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REPORT

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NTCRA 2
Technical Memorandum

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

Prepared for:
SRSNE Superfund Site PRP Group

November 1998

Updated by letter May 25, 1999
Approved by EPA July 8, 1999

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

TECHNICAL REPORT

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Transmitted Via Federal Express

November 24, 1998

Ms. Karen Lumino
United States Environmental Protection Agency
Region 1
90 Canal Street
Boston, MA 02114

Re: SRSNE Superfund Site
Draft NTCRA 2 Technical Memorandum
Project #: 1028.08331 #2

Dear Ms. Lumino:

Please find enclosed three copies of the draft NTCRA 2 Technical Memorandum for the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut. This document was prepared by Blasland, Bouck & Lee, Inc. on behalf of the SRSNE Site Potentially Responsible Parties Group.

If you have any questions or need additional information, please contact Mr. Bruce Thompson of de maximis, inc. at (860) 651-1196

Sincerely,

BLASLAND, BOUCK & LEE, INC.

Gary R. Cameron/MBL

Gary R. Cameron
Vice President

GRC/mbl
Enclosure
10578842.WPD

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1. Introduction

1.1 General

This Technical Memorandum describes completed field investigation activities, data acquisition, and technical evaluations, and proposed additional evaluations to support the design of a bedrock ground-water containment system as part of a second Non-Time Critical Removal Action (NTCRA 2) at the Solvents Recovery Service of New England, Inc. (SRSNE) Superfund Site in Southington, Connecticut (Figure 1). This document was prepared by Blasland, Bouck & Lee, Inc. (BBL), on behalf of the SRSNE Site Potentially Responsible Parties (PRP) Group. This Technical Memorandum is required pursuant to the NTCRA 2 Statement of Work (SOW). The SOW was issued by the United States Environmental Protection Agency (USEPA) as part of the Administrative Order on Consent (Order) for Removal Action and Remedial Investigation/Feasibility Study (RI/FS), which became effective on July 20, 1996. The SOW is based on the USEPA Action Memorandum for the site, which was signed by the USEPA Region I Regional Administrator on June 1, 1995, and defines the response activities and deliverables required by the SRSNE PRP Group pursuant to the Order.

Section 2 below describes the status of the NTCRA 2 Design and Study Process as described in the USEPA-approved Design and Study Work Plan (DSWP; BBL, August 1996). Certain aspects of the Design and Study Process have required or warranted modification due to the results of field investigative work. Most importantly, as summarized in Section 3, an overburden pumping test was completed between August 17 and 24, 1998, in the northern portion of the Town of Southington Well Field Property, which is situated downgradient from the SRSNE Operations Area (Figure 2). The results of the pumping test, which included pumping from overburden pumping well RW-13 (Figure 3, and shown in relation to bedrock wells and piezometers on Figure 4), indicate that substantial hydraulic control can be achieved in the bedrock by pumping from the overburden in the northern portion of the Town Well Field Property. These findings were presented in detail in Appendix B to the Draft Feasibility Study Report for the SRSNE Site (BBL, November 1998), and are summarized in Section 3. Section 4 proposes additional field work to confirm the findings of the pumping test of well RW-13 and evaluate whether the existing bedrock pumping well (RW-1R) can further enhance the hydraulic containment effected in the bedrock.

1.2 Background

The SRSNE Superfund Site is situated on approximately 14 acres of land along Lazy Lane in the Town of Southington, Connecticut. The site is located in Hartford County, approximately 15 miles southwest of the city of Hartford (Figure 1). The specific areas surrounding the site are shown on the Site Plan (Figure 2) and described below.

1.2.1 SRSNE Operations Area

The SRSNE Operations Area is located in the Quinnipiac River basin approximately 600 feet west of the Quinnipiac River channel (Figure 2). The Operations Area consists of approximately 2.5 acres of grounds and structures situated on a 3.7-acre lot. An access road extends to the north, connecting the Operations Area to Lazy Lane. The Operations Area is bordered on the east (downhill) by the Boston and Maine (B&M) railroad right-of-way and the former Cianci Property, to the north by Mickey's Garage automotive repair shop, to the west (uphill) by the S. Yorski property, and to the south by the Delahunty property, the Connecticut Light and Power (CL&P) electrical transmission line easement, and the Town of Southington Well Field.

Much of the Operations Area currently is paved with asphalt and/or concrete and is completely enclosed with security fencing. Site features include an office trailer, operations building, former ground-water treatment system control building foundation, multiple above ground storage tanks, and two concrete-surfaced drum storage areas.

Subsurface investigations within the Operations Area identified a three-dimensional zone within the overburden and bedrock containing elevated concentrations of dissolved, solvent-related volatile organic compounds (VOCs) in ground water. In addition, based on direct observations and VOC concentrations detected in soil and ground-water samples, zones of non-aqueous phase liquids (potential NAPL zones) were interpreted in the overburden and bedrock within the Operations Area in the final RI Report (BBL, June 1998). The potential NAPL zones are depicted on Figures 5 and 6. One of the primary purposes for NTCRA 2 will be to hydraulically contain VOC-impacted bedrock ground water downgradient of the Operations Area while limiting the potential for NAPL to remobilize due to NTCRA 2 ground-water extraction.

A second component of the NTCRA 2 SOW covers capping of the Operations Area. As discussed between USEPA, the Connecticut Department of Environmental Protection (CT DEP), the SRSNE PRP Group, de maximis, inc., and BBL at a meeting in Boston on February 5, 1998, Operations Area cap design and implementation will be deferred until the Record of Decision (ROD) is issued for the site.

1.2.2 Former Cianci Property

The former Cianci Property is the 10-acre parcel situated immediately east of the Operations Area, across the B&M Railroad right-of-way. The Quinnipiac River borders the eastern edge of the former Cianci Property. Lazy Lane is located to the north, and the Town of Southington Well Field borders the property to the south.

The former Cianci Property lot was occupied by the Cianci Construction Company from approximately 1969 through 1988 and was used for the storage of construction equipment and as a truck washing station. The property was sold to SRSNE in June 1988.

Until the construction of the NTCRA 1 overburden ground-water containment and treatment system in 1995, the former Cianci Property was undeveloped, but had been altered by past earth-moving and leveling activities. The former Cianci Property currently includes an overburden ground-water containment system within the NTCRA 1 Containment Area (Figure 2), and the associated ground-water treatment system building. Figures 7 and 8, respectively, show a geologic cross section location map, and an east-west oriented geologic cross section through the Operations Area and the NTCRA 1 Containment Area. Figure 8 shows the vertical extent of the plume of dissolved VOCs exceeding ground-water regulatory criteria ("regulatory plume") and the estimated profile of the hydraulic containment area achieved by the NTCRA 1 Containment System.

Based on direct observation and VOC concentrations detected in soil and ground-water samples, NAPLs are present in the overburden and the shallow bedrock within the former Cianci Property, as shown on Figures 5 and 6. To limit the potential for NAPL within either formation to be remobilized during NTCRA 2 implementation, the NTCRA 2 bedrock ground-water containment system will be installed at a safe distance downgradient of the former Cianci Property, within the Town of Southington Well Field.

1.2.3 Southington Well Field

The Town of Southington Well Field property consists of approximately 28 acres of undeveloped land situated south of the former Cianci Property and southeast of the Operations Area (Figure 2). The well field is bounded to the east by the Quinnipiac River and to the south by the Quinnipiac River and Curtiss Street. The B&M railroad right-of-way and the Delahunty property border the western perimeter of the well field. The CL&P easement runs northwest-southwest through the northern portion of the well field.

Town Production Wells No. 4 and 6 are located approximately 2,000 and 1,400 feet south of the SRSNE property, respectively. The Quinnipiac River divides the area between Production Wells No. 4 and 6.

1.3 NTCRA 2 Purpose and Objectives

The Action Memorandum signed on June 1, 1995, describes the purposes for NTCRA 2, including the design and implementation of a ground-water extraction system to minimize the migration of ground water in the bedrock from the Operations Area of the site. The NTCRA 2 SOW assumes that the ground water extracted by the NTCRA 2 containment system will be treated using the treatment system that was designed and constructed for NTCRA 1, which is located on the former Cianci Property. As presented in Appendix B to the Draft FS Report, the available data indicate that the NTCRA 1 treatment system is capable of effectively treating the ground-water that will likely be discharged from the NTCRA 2 containment system. In addition, the SRSNE PRP Group is evaluating alternative treatment technologies for the water that will be pumped from the NTCRA 2 containment system. The objectives of the NTCRA 2 containment system will be to meet specific performance standards specified by the SOW.

1.3.1 Containment System Performance Standards

The effectiveness of the of the NTCRA 2 ground-water containment system will ultimately be evaluated based on the performance standards summarized below, which are specified by the SOW.

- *The bedrock ground-water containment system shall minimize, to the extent reasonably practicable, the flow of bedrock ground water from the Operations Area of the site.* This provision acknowledges the inherent complexity of containing ground-water flow in fractured bedrock. It is expected that a substantial degree of bedrock ground-water containment required under this provision will be met through the continued operation of the existing NTCRA 1 overburden ground-water containment system, which achieves demonstrable bedrock ground-water containment. Additional ground-water extraction downgradient of the NTCRA 1 system as part of NTCRA 2 will provide, in essence, a backup containment system for bedrock ground water, which will hydraulically contain most of the dissolved-phase plume of VOCs above regulatory criteria in bedrock downgradient of the site.

- *The containment system shall establish a three-dimensional Area of Containment downgradient of the Operations Area, which will be defined in the NTCRA 2 Demonstration of Compliance Plan.* The NTCRA 2 Demonstration of Compliance Plan will be submitted with the 100% Design Report, and will describe the technical basis for demonstrating that the objective noted in the first bullet above is being met. While ground-water flow in fractured media is complex, the bedrock hydraulic responses observed during the overburden pumping test were reasonably systematic. As summarized in Section 3 and described in detail in Appendix B to the Draft FS Report (BBL, November 1998), the bedrock ground-water containment area can be delineated to the extent practicable using empirical hydraulic head measurements, interpolation of hydraulic heads between measurements points downgradient of the pumping well, and/or ground-water flow modeling.

- *Within 60 days of NTCRA 2 system startup and during the entire operation of the system thereafter, it shall be demonstrated, based on a Containment Test, that bedrock ground water within the Area of Containment is flowing in the direction of the NTCRA 2 bedrock ground-water containment system.* The demonstration of compliance procedure(s) will be described in detail in the NTCRA 2 Demonstration of Compliance Report, which will be submitted with the NTCRA 2 100% Design Report. While containment is expected to be demonstrated within 60 days following the startup of the NTCRA 2 system, bedrock ground-water containment downgradient of the SRSNE Site is not considered to be time-critical given that: 1) no ground-water receptors are situated within the bedrock regulatory VOC plume associated with the SRSNE Site, as delineated in the final RI Report (BBL, June 1998); 2) no active ground-water receptors are situated *downgradient* of the SRSNE-related bedrock regulatory VOC plume, which would attenuate or discharge into the Quinnipiac River near Curtiss Street (Figure 2) if allowed to migrate unabated; 3) the highest concentration of VOCs detected above regulatory criteria downgradient of the estimated NTCRA 2 containment area is 9 ug/L of 1,1-dichloroethene (compare to regulatory criterion of 7 ug/L; BBL, June 1998); and 4) using detailed, site-specific solute-transport parameters quantified during the completion of the RI, the average linear velocity of the SRSNE-related VOC plume in bedrock was estimated as 0.037 ft/fay (14 ft/year; BBL, June 1998). Thus, a one-month down-time would result in negligible (approximately one foot of) plume migration.

- *System adjustments shall be made, as appropriate, to satisfy the objectives listed above.* NTCRA 2 compliance will be evaluated on a relatively continuous basis, similar to NTCRA 1 compliance, and system adjustments (e.g., pump and well maintenance, level-control cleaning, or potentially addition of new pumping wells) will be made, as necessary, to maintain compliance.

These containment system performance standards provide the overall objectives for the NTCRA 2 ground-water containment system. It is anticipated that bedrock ground-water containment will be achieved using one or more ground-water extraction wells.

1.3.2 Design Investigation Performance Standards

The Design Investigation performance standards specified by the SOW require that sufficient information be obtained for USEPA to determine:

- The effect of the existing NTCRA 1 containment system on bedrock ground water;
- The pumping rates, duration, number, location (including depth) and specifications (diameter, type of sandpack, length of screen) for any wells needed for the NTCRA 2 ground-water containment system;
- The effect of the NTCRA 2 system on wetlands and floodplains that might be impacted by ground-water pumping;
- The effect of the NTCRA 2 system on private water-supply wells in the vicinity of the site; and
- The extent of the bedrock containment area.

The information listed above was obtained during the NTCRA 2 Design Investigation and, with the exception of the first bullet, was described in detail in Appendix B to the Draft FS Report. The salient findings of the NTCRA 2 Design Investigation, including the first bullet listed above, are summarized in Section 3.

In addition to these performance standards specified in the SOW, the NTCRA 2 design and study process included the following evaluations, which the SRSNE PRP Group believed to be technically prudent:

- To limit the potential for NAPL to be remobilized during NTCRA 2 pumping, a minimum "safe distance" will be maintained between any NTCRA 2 pumping wells and the overburden and bedrock potential NAPL zones (Figures 5 and 6), which were delineated in the final RI Report (BBL, June 1998). Hydraulic gradient monitoring performed during the overburden pumping test at well RW-13 indicated minor changes in hydraulic gradients, which were negligible in comparison to the range of gradients observed historically (see Table 1). Thus, pumping from well RW-13 would not be expected to remobilize NAPL. Additional hydraulic gradient monitoring will be performed within the NAPL zones during a proposed Interim Ground-Water Containment Evaluation, as discussed in Section 4.

- The assessment of the hydraulic influence of NTCRA 2 bedrock ground-water extraction on the on-going NTCRA 1 demonstration of compliance for overburden ground-water containment, which requires that the overburden hydraulic gradient be reversed within the NTCRA 1 Containment Area. While the NTCRA 1 containment system currently meets this requirement, the influence of NTCRA 2 on the continued NTCRA 1 demonstration of compliance will be evaluated. Hydraulic gradient monitoring performed during the overburden pumping test at well RW-13 indicated minor changes in hydraulic gradients, which did not interfere with NTCRA 1 compliance.

These two supplemental evaluations were detailed in Appendix B to the Draft FS Report.

2. NTCRA 2 Design and Study Process

2.1 General

The NTCRA 2 design and study process was described in detail in the DSWP (BBL, August 1996), and included the review of RI data and published literature, ground-water flow model development, a Design Investigation, and ground-water flow model refinement activities required to complete the design of an effective NTCRA 2 bedrock ground-water containment system. The status of each step of the NTCRA 2 design and study process is described below.

2.2 Remedial Investigation Data Review

Following the completion of the RI field work, the new data were incorporated into the existing hydrogeologic database for the site. The new and pre-existing data were then used to refine our current understanding of the following evaluations required to support the successful NTCRA 2 containment system design.

- The potential NAPL zones in the overburden (Figure 5) and bedrock (Figure 6) were delineated. The depth of the NAPL zones in bedrock was also estimated as extending up to 200 feet below grade based on the ground-water flow directions and the apparent depth of the VOC plume downgradient of the NAPL zone. NAPL zone delineation provided a basis to locate pumping wells RW-13 and RW-1R, and monitor for hydraulic gradient changes during pumping.

- The three-dimensional regulatory VOC plume within the bedrock was delineated, which will be the target of NTCRA 2 bedrock ground-water containment;

- The bedrock hydraulic conductivity profile was measured at nine deep bedrock boreholes based on packer testing. Specific capacity tests were also completed at shallow and deep bedrock monitoring wells, which provide additional hydraulic conductivity data within the hydrogeologic database for the site.

- The horizontal and vertical hydraulic gradients were characterized in the vicinity of the site, including the Operations Area, former Cianci Property, and Town Well Field Property. This information was used to calibrate the MODFLOW model, and, in combination with the observed plume of VOCs exceeding ground-water regulatory criteria, identify the appropriate location for NTCRA 2 ground-water extraction.

The results of these evaluations were used to complete the development of a ground-water flow model, which was used to design the NTCRA 2 ground-water extraction system prior to the Design Investigation.

2.3 Ground-Water Flow Model Development

Ground-water flow modeling was performed in two phases during the design and study process. During the first phase, a ground-water flow (MODFLOW) model was developed based on published hydrogeologic data and the information obtained during the RI. The model was calibrated to the pre-pumping, steady-state hydraulic head distribution measured on January 21, 1997 (BBL, June 1998). Simulations were performed to predict the appropriate depth, size, location, and pumping rate of the NTCRA 2 bedrock ground-water extraction well to hydraulically contain the off-site VOC plume in bedrock. The results of ground-water flow model development were described in the NTCRA 2 Interim Technical Memorandum (BBL, September 1997), which is included as Attachment A-1 in Appendix A. Attachment A-2 in Appendix A presents additional details regarding the model setup and calibration, such as boundary conditions and calibration statistics. Based on the preliminary modeling results, a bedrock ground-water pumping well and seven bedrock piezometers were installed to support a pumping test during the Design Investigation.

2.4 Design Investigation

As part of the NTCRA 2 design investigation, bedrock pumping well RW-1R and a network of seven bedrock piezometers (PZR series within the CL&P easement) were installed at the approximate locations shown on Figure 4. Following its installation, bedrock pumping well RW-1R was developed and pumped, but the maximum pumping rate was measured to be approximately 0.25 gallons per minute (gpm). In addition, during pumping at well RW-1R, negligible drawdown was observed at adjacent shallow bedrock monitoring well MW-704R. These findings suggested that the bedrock sequence penetrated by pumping well RW-1R has limited fracture permeability and that pumping well RW-1R has limited hydraulic connection to the shallow bedrock. Significant drawdown was observed, however, at adjacent deep bedrock monitoring well MW-704DR.

During a conference call between USEPA, CT DEP, and the SRSNE PRP Group on January 8, 1998, BBL informed the agencies of the low yield from pumping well RW-1R, and of the plan to attempt to improve its flow by using routine development methods. Following an additional week of surging and pumping, during a conference call between the same parties on January 16, 1998, BBL informed the agencies of the negligible improvement achieved by continued development by routine methods. During the same call, BBL identified several alternative technologies that would be assessed in the near term to help identify an appropriate method to improve the yield of bedrock pumping well RW-1R, including the following: 1) high-pressure water injection ("hydrofracting"); 2) high pressure liquid or gaseous carbon dioxide injection ("AquiFreed™"); or 3) bedrock blasting ("blasted bedrock trench" installation). On January 22, 1998, after collecting information from various vendors and discussing the costs and observed effectiveness with users of these three technologies, another conference call between the same parties was held to discuss these alternatives to improve the well RW-1R pumping rate. During that discussion, it was concluded that installing a blasted bedrock trench, connected to well RW-1R, would be the most likely technology to improve the yield of the pumping well to facilitate the NTCRA 2 pumping test. At a meeting with USEPA and CT DEP in Boston on February 5, 1998, the SRSNE PRP Group confirmed that it would focus on the installation of a blasted bedrock trench as part of the NTCRA 2 activities, and would prepare a plan to describe the proposed work. Following discussions with blasting and vibration monitoring vendors, BBL prepared DSWP Addendum No. 5 to serve as a plan for the blasted bedrock trench installation (BBL, April 1998).

While preparing for the installation of a blasted bedrock trench, BBL completed an overburden pumping test to help support the evaluation of ground-water remedial alternatives as part of the FS. A one-week overburden pumping test was performed, which established steady-state head and flow conditions after the first few days of pumping. Comprehensive ground-water elevation measurement rounds were obtained before and during pumping to empirically document the hydraulic influence of overburden pumping well RW-13 during steady-state pumping (Figures 9 through 14).

The overburden pumping test implementation and results, which are described in detail in Appendix B to the Draft FS Report and summarized in Section 3 of this Technical Memorandum, indicated that overburden pumping well RW-13 had a substantial hydraulic influence in the overburden and the shallow and deep bedrock. The bedrock ground-water containment area achieved by overburden pumping well RW-13, in conjunction with the bedrock ground-water containment provided by the twelve NTCRA 1 ground-water extraction wells, appears to meet the NTCRA 2 objectives as defined in the SOW.

During a conference call with USEPA, CT DEP, the SRSNE PRP Group, de maximis, and BBL on September 24, 1998, the results of the overburden pumping test were discussed, including the influence of pumping well RW-13 on bedrock ground-water flow. During that call, USEPA agreed that the empirical hydraulic response data were sufficient to proceed with this Technical Memorandum.

In lieu of the planned bedrock pumping test included in the NTCRA 2 Design and Study Process, and to provide additional data to confirm the interpreted bedrock ground-water containment area established by overburden pumping well RW-13, an Interim Ground-Water Containment Evaluation will be performed as described in Section 4. Existing bedrock pumping well RW-1R will also be pumped during the Interim Ground-Water Containment Evaluation to assess its potential to further enhance deep bedrock ground-water containment.

2.5 Ground-Water Flow Model Refinement

Following the Design Investigation, the MODFLOW model was modified to incorporate the hydraulic conductivity data obtained during the overburden pumping test. The horizontal hydraulic conductivity data did not require modification. The estimated horizontal to vertical anisotropy ratio, however, provided a basis to reduce the overburden anisotropy from 100:1 (assumed during model calibration) to an approximate value 10:1 within the revised model. After refining the overburden vertical to horizontal anisotropy, the model calibration statistics were reassessed, as presented in Attachment A-3 in Appendix A.

The model was then used to simulate the drawdown and containment area achieved in the overburden and bedrock formations by overburden pumping well RW-13 for comparison with the measured results from the pumping test, as presented in Appendix B to the Draft FS Report. The simulated downgradient extent of the ground-water containment area achieved by pumping well RW-13 compared closely to the calculated, theoretical location of the stagnation point, which defines the extent of the containment area downgradient of a pumping well. The stagnation point location was interpolated between measurement points. Also, the simulated containment area effected by well RW-13 in the overburden and bedrock correlate well with the overall head distributions measured during the pumping test. However, the drawdown estimated by the model slightly underestimated the magnitude of drawdown observed in the field, suggesting that the MODFLOW model may provide a conservative assessment of the hydraulic containment effectiveness of simulated pumping systems. Nevertheless, these model bench marking results indicate that the model does not require further recalibration to evaluate the effectiveness of various pumping wells as part of NTCRA 2 or the FS.

2.6 NTCRA 2 Implementation

In lieu of the NTCRA 2 bedrock pumping test, additional data will be acquired to verify the ground-water containment area in bedrock during pumping from overburden pumping well RW-13 and adjacent bedrock pumping well RW-1R. As presented in Section 4, an Interim Ground-Water Containment Evaluation is proposed to obtain more data during steady-state pumping from well RW-13, with additional pumping from bedrock pumping well RW-1R. The results of this evaluation will be presented in the NTCRA 2 100% Design Report.

If the results of the Interim Ground-Water Containment Evaluation verify that pumping from well RW-13 and potentially RW-1R, in addition to the NTCRA 1 bedrock containment influence, will achieve the requirements of the Containment Test specified in the SOW, then the NTCRA 2 implementation will consist mainly of continued operation of well RW-13 and potentially RW-1R. The pumped ground water will be treated at the existing NTCRA 1 treatment system until or unless another, preferable treatment alternative proves effective. If necessary, based on the results of the Interim Ground-Water Containment Evaluation, one or more additional extraction wells will be installed and connected to the ground-water extraction and treatment systems.

3. Design Investigation Results

3.1 General

As described above, the NTCRA 2 Design Investigation was expected to include the following activities:

- Pumping Well and Piezometer Installation -- BBL completed this task between October 28, 1997 and January 5, 1998.

- Well and Piezometer Development and Specific Capacity Testing -- BBL completed this task between October 28 and December 8, 1997.

- Bedrock Pumping Test Implementation -- An overburden pumping test was performed at well RW-13, which is adjacent to the NTCRA 2 bedrock pumping well (RW-1R), between August 17 and 24, 1998. Potentiometric data were obtained at all available bedrock wells and piezometers before and during pumping. These data indicate that the overburden pumping well established a substantial degree of bedrock ground-water containment, which may meet the objectives of the NTCRA 2 SOW. These data were described in detail in Appendix B to the Draft FS Report. In addition, Section 4 of this Technical Memorandum describes a proposed Interim Ground-Water Containment Evaluation, which will provide additional, long-term pumping data to verify the bedrock ground-water containment area effected by overburden pumping well RW-13, with and without pumping from bedrock pumping well RW-1R.

- Bedrock Ground-Water Treatability Assessment -- During the performance of an overburden pumping test at well RW-13, samples of untreated discharge were obtained. The analytical results for these samples indicate that the ground water pumped from well RW-13 can be effectively treated at the NTCRA 1 ground-water treatment system, as discussed in Appendix B to the Draft FS Report.

3.2 Pumping Well and Piezometer Installation

3.2.1 Bedrock Pumping Well RW-1R Installation

Bedrock ground-water pumping well RW-1R was installed at the location shown on Figure 4 by East Coast-Thomas Environmental, Inc., between December 18, 1997, and January 5, 1998. At the RW-1R pumping well location, a borehole was advanced to the top of bedrock using 16-inch diameter dual air-rotary (Barber rig) drilling. The top of bedrock at pumping well RW-1R was encountered 76 feet below ground surface. As described in the NTCRA 2 Interim Technical Memorandum, the design for bedrock pumping well RW-1R included a 12-inch-diameter, permanent steel casing through the overburden and grouted into the top 6 feet of bedrock (total depth of 82 feet), and a 12-inch-diameter open bedrock borehole from 82 feet below grade to a total depth of approximately 173 feet (97 feet into the bedrock). Bedrock pumping well construction details are presented in Appendix B to this Technical Memorandum.

3.2.2 Bedrock Piezometer Installation

Seven bedrock piezometers (PZR series) were installed in the CL&P easement at the locations shown on Figure 4 by East Coast-Thomas Environmental between October 28 and December 4, 1997, to provide hydraulic response data during the pumping test activities and NTCRA 2 implementation. Five shallow bedrock and two deep bedrock piezometers were selected to fill data gaps in the bedrock monitoring array, particularly in the area downgradient of bedrock pumping well RW-1R. In combination with the existing bedrock monitoring wells in the area, the proposed piezometer locations will provide an appropriate network to characterize the hydraulic response to bedrock pumping. The designation for the new piezometers is as follows (see locations on Figure 4):

- Shallow Bedrock Piezometers -- PZR-1R, PZR-2R, PZR-3R, PZR-4R, and PZR-5R; and
- Deep Bedrock Piezometers -- PZR- 2R and PZR-4R.

The new bedrock piezometer boreholes were advanced through the overburden using 8.25-inch outside diameter (OD) hollow-stem augers. In addition, rotary (4-inch roller bit) drilling and/or spun casing were used as necessary, to help advance the boreholes through cobbles and boulders in the deep overburden. Once the top of bedrock was encountered, the rotary (roller bit) drilling method was used to advance the piezometer borehole to the appropriate depth within the bedrock. Shallow and deep bedrock piezometers were installed to depths of approximately 25 feet and 90 feet below the top of bedrock, respectively. Each new bedrock piezometer was constructed with a 20-foot long, 2-inch diameter, 0.010-inch slot, Schedule 40 PVC screen and riser pipe. A Morie No. 0 or equivalent sand filter pack was placed in the well/borehole annulus from the bottom of the piezometer screen to approximately 1 to 2 feet above the top of the screen, and the remainder of the annulus was filled with bentonite to ground surface. Each new piezometer was completed at ground surface with a locking steel protective casing. Bedrock piezometer construction details are presented in Appendix B to this Technical Memorandum.

3.2.3 Survey Control

Horizontal and vertical survey control were established for each new well and piezometer by Conklin and Soroka., Inc., of Cheshire, Connecticut, including the top of the PVC riser, the top of the protective casing, and the ground surface adjacent the well, using the existing baseline for the SRSNE Site and the National Geodetic Vertical Datum (NGVD) of 1929. Survey coordinates for the new pumping well and piezometers are also listed in Appendix B to this Technical Memorandum.

The bedrock pumping well and piezometer construction details and survey coordinates were added to the existing hydrogeologic database for the site to facilitate the compilation and depiction of data

3.3 Well and Piezometer Development/Specific-Capacity Testing

3.3.1 Bedrock Pumping Well RW-1R Development

Following its installation, bedrock pumping well RW-1R was developed by surging and pumping. The maximum pumping rate measured at well RW-1R was approximately 0.25 gpm during maximum drawdown (nearly to the bottom of the well). In an attempt to improve the yield of pumping well RW-1R, the well was further developed by surging and pumping between January 6 and 13, 1998, with no improvement in maximum sustainable yield. In addition, during pumping at well RW-1R, negligible drawdown (less than 0.1 feet) was observed at adjacent shallow bedrock monitoring well MW-704R. These findings suggested that pumping well RW-1R has negligible hydraulic connection to the shallow bedrock. Significant drawdown (over 13 feet) was observed, however, at adjacent deep bedrock monitoring well MW-704DR.

Due to the apparently negligible connection of pumping well RW-1R to the shallow bedrock, the well was believed to be inadequate to allow an effective bedrock pumping test to support the NTCRA 2 design for bedrock ground-water containment. BBL evaluated various alternatives to improve the yield and hydraulic connection of bedrock pumping well RW-1R, and ultimately selected artificial bedrock fracturing (blasted bedrock trench installation), as described in detail in DSWP Addendum No. 5 (BBL, April 1998). During the process of preparing for the blasting work, an unrelated overburden pumping test was performed in the same vicinity as pumping well RW-1R as part of the FS process. The implementation and results of that pumping test are summarized below and described in detail in Appendix B to the Draft FS Report, and indicated that the overburden well has a substantial hydraulic containment effectiveness in the overburden and bedrock. The hydraulic responses measured in the bedrock, which are believed to meet the NTCRA 2 SOW objectives for bedrock ground-water containment, are discussed in detail below in Section 3.4.

3.3.2 Bedrock Piezometer Development and Specific Capacity Testing

The new bedrock piezometers were developed by pumping with a submersible pump until a minimum of five casing volumes was removed and the clarity of the pumped water improved to the extent practicable. BBL performed a specific capacity test at each new bedrock piezometer between October 30 and December 8, 1997. Specific capacity test data acquisition entailed pumping each new piezometer at a relatively constant rate and measuring the drawdown inside the tested piezometer. Specific capacity test data were used to estimate the hydraulic conductivity of the bedrock formation surrounding the screened interval of each new piezometer, as presented in Appendix C.

The test duration (t), pumping rate (Q), drawdown (s), and piezometer screen and borehole geometry were used to estimate the hydraulic conductivity of the bedrock formation surrounding the well intake section based on the method of Walton (1962).

The specific capacity test results from the bedrock piezometers are summarized below.

Piezometer	Date	Q (gpm)	t (min)	s (ft)	K (cm/sec)	K (ft/day)
PZR-1R	12/4/97	0.037	277	86.29	8.8E-7	2.5E-3
PZR-2R	12/5/97	0.0055	243	30.36	3.5E-7	9.9E-4
PZR-2DR	11/21/97	0.076	244	41.07	4.5E-6	1.3E-3
PZR-3R	12/8/97	0.29	313	67.45	1.5E-5	4.3E-2
PZR-4R	11/11/97	0.67	114	2.22	9.5E-4	2.7
PZR-4DR	12/4/97	0.11	246	40.93	6.8E-6	1.9E-3
PZR-5R	10/30/97	0.069	312	27.49	6.6E-6	1.9E-3

3.4 Pumping Test Activities

The NTCRA 2 Design and Study process called for a bedrock pumping test to provide data required to support the design of the NTCRA 2 bedrock ground-water containment system. As discussed above, bedrock pumping well RW-1R was found to yield a maximum of approximately 0.25 gpm following extensive development efforts. Also, pumping from well RW-1R had negligible influence at shallow bedrock monitoring well MW-704R, which is within approximately 20 feet of the bedrock pumping well. Therefore, an alternative approach was evaluated to attempt to improve the yield and hydraulic connection of bedrock pumping well RW-1R, which would involve installing an artificial fractured bedrock trench adjacent to the bedrock pumping well. However, during the preparation of plans to install the artificially fractured (blasted bedrock) trench, an overburden pumping test was completed at pumping well RW-13, which is situated within 60 feet of bedrock pumping well RW-1R (see Figure 4). Hydraulic responses measured during the overburden pumping test, between August 17 and 24, 1998, indicated significant hydraulic influence in the overburden and bedrock. These data indicated that pumping overburden well RW-13, in combination with the existing NTCRA 1 Containment System, appear to achieve the bedrock containment requirements of the NTCRA 2 SOW. Thus, while a bedrock pumping test has not been performed, the overburden pumping test provided adequate data to proceed with the NTCRA 2 design process.

Appendix B to the Draft FS Report presented the results of the well RW-13 pumping test in detail, and provided the following information pertinent to the NTCRA 2 Design Investigation.

- Step-Drawdown Test Results for Well RW-13.
- Constant-Rate Pumping Test Field Activities and Results.
- Hydraulic Monitoring in the Overburden NAPL Zone.
- Constant-Rate Pumping Test Data Evaluation.
- RW-13 Pumping Impact on NTCRA 1 Demonstration of Compliance.
- RW-13 Pumping Impact on Wetlands Areas.
- RW-13 Pumping Impact on Private Wells.
- Treatability Assessment.
- Comparison Between Empirical and Simulated Containment Areas.

While Appendix B to the Draft FS Report provides a detailed discussion of the above-listed evaluations, the salient findings of the RW-13 pumping test relating to the NTCRA 2 design for bedrock ground-water containment are discussed below.

BBL compiled the two rounds of comprehensive ground-water elevation measurements, obtained immediately prior to pumping at well RW-13 and prior to the termination of pumping, within the comprehensive ground-water database. These data were used to develop contour maps (Figures 9 and 10) and a north-south oriented cross section (Figure 11) to depict the three-dimensional extent of the hydraulic influence (drawdown) produced by pumping well RW-13 in the bedrock. In addition, the heads measured during pumping were used to prepare shallow and deep bedrock ground-water elevation contour maps (Figures 12 and 13), and a cross section (Figure 14) showing the RW-13 steady-state hydraulic influence and estimated containment area in three dimensions.

The steady-state drawdown and ground-water elevation data measured on the seventh day of the constant rate pumping test were evaluated in two bedrock hydrostratigraphic zones:

- *Shallow bedrock*, which represents approximately the upper 30 feet of bedrock; and
- *Deep bedrock*, which represents a zone between 60 and 90 feet below the top of bedrock.

These zones were designated during the development of the RI Work Plan (BBL, November 1995) based on geology and on the desire to add vertical resolution to the presentation of hydrogeologic data. These two monitored bedrock zones are hydraulically connected and comprise a hydrogeologic continuum from the top of bedrock downward through the deepest monitored bedrock interval. Deeper sections of bedrock, below the deepest monitoring well in the study area, are also interpreted as part of the regional ground water flow system.

3.4.1 Drawdown Contour Maps and Cross Section

The drawdown contour maps presented as Figures 9 and 10 provide an empirical demonstration of the areal extent and magnitude of the steady state pumping influence effected in the bedrock by middle/deep overburden pumping well RW-13 after approximately seven days of pumping (August 17 to August 24, 1998). Figure 11 also shows the drawdown response in cross section. In general, the wells situated furthest from pumping well RW-13 had net drawdown values of approximately 0.0 to 0.1 feet. These data indicate that the overall, regional, background potentiometric change was close to zero. In contrast, higher drawdown values were generally seen in the immediate vicinity of middle/deep overburden pumping well RW-13, with a systematic decrease in drawdown in each of the two monitored bedrock hydrogeologic zones with increasing lateral distance from the pumping well. The key deductions from the drawdown contour maps are summarized below.

- Shallow Bedrock Drawdown (Figure 9)-- Largest response of the two monitored bedrock zones, with maximum drawdown value of approximately 3.2 feet at well MW-704R. Irregular cone of depression extends approximately 600 feet to south and 500 feet west. Extent of hydraulic influence toward north at least 1,100 feet, based on consistent drawdown data at wells P-101A, P-102A, and MW-501A. Extent of influence toward east estimated as at least 400 feet. Some drawdown also observed in the shallow bedrock in Operations Area, where NAPL is known to exist in overburden and suspected in shallow bedrock. Vertical gradient between overburden and shallow bedrock at well clusters P-1A/P-1B and P-2A/P-2B, however, were still upward. Slight downward gradient observed at well cluster P-4A/P-4B, but downward head differential (0.18 ft) negligible compare to historical downward head differential (2.08 ft) measured October 1993.

- Deep Bedrock Drawdown (Figure 10) -- Substantial response, with maximum drawdown value of approximately 1.5 feet at monitoring well MW-704DR and bedrock pumping well RW-1. Irregular cone of depression extends approximately 700 feet to south and 400 feet west. Extent of hydraulic influence toward north likely at least 900 feet. Extent of influence toward east estimated as 500 feet.

The drawdown produced by pumping well RW-13 is also shown on a north-south oriented cross section presented as Figure 11. The biggest hydraulic response was observed in the shallow bedrock in the area beneath the pumping well. Furthermore, Figure 11 shows that the hydraulic influence produced by pumping well RW-13 extended vertically beyond the deepest monitored bedrock zone. The drawdown at deep bedrock monitoring well MW-704DR was 1.5 feet, which was the same drawdown observed in the middle and deep overburden at wells MW-704M and MW-704D. Thus, in spite of the fact that well RW-13 is screened in the middle and deep overburden, this well has a substantial hydraulic influence within the bedrock.

The extent of the hydraulic influence north of pumping well RW-13 in the shallow bedrock is obscured by irregular potentiometric responses in the area east of the NTCRA 1 Containment System, which may be attributed to cycling of the twelve NTCRA 1 overburden pumping wells. These extraction wells have a substantial influence on shallow bedrock heads inside and downgradient of the NTCRA 1 overburden sheet pile wall. Since the NTCRA 1 well influence would likely obscure any interpretation of RW-13 pumping response within the NTCRA 1 Containment Area, the bedrock drawdown data in this area are not contoured on Figures 9 and 10.

3.4.2 Ground-Water Elevations and Estimated Containment Area During Pumping

The bedrock ground-water elevation data measured during the seventh and final day of pumping (August 24, 1998) were contoured as shown on Figures 12 and 13. Figure 14 also shows the steady-state ground-water elevations in cross section. These figures illustrate the approximate, three-dimensional steady-state "capture zone", or "containment area", achieved after one week of pumping 22.5 gpm from middle/deep overburden pumping well

RW-13. The key deductions from the two bedrock ground-water elevation data sets measured during pumping are summarized below.

- Shallow Bedrock Ground-Water Elevations and Estimated Containment Area (Figure 12) --Largest response of the five monitored zones, with potentiometric cone of depression centered about middle/deep overburden pumping well RW-13. Approximately parabolic containment area extends south to stagnation point located approximately 310 feet south of pumping well. Estimated containment area encompasses the majority of the Operations Area and the entire Cianci Property, and extends beneath the Quinnipiac River to the vicinity of Queen Street. A second shallow bedrock containment area is evident in vicinity of NTCRA 1 overburden pumping system, with stagnation point located near well P-6. The bedrock ground-water containment area associated with the NTCRA 1 Containment System is substantial, and contains nearly all of the Operations Area.

- Deep Bedrock Ground-Water Elevations and Estimated Containment Area (Figure 13) --Significant response, with potentiometric cone of depression centered about middle/deep overburden pumping well RW-13. Approximately parabolic containment area extends south to stagnation point located approximately 185 feet south of pumping well. Estimated containment area encompasses the downgradient (east) property line of the Operations Area and the entire Cianci Property, and extends beneath the Quinnipiac River to the vicinity of Queen Street.

These ground-water elevation contour maps indicate that, during steady-state pumping of 22.5 gpm from middle/deep overburden pumping well RW-13, mappable ground-water containment areas were established in the bedrock. This interpretation is illustrated in a north-south-oriented cross section on Figure 14. As depicted on Figure 14, the hydraulic head data measured during the seventh day of pumping indicate that the RW-13 containment area extended up to 310 feet south of pumping well. In addition, the containment area achieved by pumping well RW-13 extended deeper than the interpreted bottom of ground-water regulatory VOC plume within the deep bedrock.

Figure 8 presents an east-west cross section through the NTCRA 1 Containment Area, which shows the interpreted bedrock ground-water containment area achieved by the NTCRA 1 Containment System. As shown on Figure 8, the bedrock ground-water containment area effected by the NTCRA 1 system extends approximately 120 feet downgradient of the NTCRA 1 sheetpile wall and to a depth of approximately 90 feet below the top of bedrock at the Operations Area, where dissolved VOC concentrations are relatively low (tens to hundreds of ug/L total VOCs). Figure 12 shows the estimated plan view perspective of the NTCRA 1 bedrock containment area, which contains the majority of the Operations Area.

As described in Appendix B to the Draft FS Report, the interpreted containment area associated with well RW-13 in shallow and deep bedrock were estimated based partly on ground-water flow modeling results. In addition, BBL calculated the theoretical distance to the stagnation point south of well RW-13, which correlated closely with the modeling results, and is consistent with the overall head distribution measured in the shallow and deep bedrock during pumping from well. These results are presented in Appendix B to the Draft FS Report.

Section 4 below describes additional data acquisition, which is proposed to verify the hydraulic containment effectiveness of bedrock ground water using wells RW-13 and RW-1R.

4. Interim Ground-Water Containment Evaluation

4.1 General

The SRSNE PRP Group proposes additional field activities associated with the development of the final NTCRA 2 design for bedrock ground-water containment. The proposed Interim Ground-Water Containment Evaluation will serve a similar role to the NTCRA 1 design investigation BBL performed between the completion of the NTCRA 1 Technical Memorandum (ENSR, June 1994) and the preparation of the NTCRA 1 100% Design Report (BBL, December 1994). The purpose for the Interim Ground-Water Containment Evaluation will be to provide additional data to verify whether the presumptive NTCRA 2 containment system design (well RW-13 and, potentially RW-1R), will meet the objectives of the NTCRA 2 SOW in the long term. The objectives will be to:

- Obtain select pre-pumping ground-water elevation data;
- Operate well RW-13 continuously for a period of one week and obtain a comprehensive round of ground-water elevation measurements;
- Continue to operate well RW-13 and add pumping from well RW-1R continuously for a period of one week and obtain another comprehensive round of ground-water elevation measurements; and
- Continue to operate RW-13 and well RW-1R while the ground-water elevation data are evaluated and discussed with USEPA and CT DEP (the data will be submitted with the NTCRA 2 100% Design Report.

If the results of the Interim Ground-Water Containment Evaluation confirm that well RW-13 (and potentially RW-1R) will achieve the requirements of the Containment Test specified in the SOW, then the NTCRA 2 implementation will consist mainly of the continued operation of the pumping system with continued treatment at the existing treatment system. If necessary, based on the results of the Interim Ground-Water Containment Evaluation, one or more additional extraction wells will be installed and connected to the ground-water extraction and treatment systems.

The field activities associated with the Interim Ground-Water Containment Evaluation will be performed in general accordance with the existing Project Operations Plan (POP) (BBL, August 1996).

The remainder of Section 4 discusses the proposed Interim Ground-Water Containment Evaluation activities in detail.

4.2 Field Methodology

NTCRA 1 containment monitoring will be performed throughout the Interim Ground-Water Containment Evaluation as part of NTCRA 1 activities, and will be reported in the appropriate Demonstration of Compliance report. Additional data to be obtained during the Interim Ground-Water Containment Evaluation include hydraulic head measurements within the NAPL zones to assess gradient changes, and hydraulic head monitoring to verify the bedrock containment area achieved during pumping. These activities are described below.

4.2.1 NAPL Zone Gradient Monitoring

As with the previous overburden pumping test activities, hydraulic gradients will be monitored at select pairs of wells/piezometers within the potential NAPL zones to assess the potential for NAPL to be remobilized. During the one week pumping test of well RW-13, which was completed between August 17 and 24, 1998, NAPL zone gradients were monitored throughout the test, up to and including the steady-state portion of the test. The results of that monitoring program indicated minimal change in the hydraulic gradients during pumping, as summarized in Table 1. Based on these results, the NAPL zone gradient monitoring during the Interim Ground-Water Containment Evaluation will be performed during the second pumping phase, when the influence of bedrock pumping well RW-1R is added to that of well RW-13.

When pumping from wells RW-13 and RW-1R, hydraulic gradients will be monitored frequently (several times during the first day of pumping from both RW-13 and RW-1R, and twice daily for the remainder of the first week of pumping from both wells) at the following pairs of piezometers within the NAPL zones to reduce the potential that NAPL would be mobilized due to the combined pumping influence of wells RW-13 and RW-1R. The number associated with each pair listed below is the maximum historical head differential measured at the pair, expressed as the head at the first location minus the head at the second location. This head differential will be considered a limit not to be exceeded during the Interim Ground-Water Containment Evaluation.

Bedrock Horizontal Gradient Monitoring (in Bedrock Potential NAPL Zone)

- P-6 and P-11A: 1.90 feet
- CPZ-3R and CPZ-4R: 2.60 feet

Overburden/Bedrock Vertical Gradient Monitoring (in Overburden Potential NAPL Zone)

- P-11B/P-11A: -0.63 feet (upward)
- MW-413/MW-414: 3.38 feet (downward)
- CPZ-4/CPZ-4R: -2.19 feet (upward)

If at any time during pumping, the head differential between each pair of wells/piezometers reaches the maximum relative head differential observed historically within each pair, the pumping rate(s) will be reduced or pumping will be terminated. However, a key objective of pumping-test data acquisition will be to obtain a final round of ground-water elevation measurements prior to the cessation of pumping. Therefore, the relative head differentials will be monitored frequently to assess the rate of change, if any, and allow for the final, comprehensive round of data collection before the relative gradient becomes excessive within the NAPL zones.

After the first two weeks of the Interim Ground-Water Containment Evaluation, the hydraulic conditions should be at steady state such that subsequent NAPL zone hydraulic gradient monitoring is not required.

4.2.2 Additional Manual Ground-Water Elevation Monitoring

The most significant area to monitor hydraulic heads to deduce the hydraulic containment area effected during pumping will be the area downgradient (south) of the two pumping wells to be used during the Interim Ground-Water Containment Evaluation (RW-13 and RW-1R). Recall that the NTCRA 1 compliance criteria specified a reversal of gradient test to demonstrate hydraulic containment. Similarly, it is reasonable to expect that hydraulic gradient reversal will be appropriate to demonstrate NTCRA 2 containment. As described in detail in Appendix B to the Draft FS Report, the containment areas achieved in each hydrostratigraphic zone during pumping from well RW-13 in August 1998 were deduced based on three lines of evaluation: 1) the calculated location of the stagnation point based on interpolation between points with known (measured) initial heads and drawdown; 2) ground-water flow modeling using the NTCRA 2 MODFLOW model; and 3) the general distribution of heads during pumping. All three of these approaches demonstrated a reversal of gradient extending to a similar location, hundreds of feet south of pumping well RW-13 in each stratigraphic zone. The key remaining question is whether the stagnation point location estimated from the pumping test of RW-13 is consistent through time.

Water-Level Measurements Before Pumping

One of the simplest ways to evaluate the consistency of the stagnation point downgradient of the pumping well(s) and, therefore, the robustness of the containment area effected during pumping, is to verify the hydraulic head data measured during the pumping test of well RW-13 along the line south from the pumping well. To provide the appropriate data, to BBL will obtain manual water levels measurements immediately prior to pumping at the key bedrock wells/piezometers previously used to calculate the stagnation point location (see Appendix B of the Draft FS Report), namely:

- Shallow Bedrock Wells/Piezometers--MW-704R, PZR-2R, and MW-707R; and
- Deep Bedrock Wells/Piezometers--MW-704DR, PZR-2DR, and MW-707DR.

These data will provide the basis to calculate and interpolate the pre-pumping gradient, the drawdown between measurement points, and the stagnation point location during pumping. BBL will install pressure transducers and data loggers at these same bedrock wells/piezometers to obtain relatively continuous hydraulic head data, as described below. Also, supplemental pre-pumping ground-water elevation measurements will be obtained manually at the following overburden wells and piezometers along the line extending south of the pumping well(s) to support calculation of the stagnation point location in the overburden:

- Middle Overburden Wells/Piezometers--MW-704M, PZO-2M, and MW-3; and
- Deep Overburden Wells/Piezometers--MW-704D, PZO-2D, and MW-707D.

The shallow overburden zone will not be evaluated for the stagnation point location because the shallow overburden plume, as delineated in the final RI Report (BBL, June 1998), does not extend to the location of pumping wells RW-13/RW-1R.

Water-Level Measurements During Pumping

The main body of hydraulic head data that will be collected during the Interim Ground-Water Containment Evaluation will be extensive, manual measurement rounds on the seventh day of pumping from RW-13, and again on the seventh day of pumping from both RW-13 and RW-1R. These data sets will include data from all accessible overburden and bedrock wells/piezometers in the following areas/clusters:

- Town of Southington Well Field Property;
- east of Queen Street;
- between Queen Street and River (MW-501 and P-101/MW-706 series);
- west of Operations Area (P-8/MW-702, MW-209, and PZO/PZR-6 series); and
- the remaining wells/piezometers shown on Geologic Cross Section B-B' (Figures 11 and 14).

These data will be presented as contour maps in the NTCRA 2 100% Design Report to support the following evaluations:

- the hydraulic head distribution established during pumping from one or both wells; and
- the additional drawdown created due to pumping well RW-1R;

In addition, the extensive water-level measurement rounds will provide hydraulic heads along the line downgradient from the pumping well(s) during pumping, which will be used to calculate:

- the stagnation point location in the shallow and deep bedrock during pumping from well RW-13 alone; and
- the stagnation point location in the shallow and deep bedrock during pumping from well RW-13 and RW-1R.

These calculations will also be presented in the NTCRA 2 100% Resign Report, and will be used to help delineate the bedrock containment areas achieved by pumping from well RW-13, and wells RW-13/RW-1R.

4.2.3 Transducer/Data Logger Ground-Water Elevation Monitoring

To provide continuous data to evaluate the consistency of the stagnation point location downgradient from the pumping well(s), BBL will install pressure transducers and data loggers at the key bedrock wells previously used to calculate the stagnation point location (see Appendix B of the Draft FS Report), namely:

- Shallow Bedrock Wells/Piezometers--MW-704R, PZR-2R, and MW-707R; and
- Deep Bedrock Wells/Piezometers--MW-704DR, PZR-2DR, and MW-707DR.

Data recording at these locations will begin one week prior to the initiation of pumping to record the "average" pre-pumping hydraulic gradients along the line south of the pumping wells. Data recording will continue through the completion of the two week pumping period using well RW-13, and then wells RW-13 and RW-1R. The transducer data will provide a basis to calculate and interpolate the pre-pumping gradient, the head change induced between measurement points during pumping (apparent drawdown), and the stagnation point location during pumping. It is important to note that the inference of the stagnation point location is not sensitive to background fluctuations. Whether the overall "background", regional potentiometric surface rises or falls due to precipitation, barometric pressure changes, etc., the stagnation point location can still be evaluated by recording the heads only at the locations listed above.

During the RW-13 pumping test, apparent drawdown values of approximately 0.5 feet were measured in the bedrock beneath the Operations Area. The cause for the apparent drawdown in the Operations Area could potentially be attributed to either the RW-13 pumping influence, or the hydraulic influence of the twelve NTCRA 1 ground-water extraction well pumps, which cycle on and off based on float-switch controls. To help differentiate these influences, a pressure transducer and data logger will be installed at bedrock monitoring well P-2A approximately one week prior to the start of pumping from well RW-13 to continuously record hydraulic head conditions in the bedrock in the SRSNE Operations Area. These data will provide a record of the NTCRA 1 pumping system influence, if any. Data recording will continue at well P-2A through the completion of pumping from well RW-13 for one week, and pumping from wells RW-13 and RW-1R for one week. These data will be presented as a hydrograph in the NTCRA 2 100% Design Report to show the NTCRA 1 system influence, if any, and deduce whether any discernable changes occur upon start-up of well RW-13 or well RW-1R.

4.2.4 Pumping from Well RW-13

After obtaining a week of transducer data from well P-2A, and manually measuring water levels and installing pressure transducers at the six wells listed above, pumping will be started at well RW-13. The pump will be operated at a relatively constant rate of approximately 22.5 gpm for a period of one week of pumping. On the seventh day of pumping from well RW-13, an extensive round of ground-water elevation measurements will be obtained as described above in Section 4.2.2.

4.2.5 Pumping From Wells RW-13 and RW-1R

Pumping will then be started at well RW-1R (rate expected to be less than 1 gpm), and continued at well RW-13 (approximately 22.5 gpm). Pumping at both wells will continue for a period of one week. On the seventh day of pumping from wells RW-13 and RW-13, an extensive round of ground-water elevation measurements will be obtained as described above in Section 4.2.2.

4.2.6 Pumping System Specifications

To convey pumped water to the NTCRA 1 treatment system during the Interim Ground-Water Containment Evaluation, a force main and electrical wire will be installed in a trench from the NTCRA 1 treatment building to the well RW-13/RW-1R area. Specifications for the force main, electrical supply, well pumps, and controls will be presented to USEPA under separate cover prior to field mobilization.

4.3 Data Presentation

The data obtained during the Interim Ground-Water Containment Evaluation will be presented in the NTCRA 2 100% Design Report. The following data evaluation summaries will be included in this analysis:

- ground-water elevation contour maps for the shallow and deep bedrock during pumping from well RW-13 alone, with estimated containment area boundary;
- cross section with ground-water elevation contours during pumping from well RW-13 alone, with the estimated containment area boundary;
- drawdown contour maps for the shallow and deep bedrock illustrating the difference in steady-state heads between well RW-13 pumping alone and wells RW-13 and RW-1R pumping together, which will summarize the pumping influence attributable the well RW-1R;
- cross section with contours of the difference in steady-state heads between well RW-13 pumping alone and wells RW-13 and RW-1R pumping together; which will summarize the pumping influence attributable the well RW-1R in cross section;
- ground-water elevation contour maps for the shallow and deep bedrock during pumping from wells RW-13 and RW-1R together, with the estimated containment area boundary;
- cross section with ground-water elevation contours during pumping from wells RW-13 and RW-1R together, with estimated containment area boundary;
- calculations of the stagnation point location in the shallow and deep bedrock during pumping from well RW-13 alone;
- calculations of the stagnation point location in the shallow and deep bedrock during pumping from wells RW-13 and RW-1R together; and
- hydrographs of the transducer data obtained from the three shallow bedrock and three deep bedrock wells/piezometers situated along the line extending downgradient (south) from the pumping wells, and one shallow bedrock well situated in the Operations Area.

These data evaluations will provide the basis to verify the steady-state bedrock ground-water containment area achieved by well RW-13 pumping alone, and the composite containment area achieved by wells RW-13 and RW-1R pumping together. These evaluations will also illustrate the additional benefits of pumping from well RW-1R.

4.4 Schedule

This NTCRA 2 Technical Memorandum will be submitted to USEPA by November 24, 1998. Following USEPA review, this NTCRA 2 Technical Memorandum will be revised, if necessary, and resubmitted to USEPA as a final document. The NTCRA 2 100% Design Report will be submitted to USEPA within 90 days following USEPA approval of the final NTCRA 2 Technical Memorandum. Assuming a one-month USEPA review/comment period on this draft NTCRA 2 Technical Memorandum and a two-week USEPA review/approval period for the final NTCRA 2 Technical Memorandum, the NTCRA 2 100% Design Report will be submitted to USEPA by May 21, 1999.

5. Summary and Conclusions

This Technical Memorandum fulfills the requirements specified in the NTCRA 2 SOW for reporting on the NTCRA 2 Design Investigation, and proposes a plan to obtain additional data to verify the conclusions derived from the investigation. Many of the data evaluations required for the NTCRA 2 Deign Investigation are provided by reference to Appendix B of the Draft FS Report, which contains a detailed analysis of the data obtained during the pumping test performed at overburden well RW-13 in August 1998.

Hydraulic responses measured during the overburden pumping test indicated significant hydraulic influence in the overburden and bedrock. These data indicated that pumping overburden well RW-13, in combination with the existing NTCRA 1 Containment System, appear to achieve the requirements for bedrock ground-water containment described the NTCRA 2 SOW.

The proposed Interim Ground-Water Containment Evaluation will be performed to verify the bedrock containment area achieved by well RW-13, and assess the additional hydraulic containment that may be achieved by pumping from bedrock well RW-1R. The results of the Interim Ground-Water Containment Evaluation will be presented in the NTCRA 2 100% Design Report, which (assuming expeditious agency review/comment/approval) will be submitted to USEPA by May 21, 1999.

6. References

Blasland, Bouck & Lee, Inc. (BBL). Remedial Investigation Work Plan, Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut, November 1995.

Blasland, Bouck & Lee, Inc. (BBL). Project Operations Plan, Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut, August 1996.

Blasland, Bouck & Lee, Inc. (BBL). Design and Study Work Plan: Non-Time-Critical Removal Action No. 2, Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut, August 1996.

Blasland, Bouck & Lee, Inc. (BBL). NTCRA 2 Interim Technical Memorandum submitted to Ms. Sheila Eckman, United States Environmental Protection Agency. September 25, 1997.

Blasland, Bouck & Lee, Inc. (BBL). Design and Study Work Plan Addendum No.5, Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut, April 27, 1998

Blasland, Bouck & Lee, Inc. (BBL). Remedial Investigation Report, Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut, June 1998.

Blasland, Bouck & Lee, Inc. (BBL). Draft Feasibility Study Report, Solvents Recovery Service of New England, Inc. Superfund Site, Southington, Connecticut, November 1998.

ENSR Consulting and Engineering. Groundwater Technical Memorandum, Soils Study Report, and Additional Studies Report for the SRSNE Superfund Site. June 1994.

Walton, W.C. Selected Analytic Methods for Well and Aquifer Evaluation. Illinois State Water Survey. Bulletin 49. 1962.

Tables

DRAFT

TABLE 1

SRSNE SITE
SOUTHINGTON, CONNECTICUT
NTCRA 2 TECHNICAL MEMORANDUM

OBSERVED HYDRAULIC GRADIENT CHANGES IN NAPL ZONES AND NTCRA 1 AREA DURING OVERBURDEN PUMPING TEST AT WELL RW-13

Well ID.	Distance (ft)	Observed Pre-Pumping Gradient*	Observed Drawdown (ft)	Observed Gradient Change	Estimated Pumping Gradient**
Overburden Horizontal Gradient Assessment					
TW-7A	102	0.046	-0.13	**-0.002**	0.044
CPZ-6			-0.37		
CPZ-4A	56	0.062	0.28	**0.000**	0.062
CPZ-4			0.28		
Bedrock Horizontal Gradient Assessment					
P-6	111	0.017	0.24	**0.0032**	0.020
P-11A			0.59		
CPZ-3R	81	0.032	0.09	**0.002**	0.034
CPZ-4R			0.26		

Notes

This tables reflects head changes before and after observed drawdowns associated with pumping from well RW-13 at 22.5 gpm.

* Pre-pumping gradients are the maximum observed during historical ground-water elevation measurement rounds between March 1995 and August 1998.

** Estimated pumping gradients are sum of maximum observed pre-pumping gradient and observed gradient changes during pumping.

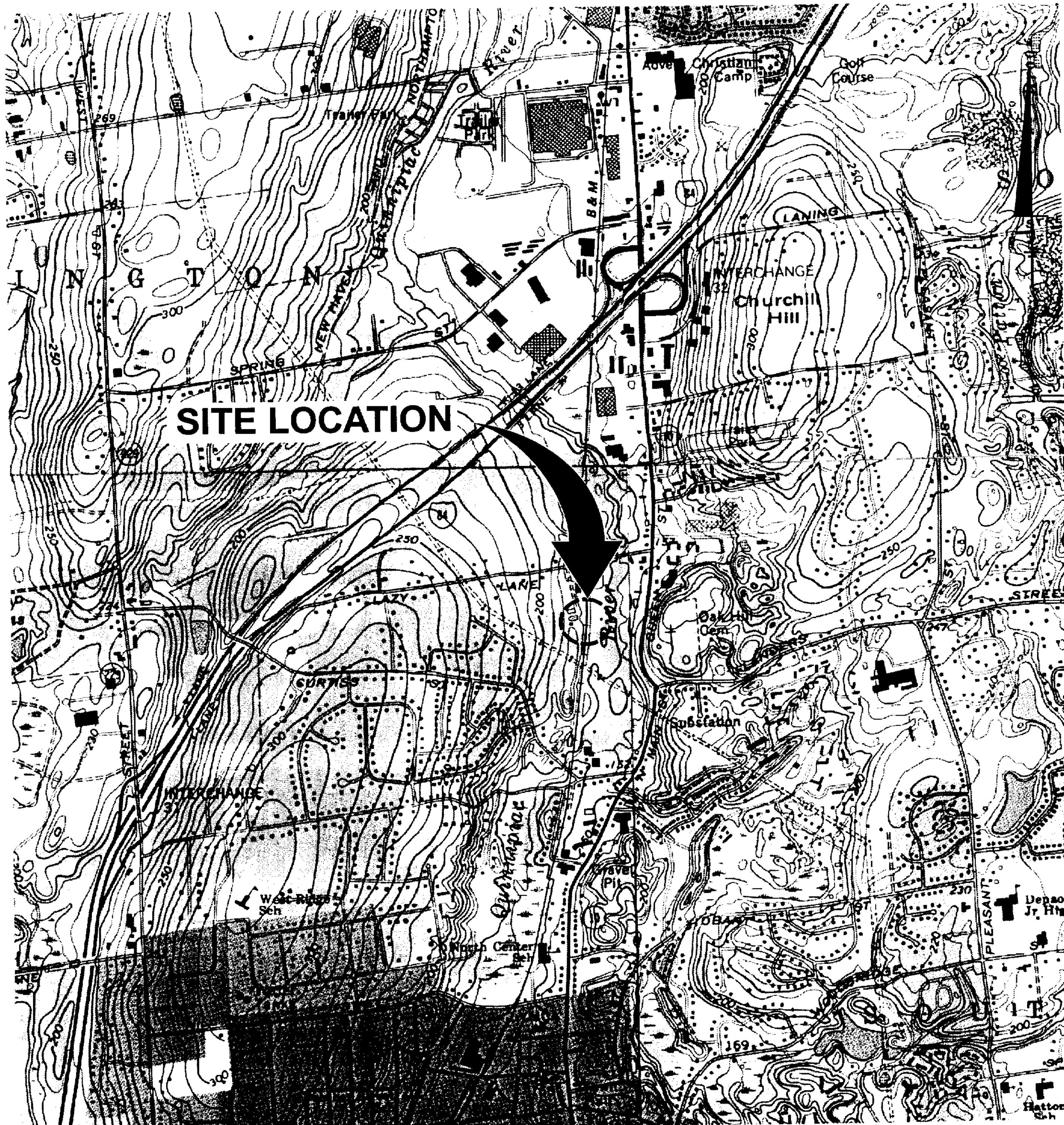
Observed drawdown at key NTCRA 1 compliance piezometers include:

CPZ-1: 0.23 feet;
CPZ-2: 0.45 feet;
CPZ-3: 0.02 feet; and
CPZ-4: 0.28 feet.

The resulting changes in head differentials are -0.22 feet at the CPZ-1/CPZ-2 compliance pair and -0.26 feet at the CPZ-3/CPZ-4 compliance pair. These minor changes did not impact NTCRA 1 Demonstration of Compliance.

Figures

Figures

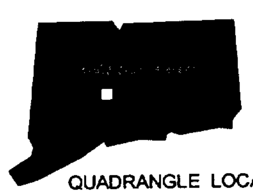


REFERENCE: SOUTHINGTON, CONN. USGS QUAD. 1968 PR 1992, MERIIDAN, CONN. USGS QUAD. 1966 PR 1984, NEW BRITIAN, CONN. USGS QUAD. 1966 PR 1984, & BRISTOL, CONN. USGS QUAD 1967 PR 1984.

2000' 0 2000'

APPROX. SCALE: 1" = 2000'

DRAFT



QUADRANGLE LOCATION

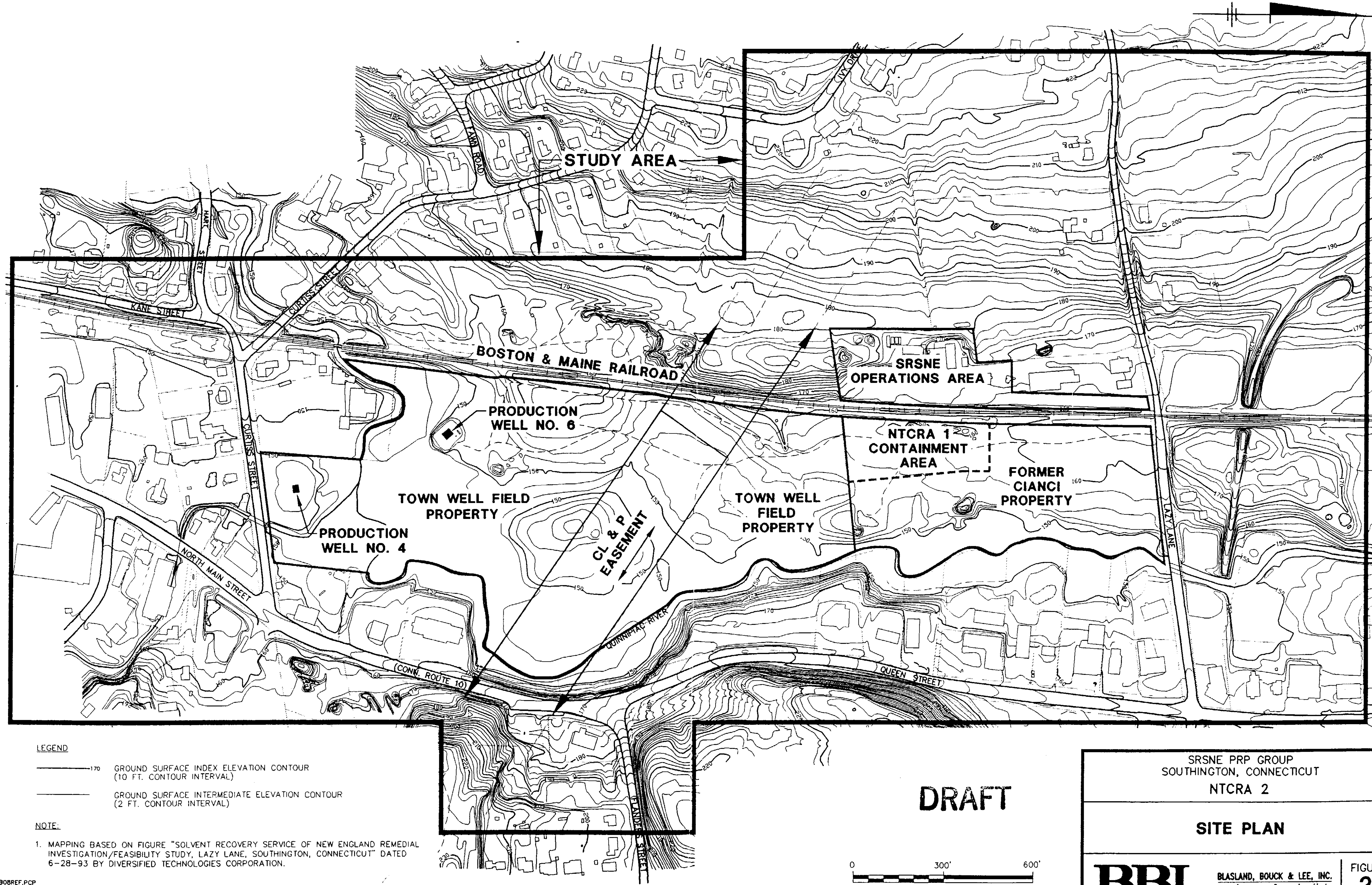
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2

SITE LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE 1

11/98 SYR D54-DJH
08331013/08331N03.cdr



LEGEND

170 GROUND SURFACE INDEX ELEVATION CONTOUR (10 FT. CONTOUR INTERVAL)

GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

DJBOBREF.PCP
X: 08325X00,08325X01:L: OFF: REF*,(XREF X01:PIPES)
8/12/96 SYR-54-DMW
08331011/08331G01.DWG

DRAFT

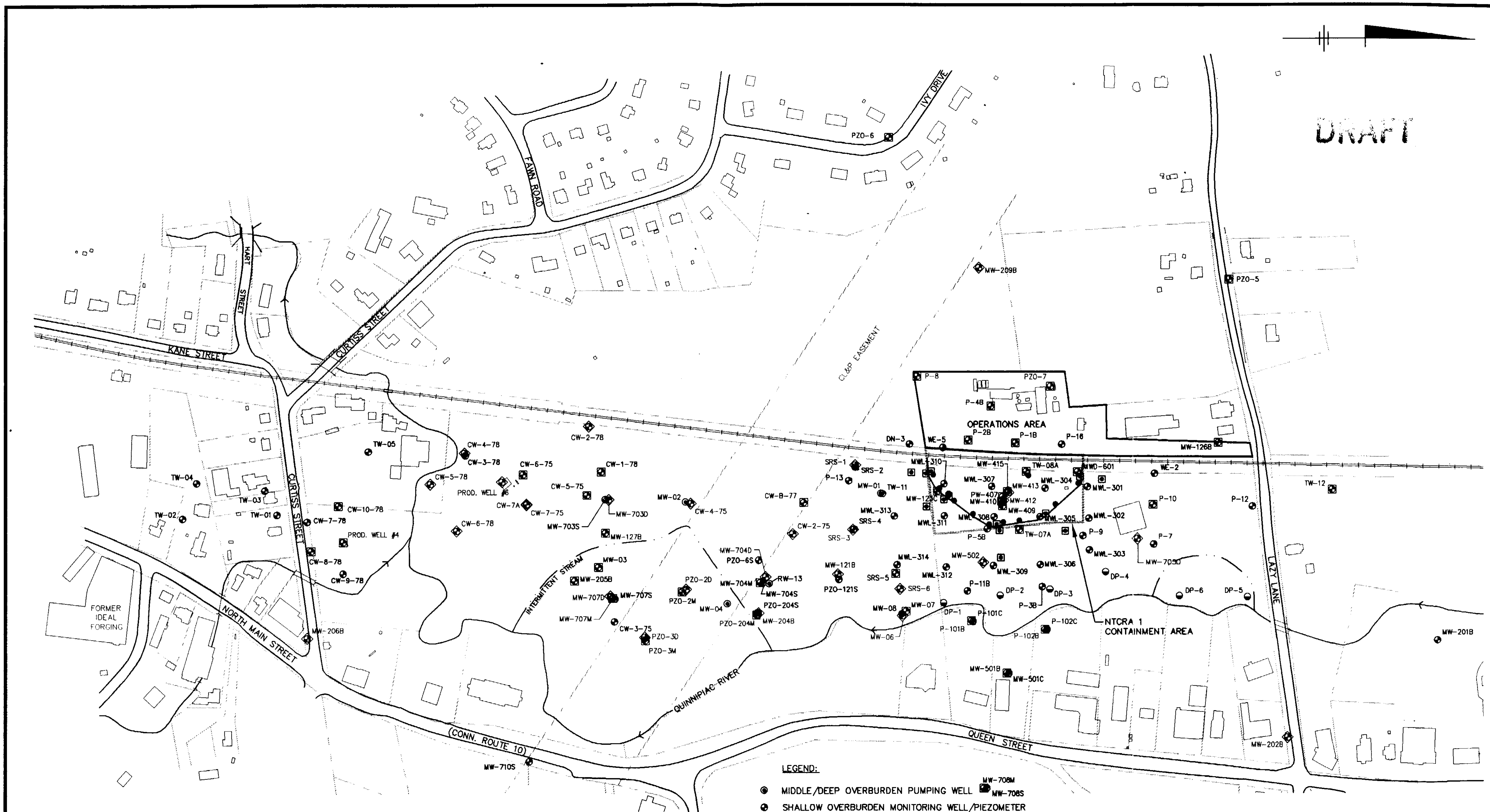
0 300' 600'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2

SITE PLAN

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 2



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

LEGEND:

- MIDDLE/DEEP OVERBURDEN PUMPING WELL (MW-708M, MW-708S)
- SHALLOW OVERBURDEN MONITORING WELL/PIEZOMETER
- MIDDLE OVERBURDEN MONITORING WELL/PIEZOMETER
- DEEP OVERBURDEN MONITORING WELL/PIEZOMETER
- OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
- NTCRA 1 EXTRACTION WELL
- NTCRA 1 COMPLIANCE PIEZOMETER
- NTCRA 1 WETLAND DRIVEPOINT

0 300' 600'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

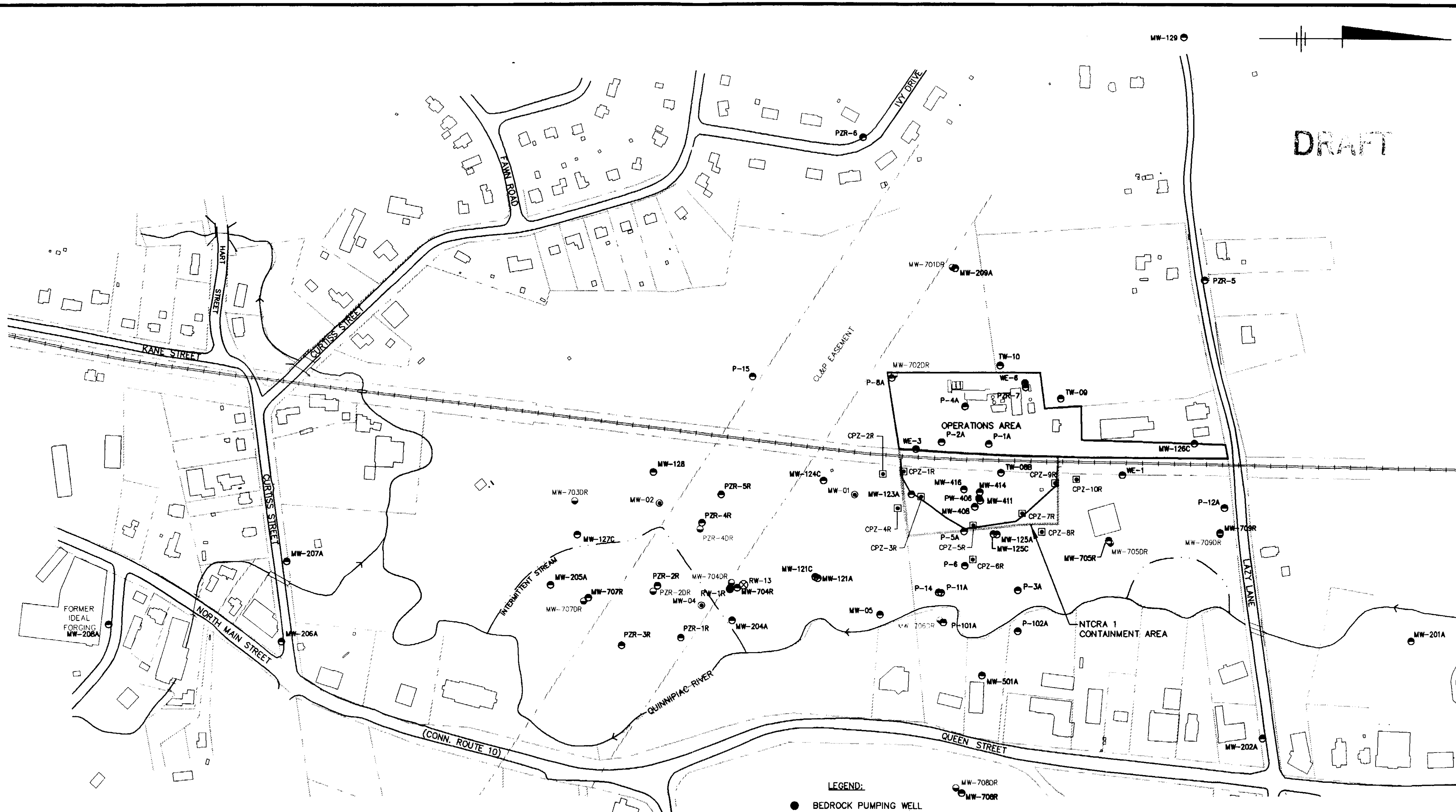
NTCRA 2

OVERBURDEN WELL, PIEZOMETER, AND DRIVEPOINT LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 3

P:STD-DL.PCP @ E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01
11/9/98 SYR-54-RLP,PGL,JMS
08331013/08331B01.DWG



LEGEND:

- ● BEDROCK PUMPING WELL
- ◉ OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
- ◓ SHALLOW BEDROCK MONITORING WELL/PIEZOMETER
- ◒ DEEP BEDROCK MONITORING WELL/PIEZOMETER
- ▣ SHALLOW BEDROCK PIEZOMETER (NTCRA 1)
- ⊗ MIDDLE/DEEP OVERBURDEN PUMPING WELL

0 300' 600'

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

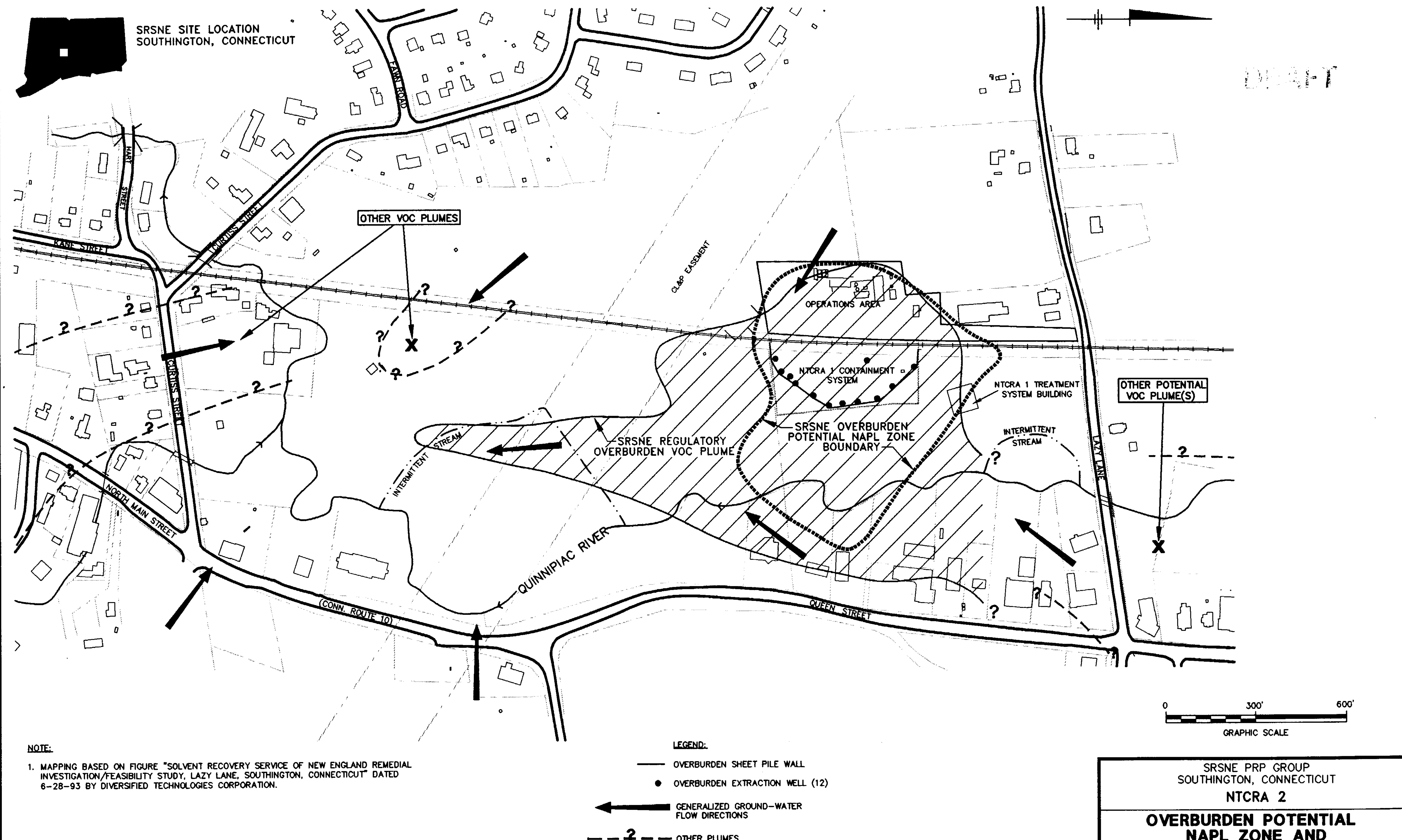
P:STD-DL.PCP @ E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01
11/4/98 SYR-54-PGL, DMW, PGL
08331006/08331B02.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2

BEDROCK WELL AND PIEZOMETER LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 4



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

L: ON=*; OFF=REF*
P: STD-BL
11/10/98 SYR-54-PGL JMS
08331013/08331T04.DWG

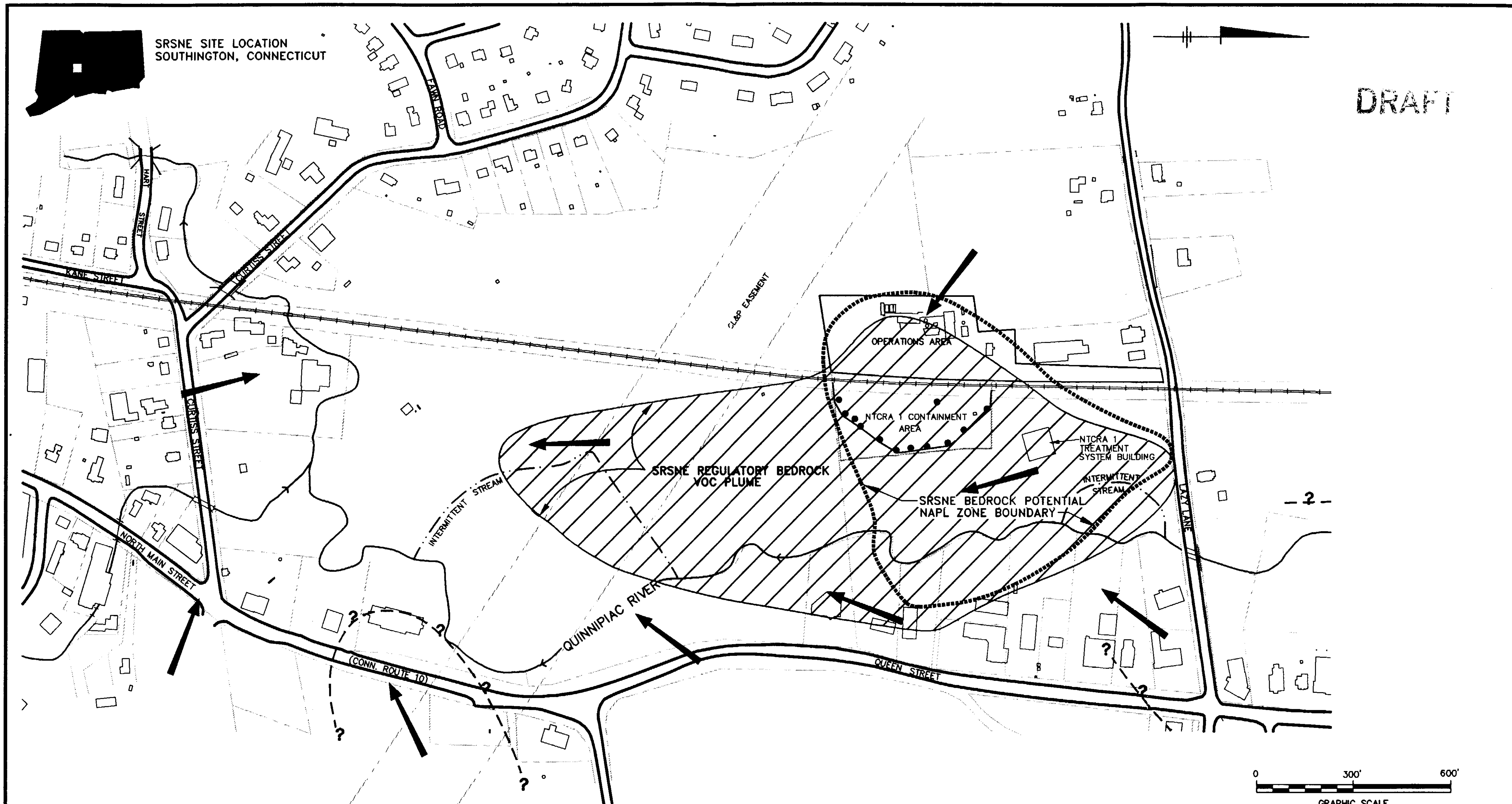
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

OVERBURDEN POTENTIAL NAPL ZONE AND REGULATORY VOC PLUME

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 5



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

LEGEND:

- OVERBURDEN SHEET PILE WALL
- ● OVERBURDEN EXTRACTION WELL (12)
- GENERALIZED GROUND-WATER FLOW DIRECTIONS
- — — 2 — — OTHER PLUMES

L: ON=*; OFF=REF*
P: STD-BL
11/10/98 SYR-54-PGL JMS
08331013/08331T03.DWG

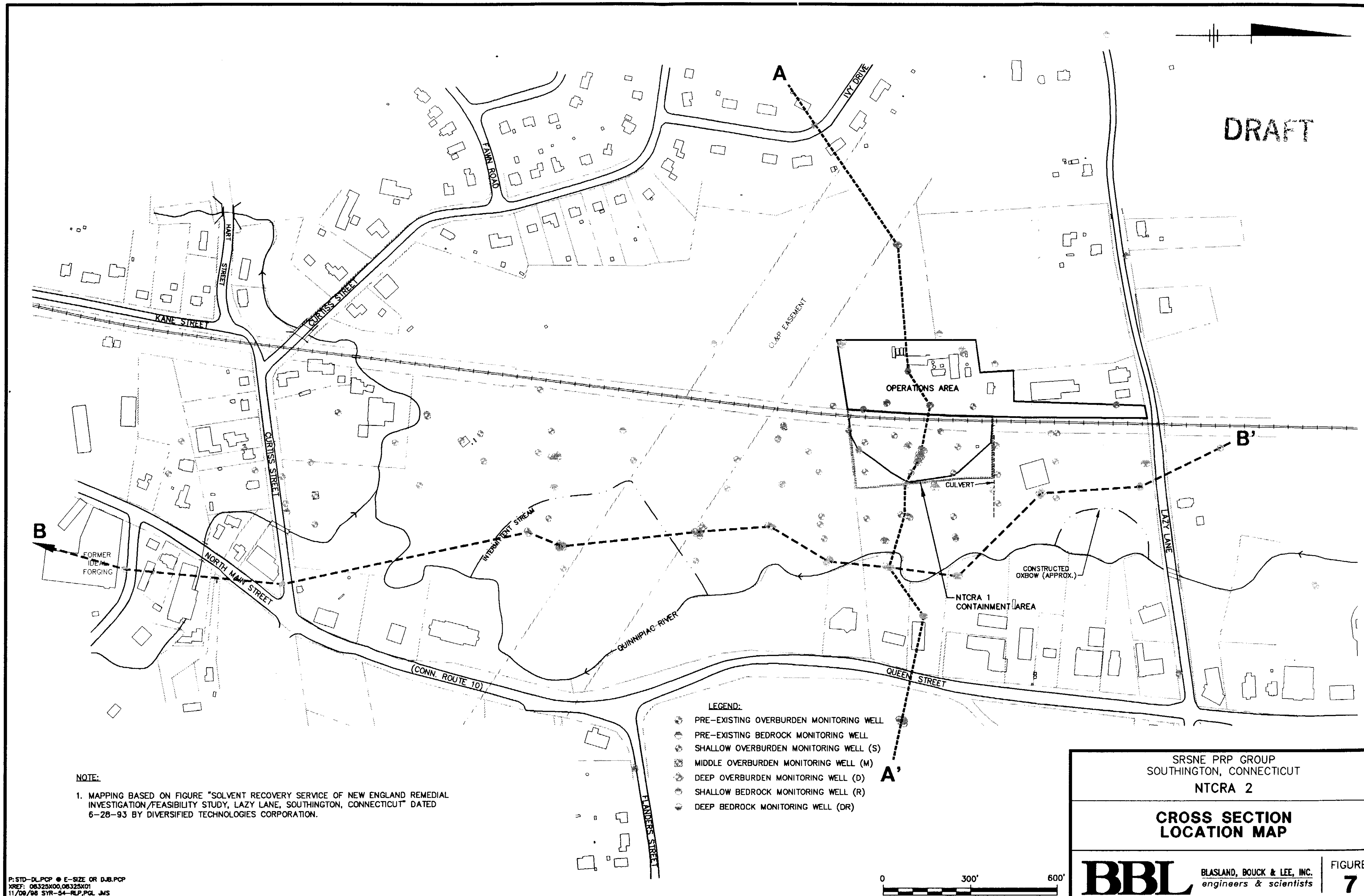
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

BEDROCK POTENTIAL NAPL ZONE AND REGULATORY VOC PLUME

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 6



NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

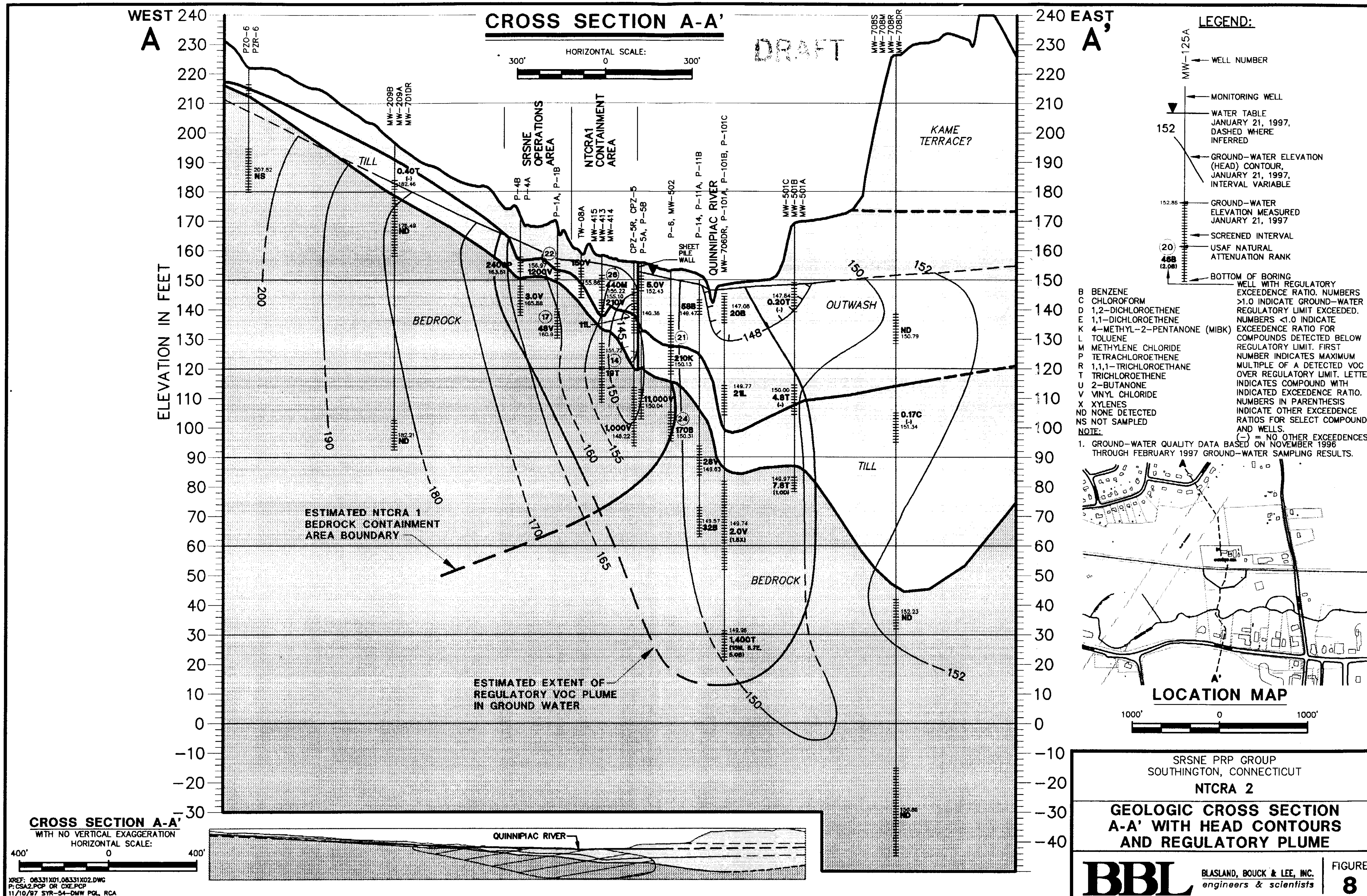
NTCRA 2

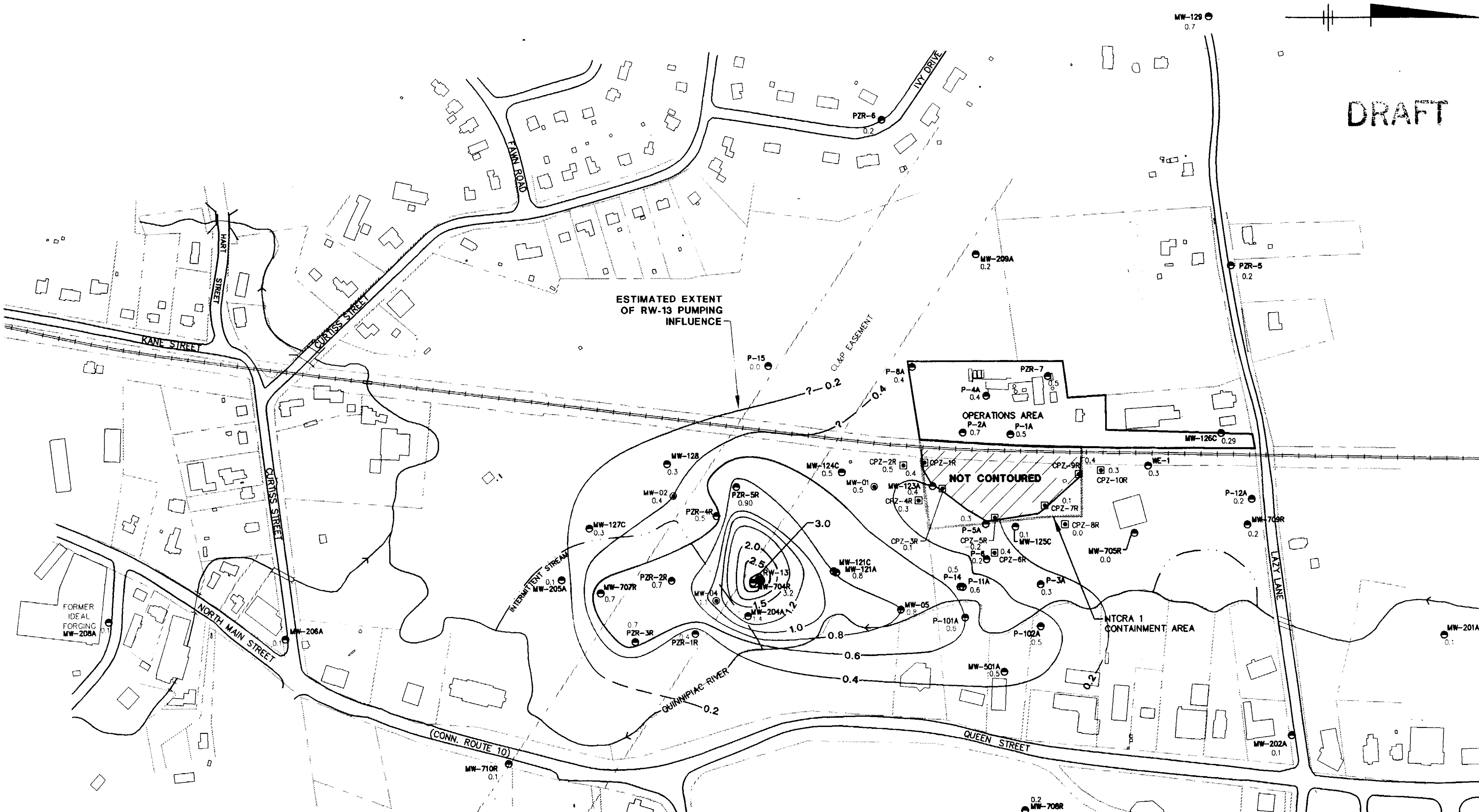
CROSS SECTION LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 7

P:STD-DL.PCP ● E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01
11/09/98 SYR-54-RLP.PGL JMS
08331013/08331B22.DWG


CROSS SECTION A-A'
HORIZONTAL SCALE:
300' 0 300'
DRAFT
WEST A
EAST A'
ELEVATION IN FEET
PZO-6 PZR-6
MW-209B MW-209A MW-701DR
SRSNE OPERATIONS AREA
NTCRA1 CONTAINMENT AREA
P-4B P-4A
P-1A, P-1B
TW-08A
MW-415 MW-413 MW-414
CPZ-5R, CPZ-5
P-5A, P-5B
P-6, MW-502
P-14, P-11A, P-11B
QUINNIPIAC RIVER
MW-706DR, P-101A, P-101B, P-101C
MW-501C MW-501B MW-501A
MW-708S MW-708M MW-708R MW-708DR
SHEET PILE WALL
KAME TERRACE?
OUTWASH
TILL
BEDROCK
ESTIMATED NTCRA 1 BEDROCK CONTAINMENT AREA BOUNDARY
ESTIMATED EXTENT OF REGULATORY VOC PLUME IN GROUND WATER
CROSS SECTION A-A'
WITH NO VERTICAL EXAGGERATION
HORIZONTAL SCALE:
400' 0 400'
QUINNIPIAC RIVER
XREF: 08331X01,08331X02.DWG
P: CSA2.PCP OR CXE.PCP
11/10/97 SYR-54-DMW PGL, RCA
08331013/08331VA2.DWG
LEGEND:
MW-125A — WELL NUMBER
MONITORING WELL
WATER TABLE JANUARY 21, 1997, DASHED WHERE INFERRED
152 — GROUND-WATER ELEVATION (HEAD) CONTOUR, JANUARY 21, 1997, INTERVAL VARIABLE
152.86 — GROUND-WATER ELEVATION MEASURED JANUARY 21, 1997
SCREENED INTERVAL
(20) — USAF NATURAL ATTENUATION RANK
BOTTOM OF BORING
468 (2.08) — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT. LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO. NUMBERS IN PARENTHESIS INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS. (-) = NO OTHER EXCEEDENCES.
B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
K 4-METHYL-2-PENTANONE (MIBK)
L TOLUENE
M METHYLENE CHLORIDE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NONE DETECTED
NS NOT SAMPLED
NOTE:
1. GROUND-WATER QUALITY DATA BASED ON NOVEMBER 1996 THROUGH FEBRUARY 1997 GROUND-WATER SAMPLING RESULTS.
LOCATION MAP
1000' 0 1000'
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2
GEOLOGIC CROSS SECTION A-A' WITH HEAD CONTOURS AND REGULATORY PLUME
BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists
FIGURE 8



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.
2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LEGEND:

- ◉ OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
- ● MIDDLE/DEEP OVERBURDEN PUMPING WELL
- ◒ SHALLOW BEDROCK MONITORING WELL/PIEZOMETER
- ▣ SHALLOW BEDROCK PIEZOMETER (NTCRA 1)
- 0.20 DRAWDOWN (FT)
- 0.2 —— DRAWDOWN CONTOUR (FT), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

0 300' 600'

P:STD-DL.PCP ● E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01
10/16/98 SYR-54-PGL, DMW, PGL
08331013/08331SM3.DWG

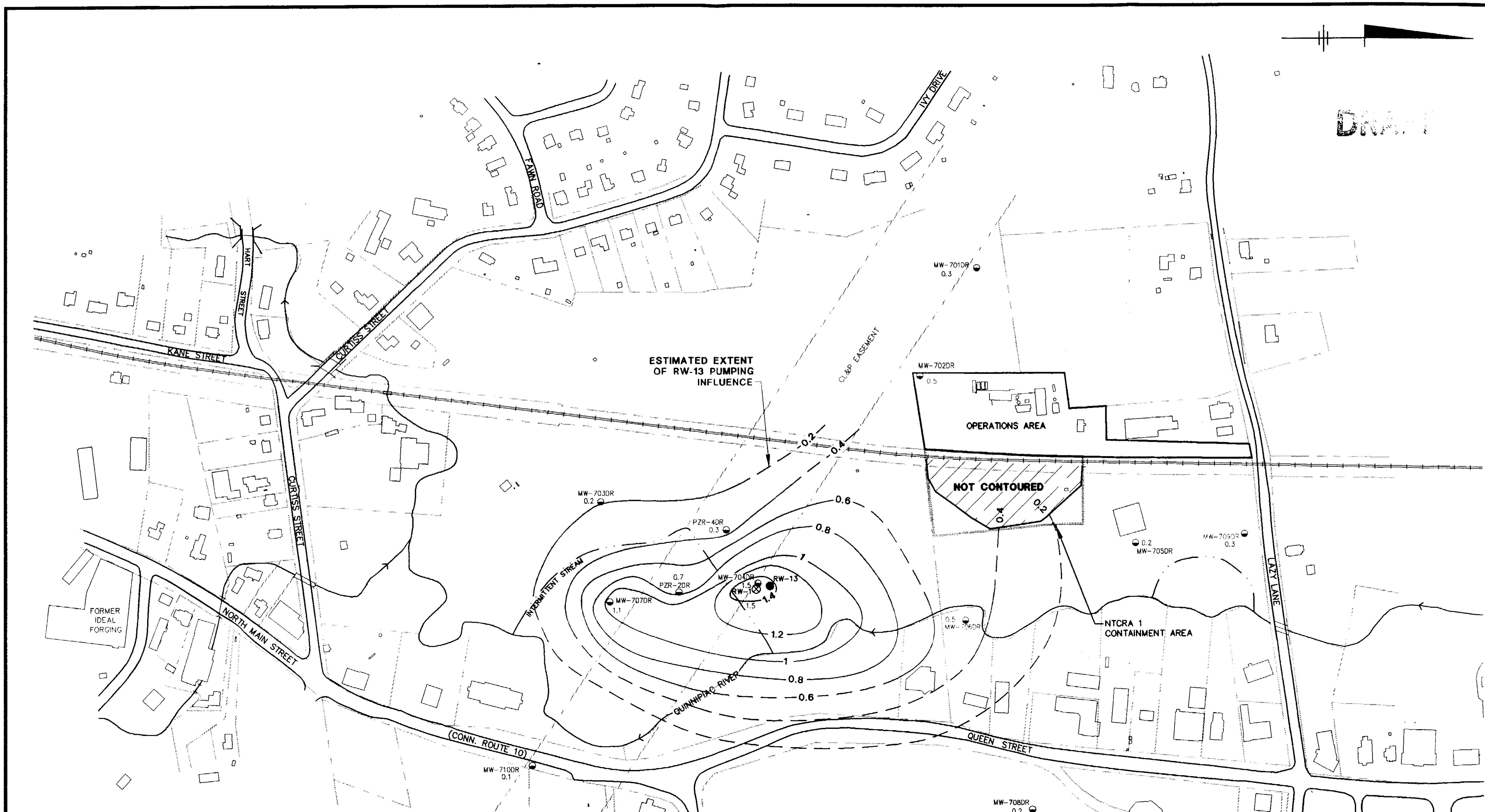
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

SHALLOW BEDROCK DRAWDOWN CONTOURS, 8/24/98 (PUMPING)

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 9



NOTES:

1. WELLS WITHIN NTCRA 1 SHEETPILE WALL NOT CONTOURED.
2. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
3. THESE DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LEGEND:

- ● MIDDLE/DEEP OVERBURDEN PUMPING WELL
- ⊗ BEDROCK PUMPING WELL
- ◒ DEEP BEDROCK MONITORING WELL/PIEZOMETER
- 0.21 DRAWDOWN (FT)
- 0.2 ——— DRAWDOWN CONTOUR (FT), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

0 300' 600'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

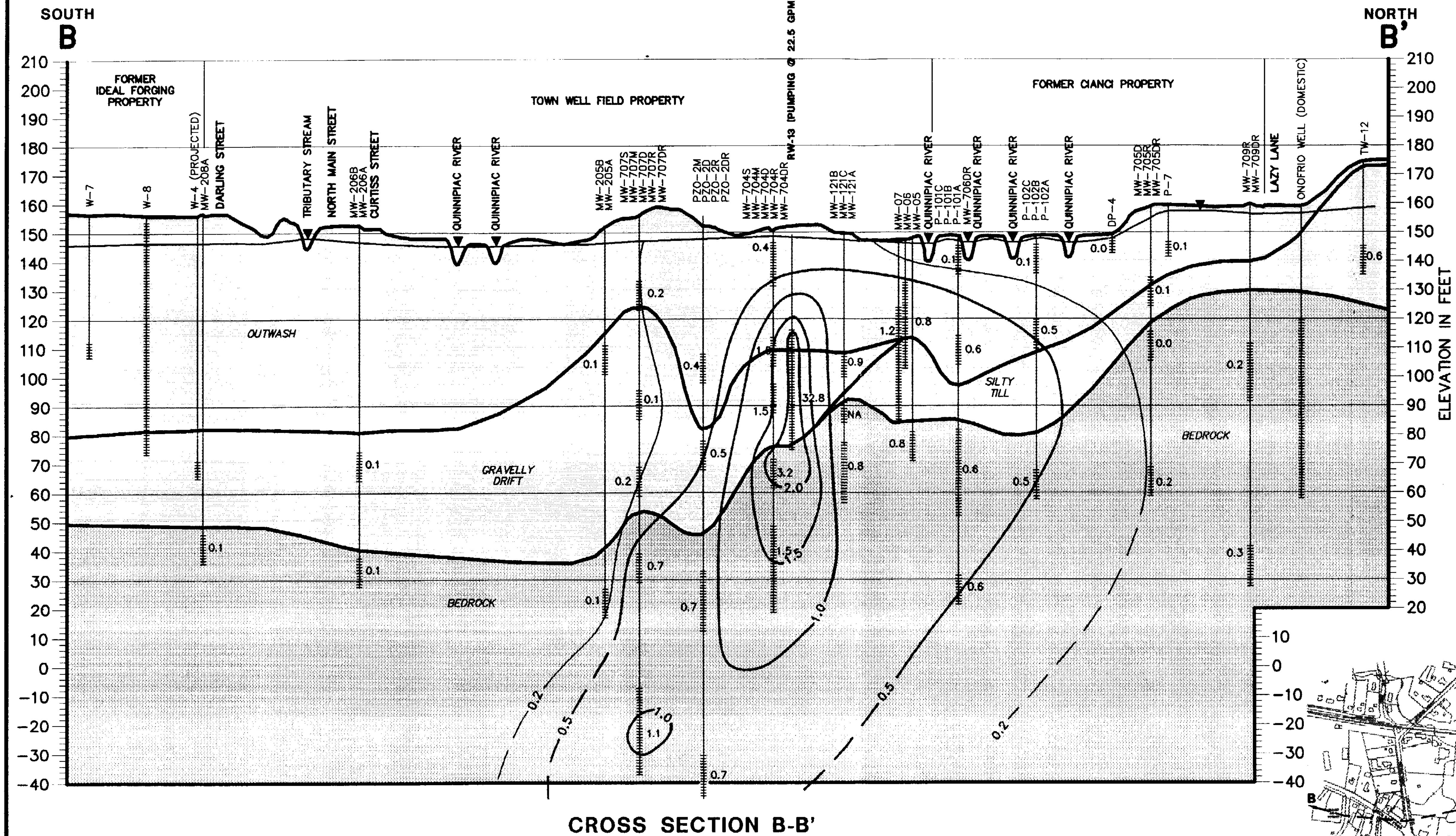
NTCRA 2

DEEP BEDROCK DRAWDOWN CONTOURS, 8/24/98 (PUMPING)

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 10

X: 08325X00,08325X01.DWG
P: STD-DL.PCP ● E-SIZE OR DJB.PCP
10/16/98 SYR-54-PGL, DMW, PGL
08331013/08331S10.DWG

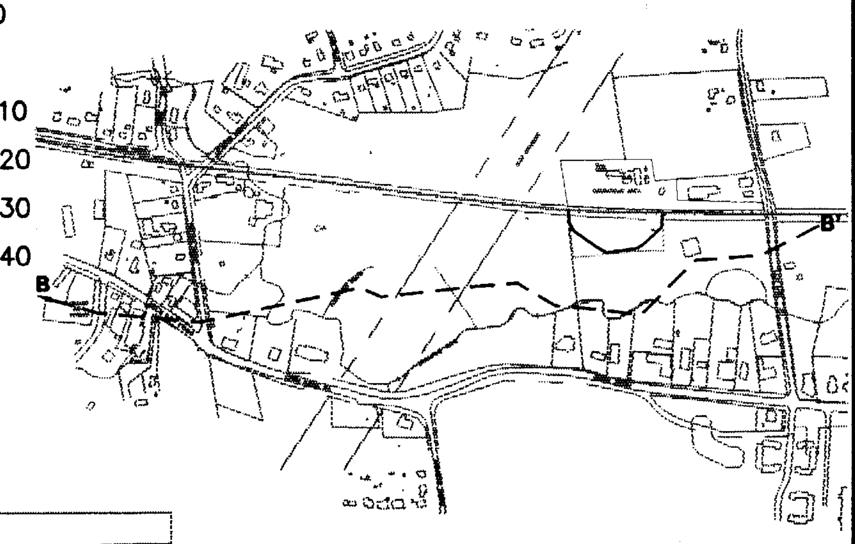


LEGEND

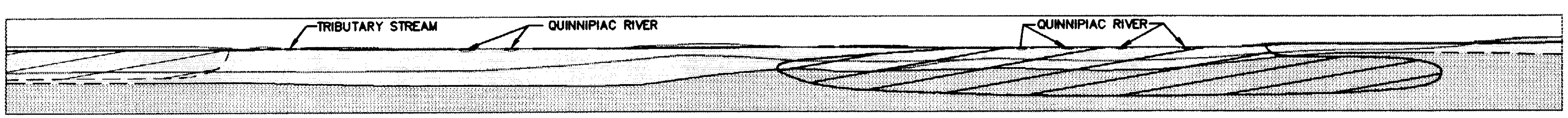
- MW-125A — WELL NUMBER
- MONITORING WELL
- ESTIMATED WATER TABLE SEPTEMBER 24, 1998, DASHED WHERE INFERRED
- 0.5 — DRAWDOWN CONTOUR SEPTEMBER 24, 1998, INTERVAL VARIABLE
- 0.2 — DRAWDOWN MEASURED SEPTEMBER 24, 1998
- SCREENED INTERVAL
- BOTTOM OF BORING

NOTE:
1. THESE DATA MEASURED SEPT. 24, 1998, AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LOCATION MAP



DRAFT



CROSS SECTION B-B' WITH NO VERTICAL EXAGGERATION

HORIZONTAL SCALE: 400' 0 400'

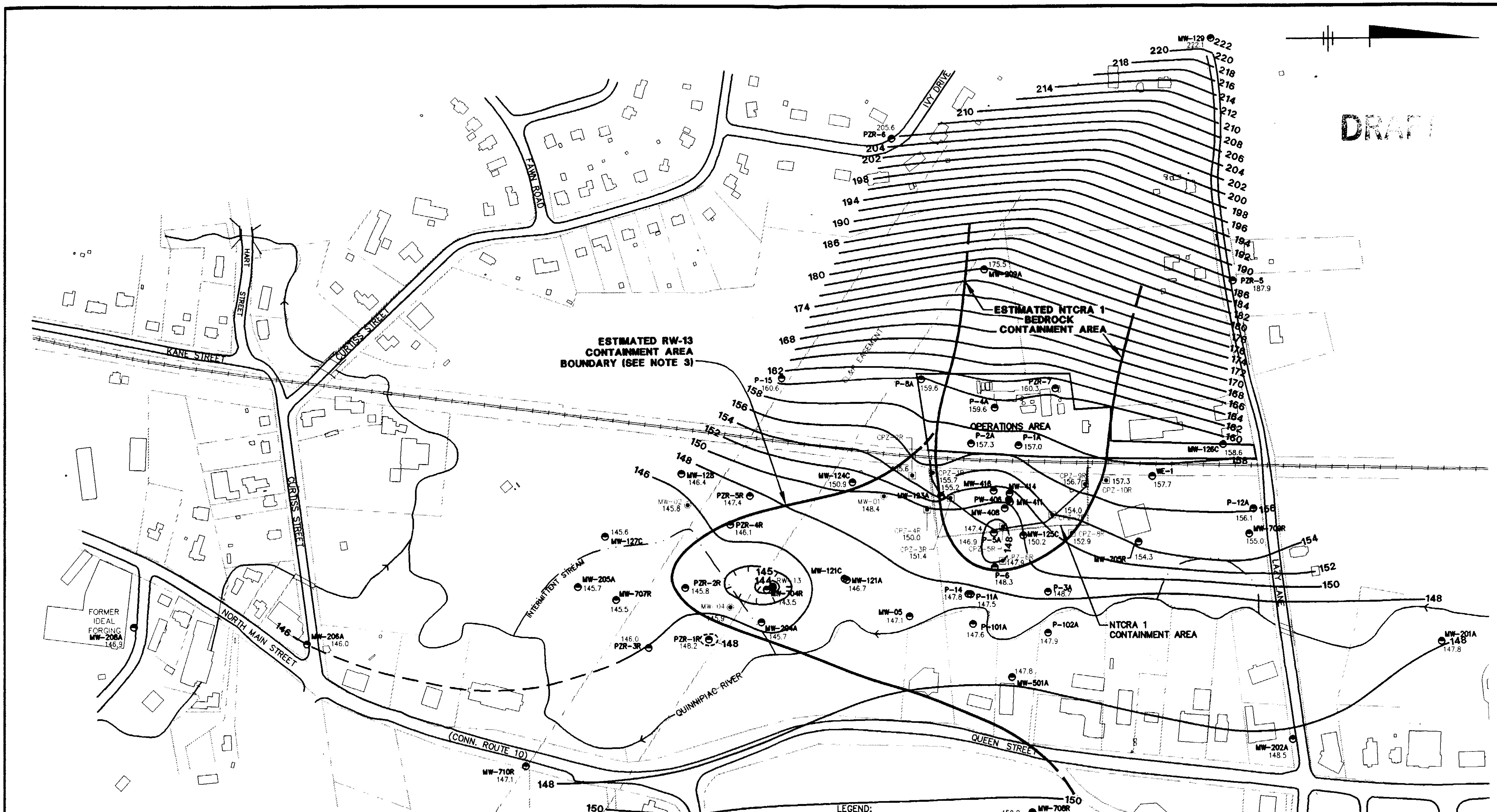
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2

GEOLOGIC CROSS SECTION B-B' WITH DRAWDOWN CONTOURS (PUMPING) AND REGULATORY PLUME

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 11

XREF: 08331X01, 08331X03.DWG
P:CSA2 OR CXE.PCP
11/09/98 SYR-54-DMW, PGL JMS
08331013/08331V84.DWG



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. GROUND-WATER ELEVATION DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).
3. ESTIMATED RW-13 CONTAINMENT AREA BASED ON SIMULATION RESULTS (ATTACHMENT B-13) AND STAGNATION POINT CALCULATION (ATTACHMENT B-14).

LEGEND:

- ● MIDDLE/DEEP OVERBURDEN PUMPING WELL
- ◒ SHALLOW BEDROCK MONITORING WELL/PIEZOMETER
- ▣ SHALLOW BEDROCK PIEZOMETER (NTCRA 1)
- ◉ OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
- 157.5 MEASURED GROUND-WATER (POTENTIOMETRIC) ELEVATION (FT AMSL)
- 160 ——— GROUND-WATER (POTENTIOMETRIC) ELEVATION CONTOUR (FT AMSL), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

0 300' 600'

P:STD-DL.PCP ● E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01
11/11/98 SYR-54-PGL, PGL, RCA
08331013/08331W07.DWG

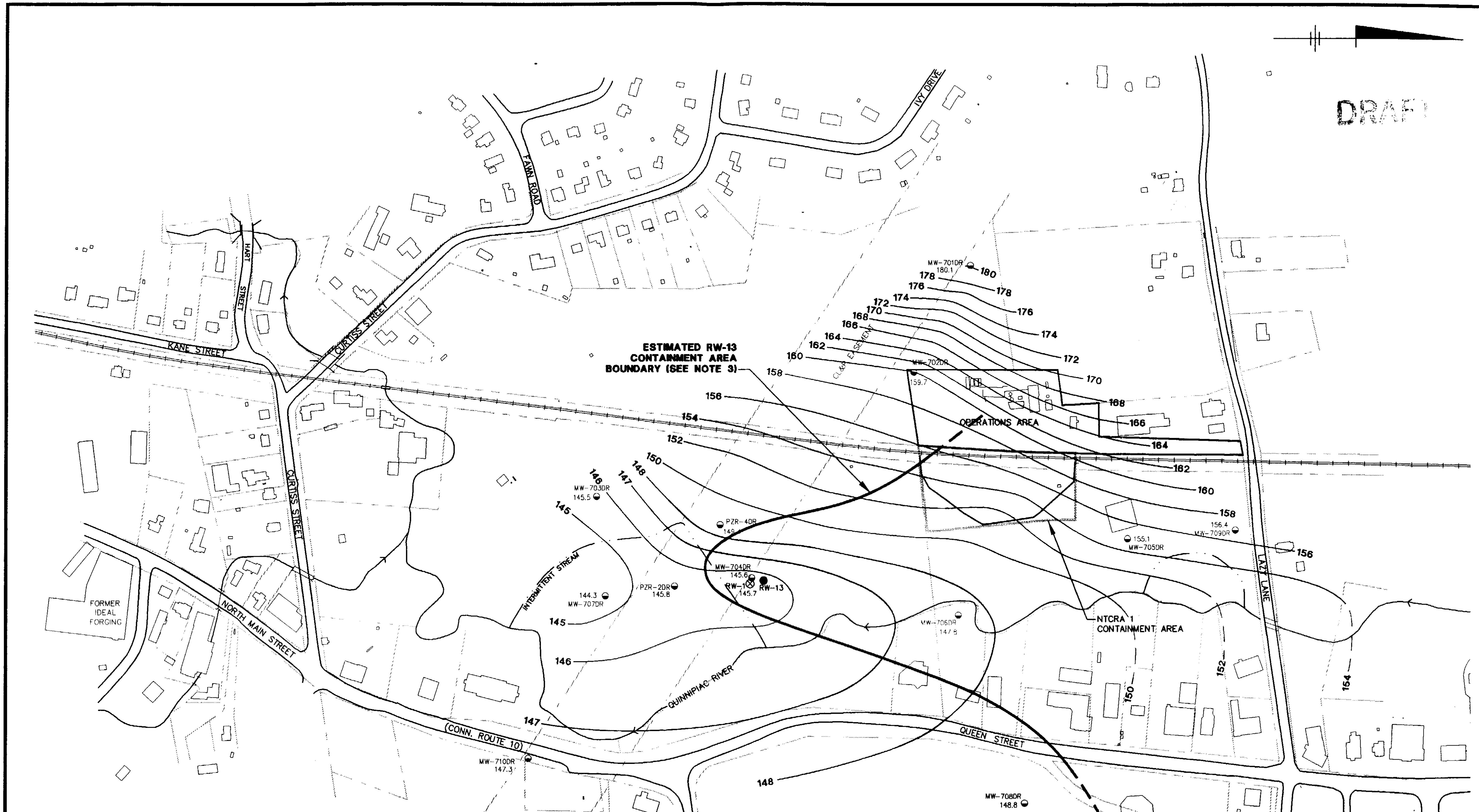
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA2

SHALLOW BEDROCK GROUND-WATER ELEVATION CONTOURS, 8/24/98 (PUMPING)

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 12



NOTES:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. GROUND-WATER ELEVATION DATA MEASURED AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).
3. ESTIMATED RW-13 CONTAINMENT AREA BASED ON SIMULATION RESULTS (ATTACHMENT B-13) AND STAGNATION POINT CALCULATION (ATTACHMENT B-14).

LEGEND:

- ● MIDDLE/DEEP OVERBURDEN PUMPING WELL
- ⊗ BEDROCK PUMPING WELL
- ◒ DEEP BEDROCK MONITORING WELL/PIEZOMETER
- 157.5 GROUND-WATER (POTENTIOMETRIC) ELEVATION (FT AMSL)
- 160 ——— GROUND-WATER (POTENTIOMETRIC) ELEVATION CONTOUR (FT AMSL), DASHED WHERE INFERRED, CONTOUR INTERVAL VARIES

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

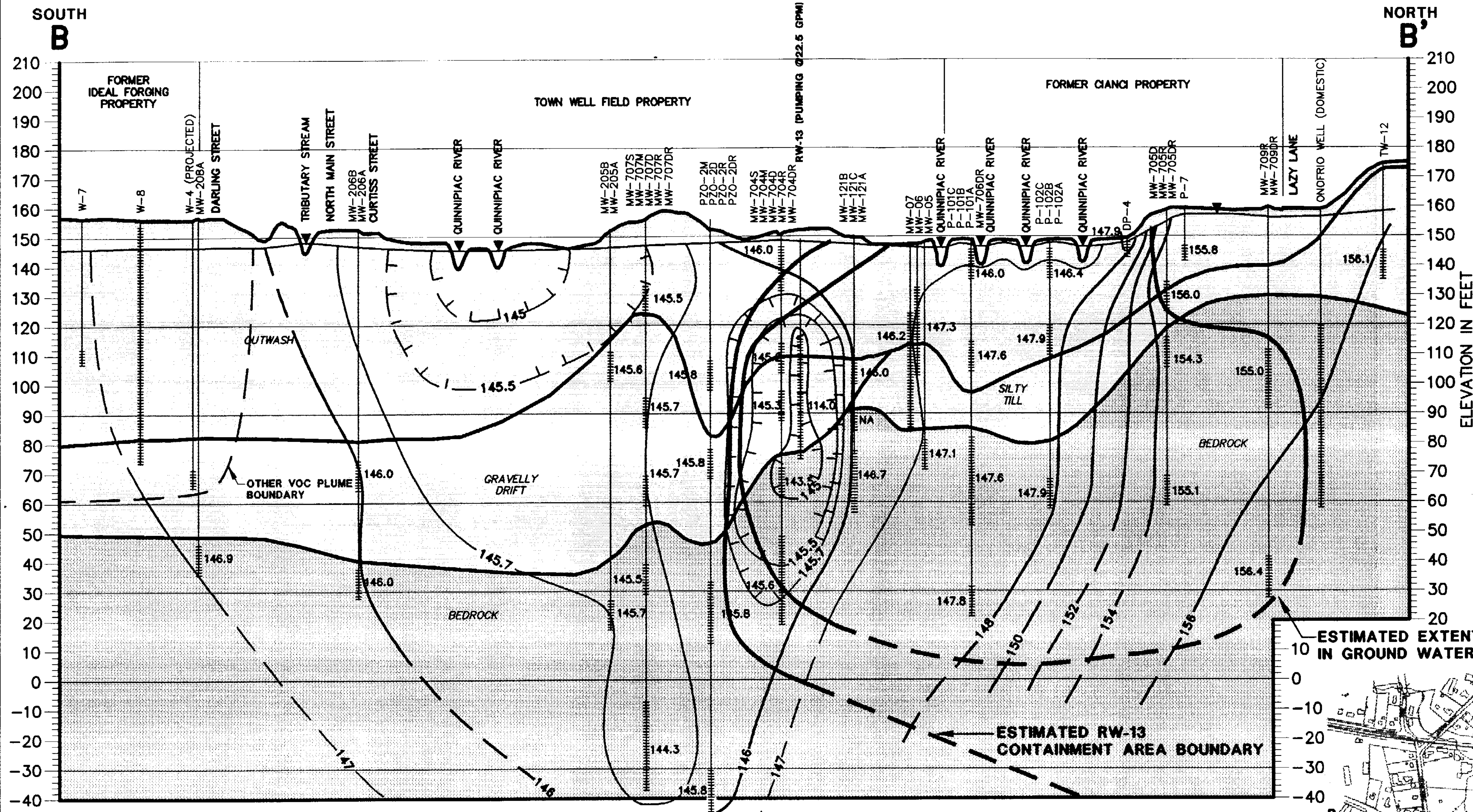
NTCRA 2

DEEP BEDROCK GROUND-WATER ELEVATION CONTOURS, 8/24/98 (PUMPING)

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 13

X: 08331XN2,08325X01.DWG
P: STD-DL.PCP ● E-SIZE OR DJB.PCP
11/8/98 SYR-54-PGL, DMW, PGL
08331013/08331W06.DWG



CROSS SECTION B-B'

HORIZONTAL SCALE: 400' 0 400'

DRAFT

LEGEND

MW-125A — WELL NUMBER

MONITORING WELL

ESTIMATED WATER TABLE SEPTEMBER 24, 1998, DASHED WHERE INFERRED

152 — GROUND-WATER ELEVATION (HEAD) CONTOUR, SEPTEMBER 24, 1998, INTERVAL VARIABLE

154.3 — GROUND-WATER ELEVATION MEASURED SEPTEMBER 24, 1998

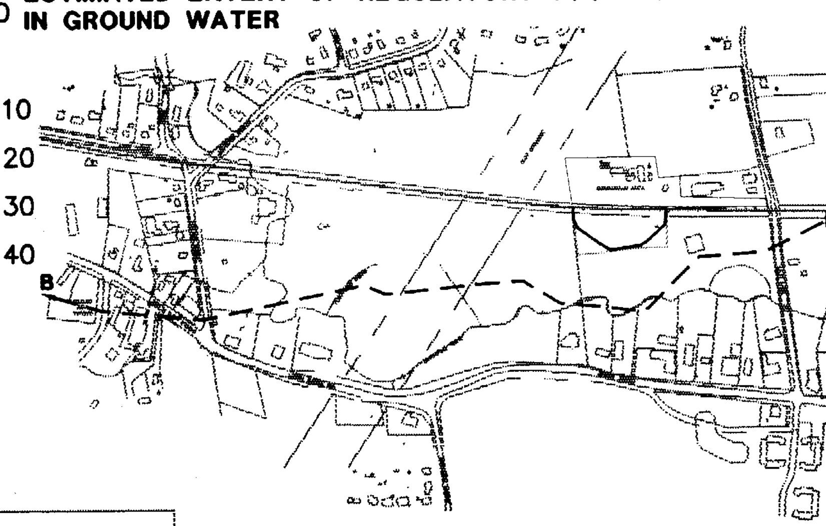
SCREENED INTERVAL

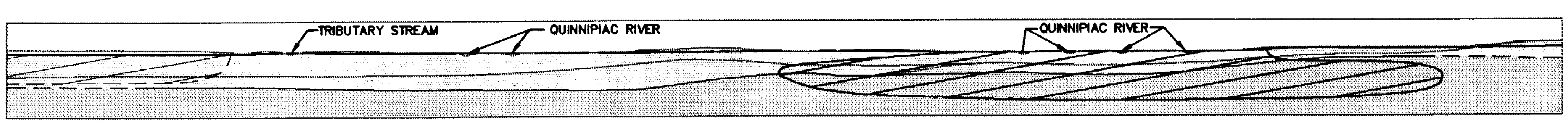
BOTTOM OF BORING

NOTE:
1. THESE DATA MEASURED SEPT. 24, 1998, AFTER SEVEN DAYS OF PUMPING FROM MIDDLE/DEEP OVERBURDEN PUMPING WELL RW-13 (Q=22.5 GPM).

LOCATION MAP

1000' 0 1000'





CROSS SECTION B-B' WITH NO VERTICAL EXAGGERATION

HORIZONTAL SCALE: 400' 0 400'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

GEOLOGIC CROSS SECTION B-B' WITH HEAD CONTOURS (PUMPING) AND REGULATORY PLUME

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 14

XREF: 08331X01, 08331X03.DWG
P:CSA2 OR CXE.PCP
11/10/98 SYR-54-DMW, PGL, RCA
08331013/08331VB1.DWG

Appendix A

Attachment A-1

MEMORANDUM

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

To: Sheila Eckman, USEPA Region I

From: Michael J. Gefell *MJG*

Re: NTCRA 2 Pumping Well and Piezometers, SRSNE Site, Southington, Connecticut

Date: September 25, 1997

cc: M. Beskind (CT DEP), L. Chu (HNUS), SRSNE Technical Committee, B.R. Thompson, B.H. Kueper, G.R.Cameron, D.F.Sauda

NTCRA 2
INTERIM TECHNICAL MEMORANDUM

This Interim Technical Memorandum was prepared by Blasland, Bouck & Lee, Inc. (BBL), to present preliminary numerical ground-water flow (MODFLOW) modeling results and describe the proposed design for a bedrock pumping well and piezometer network downgradient of the Solvents Recovery Service of New England (SRSNE) Site, located in Southington, Connecticut (Figure 1). These activities are consistent with the Non-Time Critical Removal Action No. 2 (NTCRA 2) design and study process, which will provide bedrock ground-water containment in the area downgradient of the SRSNE Site Operations Area (Figure 2). The NTCRA 2 design and study process was described in the Design and Study Work Plan (DSWP) (BBL, August 1996), which was submitted to the United States Environmental Protection Agency (USEPA) on August 30, 1996. USEPA conditionally approved the DSWP, with comments, in a letter to the SRSNE Potentially Responsible Party (PRP) Group dated October 23, 1996. To address USEPA's comments, BBL prepared a DSWP Addendum No. 1, which was submitted to USEPA on November 13, 1996.

Background

The fundamental purpose for NTCRA 2 is to minimize, to the extent reasonably practicable, the flow of ground water within the fractured bedrock from the Operations Area of the Site. However, due to the presence of non-aqueous phase liquids (NAPLs) in the bedrock immediately east (immediately downgradient) of the Operations Area (BBL, November 1995), bedrock ground water containment will be targeted in the area further downgradient (southeast) of the Operations Area to avoid remobilizing NAPL. The flow of bedrock ground water from the Operations Area can be safely contained by intercepting the ground water within the bedrock VOC plumes downgradient of the potential bedrock NAPL zone. The appropriate ground-water extraction location, therefore, will be downgradient of the potential bedrock NAPL zone, and within the off-site plumes of volatile organic compounds (VOCs) detected above regulatory criteria in shallow bedrock (Figure 3) or deep bedrock (Figure 4) ground water.

A regional MODFLOW ground-water flow model was developed as described in the DSWP (BBL, August 1996) to represent overburden and bedrock ground-water flow on a regional and site-specific scale, with model grid refinement in the vicinity of the SRSNE Site (Figure 2). The model provides the basis to complete the design for the bedrock pumping well and the network of bedrock piezometers that will be used in NTCRA 2. This Interim Deliverable describes the general setup and the preliminary results from the MODFLOW model, including the estimated pumping rate required to hydraulically control bedrock ground-water migrating downgradient of the Operations Area of the site. In addition, simulated hydraulic gradient changes were characterized to assess the potential for NAPL mobilization and to estimate the influence on NTCRA 1 Demonstration of Compliance.

As specified in the USEPA-approved DSWP, the model was used to identify the number, location, depth, diameter, and intake length of the NTCRA 2 bedrock ground-water extraction well(s), and the appropriate locations for bedrock piezometers. These construction specifications will provide the basis for the installing a bedrock pumping well and a network of bedrock piezometers during the NTCRA 2 Design Investigation. The extraction well and piezometer network will be used in a bedrock pumping test to evaluate bedrock ground-water hydraulics in the area downgradient of the site, and empirically assess the bedrock ground-water containment effectiveness of the pumping well.

Based on the pumping test results, the MODFLOW model will be refined and used for additional simulations to identify the final design for the NTCRA 2 ground-water extraction system. A detailed discussion of the NTCRA 2 MODFLOW Model design and calibration will be presented in the NTCRA 2 Technical Memorandum. The NTCRA 2 Technical Memorandum will also summarize the findings of the Design Investigation.

The remainder of this Interim Technical Memorandum presents:

- An overview of the MODFLOW ground-water flow model;
- Preliminary model results;
- A preliminary assessment of the potential for NAPL mobilization due to bedrock ground-water extraction;
- An evaluation of the potential influence of the NTCRA 2 bedrock pumping well on the NTCRA 1 Demonstration on Compliance requirements for overburden ground-water containment; and
- The proposed pumping well design and piezometer locations.

Overview of MODFLOW Ground-Water Flow Model

Ground-water flow modeling was performed using the pre/post-processor Groundwater Vistas (Rumbaugh, 1996) to facilitate the use of the United State Geological Survey (USGS) MODFLOW model (McDonald and Harbaugh, 1988). MODFLOW is a modular, three-dimensional, block-centered, finite-difference steady-state or transient flow model. A detailed discussion of the MODFLOW model, including setup, calibration, and simulation results, will be presented in the NTCRA 2 Technical Memorandum, which will be prepared after the Design Investigation. The sections below provide a brief overview of the model setup and simulation results that affect the forthcoming Design Investigation.

Model Domain

The NTCRA 2 MODFLOW model domain encompasses a section of the regional Quinnipiac River drainage basin, covering a total area of 5 square miles. The model grid dimensions are 10,800 feet (ft) (2 miles) in the east-west direction and 13,300 ft, (2.5 miles) in the north-south direction (Figure 5). The model domain is approximately centered about the SRSNE Site, and extends outward to the locations of regional surface-water features (ponds, streams, and canals) where the shallow overburden hydraulic head is known. The regional scale of the MODFLOW model allows simulation of ground-water extraction by the existing NTCRA 1 overburden ground-water extraction wells, potential NTCRA 2 bedrock ground-water extraction alternatives, or Town of Southington's Production Wells No. 4 and/or 6 with little or no impact of the pumping stresses on model boundaries.

Model Grid and Layer Structure

The model grid is rectilinear in plan view, such that the columns are oriented north to south and the rows are oriented east to west (Attachment 1). The model domain was discretized by a rectilinear, three-dimensional, block-centered finite difference model grid, consisting of 158 non-uniformly spaced rows, and 116 non-uniformly spaced columns (18,328 cells per layer). The grid in the vicinity of the SRSNE site was discretized down to cells dimensions of approximately 20 ft by 20 ft in plan view. At the periphery of the model, at a distance from the site, the grid coarsens to cells up to approximately 500 ft by 500 ft.

The model layer configuration is summarized on a schematic cross section in Attachment 1. The model grid is vertically discretized into seven layers with non-uniform interface elevations, which were defined based on geology or depth below the top of bedrock. Layers 1 and 2 represent the overburden and Layers 5 through 7 represent the bedrock. The total saturated thickness of the model ranges from approximately 600 to 720 feet and, therefore, extends to a substantial depth below the currently monitored geologic section, which extends to a maximum depth of approximately 270 feet below grade. The substantial vertical extent of the model allows the simulation of pumping wells within the overburden or the monitored portion of the bedrock with upward ground-water flow from below the simulated pumping system(s).

Portions of the hills west and northeast of the site where the water table is believed to be within the bedrock (Mazzaferro et al., 1979) were assigned as inactive cells in Layers 1 and 2.

Recharge

The recharge to ground water due to infiltration was defined for the uppermost active model layer throughout the model domain based on data reported in the literature. While reported recharge rates range from 6 to 26 inches across Connecticut (USGS, 1995), more recharge is anticipated in valley areas underlain by saturated stratified drift than in hilly areas underlain by till or bedrock (Mazzaferro, et al., 1979). Consistent with the available published information, the recharge rates identified through model calibration are generally 22 inches per year for the valleys and 6 to 9 inches per year for the hills. Other recharge rates were used to reflect anthropogenic influences on recharge, including paved areas where recharge was set to zero, areas with private septic systems where recharge was increased based on estimated domestic water use, and outflow points of storm-water culverts with well-defined catchment areas.

Regional Boundary Conditions

The regional boundary conditions for the MODFLOW model were located using USGS topographic map data for the New Britain, Meriden, and Southington quadrangles (USGS, 1992) and the Bristol quadrangle (USGS, 1984). Constant head conditions were specified in Layer 1 and Layer 2 at the periphery of the model domain approximately 5600 ft north, 5900 south, 5100 east, and 4500 west of the site. River cells were used in Layer 1 for the Quinnipiac River, associated tributaries, and other surface water features. Surface-water elevations were estimated based on USGS topographic maps. A general head boundary was used at the eastern edge of the model domain in the bottom layer of the model (Layer 7) to represent the potential regional influence of the Connecticut River on deep bedrock ground-water flow.

Private domestic wells on the hill west of the site and along Lazy Lane were simulated as a pumping rate of 450 gallons per day per well from Layer 5 (Mazzaferro et al., 1979). A hydraulic drain condition was used to simulate a submerged sanitary sewer pipe south of the site along Queen Street (Town of Southington, June 1979).

Near-Site Hydraulic Stresses

The NTCRA 1 overburden ground-water extraction system was modeled using MODFLOW drain cells and the associated sheet pile wall modeled using MODFLOW's horizontal flow barrier (HFB) package. The 30-inch underground culvert that crosses east-west beneath the former Cianci Property was simulated using MODFLOW drain cells. A zone of high hydraulic conductivity (estimated as 100 ft/day) was used to simulate the influence of the gravel-filled, force-main trench associated with the an Off-Site Interceptor System in the north portion of the Town Well Field (Loureiro, 1984). Also, the gravel-filled ditches along the railroad tracks, which commonly contain standing water and extend to the location of two ponds north of Lazy Lane, were simulated as river cells.

Hydraulic Parameters

The horizontal hydraulic conductivity values for Layers 1 and 2 within the RI study area were defined based on the existing hydrogeologic database for the site. Individual hydraulic conductivity values measured at overburden wells and piezometers were contoured to create a smooth distribution within Layers 1 and 2. The resulting grids of hydraulic conductivity data were digitally imported to define the hydraulic conductivity at each model cell in Layers 1 and 2 within the study area, with hydraulic conductivity values ranging from < 1 to >1000 ft/day. The regional hydraulic conductivity of Layers 1 and 2 beyond the study area the were estimated based on well yields reported in the literature, and were refined through calibration to final values ranging from 6 to 400 ft/day. The horizontal hydraulic conductivity of the bedrock in Layers 3 through 7, 0.35 ft./day, is the geometric mean value from packer-tests, slug-tests, and specific capacity tests at bedrock wells in the study area. This conductivity estimate is consistent with a reported value of 0.31 ft./day based on specific capacity testing of 401 wells installed in sedimentary rock units in Connecticut (USGS, 1995).

Vertical anisotropy factors (horizontal to vertical hydraulic conductivity ratios) were estimated as 100:1 for the overburden and 200:1 for the bedrock based on Neuman-Witherspoon (1972) analysis of specific capacity tests performed in either formation. In addition, a horizontal anisotropy factor (ratio of north-south to east-west hydraulic conductivity) of 4:1 was estimated for the overburden layers based on a drawdown ellipse observed during a specific capacity test (Kruseman and de Ridder, 1990). Horizontal anisotropy for the bedrock was simulated as 20:1 due to the regional, approximately 20°, eastward dip of the bedrock strata and associated bedding plane fractures (Anderson and Woessner, 1992). Horizontal anisotropy was found to be necessary to match simulated ground-water flow directions with the known shapes of the regulatory plumes in the shallow and deep bedrock, as determined during model calibration.

Model Calibration

The NTCRA 2 MODFLOW model calibration process and results will be discussed in detail in the NTCRA 2 Technical Memorandum. Attachment 2 to this Interim Technical Memorandum, however, presents a summary plot for the calibrated versus target head values. The target heads included measured or reported head values from 195 wells and piezometers in the study area and surrounding region, and ranged from approximately 140 to 265 feet elevation. During the calibration process, the residuals (difference between model heads and target heads) were reduced to <5 ft for 88% of the targets and <2 ft for 66% of the targets.

The simulated total combined flow rate of 21 gpm from the NTCRA 1 overburden ground-water extraction wells compares favorably to the historical average of 20 gpm. Also, the simulated ground-water discharge rate into the Quinnipiac River without the NTCRA 1 system operating was 33 gpm, which is reasonably consistent with the September 1992 measurement of 48 gpm (HNUS, May 1994).

The main parameters varied during model calibration to target head values were recharge, vertical hydraulic conductivity, and hydraulic stresses associated with sewers, trenches and domestic wells/leach fields. However, even after achieving a reasonable match to target heads, ground-water flow directions downgradient of the site did adequately not match the known extent and shapes of the off-site VOC plumes. Therefore, near the end of the model calibration process, directional differences in horizontal hydraulic conductivity (anisotropic conditions) were also evaluated. The effective horizontal hydraulic conductivity (geometric mean of major and minor horizontal conductivities) remained fixed throughout the anisotropy evaluation. Without anisotropy (horizontal conductivity the same in all directions), and without the NTCRA 1 system operating, simulated ground-water flow originating from the Operations Area (and the overburden and bedrock NAPL zones) discharges into the Quinnipiac River north of the Connecticut Power and Light (CL&P) easement (Figure 2). Thus, in the absence of horizontal anisotropy, the southern portions of the regulatory plumes believed to be related to the SRSNE Site can not be explained in terms of ground-water flow from the site. Particle tracking was used to compare ground-water flow paths to the observed regulatory plumes in the overburden and in the shallow and deep bedrock and evaluate the effect of horizontal anisotropy.

Through the particle tracking process, BBL interpreted that horizontal anisotropy values of approximately 4:1 in the overburden and 20:1 in the bedrock were necessary to match the observed southward extent of the plumes in the overburden and bedrock. These factors were calculated based on measured hydraulic responses in the overburden (Kruseman and de Ridder, 1990) and published methods of estimating horizontal anisotropy of dipping bedrock strata (Anderson and Woessner, 1992). Using the anisotropy factors of 4:1 in the overburden and 20:1 in the bedrock, ground-water particle path lines tracked in reverse from key bedrock wells with regulatory exceedences in shallow and deep bedrock match the interpreted regulatory plumes, as shown on Figures 6 and 7. These results indicate that the simulated bedrock ground-water flow directions in the calibrated model are consistent with the shapes of the regulatory plumes.

The potential influence of horizontal anisotropy will be clarified based on the results of the bedrock pumping test that will be performed during the Design Investigation. For the purposes of bedrock ground-water pumping simulations,

Preliminary Model Results

Following calibration, predictive simulations were run to simulate bedrock ground-water flow conditions during ground-water extraction. Several containment scenarios were run to identify optimal locations and pumping rates for a NTCRA 2 bedrock ground-water extraction well to contain the regulatory VOC plume in the bedrock. To assess the simulated capture zone affected by pumping, simulated head distributions were contoured and forward particle tracking was performed in the bedrock zone(s) requiring hydraulic control.

The results of these simulations indicated that a single extraction well pumping at a rate of approximately 18 gpm in Layers 3, 4, and 5 (shallow, middle, and deep bedrock) should contain the shallow and deep bedrock ground-water within the regulatory plume downgradient of the Operations Area of the site. Figure

8 shows the resulting, simulated containment of ground-water particle paths tracked forward from key wells with ground-water regulatory exceedences in shallow and deep bedrock. Attachment 3 presents the pumping-induced head distribution in Layers 3 through 5, respectively.

It should be noted that the simulated capture zones and drawdown distributions are considered preliminary estimates of the actual pumping response that will be observed at the site. Fractured bedrock ground-water hydraulic conditions can be extremely complicated and are dominated by the spacing and connectedness of groups of fractures. The effectiveness of a ground-water extraction system in fractured media is strongly controlled, therefore, by the number of fractures intercepted by a pumping system, e.g., a well or group of wells. At the SRSNE Site, the bedrock fractures are primarily parallel to the gently eastward-dipping bedding, and therefore several water-bearing fractures should be intercepted by the proposed vertical pumping well. Nevertheless, the bedrock fracture characteristics vary from location to location. In practice, the hydraulic effectiveness of the proposed pumping well will need to be evaluated in the field during the Design Investigation. In the event that the NTCRA 2 pumping well is not found to provide sufficient bedrock ground-water containment during the design investigation, the NTCRA 2 design will be enhanced prior to NTCRA 2 implementation to improve the connection to the fractured bedrock. Potential design enhancements may include hydrofracting the pumping well borehole, installing additional bedrock extraction wells, and/or installing a fractured bedrock trench.

Assessment of NAPL Remobilization Potential and Influence on NTCRA 1 Compliance

The simulated vertical and horizontal hydraulic gradients near the downgradient border of the estimated potential NAPL zones in overburden and bedrock were evaluated to estimate the relative NAPL remobilization potential due to the proposed NTCRA 2 bedrock pumping well. Critical hydraulic gradients required to mobilize NAPL were estimated by Dr. Bernie Kueper using the measured physical characteristics of NAPL samples obtained at the site (BBL, November 1995) and the till and bedrock physical characteristics, which were quantified during the RI. These data were used to calculate: 1) the downward gradient required for a hypothetical NAPL pool to exceed the displacement pressure for the till layer overlying the bedrock, and 2) the horizontal gradient required for a hypothetical NAPL pool currently in the bedrock fractures to exceed the displacement pressure for the fracture and migrate laterally along the fracture.

Table 1 presents the pre-pumping horizontal and vertical hydraulic gradients and the estimated pumping hydraulic gradients based on the results of the MODFLOW model. To estimate the gradients that would result during bedrock ground-water pumping, the simulated head changes caused by pumping were superimposed on observed, pre-pumping head values measured at specific pairs of wells/piezometers. Thus, the MODFLOW model was used to estimate the change in heads (drawdown values) during pumping. The pre-pumping heads were selected to represent the strongest horizontal or downward hydraulic gradient, or the weakest historical upward gradient. As shown in Table 1, the estimated pumping gradients are similar to the observed pre-pumping gradients. None of the existing upward gradients are expected to reverse to a downward component due to the proposed bedrock pumping well (20 gpm near the MW-704 cluster). Based on the simulated gradient changes, we do not anticipate horizontal or vertical NAPL mobilization during pumping at the proposed pumping well (Kueper, pers. com. with M.J. Gefell, September 1997). Dr. Kueper's NAPL mobilization assessment will be presented as part of the NTCRA 2 Technical Memorandum.

In addition, BBL evaluated he simulated drawdown in the overburden adjacent to the south side of the

NTCRA 1 sheet-pile wall to assess the potential influence on NTCRA 1 Demonstration of Compliance. The NTCRA 1 compliance requirements require an inward head differential of at least 0.3 feet as measured at pairs of overburden compliance piezometers situated on either side of the sheet-pile wall. Assuming a bedrock ground-water extraction rate of 18 gpm at the location shown on Figure 8, the simulated drawdown in the overburden outside the sheet-pile wall are estimated as approximately 0.18 feet at piezometer CPZ-2 and 0.47 feet at piezometer CPZ-4. Simulated drawdowns inside the sheetpile wall were 0.05 feet at piezometer CPZ-1 and 0.03 feet at piezometer CPZ-3. While these results indicate a decrease in the inward head differential of approximately 0.13 feet at the CPZ-1/2 pair and 0.44 feet at the CPZ-3/4 pair, the typical head differences observed at these piezometer pairs are greater >0.8 feet and >2.5 feet, respectively. These modeling results suggest that the drawdown due to bedrock pumping should not affect the ability to demonstrate compliance with the NTCRA 1 reversal of gradient requirements.

Proposed NTCRA 2 Pumping Well Design and Piezometer Network

Pumping Well Design

The bedrock ground-water pumping well will be installed to extract bedrock ground water at the approximate location shown on Figure 8. Given the recognition of VOCs in the deep bedrock during the completion of the Remedial Investigation, BBL proposes to modify the pumping well design from the preliminary design considered in the Design and Study Work Plan (BBL, August 1996). In particular, the pumping well will need to extend approximately 90 feet into the bedrock (rather than the initially assumed depth of approximately 30 feet into rock) to contain deep bedrock ground-water. Given the increased depth and cost of installing the bedrock pumping well, a 12-inch, rather than 14-inch diameter pumping well borehole will be installed. A permanent, 12-inch diameter black steel casing will be grouted approximately 3 feet into the top of competent bedrock to seal off the overburden formation, and the 12-inch diameter extraction well borehole will be advanced to a depth of approximately 95 feet below the top of bedrock (approximately 170 feet total depth). This depth and diameter are consistent with the pumping well design simulated in the NTCRA 2 ground-water flow model. The depth to the top of bedrock will be verified during drilling based on the characteristics of the air-rotary drill cuttings. Drilling mud will not be used during the drilling of the pumping well borehole(s). The extraction well will be constructed as an open bedrock well, with an intake section extending from the bottom of the permanent 12-inch casing to the bottom of the bedrock borehole.

The proposed open bedrock design is consistent with the design of private bedrock wells in the region, and is considered appropriate for the NTCRA 2 pumping well. (The former Cianci Water Supply well, which was used to obtain bedrock fracture and ground-water quality data during the RI, had an open-bedrock intake section that extended from the top of bedrock to a depth of approximately 100 feet below the top of bedrock.) The open-bedrock pumping well design is fundamentally the same as the design presented in the Design and Study Work Plan (BBL, August 1996) except that, due to the substantial increase in depth, no well screen or riser will be installed in the pumping well borehole during the Design Investigation.

Bedrock Piezometer Network

The basic design of the NTCRA 2 piezometers was presented in the USEPA-approved DSWP. Five shallow bedrock and two deep bedrock piezometers will be installed at the approximate locations shown on Figure 9 to provide hydraulic response data during the pumping test activities and NTCRA 2 implementation. These locations were selected to fill data gaps in the bedrock monitoring array, particularly in the area downgradient of the proposed pumping well location, where the extent of the capture zone will be evaluated. In combination with the existing bedrock monitoring wells in the area, the proposed piezometer locations will provide an appropriate network to characterize the hydraulic response to bedrock pumping and the shape of the resulting capture zone. Shallow and deep bedrock piezometers will be installed to a depth of approximately 25 feet and 90 feet below the top of bedrock, respectively. Each new bedrock piezometer will be constructed with a 20-feet long, 2-inch diameter, 0.010-inch slot, Schedule 40 PVC screen and riser pipe. A Morie No. 0 or equivalent filter pack will be placed in the well/borehole annulus from the bottom of the piezometer screen to approximately two feet above the top of the screen, and the remainder of the annulus will be filled with bentonite to ground surface. The new bedrock pumping well and piezometers will be located by survey with respect to the existing site coordinate system established during the initial phases of the RI completed on behalf of USEPA (HNUS, May 1994). Vertical survey control will also be established for the ground surface and the top of riser at each new bedrock pumping well and piezometer.

The proposed locations for several piezometers are within the CL&P easement that crosses the Town Well Field Property (Figure 9). Access to these locations for drilling purposes will be subject to OSHA requirements regarding safe clearance from overhead, high-tension power lines. In addition, wet, soft ground conditions along the intermittent stream that crossed the Well Field will pose access limitations associated with rig mobility. Therefore, the proposed locations should be considered approximate only, and will need be verified in the field based on actual field conditions.

Summary

This Technical Memorandum provides the basis for the NTCRA 2 Design Investigation described in the USEPA-approved DSWP. Preliminary modeling results indicate that a bedrock ground-water extraction well with a 90-foot long open-bedrock interval pumping at approximately 18 gpm may be sufficient to intercept the plumes of dissolved VOCs downgradient of the Operations Area of the site, with minimal potential for NAPL remobilization and minimal influence on NTCRA 1 Demonstration of Compliance. The modeling results provide an understanding of the bedrock ground-water capture zone and the basis for the proposed bedrock piezometer network, which will be installed in the area around the proposed pumping well during the forthcoming Design Investigation. The results of the Design Investigation and a detailed discussion of the NTCRA 2 MODFLOW model design and calibration will be presented in the NTCRA 2 Technical Memorandum.

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TABLES

TABLE 1

SRSNE SITE
NTCRA 2

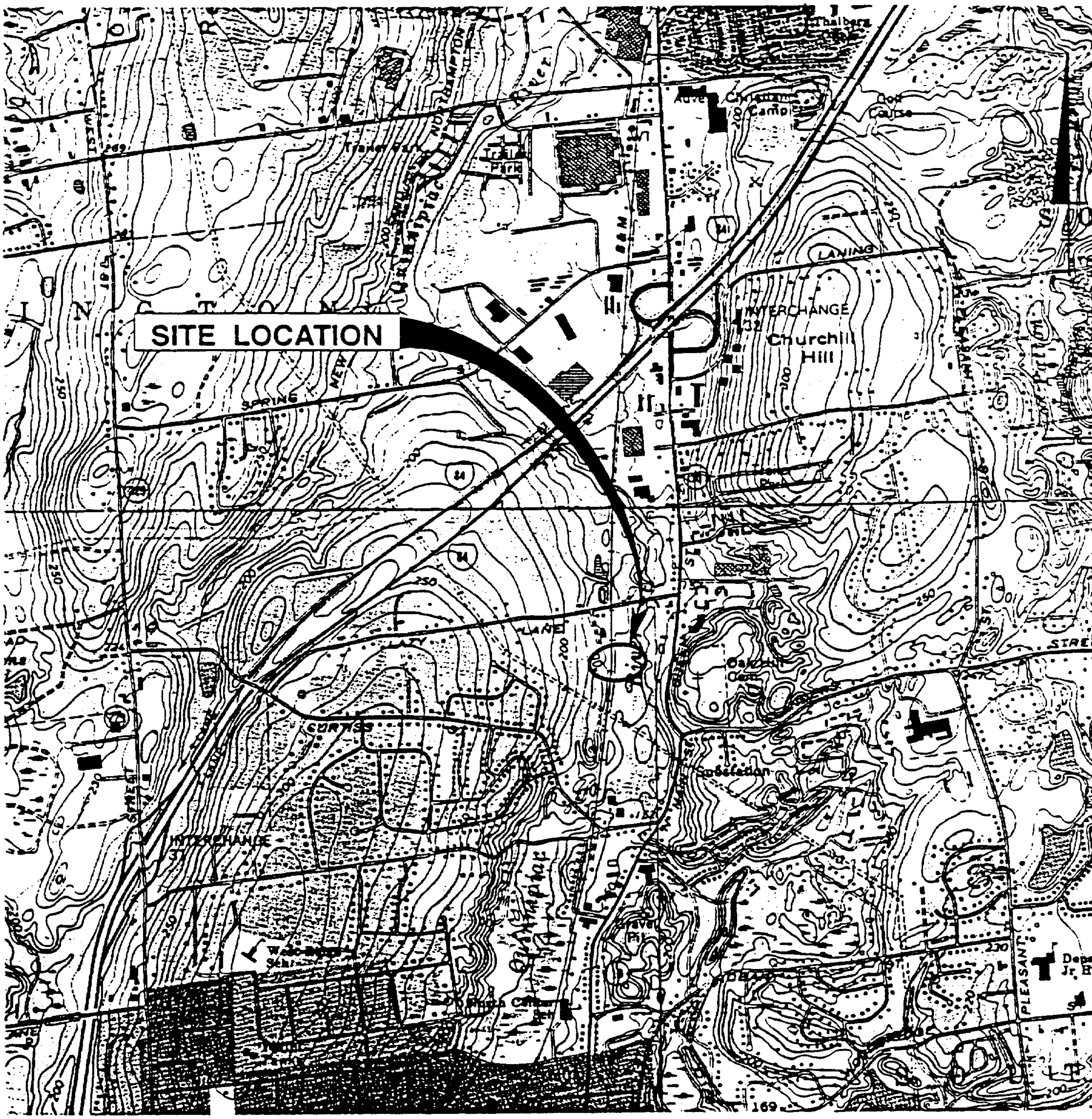
NAPL MOBILITY ASSESSMENT DUE TO SIMULATED PUMPING STRESSES

Well I.D.	Date	Observed Prepumping Head (ft AMSL)	A – B Distance (ft AMSL)	Observed Prepumping Gradient**	Simulated Prepumping Head (ft AMSL)	Simulated Pumping Head (ft AMSL)	Simulated Drawdown (ft)	Estimated* Pumping Heads (ft AMSL)	Estimated Pumping Gradient**
Bedrock Horizontal Gradient Assessment									
P-6	3/20/95	152.09	111.2	0.017	149.38	148.95	0.430	151.66	0.016
P-11A	3/20/95	150.19			148.61	148.25	0.360	149.83	
CPZ-3R	7/7/97	152.30	81.4	0.018	147.13	146.96	0.172	152.13	0.021
CPZ-4R	7/7/97	150.85			148.97	148.55	0.420	150.43	
Overburden/Bedrock Interface Vertical Gradient Assessment									
P-11B (OVB)	3/20/95	149.56	51.9	0.012	148.41	148.11	0.300	149.26	0.007
P-11A (Shall. Rock)	3/20/95	150.19			148.55	148.01	0.542	149.65	
MW-413 (OVB)	1/21/97	155.10	22.4	-0.151	148.42	148.39	0.028	155.07	-0.158
MW-414 (Shall. Rock)	1/21/97	151.72			148.70	148.52	0.183	151.54	
CPZ-4 (OVB)	1/21/97	151.20	40.0	0.055	150.54	150.07	0.470	150.73	0.042
CPZ-4R (Shall. Rock)	1/21/97	153.39			149.12	148.65	0.468	152.92	

Kv range for K1: 0.03 to 0.20 ft/day (Kv for deep overburden from model, KH/100).
Kv range for K2: 0.0018 to 0.0034 ft/day (from till sample vertical permeability results).
Kv for K3: 0.0018 ft/day (Kv for bedrock from model, KH/200).

Notes
This table reflects head conditions before and after pumping at a rate of approximately 20 gpm in Layers 3, 4, and 5 adjacent to bedrock wells MW-704R and MW-704DR.
* Estimated pumping heads determined by subtracting the simulated drawdown change from the observed prepumping heads.
** "-" indicates downward vertical gradient; vertical positive gradients are upward in this analysis.
Simulated drawdown during bedrock pumping estimated at key NTCRA 1 compliance piezometers include:
CPZ-1: 0.05 feet;
CPZ-2: 0.18 feet;
CPZ-3: 0.03 feet;
CPZ-4: 0.47 feet.
Therefore, the resulting changes in head differentials are estimated as -0.13 feet at the CPZ-1/CPZ-2 compliance pair, and -0.44 feet at the CPZ-3/CPZ-4 compliance pair.
These minor changes should not impact NTCRA 1 Demonstration of Compliance.

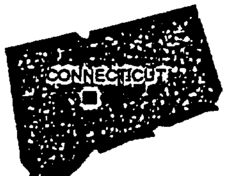
FIGURES



REFERENCE:
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

8/96 SYR D54-JVM PMC
08331096/08331N02.cdr

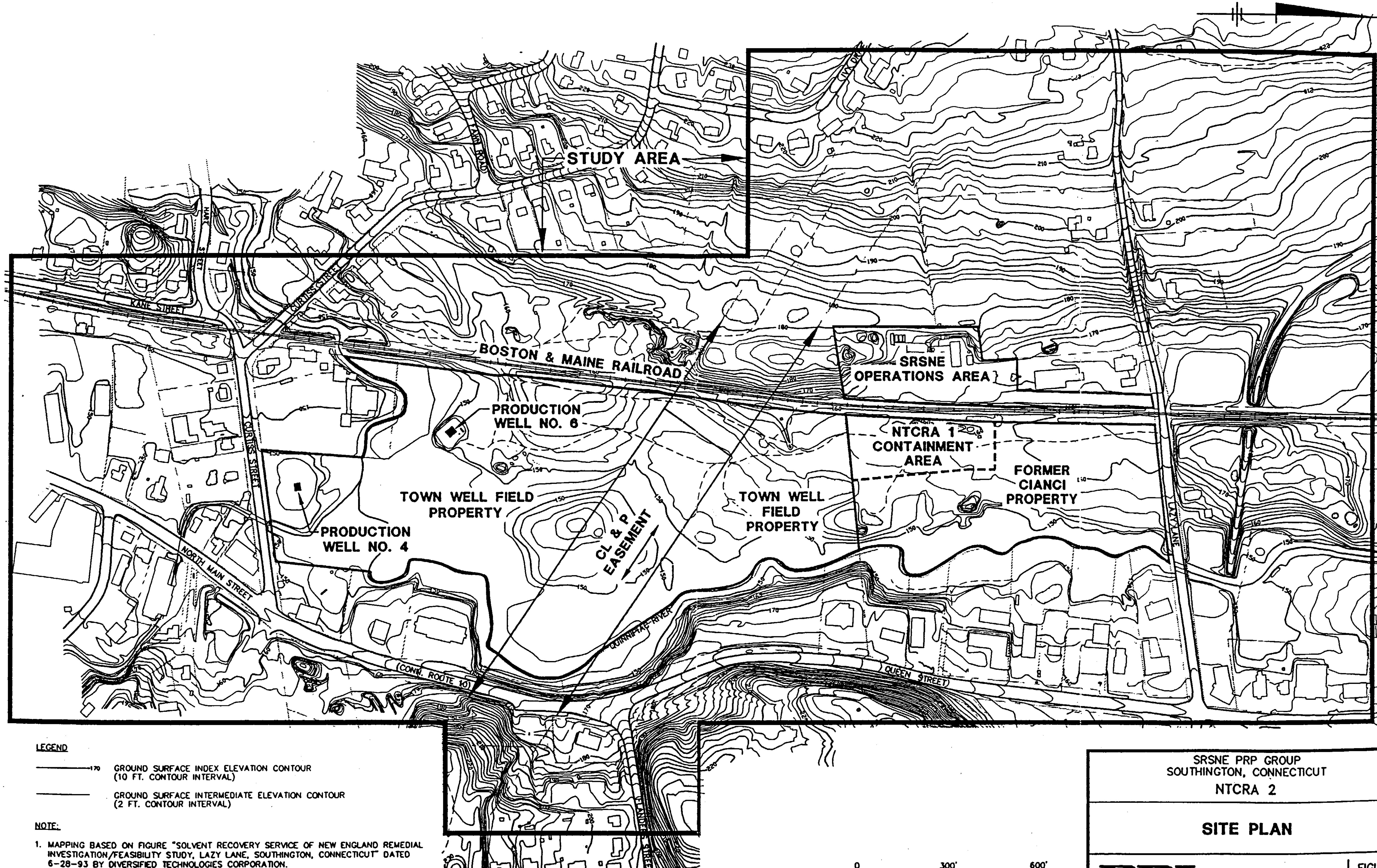
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

SITE LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 1



LEGEND

170 GROUND SURFACE INDEX ELEVATION CONTOUR (10 FT. CONTOUR INTERVAL)

GROUND SURFACE INTERMEDIATE ELEVATION CONTOUR (2 FT. CONTOUR INTERVAL)

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

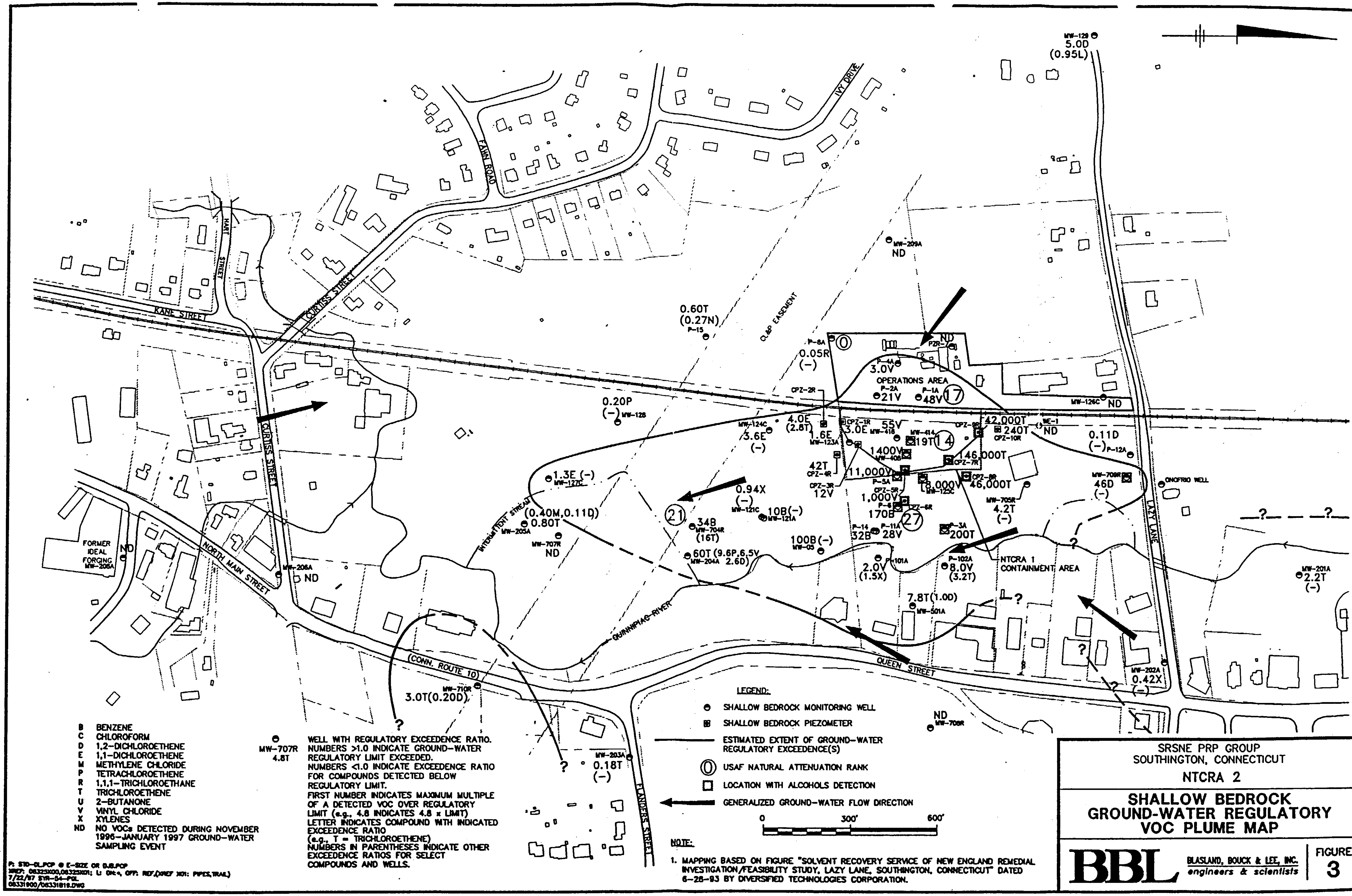
D.JBOBREF.PCP
X: 08325X00,08325X01:L: OFF: REF-(XREF X01:PIPES)
8/12/96 SYR-54-DMW
08331011/08331C01.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2

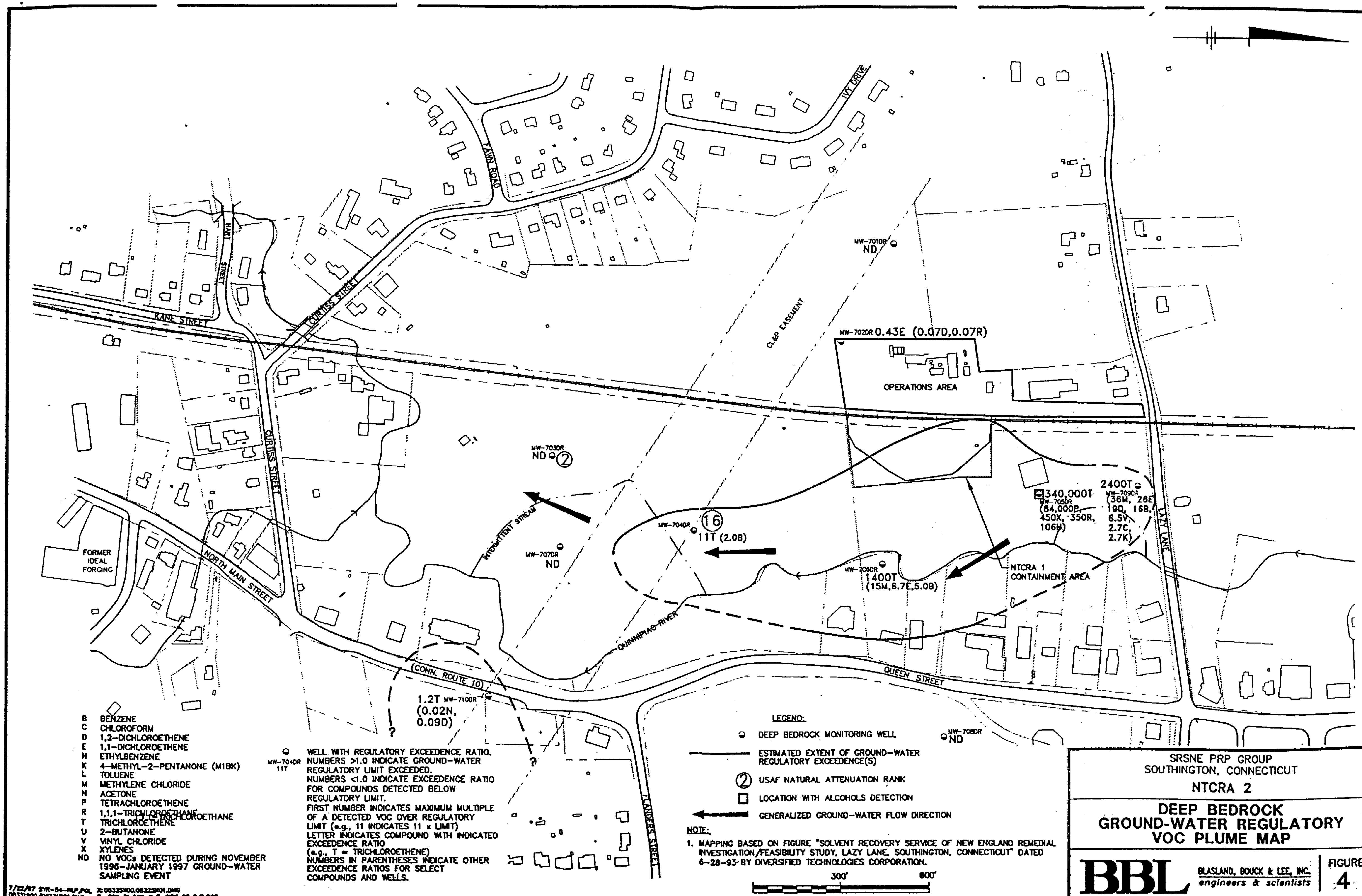
SITE PLAN

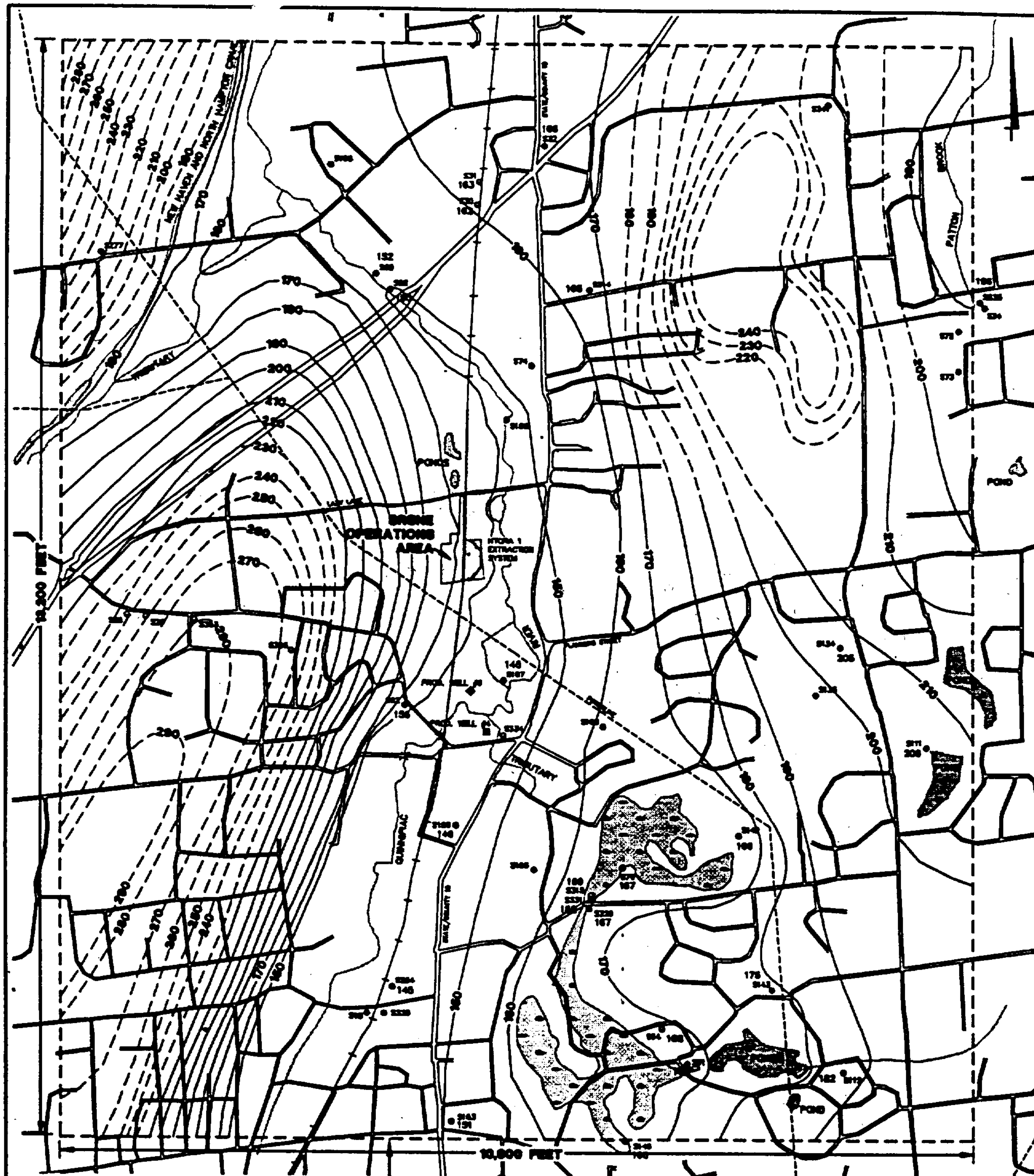
BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 2



LAZY LANE
QUEEN STREET
(CONN. ROUTE 10)
NORTH MAIN STREET
CURTISS STREET
KANE STREET
HART STREET
FAWN ROAD
IVY DRIVE
FLANDERS STREET
QUINNIPIAC RIVER
INTERMITTENT STREAM
CL&P EASEMENT
OPERATIONS AREA
NTCRA 1 CONTAINMENT AREA
FORMER IDEAL FORGING MW-206A ND
ONOFRIO WELL
MW-129 5.0D (0.95L)
MW-201A 2.2T (-)
MW-202A 0.42X (-)
MW-203A 0.18T (-)
MW-710R 3.0T(0.20D)
MW-709R 46D (-)
MW-708R ND
MW-707R ND
MW-705R 4.2T (-)
MW-209A ND
MW-126C ND
MW-206A ND
P-15 0.60T (0.27N)
MW-128 0.20P (-)
MW-127C 1.3E (-)
MW-205A (0.40M,0.11D) 0.80T
MW-204A 60T (9.6P,6.5V, 2.6D)
MW-704R 34B (16T)
MW-121A 10B(-)
MW-03 100B(-)
0.94X (-)
P-12A 0.11D (-)
ME-1 ND
P-101A 2.0V (1.5X)
P-102A 8.0V (3.2T)
MW-501A 7.8T(1.0D)
P-6A 0.05R (-)
P-4A 3.0V
P-2A 21V
P-1A 48V
MW-124C 3.6E (-)
4.0E (2.8T)
MW-123A 1.6E
CPZ-1R 3.0E
MW-41B 55V
MW-414 19T
MW-40B 1400V
CPZ-4R 42T
CPZ-3R 12V
11,000V
P-5A
CPZ-5R 1,000V
P-6 170B
P-14 32B
P-11A 28V
P-3A 200T
MW-125C 8,000V
CPZ-8R 46,000T
CPZ-7R 146,000T
CPZ-9R 42,000T
CPZ-10R 240T
0 17 14 27 21
LEGEND:
SHALLOW BEDROCK MONITORING WELL
SHALLOW BEDROCK PIEZOMETER
ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
USAF NATURAL ATTENUATION RANK
LOCATION WITH ALCOHOLS DETECTION
GENERALIZED GROUND-WATER FLOW DIRECTION
0 300' 600'
B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
M METHYLENE CHLORIDE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT
MW-707R 4.8T
WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 4.8 INDICATES 4.8 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.
NOTE:
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2
SHALLOW BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP
BBL
BLASLAND, BOUCK & LEE, INC. engineers & scientists
FIGURE 3


SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2
DEEP BEDROCK
GROUND-WATER REGULATORY
VOC PLUME MAP
BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists
FIGURE
4
LEGEND:
DEEP BEDROCK MONITORING WELL
ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
USAF NATURAL ATTENUATION RANK
LOCATION WITH ALCOHOLS DETECTION
GENERALIZED GROUND-WATER FLOW DIRECTION
NOTE:
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
300'
600'
MW-704DR
11T
WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 11 INDICATES 11 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.
B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
H ETHYLBENZENE
K 4-METHYL-2-PENTANONE (MIBK)
L TOLUENE
M METHYLENE CHLORIDE
N ACETONE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT
MW-701DR ND
MW-702DR 0.43E (0.07D,0.07R)
OPERATIONS AREA
MW-703DR ND ②
MW-704DR ⑯ 11T (2.0B)
MW-705DR 340,000T (84,000P, 450X, 350R, 106H)
MW-706DR 1400T (15M,6.7E,5.0B)
MW-707DR ND
MW-708DR ND
MW-709CR 2400T (36M, 26E, 19D, 16B, 6.5V, 2.7C, 2.7K)
MW-710DR 1.2T (0.02N, 0.09D)
NTCRA 1 CONTAINMENT AREA
CL&P EASEMENT
QUINNIPIAC RIVER
INTERMITTENT STREAM
FORMER IDEAL FORGING
LAZY LANE
QUEEN STREET
(CONN. ROUTE 10)
NORTH MAIN STREET
FLANDERS STREET
CURTISS STREET
KANE STREET
HART STREET
FAWN ROAD
IVY DRIVE
7/22/97 SYR-54-RLP,PCL X: 08325X00,08325X01.DWG
08331900/08331821.DWG P: STD-DL.PCP @ E-SIZE OR DJ.B.PCP



EXTENT OF NTCRA 2 MODFLOW MODEL DOMAIN

LEGEND

- STREET
- RIVER OR STREAM
- POND
- WETLAND
- REGIONAL WELL/BORING
- PRODUCTION WELL
- NTCRA 1 RECOVERY WELL
- 162 WATER TABLE ELEVATION AT REGIONAL WELL (FT, AMSL)
- 170 WATER TABLE ELEVATION CONTOUR LINE (FT, AMSL), 10-FOOT CONTOUR INTERVAL, DASHED WHERE INFERRED

0 1000' 2000'
GRAPHIC SCALE

NOTES:

1. BACKGROUND MAPPING COPYRIGHT 1995 AMERICAN DIGITAL CARTOGRAPHY, INC. BASED ON 1:100000 SCALE DIGITAL DATA AVAILABLE FROM THE US GEOLOGICAL SURVEY AND MEETS MAP ACCURACY STANDARDS FOR 1:100000 SCALE MAPS.
2. ALL WELL LOCATIONS ARE APPROXIMATE.
3. RI DATA MEASURED JANUARY 21, 1997 WERE USED TO INTERPRET THE WATER TABLE ELEVATION IN THE RI STUDY AREA.
4. REGIONAL WATER LEVEL DATA OBTAINED FROM MAZZAFERRO (1973) AND HAENI & ANDERSON (1980).

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SOUTHINGTON, CONNECTICUT
NTCRA 2

MODEL DOMAIN AND MEASURED/ ESTIMATED REGIONAL WATER TABLE

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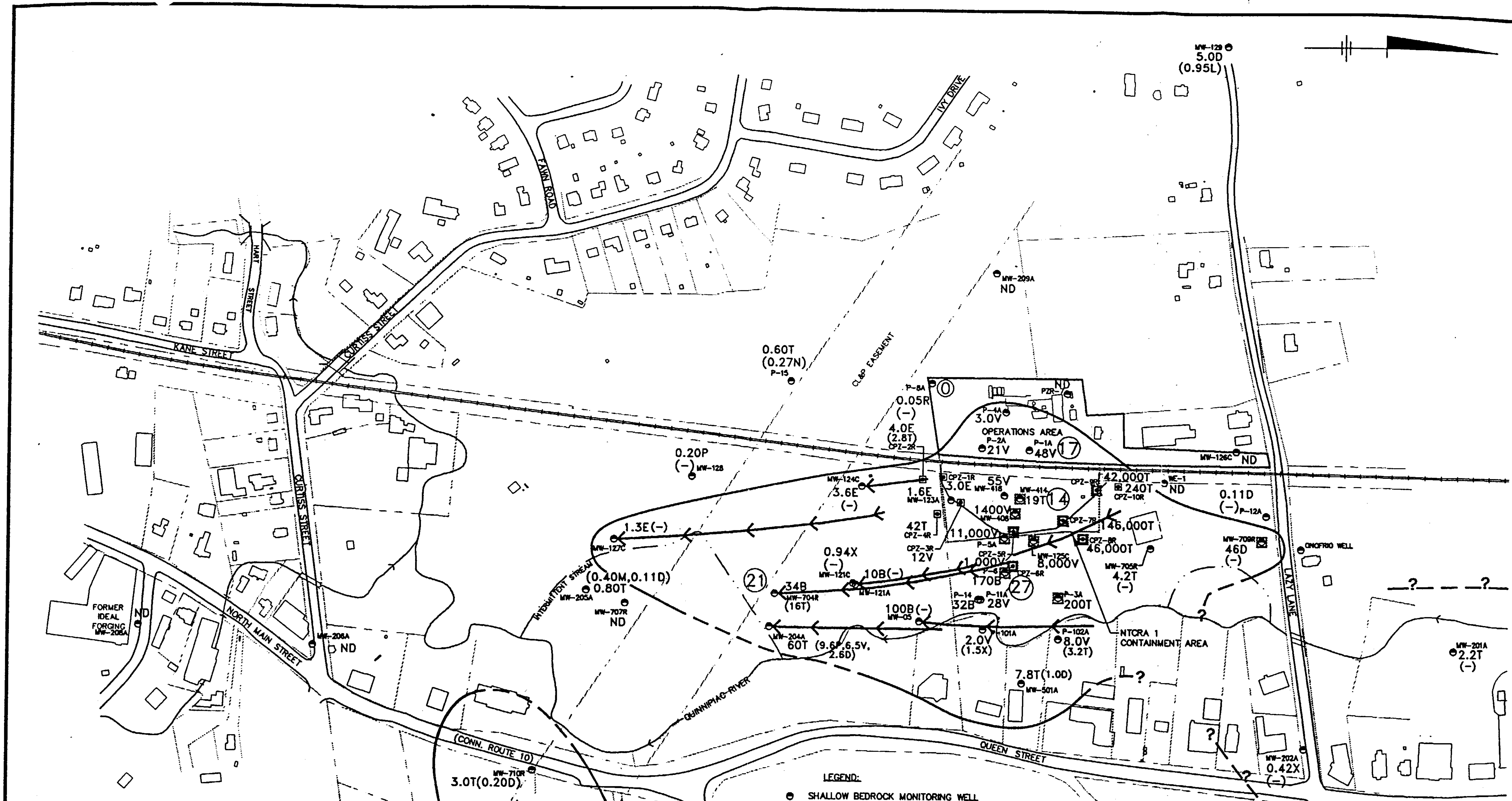
FIGURE 5



B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
M METHYLENE CHLORIDE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT

MW-707R 4.8T — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 4.8 INDICATES 4.8 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

LEGEND:

- SHALLOW BEDROCK MONITORING WELL
- SHALLOW BEDROCK PIEZOMETER
- ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
- USAF NATURAL ATTENUATION RANK
- LOCATION WITH ALCOHOLS DETECTION
- REVERSE-TRACKED PARTICLE PATHS

0 300' 600'

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. NO NTCRA 1 GROUND-WATER CONTAINMENT SYSTEM.

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

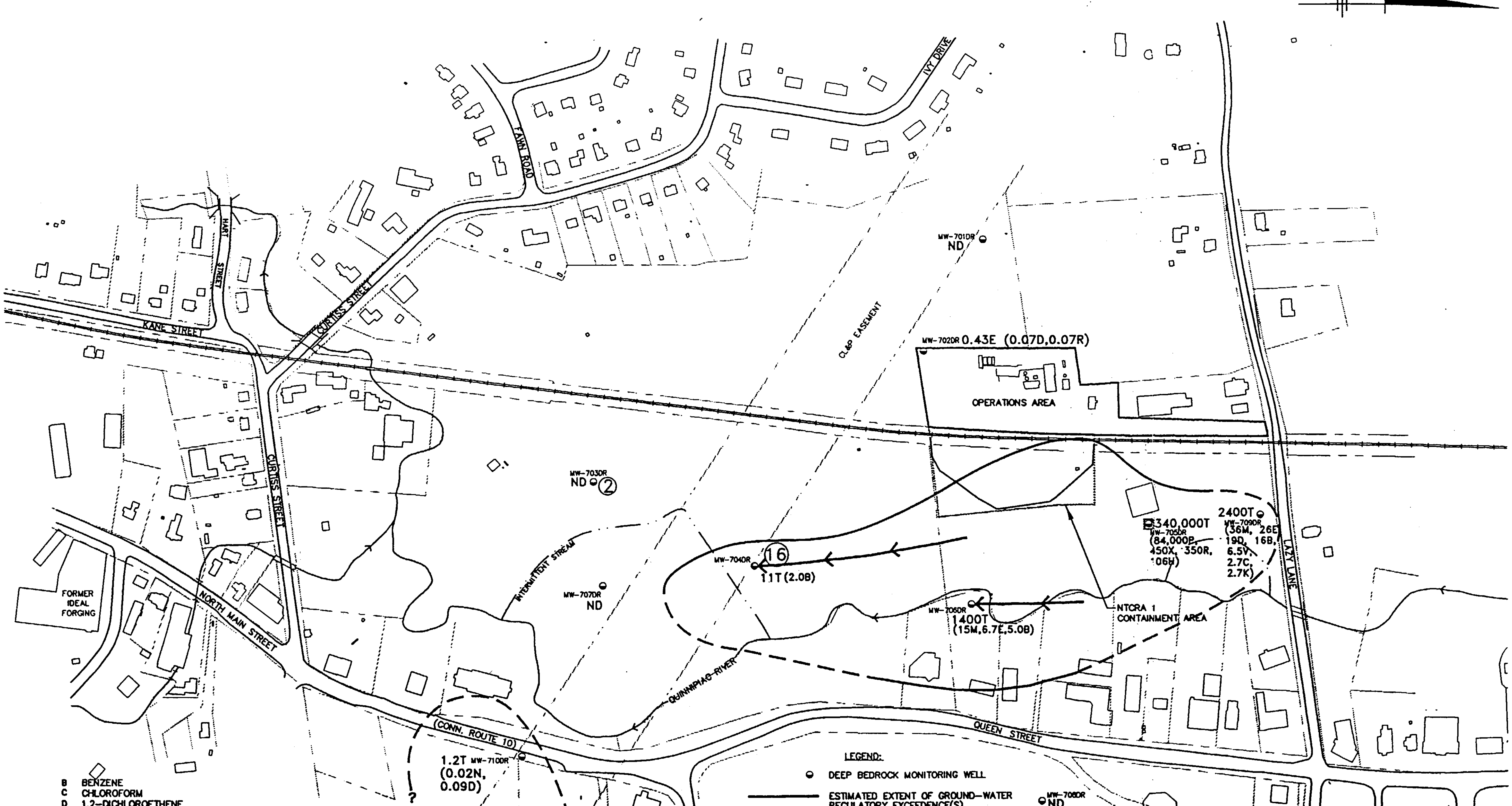
NTCRA 2

SHALLOW BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP AND SIMULATED PARTICLE PATHS

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 6

P: STD-OL.PCP @ E-SIZE OR D.PLPCP
XREF: 08325X00,08325X01; L: ON=, OFF: REF,(XREF XO1: PIPES,TRAIL)
6/11/97 SYR-54-PGL
08331900/08331818.DWG



B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
H ETHYLBENZENE
K 4-METHYL-2-PENTANONE (MIBK)
L TOLUENE
M METHYLENE CHLORIDE
N ACETONE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996–JANUARY 1997 GROUND-WATER SAMPLING EVENT

MW-7040R 11T — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 11 INDICATES 11 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

LEGEND:

- DEEP BEDROCK MONITORING WELL
- ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
- (2) USAF NATURAL ATTENUATION RANK
- LOCATION WITH ALCOHOLS DETECTION
- REVERSE-TRACKED PARTICLE PATHS

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. NO NTCRA 1 GROUND-WATER CONTAINMENT SYSTEM.

0 300' 600'

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

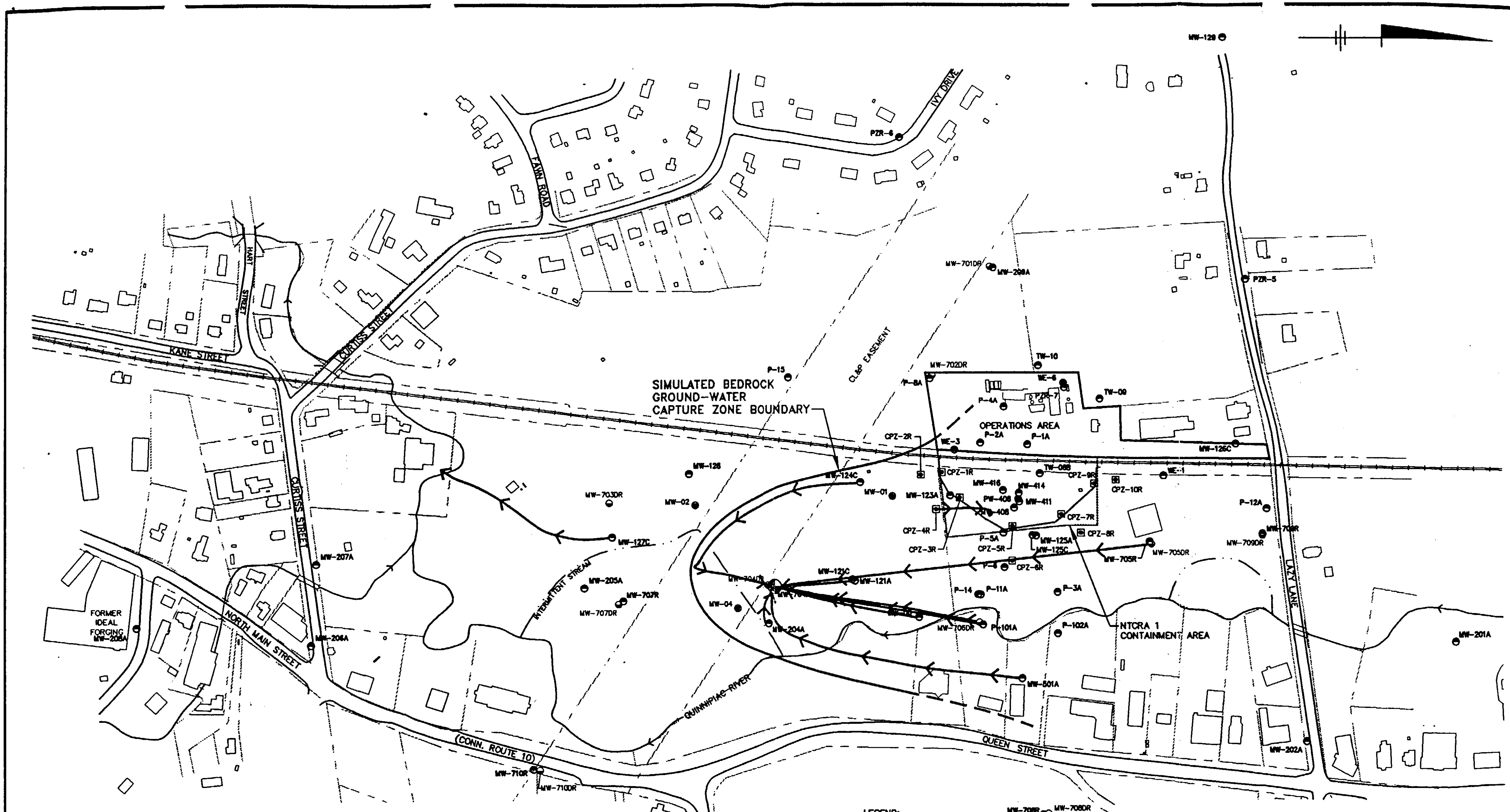
NTCRA 2

DEEP BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP AND SIMULATED PARTICLE PATHS

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 7

8/11/97 SYR-54-RLP.PCL X: 06325X00,06325X01.DWG
06331B00/06331B21.DWG P: STD-DL.PCP @ E-SIZE OR D.B.PCP



LEGEND:

- OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- SHALLOW BEDROCK PIEZOMETER (NTCRA 1)
- PROPOSED NTCRA 2 BEDROCK PUMPING WELL
- FORWARD-TRACKED PARTICLE PATHS

0 300' 600'

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.

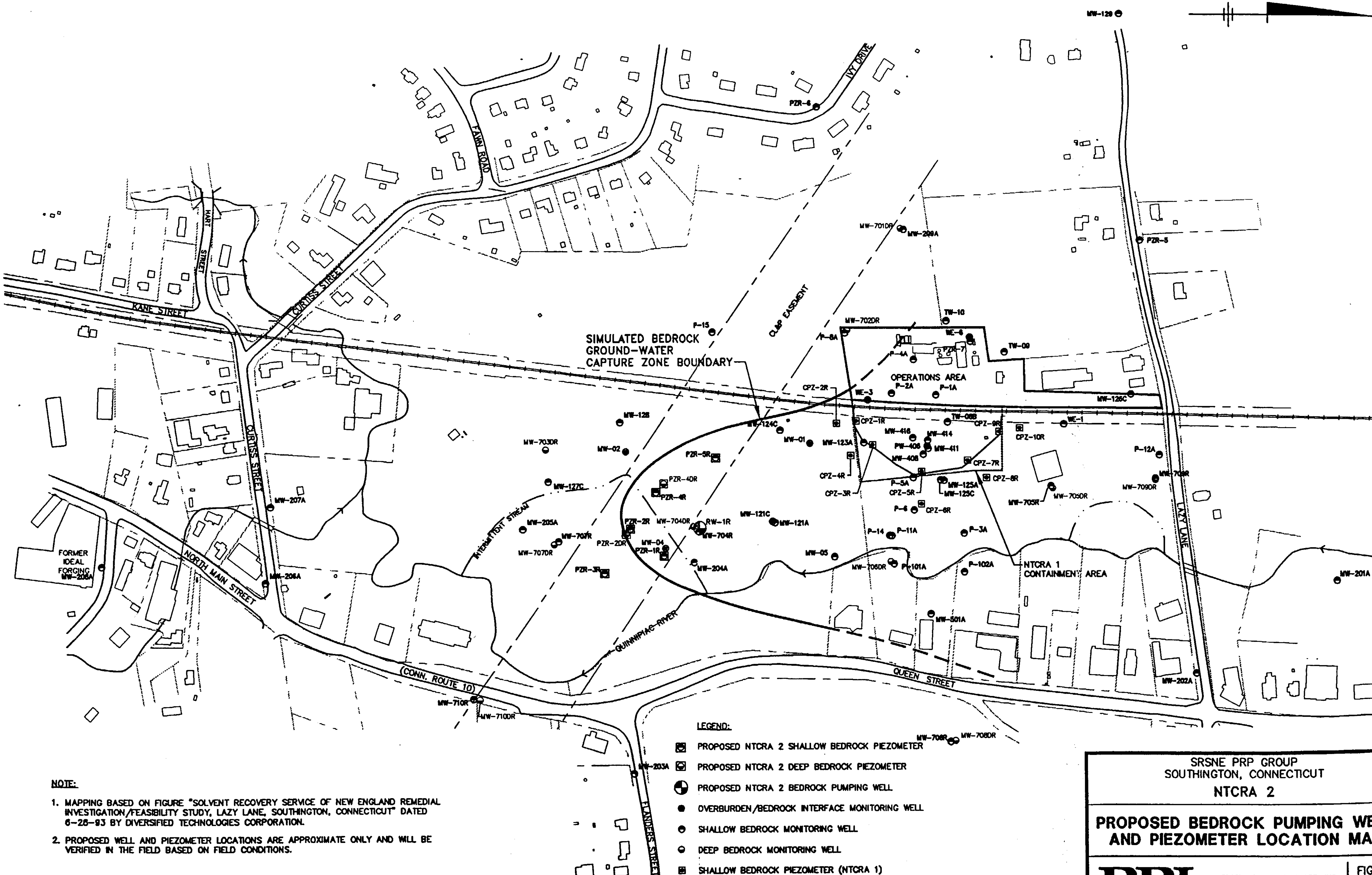
P:STD-OL.PCP @ E-SIZE OR SJB.PCP
XREF: 06325X00,06322X01
8/22/97 SYR-54-PGL DMW, PGL
06331006/06331815.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2

SIMULATED BEDROCK GROUND-WATER CAPTURE ZONE

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 8



LEGEND:

- PROPOSED NTCRA 2 SHALLOW BEDROCK PIEZOMETER
- PROPOSED NTCRA 2 DEEP BEDROCK PIEZOMETER
- PROPOSED NTCRA 2 BEDROCK PUMPING WELL
- OVERBURDEN/BEDROCK INTERFACE MONITORING WELL
- SHALLOW BEDROCK MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- SHALLOW BEDROCK PIEZOMETER (NTCRA 1)

0 300' 600'

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. PROPOSED WELL AND PIEZOMETER LOCATIONS ARE APPROXIMATE ONLY AND WILL BE VERIFIED IN THE FIELD BASED ON FIELD CONDITIONS.

P:STD-GL.PCP @ E-SIZE OR 0.5B.PCP
XREF: 08325X00,08325X01
9/23/97 SYR-54-PGL, DMW, PGL
08331008/08331816.DWG

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

PROPOSED BEDROCK PUMPING WELL AND PIEZOMETER LOCATION MAP

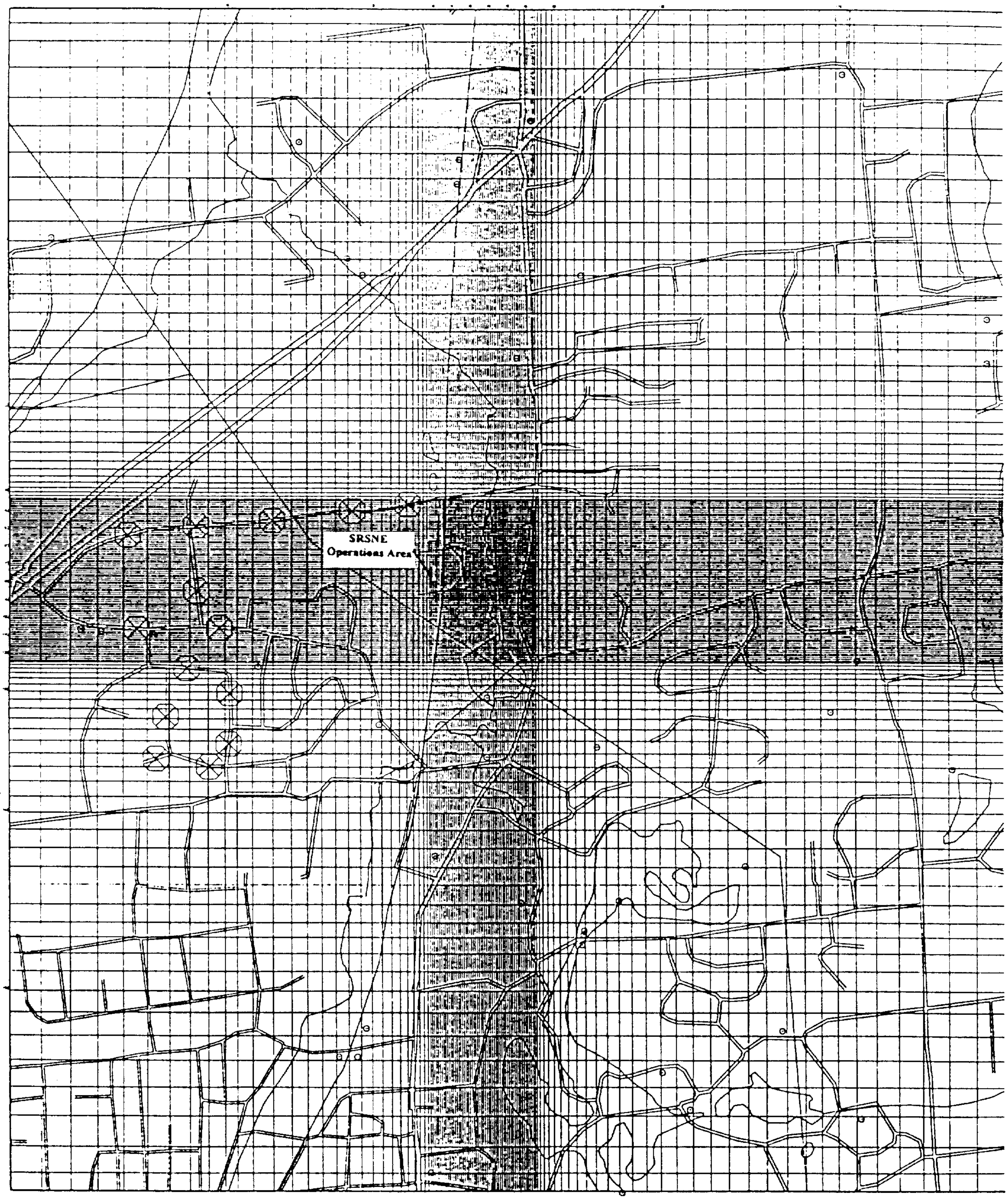
BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE 9

ATTACHMENT 1

PLAN VIEW AND SCHEMATIC CROSS-SECTION OF MODEL GRID

Plan View of the Model Grid



SRSNE SITE
SOUTHINGTON, CONNECTICUT
NTCRA2 MODFLOW MODEL
MODEL LAYER STRUCTURE

Layer 1 (Outwash)
- unconfined
- estimated saturated thickness: 0 to 120 ft.
- designated inactive where saturated thickness equals 0 ft.
- heterogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 2 (Till and Coarse Drift)
- confined/unconfined (convertible)
- estimated saturated thickness: 0 to 50 ft.
- designated inactive where saturated thickness equals 0 ft.
- heterogeneous hydraulic conductivity
- horizontally and vertically anisotropic

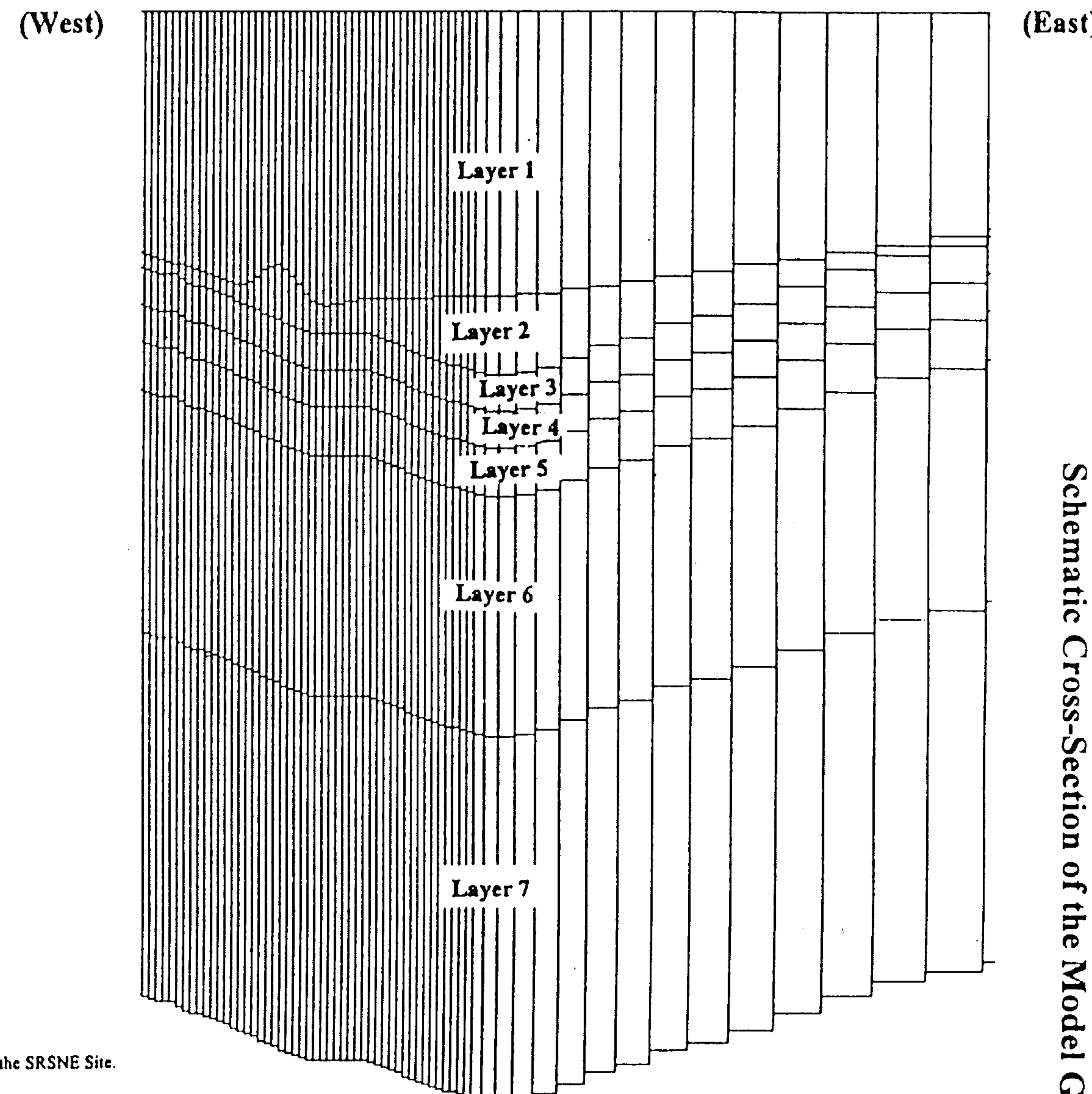
Layer 3 (Shallow Bedrock)
- confined/unconfined (convertible)
- uniform thickness: 30 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 4 (Middle Bedrock)
- confined/unconfined (convertible)
- uniform thickness: 30 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 5 (Deep Bedrock)
- confined/unconfined (convertible)
- uniform thickness: 40 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 6 (Deeper Bedrock)
- confined/unconfined (convertible)
- uniform thickness: 200 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic

Layer 7 (Deeper Bedrock)
- confined/unconfined (convertible)
- uniform thickness: 300 ft.
- homogeneous hydraulic conductivity
- horizontally and vertically anisotropic



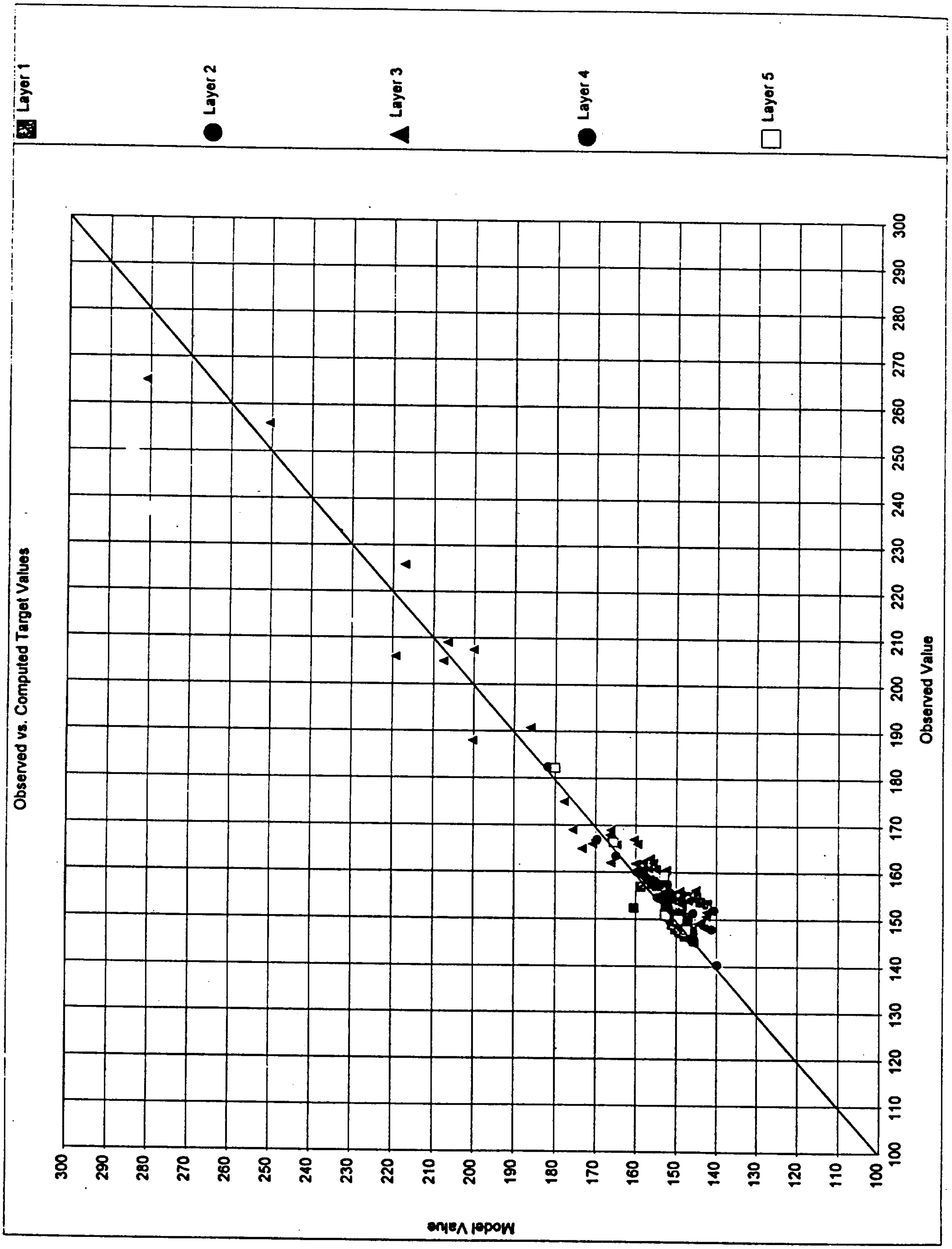
Schematic Cross-Section of the Model Grid

Note: Figure represents the central position of the model grid in east-west cross-section through the SRSNE Site.

ATTACHMENT 2

CALIBRATION SUMMARY PLOT

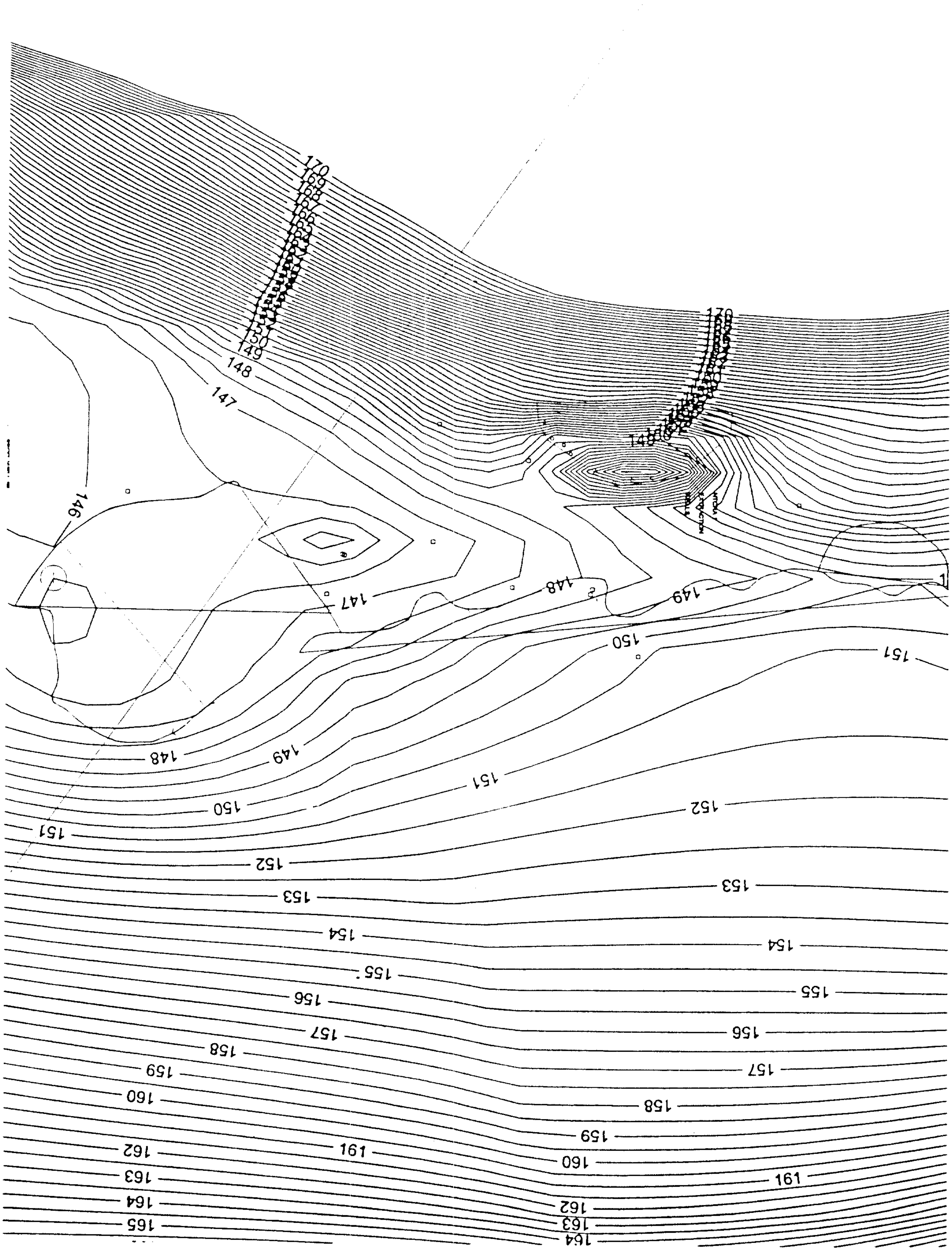
Calibration Summary Plot



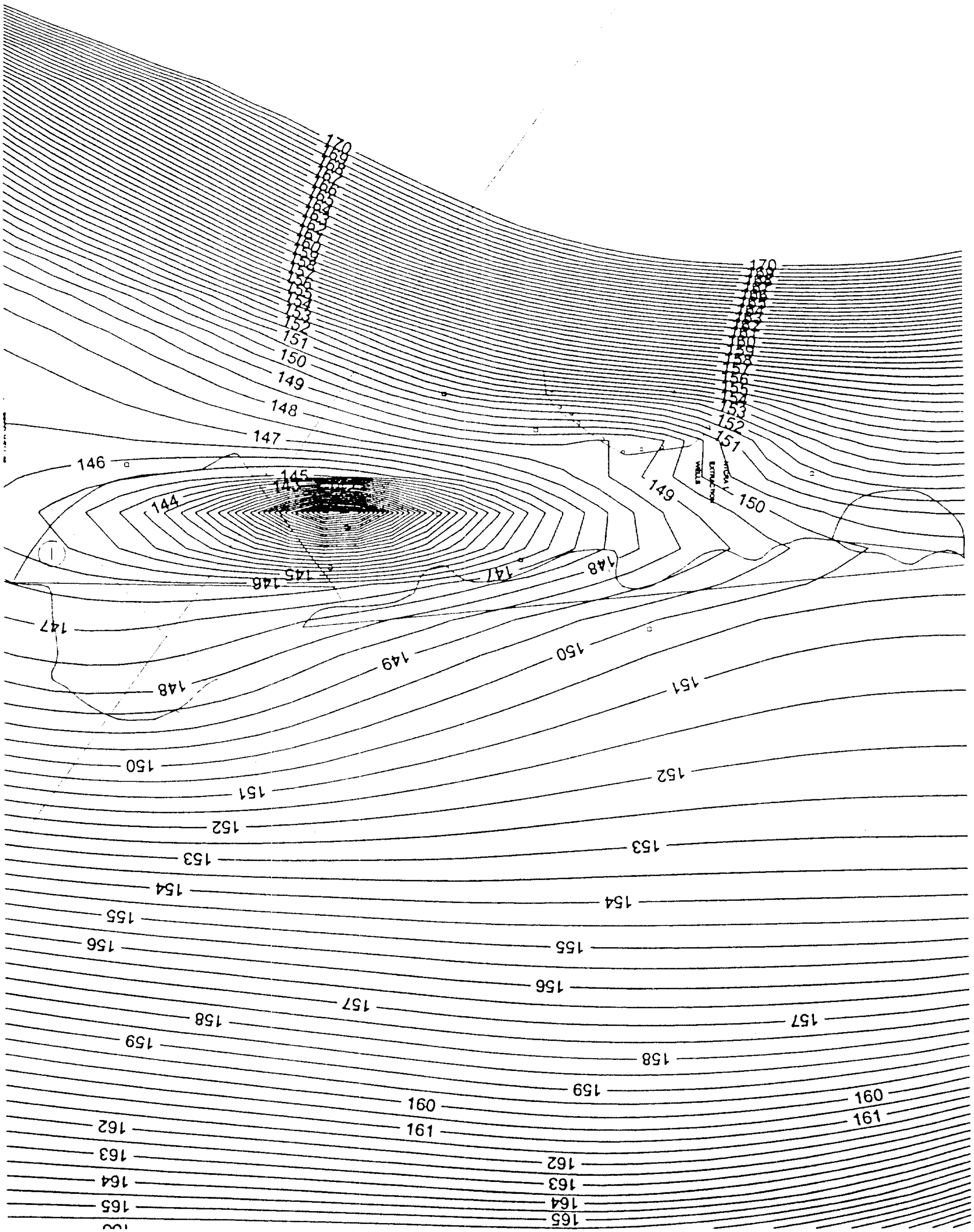
ATTACHMENT 3

SIMULATED HEADS IN LAYER 3 THROUGH 5

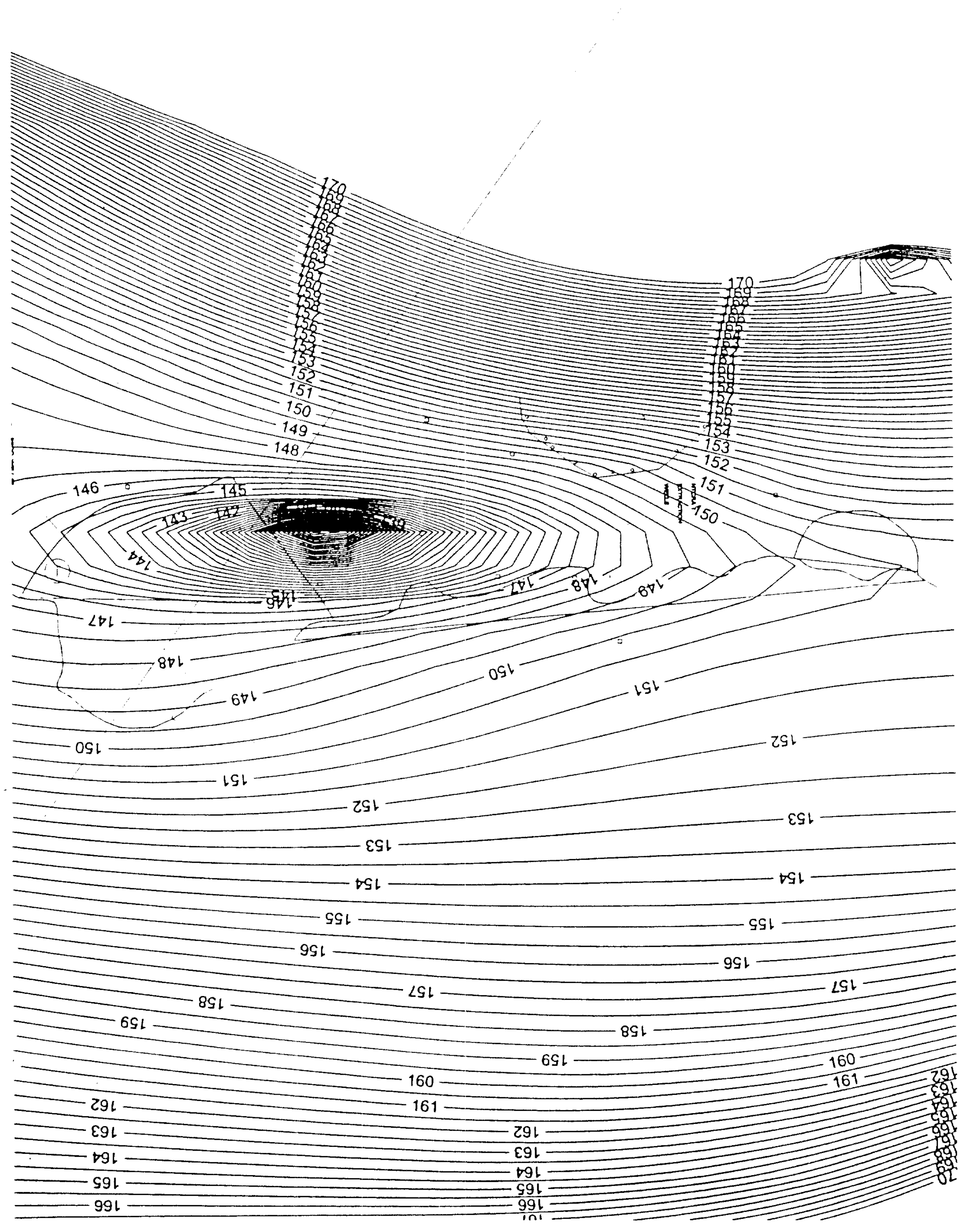
Simulated Layer 3 Heads



Simulated Layer 4 Heads



Simulated Layer 5 Heads



Attachment A-2

Attachment A-2 Original Calibrated Model Setup and Calibration

Included in this attachment are tables and figures that demonstrate the design and calibration of the original NTCRA 2 MODFLOW model as discussed in the NTCRA 2 Interim Technical Memorandum (BBL, September 1997; see Attachment A-1 to this appendix). This attachment includes:

- Calibration Statistics;
- Calibration Summary Plot;
- Table of Residuals;
- Residual Plots for Layers 1 through 5 (Plan View);
- Simulated Head Contours for Layers 1 through 5 (Plan View);
- Model Boundary Conditions for Layers 1 through 7;
- Calibrated Hydraulic Conductivity Distribution for Layers 1 and 2; and
- Simulated Overburden and Bedrock Particle Paths and VOC Plumes.

Calibration statistics were computed by using an automated spreadsheet to calculate the residual mean, residual standard deviation, absolute residual mean, minimum residual, maximum residual, range, and number of targets (ASTM Standard D5490-93). The spreadsheet is constructed to compute statistics for each layer of the model having target heads. In addition, a portion of the spreadsheet was created to calculate residual vertical gradients for each model simulation; including a plot of observed vertical gradients versus simulated vertical gradients.

References

American Society for Testing and Materials (ASTM). D 5490-93 *Standard Guide for Comparing Ground-Water Flow Model Simulations to Site-Specific Information.*

Blasland, Bouck & Lee, Inc (BBL). September 25, 1997. NTCRA 2 Interim Technical Memorandum, Solvents Recovery Service of New England, Inc., Superfund Site, Southington, Connecticut.

Original Calibrated Model

Calibration Statistics

Project: SRSNE
Simulation: SRS1717
Modeler: SAP
Date: 11/9/98
Time: 1100

	Model	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Residual Mean	1.37	1.04	1.17	1.76	2.41	1.04
Res. Std. Dev.	3.78	3.18	2.17	4.97	2.41	2.52
Abs. Res. Mean	2.70	2.13	1.56	3.93	2.41	1.63
Min. Residual	-18.80	-8.07	-3.04	-18.80	0.85	-1.68
Max. Residual	11.18	11.06	11.16	11.18	5.19	6.23
Min-Max Range	29.98	19.13	14.19	29.98	4.33	7.91
Residuals <2 ft. (%)	61	74	80	36	67	86
Residuals <5 ft. (%)	82	87	94	71	67	86
No. Residuals >10 ft.	7	1	1	5	0	0
No. of Targets	212	69	50	83	3	7

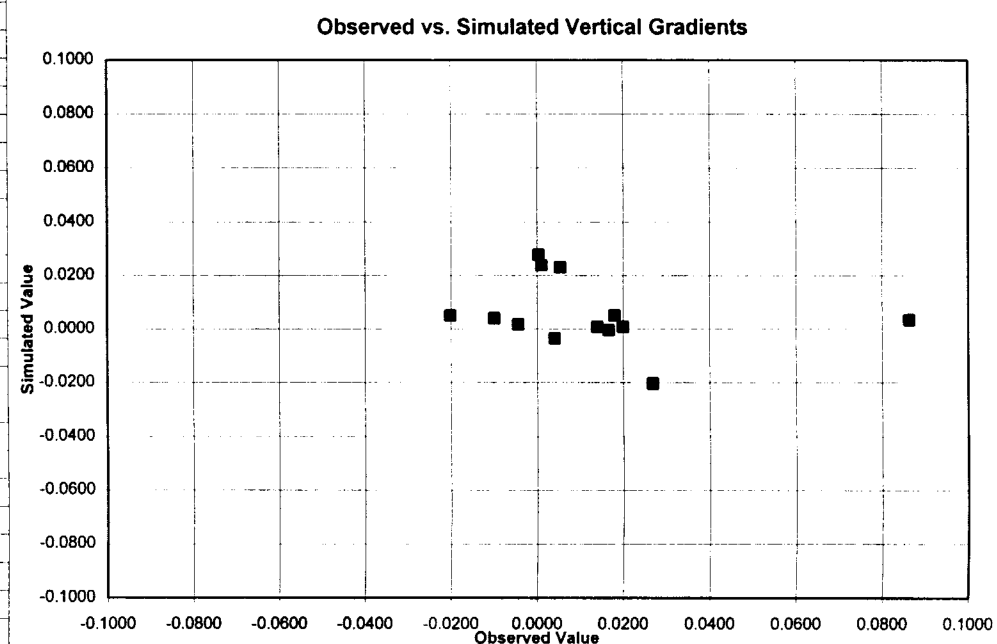
Vertical Gradients

Layer 2 (Till) and Shallow Rock (Layer 3)

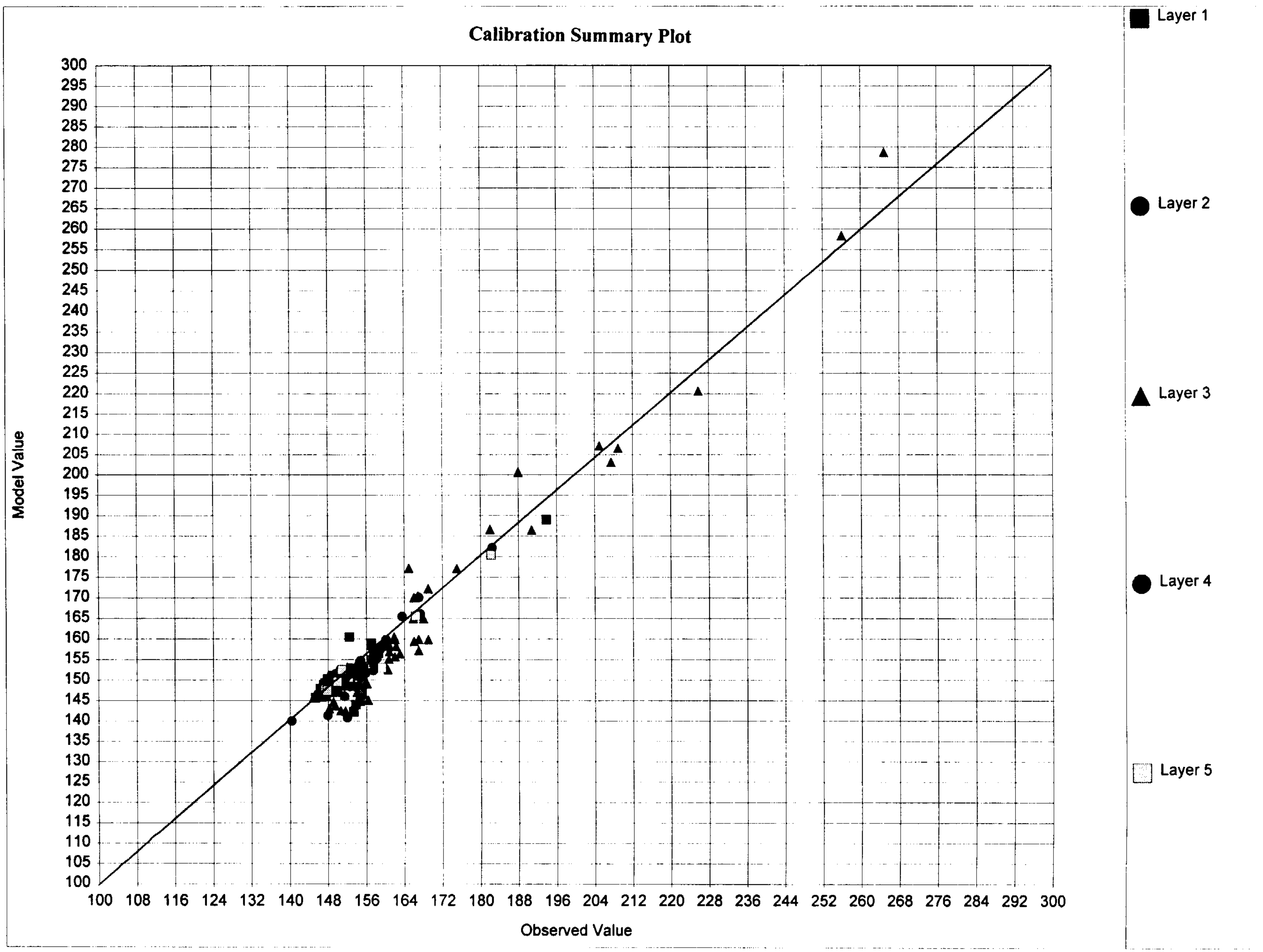
Cluster	Observed	Simulated	Residual
MW-202A,B	0.0167	-0.0005	0.0172
MW-708M,R	0.0140	0.0007	0.0133
MW-203A,B	-0.0044	0.0016	-0.0060
MW-707D,R	0.0200	0.0008	0.0192
MW-204A,CW-2-75	0.0040	-0.0037	0.0077
MW-5,MW-6	-0.0099	0.0038	-0.0137
MW-121B, C	0.0181	0.0049	0.0131
MW-126B,C	0.0863	0.0033	0.0830
		MR	0.0167

Shallow Rock (Layer 3) and Deep Rock (Layer 5)

Cluster	Observed	Simulated	Residual
MW-709R,DR	0.0269	-0.0203	0.0472
MW-708R,DR	-0.0201	0.0050	-0.0251
MW-706DR,P-101A	0.0054	0.0230	-0.0177
MW-707R,DR	0.0011	0.0238	-0.0227
MW-703DR,MW-127C	0.0003	0.0277	-0.0274
(-) indicates downward gradient		MR	-0.0091



Original Calibrated Model



Name	X	Y	Layer	Observed	Computed	Residual
CPZ-1	4751.87	6723.1	2	152.76	152.9203	-0.16026
CPZ-10	4776.5	7259.54	2	157.52	156.216	1.304045
CPZ-2	4755.25	6661.91	2	154.53	154.323	0.207023
CPZ-2A	4758.44	6706.94	2	154.8	154.8023	-0.0023
CPZ-3	4828.94	6779.01	2	147.95	141.3595	6.590519
CPZ-4	4861.06	6708.13	2	151.2	149.8029	1.397146
CPZ-4A	4839.44	6763.1	2	151.4	146.0627	5.337343
CPZ-5	4915.37	6928.51	2	140.36	139.996	0.364046
CPZ-6	5019.19	6941.85	2	150.8	149.522	1.278013
CPZ-6A	4935.12	6937.69	2	151.39	151.8665	-0.47648
CPZ-7	4882.44	7084.01	2	151.99	140.8309	11.15906
CPZ-8	4936.75	7145.26	2	154.43	151.5165	2.913484
CPZ-9	4768.94	7191.69	2	155.44	152.9916	2.448433
CW-1-78	4752.69	5691.01	1	147.4	146.0639	1.336066
CW-10-78	4856.44	4872.51	1	146.38	146.1731	0.206902
CW-2-78	4612.44	5652.51	1	147.52	146.0491	1.470954
CW-3-75	5217.44	5731.51	1	146.74	146.1453	0.59469
CW-3-78	4701.44	5268.51	1	145.3	145.7003	-0.40031
CW-5-75	4825.19	5646.01	1	146.83	146.0197	0.810272
CW-6-75	4761.44	5448.51	1	145.59	145.8434	-0.25341
CW-7-78	4905.44	4775.51	1	146.53	146.3435	0.186456
CW-8-78	4996.44	4787.51	1	147.09	146.4122	0.677791
CW-9-78	5066.44	4887.51	1	146.01	146.3802	-0.37023
CW-B-77	4849.06	6327.35	1	148.29	149.1397	-0.84975
MW-07	5185.44	6644.51	1	149.03	147.8441	1.18587
MW-121B	5071.44	6433.51	1	148.45	147.6545	0.795486
MW-123C	4813.44	6742.51	1	153.12	148.4927	4.627272
MW-127B	4942.44	5703.51	1	147.38	146.0996	1.280402
MW-201B	5276.81	8310.88	1	148.35	150.0919	-1.7419
MW-204B	5191.37	6185.19	1	148.41	147.3055	1.104495
MW-205B	5090.81	5608.16	1	146.86	146.0214	0.838573
MW-409	4859.06	6948.1	1	154.72	144.8901	9.82991
MW-410	4844.12	6945.1	1	155	146.5573	8.442663
MW-413	4817.75	6966.88	1	155.1	148.9078	6.192167
MW-415	4814.62	6962.41	1	155.22	149.1008	6.119185
MW-501B	5376.44	6959.51	1	150	150.2576	-0.25759
MW-501C	5377.44	6966.51	1	147.84	150.2804	-2.44038
MW-502	5034.44	6886.51	1	150.13	150.0558	0.074254
MW-703S	4838.56	5703.44	1	147.06	146.1042	0.955767
MW-704S	5096.62	6199.91	1	148.07	147.3958	0.674166
MW-707S	5146.94	5732.79	1	147.07	146.1408	0.929243
MW-708S	5780.94	7034.57	1	150.79	152.1604	-1.37044
MWL-301	4800.12	7214.69	1	157.06	154.9384	2.121633
MWL-302	4898.12	7219.16	1	155.34	153.3119	2.028062
MWL-303	4996	7220.79	1	150.69	151.9573	-1.26729
MWL-306	5041.06	7066.91	1	149.8	150.8449	-1.04487
MWL-311	4890	6765.04	1	151.48	150.1358	1.344236
MWL-312	5048.56	6770.51	1	149.92	148.8359	1.084067

MWL-313	4891.31	6608.47	1	150.36	149.9092	0.450834
MWL-314	5041.62	6617.04	1	149.26	148.1813	1.078726
P-10	4855.25	7419.66	1	158.52	156.5386	1.981384
P-101B	5214.31	6848.54	1	149.77	148.4218	1.348225
P-101C	5215.75	6854.19	1	147.08	148.4354	-1.35538
P-102B	5241.69	7081.51	1	149.86	149.1501	0.709933
P-102C	5241.44	7088.13	1	147.69	149.1729	-1.48293
P-11B	5122.37	6836.13	1	149.47	148.3473	1.122674
P-12	4860.75	7731.82	1	158.53	157.057	1.472972
P-13	4781.44	6467.51	1	148.87	151.1957	-2.32567
P-16	4668.62	7134.79	1	157.01	158.8478	-1.83781
P-1B	4664.19	6988.01	1	156.97	158.4798	-1.50984
P-3B	5109.37	7073.04	1	149.43	148.9826	0.447351
P-5B	4930.44	6899.51	1	152.43	160.5004	-8.07045
P-7	4978.5	7421.79	1	157.43	154.8636	2.56637
P-9	4951.44	7200.57	1	154.34	152.3305	2.009479
PW-407	4830.69	6947.29	1	155.07	147.9838	7.086233
PZO-1	4874.75	7000.57	1	153.76	144.0871	9.672904
PZO-2	4890	6986.82	1	153.34	142.2816	11.05841
PZO-3	4852.87	7123.41	1	154.48	147.605	6.875033
PZO-5	4160	7658.82	1	193.88	188.9873	4.892685
SRS-4	4931.44	6484.51	1	148.35	148.7721	-0.42206
SRS-5	5069.12	6613.35	1	148.7	148.0378	0.662236
TW-01	4883.44	4681.51	1	146.59	146.5081	0.08192
TW-02	4894.44	4386.51	1	146.85	147.0304	-0.18041
TW-03	4808.06	4643.94	1	146.71	146.5092	0.200809
TW-05	4688.44	4966.51	1	146.09	145.8418	0.248241
TW-11	4821.44	6572.51	1	151.68	151.1037	0.576318
CW-2-75	4946.44	6293.51	2	148.4	147.534	0.866006
CW-4-75	4851.44	5971.51	2	148.21	147.0082	1.201783
CW-4-78	4694.44	5266.51	2	145.41	145.7067	-0.29667
CW-6-78	4935.44	5241.51	2	146.22	145.928	0.291981
CW-7-75	4855.44	5459.51	2	145.77	145.8989	-0.12887
CW-7A	4853.44	5459.51	2	145.43	145.8976	-0.46756
DP-1	5159.31	6762.16	1	146.34	147.9826	-1.6426
DP-2	5136.19	6939.47	1	147.05	148.5356	-1.48561
DP-3	5117.19	7097.51	1	147.06	148.9265	-1.86655
DP-4	5063.44	7271.01	1	148.76	150.724	-1.96405
DP-5	5141.44	7716.16	1	147.47	148.9189	-1.44894
DP-6	5138.12	7502.01	1	147.33	149.396	-2.06596
MW-01	4820.44	6566.51	2	151.31	150.9036	0.406417
MW-02	4846.44	5954.51	2	147.87	146.9964	0.873635
MW-03	5048.44	5681.51	2	146.19	146.1276	0.062452
MW-04	5161.44	6086.51	2	148.55	147.0243	1.525728
MW-06	5199.44	6633.51	2	149.64	148.0097	1.630302
MW-126B	4663.37	7624.6	2	160.11	159.8425	0.26753
MW-202B	5576.5	7841.35	2	149.68	151.573	-1.89296
MW-203B	5890.19	5975.16	2	152.86	151.4463	1.41368
MW-206B	5265.75	4775.19	2	146.94	147.2672	-0.32722

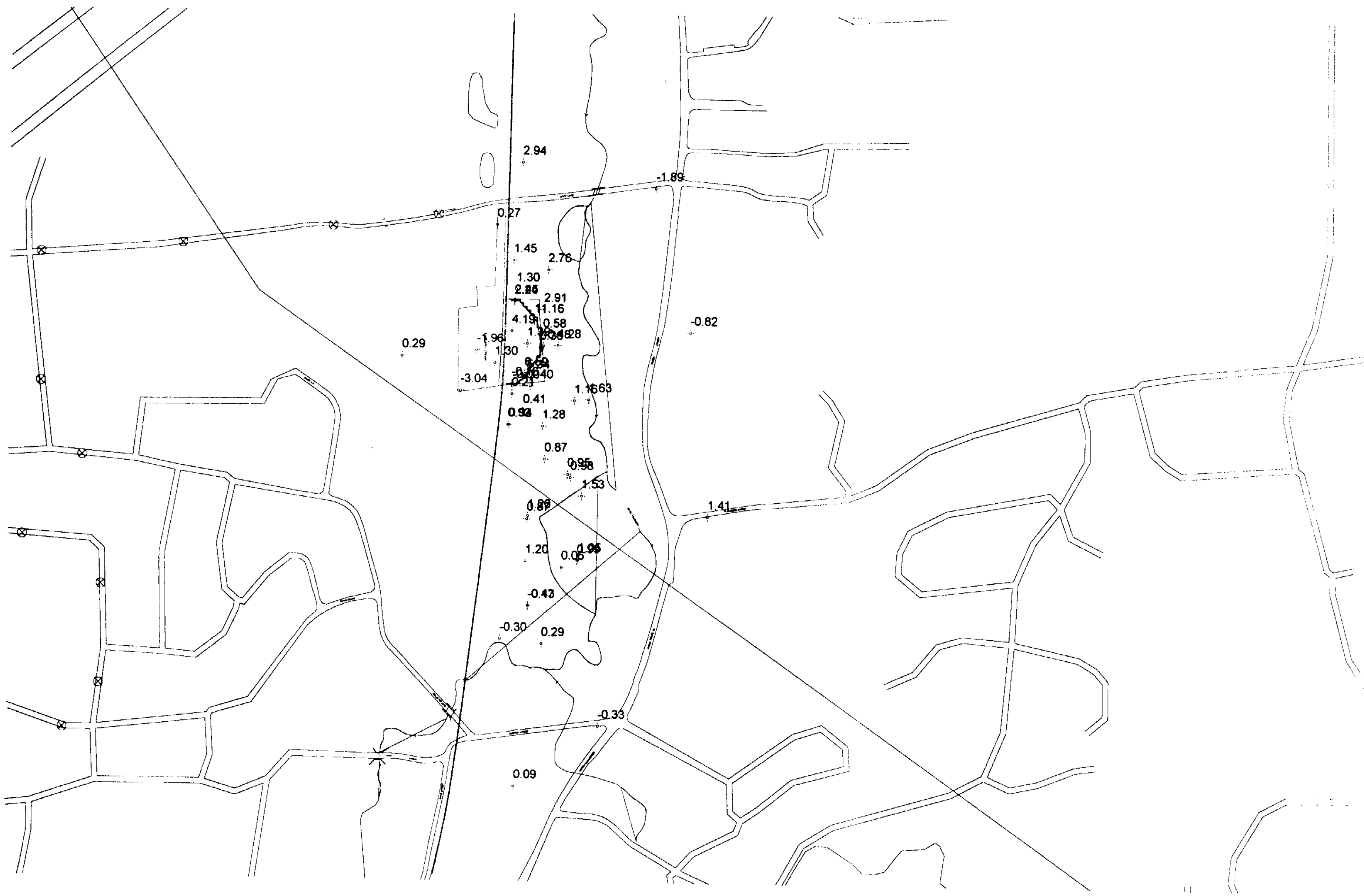
MW-209B	4121.62	6874.22	2	182.46	182.1748	0.285236
MW-412	4841.62	6951.16	2	147.28	145.8942	1.385805
MW-703D	4839.56	5713.97	2	147.41	146.2121	1.197917
MW-704D	5079.69	6207.54	2	148.15	147.1978	0.952238
MW-704M	5096.5	6190.79	2	148.16	147.1805	0.979512
MW-705D	4960.94	7370.91	2	157.28	154.5234	2.756608
MW-707D	5138.44	5719.01	2	147.14	146.1481	0.991868
MW-707M	5144.56	5725.63	2	147.2	146.1546	1.045431
MW-708M	5784	7021.66	2	151.34	152.1594	-0.81939
MWD-601	4767.62	7189.01	2	155.23	152.988	2.242035
P-2B	4655.37	6840.01	2	159.6	158.2977	1.302284
P-4B	4549.94	6910.97	2	163.51	165.4694	-1.95943
P-8	4457.44	6680.01	2	167.02	170.0559	-3.03593
SRS-1	4733.44	6487.51	2	154.01	153.0929	0.917085
SRS-2	4739.44	6487.51	2	153.77	152.8327	0.937284
SRS-3	4933.44	6480.51	2	149.8	148.5221	1.277904
SRS-6	5117.06	6626.69	2	149.07	147.9092	1.160814
TW-04	4784.44	4430.51	2	146.87	146.7792	0.090802
TW-07A	4932.44	7000.51	2	152.74	152.1569	0.58309
TW-08A	4752.44	7022.51	2	155.86	151.6694	4.190554
TW-12	4808.44	7982.51	2	158.19	155.2533	2.936726
WE-2	4759.44	7424.51	2	159	157.5454	1.454558
CPZ-10R	4772.12	7258.51	3	160.7	155.1135	5.586495
CPZ-1R	4748.25	6719.88	3	158.18	153.4609	4.719071
CPZ-2R	4756.19	6655.35	3	160.07	153.1194	6.950565
CPZ-3R	4825.87	6774.22	3	154.06	147.0947	6.96525
CPZ-4R	4861.5	6701.38	3	153.39	148.9155	4.474475
CPZ-5R	4913.94	6935.41	3	148.22	143.0832	5.136809
CPZ-7R	4877.25	7088.38	3	156.37	145.1938	11.17621
CPZ-8R	4934.31	7149.51	3	154.08	151.0046	3.075439
CPZ-9R	4783.69	7191.66	3	160.54	152.5954	7.944599
MW-05	5190.44	6646.51	3	149.36	148.1186	1.241418
MW-121A	5078.37	6450.54	3	148.86	147.7515	1.108474
MW-121C	5074.44	6442.51	3	148.75	147.7364	1.013606
MW-124C	4777.44	6468.51	3	155.33	151.1808	4.149206
MW-125A	4942.81	7009.76	3	154.61	148.9515	5.658472
MW-125C	4941.44	6998.51	3	151.8	148.6764	3.123587
MW-126C	4662.12	7627.57	3	161.75	159.9046	1.845444
MW-127C	4943.44	5697.51	3	147.4	146.2187	1.181336
MW-128	4750.44	5935.51	3	148.76	147.1367	1.623283
MW-129	3405.44	7591.51	3	225.88	220.6526	5.227395
MW-201A	5271.5	8306.44	3	148.88	150.0756	-1.19556
MW-202A	5570.87	7841.51	3	150.29	151.5543	-1.2643
MW-203A	5894.75	5976.29	3	152.62	151.5334	1.08655
MW-204A	5208.31	6183.01	3	148.66	147.2983	1.361699
MW-205A	5098.5	5613.22	3	146.92	146.0826	0.837368
MW-206A	5270.94	4774.72	3	146.96	147.2927	-0.33272
MW-208A	5217.56	4238.51	3	148.14	148.5845	-0.44448
MW-408	4857.62	6940.91	3	149.1	144.7427	4.357279

MW-411	4838.69	6957.47	3	151.41	146.3999	5.01013
MW-414	4812.19	6955.97	3	151.72	148.6075	3.11254
MW-416	4803.81	6907.04	3	156.14	149.1967	6.943311
MW-501A	5377.44	6962.51	3	149.97	150.5465	-0.57648
MW-704R	5107.75	6199.19	3	148.29	147.2035	1.086536
MW-705R	4961.75	7360.63	3	155.76	153.3424	2.417557
MW-707R	5138.25	5731.54	3	147.74	146.1713	1.568711
MW-708R	5793	7024.66	3	152.23	152.2029	0.027133
MW-709R	4942.44	7708.32	3	157.46	154.3911	3.068876
P-101A	5213.81	6842.69	3	149.74	148.6558	1.084248
P-102A	5241.19	7074.97	3	149.54	149.3897	0.150299
P-11A	5122.37	6836.13	3	149.63	148.5451	1.084887
P-12A	4860.62	7721.63	3	158.22	155.8892	2.330794
P-14	5121.81	6828.63	3	149.57	148.5296	1.04037
P-15	4456.44	6247.97	3	161.85	160.4706	1.379427
P-1A	4663.69	6983.97	3	160.9	158.183	2.717025
P-2A	4657.94	6837.91	3	162.22	158.231	3.989041
P-3A	5115.06	7075.04	3	151.06	149.1126	1.947357
P-4A	4547.69	6910.47	3	165.88	164.9984	0.881649
P-5A	4933.44	6907.51	3	150.04	147.3835	2.656519
P-6	5039.25	6910.01	3	150.31	149.314	0.995976
PW-406	4830.87	6953.97	3	150.52	147.0906	3.429416
PZR-1	4870.19	6999.63	3	149.53	143.7795	5.750473
PZR-2	4888.37	6981.76	3	151.62	142.4515	9.16851
PZR-4	4894.87	6905.22	3	150.66	142.6007	8.059329
PZR-5	4155.75	7658.57	3	190.77	186.5123	4.257728
PZR-6	3716.69	6591.85	3	207.52	203.1049	4.41513
PZR-7	4487.12	7099.29	3	166.84	170.3979	-3.55795
WE-1	4759.44	7403.51	3	160.83	156.9401	3.889926
MW-704DR	5091.5	6181.07	4	148.58	147.7254	0.854605
MW-705DR	4968.81	7366.07	4	157.5	152.3135	5.186452
P-8A	4460.69	6683.72	4	167.34	166.1387	1.201341
MW-701DR	4118.44	6870.04	5	182.21	180.4772	1.732824
MW-702DR	4451.87	6691.22	5	166.35	165.6239	0.726071
MW-703DR	4838.94	5689.35	5	147.42	147.8103	-0.39034
MW-706DR	5207	6832.22	5	149.96	149.5962	0.363825
MW-707DR	5106.75	5740.22	5	147.8	147.5065	0.29349
MW-708DR	5790.25	7040.07	5	150.86	152.54	-1.67997
MW-709DR	4942.44	7708.32	5	159.26	153.0297	6.230314
S112	9204.81	813.66	3	182	186.6309	-4.63091
S64	7046.37	1324.88	3	168	164.9266	3.073388
S61	7346.25	911.97	3	166	170.0422	-4.04222
S153	4553.56	209.04	3	151	150.6279	0.372129
S277	458.12	10659.35	3	214	232.8008	-18.8008
S29	3842.87	10241.76	3	150	152.43	-2.43
S28	3674.25	10431.76	3	152	153.1419	-1.14189
S30	4860.06	11275.82	3	162	155.7145	6.285486
S31	4884.12	11551.51	3	163	156.4836	6.51644
S32	5653.87	11994.04	3	166	159.4045	6.595503

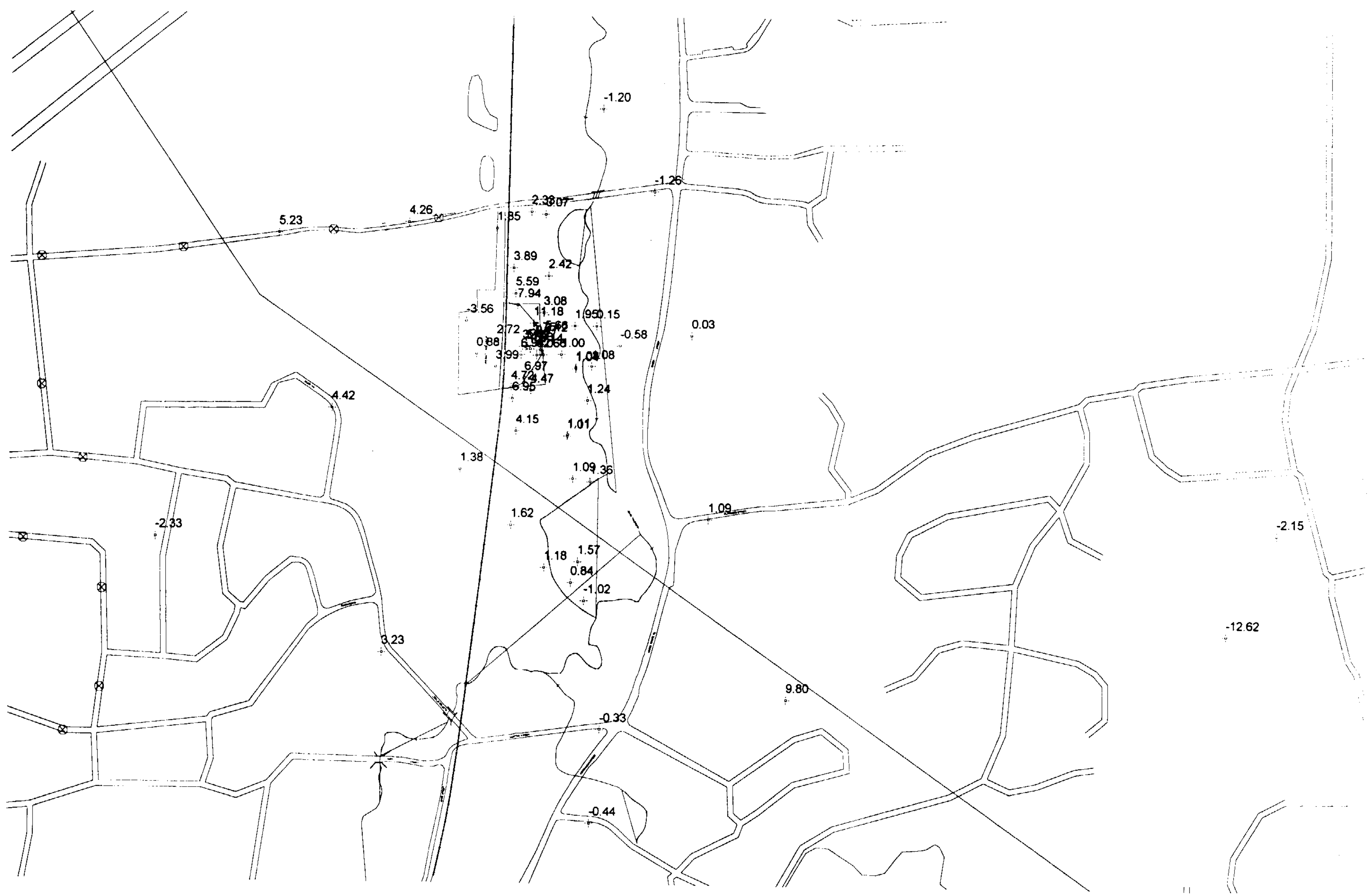
S314	6186.31	10239.85	3	165	177.2104	-12.2104
S284	3863.25	1822.13	3	145	145.9002	-0.90018
S143	8348.94	1795.6	3	175	177.1753	-2.17527
S111	10195.06	4714.22	3	209	206.5548	2.445226
S134	9175.06	5922.04	3	205	207.1509	-2.15091
S135	8884.5	5346.66	3	188	200.6154	-12.6154
S142	7955.31	3634.19	3	169	172.2184	-3.21843
S76	6582.5	3243.76	3	167	159.8848	7.115165
S326	6184.62	2757.01	3	167	159.9219	7.078101
S331	6202.37	2871.76	3	162	159.895	2.104994
S315	6209.5	2912.6	3	169	159.8632	9.136829
S156	4612.44	3748.57	3	146	147.2531	-1.2531
S160	6349	4953.6	3	167	157.1999	9.800061
S353	1568.25	6211.79	3	265	278.6609	-13.6609
S359	2698.12	5853.97	3	256	258.331	-2.33096
S62	4009.87	5206.57	3	156	152.7687	3.231312
S157	5175.06	5510.66	3	145	146.0197	-1.01974

Layer 1 Residuals (ft.)

Layer 2 Residuals (ft.)



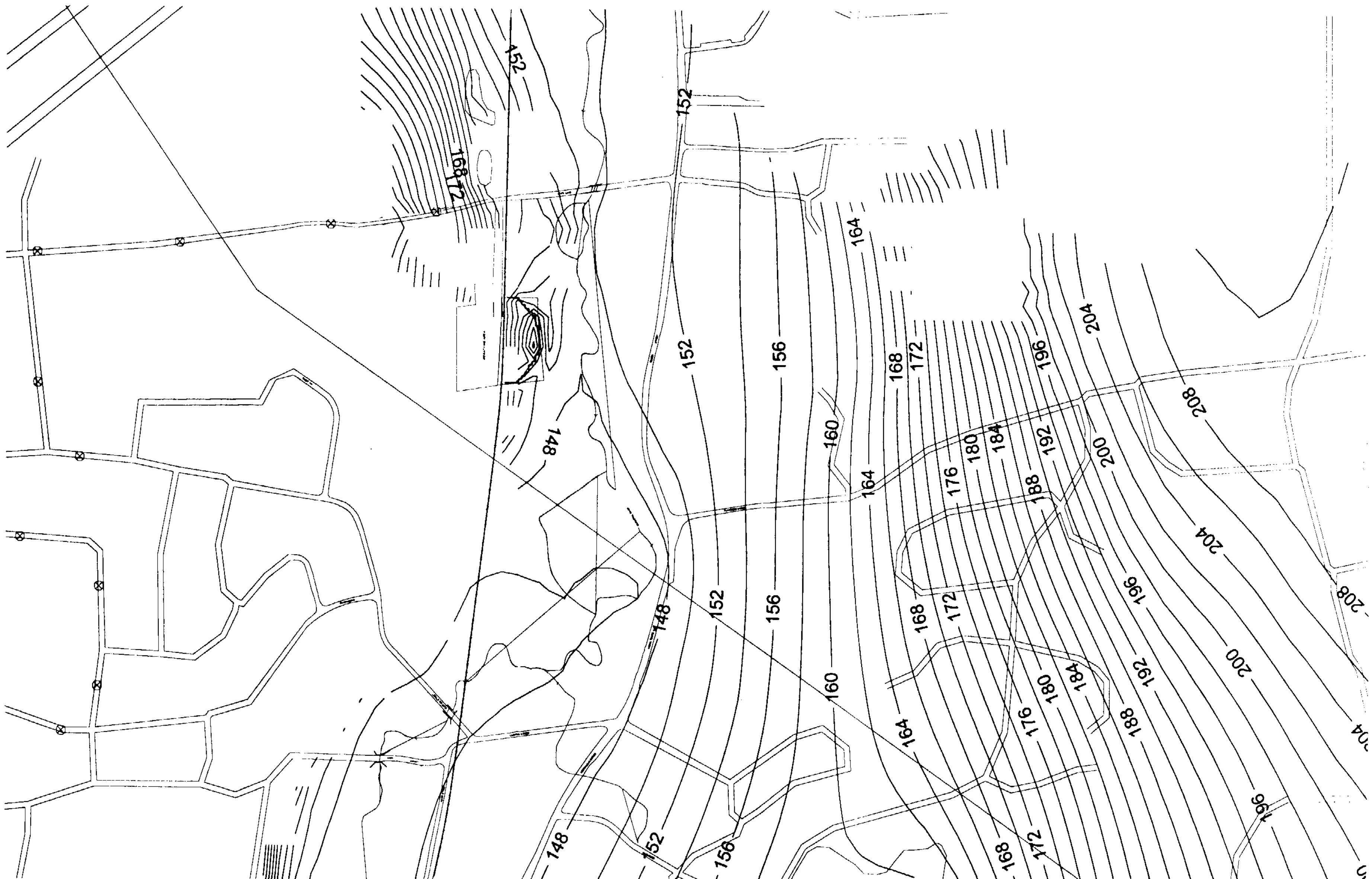
Layer 3 Residuals (ft.)



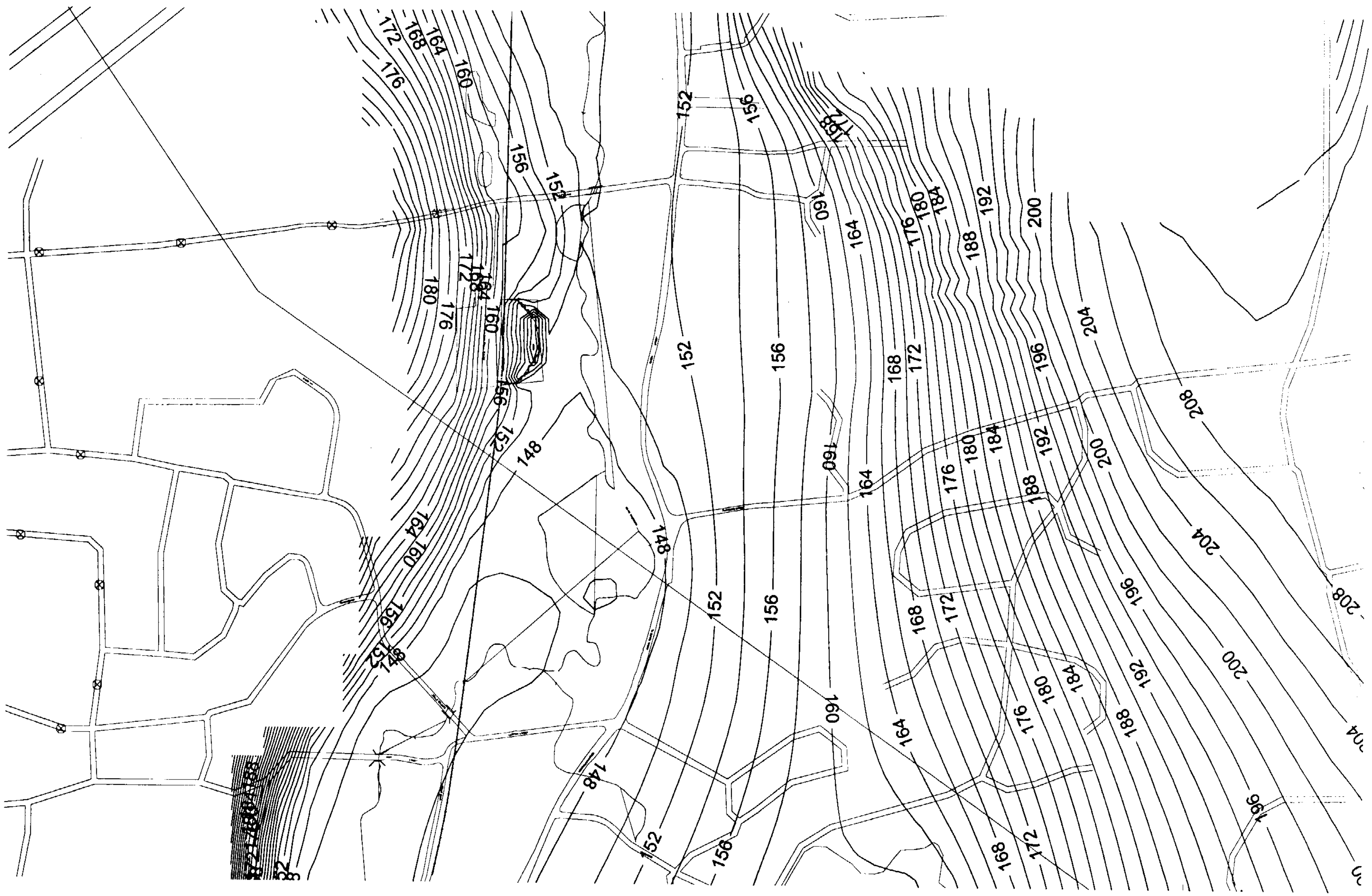
Layer 4 Residuals (ft.)

Layer 5 Residuals (ft.)

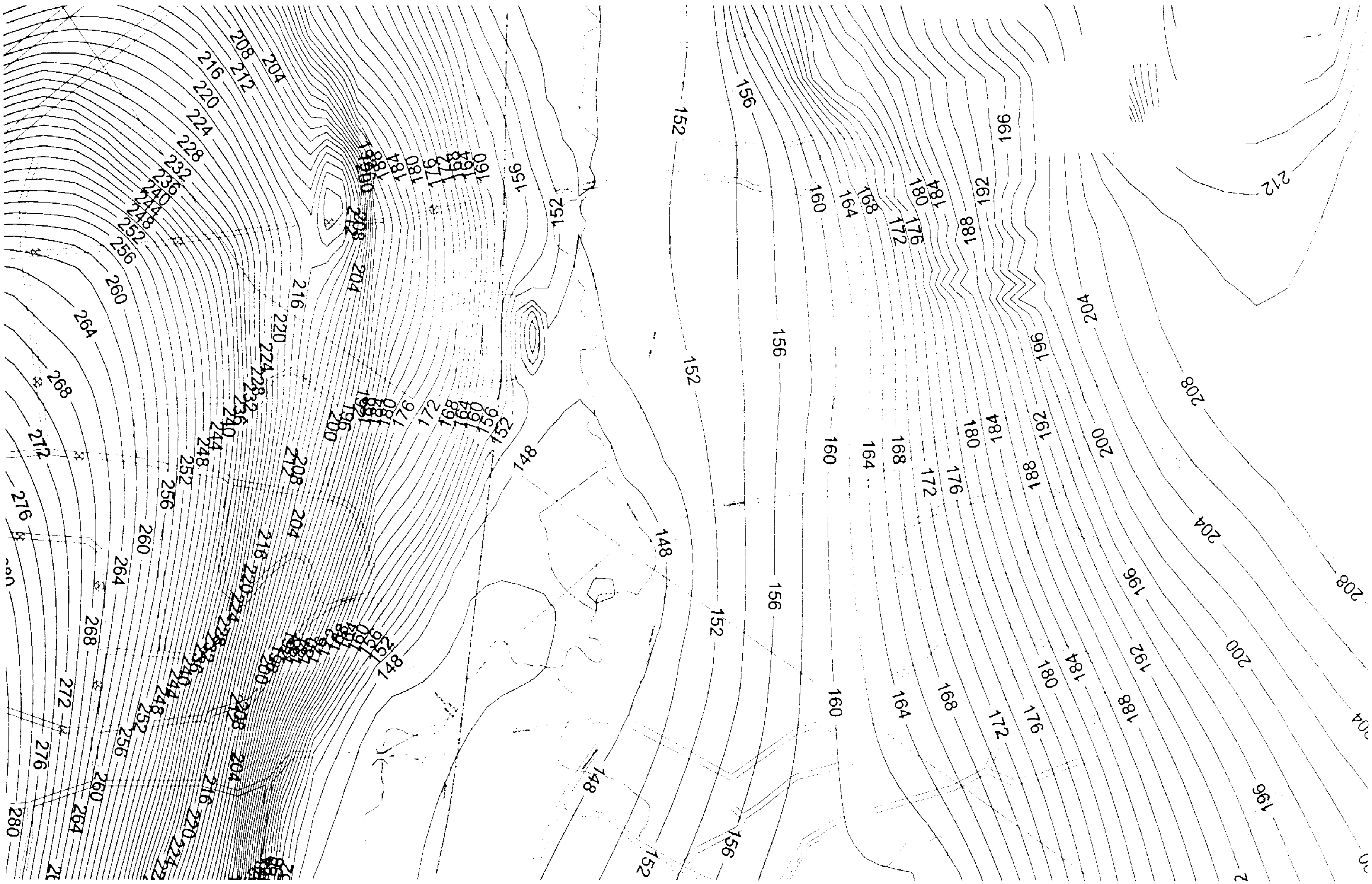
Calibrated Layer 1 Heads (ft. AMSL)



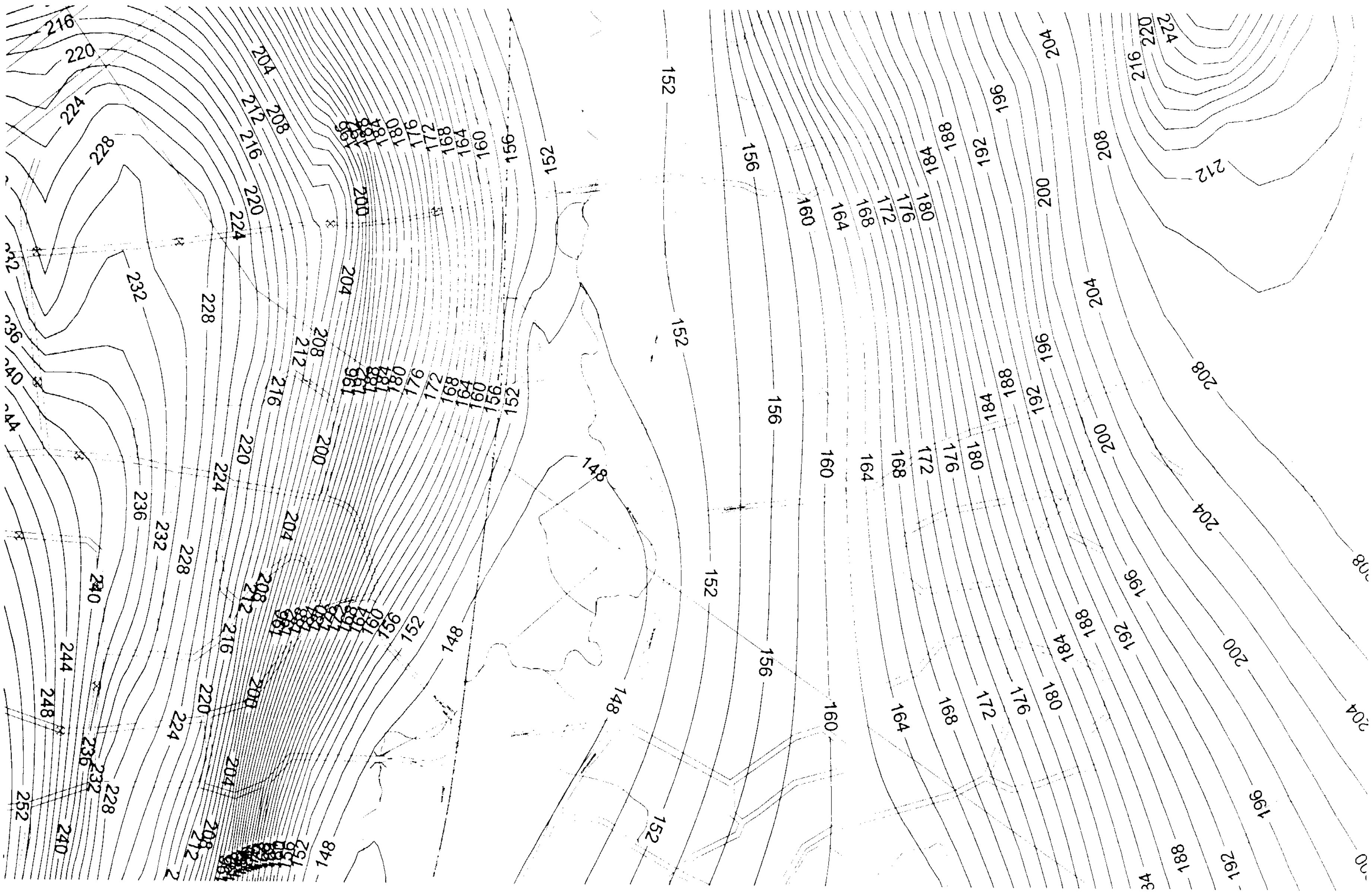
Calibrated Layer 2 Heads (ft. AMSL)



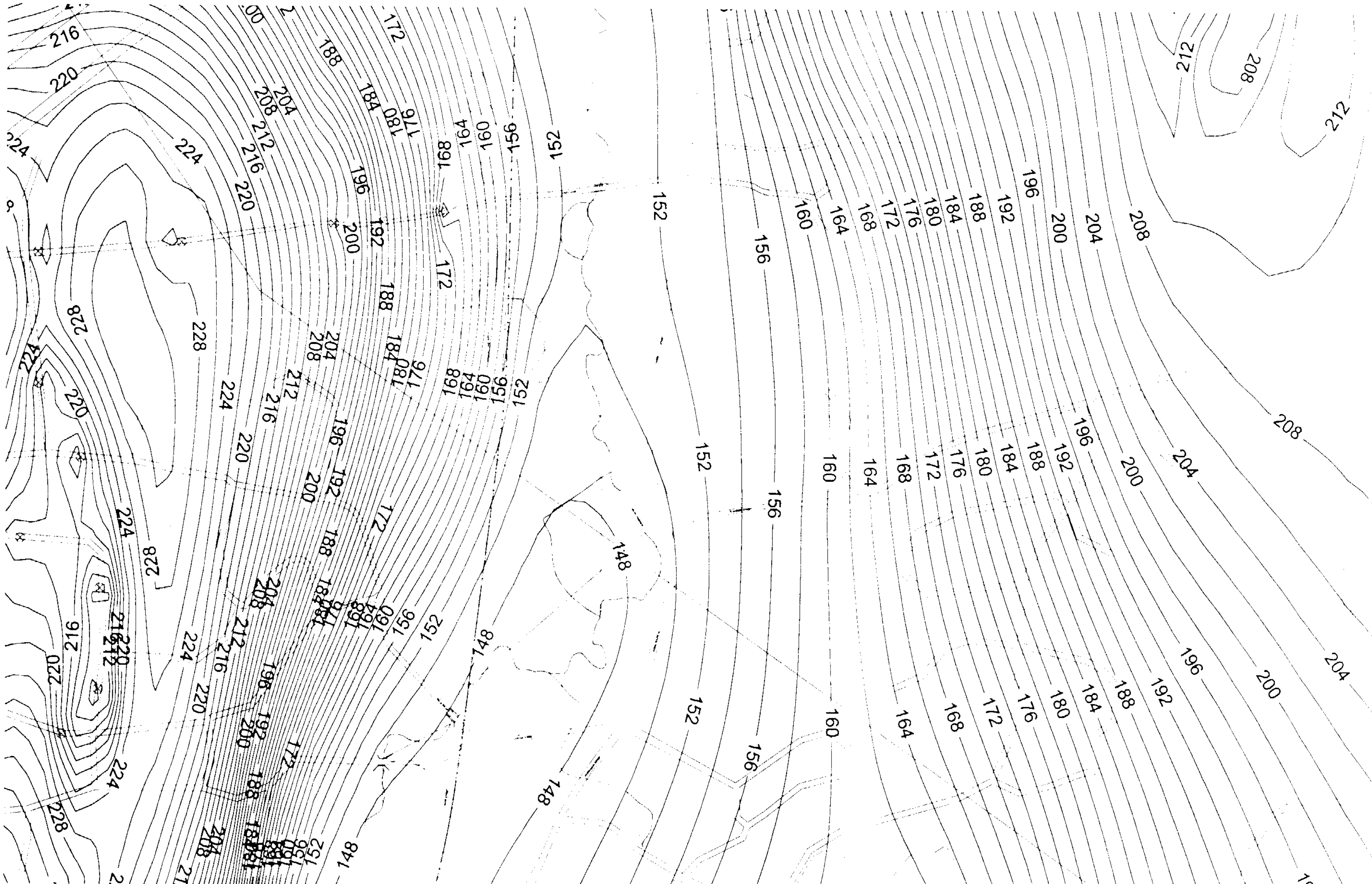
Calibrated Layer 3 Heads (ft. AMSL)



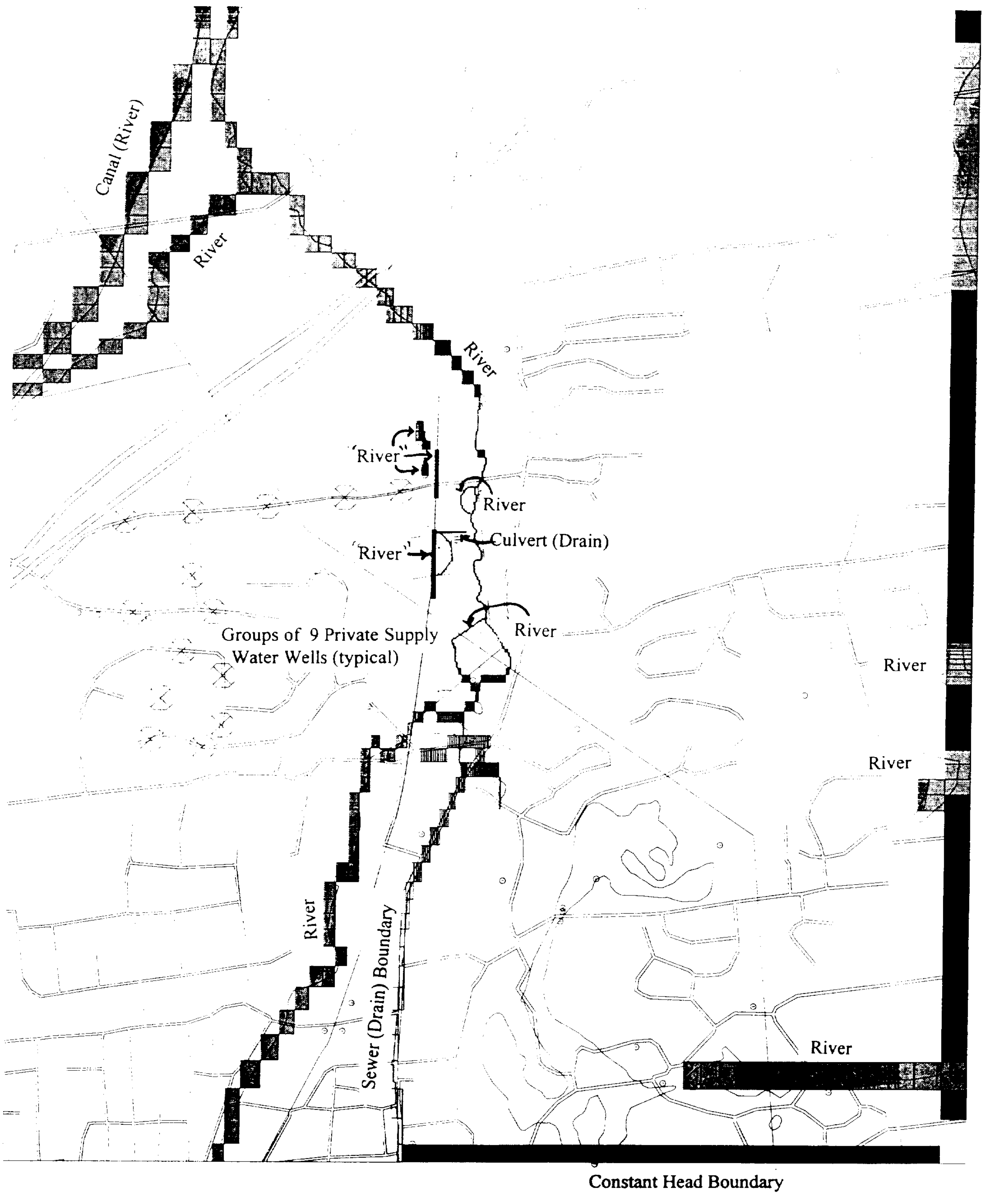
Calibrated Layer 4 Heads (ft. AMSL)



Calibrated Layer 3 Heads (ft. AMSL)

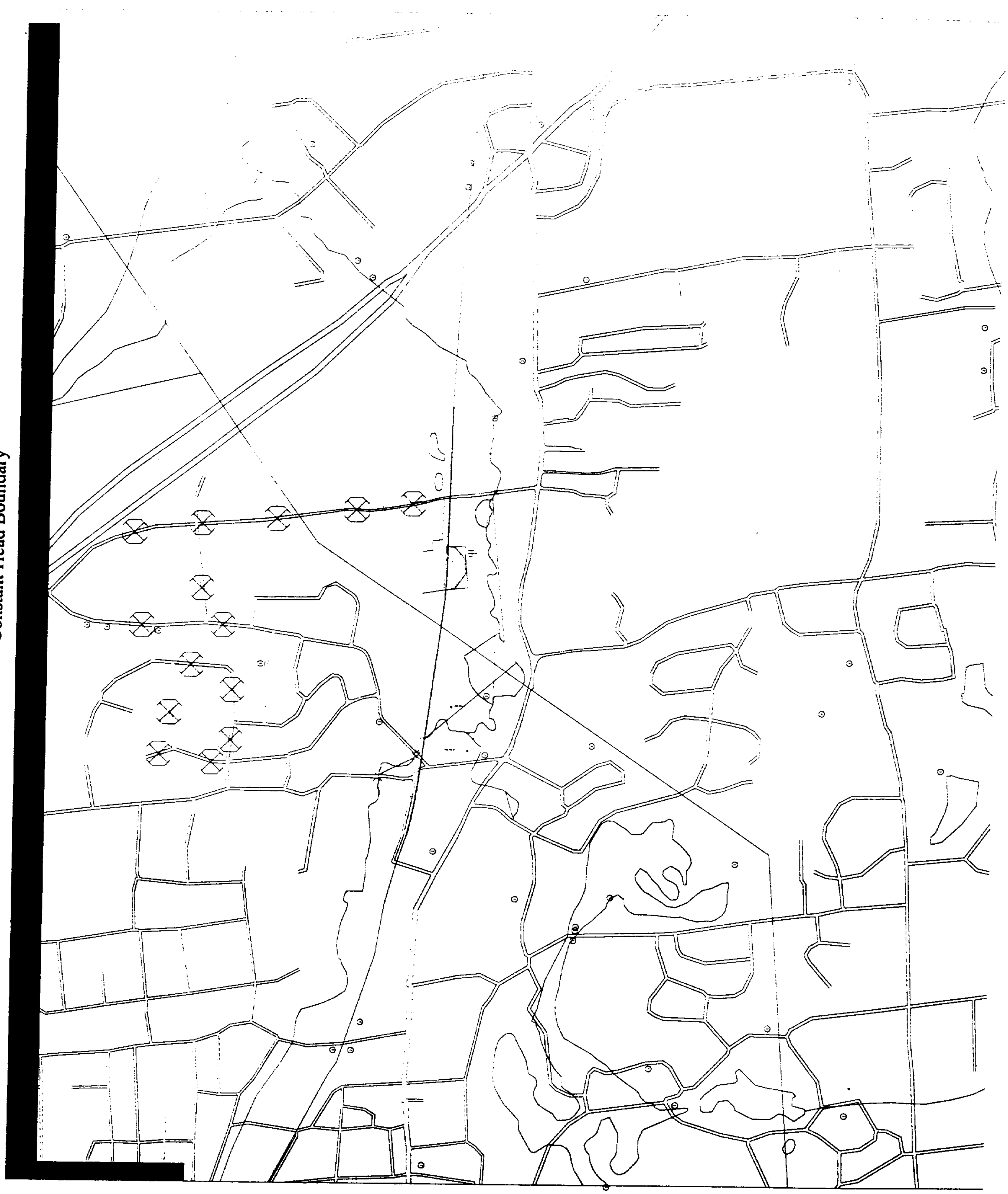


No-Flow Boundaries on All Sides of All Layers, Except Where Specified Otherwise



Layer 2 - Boundary Condition

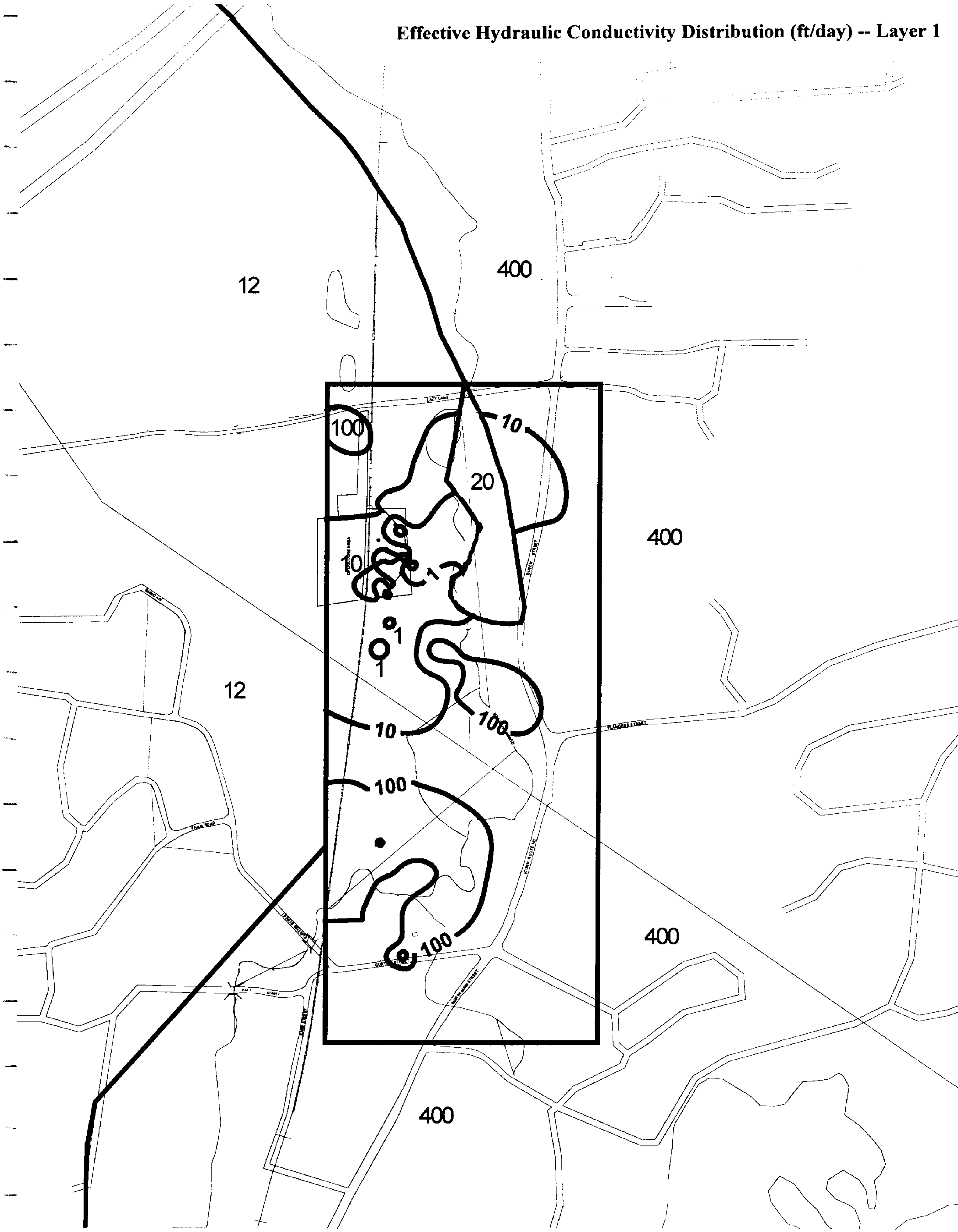
Layer 3 - Boundary Conditi



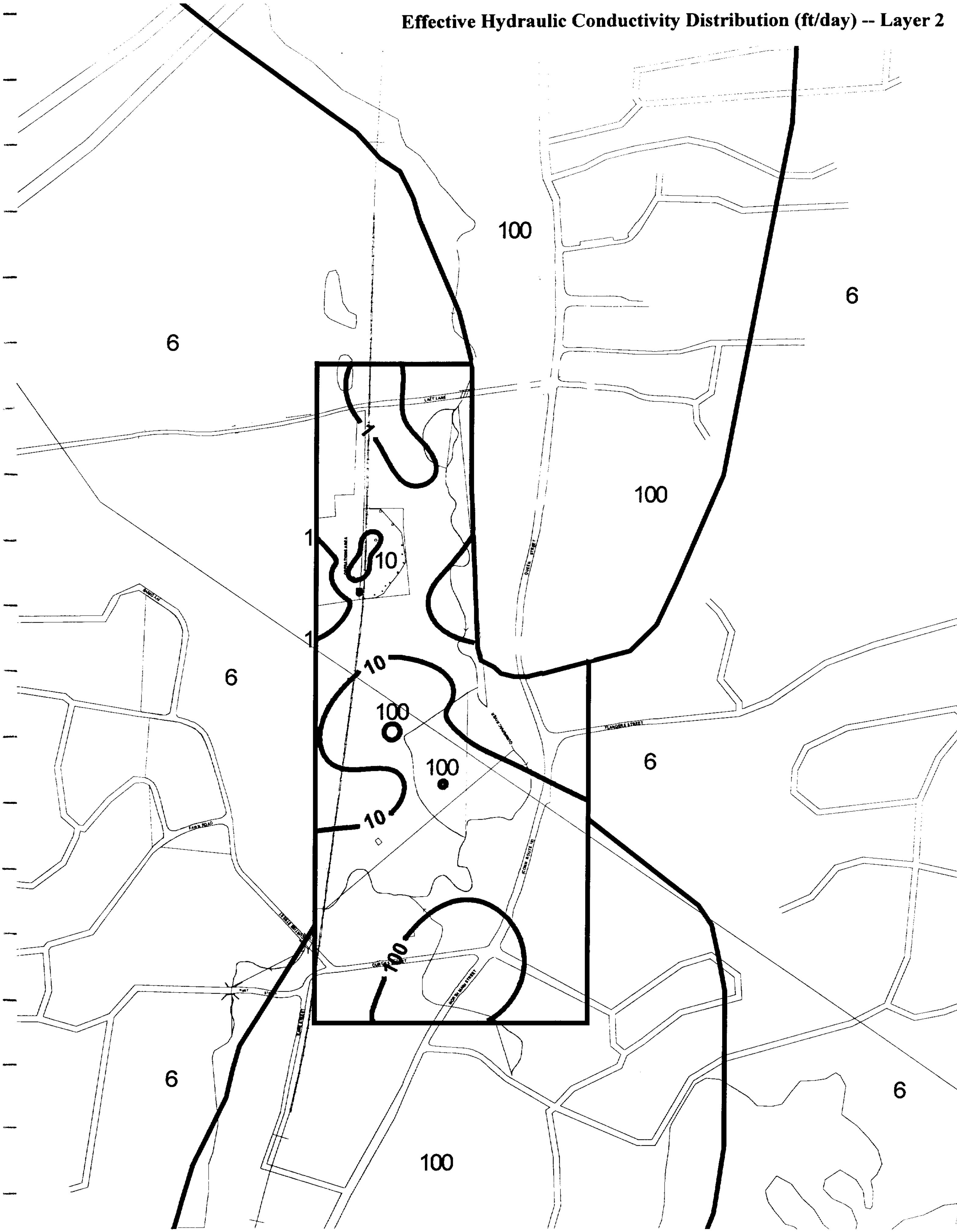
Layer 4, 5, and 6 - No Specified Boundary Conditions

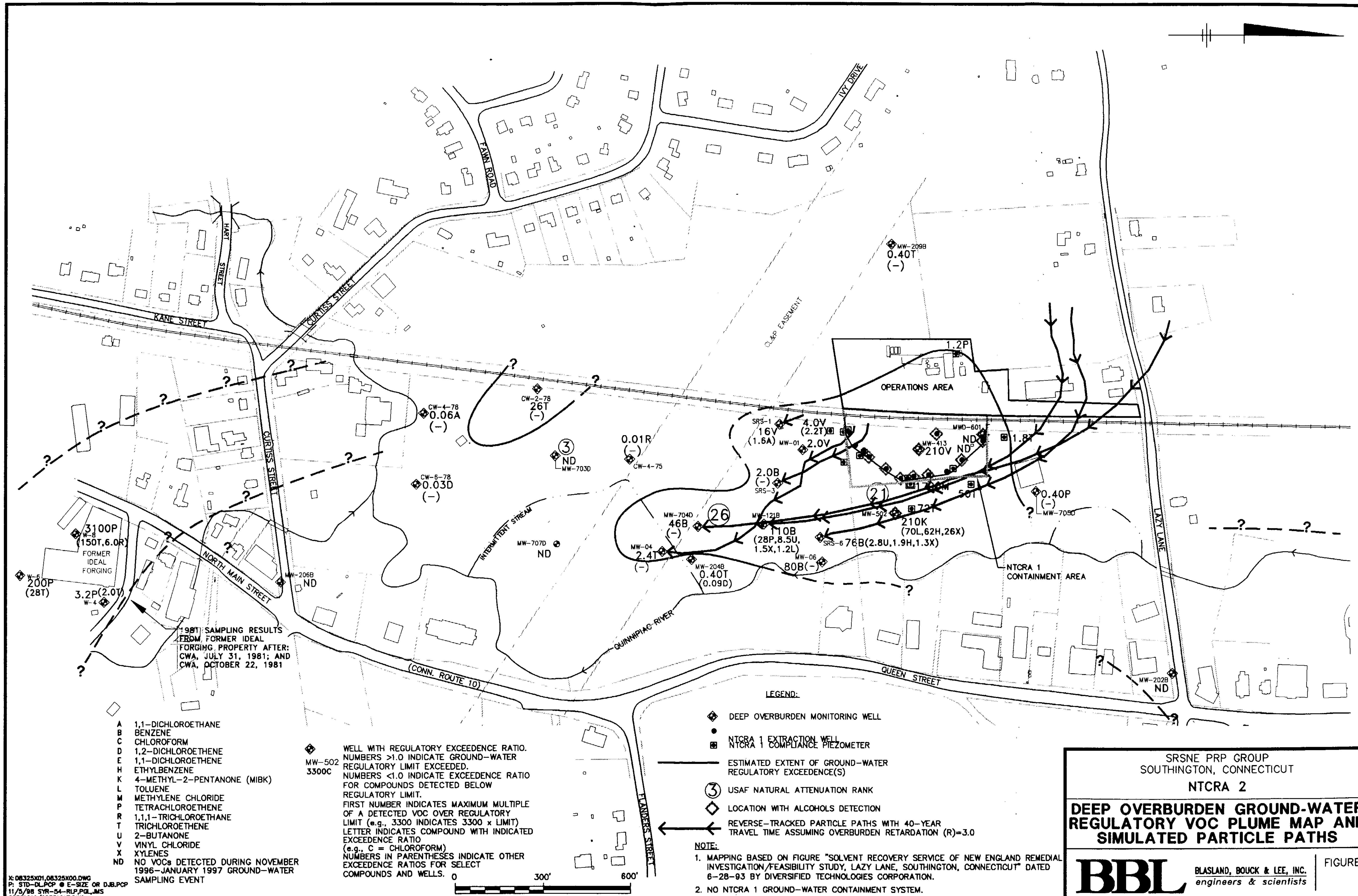
Layer 7 - Boundary Conditions

Effective Hydraulic Conductivity Distribution (ft/day) -- Layer 1

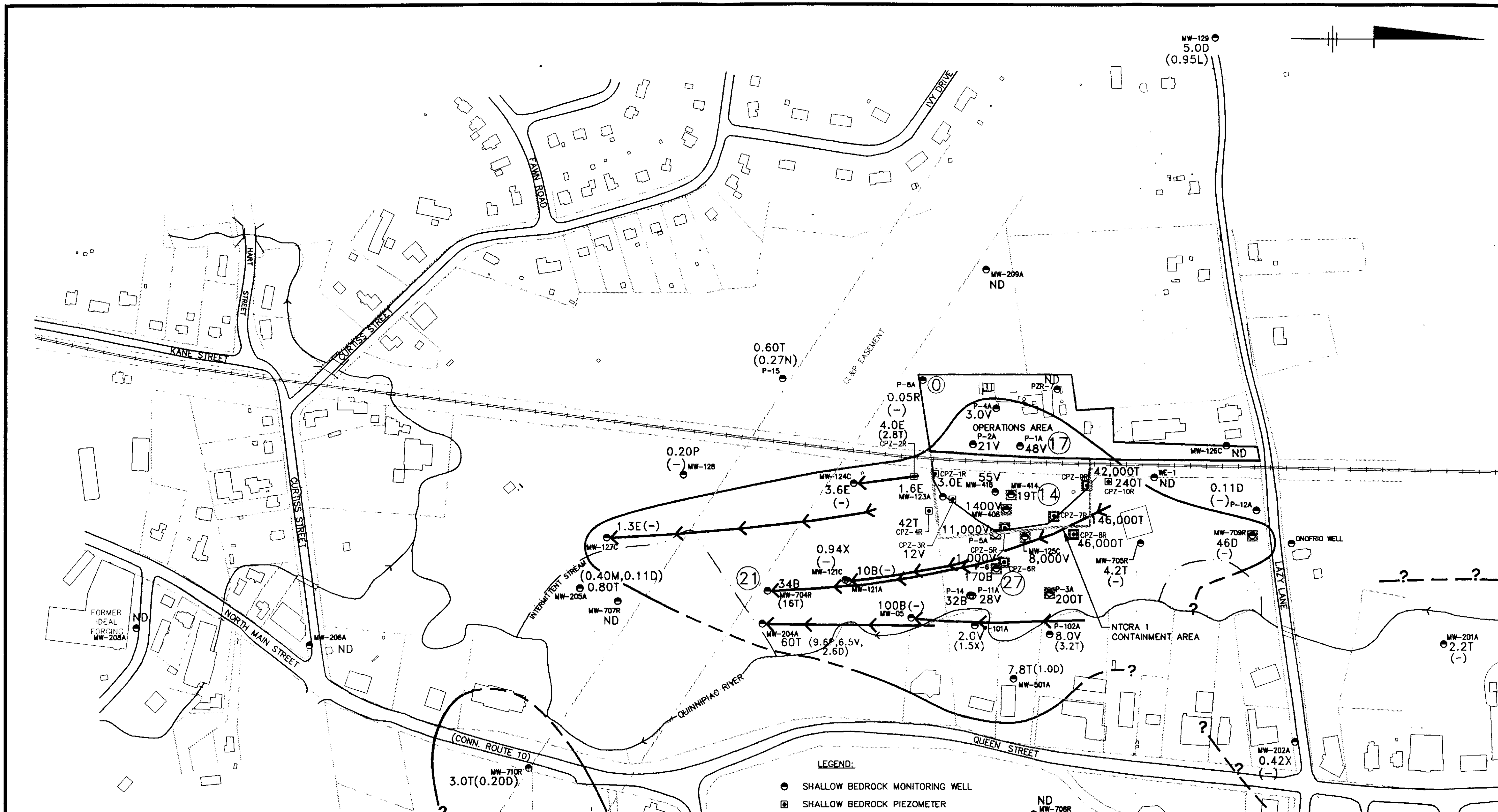


Effective Hydraulic Conductivity Distribution (ft/day) -- Layer 2





SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT
NTCRA 2
DEEP OVERBURDEN GROUND-WATER REGULATORY VOC PLUME MAP AND SIMULATED PARTICLE PATHS
BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists
FIGURE
LEGEND:
DEEP OVERBURDEN MONITORING WELL
NTCRA 1 EXTRACTION WELL
NTCRA 1 COMPLIANCE PIEZOMETER
ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
USAF NATURAL ATTENUATION RANK
LOCATION WITH ALCOHOLS DETECTION
REVERSE-TRACKED PARTICLE PATHS WITH 40-YEAR TRAVEL TIME ASSUMING OVERBURDEN RETARDATION (R)=3.0
NOTE:
1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. NO NTCRA 1 GROUND-WATER CONTAINMENT SYSTEM.
MW-502
3300C
WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 3300 INDICATES 3300 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., C = CHLOROFORM) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.
0
300'
600'
A 1,1-DICHLOROETHANE
B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
H ETHYLBENZENE
K 4-METHYL-2-PENTANONE (MIBK)
L TOLUENE
M METHYLENE CHLORIDE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT
1981 SAMPLING RESULTS FROM FORMER IDEAL FORGING PROPERTY AFTER: CWA, JULY 31, 1981; AND CWA, OCTOBER 22, 1981
FORMER IDEAL FORGING
W-8 3100P (150T,6.0R)
W-6 200P (28T)
W-4 3.2P(2.0T)
OPERATIONS AREA
NTCRA 1 CONTAINMENT AREA
CL&P EASEMENT
INTERMITTENT STREAM
QUINNIPIAC RIVER
LAZY LANE
IVY DRIVE
FAWN ROAD
CURTISS STREET
HART STREET
KANE STREET
NORTH MAIN STREET
(CONN. ROUTE 10)
QUEEN STREET
FLANDERS STREET
MW-209B 0.40T (-)
1.2P
CW-4-78 0.06A (-)
CW-2-78 26T (-)
CW-6-78 0.03D (-)
MW-703D ND
CW-4-75 0.01R (-)
MW-707D ND
MW-206B ND
SRS-1 16V (1.6A)
4.0V (2.2T)
MW-01 2.0V
SRS-3 2.0B (-)
MW-704D 46B (-)
MW-121B 110B (28P,8.5U,1.5X,1.2L)
MW-04 2.4T (-)
MW-204B 0.40T (0.09D)
MW-06 80B(-)
SRS-6 76B(2.8U,1.9H,1.3X)
MW-502 210K (70L,62H,26X)
72K
MW-413 210V
MWD-601 ND
ND
1.8T
50T
MW-705D 0.40P (-)
MW-202B ND
X: 08325X01,08325X00.DWG
P: STD-DL.PCP @ E-SIZE OR DJB.PCP
11/5/98 SYR-54-RLP,PGL,JMS
08331012/08331C17.DWG



B BENZENE
C CHLOROFORM
D 1,2-DICHLOROETHENE
E 1,1-DICHLOROETHENE
M METHYLENE CHLORIDE
P TETRACHLOROETHENE
R 1,1,1-TRICHLOROETHANE
T TRICHLOROETHENE
U 2-BUTANONE
V VINYL CHLORIDE
X XYLENES
ND NO VOCs DETECTED DURING NOVEMBER 1996-JANUARY 1997 GROUND-WATER SAMPLING EVENT

MW-707R 4.8T — WELL WITH REGULATORY EXCEEDENCE RATIO. NUMBERS >1.0 INDICATE GROUND-WATER REGULATORY LIMIT EXCEEDED. NUMBERS <1.0 INDICATE EXCEEDENCE RATIO FOR COMPOUNDS DETECTED BELOW REGULATORY LIMIT. FIRST NUMBER INDICATES MAXIMUM MULTIPLE OF A DETECTED VOC OVER REGULATORY LIMIT (e.g., 4.8 INDICATES 4.8 x LIMIT) LETTER INDICATES COMPOUND WITH INDICATED EXCEEDENCE RATIO (e.g., T = TRICHLOROETHENE) NUMBERS IN PARENTHESES INDICATE OTHER EXCEEDENCE RATIOS FOR SELECT COMPOUNDS AND WELLS.

LEGEND:

- SHALLOW BEDROCK MONITORING WELL
- SHALLOW BEDROCK PIEZOMETER
- ESTIMATED EXTENT OF GROUND-WATER REGULATORY EXCEEDENCE(S)
- (0) USAF NATURAL ATTENUATION RANK
- LOCATION WITH ALCOHOLS DETECTION
- REVERSE-TRACKED PARTICLE PATHS WITH 40-YEAR TRAVEL TIME ASSUMING BEDROCK RETARDATION (R)=811.

NOTE:

1. MAPPING BASED ON FIGURE "SOLVENT RECOVERY SERVICE OF NEW ENGLAND REMEDIAL INVESTIGATION/FEASIBILITY STUDY, LAZY LANE, SOUTHINGTON, CONNECTICUT" DATED 6-28-93 BY DIVERSIFIED TECHNOLOGIES CORPORATION.
2. NO NTCRA 1 GROUND-WATER CONTAINMENT SYSTEM.

SRSNE PRP GROUP
SOUTHINGTON, CONNECTICUT

NTCRA 2

SHALLOW BEDROCK GROUND-WATER REGULATORY VOC PLUME MAP AND SIMULATED PARTICLE PATHS

BBL BLASLAND, BOUCK & LEE, INC. engineers & scientists

FIGURE

P: STD-DL.PCP @ E-SIZE OR DJB.PCP
XREF: 08325X00,08325X01; L: ON:*, OFF: REF,(XREF X01: PIPES,TRAIL)
11/05/98 SYR-54-PGL.JMS
08331012/08331C19.DWG

Attachment A-3

Attachment A-3 Revised Model

Included in this attachment are tables and figures that demonstrate the design and calibration of the revised NTCRA 2 MODFLOW model. The only revision to the original calibrated model was an increase in the horizontal to vertical anisotropy of the overburden to 10:1 throughout the model domain. The following figures and tables are included in this attachment:

- Calibration Statistics;
- Calibration Summary Plot;
- Table of Residuals;
- Residual Plots for Layers 1 through 5 (Plan View); and
- Simulated Head Contours for Layers 1 through 5 (Plan View).

The boundary conditions simulated in the revised model are identical to the boundary conditions used in the original calibrated model. Plan view plots of the boundary conditions are included in Attachment A-2. Calibration statistics were computed by using the same automated statistical spreadsheet used in the original calibrated model.

Revised Model

Calibration Statistics

Project: SRSN2
Simulation: SRSEOSH
Modeler: SHP
Date: 11/9/98
Time: 0800

	Model	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
Residual Mean	1.08	0.20	0.27	2.16	2.20	1.73
Res. Std. Dev.	4.16	3.41	2.34	5.20	2.55	4.85
Abs. Res. Mean	2.84	2.28	1.52	4.00	2.54	3.59
Min. Residual	-13.86	-6.93	-3.31	-13.86	-0.52	-3.28
Max. Residual	17.11	11.11	10.04	17.11	4.55	10.39
Min-Max Range	30.97	18.04	13.35	30.97	5.07	13.67
Residuals <2 ft. (%)	52	56	73	37	33	43
Residuals <5 ft. (%)	84	88	94	75	100	71
No. Residuals >10 ft.	12	2	1	8	0	1
No. of Targets	208	66	49	83	3	7

Vertical Gradients

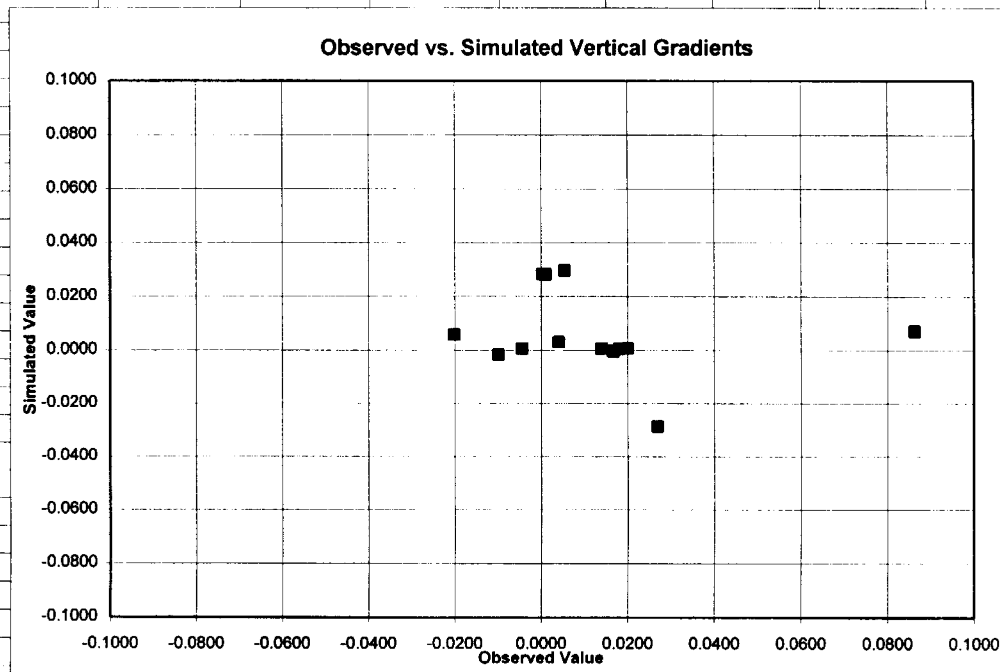
Layer 2 (Till) and Shallow Rock (Layer 3)

Cluster	Observed	Simulated	Residual
MW-202A,B	0.0167	-0.0004	0.0171
MW-708M,R	0.0140	0.0005	0.0135
MW-203A,B	-0.0044	0.0005	-0.0049
MW-707D,R	0.0200	0.0006	0.0194
MW-204A,CW-2-75	0.0040	0.0029	0.0011
MW-5,MW-6	-0.0099	-0.0018	-0.0081
MW-121B, C	0.0181	0.0004	0.0177
MW-126B,C	0.0863	0.0070	0.0793
		MR	0.0169

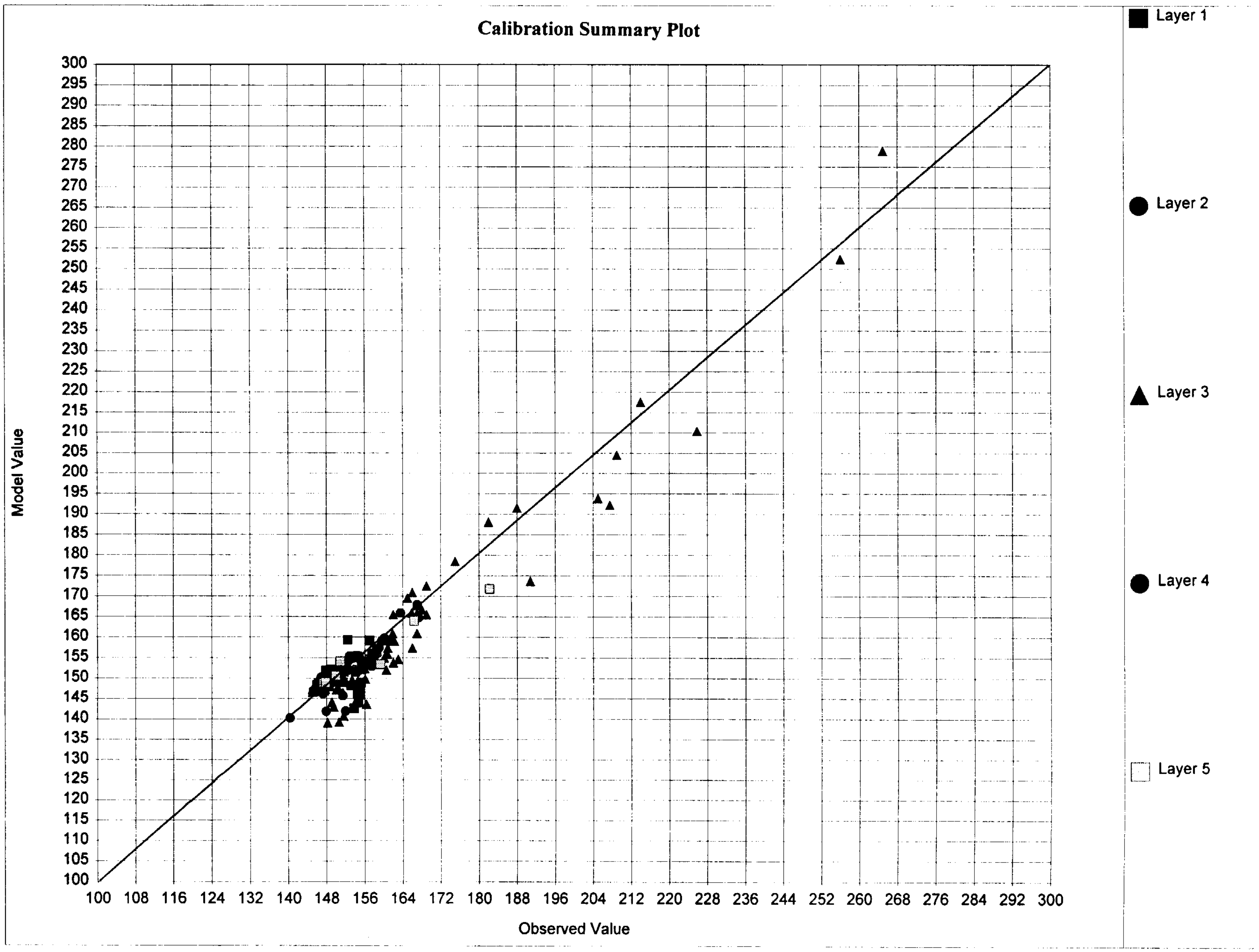
Shallow Rock (Layer 3) and Deep Rock (Layer 5)

Cluster	Observed	Simulated	Residual
MW-709R,DR	0.0269	-0.0287	0.0556
MW-708R,DR	-0.0201	0.0057	-0.0258
MW-706DR,P-101A	0.0054	0.0295	-0.0241
MW-707R,DR	0.0011	0.0282	-0.0271
MW-703DR,MW-127C	0.0003	0.0282	-0.0279

(-) indicates downward gradient — MR -0.0099



Revised Model



Name	X	Y	Layer	Observed	Computed	Residual
CPZ-1	4751.87	6723.1	2	152.76	154.4065	-1.64646
CPZ-10	4776.5	7259.54	2	157.52	156.0697	1.450263
CPZ-2	4755.25	6661.91	2	154.53	155.2984	-0.76839
CPZ-2A	4758.44	6706.94	2	154.8	155.4052	-0.60516
CPZ-3	4828.94	6779.01	2	147.95	141.8655	6.084477
CPZ-4	4861.06	6708.13	2	151.2	149.6733	1.52671
CPZ-4A	4839.44	6763.1	2	151.4	145.7167	5.683285
CPZ-5	4915.37	6928.51	2	140.36	140.2289	0.13114
CPZ-6	5019.19	6941.85	2	150.8	150.2334	0.566562
CPZ-6A	4935.12	6937.69	2	151.39	151.7282	-0.33819
CPZ-7	4882.44	7084.01	2	151.99	141.9541	10.03589
CPZ-8	4936.75	7145.26	2	154.43	151.6122	2.817755
CPZ-9	4768.94	7191.69	2	155.44	154.0587	1.381337
CW-1-78	4752.69	5691.01	1	147.4	147.0573	0.342653
CW-10-78	4856.44	4872.51	1	146.38	148.1217	-1.74174
CW-2-78	4612.44	5652.51	1	147.52	146.945	0.57499
CW-3-75	5217.44	5731.51	1	146.74	147.3233	-0.58325
CW-3-78	4701.44	5268.51	1	145.3	146.5644	-1.26443
CW-5-75	4825.19	5646.01	1	146.83	147.0672	-0.23719
CW-6-75	4761.44	5448.51	1	145.59	146.8061	-1.21606
CW-7-78	4905.44	4775.51	1	146.53	148.5637	-2.03372
CW-8-78	4996.44	4787.51	1	147.09	148.598	-1.50799
CW-9-78	5066.44	4887.51	1	146.01	148.3672	-2.35724
CW-B-77	4849.06	6327.35	1	148.29	149.48	-1.18997
MW-07	5185.44	6644.51	1	149.03	149.1464	-0.11636
MW-121B	5071.44	6433.51	1	148.45	149.2721	-0.82213
MW-123C	4813.44	6742.51	1	153.12	148.2362	4.883831
MW-127B	4942.44	5703.51	1	147.38	147.2553	0.124714
MW-201B	5276.81	8310.88	1	148.35	150.3185	-1.96852
MW-204B	5191.37	6185.19	1	148.41	149.041	-0.63101
MW-205B	5090.81	5608.16	1	146.86	147.2355	-0.37551
MW-409	4859.06	6948.1	1	154.72	144.0921	10.62787
MW-410	4844.12	6945.1	1	155	145.9818	9.018189
MW-413	4817.75	6966.88	1	155.1	148.7567	6.343264
MW-415	4814.62	6962.41	1	155.22	149.0097	6.210284
MW-501B	5376.44	6959.51	1	150	151.9394	-1.93938
MW-501C	5377.44	6966.51	1	147.84	151.954	-4.11402
MW-502	5034.44	6886.51	1	150.13	150.1972	-0.06721
MW-703S	4838.56	5703.44	1	147.06	147.1826	-0.12261
MW-704S	5096.62	6199.91	1	148.07	148.9028	-0.83284
MW-707S	5146.94	5732.79	1	147.07	147.3463	-0.27628
MW-708S	5780.94	7034.57	1	150.79	153.6956	-2.90559
MWL-301	4800.12	7214.69	1	157.06	154.6812	2.378749
MWL-302	4898.12	7219.16	1	155.34	152.9066	2.43344
MWL-303	4996	7220.79	1	150.69	151.8525	-1.16251
MWL-306	5041.06	7066.91	1	149.8	150.6452	-0.84517
MWL-311	4890	6765.04	1	151.48	149.0546	2.425439
MWL-312	5048.56	6770.51	1	149.92	149.7184	0.201611

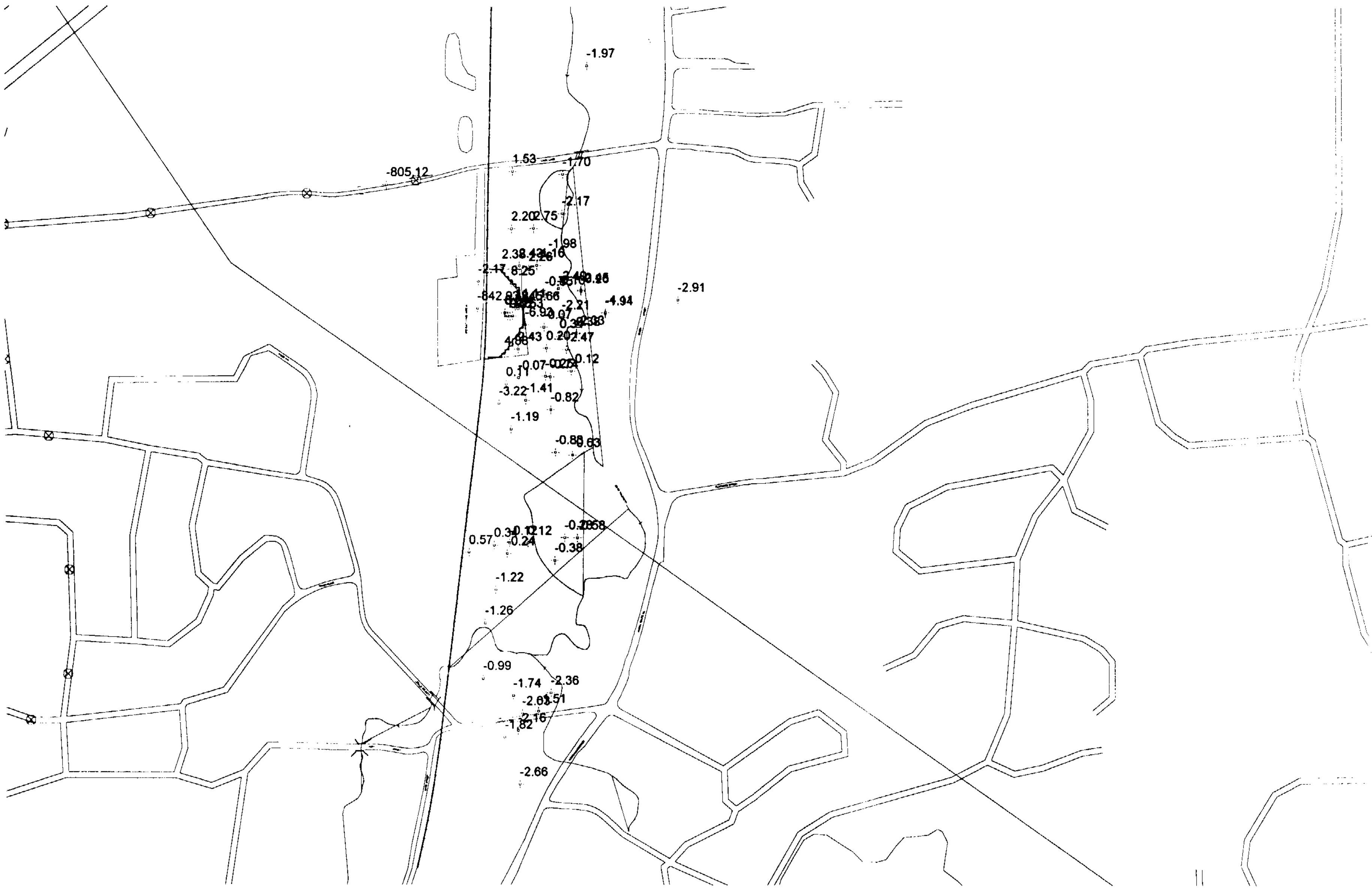
MWL-313	4891.31	6608.47	1	150.36	150.4327	-0.07271
MWL-314	5041.62	6617.04	1	149.26	149.5147	-0.25473
P-10	4855.25	7419.66	1	158.52	156.3234	2.196557
P-101B	5214.31	6848.54	1	149.77	149.392	0.377971
P-101C	5215.75	6854.19	1	147.08	149.4057	-2.32573
P-102B	5241.69	7081.51	1	149.86	150.1227	-0.26267
P-102C	5241.44	7088.13	1	147.69	150.144	-2.45397
P-11B	5122.37	6836.13	1	149.47	149.1252	0.344799
P-12	4860.75	7731.82	1	158.53	157.0006	1.52942
P-13	4781.44	6467.51	1	148.87	152.0854	-3.21544
P-16	4668.62	7134.79	1	157.01	159.1828	-2.1728
P-1B	4664.19	6988.01	1	156.97	999	-842.03
P-3B	5109.37	7073.04	1	149.43	149.5317	-0.10174
P-5B	4930.44	6899.51	1	152.43	159.3602	-6.9302
P-7	4978.5	7421.79	1	157.43	154.681	2.749012
P-9	4951.44	7200.57	1	154.34	152.0811	2.258919
PW-407	4830.69	6947.29	1	155.07	147.6931	7.376877
PZO-1	4874.75	7000.57	1	153.76	142.6515	11.10851
PZO-2	4890	6986.82	1	153.34	999	-845.66
PZO-3	4852.87	7123.41	1	154.48	146.2321	8.247932
PZO-5	4160	7658.82	1	193.88	999	-805.12
SRS-4	4931.44	6484.51	1	148.35	149.7641	-1.41411
SRS-5	5069.12	6613.35	1	148.7	149.4389	-0.73891
TW-01	4883.44	4681.51	1	146.59	148.749	-2.15898
TW-02	4894.44	4386.51	1	146.85	149.5051	-2.65509
TW-03	4808.06	4643.94	1	146.71	148.5284	-1.81837
TW-05	4688.44	4966.51	1	146.09	147.0839	-0.99393
TW-11	4821.44	6572.51	1	151.68	151.5685	0.111521
CW-2-75	4946.44	6293.51	2	148.4	148.8552	-0.45522
CW-4-75	4851.44	5971.51	2	148.21	148.012	0.197986
CW-4-78	4694.44	5266.51	2	145.41	146.5558	-1.14582
CW-6-78	4935.44	5241.51	2	146.22	147.0892	-0.86923
CW-7-75	4855.44	5459.51	2	145.77	146.9409	-1.17092
CW-7A	4853.44	5459.51	2	145.43	146.9376	-1.50761
DP-1	5159.31	6762.16	1	146.34	148.8064	-2.4664
DP-2	5136.19	6939.47	1	147.05	149.2616	-2.21164
DP-3	5117.19	7097.51	1	147.06	149.4566	-2.39658
DP-4	5063.44	7271.01	1	148.76	150.7381	-1.97807
DP-5	5141.44	7716.16	1	147.47	149.1716	-1.70158
DP-6	5138.12	7502.01	1	147.33	149.4991	-2.16911
MW-01	4820.44	6566.51	2	151.31	151.5628	-0.25276
MW-02	4846.44	5954.51	2	147.87	147.9907	-0.12066
MW-03	5048.44	5681.51	2	146.19	147.2816	-1.0916
MW-04	5161.44	6086.51	2	148.55	148.6793	-0.12928
MW-06	5199.44	6633.51	2	149.64	149.2236	0.416398
MW-126B	4663.37	7624.6	2	160.11	159.7918	0.31819
MW-202B	5576.5	7841.35	2	149.68	152.0241	-2.3441
MW-203B	5890.19	5975.16	2	152.86	155.3867	-2.52674
MW-206B	5265.75	4775.19	2	146.94	150.2508	-3.31077

MW-209B	4121.62	6874.22	2	182.46	999	-816.54
MW-412	4841.62	6951.16	2	147.28	146.201	1.07903
MW-703D	4839.56	5713.97	2	147.41	147.2107	0.199272
MW-704D	5079.69	6207.54	2	148.15	148.7434	-0.59336
MW-704M	5096.5	6190.79	2	148.16	148.7594	-0.59941
MW-705D	4960.94	7370.91	2	157.28	154.4872	2.792761
MW-707D	5138.44	5719.01	2	147.14	147.3235	-0.18353
MW-707M	5144.56	5725.63	2	147.2	147.3333	-0.13333
MW-708M	5784	7021.66	2	151.34	153.7182	-2.37822
MWD-601	4767.62	7189.01	2	155.23	154.1163	1.113742
P-2B	4655.37	6840.01	2	159.6	159.0755	0.52455
P-4B	4549.94	6910.97	2	163.51	165.871	-2.36096
P-8	4457.44	6680.01	2	167.02	167.9172	-0.89721
SRS-1	4733.44	6487.51	2	154.01	155.4523	-1.44227
SRS-2	4739.44	6487.51	2	153.77	154.9772	-1.2072
SRS-3	4933.44	6480.51	2	149.8	149.6962	0.103812
SRS-6	5117.06	6626.69	2	149.07	149.343	-0.27301
TW-04	4784.44	4430.51	2	146.87	149.0033	-2.13333
TW-07A	4932.44	7000.51	2	152.74	152.0049	0.735081
TW-08A	4752.44	7022.51	2	155.86	153.3015	2.558466
TW-12	4808.44	7982.51	2	158.19	155.5698	2.62025
WE-2	4759.44	7424.51	2	159	157.4198	1.58023
CPZ-10R	4772.12	7258.51	3	160.7	155.9469	4.75313
CPZ-1R	4748.25	6719.88	3	158.18	154.8451	3.334893
CPZ-2R	4756.19	6655.35	3	160.07	154.9462	5.123769
CPZ-3R	4825.87	6774.22	3	154.06	144.1536	9.906375
CPZ-4R	4861.5	6701.38	3	153.39	149.6363	3.753744
CPZ-5R	4913.94	6935.41	3	148.22	139.0629	9.157134
CPZ-7R	4877.25	7088.38	3	156.37	143.6499	12.72007
CPZ-8R	4934.31	7149.51	3	154.08	151.5725	2.507487
CPZ-9R	4783.69	7191.66	3	160.54	151.9661	8.5739
MW-05	5190.44	6646.51	3	149.36	149.1721	0.187855
MW-121A	5078.37	6450.54	3	148.86	149.281	-0.42103
MW-121C	5074.44	6442.51	3	148.75	149.278	-0.52801
MW-124C	4777.44	6468.51	3	155.33	152.1603	3.169661
MW-125A	4942.81	7009.76	3	154.61	149.325	5.284968
MW-125C	4941.44	6998.51	3	151.8	148.9499	2.850068
MW-126C	4662.12	7627.57	3	161.75	159.9243	1.825699
MW-127C	4943.44	5697.51	3	147.4	147.2601	0.139937
MW-128	4750.44	5935.51	3	148.76	148.0441	0.715927
MW-129	3405.44	7591.51	3	225.88	210.4314	15.44857
MW-201A	5271.5	8306.44	3	148.88	150.3037	-1.42373
MW-202A	5570.87	7841.51	3	150.29	152.0085	-1.71847
MW-203A	5894.75	5976.29	3	152.62	155.4153	-2.79534
MW-204A	5208.31	6183.01	3	148.66	149.0436	-0.38364
MW-205A	5098.5	5613.22	3	146.92	147.2441	-0.32409
MW-206A	5270.94	4774.72	3	146.96	150.3078	-3.34779
MW-208A	5217.56	4238.51	3	148.14	151.916	-3.77601
MW-408	4857.62	6940.91	3	149.1	144.0609	5.039079

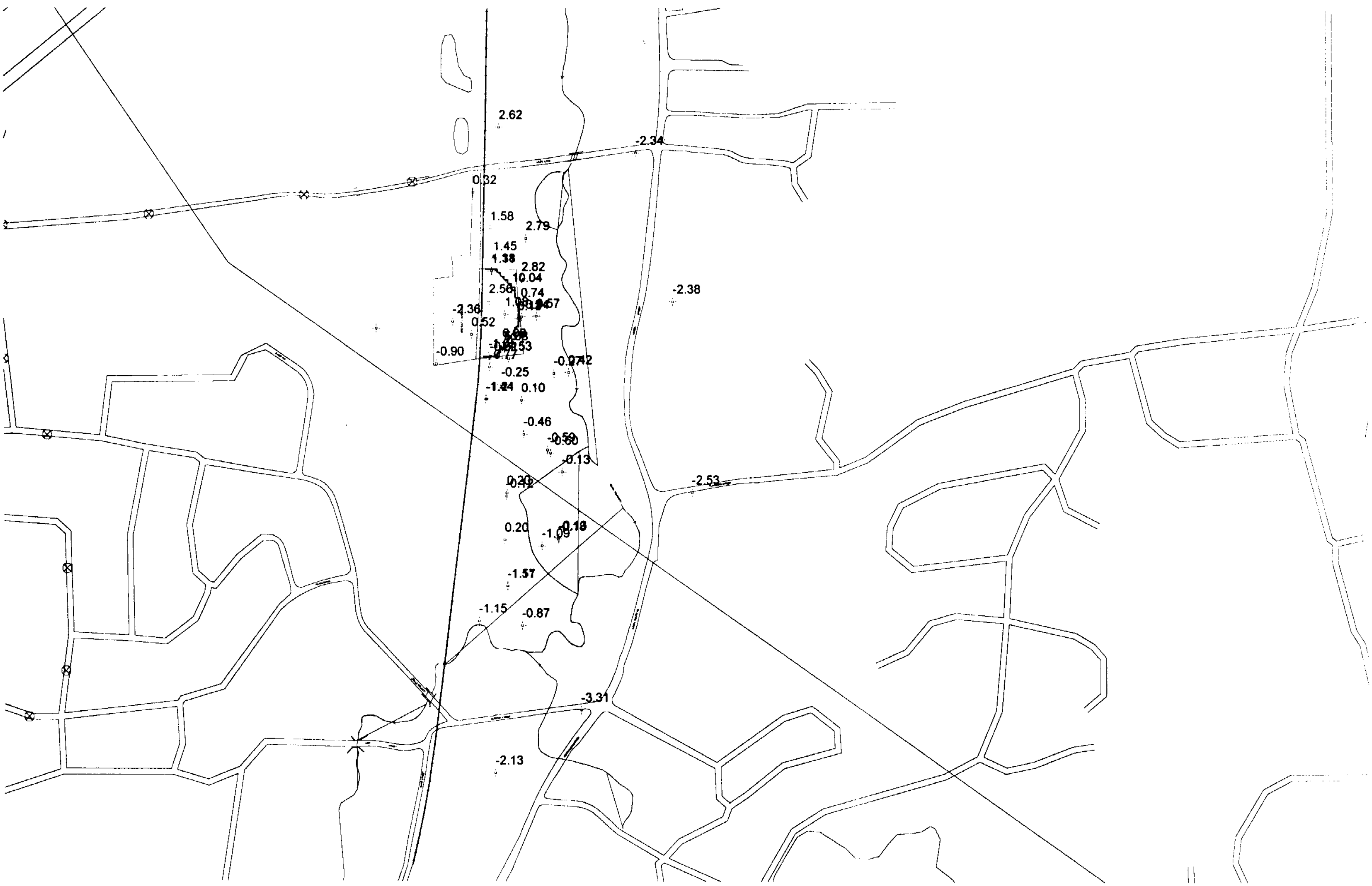
MW-411	4838.69	6957.47	3	151.41	146.4539	4.956153
MW-414	4812.19	6955.97	3	151.72	149.1263	2.593736
MW-416	4803.81	6907.04	3	156.14	149.761	6.378979
MW-501A	5377.44	6962.51	3	149.97	152.0005	-2.03053
MW-704R	5107.75	6199.19	3	148.29	148.8141	-0.52413
MW-705R	4961.75	7360.63	3	155.76	154.2455	1.514448
MW-707R	5138.25	5731.54	3	147.74	147.3416	0.398443
MW-708R	5793	7024.66	3	152.23	153.7528	-1.52277
MW-709R	4942.44	7708.32	3	157.46	155.3861	2.073896
P-101A	5213.81	6842.69	3	149.74	149.412	0.327957
P-102A	5241.19	7074.97	3	149.54	150.1122	-0.57226
P-11A	5122.37	6836.13	3	149.63	149.1689	0.461069
P-12A	4860.62	7721.63	3	158.22	156.876	1.343973
P-14	5121.81	6828.63	3	149.57	149.1659	0.404086
P-15	4456.44	6247.97	3	161.85	160.8775	0.972532
P-1A	4663.69	6983.97	3	160.9	159.0881	1.811898
P-2A	4657.94	6837.91	3	162.22	159.0159	3.204061
P-3A	5115.06	7075.04	3	151.06	149.4834	1.576625
P-4A	4547.69	6910.47	3	165.88	165.8687	0.011292
P-5A	4933.44	6907.51	3	150.04	147.128	2.91196
P-6	5039.25	6910.01	3	150.31	149.9796	0.330395
PW-406	4830.87	6953.97	3	150.52	147.3965	3.123525
PZR-1	4870.19	6999.63	3	149.53	142.9394	6.590563
PZR-2	4888.37	6981.76	3	151.62	140.725	10.89499
PZR-4	4894.87	6905.22	3	150.66	139.2649	11.39507
PZR-5	4155.75	7658.57	3	190.77	173.6636	17.1064
PZR-6	3716.69	6591.85	3	207.52	192.1891	15.3309
PZR-7	4487.12	7099.29	3	166.84	167.8268	-0.9868
WE-1	4759.44	7403.51	3	160.83	157.3348	3.495251
MW-704DR	5091.5	6181.07	4	148.58	149.0965	-0.51652
MW-705DR	4968.81	7366.07	4	157.5	152.9477	4.55226
P-8A	4460.69	6683.72	4	167.34	164.7763	2.563671
MW-701DR	4118.44	6870.04	5	182.21	171.8163	10.39374
MW-702DR	4451.87	6691.22	5	166.35	163.9378	2.412198
MW-703DR	4838.94	5689.35	5	147.42	148.8806	-1.46062
MW-706DR	5207	6832.22	5	149.96	150.6172	-0.65716
MW-707DR	5106.75	5740.22	5	147.8	148.9236	-1.12361
MW-708DR	5790.25	7040.07	5	150.86	154.1399	-3.27985
MW-709DR	4942.44	7708.32	5	159.26	153.4637	5.796344
S112	9204.81	813.66	3	182	187.998	-5.99802
S64	7046.37	1324.88	3	168	166.6924	1.307608
S61	7346.25	911.97	3	166	170.8738	-4.8738
S153	4553.56	209.04	3	151	150.9827	0.017284
S277	458.12	10659.35	3	214	217.5046	-3.50456
S29	3842.87	10241.76	3	150	152.0173	-2.01728
S28	3674.25	10431.76	3	152	152.5852	-0.5852
S30	4860.06	11275.82	3	162	153.7636	8.236406
S31	4884.12	11551.51	3	163	154.58	8.420036
S32	5653.87	11994.04	3	166	157.3672	8.632767

S314	6186.31	10239.85	3	165	169.5204	-4.52044
S284	3863.25	1822.13	3	145	146.6114	-1.61138
S143	8348.94	1795.6	3	175	178.4514	-3.45143
S111	10195.06	4714.22	3	209	204.4516	4.548353
S134	9175.06	5922.04	3	205	193.8545	11.14545
S135	8884.5	5346.66	3	188	191.4825	-3.48248
S142	7955.31	3634.19	3	169	172.5319	-3.53194
S76	6582.5	3243.76	3	167	165.7977	1.202293
S326	6184.62	2757.01	3	167	165.4342	1.56582
S331	6202.37	2871.76	3	162	165.4633	-3.46333
S315	6209.5	2912.6	3	169	165.4789	3.521093
S156	4612.44	3748.57	3	146	149.2384	-3.23843
S160	6349	4953.6	3	167	160.9638	6.036233
S353	1568.25	6211.79	3	265	278.8622	-13.8622
S359	2698.12	5853.97	3	256	252.3637	3.636266
S62	4009.87	5206.57	3	156	152.4014	3.598612
S157	5175.06	5510.66	3	145	147.1641	-2.16414

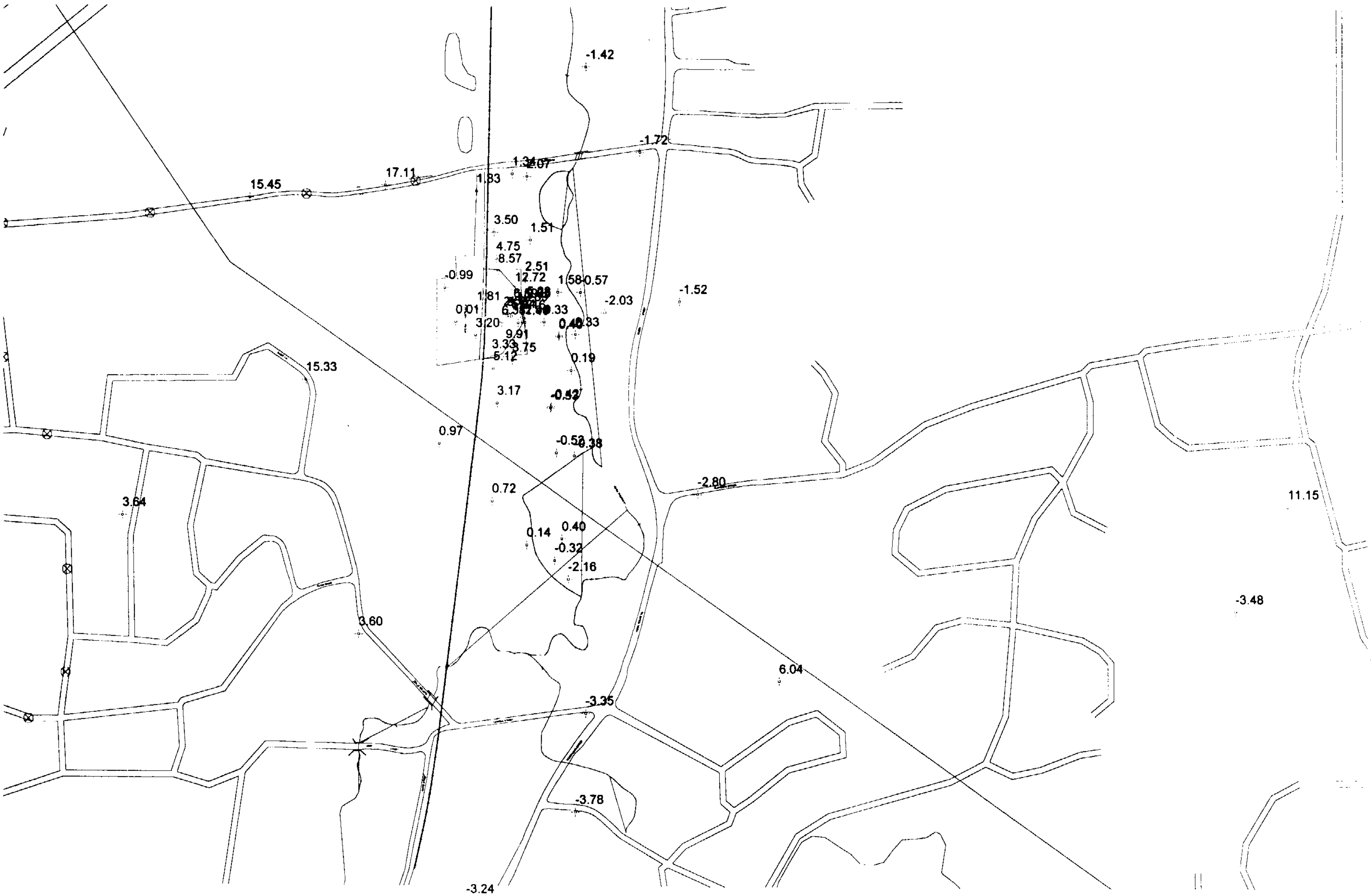
Layer 1 Residuals (ft.)



Layer 2 Residuals (ft.)

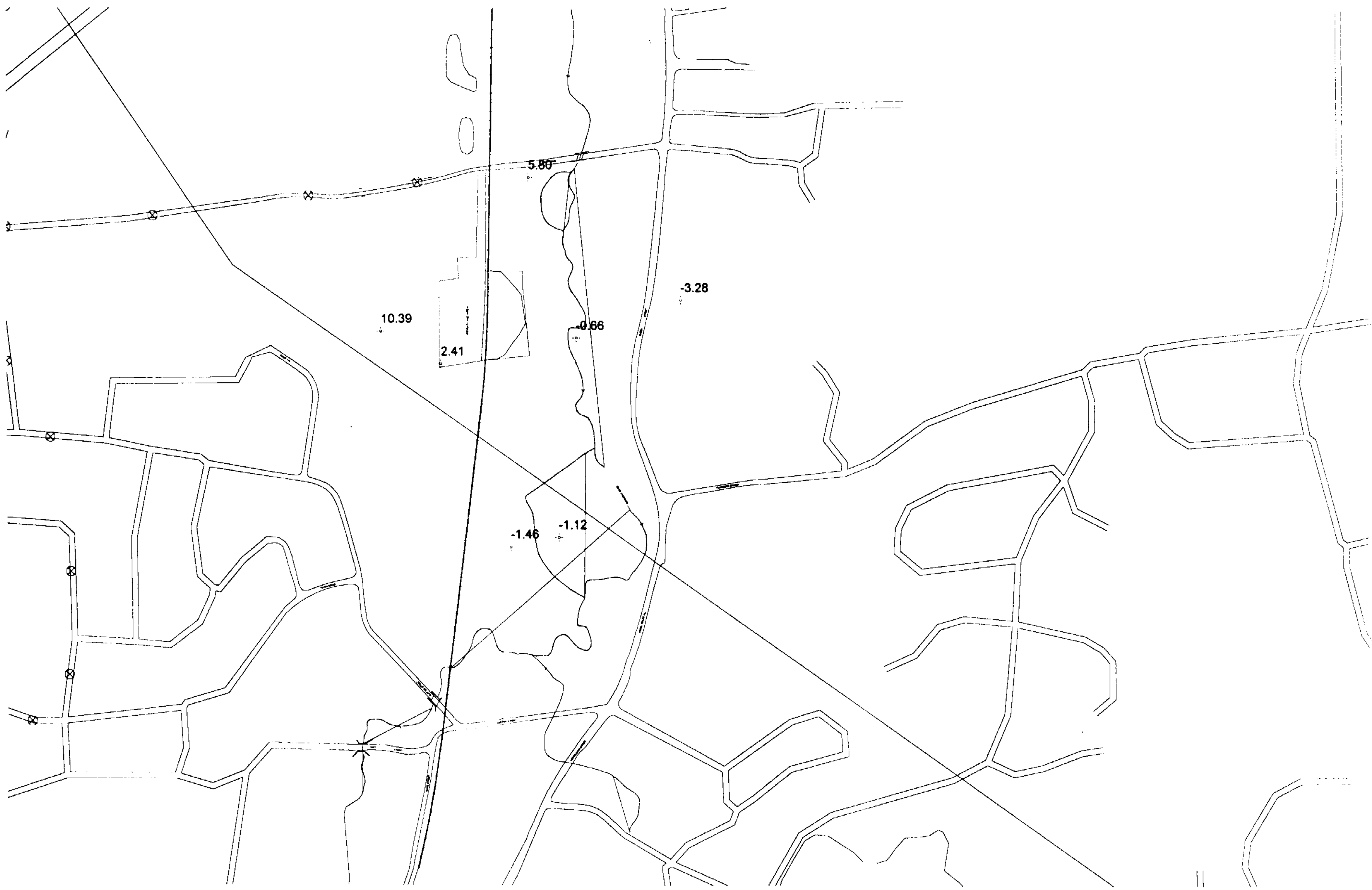


Layer 3 Residuals (ft.)

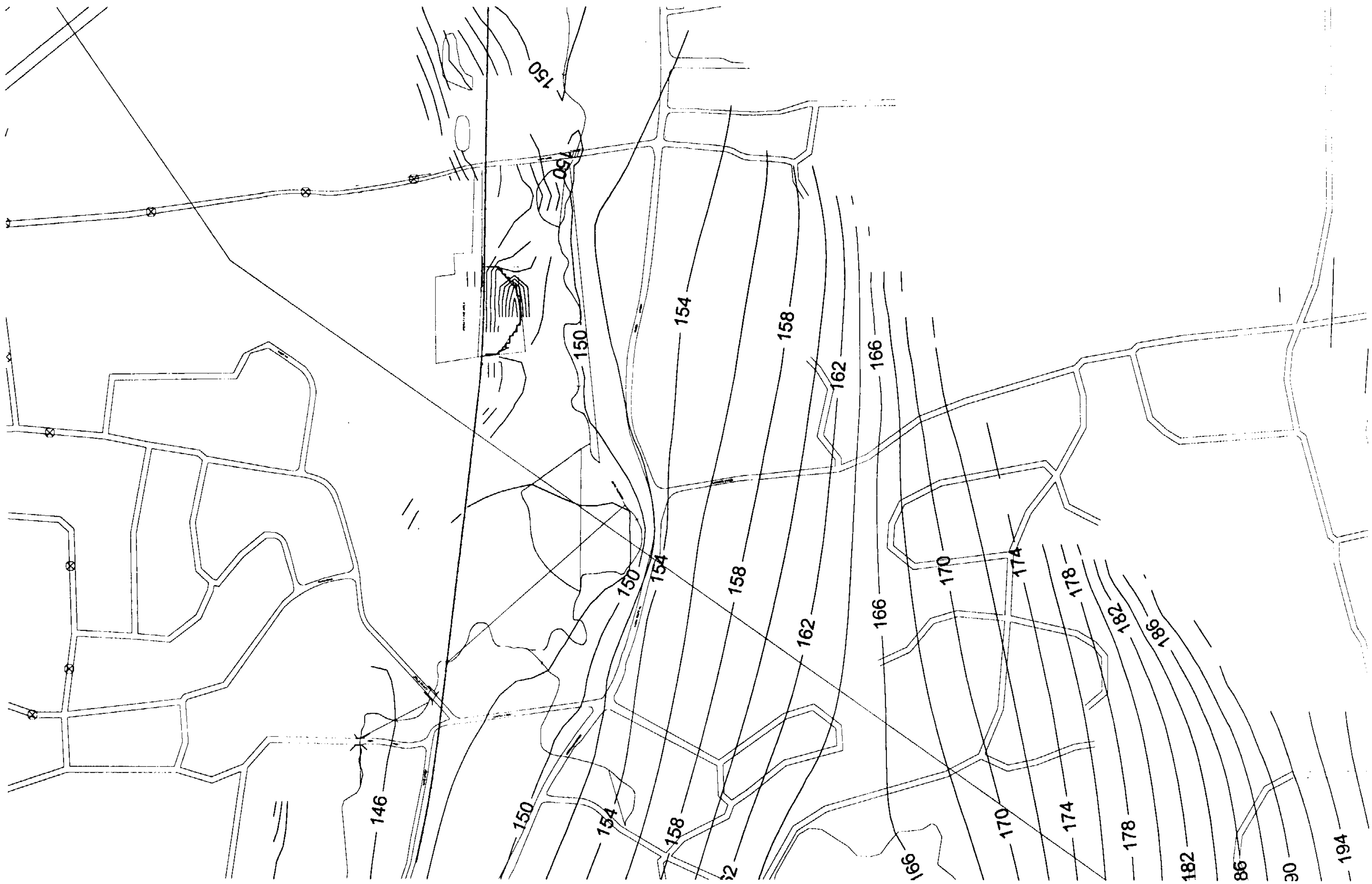


Layer 4 Residuals (ft.)

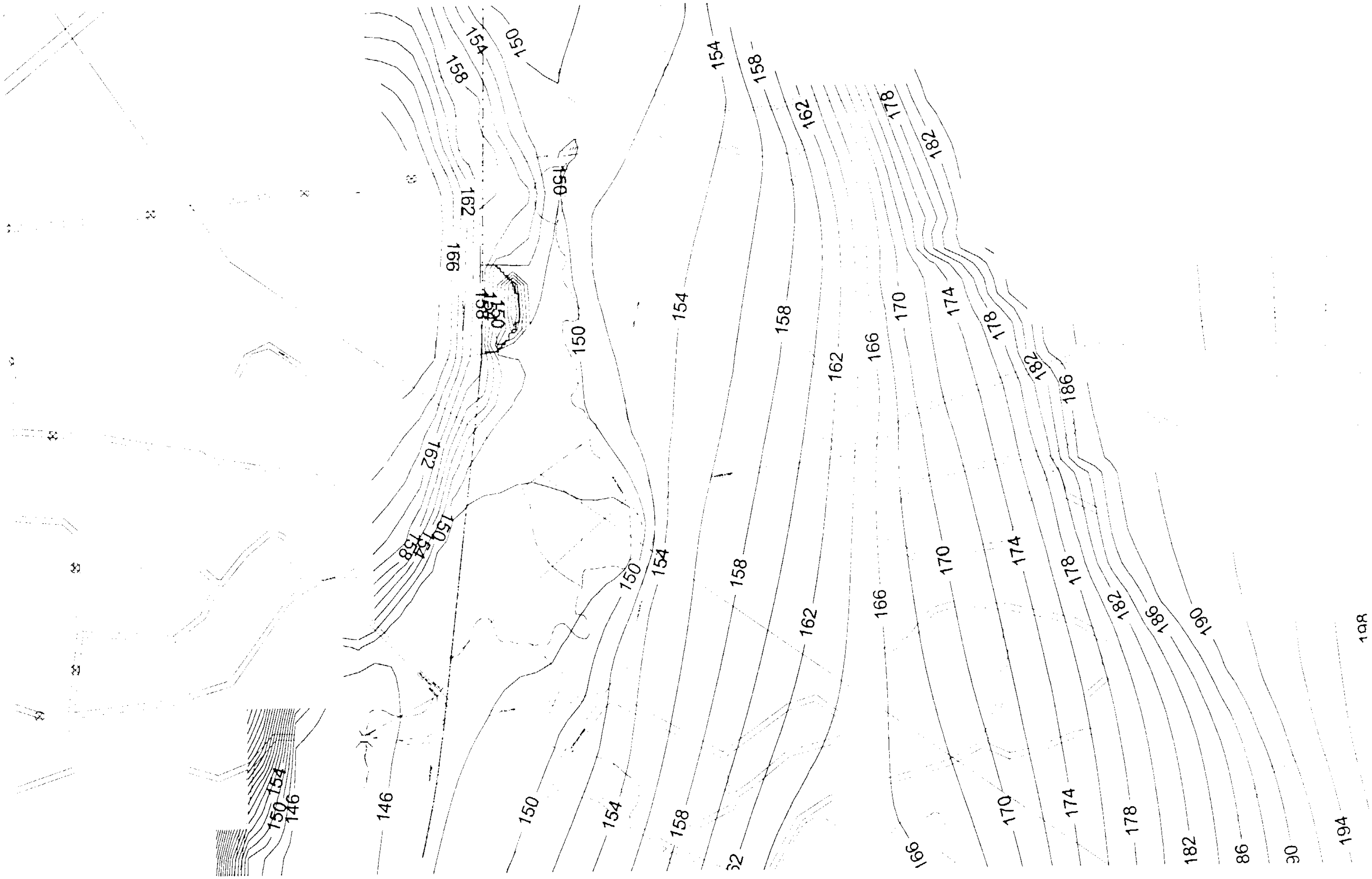
Layer 5 Residuals (ft.)



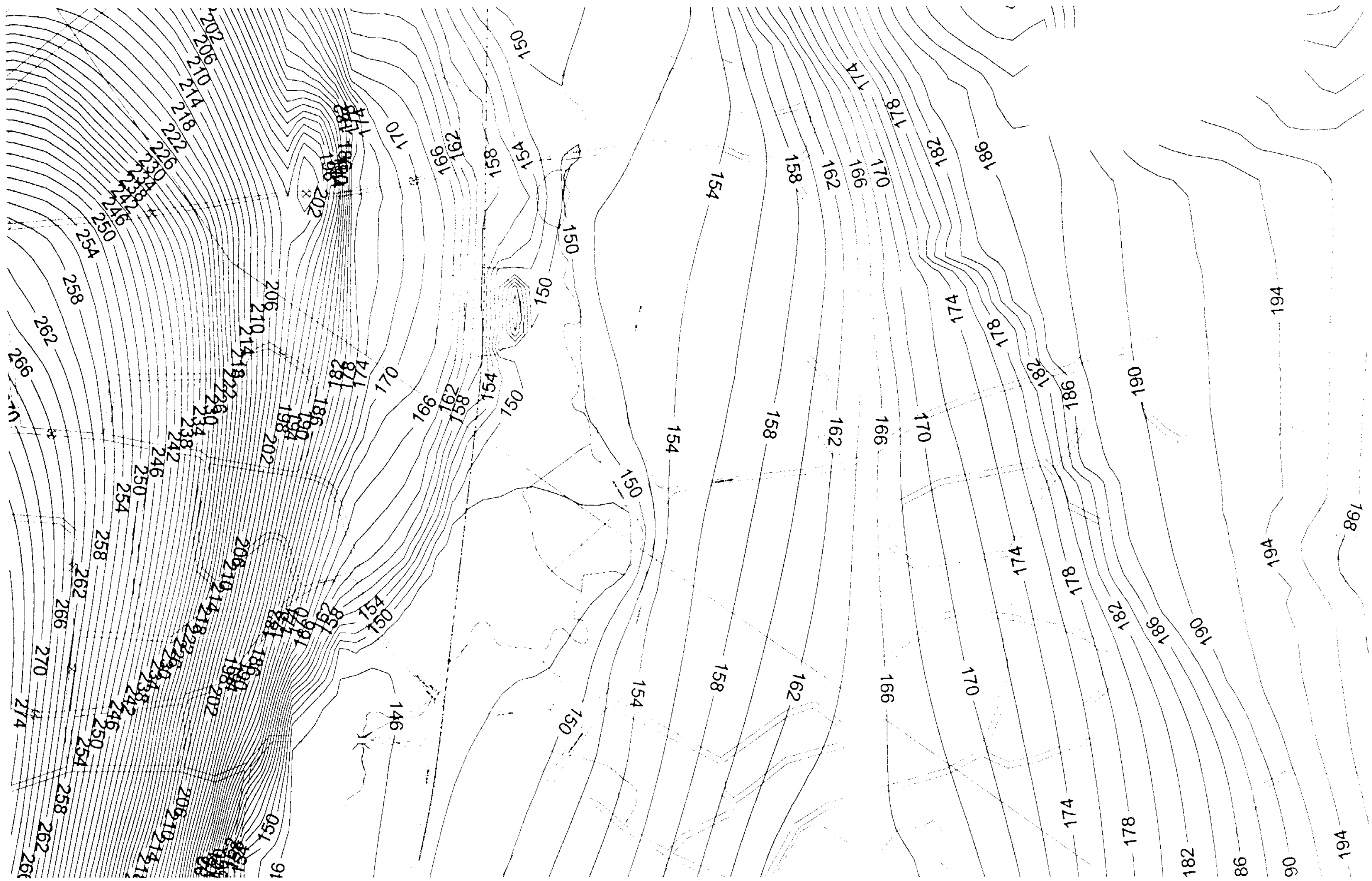
Layer 1 Heads (ft. AMSL)



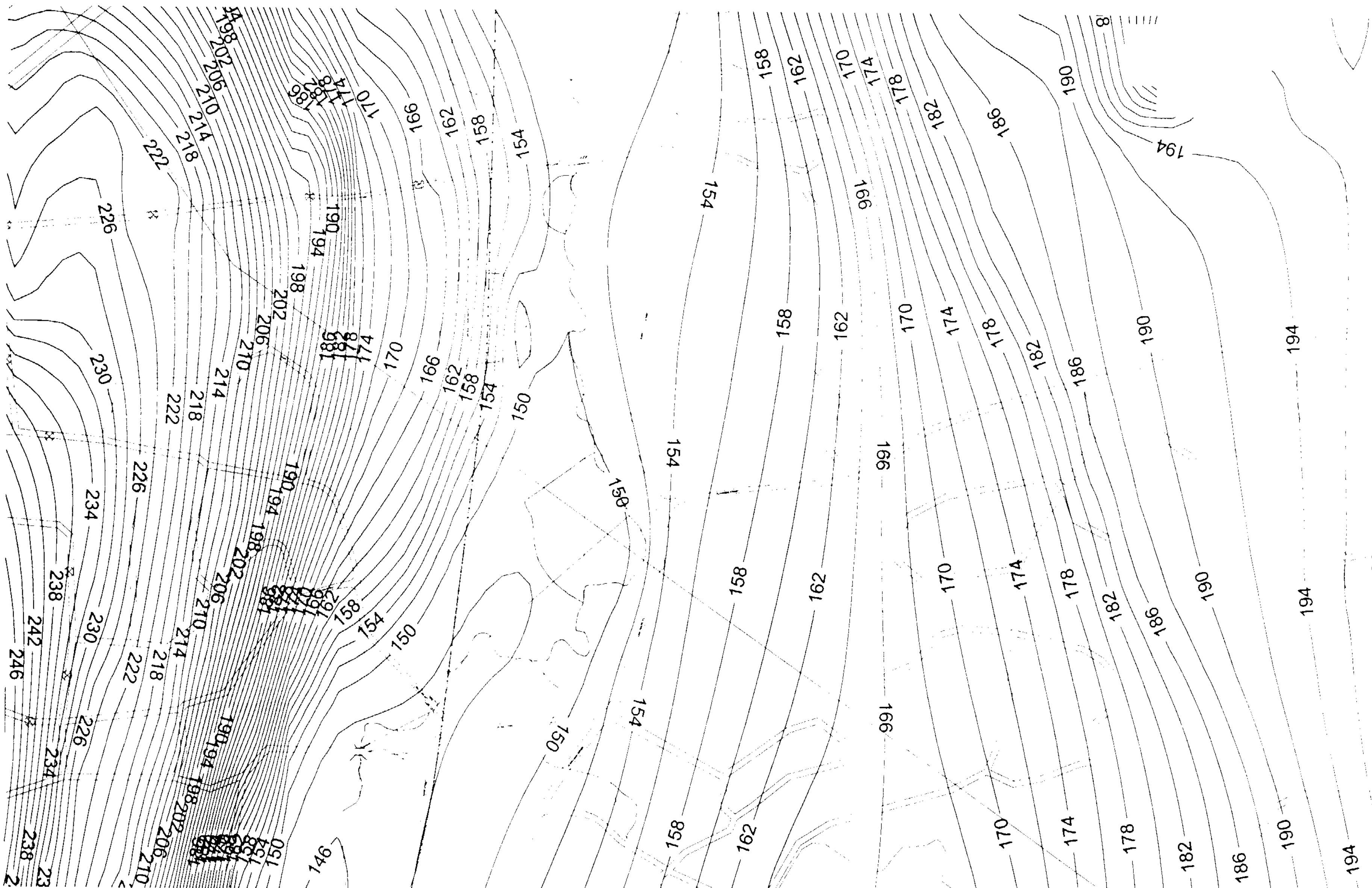
Layer 2 Heads (ft. AMSL)



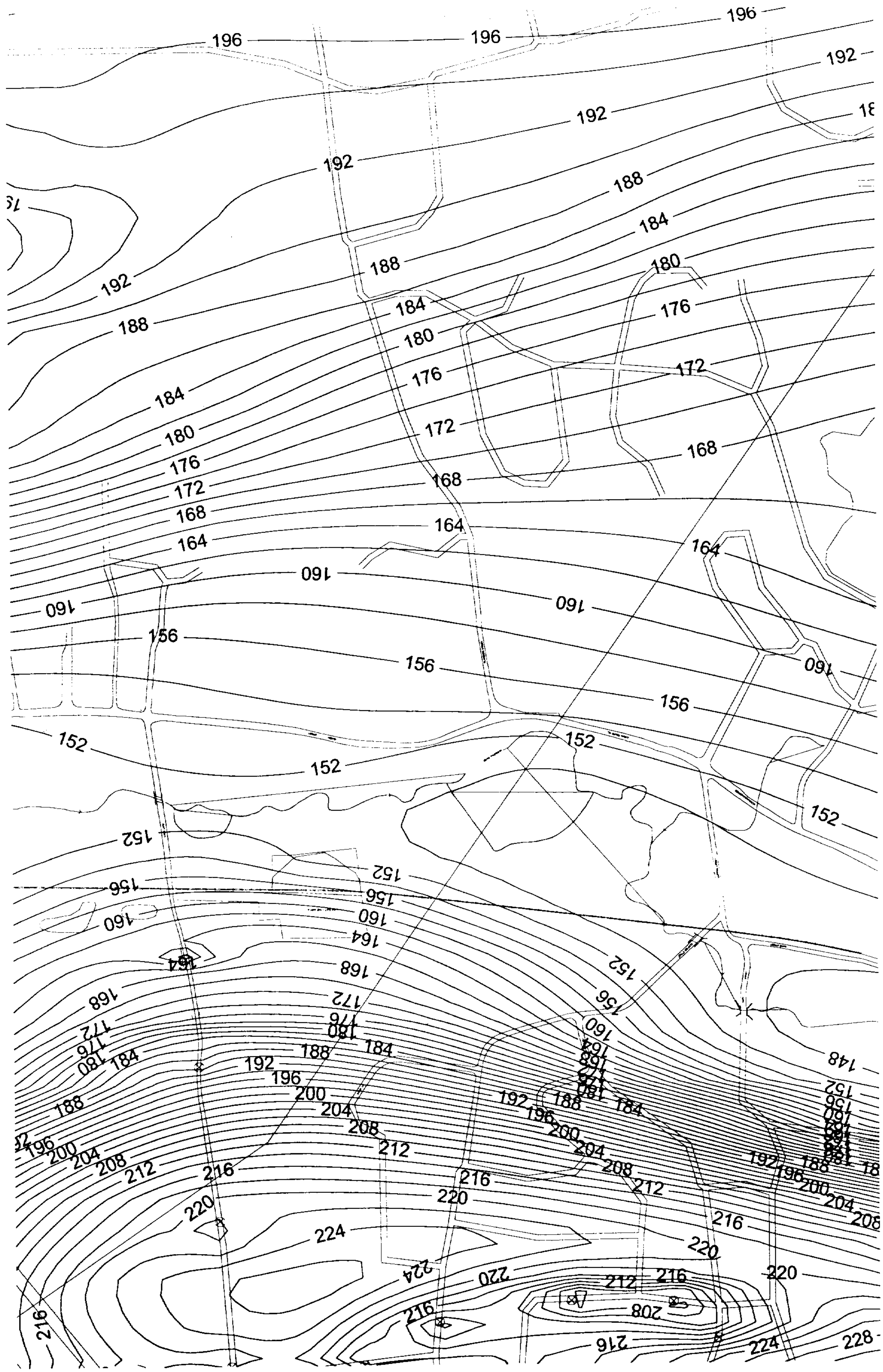
Layer 3 Heads (ft. AMSL)



Layer 4 Heads (ft. AMSL)



Layer 5 Heads (ft. AMSL)



Appendix B

SRSNE SITE
RI/FS OVERBURDEN INVESTIGATION AND NTCRA 2 DESIGN INVESTIGATION

Well and Piezometer Specifications

Location	Easting (X)	Northing (Y)	Ground Surf. Elev. (1929 NGVD)	Meas. Pt. (Top of Well) Elevation	Meas. Pt. Stickup	Depth to Top of Till	Depth to Top of Bedrock	Borehole Diameter (Inches) *	Total Well Depth from Stickup	Depth to Bottom of Borehole	Depth to Top of Bentonite	Depth to Bottom of Bentonite	Type of Sandpack Material	Depth to Top of Sandpack	Depth to Bottom of Sandpack	Screen/ Sump Material	Screen Length	Screen Diameter (Inches)	Screen Slot Size (Inches)	Depth to Top of Screen	Depth to Bottom of Screen	Sump Length	Depth to Top of Sump	Depth to Bottom of Sump	Riser Material	Riser Diameter (Inches)	Well Formation
PZR-1R	565721.5	285403.8	148.72	151.07	2.35	NA	98	8.25 & 4.0	125.7	125.5	2	101.5	Morie #0	101.5	125.5	Sch40 PVC	20.0	2	0.010	103.0	123.0	0.3	123.0	123.3	Sch40 PVC	2	Shallow Bedrock
PZR-2R	565562.5	285330.5	152.10	153.77	1.67	70	113	8.25 & 4.0	142.5	141.5	2	118.7	Morie #0	118.7	141.5	Sch40 PVC	20.0	2	0.010	120.5	140.5	0.3	140.5	140.8	Sch40 PVC	2	Shallow Bedrock
PZR-2DR	565579.3	285318.7	153.41	154.92	1.51	70	113	8.25 & 4.0	205.8	205.0	2	181.5	Morie #0	181.5	205.0	Sch40 PVC	20.0	2	0.010	184.0	204.0	0.3	204.0	204.3	Sch40 PVC	2	Deep Bedrock
PZR-3R	565745.3	285219.9	149.92	152.39	2.47	84	114	8.25 & 3.0	143.1	141.0	2	119.5	Morie #0	119.5	141.0	Sch40 PVC	20.0	2	0.010	120.3	140.3	0.3	140.3	140.6	Sch40 PVC	2	Shallow Bedrock
PZR-4R	565368.6	285470.6	152.36	153.95	1.59	NA	64	8.25 & 4.0	91.6	95.0	2	68.5	Morie #0	68.5	95.0	Sch40 PVC	20.0	2	0.010	69.7	89.7	0.3	89.7	90.0	Sch40 PVC	2	Shallow Bedrock
PZR-4DR	565388.3	285463.6	151.15	153.25	2.10	NA	64	8.25 & 4.0	157.4	156.0	2	132.7	Morie #0	132.7	156.0	Sch40 PVC	20.0	2	0.010	135.0	155.0	0.3	155.0	155.3	Sch40 PVC	2	Deep Bedrock
PZR-5R	565279.8	285532.2	152.12	154.84	2.72	NA	47	8.25 & 4.0	76.0	75.2	2	52	Morie #0	52.0	75.2	Sch40 PVC	20.0	2	0.010	53.0	73.0	0.3	73.0	73.3	Sch40 PVC	2	Shallow Bedrock
RW-1R	565570.6	285561.2	149.80	152.18	2.38	40	75	16 & 12	174.4	172.0	NA	NA	NA	NA	NA	Open Hole	90.0	12	NA	82.0	172.0	0.0	172.0	172.0	Black Steel	12	Shallow and Deep Bedrock
PZO-2M	565586.0	285328.1	152.70	154.81	2.11	70	113	8.25	58.4	70.0	2	44.0	Morie #0	44.0	58.0	Sch40 PVC	10.0	2	0.010	46.0	56.0	0.3	56.0	56.3	Sch40 PVC	2	Middle Overburden
PZO-2D	565578.2	285339.8	152.48	154.29	1.81	70	113	8.25 & 4.0	87.1	119.0	2	70.0	Morie #0	70.0	86.0	Sch40 PVC	10.0	2	0.010	75.0	85.0	0.3	85.0	85.3	Sch40 PVC	2	Deep Overburden
PZO-3M	565736.4	285211.5	150.59	152.58	1.99	84	114	8.25	58.3	58.0	2	44.0	Morie #0	44.0	58.0	Sch40 PVC	10.0	2	0.010	46.0	56.0	0.3	56.0	56.3	Sch40 PVC	2	Middle Overburden
PZO-3D	565726.3	285209.5	150.85	153.13	2.28	84	114	8.25 & 4.0	100.6	102.0	2	83.0	Morie #0	83.0	102.0	Sch40 PVC	10.0	2	0.010	88.0	98.0	0.3	98.0	98.3	Sch40 PVC	2	Deep Overburden
PZO-6S	565487.1	285569.1	151.28	153.07	1.79	40	75	8.25	24.1	23.0	2	10.0	Morie #0	10.0	23.0	Sch40 PVC	10.0	2	0.010	12.0	22.0	0.3	22.0	22.3	Sch40 PVC	2	Shallow Overburden
PZO-121S	565547.3	285819.6	150.14	152.14	2.00	54	58	8.25	14.0	12.0	1	1.5	Morie #0	1.5	12.0	Sch40 PVC	10.0	2	0.010	1.7	11.7	0.3	11.7	12.0	Sch40 PVC	2	Shallow Overburden
PZO-204S	565649.2	285564.9	149.06	151.16	2.10	79	82	8.25	15.1	13.0	1	2.0	Morie #0	2.0	13.0	Sch40 PVC	10.0	2	0.010	2.7	12.7	0.3	12.7	13.0	Sch40 PVC	2	Shallow Overburden
PZO-204M	565658.0	285561.9	149.18	151.16	1.98	79	82	8.25	58.0	58.0	2	44.0	Morie #0	44.0	56.0	Sch40 PVC	10.0	2	0.010	45.7	55.7	0.3	55.7	56.0	Sch40 PVC	2	Middle Overburden
RW-13	565560.2	285601.7	150.12	152.40	2.28	40	75	16	77.3	77.8	27	30.0	Morie #1	30.0	77.8	Sch80 SS	40.0	8	0.030	35.0	75.0	0.0	75.0	75.0	Sch80 PVC	8	Middle and Deep Overburden

1) NA - Not Available or Not Applicable
2) Measurements in feet except where noted otherwise. Elevations are in terms of feet above mean sea level (AMSL); the datum is the NGVD of 1929.
3) Wells/piezometers finished with neat cement grout above upper bentonite seal.
4) SS = Stainless steel; PVC = polyvinyl chloride

* Larger number indicates overburden borehole diameter; smaller number indicates bedrock borehole diameter or roller-bit diameter used in cobbly section of overburden.

Appendix C

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-1R
Site: SRSNE -- Southington, CT
Date: 12/04/97

Q(actual)	0.037	gpm	t	277	min	Q (comp)	0.037	gpm
S (est)	0.0001		s	86.29	ft	T (comp)	0.45	gpd/ft
r(w)	0.17	ft	LS	24	ft	K	8.8E-07	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	0.5000	0.0407
2	0.4961	0.0404
3	0.4926	0.0401
4	0.4892	0.0399
5	0.4862	0.0397
6	0.4833	0.0394
7	0.4807	0.0393
8	0.4782	0.0391
9	0.4759	0.0389
10	0.4738	0.0388
11	0.4719	0.0386
12	0.4701	0.0385
13	0.4684	0.0384
14	0.4668	0.0382
15	0.4654	0.0381
16	0.4640	0.0380
17	0.4628	0.0380
18	0.4616	0.0379
19	0.4606	0.0378
20	0.4596	0.0377
21	0.4587	0.0376
22	0.4578	0.0376
23	0.4570	0.0375
24	0.4563	0.0375
25	0.4556	0.0374
26	0.4550	0.0374
27	0.4544	0.0373
28	0.4539	0.0373
29	0.4534	0.0373
30	0.4529	0.0372
31	0.4525	0.0372
32	0.4521	0.0372
33	0.4517	0.0371
34	0.4514	0.0371
35	0.4511	0.0371
36	0.4508	0.0371

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-2R
Site: SRSNE -- Southington, CT
Date: 12/05/97

Q(actual)	0.0055	gpm	|	t	243	min	|	Q (comp)	0.0055	gpm
S (est)	0.0001		|	s	30.36	ft	|	T (comp)	0.17	gpd/ft
r(w)	0.17	ft	|	LS	22.8	ft	|	K	3.5E-07	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	0.1900	0.0062
2	0.1894	0.0061
3	0.1887	0.0061
4	0.1881	0.0061
5	0.1875	0.0061
6	0.1870	0.0061
7	0.1864	0.0061
8	0.1859	0.0061
9	0.1853	0.0060
10	0.1848	0.0060
11	0.1843	0.0060
12	0.1838	0.0060
13	0.1834	0.0060
14	0.1829	0.0060
15	0.1825	0.0060
16	0.1820	0.0059
17	0.1816	0.0059
18	0.1812	0.0059
19	0.1808	0.0059
20	0.1805	0.0059
21	0.1801	0.0059
22	0.1797	0.0059
23	0.1794	0.0059
24	0.1790	0.0059
25	0.1787	0.0058
26	0.1784	0.0058
27	0.1781	0.0058
28	0.1778	0.0058
29	0.1775	0.0058
30	0.1772	0.0058
31	0.1769	0.0058
32	0.1766	0.0058
33	0.1764	0.0058
34	0.1761	0.0058
35	0.1759	0.0058
36	0.1756	0.0058

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-2DR
Site: SRSNE -- Southington, CT
Date: 11/21/97

Q(actual)	0.076	gpm	t	244	min	Q (comp)	0.076	gpm
S (est)	0.0001		s	41.07	ft	T (comp)	2.24	gpd/ft
r(w)	0.17	ft	LS	23.5	ft	K	4.5E-06	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	2.210	0.0746
2	2.211	0.0746
3	2.212	0.0746
4	2.213	0.0747
5	2.214	0.0747
6	2.214	0.0747
7	2.215	0.0747
8	2.216	0.0748
9	2.217	0.0748
10	2.218	0.0748
11	2.218	0.0748
12	2.219	0.0749
13	2.220	0.0749
14	2.220	0.0749
15	2.221	0.0749
16	2.222	0.0749
17	2.222	0.0750
18	2.223	0.0750
19	2.223	0.0750
20	2.224	0.0750
21	2.224	0.0750
22	2.225	0.0750
23	2.225	0.0751
24	2.226	0.0751
25	2.226	0.0751
26	2.227	0.0751
27	2.227	0.0751
28	2.228	0.0751
29	2.228	0.0751
30	2.228	0.0751
31	2.229	0.0752
32	2.229	0.0752
33	2.229	0.0752
34	2.230	0.0752
35	2.230	0.0752
36	2.230	0.0752

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-3R
Site: SRSNE -- Southington, CT
Date: 12/08/97

Q(actual)	0.29	gpm	|	t	313	min	|	Q (comp)	0.29	gpm
S (est)	0.0001		|	s	67.45	ft	|	T (comp)	6.03	gpd/ft
r(w)	0.13	ft	|	LS	21.5	ft	|	K	1.3E-05	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	6.0000	0.2838
2	6.0012	0.2839
3	6.0024	0.2839
4	6.0035	0.2840
5	6.0045	0.2840
6	6.0055	0.2840
7	6.0065	0.2841
8	6.0074	0.2841
9	6.0083	0.2842
10	6.0092	0.2842
11	6.0100	0.2842
12	6.0108	0.2843
13	6.0115	0.2843
14	6.0122	0.2843
15	6.0129	0.2844
16	6.0135	0.2844
17	6.0142	0.2844
18	6.0148	0.2844
19	6.0153	0.2845
20	6.0159	0.2845
21	6.0164	0.2845
22	6.0169	0.2845
23	6.0174	0.2846
24	6.0178	0.2846
25	6.0182	0.2846
26	6.0187	0.2846
27	6.0191	0.2846
28	6.0194	0.2846
29	6.0198	0.2847
30	6.0202	0.2847
31	6.0205	0.2847
32	6.0208	0.2847
33	6.0211	0.2847
34	6.0214	0.2847
35	6.0217	0.2847
36	6.0219	0.2848

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-4R
Site: SRSNE -- Southington, CT
Date: 11/11/98

Q(actual)	0.67	gpm	|	t	114	min	|	Q (comp)	0.67	gpm
S (est)	0.0001		|	s	2.22	ft	|	T (comp)	532.58	gpd/ft
r(w)	0.17	ft	|	LS	26.5	ft	|	K	9.5E-04	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	532.6000	0.6723
2	532.5998	0.6723
3	532.5995	0.6723
4	532.5993	0.6723
5	532.5991	0.6723
6	532.5988	0.6723
7	532.5986	0.6723
8	532.5984	0.6723
9	532.5981	0.6723
10	532.5979	0.6723
11	532.5977	0.6723
12	532.5975	0.6723
13	532.5973	0.6723
14	532.5971	0.6723
15	532.5969	0.6723
16	532.5967	0.6723
17	532.5965	0.6723
18	532.5963	0.6723
19	532.5961	0.6723
20	532.5959	0.6723
21	532.5957	0.6723
22	532.5955	0.6723
23	532.5953	0.6723
24	532.5951	0.6723
25	532.5949	0.6723
26	532.5948	0.6723
27	532.5946	0.6723
28	532.5944	0.6723
29	532.5942	0.6723
30	532.5940	0.6723
31	532.5939	0.6723
32	532.5937	0.6723
33	532.5935	0.6723
34	532.5934	0.6723
35	532.5932	0.6723
36	532.5930	0.6723

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-4DR
Site: SRSNE -- Southington, CT
Date: 12/04/97

Q(actual)	0.11	gpm	t	246	min	Q (comp)	0.11	gpm
S (est)	0.0001		s	40.93	ft	T (comp)	3.32	gpd/ft
r(w)	0.17	ft	LS	23.3	ft	K	6.8E-06	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	10.0000	0.2943
2	8.1327	0.2435
3	6.7734	0.2059
4	5.7895	0.1784
5	5.0808	0.1583
6	4.5727	0.1438
7	4.2096	0.1334
8	3.9511	0.1259
9	3.7674	0.1206
10	3.6371	0.1168
11	3.5448	0.1141
12	3.4795	0.1121
13	3.4333	0.1108
14	3.4007	0.1098
15	3.3776	0.1092
16	3.3614	0.1087
17	3.3499	0.1083
18	3.3418	0.1081
19	3.3360	0.1079
20	3.3320	0.1078
21	3.3291	0.1077
22	3.3271	0.1077
23	3.3257	0.1076
24	3.3247	0.1076
25	3.3240	0.1076
26	3.3235	0.1076
27	3.3231	0.1076
28	3.3229	0.1075
29	3.3227	0.1075
30	3.3226	0.1075
31	3.3225	0.1075
32	3.3224	0.1075
33	3.3224	0.1075
34	3.3224	0.1075
35	3.3223	0.1075
36	3.3223	0.1075

QSTRANS.WK1 by M.J. Gefell, Updated, February 1993.

Based on specific capacity test data reduction technique described in Walton, W.C. 1962. Selected Analytical Methods for Well and Aquifer Evaluation, Illinois State Water Survey, Bulletin 19.

SPECIFIC CAPACITY TEST DATA REDUCTION

Well: PZR-5R
Site: SRSNE -- Southington, CT
Date: 10/30/97

Q(actual)	0.069	gpm	|	t	312	min	|	Q (comp)	0.069	gpm
S (est)	0.0001		|	s	27.49	ft	|	T (comp)	3.25	gpd/ft
r(w)	0.17	ft	|	LS	23.2	ft	|	K	6.6E-06	cm/sec

Iteration	T, gpd/ft	computed Q, gpm
1	3.0000	0.0644
2	3.0482	0.0654
3	3.0869	0.0661
4	3.1181	0.0667
5	3.1432	0.0672
6	3.1634	0.0676
7	3.1797	0.0679
8	3.1928	0.0682
9	3.2034	0.0684
10	3.2119	0.0686
11	3.2187	0.0687
12	3.2243	0.0688
13	3.2287	0.0689
14	3.2323	0.0689
15	3.2352	0.0690
16	3.2375	0.0690
17	3.2394	0.0691
18	3.2409	0.0691
19	3.2421	0.0691
20	3.2431	0.0692
21	3.2439	0.0692
22	3.2445	0.0692
23	3.2450	0.0692
24	3.2454	0.0692
25	3.2458	0.0692
26	3.2460	0.0692
27	3.2463	0.0692
28	3.2464	0.0692
29	3.2466	0.0692
30	3.2467	0.0692
31	3.2468	0.0692
32	3.2468	0.0692
33	3.2469	0.0692
34	3.2470	0.0692
35	3.2470	0.0692
36	3.2470	0.0692