effluent has been exceeded, a second sample of the effluent shall be collected and tested as described above and the results reported to the Commissioner within 30 days of the receipt of the first set of test results.

(9) If any two consecutive test results or any three test results in a single year indicate that the maximum daily toxicity limit has been exceeded, the XXX shall immediately take steps to eliminate toxicity wherever possible and shall submit a report for the review and approval of the

DRAFT

Commissioner in accordance with Section 22a-430-3(j)(10)(c) of the Regulations of Connecticut State Agencies describing proposed steps to eliminate the toxicity impact of the discharge on the receiving waterbody. Such report shall include a proposed time schedule to accomplish toxicity reduction and the XXX shall comply with any schedule approved in writing by the Commissioner.

(h) Flow

For discharges to a surface water. The discharge shall not exceed: 1) In the case of flowing surface waters, the maximum instantaneous flow shall not exceed 30 gallons per minute.

(i) Temperature

For discharges to a surface water. The temperature of the discharge shall not increase the temperature of the receiving stream above 85°F for freshwaters, and 83°F for marine waters, nor shall the discharge raise the temperature of the receiving stream more than 4°F at any time, except for marine waters during the months of July, August and September, during which time the discharge shall not raise the temperature of the receiving waters more than 1.5°F.

(j) Appearance

Discharges of water shall not contain a visible oil sheen, visible discoloration, or foaming, floating solids, or cause any such condition in the receiving water body.

2) DISCHARGE CONDITIONS: The following conditions shall be met:

(a) Any water shall be discharged to a surface water body, either directly or via a storm sewer, or to the sanitary sewer. If discharge is to a storm sewer, the surface water body to which the storm sewer discharges must be identified. If discharge is to a surface water body, directly or via a storm sewer, the Water Quality Classification of the water body must be identified. **Discharge to the ground surface, or to groundwater, either directly or via a storm sewer, is NOT allowed without prior written approval from the Commissioner.**

(b) The discharge shall not contain pollutants in excess of the levels indicated in part IV.A.1)(c). The treatment systems shall be maintained as necessary to ensure that the listed limitations are met.

(c) All lagoons, inlet and outlet structures, gates, valves, motors, pumps, and controls shall be designed and constructed to minimize short-circuiting of flow, vandalism and tampering.

DRAFT

(d) Erosion and sediment controls shall be utilized when necessary. These controls must comply with the standards set forth in the "Connecticut Guidelines for Soil Erosion and Sediment Control" (guidelines) as amended, available from the Connecticut Council on Water and Soil Conservation.

(e) Stabilization practices shall be implemented to ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized. Stabilization practices may include but not be limited to: temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, preservation of mature vegetation, and other vegetative and non-structural measures as may be identified by the guidelines. Where construction activities have permanently ceased or have temporarily been suspended for more than thirty days, or when final grades are reached in any portion of the site, stabilization practices shall be implemented within seven days.

(f) Structural practices must be implemented to divert flows away from exposed soils, store flows or otherwise limit runoff and the discharge of pollutants from the site. Such practices include but may not be limited to silt fences, earth dikes, drainage swales, sediment traps, check dams, subsurface drains, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retained systems, gabions, and temporary or permanent sediment basins. Unless otherwise specifically approved in writing, structural measures shall be installed on upland soils.

(g) Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel as necessary to provide a non-erosive velocity flow from the structure to a watercourse so that the natural physical and biological characteristics and functions are maintained and protected (e.g., maintenance of hydrologic conditions, such as the hydrodynamics present prior to the initiation of construction activities).

(h) Best Management Practices shall be implemented to ensure that no litter, debris, building materials, or similar materials are discharged to the waters of the state.

(i) Off-site vehicle tracking of sediments and the generation of dust shall be minimized.

3) MONITORING AND TREATMENT SCHEDULE: Monitoring and treatment shall be as indicated below.

(a) Sampling Frequency: The following parameters shall be monitored in accordance with the sampling frequency listed below.

Parameter	Sampling Frequency
Peroxide	Weekly
PCBs	Monthly
Dioxins	Quarterly
Furans	Quarterly
Acute Toxicity	See paragraph IV.A.1)(f)
Acute Toxicity	See paragraph IV.A.1)(g)

(b) It should be noted that for the initiation period, which consists of the time period between date of issuance and sixty days following issuance, monitoring for the parameters listed in sections IV.A.1)(b) and IV.A.1)(c), except those listed in section IV.A.3)(a), is required "Weekly", after the initiation period has expired, monitoring for these parameters is required "Twice per Month".

(c) Treatment shall consist of all treatment facilities described in XXXXXXXX documents prepared for the DEP dated XXXXXXXXXXXX.

(d) Flow Monitoring
A flow meter capable of indicating instantaneous flow and recording total daily flow shall be used continuously, during all periods of discharge, to determine flow rate.

(e) pH Monitoring
A pH meter capable of indicating and recording effluent pH shall be used continuously, during all periods of discharge, to determine pH.

(f) Monitoring Location
All wastewater samples shall be composed solely of the discharges authorized by the Substantive Requirements presented in this document, prior to combination with wastewaters of any other type or with the receiving waters. All samples shall be representative of the discharges during standard operating conditions.

(g) All sample analyses which are required by the Substantive Requirements presented in this document, and all reporting of such analyses, shall be done by a laboratory certified by the Connecticut Department of Health Services. Chemical analysis shall be performed using methods approved in accordance with 40 CFR 136 or alternative methods approved by the Commissioner which are capable of achieving limits of detection below the level established as an effluent limitation in paragraph IV.A.1)(c) of this document.

4) REPORTING REQUIREMENTS:

(a) Monitoring results shall be entered on the attached form(s) (or a copy of them) and submitted monthly for the previous month of sampling events to the following address:

*Attention: DMR Processing
Bureau of Water Management, PERD
CT Department of Environmental Protection
79 Elm Street
Hartford, CT. 06106-5127

(b) The permittee shall submit to the Commissioner monthly reports of the results of all monitoring performed in accordance with the Substantive Requirements presented in this document.

(c) If a violation of any of the discharge limits included in this document occurs **THE DISCHARGE MUST BE STOPPED IMMEDIATELY**, and written notification must be sent to the DEP/BWM/CPU within twenty-four hours. In this situation the discharge shall not be re-started without prior approval of the Commissioner.

(d) The discharger shall notify the DEP/BWM/CPU in writing of the date of final discontinuance of the discharge.

5) The Substantive Requirements presented in this document shall be non-transferrable.

6) The discharger shall comply with the following Regulations of Connecticut State Agencies which are hereby incorporated into this document, as if fully set forth herein:

(a) Section 22a-430-3:

Subsection (b) General - subparagraph (1)(D) and subdivisions (2), (3), (4) and (5)
Subsection (c) Inspection and Entry
Subsection (d) Effect of a Permit - subdivisions (1) and (4)
Subsection (e) Duty to Comply
Subsection (f) Proper Operation and Maintenance
Subsection (g) Sludge Disposal
Subsection (h) Duty to Mitigate
Subsection (i) Facility Modifications, Notification - subdivisions (1) and (4)
Subsection (j) Monitoring, Records and Reporting Requirements - subdivisions (1), (6), (7), (8), (9) and (11) (except subparagraphs (9)(A)(2), and (9)(C))
Subsection (k) Bypass
Subsection (m) Effluent Limitation Violations
Subsection (n) Enforcement
Subsection (o) Resource Conservation
Subsection (p) Spill Prevention and Control
Subsection (q) Instrumentation, Alarms, Flow Recorders
Subsection (r) Equalization

DRAFT

(b) Section 22a-430-4:

Subsection (t) - Prohibitions
Subsection (p) - Revocation, Denial, Modification
Appendices

7) The following additional terms and conditions shall be complied with:

(a) Substantive Requirements presented in this document are for the discharge of (A) pollutants in quantities and concentrations as specified herein; and (B) any substances resulting from the processes or activities described herein, in concentrations and quantities which the Commissioner determines cannot reasonably be expected to cause pollution and will not adversely affect the operation of a POTW. However, the Commissioner may seek an injunction or issue an order to prevent or abate pollution, and may seek criminal penalties against a person who willfully or with criminal negligence causes or threatens pollution.

(b) Discharge of any substance which is not from the processes or activities described in this document shall be considered a violation of Substantive Requirements presented in this document unless it is authorized by an individual permit issued under Section 22a-430 of the General Statutes or a general permit issued under section 22a-430b of the General Statutes.

8) Within fifteen days after the date the discharger becomes aware of a change in any information submitted to the Commissioner under any registration or this document, or that any such information was inaccurate or misleading or that any relevant information was omitted, the discharger shall submit the correct or omitted information in writing to the Commissioner.

9) Nothing in this document shall relieve the discharger of other obligations under applicable federal, state and local law.

10) Any document, including but not limited to any notice, which is required to be submitted to the Commissioner under the Substantive Requirements presented in this document by the discharger shall be signed by the discharger and by the individual or individuals responsible for actually preparing such document, each of whom shall certify in writing as follows: "I have personally examined and am familiar with the information submitted in this document and all attachments and certify that based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief, and I understand that any false statement made in this document or its attachments may be punishable as a criminal offense."

DRAFT

11) Any false statement in any information submitted pursuant to this document may be punishable as a criminal offense under Section 22a-438 of the General Statutes or, in accordance with Section 22a-6, under Section 53a-157 of the General Statutes.

12) The Commissioner reserves the right to make appropriate revisions to the Substantive Requirements presented in this document in order to establish any appropriate effluent limitations, schedules of compliance, or other provisions which may be necessary to adequately protect human health and the environment.

13) The Commissioner may order summary suspension of the Substantive Requirements presented in this document in accordance with Section 4-182 of the Connecticut General Statutes.

Entered as Substantive Requirements of the Commissioner of Environmental Protection.

DRAFT

______________________ Date

______________________ Robert E. Moore
Deputy Commissioner

FACILITY ID.______________
APPLICATION NO.______________
SUBSTANTIVE REQUIREMENTS NO.__________

DRAFT

SUBSTANTIVE REQUIREMENTS

SUBSEQUENT MONITORING RESULTS
(Attach copy of laboratory results)

MAIL TO: Attention: DMR Processing (for subsequent monitoring)
Bureau of Water Management, PERD
CT Department of Environmental Protection
79 Elm Street
Hartford, CT. 06106-5127

FACILITY ID._______ APPLICATION NO. ________ SUBST. REQUIRE. NO. _________

NAME OF DISCHARGER: XXXXXXXXXXXXX
SITE NAME & ADDRESS: Solvent Recovery Service
114 Lazy Lane, Southington

DISCHARGE LOCATION: Quinnipiac River

WATER QUALITY CLASSIFICATION: SB

Sample Date: ______________________
Number of hours of discharge for each day of sample collection: __________
Check one: INITIAL SCREENING OF RAW WATER _______ SUBSEQUENT MONITORING _________

Reporting of the following parameters for Monitoring Site No. 001-A (Pretreatment influent) is required. Requirements for reporting a specific parameter are indicated on the Substantive Requirements form.

Pollutant Parameters	RESULTS (w/ units)
1,2 Dichloroethane	
1,1,1 Trichloroethane	
1,1,2 Trichloroethane	
1,1 Dichloroethylene	
1,2 Dichloroethylene	
Ethyl Benzene	
Methylene Chloride	
Tetrachloroethylene	
Toluene	
Trichloroethylene	
Methyl Ethyl Ketone	
Methanol	
Ethanol	
Acetone	
Styrene	
Methyl Isobutyl Ketone	
Xylenes	
Isopropanol	
Sec-Butanol	
Tetrahydrofuran	
Iron-Total	
Copper-Total	
Lead-Total	
Nickel-Total	
Zinc-Total	

DRAFT

Reporting of the following parameters for Discharge Serial No. 001-1 (Pretreated groundwater effluent) is required. Requirements for reporting a specific parameter are indicated on the Substantive Requirements form.

Pollutant Parameters	RESULTS (w/ units)	Limits
Maximum Daily Flow	-------	43,200 gallons
Total Daily Flow	______	-------
pH	______	6.0 to 9.0
1,2 Dichloroethane	______	0.25 mg/l
1,1,1 Trichloroethane	______	4.0 mg/l
1,1,2 Trichloroethane	______	0.25 mg/l
1,1 Dichloroethylene	______	0.275 mg/l
1,2 Dichloroethylene	______	5.0 mg/l
Ethyl Benzene	______	1.0 mg/l
Methylene Chloride	______	15.0 mg/l
Tetrachloroethylene	______	0.489 mg/l
Toluene	______	4.0 mg/l
Trichloroethylene	______	3.0 mg/l
Methyl Ethyl Ketone	______	10.0 mg/l
Methanol	______	30.0 mg/l
Ethanol	______	20.0 mg/l
Acetone	______	35.0 mg/l
Styrene	______	0.5 mg/l
Methyl Isobutyl Ketone	______	2.0 mg/l
Xylenes	______	0.5 mg/l
Isopropanol	______	10.0 mg/l
Sec-Butanol	______	10.0 mg/l
Tetrahydrofuran	______	0.5 mg/l
Iron-Total	______	5.0 mg/l
Copper-Total	______	0.133 mg/l
Lead-Total	______	0.029 mg/l
Nickel-Total	______	0.5 mg/l
Zinc-Total	______	0.342 mg/l
Total Suspended Solids	______	30.0 mg/l
Peroxide	______	6.0 mg/l
PCB(s), Total	______	
Dioxins	______	
Furans	______	

ALL PARAMETERS SPECIFIED ABOVE ("PASS" OR "FAIL") ____________________

SUBSTANTIVE REQUIREMENTS

INITIAL SCREENING OR SUBSEQUENT MONITORING RESULTS
(Attach copy of laboratory results)

I certify that I have personally examined and am familiar with the information submitted in this document and all attachments and certify that based on reasonable investigation, including my inquiry of those individuals responsible for obtaining the information, the submitted information is true, accurate and complete to the best of my knowledge and belief, and I understand that any false statement made in this document or its attachments may be punishable as a criminal offense. I certify that all discharge limitations of the Substantive Requirements presented in this document have been met, otherwise if a violation of any of the discharge limits occurs, the discharge will be stopped immediately and written notification must be sent to the DEP/BWM/CPU within twenty-four hours. In this situation, the discharge shall not be re-started without prior approval of the Commissioner.

Date

Name:
Title:

cc: Groundwater Section, 79 Elm St., Hartford, CT 06106-5127
(groundwater contamination only)
cc: Town Water Pollution Control Authority (sewer discharges only)
cc: Town Engineer (surface water discharges)

Appendix E

Plans and Specifications

Non-Time-Critical Removal Action Design Drawings

Solvent Recovery Services of New England Site
Southington, Connecticut

Prepared For:
SRSNE PRP Group

December 1994

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

6723 Towpath Road
Syracuse, New York 13214
(315) 446-9120

Index

Drawing No.	Title
1	Proposed Site Plan
2	Process Flow Diagram
3	Floor Plan
4	Building Elevations
5	Miscellaneous Details

TARGET SHEET

THE MATERIAL DESCRIBED BELOW
WAS NOT SCANNED BECAUSE:

(X) OVERSIZED

() NON-PAPER MEDIA

() OTHER:

DESCRIPTION: NON TIME CRITICAL REMOVAL ACTION
DESIGN DRAWINGS;
1 PROPOSED SITE PLAN
2 PROCESS FLOW DIAGRAM
3 FLOOR PLAN
4 BUILDING ELEVATIONS
5 MISCELLANEOUS DETAILS

THE OMITTED MATERIAL IS AVAILABLE FOR REVIEW,
BY APPOINTMENT,
AT THE US EPA NEW ENGLAND SUPERFUND RECORDS CENTER,
BOSTON, MA

Non-Time-Critical Removal Action Special Conditions

Solvent Recovery Services of New England
Southington, Connecticut

Prepared for:
SRSNE PRP Group

December 1994

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

6723 Towpath Road
Syracuse, New York 13214
(315) 446-9120

Table of Contents

SECTION 00800 - SPECIAL CONDITIONS

00801 - CONTRACTOR'S RESPONSIBILITIES

The Contractor shall be familiar with the NTCRA Consent Order including the Statement of Work, and all other United States Environmental Protection Agency (USEPA) approved documents for the ground-water containment and treatment system. The Contractor shall carefully study and compare all documents and shall at once report to representatives of the SRSNE PRP Group any error, inconsistency, or omission they may discover. The Contractor shall perform no portion of the work at any time without approved shop drawings, product data, or samples for such portion of the work.

The Contractor shall supervise and direct the work, using their best skill and attention. They shall be solely responsible for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the work.

00802 - JOB SITE ADMINISTRATION

The Contractor shall keep a competent and authorized supervisory representative at the work location during working hours who shall act as the agent of the Contractor. If, in the opinion of representatives of the SRSNE PRP Group or designee, the supervisory representative or any of their successors proves incompetent, not conscientious, or not industrious, then the Contractor shall replace them upon written request by representatives of the SRSNE PRP Group. The Contractor shall only employ competent personnel on the job. Whenever representatives of the SRSNE PRP Group notify the Contractor in writing that, in their opinion, any person on the job, whether employed by the Contractor or any of the subcontractors, is incompetent, unfaithful, unsafe, disorderly, or otherwise unsatisfactory, such persons shall be immediately discharged from the contract work and shall not be employed on it, except with the written consent of representatives of the SRSNE PRP Group.

00803 - CLEARING AND SITE PREPARATION

Only that portion of the working area which is absolutely necessary and essential for installation of the ground-water containment and treatment system shall be cleared for construction. All clearing should be performed to provide minimum practical exposure of soils. The Contractor shall make every effort to avoid the destruction of common native plants, trees, or shrubs outside the area of construction so as not to unduly disturb the ecological or environmental quality of the area.

00804 - SPOIL

Excavated material which, in the opinion of the representatives of the SRSNE PRP Group, is unfit to be used as backfill or embankment shall be placed at an on-site spoil area to be determined by the representatives of the SRSNE PRP Group. All spoil areas shall be graded and seeded to match the surrounding area.

00805 - PROTECTION OF EXISTING UTILITIES

During the course of this work, it will be necessary to work adjacent to existing utilities, pipelines, structures and equipment. The Contractor shall take all necessary precautions to protect existing facilities from damage.

Locations of utilities as shown on the Design Drawings are approximate only. The Contractor shall excavate or otherwise locate to verify existing utilities in advance of his operations.

SECTION 00800 - SPECIAL CONDITIONS

00806 - LINES, GRADES, AND ELEVATIONS

Control lines and elevations which will be set by the Contractor are as follows:

- Baselines or principal centerlines, together with a suitable number of benchmarks adjacent to the work.

The Contractor shall set and maintain all necessary intermediate points, lines, grades and elevations, and provide slope stakes, offset stakes, batter boards, stakes for pipe locations, and other such items at their expense. Where the Contractor uses the laser for control, they shall periodically check the grade and alignment during each day's operation.

00807 - SUBMITTALS

For several elements of construction, the Technical Specifications (which are given on the Design Drawings and the Material and Performance Specifications) require that the Contractor prepare technical data (e.g., proposed electrical equipment layout, material test results, etc.) and submit this information for review. This requirement allows for monitoring of the Contractor's understanding of the design and prevention of any misinterpretation of the Technical Specifications that may otherwise impact the design objectives or construction schedule. The submittal of technical data, also referred to as shop drawing submittals, encompasses many elements of the construction activity. Typical submittals that will be required as part of the Technical Specifications may include the following performance data; a material list with manufacturer data showing compliance with the Technical Specifications; material samples; engineering drawings of the components showing sizes, widths, weights, connections, etc.; installation drawings; operating descriptions; layout drawings; detail drawings, etc.

All submittals shall comply with the USEPA-approved documents. The submittal review process will be an essential activity for monitoring Construction Quality Assurance before construction is initiated. The Contractor's submittal of a shop drawing will constitute their representation that they have determined and verified all quantities, dimensions, field construction criteria, materials, model numbers, and similar data. In addition, it will demonstrate that they have reviewed or coordinated each shop drawing submittal with the requirements of the Technical Specifications. Review of shop drawings by representatives of the SRSNE PRP Group will be to determine general compliance with the Technical Specifications. Submitted data will be reviewed and stamped by the representatives of the SRSNE PRP Group as follows:

1. "Reviewed" if no objections are observed or comments made;

2. "Reviewed and Noted" if minor objections, comments, or additions are made but resubmittal is not considered necessary provided the Contractor addresses the noted items;

3. "Resubmit" if the objections, comments, or additions are extensive. In this case, the Contractor would resubmit the items after revision; and

4. "Rejected" if the submittal under consideration is not, even with reasonable revision, acceptable or when the data submitted are not sufficiently complete to establish compliance with the Technical Specifications.

The shop drawing submittal and review process will afford an opportunity to monitor and control the quality of construction before construction is actually initiated.

00808 - EQUIVALENT PRODUCTS

Whenever a product is specified or described by reference of name, trade name, make or catalog number of a particular manufacturer, supplier, fabricator or distributor, the naming of the item is intended to

SECTION 00800 - SPECIAL CONDITIONS

establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of the manufacturers, fabricators, suppliers or distributors may be substituted. Substituted products may only be accepted by the representatives of the SRSNE PRP Group if sufficient information is submitted by the Contractor to allow the representatives of the SRSNE PRP Group to determine that the material or equipment proposed is equivalent to that named.

Requests for review of substitute items of material and equipment will not be accepted by the representatives of the SRSNE PRP Group from anyone other than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment, the Contractor or shall make written application to the representatives of the SRSNE PRP Group for acceptance thereof.

Applications for use of any substitute items shall be submitted by the Contractor to the representatives of the SRSNE PRP Group with sufficient time for review and to make any necessary changes prior to its scheduled installation. No applications will be considered thereafter unless the Contractor produces satisfactory evidence that the specified item is no longer manufactured or is unavailable for the project.

The representatives of the SRSNE PRP Group will be the sole judge of acceptability, and no substitute will be ordered or installed without prior written acceptance by the representatives of the SRSNE PRP Group.

00809 - MATERIALS AND ACCEPTABILITY TESTING

The Contractor shall be responsible for any inspections or testing, required by the representatives of the SRSNE PRP Group, in connection with the acceptance of a manufacturer, fabricator, supplier, or distributor of material or equipment submitted for acceptance.

Tests and certifications which will be required by the Contractor, are as follows:

1. Testing of materials which will be required in the Design Drawings and Materials and Performance Specifications;

2. Certification of concrete materials; and

3. Gradation and other testing (as required) of all select fill materials.

00810 - NOISE AND DUST CONTROL

It shall be the responsibility of the Contractor to take adequate measures for controlling dust produced by drilling, excavation, backfilling, loading, or other means. The use of calcium chloride or petroleum-based materials for dust control is prohibited.

It shall the responsibility of the Contractor to take adequate measures for keeping noise levels, as produced by construction equipment, to safe and tolerable limits as set forth by the Occupational Safety and Health Administration (OSHA), and the Connecticut State Code Guidelines and Ordinances. All construction equipment presenting a potential noise nuisance shall be provided with noise-muffling devices.

00811 - SOIL EROSION AND SILT CONTROL

Erosion control procedures, including but not limited to mulching, shall be utilized on the Site, as required. Erosion control shall occur, as required, immediately following completion of site clearing.

Filter fabrics and/or haybales shall be used, where necessary, to protect vegetation and to achieve environmental objectives to allow sediment to settle out of runoff waters that come in contact with construction areas before such water enters any surface waters.

SECTION 00800 - SPECIAL CONDITIONS

00812 - PROTECTION OF THE ENVIRONMENT

Construction procedures shall include protection of the environment to meet all pertinent federal and state regulations. Construction procedures that are prohibited include, but are not limited to:

1. Dumping of spoil material into any stream corridor, any wetlands (as defined by federal and state regulations), any surface waters, or at unspecified locations;

2. Indiscriminate, arbitrary, or capricious operation of equipment in any stream corridors, any wetlands, or any surface waters;

3. Pumping of any silt-laden water from trenches or other excavations into any stream corridors, wetlands, or surface waters;

4. Damaging vegetation beyond the extent necessary for construction of the facilities;

5. Disposal of trees, brush, and other debris in any stream corridors, wetlands, surface waters, or at unspecified locations;

6. Permanent or unspecified alteration of the flow line of a stream; and

7. Open burning of project debris.

00813 - EQUIPMENT MANUFACTURER'S MANUALS AND INFORMATION

All equipment, devices, or materials furnished by the Contractor as a part of the work shall be accompanied by all information, instructions, and data necessary for the proper and complete operation, maintenance, and repair by operating personnel. The required information, instructions, and data shall be prepared and compiled by the manufacturer of the equipment, device, or material and shall hereinafter be referred to collectively as "equipment manuals."

In addition to any specific requirements of other sections of the Materials and Performance Specifications or the Design Drawings, equipment manuals shall be required for any and all items containing moving parts; electric or electronic wiring or components; pneumatic or hydraulic devices or components; or requiring regular or special maintenance, cleaning, or lubrication. In addition to major items of equipment, this requirement for submission of equipment manuals is intended to also apply to such items as locksets; doors; finishes; electrical and lighting system components; fixtures and accessories; hoisting equipment; instrumentation; pumps; piping; valves; and accessories, etc.

Each equipment manual shall clearly and specifically identify the equipment or item which is the subject of the manual including, as applicable, the model name and number, size, serial number(s), and optional features or accessories actually included with the furnished equipment. Each equipment manual shall also include the following kinds of information, as applicable, to the item which is the subject of the manual:

- Table of contents;

- Theory of operation and functional diagrams;

- Design and operating specifications and/or criteria;

- Recommended installation arrangement, locations, wiring, criteria, procedure, etc.;

SECTION 00800 - SPECIAL CONDITIONS

- Normal and emergency operating instructions, procedures, and sequences for each possible mode of operation;
- Normal operating parameters, indications, settings, adjustments, voltages, currents, etc.;
- Troubleshooting procedures;
- Preventative or routine maintenance requirements or recommendations;
- Lubrication schedules including lube points, frequency, quantity, type, and brand name or recommended lubricants;
- Parts layout, identification, assembly diagrams, including exploded views with parts referenced by name and/or number;
- Parts list of each assembly and subassembly showing part name, number, size, composition, and quantity required down to discrete components;
- Recommended spare parts stocking lists;
- Names, addresses, and telephone numbers of factory-authorized or recommended service representatives and parts suppliers;
- Major overhaul or repair procedures including diagrams, measurements, clearances, tolerances, adjustment settings, alignment procedures, torque specs, etc.;
- Wiring diagrams and schematics;
- Elementary control diagrams;
- One-line diagrams;
- Interconnection data or diagrams for factory-wired components;
- Alignment and calibration procedures, including original or factory settings and data;
- Recommended or required special tools and maintenance, alignment, calibration, or safety equipment;
- Care and cleaning of finishes and paints used, colors, and types;
- Any other information necessary or recommended for the complete and proper operation, maintenance, and repair of the equipment by operating personnel; and
- Where an item of equipment includes components or subassemblies manufactured by other than the equipment manufacturer, all pertinent information for the subassemblies shall be included in the equipment manual prepared and compiled by the equipment manufacturer.

Information contained in an equipment manual, which is not applicable to the specific item furnished shall be clearly lined out or obliterated.

The Contractor is wholly responsible for obtaining acceptable equipment manuals from the equipment manufacturers and submitting copies to the representatives of the SRSNE PRP Group. In order to be acceptable, each copy of each equipment manual must be complete, as specified herein, and must be easily legible and clearly reproduced.

00814 - CONTRACTOR START-UP OPERATION

The Contractor shall be responsible for coordinating all initial testing and troubleshooting of the facility components. Once the equipment has been shown to be operable to the satisfaction of the representatives of the SRSNE PRP Group, the Contractor shall start up the facility in accordance with the requirements of the Operations Plan. During this period, the Contractor will be responsible for all phases of facility operation and make available qualified personnel to address any situations or operating difficulties as they arise. Following the start-up period, the Contractor shall transition operation of the facility to operating personnel designated by the representatives of the SRSNE PRP Group.

00815 - RECORD DRAWINGS

The Contractor shall mark any changes neatly and clearly on the Design Drawings using colored ink or pencil, and the construction record drawings shall be kept current on a day-to-day basis in concert with the progress of the work. Where applicable, the change marked on a drawing is to carry the notation "per Change Order No.____", or similar reference which cites the reason for the change. The day-to-day construction record drawings shall be made available to the representatives of the SRSNE PRP Group for review upon request.

The following items are examples of some of the types of changes which could occur and are to be recorded by the Contractor:

1. Change in location of project components;
2. Change in elevation of project components;
3. Change in slope of piping system, or of pitched surfaces;
4. Change in materials, such as pipe materials;
5. Change in topographical contours of finished earth surfaces;
6. Change in elevation of finished grades, streets, etc.;
7. Additions to project;
8. Elimination of a project component;
9. Relocation of existing underground utilities made necessary because of interference with project components;
10. Unforeseen modifications made to existing structures made necessary by requirements of the work;
11. Relocation of equipment; and
12. Changes in mechanical trades components (electrical, heating and ventilating, plumbing).

In addition, the construction record drawings shall show the precise as-built locations of all buried, imbedded or concealed piping or conduit, including piping or conduit fixtures, fittings and accessories and other buried features installed by the Contractor.

SECTION 00800 - SPECIAL CONDITIONS

00816 - REPLACEMENT OF PROPERTY

The Contractor shall replace all culverts, pavements, driveways, shrubs, lawns, fences, and any other property either public or private which is damaged as a result of the work. All such replacement shall be made according to the applicable specifications.

00817 - CONTRACTOR'S PERSONNEL

The Contractor shall restrict his personnel to only those areas of the Site necessary for the performance of the work. The Contractor shall instruct his personnel to observe extreme caution when working in the vicinity of mechanical equipment. The Contractor shall be solely responsible for any damage or disruption caused by their personnel.

00818 - CLEANUP

The Contractor shall be responsible for cleanup and removal from the Site of any and all rubbish and debris resulting from their operation.

00819 - SAFETY AND PROTECTION

The Contractor shall specifically comply with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL91-54). They shall erect and maintain, as required by the conditions and the progress of the work, all necessary safeguards for the safety and protection and shall comply with all applicable recommendations of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. They shall also comply with all applicable OSHA regulations, including 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response) and 29 CFR 1910.146 (Confined Spaces).

The Contractor shall develop and submit a contractor-specific Health and Safety Plan (HASP), which shall include specific health and safety risk analysis and mitigative measures related to the activities the Contractor will perform. All employees of the Contractor will be required to work in accordance with the minimum requirements of the HASP.

Personnel will be properly trained and have appropriate medical clearance to wear necessary protective equipment, as required. Prior to construction and as required throughout construction, the Contractors shall be required to provide documentation that all employees working on the Site are familiar with the HASP.

The Contractor shall designate a Health and Safety Supervisor who will have the major responsibility of implementing the requirement of its HASP. This person shall be the Contractor's superintendent unless otherwise designated in advance in writing.

The Contractor alone shall be responsible for the safety, efficiency, and adequacy of his plant, appliances, and methods. The Contractor shall be responsible for the health and safety of all subcontractors.

00820 - CONSTRUCTION MEETINGS

Prior to the start of construction activities, a pre-construction meeting shall be held with the Contractor representatives of the SRSNE PRP Group and other interested parties. Topics covered at this meeting shall include, but may not be limited to:

- Responsibilities of each organization;

SECTION 00800 - SPECIAL CONDITIONS

- Lines of authority and communication for each organization;
- Established procedures for responding to construction-related issues;
- Work area security and safety procedures;
- Procedures for the location and protection of construction materials, and for the prevention of damage of the materials from inclement weather or other adverse conditions;
- A review of Site conditions, including staging and storage locations; and
- Other topics of discussion.

During the construction period, formal progress and coordination meetings shall be held to discuss a review of work progress; field observations; construction issues and remedies; work and submittal schedule status; pending requests for changes or substitutions; and other topics, as required.

00821 - PERMITS

The Contractor is required to obtain necessary permits, licenses, and approvals required by the law or municipal ordinance.

00822 - LAW AND REGULATIONS

The Contractor shall abide by Local, State, or Federal laws or ordinances and shall cause its agents and employees to abide by Local, State, or Federal laws.

Non-Time-Critical Removal Action Materials and Performance Specifications

Solvent Recovery Services of New England
Southington, Connecticut

Prepared For:
SRSNE PRP Group

December 1994

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

6723 Towpath Road
Syracuse, New York 13214
(315) 446-9120

Table of Contents

MATERIALS AND PERFORMANCE - SECTION 02201

EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

Excavation and backfilling including the loosening, removing, refilling, transporting, storage and disposal of all materials classified as "earth" necessary to be removed for the construction and completion of all work required during implementation of the NTCRA.

1.02 RELATED WORK SPECIFIED ELSEWHERE

The following are items of materials and installation related to earthwork described under other sections:

A. Structural Excavation, Backfilling and Compacting
B. Clearing

1.03 REFERENCES

All materials and installations shall be in accordance with the latest revision of the following:

American Society for Testing and Materials - ASTM

1.04 SUBMITTALS - N/A

1.05 QUALITY ASSURANCE

The following definitions apply:

A. Excavation (or Trenching)

1. Grubbing, stripping, removing, storing and rehandling of all materials of every name and nature necessary to be removed for all purposes incidental to the construction and completion of all the work under construction.

2. All sheeting, sheetpiling, bracing and shoring, and the placing, driving, cutting off and removing of the same.

3. All diking, ditching, fluming, cofferdamming, pumping, bailing, draining, well pointing or otherwise disposing of water.

4. The removing and disposing of all surplus materials from the excavations in the manner specified.

5. The maintenance, accommodation and protection of travel and the temporary paving of highways, roads and driveways.

6. The supporting and protecting of all tracks, rails, buildings, curbs, sidewalks, pavements, overhead wires, poles, trees, vines, shrubbery, pipes, sewers, conduits or other structures or property in the vicinity of the work, whether over or underground or which appear within or adjacent to the excavations, and the restoration of the same in case of settlement or other injury.

7. All temporary bridging and fencing and the removing of same.

MATERIALS AND PERFORMANCE - SECTION 02201

EARTHWORK

B. Earth

All materials such as sand, gravel, clay, loam, ashes, cinders, pavements, muck, roots or pieces of timber, soft or disintegrated rock, not requiring blasting, barring, or wedging from their original beds, and specifically excluding all ledge or bedrock and individual boulders or masonry larger than ½-cubic yard in volume.

C. Backfill

The refilling of excavation and trenches to the line of filling indicated on the Design Drawings or as directed using materials suitable for refilling of excavations and trenches; and the compacting of all materials used in filling or refilling by rolling, ramming, or as may be required and approved by representatives of the SRSNE PRP Group.

D. Spoil

Surplus excavated materials not required or not suitable for backfills or embankments.

E. Embankments

Fills constructed above the original surface of the ground or such other elevation as specified or directed.

F. Limiting Subgrade

1. The underside of the pipe barrel for pipelines.

2. The underside of footing lines for structures.

G. Excavation Below Subgrade

1. Excavation below the limiting subgrades of structures or pipelines.

2. Where materials encountered at the limiting subgrades are not suitable for proper support of structures or pipelines, the Contractor shall excavate to such new lines and grades as required.

PART 2 - PRODUCTS

A. Steel Sheeting and Bracing

1. Shall be sound.

2. Shall conform to ASTM A 328 with a minimum thickness of 3/8-inch.

PART 3 - EXECUTION

3.01 UNAUTHORIZED EXCAVATION

Whenever excavations are carried beyond or below the lines and grades indicated on the Design Drawings, or as given or directed by representatives of the SRSNE PRP Group, all such excavated space shall be refilled with special granular materials, concrete or other materials as directed by representatives of the SRSNE PRP Group.

3.02 REMOVAL OF WATER

A. General

1. The Contractor shall, at all times, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with execution of the work or the proper placing of pipes, structures, or other work. Removal and handling of water which enters excavations shall be coordinated with representatives of the SRSNE PRP Group.

2. Unless otherwise specified, all excavations which extend down to or below the static ground-water elevations shall be dewatered by lowering and maintaining the ground water beneath such excavations at all times when work thereon is in progress, during subgrade preparation and the placing of the structure or pipe thereon.

3. Water shall not be allowed to rise over or come in contact with any masonry, concrete or mortar until at least 24 hours after placement, and no stream of water shall be allowed to flow over such work until such time as representatives of the SRSNE PRP Group may permit.

4. Where the presence of fine-grained subsurface materials and a high ground-water table may cause the upward flow of water into the excavation and may result in quick or unstable conditions, the Contractor shall install and operate an approved well point system, or similar dewatering system, designed by a registered professional engineer to prevent the upward flow of water during construction.

5. Water pumped or drained from excavations, or any sewers, drains or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction or to pavement, roads, drives and water courses.

6. Any damage caused by or resulting from dewatering operations shall be the sole responsibility of the Contractor.

B. Work Included

1. The installation of sheeting and bracing, and the furnishing of materials and labor necessary therefore.

2. The excavation and maintenance of ditches.

3. The furnishing and operation of pumps, well points and appliances needed to maintain thorough drainage of the work in a satisfactory manner.

4. The furnishing, placing, and compacting of select fill materials as required.

MATERIALS AND PERFORMANCE - SECTION 02201

EARTHWORK

3.03 STORAGE OF MATERIALS

A. Sod

Any sod cut during excavation shall be removed and stored during construction so as to preserve the grass growth.

B. Topsoil

Topsoil suitable for final grading shall be removed and stored separately from other excavated material.

C. Excavated Materials

1. All excavated materials shall be stored in locations approved by representatives of the SRSNE PRP Group so as not to endanger the work, and so that easy access may be had at all times to all parts of the excavation. Stored materials shall be kept neatly piled and trimmed, so as to cause as little inconvenience as possible to the public or adjoining property holders.

2. Special precautions must be taken to permit access at all times to fire hydrants, fire alarm boxes, police and fire department driveways, and other points where access may involve the safety and welfare of the general public.

3.04 DISPOSAL OF SPOIL MATERIALS

Spoil material shall be disposed of on-site at a location approved by representatives of the SRSNE PRP Group.

3.05 SHEETING AND BRACING

A. Installation

1. The Contractor shall furnish, place and maintain such sheeting, bracing and shoring as may be required to support the side and ends of excavations in such manner as to prevent any movement which could, in any way, injure the pipe, structures, or other work; diminish the width necessary for construction; otherwise damage or delay the work of the Contract; endanger existing structures, pipes or pavements; or cause the excavation limits to exceed the right-of-way limits.

2. In no case will bracing be permitted against pipes or structures in trenches or other excavations.

3. Sheeting shall be driven as the excavation progresses and in such manner as to maintain pressure against the original ground at all times. The sheeting shall be driven vertically with the edges tight together, and all bracing shall be of such design and strength as to maintain the sheeting in its proper position.

4. The Contractor shall be solely responsible for the adequacy of all sheeting and bracing.

B. Removal

1. In general, all sheeting and bracing, whether of steel, wood or other material, used to support the sides of trenches or other open excavations, shall be withdrawn as the trenches or other open excavations are being refilled. That portion of the sheeting extending below the top of a pipe or structural foundation shall not be withdrawn, unless otherwise directed, before more than 6 inches of earth is placed above the top of the pipe or structural foundation and before any bracing is removed. The voids left by the sheeting shall be carefully refilled with selected material and rammed tight with tools especially adapted for the purposes or otherwise as may be approved.

2. The Contractor shall not remove sheeting and bracing until the work has attained the necessary strength to permit placing of backfill.

C. Left in Place

1. If, to serve any purpose of their own, the Contractor may file a written request for permission to leave sheeting or bracing in the trench or excavation.

2. The Contractor shall leave in place all sheeting, shoring and bracing which are shown on the Design Drawings or specified to be left in place or which representatives of the SRSNE PRP Group may order, in writing, to be left in place.

3. In case sheeting is left in place, it shall be cut off or driven down as directed by representatives of the SRSNE PRP Group.

3.06 OTHER REQUIREMENTS

A. Drainage

All materials deposited in roadway ditches or other water courses shall be removed immediately after backfilling is completed and the section, grades and contours of such ditches or water courses restored to their original condition.

B. Unfinished Work

When, for any reason, the work is to be left unfinished, all trenches and excavations shall be filled and all roadways, sidewalks and watercourses left unobstructed with their surfaces in a safe and satisfactory condition. The surface of all roadways and sidewalks shall have a temporary pavement.

C. Hauling Material on Streets

When it is necessary to haul material over the streets or pavement, the Contractor shall provide suitable tight vehicles so as to prevent deposits on the street or pavements. In all cases where any materials are dropped from the vehicles, the Contractor shall clean up the same as often as required to keep the crosswalks, streets, and pavements clean and free from dirt, mud, stone and other hauled material.

MATERIALS AND PERFORMANCE - SECTION 02201

EARTHWORK

D. Dust Control

It shall be the sole responsibility of the Contractor to control the dust created by any and all of his operations to such a degree that it will not endanger the safety and welfare of the general public.

E. Erosion and Siltation Control

It shall be the sole responsibility of the Contractor to control erosion within the limits of the remedial activities. In addition, the Contractor shall be solely responsible for controlling siltation beyond the limits of the construction activities (i.e., by installing silt fences).

F. Test Pits

For the purpose of obtaining detailed locations of underground obstruction, the Contractor may make excavations in advance of the work as directed by representatives of the SRSNE PRP Group.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02203

STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION

PART 1 - GENERAL

1.01 WORK INCLUDED

Excavation and backfill as required for the construction of structures in accordance with the applicable provisions of the section entitled Earthwork unless modified herein. This covers all work during implementation of the NTCRA.

1.02 RELATED WORK SPECIFIED ELSEWHERE

The following are items of materials and installation related to earthwork described under other sections:

A. Earthwork
B. Clearing

PART 2 - EXECUTION

A. Limits of Excavation

1. Excavations shall be made to the elevations or subgrades specified and shall be only of sufficient size to allow suitable room for the proper construction of structures and appurtenances, including allowances for sheeting, dewatering and other similar work necessary for completion of the NTCRA.

2. Normal subgrade for structures shall be the underside of footing lines or mud mats, if installed.

3. In no case will undercutting excavation faces be permitted.

B. Subsurface Reinforcement

1. Where an unstable subgrade is encountered and subject to the approval of representatives of the SRSNE PRP Group, select fill may be used for subgrade reinforcement if satisfactory results can be obtained thereby. Such material shall be applied in thin layers, each layer being entirely embedded in the subsoil by thorough tamping.

2. All excess material shall be removed to compensate for the displacement by the select fill and the finished elevation shall not be above the specified subgrade.

3. Where subgrade reinforcement is unsatisfactory, a Class "D" concrete mud mat of sufficient thickness to withstand subsequent construction operations shall be installed below the specified elevation and the structural concrete deposited thereon.

C. Subsurface

Subsurface for all concrete structures shall be undisturbed original earth or, mud mat on undisturbed original earth, or where excavation below subgrade is ordered, it shall be thoroughly compacted Special Backfill or Class "D" concrete as specified or directed and shall be sufficiently stable to remain firm and intact during the preparation for the placing of concrete thereon.

MATERIALS AND PERFORMANCE - SECTION 02203

STRUCTURAL EXCAVATION, BACKFILL, AND COMPACTION

D. Removal of Water

1. The Contractor shall, at all times, provide and maintain proper and satisfactory means and devices for the removal of all water entering the excavations, and shall remove all such water as fast as it may collect, in such manner as shall not interfere with the execution of the work or the proper placing of pipes, structures or other work.

2. The removal of water shall be in accordance with the section entitled Earthwork.

E. Backfilling

1. All excavations shall be backfilled to the original surface of the ground or to such other grades as may be shown, specified or directed.

2. Backfilling shall be done with suitable excavated materials or impacted select fill which can be satisfactorily compacted during refilling of the excavation. In the event the excavated materials are not suitable, Special Backfill as specified or ordered by representatives of the SRSNE PRP Group shall be used for backfilling.

3. Any settlement occurring in the backfilled excavations shall be refilled and compacted.

a. Unsuitable Materials

1. Stones, pieces of rock or pieces of pavement greater than one cubic foot in volume or greater than 1½ feet in any single dimension shall not be used in any portion of the backfill.

2. All stones, pieces of rock or pavement shall be distributed through the backfill and alternated with earth backfill in such a manner that all interstices between them shall be filled with earth.

3. Frozen earth shall not be used for backfilling.

b. Compaction and Density Control

1. The compaction shall be as specified for the type of earthwork.

- The compaction specified shall be 95 percent of maximum dry density based upon testing and be in accordance with ASTM D-1557 for the first 10 feet of fill and 92 percent of maximum dry density for the remainder.

- The compaction equipment shall be suitable for the material encountered.

2. Where required, to assure adequate compaction, in-place density test shall be made by an approved testing laboratory.

- The moisture-density relationship of the backfill material shall be determined by ASTM D-1557, Method D. Compaction curves for the full range of materials used shall be developed.

- In-place density shall be determined by the methods of ASTM D-1556 or ASTM D-2922 and shall be expressed as a percentage of maximum dry density.

3. Where required, to obtain the optimum moisture content, the Contractor shall add sufficient water during compaction to assure the specified maximum density of the backfill. If, due to rain or other causes, the material exceeds the optimum moisture content, it shall be allowed to dry, assisted if necessary, before resuming compaction or filling efforts.

4. The Contractor shall be responsible for all damage or injury done to pipes, structures, property or persons due to improper placing or compacting of backfill.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02208

CLEARING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Clearing and grubbing within the limits indicated of the following.

1. Topsoil
2. Pieces of rock up to ½-cubic yard in volume.
3. Trees and Bushes
4. Pavements
5. Brush
6. Logs and Stumps
7. Refuse and Rubbish
8. Decayed and Growing Organic Matter
9. Snow and Ice

B. All material except topsoil and that material suitable for fill shall be placed at an on-site location approved by representatives of the SRSNE PRP Group. Topsoil shall be stockpiled for later use.

C. The Contractor shall remove, replace, support and protect all power and telephone poles and posts as required.

1.02 RELATED WORK SPECIFIED ELSEWHERE

The following are items of materials and installation related to earthwork described under other sections:

A. Earthwork

B. Structural Excavation, Backfilling, and Compaction

PART 2 - PRODUCTS

A. New power and utility poles and posts and the supporting and protecting of all poles and posts shall be in accordance with the requirements of the local power and telephone companies.

B. Stakes for tree protection shall be 2 inch diameter steel pipe, unless otherwise shown on the Design Drawings.

PART 3 - EXECUTION

3.01 GENERAL

A. Tree Protection

Any tree which will not, in the opinion of representatives of the SRSNE PRP Group, hinder construction or landscaping shall be protected by stakes placed in a circle having a radius of not less than 5 feet as measured from the base of the trunk around the tree. The stakes shall extend at least 4 feet above the existing ground. Each circle shall consist of at least 6 stakes. Landscaping within the circle shall be accomplished by hand unless otherwise permitted by representatives of the SRSNE PRP Group.

MATERIALS AND PERFORMANCE - SECTION 02208

CLEARING

B. Debris Removal

All brush or trees too large to shred shall be cut into 5-foot lengths and placed at an on-site location approved by representatives of the SRSNE PRP Group.

3.02 ENVIRONMENTAL PROTECTION

A. Prohibited Construction Procedures

1. Prohibited construction procedures include, but are not limited to:

a. Dumping of spoil material into any 100-year flood hazard area, stream corridor, any wetlands, any surface waters or at unspecified locations.

b. Indiscriminate, arbitrary or capricious operation of equipment in any stream corridors, any wetlands or any surface waters.

c. Pumping of silt-laden water from trenches or other excavations into any surface waters, any stream corridors or any wetlands.

d. Damaging vegetation beyond the extent necessary for construction of the facilities.

e. Disposal of trees, brush, and other debris in any stream corridors, any wetlands, any surface waters or at unspecified locations.

f. Permanent or unspecified alteration of the flow line of the stream.

g. Placing of wet concrete so it comes in contact with stream water.

B. Site and Access Clearing

1. Except where directed or shown, no trees shall be removed or damaged.

2. Straggling roots shall be pruned. Trees which must be pruned shall be cut cleanly and painted with tree paint. If the tree is damaged, the wood shall be repaired and painted with material approved by representatives of the SRSNE PRP Group.

3. After interfering vegetation has been removed, the Contractor shall strip any and all topsoil from the site to be excavated and stockpile it for future use.

C. Erosion and Sediment Control

1. Erosion control procedures, inclusive of mulching, shall be utilized on the site. Erosion control shall occur as required, and immediately following (weather permitting) completion of site and access clearing.

2. To allow sediment to settle out of water that interferes with construction before such water enters any surface waters, settling basins and plastic filter fabrics should be used upon representatives of the SRSNE PRP Group's direction or as otherwise required to protect vegetation and to achieve environmental objectives. Care should be taken not to damage

or kill vegetation by excessive water or by damaging silt accumulation in the discharge area.

D. Critical Impact Areas

1. "Critical Impact Area" means and includes any area, condition or feature which is environmentally sensitive, or which, if disturbed during construction, would adversely affect the environment. Critical impact areas include, but are not limited to, stream corridors, streams, inland wetlands, estuaries, coastal wetlands, slopes greater than 15 percent, highly acid, highly erodible and adverse mineral soil conditions (such as highly glauconitic soils), natural surface and manmade surface and subsurface drainage facilities and features, areas of high water table, and mature stands of native vegetation.

   a. Slopes exceeding 15 percent require special treatment such as water diversion berms, sodding, or the use of jute or excelsior blankets.

   b. Right-of-way slopes at surface water crossings or drainageways shall be protected by rip-rapping, sand bagging, sodding, or the use of jute or excelsior blankets as the conditions require. If adverse acid or mineralized ground water is present, a relatively impermeable soil shall be used for backfill at the crossing to minimize discharge of such water.

   c. Clayey material having a pH of four or less exposed during construction shall be covered with at least 1 foot of soil having a pH of five or more before seed bed preparation.

   d. To maintain natural ground-water levels and flow patterns, relatively impermeable soils should be incorporated in backfilling as blankets and anti-seep collars.

E. Dust Control

Dust shall be controlled by sprinkling and sweeping on paved areas and by sprinkling and mulching in unpaved areas. The use of calcium chloride is prohibited.

F. Noise Control

All construction equipment presenting a potential noise nuisance shall be provided with noise muffling devices.

- END OF SECTION -

MATERIALS AND PERFORMANCE SECTION - 02210

GROUND-WATER RECOVERY WELLS

PART 1 - GENERAL

1.01 DESCRIPTION

The work to be done under this Section includes the furnishing of all labor, material, transportation, tools, supplies, equipment and appurtenances necessary for the installation of ten piezometers, and seven recovery wells at the locations shown on the Design Drawings.

1.02 QUALITY ASSURANCE

A. Unless otherwise specified, equipment or material of same type, used for the same purpose shall be products of the same manufacturer. The material shall be new and of the latest design of manufacturer provided equipment or material.

B. Equipment and accessories not specifically described or identified in the manufacturer's catalog numbers shall be manufactured in conformity with applicable technical standards and shall have neat and finished appearance.

C. Install equipment in neat and workman like manner; align, level, and adjust for satisfactory operation; install so that parts are easily accessible for inspection, operation, maintenance, and repair.

1.03 SUBMITTALS

A. The Contractor shall submit its proposed schedule, plan and method for installing and developing the recovery wells as outlined in this section.

B. Detailed shop drawings and manufacturer's data concerning the pipe material; pipe joints, fittings, and well screens shall be submitted.

PART 2 - PRODUCTS

2.01 PIEZOMETER INSTALLATION

A. The ten piezometers shall be installed in the overburden to a depth of approximately 20 feet.

B. Each piezometer shall be 2-inch diameter, Schedule 40 PVC, and include a 0.010-inch slot PVC screen that extends from the water table to the top of till (an average depth interval of approximately 5 to 20 feet).

C. The borehole/piezometer annulus shall be back-filled with Morie No. 0 filter pack or equivalent to approximately 1 to 2 feet above the top of the screen. A 1- to 2-foot thick bentonite pellet seal shall be placed above the filter pack, and the remainder of the annulus shall be sealed with neat cement grout to ground surface.

D. Each piezometer shall be completed above ground surface with a protective casing with lockable cap set in a 1-foot thick concrete surface pad.

E. Piezometer boreholes shall be sampled every five feet through the overburden for geologic characterization.

MATERIALS AND PERFORMANCE SECTION - 02209

GROUND-WATER RECOVERY WELLS

F. The Contractor shall develop each piezometer by surging and bailing or pumping until the turbidity of the ground water purged from each piezometer is reduced to the extent practicable. At a minimum, each piezometer shall be developed for approximately two hours.

G. All ground water purged from the piezometers during development must be placed by the Contractor into an on-site liquid-waste container.

2.02 RECOVERY WELL INSTALLATION

A. The seven recovery wells shall be constructed as shown on the Design Drawings. Each recovery well borehole shall be advanced using 14-inch diameter drive-and-wash and/or air rotary drilling methods to the depth of the top of bedrock, which is estimated as approximately 25 to 35 feet in the proposed drilling areas.

1. Drilling mud will not be used during the drilling of the recovery well boreholes.

2. The anticipated geologic materials include sandy outwash from ground surface to approximately 16 feet and sandy till from 16 to the top of bedrock.

B. During drilling of each recovery well borehole, split-spoon sampling will be performed to provide geologic characterization and identify the depth of the weathered bedrock.

C. Each ground-water recovery well will be installed through the 14-inch casing with central liners and will be placed with the bottom of the well sump at the approximate depth of the top of bedrock. The annulus between the sump and borehole wall will be sealed with grout.

D. Each well will include a 3-foot long blank sump, an approximately 15-foot long, 8-inch diameter, continuous-wound, 0.020-inch slot stainless steel screen and 8-inch diameter, Schedule 40 PVC riser pipe. A filter pack consisting of Morie No. 0 sand (or equivalent) shall be placed in the well/borehole annulus from the bottom of the well screen to approximately 5 feet below ground surface.

E. To facilitate injection of chemicals during operation and maintenance of the recovery wells and monitoring drawdown in the filter pack during pumping, two 1-inch diameter, slotted PVC pipes shall be installed at opposite locations within the recovery well borehole annulus. These pipes shall be slotted from the bottom to the top of the filter pack.

F. A 1-foot thick, hydrated bentonite pellet seal will be placed above the sand pack, and the remainder of the annulus will be filled with concrete to ground surface. The well shall be completed approximately 1 foot below ground surface within a lockable concrete vault.

G. The Contractor shall develop each newly installed recovery well to produce sediment-free discharge water. The development process will consist of alternately surging the well with an appropriate surge block for a minimum period of 2 hours and pumping the well to evacuate sediment and remove fines to the extent practical.

2.03 BENTONITE

The bentonite pellet seal material shall be a hydrated bentonite seal as manufactured by American Colloid Company, Dow Chemical Company or equal.

MATERIALS AND PERFORMANCE SECTION - 02210

GROUND-WATER RECOVERY WELLS

2.04 CONCRETE

The concrete material shall be ASTM C150, Type II concrete.

PART 3 - EXECUTION

3.01 RECOVERY WELL CONSTRUCTION

A. Materials delivery, storage and handling

1. All riser pipe and well screens supplied under this Contract shall be shipped, stored and handled in accordance with the recommendations of the manufacturer.

2. All riser pipe and well screens shall be steam cleaned and water rinsed with a control source water prior to installation.

B. Materials Inspection

1. Prior to well installation, all riser pipes, well screens, and granular material shall be inspected by the Contractor for conformance with the standards and specifications.

2. All materials not meeting the requirements of the applicable specifications shall be rejected.

C. Borehole Drilling

1. The Contractor shall drill the recovery wells at the locations shown in the Design Drawings.

2. The Contractor shall use appropriate drilling equipment and procedures to drill the recovery well boreholes.

3. All drilling equipment and well or piezometer screens and risers shall require steam cleaning on site by the Contractor prior to use/installation. The Contractor will construct and maintain a decontamination pad to collect all wastewater and solids generated during steam cleaning.

3.02 ACCEPTANCE

A. If at any time during the installation of the recovery wells, it is determined that a recovery well has not been installed to the standards of this Specification, the Contractor will abandon the hole and grout its full depth and initiate construction of a new well.

B. During the installation of the well, the Contractor shall demonstrate that the full depth of the recovery well is free from any obstructions and clear of any formation materials and that the well will operate as designed, or the well will be deemed unacceptable and will be abandoned as discussed in A above.

3.03 RECORDS

A. The Contractor shall prepare a typed, legible copy of a subsurface log for the recovery wells as follows:

MATERIALS AND PERFORMANCE SECTION - 02209

GROUND-WATER RECOVERY WELLS

1. A record of the soil materials penetrated and the depth to which they were encountered.

2. A record showing the lengths and diameters of casing, screen, and riser pipe used in drilling and installation, and the location of packers, plugs and seals.

3. Static ground-water level upon completion prior to development and subsequent to development.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 02411

STEEL SHEETING

PART 1 - GENERAL

1.01 WORK INCLUDED

All labor, materials, equipment, surveys and services necessary for or incidental to the following.

A. The furnishing and driving of the Steel Sheeting.

B. The furnishing and installing of wales and bracing.

C. The removal of temporary sheeting, wales and bracing.

1.02 QUALITY ASSURANCE

A. Driving and Erecting: Regularly engaged in the driving and erection of steel sheeting.

B. Qualifications of Welders: In accordance with the American Welding Society (AWS). Qualified within the past year.

C. Codes and Standards

1. American Welding Society (AWS)
2. American Society for Testing and Materials (ASTM)
3. American Institute of Steel Construction (AISC)

1.03 SUBMITTALS

A. Shop Drawings

Plans and/or elevation locating and defining all materials furnished. All structures, utilities, poles and pertinent items shall be shown and dimensioned.

B. Certificates

Certify that materials are new and meet or exceed specification requirements.

C. Design Calculations for Bracing of Trenches or Excavations

Prepared by a professional engineer licensed in the State of Connecticut.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Steel Sheet Piling - Shall meet or exceed one of the following:

1. ASTM A 328
2. ASTM A 572 - Grade 50 and 55
3. ASTM A 690

MATERIALS AND PERFORMANCE - SECTION 02411

STEEL SHEETING

B. Structural Shapes

ASTM A 36

C. Hammer

1. Single or double acting air or steam hammer.
2. Vibratory hammer.

D. Permanent steel sheet piling shall be new and unused.

PART 3 - EXECUTION

3.01 PREPARATION FOR DRIVING

A. Determine piling layout.
B. Establish necessary lengths.
C. Locate and protect all underground utilities, piping, structures, etc.

3.02 INSTALLATION

A. Installation of sheeting as shown on the Design Drawings.

B. Any material which stops the driving shall be removed by the Contractor.

C. Plumb within 4 percent of pile length.

D. Sheeting shall be constructed so as to keep the excavations free from earth, water, ice or snow.

E. Sheeting shall be constructed to meet all safety requirements.

F. All sheets shall interlock.

G. Driving shall continue until the top of bedrock is reached (estimated to be 25-35 feet).

H. Sheeting shall be cut to grade.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

PART 1 - GENERAL

1.01 WORK INCLUDED

All labor, materials, services and equipment necessary for furnishing and installing all reinforced concrete and non-shrink grout required for the completion of the work.

1.02 RELATED WORK SPECIFIED ELSEWHERE

The following are items of materials and installation related to circuit protective devices described under other sections:

A. Earthwork
B. Structural Excavation, Backfilling, and Compaction

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM). The following ASTM specifications are referred to in these specifications and are to be considered a part of these specifications:

C 31 Standard Method of Making and Curing Concrete Test Specimens in the Field

C 33 Standard Specifications for Compressive Strength of Cylindrical Concrete Specimens

C 39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

C 94 Standard Specification for Ready-Mix Concrete

C 143 Standard Test Method for Slump of Portland Cement

C 150 Standard Specification for Portland Cement

C 171 Standard Specification for Sheet Materials for Curing Concrete

C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

C 260 Standard Specification for Air-Entraining Admixtures for Concrete

C 494 Standard Specification for Chemical Admixtures for Concrete

B. American Concrete Institute (ACI). The following codes, standards and recommendations of the ACI are intended to specify minimum standards of performance:

ACI 211.1 Standard Practice for Selecting Proportions for Normal and Heavyweight Concrete

ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete

ACI 301 Specifications for Structural Concrete for Buildings

ACI 302	Guide for Concrete Floor and Slab Construction
ACI 304	Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 309	Standard Practice for Consolidation of Concrete
ACI 315	Manual of Standard Practice for Detailing Reinforced Concrete Structures
ACI 350	Concrete Sanitary Ownering Structures

C. American Association of State Highway and Transportation Officials (AASHTO).

D. American Welding Society (AWS).

E. Concrete Reinforcing Steel Institute (CRSI).

F. Federal Specifications (FS).

G. American Plywood Association (APA).

H. U.S. Product Standards (PS).

I. For all standards and test methods, the latest revision shall apply.

1.04 SUBMITTALS

A. Concrete Mix Design

1. The concrete mix design submittal shall include, at minimum, the following data:

a. Basis of design in accordance with ACI 318-89, Section 5.3 - Proportioning on the Basis of Field Experience and/or Trial Mixtures.

b. Indicate the amounts of all ingredients including cement, fine and coarse aggregates, water, air content, and admixtures, with weight of aggregates stated in a saturated surface dry condition.

c. Concrete slump.

d. Manufacturer's technical data for all admixtures and cement.

e. Sieve analysis of fine and coarse aggregates.

B. Shop drawings showing all steel reinforcement, chairs, joint locations, embedded items and accessories.

C. Mill test certificates for concrete and steel reinforcement.

D. Manufacturer's literature for all products.

E. Test results of field and lab testing of concrete as they become available.

F. Methods to be employed when installing welded wire mesh, to ensure proper placement in concrete. The method shall employ the utilization of metal chairs, spacers or hangers, to position the mesh prior to placing concrete. Methods which require pulling the mesh into place by using hooks, shovels, picks or other tools during concrete placement will not be acceptable.

G. Curing methods to be employed to keep concrete moist.

H. Methods to be employed to install the coating system and protect and limit dust during surface preparation activities.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

All damaged or contaminated materials will be rejected and removed from the site by the Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement: ASTM C 150, Type II

B. Fine Aggregate: Natural Sand Meeting ASTM C 33

C. Coarse Aggregate: Crushed Stone with a nominal sieve size of ¾-inch which meets the requirements of ASTM C 33 Type 6 or 67 stone.

D. Water: Clear and free from injurious amounts of oil, acid, alkali, organic matter or other deleterious substances.

E. Admixtures

1. Water Reducing Admixture: ASTM C 494, Type A

2. High Range Water Reducing Admixture (Superplasticizer): ASTM C 494, Type F or G

3. Water Reducing, Retarding Admixture: ASTM C 494, Type D

4. Non-Chloride Accelerator: ASTM C 494, Type C or E

5. Air Entraining Admixture: ASTM C 260

6. Calcium Chloride: Calcium chloride or admixtures containing more than 0.1 percent chloride ions are not permitted.

F. Bonding Compound: Polyvinyl acetate, rewettable type.

G. Epoxy Adhesive: Two component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

H. Waterproof paper for curing concrete conform to ASTM C 171.

I. Bars: Deformed bars of new billet steel conforming to ASTM A 615, Grade 60.

J. Welded Wire Fabric: Cold drawn steel wire conforming to ASTM A 185. Furnish in flattened sheets or mats, of the sizes indicated.

K. Tie Wire: FS QQW461G, annealed steel, black, 16 gauge minimum. Column Spirals: Mill fabricated from colddrawn steel wire conforming to ASTM A 82.

L. Reinforcing Accessories: Reinforcing accessories, bar supports, chairs spacers, bolsters, etc., shall be of suitable types and sizes in accordance with ACI 315. All chairs, bolsters, etc., placed in contact with forms shall have contact legs made of polyethylene or upturned steel legs dipped in polyethylene leaving a coating with a minimum thickness of $^1/_8$-inch.

M. Formwork (Conform to ACI 347)

1. No formwork or form facing material which has a permanent set in it shall be used in the work.

2. All forms to be constructed of wood or plywood.

3. Metal forms may be used when forming precast concrete structural units.

N. Lumber

1. Softwood framing lumber: PS 2070.

2. Grade marked by grading rules agency approved by American Lumber Standards Committee.

O. Plywood: Exterior type softwood plywood, PS 1-66.

P. Form Ties

1. Ties shall be left in place and equipped with swaged washers (water stops) or other approved devices to prevent seepage of moisture along the tie.

2. Depth of breakback: minimum 1 inch.

Q. Form Coatings

1. Non-staining.

2. Compatible with subsequent finishing and bonding requirements.

R. Expansion Joints

1. Expanding Polyethylene Foam Rods

a. Flexible, compressible, closed-cell polyethylene of not more than 25 percent compression deflection at 8 pounds per square inch (psi) shall be provided for backup material in the joint system as shown on the Contract Drawings.

b. Higher compression deflection strength shall be provided as may be necessary to withstand installation forces and provide proper support for sealants.

c. Surface water absorption shall be not more than 0.1 pounds per square foot.

2. Sponge Rubber Joint Filler

a. Sponge rubber joint filler shall be a high-quality blown sponge rubber of uniform thickness and density.

b. Conform to the requirements of ASTM D 1752, Type 1; FS HH-F341e Type II, Class "A"; and AASHTO M153, Type 1.

S. Non-Shrink Grout

1. All grout shall be non-metallic, non-shrink, non-gas-forming pre-blended and ready-for-use requiring only the addition of water.

a. Grout shall contain no metals nor rust or corrosion promoting agents, or gypsums.

b. The addition of set control agents or water reducers will not be allowed.

2. Grout shall conform to the following properties:

Property	Test Method	Requirements
Shrinkage Below Placement Volume	ASTM C 827	0
Drying Shrinkage	CRD 588-76	0
Expansion	CRD 588-76 Maximum	0.40%
Compressive Strength 24 Hours 7 Days	ASTM C 109	 3,000 psi 6,000 psi
Initial Set Time	ASTM C 191	Minimum 45 Minutes
Pull-Out Strength	#5 Bar Grouted 6-Inches Deep in 7/8-Inch Diameter Hole in Saturated Surface Dried Concrete	10,000 lbs.

T. Polyvinyl Chloride (PVC) Waterstops

1. PVC material shall be compounded from virgin PVC resins and shall contain no reclaimed, reground or reworked materials.

2. Six (6) inches long by 3/8-inch minimum web with a 1/4-inch diameter center bulb.

U. Perimeter Insulation

1. Extruded Polystyrene Insulation

a. Closed-cell, expanded polystyrene board complying with FS-HH-I-524, Type II, Class "B".

b. Compressive strength - 30 psi.

c. Maximum water absorption - 0.10 percent.

d. Maximum water vapor transmission - 1.0 perm-inch.

e. Thermal conductivity (k value) at 75°F - 0.20 per inch thickness.

f. Integrally formed skin.

2. Styrofoam Insulation

a. "Styrofoam SM" as manufactured by the Dow Chemical Corp., or equal.

b. Molded "Styropor" (2.0 pcf density) as manufactured by BASF Wyandotte or equal.

c. Adjusted thicknesses shall be provided when a material having a different thermal conductivity value is approved for use.

V. Concrete Sealants

1. Sealants shall be one or two component elastomeric compound of polyurethane base. Polyurethane base sealants shall meet the requirements of Federal Specification TT-S-00227 or TT-S-00230. Primers shall be non-bleeding, non-staining, clear-drying materials as recommended by the sealant manufacturer.

2. Sealants for horizontal concrete surfaces in exposed areas shall be non-tracking.

3. Solvents, cleaning agents, and other accessory materials shall be as recommended by the sealant manufacturer.

4. Sealants shall not be applied to any concrete surfaces which are scheduled to receive the concrete coating system.

W. Concrete Coating System

Concrete coating system shall be suitable to the intended use.

2.02 CONCRETE MIX DESIGN

A. All mix designs shall be proportioned in accordance with ACI 318-89 Section 5.3 - Proportioning on the Basis of Field Experience and/or Trial Mixtures of ACI 318-89. If trial batches are used, they shall be established by an approved commercial testing laboratory, employed by the Contractor, and approved by representatives of the SRSNE PRP Group.

B. Method of proportioning shall conform to ACI 211.1, "Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete."

C. All concrete shall have a minimum 28-day compressive strength of 4,000 psi, a maximum water-cement ratio by weight of 0.45 and a minimum cement content of 550 pounds per cubic yard.

D. All concrete shall contain a water-reducing admixture.

E. All concrete exposed to the weather or water, or subject to freezing shall be air-entrained.

F. Slump: Concrete without high range water reducing admixture - 3 inches maximum.

G. Air Content: 4.5 to 7.5 percent.

H. Rate of Hardening

Concrete mixes shall be designed to produce the following rates of hardening:

1. General Concrete

   Ambient temperatures 50°F to 85°F - Normal rate of hardening.
   Ambient temperatures over 80°F - Retarded rate of hardening.
   Ambient temperature under 50°F - Accelerated rate of hardening.

2. Mass Concreting

   Ambient temperatures over 40°F -- Retarded rate of hardening.

I. Do not change the mix design except as approved by representatives of the SRSNE PRP Group to maintain quality control.

PART 3 - EXECUTION

3.01 CONCRETE

A. Batching: ACI 304.

B. Mixing, Transporting and Discharging: ASTM C 94.

C. Placing: ACI 304.

D. Cold Weather Concrete: ACI 306 (below 40°F).

E. Hot Weather Concrete: ACI 305 (above 80°F).

F. Finishing

1. Exposed Floors and Slabs

   a. Bull Float
   b. Hand Float
   c. Power Trowel
   d. Hand Trowel
   e. Curing and Sealing Compound

2. Sidewalk, Walkway, Loading Docks - Broom Finish

3. Formed Surfaces

   a. Rubbed until all marks are obliterated and a uniformly smooth finish is obtained.

   b. If, upon removing the forms, any voids or honeycomb are found, such faults shall be corrected immediately by the Contractor.

4. Curing

   Maintain all concrete in a moist condition for the duration of curing specified using methods that will insure complete and continuous saturation.

G. Field Testing and Inspection

1. To be performed by an independent testing laboratory.

2. The Contractor shall provide facilities necessary to obtain and handle representative samples of materials to be tested and furnish all necessary cooperation and assistance.

3. The testing laboratory shall be responsible for the field control of all concrete and may reject batches for high slump, uncontrolled air entrainment, or delays.

4. Field Test Cylinders: During the progress of the work, a set of six 6-inch by 12-inch cylinders shall be made for each 50 yards of concrete placed, or fraction thereof placed each day.

   a. For each set of six cylinders, two shall be tested at 7 days and two shall be tested at 28 days.

   b. In the case of questionable or unsatisfactory test results, the remaining two cylinders shall be tested at 40 days or as directed by representatives of the SRSNE PRP Group.

   c. Each cylinder shall be properly labeled with an identifying mark.

   d. The making and curing of test cylinders shall be in accordance with ASTM C 31.

   e. Cylinders shall be tested in accordance with ASTM C 39.

f. Making, pickup and curing of the cylinders shall be the responsibility of the testing laboratory, but the Contractor shall cooperate in protecting the cylinders and in notifying the testing laboratory of scheduled pours.

5. Slump Tests: ASTM C 143.

6. Air Content Test: ASTM C 173 or ASTM C 231.

7. Criteria for Acceptance: ACI 318, Section 5.6.

8. Written reports shall be submitted to representatives of the SRSNE PRP Group.

9. Repair of defective areas shall conform to ACI 301, Chapter 9, except that a bonding compound shall be used.

3.02 REINFORCEMENT

A. Conform to the CRSI Manual of Standard Practice.

B. Bending shall be done accurately without the use of heat. Bars having cracks or splits at the bends shall be rejected.

C. All steel shall be free from loose rust, scale, grease, oil, dirt, or other materials which impair the bond with concrete.

D. All steel reinforcement and welded wire mesh shall be accurately positioned and strongly secured by tie wires or clips at intersections, and supported by metal chairs, spacers or hangers. Pulling steel reinforcement and/or welded wire mesh into place will not be allowed.

3.03 FORMWORK

A. The Contractor shall be responsible for designing and constructing suitable and adequate falsework, centering and formwork in conformance with ACI 347, "Recommended Practice for Concrete Formwork."

B. Plywood: Conform to tables for form design in APA Form V345-72. Deflection of form facing material between supports: Not over 0.0025 x span.

C. Forms shall be designed so that the finished concrete will conform to the shape, true to line, and the proper dimensions as called for on the Contract Drawings.

D. The design of forms shall take into account the effect of vibrations of concrete as it is placed.

E. The forms shall be substantial, unyielding and constructed mortar tight and of sufficient rigidity to prevent distortion due to the pressures of concrete and other loads incidental to the construction operations.

3.04 CONCRETE COATING SYSTEM

A. The concrete coating system will be installed and inspected by a Contractor authorized and/or approved by the coating manufacturer.

MATERIALS AND PERFORMANCE - SECTION 03002

REINFORCED CONCRETE

B. The Contractor shall be responsible for erecting and disposing of all temporary structures, etc., to protect the coating system (while curing) and to contain any dust, debris, or vapors that may result during installation of the coating system (including surface preparation).

C. Coating system application to the treatment system enclosure concrete curb and floor.

1. Surface Preparation

   Surface preparation shall be conducted in accordance with the coating manufacturer's written requirements (i.e., clean surface, etc).

2. Coating System Application

   Coating system application (including mixing instructions) shall be conducted in accordance with the manufacturer's written recommendations.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. This section covers supply and process performance of the metals treatment system.

2. The metals treatment system shall consist of the following:

a. One 10,000 gallon steel equalization tank cover and mixer.

b. One 1,000 gallon clarifier feed tank with cover and mixer.

c. One inclined plate clarifier with two mixers (rapid and slow), and cover.

d. One sand filter with cover.

e. Two 3,000-gallon steel tanks (oxidation feed tank and GAC feed tank) with covers and mixers.

f. Two caustic soda addition metering pumps, two polymer addition metering pumps, and two sulfuric acid metering pumps.

g. One 10-foot diameter x 11 feet high steel gravity thickener tank with conical bottom.

h. One sludge dewatering filter press.

i. Four air-operated diaphragm pumps.

j. Six close coupled process pumps.

k. Two 55-gallon caustic soda drums.

l. Two 55-gallon sulfuric acid drums.

m. Two 55-gallon polymer drums.

n. Instantaneous and totalizing flow meters and pressure gauges as shown on Figure 2 of the Design Drawings.

o. One compressed air system designed to supply air to the sand filter, pneumatic pumps, and filter press with back-up compressor to allow for maintenance.

p. Two sump pumps complete with level floats.

q. Controls as specified in Part 2 of this section.

r. Complete set of recommended spare parts, repair kits, or calibration instruments.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

s. Three copies of an operation and maintenance manual for all components.

1.02 QUALITY ASSURANCE MANUFACTURER

A. The inclined plate clarifier and filter press shall be manufactured by Hoffland Environmental or equal.

B. The sand filter shall be manufactured by Parkson Corporation or equal.

C. Meter pumps shall be manufactured by Pulsafeeder or equal.

D. Mixers shall be manufactured by Lightning or equal.

E. Pneumatic pumps shall be manufactured by Wilden Pumps or equal.

F. Filter press shall be manufactured by Hoffland Environmental or equal.

G. Process and sump pumps shall be manufactured by Goulds Pumps, Inc. or equal.

1.03 SUBMITTALS

A. Shop Drawings

1. The Contractor shall submit shop drawings showing the complete metals treatment system, including equipment sizes, dimensions, connections, and materials of construction.

B. Other Submittals

1. The Contractor shall submit other information including, but not limited to, a listing of equipment components, recommended spare parts, installation instructions, blower and pump performance curves, templates for foundation connections and manufacturer's warranty.

2. The Contractor shall provide 3 copies of manufacturer's equipment manuals covering operation and maintenance, start-up and shut-down procedures, and trouble-shooting.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

A. The inclined plate clarifier, 10,000 gallon equalization tank, 1,000 gallon clarifier feed tank, two 3,000 gallon feed tanks, and sludge thickening tank shall be constructed of corrosion-resistant, painted A-36 steel.

B. The clarifier plates shall be fabricated of fiber reinforced plastic (FRP) with Viton or Teflon gaskets. The plates shall be supported by stainless-steel dividers.

C. All mechanical welded parts shall be compatible with organic compounds. Diaphragms, seals, and seats shall be constructed of Viton.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

D. Metering pumps shall be diaphragm type with polypropylene head and fittings and Type 316 stainless steel valve balls, teflon diaphragm and teflon seal rings.

E. Sludge pump welded parts shall be of cast iron. Elastomer, diaphragms, and valve balls shall be constructed of Viton.

F. Centrifugal pump casing shall be of stainless steel construction. Seals and elastomers shall be constructed of Viton.

G. The filter press shall be constructed with an A-36 steel frame. The filter plates shall be gasketed polypropylene recessed plates. The filter press cloths shall be of polypropylene. The filter cloths shall be Oxford weave, scoured and heat set. The press side bars shall be of heavy-duty steel tubing. (Solid side bars, channel iron, and I-beams shall not be used for side bars). Type 304 stainless-steel caps shall be installed on the side rails.

2.02 DESIGN

A. The metals pretreatment system is designed to remove from water the metals specified in Part 4 of this section. The metals treatment system design shall include the following:

B. Inclined Plate Clarifier

1. The clarifier shall be a Hoffland Model 600/60/50 and provide 570 square feet of total projected plate area. This area shall be divided to provide 456 square feet of clarification area and 114 square feet of inlet area.

2. The maximum flow rate through the clarifier shall not exceed 100 gallons per minute (gpm).

3. Plates shall be a minimum of 0.09 inches thick FRP. Plates shall be 8 feet long by 2 feet wide. Continuous PVC I-Beam stiffeners shall run the full length of the plates, forming a minimum flow profile ratio of 8:1. The stiffeners shall be placed on a maximum of 12" centers. Plates shall be manufactured in rigid plate pack assemblies held together with nylon clips.

4. Velocities through the inclined plate clarifier shall be kept below one foot per second.

5. The clarifier shall have a minimum 6 inches freeboard at 100 gpm.

6. The clarifier tank shall be a minimum thickness of 3/16 inches.

7. The clarifier sludge hopper shall be fabricated from ASTM A-36 steel. Minimum hopper thickness shall be ¼". The sludge hopper shall provide a minimum of 500 gallons of sludge storage.

8. The rapid mix and flocculator tank combination shall be a minimum of 67 gallon and 270 gallon capacity, respectively.

9. Plates shall withstand a load of 100% sludge with a specific gravity of 1.4.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

10. The clarifier shall be supported on legs with sufficient height to allow it to discharge by gravity to the sand filter.

C. Metering Pumps

1. The metering pumps shall be mechanically driven diaphragm-type with polypropylene head and fittings, Type 316 stainless steel valve balls, Teflon diaphragm, and Teflon seal rings.

2. The pumps shall vary stroke frequency automatically in proportion to a 4-20 mA DC signal. The stroke length shall be manually adjustable. Pump feed shall range as follows.

a.	Caustic Metering Pumps:	0.02 to 0.10 gallons per hour
b.	Polymer Metering Pumps:	0.003 to 0.012 gallons per hour
c.	Acid Metering Pumps:	0.009 to 0.036 gallons per hour

3. The pump housing shall be wired for 120V AC, single-phase power if <¼ horsepower (HP) or else 230 volt. The motor shall be TEFC and rated for continuous duty.

4. The pumps shall be manufactured by Pulsafeeder or equal.

D. Mixers

1. The mixers shall be direct drive constant speed mixers. The mixers shall be equipped with a turbine-type impeller.

2. The wetted parts of the mixer shall be of stainless steel, impeller-mounted on a stainless steel shaft.

3. The mixer motor shall be wired for 120V AC single-phase power if <¼ HP or else 230 volt, three-phase. The motor shall be TEFC and rated for continuous duty.

4. The mixers shall be manufactured by Lightning or equal.

E. Gravity Thickener Tank

The gravity thickener tank shall be a 10-foot diameter by 11-foot high conical bottom tank supported on legs with sufficient height as to allow access for sludge to be withdrawn from the bottom.

F. Covers

The inclined plate clarifier and all tanks shall include a vapor-tight cover vented as shown on the Design Drawings.

G. Filter Press

1. Filter press shall have a minimum capacity of 15 cubic feet. Filter press shall have an air-operated hydraulic closure mechanism, with no electrical components and lockable in the

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

closed position. Provide air piping as required. Filter press shall have a core air blowdown system, including header piping, valves, and regulator.

2. The filter plates shall be 800 mm gasketed polypropylene recessed plates to form 1¼" recess chamber with center feed eye, four filtrate ports, molded drainage surface, and equipped with four @ stay bosses. Plates without stay bosses will not be permitted.

3. The drain collection header shall be installed with an individual manual control valve for each corner discharge port. A common header shall join all discharge ports to a single outlet.

4. A pneumatic surge damper shall be installed in the press inlet line. A control valve shall also be installed in the inlet line.

5. A common discharge header shall be built into the plates to the collect filtrate and transfer to collection header on the press head section.

6. A complete set of polypropylene filter press cloths, plus three spare cloths, shall be included. The filter cloths shall have a 2 to 3 cfm rating.

7. The press shall be designed to withstand a maximum operating pressure of 225 psi.

8. The filter press will utilize the compaction pressure of the sludge pump to dewater sludge into cakes of 25% to 60% solids.

9. Press shall include a pneumatic plate spreader to separate the plates sufficiently allowing the filter cake to drop directly from the cavity. For operator safety, no moving components of the system shall have over 24 inches of total travel at any one cycle. The pneumatic plate spreader shall be constructed of steel tubing and painted.

10. A double diaphragm air pump shall be integrally mounted to the press frame complete with filter and regulator and valve.

11. A hand pump system with over pressure bypass shall be provided to maintain press integrity during power or air failures.

12. Sludge dumpster shall be included and shall be sized to hold entire contents of filter press when bulked up after discharge from press.

13. The filter press will have integral pneumatically operated drip trays located directly below the filter plates to collect the cloth washing spray and leakage from non-gasketed plates. The tray shall be sloped to direct the water to longitudinal trough running along one side, where it shall be piped to the filtrate line. The drip tray will be of the sliding tray type, arranged for lateral opening for cake discharge. The sliding tray shall be operated on mounted tracks with V-rollers. The tray shall be fabricated of steel (epoxy painted). The drip tray will be controlled from the control panel with provision for manual and semi-automatic operation modes. Interlocks shall be provided so that the press discharge cycle cannot operate with the tray in the closed position. The drip tray will run the entire length of the platform opening.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

14. In the event of low hydraulic pressure, the filter press system shall automatically discontinue pumping. The press shall also be equipped with a high-pressure shutoff switch and pressure relief bypass on the pneumatic and hydraulic systems. The filter press control panel shall control the hydraulic pressure gauge to easily monitor the hydraulic system.

15. Filtrate will be directed by gravity to a small sump with a pump which will direct flow to the equalization tank. Sump pump shall be compatible with the materials contained within the water.

H. Sand Filter

1. The filter shall consist of a cylindrical tank with a conical hopper; feed inlet manifold, feed distribution radials; filtrate weir and flume; airlift pipe, internal sand washer, sand distribution cone(s), reject compartment with weir and flume and a compressed air control system.

2. The filter shall operate in a manner such that the total cross-sectional area of each filter shall be in continuous filtration and a continuous backwash mode. There shall be no interruption of the filtration process by shutting down a part or a whole filter for backwashing.

3. The filter shall be a continuous backwash, upflow, deep bed, single media filter. Mixed or multiple media shall not be allowed.

4. The filter shall operate countercurrently. The feed shall be upflow with sand moving downward.

5. Each filter shall provide a minimum of 38 square feet of filtration area.

6. Each filter tank shall be 15 feet - 5 inches in height and have an inside tank diameter of 7 feet - 0 inches.

7. Each tank shall come complete with 150# drilled flanged connections including an 8 inch feed connection, 3 inch reject connection, 8 inch filtrate connection, and a 1 inch drain connection.

8. Each tank shall have a wall thickness of 3/16 - 5/16 inch (tapered sides).

9. The filter shall be designed for a filtration bed depth of 40 inches.

10. The filter shall not contain any moving parts.

11. The filter shall not contain any screens, wedgewires, grids, etc., to retain the media in place.

12. The air supply system shall consist of a separate panel including an air filter, control valve, air flow meter, pressure regulator, and pressure gauge.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

13. The unit shall come complete with access ladder and platform.

14. The units shall be designed to filter out suspended solids from a peak flow of 100 gpm of ground water (clarifier effluent) feed stream containing approximately 20 ppm TSS.

15. The filter shall produce a continuous filtrate stream and a continuous reject stream and shall not be shut down for any backwash cycles. No backwash valves, pumps, instrumentation shall be required for backwash cycles.

16. The sand bed shall be continuously backwashed internally and redistributed on top of the sand bed an average of 4-8 times per 24 hours.

17. Continuous sand cleaning shall be accomplished within the filter using filtered water. Filter influent (feed) shall not be used for sand cleaning. External sand movement or washing will not be allowed.

18. The headloss through the filter shall not exceed 36 inches.

19. The backwash surface loading rate shall exceed 100 gpm/square foot to ascertain a superior scouring and cleaning of the sand.

20. The air scouring of the sand shall exceed 50 SCFM/square foot. This shall be accomplished by the supply of 1-4 SCFM of air at 15-25 psi. (Air supplied by the customer).

I. Sludge Pumps

Sludge pumps shall be air-operated, double diaphragm pumps with cast iron body and Viton diaphragms, Viton valve balls, and Viton valve seats capable of 70 gpm at 110 psig.

J. Flow Meters

Flow meters shall be analog type which displays instantaneous flow rate and totalized flow rate. All diaphragms, seats or seals shall be Viton.

K. Sump Pumps

Sump pumps for treatment enclosure and filter press room shall be a submersible type with 316 stainless steel casing.

L. Air Compressor

Air compressor to be of sufficient capacity to service the air requirements of the metals pretreatment system and be of duplex design.

2.03 CONTROLS

A complete PLC unit shall be included for the metals pretreatment system to control pumping, mixing, chemical feed, sludge processing, etc. The controls shall include, at a minimum, the following:

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

1. Level control in equalization tank to control pumping and mixing. The level controls will be programmed to maintain a particular level in the equalization tank by varying the speed of the influent transfer pump drive.

2. All pumps to automatically switchover in case of failure.

3. Caustic and acid addition based upon pH measurement in clarifier feed tank and oxidation feed tank, respectively.

4. Polymer addition based upon flow into the clarifier feed tank.

5. Sludge transfer pumps to thickener and filter press based upon an adjustable timer.

6. Level control from oxidation feed tank to control pumping and mixing. The level controls will be programmed to maintain a particular level in the oxidation feed tank by varying the speed of the oxidation feed pumps.

7. High pressure shut-off switch for the sludge transfer pumps to the filter press.

8. Air compressors to automatically switchover in case of failure.

9. Level control in treatment system building sump and filter press room sump.

2.04 ALARMS

The following alarms shall be included in the metals treatment system:

1. High and low level in equalization tank.

2. High and low level in oxidation feed tank.

3. High and low level in GAC feed tank.

4. Metering pump failure.

5. Mixer failure.

6. Air compressor failure.

7. Process pump failure.

8. High level in treatment building sump and filter press room sump.

9. High discharge pressure on sludge pump.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

2.05 SYSTEM COATINGS

A. Steel Tank Surfaces

1. Steel tank surfaces must be dry and clean, in accordance with the following requirements. Remove all grease, oil, and contaminants, as outlined in SSPC SP1. Remove all welding spatter and grind burrs on cut edges and rough welds smooth. Blast-clean all surfaces after fabrication, in accordance with SSPC SP5, with profile depth of 1.5 to 2.5 mils. Apply first primer before any rust bloom forms.

All exterior, non-seal welded joints shall be filled with rubber caulking before painting.

a. Exterior Surfaces

Shop First Coat - Apply one coat dry film thickness of 4 mils of a high-build catalyzed epoxy. Apply to all steel surfaces, except the areas within 2" adjacent to field welds and surfaces specified to be hot-dip galvanized. The paint shall be Dupont 25p or equal.

Shop Finish Coat - Apply one coat dry film thickness of 1.5 mils of a polyurethane paint. Recoat at time interval recommended by the manufacturer; the final coat shall be Dupont iron polyurethane or equal.

Third Coat - Field touch-up of damaged and unpainted areas shall be the same as specified first and second coats at the same film thickness.

The total dry film thickness shall be a minimum of 4 mils.

b. Interior Surfaces

Shop First Coat - Apply one coat dry film thickness of 4 mils of an immersion grade high-build catalyzed epoxy. Apply to all steel surfaces, except the areas within 2" adjacent to field welds and surfaces specified to be hot-dip galvanized. The paint shall be Dupont 25p or equal.

Shop Finish Coat - Apply one coat dry film thickness of 4 mils of an immersion grade high-build catalyzed epoxy. Recoat at time interval recommended by the manufacturer. The final coat shall be Dupont 25p or equal.

Third Coat - Field touch-up of damaged and unpainted areas shall be the same as specified first and second coats at the same film thickness (liquid contact).

The dry film thickness shall be a minimum of 6 mils.

All liquid contact surfaces that are not coated shall be made of a corrosion-resistant material and left uncoated. Recommended materials are stainless-steel and Teflon.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

B. Clarifier Surfaces

1. Surface Preparation

All carbon steel surfaces shall be sandblasted in accordance with the Steel Structures Painting Council Surface Preparation ANSI SSPC SP-06 "Commercial Blast Condition", latest edition, on all non-wetted surfaces and ANSI SSPC SP-10 "Near-White Metal Blast Condition" for all wetted surfaces.

2. Paintings & Coatings

All carbon steel surfaces shall be painted as follows.

3. Exterior Surfaces

a. The base coat shall be DuPont High Solids Epoxy Mastic LF-63325P shale gray at a spread rate of 5-6 mils DFT.

b. The finish coat shall be DuPont High Solids 50P Polyacryl Anhydride Enamel, Safety Blue at a spread rate of 1.5-2.5 mils DFT.

c. Total DFT shall be 6.0 mils minimum average.

d. Primer and paint shall be applied in accordance with coating manufacturer's recommendations.

4. Interior Surfaces

a. The base coat shall be DuPont High Solids Epoxy Mastic LF-63325P shale gray at a spread rate of 5-6 mils.

b. The finish coat shall be DuPont Solids Epoxy Mastic LF-65M25P Safety Blue at a spread rate of 5-6 mils.

c. Total DFT shall be 10.0 mils minimum average.

d. Primer and paint shall be applied in accordance with coating manufacturer's recommendations.

5. Stainless steels, nickel, monel, lead, Hastelloy, galvanized steel, rubber, plastic or fiberglass surfaces, drives, motors, etc., and fasteners shall not be painted.

2.06 IDENTIFICATION

A. All equipment shall be furnished with a permanently attached manufacturer's nameplate, and model number/serial number/patent number plate.

B. A durable shipping tag shall be securely attached to each package shipped and shall be plainly marked with the mark number corresponding to the installation instructions.

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

PART 3 - EXECUTION

3.01 GENERAL

The metals pretreatment system shall be installed in accordance with the Design Drawings and manufacturer's recommendations.

3.02 FIELD REPRESENTATIVE

A manufacturer's field representative shall be on-site to inspect and test the metals pretreatment equipment and certify that the installation has been performed in accordance with manufacturer's recommendations, and that the system is ready for operation by others. Inspection shall include, but not be limited to, the following:

1. Soundness;
2. Completeness;
3. Correctness of alignment;
4. Leak test; and
5. Level (within ¼" side-to-side and end-to-end).

PART 4 - EQUIPMENT PERFORMANCE

4.01 GENERAL

A. The metals treatment system shall be capable of treating the influent water to achieve the effluent requirements for the parameters listed below at an average flow rate of 100 gpm, at an average temperature of 55°F:

Parameter	Treatment System Influent Concentration (mg/l)	Treatment System Target Effluent Concentration (mg/l)
Iron	49 - 24	<5.0

Note:

mg/l = milligrams per liter.

4.02 PERFORMANCE VERIFICATION

A. The manufacturer shall submit performance verification data for review as part of submittals. This submittal shall consist of data by which the manufacturer's representative shall demonstrate the metals pretreatment system meets all conditions outlined in Part 4 of this section.

B. A performance verification test shall be conducted to confirm the metals pretreatment system meets all conditions outlined in Part 4 of this section for a consecutive period of thirty (30) days and shall include, as a minimum, the following:

MATERIALS AND PERFORMANCE - SECTION 11040

METALS PRETREATMENT SYSTEM

1. The performance verification will not be allowed until a manufacturer's representative has inspected the installation of the metals pretreatment system to ensure proper assembly, erection, and alignment.

2. The performance tests shall be conducted by the Contractor using a laboratory approved by the representatives of the SRSNE PRP Group.

3. Final acceptance of the metals treatment system shall depend upon satisfactory operation, as demonstrated by the field performance evaluation.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 11050

ENHANCED OXIDATION TREATMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. This section covers supply and process performance of the enhanced oxidation treatment system.

2. The enhanced oxidation treatment system shall be manufactured by Vulcan Peroxidation Systems, Inc. or equal and will consist of the following:

   a. Two Model 360 perox-pure modular hydrogen peroxide oxidation units capable of destroying soluble toxic organic contaminants in water. The perox-pure system shall incorporate corrosion resistant fluorocarbon-lined oxidation chambers; horizontally mounted medium pressure UV lamps; indicators to monitor lamp performances; a sequential hydrogen peroxide addition feature to provide easy process optimization; an automatic self-propelled tube cleaning divide; and all other appurtenances required for a complete operating UV/oxidation system.

   b. One Model PM-7000 peroxide storage/feed unit which includes a 7,000-gallon industry standard alloy 5054-H32 storage tank, four(4) peroxide metering pumps, stainless steel interconnecting piping, gauges, sensors, and control panel for tie-in to perox-pure units.

1.02 QUALITY ASSURANCE

A. Warranties

1. The enhanced oxidation system shall be subjected to a complete thirty (30) day trial performance evaluation. If by the end of the 30 day period the system is not performing to design criteria, the representatives of the SRSNE PRP Group may return the system to the manufacturer at no charge.

2. The manufacturer shall warranty all materials and workmanship for a period of one year, effective on the date of performance verification.

3. The manufacturer shall provide a one-year performance guarantee on the treatment of influent water by the enhanced oxidation system under the range of conditions designated in Part 4 of this section, effective on the date of performance verification.

4. The manufacturer shall warranty the structural integrity of the enhanced oxidation system for a period of five years, effective on the date of performance verification.

1.03 SUBMITTALS

A. Shop Drawings

1. The Contractor shall submit shop drawings showing the complete enhanced oxidation treatment system including equipment sizes, widths, weights, and connections.

MATERIALS AND PERFORMANCE - SECTION 11050

ENHANCED OXIDATION TREATMENT SYSTEM

B. Other Submittals

1. The manufacturer shall submit other information including, but not limited to, a listing of equipment components, materials of construction, recommended spare parts list, installation instructions, templates for foundation connections of all supplied equipment, recommended initial start-up procedures, and manufacturer's warranty.

2. The manufacturer shall provide five (5) copies of the following: operation manual (including start-up and shutdown procedures), maintenance manual (including parts listing and preventative maintenance information), and trouble-shooting guide.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

A. All equipment, supports, fasteners, and connectors shall be constructed of maintenance-free materials.

B. Oxidation chamber shall be fluorocarbon-lined 6063-T6 aluminum or 316 stainless steel or equal.

C. Skids and supports shall be carbon steel ASTM A-36 chemical resistant painted or equal.

D. Peroxide piping shall be 316 stainless steel or equal.

E. Process piping shall be Schedule 80 CPVC or equal.

F. Electrical enclosures shall be enameled carbon steel or equal.

2.02 DESIGN

A. The enhanced oxidation system shall consist of two hydrogen peroxide oxidation units designed to remove from water the organic compounds specified in Part 4 of this section from water according to performance requirements under the range of conditions designated in Part 4 of this section.

B. Oxidation Chamber

1. Lamps shall be horizontally mounted and removable without draining the oxidation chamber.

2. The lamp and enclosures shall be provided with hinged and gasketed doors.

3. All UV sensitive materials shall be shielded from the UV rays by material reflective of, or resistant to, UV.

4. The UV lamps shall be protected against contact with the fluid in the event of a leak.

5. Water shall be separated from contact with the UV lamps by quartz tubes sized for optimum lamp operating temperature.

6. The UV/oxidation chamber shall be designed to efficiently distribute and collect the process water throughout the entire oxidation chamber in order to eliminate an uneven flow pattern or

short-circuiting. Piping connections shall be designed so that the UV/oxidation chamber will remain full of fluid after shutdown.

7. The oxidation chamber shall not have chamber penetrations for automatic quartz tube cleaner actuation mechanism.

8. The system shall be equipped with a slide out mechanism to eliminate potential personnel problems with moving and securing the ballast.

9. The units shall be designed such that operators cannot be subjected to UV light.

10. In addition to conventional grounding and insulation, the unit shall employ an external ground fault sensor and a shunt trip. The shunt trip will activate when the primary or secondary exhibits an electrical short of 4 amps or greater.

C. Electrical Enclosures

1. Electrical enclosures shall have hinged and lockable doors.

2. Electrical enclosure cabinets shall be weatherproof. Lamp drive enclosures will be provided with intake and air cooling fans to control the inside temperature. The fans shall operate continuously when the unit is running.

3. Access doors shall have limit switches to shut the power off should the doors be opened.

D. Circuitry

1. All wiring and electrical connections shall be protected against moisture to prevent electrical short or failure. Pressure indicators and temperature switches shall be in weatherproof housing.

2. All wiring and electrical components within the system shall be designed, constructed and installed in accordance with the latest edition of the National Electrical Code and all applicable State and local electrical codes.

3. Circuitry within the lamp drive enclosure shall be protected and disconnected by pre-wired circuit breaker rated at 30,000 amp minimum AIC with external ground fault sensor and shunt trip.

4. Lamp drives shall be of the high-power factor type.

E. Peroxide Feed

Connection for injection of Peroxide in quantities suitable for the process shall be provided. If required by the process, means for complete mixing of the Peroxide and process water, and for variable, staged injection shall be provided.

F. Automatic Cleaner

1. The enhanced oxidation system shall incorporate an automatic quartz tube cleaning system, programmable by the user for variable operation period frequency and duration dependent

upon the requirements of the installation. Cleaner shall be constructed of stainless steel and/or UV resistant materials. The tube cleaner control system shall be capable of changed in both frequency of operation cycles and duration of each cycle. It shall also be capable of automatic variation of these cycles in response to changes in flow rate or signals from a remote control system based on, for example, effluent contaminant concentration.

2. The tube cleaner mechanism shall not require sliding shaft seals through the wall of the oxidation chamber. It shall effectively wipe the lamp tube to prevent accumulation of deposits that interfere with transmittance of UV light from the lamp. To prevent accumulation of deposits on the wall of the oxidation chamber, the wiper shall also clean the inside of the oxidation chamber. The interior of the oxidation chamber shall be finished in a manner to minimize deposits of material.

3. The wiper mechanism shall wipe any point opposite the UV lamp a minimum of 4 times per pass. For extended tube wiper life, the wiper shall be retained in a recess away from the UV lamps so that it is shielded from UV light during the period between cycles. For even wiper wear distribution, the wiper shall be free to rotate around the longitudinal axis of the quartz tube.

2.03 INSTRUMENTATION AND CONTROLS

A. The enhanced oxidation system shall be controlled via a touch-screen interface to a programmable logic controller (PLC) Siemens Model TI 435 or TI 545 or equal. Controls shall be provided to allow automatic operation of the following:

1. Individual UV lamps;
2. Chemical feed pumps;
3. Shutdown of the enhanced oxidation system under certain alarm conditions;
4. Lamps shall be programmed to turn on and shut off with variations in flow;
5. The system will activate the opening and closing of a ball valve following the system to recycle an adjustable amount of water back to the equalization tank; and
6. When the flow through the system is too low, a ball valve located before the enhanced oxidation system will be activated to recycle flow back through to the equalization tank. This will continue until the flow has built up sufficient for its operation.

B. Alarm controls for the enhanced oxidation system shall include:

1. High temperature in lamp drive enclosure;
2. Low water flow (adjustable);
3. High water temperature;
4. Moisture in lamp end enclosure;
5. Access door opening;
6. Remote contact closure;
7. Low peroxide pressure;
8. Low peroxide splitter flow (if splitter is provided);
9. Overpressure relief flow;
10. Low oxidation chamber water level;
11. Tube cleaning system failure;
12. Lamp low current detection;
13. Lamp contactor failure;
14. Emergency stop;

15. Primary ground fault; and
16. Secondary ground fault.

C. Alarm conditions shall be displayed on the touchscreen with "First Out" indicator. Flow indicator calibrated in gpm, with totalizer, shall be provided. A system to indicate the operating status of each lamp shall be provided.

D. An elapsed timer meter shall be provided to indicate the number of hours of module operation. Timer shall be resettable with access codes.

2.04 PAINTING

All exposed metal surfaces (other than stainless steel) shall be corrosion resistant painted.

PART 3 - EXECUTION

3.01 GENERAL

The installation of the enhanced oxidation system shall be in accordance with the manufacturer's recommendations.

3.02 FIELD REPRESENTATIVE

A manufacturer's field representative shall be on-site to inspect and test the enhanced oxidation system equipment and certify that the installation has been performed in accordance with manufacturer's recommendations, and that the system is ready for operation by others. Inspection shall include, but not be limited to, the following:

1. Soundness;
2. Completeness;
3. Correctness of alignment;
4. Leak test; and
5. Level.

PART 4 - EQUIPMENT PERFORMANCE

4.01 GENERAL

The enhanced oxidation system shall be capable of removing the treatment parameters listed below to the given treatment system target effluent concentration from an influent water.

Parameter	Treatment System Influent Concentration (mg/l)	Treatment System Target Effluent Concentration (mg/l)
Organic Compounds		
Trichloroethene	1.3 - 0.81	<0.005
Benzene	<0.58	<0.005

MATERIALS AND PERFORMANCE - SECTION 11050

ENHANCED OXIDATION TREATMENT SYSTEM

Parameter	Treatment System Influent Concentration (mg/l)	Treatment System Target Effluent Concentration (mg/l)
Tetrachloroethene	0.58 - 0.18	<0.005
Toluene	16 - 7.1	<0.005
Ethylbenzene	8.5 - 2.7	<0.005
Total xylenes	2.5 - 1.0	<0.005
Vinyl chloride	2.8 - 1.1	<0.005
Chloroethane	2.8 - 1.0	<0.005
1,1-Dichloroethene	<0.58	<0.005
1,1-Dichloroethane	3.1 - 1.1	0.070
Tetrahydrofuran	5.5 - 1.4	<0.020
cis-1,2-Dichloroethene	8.4 - 3.1	<0.005
1,2-Dichloroethane	<0.58	<0.007
1,1,1-Trichloroethane	2.5 - 1.0	0.26
1,1,2-Trichloroethane	<0.58	<0.014
Methylene chloride	3.0 - 0.88	0.095
Styrene	<0.58	<0.005
Ethanol	<1.0	<1
Methanol	1.4 - 1.1	<1
2-Butanol (sec-Butanol)	57 - 8.5	<1
2-Propanol (Isopropanol)	89 - 14	<1
Acetone	36 - 7.6	0.63
2-Butanone (Methyl Ethyl Ketone)	40 - 7.9	<0.04
4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	6 - 2.1	<0.02

Notes:

1) mg/l = milligrams per liter
2) SU = standard units

MATERIALS AND PERFORMANCE - SECTION 11050

ENHANCED OXIDATION TREATMENT SYSTEM

4.02 PERFORMANCE VERIFICATION

A. The manufacturer shall submit performance verification data for review as part of submittals. This submittal shall consist of data by which the manufacturer's representative shall demonstrate the enhanced oxidation system meets all conditions outlined in Part 4 of this section.

B. A performance verification test shall be conducted to confirm the system meets all conditions outlined in Part 4 of this section for a consecutive period of thirty (30) days and shall include, as a minimum, the following:

1. The performance verification will not be allowed until a manufacturer's representative has inspected the installation of the enhanced oxidation system to ensure proper assembly, erection, and alignment.

2. The performance tests shall be conducted by the Contractor using a laboratory accepted by the SRSNE PRP Group.

3. Final acceptance of the enhanced oxidation system shall depend upon satisfactory operation, as demonstrated by the field performance evaluations.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 11160

LIQUID-PHASE GAC TREATMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. This specification establishes the requirements for the furnishing and installation of two skid mounted liquid-phase granular activated carbon (GAC) units in series as specified herein and shown on the Contract Drawings. Each skid mounted GAC unit shall consist of two vessels interconnected in parallel.

2. The installed GAC units shall have the capability to operate in a number of modes depending on the treatment objectives. Each skid mounted GAC unit shall consist of two vessels, each with a 2,000 pound (lb) carbon capacity. The first skid mounted GAC unit shall be designed to remove any remaining organic compounds, while the second GAC unit shall be designed to remove residual peroxide (from the enhanced oxidation treatment system). The installation and piping arrangement between the two GAC units shall be such that the following operations can be performed:

   - Parallel flow through both vessels of each unit; and
   - Continuous flow through one vessel while the other vessel is out of service for carbon exchange activities

3. Each carbon vessel shall be capable of accommodating a maximum flow of 100 gpm in series or 50 gpm when operated in parallel.

4. The two GAC units shall be Calgon Corporation Model 4 skid mounted granular activated carbon adsorption system or equal.

5. GAC Unit No. 1 shall contain 2,000 lbs of Filtrasorb 100 GAC or equal with a U.S. standard sieve size of 8 x 30. Unit No. 2 shall contain 1,000 lbs of the Calgon Carbon Centaur or equal with a U.S. standard sieve size of 8 x 30.

6. GAC Unit No. 1 shall have upflow backwashing capabilities for both vessels.

1.02 SUBMITTALS

A. The Contractor shall submit the following items for approval by representatives of the SRSNE PRP Group:

1. Written and schematic process description indicating compliance with 1.01 above. The submittal shall include descriptions of all operational modes as well as procedures for carbon exchange.

2. Shop Drawings to scale with all necessary plan and elevation views to identify and locate the two vessels, interconnecting piping, service connections, influent/effluent connections, overall height and width dimensions, and structural support.

3. Detailed design drawings for all ancillary components (valves, piping, vents, etc.) to include materials of construction, type and manufacturer, connection details, and interior and exterior coatings.

4. Information related to the proposed equipment vendor. This information shall include a proposal supplied by the vendor which includes a listing of similar applications and relevant experience.

5. Recommended spare parts listing.

6. Manufacturer's warranty information.

7. Customer service information to include local contact person(s), address, phone number, and billing rates.

8. Specifications for the proposed carbon supply, source, and current material cost.

9. Calculation of the pressure drop across the carbon vessel (including the piping arrangement) at flow rate of 50 and 100 gpm.

10. Operations and maintenance information.

11. Information indicating that the influent parameters have been reviewed and the materials of construction and interior/exterior coatings are suitable for this application. Suitable shall be defined as corrosion-resistant and resistant to general breakdown or deterioration of material.

1.03 APPLICABLE CODES, STANDARDS, AND SPECIFICATIONS

A. American Society of Testing and Materials
B. American Society of Mechanical Engineers
C. American National Standards Institute
D. Steel Structures Painting Council

1.04 PERFORMANCE

A. The influent to the ground-water treatment system will be subject to treatment for the removal of solids, metals, and organic compounds prior to the GAC units. The GAC units installed in series shall be capable of treating hydrogen peroxide to an effluent level of 6.0 milligrams per liter (mg/l).

B. All materials of construction should be compatible with and resistant to the parameters identified in 1.04.A at a pH between 6 and 9.

PART 2 - PRODUCTS

2.01 DESCRIPTIONS

A. Adsorber Vessels

1. Two complete GAC units are required. Each unit consists of two vessels. Therefore, this specification includes four vessels. All four vessels are to be identical with exception to backwash piping.

2. Each vessel shall be cylindrical and pressure rated (75 psig at 150°F). The vessel shall be constructed of carbon steel in accordance with all applicable ASME Codes. The overall vessel height shall be determined based on the height of carbon within the vessel plus an additional 10 to 15 percent margin for bed expansion during upflow backwashing of the carbon.

3. The vessels shall be designed for a downflow application. Vessel penetrations will be required for inlet and outlet connections (2-inch diameter each), carbon exchange piping (carbon dry fill opening in the top 11-inch x 15-inch hand hole and carbon discharge hose connection in the bottom 2-inch kamlock type). All tank penetrations shall be flushed to the inside surface of the vessel and provided with ANSI-rated 150-pound flanges at the connection point outside of the vessel.

4. The underdrain collection system shall be designed to retain the carbon material while allowing passage of water at the design flow with minimal pressure drop. The materials of construction shall be compatible with the water characteristics. Only carbon material indicated in 2.02 shall be placed within the vessel.

5. Vessel coating shall be in accordance with 2.01D.

6. The external surface of each vessel shall be manufactured with the openings, and other appurtenances specified herein or on the Design Drawings. All fittings shall be installed by the vessel manufacturer at the time and place of manufacture. Under no conditions shall fittings be changed or tank modifications conducted in the field by the Contractor without the written approval of the manufacturer.

B. Process and Utility Piping

1. The interconnecting piping between the two vessels of a given carbon unit shall be the responsibility of the carbon system vendor. The piping arrangement shall be capable of complying with the requirements of 1.01.A.2. The interconnection between the two carbon systems shall be the responsibility of the Contractor.

2. All piping shall be ASTM A53 Grade B carbon steel rated for 150 psig at 500°F. Flanges shall be cast iron, ASTM A126, Class A, drilled for Class 150.

3. A 2-inch gravity drain line shall be installed along the base of carbon system to collect and drain the GAC vessel.

4. A pressure relief rupture disk shall be provided with each vessel to provide pressure relief for the tank at an internal pressure of approximately 72 psig.

5. Each activated carbon vessel for GAC Unit No. 1 shall include connections to allow the introduction and exit of backwash water. The connections shall be easily accessible. The pipe and valve sequence shall be such that backwash water is introduced to the activated carbon unit with a minimum of valve operations.

C. Steel Skid Installation

1. Each GAC unit shall be provided with a steel skid for mounting two adsorber vessels and containment of piping (not transport of system). Each skid shall consist of steel channels

and all necessary cross bracing. Slots shall be provided in supporting channels for installation on foundation if required. The steel skid shall be finish painted similar to the exterior of the carbon steel piping as described below.

D. Interior/Exterior Coatings

1. All adsorber surfaces are to be degreased prior to sandblasting and painting. The adsorber internal surface that will be lined shall be blasted to a white metal surface to provide an anchor pattern in the metal corresponding to a degree of profile of 4 mils, minimum. The exterior of the adsorbers shall be sandblasted or power tool cleaned to the degree specified by SSPC-SP2-63.

2. The interior of the adsorbers that will be in contact with the GAC shall be lined to prevent corrosion that will occur when wet activated carbon is in contact with carbon steel. This lining shall also exhibit abrasion-resistant qualities to prevent erosion by movement of the granular media.

   Following cleaning of the exterior, finish painting using a two-coat epoxy mastic coating system prior to the formation of any rust. The two-coat system shall consist of a high solids, polyamine/bisphenol, an epoxy formulation.

3. The exterior of the piping shall be power tool cleaned to the degree specified by SSPC-SP3-63 with a finish exterior painting of a two-coat epoxy mastic coating system for outside service, which must be applied to the exterior of the piping before rust can form.

E. Carbon Exchange

When the carbon in one of the vessels becomes saturated with contaminants adsorbed from the water, this vessel shall be taken out of service to replace the spent GAC with fresh GAC. The flow shall be diverted to the remaining adsorber allowing the treatment system to remain in service. The adsorber is pressurized with compressed air (30 psig) and the spent carbon is displaced into a receiving trailer. Fresh carbon can be transferred as a slurry from a delivery container to the empty adsorber utilizing pressure.

2.02 ACTIVATED CARBON

A. The activated carbon for GAC Unit No. 1 shall be Calgon Filtrasorb 300 or approved equal.

B. The activated carbon for GAC Unit No. 2 shall be Calgon Centaur 8 x 30 or approved equal.

C. Each vessel of GAC Unit No. 1 shall be provided with 2,000 pounds of GAC. Each vessel of GAC Unit No. 2 shall be provided with 1,000 pounds of GAC. The activated carbon shall be granular and manufactured from bituminous coal. The two GAC units shall conform to the following specifications:

Property	GAC Unit No. 1	GAC Unit No. 2
Iodine No. (minimum)	900	800
Abrasion No. (minimum)	75	75

MATERIALS AND PERFORMANCE - SECTION 11160

LIQUID-PHASE GAC TREATMENT SYSTEM

Property	GAC Unit No. 1	GAC Unit No. 2
Effective Size	0.8 - 1.0 mm	1.5 - 1.7 mm
Screen Analysis:		
Larger than No. 8 mesh (maximum %)	15%	15%
Smaller than No. 30 mesh (maximum %)	4%	4%
Water Soluble Ash (maximum %)	1	8
Moisture, as packed (maximum %)	2	2

The delivered activated carbon must be accompanied by an analysis sheet certifying compliance with the specifications.

2.03 SPARE PARTS

The Contractor shall provide all spare parts, repair kits, or calibration instruments as recommended by the carbon system manufacturer as part of the purchase of the system at no added cost to the SRSNE PRP Group.

PART 3 - EXECUTION

3.01 INSTALLATION

The installation of the activated carbon units shall be in accordance with the manufacturer's recommendations.

3.02 PERFORMANCE TESTS

Following installation, the adsorption system shall be pressure tested at the design rating for the vessel to check the tanks, piping, and valves for leakage.

3.03 WARRANTIES

The system supplier shall warrant the system to be free from defects in materials and workmanship for a period of 18 months from delivery of equipment or one year from start-up of the adsorption system, whichever occurs first.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 11170

AIR TREATMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Specified

1. This specification dictates the responsibility of the Contractor in furnishing and installing an air treatment system for the extraction and treatment of off-gas emissions from the process equipment venting system.

2. The work specified in this section includes the furnishing and installation of two blowers (one as an installed spare), two granular activated carbon (GAC) air treatment vessels installed in parallel, connecting ductwork from the GAC vessels, vent piping, and an exhaust stack vent from treatment vessel.

3. Also to be supplied is ancillary equipment necessary for the removal and replacement of spent carbon from the system.

1.02 SUBMITTALS

A. Shop drawing of GAC vessels, blowers, and all related equipment, showing dimensions, materials, and sizes of unit components.

B. Air flow versus pressure drop curve for submitted vessel.

C. Performance curve for submitted blowers.

D. Operations and maintenance manual.

E. List of manufacturer's recommended spare parts.

1.03 APPLICABLE CODES, STANDARDS AND SPECIFICATIONS

A. American Society of Testing and Materials.

B. All ductwork shall be in accordance with SMACNA Standards.

C. All coils and filters are to be ARI rated.

D. All fans to be AMCA capacity and sound power rated.

E. All terminal air delivery devices to be ADC rated.

1.04 PERFORMANCE

A. The treatment of the off gas emissions from the process equipment venting system shall be by GAC contained in a modular, prefabricated unit capable of effectively treating an air flow of 700 SCFM.

MATERIALS AND PERFORMANCE - SECTION 11170

AIR TREATMENT SYSTEM

PART 2 - PRODUCTS

2.01 DESCRIPTION

A. Vapor-Phase GAC Units

1. The vapor-phase GAC units shall be of similar dimensions as shown on the Design Drawings.

2. The vapor-phase GAC units shall contain 1,000 pounds of carbon material. The units shall be Carbtrol Model G-4 or equal. The GAC shall be supported within the canister by an FRP grating.

3. The vapor-phase GAC units shall contain inlet and outlet flanged fittings. In addition, a drain port with removable plug shall be included along the bottom edge of the unit.

B. Ductwork Connections

1. The connection of the inlet opening of the vapor-phase GAC units to the vent piping and the exhaust vent from the unit shall be coordinated with the requirements of the system.

2. The exhaust vent located over each vented unit shall be designed to allow removal of the cover without removal of the vent. The vent shall be securely attached to the roof framing system. The vent shall be designed and fabricated with a support collar and bracing connection as required to resist all horizontal and vertical loads. Design and fabrication detail will be coordinated with the Pre-Engineered Metal Building System manufacturer.

C. Sampling Ports

Sample ports of a type recommended by the manufacturer shall be installed to monitor the treatment effectiveness of the system.

D. Blowers

1. Blowers shall be belt driven, centrifugal type, with field rotatable housing and shall be licensed to bear the AMCA seal.

2. Blower housing, inlet cone and wheel shall be aluminum fabrication, and the polished steel shaft shall be covered with an aluminum sleeve. Unit shall be AMCA Type A spark-resistant construction, with no bearings, drive components, or electrical devices located in the air stream.

3. Bearings shall be relubricable type, heavy duty, self-aligning, shielded, mechanically sealed, and shall have a minimum L-10 life of 50,000 hours.

4. Motors shall be explosion proof, and unit shall be provided with variable pitch sheaves. Sheaves shall be selected such that actual operating conditions are met with the sheaves at the approximate mid-point of adjustment.

5. Unit capacity shall be 700 CFM at 8" water column.

MATERIALS AND PERFORMANCE - SECTION 11170

AIR TREATMENT SYSTEM

6. Manufacturer & Model to be Hartzell Series 052 AH or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

The installation of the GAC unit for treating the tank venting emissions shall be in accordance with the Design Drawings, approved Shop Drawings, and manufacturer's recommendations.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 13600

PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. All labor, material, and equipment necessary to design, fabricate, and erect the pre-engineered metal building system as indicated on the Design Drawings and as specified herein.

B. All labor, material, and equipment necessary to design, install, and start-up building electrical, lighting, heating, and ventilating systems as specified herein.

1.02 QUALITY ASSURANCE

The pre-engineered building system shall be the design of a manufacturer regularly engaged in the fabrication of pre-engineered structures conforming as specified hereafter to the metal building manufacturers association standards.

1.03 DESCRIPTION

A. The building covered by this specification is a clearspan rigid frame (RF) as manufactured by Varco Pruden Framing Systems or equal. The building shall have a gabled roof. The stability shall be obtained from the wall and roof panels which shall combine both the structural support and cover in one unit. Purlins shall be utilized and girts shall be inset mounted with the columns.

B. The gabled roof slope starting at both side wall eaves and terminating at the ridge shall not be less than one unit of rise (vertical) to twelve units run (horizontal).

1.04 DESIGN BASIS

A. Steel Construction Manual of American Institute of Steel Construction, current edition and American Iron and Steel Institute's "Specification For The Design of Cold-Formed Steel Structural Members" of current edition. American Welding Society "Code for Welding in Building Construction" of current issue.

B. ASTM standards as amended to date: A-325 for Quenched and Tempered Steel Bolts; A-307 for Steel Machine Bolts and Nuts; ANSI Standard B1-1-60 for determining tensile stress area of threaded ends of rods.

C. The roof purlin system shall be supported by the endwalls and the interior frame. The eave strut shall frame into and between the columns and the endwalls. The rake girt shall frame into and between the eave strut and ridge purlins. Intermediate wall girts shall not be permitted.

D. The roof and wall panels, purlins, and the frame, properly braced and tied shall be designed to carry all vertical and horizontal loads. All horizontal loads shall be resisted by the walls and frame. The roof system shall distribute all racking forces from horizontal loads to the frames by diaphragm action or by a supplemental tension bracing system.

E. The building system shall also be designed to support the miscellaneous appurtenant loads such as lights, unit heaters, piping conduits, equipment, etc., as shown on the Design Drawings and as specified in other sections. Provide additional frame around all openings as required to support all loads.

MATERIALS AND PERFORMANCE - SECTION 13600

PRE-ENGINEERED METAL BUILDING SYSTEM

F. Rigid frames shall be of tapered and/or constant sections considered as hinged at the base, with field bolted tension-type splices at each haunch and at the ridge.

G. The purlins and intermediate wall girts shall be considered as simple span beams.

H. Door and louver openings and all penetrations shall be designed to structurally replace the sidewall panels displaced.

1.05 DESIGN CRITERIA

The metal building system shall be designed and constructed in accordance with Connecticut State Building Code - Connecticut Supplement dated June 15, 1994, and all Town of Southington, Connecticut Zoning Regulations effective May 20, 1957, as amended through November 23, 1993.

1.06 SUBMITTALS

A. Shop Drawings

1. Submit detailed shop and erection drawings showing all pertinent information necessary for the fabrication and erection of the building system.

2. Anchor bolts and other embedded items in the concrete shall be indicated on the shop drawings.

3. Color selection charts for interior and exterior wall panels, roof panels, and doors.

4. Manufacturers literature on the overhead door and the mandoor and associated hardware.

5. All wall penetrations proposed by the Contractor shall be waterproof, structurally sound, and amenable to pipeline movement. The Contractor shall coordinate with representatives of the SRSNE PRP Group for development and installation of any wall penetrations for piping.

6. Prior to obtaining any material in connection with electrical work, detailed shop drawings shall be submitted in accordance with each section. In addition to equipment data, shop drawings shall be submitted for review which show proposed raceway layout, electrical equipment layout, grounding system layout, interconnecting wiring, and elementary diagrams.

7. Electrical service one-line diagram.

B. Design Computations

1. All computations and drawings shall carry the stamp of a registered professional engineer fully licensed to practice in the State of Connecticut.

2. All loads and reactions for the proper design of the foundation shall be supplied by the system manufacturer.

MATERIALS AND PERFORMANCE - SECTION 13600

PRE-ENGINEERED METAL BUILDING SYSTEM

1.07 GUARANTEES

Upon completion of the building system, the Contractor shall furnish representatives of the SRSNE PRP Group with two copies of the manufacturer's guarantee for the following items.

A. The materials used in the building system shall carry a guarantee against defects in composition, design, and workmanship for a period of five years.

B. The erection and installation of the building system shall carry a guarantee against defects in workmanship for a period of one year.

1.08 ACCESSORIES

The Contractor shall provide cut-sheets, manufacturer literature, and shop drawings showing the locations of all components listed below. Upon review of these shop drawings, the Contractor shall provide the following accessories:

A. Overhead doors shall be insulated steel coil door with hand-chain hoist.

B. Mandoors shall be insulated steel.

C. Ventilation

Building ventilation shall be provided to maintain temperatures below 100°F (consult Enhanced Oxidation System manufacturer for information pertaining to temperature rise associated with treatment equipment).

D. Electric Heat

Unit heaters shall be provided as necessary to maintain building temperature above freezing.

E. Lighting Fixtures and Receptacles

Building shall be provided with adequate lighting for both inside and outside.

F. Security Access System

1. Keyed-alike door locks shall be provided on all mandoors.

2. An unauthorized entry alarm shall be provided for all doors and interconnected to the main system control panel and autodialer.

G. New Electric Service

1. Coordinate with utility to provide the required new electric service to the treatment system building.

MATERIALS AND PERFORMANCE - SECTION 13600

PRE-ENGINEERED METAL BUILDING SYSTEM

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials shall be new, free from defects and imperfections, fabricated in a workmanlike manner and shipped with necessary protection to assure delivery in first-class condition.

B. Wall panels shall be Span Loc, interlocking 24 gauge minimum, with a Kynar finish.

C. Roof panels shall be standing seam roof type, 24 gauge minimum, interlocking, with a Kynar finish.

D. Metal eave trim and fascia shall be 26 gauge minimum with a Kynar finish.

E. The interior metal wall liner shall be 26 gauge minimum painted steel.

F. Roof insulation shall be blanket-type, 6-inch thick minimum with a vapor resistant membrane. Insulation shall be placed over the roof support members.

G. Wall insulation shall be 4-inch thick minimum with a vapor resistant membrane.

PART 3 - EXECUTION

3.01 FABRICATION

All components of the structure will be fabricated in accordance with the reviewed shop drawings to form a completely watertight and weatherproof structure.

3.02 ERECTION

Complete erection of the building shall be by the manufacturer or its authorized representative. The authorized representative shall be skilled in the successful erection of pre-engineered metal building systems.

- END OF SECTION -

MATERIALS AND PERFORMANCE - SECTION 16101

ELECTRICAL GENERAL

PART 1 - GENERAL

1.01 WORK INCLUDED

This section shall include general requirements for all electrical work performed.

1.02 REFERENCES

Where applicable, specified, and shown, the latest revisions to the following standards and codes shall be met except where more stringent requirements have been specified:

A. Local Building Codes
B. National Fire Protection Association - NFPA
C. National Electrical Code - NEC
D. Underwriters Laboratories, Inc. - UL
E. National Electrical Manufacturers Association - NEMA
F. Institute of Electrical and Electronic Engineers - IEEE
G. American Society of Testing Materials - ASTM
H. Insulated Cable Engineers Association - ICEA
I. Association of Edison Illuminating Companies - AEIC
J. American National Standard Institute - ANSI
K. Occupational Safety Hazards Act - OSHA
L. Instrument Society of America Standard - ISA
M. Factory Mutual Engineering & Research Corporation - FM

1.03 SUBMITTALS

A. Prior to obtaining any material in connection with electrical work, detailed shop drawings shall be submitted in accordance with each section.

B. Prior to obtaining any material in connection with general electrical equipment, detailed shop drawings shall be submitted for approval that show proposed raceway layout, electrical equipment layout, grounding system layout, interconnecting wiring and elementary diagrams.

1.04 QUALITY ASSURANCE

A. Unless otherwise specified, equipment or material of the same type, used for the same purpose shall be products of the same manufacturer. All material shall be new and of the latest design of the manufacturer providing equipment or material.

B. Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be manufactured in conformity with NEMA, IEEE, or other applicable technical standards and shall have neat and finished appearance.

C. Install equipment in neat and workman like manner; align, level and adjust for satisfactory operation; install so that parts are easily accessible for inspection, operation, maintenance and repair. Deviations from indicated arrangements are subject to review and approval prior to installation.

MATERIALS AND PERFORMANCE - SECTION 16101

ELECTRICAL GENERAL

1.05 INSPECTION

A. The work shall be subject to inspection by a representative of the state and local authorities having jurisdiction, and all work shall pass such inspection.

B. The Contractor shall furnish to representatives of the SRSNE PRP Group a certificate of compliance of the completed installation with the requirements of the NEC. This certificate shall be completed by the agency listed above.

1.06 DESIGN DRAWINGS

A. Equipment Location

1. The locations of equipment, fixtures, outlets and similar devices shown on the Design Drawings are approximate only.

2. The Contractor shall determine the exact locations of the equipment, outlets, box-outs, sleeves of similar items required for the coordination of electrical work with the structural, architectural, mechanical or other work.

B. Drawings Diagrammatic

1. Circuit diagrams shown are diagrammatic and functional only and are not intended to show exact circuit layouts, number of fittings, or other installation details. The Contractor shall furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown.

2. Conduits beyond first pushbutton and control device and conduits containing lighting circuits beyond panelboards are not scheduled.

a. The number of conductors shown is not necessarily the correct number required.

b. As many conductors as are required in each case shall be installed.

c. A ground conductor shall be furnished with every electrical circuit.

1.07 SAFETY

A. Construction Safety

1. Contractors shall furnish and place proper guards for prevention of accidents, provide all trench shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, or other safety features required to secure safety of life or property. Provide and maintain sufficient lights during night hours to secure such protection.

2. Contractors shall furnish and install all necessary safety warning devices such as flags, signs, etc. as required for their work.

3. Overhead work shall be done only if area below is clear of all personnel.

B. Electrical Safety

1. Any energized electrical system panel board cover, removed in processing a job, shall be replaced immediately any time the job site is to be unattended by the Contractor personnel.

2. All electrical work for providing temporary power and lighting for construction shall be in accordance with NEC and OSHA.

1.08 PROTECTED WORK

A. Plywood backing panels for interior electrical equipment shall be $^3/_4$-inch flame retardant treated, standard grade interior type plywood with exterior glue. Exterior plywood panels shall be $^3/_4$-inch painted marine plywood.

B. In the areas designated as Hazardous and where explosion-proof work is shown or specified, all work shall meet the requirements of the NEC for Class 1, Division 1 locations.

C. Where installed outdoors or in areas designated as wet locations, all work shall meet the requirements of the NEC for wet locations.

1.09 DELIVERY, HANDLING, AND STORAGE OF MATERIAL

A. Materials and equipment shall be delivered to the site of the work in their original containers, and containers shall not be opened until inspected by representatives of the SRSNE PRP Group.

B. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damaged by water.

1. If any apparatus has been damaged, such damage shall be made good by the Contractor.

2. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried and put through such special tests as will be directed by representatives of the SRSNE PRP Group, or at the discretion of representatives of the SRSNE PRP Group shall be replaced by the Contractor.

1.10 COORDINATION

Contractor shall coordinate with Utility to establish a mutually agreed upon schedule compatible with the requirement of the project.

- END OF SECTION -

Appendix F

Key Design Calculations and Vendor Information

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
Lyons F - Design Calculations and Vendor Information				

Table of Contents

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
[illegible]				1

A. Tanks

1. Equalization Tank
Size = 14 feet diameter × 9 feet high
Volume = 10,362 gallons
Flow = 100 gpm
Retention Time = 10,000 / 100 = 100 minutes

Provide 1 foot free board on tank
Actual Size = 14 feet diameter × 10 feet high

2. Clarifier Feed Tank
Size = 6 feet × 6 feet × 4 feet height
Volume = 1077 gallons
Flow = 100 gpm
Retention Time = 1,000 / 100 = 10 minutes

3. Oxidation Feed Tank and GAC Feed Tank
Size = 8 feet × 8 feet × 6.5 feet height
Volume = 3111 gallons
Flow = 100 gpm
Retention Time = 3,000 gallons / 100 gpm = 30 minutes

Provide 1 foot free board on tank
Actual Size = 8 feet × 8 feet × 8 feet height

SUBJECT	PROJ. NO.	BY	DATE	SHEET
I [illegible]				

B. [illegible]

1. Equalization Tank = 10,000 gallons [illegible]

Velocity Gradient (G) = 250 sec^{-1}

$G = \sqrt{550P / V\mu}$ where P = horsepower

V = Volume = 1337 ft^3

μ = viscosity = 2.5 × 10^{-5} [illegible]

$G = \sqrt{550P / 1337(2.5 \times 10^{-5})}$

$250 = \sqrt{550P / 1337(2.5 \times 10^{-5})}$

$250 = \sqrt{16455P}$

P = 3.80

2. Clarifier ~~feed~~ Tank = 1,000 gallons

Velocity Gradient (G) = 250 sec^{-1}

$G = \sqrt{550P / V\mu}$ V = 133 [illegible]

μ = 2.5 × 10^{-5} lb-s/ft^2

$250 = \sqrt{550P / 133(2.5 \times 10^{-5})}$

$250 = \sqrt{165377P}$

P = .38

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
I. Treatment System Basis of Design				1

E. Agitator Design

3. Oxidation Feed Tank = 3000 gallons

Velocity Gradient (G) = 250 sec

$G = \sqrt{550P / V\mu}$ $V = 401$

$\mu = 2.5 \times 10^{-5}$

$250 = \sqrt{550P / 401(2.5 \times 10^{-5})}$

$250 = \sqrt{54849P}$

$P = 1.140$

4. Fast Mix Chamber 200 gallons

$G = \sqrt{550P / V\mu}$ $V = 26.74$

$\mu = 2.5 \times 10^{-5}$

$250 = \sqrt{550P / 26.74(2.5 \times 10^{-5})}$

$P = 0.076$

Both fast and slow mix chambers will be provided with 1/4 HP Agitators

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
[illegible]				

C. Chemical Addition

1. Caustic Soda Addition

Addition Rate [illegible] $= 40\ \frac{mg}{l}$

Caustic Content $= 15\%$

$$40\ \frac{mg}{l} \times 0.15 = 6\ \frac{mg}{l}\ @\ 100\%$$

$$= 12\ \frac{mg}{l}\ @\ 50\%$$

Flow Rate = 100 gpm

Addition Rate $= 12\ \frac{mg}{l}$

Caustic Weight at 50% = [illegible] $\frac{lb}{gal}$

Usage:

$$100\ \frac{gal}{min} \times 12\ \frac{mg}{l} \times 3.8\ \frac{l}{gal} \times \frac{lb}{454{,}000\ mg} \times \text{[illegible]} \times \text{[illegible]}$$

= [illegible] gal / day

= [illegible] gal / [illegible]

Specify Metering Pump at [illegible] to [illegible] gal / [illegible]

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
[illegible]				

C. Chemical Addition (cont)

2. Sulfuric Acid Addition

Addition Rate (assumed 2 to 1.22 ratio) 4.8 mg/l [illegible]

Addition Rate using 93% active = 5.16 mg/l
Acid Weight at 93% = 14.2 lb/gal
Usage:

$\frac{100 \text{ gal}}{\text{min}} \times \frac{5.16 \text{ mg}}{l} \times \frac{3.8 \, l}{\text{gal}} \times \frac{\text{lb}}{454{,}000 \text{ mg}} \times \frac{1 \text{ gal}}{14.2 \text{ lb}} \times \frac{1440 \text{ min}}{\text{day}}$

$= 0.44$ gallons/day

$= 0.018$ gallons/hour

Specify Metering Pump at 0.009 — 0.036 gallons/hour

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
[illegible]				

C. Chemical Addition (cont.)

3. Polymer Addition

Flow = 100 gpm

Addition Rate (treatability test [illegible]) = 1 mg/L

Polymer Weight = 8.6 $\frac{lbs}{gallon}$ (assumed)

$100 \frac{gal}{min} \times \frac{1\ mg}{L} \times 3.8 \frac{L}{gal} \times \frac{1\ lb}{454{,}000\ mg} \times \frac{1\ gal}{8.6\ lb} \times \frac{1440\ min}{day}$

$= 0.14$ gal/day

$= 0.006$ gal/hr

* Specify Metering Pump at 0.003 to [illegible] gal/hr

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
I Treatment System Calculations				

D. Sludge Production

Flow = 100 gpm
Suspended Solids = 50 mg/l

$100 \frac{gal}{min} \times 1440 \frac{min}{day} \times 8.34 \frac{lb}{gal} \doteq 1200{,}000$

$1{,}200{,}000 \times \frac{50}{1{,}000{,}000} = 60 \frac{lb}{day}$ dry sludge

$60 \frac{lb}{day} \times \frac{1 \text{ gal}}{8.34 \text{ lbs}} = 7.2 \frac{\text{gallons}}{\text{day}}$ dry solids

$7.2 \frac{\text{gallons}}{\text{day}}$ (dry solids) = 30% of total concentration

$60 \frac{\text{lb dry sludge}}{\text{day}} \times \frac{100 \text{ lb filter cake}}{35 \text{ lb solids}} \times \frac{ft^3 \text{ filter cake}}{90 \text{ lb}}$

$= 1.9 \frac{ft^3 \text{ filter cake}}{\text{day}}$

Size Filter Press for 7 days = 13.3 ft^3

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS

SUBJECT	PROJ. NO.	BY	DATE	SHEET
I. [illegible]				

E. Gravity Thickening Tank

Sludge Quantity = 60 lb/day
Concentration (from clarifier) = 1% (assumed)
Solid loading Criteria = 10 lb/ft^2/day
Size Thickener for 2 week volume = 840 lb

$$\text{Tank Area} = \frac{840 \text{ lb/2 wks}}{10 \text{ lb/ft}^2\text{/2 wks}} = 84 \text{ ft}^2$$

$$\text{Diameter} = \left(\frac{84 \times 4}{\pi}\right)^{1/2} = 10.3 \text{ feet}$$

Depth = 10 feet (standard [illegible])

$$\text{Volume of Applied Sludge} = \frac{840}{0.01 \times 62.4} = 1346 \ [illegible]$$

= [illegible]

= 7[illegible] gpd

$$\text{Overflow Rate of Applied Sludge} \ \frac{[illegible]}{84} = 8.56 \ \frac{\text{gpd}}{\text{ft}^2}$$

Underflow Concentration [illegible] (assumed)

$$\text{Volume of Thickened Sludge} = \frac{840 \ [illegible]}{[illegible]} = 135 \ \frac{\text{ft}^3}{2 \text{ wks}}$$

= [illegible]

Storage [illegible]
(assume 3 ft [illegible])

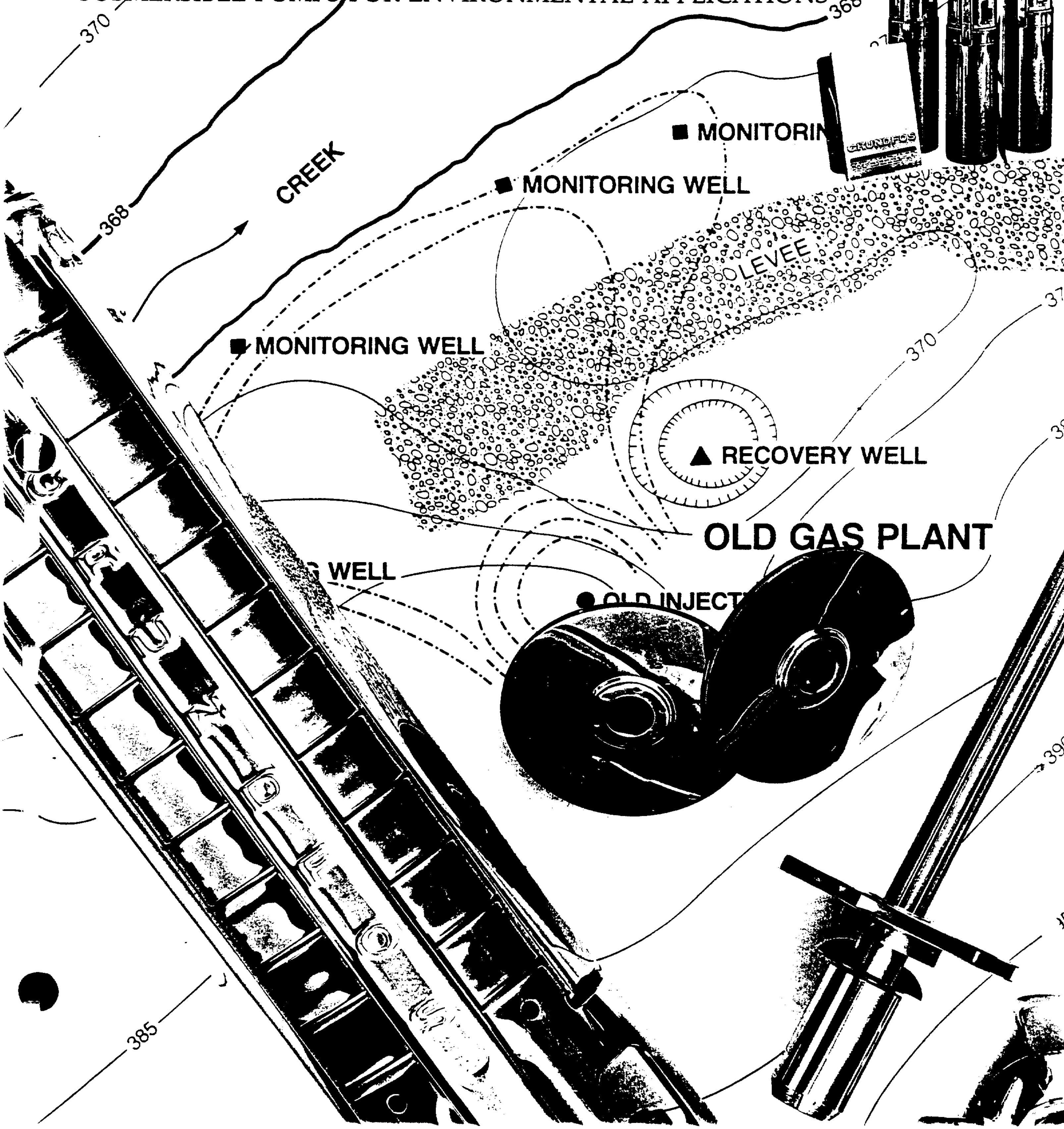
$$= \frac{84 \times 3 \times 2 \text{ wks}}{135 \text{ ft}^3/2 \text{ wks}} = 1.86 \text{ wks}$$

II. Vendor Information
A. Well Pumps

GRUNDFOS

Redi-Flo4

SUBMERSIBLE PUMPS FOR ENVIRONMENTAL APPLICATIONS

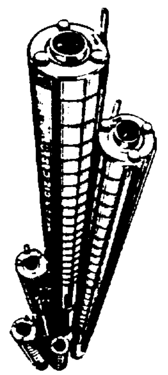


GRUNDFOS

Redi-Flo4
Environmental
Submersible Pumps

10E

Submittal Data 3450 RPM 60 Hertz



JOB or CUSTOMER:

ENGINEER:

CONTRACTOR:

SUBMITTED BY: DATE:

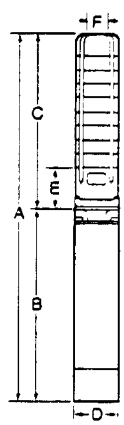
APPROVED BY: DATE:

ORDER NO.: DATE:

SPECIFICATION REF.:

QUANTITY	TAG NO.	MODEL NO.	GPM	FEET	VOLT	PHASE	COMMENT

Dimensions



Technical Data

FLOW RANGE: 5 to 14 US GPM

MOTORS: Grundfos MS402E Environmental Submersible Motor (Standard)
Maximum Operating Temperature: 104°F (40°C)
Maximum Operating Pressure: 220 PSI
Maximum Number of Starts Per Hour: 100
Minimum Recommended Flow Past Motor: 0.25 ft/sec
(NOTE: Franklin Pollution Recovery motor is optional.)

DISCHARGE SIZE: 1¼" NPT

PUMP END CONSTRUCTION MATERIALS: Stainless Steel and Teflon®

INSTALLATION: Unit to be installed vertically for submerged operation.

Electrical Data, Dimensions, and Weights ①

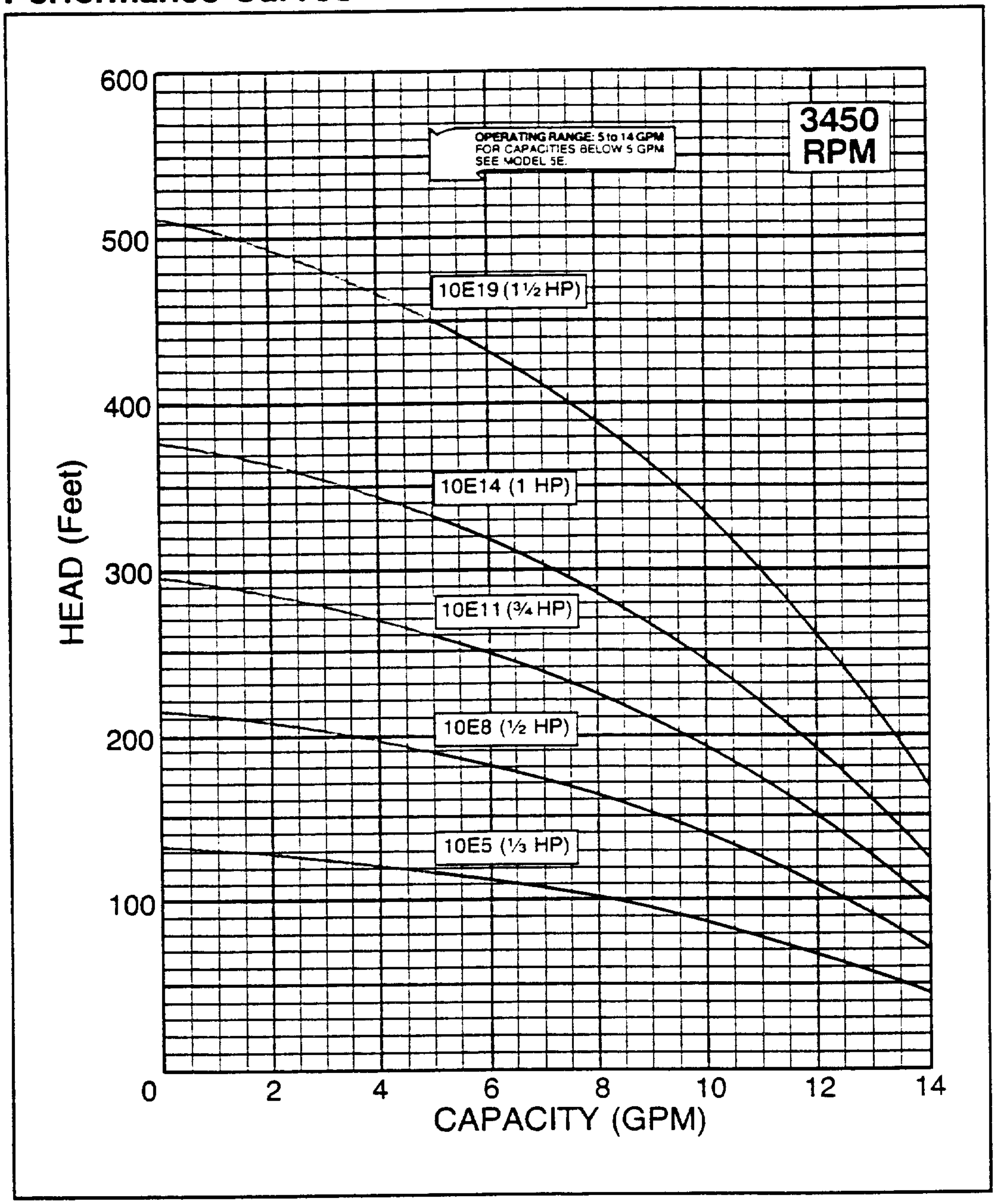
PUMP TYPE	MOTOR				DIMENSIONS (In Inches)						NET WEIGHT (LBS.)②	SHIP. WEIGHT (LBS.)②
	HP	SF	PH	VOLTS	OVERALL LENGTH A	MOTOR LENGTH B①	PUMP END LENGTH C	MAX. DIA. D	INLET E	DISCH. PIPE SIZE (NPT) F		
10E5	⅓	1.75	1	230	20 5/16	10	10 5/16	3 31/32	3 ¼	1 ¼	24	25
10E8	½	1.60	1	230	23 9/16	10 13/16	12 ¾	3 31/32	3 ¼	1 ¼	26	28
10E11	¾	1.50	1	230	26 9/16	11 ⅜	15 3/16	3 31/32	3 ¼	1 ¼	28	30
10E14	1	1.40	1	230	29 11/16	12	17 11/16	3 31/32	3 ¼	1 ¼	31	32
10E19	1 ½	1.30	1	230	35 ⅜	13 9/16	21 13/16	3 31/32	3 ¼	1 ¼	35	37

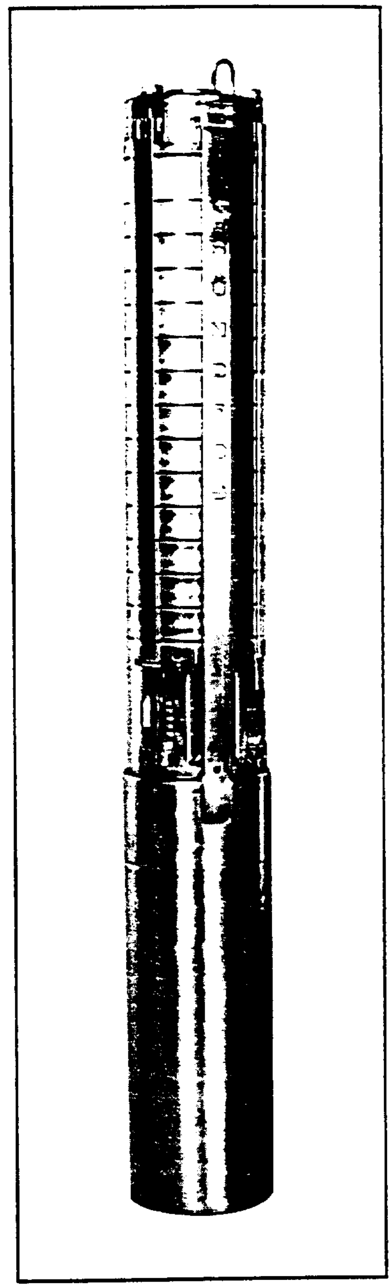
① Data for Grundfos MS402E motors. ② Does not include motor leads.

10E

Redi-Flo4 Environmental Pump

Performance Curves





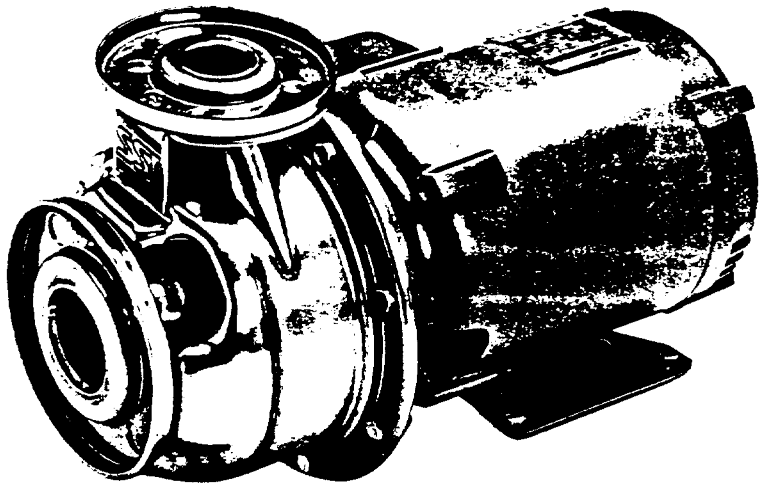
Materials of Construction

REDI-FLO4 PUMP END	
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Check Valve Seat	304 Stainless Steel & Teflon®
Diffuser Chamber	304 Stainless Steel
Impeller Seal Ring	Teflon®
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Pump Shaft	304 Stainless Steel
Coupling	329/420/431 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Priming Inducer	304 Stainless Steel
Intermediate Bearings	Teflon®

NOTE: Specifications are subject to change without notice.

GRUNDFOS ENVIRONMENTAL MOTOR	
Nema Top	304 Stainless Steel
Studs & Fasteners	304 Stainless Steel
Nuts	316 Stainless Steel
Sand Slinger	Viton®
Shaft Extension	431 Stainless Steel
Diaphragm	Viton®
Stator Housing	304 Stainless Steel
Fill Plug Screw	304 Stainless Steel
Fill Plug Washer	Teflon®

GRUNDFOS ENVIRONMENTAL MOTOR LEADS	
Connector Sleeve	304 Stainless Steel
Connector Potting	Scotch Cast #4® Epoxy w/Viton® Cap
Connector Plug	Viton®
Lead Insulation	Teflon®



G&L
STAINLESS STEEL

Close-Coupled Centrifugal Pump

MODEL

SST-C

S-Group

FEATURES

Close-Coupled Design:
Compact design saves space and simplifies maintenance.

Superior Materials of Construction:
AISI TYPE 304 Stainless Steel for reduced corrosion and improved strength and ductility.

Back Pull-out Design:
Simplifies pump maintenance and reduces down-time.

Rigid Motor Adapter:
Cast Iron material for maximum support and alignment accuracy.

Mechanical Seal:
Standard John Crane Type 21 Seal interchangeable on Models 3656 and 3657 for reduced inventory requirements.

Drive Motors:
NEMA Standard JM shaft motors 1 or 3 phase interchangeable with Models 3656 and 3657.

Suction and Discharge Flanges:
Standard 150 lb. ANSI raised face flange connections.

APPLICATIONS

Specifically designed for all traditional Cast Iron or Bronze fitted water and low grade corrosive services.

- Water circulation
- Booster systems
- Liquid transfer
- HVAC pump replacements
- General service pumping

SPECIFICATIONS

Capacities to...
500 GPM (114m³/hr) at 3500 RPM
250 GPM (57m³/hr) at 1750 RPM

Heads to...
450 ft. TDH (128m) at 3500 RPM
110 ft. TDH (33m) at 1750 RPM

Maximum Working Pressure to...
230 PSI (15 bars)

Maximum Temperature to...
212°F (100°C) with standard seal
or
250°F (121°C) with optional high temperature seal

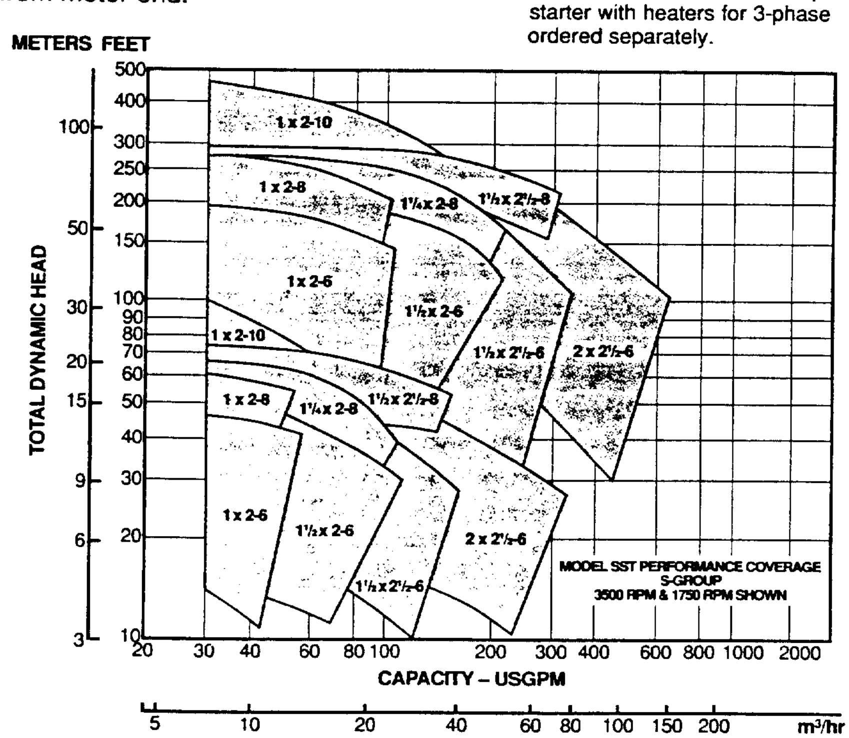
All Wetted Components of AISI TYPE 304 Stainless Steel

Rotation clockwise when viewed from motor end.

Enclosed Impeller and replaceable Wear Ring for high efficiency and maximum wear life.

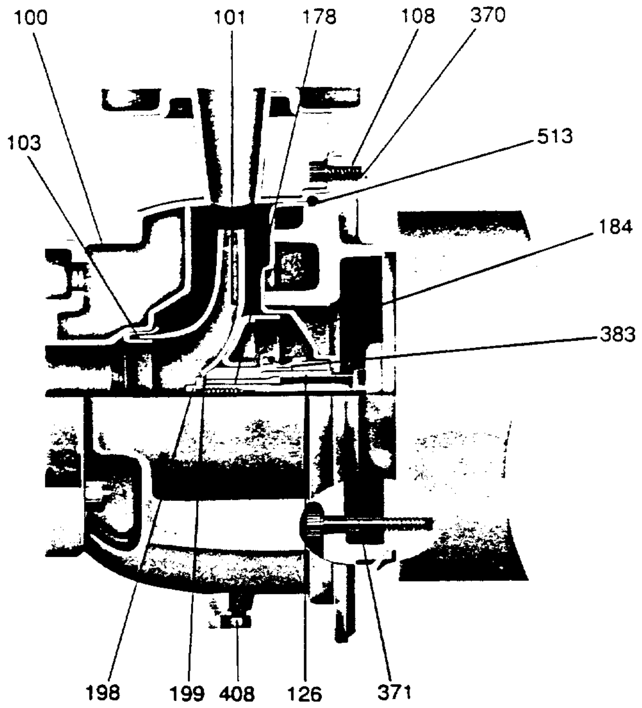
Motors:
NEMA Standard JM shaft open-dripproof, totally enclosed and explosion-proof enclosures, 60 Hz, 1750 or 3500 RPM.
Single phase ODP (115/230v)
3500 RPM..1–10HP
1750 RPM..1–3HP
Three phase ODP, TEFC/Exp. Proof (208–230/240v)
3500 RPM..1–25HP
1750 RPM..1–3HP

NOTE: Overload protection must be provided. Contactor with overload for 1-phase or starter with heaters for 3-phase ordered separately.



G

Effective September, 1990
BGLSST-C



MATERIALS OF CONSTRUCTION

Item	Description	Material
100	Casing	AISI TYPE 300 Stainless Steel
101	Impeller	
103	Wear Ring	
184	Seal Housing	
126	Shaft Sleeve	
178	Impeller Key	
198	Impeller Bolt	
199	Impeller Washer	
370	Socket Head Cap Screw (Casing to Adapter)	
108	Adapter	Cast Iron ASTM A48CL20
371	Hex Head Cap Screw (Adapter to Motor)	Steel SAE 1200 Series
513	O-Ring	Buna-N
408	Drain Plug - 3/8 NPT	AISI TYPE 304 S.S.
383	Mechanical Seal Part No. 10K13	Carbon/Ceramic Buna Elastomers 300 S.S. Metal Parts

MOTOR FRAME SELECTIONS

Motor Frame	MOTOR HORSEPOWER 3500 RPM 1Ø ODP	3500 RPM 1Ø TEFC*	3500 RPM 3Ø ODP	3500 RPM 3Ø TEFC	1750 RPM 1Ø ODP	1750 RPM 1Ø TEFC*	1750 RPM 3Ø ODP	1750 RPM 3Ø TEFC
143JM	–	–	–	–	–	–	1	1
145JM	2	2	2-3	2	1-1 1/2	1-1 1/2	1 1/2-2	1 1/2-2
182JM	3	3	5	3	2	2-3	3	3
184JM	5	5	7 1/2	5	3	–	5	5
213JM	7 1/2	–	10	7 1/2	5	–	7 1/2	7 1/2
215JM	10	–	15	10-15	–	–	–	–
254TCZ	–	–	20	–	–	–	–	–
256TCZ	–	–	25	20-25	–	–	–	–

NOTE: 254TCZ and 256TCZ frames built with 215JM shaft extension.
*Consult factory for single phase TEFC motors.

OPTIONAL MECHANICAL SEALS

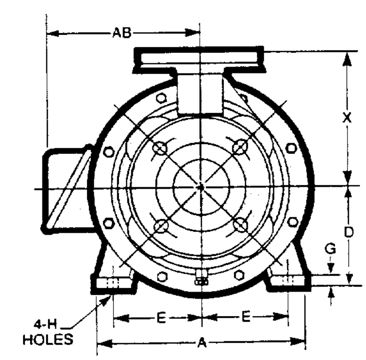
John Crane Type 21 Mechanical Seal

Item	Part No.	Rotary	Stationary	Elastomers	Metal Parts	Intended Duty
383 Options	10K19	Carbon	Ni-Resist	EPR	316 S.S.	Hi-Temperature
	10K25		Ceramic	Viton		Chemical
	10K27		Tungsten Carbide	Viton		Hi-Temperature Mild Abrasive

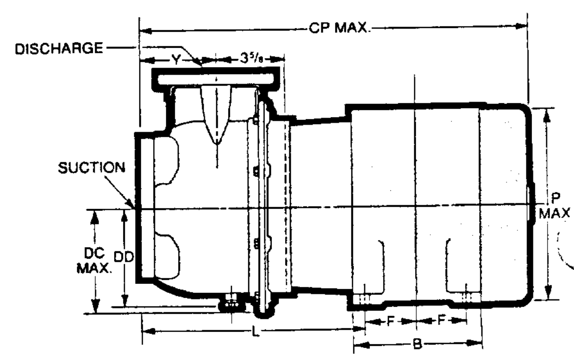
WEIGHTS AND DIMENSIONS

(All dimensions in inches and weights in lbs. Do not use for construction purposes.)

Pump	150 lb. Flange Suction	150 lb. Flange Disch.	Dimensions Determined by Pump CP Max.	DC Max.	DD	X	Y	Dimensions L Determined by Pump and JM Motor Frame 143/145	182/184	213/215	254/256	Pump Wt. (lb.)
1 x 2-6	2	1	25 3/8	5	4 3/4	6 3/8	3 1/8	9 5/8	10 1/4	11 1/4		24
1 x 2-8				5 3/8	5 3/8	7 1/8						32
1 x 2-10			27 7/8	6 5/8	6 5/8	8 7/8	4	10 1/2	11 1/8	12 1/8	12 3/8	54
1 1/4 x 2-6		1 1/4	25 3/8	5	4 3/4	6 3/8	3 1/8	9 5/8	10 1/4	11 1/4		24
1 1/4 x 2-8				5 5/8	5 3/8	7 1/8						32
1 1/2 x 2 1/2-6	2 1/2	1 1/2	25 1/2	5	4 3/4	6 3/8	3 1/4	9 3/4	10 3/8	11 3/8		25
1 1/2 x 2 1/2-8			27 7/8	5 5/8	5 3/8	7 1/8	4	10 1/2	11 1/8	12 1/8	12 3/8	34
2 x 2 1/2-6		2		5	4 3/4							25



JM Frame	Dimensions Determined by JM Motor Frame (Dimensions may vary w/Manufacturer) A	AB	B	D	E	F	G	H Dia.	P Max.	Motor Wt.(lb.)
143	6 1/2	5 1/4	6	3 1/2	2 3/4	2	1/8	11/32	6 5/8	41
145						2 1/2				57
182	8 1/2	5 7/8	6 1/2	4 1/2	3 3/4	2 1/4	3/16	13/32	7 7/8	77
184						2 3/4				97
213	9 1/2	7 3/8	8	5 1/4	4 1/4		7/32		9 5/8	122
215						3 1/2				155
254TCZ	11 1/4	9	9 1/2	6 1/4	5	4 1/8	1/4	17/32	11 1/2	265
256TCZ			11 3/4			5				320



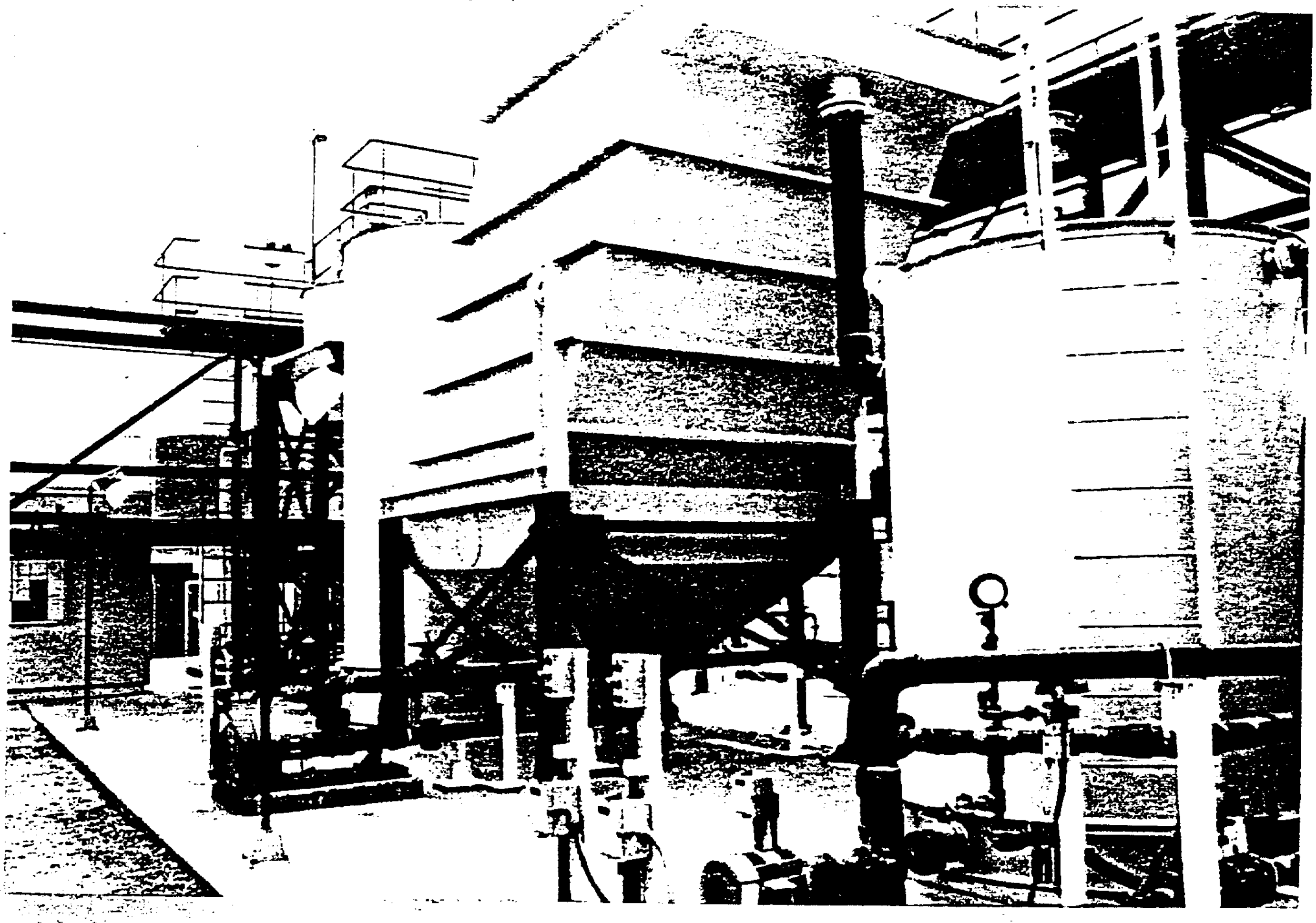
NOTE: 254TCZ & 256TCZ frames built with 215JM shaft extension.
NOTE: Pumps shipped in vertical discharge position. May be rotated in 45° increments.
Tighten 3/8–16 bolt to 12 ft.-lb. and 7/16–14 bolts to 20 ft.-lb. torque limit.

G&L
A GOULDS PUMPS COMPANY

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE.

PRINTED IN U.S.A.

INCLINED PLATE CLARIFIER



Hoff land Environmental

Atlantes Chemical Systems, Inc.

ACS

303 Silver Spring Road
Conroe, Texas 77303
(409) 856-4515

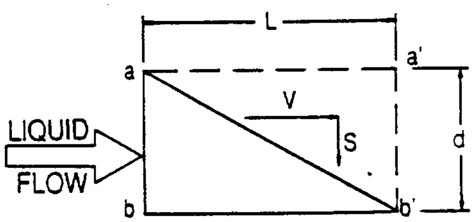
ACS INCLINED PLATE CLARIFIERS USE GRAVITY & INNOVATIVE ENGINEERING

GENERAL

A gravity clarifier is the most economical method of removing solids from liquid because **natural gravity** is the source of energy and it is **free**. A clarifier simply provides a non-turbulent zone where heavier than liquid solids, suspended by turbulence, are given sufficient time to settle to a quiescent surface. The **ACS** inclined plate clarifiers are compact units with multiple layers of settling area utilizing less than 25% of the floor space required by conventional clarifiers.

PRINCIPLE OF HORIZONTAL CLARIFIER

A particle carried forward by the velocity of the liquid flow must settle at a rate that allows it to reach the bottom before passing through the clarifier. Thus, particles beginning at a point "a" must traverse some route lying between ab and ab' in order to avoid being carried over the outlet.



If $\underline{V}$ is the horizontal velocity of the liquid, $\underline{s}$ the solid particle vertical settling velocity, L the length of the settling device, and $\underline{d}$ its depth, then particles entering at point $\underline{a}$ will settle to the bottom of the device only if $\underline{V}$ does not exceed: s (L/d)

since V max/s = L/d then,
V max = s (L/d)

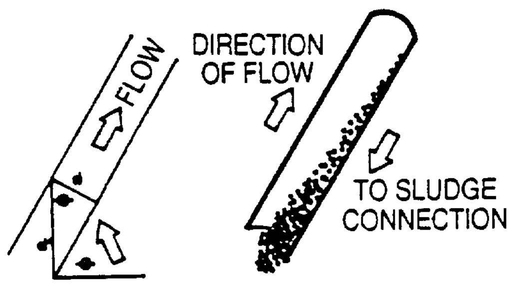
Therefore, the velocity at which a horizontal clarifying device may be operated successfully is directly proportional to its length and inversely proportional to its depth.

This analysis applies to multiple horizontal plate units also. The spacing between plates is usually a few inches as opposed to a depth of several feet in a horizontal tank; therefore, "settling-out" times are dramatically reduced. The flow must be non-turbulent to prevent settled solids from being reentrained within the moving liquid. Small plate spacing and a large surface area permits laminar flow at higher velocities than large horizontal tanks would allow.

Horizontal clarifying devices become self-flushing if they are inclined at an angle which exceeds the angle of repose of the settled solids. In such cases, flow enters the lower end of the device where settling particles move to the floor eventually sliding back out the entrance. Clear effluent leaves the top of the device.

However, when the device is inclined, the furthest settling particles no longer fall through distance d but some longer distance $\underline{d'}$. This new longer settling distance $\underline{d'}$ is related to $\underline{d}$ by the relation:

$$d = d' \cos \theta$$



Theta "θ" is the angle, the device is inclined to the horizontal plane. Thus settling distance is increased by the factor: 1/cos θ
In the case where θ = 60°
1/cos θ = 2
The maximum settling distance is twice the distance between the plates. It is apparent then that the lower the angle of inclination, the smaller the settling distance. However, the angle of inclination must exceed the angle of repose of the solids to be separated. The previous equation may be modified to express the cosine of an inclined plate clarifying system as:

$$V\,max = \frac{L}{d/\cos\theta}\,(s) = \frac{L\cos\theta}{d}\,(s)$$

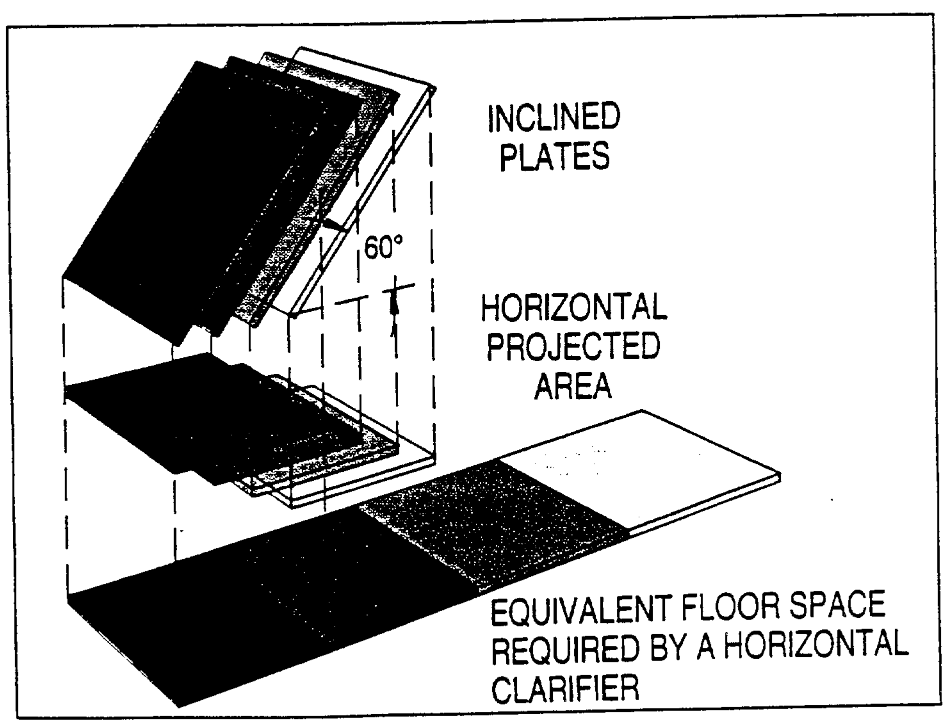
INCLINED PLATE CLARIFIER

A reduction of the required floor space is acquired by diminishing the separation between the horizontal plates to a few inches and stacking the settling surfaces. Inclining the plates to provide self flushing, 45° for heavy particles and 60° for light particles, reduces the available horizontal projected area (effective settling area) by a factor equivalent to the cosine of the angle. The surface area diagram (below) graphically compares the floor space requirements of an **ACS** inclined plate clarifier with the equivalent horizontal projected settling area.

SETTLING RATE

The settling rate for a specific solid should be determined by standard laboratory tests. Light particles, such as metal hydroxides, usually require a design parameter of 0.25 gallons per minute per square foot of horizontal projected area. These low density solids require the inclined plates to be set at a 60° angle to induce the particles to slide down the plate. Heavier particles (such as sand that easily flow) will readily slide from plates set at a 45° angle.

Maximum flow rate of an inclined plate clarifier is based on the flow rate per unit of a horizontally projected surface area. Retention time in the clarifier is not a design criteria. However, attaining optimum performance requires the prudent design to recognize several additional, very important factors.



INLET PLENUM

An inlet plenum must be provided to uniformly distribute the influent to the inclined plate compartments. Laminar flow must be established as the flow enters the plate area. The hydraulic momentum of the incoming liquid must be dissipated to prevent channeling. The **ACS** design does not use orifices which may clog with heavy suspended solids.

OUTLET AREA

The outlet area must be designed to force uniform flow from all plate compartments and also over the entire width of the plates. For example, wide plates (4 foot and over) with side outlets do not utilize the center section and must be proportionately decreased. A poorly designed outlet can result in only 50 - 60% plate utilization. The **ACS** clarifier utilizes an orifice type weir with orifices placed on each side of the plate to force uniform flow from each compartment.

EQUALIZATION COMPARTMENT

The **ACS** inclined plate clarifier provides equalized flow between two or more plate packs. After installation, clarifiers will often settle which creates channeling and turbulence through one of the plate packs. A prudent design prohibits channeling.

SOLIDS REMOVAL

Solids sliding off the plates must be provided with a sufficiently large compartment to insure adequate capacity for the accumulated solids. Turbulence and channeling are avoided by continuously removing the solids which will disrupt the flow pattern if allowed to build up and contact the inclined plate.

There are essentially only two designs of sludge storage compartments in general use. The conventional design is an inverted cone or pyramid with angles to match the expected angle of repose of the solids to be collected.

Due to the hydrostatic head present before and during sludge removal, two adverse conditions tend to be created. The sludge which accumulates between draw downs will compact, changing its angle of repose. With the draw off pipe open the hydrostatic head will cause the more fluid supernatent to create a channel (rat hole) from the top sludge layer to the outlet. The result is too much liquid and not enough sludge removed.

The preferred design is a compartment with almost a flat bottom and a top driven motorized rake which will break up compacted sludge and direct the sludge to the center discharge point preventing the "rat hole" phenomenon. This design also allows for the maximum amount of sludge storage below the plates for a given height (three times as much as a cone bottom design).

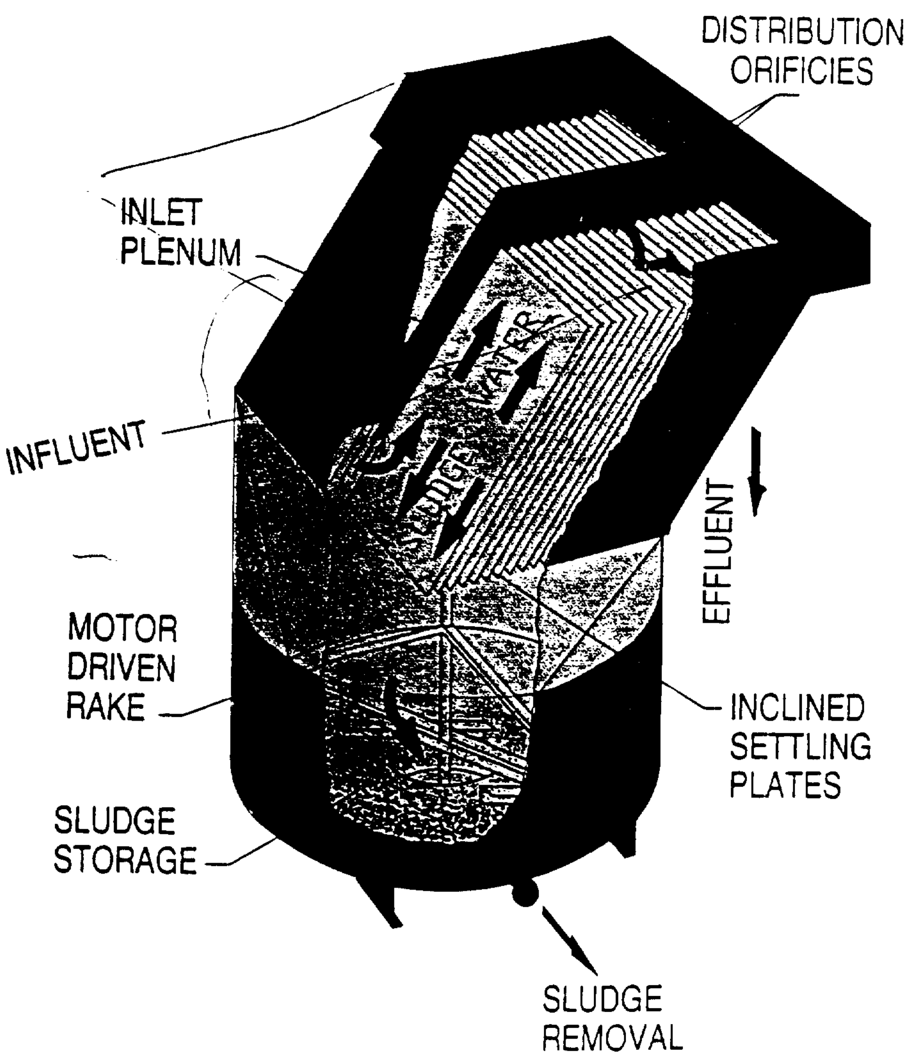
SLUDGE THICKENING

For most applications there is insufficient volume below the inclined plates to provide adequate storage time to attain sludge thickening or compaction. A secondary tank is required to provide sufficient storage time to accumulate and thicken the collected solids. Laboratory studies must be performed on each sludge to determine thickening rate. Usually sludges must be retained in non-turbulent condition for 4-24 hours to reach an optimum concentration. A typical well-flocculated clarifier influent may contain 300-500 ppm suspended solids. The solids will settle to a volume of approximately 10% of the initial volume (0.3-0.5%). Hence, a 10% underflow is required to remove the accumulated solids. The sludge accumulator or sludge thickener must have the capacity to store the accumulated solids for at least 24 hours. The filter press or other compaction device must be sufficiently large to continuously compact the collected solids. Contact your **ACS** technical representative to assist you in the sizing of your liquid solid separation and solids compaction system.

CONSTRUCTION

ACS inclined plate clarifiers are constructed of ¼" ASTM A36 structural carbon steel. The inclined plates are fiber reinforced plastic with spacers and brackets fabricated of 304 stainless steel and polyvinyl chloride plastic. Units will be fabricated entirely of stainless steel on request. All carbon steel surfaces are media blasted to SSPC-SP-6 finish and coated on the interior with high build polyester epoxy and the exterior with acid resistant epoxy. The units will be coated with FRP on request.

ACS Inclined Plate Clarifier with Motorized Sludge Rake



MANUFACTURING SPECIFICATIONS

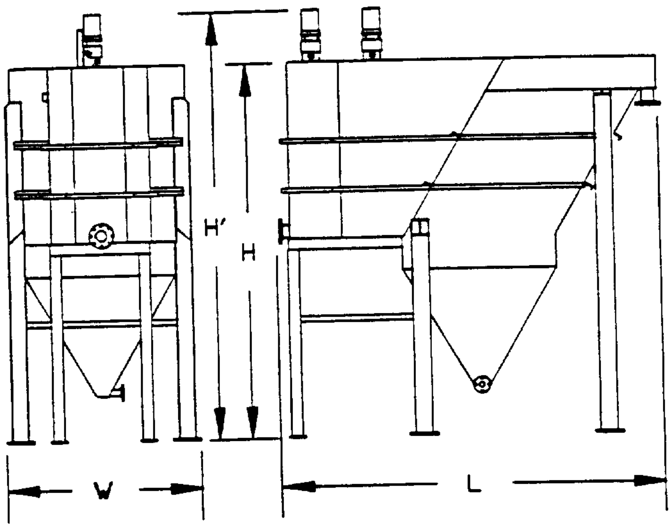
1. Self supporting - suitable for foundation mounting
2. Fabricated of ¼" A36 steel.
3. Lifting lugs provided.
4. Surfaces are sand blasted to SSPC-SP-6 and painted with acid resistent epoxy paint.
5. FRP inclined plates are separated by plastic I beams set on a 60° angle.
6. Design settling rate of .25 gpm/sq. ft. horizontal projected area.

OPTIONAL EQUIPMENT

- Flash mix & flocculate sections with mixers
- Acid resistent FRP coating on interior and/or exterior
- All stainless steel construction
- Pumping systems
- Automatic sludge removal system
- Oil skimmers
- Covers
- Ladders and platforms
- Seismic zone certification

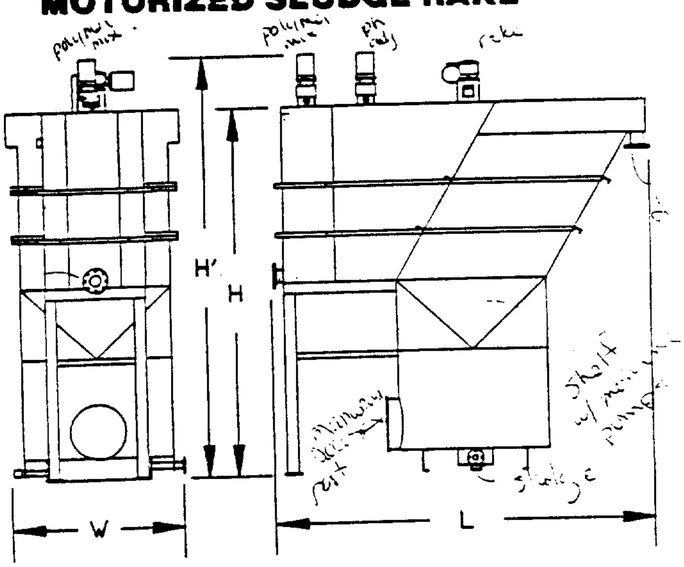
INSTALLED DIMENSIONS ACS INCLINED PLATE CLARIFIER

INVERTED PYRAMID



inlet

MOTORIZED SLUDGE RAKE



Slant Plate Clarifier With Inverted Pyramid Bottom

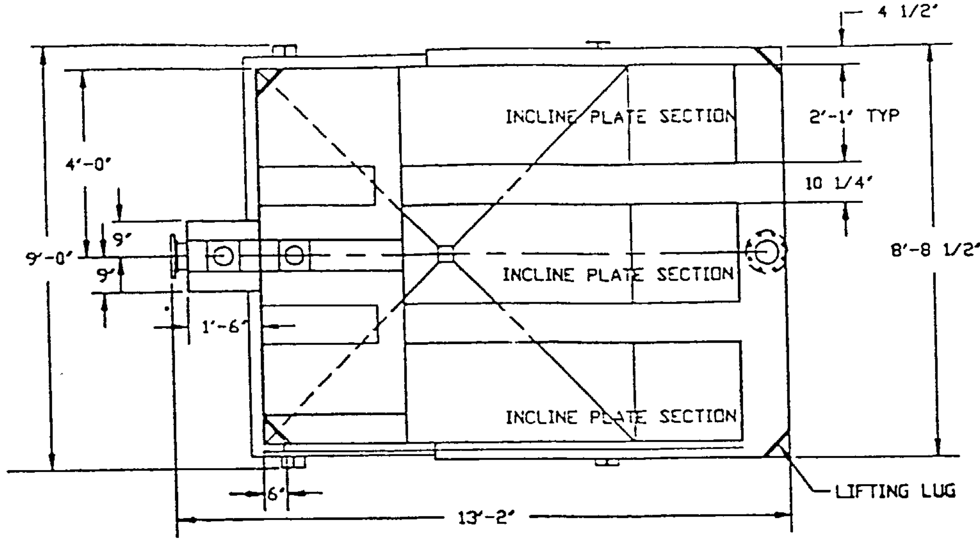
Slant Plate Clarifier With Motorized Rake

[illegible]

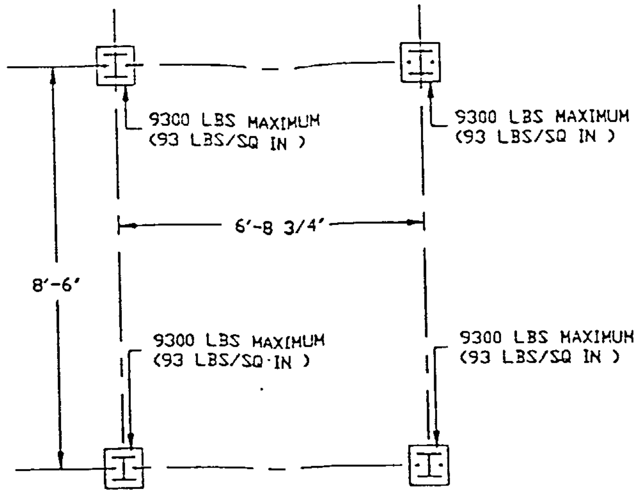
NOTES:

1. **ACS** Model No. (110/60/SA) typically indicates: 110 sq. ft. horizontal projected area. 60 indicates the angle of inclination of the plates. "m" indicates motorized sludge rake, "s" indicates sloped bottom, A indicates the length of the settling plate, A is 30" long, B is 60" long, C is 120" long.
2. Flash mix and flocculate sections for C size clarifiers are shipped separately.
3. Clarifiers supplied with 45° inclined plates will have 40% more horizontal projected area for the equivalent outside dimensions.
4. Dimensions given are approximate.
5. **ACS** will custom fabricate clarifiers to accommodate reduced floor space or ceiling heights.

II. Vendor Information
C. Inclined Plate Clarifier

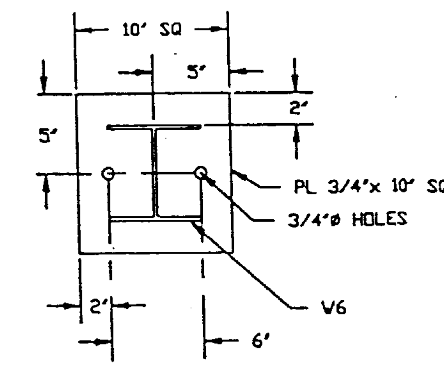


PLAN

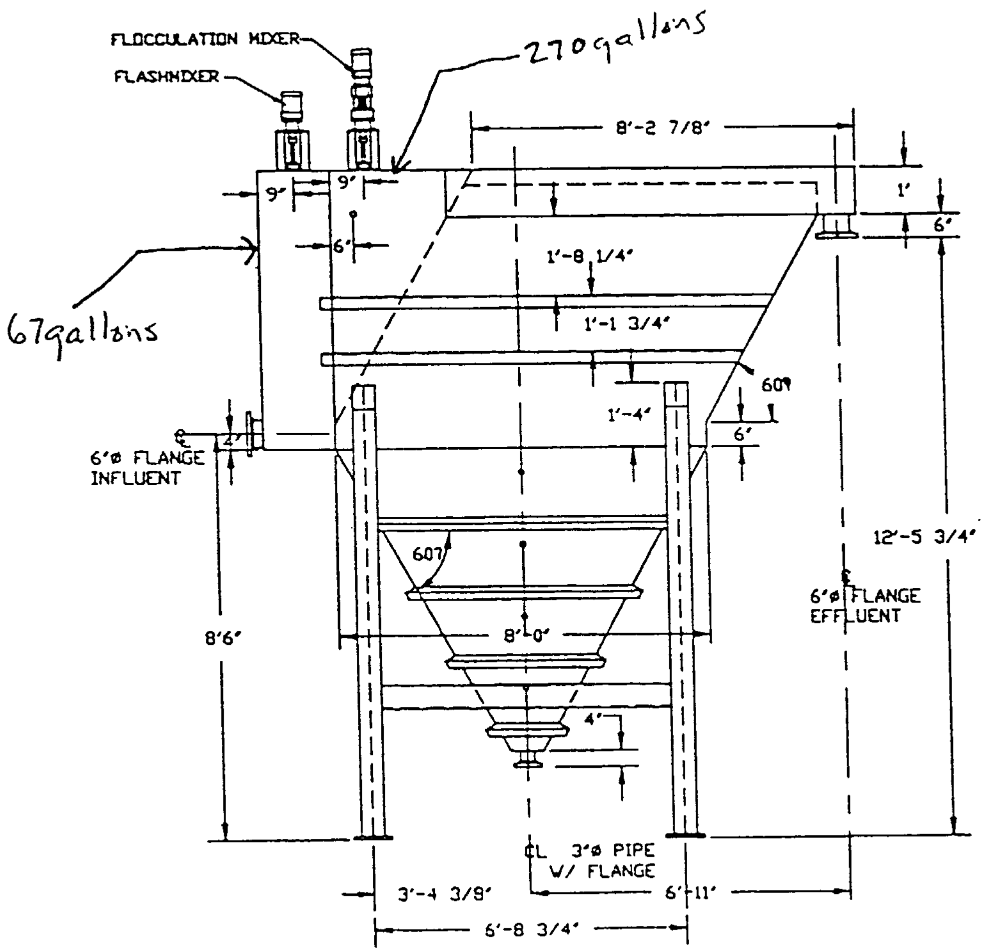


FOOTING PLAN

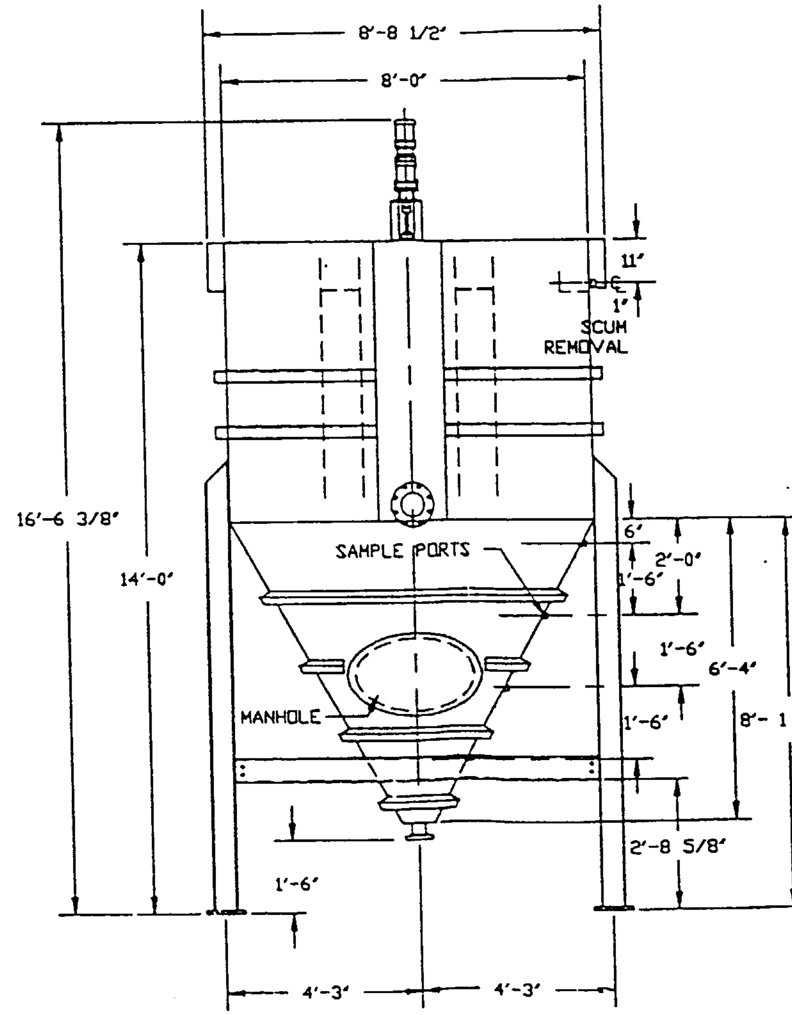
ANCHOR BOLTS TO BE 5/8"ø W/ 3 1/2" PROJECTION



TYP BASE PLATE



ELEVATION



LEFT ELEVATION

NOTES:

ALL WELDING PROCEDURES TO BE ACCORDING TO AMERICAN WELDING SOCIETY (AWS) PUBLICATION D 1.1-84 STEEL STRUCTURAL WELDING CODE

ALL STEEL PLATE MATERIAL TO BE CARBON STEEL, 1/4" THICK, ASTM A-36.

PREPARATION: ALL PAINTED SURFACES SANDBLAST TO SSPC-6

PAINT SPEC'S:
A: INTERIOR: 2 COATS (EA) 5 1/4 MILS OF 25p DuPONT (TOTAL 10 1/2 MILS DFT)
B: EXTERIOR: 2 COATS (EA) 5 1/4 MILS) 25p DuPONT & FINISH COAT 1 1/2 MILS IMRON (TOTAL 12 1/2 MILS DFT)

TANK AND FITTINGS TO BE HYDROSTATICALLY TESTED BEFORE SAND BLASTING

CLARIFIER SPECIFICATIONS:
SHIPPING WT = 5400 LBS

OPERATING WT = 37150 LBS

SURFACE AREA SPECS:
120 @ 2'x5' FRP PLATES
SURFACE AREA = 1200 SQ FT
HORIZ PROJECTED AREA = 600 SQ FT
AVERAGE FLOW RATE = 150 GPM

SLUDGE HOPPER CAPACITY = 1550 GALS

ALL FLANGES TO BE 150 LB RAISED FACE CARBON STEEL AND ALL COUPLINGS TO BE FNPT CARBON STEEL

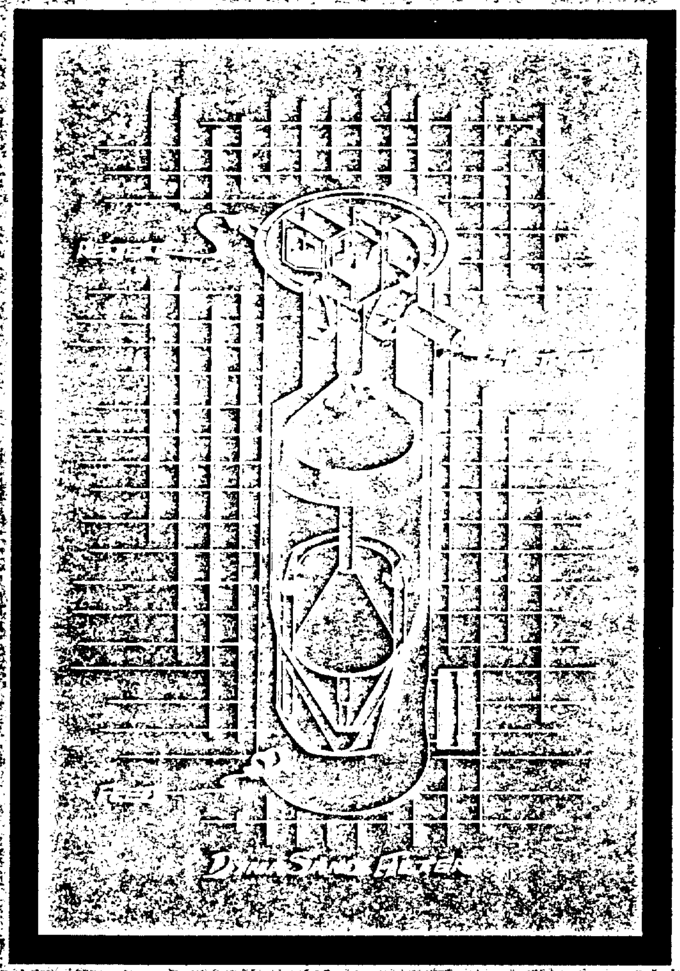
NOTES:
SLANT PLATE PACKS CONSTRUCTED OF FRP 2'x5' PANELS, FASTENERS OF 300 SERIES STAINLESS STEEL

FLASH/FLOCC MOTOR
FLOCCULATION MIXER - 10"ø PADDLE AGITATOR W/ SUMITOMA MODEL VTM 2002-3090, 1/8 Hp, 480 VAC, 3 PHASE MOTOR, MECHANICAL VARIABLE SPEED 10.5 TO 52 RPM
SUB ASSEMBLEY:
(1) LOVEJOY L095 - 3/4" COUPLING
(1) LOVEJOY L095 - 1 1/8" COUPLING
(1) LOVEJOY L095 - SPYDER
(1) PTC BEARING (3/4")- F3-U212N

FLASHMIXER - 6"ø PADDLE AGITAOR W/ SUMITOMA MODEL 3085, 29/1 RATIO, 1/8 Hp,480 VAC, 3 PHASE MOTOR
SUB ASSEMBLY:
(1) LOVEJOY L095 - 3/4" COUPLING
(1) LOVEJOY L095 - 3/4" COUPLING
(1) LOVEJOY L095 - SPYDER
(1) PTC BEARING (3/4")- F3-U212N

REV	BY	DATE	DESCRIPTION
DRAWN BY LOUIS S		DATE 7/26/91	ACS ENVIRONMENTAL 303 SILVER SPRING RD CONROE, TX
PROJECT ENGR			
PROPRIETARY INFORMATION THIS DOCUMENT CONTAINS ACS ENVIRONMENTAL PROPRIETARY INFORMATION WHICH MAY NOT BE USED FOR THE BENEFIT OF OTHERS EXCEPT BY EXPRESSED PERMISSION OF ACS ENVIRONMENTAL			600/60/SB CLARIFIER
SCALE 1/2=12	ACS-600SB-A1	SHEET 1/1	REV 6

II Vendor Informati
D. Dynasand Filte



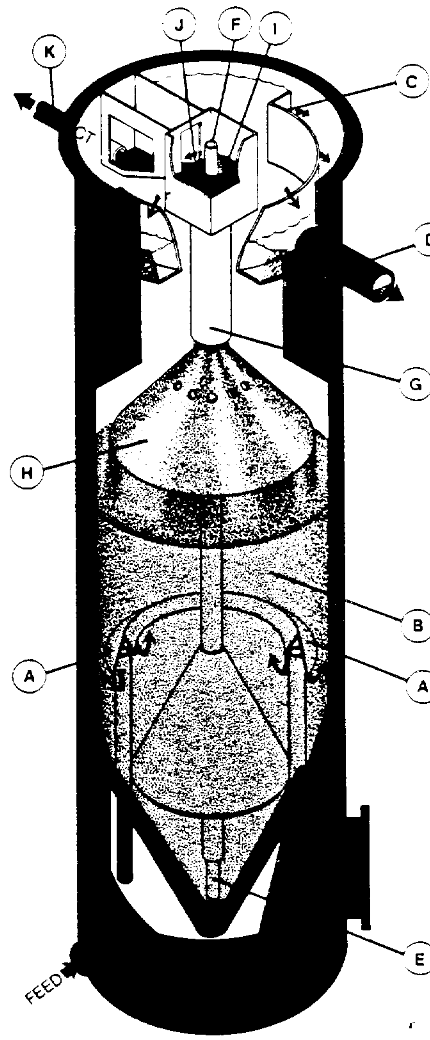
DYNASAND® FILTER

PARKSON CORPORATION

DynaSand Filter
The Proven Concept in Sand Filtration

The DynaSand Filter is a continuous backwash, upflow, deep-bed granular media filter. The filter media is continuously cleaned by recycling the sand internally through an airlift pipe and sand washer. The regenerated sand is redistributed on top of the sand bed, allowing for a continuous uninterrupted flow of filtrate and reject (backwash) water.

Feed is introduced into the bottom of the filter, then flows upward through a series of riser tubes and is evenly distributed into the sand bed through the open bottom of an inlet distribution hood (A) (Fig. 1). The influent flows upward, through the downward moving sand bed (B), with the solids being removed. The clean filtrate exits from the sand bed, overflows a weir (C), and is discharged from the filter (D). Simultaneously, the sand bed, along with the accumulated solids, is drawn downward into the suction of an airlift pipe (Fig. 2) which is positioned in the center of the filter. A small volume of compressed air is introduced into the bottom of the airlift (E). The air lifts the dirty sand up the airlift pipe, and air scours the sand at a rate of 100 to 150 SCFM/ft.^{2}. The impurities are scoured loose from the sand during this violently turbulent upward flow. Upon reaching the top of the airlift (F), the dirty slurry spills over into the central reject compartment (I). The sand is returned to the sand bed through the gravity washer/separator (G) which allows the fast settling sand to penetrate, but not the dirty liquid. The washer/separator is placed concentrically around the upper part of the airlift and consists of several stages to prevent short circuiting (Fig. 3). By setting the filtrate weir (C) above the reject weir (J), a steady stream flows upward, countercurrent to the sand, through the washer section and cleans the sand at a backwash loading rate of 50-100 gpm/ft.^{2}. A continuous reject flow exits near the top of the filter (K), carrying away the dirt and impurities removed in the filter. Since the sand has a higher settling velocity than the dirt particles, it is not carried out of the filter. The clean sand is redistributed by means of a sand distribution cone (H). The sand bed is continuously cleaned while both a continuous filtrate and a continuous reject stream are produced.



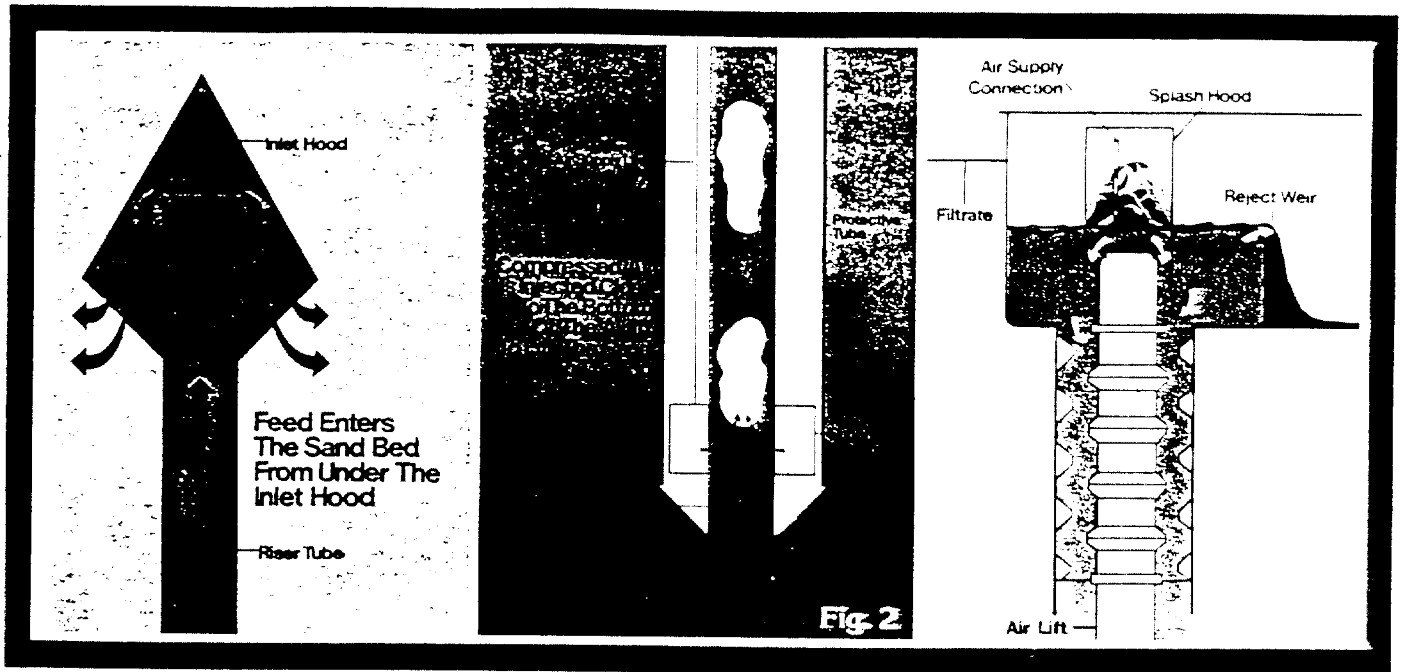
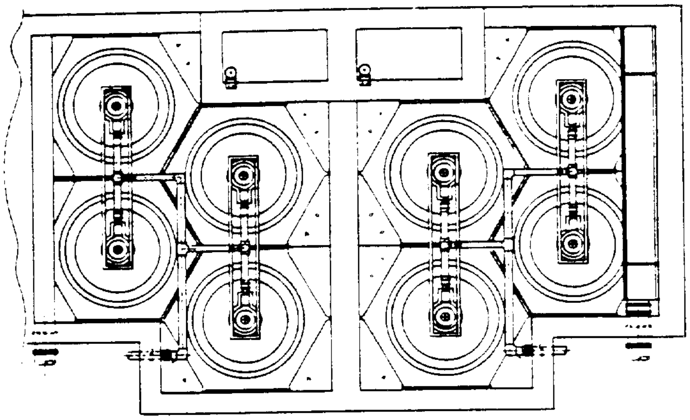
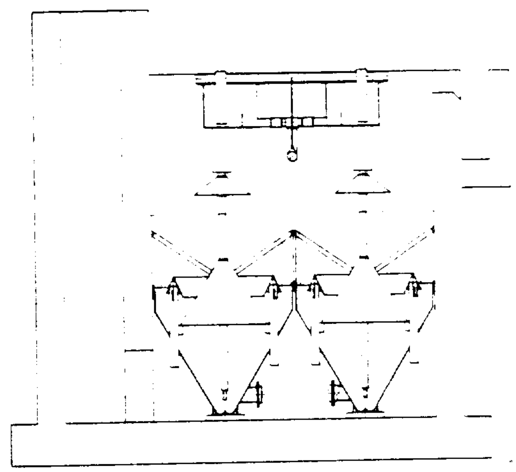


Fig. 2

Features and Benefits

Continuously Cleaned Sand Bed	No shutdown for backwash cycles Elimination of ancillary equipment No flow control valves, splitter boxes, backwash controls Elimination of mud balls
No Moving Parts	Little operator attention or maintenance required
Low Pressure Drop	Easily gravity fed (pressure drop less than 24") Low power consumption
Single Media	Eliminates internal screens, grids, underdrains, etc.
High Solids Capability	Handles upstream upsets more easily Improves loading rates where loading is limited by solids capacity
Continuous Reject (Backwash)	Eliminates backwash holding tanks, high volume pumps Small continuous stream easily returned to process





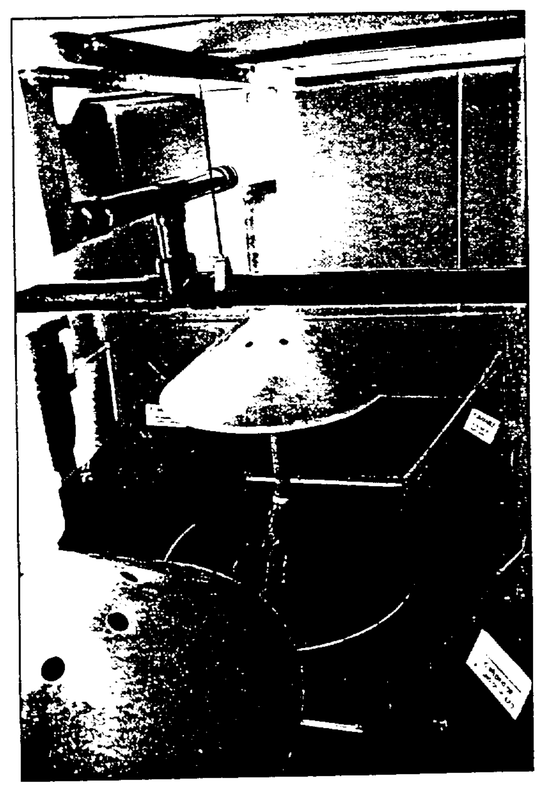
Concrete Basin

For large flow applications, the concrete basin design consisting of multiple modules within individual cells is available. The number of modules and cells can be individually tailored to particular flow and process requirements. In the example above, for instance, two separate cells with four modules per cell are outlined.

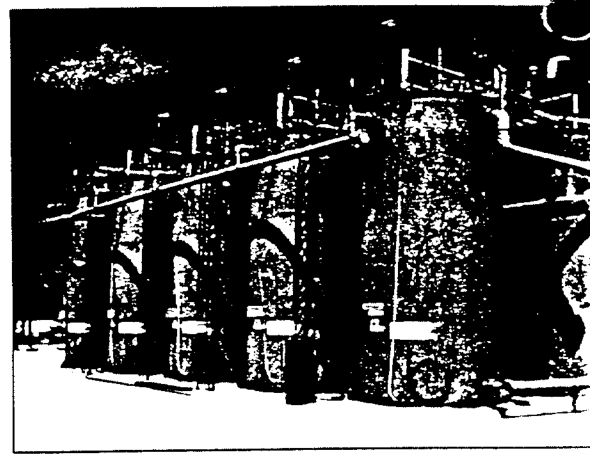
The DynaSand Filter concept is provided through Parkson supplied internals. The customer supplied basin is constructed per Parkson dimensions. With this concrete module concept, the ultimate flow capability is limitless.

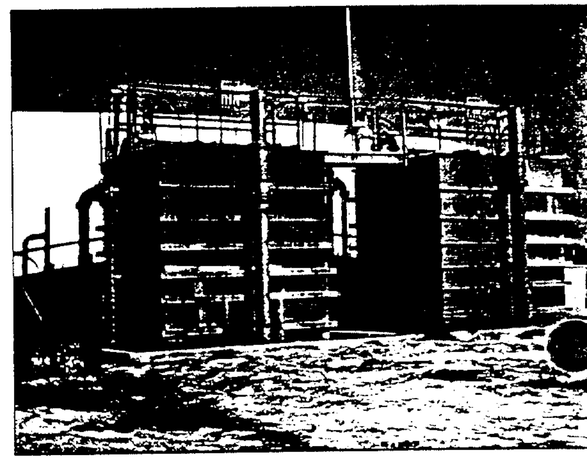
The continuous cleaning of the sand makes the pressure drop equal for all modules. Thus, there is no need to provide partitions to segregate the sand and, as with multiple package unit installations, individual feed flow control to each module is not required.

The photograph (at right) shows two modules in one cell.



Multiple units can be installed and still maintain system simplicity. Since all filter beds are continuously being cleaned, the pressure drop remains low and equal among the filters, assuring even feed to each filter without the need for splitter boxes or flow controls. A typical multiple unit installation uses a common header pipe with feed connections and isolation valves for each filter.





All equipment described in this brochure is protected by patents, and additional patents may be pending.

PARKSON CORPORATION

2727 N.W. 62nd Street
P.O. Box 408399
Fort Lauderdale, Florida 33340-8399
305 974-6610

An Axel Johnson Inc. Company

Other Parkson Products

Lamella® Gravity Settler/Thickener - a compact inclined plate separator. Bulletin LT103

Magnum® Press - a continuous belt/filter press. Bulletin MP201

Aqua Guard® Screen - a self-cleaning bar/filter screen. Bulletin AG400

Roto-Guard® Screen - a fine-screening system for wastewater. Bulletin RG701

AquaLift™ - screw pump. Bulletin AL901

Wyss® Flex-A-Tube® - fine bubble diffuser. Bulletin WD800

FineAir - ceramic dome diffuser. Bulletin FA100

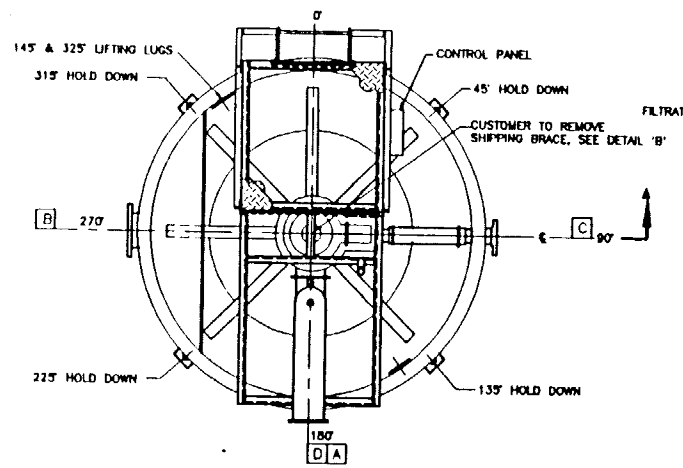
Aeration Panel - highest oxygen transfer efficiency. Bulletin PA1101

OxyCharger® Static Aerator - for energy-free aeration. Bulletin OC600

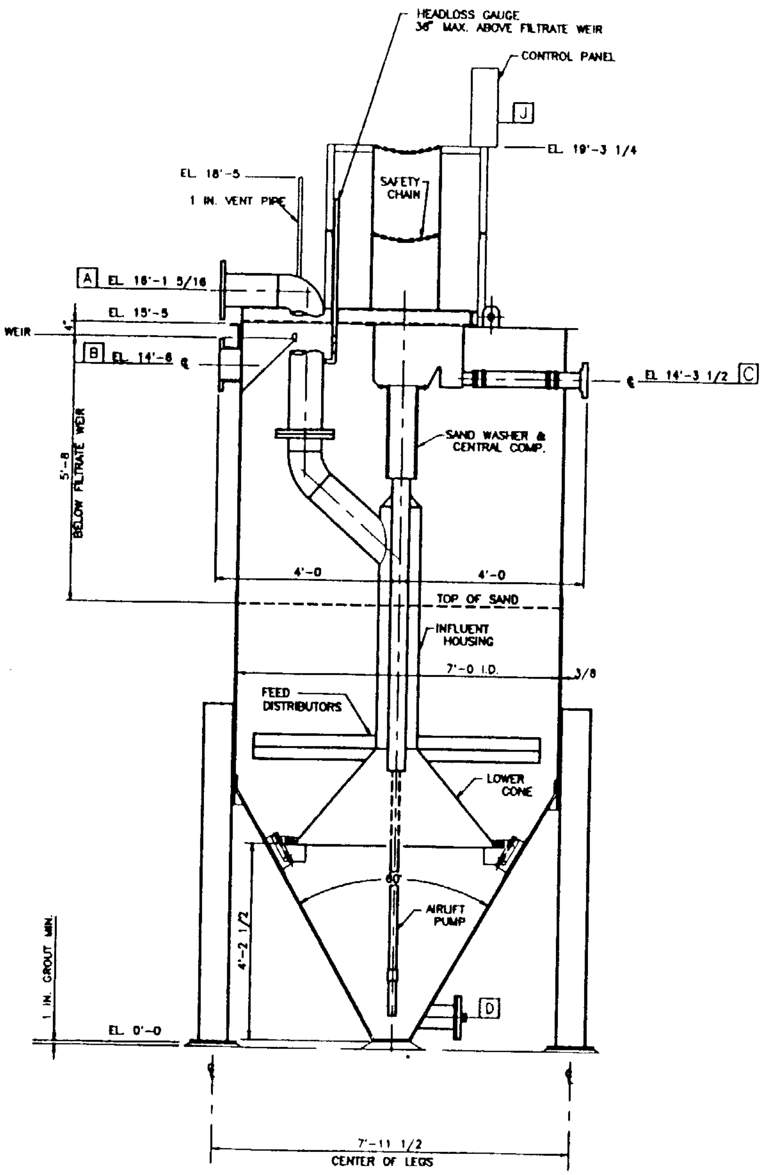
The Biolac® System - cost-effective biological treatment. Bulletin BL501

NOTES:

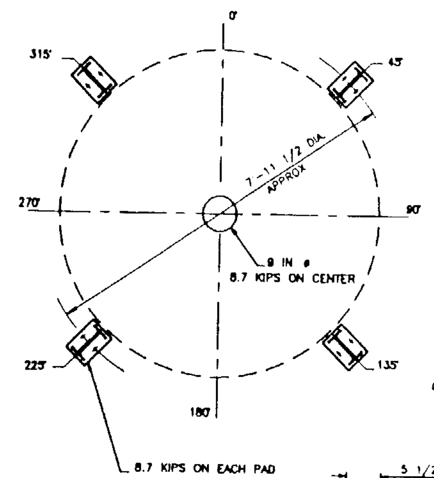
1. THIS DRAWING TO BE USED FOR GENERAL INFORMATION ONLY. NOT FOR CONSTRUCTION
2. MATERIAL OF CONSTRUCTION:
   TANK FRP WITH STEEL LEGS
   AIRLIFT AND INFLUENT HOUSING, 304 SS
3. WEIGHTS
   SHIPPING WEIGHT 2,800#
   TANK & SAND 22,800#
   TANK W/SAND & WATER 43,600#
4. ALL CARBON STEEL SURFACES TO BE SANDBLASTED THEN COATED WITH PRIMER AND PARKSON BLUE EPOXY PAINT.
5. A FLAT HORIZONTAL FOUNDATION MUST BE PROVIDED FOR THE FILTER WITH THE BEARING AS ON THE LOADING DIAGRAM.
6. TANKS SHOULD BE INSTALLED LEVEL

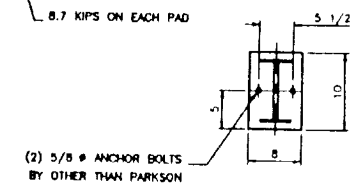


PLAN VIEW



SECTIONAL ELEVATION A-A
SEE PLAN FOR TRUE ORIENTATION





BASE PLATE DETAIL

SANDFILTER 38 SQ.FT
40 IN. SAND BED

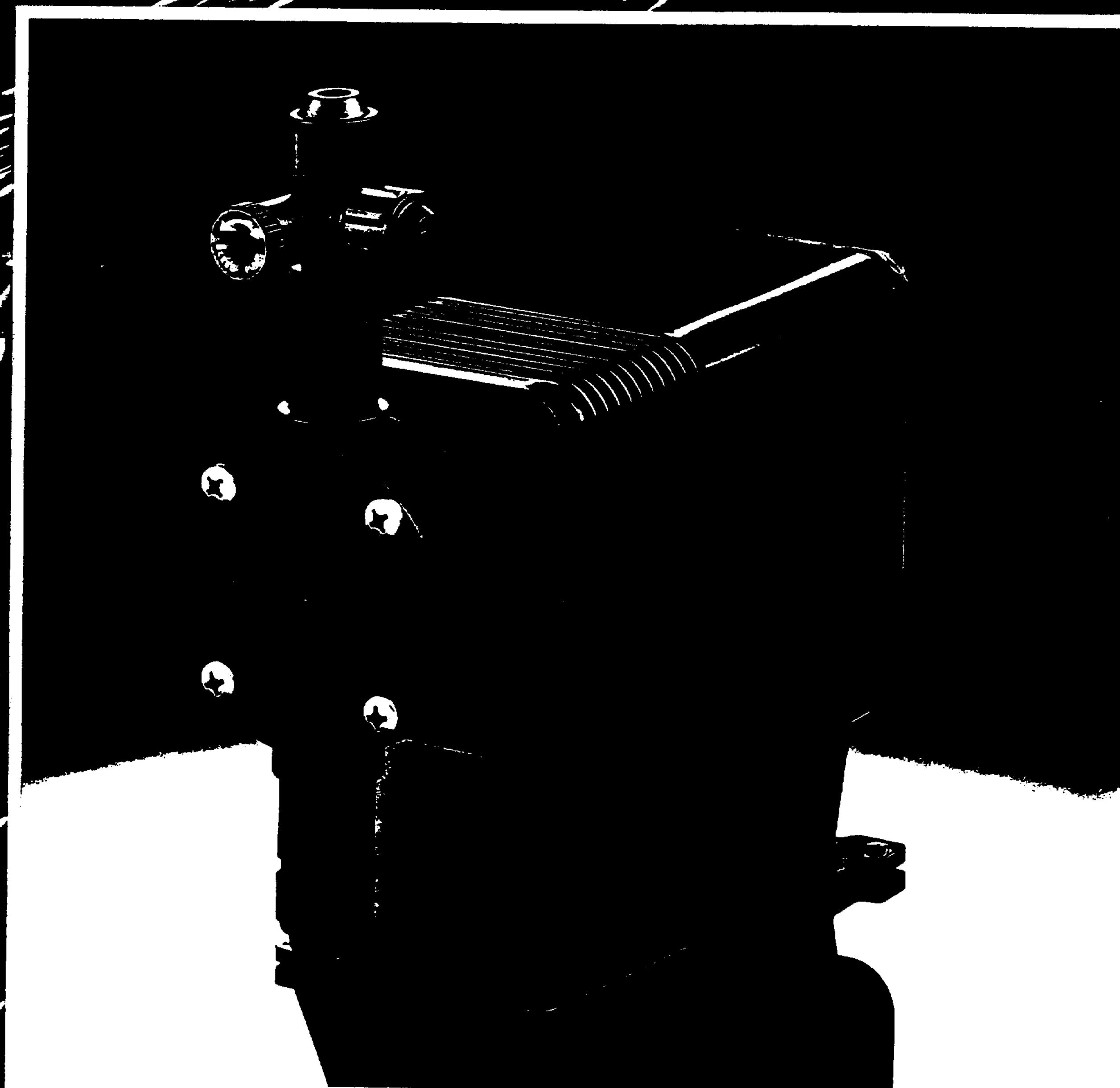
NOZZLE SCHEDULE					
LTR	SIZE	RATING	FACE/DECL	SERVICE	REMARKS
A	8 IN.	150#	RF	INLET	FEED
B	8 IN	150#	RF	OUTLET	FILTRATE
C	3 IN	150#	RF	OUTLET	REJECT
D	1 IN	150#	NPT	INSIDE DRAIN	VALVE
E					
F					
G					
H					
J	1/4 IN		MPT	CUSTOMER AIR	
K					
MH					

PARKSON CORPORATION
DynaSand FILTER
ARRANGEMENT
38 SF FRP STD. BED
3F-3031
D
STANDARD

PULSAtron®

Electronic Metering Pumps

The First Affordable Electronic Metering Pump With True Metering Performance.



Pulsafeeder

An Inside Look At Advanced PULSAtron Technology

With the development of PULSAtron, Pulsafeeder had the opportunity to consider every aspect of electronic pump design. The result is a complete line of pumps, with more features and better benefits than ever before.

Metering Performance

Our guided valve design and the high degree of sphericity of PULSAtron's ball check valves provide a superior seal and contribute to exceptional metering reproducibility.

Tested And Proven Pump Head Materials

Select PULSAtron pumps come standard with glass-filled polypropylene, clear acrylic-like (SAN), PVC, PVDF and 316SS head and fittings.

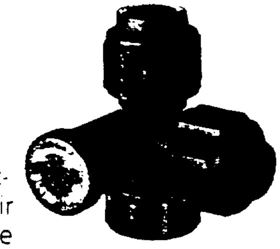
Superior Diaphragms

Teflon-faced, metal-reinforced diaphragms are designed and constructed to exacting standards for leak-free, seal-less integrity and long life.

Higher Viscosity Capability

A straight flow path and ample clearance between the diaphragm and head enable standard PULSAtron Series E PLUS and Series E pumps to handle viscous chemicals up to a viscosity of 3000 CPS. For higher viscosity applications, larger, spring-loaded connections are available.

Bleed Valve Assembly



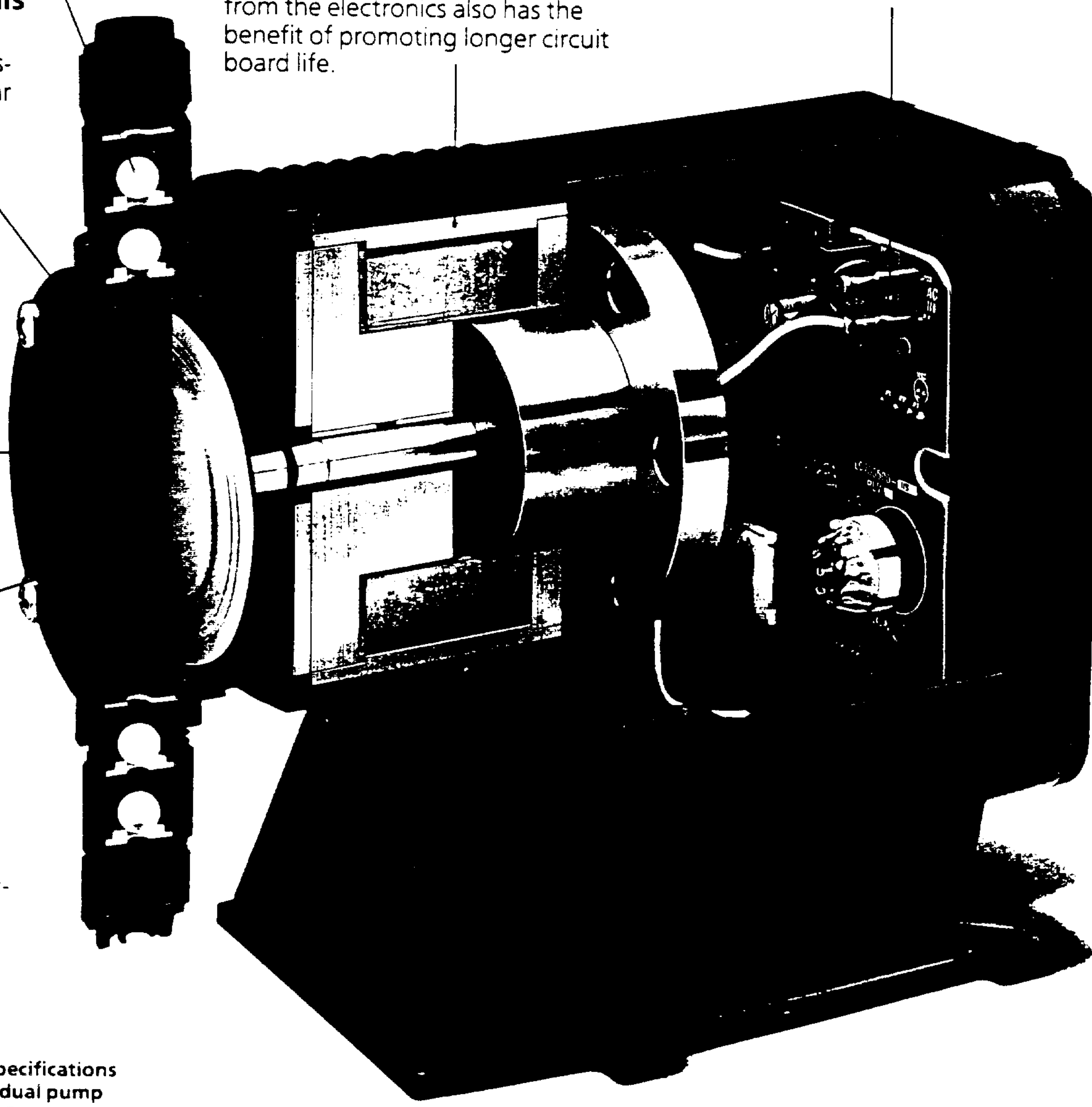
Bleed valves evacuate entrapped air or vapors from the pump head to aid in priming. They also provide a safe way to drain liquid and relieve pressure from the discharge line.

Solenoids Designed To Dissipate Heat

Our high quality solenoid is separately encapsulated in a fin-cooled enclosure that effectively dissipates heat. As a result, pressure handling capability is maintained. And keeping heat away from the electronics also has the benefit of promoting longer circuit board life.

Advanced Electronic Components

PULSAtron circuit boards utilize the latest electronics to enhance performance and dependability. Our timing circuit is highly reliable and, by design, virtually unaffected by temperature, EMI and other electrical disturbances. All electronics are O-ring sealed for water-resistance. And a transient voltage suppressor is utilized to protect electronics. Components are mounted to the circuit board to reduce the number of wired connections and improve circuit reliability.



For complete information on specifications and model selections for individual pump series consult REFERENCE GUIDE NO. EMP-003.

PULSAtron Gives You Total Pump Control

PULSAtron pumps feature a 100:1 ndown ratio for versatile meter- over a wide range of flow es. With the stroke length at maximum, select the desired flow with the stroke rate adjustment. For lower flow rates, uce the stroke length.

Stroke Length Adjustment
Use the large, easy to grip dial to reduce the stroke length to the required value. A special two piece adjustment shaft is used to keep the dial snug to the dial setting graduations throughout the entire stroke length scale. Once the appropriate stroke length is selected, lock it in with Stroke Lock. It's the easy way to reduce stroke drift and maintain settings.

Stroke Rate Adjustment
Choose the desired flow by setting the strokes per minute between 10% and 100% of maximum.

Power On LED
This green LED is activated when the pump is switched on. If the pump is on, and pumping, it also functions as a pulse indicator.

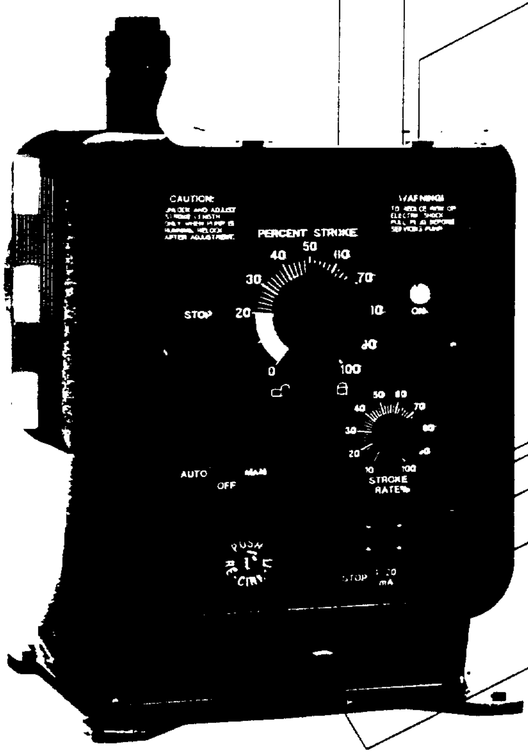
Stop Input Terminal
An external control that automatically stops the pump connects to this terminal. For example, feedback from a liquid level gauge will stop the pump when the chemical supply reaches a preselected level.

Automatic External Control
A computer or microprocessor can remotely adjust stroke rate on Series E PLUS PULSAtron pumps. Using the 4-20 mADC direct input, this model can proportionally feed chemical treatments. Also available is an External Pacing input for use with contacting flowmeters.

Stop LED
This red LED is activated when an external switch closure has stopped the pump.

Auto/Off/Manual Selector
Choose manual operation, activate the 4-20 mADC direct input, or turn the pump off with this control. (Series E PLUS pumps with External Pacing will have an EXT position in place of AUTO.)

Circuit Breaker Reset
An external push button on the control panel allows you to conveniently resume pumping after circuit overload conditions have been corrected.



The control panel shown is a Series E PLUS model. Control panels vary by model.

Broad Range of Pumps

Series E PLUS
Seventeen distinct models are available with pressure capabilities to 250 psig @ 40 GPD and capacities to 500 GPD @ 20 psig. Maximum discharge is reproducible to within ±2% of maximum capacity. Pump heads, valves and fittings can be ordered in several corrosion-resistant materials that will safely handle a wide variety of chemicals. Plastic, elastomeric and alloy materials, such as Polypropylene, PVC, PVDF, Teflon,* Hypalon,* Viton,* stainless steel and Alloy C, are available for wetted parts. ***UL Listed*** for demanding *OUTDOOR* and indoor applications. Also **CSA** approved.

Series E
There are eight distinct models with pressure capabilites to 250 psig @ 11 GPD and capacities to 44 GPD @ 100 psig. Maximum discharge is reproducible to within ±3% of maximum capacity. Series E PULSAtron pumps feature a clear acrylic-like (SAN) pump head. Liquid end materials same as Series E PLUS.
UL Listed for demanding *OUTDOOR* and indoor applications. Also **CSA** approved.

Series A PLUS
Four versatile models with capacities to 12 GPD @ 150 psig and capacities to 30 GPD @ 100 psig. The Series A PLUS has several interchangeable wetted components with the Series E PLUS and E for easy field maintenance. Maximum discharge is reproducible to within ±3% of maximum capacity. Liquid end materials same as Series E PLUS.

Series A
Two lighter duty models with pressure capabilities to 150 psig @ 15 GPD and capacities to 30 GPD @ 100 psig are available. Maximum discharge is reproducible to within ±5% of maximum capacity. PVC pump head and fittings are standard.

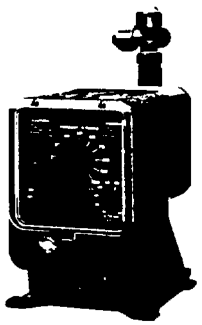
Series C PLUS
Economy and performance with four durable models available, designed with on-line adjustable stroke length and rate. Maximum capacity to 30 GPD @ 80 psig and the discharge is reproducible to within ±3% of maximum capacity. Liquid end materials same as Series E PLUS.

Series C
Four compact and rugged models with capacities up to 30 GPD @ 80 psig are available for less demanding requirements. All models are designed with an on-line adjustable stroke length and fixed stroke rate. Maximum discharge is reproducible to within ±3% of maximum capacity. Liquid end materials same as Series E PLUS.
UL Listed for demanding *OUTDOOR* and indoor applications. Also **CSA** approved.

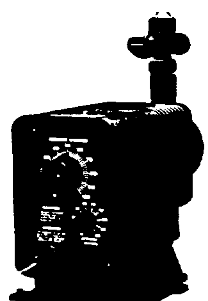
*Teflon, Hypalon and Viton are registered trademarks of E. I. DuPont Company.

Liquid E
Materials Av

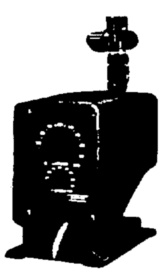
Key Features



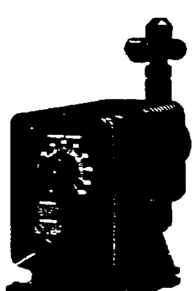
Series E PLUS
- 4–20mADC direct and Stop inputs or External Pacing and Stop inputs are available
- Auto-Off-Manual switch
- Highly reliable timing circuit
- EMI resistant
- Thermally protected solenoid with auto-reset
- Panel mounted circuit breaker
- Indicator lights
- Bleed valve assembly



Series E, A PLUS and C PLUS
- Manual function controls for Stroke Rate and Stroke Length
- Highly reliable timing circuit
- EMI resistant
- Thermally protected solenoid with auto-reset
- Bleed valve assembly



Series A
- Manual function controls for Stroke Rate and Stroke Length
- Bleed valve assembly



Series C
- Our lowest cost alternative
- Manual function control for Stroke Length
- Highly reliable timing circuit
- EMI resistant
- Thermally protected solenoid with auto-reset
- Bleed valve assembly

Six PULSAtron Series For A Broad Range Of Markets And Applications

Cooling Water Treatment
Recirculating or once-through, open or closed, today's environmental and energy-saving considerations place tough demands on cooling systems. Chemical treatment programs are becoming highly sophisticated, and automatic control of their injection systems is becoming commonplace. Our Series E PLUS PULSAtron pumps with either 4–20mADC direct or External Pacing controls are ideal for such applications.

Boiler Water Treatment
Internal scale and corrosion programs are an important part of boiler water treatment. PULSAtron pumps are a cost-effective, reliable choice to inject corrosion inhibitors into feedwater and condensate systems. Series E PLUS pumps interface with make-up water flow meters when direct control is required.

Water Clarification
From large industrial plants to local municipalities, today's solids separation systems use modern coagulant and flocculant polymers with a wide range of viscosities, usage rates and material compatibilities. Our PULSAtron pumps with their high viscosity capability are a perfect match.

Disinfection Of Drinking Water
PULSAtron pumps are ideal for continuous feed of bacteria-killing chemicals into drinking water in both domestic and commercial settings. For direct control from a contacting flow meter select the Series E PLUS with optional external pacing capability or integrate our *Control-Mate* proportional adaptor into your system.

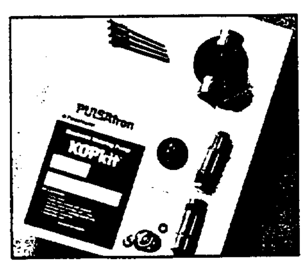
Taste, Color and Odor Control
Oxidizing agents, such as chlorine and bromine, remove iron, sulfur and other harmful material and improve the aesthetic nature of drinking water. PULSAtron has a full range of models for an economical choice to this metering application.

Swimming Pools
PULSAtron pumps control swimming pool sanitization, pH levels and harmful bacteria in commercial applications by metering acids, caustics, and oxidizing agents into pool water.

Ask for a demonstration and see for yourself that no other electronic pumps offer so much performance at such affordable prices.

Keep On Pumping Kits Will Save You Time And Money.

Pulsafeeder has built a reputation for superior reliability by supplying carefully-designed, high-quality equipment. Even the best equipment, however, requires a minimal amount of maintenance. KOPkits* are designed to guard against unnecessary downtime and assure you the highest level of efficient and uninterrupted service from our PULSAtron pumps. KOP contain recommended spare part for those parts that usually require preventive maintenance.



1237 East Main St.
Rochester, New York 14609

POLYTEC, INC.

1-716-288-2960
Fax: 315-331-1939
Fax: 716-288-2961

James E. Garen

Pulsafeeder
Manufacturers of Quality Pumps, Controls and Systems
27101 Airport Road
Punta Gorda, Florida 33982
813-575-2900
Fax: 813-575-4085

Catalog No. EMP-001

Printed in U.S.A.

It's Easy To Select The Pump You Need

Follow the step by step approach to choosing the features you need, and when you're through, you'll have the exact model number for the PULSAtron® pump you want.

1,2 3,4 5 6 - 7 8 9 10 11,12,13

- Options
- Connection Type / Size
- Ball Material
- Seat & O-Ring Material / Quantity
- Head / Fittings / Diaphragm Materials
- Electrical
- Controls
- Size—Pressure & Capacity
- Series Name

Model Selection Guide

Position 1,2 Series Name

Series E PLUS=LP; Series E=LE; Series A PLUS=LB; Series C PLUS=LD; Series A=LA; Series C=LC

Position 3,4 Size

Pressure and Capacity (Use charts below)

Series E PLUS

Capacity, nominal	GPD	5	6	11	12	20	21	24	40	42	44	75	94	120	190	240	500
	GPH	0.20	0.25	0.45	0.50	0.83	0.87	0.91	1.66	1.75	1.83	3.12	3.33	5.00	8.00	10.00	20.00
	LPD	18	22	41	45	75	79	83	151	158	166	283	302	454	719	908	1892
Pressure, max. PSIG/Bar																	
250 / 17		B2	—	03	—	F4	—	—	H4	—	—	—	—	—	—	—	—
150 / 10		—	A2	—	B3	—	D4	—	—	G4	—	H5	—	—	—	—	—
100 / 7		—	—	—	A3	—	—	B4	—	—	E4	—	G5	H6	—	—	—
50 / 3.3		—	—	—	—	—	—	—	—	—	—	—	—	—	K7	—	—
35 / 2.4		—	—	—	—	—	—	—	—	—	—	—	—	—	—	H7	—
20 / 1.3		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	H8

Series E

Capacity, nominal	GPD	5	6	11	12	21	22	44
	GPH	0.20	0.25	0.45	0.50	0.87	0.91	1.83
	LPD	18	22	41	45	79	83	166
Pressure, max. PSIG/Bar								
250 / 17		12	—	33	—	—	—	—
150 / 10		—	02	—	13	34	—	—
100 / 7		—	—	—	03	—	14	44

Series A PLUS

Capacity, nominal	GPD	6	12	22	30
	GPH	0.25	0.50	0.91	1.25
	LPD	22	44	83	113.50
Pressure, max. PSIG/Bar					
150 / 10		02	03	—	—
100 / 7		—	—	04	64

Series A

Capacity, nominal	GPD	15	30
	GPH	0.62	1.25
	LPD	56	113
Pressure, max. PSIG/Bar			
150 / 10		MA	—
100 / 7		—	MB

Series C PLUS

Capacity, nominal	GPD	6	12	22	30
	GPH	0.25	0.50	0.91	1.25
	LPD	22	44	83	113.50
Pressure, max. PSIG/Bar					
80 / 5.6		02	03	04	54

Series C

Capacity, nominal	GPD	6	12	22	30
	GPH	0.25	0.50	0.91	1.25
	LPD	22	44	83	113.50
Pressure, max. PSIG/Bar					
80 / 5.6		02	03	04	54

Position 5 Controls

	Series E PLUS	Series E, A PLUS, C PLUS	Series A	Series C
Manual stroke length only	—	—	—	S
Manual, dual function	S	S	S	—
External Pacing, w/Stop	E	—	—	—
4–20 mADC direct, w/Stop	M	—	—	—

Position 6 Electrical (All Series)

115 VAC / 50–60 Hz / 1ph, with 6 ft., 3 wire U.S. power cord and grounded plug = A
230 VAC / 50–60 Hz / 1 ph, with 6 ft., 3 wire U.S. power cord and grounded plug = B
To specify a power cord without plug, change Options 11,12,13 to 300.
For special power cord with plug, consult factory.

Position 7 Head/Fittings/Diaphragm Material[1]

	PSI, Max.	Series E PLUS	Series E, A PLUS, C PLUS	Series A	Series C
PVDF / PVDF / TFE-faced HYP	250	K	K	—	K
316SS / 316SS / TFE-faced HYP	250	A	A	—	A
GFPPL / GFPPL / TFE-faced HYP	250	P	P	—	P
PVC / PVC / TFE-faced HYP	100	V	V	—	V
SAN / PVC / TFE-faced HYP	100	S	S	—	S
PVC / PVC / TFE-faced NPR	150	—	—	A	—

Position [8] Seat and O-Ring Material/Quantity of Checks

	PSI. Max.	Series E PLUS, E, A PLUS, C PLUS, C	Series A
Teflon / double	250	T	—
Hypalon / single	150	H	—
Hypalon / double	150	—	A
Viton / single	150	V	—
Viton / double	150	—	B
EPDM / single	150	E	—
Teflon-coated / double	150	—	C

Position [9] Ball Material

Series E PLUS, E, A PLUS, C PLUS, C
Ceramic = C
Teflon = T
316 SS = S
Alloy C = H

Series A
Ceramic = C

Position [11,12,13] Options

Custom features available

Position [10] Connection Type — Size (ID x OD)/Ball Size (diam.)

Series E PLUS, E, A PLUS, C PLUS, C

Viscosity ≤ 1000 cps	Model Capacity GPD, Max.	
Tubing - 1/4" x 3/8" / 1/4"	5 TO 44	1
Tubing - 3/8" x 1/2" / 1/4"	5 TO 44	A
Tubing - 3/8" x 1/2" / 3/8"	40 TO 240	3
Tubing - 1/2" x 3/4" / 1/2"	500 GPD	8
Piping - 1/4" FNPT / 1/4"	5 TO 44	2
Piping - 1/4" FNPT / 3/8"	40 TO 240	4
Piping - 1/2" FNPT / 1/2"	500 GPD	C
Viscosity > 1000 cps - See Note 2		
Series A		
Tubing - 1/8" x 1/4" / 5/16"	15	X
Tubing - 1/4" x 3/8" / 5/16"	15, 30	Y

Note: For special metric fittings and tubing, consult factory.

Specifications

Liquid End Materials[1]								
Series	Pump Head	Diaphragm	Check Valves: Seats / O-rings	Check Valves: Balls	Fittings	Bleed Valve	Injection Valve Assembly Foot Valve Assembly	Tubing
E PLUS, E, A PLUS, C PLUS and C	GFPPL PVC SAN PVDF 316SS	Teflon-faced Hypalon backed	Teflon, Hypalon, Viton, EPDM	Ceramic, Teflon, 316SS, Alloy C	GFPPL PVC PVDF 316SS	Same as fitting and check valve selected, except 316SS	Same as fitting and check valve selected	Clear PVC White PE
A	PVC	Teflon-faced Neoprene-backed	Hypalon, Viton, Teflon-coated Elastomer	Ceramic	PVC	Same as fitting and check valve selected		Clear Vinyl White PE

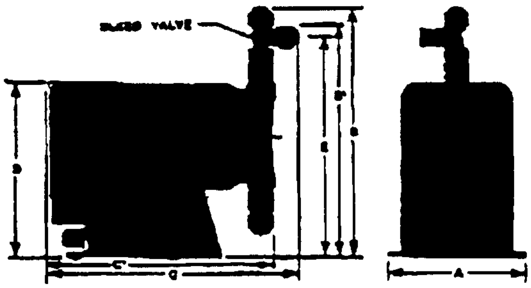
[1]Material Code—GFPPL = Glass-filled Polypropylene, PVC = Polyvinyl Chloride, SAN = Styrene-Acrylonitrile, PVDF = Polyvinylidene Fluoride, TFE = Teflon®, HYP = Hypalon®, NPR = Neoprene, EPDM = Ethylene Propylene Diene Monomer, SS = Stainless Steel, PE = Polyethylene. Teflon, Hypalon and Viton are registered trademarks of E.I. DuPont Company

	Series E PLUS	Series E	Series A PLUS	Series A
Pressure, max; PSI / BAR @ GPD / GPH / LPD	250 / 17 40 / 1.66 / 151	250 / 17 11 / .45 / 41	150 / 10 12 / .50 / 44	150 / 10 15 / .62 /
Capacity (nominal), max; GPD / GPH / LPD @ PSI / BAR	500 / 20 / 1892 20 / 1.3	44 / 1.83 / 166 100 / 7	30 / 1.25 / 113 100 / 7	30 / 1.25 / 100 / 7
Approvals	U.L., CSA	U.L., CSA	—	—
Reproducibility, at max Capacity; % (±)	2	3	3	5
Viscosity, Max; CPS	1000[2]	1000[2]	1000	300
Suction Lift @ 1 CPS, max; ft / M @ 3000 CPS	10 / 3.1 (once primed) 3.5 / 1.1	10 / 3.1 (once primed) 3.5 / 1.1	5 / 1.5 (once primed) N / A	5 / 1.5 (on N / A
Stroke Frequency, max; SPM	125	125	125	130
Stroke Frequency Control, (Automatic)	4–20 mADC Direct, w/Stop External Pacing, w / Stop	N / A	N / A	N / A
Stroke Frequency Control, (Manual)	On-Line Adjustable	On-Line Adjustable	On-Line Adjustable	On-Line Ar
Stroke Frequency Turn-Down Ratio	10:1	10:1	10:1	10:1
Stroke Length Control (Manual)	On-Line Adjustable	On-Line Adjustable	On-Line Adjustable	On-Line A
Stroke Length Turn-Down Ratio	10:1	10:1	10:1	10:2
Power Input	115VAC / 50–60Hz / 1 ph 230VAC / 50–60Hz / 1 ph	115VAC / 50–60Hz / 1 ph 230VAC / 50–60Hz / 1 ph	115VAC / 50–60Hz / 1 ph 230VAC / 50–60Hz / 1 ph	115VAC / 230VAC /
Average Current Draw @ 115 VAC; Amps	1.0	0.6	0.6	0.7
Peak Input Power; Watts	300	130	130	80
Average Input Power @ max SPM; Watts	130	50	50	35
Circuit Board Protection	Circuit Breaker (Panel-Mount)	Fuse, 1.5 Amp (Board-Mount)	Fuse, 1.5 Amp (Board-Mount)	Fuse, 2 A
Connections—Tubing	1/4" ID x 3/8" OD, 1/4" Ball 3/8" ID x 1/2" OD, 1/4" Ball 1/4" FNPT, 3/8" Ball 1/2" ID x 3/4" OD, 1/2" Ball	1/4" ID x 3/8" OD, 1/4" Ball 3/8" ID x 1/2" OD, 1/4" Ball	1/4" ID x 3/8" OD, 1/4" Ball 3/8" ID x 1/2" OD, 1/4" Ball	1/8" ID x 1/ 1/4" ID x 3/
—Piping	1/4" FNPT, 1/4" Ball 1/2" FNPT, 1/2" Ball	1/4" FNPT, 1/4" Ball	1/4" FNPT, 1/4" Ball	N / A
Injection Anti-Siphon / Back Pressure Valve, w / Tubing	Standard	Standard	Standard	Standard
Foot Valve / Strainer, w / Tubing	Standard(a)	Standard(a)	Standard	Standard
Bleed Valve Assembly, w / Tubing	Standard(b)	Standard(b)	Standard(b)	Standard(b)
Switch, Panel Mount	On-Off or Auto-Off-Manual	N / A	N / A	N / A
LED Indicator Lights, Panel Mount	Power On-Green Stop (w / Auto)–Red	N / A	N / A	N / A
Transparent Control Panel Cover	Standard	N / A	N / A	N / A

[2]For Viscosity up to 3000 CPS, select connection size 3, 4, 8 or C with 316SS ball material. Flow rate will determine connection/ball size.
For Viscosity >3000 CPS, request additional selections from your Sales Representative.

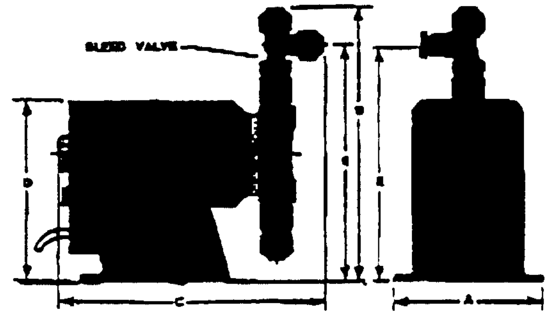
(a) Not available with High Viscosity (>3000 CPS) connections
(b) Not available with Piping Discharge Connections.

Dimensions



Series E PLUS Dimensions (Inches)								
Model No.	A	B	B'	C	C'	D	E	Shipping Weight (Lbs.)
LPA2	5.4	10.2	–	10.8	–	7.5	9.0	13
LPA3	5.4	10.6	–	10.7	–	7.5	9.2	13
LPB2	5.4	10.3	–	10.8	–	7.5	9.0	13
LPB3	5.4	10.6	–	10.7	–	7.5	9.2	13
LPB4	5.4	10.6	–	10.7	–	7.5	9.2	13
LPD3	5.4	10.6	–	11.2	–	7.5	9.2	15
LPD4	5.4	10.6	–	11.2	–	7.5	9.2	15
LPE4	5.4	10.6	–	11.2	–	7.5	9.2	15
LPF4	5.4	10.6	–	11.7	–	7.5	9.2	18
LPG4	5.4	10.6	–	11.7	–	7.5	9.2	18
LPG5	5.4	11.0	–	11.2	–	7.5	9.6	18
LPH4	6.2	11.0	–	11.2	–	8.2	9.6	21
LPH5	6.2	11.2	–	11.2	–	8.2	10.0	21
LPH6	6.2	11.1	–	11.2	–	8.2	10.0	21
LPH7	8.1	11.7	–	11.2	–	8.2	10.2	21
LPH8*	8.1	–	10.9	–	10.6	8.2	–	25
LPK7	8.1	11.7	–	11.2	–	8.2	10.2	21

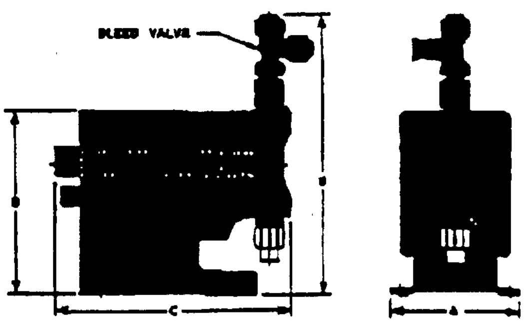
Note: Inches x 2.54 = cm
* The LPH8 is designed without a bleed valve available.



Series E Dimensions (Inches)						
Model No.	A	B	C	D	E	Shipping Weight (Lbs.)
LE02	5.0	9.6	9.6	6.5	8.2	10
LE03	5.0	9.9	9.5	6.5	8.5	10
LE12	5.0	9.6	9.6	6.5	8.2	10
LE13	5.0	9.9	9.5	6.5	8.5	10
LE14	5.0	9.9	9.5	6.5	8.5	10
LE73	5.4	10.6	11.4	7.5	9.2	15
LE34	5.4	10.6	11.4	7.5	9.2	15
LE44	5.4	10.6	11.4	7.5	9.2	15

Note: Inches x 2.54 = cm

Series A PLUS Dimensions (Inches)						
Model No.	A	B	C	D	E	Shipping Weight (Lbs.)
LB02	5.0	9.6	9.5	6.5	8.2	10
LB03	5.0	9.9	9.5	6.5	8.5	10
LB04	5.0	9.9	9.5	6.5	8.5	10
LB64	5.0	9.9	9.5	6.5	8.5	10



Series A Dimensions (Inches)					
Model No.	A	B	C	D	Shipping Weight (Lbs.)
LAMA	4.2	10.0	7.9	6.3	9
LAMB	4.2	10.0	7.9	6.3	9

Series C PLUS Dimensions (Inches)						
Model No.	A	B	C	D	E	Shipping Weight (Lbs.)
LD02	5.0	9.6	9.5	6.5	8.2	10
LD03	5.0	9.9	9.5	6.5	8.5	10
LD04	5.0	9.9	9.5	6.5	8.5	10
LD54	5.0	9.9	9.5	6.5	8.5	10

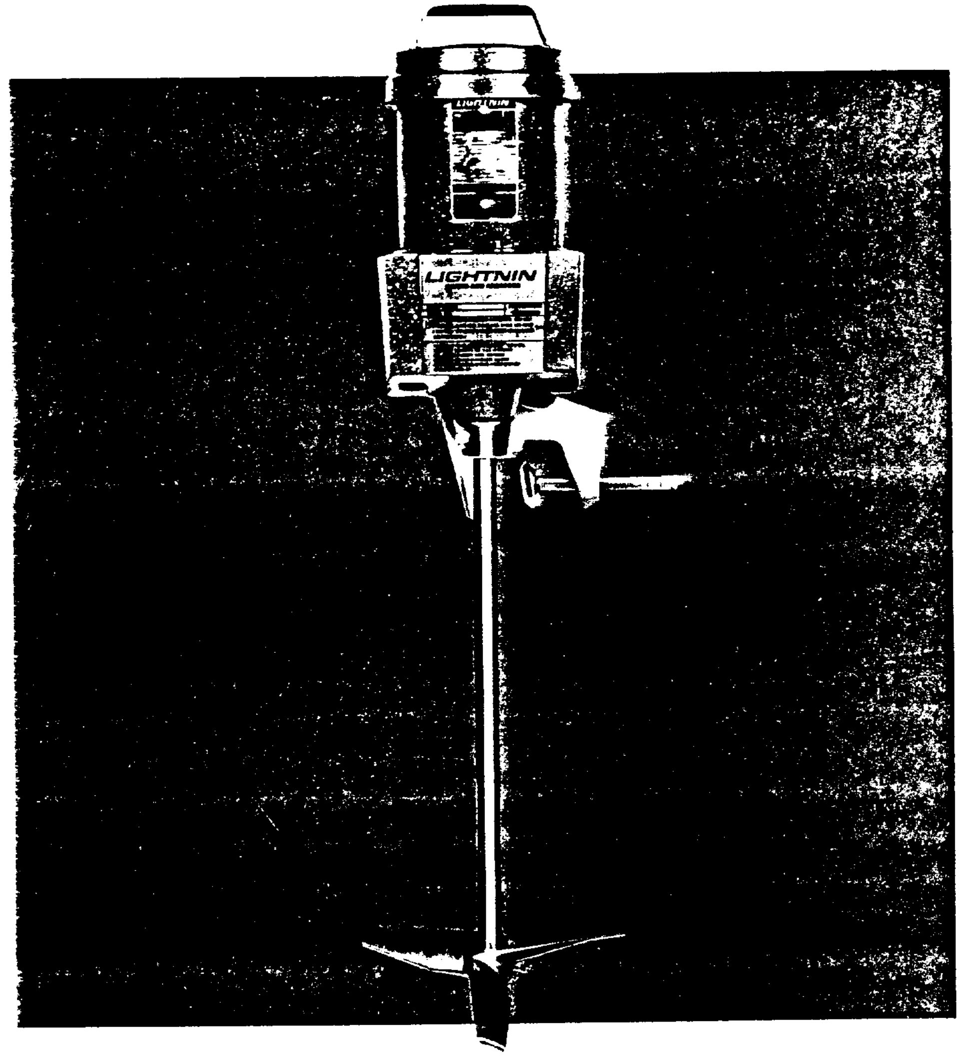
Series C Dimensions (Inches)						
Model No.	A	B	C	D	E	Shipping Weight (Lbs.)
LC02	5.0	9.6	9.5	6.5	8.2	10
LC03	5.0	9.9	9.5	6.5	8.5	10
LC04	5.0	9.9	9.5	6.5	8.5	10
LC54	5.0	9.9	9.5	6.5	8.5	10

Pulsafeeder
Manufacturers of Quality Pumps, Controls and Systems
27101 Airport Road
Punta Gorda, Florida 33982
813-575-2900
Fax: 813-575-4085

Technical Sheet No. EMP-003

Printed in U.S.A. 2/92

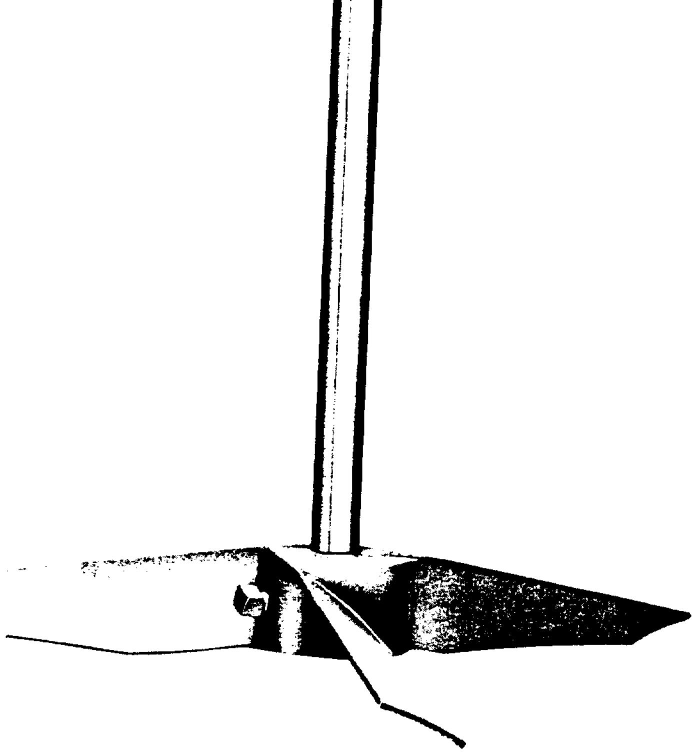
Portable, Fixed Mount And Inliner Mixers



Getting The Job Done Right

LIGHTNIN®

More mixing, less cost

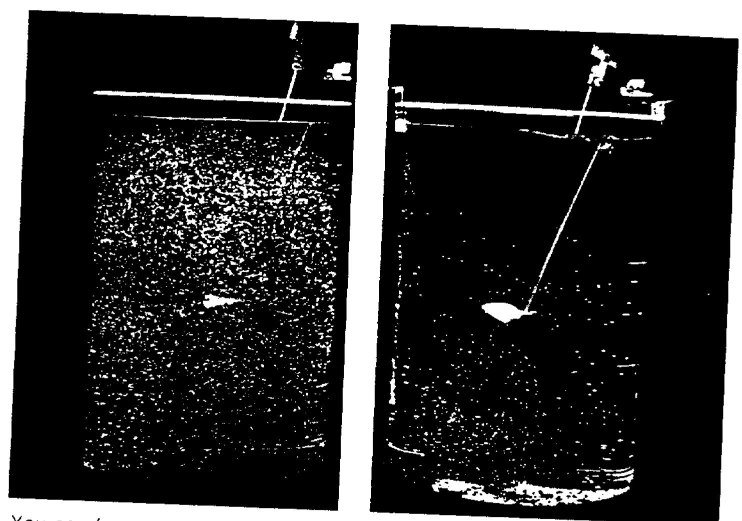


A310 Impeller develops 50% more mixing than ordinary props

You save in electrical power costs over the many years you use your Lightnin mixer.

The reason is the impeller. The blades of our A310 Impellers have a special contour which creates 50% more mixing than conventional 3-bladed marine-type props. This design also outperforms **every** competitive impeller we've tested over the last 20 years. With Lightnin, you get more mixing for the horsepower, 50% more.

In process studies, the A310 Impeller acts as a scale up constant. All impellers supplied on Lightnin portables are geometrically similar. This permits meaningful scale up for big production runs.



You see for yourself how the A310 Impeller, left, sweeps the bottom clean, while at the same power level a conventional prop, right, leaves unmixed solids.

The LIGHTNIN Guarantee

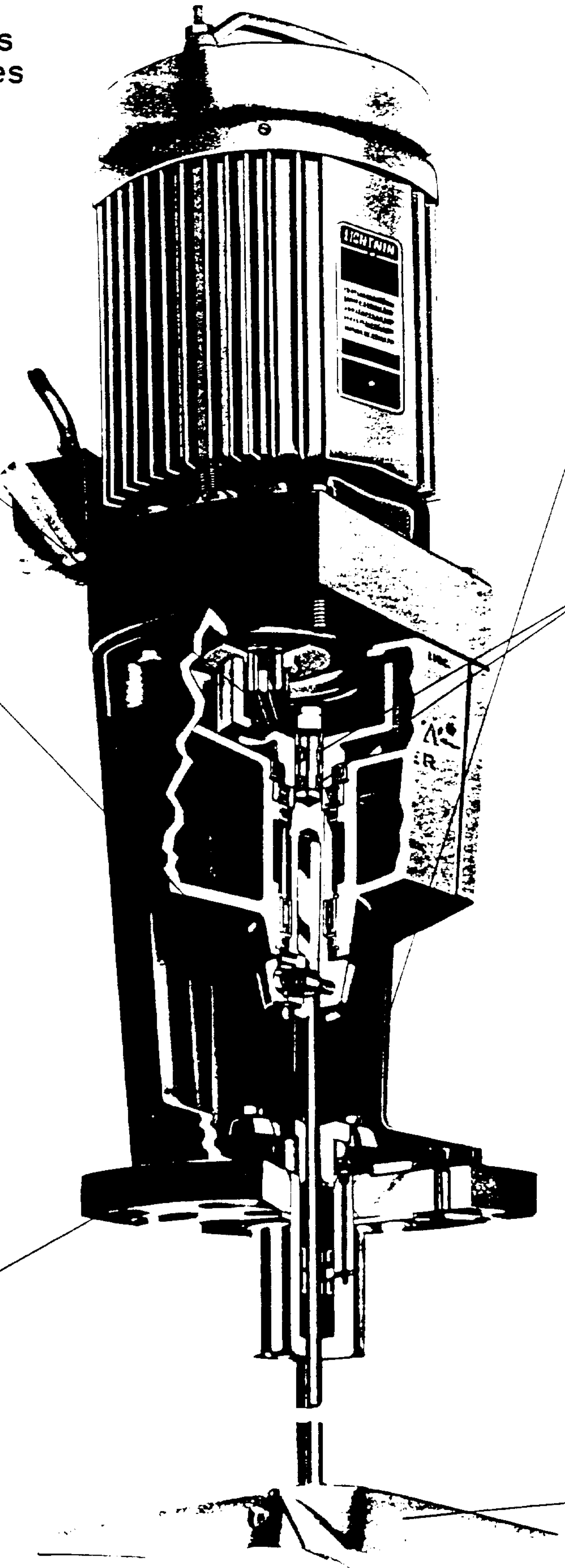
Mixing Equipment Co., guarantees that in the case of a failure of any mixer in this catalog, which you feel is our responsibility, we will repair or replace it to your satisfaction or we will refund the purchase price. This guarantee applies for the first full year you use your mixer or for 18 months after we ship it, whichever comes first.

Portable mixers were the very first Lightnin products back in 1923. We still occasionally discover an original model going strong after 50 years' service or more.

Every day, we see Lightnin Mixers operating continuously around the clock after 20 years or more...but that's how we build them...for years of non-stop mixing.

LIGHTNIN fixed mounts for closed tanks

XJC & XJDS Series
XDC & XDDS Series



LIFETIME LUBRICATED.

All shaft, motor bearings, and gears are lifetime lubricated. No need to change lubricant.

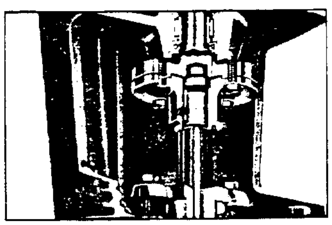
MOTORS AND DRIVES TO MATCH THE WORK.

Drive can be through single reduction helical gears as shown. Or it can be direct. Drive design and motors are the same proven performers used on other fixed mounts and standard portables.

POSITIVE CHUCK.

Grip bears against tapered flat on mixer shaft. Unless intentionally released, shaft cannot drop out.

REMOVABLE COUPLING.



Adds stability for long overhung shafts. Flange is rabbetted and keyed to assure positive alignment.

STANDARD OR SPECIAL FLANGES.

Standard ASA 150# series flanges are supplied in solid steel or in steel faced with 316 stainless for corrosion resistance. Other materials and special flanges can be furnished on request to mate with larger openings, or adaptors provided to fit smaller openings.

SEAL OR STUFFING BOXES TO MATCH THE PROCESS.

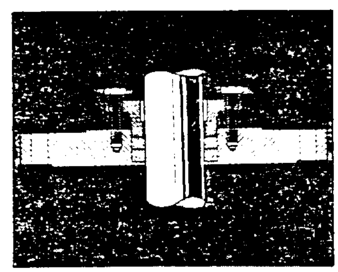
Standard 150 psig stuffing box Uses 7 rings of die-molded packing with separators, a lubricant distributing GFT* lantern ring, grease fitting, and adjustable 316SS* packing gland. Where needed, we can adapt for pressures to 300 psig. Cooling or heating jacket, lubricant trap and leak detector available as accessories

*Other materials available to suit process.

GEAR PROTECTION

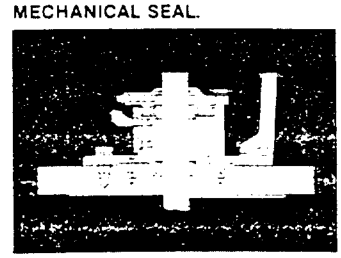
Exclusive grip springs protect against shock loads.

OPTIONAL 25 PSIG STUFFING BOX.



A simpler design for lower pressures. Uses 2 rings of die-molded packing and a packing gland.

MECHANICAL SEAL.



Provides most positive sealing. Minimizes maintenance.

HIGH EFFICIENCY A310 IMPELLER.

See page 25 for optional, special purpose impellers

MATCHED TO YOUR TANK.

The tank and the process determine the mixer, and your Lightnin representative has all the ways to match our mixer to your pressurized vessel.

After all, we guarantee process results, so we'll make sure we specify the optimum fixed mount for your tank. Call us early.

HIGH FLOW, GEAR DRIVEN FIXED MOUNTS FOR CLOSED TANKS

Model	Mixer Wgt Lbs	A	B With Chuck	B With Cplg	C	D	E
XJC-30	105	26¾	9½	5⅞	1⅜	3⅞	⅜
XJC-43	120	26¾	9½	5⅞	1⅜	3⅞	⅜
XJC-65	170	28	10⅛	5½	1⅝	4¾	½
XJC-87	180	28	10⅛	5½	1⅝	4¾	½
XJC-117	190	28¾	10⅛	5½	1⅝	4¾	½
XJC-174	215	32½	10¼	6⅝	1⅞	4¾	½
XJC-230	225	34¼	10¼	6⅝	1⅞	4¾	½
XJC-350	235	34¼	10¼	6⅝	1⅞	4¾	½

HIGH SHEAR, DIRECT DRIVE FIXED MOUNTS FOR CLOSED TANKS

Model	Mixer Wgt Lbs	A	B With Chuck	B With Cplg	C	D	E
XDC-30	102	25	9¾	6⅜	0	3⅞	⅜
XDC-43	120	25	9¾	6⅜	0	3⅞	⅜
XDC-87	130	25¼	9¾	6⅜	0	3⅞	⅜
XDC-117	135	26	9¾	6⅜	0	3⅞	⅜
XDC-174	180	28	10¼	6⅝	0	4¾	½
XDC-230	186	29¾	10¼	6⅝	0	4¾	½
XDC-350	216	29¾	10¼	6⅝	0	4¾	½

NOTES:

DEPENDENT ON APPLICATION.

- ALSO AVAILABLE WITH ELECTRONIC VARIABLE SPEED DRIVE.
- WEIGHT WILL VARY WITH MOTOR ENCLOSURE AND SHAFT AND IMPELLER SELECTION.
- DIMENSIONS ARE MAXIMUM – WILL VARY WITH MOTOR ENCLOSURE. CONDUIT BOX NOT INCLUDED WITH EXPLOSION PROOF MOTOR.

150 LB. ANSI (ASA) FLANGE DRILLING.

SIZE	O.D.	B.C.	NO. OF HOLES	SIZE OF BOLTS
5	10	8½	8	¾
6	11	9½		
8	13½	11¾		

ALL BOLT HOLES STRADDLE CENTERLINE. MOUNTING BOLTS FURNISHED BY OTHERS.

FLANGES LARGER THAN STANDARD ARE AVAILABLE. AND UNITS CAN BE ADAPTED TO MOUNT ON SMALLER FLANGES.

- DIMENSIONS ARE FOR REFERENCE ONLY UNLESS CERTIFIED.
- HANDLES ARE SHOWN 90° OUT OF POSITION.

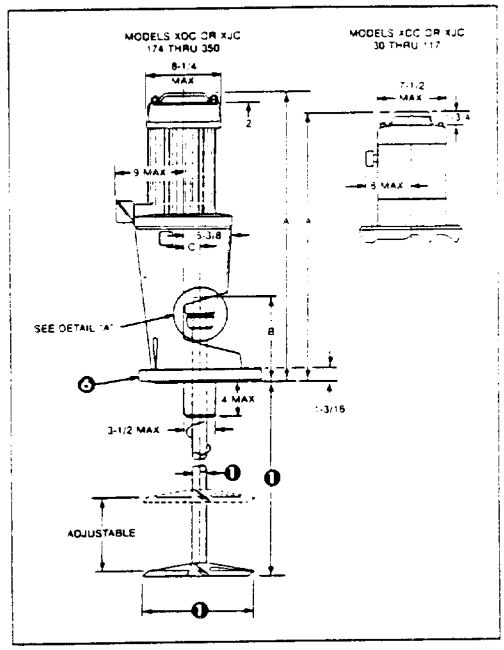
Mixer Housing — Aluminum*

Chuck or Rigid Coupling — Electroless nickel plated chuck or steel rigid coupling. Both are also available in 316SS as an option.

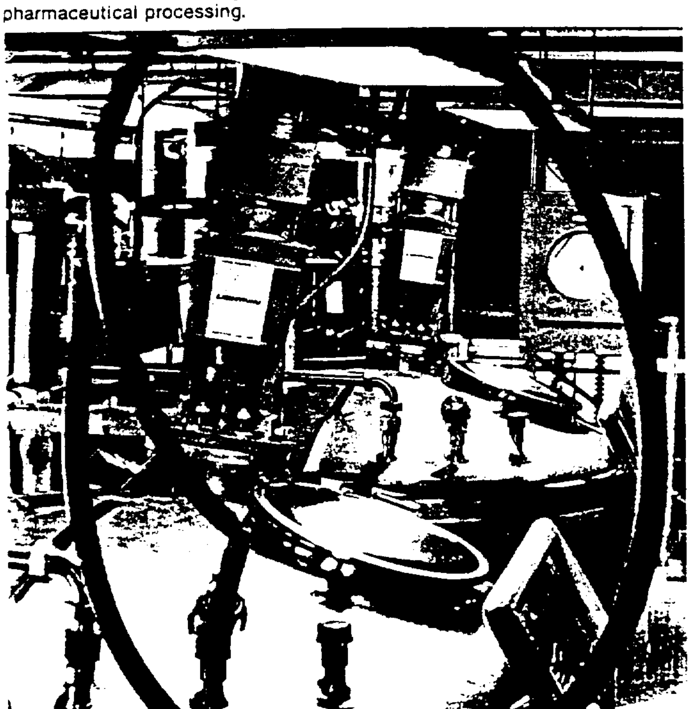
Shaft and Impellers — Steel, Type 316 stainless. Also available in any wrought commercial alloys and with coverings of such materials as rubber, PVC, polymers and fluorocarbons.

Paint — Styrenated alkyd enamel, 400 hours minimum salt spray resistance.

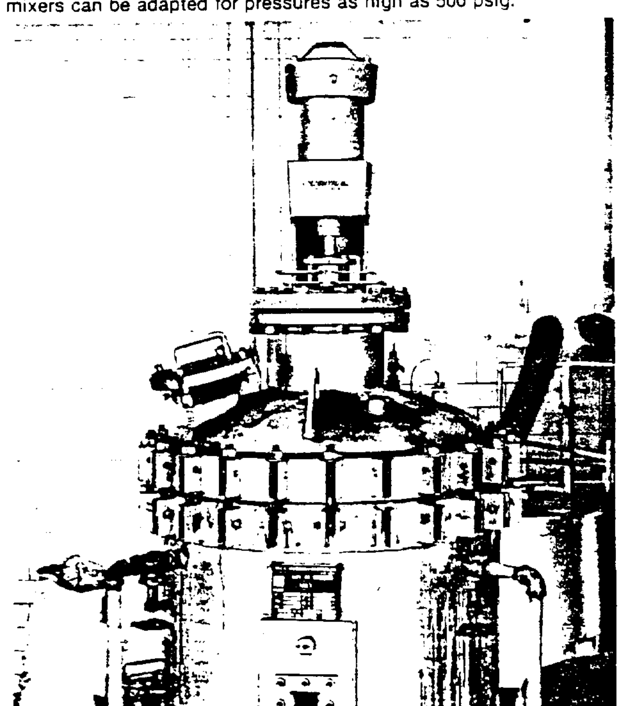
*Other materials available



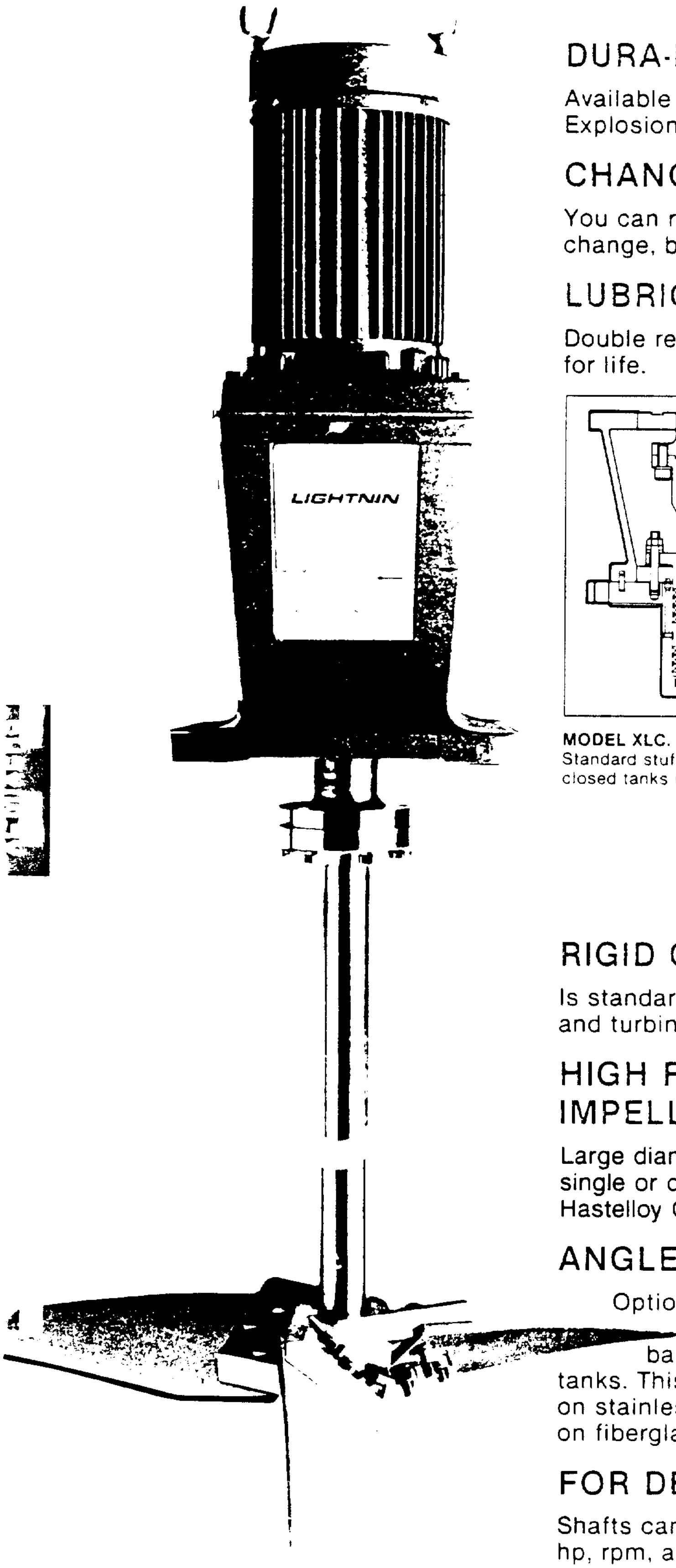
Fixed mounts with stuffing boxes find wide use on the closed tanks of pharmaceutical processing.



For gas-liquid contacting, Lightnin fixed-mount, mechanical seal mixers can be adapted for pressures as high as 500 psig.



XL Mixers



DURA-MIX™ HIGH EFFICIENCY MOTORS.

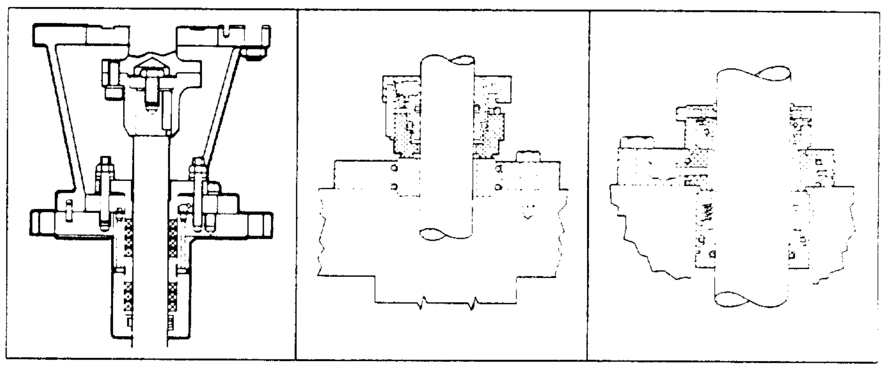
Available 1 to 5 hp. Bearings are lubricated for life. Explosion proof model available.

CHANGE GEARS.

You can readily change speeds as process requirements change, by simply changing gears.

LUBRICATED FOR LIFE.

Double reduction gears and bearings are grease lubricated for life.



MODEL XLC. Standard stuffing box is for closed tanks up to 150 psig.

MODEL XLSS. **MODEL XLDS.** New mechanical seals can operate dry or with liquid lubrication.

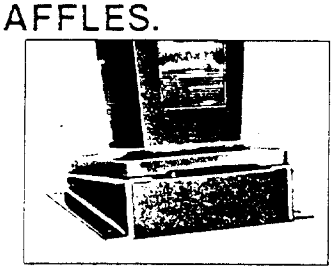
RIGID COUPLING.

Is standard and makes for easy installation of lower shaft and turbine.

HIGH FLOW HIGH EFFICIENCY A310 IMPELLERS.

Large diameter impellers assure high pumping action. Available in single or dual configuration. Materials available: Steel, 316SS, Hastelloy C.

ANGLE RISERS ELIMINATE BAFFLES.

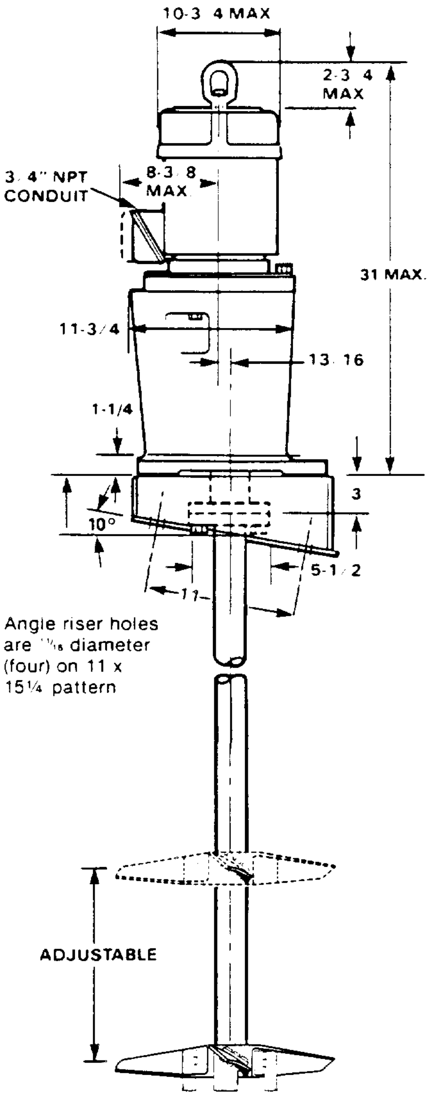


Optional angle risers provide angular off-center mounting so that baffles are not needed in open tanks. This means savings of up to 10% on stainless steel tanks and up to 15% on fiberglass tanks.

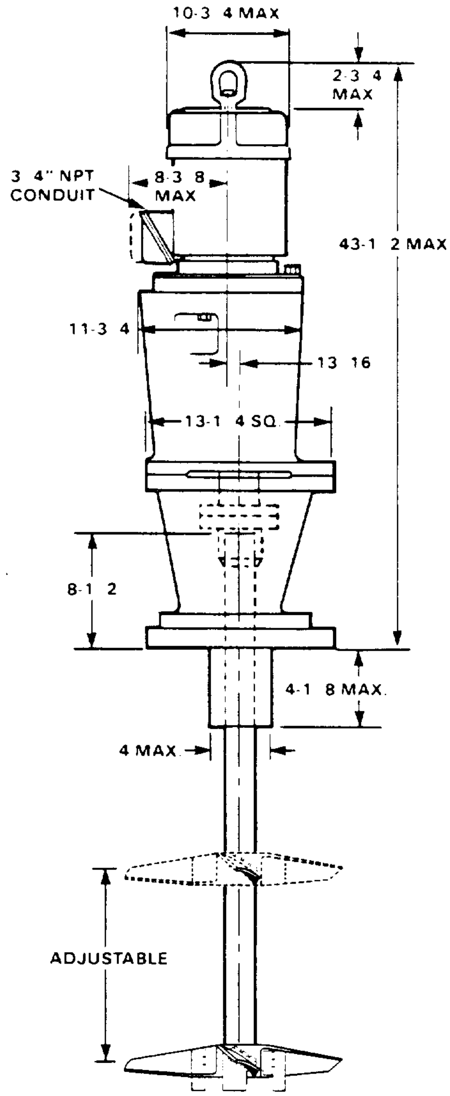
FOR DEEP TANKS.

Shafts can range up to 15', depending on hp, rpm, and impellers.

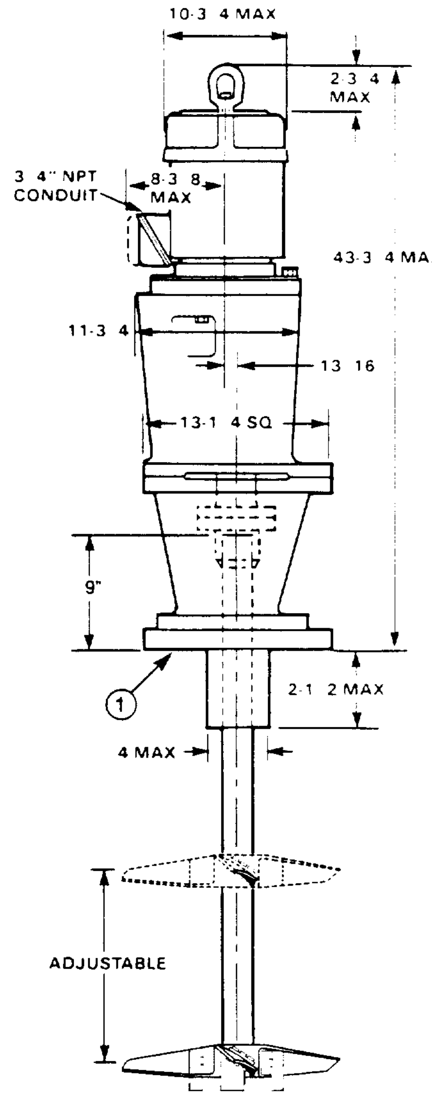
For additional details, ask for Bulletin B-581.



XLQ for open tanks.



XLC with standard stuffing box for closed tanks up to 150 psig.



XLSS with single mechanical seal for closed tanks.
XLDS with double mechanical seal for closed tanks.
1) Standard mounting flange 150 lb. 8" ANSI (ASA) series drilling.

MODEL XLQ

MODEL	HP	BASIC MIXER WEIGHT-LBS	TOTAL MIXER WGT SINGLE IMPELLER	TOTAL MIXER WGT DUAL IMPELLERS
XL Q-100B	1.0	186	312	328
XL Q-100D			340	354
XL Q-100F			372	400
XL Q-100H			420	468
XL Q-150B	1.5		313	330
XL Q-150D			340	364
XL Q-150F			373	388
XL Q-200B	2.0	190	317	334
XL Q-200D			345	348
XL Q-200F			369	375
XL Q-300B	3.0	195	323	341
XL Q-300C			345	360
XL Q-500A	5.0	200	329	N.R.

MODEL XLC

MODEL	HP	BASIC MIXER WEIGHT-LBS	TOTAL MIXER WGT SINGLE IMPELLER	TOTAL MIXER WGT DUAL IMPELLERS
XL C-100B	1.0	290	413	429
XL C-100D			441	455
XL C-100F			473	501
XL C-100H			521	569
XL C-150B	1.5		414	431
XL C-150D			441	465
XL C-150F			474	489
XL C-200B	2.0	294	418	435
XL C-200D			446	460
XL C-200F			470	487
XL C-300B	3.0	299	424	442
XL C-300C			446	472
XL C-500A	5.0	305	431	N.R.

MODELS XLSS, XLDS

MODEL	HP	BASIC MIXER WEIGHT-LBS	TOTAL MIXER WGT SINGLE IMPELLER	TOTAL MIXER WGT DUAL IMPELLERS
XLSS & XLDS-100B	1.0	300	423	439
XLSS & XLDS-100D			451	465
XLSS & XLDS-100F			483	511
XLSS & XLDS-100H			531	579
XLSS & XLDS-150B	1.5		524	441
XLSS & XLDS-150D			451	475
XLSS & XLDS-150F			484	499
XLSS & XLDS-200B	2.0	304	428	445
XLSS & XLDS-200D			456	470
XLSS & XLDS-200F			480	497
XLSS & XLDS-300B	3.0	309	434	452
XLSS & XLDS-300C			456	482
XLSS & XLDS-500A	5.0	315	440	N.R.

LIGHTNIN variable speeds

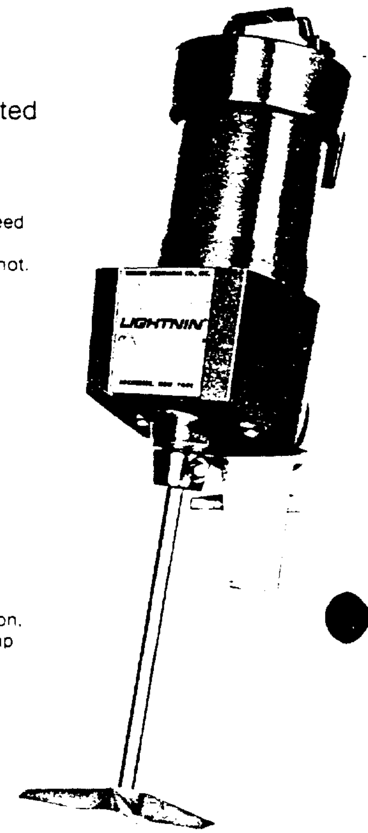
PRECISE SPEED CONTROL . . . SERIES SCR.

Set the speed, and these mixers hold that speed, despite changes in loading. Within ±1% for integral hp., within ±5% for fractional hp. You can accurately vary the speed, and accurately repeat the speed to optimize mixing for:

- Changing viscosity, batch to batch.
- Varying liquid levels.
- Aeration requirements.
- Pilot plant studies.
- Multiple step processing.
- Reduced agitation during drainage.

Separate speed control mounts by mixer or remotely to save the operator steps.

Solid state control unit converts ac to dc to operate the dc motor supplied. Sophisticated feedback monitoring circuit accurately maintains speed at the rate set.



SCR VARIABLE SPEED, HIGH FLOW, GEAR DRIVE MIXERS

hp	Current	Clamp Mount	Fixed Mount, open tank	Fixed Mount, stuffing box	Fixed Mount, mechanical seal
.3	115V, 50/60 Hz 1 Phase	XJ30-SCR	XJQ30-SCR	XJC30-SCR	XJDS30-SCR
.43	115V, 50/60 Hz 1 Phase	XJ43-SCR	XJQ43-SCR	XJC43-SCR	XJDS43-SCR
.87	115V, 50 Hz 1 Phase	XJ87-SCR	XJQ87-SCR	XJC87-SCR	XJDS87-SCR
1.17	230V, 60 Hz 1 Phase	XJ117-SCR	XJQ117-SCR	XJC117-SCR	XJDS117-SCR
1.74	230V, 60 Hz 1 Phase	XJ174-SCR	XJQ174-SCR	XJC174-SCR	XJDS174-SCR

Mixer dimensions are the same as for equivalent single speed mixers with nearest HP

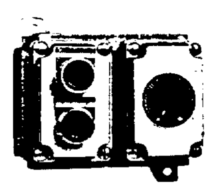
Operator control station. Speed can be changed anytime, whether mixer is running or not. Also available in waterproof NEMA 4 enclosure.

SCR VARIABLE SPEED, HIGH FLOW, DIRECT DRIVE MIXERS

hp	Current	Clamp Mount	Fixed Mount, open tank	Fixed Mount, stuffing box	Fixed Mount, mechanical seal
.3	115V, 50/60 Hz 1 Phase	XD30-SCR	XDQ30-SCR	XDC30-SCR	XDDS30-SCR
.43	115V, 50/60 Hz 1 Phase	XD43-SCR	XDQ43-SCR	XDC43-SCR	XDDS43-SCR
.87	115V, 50 Hz 1 Phase	XD87-SCR	XDQ87-SCR	XDC87-SCR	XDDS87-SCR
1.17	230V, 60 Hz 1 Phase	XD117-SCR	XDQ117-SCR	XDC117-SCR	XDDS117-SCR
1.74	230V, 60 Hz 1 Phase	XD174-SCR	XDQ174-SCR	XDC174-SCR	XDDS174-SCR

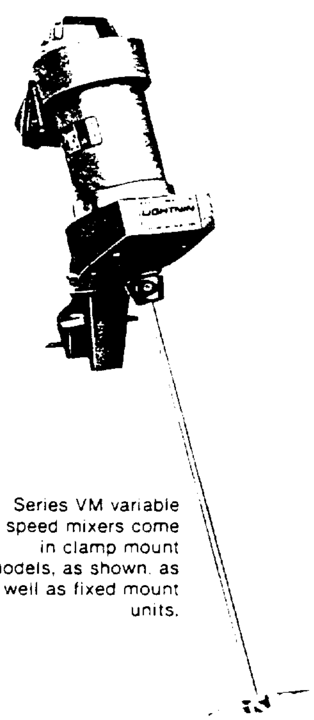
Mixer dimensions are the same as for equivalent single speed mixers with nearest HP

Explosion-proof control station, supplied with 1/3, 3/4 and 1 hp units for Class I, Group D.



ECONOMICAL, SELF-CONTAINED ELECTRONIC CONTROL . . . SERIES VM.

Moves from job to job as easily as any constant speed portable.

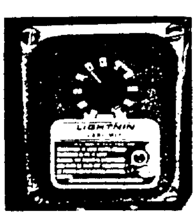


Series VM variable speed mixers come in clamp mount models, as shown, as well as fixed mount units.

VM VARIABLE SPEED MIXERS

Drive	hp	Current	Clamp Mount	Fixed Mount, open tank	Fixed Mount, stuffing box	Fixed Mount, mechanical seal
Gear	1/3	115-50/60-1 or 220-50/60-1	XJ33-VM	XJQ33-VM	XJC33-VM	XJDS33-VM
Gear	3/4	230-50/60-1	XJ75-VM	XJQ75-VM	XJC75-VM	XJDS75-VM
Direct	1/3	115-50/60-1 or 220-50/60-1	XD33-VM	XDQ33-VM	XDC33-VM	XDDS33-VM
Direct	3/4	230-50/60-1	XD75-VM	XDQ75-VM	XDC75-VM	XDDS75-VM

Mixer dimensions are the same as for equivalent single speed mixers. For XD33-VM dimensions, for example, see XD30 on page 7.



With solid state control mounted directly on the mixer, operator can dial the desired mixing result.

ADJUST-A-MIX™
AC VARIABLE FREQUENCY MOTOR CONTROL.

Make any AC 3 phase mixer a variable speed.

Solid state circuits convert normal 50 or 60 Hz power to controlled variable frequency power.

Motor output speed is directly proportional to the frequency of the input power.

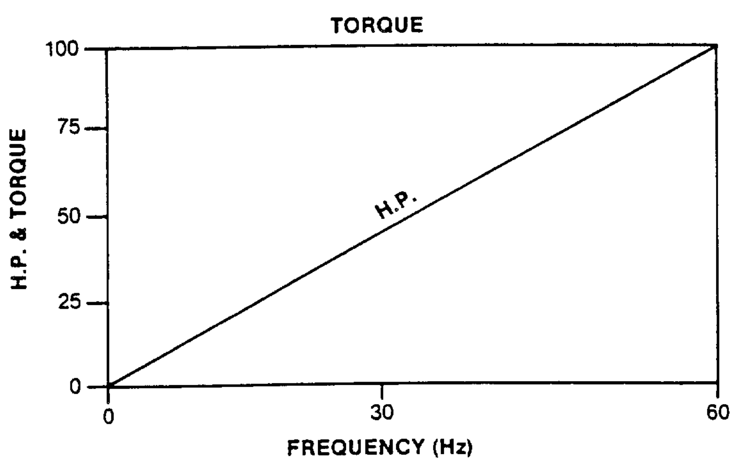
Input is 230V, 50 or 60 Hz, single phase current, 3 phase on some models.

A fractional horsepower unit is available for 115V, 50 or 60 Hz, single phase current.

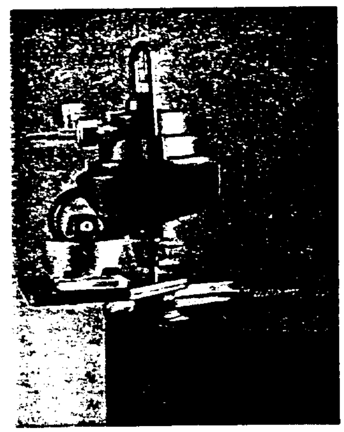
Output is 230V, 60 Hz, 3 phase current.

You can retrofit any 230V, 3 phase, 60 Hz, AC mixer in this book for variable speed control.

0-60 HZ PERFORMANCE OF TYPICAL 1 HP MOTOR WITH ADJUST-A-MIX CONTROL.



For further information ask for Adjust-A-Mix Bulletin B-608.

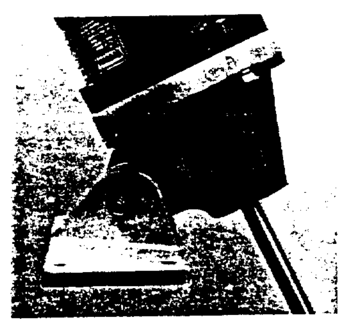


BUNG ADAPTOR.

Provides firm support to turn any standard 55-gallon drum with 2" NPT bung into a mixing tank.

For all direct drive units from ¼ to 1 hp, both electric and air operated.

Adaptor comes complete with bolts for cup plate mount. Cup plate mount and folding impeller should be ordered with mixer.



SURFACE MOUNT ADAPTER

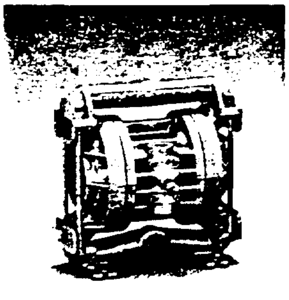
MOUNTINGS

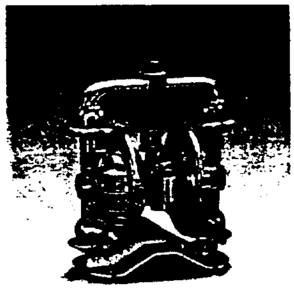
WILDEN® PUMPS

Air Operated Double Diaphragm

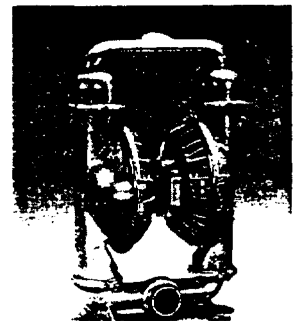
WILDEN METALLIC PUMPS

Wilden makes a complete line of air-operated, double diaphragm pumps with wetted parts available in: aluminum cast iron, 316 stainless steel and Hastelloy. Non-wetted air side parts are available in: aluminum, cast iron, 316 stainless steel and polypropylene (M4 model only). Elastomers are available in: Neoprene, Buna N, Nordel, Viton, Hypalon, polyurethane, Saniflex™ or patented Wilden Teflon®. (Not all models available with all options.)


M-2

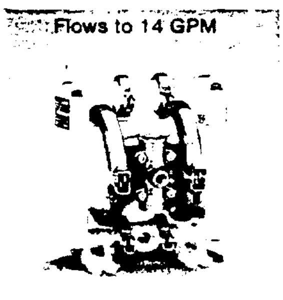

M-4


M-8

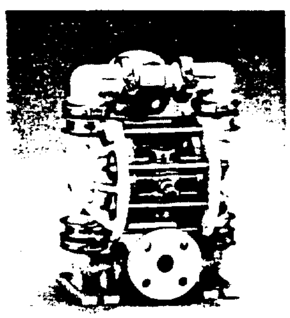

M-15

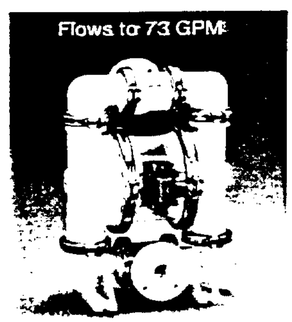
WILDEN ENGINEERED PLASTIC PUMPS

Wilden proudly present the Champ™. Available in four sizes for flow rates from 1/10 to 155 gallons per minute. A pump we build with pride to handle the most corrosive chemical process application. Engineered in response to requests for a reliable, non-metallic, sealless, positive displacement pump. The Champ™, available in Teflon® PFA, polypropylene or PVDF, adds emphasis to the versatility of the Wilden air-operated, double-diaphragm pump line.

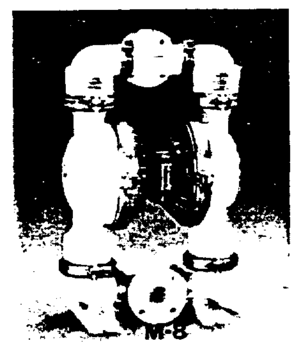


M-1


M-2

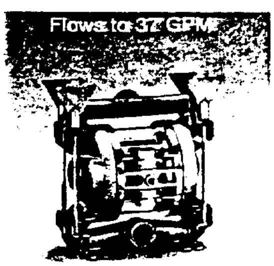


M-4

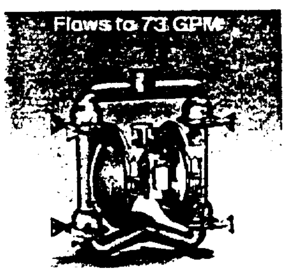

M-8

WILDEN FOOD PROCESSING PUMPS

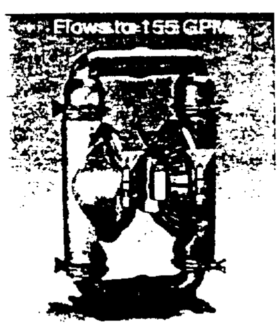
In addition to the USDA accepted Foodmaster™, Wilden manufactures a complete line of process pumps for all those applications which must comply with FDA standards. All food contact parts are 316 stainless steel and all elastomers are FDA approved Saniflex™. These models are ideal for sauces, purees, jams, tomato paste, and other food products that are thick, abrasive, or have a sensitive texture that requires gentle pumping action. The Wilden line of food processing pumps use a gentle pushing action; there are not rotors, lobes, or gears to tear or mash delicate products.



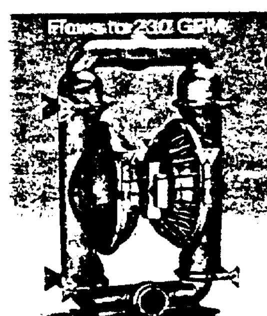
M-2



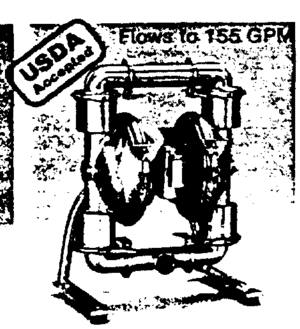
M-4



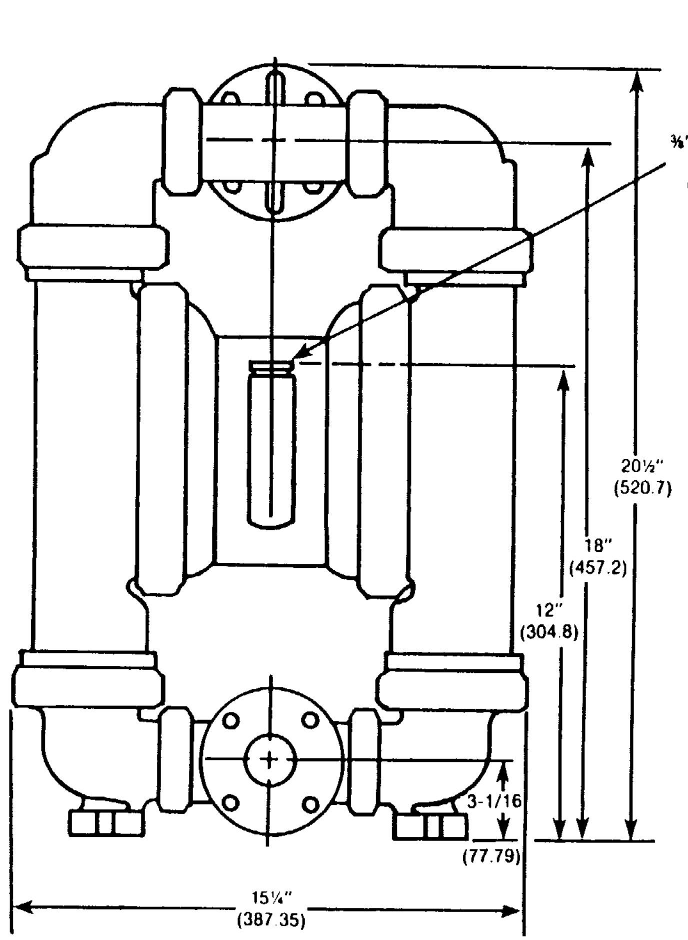
M-8

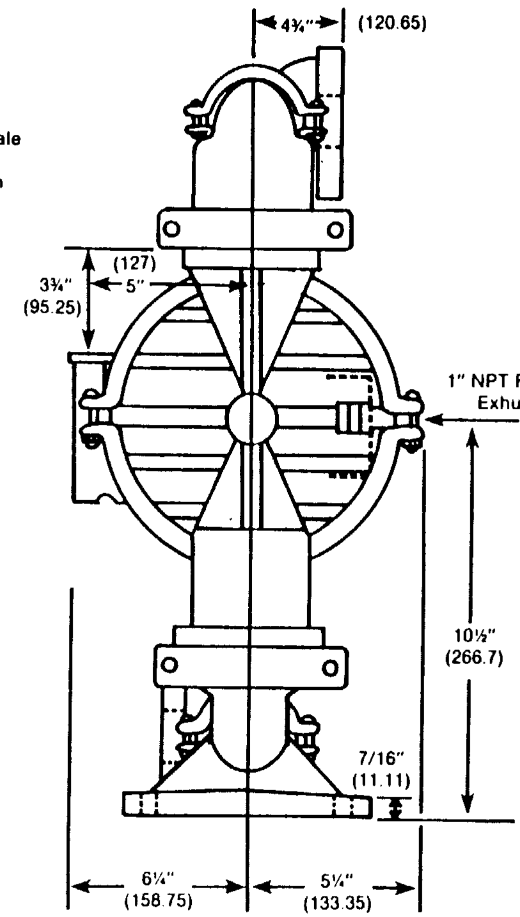


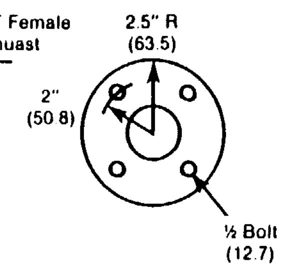
M-15



M-8

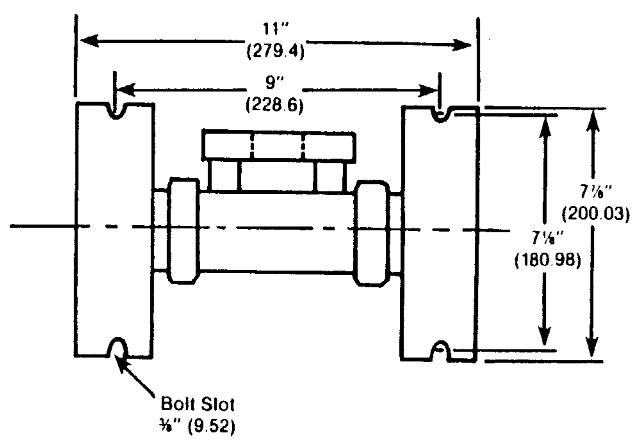






American Standard Pipe Flange - 150 Pound Class - 1.5 inch pipe.

(   ) Millimeters



CERTIFIED DIMENSIONAL DRAWING
WILDEN MODELS

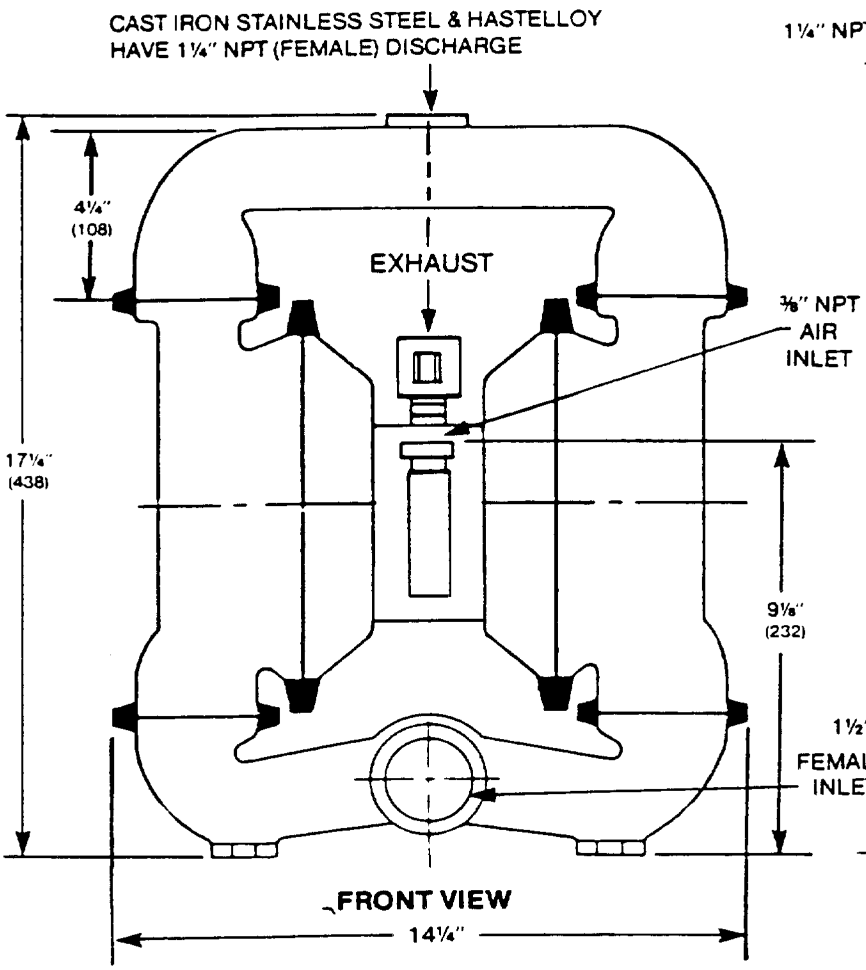
MODEL M-4 CHAMP

M4/PO
M4/PT
M4/UO

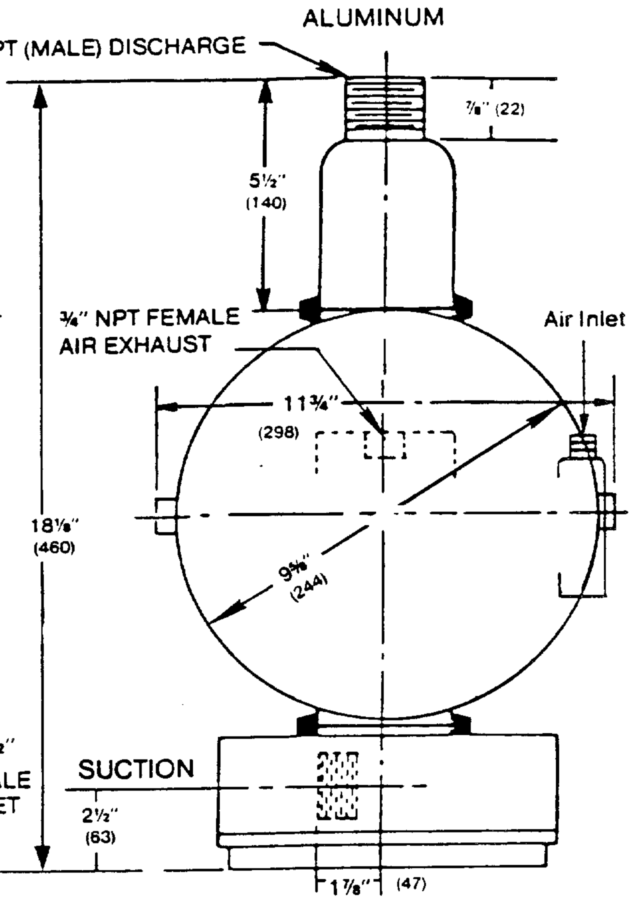
M4/KO
M4/KT
M4/UP

WILDEN PUMP & ENGINEERING CO.®
22069 Van Buren Street / P.O. Box 845 / Colton, CA 92324
Phone (714) 422-1700 / Telex 676-452 / FAX 714-422-1785 – 714-422-1786

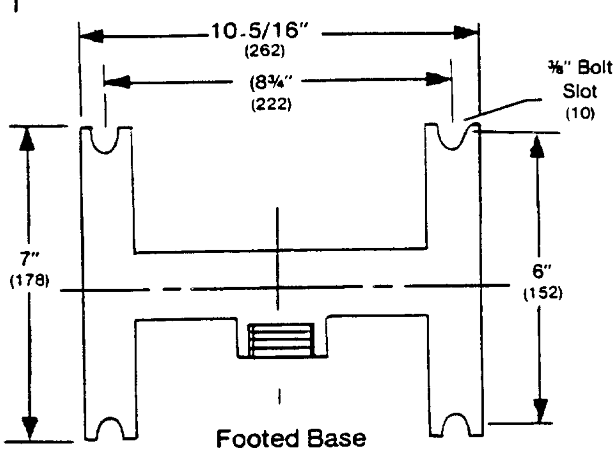
CERTIFIED DIMENSION DRAWING MODEL M4



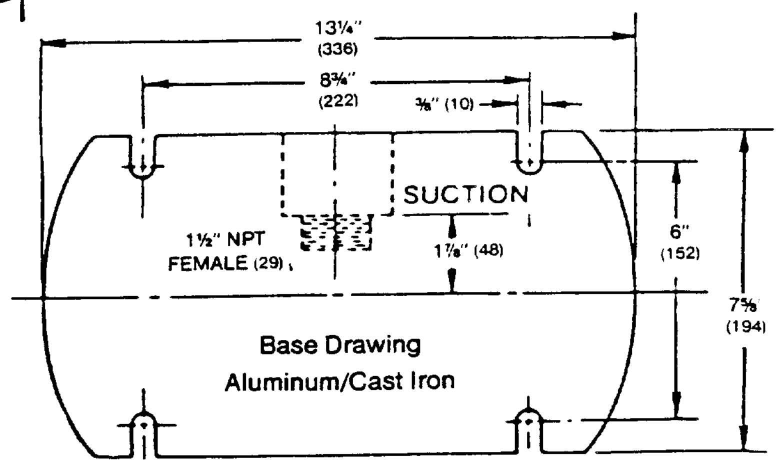
FRONT VIEW



SIDE VIEW



Footed Base
Stainless Steel/Hastelloy



Base Drawing
Aluminum/Cast Iron

NOTE: Suction and discharge nipples on standard aluminum pumps are mild steel and on alloy-fitted aluminum pumps are stainless. **NOTE:** Nipples are cast in and cannot be removed. All other models have female connections threaded into the casting.

NOTE: Models M4/SG and M4/SN have 2" standard tri-clamp style fittings.
O.D. — 2.516" I.D. — 1.625"

NOTE: Drawing depicts pump utilizing metal center section.

( ) Millimeters

CERTIFIED DIMENSIONAL DRAWING WILDEN MODELS:

M4/OO	M4/TB	M4/SJ
M4/OA	M4/HO	M4/ST
M4/BO	M4/HJ	M4/WO
M4/OB	M4/HT	M4/WS
M4/BT	M4/SO	M4/WT

RBG-C-40
3/89

®
WILDEN PUMP & ENGINEERING CO.
22069 Van Buren Street / P.O. Box 845 / Colton, CA 92324
Phone (714) 422-1700 / Telex 676-452 / FAX 714-422-1785 – 714-422-1786

SPECIFICATIONS AND PERFORMANCE

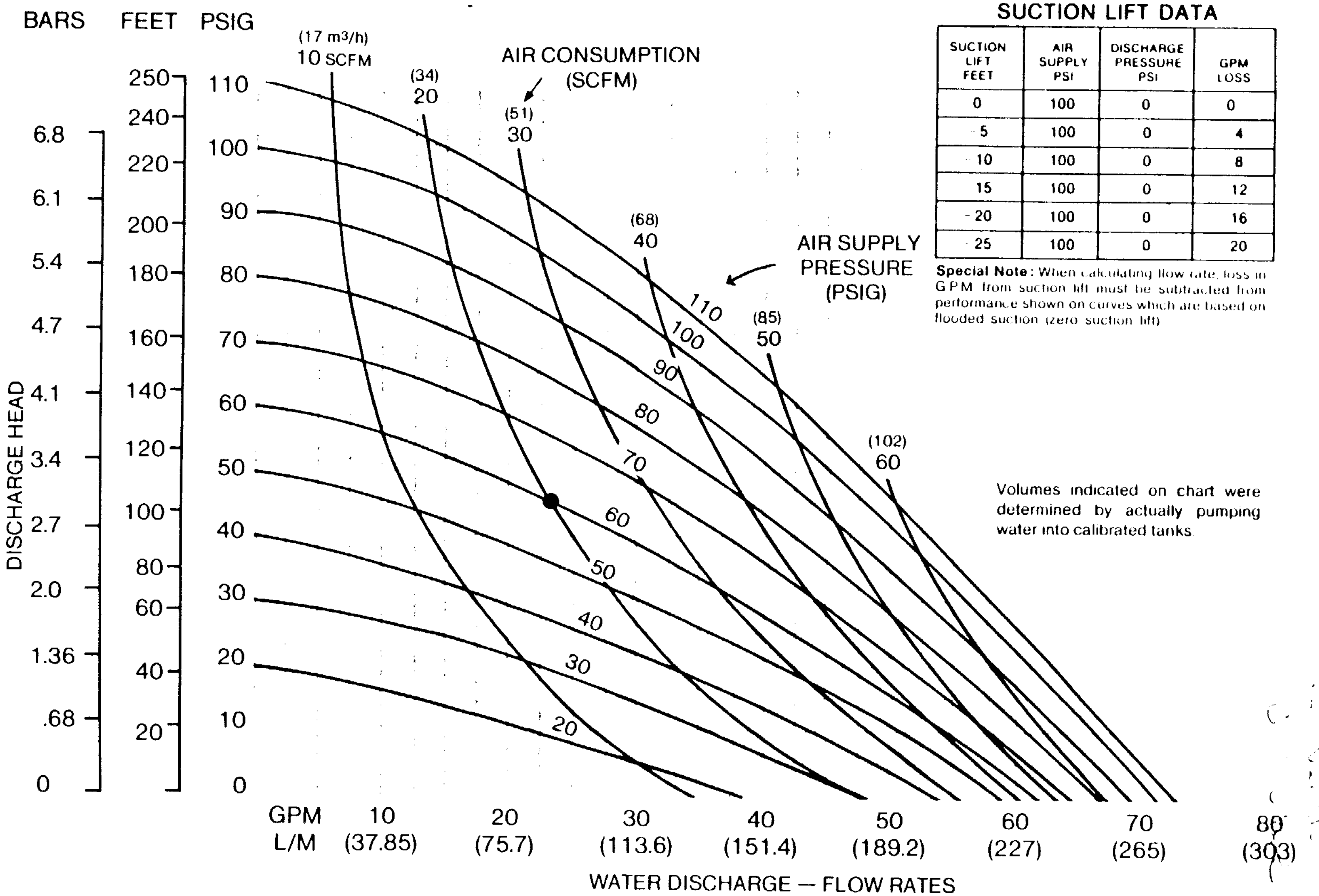
WILDEN® MODEL M4® CHAMP

Height .... 20½"
Width .... 15¼"
Depth .... 11½"
Weight .... PVDF 44 lbs.
POLYPROPYLENE 38 lbs.
Air Inlet .... ⅜" N.P.T.
Inlet ...... Standard 1½" Pipe FLG.
Outlet..... Standard 1½" Pipe FLG.
Suction Lift...... 22' Dry 27' Wet
Max. Size Solids .. 3/16" Dia.

Example: *To pump 22.5 gpm against a discharge pressure head of 45 psig, requires 60 psig and 20 scfm air consumption. (See dot on chart.)*

Note: For M4 pumps fitted with Teflon diaphragms reduce water discharge figures by 20%. Suction lift for M4 pumps with Teflon diaphragms: 12 ft. dry, 25 ft. wet.

Caution: Do not exceed 125 psig air supply pressure.



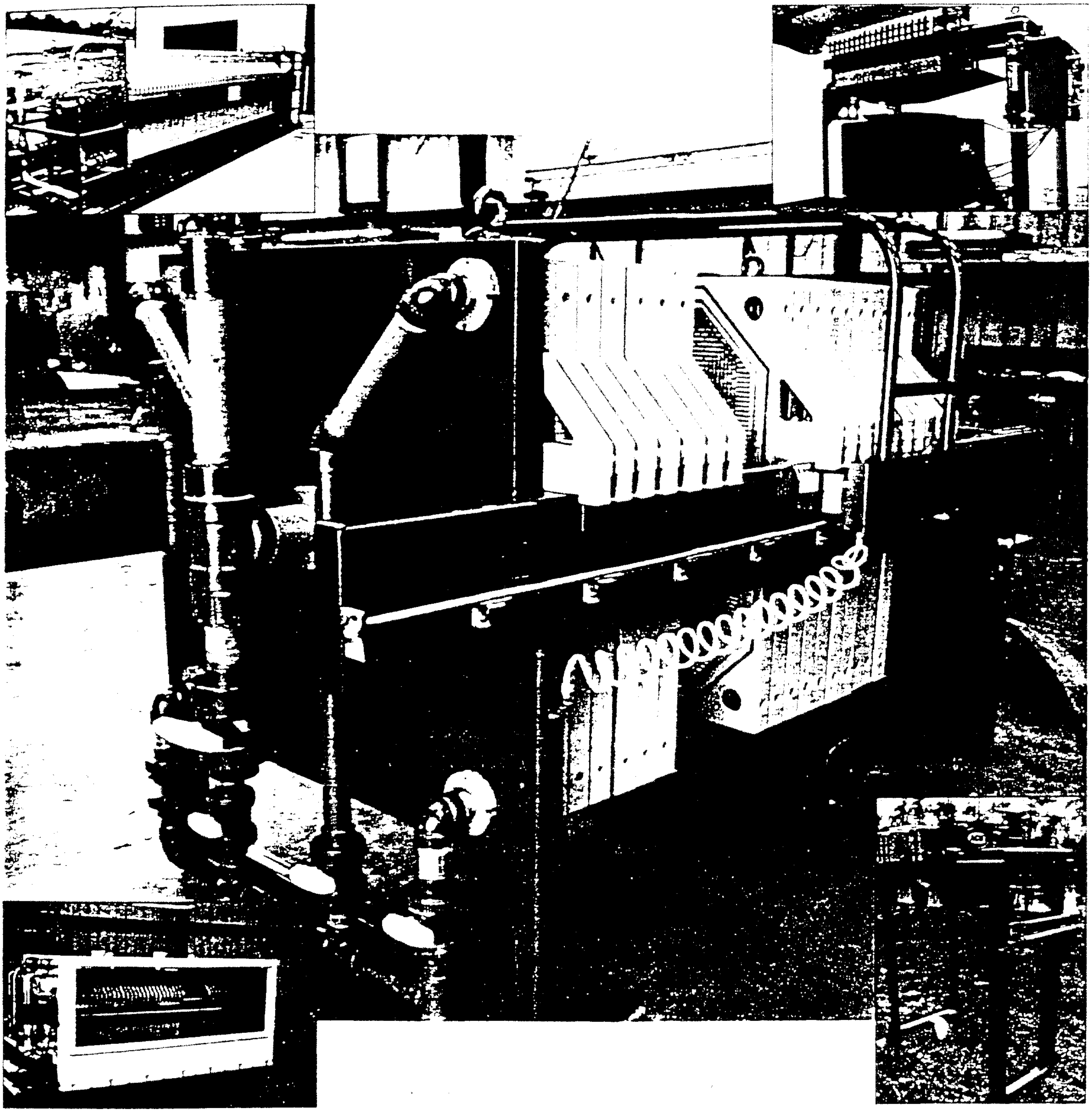
SUCTION LIFT DATA

SUCTION LIFT FEET	AIR SUPPLY PSI	DISCHARGE PRESSURE PSI	GPM LOSS
0	100	0	0
5	100	0	4
10	100	0	8
15	100	0	12
20	100	0	16
25	100	0	20

Special Note: When calculating flow rate, loss in GPM from suction lift must be subtracted from performance shown on curves which are based on flooded suction (zero suction lift).

Volumes indicated on chart were determined by actually pumping water into calibrated tanks.

FILTER PRESS



ACS ENVIRONMENTAL

303 Silver Spring Road Conroe, Texas 77303
Phone (409) 856-4515 Fax (409) 856-4589

The **ACS** Environmental Filter Press is one of the most efficient means of liquid/solid separation through pressure filtration; either for solution filtration or sludge (precipitated sediment) volume reduction. It provides a simple, reliable method of high compaction pressure to compress and dewater solids into cakes of 25 - 60% total concentration and produces clearer filtrate solutions than other types of filtration systems which remove only free water. Removing flocculated water, water containing polymer based oils bound by polar attraction or other cohesive forces, require high pressure mechanical equipment, which apply forces greater than gravity.

ACS

Solution

APPLICATIONS

- Precious metal recovery
- Dewatering hazardous wastes
- Reduction of waste solids
- Food processing
- Process filtration and cake washing
- Municipal sludge dewatering
- Clarification of processed fluids
- Pharmaceuticals and chemicals
- Wine filtration
- Biological filtration

COMPONENTS

The **ACS** Filter Press is equipped with lightweight corrosion resistant polypropylene filter plates (gasketed, non-gasketed, membrane) and can be engineered with an automatic plate shifter for easy and safe removal of compacted solids. A self-compensating hydraulic system automatically prevents decreases in closure pressure due to thermal expansion/contraction of the chambers between the polypropylene filter plates. An air blowdown manifold is provided to purge the filter press of excess water creating a drier sludge cake.

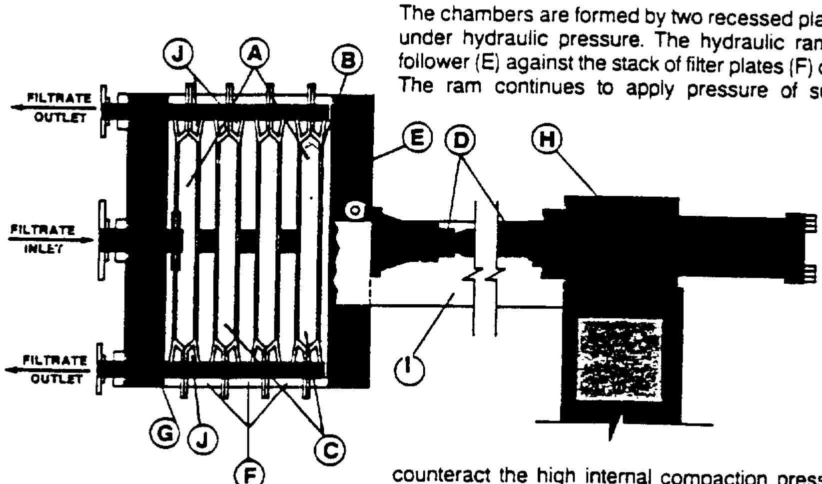
CONSTRUCTION

The **ACS** Filter Press is constructed of heavy duty carbon steel or stainless steel designed to withstand up to 225 psi pumping pressure. All structural steel is sand blasted, primed and painted with corrosion resistant epoxy paint. Internal components are constructed of high molecular weight heat stabilized chemical resistant plastic. Areas subject to wear such as the top of the side rails are covered with corrosion resistant wear plates. **ACS** Environmental's custom manufacturing policy will tailor a Filter Press for your specific application.

OPERATION

Dewatering is accomplished by pumping sludge into chambers (A) surrounded by filter membranes (B). As pumping pressure is increased, the filtrate is forced through the accumulated filter cake (C) and membrane, leaving the chambers full of solid filter cake.

The chambers are formed by two recessed plates held together under hydraulic pressure. The hydraulic ram (D) moves the follower (E) against the stack of filter plates (F) closing the press. The ram continues to apply pressure of sufficient force to counteract the high internal compaction pressures. The head stock (G) and tail stock (H) are held in place by specifically engineered side rail support bars (I).



The filtrate passes through the filter membrane and is directed by channels in the plates and drain ports (J) to the head stock for discharge. The filtrate typically contains less than 15 ppm suspended solids. The filter cake is easily removed by simply reversing the hydraulic ram thus opening the press. The lightweight plates may then be moved apart, permitting the compacted cake to fall from the chambers.

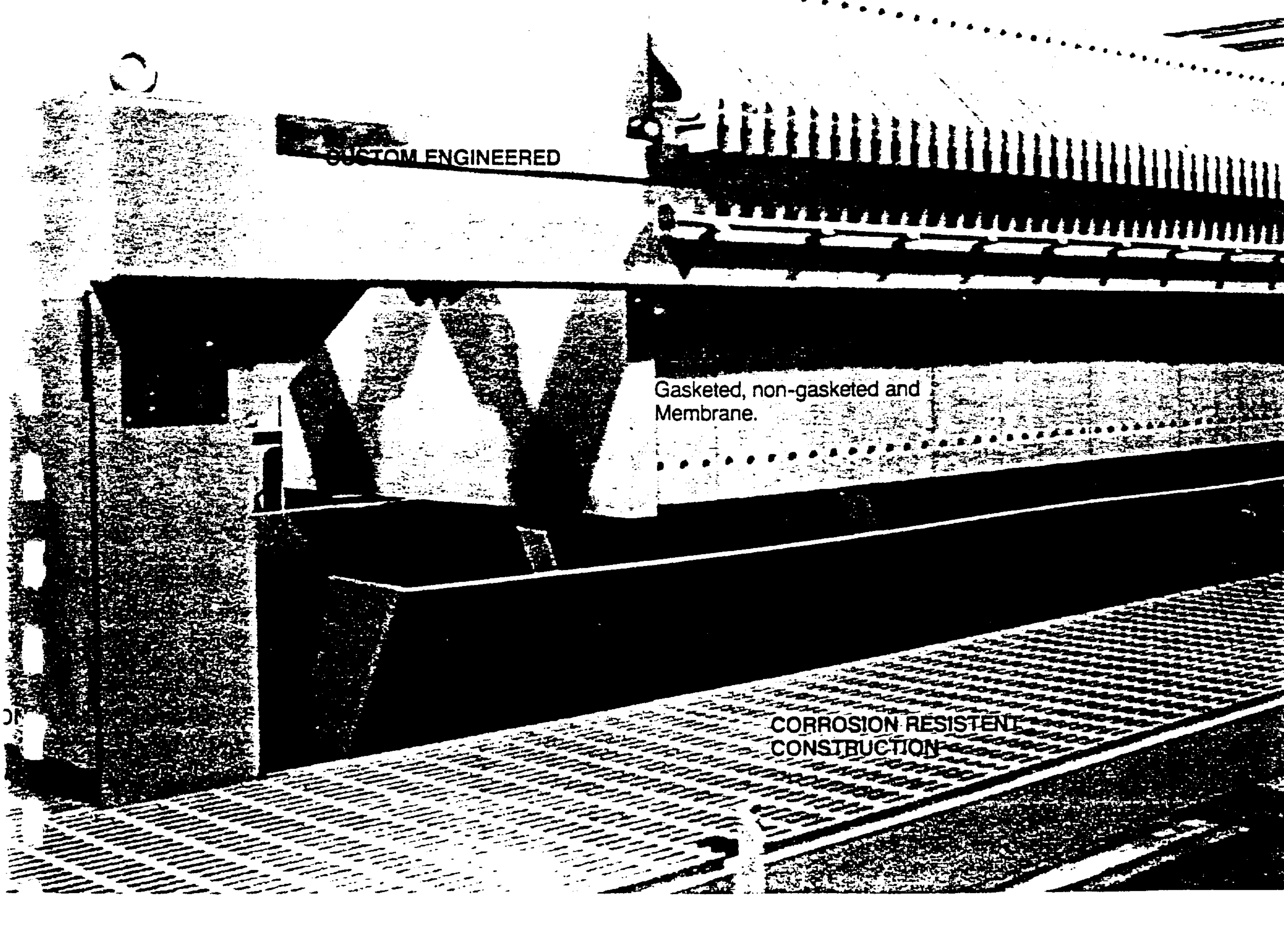
S FILTER PI

tration

Solids Con

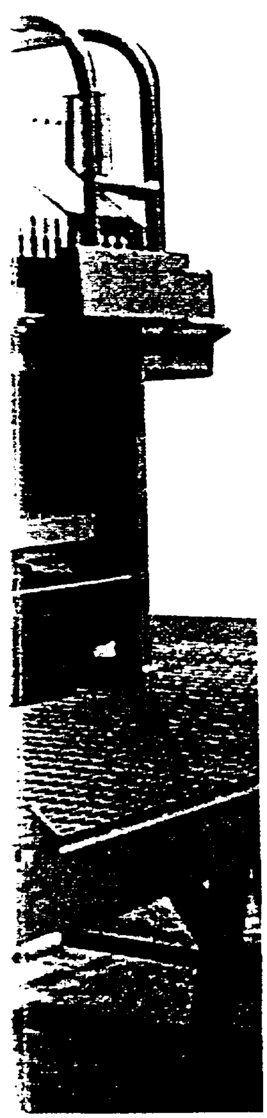
AIR OPERATED
PLATE SHIFTER

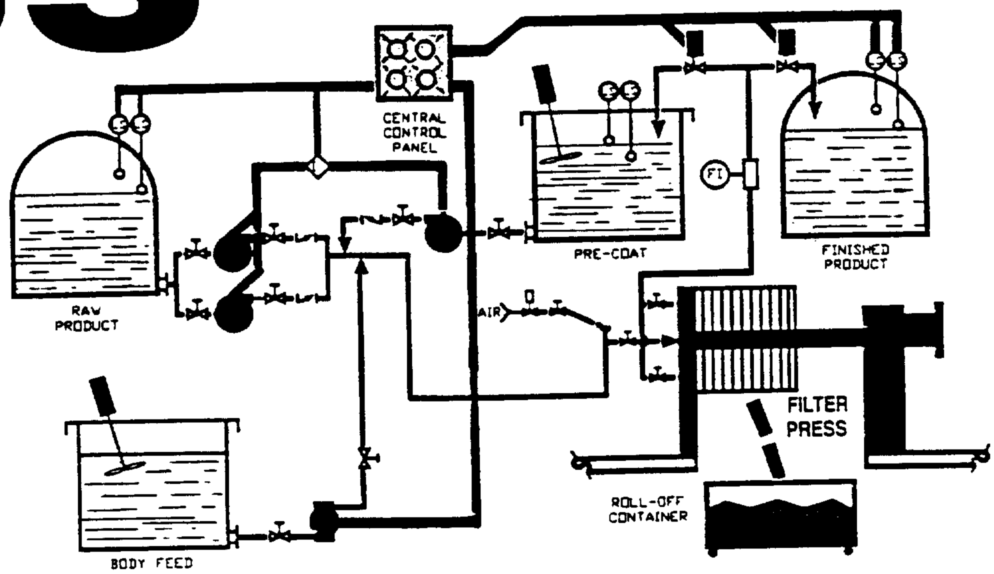
P OPERATION



RESS

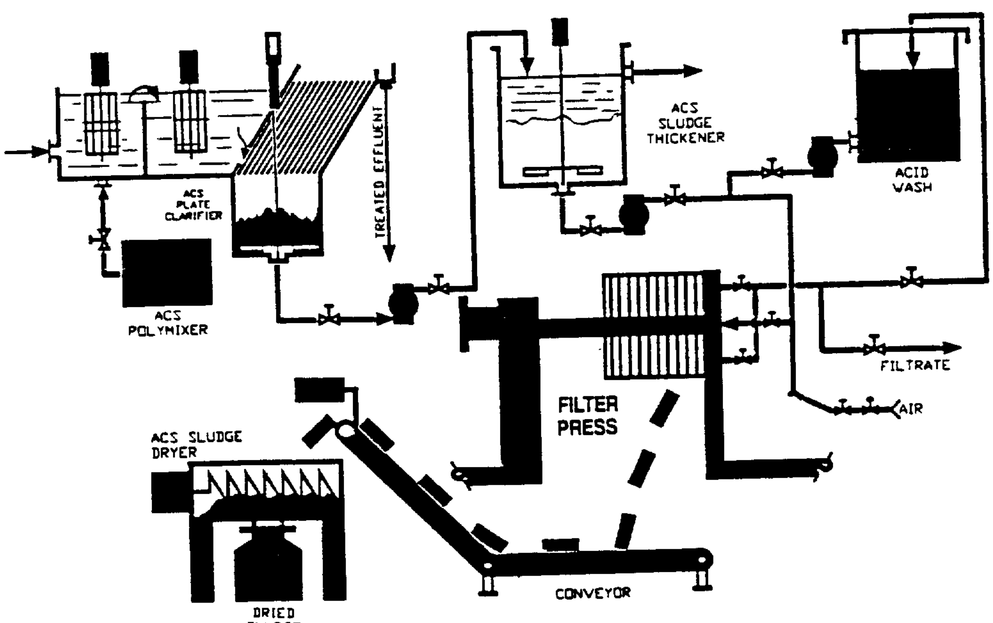
paction





SOLUTION FILTRATION SYSTEM

The **ACS** Environmental Filter Press uniformly pre-coats the entire filtration surface area with filter aids such as diatomaceous earth, perlite, or cellulose fibers before filtering solutions through systems engineered specifically for solution filtration. High pressure filtration presses are designed to replace filter cartidges by providing high throughput, longer filter runs, and excellent filtrate clarity.



SOLIDS COMPACTION SYSTEM

The **ACS** Environmental Filter Press provides high pressure (120 or 225 psi) to compress solids into dry sludge cakes of 25 - 60% total solids concentration. This concentration of solids produces dramatic reductions in volumes of sludge and their associated disposal costs; up to 10 times. If filter cake washing is required, the ACS Filter Press features both core washing and panel washing.

SIZING YOUR ACS FILTER PRESS

The **ACS** Filter Press will compact sludge to a dry cake having a density that is not only dependent upon the ultimate compaction pressure, but also the specific characteristics of a particular sludge.

The chart on the right exhibits the average dry weight of three common sludges. Use the accompanying equation to calculate the size of your filter press. First determine the quantity of sludge to be processed per cycle (minimum of 8 hours per cycle is recommended). Then insert the solids content (ppm must be divided by 1,000,000 and percent divided by 100), weight per gallon of the liquid in pounds, and pounds dry weight per cubic foot (from the chart). Complete the equation to calculate the capacity of the filter press.

The cycle time is dependant upon both the sludge dewatering characteristics and the solids content. High solids content dramatically shortens the compaction cycle. Please contact your **ACS** representative for recommendations on sludge thickening equipment.

Sludge Type	% of cake dry weight solids	Average pounds dry weight per cubic foot
Biological Sludge	15-25	15
Metal Hydroxide Sludge	25-40	25
Lime Treated Sludge	30-60	35

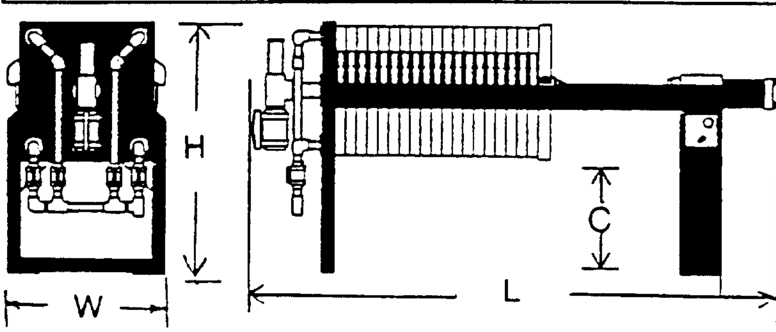
CALCULATING FILTER PRESS CAPACITY

1,000	X	.01	X	8.34	÷	25	=	3.3
total gallons per cycle		solids by weight (1%)		weight/gal		#/cu. ft.		cubic ft. capacity per cycle

* Cycle time is dependent upon sludge charactistics and solids.

ACS FILTER PRESS MODEL/CAPACITY/FILTRATION AREA

Nominal Capacity*	(cu. ft.)	.3	.5	.6	1	1.5	2	3	4	5	6	8	10	12	15	20	25	30	40	50	60	80	100	150	200
27"W	AREA FT^2	7	10	14	21	35	42	67	88	AA Presses are manual only.									Standard				C=30		H=50
AA 18.5"x18.5"	CHAMBERS	2	[illegible]	4	6	10	12	19	25	Empty Weight 720 + 20#/Chamber									Drum Discharge				C=42		H=61
470 MM	LENGTH	43	45	47	54	63	69	84	99										Portable				C=12		H=36
34"W	AREA FT^2			12	19	32	44	64	89	108	128	178	223	240					Standard				C=30		H=56
A 25"x25"	CHAMBERS			2	3	5	7	10	14	17	20	28	35	40					Drum Discharge				C=42		H=72
630 MM	LENGTH			78	81	85	90	97	106	113	120	129	155	168	Empty Weight 1610 + 30#/Chamber										
41"W	AREA FT^2						40	60	80	100	120	160	200	240	300	400	500		Standard				C=30		H=63
B 31.5"x31.5"	CHAMBERS						4	6	8	10	12	16	20	24	30	40	50		Drum Discharge				C=42		H=79
800 MM	LENGTH						89	94	99	104	109	119	129	139	154	180	205		Empty Weight 3150+ 50#/Chamber						
52"Wx57"H	AREA FT^2														300	400	500	600							
C 40"x40"	CHAMBERS	Empty Weight 6500 + 95#/Chamber													20	27	33	40							
1000 MM	LENGTH														136	154	172	187							
62"Wx67H	AREA FT^2															413	510	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
D 48"x48"	CHAMBERS	Empty Weight 9800 + 110#/Chamber														17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
1200 MM	LENGTH															121	132	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
66"Wx68H	AREA FT^2																			1047	1260	[illegible]	[illegible]	3170	
E 51"x51"	CHAMBERS	Empty Weight 11500 + 150#/Chamber																		34	41	[illegible]	[illegible]	103	
1300 MM	LENGTH																			189	206	[illegible]	[illegible]	360	
74"Wx76H	AREA FT^2																					1640	2110	[illegible]	[illegible]
F 59"x59"	CHAMBERS	Empty Weight 13200 + 210#/Chamber																				41	52	[illegible]	[illegible]
1500 MM	LENGTH																					217	246	[illegible]	384



***NOTE:**

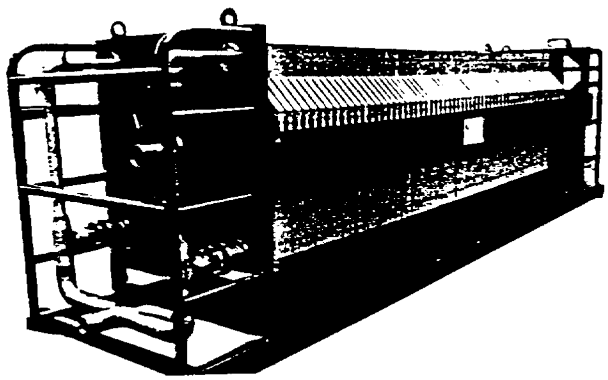
1. **Dimensions listed are approximate and may change without notice. Please contact ACS for certified dimensions.**
2. **Capacity/length/area are based upon 1 1/4" thick filter cake (5/8" recess). Increasing or decreasing the cake thickness will inversely vary the press length.**
3. **D, E & F Model standard presses are designed to be mounted on structures over roll-off containers or conveyors.**

OPTIMUM SIZES EXTENDED SIZES

ACS Environmental

will custom engineer and manufacture a wide variety of filter presses tailored to your specific needs.

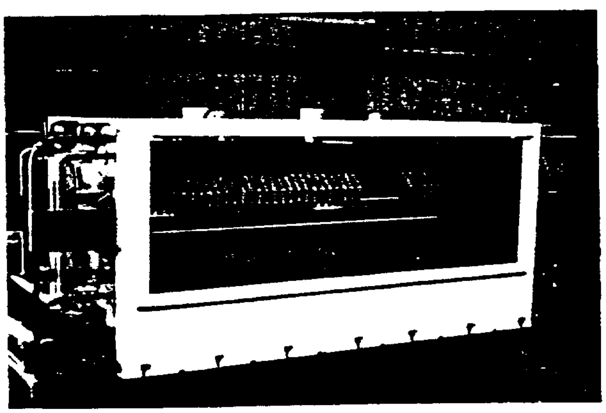
2 CU. FT. FILTER PRESS



300 CU. FT. FILTER PRESS

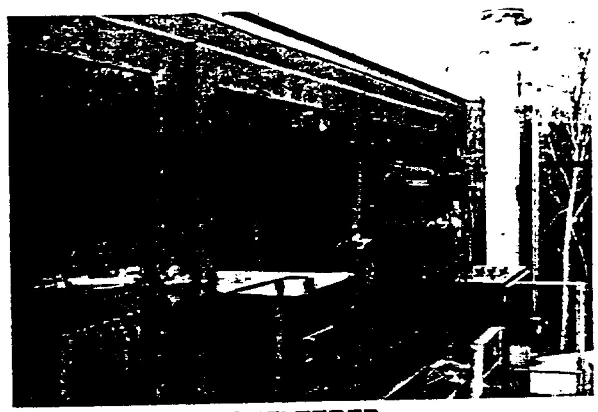
AUTOMATIC PLATE SHIFTERS

ACS manufactures four bar design overhead plate shifters for total automatic dewatering systems.



SKID MOUNTED

ACS manufactures skid mounted filter presses for temporary industrial applications; mobile installations such as oil field applications and sludge pit remediation.



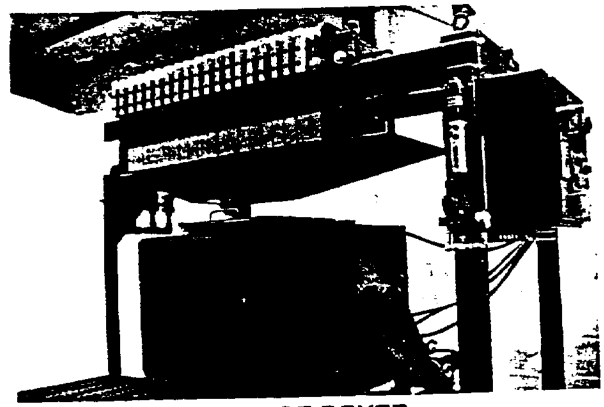
SHELTERED

ACS manufactures enclosed filter presses to contain toxic hydrocarbon vapors or radio active wastes. The unit is designed to be operated remotely without any human interference.

ACS ENVIRONMENTAL

303 Silver Spring Road • Conroe, Texas 77303

Phone (409) 856-4515 • Fax (409) 856-4589



SLUDGE DRYER

ACS manufactures a full line of indirect heat sludge dryers to further reduce your sludge volume by up to 75%.

H. Vendor Information

H. Filter Press

B-FILTER PRESS SPECIFICATIONS USING EIMCO PLATES (225 PSI)

Cu. Ft.	CHAMBERS	PLATES	5' x 24' STROKE RAM A	B	C	SHIPPING WT. (lbs.)	OPERATING WT. (lbs.)
12	26	1 + 25 + 1	160 1/2'	108 3/4'	117 1/2'	X	X
15	32	1 + 31 + 1	175 3/4'	124'	132 3/4'	X	X
20	43	1 + 42 + 1	203 1/2'	151 3/4'	160 1/2'	X	X
25	54	1 + 53 + 1	231 1/4'	179 1/2'	188 1/4'	X	X

B-FILTER PRESS SPECIFICATIONS USING FURON PLATES (225 PSI)

Cu. Ft.	CHAMBERS	PLATES	5' x 24' STROKE RAM A	B	C	SHIPPING WT. (lbs.)	OPERATING WT. (lbs.)
12	24	1 + 23 + 1	159 3/4'	108'	116 3/4'	X	X
15	30	1 + 29 + 1	176'	124 1/4'	133'	X	X
20	39	1 + 38 + 1	200'	148 1/4'	157'	X	X
25	49	1 + 48 + 1	227'	175 1/4'	184'	X	X

NOTES:

B-12 FILTER PRESS IS SHOWN.

ALL WELDING PROCEDURES TO BE ACCORDING TO AMERICAN WELDING SOCIETY (AWS) PUBLICATION D 11-90 STEEL STRUCTURAL WELDING CODE

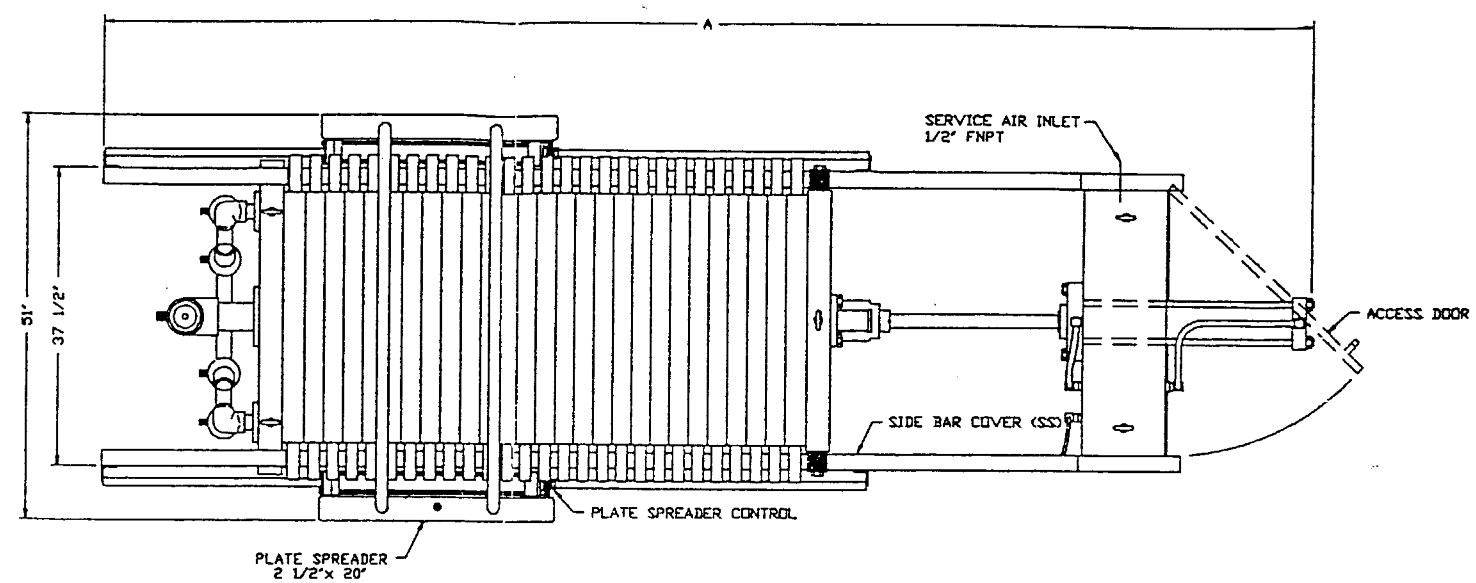
ALL STEEL PLATES TO BE CARBON STEEL ASTM A-36. ALL STRUCTURAL MEMBERS TO BE CARBON STEEL ASTM A-36

PAINTING: TOTAL OF 7-8 MILS.

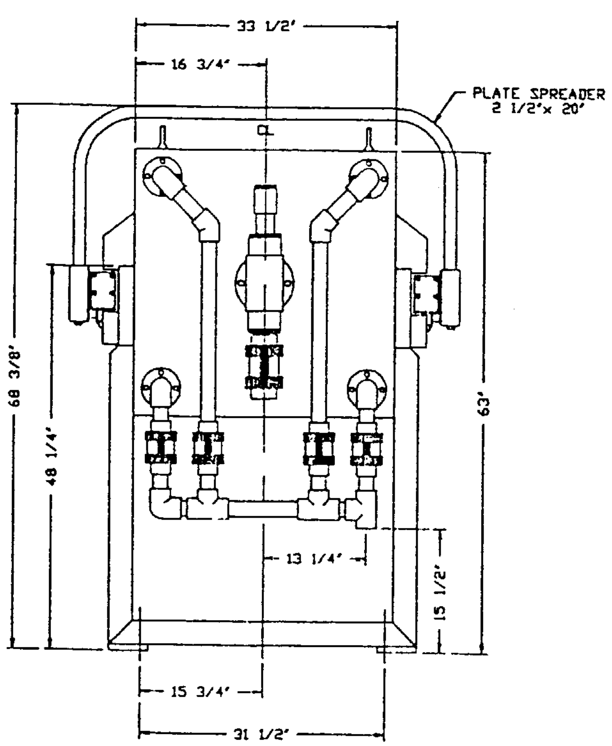
FILTER PRESS 'B' SPECIFICATIONS
800 MM (31.5'x 31.5') PLATES 225 PSI
PLATE WEIGHT = 53 LBS EACH
(EIMCO OR FURON)
1.25' FILTER CAKE THICKNESS
SEE TABLET FOR QUANTITY

AIR SERVICE: INTERMITTENT 5 SCFM @ 80 PSIG
OPERATING PRESSURE: 110 PSIG
HYDRAULIC PRESSURE: OPERATION = 4500 PSIG
MAXIMUM = 5000 PSIG

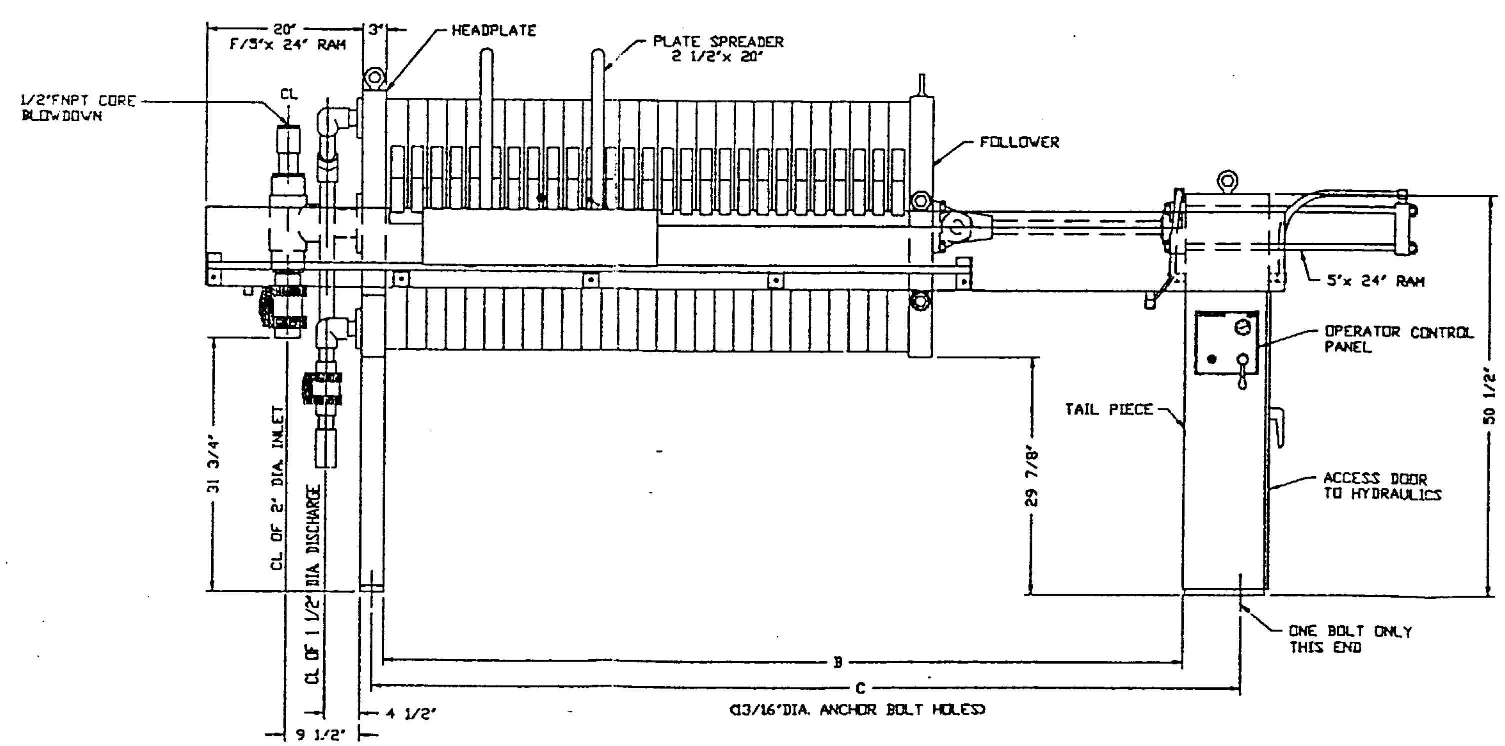
FILTER MEDIA: 2x2 TWILL WEAVE, MULT FILAMENT SPUN STABLE, HEAVY DUTY POLYPROPYLENE YARN WITH A 70x39 THREAD COUNT



PLAN



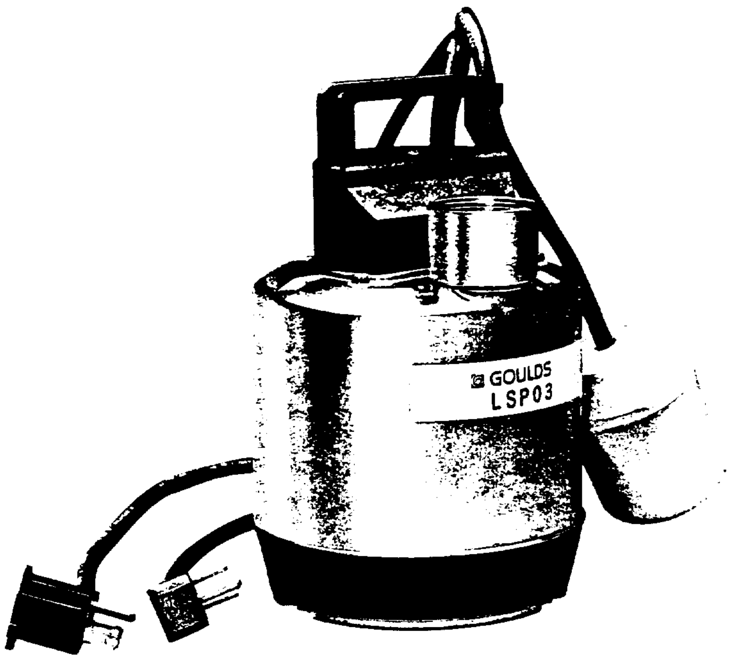
LEFT ELEVATION



ELEVATION

APPROVED BY:	
☐ CHIEF ENGINEER	DATE
☐ PROJECT MANAGER	DATE
☐ PURCHASING	DATE
☐ RESEARCH & DEVELOPMENT	DATE

REV	BY	DATE	DESCRIPTION
DRAWN BY LPK		DATE 11/19/93	ACS ENVIRONMENTAL 303 SILVER SPRING RD CONROE, TX TEL. (409) 856-4515
PROJECT ENGR.			
JOB NO. --		CODE NO. 023	
PROPRIETARY INFORMATION THIS DOCUMENT CONTAINS ACS ENVIRONMENTAL PROPRIETARY INFORMATION WHICH MAY NOT BE USED FOR THE BENEFIT OF OTHERS EXCEPT BY EXPRESSED PERMISSION OF ACS ENVIRONMENTAL			'B' FILTER PRESS WITH 2 1/2'x 20' PLATE SPREADER 1 1/4' FILTER CAKE
SCALE 1=12		FPB-1C	SHEET 1C



Goulds

Submersible Sump Pump

MODEL

LSP03

APPLICATIONS

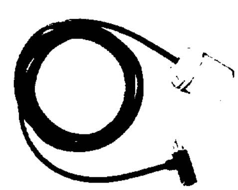
Specially designed for the following uses:
- Basement Draining
- Water Transfer
- Dewatering

SPECIFICATIONS

Pump:
- Discharge size: 1 1/2" NPT.
- Capacities: to 40 GPM.
- Maximum head: 21 feet TDH.

Power cord:
- Heavy duty 3-wire 16/3 SJT with NEMA 5-15 P 3-prong grounding plug, 115 volts.
- Power cord length: 10 feet.
- Temperature: 104°F (40°C) maximum liquid temperature.

Motor:
- 1/3 HP, 115 volt, 60 Hz, Single phase, 3400 RPM.
- Built-in thermal overload protection with automatic reset.
- Permanent-Split-Capacitor type.
- Amps: 2.8 maximum.
- Class F insulation.
- Stainless steel shaft.



- **Separate Float Switch is supplied with pump.**
- **Heavy duty 3-wire 16/3 SJT electrical cord with NEMA 5-15P 3-prong grounding plug Series-connected ("Piggy-back" type).**
- **Switch cord length: 10 feet.**

FEATURES

Corrosion-resistant construction.

304 Stainless Steel motor casing and fastners.

Glass-filled thermoplastic impeller and volute.

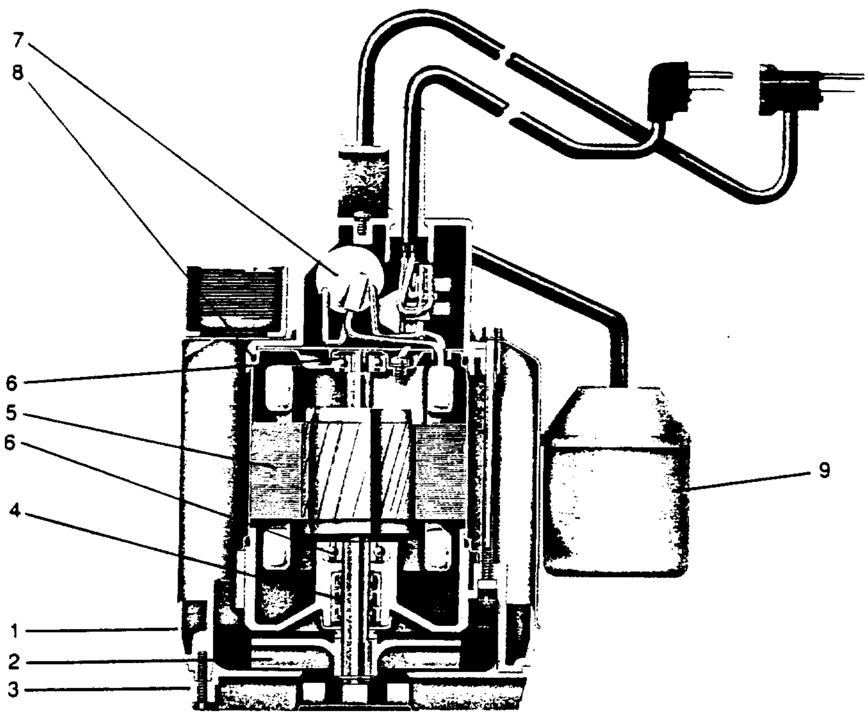
Ball bearing construction. Both upper and lower bearings are greased for life.

Motor is permanently lubricated for extended service life and is powered for continuous operation. All ratings are within the working limits of the motor.

303 Stainless Steel shaft.

Separate float switch is attached to the pump at the factory. Float switch is adjustable for various liquid levels. Easily removed for direct pump operation or switch replacement.

Complete unit is lightweight, portable and easy to service.



Goulds

Submersible Sump Pump

MODEL

LSP03

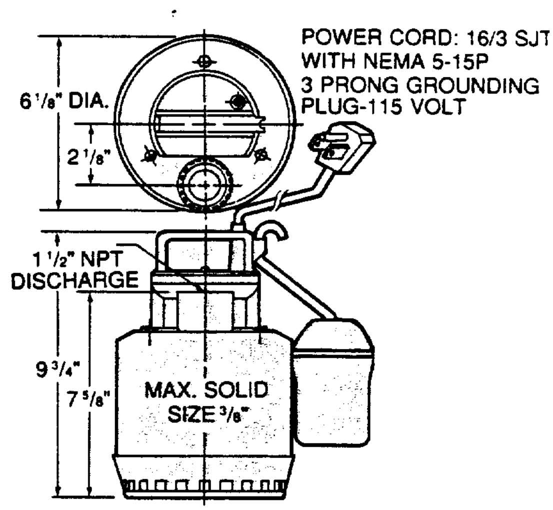
PARTS

Item No.	Part Description
1	Casing
2	Impeller
3	Suction Strainer
4	Shaft Seal with Cover
5	Motor
6	Bearing
7	Capacitor
8	O-Ring
9	Float Switch

DIMENSIONS AND WEIGHTS

Horsepower	$^1/_3$
Voltage	115
Amps	2.6 Max.
Phase	1
RPM	3400
Weight (lbs.)	9

(All dimensions in inches and weights in lbs. Do not use for construction purposes. Drawing is not to scale.)

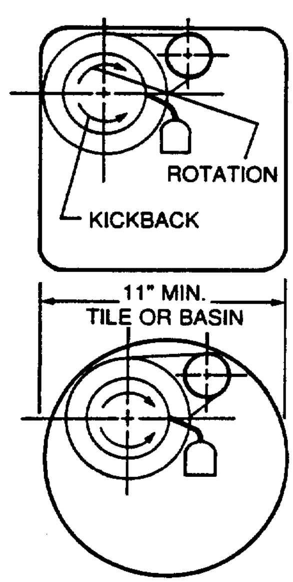


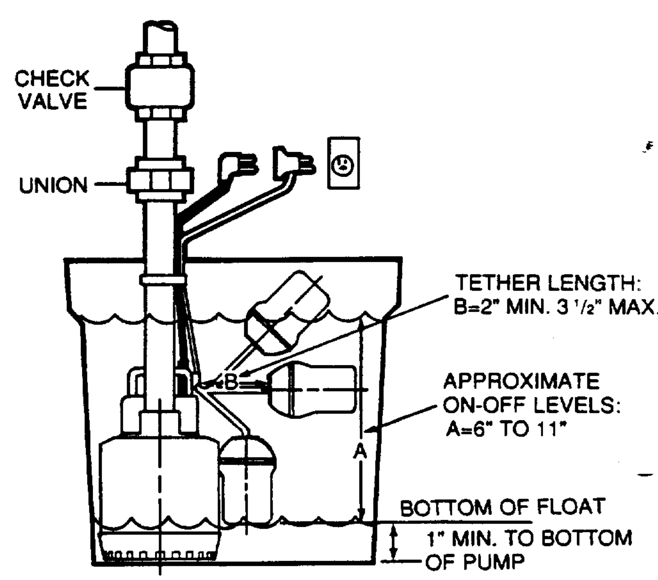
PERFORMANCE RATINGS

Total Head-Ft.*	20	15	10	5
Gallons Per Hour	300	1200	1740	2220

(In gallons per hour)
*Vertical distance from water level to highest point in discharge—plus pipe friction.
Maximum pump submergence is 10 ft.

INSTALLATION





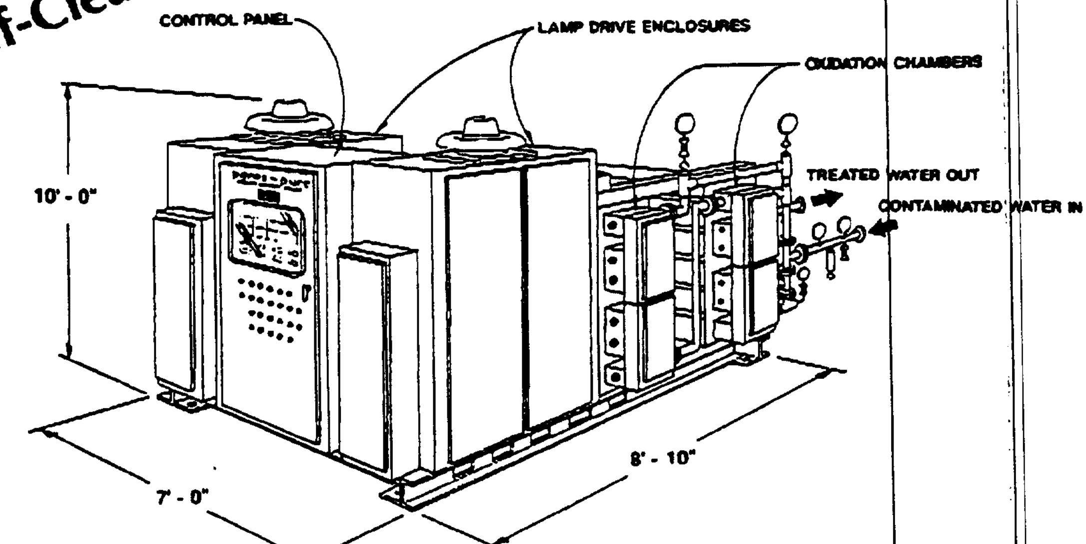
perox-pure™

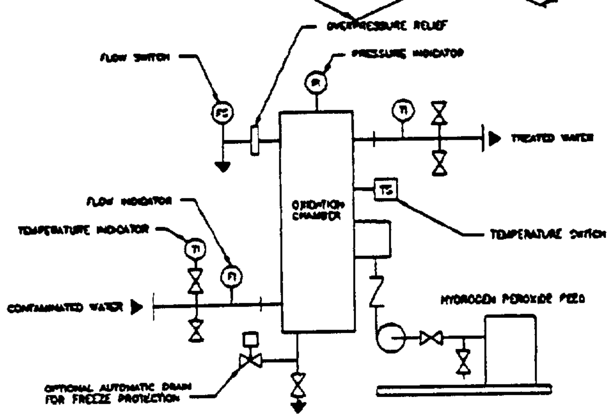
ORGANIC DESTRUCTION PROCESS

MODULAR TREATMENT SYSTEM

MODEL E-360

w Self-Cleaning





SPECIFICATIONS	Model E-360	
Flow Rate: Maximum	200 gpm	800 gpm
Connections:	150# Flange	150# Flange
Inlet:	3"	6"
Outlet:	3"	6"
Power Supply:	3 pH/60Hz/480V, 360KW (2 @ 180 KW)	
Electrical Encl.:	NEMA 3R	
Material - Wetted Parts:	Quartz, Fluoropolymers	
External Parts:	Enameled Steel	
Weight - Shipping:	12500 lbs.	
Operating:	13800 lbs.	

The perox-pure™ chemical oxidation system consists of modular, skid-mounted equipment designed to treat water contaminated by dissolved organic compounds. Bench-scale process evaluations will determine pretreatment requirements (if any) and the oxidation time necessary for the desired treatment level. Full-scale oxidation chamber volume, UV requirements and oxidant dosage are then selected.

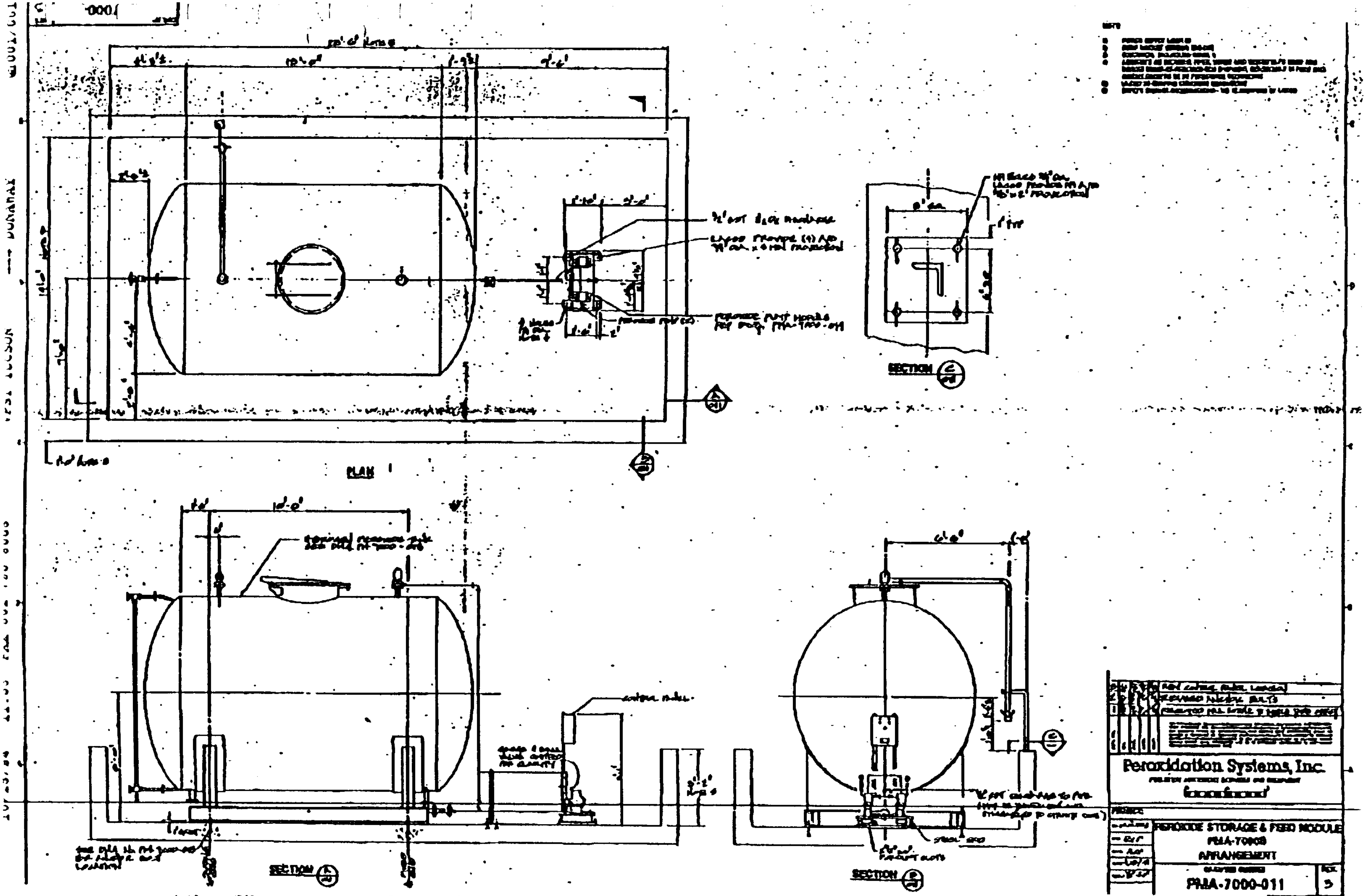
The perox-pure™ system incorporates corrosion resistant fluorocarbon-lined oxidation chambers and horizontally mounted medium pressure UV lamps. Indicators are provided to monitor performance of each lamp. A sequential hydrogen peroxide addition feature provides easy process optimization for maximum economy. In addition, a patented tube cleaning device maximizes performance and minimizes maintenance time. The cleaning device is automatic and self propelled, requiring no external actuating mechanism or sliding shaft seals. Other design features include shop-wired and tested control panels interlocked with personnel and process safety features to shut-off power and display the cause at preset conditions. Installation is quick and easy.

The perox-pure™ system and its components are covered by numerous issued and pending patents.

Peroxidation Systems Inc.

5151 E. Broadway, Suite 600 Tucson, Arizona 85711 602-790-8383 FAX 602-790-8008

pp - 6.27-3/92


PLAN
SECTION
SECTION
SECTION
Peroxidation Systems, Inc.
PEROXIDE STORAGE & FEED MODULE
PMA-7000B
ARRANGEMENT
PMA-7000-011
5

AIR COMPRESSORS

5 AND 10 HP TWO-STAGE DUPLEX AIR COMPRESSORS

SPEEDAIRE DUPLEX DESIGN

- Provides emergency air power and saves expensive down-time if one of the pumps or motors would require repair
- During times of heavy air usage, both pumps/motors will operate to maximize CFM output
- All models include factory mounted and wired control panel consisting of definite purpose magnetic starters and alternators
- Built-in alternator provides equal pump usage
- Premounted control panel saves time, labor, and expense of installation
- Built for auto dealers, body shops, industrial machinery and assembly line environments, printing plants, oil/mining, tire retreading
- All models comply with State of California Code 462 (L) (2)
- Green metallic finish

OIL LUBRICATED PUMPS

- Cast iron cylinders, crankcase, and pistons for extended life
- Deep finned intercooler and aluminum head for cooler running temperatures
- Long life stainless steel self-cleaning valves and durable ductile iron counter-balanced crankshaft
- Easy-to-read metal oil sight gauge
- Quiet operation with heavy-duty Solberg air filter/silencer
- Low RPM allows cooler temperatures and longer valve life
- Designed for start/stop operation
- Splash-type lubrication

MOTOR FEATURES

- Open dripproof 1 or 3 phase industrial duty motors, 1.15 service factor

TANK MOUNT FEATURES

- Safe operation with ASME tank and safety valve. Includes tank drain, pressure gauge, and receiver shutoff valve
- Alternator requires 120V power supply
- 145 PSI On/175 PSI Off (lead); 125 PSI On/155 PSI Off (lag)

DAYTON LIMITED WARRANTY

Dayton Electric Mfg. Co. warrants compressor pumps two years, all other parts and labor one year. Text of warranty available on request. See "Manufacturers' Warranties" on page opposite inside back cover.

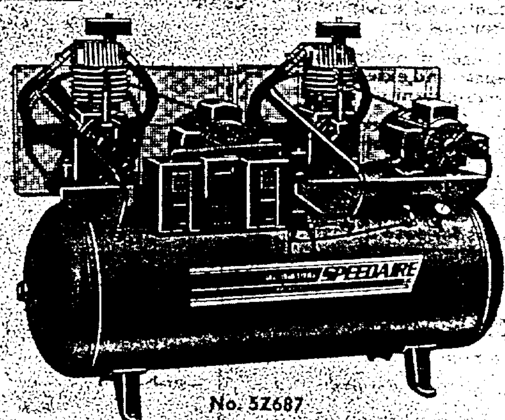
FREIGHT PREPAID ON ORDERS OF $900 OR MORE
See Freight Policy On Page Opposite Inside Back Cover

2 YEAR PUMP WARRANTY

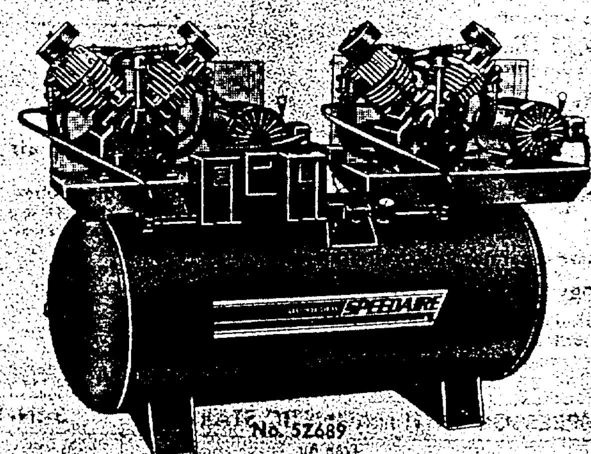
SPEEDAI

CAST IRON SE

Made in the U.S.A.



No. 5Z687



No. 5Z689

COMPRESSOR SPECIFICATIONS

HP	Stock No.	Pump RPM	Pump Cyls.	Pump Bore*	Pump Stroke	Oil Cap.
5	5Z687 5Z688	685	2	4¾, 2½"	3"	4 qts
10	5Z689	685	4	4¾, 2½	3	8

(*) Low pressure cylinder/high pressure cylinder.

DUPLEX AIR COMPRESSOR ORDERING DATA

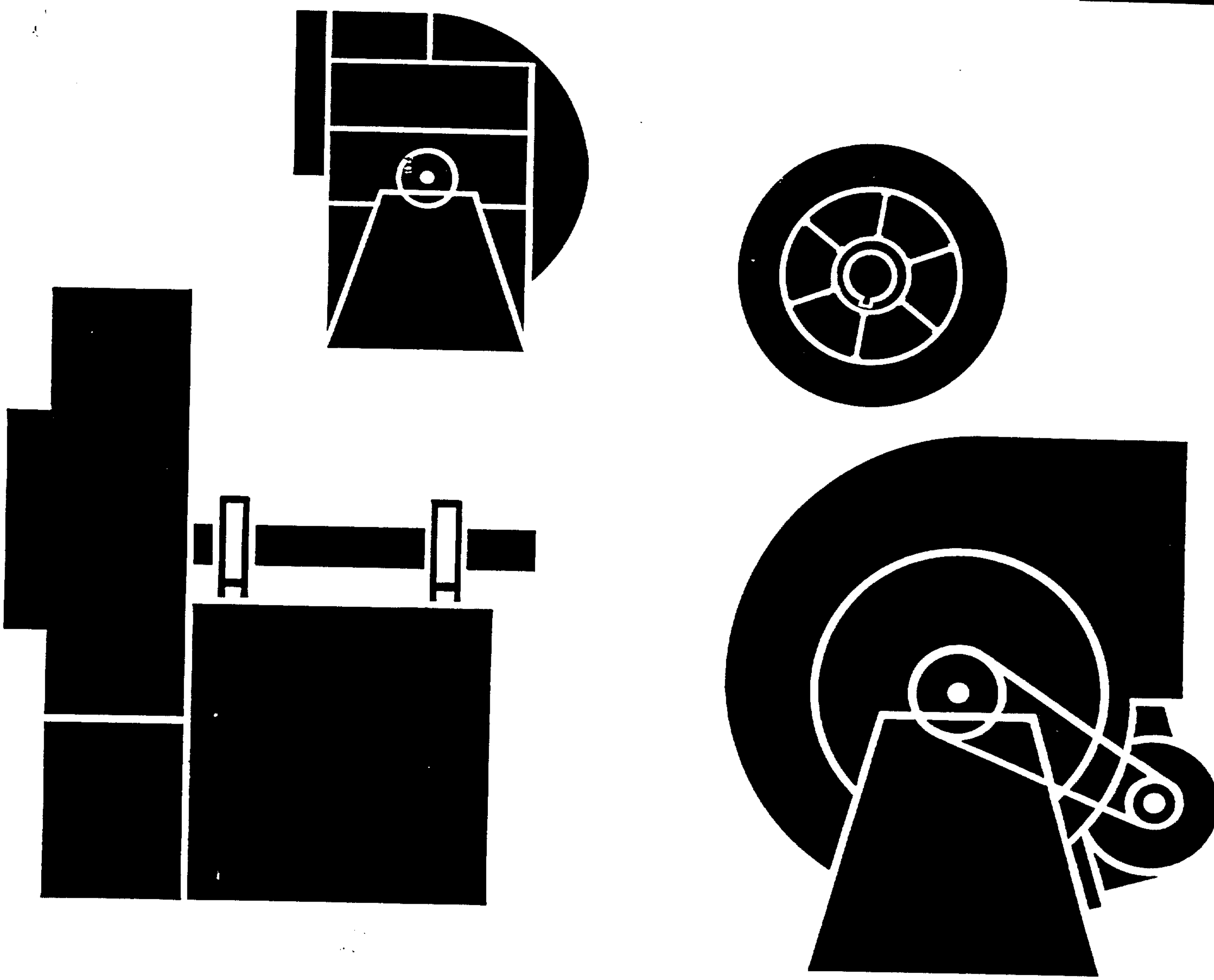
HP	Phase	Volts, 60 Hz	Tank Gallons	Tank Type	Displ. CFM	Free Air CFM @ 175 PSI†	Dimensions L	Dimensions W	Dimensions H	With 230V, 60 Hz Magnetic Starter Stock No.
5(2)	1	230V	120	Horizontal	42.2	34.2	71"	26½"	54"	5Z687
~~5(2)~~	~~3~~	~~230/460~~	~~120~~	~~Horizontal~~	~~42.2~~	~~34.2~~	~~71"~~	~~26½"~~	~~54"~~	~~5Z688~~
10(2)	3	230/460	200	Horizontal	84.4	68.4	82	30	59	5Z689

(†) Ratings are based on both pumps operating.

Industrial Exhausters

Product Descriptions
Dimensions
Series 052 Performance ... 0″ to 20″ Static Pressure
Series 053 Performance ... 20″ to 30″ Static Pressure
Series 054 Performance ... 30″ to 46″ Static Pressure

amca CERTIFIED RATINGS
AIR PERFORMANCE
AIR MOVEMENT AND CONTROL ASSOCIATION, INC.



HARTZELL®

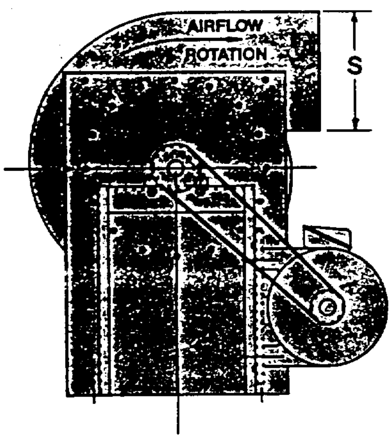
Hartzell Fan, Inc., Piqua, Ohio 45356

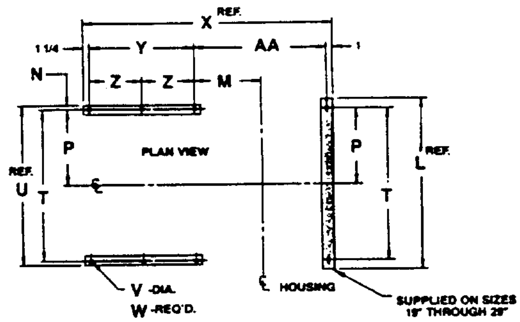
Bulletin A-155-C March 1992

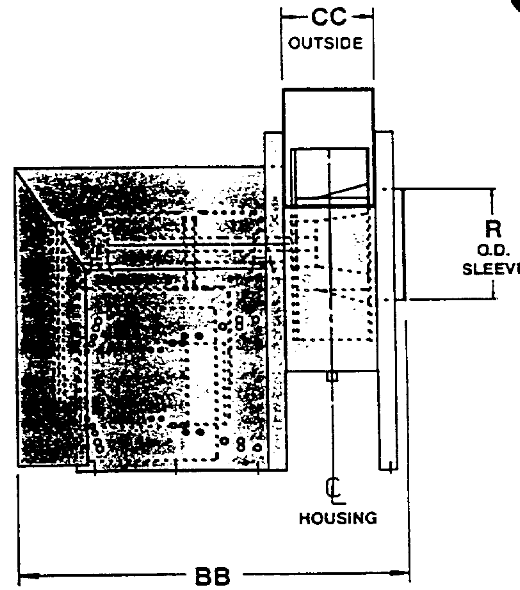
Dimensions - Arrangements 1, 9 or 10

SERIES 05

Sizes 12 Through 29, Rotatable Housing







Clockwise Rotation Shown.
Counterclockwise Opposite.

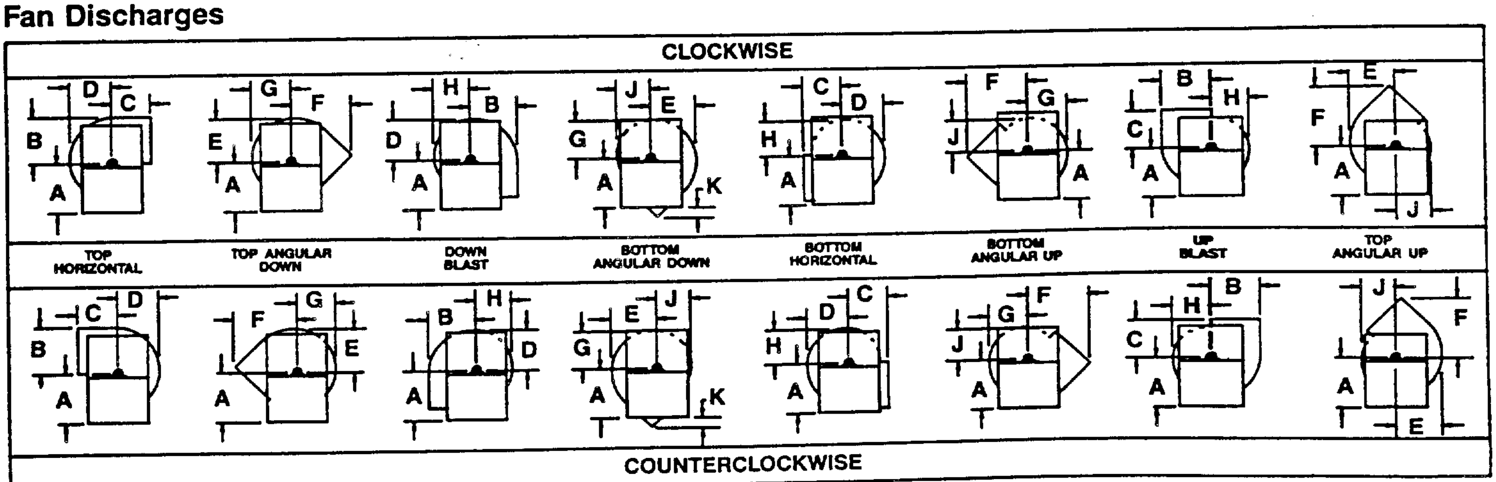
Principal Dimensions (Inches)

Fan Size	A	B	C	D	E	F	G	H	J	K	L	M	N
12	18 1/2	11 5/8	14 1/4	10 3/8	10 15/16	18 5/16	9 3/4	9 3/16	8 1/2	—	18 3/4	5 1/2	1
15	21 1/2	14 3/4	16 5/8	13 3/16	13 15/16	22 3/16	12 3/8	11 11/16	10 13/16	11/16	20 3/4	6 5/16	1
19	24 1/4	18 1/16	18 7/8	16 3/16	17 1/16	26 1/8	15 3/16	14 1/4	13 1/4	1 7/8	27 3/4	8 3/4	1
22	30	21 5/16	22	19 3/16	20 1/8	30 5/8	17 7/8	16 7/8	15 5/8	5/8	28 1/8	7 15/16	1
26	33 15/16	24 9/16	23 5/8	22	23 1/4	34 1/8	20 5/8	19 7/16	18 1/16	1 1/8	30	8 13/16	1
29	37	27 7/8	27 1/2	24 15/16	26 5/16	39 1/8	23 3/8	22	20 7/16	—	38 3/8	12 3/8	1 3/4

Fan Size	P	R	S	T	U	V	W	X	Y	Z	AA	BB	CC
12	8 1/8	7	7 1/8	16 1/4	18 3/4	11/16	6	24 3/4	12 3/4	—	9 3/4	35 1/8	6 3/16
15	9 1/8	9	9	18 1/4	20 3/4	11/16	6	29 3/8	15 3/4	—	11 3/8	39 11/16	7 13/16
19	12 5/8	11	11	25 1/4	27 3/4	11/16	6	35 11/16	18 3/4	9 3/8	14 11/16	46	9 9/16
22	12 11/16	13	12 15/16	25 3/8	28 1/8	11/16	8	37 1/4	20 1/4	10 1/8	14 3/4	47 3/4	11 1/4
26	12 11/16	15	14 7/8	25 3/8	30	11/16	8	41 3/16	22 1/2	11 1/4	16 7/16	51 5/8	12 15/16
29	16 7/8	17	16 5/8	33 3/4	37 1/4	13/16	9	47 3/8	22 3/4	11 3/8	21 5/8	57 3/8	14 7/16

Dimensions and specifications are subject to change. Certified prints are available.

Fan Discharges



NOTE: For bottom angular down and/or down blast, contact factory when discharge flanges are required.

Series 052

12

MH Wheel

Series 052

15

MH Wheel

Series 052. Material Handling Wheel (MH Wheel)

Wheel Diameter: 12.250 in. Inlet Diameter: 6 25/32 in. I.D. Wheel Circumference: 3.21 ft. Outlet Area: .273 sq. ft.

CFM	Outlet Velocity FPM	1 ''SP RPM	1 ''SP BHP	2 ''SP RPM	2 ''SP BHP	4 ''SP RPM	4 ''SP BHP	6 ''SP RPM	6 ''SP BHP	[illegible] RPM	[illegible] BHP	10 ''SP RPM	10 ''SP BHP	12 ''SP RPM	12 ''SP BHP	14 ''SP RPM	14 ''SP BHP	16 ''SP RPM	16 ''SP BHP	18 ''SP RPM	18 ''SP BHP	20 ''SP RPM	20 ''SP BHP
250	916	1172	0.09	1601	0.19	2238	0.43	2734	0.74	3155	1.08												
300	1099	1207	0.10	1626	0.21	2249	0.48	2739	0.79	3158	1.15	3528	1.54	3864	1.97	4172	2.43						
350	1282	1244	0.12	1656	0.24	2263	0.52	2750	0.85	3164	1.22	3532	1.63	3866	2.07	4175	2.55	4462	3.05	4731	3.57		
400	1465	1283	0.14	1688	0.27	2286	0.57	2763	0.93	3175	1.30	3539	1.73	3871	2.19	4178	2.67	4464	3.17	4734	3.72	4989	4.29
450	1648	1325	0.17	1725	0.31	2313	0.62	2779	0.99	3187	1.40	3550	1.82	3879	2.30	4182	2.80	4468	3.33	4737	3.88	4991	4.45
500	1832	1369	0.19	1763	0.35	2344	0.69	2805	1.06	3203	1.49	3562	1.95	3891	2.42	4193	2.93	4475	3.48	4741	4.05	4996	4.64
550	2015	1418	0.22	1802	0.39	2377	0.75	2832	1.14	3225	1.59	3578	2.07	3903	2.58	4205	3.09	4486	3.63	4751	4.22	5002	4.83
600	2198	1465	0.26	1842	0.43	2413	0.82	2863	1.24	3251	1.69	3598	2.18	3918	2.71	4217	3.27	4498	3.82	4762	4.39	5013	5.02
650	2381	1518	0.30	1885	0.48	2449	0.90	2895	1.34	3279	1.79	3623	2.30	3938	2.84	4233	3.42	4510	4.02	4774	4.62	5024	5.23
700	2564	1575	0.34	1929	0.53	2488	0.98	2930	1.44	[illegible]	[illegible]	3651	2.43	3963	2.99	4252	3.58	4527	4.20	4788	4.84	5036	5.49
750	2747	1633	0.39	1977	0.59	2527	1.06	2967	1.55	3343	2.06	3681	2.58	3990	3.15	4278	3.75	4546	4.37	4804	5.04	5050	5.73
800	2930	1694	0.45	2024	0.66	2566	1.14	3002	1.66	3377	2.19	3713	2.75	4019	3.31	4304	3.93	4572	4.57	4825	5.24		
850	3114	1756	0.51	2073	0.73	2607	1.23	3041	1.77	3414	2.33	3745	2.92	4051	3.51	4332	4.11	4599	4.78	4850	5.46		
900	3297	1821	0.58	2126	0.81	2650	1.33	3080	1.89	3450	2.48	3779	3.09	4082	3.71	4364	4.34	4626	4.98	4877	5.69		
950	3480	1889	0.65	2181	0.89	2692	1.42	3119	2.02	3487	2.64	3816	3.26	4115	3.91	4395	4.57	4657	5.23	4905	5.93		
1000	3663	1956	0.74	2239	0.99	2738	1.53	3159	2.14	3526	2.79	3852	3.45	4151	4.12	4427	4.80	4689	5.50	4935	6.20		
1050	3846	2023	0.83	2297	1.09	2785	1.65	3200	2.28	3565	2.95	3889	3.64	4188	4.33	4461	5.04	4721	5.77	4967	6.50		
1100	4029	2092	0.92	2358	1.19	2835	1.78	3243	2.43	3604	3.12	3928	3.83	4223	4.55	4498	5.28	4753	6.03	4999	6.80		
1150	4212	2161	1.03	2418	1.31	2881	1.91	3286	2.58	3644	3.28	3968	4.03	4260	4.78	4535	5.54	4789	6.31	5031	7.10		
1200	4396	2232	1.14	2480	1.43	2929	2.06	3329	2.73	3685	3.47	4006	4.23	4299	5.01	4570	5.80	4826	6.59	5065	7.40		
1250	4579	2303	1.27	2545	1.57	2982	2.21	3377	2.91	3728	3.66	4046	4.43	4339	5.24	4607	6.07	4862	6.89				
1300	4762	2374	1.40	2612	1.71	3036	2.38	3425	3.09	3770	3.86	4086	4.65	4377	5.49	4647	6.33	4898	7.19				
1350	4945	2446	1.54	2680	1.87	3091	2.55	3475	3.27	3812	4.05	4127	4.88	4416	5.74	4686	6.61	4936	7.50				
1400	5128	2518	1.69	2747	2.04	3150	2.73	3521	3.48	3858	4.27	4170	5.13	4457	5.98	4725	6.90	4976	7.80				
1450	5311	2591	1.85	2814	2.21	3210	2.93	3569	3.69	3906	4.51	4213	5.37	4496	6.26	4764	7.19	5015	8.12				
1500	5495	2665	2.02	2882	2.40	3266	3.13	3618	3.92	3954	4.74	4255	5.62	4539	6.54	4804	7.46	5054	8.45				
1550	5678	2740	2.22	2950	2.59	3327	3.35	3673	4.16	4005	4.99	4299	5.88	4582	6.84	4844	7.78						
1600	5861	2814	2.41	3019	2.80	3388	3.58	3727	4.40	4049	5.27	4348	6.18	4624	7.13	4885	8.11						
1650	6044	2887	2.61	3090	3.01	3449	3.81	3782	4.66	4098	5.54	4393	6.47	4666	7.42	4928	8.45						
1700	6227	2961	2.83	3161	3.24	3511	4.06	3840	4.94	4146	5.84	4445	6.77	4711	7.74	4971	8.79						
1750	6410	3037	3.06	3232	3.49	3576	4.33	3900	5.23	4198	6.15	4492	7.09	4760	8.10	5013	9.13						
1800	6593	3114	3.31	3303	3.75	3642	4.61	3958	5.53	4252	6.47	4538	7.43	4806	8.45	5055	9.48						

Wheel Diameter: 15.625 in. Inlet Diameter: 8 23/32 in. I.D. Wheel Circumference: 4.09 ft. Outlet Area: .444 sq. ft.

CFM	Outlet Velocity FPM	1 ''SP RPM	1 ''SP BHP	2 ''SP RPM	2 ''SP BHP	4 ''SP RPM	4 ''SP BHP	6 ''SP RPM	6 ''SP BHP	8 ''SP RPM	8 ''SP BHP	10 ''SP RPM	10 ''SP BHP	12 ''SP RPM	12 ''SP BHP	14 ''SP RPM	14 ''SP BHP	16 ''SP RPM	16 ''SP BHP	18 ''SP RPM	18 ''SP BHP	20 ''SP RPM	20 ''SP BHP
400	901	917	0.14	1254	0.30	1754	0.70	2143	1.19	2473	1.75												
500	1126	950	0.17	1278	0.35	1765	0.79	2149	1.30	2476	1.89	2766	2.53	3030	3.24	3271	3.98						
600	1351	987	0.21	1307	0.41	1780	0.88	2160	1.43	2484	2.04	2770	2.71	3032	3.44	3274	4.21	3499	5.04	3710	5.91	3910	6.81
700	1576	1025	0.25	1341	0.48	1805	0.98	2174	1.57	2495	2.22	2780	2.90	3038	3.66	3278	4.47	3502	5.32	3712	6.20	3912	7.14
800	1801	1067	0.30	1377	0.56	1834	1.10	2196	1.71	2509	2.40	2791	3.15	3049	3.90	3286	4.74	3507	5.62	3717	6.54	3916	7.50
900	2026	1114	0.36	1415	0.64	1865	1.23	2222	1.87	2530	2.59	2806	3.37	3060	4.21	3297	5.04	3518	5.92	3725	6.88	3922	7.87
1000	2251	1160	0.44	1454	0.73	1900	1.38	2252	2.06	2555	2.79	2827	3.60	3076	4.47	3310	5.39	3529	6.32	3736	7.25	3932	8.25
1100	2477	1213	0.52	1495	0.83	1936	1.53	2283	2.26	2584	3.03	2852	3.86	3098	4.75	3325	5.69	3543	6.70	3748	7.72	3944	8.74
1200	2702	1269	0.62	1540	0.94	1974	1.68	2319	2.47	2615	3.30	2880	4.14	3123	5.05	3349	6.03	3559	7.04	3763	8.12	3956	9.23
1300	2927	1327	0.73	1586	1.07	2011	1.85	2353	2.70	2647	3.57	2910	4.47	3150	5.38	3374	6.38	3584	7.43	3782	8.52	3972	9.65
1400	3152	1387	0.85	1633	1.21	2051	2.03	2391	2.93	2682	3.85	2941	4.80	3181	5.78	3401	6.76	3610	7.84	3807	8.96		
1500	3377	1451	0.99	1686	1.37	2092	2.23	2428	3.17	2717	4.15	2976	5.13	3212	6.18	3432	7.22	3637	8.27	3833	9.43		
1600	3602	1516	1.15	1740	1.55	2134	2.43	2467	3.41	2754	4.46	3011	5.51	3244	6.58	3463	7.69	3668	8.81	3861	9.93		
1700	3828	1581	1.33	1797	1.75	2179	2.67	2506	3.69	2792	4.77	3046	5.89	3280	7.00	3494	8.16	3699	9.34	3891	10.53		
1800	4053	1647	1.52	1854	1.96	2227	2.92	2547	3.98	2830	5.10	3084	6.27	3315	7.45	3530	8.65	3730	9.87	3922	11.12		
1900	4278	1714	1.74	1913	2.20	2273	3.19	2588	4.28	2868	5.44	3121	6.67	3351	7.91	3565	9.16	3765	10.43	3953	11.72		
2000	4503	1783	1.97	1974	2.45	2320	3.50	2633	4.61	2909	5.82	3159	7.08	3389	8.37	3600	9.69	3800	11.00				
2100	4728	1851	2.23	2038	2.74	2373	3.82	2678	4.97	2950	6.21	3197	7.50	3426	8.86	3637	10.23	3835	11.61				
2200	4953	1920	2.52	2104	3.05	2426	4.16	2726	5.34	2990	6.61	3237	7.96	3464	9.35	3676	10.77	3871	12.22				
2300	5178	1990	2.82	2168	3.39	2482	4.53	2771	5.75	3036	7.05	3279	8.45	3502	9.86	3713	11.35	3910	12.83				
2400	5404	2061	3.15	2233	3.75	2539	4.93	2817	6.19	3080	7.53	3319	8.94	3542	10.41	3751	11.89	3947	13.48				
2500	5629	2133	3.52	2299	4.13	2596	5.35	2868	6.66	3130	8.01	3360	9.44	3583	10.99	3789	12.52						
2600	5854	2204	3.91	2365	4.54	2654	5.80	2921	7.15	3173	8.55	3407	10.03	3624	11.58	3829	13.17						
2700	6079	2275	4.32	2433	4.97	2713	6.28	2974	7.67	3220	9.10	3452	10.62	3665	12.17	3870	13.85						
2800	6304	2347	4.76	2502	5.44	2774	6.79	3030	8.23	3266	9.71	3502	11.22	3710	12.84	3911	14.54						
2900	6529	2420	5.25	2570	5.95	2837	7.34	3088	8.82	3319	10.34	3544	11.90	3755	13.55	3952	15.22						
3000	6754	2494	5.77	2639	6.48	2902	7.93	3143	9.43	3371	10.99	3592	12.59	3802	14.26								

Performance shown is for Installation Type D: ducted inlet/ducted outlet. Performance data is based on standard air conditions (0.075#/ft.^{3}).

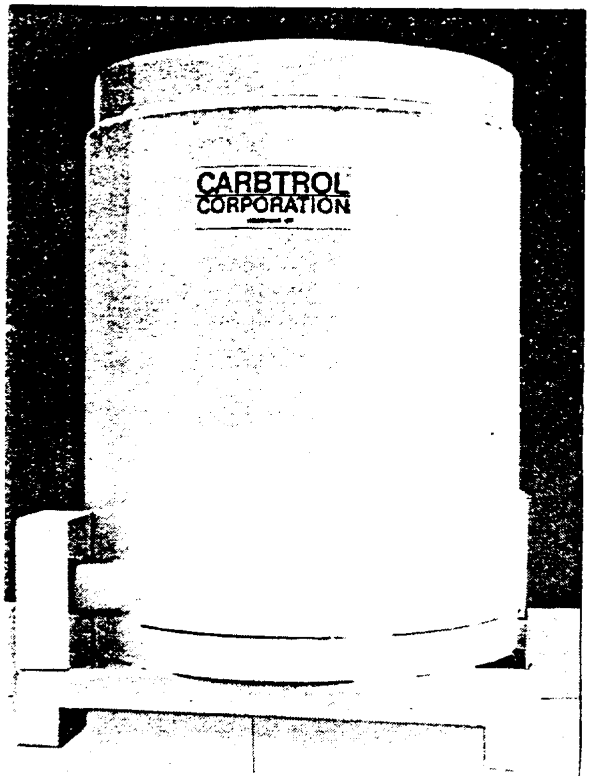
BHP does not include drive losses.

NOTE: Screened area represents most efficient fan selection.

CARBTROL®

AIR PURIFICATION ADSORBERS

1,000 LB. ACTIVATED CARBON G-4
1,800 LB. ACTIVATED CARBON G-6



FEATURES

- Low pressure drop.
- High activity carbon.
- Fork lift fittings for easy handling.
- 4" Ø slotted inlet distributor.
- DOT rated. Acceptable for transport of hazardous waste.

SPECIFICATIONS

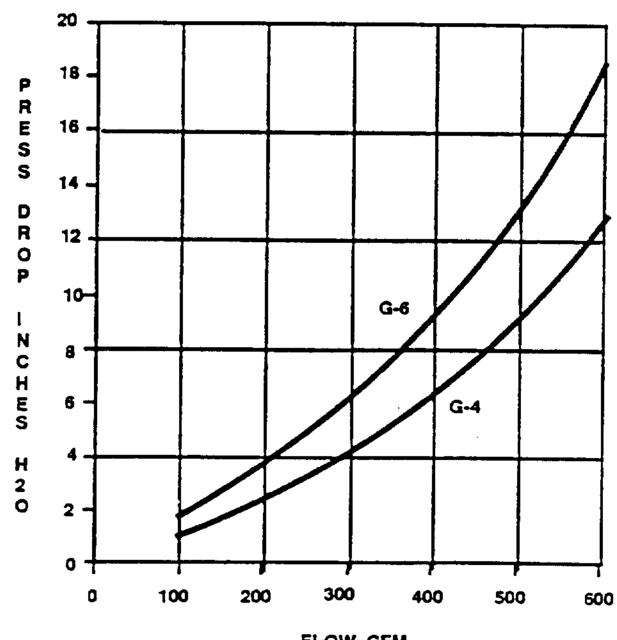
G-4

CARBON: 1,000 lbs.
DIMENSIONS: 45-1/2" Ø x 62" height
SHIPPING WT: 1,500 lbs.

G-6

CARBON: 1,800 lbs. *
DIMENSIONS: 45-1/2" Ø x 86" overall ht.
SHIPPING WT: 2,500 lbs.

* 2,000 lbs. option available



CARBTROL®
CORPORATION

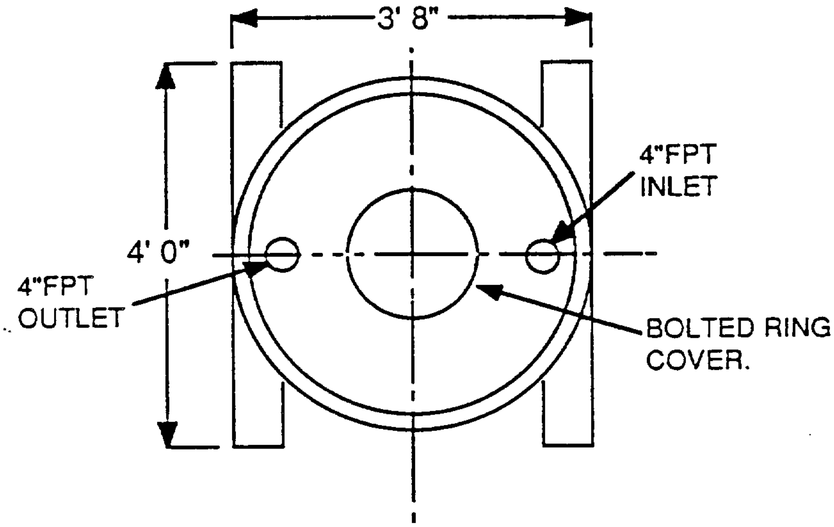
51 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

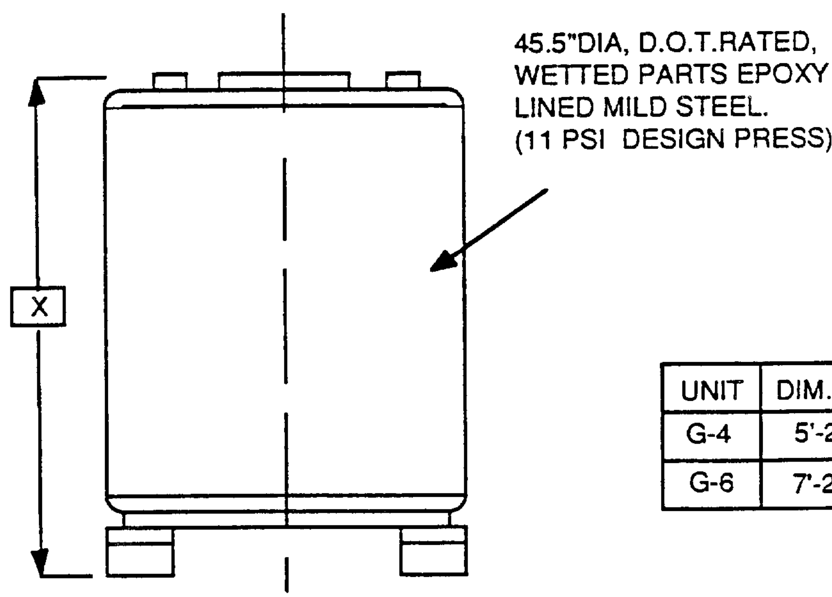
 AT-411/#1

CARBTROL®

AIR PURIFICATION ADSORBERS

1,000 LB. ACTIVATED CARBON G-4
1,800 LB. ACTIVATED CARBON G-6





UNIT	DIM. "X"
G-4	5'-2"
G-6	7'-2"

CARBTROL®
CORPORATION
51 Riverside Avenue, Westport, CT 06880 • 1-800-242-1150 • (203) 226-5642

CALGON
CALGON CARBON CORPORATION

System Bulletin

MODEL 4

Granular Activated Carbon Adsorption System

The Calgon Carbon Model 4 is an adsorption system designed specifically for the removal of dissolved organic contaminants from liquids using granular activated carbon. The Model 4 reflects Calgon Carbon's extensive experience in adsorption system design and operation.

The Model 4 system is delivered completely assembled on a steel skid, requiring only site process and utility hookups to be ready for operation. The pre-engineered Model 4 design is available with three piping materials of construction options to satisfy most requirements.

The process piping network for the Model 4 accommodates operation of the adsorbers in parallel or series. In series operation, the first stage can be isolated from the flow, have the granular carbon exchanged, and returned to operation as the second stage without interrupting treatment.

The Model 4 system allows for ease of granular activated carbon exchange. The system is suited for use with Calgon Carbon's Bulk-Back Service in which the granular activated carbon is supplied in containers for convenient transfer to the adsorbers. Bulk-Back units also receive the spent carbon from the adsorbers for return to Calgon Carbon for reactivation services.

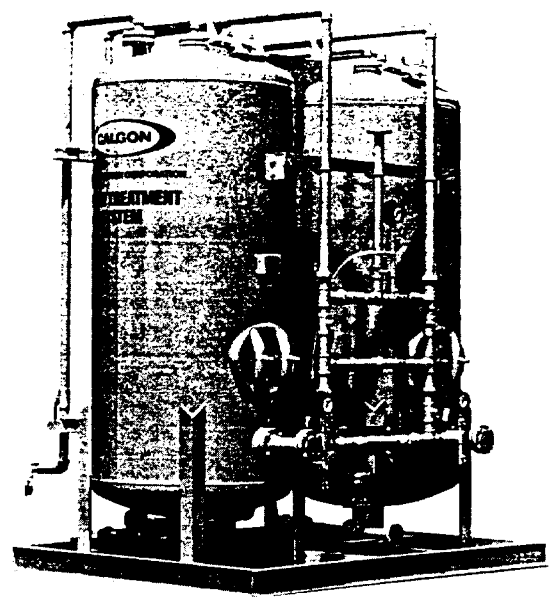
MATERIALS OF CONSTRUCTION

Adsorbers: Carbon steel ASME code pressure vessels
Adsorber internal lining: Vinyl ester lining (nominal 40 mil) for potable water and most liquid applications
System external coating: Epoxy mastic paint system
Standard adsorption system piping options:

Solid PVC Piping System
- Schedule 80 PVC pipe and PVC ball valves
- Schedule 80 PVC underdrain and PPL screened nozzles

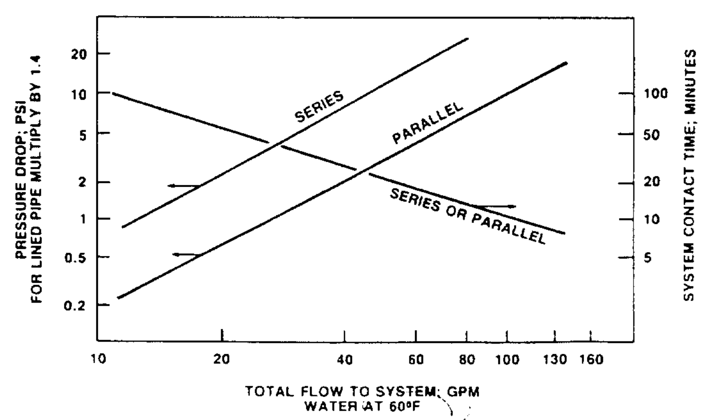
Carbon Steel Piping System
- Schedule 80 steel pipe and ductile iron ball valves
- PPL lined carbon discharge with TFE lined plug valve
- Schedule 80 PVC underdrain and PPL screened nozzles

Polypropylene Lined Piping System
- PPL lined steel pipe and diaphragm valves
- TFE lined plug valves on carbon fill and discharge
- Solid PPL underdrain and screened nozzles



OPERATING CONDITIONS

Carbon per adsorber:	72 cubic feet (2,000 lbs)
Pressure rating:	75 psig
Pressure relief:	Rupture disk - 72 psig setting
Vacuum rating:	14 psig
Temperature rating:	150°F maximum
Backwash rate:	125 gpm (40% expansion)
Carbon transfer mode:	Pressure slurry transfer
Utility air:	30 scfm at 30 psig (not recommended for PVC pipe)
Utility water:	100 gpm at 30 psig
Freeze protection:	None provided; enclosure or protection recommended



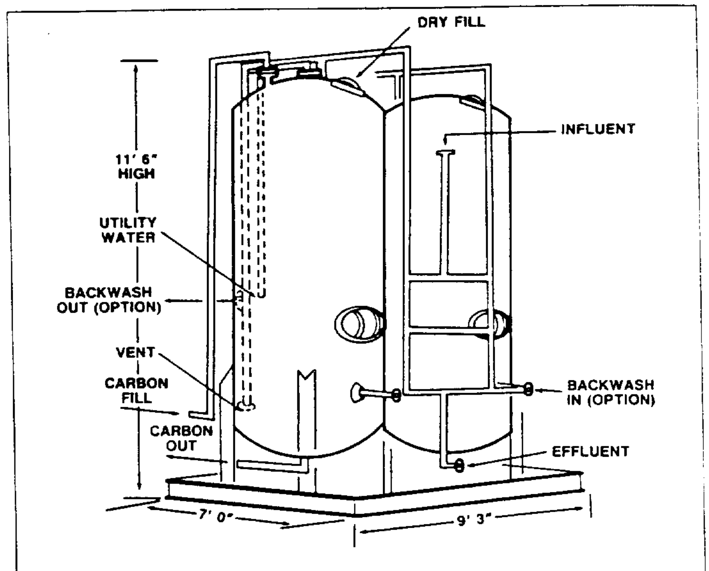
ELF

EPM 12/91

CALGON CARBON CORPORATION • P.O. BOX 717 • PITTSBURGH, PA 15230-0717 • PHONE 1-800-4CARBON/422-7266

DIMENSIONS AND FIELD CONNECTIONS

Adsorber vessel diameter:	4 ft
Process pipe:	2 in
Process pipe connection:	2 in flange
Utility water connection:	1 1/2 in flange
Utility air connection:	3/4 in hose connection
Carbon hose connection:	2 in Kamlok type
Carbon dry fill opening:	top 11 in x 15 in handhole
Backwash connections:	3 in flange
Drain/vent connection:	2 in flange; unrestricted
Adsorber maintenance access:	14 in x 18 in manway
System shipping weight:	9,000 lb with carbon
System operating weight:	26,000 lb



NOMINAL DIMENSIONS/CONNECTION LOCATIONS

CAUTION

Wet activated carbon preferentailly removes oxygen from air, In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low-oxygen spaces should be followed, including all applicable federal and state requirements.

For more information on the product described in this bulletin, or information on other adsorption equipment, please contact one of our Regional Sales Offices located nearest to you:

SALES OFFICES

Region I
P.O. Box 6768
Bridgewater NJ 08807
Tel (908) 526-4646
Fax (908) 526-2467

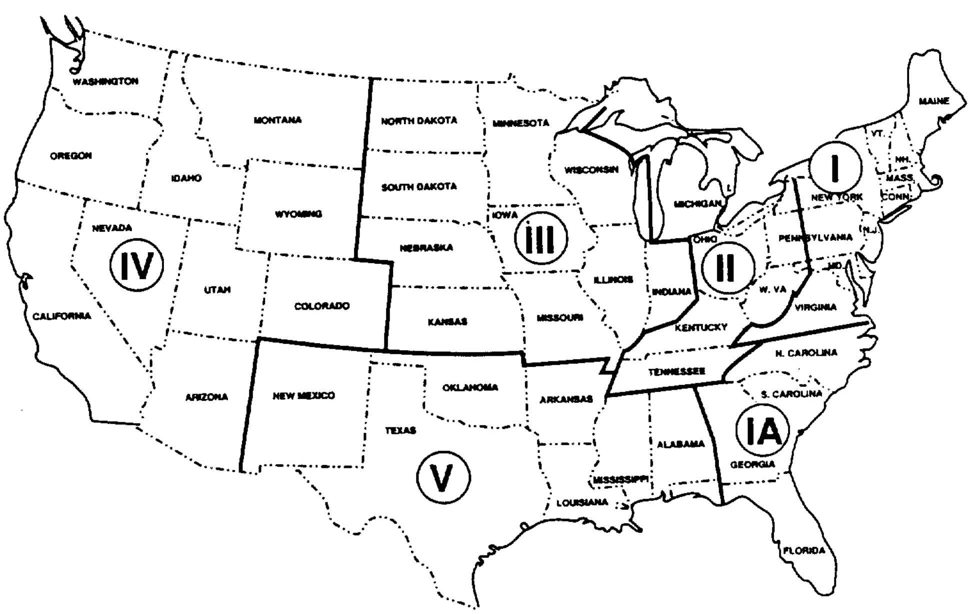
Region IA
5600 77 Center Drive
Suite 200
Charlotte NC 28217
Tel (704) 527-7580
Fax (704) 523-3550

Region II
P.O. Box 717
Pittsburgh PA 15230-0717
Tel (412) 787-6700
800/4-CARBON
Fax (412) 787-6676

Region III
4343 Commerce Court
Suite 400
Lisle IL 60532
Tel (708) 505-1919
Fax (708) 505-1936

Region IV
2121 South El Camino Real
San Mateo CA 94403
Tel (415) 572-9111
Fax (415) 574-4466

Region V
Benchmark 1 Building
13430 Northwest Freeway
Suite 804
Houston TX 77040-6071
Tel (713) 690-2000
Fax (713) 690-7909



International
P.O. Box 717
Pittsburgh PA 15230
Tel (412) 787-4519
Fax (412) 787-4523

Canada
Calgon Carbon Canada, Inc.
Suite 304
6303 Airport Road
Mississauga, Ontario
Canada L4V 1R8
Tel (416) 673-7137
Fax (416) 673-8883

Belgium
Chemviron Carbon
Boulevard de la Woluwe 60
Boite 7
B-1200 Brussels, Belgium
Tel 32 2 773 02 11
Fax 32 2 770 93 94

CALGON

CALGON CARBON CORPORATION

CALGON

CALGON CARBON CORPORATION

PRODUCT BULLETIN

CENTAUR™ 8x30

GRANULAR ACTIVATED CARBON

DESCRIPTION

CENTAUR™ 8x30 is a liquid phase virgin activated carbon that has been manufactured to develop catalytic functionality. The product is unique in that it concentrates reactants via adsorption and then promotes their reaction on the surface of the pores. CENTAUR™ 8x30 is produced from bituminous coal using a patented process. Although, it is not impregnated with metals or alkali, it displays the catalytic function of these materials. In most cases, it can be reactivated and does not present the disposal concerns associated with impregnated carbon.

APPLICATIONS

CENTAUR™ 8x30 can be utilized in the liquid phase for the promotion of oxidation, reduction, decomposition, substitution, and elimination reactions. Specific applications include H_2S oxidation in sour water, peroxide destruction, and chloramine removal. CENTAUR™ 8x30 provides a combination of low pressure drop, moderate kinetics, and good resistance to fines generation. Thermal reactivation is an option for recycle and reuse of this product to minimize operating costs and eliminates disposal concerns.

DESIGN CONSIDERATIONS

CENTAUR™ 8x30 is intended primarily for use in liquid phase systems to promote catalytic reactions. The carbon can be utilized in a number of reactor configurations with required contact times typically in the 1-3 minute range. The reaction rate is application specific. The field packed density of the product is typically 36 lb/ft.³.

PACKAGING

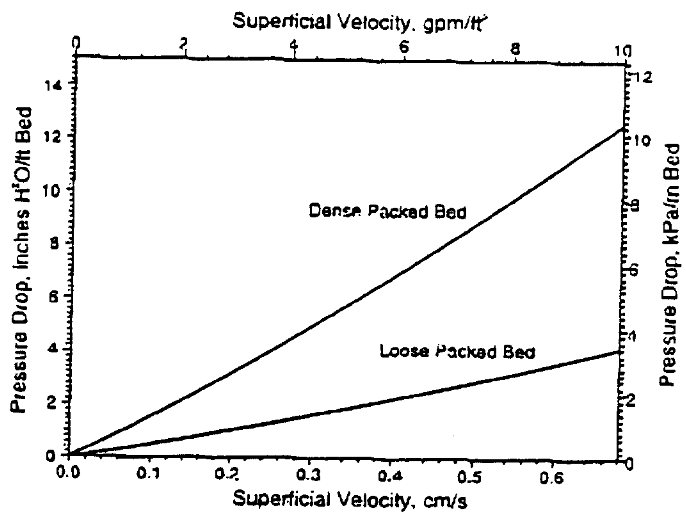
225 lb (102.3 kg) fiber drum

PROPERTIES

Peroxide No.*	14 max
Iodine No., mg/g:	800 min
Ash, by weight%:	8 max
Moisture, by weight%, as packed:	2 max
Apparent Density, g/ml	.58 -.62 min
Abrasion Number	75 min
Mean Particle Diameter	1.5-1.7 mm
U.S. Sieve Series:	
Percent on 8 mesh	15% max
Percent through 30 mesh	4% max

*Peroxide number utilizes the rate of decomposition of hydrogen peroxide by the carbon and is an indicator of the amount of catalytic activity.

PRESSURE DROP CURVE



MANUFACTURING

Catlettsburg, KY

CALGON CARBON CORPORATION • P.O. BOX 717 • PITTSBURGH, PA 15230-0717 • PHONE 1-800-4CARBON

FEATURES	BENEFITS
• Catalytic Activity	• Smaller system size • Low capital requirements
• Not Impregnated	• No safety concerns with exotherms, ignition temperature, toxicity
• Improved Trace Organic Capacity	• More capacity per unit volume - lower use rates
• High Hardness	• Reduced fines - handling loss
• Works at Low Oxidant Levels	• Wide applicability. Can eliminate chemical addition
• Simple Equipment Design	• Reliable, handles spikes in concentration, no metering of chemicals
• Reduced Carbon Requirements	• Reduces operating costs
• Enhanced Performance	• Achieves greater degree of contaminant removal at reduced costs

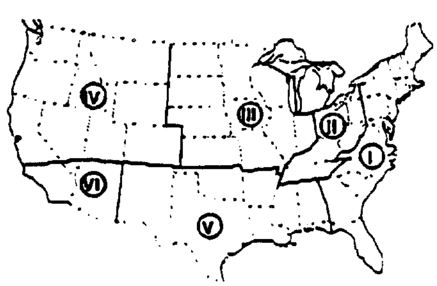
SAFETY MESSAGE

Wet activated carbon preferentially removes oxygen from air. In closed or partially closed containers and vessels, oxygen depletion may reach hazardous levels. If workers are to enter a vessel containing carbon, appropriate sampling and work procedures for potentially low oxygen spaces should be followed, including all applicable federal and state requirements.

SALES OFFICES

Region I
Bridgewater, NJ
Tel (908) 526-4646
Fax (908) 526-2467

Region II
Pittsburgh, PA
Tel (412) 787-6700
800/4-CARBON
Fax (412) 787-6676



Region IV
San Mateo, CA
Tel (415) 572-9111
Fax (415) 574-4466

Region V
Houston, TX
Tel (713) 690-2000
Fax (713) 690-7909

Region III
Lisle, IL
Tel (708) 505-1919
Fax (708) 505-1936

Latin America/ Asia Pacific
Pittsburgh, PA
Tel (412) 787-4519
Fax (412) 787-4523

Canada
Calgon Carbon Canada, Inc.
Mississauga, Ontario
Tel (905) 673-7137
Fax (905) 673-8883

Europe
Chemviron Carbon
Brussels, Belgium
Tel 32 2 773 02 11
Fax 32 2 770 93 94

Region VI
Carlsbad, CA
Tel (619) 431-5550
Fax (619) 431-8169

If at any time our products or services do not meet your requirements or expectations, or if you would like to suggest any ideas for improvement, please call us at 1-800-548-1999. From outside the U.S. please call +1-412-787-6700.

CALGON

CALGON CARBON CORPORATION

Appendix G

Demonstration of Compliance Plan

This DCP has
been superseded
by the DCP
submitted 6/22/95
by BBL &
approved 7/13

KSM

I. Introduction and Background

This appendix presents the Demonstration of Compliance Plan (DCP) for the NTCRA ground-water containment and treatment system for the SRSNE Site. This DCP was prepared by BB&L, on behalf of the SRSNE PRP Group, to verify the effectiveness of the ground-water containment and treatment system described in detail in the "100% Ground-Water Containment and Treatment System Design Report" (BB&L, December 1994). This DCP was prepared pursuant to the NTCRA SOW, which provided specific performance standards for the ground-water containment and treatment system, and criteria that will be used to evaluate the effectiveness of the system.

The ground-water containment system will be installed in the Containment Area, which is defined in the SOW as the general area within the former Cianci property that is downgradient (east) of the Operations Area, upgradient (west) of the Lower Till Window, north of the Town of Southington wellfield property, and south of an underground 36-inch-diameter RCP that extends from the Operations Area to the Quinnipiac River (Figure G-1). In vertical section, the Containment Area includes the saturated outwash deposits from the water table to the top of the glacial till. Based on the available geologic data from the site, a layer of glacial till is laterally continuous immediately above the weathered top of bedrock throughout the Containment Area (HNUS, May 1994; ENSR, June 1994; BB&L, December 1994). The thickness of the saturated outwash deposits above the till ranges from approximately 13 feet in the west-central portion of the Containment Area to approximately 24 feet along the eastern edge of the Containment Area.

The ground water recovered by the containment system will be pumped to the ground-water treatment system. Treated effluent from the treatment system will be discharged into the Quinnipiac River via the existing underground RCP pipeline shown on Figure G-1.

The remaining sections of this DCP describe:

- The design of the ground-water containment system, as it relates to the DCP;
- The ground-water containment and treatment system performance standards;
- The acquisition of field data that will be used to evaluate the effectiveness of the ground-water containment and treatment system;
- Adjustments to the ground-water containment and treatment system; and
- Data interpretation and reporting.

II. Ground-Water Containment System Design

The proposed design for the ground-water containment system includes an array of ground-water recovery wells and a downgradient hydraulic barrier wall that will hydraulically and physically contain overburden ground water entering the Containment Area from the SRSNE Operations Area (Figure G-2). The overburden ground-water recovery wells will extract overburden ground water on the upgradient (west) side of the flow barrier, establishing an inward hydraulic gradient across the hydraulic barrier. The design of the hydraulic barrier and the ground-water recovery wells are described in more detail in the "100% Ground-Water Containment and Treatment System Design Report" (BB&L, December 1994).

The results of numerical ground-water flow (MODFLOW) simulations, presented in Appendix B of this report, predict that a hydraulic divide will be established at the outer surface of the hydraulic barrier wall during the implementation of the ground-water containment system. The overburden ground-water elevation (head) immediately inside (west of) the hydraulic barrier will be lower than the head immediately outside (east of) the barrier wall. The hydraulic gradient across the barrier will therefore be inward with respect to the configuration of the barrier wall, creating a continuum of hydraulic control. East of the hydraulic divide, the hydraulic gradient will be eastward toward the river. West of the two ends of the sheet-piling, ground-water flow will converge into the sheet-piled area.

III. Ground-Water Containment and Treatment System Performance Standards

This DCP describes the acquisition and interpretation of field data that will be used to verify that the ground-water containment and treatment systems comply with the performance standards specified in the SOW. The performance standards for the containment system are to:

- Prevent the migration of all contaminated overburden ground water from the Operations Area of the Site; and

- Prevent the migration of all contaminated overburden ground water from the Operations Area into the bedrock aquifer through the lower till window that forms the eastern boundary of the Containment Area.

The containment-system performance standards will be evaluated based on the Reversal of Gradient Test, as presented in the SOW. The acquisition and analysis of field data for the Reversal of Gradient Test are described in more detail below.

The treatment system performance standards require that the system treat the impacted ground water pumped from the containment system to concentrations that meet all applicable or relevant and appropriate requirements (ARARs). The treatment system effluent limits will be developed by the Connecticut Department of Environmental Protection (CT DEP).

IV. Field Data Acquisition

The data required to demonstrate compliance with the ground-water containment and treatment system performance standards will be obtained in the form of head measurements from wells and piezometers installed in the area of the containment system, flow measurements from the containment-system recovery well array, and treatment system effluent pumping rates and analytical data. Field methods used to obtain the necessary data to demonstrate compliance will be performed in general accordance with the relevant standard operating procedures presented in the "Final Soil, Groundwater, and Additional Studies Workplan for the SRSNE Superfund Site" (ENSR, March 1994), which are included in Attachment G-1.

As specified in the SOW, the effectiveness of the ground-water containment system at achieving the performance standards will be evaluated based on the results of a Reversal of Gradient Test. The successful Reversal of Gradient Test will show that the following two conditions are achieved during operation of the ground-water containment system:

- Within the Containment Area, overburden ground water east and downgradient of the Operations Area is flowing in the direction of the ground-water extraction wells; and

- Overburden ground-water flow is reversed and maintained in the direction of the extraction system within the area defined by (west of) the interpreted hydraulic divide that forms east of the extraction system.

The Reversal of Gradient Test is to be demonstrated within a 30-day "Compliance Period," which begins at the initiation of operations of the ground-water containment and treatment system, and during the entire operation of the system thereafter. The Reversal of Gradient Test results will be evaluated based on field measurements of hydraulic heads at a specified array of monitoring locations installed within the saturated outwash. To verify that each of the two requirements of the Reversal of Gradient Test are satisfied during operation of the ground-water containment system, two different groups of wells/piezometers will be monitored, as described below.

Reversal of Gradient Test - Requirement #1

To confirm that overburden ground water east and downgradient of the Operations Area within the Containment Area is flowing in the direction of the ground-water extraction wells (Reversal of Gradient Test Requirement #1), head measurements will be obtained at the following wells/piezometers installed within the overburden in the general vicinity of the ground-water containment system: RW-1, RW-2, RW-3, RW-4, RW-5, RW-6, RW-7, RW-8, RW-9, RW-10, RW-11, MW-409, MW-415, MWL-301, MWL-304, MWL-305, MWL-307, MWL-308, MWL-310, P-16, P-2B, PZO-1, PZO-2, and PZ0-3. Data will also be obtained at wells MWL-302, MWL-306, MWL-309, MWL-311, and TW-7A to assess the hydraulic response in the area between the hydraulic barrier wall and the river. Also, to evaluate the vertical hydraulic gradient between the outwash deposits and the underlying till or bedrock during operation of the overburden ground-water containment system, comparative hydraulic head data will be measured at the following wells and piezometers installed in the till or bedrock: MW-408, MW-414, MW-416, PZR-1, PZR-2, and PZR-4. Ground-water elevations will be measured weekly at the locations listed above during the Compliance Period and the first 12 months of operation of the containment system.

Reversal of Gradient Test - Requirement #2

To verify that overburden ground-water flow is reversed and maintained in the direction of the extraction system within the area defined by (west of) the interpreted hydraulic divide that forms east of the extraction system (Reversal of Gradient Test Requirement #2), five pairs of compliance piezometers, CPZ-1 through CPZ-10, will be installed at the locations shown on Figure G-2. The SOW, which was prepared under the assumption that the containment system would consist of only recovery wells and/or trenches, indicated that separate compliance piezometers should be installed in the shallow, middle, and deep outwash at each compliance monitoring location. The proposed use of an essentially impermeable hydraulic barrier, however, renders separate piezometers unnecessary. The proposed monitoring network will include a single fully penetrating piezometer at each compliance piezometer location. At each compliance piezometer location, a piezometer screened throughout the shallow, intermediate, and deep portions of the saturated outwash will be installed within a borehole drilled to the top of till. Each piezometer will be constructed using Schedule 40 PVC and will include a 0.010-inch-slot screen installed within a Morie #0 or equivalent sand filter pack. A minimum one-foot-thick, hydrated bentonite seal will be placed above the filter pack, and the remainder of the borehole will be grouted to ground surface. Each compliance piezometer will be developed to enhance the hydraulic connection between the piezometer and the surrounding formation.

Hydraulic head data will be obtained from these compliance piezometers on the same schedule as described above. The hydraulic gradient will be considered reversed, and inward across the hydraulic barrier wall when the hydraulic head data measured at piezometers inside the barrier wall (at locations CPZ-1, CPZ-3, CPZ-5, CPZ-7, and CPZ-9) are at least ~~0.1~~ 0.3 foot lower than the heads measured at the corresponding piezometers located immediately opposite the wall. For example, heads will be compared between the following pairs of piezometers: CPZ-1 and CPZ-2; CPZ-3 and CPZ-4; CPZ-5 and CPZ-6; CPZ-7 and CPZ-8; CPZ-9 and CPZ-10.

As specified in the SOW, to verify the continuity of the hydraulic gradient reversal across the hydraulic barrier wall, relatively continuous head measurements will be recorded at Piezometers CPZ-5 and CPZ-6. These data will be obtained every four hours during the Compliance Period and the first 30 days thereafter, and on a daily basis during the remaining 11 months of the first year of containment-system operation.

In addition to the hydraulic head measurements described above, the flow rate from the containment system will be recorded continuously using an in-line totalizing flow meter (located in the treatment system building) throughout the Compliance Period and the first 12 months thereafter. The cumulative volume of ground water pumped by the containment-system recovery wells will be documented daily during the first week of the Compliance Period, and on a weekly basis for the remainder of the Compliance Period and the first 12 months of system operation. The effluent from the treatment system will also be monitored in terms of flow rate and water-quality characteristics, as required by the terms of the effluent limits to be established by the CT DEP.

V. System Adjustments

If, based on the review of hydraulic head data measured at the site during the ground-water containment system operation, the system does not appear to satisfy the containment-system performance standards, adjustments will be made to the containment system to establish and maintain hydraulic containment. These adjustments may include the modification of ground-water recovery rates at the recovery wells or the installation of additional recovery wells, if necessary. Similarly, if the analytical results of treatment system effluent do not meet the discharge limitations established in the discharge permit, the treatment system will be modified, as necessary, to attain the requirements for discharge.

VI. Demonstration of Compliance Reports

The results of the ground-water containment and treatment system monitoring activities described above will be presented in Demonstration of Compliance Reports, which will be submitted for United States Environmental Protection Agency (USEPA) review and approval within seven days of the end of the Compliance Period, and monthly thereafter. These reports will contain the information necessary to demonstrate compliance with the performance standards for the ground-water containment and treatment system, descriptions of adjustments made to the system, and conclusions regarding compliance, as well as the basis for these conclusions. If compliance is not demonstrated, based on the data acquired under the

DCP, a plan and schedule will be presented describing the actions that will be undertaken to establish compliance with the performance standards.

To demonstrate the effectiveness of the ground-water containment system, Demonstration of Compliance Reports will include:

- A table of hydraulic head data measured on the last day of the Compliance Period, in the first Compliance Report submittal and, in subsequent reports, every 30th day thereafter;

- Contours of hydraulic head data measured on the last day of the Compliance Period in the first Compliance Report submittal and, in subsequent reports, every 30th day thereafter, which will show the hydraulic gradient and the location of the hydraulic divide within the saturated outwash; and

- Hydrographs of hydraulic head Compliance Piezometers CPZ-5 and CPZ-6, which will verify the temporal continuity of the gradient reversal across the barrier wall.

The hydraulic head contours will be used to interpret the location of the hydraulic divide and to verify that all overburden ground-water between the Operations Area and the recovery wells, and between the recovery wells and the interpreted hydraulic divide, is flowing in the direction of the recovery wells. The tabulated hydraulic head data measured at pairs of compliance piezometers situated at the same depth interval on either side of the barrier wall will be used to verify that the hydraulic gradient across the wall is inward (toward the west), based on a minimum head differential of ~~0.1~~ 0.3 foot as measured on either side of the wall. Also, tabulated head data from wells/piezometers installed in the till or bedrock will be compared to the head data from nearby wells/piezometers installed in the outwash to verify that the vertical gradient is upward in the vicinity of the containment system. The hydrographs from Compliance Piezometers CPZ-5 and CPZ-6 will be used to verify that the gradient reversal at the barrier wall is continuous through time.

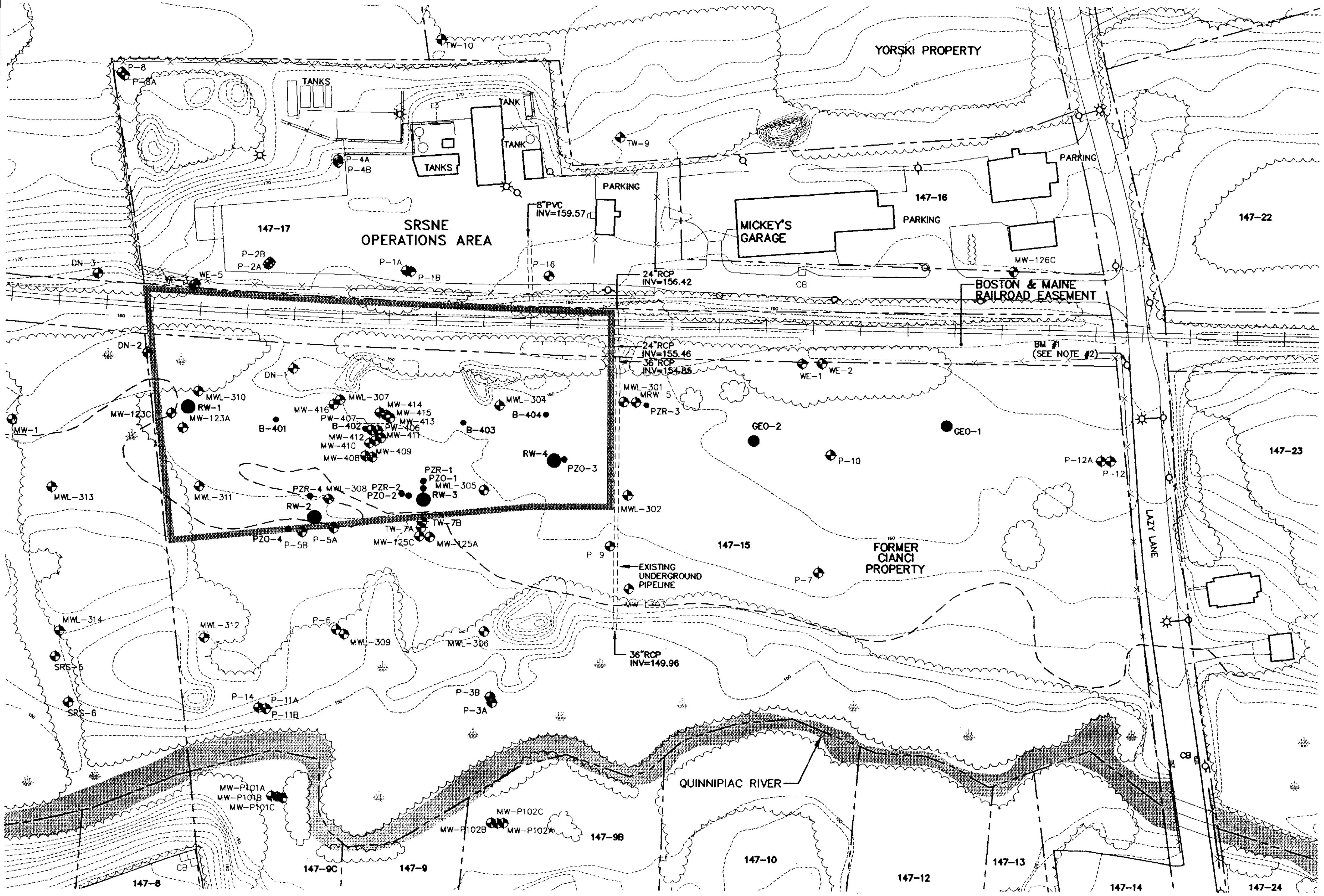
If the containment system performance standards are not demonstrated based on the compliance monitoring data, a plan and schedule will be presented in the same Demonstration of Compliance Report describing actions that will be taken to achieve the containment system performance standards.

The Demonstration of Compliance Reports also will present the following information pertinent to the ground-water treatment system operation:

- Tabulated summary of the total volume of water pumped from the Containment Area and discharged to the Quinnipiac River;
- Tabulated summary of the analytical results from discharge monitoring specified by the CT DEP; and
- Tabulated comparison of the discharge monitoring analytical results to the discharge limitations established by the CT DEP.

If the CT DEP discharge limitations are not demonstrated by the compliance monitoring data for the treatment system, a plan and schedule will be presented in the Demonstration of Compliance Report describing modifications to the operation or design of the treatment system necessary to achieve the ground-water treatment system performance standards.

Figures



LEGEND

	PROPERTY LINE
	100-YEAR FLOOD LIMIT
	WATER
	RIVER
	WETLAND
P-10	MONITORING WELL
PZR-3	PIEZOMETER
RW-5	RECOVERY WELL
	CONTAINMENT AREA
147-15	TAX MAP NUMBER
	EXISTING STRUCTURE
	VEGETATION
	EXISTING CONTOUR
—x—x—	FENCE
	UTILITY POLE
	LIGHTING

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).
4. THE LOCATION OF EXISTING WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

VIEW: 50
LAYER: ON=*; OFF=2,A1,REF
XREF: 08325X05
12/94-54 PMC AK
08325001/08325G19.DWG

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

No.	Date	Revisions	Init

In charge of ________
Designed by ________
Drawn by ________
Checked by ________

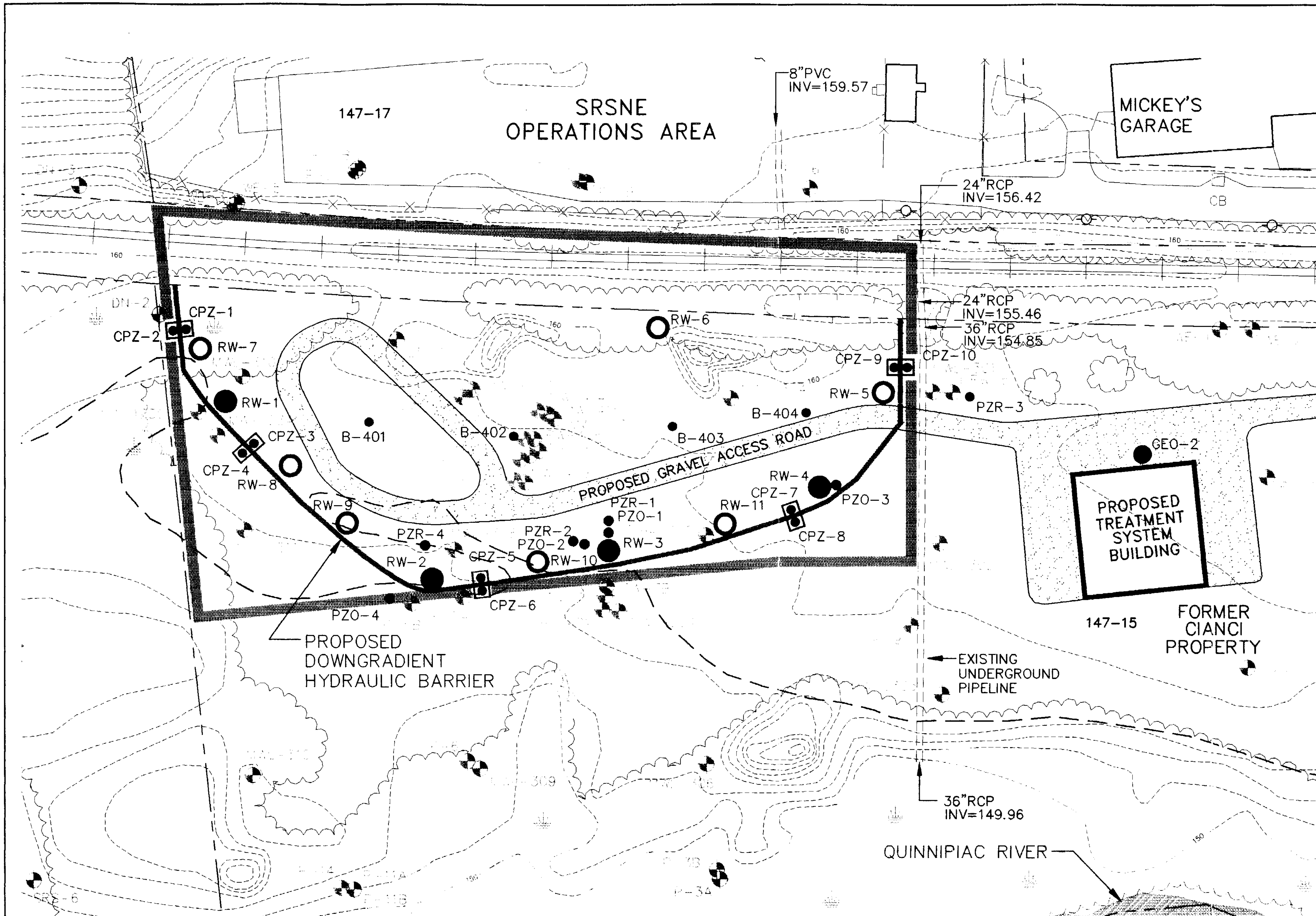
BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS
SYRACUSE, NEW YORK

SRSNE PRP GROUP • SOUTHINGTON, CONNECTICUT

NON-TIME-CRITICAL REMOVAL ACTION
SRSNE SITE

EXISTING SITE PLAN

File Number 083.25
Date DECEMBER 1994
FIGURE G-1



LEGEND

- PROPERTY LINE
- 100-YEAR FLOOD LIMIT
- WATER
- RIVER
- WETLAND
- MONITORING WELL
- PZR-3 PIEZOMETER
- RW-1 RECOVERY WELL
- RW-9 PROPOSED RECOVERY WELL
- CONTAINMENT AREA
- 147-15 TAX MAP NUMBER
- EXISTING STRUCTURE
- VEGETATION
- EXISTING CONTOUR
- FENCE
- CPZ-6 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).
4. THE LOCATIONS OF EXISTING AND PROPOSED WELLS AND PIEZOMETERS ARE APPROXIMATE ONLY.

VIEW: 30
LAYER: ON=*; OFF=1,REF
XREF: 08325X05
12/94-54 PMC AK
08325001/08325G18.DWG

NO ALTERATIONS PERMITTED HEREON EXCEPT AS PROVIDED UNDER SECTION 7209 SUBDIVISION 2 OF THE NEW YORK STATE EDUCATION LAW

No.	Date	Revisions	Init

In charge of ________
Designed by ________
Drawn by ________
Checked by ________

BLASLAND, BOUCK & LEE, INC.
ENGINEERS & SCIENTISTS
SYRACUSE, NEW YORK

SRSNE PRP GROUP • SOUTHINGTON, CONNECTICUT
NON-TIME-CRITICAL REMOVAL ACTION
SRSNE SITE

PROPOSED COMPLIANCE MONITORING LOCATIONS

File Number 083.25
Date DECEMBER 1994

FIGURE **G-2**

Attachment G-1

Standard Operating Procedures

Number	Title
7115	Subsurface Soil Sampling, Rev. 3
7130	Groundwater Sample Collection from Monitoring Wells, Rev. 2
7220	Monitoring Well Construction and Installation, Rev. 3
7221	Monitoring Well Development, Rev. 1
7315	Operation/Calibration of HNu Photoionization Analyzer, Rev. 2
7510	Packaging and Shipment of Samples, Rev. 2
7600	Decontamination of Equipment, Rev. 3

These SOPs are from the Final Soil, Groundwater, and Additional Studies Workplan for the SRSNE Superfund Site (ENSR, March 1994).

ENSR STANDARD OPERATING PROCEDURE

Number: 7115 **Date of Issue:** 2nd Qtr.1993

Revision: 3

Title: Subsurface Soil Sampling (Split-Spoon)

Organizational Acceptance	Authorization	Date
Originator	Charles Martin	3/2/84
Technical Reviewer	Arthur Lazarus	3/2/84
Technical Reviewer	Elaine Moore	3/2/84
Technical Reviewer		
Quality Assurance	Scott Whittemore	3/2/84

Revision #	Changes	Authorization	Date
1	• Update	Scott Whittemore Charles Martin Arthur Lazarus Elaine Moore	3/2/84 3/2/84 3/2/84 3/2/84
2	• Use of recirculated water must be documented in Field Log Books • All field documentation must be completed ASAP to ensure traceability • Miscellaneous rewording	Scott Whittemore Elaine Moore Charles Martin	10/15/86 10/15/86 10/16/86
3	• Format update • Boring Log update	Mike Dobrowolski	4/27/93

Organizational acceptance signatures are maintained on file with the original document in the Quality Assurance Library in Acton, MA.

ENSR Consulting and Engineering

Subsurface Soil Sampling (Split-Spoon)

Date:	2nd Qtr. 1993
Revision No:	3
Author:	Charles Martin
Discipline:	Geosciences

1.0 PURPOSE AND APPLICABILITY

This SOP describes the methods used in obtaining subsurface soil samples for identification of soil grain-size distributions, stratigraphic correlations, and chemical analysis (if required). Subsurface soil samples are obtained in conjunction with soil boring and monitoring-well installation programs and provide direct information as to the physical makeup of the subsurface environment. This SOP covers subsurface soil sampling by split-spoon only, as this is the means most often used for obtaining samples from unconsolidated deposits. (See also. ENSR SOP 7220 - Monitoring Well Construction).

2.0 RESPONSIBILITIES

2.1 Project Geologist/Engineer

It shall be the responsibility of the project geologist/engineer to observe all activities pertaining to subsurface soil sampling to ensure that all the standard procedures are followed properly, and to record all pertinent data on a boring log. It is also the geologist/engineer's responsibility to indicate to the contract driller at what specific depth samples shall be collected. The geologist/engineer will maintain custody of all samples until they are shipped or delivered to their appropriate destination.

2.2 Driller

It shall be the responsibility of the contract driller to provide the necessary materials for obtaining subsurface soil samples including the split-spoon sampler. Standard Penetration Tests (SPT) (ASTM: 1586-67) will be conducted by the contract driller if required by the project. Equipment decontamination shall also be the responsibility of the driller.

3.0 REQUIRED MATERIALS

In addition to those materials provided by the contract driller, the geologist/engineer will provide:

- sample bottles and labels
- boring logs
- field notebook
- chain-of-custody forms and tape
- ENSR SOP 7210, Rock Core Drilling
- ENSR SOP 7220, monitoring Well Installation
- ENSR SOP 7510, Packaging and Shipment of Samples
- ENSR SOP 7600, Decontamination of Equipment

4.0 METHOD

4.1 General Procedures

The sampling depth interval is typically one (1) sample per every five (5) vertical feet with additional samples taken, at the discretion of the project geologist/engineer, when significant textural, visual or odor changes are encountered.

Specific requirements described in a project's task plan may call for deviations from the standard procedures but these will be taken into account on a project by project basis. Any deviations from specified procedures will be recorded on the boring log and the Field Log Book with rationale.

4.2 Advancing Casing

4.2.1 The casing shall be advanced to the required depth. All loose material within the casing shall be removed prior to sampling. The casing shall be advanced according to project requirements. Borings are typically advanced by two methods. drive-and-wash casing, and hollow-stem augering. The casing shall be of the flush joint or flush couple type and of sufficient size to allow for soil sampling, coring, and/or well installation. All casing sections shall be straight and free of any obstructions. Hollow-stem augers or solid flight augers with casing may be used according to specific project requirements as described in the project task plan. If hollow-stem augers are to be used, the bit shall be equipped with a plug device to be removed at the required sampling depth.

4.2.2 For those borings which encounter obstructions. the casing shall be advanced either past or through the obstruction by drilling, mechanically fracturing, or blasting (if required). If the obstruction is bedrock, a rock core shall be taken according to project requirement and following the standard procedures for rock coring (ENSR SOP # 7210 Rock Core Drilling).

4.2.3 The use of recirculated water shall not be permitted when casing is being driven, unless specified in the project task plan, directed and properly documented (in field notebook, logs) by the geologist/engineer.

4.2.4 If recirculated water is used all loose material within the casing shall be removed by washing to the required sampling depth using a minimum amount of water. Care shall be taken to limit recirculation of the wash water to those times when the water supply is extremely limited or unavailable.

4.3 Standard Procedures - Soil Sampling

4.3.1 Subsurface soil samples shall be obtained using a split-tube type similar (split spoon) having a 2-inch O.D. with a corresponding 1 3/8-inch I.D. and a 18- or 24-inch long sample capacity. It shall be equipped with a ball check valve and may require a flap valve or basket-type retainer for loose-soil sampling. Sampling frequency will be as stated in Section 4.1, or as otherwise specified in the project task plan.

4.3.2 Sampling depth shall be independently determined by the inspecting geologist, and any discrepancies shall be resolved prior to obtaining the sample.

4.3.3 Samples shall be obtained using the standard penetration test (SPT), which allows for determination of resistance within the deposits. The sampler shall be driven using a 140-pound hammer with a vertical drop of 30-inches using 1 to 2 turns of the rope on the cathead. A certificate indicating exact weight may be required for documentation purposes. The number of hammer blows required for every 6 inches of penetration shall be recorded on the boring log.

4.3.4 The sampler shall be immediately opened upon removal from the casing. If the recovery is inadequate, another attempt shall be made before drilling progresses. Adequate recovery should be no less than 12 inches, not including any residual wash material brought up with the sample.

4.3.5 The sample shall be split if necessary, placed in the appropriate container, labelled, and placed in the storage box. The boring log and the sample container/label should contain the following information for each sample: site name, boring location, depth, blow counts, recovery, sample number and collection date. The type of material shall be indicated in the boring logs and will be described using the Unified Soil Classification System (ASTM: D2487-69 and D2488-69).

4.3.6 The sampler shall be cleaned with water between attempts in order to prevent cross-contamination. If further decontamination is required it will be conducted in accordance with ENSR SOP 7600, Decontamination of Equipment.

4.3.7 Proper procedures for delivery to the designated laboratory shall be initiated when all samples are collected. This includes packaging, shipping with sample logs, analysis request forms, and chain of custody forms. Refer to ENSR SOP 7510, Packaging and Shipment of Samples.

5.0 QUALITY CONTROL

Quality control requirements are dependent on project-specific circumstances and objectives. These requirements should be described in the Project Quality Assurance Plan.

6.0 DOCUMENTATION

Various forms are required to ensure that adequate documentation of each sample is followed and will include:

- Sample logs
- Boring logs
- Field Log Book entries
- Chain of custody forms
- Shipping forms

The Field Log Book will be kept as an overall log of all samples collected throughout the study. All documents are retained in the appropriate project files indefinitely. It is important that all field documentation be as complete as possible to ensure traceability (QA/QC requirements).

7.0 REFERENCES

Not applicable.

ENSR

BORING LOG

Sheet 1 of

Project No. ______ Date - Start ______ Finish ______ Boring ______

Project Name ______ Drilling Co. ______

Location ______ Drilling Method ______

Total Depth ______ Inspector ______ Reviewer ______

Remarks ______

Depth Feet	Sample				Graphic Log	Lithologic Description	Equipment Installed
	Type & No.	Blows per 6 in.	Depth Range	Rec.			

M880278

ENSR STANDARD OPERATING PROCEDURE

Number: 7130 **Date of Issue:** 2nd Qtr.1993

Revision: 2

Title: Ground-Water Sample Collection from Monitoring Wells

Organizational Acceptance	Authorization	Date
Originator	Christopher Carlio	3/13/84
Technical Reviewer	Arthur Lazarus	3/13/84
Technical Reviewer	Elaine Moore	3/13/84
Technical Reviewer		
Quality Assurance	Scott Whittemore	3/13/84

Revision #	Changes	Authorization	Date
1	• Addition of Equipment Checklists • The use of electronic sounding devices for water-level measurements has been removed • Unnecessary steps have been deleted from decontamination procedures • Volume requirements for ground-water purging has been changed from 4 - 10 to 3 - 10 volumes • Additional bailing details added • Additonal figures were added • Miscellaneous rewording	Scott Whittemore Charles Martin Elaine Moore	9/5/86 9/11/86 9/10/86
2	• Ground-Water Sample Collection Record, Chain-of-Custody and Sample Label form updates • Format update	Mike Dobrowolski	4/27/93

Organizational acceptance signatures are maintained on file with the original document in the Quality Assurance Library in Acton, MA.

Ground-Water Sample Collection from Monitoring Wells

Date: 2nd Qtr. 1993
Revision No: 2
Author: Christopher Carlio
Discipline: Geosciences

1.0 PURPOSE AND APPLICABILITY

This standard operating procedures (SOP) is concerned with the collection of valid and representative samples from ground-water monitoring wells. The scope of this document is limited to field operations and protocols applicable during ground-water sample collection.

2.0 RESPONSIBILITIES

The site coordinator or designee will have the responsibility to oversee and ensure that all ground-water sampling is performed in accordance with the project-specific sampling program and this SOP. In addition, the site coordinator must ensure that all field workers are fully apprised of this SOP. The field team is responsible for proper sample handling as specified in SOP 7510, Packaging and Shipment of Samples.

3.0 REQUIRED MATERIALS

The list below identifies the types of equipment which may be used for a range of ground water-sampling applications. From this list, a project-specific equipment list will be selected based upon project objectives, the depth to ground-water, purge volumes, analytical parameters and well construction. The types of sampling equipment are as follows:

- Purging/Sample Collection

  Bailers
  Centrifugal Pump
  Submersible Pump
  Peristaltic Pump

- Sample Preparation/Field Measurement

  pH Meter
  Specific Conductance Meter
  Filtration Apparatus

Water-Level Measurement Equipment

Additional equipment to support sample collection and provide baseline worker safety will be required to some extent for each sampling task. The additional material are separated into two primary groups: general equipment which is reusable for several samplings, and materials which are expendable.

- General

  Project-specific Sampling Plan
  Deionized-water dispenser bottle
  Decontamination Solvent-dispenser bottle
  Site-specific Health & Safety equipment (gloves, respirators, goggles)
  Field data sheets and/or log book
  Preservation solutions
  Sample containers
  Buckets and intermediate containers
  Coolers
  First-Aid kits

- Expendable Materials

  Bailer Cord
  Respirator Cartridges
  Gloves
  Water Filters
  Chemical-free paper towels
  Plastic sheets

Equipment checklists have been developed to aid in field trip organization and should be used in preparation for each trip.

- ENSR SOP 7131. Field Filtration of Water Samples for Inorganics

- ENSR SOP 7510, Packaging and Shipment of Samples

- ENSR SOP 7600, Decontamination of Equipment

4.0 METHOD

4.1 Water-Level Measurement

4.1.1 Prior to obtaining a water-level measurement, cut a slit in one side of a plastic sheet and slip it over and around the well, creating a clean surface onto which the sampling equipment can be positioned. This clean working area should be a minimum of eight feet square. Care will be taken not to kick, transfer, drop, or in any way let soil or other materials fall onto this sheet unless it comes from inside the well. Do not place meters, tools, equipment, etc. on the sheet unless they have been decontaminated.

4.1.2 Unlock and/or open the monitoring well. Enter a description of condition of the security system and protective casing on the Ground-Water Sample Collection Record shown in Figure 1.

4.1.3 Check for the measuring point for the well. The measuring point location should be clearly marked on the outermost casing or identified in previous sample collection records. If no measuring point can be determined, a measuring point should be established. Typically, the top (highest point) of the protective or outermost well casing will be used as the measuring point. The measuring point location should be described on the Ground-Water Sample Collection Record and should be the same point used for all subsequent sampling efforts.

4.1.4 To obtain a water-level measurement lower a decontaminated steel or fiberglass tape into the monitoring well. Care must be taken to assure that the water-level measurement device hangs freely in the monitoring well and is not adhering to the wall of the well casing. The water-level measuring tape will be lowered into the well until the audible sound of the unit is detected or the light on an electronic sounder illuminates. At this time the precise measurement should be determined (to hundredth of a foot) by repeatedly raising and lowering the tape to converge on the exact measurement. The water-level measurement as well as the point of measurement should be entered on the Ground-Water Sample Collection Record.

4.1.5 Decontamination

The measurement device shall be decontaminated prior to and immediately after use in accordance with ENSR SOP 7600. Decontamination of Equipment. Generally, only that portion of the tape which enters the water table should be cleaned. It is important that the measuring tape is never placed directly on the ground surface.

4.2 Purge-Volume Computation

All monitoring wells to be purged prior to sample collection. Depending upon the ease of purging, 3 to 10 volumes of ground water present in a well shall be withdrawn prior to sample collection or one volume if the well can be purged dry. The volume of water present in each well shall be computed based on the length of water column and well casing diameter. The water volume shall be computed using the volume factors or graph presented in Figure 2.

4.3 Well Purging

Purging must be performed for all ground-water monitoring wells prior to sample collection in order to remove stagnant water from within the well casing and ensure that a representative sample is obtained. The following sections explain the proper procedures for purging and collecting water samples from monitoring wells.

Three general types of equipment are used for well purging: bailers, surface pumps, or down-well submersible pumps.

In all cases pH and/or specific conductance will be monitored during purging. Field parameter values will be entered on the Ground-Water Sample Collection Record along with the corresponding purge volume.

4.3.1 Bailing

In many cases bailing is the most convenient method for well purging. Bailers are constructed using a variety of material: generally, PVC stainless steel, and Teflon®. Care must be taken to select a specific type of bailer that suits a study's particular needs. Teflon® bailers are generally most "inert" and are used most frequently. Keep in mind the diameter of each monitoring well so that the correct size bailers are taken to the site. It is preferable to use one bailer per well: however. field decontamination is a relatively simple task if required.

Bailing presents two potential problems with well purging. First, increased suspended solids may be present in samples as a result of the turbulence caused by raising and lowering the bailer through the water column. High solids concentrations may require that total suspended solids (TDS) and the chemical character of solids be evaluated during sample analyses. Second, bailing may not be feasible for wells which require that greater than twenty (20) gallons be removed during purging. Such bailing conditions mandate that long periods be spent during purging and sample collection or that centrifugal pumps be used. All ground-water collected from monitoring wells for subsequent volatile organic compounds analyses shall be collected using bailers, regardless of the purge method.

4.3.2 Surface Pumping

Ground-water withdrawal using pumps located at the ground surface is commonly performed with centrifugal or peristaltic pumps.

All applications of surface pumping will be governed by the depth to the ground-water surface. Peristaltic and centrifugal pumps are limited to conditions where ground water need only be raised through approximately 20 feet of vertical distance. The lift potential of a surface pumping system will depend upon the net positive suction head of the pump and the friction losses associated with the particular suction line, as well as the relative percentage of suspended particulates.

Surface pumping can be used for many applications of well purging and ground-water sample collection. In all cases, pumping cannot be used for the collection of samples to be analyzed for volatile organic compounds (VOCs).

- Peristaltic Pump

  Peristaltic pumps provide a low rate of flow typically in the range of 0.02-0.2 gallons/min (75-750 ml/min). For this reason, peristaltic pumps are not particularly effective for well purging. Peristaltic pumps are suitable for purging situations where disturbance of the water column must be kept minimal for particularly sensitive analyses. Peristaltic pumps are most often used in conjunction with field filtering of samples and therefore can be used to obtain water samples for direct filtration at the wellhead.

- Centrifugal Pump

  Centrifugal pumps are designed to provide a high rate of pumping, in the range of 10-40 gallons per minute (gpm), depending on pump capacity. Discharge rates can also be regulated somewhat provided the pump has an adjustable throttle.

  When centrifugal pumps are used, samples should be obtained from the suction (influent) line during pumping by an entrapment scheme (Figure 3). Construction of this sampling scheme is relatively simple and will not be explained as part of this SOP. It is suggested that if samples cannot be obtained before going through the pump, that samples be obtained by using a bailer once pumping has ceased. Collecting samples from the pump discharge is not recommended.

4.3.3 Submersible Pump

Submersible pumps provide an effective means for well purging and in some cases sample collection. Submersible pumps are particularly useful for situations where the depth to water table is greater than twenty (20-30) feet and the depth or diameter of the well requires that a large purge volume be removed during purging.

ENSR uses the Johnson-Keck pump model SP-81 which has a 1.75 inch diameter pump unit. The pump diameter restricts use to monitoring wells which have inside diameters equal to or greater than two (2) inches. As with other pump-type purge/sample collection methods. submersible pumps will not be used for the collection of samples for analyses of volatile organic compounds. Submersible pumps should never be used for well development as this will seriously damage the pump.

4.4 Sample Collection Procedures

4.4.1 Bailing

Obtain a clean/decontaminated bailer and a spool of polypropylene rope or equivalent bailer cord. Using the cord at the end of the spool, tie a bowline knot or equivalent through the bailer loop. Test the knot for security and the bailer itself to ensure that all parts are intact prior to inserting the bailer into the well.

Remove the protective foil wrapping from the bailer, and lower the bailer to the bottom of the monitoring well and cut the cord at a proper length. Boiler rope should never touch the ground surface at any time during the purge routine.

Raise the bailer by grasping a section of cord using each hand alternately in a "rocking" action. This method requires that the samplers' hands be kept approximately 2-3 feet apart and that the bailer rope is alternately looped onto or off each hand as the bailer is raised and lowered.

Bailed ground water is poured from the bailer into a graduated bucket to measure the purged water volume.

For slowly recharging wells, the bailer is generally lowered to the bottom of the monitoring well and withdrawn slowly through the entire water column. Rapidly recharging wells should be purged by varying the level of bailer insertion to ensure that all stagnant water is removed. The water column should be allowed to recover to 70-90% of its static volume prior to collecting a sample. Water samples should be obtained from midpoint or lower within the water column.

Samples collected by bailing will be poured directly into sample containers from bailers which are full of fresh ground water. During sample collection, bailers will not be allowed to contact the sample containers.

4.4.2 Peristaltic Pump

Place a new suction and discharge line to the peristaltic pump. Silicon tubing must be used through the pump head. A second type of tubing may be attached to the silicon tubing to create the suction and discharge lines. Such connection is advantageous for the purpose of reducing tubing costs, but can only be done if airtight connections can be made. Tygon tubing will not be used when performing well purging or collecting samples for organic analysis. The suction line must be long enough to extend to the static ground-water surface and reach further should drawdown occur during pumping.

Measure the length of the suction line and lower it down the monitoring well until the end is in the upper 2-5 inches of the water column present in the well. Start the pump and direct the discharge into a graduated bucket.

Measure the pumping rate in gallons per minute by recording the time required to fill a selected volume of a bucket. Flow measurement shall be performed three times to obtain an average rate.

The pumping shall be monitored to assure continuous discharge. If drawdown causes the discharge to stop, the suction line will be lowered very slowly further down into the well until pumping restarts.

Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record.

Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and specific conductance) have stabilized.

When the sample bottles are prepared, each shall be filled directly from the discharge line of the peristaltic pump. Care will be taken to keep the pump discharge line from contacting the sample bottles. Ground-water samples requiring filtration prior to placement in sample containers, will be placed in intermediate containers for subsequent filtration or filtered directly using the peristaltic pump.

At each monitoring point when use of the peristaltic pump is complete, all tubing including the suction line, pump head and discharge line must be disposed of. In some cases where sampling will be performed frequently at the same point, the peristaltic pump tubing may be retained between each use in a clean zip-lock plastic bag.

4.4.3 Centrifugal Pump

- Direct Connection Method (Note: This method requires that the well casing be threaded at the top.)

  Establish direct connection to the top of the monitoring well if possible using pipe connections, extensions, and elbows, with Teflon® tape wrapping on all threaded connections. If the centrifugal pump will subsequently be used for sample collection, a sample isolation chamber will be placed in the suction line configuration as shown in Figure 3.

  Prime the pump by adding tap water to the pump housing until the housing begins to overflow.

  Start the pump and direct the discharge into a graduated bucket or a bucket of known capacity (>2.5 gallons).

  Start the pump and measure the pumping rate in gallons per minute by recording the time required to fill the graduated bucket. Flow measurement should be checked periodically to determine if pumping rates are continuous, fluctuating, or diminishing. If discharge stops, the pump will be throttled back to determine if pumping will restart at a lower rate. If pumping does not restart, the pump should be shut off to allow the well to recharge.

Measurements of pH and specific conductance will be made periodically during well purging. All readings will be entered on the Ground-Water Sample Collection Record. Samples will be collected after the required purge volume has been withdrawn and the field parameters (pH and specific conductance) have stabilized. Samples should be collected from an in-line discharge valve or with a bailer. The pump should be properly decontaminated between wells.

- Down-Well Suction-Line Method

  Lower a new suction line into the well. The suction line will have a total length great enough to extend to the water table and account for a minimum of five (5) feet of drawdown. Note should be made that drawdown may exceed the depth where pumping will terminate as a result of a limitation derived from suction-line conditions and the lift potential of the pump. All connections should be made using Teflon® ferrules and Teflon® thread wrapping tape. Run the pump as per Section 4.4.3.

  At each monitoring well when use of a centrifugal pump is complete, all suction line tubing should be disposed of properly.

4.4.4 Submersible Pump

Prior to using a submersible pump, a check will be made of well diameter and alignment. A 1.75 inch diameter decontaminated cylindrical tube should be lowered to the bottom of each monitoring well to determine if the alignment or plumbness of a well is adequate to accommodate the submersible pump. All observations will be entered in the Ground-Water Sample Collection Record.

Slowly lower the submersible pump into the monitoring well taking notice of any roughness or restrictions within the riser.

Count the graduations on the pump discharge line and stop lowering when the stainless steel portion is below the uppermost section of the static water column within monitoring well. Secure the discharge line and power cord to the well casing.

Connect the power cord to the power source (i.e.. rechargeable battery pack or auto battery) and turn the pump on (forward mode). When running, the pump can usually be heard by listening near the well head.

Voltage and amperage meter readings on the pump discharge must be checked continuously. The voltage reading will decline slowly during the course of a field day representing the use of power from the battery. Amperage readings will vary depending upon the depth to water table. Amperage readings greater than 10 amps usually indicate a high solids content in the ground water which may cause pump clogging and serious damage. If a steady increase in amperage is observed, the pump should be shut off, allowed to stop, switched to the reverse mode, stopped again and then placed in forward mode. If high amperage readings persist, the pump should be withdrawn and checked using the large upright cylinder and tap water. Ground-water conditions such as high solids may require that an alternate purge/sample method be used.

Drawdown must also be monitored continuously by remaining near the well at all times and listening to the pump. When drawdown occurs, a metallic rotary sound will be heard as the pump intake becomes exposed and ceases to discharge water, but continues to run. The pump should be lowered immediately to continue pumping water within the uppermost section of the static water column.

NOTE: The submersible pump cannot be allowed to run while not pumping water for more than five seconds or the pump motor will burn out.

If drawdown continues to the extent that the well is pumped dry, the pump should be shut off and the well allowed to recharge. This on/off cycle may need to be repeated several times in order to purge the well properly.

Measurements of the pumping rate, pH, and specific conductance should be made periodically during well purging.

All readings and respective purge volumes should be entered on the Ground-Water Sample Collection Record.

While pumping is on-going and when sample bottles are prepared, bottles will be filled directly from the discharge line of the pump taking care not to touch sample bottles to the discharge line.

At each monitoring well when use of the submersible pump is complete, the pump, discharge line and power cord shall be decontaminated according to the procedures contained ENSR SOP 7600 Decontamination of Equipment.

4.5 Sample Preparation

4.5.1 Prior to sample collection or shipment, ground-water samples may require filtration and/or preservation dependent on the specific type of analysis required.

4.5.2 Specific preservation techniques are described in the EPA document, Handbook for Sampling and Sample Preservation of Water and Wastewater (EPA-600/4-82-029). The EPA manual and laboratory manager should be consulted during the planning stage of the project. Project-specific sampling plans shall be assembled using the approved procedures obtained from the EPA manual.

4.5.3 Filtration

Ground-water samples collected for dissolved metals analyses will be filtered prior to being placed in sample containers in accordance with ENSR SOP 7131, Field Filtration of Water Samples for Inorganics.

Ground-water filtration will be performed using a peristaltic pump and a 0.45 micron, water filter. Typically the water filters are 142 mm in diameter and are usually placed in 142 mm polycarbonate housings.

The filtration of ground-water samples shall be performed either directly from the monitoring well or from intermediate sample containers such as decontaminated buckets. In either case. well purging shall be performed first. Fresh ground water shall then be filtered and discharged from the filtration apparatus directly into sample containers.

For most dissolved metal analyses. pH adjustment of the sample is also required and shall be performed after filling the sample bottles. This is generally accomplished using laboratory supplied compounds such as sulfuric or nitric acid and sodium hydroxide. The preservative shall be identified in the Quality Assurance or Sampling Plan.

5.0 QUALITY CONTROL

Quality control requirements depend on project-specific circumstances and objectives and should be addressed in the Quality Assurance Project Plan (QAPP).

6.0 DOCUMENTATION

A number of different documents must be completed and maintained as a part of ground-water sampling effort. The documents provide a summary of the sample-collection procedures and conditions, shipment method, the analyses requested and the custody history. The list of documents is:

- Ground-water sample collection record
- Sample labels
- Chain of custody forms and tape
- Shipping receipts

Sample labels shall be completed at the time each sample is collected and will include the information listed below. A sample label is shown in Figure 4.

- Client or project name
- Sample number
- Designation (i.e., identification of sample point no.)
- Analysis

- Preservative (e.g., filtration, acidified pH<2 HNO_3)
- Sample-collection date
- Sampler's name

Figure 5 displays the chain of custody record used by ENSR. The chain of custody form is the record of sample collection and transfer of custody. Information such as the sample collection date and time of collection, sample identification and origination, client or project name shall be entered on each chain of custody record. In accordance with 40 CFR 261.4(d) the following information must accompany all ground water samples which are known to be non-hazardous and to which U.S. Department of Transportation and U.S. Post Office regulations do not apply. Such information is:

- sample collector's name, mailing address and telephone number,
- analytical laboratory's name, mailing address and telephone number,
- quantity of each sample,
- date of shipment, and
- description of sample.

The chain of custody forms provide a location for entry of the above-listed information.

7.0 REFERENCES

EPA. Handbook for Sampling and Sample Preservation of Water and Wastewater EPA-600/4-82-029, September 1982.

Geotrans, Inc. RCRA Permit Writer's Manual, Ground-Water Protection prepared for U.S. EPA. Contract No. 68-01-6464, October 1983.

Code of Federal Regulations, Chapter 40 (Section 261.4(d).

ENSR

WELL NO.

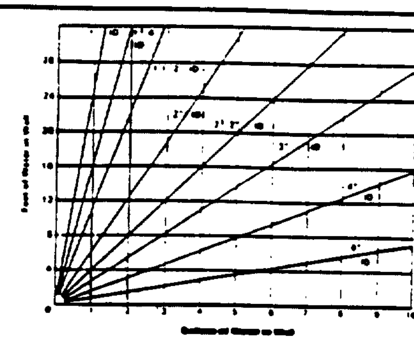
GROUND WATER SAMPLE COLLECTION RECORD

Project No. ______________ Date ________ Time: Start ________ am/pm

Project Name ______________ Finish ________ am/pm

Location ______________

Weather Conds.: ______________ Collector ______________



1. WATER LEVEL DATA: (measured from ToC)

a. Total Well Length ________ Well Casing Type ________

b. Water Table Depth ________ Casing Diameter ________

c. Length of Water Column ________ (a-b)

d. Calculated Purgeable Volume ________

2. WELL PURGEABLE DATA

a. Purge Method ______________

b. Required Purge Volume (@ ________ well volumes) ______________

c. Field Testing: Equipment Used ______________

Volume Removed	T°	PH	Spec. Cond.	Color	Other

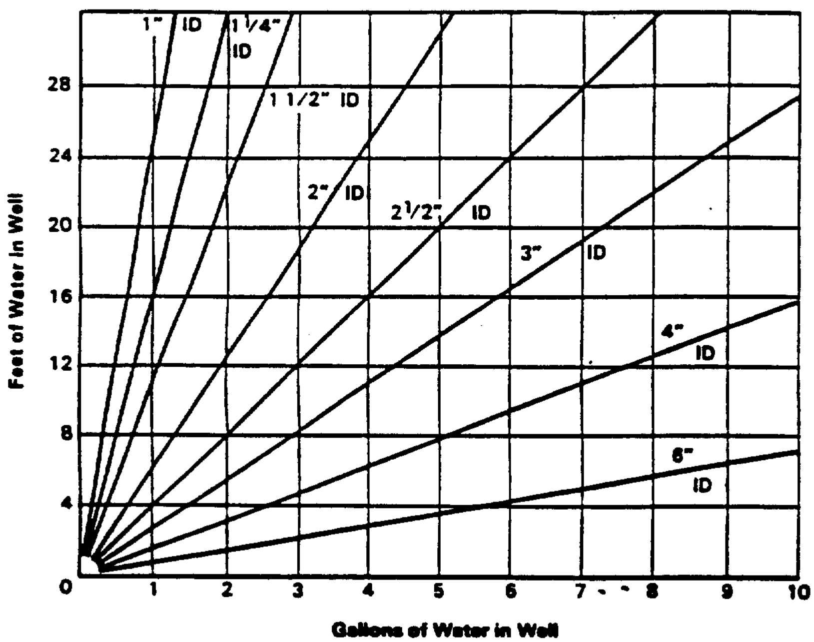
3. SAMPLE COLLECTION: Method ______________

Container Type	Preservation	Analysis Req.

Comments ______________

M880944

Figure 1

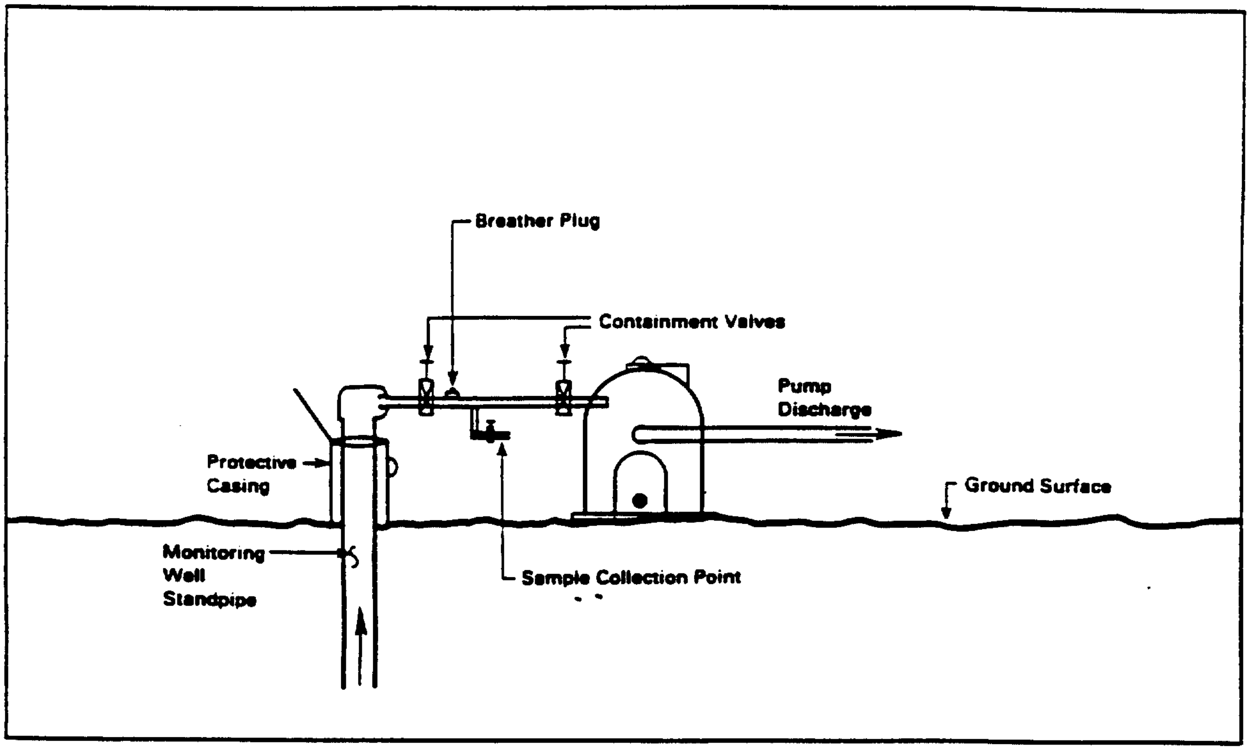


(a) Graphical Explanation

Volume/Linear Ft. of Pipe		
ID(in)	Gal	Liter
1/4	0.003	0.010
3/8	0.006	0.022
1/2	0.010	0.039
3/4	0.023	0.087
1	0.041	0.154
2	0.163	0.618
3	0.367	1.39
4	0.653	2.47
6	1.47	5.56

(b) Volume Factors

Figure 2 Purge Volume Computation



8403003

Figure 3   Down Well Suction Line Configuration

M910271

ENSR
ENSR Consulting and Engineering

SITE ________________ PROJECT# ______________

SAMPLE ID# ______________________________

ANALYSIS ________________________________

PRESERVATIVE: HNO_3, H_2SO_4, OTHER __________

DATE ____________________ TIME ______________

SAMPLER _________________________________

OTHER ___________________________________

Figure 4 Sample Container Label

MO0376

ENSR

CHAIN OF CUSTODY RECORD

Page ___ of ___

Client/Project Name:

Project Location:

Project Number:

Field Logbook No.:

Sampler: (Print Name) /Affiliation:

Chain of Custody Tape No.:

Signature

Send Results/Report to:

Analysis Requested

Field Sample No./ Identification	Date	Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	Field Filtered								Lab I.D.	Remarks

Relinquished by: (Print Name)	Date:	Received by: (Print Name)	Date:
Signature:	Time:	Signature:	Time:
Relinquished by: (Print Name)	Date:	Received by: (Print Name)	Date:
Signature	Time:	Signature:	Time:
Relinquished by: (Print Name)	Date:	Received by: (Print Name)	Date:
Signature:	Time:	Signature:	Time:

Analytical Laboratory (Destination):

Serial No. 6118

Figure 5 Sample Chain-of-Custody Record

ENSR

STANDARD OPERATING PROCEDURE

Number: 7220 **Date of Issue:** 2nd Qtr.1993

Revision: 3

Title: Monitoring Well Construction and Installation

Organizational Acceptance	Authorization	Date
Originator	Tim Cosgrave	3/23/89
Technical Reviewer	William Gregg	4/18/89
Technical Reviewer	Maury Veatch	5/2/89
Technical Reviewer		
Quality Assurance	Scott Whittemore	5/12/89

Revision #	Changes	Authorization	Date
2	Complete re-write	Tim Cosgrave	3/23/89
		William Gregg	4/18/89
		Maury Veatch	5/2/89
		Scott Whittemore	5/12/89
3	Format update	Mike Dobrowolski	4/27/93

Organizational acceptance signatures are maintained on file with the original document in the Quality Assurance Library in Acton, MA.

Monitoring Well Construction and Installation

Date: 2nd Qtr. 1993
Revision No: 3
Author: Tim Cosgrave
Discipline: Geosciences

1.0 PURPOSE AND APPLICABILITY

This SOP establishes the method for installing ground water monitoring wells. These wells will be installed to monitor the depth to ground water, to measure aquifer properties and to obtain samples of ground water for chemical analysis.

1.1 Quality Assurance Planning Considerations

The following aspects of monitoring well design and installation procedures will depend on project-specific objectives and circumstances and should be addressed in the Quality Assurance Project Plan (QAPP).

- Construction materials for well screen, riser, filter pack and seals;
- Borehole drilling method;
- Depth and length of screen;
- Location and composition of seals; and
- Well head completion and protection.

Some states and EPA Regions have promulgated comprehensive guidelines for monitoring well configuration and for subsurface investigation procedures. These guidelines will be followed as applicable and deviations from this SOP to accommodate those requirements will be explained in the QAPP.

1.2 Health and Safety Considerations

Monitoring well installation may involve chemical hazards associated with materials in the soil or aquifer being explored; and always involves physical hazards associated with the drill rig and well construction methods. When wells are to be installed in locations where the aquifer and/or overlying materials may contain chemical hazards, a Health and

Safety Plan must be prepared and approved by the Health and Safety Officer before field work commences.

In addition, the following protective measures are required:

- all persons within 50 feet of the drill rig must wear hard hats and safety shoes. Hearing protection must be provided during periods of excessive noise; and

- personnel who are not directly involved in overseeing, inspecting or performing the drilling and well installation will remain at least 100 feet away from the drill rig.

2.0 RESPONSIBILITIES

2.1 Project Manager

2.1.1 It is the responsibility of the Project Manager to ensure that each project involving monitoring well installation is properly planned and executed, and that the safety of personnel from chemical and physical hazards associated with drilling and well installation is protected.

2.1.2 Some states have specific requirements regarding the construction of monitoring wells. It is the responsibility of the Project Manager to understand these regulations and any permitting requirements that may be necessary, and to ensure that the well installation program complies with all state and local requirements.

2.2 Project Geologist/Engineer

It is the responsibility of the Project Geologist or Engineer to directly oversee the construction and installation of the monitoring well by the subcontract driller to ensure that the well-installation specifications defined in the project work plan are adhered to and that all pertinent data are recorded on the appropriate forms.

3.0 REQUIRED MATERIALS

3.1 The monitoring well shall consist of a commercially available well screen constructed of PVC, stainless steel, teflon, or fiberglass pipe of minimum

2-inch nominal diameter. The length of the screen and the size of the screen slots shall be determined by the inspecting geologist or specified in the project work plan depending upon the grain-size distribution of the aquifer materials. PVC, stainless steel, steel, teflon,or fiberglass riser pipe of minimum 2-inch nominal diameter shall be used to complete the monitoring well to ground surface. The riser pipe shall be connected by flush-threaded, coupled or welded watertight joints. No solvent or anti-seize compound shall be used on the joints.

3.2 The section of riser pipe that sticks up above ground shall be protected by a steel guard pipe set at least 2 feet into a concrete surface seal. The top of the guard pipe shall have a vented lockable cap. Alternatively, a road box may be installed, if it satisfies the security requirements of the project. Road-box installations must use a watertight seal inside of the riser pipe to prevent surface water from entering the well.

3.3 Other materials used for well construction include silica sand, bentonite, cement, and a calibrated tape for length measurements and water-level measurements. Construction materials are generally provided by the drilling subcontractor.

3.4 ENSR SOP 7221, Monitoring Well Development

4.0 METHOD

4.1 Borehole Requirements

The diameter of the borehole must be a minimum of 2 inches greater than the outside diameter of the well screen or riser pipe used to construct the well. This is necessary so that sufficient annular space is available to install filter packs, bentonite seals, and grout seals.

Rotary drilling methods requiring bentonite-based drilling fluids should be used with caution to drill boreholes that will be used for monitoring well installation. The bentonite mud builds up on the borehole walls as a filter cake and permeates the adjacent formation, significantly reducing the permeability of the material adjacent to the well screen.

If water or other drilling fluids have been introduced into the boring during drilling or well installation, samples of these fluids should be obtained and analyzed for chemical constituents that may be of interest at the site.

4.2 Procedure for Construction

4.2.1 After drilling and soil sampling have been completed. total open depth of the borehole shall be measured with a weighted, calibrated tape measure.

4.2.2 If the borehole has been advanced to a depth greater than that of the bottom of the well to be installed, bottom grouting, or bentonite pellet sealing, of the borehole will be required. A heavy plumb bob on a calibrated tape shall be used to determine the total depth of the boring. This depth measurement shall be used with the required bottom elevation of the well screen to calculate the thickness of the grout plug. If bottom grouting is necessary, then provisions should be made to support the screen and riser pipe to prevent them from sinking into the grout. The depth to the top of the grout should be checked often with a weighted tape measure.

4.2.3 The assembled screen and riser or its constituent parts shall be decontaminated with a detergent and water wash and triple deionized water rinse. Steam-cleaning also can be done to decontaminate the well materials. Decontaminated well components should be wrapped in plastic until installed in the boring. All personnel handling the decontaminated well components should exercise great care not to contaminate these components as they are installed in the borehole.

4.2.4 The well screen and riser pipe generally are assembled as they are lowered into the borehole. As the assembled well is lowered, care shall be taken to ensure that it is centered in the hole. In boreholes which are determined to be not plumb, centralizers should be used on the tail pipe below the screen and/or the midpoint and top of the screen. This will assure that the screened portion of the well is centrally located in the borehole with a uniform thickness of sand or filter pack between the screen and the borehole wall. In all holes greater than 25 feet in depth, centralizers should be used.

4.2.5 The annular space surrounding the screened section of the monitoring well and at least 1 foot above the top of the screen shall be filled with an appropriately graded, clean sand or gravel. In no case shall the sand pack be longer than 1.5

times the length of the screen. A minimum 1-foot thick layer of very fine sand (i.e.. sand-blasting sand) should be placed immediately above the well screen sand pack. This layer is designed to prevent the infiltration of sealing components (bentonite or grout) into the sand pack. As each layer is placed, a weighted tape should be lowered in the annular space to verify the depth to the top of the layer.

Depending on the depth of the well, the diameters of the borehole and well materials, and the depth to the static water level, satisfactory placement of the sand pack may require the use of a tremie pipe.

4.2.6 Bentonite seals, either pellets or slurry, a minimum of 2 feet thick shall be installed immediately above the artificial gravel pack in all monitoring wells. The purpose of the seal is to provide a barrier to vertical flow of water in the annular space between the borehole and the well. Bentonite is used because it swells significantly upon contact with water. Pellets generally can be installed in shallow boreholes by pouring them very slowly from the surface. If they are poured too quickly, they may bridge at some shallow, undesired depth. Powdered bentonite shall be installed by mixing a very thick slurry and using a tremie pipe to inject the seal material at the desired depth in the borehole. Bentonite slurry should be pumped into the annular space using a side-discharge tremie pipe located about 2 feet above the fine-sand pack. Side discharge will ensure the integrity of the sand pack.

In situations where the monitoring well screen straddles the water table, the seal will be in the unsaturated zone and pure bentonites (pellets or powder) will not work effectively as seals due to dessication. Seals in this situation should be a cement/bentonite mixture containing 2 to 10 percent bentonite by weight. This type of mixture shall be tremied to the desired depth in the borehole.

4.2.7 The remaining length of borehole shall be backfilled with grout to within 2 feet of the ground surface. This grouting will consist of a cement/bentonite mixture. A tremie pipe shall be used to install the grout. Drill cuttings, even those known not to be contaminated, shall not be used as backfill material.

4.2.8 The steel guard-pipe shall be placed around the riser, and the borehole around the guard pipe shall be dug out to approximately a 1-foot radius to a depth of 2 feet, and filled with concrete. The concrete pad shall be sloped so that drainage occurs away from the well. All completed wells will have identification numbers clearly painted on the cap and guard pipe with bright colored paint.

Generally, the protective guard pipe will be lockable. A point on the top of the riser pipe will be marked (paint spot or cut notch) to indicate the surveyed elevation position, known as the "measuring Point" (MP).

A vent hole must be installed in the protective casing in an area that is protected from precipitation. Road box installations should not be vented.

4.2.9 Measure the depth to the stabilized water level and record on the ground water monitoring well detail report (Figure 1).

4.2.10 At some point after installation of a well and prior to use of the well for water level measurements or water quality samples, development of the well shall be undertaken in accordance with ENSR SOP 7221, Monitoring Well Development.

5.0 QUALITY CONTROL

5.1 The borehole will be checked for total open depth, and extended by further drilling or shortened with a grout plug, if necessary, before any well construction materials are placed.

5.2 Water level will be checked repeatedly during well installation to ensure that the positions of well screen, sand pack and seal, relative to water level, conform to project requirements.

5.3 The depth to the top of each layer of packing (i.e., sand, bentonite, grout, etc.) will be verified and adjusted if necessary to conform to the requirements of this SOP and the QAPP before the next layer is placed.

5.4 If water or other drilling fluids have been introduced into the boring during drilling or well installation, samples of fluids should be obtained and analyzed for chemical constituents that may be of interest at the site.

6.0 DOCUMENTATION

During installation of each monitoring well, a series of measurements shall be taken and recorded. These measurements shall include:

- length of tail pipe (if used)
- length of screen
- length of riser pipe
- total length of well
- depth to stabilized water level

Other data include the screen and riser pipe materials, diameters of the respective components, screen slot size, type and thickness of the sand pack, thicknesses and different types of grouting materials, and elevation of the top of the guard pipe, established measuring point, and ground surface after surveying is complete.

All data shall be recorded on site onto the ground water monitoring well detail report (Figure 1) and all wells shall be referenced onto the appropriate site map. A Field Log Book and/or boring log can be used as additional means of recording data. In no case shall the Field Log Book or boring log take the place of the ground water monitoring well detail report. All documentation shall remain in the project files indefinitely.

7.0 REFERENCES

Not applicable.

APPENDIX

Annulus: The space between the borehole wall and the outside of the well screen or riser pipe.

Filter Pack: A well-graded, clean sand or gravel placed around the well screen to prevent the entry of very fine soil particles.

Grout Plug: A cement/bentonite mixture use to seal a borehole that has been drilled to a depth greater than the final depth at which the monitoring well is to be installed.

Guard Pipe: A pipe, usually made of steel, placed around that portion of the well riser pipe that extends above the ground surface. As well as providing security to a well, it may provide a fixed elevation for surveying.

Riser Pipe: The section of unperforated well construction material used to connect the well screen with the ground surface. Frequently it is made of the same material and has the same diameter as the well screen.

Road Box: A man-hole set into the ground around a well installation. Usually constructed in areas where the monitoring well cannot extend above the ground surface for traffic or security reasons.

Tremie Pipe: A small diameter pipe that will fit in the annulus and is used to inject filter sands, seal materials, or cement/bentonite grout under pressure.

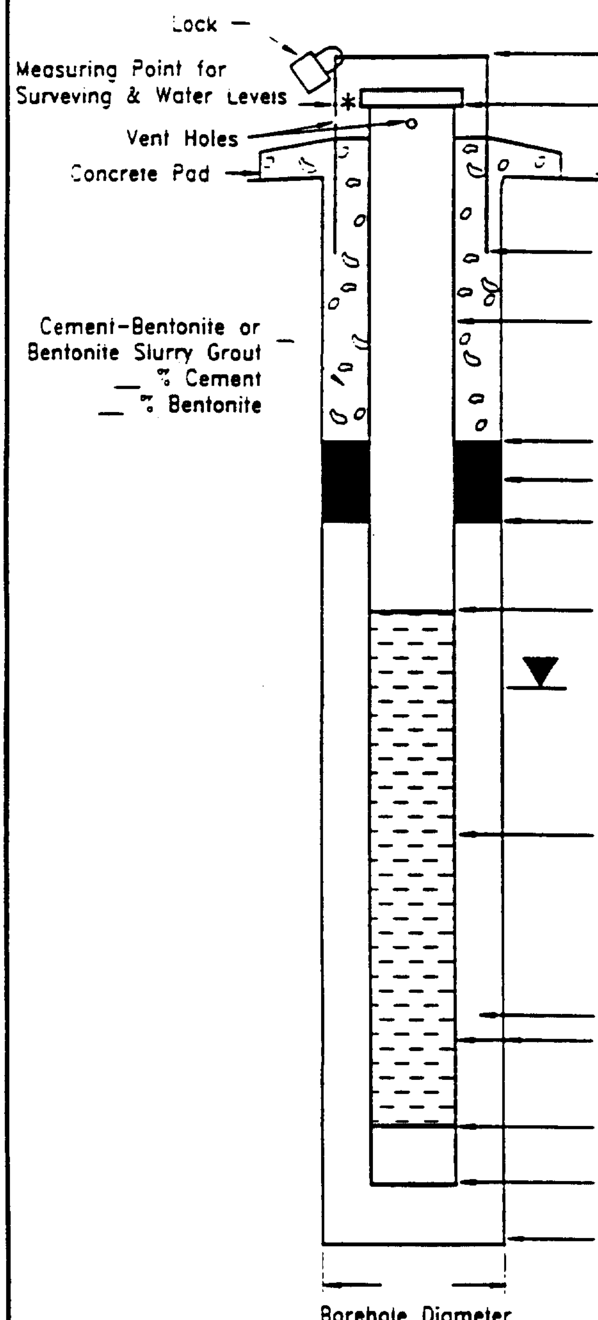
Well Screen: That portion of the well casing material that is perforated in some manner so as to provide a hydraulic connection to the aquifer. Typically a well screen has slots but holes, slits, louvers, and other perforations can, in some situations, be used.

Project No: ____________ Client: ____________ Site: ____________ **WELL No:**

Well Location: ____________ Date Installed: ____________

Contractor: ____________ Method: ____________ Inspector: ____________

MONITORING WELL CONSTRUCTION DETAIL



	Depth from G.S. (feet)	Elevation (NGVD)
Top of Steel Guard Pipe	______	______
Top of Riser Pipe	______	______
Ground Surface (G.S.)	0.00	______
Bottom of Steel Guard Pipe	______	______
Riser Pipe: Length ______ Inside Diameter (ID) ______ Type of Material ______		
Top of Bentonite Seal	______	______
Bentonite Seal Thickness ______		
Top of Sand	______	______
Top of Screen	______	______
Stabilized Water Level	______	______
Screen: Length ______ Inside Diameter (ID) ______ Slot Size ______ Type of Material ______		
Type/Size of Sand ______		
Sand Pack Thickness ______		
Bottom of Screen	______	______
Bottom of Tail Pipe: Length ______	______	______
Bottom of Borehole	______	______

Approved:

* Describe Measuring Point: ____________

____________ Signature ____________ Date

ENSR.

ENSR

STANDARD OPERATING PROCEDURE

Number: 7221 **Date of Issue:** 2nd Qtr.1993

Revision: 1

Title: Monitoring Well Development

Organizational Acceptance	Authorization	Date
Originator	Tim Cosgrave	3/23/89
Technical Reviewer	William Gregg	4/18/89
Technical Reviewer	Maury Veatch	5/2/89
Technical Reviewer		
Quality Assurance	Scott Whittemore	5/12/89

Revision #	Changes	Authorization	Date
1	Format update	Mike Dobrowolski	4/27/93

Organizational acceptance signatures are maintained on file with the original document in the Quality Assurance Library in Acton, MA.

ENSR Consulting and Engineering

Monitoring Well Development

Date:	2nd Qtr. 1993
Revision No:	1
Author:	Tim Cosgrave
Discipline:	Geosciences

1.0 PURPOSE AND APPLICABILITY

1.1 This SOP describes the methods used for developing monitoring wells after original installation and prior to use of the well for obtaining water level measurements or water quality samples. Development should not be confused with purging, the purpose of which is to evacuate the monitoring well system of stagnant water which may not be representative of the aquifer. For purging procedures refer to ENSR SOP 7130, Ground-Water Sample Collection from Monitoring Wells.

1.2 Monitoring well development and/or rehabilitation are necessary to ensure that complete hydraulic connection is made and maintained between the well and the aquifer material surrounding the well screen and packing materials. Development is necessary after original installation of a monitoring well to (1) reduce the compaction and inter-mixing of grain sizes produced during drilling; (2) to increase the porosity and permeability of the artificial filter pack by removing the finer grain-size fraction introduced near the screen by drilling and well installation; and (3) to remove any foreign drilling fluids that coat the borehole or that may have invaded the adjacent natural formation.

1.3 This procedure applies to monitoring wells in which siltation has been determined to have occurred. After a well has been installed for some period of time (ranging from months to years), siltation of the well may occur and rehabilitation will be necessary to re-establish complete hydraulic connection with the aquifer.

1.4 Health and Safety Considerations

Monitoring well development may involve chemical hazards associated with materials in the soil or aquifer being explored; and always involves physical hazards associated with the heavy equipment that may be used for various development techniques. When wells are to be installed and developed in locations where the aquifer and/or overlying materials may contain chemical hazards, a Health and Safety Plan must be prepared and approved by the Health and Safety Officer before field work commences.

1.5 Method Selection

The appropriate development method will be selected for each project on the basis of the circumstances. objectives and requirements of that project. Further. some states and EPA regions have promulgated comprehensive guidelines for ground water monitoring and subsurface investigation procedures. The provisions of this SOP will be adapted to these project-specific requirements in the Quality Assurance Project Plan (QAPP). Each QAPP will describe the specific method(s) to be used and the rationale, including trade-offs associated with the nature of the aquifer formation, chemical analytical objectives. and client or agency requirements.

1.6 Purge Water and Sediment Disposal

The QAPP must specify the means for disposing of purged sediment-laden water. In most cases. disposal of this material will follow the methods used in the original installation of the borehole. If soil and/or ground water contamination conditions in a well have changed, it may be necessary to specify new disposal methods for wells that are being re-developed.

2.0 RESPONSIBILITIES

Development of new monitoring wells is the responsibility of the geologist or hydrogeologist involved in the original installation of the well. The geologist may, in fact, contract with the well driller to develop new wells under the geologist's guidance and oversight. Records of well development methods and results are to be kept by the geologist.

Any person using existing monitoring wells for any purpose is responsible for verifying the original well construction details and determining if a well requires rehabilitation.

3.0 REQUIRED MATERIALS

The following list identifies the types of equipment which may be used to develop monitoring wells. Exact equipment needs will be well-specific and will depend upon the diameter of the well. the depth to the static water level and other factors such as project objectives.

3.1 Surge Block

A surge block consists of a rubber (or leather) and metal plunger attached to rod or pipe of sufficient length to reach the bottom of the well. Well drillers usually can provide surge blocks for large diameter wells (greater than 6 inches). Surge blocks for smaller diameter wells can be constructed easily of materials readily accessible in any hardware store. A recommended design is shown in Figure 1. To reduce cross-contamination of monitoring wells, a new plunger generally is used in each well to be developed and the rod is decontaminated in accordance with procedures in ENSR SOP 7600, Decontamination of Equipment.

3.2 Pump

A pump is necessary to remove large quantities of silt-laden ground water from a well after using the surge block. In some situations, the pump alone is used to both surge the well and remove the fines. Since the purpose of well development is to remove suspended solids from a well, the pump must be capable of moving some solids without damage. The preferred pump is a centrifugal because of its ability to pump solids. but a centrifugal pump will work only where the depth to static ground water is less than approximately 25 feet. In deep ground water situations, a positive-displacement pump such as a submersible or bladder pump will be necessary.

3.3 Bailer

A bailer is to be used to purge silt-laden water from wells after using the surge block. In some situations, the bailer can be used to surge a well but the use of a bailer for surging is not recommended. The bailer is to be used for purging in situations where the depth to static water is greater than 25 feet and the silt loading is greater than that which can be handled by positive-displacement pumps.

3.4 Compressed Gas

Compressed gas, generally nitrogen, can be used to both surge and purge a monitoring well. A nitrogen tank is used to inject gas at the bottom of the water column, driving sediment-laden water to the surface. Compressed gas can also be used for "jetting" - a process by which the gas is directed at the slots in the well screen to cause turbulence (thereby disturbing fine materials in the adjacent filter pack). Compressed gas is not limited to any depth range.

The hose or pipe which will be installed in the well for jetting should be equipped with a horizontal (side) discharge nozzle and one or more small holes in the bottom of the hose to enhance the lifting of sediment during jetting.

Since the compressed gas will be used to "lift" water from the monitoring well, provisions must be made for controlling the discharge from contaminated wells. This is generally accomplished by attaching a "tee" discharge to the top of the casing and providing drums to contain the discharged water. Gas-lifting must never be done in contaminated wells without providing discharge control apparatus.

3.5 Decontamination Equipment

Standard equipment for decontaminating field apparatus in accordance with ENSR SOP 7600 will be used to decontaminate all equipment used to develop monitoring wells.

3.6 Monitoring Well Construction Details

A copy of the original Monitoring Well Construction Detail form for the well to be developed must be obtained from the project manager. This form provides critical information regarding the construction of the monitoring well and must be in the possession of the well development crew so that pertinent well construction details, such as total depth, are known.

3.7 Supporting ENSR SOPs

- 7130 - Ground-Water Sample Collection from Monitoring Wells
- 7220 - Monitoring Well Construction and Installation
- 7600 - Decontamination of Equipment

- 7720 - Rising-Head/Falling-Head Permeability Testing

4.0 METHOD

4.1 General Procedure

4.1.1 Conduct a permeability test as described in ENSR SOP 7720 to determine the hydraulic conductivity of the screened interval. The results of this test, along with other tests conducted during the development process, will be used to evaluate the success of the development.

4.1.2 Water is caused to move in and out through the monitoring well screen to move silt and clay particles out of the filter pack around the well screen and into suspension within the well. Water movement is effected using a surge block, bailer, or a compressed gas. In some situations, pumping water may effect satisfactory development, but pumping alone is not generally recommended.

4.1.3 The sediment-laden water is removed from the monitoring well using a pump, bailer, or air compressor.

4.1.4 Surging of the well is continued until the water removed is essentially free of suspended silt and clay particles. During the surging/purging cycles, a permeability test should be performed as described in ENSR SOP 7720 to monitor and evaluate the development process.

4.1.5 Generally, a permeability test as described in ENSR SOP 7720 is used to confirm that a reliable hydraulic connection has been established (or re-established) between the well and the surrounding aquifer material.

4.2 Selection of a Specific Procedure

The construction details of the well can be used to initially define the method of purging a well with due consideration being given to the level of contamination.

The criteria for selecting a well development method include well diameter, total well depth, static water depth, screen length, the likelihood and level of contamination, and the type of geologic formation adjacent to the screened interval.

The limitations, if any, of a specific procedure are discussed within each of the following procedures.

Methods that involve placing water into the well may be objectionable to some state and federal agencies. In such cases the surge block procedure may be preferable over the pumping procedure.

4.3 Specific Procedure: Surge Block

4.3.1 A surge block effectively develops most monitoring wells. if the geologic layering in the screened interval includes permeable and impermeable layers (e.g., gravels and clays), it is possible that surging could remove fines from the impermeable layers and force them into the permeable layers. This problem can be minimized by using fewer surging cycles, using a surge block which is looser fitting and/or increasing the purging volume or time of development.

4.3.2 Construct a surge block using the design in Figure 1 as a guide. Specific materials will depend upon the diameter of well to be developed. The diameter of the flexible rings must be sufficient to cause a tight seal within the well casing, and the rods must be of sufficient length to reach to the bottom of the monitoring well.

4.3.3 Insert the surge block into the well and lower it slowly to the level of static water. Start the surge action slowly and gently above the well screen using the water column to transmit the surge action to the screened interval. A slow initial surging, using plunger strokes of 3 to 5 feet, will allow material which is blocking the screen to separate and become suspended.

4.3.4 After a number (5 to 10) of plunger strokes, remove the surge block and purge the well using a pump or bailer. The returned water should be heavily laden with suspended silt and clay particles. As development continues, slowly increase the depth of surging to the bottom of the well screen. For monitoring wells with long screens (greater than 10 feet) surging should be undertaken along the entire screen length in short intervals (2 to 3 feet) at a time.

4.3.5 Continue this cycle of surging and purging until the water yielded by the well is free of visible suspended material.

4.4 Specific Procedure: Pump

4.4.1 Well development using only a pump is most effective in those monitoring wells that will yield water continuously. Effective development cannot be accomplished if the pump has to be shut off to allow the well to recharge.

4.4.2 Set the intake of the pump in the center of the screened interval of the monitoring well.

4.4.3 Pump a minimum of three well volumes of water from the well while using the intake hose of the pump as a plunger. The motion of the intake hose will act to a limited extent as a surge block.

4.4.4 Occasionally, where appropriate, use the pump to fill the monitoring well to the top of the casing and allow the water level to decline to the static level, thereby forcing water back into the formation. This action will cause water to exit the well screen and reduce the bridging of materials caused by water flowing in one direction through the well screen while pumping.

The water used to fill the monitoring well should be the same water removed from the well during the previous pumping cycle. The sediment previously pumped from the well must be removed from the water prior to re-introduction to the well. A steel drum can be used as a sediment-settling vessel.

4.4.5 Continue pumping water into and out from the well until sediment-free water is obtained.

4.5 Specific Procedure: Bailer

4.5.1 Lower the bailer into the screened interval of the monitoring well.

4.5.2 Using long, slow strokes, raise and lower the bailer in the screened interval simulating the action of a surge block.

4.5.3 Periodically bail standing water from the well to remove silt and clay particles drawn into the well.

4.5.4 Continue surging the well using the bailer and bailing water from the well until sediment-free water is obtained.

4.6 Specific Procedure: Compressed Gas (Nitrogen)

4.6.1 Although the equipment used to develop a well using this method is more difficult to handle and use, well development using compressed gas for jetting is considered to be a very effective method. This method also is the most generally applicable because it is not limited by well depth, well diameter or depth to static water, but caution must be exercised in highly permeable formations not to inject gas into the formation.

4.6.2 Lower the gas line from the gas cylinder into the well, setting it near the bottom of the screened interval. Install the discharge control equipment at the well head.

4.6.3 Set the gas flow rate to allow continuous discharge of water from the well. The discharge will contain suspended clay and silt material.

4.6.4 At intervals during gas-lifting, especially when the discharge begins to contain less suspended material, shut off the air flow and allow the water in the well to flow out through the screened interval to disturb any bridging that may have occurred. Re-establish the gas flow when the water level in the well has returned to the pre-development level.

4.6.5 Jetting of the screened interval also can be done during gas-lifting of water and sediment from the well. This is accomplished by using a lateral-discharge nozzle on the gas pipe or hose and slowly moving the nozzle along the length of the screened interval. Jetting should be done beginning at the bottom of the well screen and moving slowly upwards along the screened interval. To enhance gas lifting of sediment.

occasionally raise the discharge nozzle into the cased portion of the well and discharge sediment-laden water.

4.6.6 Continue gas-lifting and/or jetting until the water returned in the air stream is free from suspended material.

5.0 QUALITY CONTROL CHECKS

A well has been successfully developed when one or more of the following criteria are met:

- the well yields only clear, sediment-free water.
- two or more permeability tests in accordance with ENSR SOP 7720 yield repeatable hydraulic conductivity values.
- the original depth of the well, as described on the Monitoring Well Construction Detail form in ENSR SOP 7220, is clear of sediment and that depth is maintained for some period of time (longer than hours, probably less than one year).

6.0 DOCUMENTATION

The Monitoring Well Development Record (Figure 2) will be completed by the geologist or hydrogeologist conducting the development. In addition, a Field Log Book should be maintained detailing any problems or unusual conditions which may have occurred during the development process. Any in ability to return the well to the original specifications will be noted on the original copy of the Monitoring Well Construction Detail form and on the Monitoring Well Development Record.

All documentation will be retained in the project files following completion of the project.

7.0 REFERENCES

Not applicable.

APPENDIX

Bridging: A condition within the filter pack outside the well screen whereby the smaller particles are wedged together in a manner that causes blockage of pore spaces.

Hydraulic Conductivity: a characteristic property of aquifer materials which describes the permeability of the material to a particular fluid (usually water).

Hydraulic Connection: A properly installed and developed monitoring well should have a complete hydraulic connection with the aquifer. The well screen and filter material should not provide any restriction to the flow of water from the aquifer to the well.

Permeability Test: Used to determine the hydraulic conductivity of the aquifer formation near a well screen. Generally conducted by displacing the water level in a well and monitoring the rate of recovery of the water level as it returns to equilibrium. Various methods of analysis are available to calculate the hydraulic conductivity from these data.

Screened Interval: That portion of a monitoring well that is open to the aquifer.

Static Water Level: The water level in a well that represents an equilibrium condition when the aquifer is not being stressed (no nearby withdrawal or injection of water). Since the ground water conditions are generally dynamic. static is a condition that holds true only for short periods of time (anywhere from minutes to years depending on cultural and climatic influences).

Well Surging: That process of moving water in and out of a well screen to remove fine sand, silt and clay size particles from the adjacent formation.

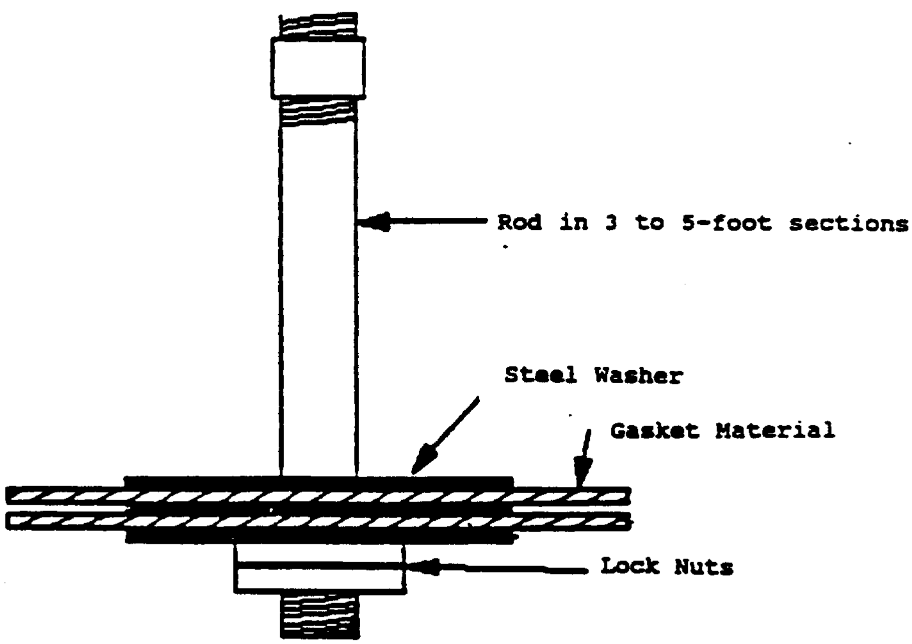
Well Purging: The process of removing water from a well to allow in situ formation water to enter the well. Generally thought of in terms of removing standing water from a well prior to the collection of water samples for quality determination, the process also is conducted to remove suspended particles from the well after well surging.

Well Screen: That portion of the well casing material that is perforated in some manner so as to provide a hydraulic connection to the aquifer. Typically a well screen has slots but holes. slits. louvers. and other perforations can. in some situations. be used.

Figure 1

SURGE BLOCK DESIGN

Steel washers should be 1/2" to 3/4" smaller diameter than the well ID. Gasket can be rubber or leather and should be the same diameter or 1/8" smaller than the well diameter to compensate for swelling of the leather. Rod can be steel, fiberglass, or plastic but must be strong and lightweight.



NOT TO SCALE

ENSR CONSULTING & ENGINEERING

Figure 1
Surge Block Design

TMC 11/10/88 SOP 7221

Figure 2

ENSR

MONITORING WELL DEVELOPMENT RECORD

DATE: ______________________ WELL I.D.: ______________________

PROJECT NAME: ______________________ LOCATION: ______________________

PROJECT NUMBER: ______________________ DEVELOPER: ______________________

☐ ORIGINAL DEVELOPMENT ☐ REDEVELOPMENT ORIGINAL DEVELOPMENT DATE: __________

WELL DATA

Well Diameter	
Total Well Depth	
Depth to Top of Screen	
Depth to Bottom of Screen	
Depth to Static Water Level	

Geology at Screened Interval	
Likely Contaminants	
Purge Water and Sediment Disposal Method	

DEVELOPMENT METHOD	PURGING METHOD	PERMEABILITY TEST RESULTS

ACCEPTANCE CRITERIA

Signature ______________________ Date __________

M890322

STANDARD OPERATING PROCEDURE

Number: 7315 **Date of Issue:** 2nd Qtr.1993

Revision: 2

Title: Operation/Calibration of the HNU Photoionization Analyzer

Organizational Acceptance	Authorization	Date
Originator	Charles Martin	3/13/84
Technical Reviewer	Arthur Lazarus	3/13/84
Technical Reviewer	Elaine Moore	3/13/84
Technical Reviewer		
Quality Assurance	Scott Whittemore	3/13/84

Revision #	Changes	Authorization	Date
1	Complete re-write	Scott Whittemore	5/1/87
		Charles Martin	5/6/87
		Elaine Moore	5/6/87
2	Format update	Mike Dobrowolski	4/27/93

Organizational acceptance signatures are maintained on file with the original document in the Quality Assurance Library in Acton, MA.

ENSR ENSR Consulting and Engineering

Operation/Calibration of HNU Photoionization Analyzer

Date: 2nd Qtr. 1993

Revision No: 2

Author: Charles Martin

Discipline: Geosciences

1.0 PURPOSE AND APPLICABILITY

1.1 This document describes the procedures necessary for operation and calibration of the HNU Photoionization Analyzer. The HNU is primarily used by ENSR personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

Personnel responsible for using the HNU should first read and thoroughly familiarize themselves with the instrument instruction manual.

1.2 Principle of Operation

The HNU is a non-specific vapor/gas detector. The hand-held probe houses a photoionization detector (PID), consisting of an ultraviolet (UV) lamp and two electrodes, and a small fan which pulls ambient air into the probe inlet tube. All organic and inorganic vapor/gas compounds having ionization potentials (IP) lower than the energy output of the UV lamp are ionized; and the resulting potentiometric change is seen as a needle deflection, proportional to vapor concentration, on the potentiometer of the readout/control box.

1.3 Specifications

Detection range*:	0.1 to 2,000 ppm.
Linear range*:	0.1 to 400 ppm.
Response time:	3 seconds to 90% full scale deflection.
Operating temperature:	-10°C to 40°C.
Operating time on battery, continuous use, without recorder:	approximately 10 hours: at lower temperatures time is reduced.

Recharge from full discharge: full recharge 12-14 hours.

*When equipped with 10.2 eV probe with SPAN set at 9.8 and measuring benzene. Values may vary for other compounds and conditions.

1.4 Health and Safety Considerations

Only photoionization analyzers stamped Division I Class I may be used in explosive atmospheres. Refer to the project Health & Safety plan for instructions pertaining to instrument use in explosive atmospheres.

2.0 RESPONSIBILITIES

2.1 It is the responsibility of the Project Manager to ensure that the necessary equipment is available and that field personnel are adequately trained in its use.

2.2 It is the responsibility of the field operator to calibrate and operate the HNU in accordance with the requirements of this procedure.

3.0 REQUIRED MATERIALS

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated.
- Regulator for calibration gas cylinder
- Approximately 3-4 feet of teflon tubing
- "Magic Marker"

4.0 METHOD

4.1 Preliminary Steps

4.1.1 Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

4.1.2 The sensor probe is carried separately in the instrument carrying case. For most safety and survey work. the 10.2 eV probe is used, as it detects more compounds than the 9.5 eV probe and is more durable than the 11.7 eV probe. Unclamp the cover from the readout/control box and remove the inner lid from the cover. Screw the inlet tube onto the sensor probe. Attach the probe cable plug to the 12 pin keyed socket on the readout panel by matching the alignment slot in the plug to the key in the connector, and screwing down the probe connector until a distinct snap and lock is felt.

4.1.3 Turn the function switch to the BATT (battery check) position. The meter needle will deflect to the green zone if the battery is fully charged. If the needle is below the green arc or if the low battery indictor comes on, the battery must be recharged (Section 4.5) before the analyzer is used.

4.2 Operation

4.2.1 Turn the function switch to the appropriate range. Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify that the UV lamp is on by briefly looking into the probe from a distance greater than six inches to observe a purple glow.

WARNING:Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

4.2.2 At the beginning of each day, check the calibration (Section 4.3) and make adjustments if necessary. Record the calibration information in the Field Log Book.

4.2.3 The instrument is now operational. Readings should be taken on the lowest possible scale and recorded in the Field Log Book.

4.2.4 When the HNU is not being used or between monitoring intervals, the function switch should be set on the STANDBY position to conserve battery power and UV lamp life.

4.2.5 At the end of each day, recheck calibration (Section 4.3) and record the information in the Field Log Book.

4.2.6 To shutdown the HNU, turn the function switch to OFF.

4.2.7 Recharge the battery after each use (Section 4.5).

4.2.8 When transporting, disconnect the probe cable connector from the control panel and return the instrument to its stored condition.

4.3 Calibration Procedures

4.3.1 For measurement on the 0-20 ppm or 0-200 ppm ranges only one calibration gas standard is required. Calibration on the 0-200 ppm range will provide accurate values on the 0-20 ppm range as well.

4.3.2 Connect the probe tip to the gas cylinder regulator, observing safety precautions. A t-fitting and plastic tubing can be used to ensure that the gas is delivered to the probe at atmospheric pressure (Figure 1). Adjust the regulator so that the gas is delivered at 150-200 cubic centimeters per minute. The fan inside the probe draws approximately 100 cc/min.

4.3.3 Set the function switch to the proper range setting, based on the calibration gas used, and record the meter reading in the Field Log Book. Also record the calibration gas composition and concentration, the date and the time.

4.3.4 If the adjustment is necessary, turn the span as required to read the ppm concentration of the gas standard, or the equivalent concentration of benzene if the HNU is being calibrated to benzene.

4.3.5 Recheck the zero setting. If readjustment of the zero setting is necessary, repeat the span adjustment. Record the span setting and the new meter reading. Whenever the span is changed, the zeroing procedure should be repeated.

4.3.6 If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 4.4).

4.3.7 Alternate Calibration Technique. It may be more convenient in certain circumstances to employ the use of a Tedlar bag filled with calibrant instead of a calibration cylinder. In that case, the bag (usually 3-10 liter capacity) should be filled with the appropriate calibrant and brought to the HNU. The HNU probe should be connected to the discharge fitting on the bag using a piece of flexible tubing. Allow the HNU to draw the calibrant from the bag and follow the instructions as indicated in 4.3.3 and 4.3.4.

4.4 Probe Cleaning

4.4.1 During periods of operation, moisture, dust, or other foreign matter can be drawn into the probe and form deposits on the surface of the UV lamp and ion chamber. This causes interference with the ionization process and produces erroneous readings. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, or drifting. In most cases, the following field cleaning procedure is sufficient to correct this condition.

4.4.2 Turn the function switch to the OFF position. Disconnect the probe cable connector at the readout panel. Unscrew the probe inlet tube from the end cap and clean the inside of the tube making sure that the tube is dry and lint-free when finished. A pipe cleaner or a kim-wipe and piece of wire can be used. Keeping the probe upright, remove the two screws holding the end clamp in place and remove the cap and ion chamber. Place one hand over the top of the lamp housing and tilt slightly. The light source will slide out of the housing. Take care not to lose or misplace o-rings or other parts. Do not touch the internal parts of the probe, particularly the UV lamp, with the bare hand during cleaning or reassembly. Surgical gloves are recommended. Clean the internal parts with a non-abrasive, lint-free paper towel (e.g., kim-wipe) and reassemble the probe.

4.5 Battery Charging

4.5.1 The battery charger is stored inside the instrument cover. To charge the battery, first insert the mini plug of the charger into the jack on the side of the meter, with the function switch in the OFF position. Next, insert the charger plug into a 120VAC single phase, 50-60 HZ outlet.

4.5.2 To ensure that the charger is functioning, turn the function switch to BATT. The meter should deflect full scale. The sensor probe cable must be connected to the control panel for a battery check response. For normal battery charging, leave the function switch in the OFF position.

4.5.3 The battery is fully charged after 14 hours of charging. The charger can be left on indefinitely without damage. Disconnect the charger from the electrical outlet before disconnecting the mini plug from the instrument.

With the function switch turned to the appropriate range setting, the HNU may be operated while recharging.

4.6 Troubleshooting Tips

4.6.1 One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant needle deflection should be observed within 3 second with the function switch set a 0-20 (after shave lotion or cologne also will make the needle deflect).

4.6.2 Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

4.6.3 A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings.

4.6.4 Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

4.6.5 A zero reading on the meter should not necessarily be interpreted as an abasence of air contaminants. The detection capabilities of the HNU are limited to those compounds which will be ionized by the particular probe used.

4.6.6 Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

4.6.7 If a negative deflection of the HNU meter is noted the ion chamber is dirty and needs cleaning. The chamber may be soaked in a solvent such as methanol in a soil bath air dried and then baked for two to four hours at a temperature of 100°C and not exceeding 105°C.

4.6.8 When high concentrations of hydrocarbons enter the ionization chamber in the HNU a "quenching" effect takes place. Typically, it is noted by a sharp needle movement once the flow of gas is pierced by the HNU probe. Within one to two seconds the needle fades to zero point. To check whether or not the quenching effect is taking place, move the HNU probe to just outside the hole created in the foil. Get another reading after five to ten seconds. If quenching is taking place a very erratic needle movement will occur. Once an operator has seen this phenomena it is fairly easy to recognize.

5.0 QUALITY CONTROL

A calibration check of the HNU will be conducted once each day of sampling or whenever instrument operation is suspect. The HNU will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within +/- 10.0%. If the instrument responds outside this tolerance, it must be recalibrated.

6.0 DOCUMENTATION

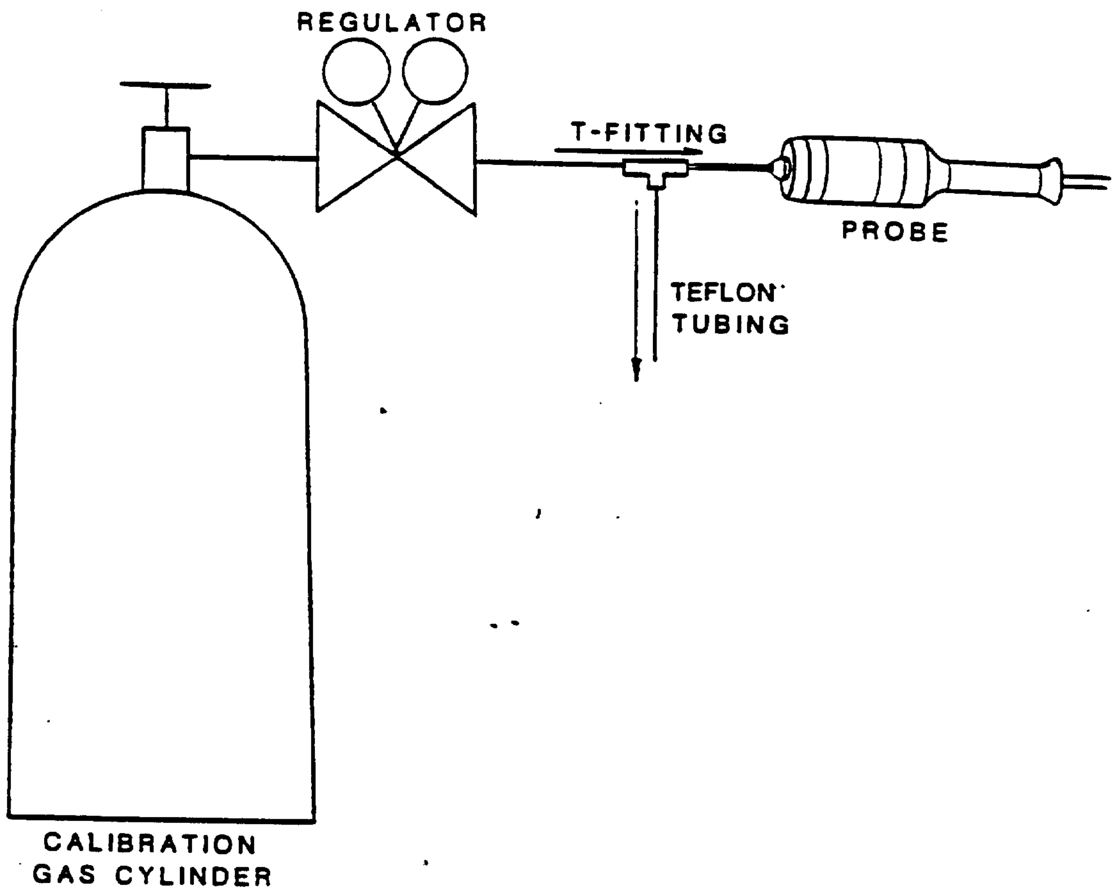
Safety and survey monitoring with the HNU will be documented in a bound Field Log Book and retained in the project files. The following information is to be recorded:

- Project name and number.
- Operator's signature.

- Date and time of operation.
- Calibration gas used.
- Calibration check at beginning and end of day (meter readings before adjustment).
- Span setting after calibration adjustment.
- Meter readings (monitoring data obtained).
- Instances of erratic or questionable meter readings and corrective actions taken.
- Instrument response verifications - magic marker (Section 4.6.1) or similar test.

7.0 REFERENCES

Not applicable.


REGULATOR
T-FITTING
PROBE
TEFLON
TUBING
CALIBRATION
GAS CYLINDER

ENSR **STANDARD OPERATING PROCEDURE**

Number: 7510 **Date of Issue:** 2nd Qtr.1993

Revision: 2

Title: Packaging and Shipment of Samples

Organizational Acceptance	**Authorization**	**Date**
Originator	Christopher Carlio	3/13/84
Technical Reviewer	Arthur Lazarus	3/13/84
Technical Reviewer	Elaine Moore	3/13/84
Technical Reviewer		
Quality Assurance	Scott Whittemore	3/13/84

Revision #	Changes	Authorization	Date
1	• Chain-of-Custody procedure for hinged coolers added • Miscellaneous rewording	Scott Whittemore Elaine Moore	9/19/86 10/13/86
2	• Format update • Chain-of-Custody form update	Mike Dobrowolski	4/27/93

Organizational acceptance signatures are maintained on file with the original document in the Quality Assurance Library in Acton, MA.

SOP NO: 7510

ENSR ENSR Consulting and Engineering

Packaging and Shipment of Samples

Date:	2nd Qtr. 1993
Revision No:	2
Author:	Christopher Carlio
Discipline:	Geosciences

1.0 PURPOSE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes the procedures associated with the packaging and shipment of samples. Two general categories of samples exist: environmental samples consisting of air, water and soil; and waste samples which include non-hazardous solid wastes and hazardous wastes as defined by 40 CFR Part 261.

2.0 RESPONSIBILITIES

2.1 Project Manager

It is the responsibility of the project manager to assure that the proper packaging and shipping techniques are utilized for each project.

2.2 Field Team Leader

The field team leader shall be responsible for the enactment and completion of the packaging and shipping requirements outlined in the project specific sampling plan. The field team leader shall be responsible to research, identify and follow all applicable U.S. Department of Transportation (DOT) regulations regarding shipment of materials classified as waste.

3.0 REQUIRED MATERIALS

- Sample cooler
- Bubble wrap
- "Blue Ice" refreezable ice packs
- Fiber tape

- Zip lock plastic bags

4.0 METHOD

The objective of sample packaging and shipping protocol is to identify standard procedures which will minimize the potential for sample spillage or leakage and maintain field sampling program compliance with U.S. EPA and U.S. DOT regulations.

The extent and nature of sample containerization will be governed by the type of sample, and the most reasonable projection of the sample's hazardous nature and constituents. The EPA regulations (40 CFR Section 261.4(d)) specify that samples of solid waste, water, soil or air, collected for the sole purpose of testing, are exempt from regulation under the Resource Conservation and Recovery Act (RCRA) when all of the following conditions are applicable:

- Samples are being transported to a laboratory for analysis;

- Samples are being transported to the collector from the laboratory after analysis;

- Samples are being stored (1) by the collector prior to shipment for analyses, (2) by the analytical laboratory prior to analyses, (3) by the analytical laboratory after testing but prior to return of sample to the collector or pending the conclusion of a court case.

Qualification for transportation as described above require that sample collectors comply with U.S. DOT and U.S. Postal Service (USPS) regulations. If U.S. DOT and USPS regulations are found not to apply, the following information must accompany all samples and will be entered on a sample specific basis on chain of custody records:

- sample collector's name, mailing address and telephone number,

- analytical laboratory's name, mailing address and telephone number,

- quantity of sample,

- date of shipment.

- description of sample, and

In addition, all samples must be packaged so that they do not leak, spill or vaporize.

4.1 Place plastic bubble wrap matting over the base and bottom corners of each cooler or shipping container as needed to manifest each sample.

4.2 Obtain a chain of custody record as shown in Figure 1 and enter all the appropriate information as discussed above. Chain of custody records will include complete information for each sample. One or more chain of custody records shall be completed for each cooler or shipping container as needed to manifest each sample.

4.3 Wrap each sample bottle individually and place standing upright on the base of the appropriate cooler, taking care to leave room for some packing material and ice or equivalent. Rubber bands or tape should be used to secure wrapping, completely around each sample bottle.

4.4 Place additional bubble wrap and/or styrofoam pellet packing material throughout the voids between sample containers within each cooler.

4.5 Place ice or cold packs in heavy duty zip-lock type plastic bags, close the bags, and distribute such packages over the top of the samples. Add additional bubble wrap/styrofoam pellets or other packing materials to fill the balance of the cooler or container.

4.6 Obtain two pieces of chain of custody tape as shown in Figure 2 and enter the custody tape numbers in the appropriate place on the chain of custody form. Sign and date the chain of custody tape.

4.7 To complete the chain of custody form enter the type of analysis required for each sample, by container, under the "ANALYSES" section. Under the specific analysis enter the quantity/volume of sample collected for each corresponding analysis.

4.8 If shipping the samples where travel by air or other public transportation is to be undertaken, sign the chain of custody record thereby relinquishing custody of the samples. Relinquishing custody should only be performed when directly transmitting custody to a receiving party or when transmitting to a shipper for subsequent receipt by the analytical laboratory. Shippers should not be asked to sign chain of custody records.

4.9 Remove the last copy from the chain of custody record and retain with other field notes. Place the original and remaining copies in a zip-lock type plastic bag and place the bag on the top of the contents within the cooler or shipping container.

4.10 Close the top or lid of the cooler or shipping container and with another person rotate/shake the container to verify that the contents are packed so that they do not move. Improve the packaging if needed and reclose.

4.11 Place the chain of custody tape at two different locations on the cooler or container lid and overlap with transparent packaging tape. For coolers with hinged covers, if the hinges are attached with screws, chain of custody tape should also be used on the hinge side.

4.12 Packaging tape should be placed entirely around the sample shipment containers. A minimum of two full wraps of packaging tape will be placed at least two places on the cooler. Shake the cooler again to verify that the sample containers are well packed.

4.13 When transporting samples by automobile to the laboratory, and where periodic changes of ice are required, the cooler should only be temporarily closed so that reopening is simple. In these cases, chain of custody will be maintained by the person transporting the sample and chain of custody tape need not be used. If the cooler is to be left unattended, then chain of custody procedures should be enacted.

4.14 If shipment is required. transport the cooler to an overnight express package terminal or arrange for pickup. Obtain copies of all shipment records as provided by the shipper.

4.15 If the samples are to travel as luggage, check with regular baggage.

4.16 Upon receipt of the samples, the analytical laboratory will open the cooler or shipping container and will sign "received by laboratory" on each chain of custody form. The laboratory will verify that the chain of custody tape has not been broken previously and that the chain of custody tape number corresponds with the number on the chain of custody record. The analytical laboratory will then forward the back copy of the chain of custody record to the sample collector to indicate that sample transmittal is complete.

5.0 QUALITY CONTROL

Not Applicable

6.0 DOCUMENTATION

As discussed in Section 4.0 the documentation for supporting the sample packaging and shipping will consist of chain of custody records and shipper's records. In addition a description of sample packaging procedures will be written in the Field Log Book. All documentation will be retained in the project files following project completion.

M901376

ENSR

CHAIN OF CUSTODY RECORD

Page ____ of ____

Client/Project Name:	Project Location:
Project Number:	Field Logbook No.:
Sampler: (Print Name) /Affiliation:	Chain of Custody Tape No.:
Signature	Send Results/Report to:

Analysis Requested

Field Sample No./ Identification	Date	Time	Grab	Comp	Sample Container (Size/Mat'l)	Sample Type (Liquid, Sludge, Etc.)	Preservative	Field Filtered							Lab I D	Remarks

Relinquished by: (Print Name) Signature	Date: Time:	Received by: (Print Name) Signature:	Date: Time:	Analytical Laboratory (Destination):
Relinquished by (Print Name) Signature	Date: Time	Received by: (Print Name) Signature:	Date: Time:	
Relinquished by (Print Name) Signature	Date: Time	Received by: (Print Name) Signature:	Date: Time:	Serial No. 6118

ENSR

Date

Sig.

№ 002233

ENSR STANDARD OPERATING PROCEDURE

Number: 7600 **Date of Issue:** 2nd Qtr.1993

Revision: 3

Title: Decontamination of Field Equipment

Organizational Acceptance	Authorization	Date
Originator	Charles Martin	3/2/84
Technical Reviewer	Arthur Lazarus	3/2/84
Technical Reviewer	Elaine Moore	3/2/84
Technical Reviewer		
Quality Assurance	Scott Whittemore	3/2/84

Revision #	Changes	Authorization	Date
1	Update	Charles Martin Arthur Lazarus Elaine Moore Scott Whittemore	3/2/84 3/2/84 3/2/84 3/2/84
2	• Addition of Health and Safety Considerations, Quality Assurance Planning Considerations, Training Requirements, QA/QC Checks, and Documentation sections • Addition of nitric acid wash for metals analyses • Addition of heavy equipment decontamination protocol • Miscellaneous edits and updates	Charles Martin Ken Fossey Mike Dobrowolski	3/12/90 4/3/90 5/3/90
3	Format update	Mike Dobrowolski	4/27/93

Organizational acceptance signatures are maintained on file with the original document in the Quality Assurance Library in Acton, MA.

Decontamination of Field Equipment

Date: 2nd Qtr. 1993

Revision No: 3

Author: Charles Martin

Discipline: Geosciences

1.0 PURPOSE AND APPLICABILITY

1.1 This SOP describes the methods to be used for the decontamination of all field equipment which may become contaminated or act as a contamination source during a sample collection task. The equipment may include split-spoon samplers, bailers, trowels, shipping coolers, drill rigs, backhoes, or any other type of equipment used during field activities.

Decontamination is performed as a quality assurance measure and a safety precaution.

- Improperly decontaminated sampling equipment can lead to misinterpretation of environmental data due to interference caused by cross-contamination.
- Decontamination protects field personnel from hazardous materials and protects the community by preventing uncontrolled transportation of contaminants at or from a site.

1.2 Decontamination is accomplished by manually scrubbing, washing, or spraying equipment with detergent solutions, tap water, distilled/deionized water, steam, or solvents. Equipment will be allowed to air dry after being decontaminated or may be wiped dry with chemical-free paper towels if immediate use is necessary.

The decontamination method and agents are to be determined on a project specific basis and must be stated in the Quality Assurance Project Plan (QAPP).

1.3 The frequency of equipment use dictates that most decontamination be accomplished at each sampling site between collection points. All cleaning materials and wastes should be stored in a central location so as to maintain control over the quantity of materials used or produced throughout the study. Decontamination waste products such as liquids, solids, rags, gloves, etc., will be collected and disposed of as specified in the QAPP.

1.4 Health and Safety Considerations

Decontamination procedures may involve;

- chemical exposure hazards associated with the medium being explored or solvents employed and may also involve:

- physical hazards associated with decontamination equipment.

When decontamination is performed on equipment which has been in contact with hazardous materials or when the quality assurance objectives of the project require decontamination with chemical solvents, the measures necessary to protect personnel must be addressed in the Health and Safety Plan.

The Health and Safety Plan must be approved by the project Health and Safety Officer before work commences, must be distributed to all personnel performing equipment decontamination and must be adhered to as field activities are performed.

1.5 Quality Assurance Planning Considerations

The following topics must be considered and addressed during the formulation of a decontamination strategy and should be outlined in the Quality Assurance Project Plan (QAPP). Each are dependent on site logistics, site-specific chemistry, the nature of the contaminated media and the objectives of the study.

- decontamination method

- solvent

- frequency

- location on site

- the method of containment and disposal of decontamination wash solids and solutions and

- state and local agency specific requirements for the selection of solvents and decontamination procedures.

1.5.1 The ideal situation would be to have all sampling equipment such as bailers, trowels and shovels laboratory decontaminated and dedicated to one sampling location for each day of sampling.

1.5.2 Laboratory decontamination may not be a practical option, however, depending on the scope of the project. It may be to expensive to obtain laboratory decontaminated sampling devices for short-term projects or projects which have numerous sampling locations. Sampling equipment such as split-spoon samplers or hand augers are too large to have laboratory cleaned. Finally, it may be difficult to schedule the necessary laboratory procedures.

1.5.3 There are several factors which need to be considered when deciding upon a decontamination solvent:

- the solvent should not be an analyte of interest;
- the solvent must be relatively stable so that it can be handled and stored in the field without special handling requirements;
- all sampling equipment must be resistant to the solvent;
- the solvent must be evaporative or water soluble or preferably both;
- state or local agencies may have specific requirements regarding decontamination solvents; and
- the analytical objectives of the study.

1.5.4 Methanol is the solvent of choice for general organic analyses. It is relatively safe and effective. A 10% nitric acid in deionized water solution is the solvent of choice for general metals analyses. Nitric acid use is restricted to use on Teflon, plastic or glass equipment.

1.5.5 If used on metal equipment, nitric acid will eventually corrode the metal and lead to the introduction of metals to the collected samples. If it is necessary to use metal sampling equipment for metals sampling, the procedure for decontamination will be:

- a non-phosphate detergent wash
- a tap water rinse
- a double distilled/deionized water rinse

State or local agencies may take exception to this procedure and require an acid wash. If this is the case, it must be recognized that the use of nitric acid on metal sampling equipment may lead to analytical interferences.

1.5.6 Decontamination should be performed far enough away from the source of contamination so as not to be affected by the source but close enough to the sampling site to keep handling to a minimum.

1.5.7 If heavy equipment such as drill rigs or backhoes are to be decontaminated, then a central decontamination station should be considered. Power may be required to run steam generators or high pressure water pumps. A water source may also be necessary. The construction of a sealed concrete pad with drains and walls, or other suitable temporary structure, to contain sprays and splashes may be necessary. Rinse and wash solutions should be collected and contained in 55 gallon metal or plastic drums.

1.5.8 Depending on the nature of the contaminated media or the decontamination solvents utilized, it may be necessary to collect and dispose of all particulate matter and wash solutions. If containment is necessary it may be achieved by performing the decontamination in large galvanized tubs or over plastic sheeting.

1.5.9 Upon review of the analytical data generated from the sampling program, the proper disposal method of these waste products will be determined.

2.0 RESPONSIBILITIES

2.1 It is the responsibility of the project manager to ensure that the proper decontamination procedures are followed and that all waste products of decontamination are properly stored and disposed.

2.2 It is the responsibility of the project safety officer to design and effect safety measures which provide the best protection for all persons involved directly with sampling and/or decontamination.

2.3 It is the responsibility of any subcontractors (i.e., drilling contractors) to follow the proper, designated decontamination procedures that are stated in their contracts and outlined in the project QA and/or Health and Safety Plan.

2.4 It is the responsibility of all personnel involved with sample collection or decontamination to adhere to the decontamination requirements and procedures in this SOP and in project specific Health and Safety Plans and QA plans, to maintain a clean working environment and to reasonably assure that contaminants are not negligently introduced to the environment.

3.0 REQUIRED MATERIALS

Decontamination agents may include: LIQUI-NOX or other phosphate-free biodegradable detergent solutions, tap water, distilled/deionized water, nitric acid, methanol, isopropanol, acetone or other appropriate solvent as specified in the QAPP.

- Personal protective equipment (defined in project Health and Safety Plan)
- Chemical-free paper towels
- Disposable gloves
- Waste storage containers: drums, boxes, plastic bags
- Cleaning containers: plastic buckets, galvanized steel pans, plastic (nalgene or equivalent) upright cylinder
- Cleaning brushes

- High pressure water or steam generator (if necessary)
- Plastic sheeting
- Plastic water storage containers

4.0 METHOD

4.1 General Procedures

4.1.1 The purpose of decontamination is three-fold.

- The first is to ensure that any compounds or contaminants which have been determined through chemical analyses to be present in a sample are in fact native to the sample.

  All sampling equipment such as bailers, trowels, shovels, tape measures, split-spoon samplers, dredges, sample containers, sample shipment coolers, etc., must be decontaminated before use to ensure that contaminants have not been introduced to the sample during the sampling process.

- The second purpose of decontamination is to minimize the exposure of sampling personnel to hazardous materials.

- The third purpose of decontamination is to prevent the introduction of new contaminants to a sampling site or prevent the transportation of compounds or contaminants from the site.

  Heavy equipment such as trucks, drilling rigs and backhoes should be decontaminated upon arrival at the site to prevent the introduction of road chemicals or contaminants from a previous site. Monitoring well riser pipes, screens and drilling augers must also be decontaminated to prevent the introduction of contaminants.

It should be assumed that all sampling equipment, including gloves, are contaminated until the proper decontamination procedures have been performed on them and that contaminated equipment can lead to invalid analytical results.

4.1.2 Unless the decontaminated equipment or construction materials are to be used immediately, they should be wrapped in aluminum foil, shiny side out, and stored in a designated "clean" area. Field equipment can also be stored in plastic bags to eliminate the potential for contamination.

Field equipment should be inspected and decontaminated prior to use if the equipment has been stored for long periods of time.

If customized procedures are not stated in the QAPP the standard procedures specified below shall be followed.

4.2 Decontamination for Organic Analyses

4.2.1 Determine from the QAPP the method of containment for the particulate and wash solution products of decontamination. Typically, smaller equipment will be decontaminated in a plastic or galvanized tub. The brush and container used for the decontamination process should be treated in the same manner as sampling equipment in steps 4.2.2 through 4.2.10.

4.2.2 Decontamination is to be performed before sampling events and between sampling points.

4.2.3 Remove all solid particles from the equipment or material by brushing and then rinsing with available tap water. This initial step is performed to remove gross contamination.

Depending on the size of the equipment being decontaminated, this may be preceded by a steam or high pressure water rinse to remove solids and/or residual oil or grease.

See Section 4.5 for decontamination of heavy equipment.

4.2.4 Wash the equipment or sampler with LIQUI-NOX or other phosphate-free detergent solution.

4.2.5 Rinse with tap water or distilled/deionized water until all detergent and other residue is washed away. Rerinse if necessary or repeat previous steps as necessary.

4.2.6 Rinse with methanol or other appropriate solvent. The solvent to be used should be specified in the QAPP.

4.2.7 Rinse with deionized water to remove any residual solvent.

4.2.8 Allow the equipment or material to air-dry in a clean area or wipe with chemical-free paper towels before use.

4.2.9 Dispose of soiled materials and wash solutions in the designated disposal containers.

4.3 Decontamination for Metals Analyses

4.3.1 For Teflon, plastic and glass, follow the procedures outlined in 4.2, however, use a 10% nitric acid solution as the solvent rinse in step 4.2.7.

4.3.2 For metal equipment, follow steps 4.2.1 through 4.2.6 and allow the equipment or material to air dry in a clean area or wipe with chemical-free paper towels before use.

4.4 Decontamination of Submersible Pumps

4.4.1 This procedure will be used to decontaminate submersible pumps before and between ground-water sample collection points as well as the end of each day of use. If different pumps are used, consult the QAPP for specific decontamination procedures.

4.4.2 During decontamination the submersible pump will be placed on a decontaminated surface, such as a plastic sheet.

4.4.3 When removing the submersible pump from each well the power cord and discharge line will be wiped dry using chemical-free disposable towels. Should the pump be fitted with a disposable discharge line, disconnect the line and dispose of it.

4.4.4 Clean an upright plastic-nalgene cylinder first with a methanol. 10% nitric acid or other specified solvent and then a distilled/deionized water rinse, wiping the free liquids after each.

4.4.5 For reversible pumps, reverse the pump to backwash all removable residual water present in the pump tubing. The pump should be shut off as soon as intermittent flow is observed from the reverse discharge.

4.4.6 Rinse the stainless steel submersible down hole pump section with a detergent solution followed by a water rinse and a liberal application of the specified solvent.

4.4.7 Place the submersible pump section upright in the cylinder and fill the cylinder with tap water, adding 50-100 ml of specified solvent for every one liter of water.

4.4.8 Activate the pump in the forward mode, withdrawing water from the cylinder.

4.4.9 Continue pumping until the water in the cylinder is pumped down and air is drawn through the pump. At this time air pockets will be observed in the discharge line. Shut off the pump immediately.

4.4.10 Remove the pump from the cylinder and place the pump in the reverse mode to discharge all removable water into a disposal container.

4.4.11 Using the water remaining in the cylinder, rinse the sealed portion of the power cord and discharge tube by pouring the water carefully over the coiled lines.

4.4.12 On reaching the next monitoring well, place the pump in the well casing and wipe dry both the power and discharge lines with a chemical-free paper towel as the pump is lowered.

4.5 Decontamination of Heavy Equipment

4.5.1 Upon arrival and prior to leaving a sampling site, all heavy equipment such as drill rigs, trucks, and backhoes should be thoroughly cleaned. This can be accomplished in two ways, steam cleaning or high pressure water wash and manual scrubbing.

4.5.2 Consult the QAPP for instruction on the location of the decontamination station and the method of containment of the wash solutions. Depending on the scope of the project it may be necessary to construct a sealed cement pad with draining capabilities and walls, or other suitable temporary structure, to contain splashes and sprays. A water supply and power source would also be required.

4.5.3 Following the initial cleaning, only those parts of the equipment which come in close proximity to sampling activity should be decontaminated in between sampling events. This would include items such as the backhoe bucket and extension arm.

5.0 QUALITY CONTROL

Necessary quality control checks and acceptance criteria are dependent on site specific chemistry, the nature of the media sampled and the objectives of the study. These checks shall be determined on a project specific basis and shall be outlined in the QAPP or project work plan.

5.1 General guidelines for the quality control checks for decontamination of field equipment are as follows:

- the collection of at least one field blank from the decontaminated equipment per day.
- For the sampling of soils and other solids, a solid field blank is not collected. Instead, decontamination rinsate samples should be collected as field blanks. Although the matrices differ, this water decontamination rinsate sample will provide an indication of the potential contamination due to inadequate decontamination procedures or ambient conditions.

- one shipping blank should accompany each shipment of aqueous samples destined for volatile organic analyses.

In this manner, a qualitative, and in the case of field blanks, quantitative assessment of potential contamination, and of effectiveness of the decontamination process is obtained.

5.2 Field Blanks

5.2.1 Field blanks are prepared for water sampling by pouring laboratory supplied deionized water into or over the freshly decontaminated sampling equipment (bailer, water level measurement tape, etc.) and then transferring this water into a sample container.

- Field blanks should be collected in the same location that samples are collected to determine if ambient VOCs are impacting the samples.
- Sample containers should be filled to the same levels as the samples the blanks are intended to represent.
- Field blanks should be labeled as a sample and submitted to the laboratory to be analyzed for the same parameters as the associated sample.
- Field blank sample numbers, as well as collection method, time and location should be recorded in the field notebook.

5.2.2 Field blanks should also be collected following the decontamination of submersible pumps.

- The pump should be used to withdraw laboratory supplied deionized water from the container and fill a sample container.
- The pump field blank should then be treated as in 4.2.1.

5.2.3 For soil and other solid samples, a solid field blank is not collected. Instead decontamination rinsate samples should be collected. Immediately following the decontamination of the soil sampling equipment (trowel, shovel, split-spoon samplers, dredge, etc.), laboratory supplied deionized water shall be applied to the entire sampler with a squirt bottle and then collected in a sample container.

- Sample containers should be filled to the same levels as the samples the rinsates are intended to represent.

- Decontamination rinsates should then be labeled as a sample and submitted to the laboratory to be analyzed for the same parameters as the associated samples.

- Decontamination rinsate sample numbers, as well as collection method, time and location should be recorded in the field notebook.

5.3 Shipping Blanks

5.3.1 Shipping blanks are used to identify errors introduced by cross-contamination of samples during shipping, sample bottle preparation and blank water quality.

- Analysis of shipping blanks is restricted to volatile compounds because these compounds demonstrate the greatest capacity for migration.

- Shipping blanks are sample containers which are filled with deionized water in the laboratory and placed in the sample shipping coolers when the sampling kits are assembled.

- They remain in the coolers in the field and are not opened.

- They are returned to the laboratory with the collected samples and analyzed for the same parameters as the associated samples.

- The volume of each shipping blank should be the same as the volume of the samples with which it is shipped and it should be in the same type of container as the samples.

6.0 DOCUMENTATION

Comprehensive documentation of decontamination is accomplished by completion of the following:

6.1 Field Notebook Entries

- Date, time and location of each decontamination event
- Equipment decontaminated
- Solvents
- Notable circumstances
- Identification of field blanks and decontamination rinsates
- Method of blank and rinsate collection
- Date, time and location of blank and rinsate collection

6.2 Field Blank and Decontamination Rinsate Sample Labels

- Blanks and rinsates should be labeled as samples

6.3 Chain-of-Custody Forms

- Instructions for lab analyses of blanks and rinsates

7.0 REFERENCES

Not applicable.