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FINAL

Feasibility Study

ITT Sealectro
Mamaroneck, New York

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Contents

List of Tables

Tables located in text of report

Tables located at end of report

List of Figures

List of Appendices

List of Exhibits

List of Abbreviations

ACO	Administrative Order on Consent
ARARs	applicable or relevant and appropriate requirement
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CWA	Clean Water Act
1,1-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-dichloroethene
DNAPL	dense non-aqueous phase liquid
DOT	Department of Transportation
FS	feasibility study
GPR	ground penetrating radar
IRMs	interim remedial measures
LNAPL	light non-aqueous phase liquid
NCP	National Contingency Plan
NYCRR	New York Code of Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
PCE	tetrachloroethene
PEL	permissible exposure levels
POTW	publicly owned treatment works
PVC	polyvinyl chloride
RA	risk assessment
RAO	remedial action objectives
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	record of decision
SCG	standards, criteria, and guidelines
SVOC	semivolatile organic compound
TBC	to be considered
TCA	1,1,1 trichloroethane
TCE	trichloroethene
TI	technical impracticality

TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound
WCDEF	Westchester County Department of Environmental Facilities

1. Introduction

1.1. Purpose and organization of the report

This document presents the Feasibility Study (FS) Report for the former ITT-Sealectro Inc. facility (ITT-Sealectro), Site #360027, located at 139 Hoyt Street in Mamaroneck, New York ("the site"). This report fulfills Section IV of the Administrative Order of Consent (ACO) which became effective on October 8, 1992. Figure 1-1 illustrates the location of the site.

The Site is a Class 2 - priority 3 inactive hazardous waste site as classified by the New York State Department of Environmental Conservation (NYSDEC). The priority 3 designation indicates that the site does not pose an immediate threat to the public or the environment. Multiple investigations and several interim remedial measures (IRMs) have been completed at the site to address known areas of contamination. The most recent investigation completed was the Remedial Investigation (RI). The results of the RI, as well as the previous investigations are presented in the *Remedial Investigation Report* dated December 1994 and the *Remedial Investigation Report Addendum* dated July 1995 (O'Brien & Gere 1994; O'Brien & Gere 1995). The RI was subsequently approved by the NYSDEC in August 1995. Four IRMs were performed at the site. The IRMs included removal of nine underground storage tanks, removal and off-site disposal of approximately 148 yd^3 of contaminated soils, recovery of approximately 234 gallons of fuel oil, removal of approximately 27 lbs of volatile organic compounds (VOCs) from soil using a pilot *in situ* air stripping system and removal of 678 lbs of VOCs from the continuing ground water recovery system. The IRMs are summarized in the *Interim Remedial Measures Report* (O'Brien & Gere 1992b).

A draft Feasibility Study (FS) Report was submitted to the NYSDEC in November 1995. The NYSDEC reviewed the draft FS and provided comments in letters dated January 31, 1996 and February 27, 1996. At that time, NYSDEC also encouraged ITT to consider an innovative technology for use at the ITT-Sealectro site. Based n experience at another site, ITT identified hydrogen peroxide injection technology for the Sealectro site and submitted a June 24, 1996 letter to NYSDEC that incorporated hydrogen peroxide treatment as a sixth alternative in the FS. In a September 16, 1996 letter, NYSDEC indicated that pilot scale testing of the hydrogen peroxide injection technology would be needed before it could be included as a viable alternative in the FS. Subsequent information from pilot tests performed at other sites suggested that the technology may not be effective at the ITT-Sealectro site. Therefore, the alternative was not pursued any further.

NYSDEC and ITT met on September 11, 1997 to discuss the technical aspects of remediation at the site. As a follow-up to the meeting, an October 17, 1997 letter was submitted to the NYSDEC with a detailed proposal for implementation of the November 1995 FS Alternative 2: Institutional Controls. In response to that proposal, NYSDEC developed another alternative, consisting of ground water monitoring and a contingency remedy, and outlined the alternative in their letters of January 6, 1998 and March 11, 1998. ITT and NYSDEC met a number of times in 1998 to discuss the alternative. This alternative was subsequently agreed upon by both parties and has been incorporated into this FS as Alternative 4.

This Final FS Report documents the formulation and evaluation of five remedial alternatives for the site, and includes the ground water monitoring and contingency remedy as Alternative 4. The FS was conducted in accordance with ITT-Sealectro *RI/FS Work Plan* (O'Brien & Gere 1993), *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA,* EPA/540/G-89/004 (USEPA 1988), *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP; Federal Register 1990), *Guidance for Evaluating the Technical Impracticability of Ground Water Restoration* (USEPA 1993) as well as the NYSDEC revised *Technical and Administrative Guidance Memorandum (TAGM) on Selection of Remedial Alternatives at Inactive Hazardous Waste Site*, NYSDEC 1990.) In addition to incorporation of a new Alternative 4, this Final FS Report addresses comments on the 1995 Draft FS issued by NYSDEC in letters dated January 31, 1996 and February 27, 1996 (NYSDEC 1996; NYSDEC 1996b).

This Report is organized in accordance with the USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, (USEPA 1988).

The contents of each section of this report are as follows:

Section 1 - This section includes the introduction to the FS, presents the report organization, and a description of the site setting, site history and a summary of the RI. The summary includes a discussion of site geology and hydrogeology, environmental history, areas of concern, nature and extent of contamination, contaminant fate and transport, and the risk assessment (RA). Also included is a discussion of IRMs implemented to address known areas of contamination at the site and an evaluation of their effectiveness.

Section 2 - This section includes a discussion of potential chemical-specific and location-specific applicable or relevant and appropriate standards, criteria, and guidelines (SCGs) for the site. It also discusses the physical and technical limits to remediation, and the remedial action objectives (RAOs) for the site.

Section 3 - This section presents calculations of the quantity of soil and ground water impacted by site operations and summarizes general response actions. In addition, potential remedial technologies and process options are identified, screened and evaluated.

Section 4 - This section discusses the remedial alternatives developed.

Section 5 - This section presents a detailed evaluation of the five most promising remedial actions identified in Section 4 with respect to the nine criteria specified in the NCP.

Section 6 - This section presents the conclusions of the FS.

1.2. Site background

1.2.1. Site setting

The Former ITT-Sealectro site is located in an industrialized area of Mamaroneck, New York (Figures 1-1 and 1-2). Industries in the immediate vicinity of the site include: Blood Brothers Wrecking Yard, which is located north across the Sheldrake River; Marvel Industries, Inc. (a plastics fabricator), which is located to the west; and a photographic and film processing facility and dance studio which are located to the east. Hoyt Street and Amtrak-Metropolitan Transportation Authority train lines border the site to the south.

The 0.92 acre site is relatively flat. One large building occupies the site, and paved parking areas cover nearly the entire remaining area. The majority of the site is fenced in order to maintain site security. As stated in the RI Report, the Village of Mamaroneck is supplied by public water. The water is purchased from New York City reservoirs. A local ordinance requires that public water be utilized for potable supplies, provided a supply line is located within 500 ft of the property line.

The Sheldrake River borders the site to the north. The Sheldrake River is a Class C river and a tributary to the Mamaroneck River that drains into Mamaroneck Harbor and Long Island Sound which are within 1 mile of the site. Where it flows past the site, the Sheldrake River is approximately 15 ft wide and 1 ft deep. The river is prone to flooding and is channeled by stone retaining walls that are about 8 ft high. Debris, typically consisting of automobile parts, glass and assorted refuse, is found in the river.

1.2.2. Site history

The Sealectro Corporation owned and operated an electronics parts manufacturing and assembly facility at the 139 Hoyt Street from 1960 to 1981. The previous tenant at the building manufactured jewelry. In November 1981, BICC plc acquired Sealectro through a stock purchase. In March 1986, Sealectro-BICC sold the building and land to 139 Hoyt Street Associates, who in turn leased the same property back to Sealectro-BICC. ITT Corporation purchased Sealectro from BICC plc in August 1988. The resulting company was ITT-Sealectro, an ITT Electronic Components, Inc. Company (now known as ITT Cannon, Inc.).

ITT-Sealectro ceased operations at the site in November 1990. The property remained under the ownership of 139 Hoyt Street Associates until July 1991 at which time National Westminster Bank initiated foreclosure proceedings. In 1995 the property was sold to Simone Development Company who is the current owner. The building has been subdivided and is currently being used for tile storage and a medial center.

Several manufacturing operations including screw machine operations, electroplating, and connector assembly were performed at the facility. The screw machine operation was located in the southwest portion of the building and was discontinued in January 1975. The electroplating department, which was located in the northeast corner of the building, operated until 1986. Reportedly the amount and type of hazardous waste generated at the facility was considerably reduced after 1986. From 1986 until 1990, the facility was primarily used to assemble small parts and not for manufacturing. Limited quantities of 1,1,1-trichloroethane (TCA), which was used as a contact cleaner, and small amounts of machine oil were reportedly used during this period.

1.3. Investigation summary

Multiple investigations have been completed at the site. During the investigations, seven areas of concern were identified (Figure 1-2). These areas are:

1. Fuel Oil Underground Storage Tank (UST) Area - Former location of a 2,500 gallon fuel oil tank
2. Solvent UST Area - Former location of eight USTs containing cutting oils, waste oils, and solvents
3. Shed Area - Location where solvents were stored or handled
4. Former Drum Storage Pad - Location where drums of solvent and oils were stored
5. Waste Water Treatment Area - Location of three underground waste water storage tanks which were closed in-place in this area
6. Ground Water - Ground water at the site has been impacted by operations at the various areas of concern identified above
7. Sheldrake River - Ground water from the site discharges to the River.

The following investigations were completed at the site:

- 1986. An initial study was completed by O'Brien & Gere Engineers, Inc. (O'Brien & Gere 1986) as part of the property transfer from Sealectro-BICC to 139 Hoyt Street Associates.
- 1988. An environmental assessment of soil and ground water was conducted in 1988 by TRC Environmental Consultants, Inc. (TRC 1988) for ITT Corporation in association with the purchase of Sealectro.

- 1989. A soil sampling program was implemented in August 1989 by O'Brien & Gere. The purpose of the study was to evaluate the extent of impacted soil at the Former Drum Storage Pad and to document existing ground water quality conditions.

- 1991. A draft Environmental Investigation Report was prepared by Leggette, Brashears & Graham, Inc. (LB&G) in May 1991 for BICC plc to verify the existence of the solvent USTs and evaluate the possible presence of VOCs in subsurface soils.

- 1992. A Phase I RI study was completed by O'Brien & Gere (O'Brien & Gere 1992) that included the collection of soil and ground water samples from the Former Drum Storage Pad Area, Solvent UST, Wastewater Treatment Area, Fuel Oil UST Area, and the collection of sediment and surface water samples from the Sheldrake River.

- 1994. O'Brien & Gere conducted the RI, which is the most recent study completed at the site. The tasks completed in the RI were based on the conclusions of the Phase I RI and the requirements contained in the ACO. As part of the RI, the extent of VOCs and dense non-aqueous phase liquids (DNAPLs) in the subsurface soil and shallow ground water were further evaluated, and a baseline human health risk assessment was completed. The findings from the RI and the data from the previous investigations were summarized in the *ITT-Sealectro Remedial Investigation Report* dated December 1994, and the *RI Report Addendum* dated July 1995. The RI was subsequently approved by the NYSDEC in August 1995.

- 1995. As part of the draft FS, a test ground water recovery well was installed and an aquifer performance test was completed to assess the hydraulic characteristics of the aquifer.

These studies delineated the site hydrogeology and the nature and extent of contamination. The results from the studies form the basis for the evaluation conducted in this FS.

1.3.1. Site geology and hydrogeology

As a result of installing twelve ground water monitoring wells and approximately fifty soil borings during the various activities, the site geology and hydrogeology is well documented (see Figure 1-3). The site geology and hydrogeology are critical to the fate and transport of contaminants in soil and ground water.

Regionally, the site is located in the Manhattan Hill Sub Area of the New England Physiographic Province. The topography of the area is predominately composed of low-lying plains and flat broad valleys, separated by northeast trending low rolling hills. The topography is the result of alternating ridges and depressions in the bedrock surface, which trend in a northeasterly direction.

Figure 1-4 presents a generalized hydrogeologic cross-section which illustrates the site geology. The site geology consists of three unconsolidated units that overlie gray granitic gneiss bedrock. The bedrock is located between 29 and 40 ft below the ground surface. The elevation of the top of bedrock is lower to west and south of the building. The unconsolidated deposit immediately above the bedrock is comprised of sand and gravel. The thickness of this unit varies from 10 to 24 ft. The unit is thickest in the vicinity of MW-4 and thinnest in the vicinity of MW-3 and under the building. The observed relative percentages of sand and gravel are not uniform and can vary over relatively short distances. The sand and gravel unit probably represents fluvial deposits.

The middle unit consists of inter layered discontinuous lenses of sand, silt, and clay. Individual lenses vary in thickness and texture, and they are not laterally extensive. This middle unit is 8 to 18 ft thick, with the thickest portion in the vicinity of the Sheldrake River. The upper-most unconsolidated unit is comprised of fill. It is composed of black, fine to coarse grained sand, fine to coarse grained gravel, with cinders and slag. The thickness varies from 2 to 7 ft. The fill was probably used to make the low-lying area near the river useable for construction.

Ground water occurs between 5 ft and 8 ft below the ground surface. The depth to water varies with seasons and river stage. Two ground water zones have been identified. The shallow zone occurs in the sand, silt and clay unit while the deep ground water zone occurs in the sand and gravel unit. The average hydraulic conductivity of the shallow zones is 4.0 x 10^{-4}/ft/min, and the hydraulic conductivity of the deep zone is 1.5 x 10^{-2} ft/min. Ground water in both the shallow and deep zones flows to the Sheldrake River (see Figures 1-5 and 1-6). An upward hydraulic gradient and a good hydraulic connection between the river and the shallow and deep ground water zones suggests that the ground water flowing beneath the site discharges to the Sheldrake River. The estimated combined ground water discharge to the river is 2900 gal/day (Appendix A). An area of higher ground water elevations in the shallow ground water zone has been identified near the northeastern corner of the facility. The size of this ground water mound appears to vary during the year and may affect the direction of shallow ground water flow.

The permeability of the bedrock in the area is reportedly low. Due to the presence of the Sheldrake and Mamaroneck Rivers and Long Island Sound, it is expected that ground water generally flows from the bedrock to the unconsolidated deposits and surface waters in the Mamaroneck area. At the Former ITT-Sealectro site, it is likely that the ground water in the bedrock is discharging to the unconsolidated deposits adjacent to the Sheldrake River.

1.3.2. Nature and extent of contamination

Fuel Oil UST Area. A 2500 gallon fuel oil UST was located on the southeast portion of the property adjacent to Hoyt Street as indicated on Figure 1-2. The tank contained No.2 fuel oil, and supplied fuel to the boiler for the heating system. On February 4, 1992, while completing the Phase I RI, light non-aqueous phase liquid (LNAPL) was observed in a borehole adjacent to the tank. Total petroleum hydrocarbon (TPH) concentrations of up to 23,000 mg/kg were detected in the soils in this area. The NYSDEC was immediately notified of the spill (Spill #9101862). The NYSDEC Division of Spill Management was initially involved with the underground fuel tank removal. Because of the presence of leaking solvent USTs, discussed later, the Division of Hazardous Waste Remediation became the lead NYSDEC Division for this spill. As part of an IRM, a ground water depression pump and a LNAPL recovery system were installed. The UST and a portion of the stained soil in the area were removed in April 1992. Presently, the building is heated with natural gas, and no fuel oil is stored on-site.

The extent of soils impacted by the fuel oil UST has been documented. The western edge of the area between B-21 and the Fuel Oil UST, the eastern edge near B-29, and the southern edge coincides with the former UST excavation since no stained soil was observed in this area (see Figure 1-7). To the north, low concentrations of semi-volatile organics compounds (SVOCs) typical of fuel oil were detected. Ground water has not been impacted by dissolved constituents from the Fuel Oil UST Area.

The occurrence of LNAPL was limited to the immediate area adjacent to MW-8 and the fuel oil recovery well (RW-1). LNAPL was not detected to the north beneath the building, nor to the east in MW-9, which is located 10 ft from the recovery well. No NAPL was identified to the south in the UST excavation. The risk assessment identified an estimated risk within acceptable guidelines in this area. The recovery system in this area was shut off in 1995 after it was determined that all the recoverable LNAPL had been recovered.

Solvent UST Area. The Solvent UST Area is located in the southwest portion of the building as indicated on Figure 1-2. As part of an IRM, eight USTs and approximately 87 yd^3 soil were removed in April 1991. Prior to completing the excavation in the Solvent UST Area, a test boring was completed. The total VOC concentrations detected in the boring ranged from 2.4 mg/Kg to 207,800 mg/Kg. During the tank removal, it was evident that the tanks had leaked, and the NYSDEC was immediately notified (Spill No. 9101862). Because of the presence of leaking solvent USTs, the Division of Hazardous Waste Remediation became the lead NYSDEC division and replaced the division of Spill Management.

As part of a second IRM completed in April 1992, an additional 85 yd^3 of soil was removed from this area. Post excavation samples collected in April 1992 from the Solvent UST area are presented in the RI Report. Three samples were collected from the bottom and sides of the excavation. Total VOC concentrations ranged from 0.84 mg/Kg to 2,214.3 mg/Kg. It should be noted that the soil excavation at the Solvent UST area was constrained to the north and west by the building and to the south by underground utilities. The excavation was limited to a depth of approximately 11.5 ft below grade, because "running sands" were encountered. A ground water recovery well (RW-2) and treatment system were installed and have been operational since 1992.

During the RI, soil containing DNAPL were identified in this area. DNAPL is a dense non-aqueous phase liquid with a specific gravity greater than water. Because it is heavier than water it tends to sink. Typical industrial sources of DNAPL are chlorinated solvents including trichloroethene (TCE) and TCA. Due to the physical characteristics of the DNAPL and the discontinuous lenses of sand, silt and clay, the DNAPL was identified in discreet lenses within a soil sample. The majority of soil in a sample did not contain DNAPL. The occurrence of discrete lenses with DNAPL appeared to correlate with the occurrences of a different soil texture, such as a sand lens within silt. No accumulation of DNAPL were detected in the soils, on the bedrock surface, or in the site monitoring wells.

The horizontal extent of DNAPL in the area is loosely defined by borings B-21 to the east, B-18 to the south, B-49 and B-53 to west, and B-34 and B-52 to north (see Figure 1-3). The vertical extent of DNAPL has also been defined. The highest VOC concentrations were detected in the upper 12.5 ft of the soil; however, there are isolated occurrences of VOC/DNAPL below a depth of about 16 ft. The concentrations of VOCs decreased by at least two orders of magnitude between the shallow and deep zones. Investigations have indicated that there is no DNAPL at the overburden/bedrock interface in the vicinity of the Solvent UST Area.

Shed Area. Prior to completing the RI, the Shed Area was not recognized as a source area (Figure 1-2). The ground penetrating radar (GPR) survey, completed in October 1993, identified strong non-ionic responses in the Shed Area which suggested that contamination might be present. Soil borings completed as part of the RI confirmed the results of the GPR survey; soil containing DNAPL was identified in the Shed Area. The distribution of DNAPL in the soils in this area was similar to that in the Solvent UST Area.

The data indicated that the highest concentrations of VOCs was near B-33 and B-50 (see Figure 1-3). The primary compounds of concern identified in the Shed Area are VOCs consisting of PCE, TCE, TCA and their associated break down products. The concentrations of VOCs in the Shed Area are as high as 523 mg/kg. The horizontal extent of the soils containing VOCs was loosely defined by the Sheldrake River to north, boring B-51 to the east, MW-2 to the west. The southern extent of DNAPL in the Shed Area is intermingled with the DNAPL lenses associated with the Solvent UST Area.

The vertical extent of DNAPL was greatest in the vicinity of boring B-36 and extended to a depth of about 30 ft. This conclusion was based on field screening and laboratory analyses. The data suggest that DNAPL did not migrate to the top of bedrock.

Former Drum Storage Pad. The Former Drum Storage Pad is located adjacent to the Sheldrake River along the northwest corner of the building (Figure 1-2). This area was used to store drums containing solvents and lubricating oils. Samples collected during previous investigations contained TCA, TCE, PCE, 1,2-dichloroethylene (1,2-DCE), 1,2-dichloroethane (1,2-DCA), xylene and toluene. Total VOC concentrations ranged between non-detect to 76.7 mg/kg. The horizontal extent of contamination in this area was determined prior to the RI. The northern extent is the Sheldrake River, the western extent is near B-1; and the southern extent is near B-13 (Figure 1-8). The eastern extent is near B-2; however; there was no clear demarcation between the soils impacted by operations at the Shed Area and those at the Former Drum Storage Pad.

As part of an IRM, a pilot *in situ* air stripping program was completed in 1992 to remove VOCs from the soil. During the RI, eight soil borings were completed and subsurface soil samples were collected to evaluate the effectiveness of the IRM. The data indicate that the concentrations of VOCs decreased by one to three orders of magnitude at most test locations. In addition, low concentrations of SVOCs which are indicative of lubricating oils were detected. Although SVOCs were found in the soils, no SVOCs have been detected in the ground water at the site. Therefore, it can be concluded that the SVOCs are not migrating in the ground water. The data indicate that the pilot *in situ* air stripping effectively remediated the soils. The RA identified an estimated risk within acceptable guidelines in this area, and this area was therefore not addressed during the FS.

Wastewater Treatment Area. The Wastewater Treatment Area consists of three closed USTs that are located along the northeast portion of the site (Figure 1-2). The tanks were used by Sealectro to treat their plating wastewater. The tanks were closed in 1986 when electroplating operations at the facility were discontinued.

The results from several investigations indicated concentrations of copper and nickel at several isolated locations. Low concentrations of VOCs were detected below the ground water table. However, they are not indicative of a source area; rather, they have likely migrated from the Solvent UST Area. In summary, impacts from this area were minor and localized, and the risks posed on the soils were estimated to be within acceptable guidelines. Therefore, this area was not addressed during the FS.

Ground Water Quality. Twelve ground water monitoring wells have been installed at the site (see Figure 1-3). The ground water chemistry data indicate that the primary compounds of concern were VOCs. The primary VOCs detected were PCE, TCE, TCA and their associated breakdown products including 1,1-DCA and 1,2-DCE. Inorganic concentrations were similar to background.

The DNAPL in the soils at the Solvent UST Area and Shed Areas appear to be the source of the dissolved VOCs in ground water. The highest concentrations of VOCs were detected at recovery well RW-2, which was installed in the Solvent UST Area (see Figure 1-3). The concentrations of VOCs decreased radially away from the Solvent UST and Shed Areas.

Several rounds of ground water samples were collected between 1988 and 1990. In July 1991 a quarterly sampling program was initiated and it continues to date; as many as 31 rounds of samples have been collected from selected monitoring wells. A summary of the trends for each well is presented below:

MW-2 The concentrations of VOCs have steadily decreased since 1988. Total VOC concentrations between 1988 and 1991 ranged from 221 to 385 μg/L. Total VOCs concentrations since 1996 have ranged from 38 to 108 μg/L. The VOC concentrations in MW-2 have decreased by approximately 450% since 1991.

MW-2D Very low concentrations of VOCs were detected in this well between February 1992 and February 1994. However, between February and May 1994, the VOC concentrations began to increase significantly. The maximum concentration of total VOCs detected was 7,800 μg/L in February 1995. The primary VOCs in the samples were tetrachloroethene (PCE) and 1,1,1-trichloroethane. Since February 1996, the concentrations have decreased and have ranged from 670 to 2,240 μg/L. An analysis of the data suggests that, during one or more of the intrusive activities conducted at the site, DNAPL may have been mobilized. The mobilization of the DNAPL may in turn have caused an increase in the dissolved VOC concentration at this well.

MW-3 Overall, total VOC concentrations have steadily decreased in this well. However, there continues to be some minor cyclical fluctuations in the VOC concentrations. These fluctuations are likely due to seasonal variations in ground water elevations and flow directions. The maximum concentration of total VOCs was 1,720 μg/L in July 1991. Since August 1993 the total VOC concentrations have ranged from 414 to 6 μg/L.

MW-3D The total VOC concentrations at this well have decreased significantly since monitoring was initiated. The maximum total VOC concentration detected at this location was 807 μg/L in February 1992. Since November 1996 the total VOC concentrations have ranged from 3 to 45 μg/L.

MW-11 The total VOC concentrations at this well have decreased significantly since the start of monitoring. The maximum total VOC concentration detected at this location was 482 μg/L in February 1994. Since November 1994, the concentrations have ranged from non-detect to 84 μg/L.

MW-12 The total VOC concentrations in MW-12 have followed a pattern that is similar to that observed in monitoring well MW-2D. Very low concentrations of VOCs were detected in this well between February 1994 and November 1994. The total VOC concentrations have increased significantly since February 1995, and a maximum concentration of 25,600 μg/L was detected in May 1997. The total VOC concentrations since May 1997 have ranged from 7,020 to 23,560 μg/L. Similar to MW-2D, the data suggests that during one or more of the intrusive activities at the site, DNAPL may have been mobilized. The mobilization of the DNAPL may in turn have caused an increase in the dissolved VOC concentrations at this well.

In summary, the total VOC concentrations at four of the six monitoring wells have shown a significant decrease since the start of monitoring in 1988. The total VOC concentrations at these four wells are now at or below 205 ppb. The total VOC concentrations at the two remaining wells, MW-2D and MW-12, exhibit a significantly different trend. In these two wells there is a spike in VOC concentrations after the first one to two years of monitoring. The spike does not show any correlation with fluctuations in ground water elevations or ground water flow direction. An analysis of the types of VOCs that show an increase in concentration and the timing of site field activities suggest that the VOC concentration increases are related to the mobilization of DNAPL.

The western extent of VOCs in the ground water was near well nest MW-2; and the eastern extent is near MW-3. The northern extent is bounded by the Sheldrake River, as ground water from both the shallow and deep zones apparently discharge to the Sheldrake River. Concentrations of VOCs in the Sheldrake River were similar upgradient and downgradient of the site, therefore no impacts by VOCs to the Sheldrake River from the site were documented.

The vertical extent of ground water was assumed to be bounded by the top of bedrock. Ground water samples collected from discreet intervals at MW-2D and MW-3D indicated that the concentrations of VOCs immediately above bedrock were lower than the concentrations in the samples collected from the entire screened interval. These data indicated that no DNAPL is present immediately atop the bedrock surface.

Sheldrake River. The Sheldrake River is a Class C River, located along the northern property boundary of the site. Visual inspection of the river indicates automobile parts, broken glass, and refuse. During site activities in January 1992, a gasoline release from the adjacent junk yard was noted and reported. In addition, reports obtained from the United States Geological Survey, Westchester County Health Department, and the Village of Mamaroneck document that the quality of the river has been degraded upstream of the site.

Surface Water. Surface water samples were collected during several investigations to assess if site activities have impacted the river. The data indicated that the concentrations of VOCs and inorganics in the upstream samples were similar to the downstream concentrations. Due to the degraded nature of the surface water upstream of the site, no impacts due to the site were documented.

Sediment. Sediment samples were collected during several investigations to assess if site activities have impacted the river. Similar concentrations of most compounds were detected between upstream and downstream samples with the exception of copper. Copper was detected at a higher concentration adjacent to the site; however, the elevated concentrations were localized. Given the degraded nature of the river, the source of the copper could not be identified.

Given the degraded nature of the Sheldrake River, no impacts related to the site could be documented. Therefore, the Sheldrake River will not be addressed as part of the FS.

1.3.3. Contaminant fate and transport

As discussed in Section 1.3.2, the primary concern at the site is the presence of VOCs/DNAPL in the subsurface soil. The source of the VOCs are the Solvent UST and the Shed Areas. The VOCs migrating from these areas could potentially affect five media: soil, ground water; surface water, sediment, and air. A summary for each of the various media are presented below.

Soil. As previously discussed, DNAPL in the soil in the vicinity of the Solvent UST and Shed Areas acts as the source of VOCs. VOCs could migrate in the subsurface as volatiles in soil gas, dissolved in ground water or as a separate phase liquid. At the site the distribution of DNAPL is complicated by the heterogenous nature of the soils in both the shallow and deep ground water zones. The soils in the shallow zone consist of discontinuous inter-layered clay, silt, and sand. The soils in the deep ground water zone consist of lenses of sand and gravel.

No mobile DNAPL was detected at the site; rather, residual DNAPL was detected at varying degrees of saturation in the soil. A small change in soil grain size, either vertically or horizontally in a lens may cause a stratigraphic trap which prevents further migration of DNAPL. This trapped DNAPL represents a long term source of VOCs to the ground water. At the site the horizontal and vertical extent of DNAPL in the soil has been assessed.

Ground water. Ground water flowing past residual DNAPL leaches soluble components from the DNAPL, thereby creating a dissolved contaminant plume. The dissolved contaminant plume migrates in the direction of ground water flow, although the velocity at which the dissolved constituents migrate may be retarded when compared to the ground water. In addition, as the dissolved ground water plume migrates the constituents may undergo biodegradation. The occurrence of biodegradation is evident at the site by the presence of degradation products such as 1,1-DCA, 1,2-DCE and vinyl chloride. The site data suggests that biodegradation of VOCs is occurring more readily in the shallow ground water zone.

Surface water and sediment. The ground water in both the shallow and deep ground water zones discharges into the Sheldrake River at an estimated rate of approximately 2900 gal/day. In the RI it was documented that, due to the small quantity of ground water discharging to the river, impacts directly attributed to the site could not be discerned from the already degraded nature of the river.

Air. As part of the RI, three indoor air samples were collected to assess if VOCs were migrating into the building at concentrations exceeding Occupational Safety and Health Administration (OSHA) permissible exposure levels (PELs). The results of the sampling indicated that no VOCs were detected in the indoor air and that the air quality met OSHA requirements.

1.3.4. Risk assessment summary

A baseline human health risk assessment was completed to assess the possible impacts to public health and the environment at the site. The RA was completed in two steps. The initial step was to evaluate potential exposure pathways, these pathways describe the course that a chemical takes from the source to the exposed individual under current and future site conditions. A complete pathway is defined where there is the potential for humans to be exposed and an incomplete pathway is defined where there is little or no potential that humans may be exposed. The second step for complete exposure pathways, is the calculation of risk posed by that pathway to humans.

It was concluded in the RA that incomplete exposure pathways under current conditions included contact with site soils, ground water consumption, and vapor migration to off-site buildings. The RA documented four complete exposure pathway including: direct contact with the Sheldrake River, current and future on-site worker inhalation of vapors migrating from the subsurface soils and ground water to indoor air, future on-site worker contact with ambient dusts, vapors, and direct contact due to soil excavation.

Indoor air. This pathway was complete for the current and future uses of the on-site building, as VOCs from the soil and ground water may volatilize to soil vapor and migrate through the building foundation. Although no VOCs were detected in indoor air samples collected during the RI, the USEPA RA requirements for air data are significantly lower than OSHA requirements. Therefore, a screening model, based on current USEPA guidelines, was used to estimate indoor air concentration from the concentrations of VOCs in the soil, ground water, or both. A Hazard Index of 0.6 was estimated for the on-site worker and that number is below the USEPA's recommended limit of 1. The estimated cancer risk for the on-site worker was 2.15×10^{-5} and is within the acceptable guidelines set forth in the NCP.

Future construction worker and direct contact. There is a complete exposure pathway for future on-site workers associated with ambient dusts, vapors, and direct contact with soils. While contact with specific hot-spots may require the use of personal protective measures, both the estimated Hazard Index and cancer risks are within acceptable guidelines. The estimated cancer risk is 6×10^{-7} and the Hazard Index is 0.15.

Sheldrake River. While contact with the water of the Sheldrake River was identified as a complete exposure pathway, the predicted concentrations of compounds of concern were extremely low and do not present an unacceptable risk to human health. Quantification of this exposure pathway was, therefore, not necessary.

In summary the results of the RA indicate that the risks associated with the site are within the acceptable ranges set forth by the USEPA and the NCP. However, according to the RA there is the potential for acute effects from short term exposures to specific hot-spots which are a minimum of 5 ft below the ground. In general, these effects would be transient and reversible on cessation of exposure. Use of appropriate personal protective measures would minimize the potential for acute effects. The risk assessment forms the basis for determination of the need for site remediation. Since site related risks are estimated to be within acceptable guidelines, no site remediation is necessary to eliminate or reduce risks. Therefore, site remediation, if conducted, will not be driven by existing site risks. However, if future construction work is conducted, the use of personal protective measures will be required to minimize the potential for acute effects.

1.4. Interim remedial measures

As extensive IRM program was implemented from 1991 to the present at the site to address known sources of contamination and to minimize the potential for off-site migration. The IRMs were approved by the NYSDEC. The IRMs were documented in a *Interim Remedial Measures* report dated November 1992 (O'Brien & Gere 1992b). A description of each IRM and its effectiveness in reducing contaminants are summarized below.

1.4.1. Solvent UST and soil removal

The area was first identified in December 1990, after vent pipes associated with waste solvent storage tanks were observed during a site visit. As a result of the unknown condition of the USTs, ITT-Sealectro elected to remove the USTs and dispose of them off-site. The eight USTs were excavated in May 1991 by OBG Technical Services, Inc. Two 275-gallon and six 550-gallon tanks and 148 yd^3 of impacted soils were removed. The contents of the USTs (2800 lbs of tank bottom sludge and 2575 gallons of liquid) were pumped into 55-gallon drums, sampled and held on-site until proper disposal methods could be determined. During the removal of one tank, it was evident that the tank had leaked because it was partially filled with ground water. The NYSDEC was immediately notified of the spill (Spill #9101862). Post-excavation soil samples collected in June 1991 indicated that the concentrations of VOCs in the soils were in excess of 6300 mg/kg. TPH concentrations greater than 8200 mg/kg were also present in the post-excavation samples.

Based on the analytical data, the soils excavated during the removal of the USTs and the tank contents were classified as hazardous. In August 1991, 148 yd^3 of soil were incinerated at LWD, Inc. located in Calvert City, Kentucky. In addition, 2800 lbs of solid material consisting of tank bottom sludge and 2575 gallons of liquid from the USTs were manifested for disposal at the Environmental Waste Resources in Connecticut. Disposal manifests were presented in the *Interim Remedial Measures Program* Report (O'Brien & Gere 1992b).

In October 1991, test boring EB-1 was drilled along the side of the UST excavation to evaluate the vertical extent of impacted soils in this area. Data collected from soil samples in EB-1 suggested that the highest concentrations of VOCs were limited to the top 14 ft of soil. Based on the data from EB-1, a soil excavation program was proposed to remove residual saturated or heavily impacted soils to a depth 15 ft below ground surface. Prior to excavating, a dewatering well was installed in March 1992 to lower the ground water table to allow excavation of the upper portion of the saturated zone. Initially, ground water from MW-5 contained approximately 215 μg/L of total VOCs. The ground water was treated via carbon adsorption and discharged to the publicly owned treatment work (POTW) as approved by Westchester County Department of Environmental Facilities (WCDEF).

In April 1992, the soil excavation program at the Solvent UST area commenced. Sheet piling was used to stabilize the excavation to protect the building and its foundation. The width and length of the excavation was approximately 12 ft x 22 ft. It was originally proposed that soils be excavated to a depth of 15 ft. This depth was selected based on data collected from the test boring. During the excavation activities, running sands were encountered and the depth of excavation was limited to 11.5 ft. Approximately 85 yd^3 of soil were manifested for incineration at LWD, Inc. located in Calvert City, Kentucky. Post-excavation soil samples were obtained to characterize the remaining soils.

A ground water recovery system was subsequently installed in the excavation to recover ground water, including that portion of the plume which may have migrated under the building. The recovery system consists of six stainless steel horizontal well points installed at a depth of 10.5 ft and driven approximately 15 ft horizontally beneath the building. The well points discharge to a gravel trench that is connected to a 12-inch collection sump designated as RW-2. The recovery system has operated from 1992 to the present and yields approximately 1 gal/min (gpm). Between 1992 and September 1993, the ground water was treated by carbon absorption prior to being discharged to the POTW. A new treatment system was installed as part of an IRM modification and was operational on September 17, 1993.

The ground water collection and treatment system consists of two pneumatically operated ground water collection pumps, an oil/water separator, a closed loop *ex situ* air sparging tank, vapor phase carbon adsorption canisters for return air to the sparging tank, an air blower, a treated effluent booster pump, and associated piping valves and instrumentations. The two pneumatic operation pumps collected ground water from two recovery wells, RW-1 and RW-2, located in the Fuel Oil UST Area and Solvent UST Area, respectively. The ground water was directed from each well, by separate above-ground piping, to the oil/water separator tank where sediments settle as the water flows over an inlet/weir sludge baffle. The treatment system effluent is presently discharged to the POTW. RW-1 operation was discontinued in 1995 following completion of product recovery. At this time, RW-2 is the only recovery well in operation.

1.4.2. Fuel oil tank removal and LNAPL recovery

As part of the Phase I RI, two test borings were installed around the perimeter of the 2500-gallon UST. On February 4, 1992, LNAPL was observed in boring B-22. The NYSDEC was immediately notified of the spill (Spill #9101862). Monitoring well MW-8 was subsequently installed in B-22 (see Figure 1-5).

Based on this information, an IRM, consisting of a recovery well (RW-1) with a ground water depression and product recovery system, was implemented adjacent to MW-8. The recovery system was operational by February 19, 1992. For the first month of operation, the system collected an average of 20 gallons of fuel oil per week with a ground water pumping rate of 2 gal/hr.

The fuel oil tank, associated piping, and stained soil were removed in April 1992 by OBG Technical Services, Inc. Several areas of stained soils were observed and approximately 60 yd^3 of impacted soil were removed. The final excavation was completed below the ground water table and was 13 ft wide, 14 ft long and about 9 ft deep. The size of the excavation was constrained by overhead and underground utilities and the presence of the building. The excavated material was classified as non-hazardous and disposed at the Mount Hope Asphalt Plant in Calverton, New York for asphalt batching. Presently, the building is heated with natural gas and no fuel oil is stored on-site.

After removal of the tank and affected soils in April 1992, the fuel oil collection rate initially stabilized at 1 to 2 gal/wk and then decreased. Because the efficiency of the fuel oil recovery system had decreased, six additional borings (B-25, B-26, B-27, B-28, B-29 and B-30) and two ground water monitoring wells (MW-9 and MW-10) were installed in December 1992 to evaluate a location for a new recovery well (Figures 1-5 and 1-7). The results indicated that no LNAPL was present in any borings or monitoring wells and that the existing recovery well RW-1 was properly located.

A total of about 234 gallons of fuel oil (LNAPL) was recovered. Recovery of LNAPL was completed in 1995 and the system has been shut down.

1.4.3. Pilot *in situ* air stripping

A pilot *in situ* IRM was completed at the Former Drum Storage Pad Area, located adjacent to the Sheldrake River along the northwest corner of the building. Numerous soil samples were collected during various investigations, and the data indicate that TCA, TCE, PCE, 1,2-DCE, 1,1-dichloroethene (1,1-DCE), 1,2-DCA, xylene, and toluene were found with the highest frequency in the soil.

An *in situ* air stripping pilot study was performed in July 1990 to assess the effectiveness of *in situ* air stripping technologies for removing VOCs from site soils. Various system parameters, including blower speed and the number of open air inlets, were regulated throughout the pilot study to assess the most efficient design for a full scale system. The data from the pilot study were also used to estimate the VOC mass removal rate and areal influence of the system. The conclusions drawn from the pilot test were: 1) *in situ* air stripping was feasible at the site, 2) the areal influence of one extraction well is greater than 20 ft; and 3) the need for air inlet wells was minimal due to the air inflow through the bank of the Sheldrake River. The findings of the test were documented in the report entitled *In Situ Vacuum Extraction Pilot Study Results* dated July 1990 (O'Brien & Gere 1990).

A long-term pilot scale *in situ* air stripping program was completed as an IRM from May 12, 1992 through October 6, 1992. The data collected during the operation of the ISAS indicated that approximately 29 lbs of VOCs were removed from the soils. During the RI, subsurface soil samples were collected from eight soil borings to evaluate the effectiveness of the IRM. The data indicate that the concentrations of VOCs decreased by one to three orders of magnitude at most locations. The data indicate that the ISAS effectively removed VOCs from the soils.

1.4.4. Contaminant reduction

The IRMs were implemented to address known sources of contamination. The effectiveness of the IRMs in reducing VOC concentrations in the site soils has been evaluated and is summarized below. Specific calculations are presented in Appendix A.

The mass of VOCs removed during soil excavations at the Solvent UST Area was estimated to be 1085 lbs (85 gal). This estimation is based on the mass of soil removed, the average concentration of VOCs detected at B-17 (located in center of the Solvent UST Area) and the average concentration of VOCs remaining at the perimeter of the excavation.

The ground water recovery system installed at the Solvent UST Area has also effectively reduced the quantity of VOCsin the ground water and controlled the migration of VOCs away from the Solvent UST Area. The estimated mass of VOCs removed via ground water recovery to date is 717 lbs (56.3 gal).

As previously mentioned the pilot *in situ* air stripping IRM was effective in reducing the quantity of VOCs at the Former Drum Storage Pad. The mass of VOCs removed was calculated using two approaches. The first method utilized laboratory results of air samples collected from the *in situ* air stripping effluent. The mass of VOCs removed using this calculation was estimated to be 29 lbs. The mass of VOCs removed as calculated by comparing soil VOC concentrations prior to implementing the *in situ* air stripping with soil VOC concentrations subsequent to implementation is

27 lbs. Therefore, the average mass of VOCs removed was estimated to be 28 lbs.

Using the above estimates, the total mass of VOCs removed during the IRMs can be estimated.

VOCs removed via Soil Excavation	1085	lbs
VOCs removed via Ground Water Recovery	717	lbs
VOCs removed via ISAS	28	lbs

Total VOCs removed	1830	lbs

The mass of VOCs remaining in the soil at the site following the IRMs was calculated using average VOC concentrations in the soil from the shallow and deep ground water zone (Appendix A). A total of 1675 lbs (131.9 gallons) of VOCs are estimated to remain in the subsurface.

The mass of VOCs removed during to the implementation of the IRMs was estimated to be 1830 lb This mass represents 52 % of the estimated total mass of VOCs present at the site prior to initiation of any IRMs.

1.5. Summary

The results from extensive site investigations have been used to document the nature and extent of contamination at the former Sealectro site. These investigations have identified residual DNAPL in the subsurface soils. No recoverable DNAPL was detected and DNAPL did not extend to the top of bedrock. VOCs have also been found in the site ground water in both the shallow and deep overburden ground water zones. Based upon: 1) the low VOC concentration in ground water on the top of bedrock in MW-2D; 2) the vertical extent of DNAPL and VOCs in the soils documented in the RI Report; 3) the low permeability of the bedrock; 4) the discharge of the overburden ground water to the Sheldrake River; and 5) the expected discharge of ground water in the bedrock to the overburden in the vicinity of the Sheldrake River, it was concluded in the RI Report that it is unlikely that the bedrock has been impacted. Therefore, VOCs are not expected to extend into the bedrock or off-site ground water.

The RA identified four complete exposure pathways: current and future on-site worker inhalation of vapors migrating from the subsurface soils and ground water to indoor air; future on-site worker contact with ambient dust and vapors, future on-site construction worker direct contact with subsurface soils and ground water discharge to the Sheldrake River. The potential risk associated with each of these complete exposure pathways was examined. For each of these pathways, the potential risk was estimated to be within the acceptable guidelines set forth by the USEPA and the NCP.

The RI concluded that the risks associated with the site are estimated to be within acceptable ranges. Since there is no unacceptable risk posed by current or future conditions at the site, there is no risk-based need for further remediation at the site. Accordingly, the elimination or reduction of risk will not be considered a remedial action for the site.

2. Development of remedial action objectives

2.1. Introduction

The objective of the first phase of the FS is to develop (RAOs) for the site. RAOs are specific goals to protect human health and the environment. RAOs are typically based on SCGs and risk-based objectives.

In this section, potential chemical-specific and location-specific SCGs are identified; physical and technical limits to remediation are discussed; and RAOs are identified.

2.2. Identification of potential chemical-specific and location-specific standards, criteria, and guidelines

2.2.1. Introduction

Chemical-specific and location-specific regulatory requirements are considered during the development of RAOs. USEPA and NYSDEC use different terminologies for evaluation of regulatory requirements. USEPA requires that remedial actions comply with "applicable or relevant and appropriate requirements (ARARs)" under federal or state environmental law at the completion of remedial action. USEPA also requires evaluation of "to be considered" material (TBCs). ARARs are defined in the CERCLA *Compliance With Other Laws Manual* (USEPA 1988a) as those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or circumstance at a site. Compliance with ARARs is a requirement of the NCP.

NYSDEC evaluates compliance with applicable or relevant and appropriate SCGs. In accordance with NYSDEC guidelines, SCG terminology is used throughout this report. Under NYSDEC environmental regulations (6NYCRR 375-1.10 (1) (i), (ii), and (iii)) a remedial program must not be inconsistent with NCP, and the remedy must be selected upon consideration of SCGs. NYSDEC requires that a selected remedy conform to "standards and criteria" that are generally applicable, consistently applied, and officially promulgated, that are either directly applicable, or that are not directly applicable but are relevant and appropriate, unless good cause exists why conformity should be dispensed with. In addition, a selected remedy should be designed with consideration being given to guidance determined, after the exercise of engineering judgement, to be applicable on a case-specific basis. NYSDEC SCGs include both NYS standards, criteria and guidance and those Federal standards, criteria and guidance to the extent that they are more stringent than those of NYS.

SCGs are classified in three categories: chemical-specific, location-specific, and action-specific. Chemical-specific SCGs are health-based or risk-based numerical values which, when applied to site-specific conditions, result in the establishment of numerical values. These numerical values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. Location-specific SCGs set restrictions on activities based on the characteristics of the site or immediate environs. Action-specific SCGs are usually technology or activity based requirements or limitations on actions taken with respect to hazardous wastes (NYSDEC 1990). Action-specific SCGs are identified based on the components of remedial alternatives, and are discussed in Section 5.

2.2.2. Potential chemical-specific SCGs

The following are identified as potential chemical-specific SCGs for the site. Detailed evaluation of these potential SCGs with respect to each alternative is presented in Section 5, and a summary of the requirements is presented in Table 2-1, 2-2 and 2-3.

New York State

- Class GA Ground Water Quality Standards (6 NYCRR 703)

- Determination of Soil Cleanup Objectives and Cleanup Levels [NYSDEC *Technical and Administrative Guidance Memorandum*, January 24, 1994 (proposed revisions dated April 1995)].

Comparison of ground water data to Class GA Standards is presented in Table 2-2, and comparison of soil data to NYSDEC Cleanup Objectives is presented in Table 2-3.

2.2.3. Potential location specific SCGs

The following are identified as potential location-specific SCGs for the site. Detailed evaluation of these potential SCGs, with respect to each alternative, is presented in Section 5, and a summary of the requirements is presented in Table 2-4.

New York State

- Floodplain Management (6 NYCRR 500)
- Hazardous Waste Facility - Floodplain (6 NYCRR 373-2.2)

2.3. Physical and technical limits to remediation

The remediation of a site is typically constrained in some degree by physical, technical, and legal limits. Site conditions such as physical access, legal issues and contaminant distribution can restrict or preclude effective remediation of a site. There is an increasing awareness in the environmental field that the nature of contamination and the limits of technology can restrict or prevent the successful remediation of sites. This section examines site conditions, literature reports and calculations in order to evaluate the extent of site remediation which could be expected at the former ITT-Sealectro site.

2.3.1 Site conditions

Various conditions at the site limit the alternatives available for remediation. These conditions include above ground physical restrictions, subsurface conditions, distribution of contaminants, and legal access limitations.

The former ITT-Sealectro site is 0.92 acres with a building that covers the central half of the property. The location of the building, and the presence of the Sheldrake River on the northern edge of the property, and utilities and Hoyt Street on the southern edge of the property leave only about one quarter of an acre of accessible space on each side of the building for site remedial activities.

The property is owned by a third party (Simone Development Company), and the building is currently occupied by two tenants. The presence of the tenants in the building severely limits the nature and scope of remedial activities which could occur in the building. In addition, the available space outside the building is needed for parking. Therefore, remedial activities occurring outside the building would interfere with the use of the facility. Since the new owner is not a party to the ACO with the NYSDEC, the ability of the responsible parties under the ACO to access the site is restricted.

These physical and legal conditions at the site present serious obstacles to *ex situ* remedial activities. These conditions also impose significant constraints on the nature and scope of *in situ* remedial activities.

The subsurface geology at the site has been documented to be heterogeneous. Within the shallow ground water zone, layers of sand, silt, and clay are interfingered. The deep ground water zone contains varying amounts of sand and gravel. This geologic heterogeneity has affected the distribution of subsurface contamination. More importantly, this heterogeneity significantly affects the flow of ground water, air or other potential liquids that might be used for remediation at the site.

The RI documented that DNAPL is present in the subsurface soils. The DNAPL is not uniformly distributed but occurs within the soil in discrete lenses. Some of the soil samples collected during the RI contained one thin lens which showed evidence of DNAPL; other samples contained multiple lenses or thicker lenses with DNAPL. The discrete lenses that contained DNAPL appeared to correlate with the occurrence of lenses of different soil texture, such as a sand lens in silt.

The DNAPL occurs as residual material in the soil lenses and is currently trapped within the pore spaces by interfacial tension. No pools of DNAPL, which could be recovered by pumping, were encountered during the site investigations. The degree of residual saturation of DNAPL in the soils varies; consequently, the VOC concentration found in the soil varies.

Some of the lenses of soil had a high residual saturation of DNAPL as evidenced by field observations and laboratory analyses. In other soil lenses, the DNAPL only occurs as isolated droplets within the sample.

The above description of the heterogeneous distribution of DNAPL and variable residual saturation by DNAPL is consistent with the theoretical understanding of the migration and occurrence of DNAPLs in the subsurface. The current scientific literature documents that DNAPL migration and distribution in the subsurface is not uniform and homogeneous Schwindle, 1988a; Mercer and Cohen, 1990; USEPA, 1992; Cohen and Mercer, 1993; National Research Council, 1994; and Pankow and Cherry, 1996. Rather, the migration and residual presence of DNAPL is controlled by the heterogeneities of the geology. Both macro-scale and micro-scale heterogeneities can affect DNAPL migration and residual saturation. As DNAPLs migrate through the subsurface, some of the material is retained in the soil it contacts. This residual DNAPL can occur as isolated droplets in an otherwise unaffected soil sample, as films on some soil particles, or can fill pores in a soil sample.

As a result of the heterogeneous distribution of DNAPL at the site, the subsurface distribution of the DNAPL could not be clearly defined. This lack of definition will hinder the ability to target areas of DNAPL for removal.

The presence of soil contamination below the ground water table also makes remediation of the soil more difficult. An estimated 80 to 85% of the residual DNAPL is located below the ground water table (Appendix A). An estimated 46% of the soil containing DNAPL is located beneath the building (Appendix A).

2.3.2. Literature

The current technical literature recognizes that the presence of DNAPL significantly limits the ability of remedial technologies to successfully meet cleanup goals. The National Research Council (1994) reviewed forty-two sites across the United States which had DNAPL and heterogeneous hydrogeologic conditions, sites which were designated category 4 sites. None of the sites had been fully cleaned up. In fact, the National Research Council states that, "Cleanup of sites in category 4 to health-based standards is extremely unlikely," (p. 96). Pankow and Cherry (1996) states "of the thousands of sites that are contaminated with DNAPL in North America, none has been fully restored to drinking water standards" (p. 483). The USEPA states "Except for excavation, there are no proven technologies to reduce the total mass of subsurface DNAPL to levels low enough to effect full restoration of a contaminated aquifer." (USEPA 1992, p.10).

The recognition that DNAPLs will prevent the full restoration of a contaminated aquifer is based upon the difficulties associated with the removal of residual DNAPL in saturated soils. The removal of this residual DNAPL is critical to the remediation of a site. The USEPA (1992) provides a brief discussion of the problems associated with residual DNAPLs and remediation.

> DNAPL recovery may be enhanced by injecting fluids or agents into the DNAPL zone to increase hydraulic gradients, reduce water/DNAPL interfacial tension, reduce DNAPL viscosity, and/or increase DNAPL solubility. However, there are practical technical problems which limit the effectiveness of these methods in the field. The complex subsurface distribution of DNAPL is a function of geologic heterogeneities. These heterogeneities, in conjunction with permeability reductions caused by the presence of DNAPL, can prevent injected fluids or agents from making thorough contact with subsurface DNAPL. The use of enhanced DNAPL recovery techniques in the area of hazardous waste remediation is in its infancy.....Consequently, very little information is available concerning field applications of enhanced DNAPL recovery techniques. (USEPA 1992, p.10).

Panhow and Cherry (1996) provide a comparison with the petroleum industry to indicate the limitations currently faced in DNAPL remediation.

> The petroleum industry has spent billions of dollars on research and field trials to enhance the recovery of petroleum LNAPLs from oil fields. The petroleum industry considers that it has achieved exceptional success . . . when the efficiency of oil recovery increases . . . to the 30 to 40% range . . . In contrast, when remediating a DNAPL source zone, we must normally aim for > 98.9% contaminant removal. . . (Panhow and Cherry 1996, p 502).

A 1998 report prepared by John C. Fountain for the Ground-Water Remediation Technologies Analysis Center entitled Technologies for Dense Nonaqueous Phase Liquid Source Zone Remediation (Fountain

1998) contained a review of currently available remedial technologies. The report concluded that:

"Two characteristics of common DNAPL components, low aqueous solubilities and high interfacial tensions with water, result in the persistence of a nonaqueous phase and very irregular distribution of DNAPL in the subsurface. This in turn presents significant difficulties for site characterization and remediation. Both characterization and remediation efforts also may risk mobilizing DNAPL and hence spreading contamination to previously clean regions.... Due to the lack of carefully controlled field tests at DNAPL sites, the ultimate level of clean up attainable for most technologies has not yet been documented. Indeed, due to the difficulty in determining DNAPL distribution, the level of clean up achieved even in controlled field tests has seldom been well established. Based on existing data, it may be expected that a combination of contaminant distribution, geologic heterogeneities and technological limitations will cause as least some DNAPL to remain after remediation by any available technology." (Fountain 1998, p.1)

Two recent studies highlight the limitations associated with DNAPL remediation. Michalski, Metlitz and Whitman (1995) present a controlled field study of enhanced DNAPL recovery from below the ground water table. DNAPL recovery was enhanced through the use of partial dewatering, hot water injection, final dewatering, and thermally enhanced vapor extraction. The enhanced recovery lasted six weeks and reduced soil concentrations. However, average residual soil concentration after the enhanced recovery was 605 mg/kg which exceeds the concentrations observed at the former ITT-Sealectro Site. The average soil concentration will continue to cause ground water concentrations in excess of standards.

Fountain (1998) reports that a surfactant pilot test in poorly sorted sandy soils was performed at Hill AFB. The DNAPL was primarily composed of TCE. The test reported that DNAPL removal rates exceeded 99% yet concentrations in ground water at the end of the test were about 10 mg/l far in excess of SCGs.

In summary, the current state of remedial technology is such that remediation of DNAPL site to levels which meet health based standards is currently not feasible. These limitations combined with potential liabilities caused by mobilizing DNAPL demonstrate that active remediation of DNAPL is not a realistic remedial alternative for the Sealectro site.

2.3.3. Site evaluation

The literature review indicates that full site remediation is not possible given the current state of technology. In order to assess the effectiveness of remedial technologies to achieve chemical-specific SCGs as it relates to the site, the following evaluation was completed. Dr. Jon Sykes of the University of Waterloo developed two equations in order to evaluate the potential effectiveness of source removal. The equations and a detailed discussion of the results of the calculations are presented in Appendix B. The calculations present the expected change in site ground water quality for different remediation scenarios.

The IRM activities have already reduced time required for ground water quality to meet SCGs.

The effectiveness evaluation indicates that the VOC concentrations in the ground water can not be expected to meet ground water SCGs for an extended period of time. Removal of a portion of the VOC source will reduce the ultimate period of time for ground water quality to meet SCGs. However, even assuming one could remove 95% of the original VOC mass in the subsurface, ground water quality would not be expected to meet ground water SCGs within the typical 30 year time frame for remedial actions.

The reason that the VOC concentrations in the ground water may not meet ground water standards for an extended period of time is due to the nature of the natural flushing process of the ground water. As ground water passes through the zone with the residual DNAPL, the VOCs are dissolved and transported away by the ground water. The rate at which VOCs are removed from the source depends upon the rate of ground water flow and the amount of ground water which contacts the residual DNAPL. Ground water that does not contact the DNAPL will not dissolve the VOCs. As the residual DNAPL dissolves, the size and surface area of the residual DNAPL decreases. The smaller size and surface area means that less ground water contacts the residual DNAPL; therefore, the rate of VOC removal from the source declines along with the size and surface area of the DNAPL (Pankow and Cherry 1996, p.p. 220-222; National Research Council 1994, p. 111). In addition, the presence of DNAPL acts to reduce the permeability of the source zone and thereby reduces the volume of ground water flowing through the zone and dissolving the DNAPL (Powers, *et al.* 1998). Pankow and Cherry present the results of a laboratory DNAPL flushing study conducted by

Lamarche. In this study, the rate of decline of TCE concentration decreased with time. It required 250 pore volumes of flushing for the TCE concentrations to initially decline two orders of magnitude. Yet the concentration declined only an additional 1½ orders of magnitude during the next 1250 pore volumes of flushing. This correlation between the rate of VOC removal and the decline in the residual DNAPL mass results in an extended cleanup time for sites with DNAPL.

2.3.4. Summary

The site conditions, the current literature on DNAPL remediation, and the calculated ground water cleanup times for the site indicate that the site can not be expected to meet chemical-specific SCGs for decades. Remedial technologies i are not currently available to allow site remediation to attain chemical-specific SCGs in the near future. It is not expected that site conditions will meet the chemical-specific SCGs for decades. Therefore, a waiver of the chemical-specific SCGs may be necessary for the site for the duration of the 30 year assessment period.

USEPA's *Guidance for Evaluating the Technical Impracticability of Ground Water Restoration* (USEPA 1993) recognizes that some sites will not attain chemical-specific SCGs and provides a basis for implementing Technical Impracticability (TI) waivers at sites with DNAPLs. A recent memo from the Assistant Administrator for the USEPA to Regional Administrators (Exhibit A) indicates that the USEPA expects that TI waivers will be part of RODs for sites with DNAPLs. This is a clear recognition on the part of the USEPA that DNAPL sites are not likely to be remediate successfully and that requiring sites to meet chemical-specific SCGs is not practical.

A TI waiver must be invoked when either of the following specific criteria are met:

- Engineering feasibility. The current engineering methods necessary to construct and maintain an alternative that will meet the SCGs cannot reasonably be implemented, as is the case with DNAPLs.

- Reliability. The potential for the alternative to continue to be protective into the future is low, either because the continued reliability of technical and institutional controls is doubtful, or because of inordinate maintenance costs.

Similarly, under NYSDEC environmental regulations (6NYCRR 375-(10 (1) (i) a-d) conformity with an SCG can be dispensed with if a good cause such as the following exists:

- The proposed action is only part of a complete program that will conform to such standard or criterion [of guidance] upon completion; or
- Conformity to such standard or criterion will result in greater risk to the public health or to the environment than alternatives; or
- Conformity to such standard or criterion is technically impracticable from an engineering perspective; or
- The program will attain a level of performance that is equivalent to that required by the standard or criterion through the use of another method or approach.

2.4. Remedial action objectives

RAOs for a site are developed based upon the results of the site risk assessment and SCGs. The RAOs are designed so that site remedial activities will reduce or eliminate any identified risks and the media at the site will meet SCGs. It was concluded in the risk assessment that the estimated risks posed by current and future conditions at the site are within acceptable limits. As documented in the RI Report, and summarized in Section 1.3.4 of the FS Report, contaminant migration pathways were incomplete or the estimated risks were within acceptable guidelines. The only potential concern identified was the potential for future construction workers to contact specific hot-spots of subsurface soil contamination. However, this concern is easily anticipated with protective clothing.

The site is not expected to meet chemical-specific SCGs for 30 years. RAOs have not been designed based upon a goal of meeting SCGs in the near future.

The RAOs for the Former ITT-Sealectro site were developed with the goal of protecting workers and the environment and improving current site conditions. The following RAOs have been developed for the site:

- Provide for protection of human health and the environment
- Limit construction worker contact with the site soils
- Avoid site activities which could exacerbate the current distribution of contaminants and migration of contaminants.

Aggressive remedial activities have the potential to exacerbate the existing contamination problem by mobilizing the DNAPL. Such uncontrolled migration would exacerbate the existing soil and ground water contamination and could introduce DNAPL into the bedrock beneath the site or off-site.

3. Identification and screening of technologies

3.1. Introduction

The purpose of the FS is to identify and assess promising remedial technologies, from which a range of remedial alternatives can be developed for the site. The identification and screening of technologies was accomplished using a multi-phased approach based on USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA,* Interim Final (USEPA 1988); this approach is consistent with the NCP. This process included the development of general response actions; identification of volumes or areas of media; identification and screening of remedial technologies and process options; and evaluation of process options as described below.

3.2. Media volumes and general response actions

3.2.1. Media volumes

The areas and volumes of contaminated media have been estimated based on the site conditions identified in the RI, the nature and extent of contamination, potential exposure routes, and levels of protection specified by the RAOs. As presented in the RI Report, the horizontal and vertical extent of the DNAPL is defined by occurrences of lenses of DNAPL in the soil. Since the DNAPL distribution is heterogenous in nature, the media volumes presented here do not suggest that the bulk of the defined area contains DNAPL. Rather, lenses of DNAPL occur within the defined boundary. The DNAPL boundary was estimated so that media volumes could be calculated and used to present a representative comparison of alternatives. Calculations presented in Appendix A suggest that less than 1% of this volume of soil contains residual DNAPL.

Due to the small size of the site, the areas defined as the Solvent UST Area, the Shed Area, and the Former Drum Storage Pad Area are defined as one contiguous area for analysis with respect to the alternatives defined in the FS. Subsurface DNAPL is located in both the shallow and deep zone aquifers. The shallow zone is defined as a layer of silty sands extending to an approximate depth of 20 ft below grade. The deep zone is comprised of saturated coarse grained sands and gravel beneath the shallow zone and extends to bedrock at an approximate depth of 30 to 40 ft. The following sections present the area and media volumes for soil and ground water.

Soil: The areal extent of soil containing DNAPL is estimated to be 0.27 acres. As shown on Figure 3-1, the horizontal extent of DNAPL in the shallow zone is approximately defined by RI soil boring B-21 and B-52 to the east; B-49 and B-13 to the west; and B-51 to the north. The estimated volume of soil in this shallow zone is 184,000 ft^3 (6,815 yd^3) (Appendix C).

As shown on Figure 3-2, the horizontal extent of the DNAPL in the deep zone is approximately defined by RI soil borings B-52 and B-35 to the east; B-19 to the south; B-53 to the west; and B-54 to the northeast. The estimated volume of soil in the deep zone is 118,800 ft^3 (4400 cy).

The total estimated volume of soil containing DNAPL, a combination of the estimated volumes for the shallow and deep zones, is 302,800 ft^3 (11,215 yd^3).

Ground water The horizontal and vertical limits of VOCs in the ground water are based upon quarterly ground water monitoring results from 1991 as presented in the RI Report, and vertical delineation sampling conducted on May 15, 1995. Table 2-2 presents a comparison of the most recent quarterly ground water sampling results (August 29, 1995) to chemical-specific SCGs. This comparison is presented for information purposes only since, as previously discussed, the site is not expected to meet chemical-specific SCGS due to the presence of residual DNAPL in site soils and the limitations of currently available remedial technologies in addressing DNAPL. Furthermore, there is no risk posed by the ground water pathway at the site.

The northern extent of VOCs in the ground water is the Sheldrake River. Both the shallow and deep ground water zones discharge to the Sheldrake River (O'Brien & Gere 1994). The eastern and western edges of the VOC plume occur near the property boundaries. Based on the VOC concentrations in well nests MW-2 and MW-3, the close proximity of the

Sheldrake River, and the fact that ground water discharges to the Sheldrake River, it is likely that the VOC plume does not extend much beyond the property boundaries.

The vertical extent of VOCs is assumed to be defined by the top of bedrock because of the upward vertical hydraulic gradient which exists at the site (O'Brien & Gere 1994). As a result of the upward gradient, ground water in the shallow and deep ground water zones discharge into the Sheldrake River and would not be expected to migrate downward into bedrock. Furthermore, the low permeability of the bedrock relative to the overburden would be expected to restrict the migration of ground water and VOCs into the bedrock.

The total volume of ground water within these defined limits is approximately 2.8×10^6 gallons (Appendix C).

3.2.2. General response actions

General response actions are medium-specific actions which may be combined into alternatives to satisfy the RAOs. The general response actions which are applicable to the site can be categorized as institutional actions, containment actions, removal actions, disposal actions, treatment actions, and discharge actions. In addition, no action is also considered in accordance with USEPA guidance (USEPA 1988). A brief description of each general response action follows.

No Action. This general response action does not include technologies but rather can be used to track site conditions in the absence of remediation. No action is typically carried through the FS as an alternative which is used as a basis for comparing the other alternatives.

Institutional Actions. Institutional actions include local, state, and federal restrictions which can be enacted and enforced to protect public health and the environment in the vicinity of the site before, during, and/or after implementation of remedial action. Site access restrictions, such as fencing, and site use restrictions, such as deed restrictions, are also considered institutional actions.

Monitoring Actions: Monitoring actions include ground water monitoring, usually over a specific timeframe, to evaluate changes in ground water quality with time.

Containment Actions: Containment actions include technologies which isolate materials from migration pathways or receptors such that exposure pathways are not complete.

Removal Actions: Removal actions include technologies which remove impacted media from the site.

Disposal Actions: Disposal actions include options for disposing of contaminated or treated waste generated during a removal action or a treatment action.

Treatment Actions. Treatment actions address contaminants by reducing their toxicity, mobility, or volume.

Discharge Actions. Discharge actions include options for disposition of treated or untreated water.

Potentially applicable remedial technologies for each general response action discussed above are presented in the following sections.

3.3. Identification and screening of technologies and process options

Potentially applicable remedial technologies and process options for each general response action were identified in this step and screened for technical implementability. The identification and screening process is discussed in the following subsections and is summarized in Tables 3-1 and 3-2 for soil and ground water, respectively.

3.3.1. Identification of technologies and process options

The identification of relevant technologies and process options for soil and ground water was based on engineering experience and a review of relevant literature and technology databases. The following technology databases were reviewed:

- Vendor Information System for Innovative Treatment Technologies, version 3.0
- CERCLA Record of Decision Database
- Alternative Treatment Technology Information Center
- Risk Reduction Engineering Laboratory Treatability Database

- National Groundwater Information Center Database.

Technologies and process options were identified for soil and ground water media at the site. Tables 3-1 and 3-2 present the technologies and process options identified for soil and ground water, respectively. Because site impacts were not evident in air, surface water, or sediment, as documented in the RI Report, RAOs were not developed for these media and technologies and process options were not identified for these media.

3.3.2. Screening of technologies and process options

Process options were screened on the basis of technical implementability. The technical implementability of each identified process option was evaluated with respect to site contaminant information, site physical characteristics, and areas and volumes of affected media. Documentation of the screening of process options is presented in Tables 3-1 and 3-2 for soil and ground water, respectively.

With the exception of vegetated soil cover, clay cover, and membrane cover, technology process options identified for soil in Table 3-1 were considered potentially applicable. Vegetated soil cover, clay cover, and membrane cover were not considered potentially applicable because the majority of impacted soil at the site is located beneath facility buildings and paved areas. With the exception of infiltration galleries and irrigation, technology process options identified for ground water in Table 3-2 were considered potentially applicable. Infiltration galleries and irrigation were screened out because the majority of ground surface at the site is covered by facility buildings and asphalt. Descriptions of the process options which were considered potentially applicable are listed below.

SOILS

Institutional actions

Fencing. Currently, the majority of the site is fenced to maintain site security. Gates with locks currently exist on the fence which limit access to the Shed Area, Former Drum Storage Pad Area and a portion of the Solvent UST Area. As an institutional action, the fence would be left in place and maintained to continue its present function.

Deed restrictions. With respect to the impacted soil, deed restrictions incorporated into a property deed could impose land use restrictions that would prohibit or control activities which would expose impacted soil or impair the integrity of a cover.

Containment actions

Asphalt. An asphalt cover would involve installation of asphalt pavement over impacted soils. An asphalt cover would isolate impacted soil, reduce surface water infiltration, and provide for erosion control. The majority of the open areas at the site are currently covered with asphalt.

Slurry wall. A slurry wall is a subsurface barrier used to contain or divert ground water. Slurry walls are constructed in a vertical trench excavated under a slurry of clay-like material. Sheet piling and dewatering are typically not necessary when using this method of excavation, as the slurry hydraulically shores the trench to prevent collapse and prevent fluid losses into surrounding ground. There are several different types of slurry walls which are differentiated by the materials used to backfill the slurry trench. The most common types of slurry walls are soil-bentonite slurry walls and cement-bentonite slurry walls. Soil-bentonite slurry walls have been demonstrated to achieve a permeability of about $1x10^{-8}$ cm/sec, while cement-bentonite slurry walls generally achieve a permeability of about $1x10^{-6}$ cm/sec (USEPA 1985). Slurry walls may be placed upgradient, downgradient or around the perimeter of the area where ground water diversion/containment is needed. These walls are typically keyed into an underlying zone of low permeability such as bedrock. Bedrock at the site is approximately 30 ft to 40 ft below ground surface. A slurry wall installed at the site would most likely be keyed into the underlying bedrock.

Sheet piles. Sheet piling may be used as a subsurface vertical barrier to contain or divert ground water. Sheet piles, typically constructed of steel, would be driven into the soil to the depth required. Like slurry walls, sheet piling may be placed upgradient, downgradient, or around the perimeter of the area where ground water diversion/containment is needed.

Removal actions

Excavation (backhoe/crane). Excavation would involve the removal of impacted soil using conventional construction equipment such as backhoes and front-end loaders for subsequent treatment or disposal.

Disposal actions

Commercial landfill. Excavated soil could be transported off-site to a permitted landfill facility for disposal. Treatment of soil to meet RCRA Land Disposal Restriction (LDR) requirements would likely be necessary due to the presence of chlorinated solvents.

In Situ Treatment Actions

In situ air stripping. This process involves installation of extraction wells screened in the unsaturated zone. Soil vapor is extracted through the wells by a vacuum and the vapor may require further treatment such as carbon adsorption or oxidation. This process can be enhanced by biodegradation (for example, bioventing) where air flow is increased to the subsurface, thereby enhancing the ability of indigenous microorganisms to degrade the contaminants *in situ*. *In situ* air stripping was implemented as an IRM at the Former Drum Storage Pad Area (Section 1.4.3). *In situ* air stripping can also be implemented using dual-phase extraction to recover soil vapor and ground water concurrently.

Air sparging. Air sparging is an *in situ* technology used primarily to recover VOCs in the saturated zone. Air sparging, when used in conjunction with an *in situ* air stripping system, can strip soils below the water table of VOCs. Contaminant-free air is introduced into the aquifer in the form of minute bubbles utilizing microporous bubblers (or sparge points). VOCs below the water table are stripped from the soils by a combination of volatilization and biodegradation as the air flows through the water column and into the unsaturated zone. The movement of the air bubbles tends to facilitate the transfer of VOCs into soil pore spaces in the unsaturated zone where they can be removed by an *in situ* air stripping system. In addition, the sparged air maintains high dissolved oxygen (DO) levels in the subsurface, which enhances natural biodegradation.

Solidification/stabilization. Solidification/stabilization is a process which involves the addition of cement or pozzolanic materials to soil to produce a stable and inert mass. This process immobilizes constituents in the soil, but does not destroy or reduce the toxicity of contaminants.

Implementation of this technology *in situ* would involve the use of augers or other equipment to mix the solidification/stabilization agents with the soil. This technology is not considered effective for organic contaminants.

Soil flushing. Soil flushing involves the use of a ground water extraction system to flush ground water through contaminated soil zones. Continued flushing facilitates desorption of constituents from soil which are removed through the ground water extraction system.

Surfactant flushing. Surfactant flushing involves the application of a surfactant to impacted soils. Surfactants reduce the surface tension between liquids or between a liquid and a solid, or increase the solubility of contaminants, thus enhancing constituent removal. Surfactants and mobilized constituents are recovered using a ground water extraction system.

Steam injection. Steam injection is a method of enhancing contaminant removal during ground water extraction. Steam is injected into or below the zone of soil contamination to increase the temperature and therefore the vaporization rate of contaminants. Additionally, contaminated soil, water, and NAPLs may be physically displaced by the condensate that forms in front of the steam zone.

Bioremediation. *In situ* biological treatment involves the degradation of soil contaminants in place by indigenous microorganisms. *In situ* biological treatment of unsaturated soil at the site could be implemented by use of an auger to mix soil *in situ*. Bioventing is an *in situ* process in which wells screened in the vadose zone are utilized to distribute air through the soil to help enhance conditions for microorganisms. Biological treatment of saturated soils can be accomplished by injecting nutrients and oxygen sources into subsurface soils through ground water injection and extraction wells.

***Ex situ* treatment actions**

Ex situ air stripping. *Ex situ* air stripping is an aboveground treatment process. The soil is excavated and placed in an aboveground pile and perforated piping would be is placed throughout the soil pile. A vacuum would be applied to the perforated piping which would cause the constituents in the soil to volatilize into the air. Extracted soil vapor may require treatment.

Bioremediation. *Ex situ* biological treatment is a process in which indigenous microbes degrade organic constituents biologically, in an above-ground system such as landfarming, composting, slurry reactor, or pile treatment.

Incineration. Incineration is a thermal destruction treatment method which uses high temperature oxidation under controlled conditions to combust organic substances into products that generally include CO_2, H_2O vapor, SO_2, NO_x, HCl, and ash. The occurrence of products of incomplete combustion require air pollution control equipment to prevent the release of undesirable constituents into the atmosphere. Disposal of treated soil, with some ash, is also required. Incineration can be an effective process to destroy site-related organic constituents in soil.

Thermal desorption. Low temperature thermal desorption is an *ex situ* process that uses either direct or indirect heat exchange to volatilize organic constituents from soil. Thermal desorption is a physical separation process and not an organic destruction (incineration) process. The relatively low operating temperatures (200 to 1500°F) tend to make thermal desorption less energy intensive and thus, less costly, than incineration. The volatilized contaminants from the thermal desorption process are typically directed to a secondary system for incineration, adsorption on activated carbon, or recovery by condensation.

GROUND WATER

Institutional actions

Ground water use restriction. Potable use of impacted ground water may be restricted through advisories or property deed notations. A local ordinance is currently in place which eliminates the use of private drinking water wells.

Containment actions

Slurry wall. A slurry wall is a subsurface barrier used to contain or divert ground water. Slurry walls are constructed in a vertical trench excavated under a slurry of clay-like material. Sheet piling and dewatering are typically not necessary when using this method of excavation, as the slurry hydraulically shores the trench to prevent collapse and prevent fluid losses into surrounding ground. There are several different types of slurry walls which are differentiated by the materials used to backfill the slurry trench. The most common types of slurry walls are soil-bentonite slurry walls and cement-bentonite slurry walls. Soil-bentonite slurry walls have been demonstrated to achieve a permeability of about $1x10^{-8}$ cm/sec (USEPA 1985). Slurry walls may be placed upgradient, downgradient or around the perimeter of the area where ground water diversion/ containment is needed.

Sheet piles. Sheet piling may be used as a subsurface vertical barrier to contain or divert ground water. Sheet piles, typically constructed of steel, would be driven into the soil to the depth required. Like slurry walls, sheet piling may be placed upgradient, downgradient, or around the perimeter of the area where ground water diversion/containment is needed.

Recovery actions

Ground water recovery can be implemented for hydraulic containment purposes, as well as for mass removal purposes.

Recovery wells. Contaminated ground water could be recovered by pumping extraction wells. Ground water recovery is currently used in the Solvent UST Area. Dual-phase recovery wells can also be used to collect soil vapor and ground water concurrently.

Recovery trench. Impacted ground water could be collected in a downgradient interceptor trench. Trenches are installed to the bottom of the zone of contamination, and high permeability backfill is placed in the trench. Ground water is removed through a pipe drain system or through a well installed in the trench.

In situ treatment actions

Air sparging. Air sparging is an *in situ* technology used primarily to recover VOCs in the saturated zone. Air sparging, when used in conjunction with an *in situ* air stripping system, enables ground water to be stripped of VOCs. Contaminant-free air is introduced into the affected aquifer system in the form of minute bubbles utilizing microporous bubblers (or sparge points). VOCs below the water table are removed by a volatilization and often, biodegradation as the air percolates through the water column and into the unsaturated zone. The movement of the air bubbles tends to facilitate the transfer of VOCs into soil pore spaces in the unsaturated zone where they can be removed by an *in situ* air stripping system.

Bioremediation. Natural microbial degradation of organic contaminants *in situ* can be enhanced through injection of necessary nutrients and/or cometabolites to the subsurface. Injection wells can be used to supply the needed nutrients and/or co-metabolites to the indigenous microbial organisms in the subsurface which are capable of destroying the contaminants.

Ex situ treatment actions

Air stripping. Air stripping involves the contact of ground water with air in a countercurrent packed or tray column or bulk reactor to transfer volatile contaminants from the ground water to the air. Depending on the resulting characteristics of the discharging air stream, air pollution controls may be required. *Ex situ* air stripping via a sparge tank is currently used in the treatment of ground water extracted from the Solvent UST area. VOCs are stripped from the influent ground water via sparging in an air sparge tank. Air containing VOCs is then treated with two vapor phase carbon units. The treated air is recirculated into the air sparge tank. No air emissions are associated with this system.

Carbon adsorption. Activated carbon can adsorb organic contaminants from ground water or vapor onto its surfaces during contact. The carbon must be periodically replaced, regenerated, treated and/or disposed. Regeneration may be accomplished on-site or off-site at a permitted commercial hazardous waste facility. Carbon disposal would be off-site at a permitted commercial hazardous waste facility. Air containing VOCs from the on-site air sparging tank are currently treated using carbon adsorption and then recirculated.

Adsorptive resins. Commercial resins are available which can adsorb organic contaminants from the ground water during contact. Such resins are typically regenerated on-site on a periodic basis.

Settling. Settling would involve pumping of ground water into a holding tank to settle solids or NAPLs, if present, in the extracted ground water. Separation of solids or NAPLs from ground water improves the effectiveness of subsequent treatment. Solids would be transported off-site for treatment and/or disposal at a permitted commercial hazardous waste facility. Recovered NAPLs would be transported off-site for reclamation and/or treatment at a permitted commercial hazardous waste facility. Settling, in the form of an oil/water separator, is currently part of the ground water treatment for the Solvent UST area.

Filtration. Filtration would involve pumping of ground water through a semipermeable medium to separate solids from the water phase. Separation of solids from ground water would improve the water quality before further treatment and discharge. Solids would be transported off-site for treatment and/or disposal at a permitted commercial hazardous waste facility.

Chemical oxidation. Chemical oxidation involves the addition of oxidation agents, such as hydrogen peroxide or ultraviolet light, to recovered ground water to oxidize organic contaminants. Sludge management would be required with this response action.

Biological. A biological reactor could be used to enhance conditions for co-metabolic degradation of chlorinated organics. Nutrients, cometabolites, and aeration would be provided as necessary to optimize degradation. Sludge management would be required.

Discharge actions

Sheldrake River. Treated ground water could be discharged to an on-site surface water body, such as the Sheldrake River. Although an actual permit would not be required under the ACO, discharge limitations and monitoring requirements would be established by the NYSDEC in accordance with the substantive requirements of applicable regulations.

Recharge wells. Treated ground water could be returned back to the ground through recharge wells. Although an actual permit would not be required under the ACO, discharge limitations would be established by the NYSDEC in accordance with the substantive requirements of applicable regulations.

Off-site treatment facility

Commercial treatment facility. Extracted ground water could be transported off-site to a commercial permitted facility for treatment.

POTW. Recovered ground water could be discharged to a publicly owned treatment works (POTW), such as the WCDEF wastewater treatment plant, through an on-site sewer system. Pretreatment would likely be necessary to meet applicable POTW discharge limitations. Discharge monitoring would be necessary to document compliance with the limits.

Currently, ground water at the site is treated and monitored prior to discharge to the WCDEF POTW.

3.4. Evaluation and selection of technologies and process options

Technologies and process options identified in the initial screening were further evaluated according to the criteria of effectiveness, implementability, and cost. Based on the results of this evaluation, representative process options were selected for incorporation into interim remedial alternatives. The evaluation and selection of technologies and process options is described in the following subsections and documented in Tables 3-3 and 3-4 for soil and ground water, respectively.

3.4.1. Evaluation of technologies and process options

Tables 3-3 and 3-4 present a summary of the evaluation of the technically implementable technologies and process options identified for soil and ground water, respectively. Evaluation with respect to the effectiveness criterion included consideration of the following:

- Effectiveness of the process options in meeting applicable RAOs and their ability to handle the estimated volumes and/or areas of media involved at the site

- Experience and reliability of the process options for the media and conditions at the site

- Potential effects on human health and the environment during construction and implementation.

The technical and institutional aspects of implementing the process options were assessed with respect to the criteria for implementability. The capital and operation and maintenance (O&M) costs of each process option were evaluated and categorized as high, medium, or low relative to other process options of the same technology type.

3.4.2. Selection of representative technologies and process options

Based on the evaluation of technologies and process options, the most favorable process options were chosen as representative process options. Selecting representative process options simplifies the assembly of alternatives, but does not eliminate other process options. The process option actually used to implement remedial action may be selected in the remedial design phase.

Selected representative process options for soil and ground water are indicated with an asterisk on Tables 3-3 and 3-4, respectively. Representative process options which were selected for the soil include:

- fencing
- deed restrictions
- asphalt cover
- slurry wall
- *in situ* air stripping
- *in situ* air sparging

Representative process options which were selected for the ground water include:

- ground water use restriction
- ground water monitoring
- slurry wall
- recovery wells
- *in situ* air sparging
- *ex situ* air stripping
- carbon adsorption
- settling
- POTW discharge

The following discussion presents the rationale for not selecting process options as representative process options for inclusion in remedial alternatives.

SOILS

Containment actions. Sheet piling was not chosen as a representative process option because a slurry wall was deemed to be more cost-effective and practical for site containment. Underground utilities present at the site severely inhibit installation of sheet piling without relocation.

Removal actions, disposal actions, and ex situ treatment actions. Excavation was not selected as a representative process option for remedial alternative assembly because removal of impacted soils remaining at the site is not practical. Over 40 percent of the impacted soils are located beneath facility buildings and asphalt pavement. Disposal actions and *ex situ* treatment actions were also subsequently not selected for inclusion in remedial alternatives. The limited space available on the site, and the potential interference with the tenants in the building preclude the implementation of disposal actions or *ex situ* remedies at the site.

In situ treatment actions. In situ solidification/stabilization was not selected as a representative process option because its effectiveness on soils with chlorinated organic solvents is not proven and its effectiveness would be further limited due to the presence of DNAPL. A bench-scale test was conducted on site soils to evaluate pre-stabilization leachable organics and post-stabilization leachable organics and determine net reduction of contaminant loading to the ground water after treatment. Site soils were mixed with varying amounts of clay and Portland cement, cured, and then analyzed for Total VOCs via TCLP methods. The results of the stabilization/solidification evaluation indicated a general reduction in leachable organics. However, the concentrations of TCE were not reduced below the TCLP regulatory limits indicating that solidification/stabilization would not eliminate contaminant loadings to the ground water at the site. In addition, the presence of DNAPL in the subsurface soils would further limit the effectiveness of this technology. Appendix D presents the complete results of the bench scale testing.

Surfactant flushing and steam injection were not selected as representative process options for inclusion in remedial alternatives. Surfactant and steam enhance the mobility of DNAPL, which enhances DNAPL extractability from the subsurface but also provides the potential for uncontrolled migration of DNAPL in the subsurface (USEPA 1992; and

National Research Council 1994; Pankow and Cherry 1996; and Fountain 1998). Uncontrolled migration of DNAPL would not be consistent with the RAOs. The introduction of surfactants involves the addition of a new contaminant to the ground water with associated issues related to the toxicity, migration, collection and treatment of the surfactants (Pankow and Cherry 1996). Further, the ability to maintain hydraulic control over mobilized DNAPL is difficult (Pankow and Cherry 1996). While calculations and tests can be performed, such calculations and tests do not reliably address the heterogeneities at the site. It would be unacceptable and represent a greater risk than is currently posed by the DNAPL, for the DNAPL to be mobilized and migrate into the bedrock or off-site. Hydraulic control of mobile DNAPL typically requires high hydraulic gradients and consequently high ground water pumping rates. Such high pumping rates would capture ground water on neighboring sites, may impact the water flow in the river, and could cause significant drawdown and damage the building foundation.

Finally, although controlled field trials of surfactant have demonstrated significant DNAPL mass removal, some DNAPL has persisted in all of the trials (Fountain 1998). The presence of subsurface heterogeneities suggests that some residual contamination will inevitably result and SCGs will not be attained.

Based upon these issues, it was concluded that the use of surfactants or steam flushing was not appropriate at the Sealectro site.

In situ bioremediation was not selected as a process option because of the difficulties associated with achieving a consistent distribution of nutrients and oxygen in heterogeneous subsurface materials such as those at the site. This conclusion is substantiated by the bioremediation bench-scale testing of site soils conducted by Biotrol, Inc. of Eden Prairie, Minnesota. Biotrol's evaluation indicated that while methane-enhanced nutrient growth (aerobic) for site soils was favorable, the physical properties of the soil, such as the fine grain size, heterogeneity, and low hydraulic conductivity of site soils, would limit *in situ* bioremediation. Incomplete biodegradation may cause degradation products of chlorinated solvents, such as vinyl chloride, to be created. In addition, the presence of DNAPLs significantly slow the effectiveness of bioremediation because of permeability reductions and DNAPL toxicity to organics. Appendix D presents the complete results of Biotrol's evaluation.

In addition, bioremediation of chlorinated solvents is relatively innovative since both aerobic and anaerobic bioremediation processes would be required to degrade the chlorinated solvents to non-hazardous constituents.

GROUND WATER

Containment actions. Sheet piling was not chosen as a representative process option because a slurry wall was deemed to be more cost-effective and practical for site containment.

Recovery actions. A recovery trench was not selected as a representative process option because recovery wells were considered more suitable based on site constraints.
In situ treatment actions. In situ bioremediation was as a suitable process option for ground water. It is difficult to achieve a consistent distribution of nutrients and oxygen in heterogeneous subsurface materials such as those at the site. Bioremediation can also produce degradation by-products such as vinyl chloride. Further, the presence of DNAPLs significantly slows the effectiveness of bioremediation.

Ex situ treatment actions. Adsorptive resins and filtration were not selected as representative process options because other treatment technologies currently being used for ground water treatment at the site were considered more cost-effective (oil/water separation, air stripping, and vapor-phase carbon adsorption).

Discharge actions. Discharge to the Sheldrake River and discharge to ground water were not included in the remedial alternatives because the existing treatment system at the site discharges to the WCDEF POTW. Discharge to a commercial treatment facility was also not selected based on cost and excessive transportation requirements.

4. Development of alternatives

4.1. Introduction

The general response actions and selected representative process options for soil and ground water were combined to form remedial alternatives to address the RAOs. Alternatives were developed to address a contiguous area of the site consisting of the Solvent UST Area, Former Drum Storage Pad Area, and the Shed Area.

Five alternatives were developed for the site. The no action alternative was included in the range of alternatives in accordance with USEPA guidelines (USEPA 1988) and the NCP. One alternative consisting of institutional controls was developed; additionally, one monitoring coupled with a contingency remedy (ground water extraction/treatment) alternative, one containment (slurry wall) alternative, and one source treatment (*in situ* air stripping/air sparging) alternative were developed. Summaries of the remedial alternatives developed for the site are presented in Table 4-1. Descriptions of the remedial alternatives are presented in the subsections below.

4.2. Alternative 1: No action

Alternative 1 is the no action alternative. A no action alternative is required by the NCP and serves as a benchmark for the evaluation of action alternatives. This alternative provides an assessment of the environmental conditions at the site if no further remedial actions are implemented.

Alternative 1 would involve decommissioning of the existing IRM ground water collection and treatment system. The existing treatment system would be taken out of service, and the solvent recovery well would be abandoned.

Five-year reviews would be conducted as part of Alternative 1 as required by the NCP. Five-year reviews are conducted to evaluate continued protection of human health and the environment. For the purposes of estimating costs in Section 5, it was assumed that five-year reviews would be conducted over a 30-year period.

4.3. Alternative 2: Institutional actions

Alternative 2 is the institutional actions alternative. Institutional actions would require implementation of deed restrictions, fencing, maintenance of the existing asphalt cover and ground water monitoring.

Deed restrictions would include land use restrictions to address the conduct of activities which could expose contaminated materials. Deed restrictions would also include restrictions prohibiting the installation of potable wells at the site. The local ordinance that requires residential and commercial buildings within 500 ft of the public supply to be connected to the public water system would continue. The existing asphalt cap would be maintained to limit human contact with site soils and minimize mobilization of soil particles due to airborne dispersion and runoff. An 8 ft fence is currently in place around the Former Drum Storage Area and Shed Area. Additional fencing would be required around a portion of the Solvent UST Area.

Continuation of a ground water monitoring program would provide a data base with which to evaluate ground water quality over time. For the purpose of the alternative evaluation, we assumed that the ground water monitoring program would consist of monitoring of six existing monitoring wells (quarterly for 2 years and annually from years 3 to 30). The ground water samples would be analyzed for VOCs via Method 8010/8020 and TPH via method 418.1. The analytical parameters are based on the type of contaminants present at the site and current ground water monitoring requirements. Installation of additional monitoring wells would not be necessary.

Since no ground water treatment would be conducted as part of Alternative 2, the existing ground water treatment system would be taken out of service and the solvent and fuel oil recovery wells would be abandoned.

O&M associated with Alternative 2 would include project management associated with long-term ground water monitoring, fencing, deed restrictions, ground water use restriction, and the asphalt cover. Five-year reviews would be conducted as required by the NCP to evaluate continued protection of human health and the environment. For purposes of estimating costs in Section 5, it was assumed that O&M activities would continue over a 30-year period.

4.4. Alternative 3: Containment via slurry wall

Alternative 3 includes deed restrictions, fencing, asphalt cover, ground water monitoring, installation of a slurry wall containment system, operation of one ground water recovery well, *ex situ* ground water treatment (air stripping, settling and vapor-phase carbon adsorption), and discharge of treated ground water to the WCDEF POTW (Figure 3-3).

Deed restrictions would include land use restrictions to address the conduct of activities which could expose contaminated materials. Deed restrictions would also include restrictions prohibiting the installation of potable wells at the site. The local ordinance that requires residential and commercial buildings within 500 ft of the public supply to be connected to the public water system would continue. The existing asphalt cap would be removed during installation of the containment wall; however, it would subsequently be replaced to limit human contact with site soils and minimize mobilization of soil particles due to airborne dispersion and runoff. An 8 ft foot fence is currently in place around the Former Drum Storage Area and Shed Area. Additional fencing would be required around a portion of the Solvent UST Area.

Continuation of the ground water monitoring program would provide a data base with which to evaluate ground water quality over time. It was assumed for this evaluation that ground water monitoring would consist of collecting samples from six existing monitoring wells (quarterly for 2 years and annually for years 3 through 30). The ground water samples would be analyzed for VOCs via Method 8010/8020 and TPH via method 418.1. The analytical parameters are based on the type of contaminants present at the site and current ground water monitoring requirements. Ground water monitoring would continue for 30 years with five-year review periods as required by the NCP (Federal Register 1990). The purpose of the five-year review would be to evaluate the site with regard to the protection of human health and the environment. Installation of additional monitoring wells is not anticipated.

The slurry wall would be installed around the perimeter of the site from the western property boundary to the sidewalk on the south side of site to the northeast property boundary, and to the northern property boundary at the Sheldrake River. As a result of the small size of the site, installation would consist of standard construction trenching techniques that would not require sloping of the excavation. A 2 to 3 ft wide vertical trench would be excavated using a backhoe, clamshell, or combination; the vertical trench would be excavated to 3 to 5 ft and filled with a bentonite slurry to stabilize the trench walls. The vertical trench excavation would continue to the top of bedrock at an approximate depth of 30 to 40 ft. The trench would remain filled with bentonite slurry to a depth of 3 to 4 ft above the ground water table until excavation is complete. When the excavation is completed to the required depth, the trench would be filled with the engineered material (soil bentonite mixture) by displacing the bentonite slurry. The containment wall would be "keyed" into the underlying bedrock. This method would be continued until each side of the containment wall is complete.

Construction of the containment wall between the building and the Sheldrake River would require temporary diversion of the river such that construction equipment could access that area. The containment wall would be constructed by driving temporary steel sheet piling along the embankment to the top of bedrock at a depth of approximately 30 to 40 ft in order to support placement of the soil-bentonite mixture behind the sheet piling.

The presence of the containment wall around the site perimeter would limit ground water flow across the site, and could cause an increase in the ground water level within the containment wall due to periodic surface water infiltration. In addition, small quantities of ground water would migrate from inside of the containment wall outside to the site. The total outflow to the site via infiltration of precipitation and leakage through the containment wall was calculated to be 0.2 gpm (Appendix C). In order to reduce the ground water level within the containment wall, a recovery well would be installed. The recovery well would be 6 inches in diameter and constructed of stainless steel. The bottom of the well would extend to approximately 15 ft in depth with 10 ft of well screen. The existing recovery wells, RW-1 and RW-2, would be closed and the piping would be removed.

Ground water would be pumped from the new recovery well to the existing ground water treatment system via 1-inch Schedule-40 PVC piping. Operation of the existing recovery wells would not continue; however, the control panel for the existing ground water treatment would require minor modifications.

Subsequent to treatment, the effluent from the treatment system would be discharged to the WCDEF POTW via the existing discharge point located within the shed. It is likely that the existing discharge permit with the WCDEF would not have to be updated given the minimal flow.

Subsequent to installation of the containment wall, recovery well and associated piping, the asphalt cap would be replaced. The replacement cover would consist of 4 to 6 inches of base course material overlain by 2 to 4 inches of asphaltic pavement. Replacement of the asphalt cover would limit contact with site soils via airborne dispersion and runoff.

O&M associated with Alternative 3 includes project management, continued compliance monitoring for VOCs via Method 8010/8020 and Oil & Grease of the discharge to the WCDEF POTW, mechanical inspection and servicing of ground water treatment system components, vapor phase carbon replacement, ground water monitoring, and five-year reviews. Five-year reviews would be conducted as required by the NCP to evaluate continued protection of human health and the environment. For the purposes of estimating costs in Section 5, it was assumed O&M would continue over a 30-year period.

4.5. Alternative 4: Ground water monitoring and contingency remedy

Alternative 4 includes deed restrictions, fencing, maintenance of the existing asphalt cover, continued operation of the solvent UST IRM ground water monitoring, and a contingency remedy. The contingency remedy would be implemented in the event that annual ground water trigger levels are exceeded by 20% for three continuous years. The contingency remedy consists of ground water extraction, oil/water separation, air stripping, vapor-phase carbon adsorption, and discharge of treated ground water to the WCDEF POTW (Figure 3-4). The existing IRM ground water collection and treatment system would remain in operation as long as it remains effective in recovering VOCs from the solvent UST area.

Deed restrictions would include land use restrictions to address the conduct of activities which could expose contaminated materials. Deed restrictions would also include restrictions prohibiting the installation of potable wells at the site. The local ordinance that currently requires residential and commercial buildings within 500 ft of public supply to be connected to the public water system would continue. The existing asphalt cover would be maintained to limit human contact with site soils and minimize mobilization of soil particles due to airborne dispersion and runoff. An 8 ft fence is currently in place around the Former Drum Storage Pad Area and Shed Area. Additional fencing would be required around a portion of the Solvent UST Area.

The ground water monitoring program, which has been conducted at the site since 1988, would continue under this alternative. The monitoring data would be used to continue the evaluation of the ground water quality and document concentration trends. The ground water monitoring program is described in the Ground Water Monitoring Plan Work Plan (O'Brien & Gere 1998) (Appendix F). It is assumed that ground water monitoring would consist of quarterly sampling during the first 2 years and annual sampling from years 3 to 30 at six existing monitoring wells (MW-2, MW-2D, MW-3, MW-3D, MW-11, and MW-12). The samples will be analyzed for VOCs via USEPA Method 8021. The analytical parameters are based on the type of contaminants present at the site and current ground water monitoring requirements. It is assumed that ground water monitoring will continue for 30 years with five-year review periods as required by the NCP (Federal Register 1990). The purpose of the five-year review is to evaluate the site in regards to the protection of human health and the environment. Installation of additional monitoring wells is not anticipated.

In addition to ground water monitoring, it is anticipated that the solvent UST IRM, which consists of ground water recovery treatment and discharge, would continue operating at the site. Discontinuation of IRM operation would be dependent on ground water conditions described below.

The contingency remedy would consist of ground water recovery from areas where the VOC concentrations in the ground water exceed the Annual Trigger Criteria by more than 20% for three continuous years. These criteria are described in more detail in the Ground Water Monitoring Plan (O'Brien & Gere 1998). The contingency remedy would operate as an expansion of the existing IRM.

Ground water would be pumped from the extraction well to the existing ground water treatment system. The extracted water would then be treated using air stripping technology to transfer the volatile organics from the water to the air. With the closed loop treatment system currently in use, there would be no air emissions. After treatment, the water would be discharged to the WCDEF POTW through the on-site sewer system. The existing discharge permit with the WCDEF POTW would be modified to include the new flows into the sewer system. This treatment technology has been proven effective at the site and can be readily implemented assuming the POTW permit remains in effect.

During operation of the IRM and/or the contingency remedy, site conditions will be evaluating on a continual basis and both the IRM and the contingency remedy may be shut down under certain circumstances. A preliminary list of the conditions that might lead to shut down of the recovery systems includes:

- If the Ground Water Monitoring Program indicates that ground water VOC concentrations are consistently below trigger levels as described in the Ground Water Monitoring Program Work Plan
- If POTW discharge costs become significantly higher than included in present cost estimates
- If changes in regulatory criteria occur
- If monitoring data demonstrate that the ground water extraction systems are no longer effective.

The specific shut down criteria for the contingency remedy are further described in the contingency remedy plan (O'Brien & Gere 1999).

Deed restrictions, fencing, ground water monitoring, and maintenance of the asphalt cover would continue for 30 years. O&M associated with Alternative 4 includes ground water treatment system operation and maintenance, project management, and ground water monitoring. Five-year reviews would be conducted as required by the NCP to evaluate continued protection of human health and the environment. For the purposes of estimating costs in Section 5, it was assumed that O&M would include: continued compliance monitoring for VOCs and Oil and Grease of the discharge to the WCDEF POTW, mechanical inspection and servicing of ground water treatment system components, and vapor phase carbon replacement associated with the IRM. These O&M costs would continue for 30 years. At this point it is not known whether the contingency remedy will be necessary or, if it is, the year in which it would be implemented. For the purposes of the cost estimate, it was assumed that additional O&M costs associated with the implementation of the contingency remedy would start in the fifth year of ground water monitoring for a duration of 25 years.

4.6. Alternative 5: *In situ* air stripping and air sparging

Alternative 5 includes deed restrictions, fencing, maintenance of the asphalt cover, ground water monitoring, installation of an *in situ* air stripping system, and installation of an *in situ* air sparging system (Figure 3-5).

Deed restrictions would include land use restrictions to address the conduct of activities which could expose contaminated materials. Deed restrictions could also include restrictions prohibiting the installation of potable wells at the site. The local ordinance that currently requires residential and commercial buildings within 500 ft of public supply to be connected to the public water system would continue. The existing asphalt cover would be maintained to limit human contact with site soils and minimize mobilization of soil particles due to airborne dispersion and runoff. An 8 ft fence is currently in place around the Former Drum Storage Pad Area and Shed Area. Additional fencing would be required around a portion of the Solvent UST Area.

Continuation of a ground water monitoring program would provide a data base with which to evaluate ground water quality over time. It was assumed that the ground water program would consist of quarterly monitoring of six existing monitoring wells. The samples would be analyzed for VOCs via Method 8010/8020 and TPH via Method 418.1. The analytical parameters are based on the type of contaminants present at the site and current ground water monitoring requirements. Installation of additional monitoring wells is not anticipated.

In situ air stripping will remove VOCs from the vadose zone soils. The *in situ* air stripping system would consist of a positive displacement blower unit with a manifolded extraction well system, ten extraction wells, ten passive air inlet wells, and an air emission control system (vapor-phase carbon and associated piping). The inlet and six of the extraction wells would be installed outside the building and would operate in the vadose zone (0 ft to 8 ft). Four extraction wells would be installed inside the building.

The eleven shallow (to 6 ft) extraction wells, two deep extraction wells (to 30 ft), and inlet wells (to 6 ft) would be four inches (inner diameter), constructed of Schedule-80 PVC, and flush mounted.

The extraction wells would be placed in the former Solvent UST area and former Shed area in the pattern indicated in Figure 3-5. Based on the data collected during the RI, the highest concentrations of VOCs are located in borings B-19, B-32, and B-17, the locations of the extraction wells will be biased toward these borings. *In situ* air stripping will not be implemented in the Former Drum Storage Pad Area since this area was remediated during the IRM conducted on vadose zone soils from May 12, 1992 to October 6, 1992.

The location of the extraction wells would be designed so that their zones of influence encompassed areas of known DNAPL. The assumed radius of influence of both the deep and shallow extraction wells in the vadose zone is approximately 20 ft based on the results of the pilot *in situ* air stripping IRM conducted at the site in 1992.

In situ air sparging would be used to remove VOCs from the saturated zone and the system would consist of an air sparging blower, a sparge air delivery system, an air stripping system, and an air emission control system. The sparge air delivery system would include nine sparge wells, two extraction/sparge wells, and a series of horizontal wells installed beneath the foundation of the building. Based on the vertical limits of total VOCs detected during the RI the horizontal wells will be installed at a depth of 28 ft below ground surface. The horizontal and vertical wells would be connected to a manifold which is connected to the positive side of the air sparging blower. A filter would remove abrasive particles and water droplets from the air stream before the air passes through the blower into the sparge air delivery system.

The *in situ* air sparge recovery system would be comprised of *in situ* air stripping extraction wells connected to the suction side of a blower unit. The extraction wells would be constructed of 4-inch inner diameter Schedule-80 PVC riser casing and a 0.02-inch slotted Schedule-80 PVC well screen. Where appropriate, the *in situ* air stripping and air sparge recovery system recovery wells may be combined.

It is anticipated that the air emission control unit for the *in situ* air stripping system could be used in conjunction with the air sparging system. Air flow through the *in situ* air stripping and air sparging systems is induced by the air stripping unit blower such that air flows from the extraction wells through an aluminum manifold and flexible hoses, to a filter device to remove airborne dust, through the blower, and finally to a carbon adsorption bed air stripping unit and exhaust stack. The blower speed is regulated by an electric control panel which adjusts the gearing ratio of the blower. Pressure gauges would monitor pressure at the extraction wells, and the system would also be equipped with high temperature and high vacuum switches for automatic shutdown of the unit. An existing electrical hook-up for the ground water treatment system would be used as a direct power source. The system would be connected to an auto dial system which would notify the appropriate personnel in the instance of a malfunction.

The collected air would be directed to an air emission control unit consisting of prefabricated carbon canisters. The exhaust stack would be equipped with sample ports to measure the air flow speed and pressure differentials and to collect air samples for VOC analysis. The sample ports would be monitored bimonthly and one air sample for laboratory analysis would be collected monthly.

The *in situ* air stripping and air sparging system O&M would be as follows: Remedial technology systems typically recover relatively high masses of contaminants at the onset of operation. During this early time the pounds of contaminants removed per dollar of remediation cost is relatively high. There is a period when the mass removed per unit time declines and eventually becomes asymptotic. The pounds removed per dollar of remedial cost will also decrease during this period and will also tend to become asymptotic. The potential extent of the decrease in pounds removed per dollar cost is site specific. The proposed criteria for evaluating the limits of the technology and for discontinuing the operation area as follows: 1) the system will be operated for a minimum of two years; 2) the system will be discontinued when the pound of VOC removed per dollar of remedial cost becomes asymptotic; 3) the system will be discontinued when the pound removed per dollar cost decreases by one order of magnitude; or 4) the system will be operated for a maximum of 10 years. Attainment of any of these criteria will be an indication that the remedial technology is no longer effective and is not providing a significant benefit for the effort. These shut down criteria would be evaluated over the period of six months. When one of these criteria has been met, then the limits of the technology will have been reached, and treatment system operation will be discontinued.

Deed restrictions, fencing, ground water monitoring, and maintenance of the asphalt cover would continue long-term.

O&M associated with Alternative 5 would include *in situ* air stripping, air sparging system O&M, project management, and ground water monitoring. Five-year reviews would be conducted as required by the NCP to evaluate continued protection of human health and the environment. For the purposes of estimating costs in Section 5, it was assumed that O&M including bimonthly and monthly compliance monitoring of the exhaust stack for VOC, mechanical inspection and servicing of *in situ* air stripping and air sparging systems, and vapor phase carbon replacement would continue for 10 years. It was assumed for the cost estimate that the remaining O&M activities would continue over a 30-year period.

5. Detailed analysis of remedial alternatives

5.1. Introduction

The second phase of a FS involves the screening of alternatives. In this phase, alternatives are screened based on effectiveness, implementability, and cost so the number of alternatives undergoing detailed analysis can be limited to a reasonable number. Five remedial alternatives have been developed for the site in this FS. Because this number of alternatives was deemed manageable for detailed analysis, the screening of alternatives was not performed.

The objective of the third phase of the FS, detailed analysis of remedial alternatives, is to develop sufficient information to allow the remedial alternatives to be compared and a remedial action selected for the site. The detailed analysis consists of an individual assessment of each remedial alternative with respect to seven evaluation criteria, encompassing overall feasibility and, as appropriate, statutory requirements, as well as a comparative evaluation designed to consider the relative performance of each of the remedial alternatives.

5.2. Individual analysis of remedial alternatives

Each remedial alternative was evaluated individually with respect to the following seven of the nine NCP/NYSDEC evaluation criteria:

- Overall protection of human health and the environment;
- Compliance with legally applicable or relevant and appropriate SCGs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;

- Short-term impacts and effectiveness;
- Implementability; and
- Cost.

Community acceptance and state acceptance are the two remaining criteria which are evaluated in the Record of Decision (ROD) for the site. The individual detailed analysis of alternatives is discussed in the subsections below and is summarized in Table 5-1.

5.2.1. Overall protection of human health and the environment

The analysis of each alternative with respect to overall protection of human health and the environment provides an evaluation of whether the alternative would be protective and how protection would be achieved through institutional controls, engineering controls, and/or treatment. The individual analysis of the remedial alternatives with respect to this criterion is summarized in Table 5-1.

The potential risks posed by current and future site conditions were evaluated and the estimated risks were determined to be within acceptable guidelines. Future site construction workers would need to wear appropriate personal protection equipment (PPE) to minimize the potential for acute effects from exposure to subsurface hot spots. Further, although ground water discharges to the Sheldrake River, the RI Report verified that risks associated with the discharge are estimated to be within acceptable guidelines.

Alternative 1 - no action. Since estimated risks to human health and the environment were within acceptable guidelines, the no action alternative would provide overall protection of human health and the environment under current conditions. Alternative 1 does not, however, provide a means to limit contact with soil. Alternative 1 would preclude contact with ground water through the local ordinance. Five- year reviews would provide the only means to evaluate site conditions over time.

Alternative 2 - institutional actions. The estimated risks to human health and the environment were within acceptable guidelines, the institutional actions alternative would provide overall protection of human health and the environment. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil. The local ordinance requiring use of the public water system for facilities located within 500 ft of the public water main would preclude contact with contaminated ground water. Ground water monitoring and five-year reviews would provide a means of monitoring site conditions over time.

Alternative 3 - containment via slurry wall. The containment via slurry wall alternative would provide overall protection of human health and the environment. The slurry wall, with limited ground water recovery, would minimize horizontal ground water migration from the source areas. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil. The local ordinance limiting ground water use would preclude contact with contaminated ground water. Ground water monitoring and five-year reviews would provide a means of monitoring site conditions over time.

Alternative 4 - ground water monitoring and contingency remedy. This alternative would provide overall protection of human health and the environment. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil. The local ordinance limiting ground water use would preclude contact with contaminated ground water. Ground water monitoring and five-year reviews would provide a means of monitoring site conditions over time. If triggered, the localized ground water recovery and treatment components of the contingency remedy would reduce contaminant mass and limit ground water migration.

Alternative 5 - in situ air stripping and air sparging. This alternative would provide overall protection of human health. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil. The local ordinance limiting ground water use would preclude contact with contaminated ground water. With the *in situ* air stripping/air sparging alternative, there would be a potential for volatilized subsurface contaminants released during sparging to migrate to indoor building air. *In situ* air stripping and air sparging would reduce contaminant mass. Ground water monitoring and five- year reviews would provide a means of monitoring site conditions over time.

5.2.2. Compliance with SCGs

The purpose of this section is to identify action-specific SCGs associated with the remedial alternatives developed in Section 4 and to evaluate compliance with chemical-specific, location-specific, and action-specific

SCGs for each alternative. Potential chemical-specific and location-specific SCGs were presented in Section 2.2.2 and 2.2.3. A detailed evaluation of compliance with potential SCGs is summarized in Table 5-1. A tabular summary of which SCGS are associated with each alternative is presented in Table 5-2.

The following were identified as potential action-specific SCGs for the site. A summary of the action-specific SCG requirements is presented in Table 5-3.

Federal

- OSHA - General Industry Standards (29 CFR 1910)
- OSHA - Safety and Health Standards (Construction Industry Standards) (29 CFR 1926)
- OSHA - Record keeping, Reporting, and Related Regulations (29 CFR 1904)
- OSHA - Hazardous Waste Operations and Emergency Responses (29 CFR 1910.120)
- Clean Water Act Pretreatment Regulations (40 CFR 403)
- DOT Rules for Hazardous Materials Transport (40 CFR 107, 171.1, 171.5)

New York

- New York State Stream Encroachment Requirements (6 NYCRR 608)
- New York State Identification and Listing of Hazardous Wastes (6 NYCRR 371)
- New York State Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities (6 NYCRR 372)
- New York State Standards for Owners/Operators of Permitted Hazardous Waste Facilities (6 NYCRR 373-2.2)
- New York State Preparedness and Prevention (6 NYCRR 373-2.3)

- New York State Contingency Plan and Emergency Procedure (6 NYCRR 373-2.4)
- New York State Land Disposal Restrictions (6 NYCRR 376)
- New York State Air Quality Emission Limits (6 NYCRR 212)
- New York State Air Quality Standards (6 NYCRR 257)

Local

- WCDEF Discharge Limitations
- Soil Erosion and Sediment Control, (Town of Mamaroneck Local Law No. 8)

Alternative 1 - Chemical-specific SCGs, NYS Class GA ground water standards and NYSDEC soil cleanup objectives may not be attained within the 30 year assessment period by Alternative 1, due to the technical limitations discussed in Section 2. The No action alternative would be in compliance with location-specific SCGs, NYS floodplain management requirements (6 NYCRR 500) and NYS hazardous waste facility floodplain requirements (6 NYCRR 373-2). There are no action-specific SCGs for Alternative 1.

Alternative 2. Chemical-specific SCGs, NYS Class GA ground water standards and NYSDEC soil cleanup objectives may not be attained within the 30 year assessment period due to the technical limitations discussed in Section 2. The institutional controls alternative would be in compliance with location-specific SCGs including the NYS floodplain management requirements (6 NYCRR 500) and the NYS hazardous waste facility floodplain requirements (6 NYCRR 373-2) for the institutional actions alternative. Performance of monitoring and inspection activities would be consistent with the action-specific SCGs for Alternative 2, OSHA requirements.

Alternative 3. Chemical-specific SCGs, NYS Class GA ground water standards and NYSDEC soil cleanup objectives will not be attained due to the technical limitations discussed in Section 2 and the containment of the DNAPL and VOCs in the soil and ground water by the slurry wall. Alternative 3 would be in compliance with location-specific SCGs including the NYS floodplain management requirements (6 NYCRR 500) and the NYS hazardous waste facility floodplain requirements (6 NYCRR

373-2). Although NYS permits would not be required under the ACO for on-site work, construction of the slurry wall would be in accordance with the substantive requirements of these regulations.

Action-specific SCGs for Alternative 3 include NYS stream encroachment requirements (6 NYCRR 608); OSHA regulations; NYS hazardous waste regulations related to residual waste manifesting, transport, and disposal; NYS hazardous waste management facility regulations; Department of Transportation (DOT) transport requirements; Clean Water Act (CWA) pretreatment regulations; WCDEF POTW discharge limitations; and local soil erosion and sediment control requirements. Although a stream encroachment permit would not be required under the ACO for on-site work, construction of the slurry wall would be in accordance with the substantive requirements of that regulation. Performance of remedial activities would be consistent with OSHA requirements. Water treatment residuals would be managed, transported, and disposed in accordance with NYS hazardous waste and DOT requirements. Although a NYS hazardous waste management facility permit would not be required under the ACO for on-site work, management of ground water and residuals would be consistent with the substantive requirements of these regulations. Discharge of treated ground water to the POTW would be in accordance with CWA pretreatment regulations and WCDEF discharge limitations. A soil erosion and sediment control plan would be developed as necessary to meet local requirements.

Alternative 4. Chemical-specific SCGs, NYS Class GA ground water standards, and NYSDEC soil cleanup objectives may not be attained due to the technical limitations discussed in Section 2. Alternative 4 would be in compliance with location-specific SCGs including the NYS floodplain management requirements (6 NYCRR 500) and the NYS hazardous waste facility floodplain requirements (6 NYCRR 373-2). Although NYS permits would not be required under the ACO for on-site work, construction activities in the floodplain would be in accordance with the substantive requirements of these regulations.

Action-specific SCGs for Alternative 4 include OSHA regulations; NYS hazardous waste regulations related to residual waste manifesting, transport, and disposal; NYS hazardous waste management facility regulations; DOT transport requirements; CWA pretreatment regulations; and WCDEF POTW discharge limitations. Performance of remedial activities would be consistent with OSHA requirements. Water treatment residuals would be managed, transported, and disposed in accordance with

NYS hazardous waste and DOT requirements. Although a NYS hazardous waste management facility permit would not be required under the ACO for on-site work, management of ground water and residuals would be consistent with the substantive requirements of these regulations. Discharge of treated ground water to the POTW would be in accordance with CWA pretreatment regulations and WCDEF discharge limitations.

Alternative 5. Chemical-specific SCGs, NYS Class GA ground water standards and NYSDEC soil cleanup objectives may not be attained within the 30 year assessment period due to the technical limitations discussed in Section 2. Alternative 5 would be in compliance with location-specific SCGs including the NYS floodplain management requirements (6 NYCRR 500) and the NYS hazardous waste facility floodplain requirements (6 NYCRR 373-2). Although NYS permits would not be required under the ACO for on-site work, construction activities in the floodplain would be in accordance with the substantive requirements of these regulations.

Action-specific SCGs for Alternative 5 include OSHA regulations; NYS hazardous waste regulations related to residual waste manifesting, transport, and disposal; NYS hazardous waste management facility regulations; DOT transport requirements; and NYS air quality regulations. Performance of remedial activities would be consistent with OSHA requirements. Water treatment residuals would be managed, transported, and disposed in accordance with NYS hazardous waste and DOT requirements. Although a NYS hazardous waste management facility permit would not be required under the ACO for on-site work, management of ground water and residuals would be consistent with the substantive requirements of thee regulations. Air emissions from the *in situ* air stripping and air sparging system would be controlled as necessary to meet NYS requirements.

5.2.3. Long-terms effectiveness and permanence

To evaluate long-term effectiveness and permanence, the adequacy and reliability of controls used to manage various materials were assessed for each remedial alternative. The individual analysis of each remedial alternative with respect to this criterion is summarized in Table 5-1.

Current and future site conditions were evaluated and the risks posed by the site to human health and the environment were found to be within acceptable guidelines. Further, although ground water discharges to the Sheldrake River, risks associated with the discharge are within acceptable guidelines. As discussed in Section 1.4, several IRMs have been performed at the site to address known sources of contamination. As discussed in Section 2.3, it is technically impractical to reduce the concentrations of VOCs in the soil further to attain chemical-specific SCGs.

Alternative 1 - The magnitude of the current and future residual risk to human health and the environment is estimated to be within acceptable guidelines. The no action alternative does not provide adequate or reliable means to limit future contact with soil. The local ordinance limiting ground water use would preclude contact with contaminated ground water. The local ordinance is an adequate and reliable control for notification that site ground water should not be used.

Alternative 2 - The magnitude of residual risk to human health and the environment is estimated to be within acceptable guidelines for the institutional actions alternative. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil. The local ordinance limiting ground water use would preclude contact with contaminated ground water. Ground water monitoring would provide a means of monitoring site conditions over time.

Deed restrictions, fencing, and asphalt cover maintenance are adequate and reliable controls for restriction of contact with soil; controls restricting ground water discharge to the Sheldrake River are not necessary. The local ordinance is an adequate and reliable control to ensure that site ground water is not used. Ground water monitoring is an adequate and reliable means of tracking site conditions over time.

Alternative 3. The magnitude of residual risk to human health and the environment is estimated to be within acceptable guidelines for the containment alternative. The slurry wall would minimize the horizontal migration of ground water at the site. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil. The local ordinance limiting ground water use would preclude contact with contaminated ground water. Ground water monitoring would provide a means of checking site conditions over time.

A slurry wall is an adequate and reliable containment technology. Deed restrictions, fencing, and asphalt cover maintenance are adequate and reliable controls for restriction of contact with soil. The local ordinance is an adequate and reliable control to ensure that site ground water is not used. Ground water monitoring is an adequate and reliable means of tracking site conditions over time.

Alternative 4. The magnitude of residual risk to human health and the environment is estimated to be within acceptable guidelines for the ground water monitoring and contingency remedy. Natural attenuation and the contingency remedy, if triggered, would reduce contaminant mass at the site. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil. The local ordinance limiting ground water use would preclude contact with contaminated ground water. Ground water monitoring would provide a means of checking site conditions over time.

Ground water recovery and treatment is a reliable technology for contaminant mass removal from the saturated zone. Deed restrictions, fencing, and asphalt cover maintenance are adequate and reliable controls for restriction of contact with soil. The local ordinance is an adequate and reliable control ensure that site ground water should not be used. Ground water monitoring is an adequate and reliable means of tracking site conditions over time.

Alternative 5. The magnitude of residual risk to human health and the environment is estimated to be within acceptable guidelines for the *in situ* air stripping/air sparging alternative. *In situ* air stripping/air sparging would reduce contaminant mass at the site. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil and would preclude contact with ground water. Ground water monitoring would provide a means of checking site conditions over time.

In situ air stripping/air sparging is a reliable technology for contaminant mass removal from the unsaturated and saturated zones. Deed restrictions, fencing, and asphalt cover maintenance are adequate and reliable controls for restriction of contact with soil. The local ordinance is an adequate and reliable control to notify the public that site ground water should not be used. Ground water monitoring is an adequate and reliable means of tracking site conditions over time.

5.2.4. Reduction of toxicity, mobility, of volume through treatment

The evaluation of the reduction of toxicity, mobility, or volume through treatment addresses the expected performance of treatment technologies employed in each alternative. The individual analysis of each remedial alternative with respect to this criterion is summarized in Table 5-1.

Alternative 1 - No active treatment technologies are proposed for the no action alternative. However, natural attenuation of organic constituents in the subsurface is expected to continue over time. Based on the presence of solvent breakdown products such as vinyl chloride, 1,2 DCE and 1,2 DCA in the ground water, it is believed that natural attenuation is already occurring. A significant reduction in the volume of contaminants at the site has already occurred as part of the IRMs at the site, as discussed in Section 1.4.

Natural attenuation of organic constituents is irreversible and is expected to reduce the toxicity and volume of contaminated soil and ground water over time. No treatment residuals are associated with natural attenuation.

Alternative 2 - No active treatment technologies are proposed for the institutional actions alternative. However, natural attenuation of organic constituents in the subsurface is expected to continue over time. Based on the presence of solvent breakdown products such as vinyl chloride, 1,2 DCE and 1,2 DCA in the ground water, it is believed that natural attenuation is already occurring. A significant reduction in the volume of contaminants at the site has already occurred as part of the IRMs at the site, as discussed in Section 1.4.

Natural attenuation of organic constituents is irreversible and is expected to reduce the toxicity and volume of contaminated soil and ground water over time. No treatment residuals are associated with natural attenuation.

Alternative 3. For the containment via slurry wall alternative, the small volume of ground water recovered from the recovery well would be treated using *ex situ* air sparging with recirculated vapor and vapor-phase carbon adsorption. Treated ground water would be discharged to the WCDEF POTW for further treatment. Additionally, natural attenuation of organic constituents in the subsurface is expected to continue over time. Treatment of ground water has also been performed as part of the IRMs at the site, as discussed in Section 1.4.

The slurry wall will not reduce the volume or toxicity of the VOCs but would minimize the horizontal mobility of VOCs in the subsurface soils and ground water. Treatment of approximately 0.2 gpm of ground water is estimated. The ground water treatment technologies are irreversible.

Residuals generated from ground water treatment would include vapor-phase carbon and solids.

Natural attenuation of organic constituents is irreversible and is expected to reduce the toxicity and volume of contaminated soil and ground water over time. No treatment residuals are associated with natural attenuation.

Alternative 4 - Ground water recovered during continuation of the IRM and, if necessary, as part of the contingency remedy alternative, would be treated using *ex situ* air sparging with recirculated vapor, and vapor-phase carbon adsorption. Treatment would continue until the shutdown criteria described in Section 4 are attained. Treated ground water would be discharged to the WCDEF POTW for further treatment. Additionally, natural attenuation of organic constituents in the subsurface is expected to continue over time. Treatment of ground water has also been performed as part of the IRMs at the site, as discussed in Section 1.4.

Ground water extraction and treatment would reduce the mobility, toxicity and volume of contaminated ground water at the site. During the approximate 6 1/2 year period that the ground water recovery IRM has been operated, an estimated 717 lbs of VOCs have been removed from the ground water.

The ground water treatment technologies are irreversible. Residuals generated from ground water treatment would include vapor-phase carbon and solids. Natural attenuation of organic constituents is irreversible and is expected to reduce the toxicity and volume of contaminated ground water over time. No treatment residuals are associated with natural attenuation.

Alternative 5 - Soil and ground water would be treated using *in situ* air stripping and air sparging. Vapor-phase emissions would be treated using carbon adsorption. Additionally, enhanced biodegradation of organic constituents via air stripping in the subsurface is expected to occur. Treatment would continue until the shutdown criteria described in Section 4 are attained. Additionally, natural attenuation of organic constituents in the subsurface is expected to continue over time.

Air sparging removes VOCs from the subsurface by volatilizing the VOCs and transporting them to the ground surface in the gaseous phase. If the injected air channels contact DNAPL, the VOCs would volatilize directly from the DNAPL to the air bubble. When the air channels contact ground water containing dissolved VOCs, then the VOCs will volatilize from the ground water into the air phase.

When air is injected into the saturated zone, the majority of the air contacts ground water. Only a small portion of the air would contact the DNAPL. Calculations for the former Sealectro site (Appendix E) demonstrate that less than 1% of the ground water flowing through the source area contacts DNAPL. It is unlikely that air would contact more DNAPL than the ground water. Therefore, since the majority of the air contacts ground water, the removal rate of VOCs from the subsurface by sparging will be dependent upon the mass of VOCs dissolved in the ground water.

Since the infected air is most frequently in contact with ground water, the ability of sparging to remove source material from the subsurface will be controlled by the mass of VOCs in the ground water. Increased concentrations of VOCs in ground water and/or higher rates of contaminated ground water flow past the injected air would result in higher removal rates by sparging.

The above theory of the mechanisms of air sparging has been presented in the literature by Unger *et. al.* (1995) and Johnson *et. al.* (1993). "Where NAPL is in contact with an air channel, contaminants will volatilize by direct evaporation from the NAPL surface. Given the postulated conceptual flow model, the greater contaminant mass will likely be located beyond the air channels in water saturated zones. Removal of this mass will depend upon diffusive transport to the air-water interface, which is inherently a slow process." (Johnson, *et. al.* 1993). "First, at early times, the gas phase directly contacts the DNAPL, ..., causing relatively rapid transfer of contaminant from the nonaqueous to the gas phase and subsequent removal by the vacuum extractor. Second, at later times, remediation is controlled by the transfer of contaminant from the nonaqueous phase to the aqueous phase below the water table." (Unger *et. al.* 1995).

In situ air stripping and air sparging would reduce the toxicity and volume of contaminated soil and ground water at the site. These treatment technologies are irreversible. Residuals generated would include vapor-phase carbon.

Natural attenuation of organic constituents is irreversible and is expected to reduce the toxicity and volume of contaminated soil and ground water over time. No treatment residuals are associated with natural attenuation.

5.2.5. Short-term effectiveness

The short-term effectiveness criterion addresses (a) the protection of workers and the community during construction and implementation of each alternative, (b) environmental effects resulting from the implementation of each alternative, and (c) the time required to achieve the remedial objectives. The individual analysis of each remedial alternative with respect to this criterion is presented in Table 5-1.

Alternative 1 - The no action alternative would be protective of the community under current and future site conditions. Alternative 1 would not limit contact with soil in the future. Ground water use would be restricted through the local ordinance.

No adverse environmental impacts are anticipated for Alternative 1. With respect to RAOs, Alternative 1 would provide for future protection of human health and the environment or site construction workers. Upon implementation, Alternative 1 would not cause the mobilization of DNAPL. However, VOCs in the ground water would continue to migrate.

Alternative 2 - The institutional actions alternative would be protective of the community through institutional controls. The community would be restricted from access to the site through fencing and deed restrictions. Ground water use would be restricted through the local ordinance. Appropriate protective equipment would be used during monitoring and inspection activities for protection of workers.

No adverse environmental impacts are anticipated for Alternative 2. Alternative 2 would achieve RAOs upon implementation. Alternative 2 would provide for protection of human health and the environment, limit construction worker contact with site soils, and avoid activities which could cause the mobilization of DNAPL. VOCs in the ground water would continue to migrate.

Alternative 3 - The containment via slurry wall alternative would be protective of the community through institutional controls. The community would be restricted from access to the site through fencing and deed restrictions. Ground water use would be restricted through the local ordinance. Contaminant transport would be mitigated during slurry wall construction to minimize community impacts. Appropriate protective equipment would be used during monitoring and inspection activities for protection of workers.

Alternative 3 would achieve RAOs upon implementation. Alternative 3 would provide for protection of human health and the environment, limit construction worker contact with site soils except during construction of the slurry wall.

Alternative 4. The ground water monitoring and contingency remedy would be protective of the community through institutional controls. The community would be restricted from access to the site through fencing and deed restrictions. Ground water use would be restricted through the local ordinance. Appropriate protective equipment would be used during monitoring and inspection activities for protection of workers.

Alternative 4 would achieve RAOs upon implementation. Alternative 4 would provide for protection of human health and the environment, limit construction worker contact with site soils, and avoid activities which could cause the mobilization of contaminants.

Alternative 5. With the *in situ* air stripping/air sparging alternative, there is a potential for uncontrolled migration of subsurface contaminants volatilized by air sparging to indoor building air. The community would be restricted from access to the site through fencing and deed restrictions. Ground water use would be restricted through the local ordinance. Treatment of off-gases would be controlled as necessary for community protection. Appropriate protective equipment would be used during monitoring and inspection activities for protection of workers.

Alternative 5 would achieve RAOs upon implementation. Alternative 5 would provide for protection of human health and the environment, and limit construction worker contact with site soils except during construction of the remedial system. The construction activities could exacerbate the current distribution of contaminants and migration of contaminants while the operation of the remedy would not be expected to disturb the distribution of contaminants.

5.2.6. Implementability

The analysis of the implementability of the remedial alternatives involved assessment of the following:

- Ability to construct and operate the technologies;
- Reliability of the technologies;
- Ease of undertaking additional remedial action;
- Ability to monitor the effectiveness of each action;
- Ability to obtain any approvals necessary from other regulatory agencies; and
- Availability of services, capacities, equipment, materials and specialists.

Results of the evaluation of implementability for each remedial alternative are summarized in Table 5-1.

Coordination with and cooperation of the property owner at the time the remedial activities are implemented is a factor which affects the implementability of each alternative. Contaminated soils are located beneath the building at the site and beneath paved areas; these structures are currently being used.

Alternative 1 - With a minimal level of cooperation from the property owner for five-year reviews, the no action alternative would be readily implementable.

Alternative 2 - With a level of cooperation higher than that required for Alternative 1 from the property owner, the institutional actions alternative would be readily implementable. Fencing, deed restrictions, asphalt cover maintenance, and ground water monitoring could be reliably implemented. If necessary, additional remedial actions could be readily executed at the site. Legal coordination with the local government and the property owner would be necessary to put the deed restrictions in place.

Alternative 3 - With a significant level of cooperation from the property owner and NYSDEC, that may be difficult to obtain, the containment via slurry wall alternative would be implementable. Site constraints, such as proximity to river, underground utilities, and aboveground structures and pavement, would make the slurry wall construction difficult. Coordination with NYSDEC would be required relative to river disturbance. A recovery well could be reliably installed and operated. Only minor modification of the existing ground water treatment system would be needed. Fencing, deed restrictions, asphalt cover maintenance, and ground water monitoring could be reliably implemented. Ground water monitoring would provide the means to monitor the site conditions over time. Legal coordination with the local government and the property owner would be necessary to put the deed restrictions in place. Coordination with the WCDEF POTW would be needed for discharge of treated ground water to the POTW. POTW capacity and off-site disposal facility capacity for treatment residuals (spent carbon, solids, and NAPL) are anticipated to be available.

Alternative 4 - With a reasonable level of cooperation of the property owner, minimally increased from that for Alternative 2, the ground water monitoring and contingency remedy alternative would be implementable. Ground water monitoring would provide the means to monitor the site conditions over time. If necessary, contingency remedial actions could be readily executed at the site. Pumps and piping to existing wells could be reliably operated. Only minor modification of the existing ground water treatment system would be needed. Fencing, deed restrictions, asphalt cover maintenance, and ground water monitoring could be reliably implemented. Legal coordination with the local government and the property owner would be necessary to put the deed restrictions in place. Coordination with the WCDEF POTW would be needed for discharge of treated ground water to the POTW. POTW capacity and off-site disposal facility for treatment residuals (spent carbon, solids, and NAPL) are anticipated to be available.

Alternative 5. With a significant level of cooperation from the property owner, that may be difficult to obtain, the *in situ* air stripping/air sparging alternative would be implementable. Wells and air stripping/air sparging systems could be reliably installed and operated. Fencing, deed restrictions, asphalt cover maintenance, and ground water monitoring could be reliably implemented. Ground water monitoring would provide the means to monitor the site conditions over time. Legal coordination with the local government and the property owner would be necessary to put the deed restrictions in place. Off-site disposal facility capacity for treatment residuals (spent carbon, solids, and NAPL) is anticipated to be available.

5.2.7. Cost

The objective of evaluating costs during the detailed analysis of the alternatives was to facilitate comparative analyses among the alternatives.

Cost estimates were prepared for each remedial alternative based on vendor information and quotations, cost estimating guides, and engineering experience. Both capital and O&M costs were estimated. Capital costs are those required to construct a remedy and include both direct and indirect capital costs. O&M costs are those which are expected to be incurred yearly throughout implementation of the remedy. Total capital and O&M costs were estimated for each remedial alternative. The present worth value of the O&M costs, which represents the amount of money that, if invested in the base year and disbursed as needed would be sufficient to cover future costs associated with the action, were also determined. In accordance with recommendations in USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, dated October 1988, present worth costs were calculated using a 5% discount rate.

Detailed cost estimates for the remedial alternatives are presented in Tables 5-4 through 5-8 Although these cost estimates are considered preliminary, they are sufficiently detailed for purposes of comparing the remedial alternatives presented in the FS. Cost estimates for the selected remedial alternative will be refined during remedial design.

For Alternative 4, capital and operating costs for an assumed contingency remedy are included in the cost estimates, though these costs would only be incurred if the contingency remedy is implemented. For the purpose of O&M costs associated with the contingency remedy, it was assumed that the contingency remedy would be triggered in year 5.

A summary of the estimated total capital, total annual O&M, and total present worth costs for each alternative is presented in Table 5-4.

Table 5-4. ***Total estimated costs***

Alternative	Capital (x 1000)	O&M (x 1000)	30-Year Present Worth (x 1000)
1 (No action)	$102	10 (Years 1-30)	$130
2 (Institutional actions)	$123	$51 (Years 1-5) $20 (Years 5-30)	$540
3 (Containment via slurry wall)	$2,700	$191 (Years 1-5) $125 (Years 5-15) $110 (Years 15-30)	$4,600
4(Ground water monitoring and contingency remedy)*	$182	$134 (Years 1-5) $122 (Years 5-30)	$2,100

Table 5-4. *Total estimated costs*

Alternative	Capital (x 1000)	O&M (x 1000)	30-Year Present Worth (x 1000)
5 (*In situ* air stripping/ air sparging)	$962	$206 (Years 1-10) $20 (Years 10-30)	$2,400

*Note: Costs for Alternative 4 assume contingency remedy triggered. Bulk of capital costs are associated with contingency remedy.

Source: O'Brien & Gere Engineers, Inc.

5.2.8. Supporting agency acceptance

Supporting agency acceptance will be documented in the proposed remedial action plan (PRAP) and the ROD.

5.2.9. Community acceptance

Community acceptance will be documented in the ROD based on public comment received during the public comment period following NYSDEC presentation of the PRAP.

5.3. Comparative analysis of remedial alternatives

In the comparative analysis of the remedial alternatives, the performance of each alternative was evaluated relative to each of the others with respect to each of the evaluation criterion. Comparisons are documented in the following subsections.

5.3.1. Overall protection of human health and the environment

Current and future site conditions pose estimated risks to human health which are within acceptable guidelines. Further, although ground water discharges to the Sheldrake River, risks associated with the discharges are estimated to be within acceptable guidelines. As discussed in Section 1.4, several IRMs have been performed at the site to address known sources of contamination. Approximately 1830 lbs of VOCs have been removed through IRMs. As discussed in Section 2.3, it is technically impractical to reduce the remaining VOCs in the soils and ground water at the site to chemical-specific SCGs in the near future because of the site conditions and the presence of DNAPL in saturation in the soils.

Each alternative, except for the no action alternative, would provide equivalent protection through institutional actions. Deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil and the local ordinance limiting ground water use would preclude contact with contaminated ground water. Ground water monitoring would provide a means of checking site conditions over time for each alternative. Alternative 1 does not include ground water monitoring or a way in which to evaluate site conditions, other than the five-year review, nor does Alternative 1 provide means for limiting future contact with soil and would subsequently not provide future protection of human health and the environment.

Alternative 3 (containment via slurry wall) would provide for minimization of horizontal ground water migration, but would cause disturbance to the river channel and may mobilize DNAPL during construction. Alternative 4 (ground water monitoring and contingency remedy) would provide additional contaminant mass reduction with ground water extraction and treatment and would limit contaminant migration during system operation. Alternative 5 (*in situ* air stripping/air sparging) would also provide additional contaminant mass reduction with soil and ground water treatment. However, this alternative may result in a potential for impacts to indoor air quality with possible volatilization of subsurface organic contaminants from air sparging wells. During installation of wells, DNAPL may also be mobilized.

5.3.2. Compliance with SCGs

With respect to chemical-specific SCGs, neither NYS Class GA ground water standards nor NYSDEC soil cleanup objectives would be attained in the near future by any of the five alternatives. The site conditions, which prevent attainment of SCGs, and the current knowledge of and technologies available for remediation of DNAPL are discussed in Section 2. If necessary, the criteria of the TI waiver would be met for non-attainment of chemical-specific SCGs for each alternative.

NYS floodplain management regulations (6 NYCRR 500) and NYS hazardous waste floodplain requirements (6 NYCRR 373-2) would be location specific SCGs associated with each alternative. Although NYS permits would not be required for on-site work under the ACO, implementation of each of these alternatives would be consistent with substantive portions of these regulations.

No action-specific SCGs were identified for Alternative 1. OSHA regulations would be potential action-specific SCGs for Alternatives 2 through 5. The activities conducted during the implementation of each of these alternatives would be consistent with OSHA requirements. NYS hazardous waste regulations related to residual waste manifesting, transport, and disposal and DOT transport requirements would be potentially applicable action-specific SCGs for Alternatives 3, 4, and 5.

CWA pretreatment regulations and WCDEF POTW discharge limitations would be potential action-specific SCGs for POTW discharge in Alternatives 3 and 4; these requirements would be met. NYS stream encroachment permit requirements (6 NYCRR 608) and local soil erosion and sediment control requirements would be potentially applicable to slurry wall construction in Alternative 3; a plan would be developed in accordance with the soil erosion sediment control requirements as necessary. Although a NYS hazardous waste management facility permit would not be required under the ACO for on-site work, management of ground water and residuals would be consistent with the substantive requirements of these regulations for Alternatives 3, 4, and 5. For Alternative 3, although a NYS permit would not be required for on-site work under the ACO, construction of the slurry wall would be consistent with substantive portions of these regulations.

Therefore, each alternative would attain location-specific and action-specific SCGs. Each alternative would meet the criteria for a TI waiver for chemical-specific SCGs.

5.3.3. Long-term effectiveness and permanence

The magnitude of residual risk to human health under current site conditions is estimated to be within acceptable guidelines. Further, although ground water discharges to the Sheldrake River, risks associated with the discharges are estimated to be within acceptable guidelines. As discussed in Section 1.4, several IRMs have been performed at the site to address known sources of contamination. As discussed in Section 2.3, it is technically impractical to reduce contaminant mass further to attain chemical-specific SCGs.

The magnitude of residual risk is currently estimated to be within acceptable guidelines for each of the alternatives. Alternative 1, no action, would not provide for future limits on contact with ground water through the local ordinance. For Alternatives 2, 3, 4, and 5, deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil, and the local ordinance limiting ground water use would preclude contact with contaminated ground water. Each of these controls is an adequate and reliable control for restriction of contact with soil or ground water and would provide long-term effectiveness. Ground water monitoring is an adequate and reliable means of tracking site conditions over time for Alternatives 2, 3, 4, and 5.

In Alternative 3, the slurry wall would minimize the horizontal migration of ground water at the site. A slurry wall is an adequate and reliable containment technology. However, the slurry wall would reduce the rate of attenuation of the contaminants when compared to the other four alternatives. This reduced rate of attenuation is due to the reduced rate of ground water flow through the source areas. Alternative 4, ground water monitoring and contingency remedy, would be somewhat effective in reducing contaminant mass at the site and is an adequate and reliable technology. Alternative 5, *in situ* air stripping/air sparging, would be somewhat effective in reducing contaminant mass at the site over a limited time period.

The rate of ground water flow through the source area and the rate of VOC removal from the ground water will govern the rate of DNAPL mass reduction. The rate of VOC mass reduction may be greater for Alternative 5 than for Alternative 4 for a short period of time. However, long-term effectiveness evaluations indicate that Alternative 5 would not be expected to meet SCGs in a significantly shorter period of time than Alternative 4.

5.3.4. Reduction of toxicity, mobility or volume through treatment

Treatment of ground water has been performed as part of the IRMs at the site, as discussed in Section 1.4. Alternatives 1 and 2, the no action and institutional actions alternatives, do not include active treatment technologies. However, as in each of the alternatives, natural attenuation of organic constituents in the subsurface is expected to continue over time. Natural attenuation of organic constituents is irreversible and is expected to reduce the toxicity and volume of contaminated soil and ground water over time. No treatment residuals are associated with natural attenuation.

Alternative 3 would provide a reduction of contaminant mobility with installation of the slurry wall, and would provide for treatment of approximately 0.2 gpm of ground water using irreversible oil/water separation, bulk air stripping with recirculated vapor, and vapor-phase carbon adsorption technologies. The implementation of these technologies would result in the generation of spent carbon, and solids residuals. Further treatment would be provided at the POTW. Alternative 4 would provide for reduction of toxicity, mobility, and volume with ground water extraction and treatment if the contingency remedy is implemented. Ground water would be treated using the same technologies as in Alternative 3, including the POTW, and would generate similar residuals. Alternative 5 would provide for reduction of soil and ground water toxicity, mobility, and volume with *in situ* air stripping and air sparging. Spent vapor-phase carbon residual management would be necessary for Alternative 5.

5.3.5. Short-term effectiveness

Short-term effectiveness relates to protection of community and workers during remediation, the potential environmental impacts of remediation, and the time required to achieve RAOs. The estimated risks posed by current and future site conditions to human health are within EPA's acceptable guidelines. Alternative 1, no action, would not limit contact with soil in the future; however, it would limit future contact with ground water through the local ordinance. In Alternatives 2 - 5 , the community would be restricted from access to the site through fencing and deed restrictions and from use of ground water through the local ordinance. Appropriate protective equipment would be used by workers during remedial activities in Alternatives 2, 3, 4, and 5. Further, appropriate mitigation methods would be used to minimize off-site contaminant transport during construction and minimize environmental impacts. Alternatives 3 and 4 would not pose risks to the community or workers. There may be a potential to mobilize DNAPL during construction activities for Alternatives 3 and 5. There may be a potential during operation of Alternative 5 for VOCs mobilized during air sparging to migrate into indoor building air. No adverse environmental impacts are anticipated for Alternatives 1, 2, or 4.

With respect to RAOs, Alternative 1 would not provide for future protection of human health and the environment or site workers. Alternatives 1, 2, and 4 would not cause the mobilization of contaminants. Alternatives 2, 3, 4, and 5 would achieve RAOs upon implementation.

Alternatives 2 and 4 would provide for protection of human health and the environment, limit construction worker contact with site soils, and avoid activities which could cause the mobilization of contaminants. Alternatives 3 and 5 may mobilize DNAPL during construction.

5.3.6. Implementability

Coordination and cooperation of the property owner at the time of remedial activities is a factor which affects the implementability of each alternative. Contaminated soils are located beneath the on-site building and the asphalt pavement, both of which are currently being used by tenants. As a result of the significant amount of construction involved, alternatives 3 and 5 would require an inordinate level of cooperation from the property owner and the existing tenants, while Alternatives 1, 2, and 4 would require less cooperation from the property owner.

The following components of Alternatives 2, 3, 4, and 5 could be readily implemented with cooperation of the property owner: fencing, asphalt cover maintenance, and ground water monitoring. Legal coordination with the local government and the property owner would be necessary to put the deed restrictions in place and maintain the local ordinance restricting ground water use.

Alternatives 1 2, and 4 would, therefore, be readily implementable with the cooperation of the property owner. For Alternative 3, site constraints, such as proximity to river, underground utilities, and above ground structures and pavement, would make construction of the slurry wall difficult, and coordination with NYSDEC would be required relative to river disturbance. For Alternative 3, a recovery well could be reliably installed and operated, and only minor modification of the existing ground water treatment may be needed. Alternatives 3 and 4 would require coordination with the WCDEF POTW for discharge of treated ground water to the POTW. POTW capacity and off-site disposal facility capacity for treatment residuals are anticipated to be available. For Alternative 4, should the contingency remedy be implemented, modifications of the existing ground water treatment system may be needed. The *in situ* air stripping/air sparging systems in Alternative 5 could be reliably installed and operated; although well installation could be restricted by property use and underground utilities. Off-site disposal facility capacity for residuals is anticipated to be available.

5.3.7. Cost

Capital, O&M, and total present worth costs for each alternative were estimated. For the purposes of cost estimates, it was assumed that the treatment components of Alternative 5 would be operated for 10 years, while the contingency remedy component of Alternative 4 would commence in year 5 for a duration of 25 years. It was further assumed that the remaining O&M components of each alternative would continue over a 30-year period.

Alternative 1 is the least expensive alternative. Of the action alternatives, Alternative 2 is least expensive; Alternative 3 is most expensive on a 30-year present worth basis, and Alternative 5 is more expensive than Alternative 4.

A cost comparison of alternatives is presented as follows:

Table 5-5. ***Total estimated costs***

Alternative	Capital (x 1000)	O&M (x 1000)	30-Year Present Worth (x 1000)
1 (No action)	$102	10 (Years 1-30)	$130
2 (Institutional actions)	$123	$51 (Years 1-5) $20 (Years 5-30)	$540
3 (Containment via slurry wall)	$2,700	$191 (Years 1-5) $125 (Years 5-15) $110 (Years 15-30)	$4,600
4(Ground water monitoring and contingency remedy)*	$182	$134 (Years 1-5) $122 (Years 5-30)	$2,100
5 (*In situ* air stripping/ air sparging)	$962	$206 (Years 1-10) $20 (Years 10-30)	$2,400

*Note: Costs for Alternative 4 assume contingency remedy triggered. Bulk of capital costs are associated with contingency remedy.

Source: O'Brien & Gere Engineers, Inc.

5.3.8. Supporting agency acceptance

Supporting agency acceptance will be documented in the PRAP and the ROD.

5.3.9. Community acceptance

Community acceptance will be documented in the ROD following the public comment period.

6. Summary and conclusions

This FS was completed for the former ITT-Sealectro Inc. facility (Site #360027) in Mamaroneck, New York. This FS fulfills the requirements of the ACO dated October 8, 1992.

This FS was based upon the investigation results and RA presented in the RI Report which was approved by the NYSDEC in August 1995. This RI Report documented the nature and extent of contamination at the site. Seven areas of concern were evaluated during the RI and of these seven areas, three were eliminated from consideration in the FS. The areas eliminated were: the Former Drum Storage Area, the Wastewater Treatment Area, and the Sheldrake River. The former Drum Storage Area contained VOCs in the unsaturated zone soils, but a pilot *in situ* air stripping program successfully reduced VOC concentrations. Furthermore the potential risk associated with the remaining VOCs is estimated to be within acceptable guidelines and within the ranges set by the USEPA and NCP.

The Wastewater Treatment Area was eliminated from further consideration because localized concentrations of copper and nickel were the only impacts identified. The potential risk associated with these localized inorganics is estimated to be within acceptable guidelines set by the USEPA and NCP.

With regard to the Sheldrake River, no impacts related to the site could be distinguished from the already degraded nature of the river. Therefore the Sheldrake River was not considered in the FS.

The Fuel Oil UST Area was the site of a LNAPL recovery operation. The mobile LNAPL has been recovered and the system was shut down in 1995. No ground water impacts were identified in this area and the bulk of the impacted soil was removed during an IRM completed in 1992. The potential risk associated with the remaining petroleum hydrocarbons in the soil is estimated to be within acceptable guidelines set by the USEPA and NCP.

The Solvent UST Area and the Shed Area were addressed as one area because of the similarity in the types of VOCs and the proximity of the areas to one another. The RI contained documentation that the subsurface soil in both areas has been impacted by VOCs and DNAPL. The horizontal and vertical extent of the DNAPL has been defined.

The final area of concern is the ground water. The data collected during the RI verified the presence of VOCs in the ground water on the site. The source of the VOCs is the DNAPL present in the Solvent UST and Shed Areas. The horizontal extent of the VOCs in the ground water is generally coincident with the property boundary. The VOCs in ground water occur in the two overburden ground water zones, and do not appear to extend into bedrock. This conclusion is based upon: 1) the lower VOC concentration on the top of bedrock in MW-2D; 2) the vertical extent of DNAPL and VOCs in the soils documented in the RI Report; 3) the low permeability of the bedrock; 4) the discharge of the overburden ground water to the Sheldrake River; and 5) the expected discharge of ground water in the bedrock to the overburden in the vicinity of the Sheldrake River. Even if minor impacts had occurred, the fact that the Mamaroneck area is serviced by public water eliminates a potential exposure route. The site ground water discharges to the Sheldrake River along the northern edge of the property. No impact to the Sheldrake River was documented. The potential risk associated with the ground water discharge to the Sheldrake River is estimated to be within acceptable guidelines.

Interim remedial actions were completed at the site to address known areas of contamination. The IRMs included soil removal, UST removal, LNAPL recovery, ground water recovery, and pilot *in situ* air stripping program. These IRMS removed an estimated 1830 pounds of VOCs from the site which represent about 52% of the original mass of VOCs in the subsurface at the site.

A RA was completed during the RI and is contained in the NYSDEC-approved RI Report. This RA identified four complete exposure pathways: current and future on-site worker inhalation of vapors migrating from the subsurface soils and ground water to indoor air, future on-site workers' contact with ambient dust and vapors, future on-site workers' direct contact with subsurface soils, and ground water discharge to the Sheldrake River. The potential risk associated with each of these complete exposure pathways was examined and documented in the NYSDEC-approved RA. For each of these pathways, the potential risks were estimated to be within acceptable guidelines set forth by the USEPA and the NCP.

The RI concluded that the estimated risks associated with the site were within acceptable guidelines. Since there are no unacceptable risks posed by current or future conditions at the site, there is no risk-based need for further remediation at the site. Accordingly, the elimination or reduction of risk will not be considered a remedial action objective for the site.

There are various site conditions which make the implementation of any remedial alternative difficult. These conditions include above ground physical restrictions, subsurface utilities, geological conditions, distribution of contaminants, and legal access limitations. The presence of a building and underground utilities and the proximity of the Sheldrake River and Hoyt Street to the site mean that there is only about one quarter of an acre of accessible space on each side of the building for remedial activities.

Neither the current site owner nor the tenants are party to the ACO with the NYSDEC. Therefore, the ability of the responsible parties under the ACO to access the site is restricted. The use of the site by the owner and the tenants limits the nature and types of remedial activities which could occur on the site without disruption to their operations.

It was documented in the RI report that the subsurface geology and the distribution of DNAPL are heterogeneous. The DNAPL occurs as residual material in the soil lenses and it is currently immobilized within the pore spaces. No pools of DNAPL, which could be recovered by pumping, were encountered during the site investigations. The distribution of DNAPL observed at the site is consistent with the theoretical understanding in the scientific literature of the migration and occurrence of DNAPLs in the subsurface.

An estimated 85% of the soil that contains DNAPL is located below the ground water table and an estimated 41% of the soils containing DNAPL are located beneath the building. These conditions significantly limit the ability to remediate the site.

The current technical literature recognizes that the presence of DNAPL significantly limits the ability to remediate sites to meet identified cleanup goals. The recognition that DNAPLs will prevent the full restoration of a contaminated aquifer is based upon the difficulties associated with the removal of residual DNAPL in saturated soils. Currently excavation is the only remedial technology which has been demonstrated to successfully remove sufficient DNAPLs from the subsurface to allow the ground water at the site to meet SCGs in the near future.

Site specific calculations were completed to evaluate the effectiveness of potential site remedial activities. Removal of a portion of the source will reduce the ultimate period of time needed for ground water quality to meet standards. However, even assuming one could remove 95% of the VOCs in the subsurface, ground water quality would not be expected to meet SCGs within decades. Since there is no remedial technology currently available to ensure that soil and ground water at the site will meet SCGs in the near future, it is not appropriate to expect the site to meet the SCGs. Therefore a waiver of the chemical specific SCGs may be necessary for the site.

The RAOs for the former Sealectro site were developed with the goal of protecting workers and the environment and improving current site conditions. The following RAOs have been developed for the site:

- Protection of human health and the environment
- Limit construction worker contact with the site soils
- Avoid site activities which could exacerbate the current distribution of contaminants and migration of contaminants.

Potential remedial technologies for soil and ground water were screened with respect to effectiveness, reliability and potential effects on human health and the environment. *Ex situ* technologies were eliminated because 41% of the soil with DNAPL is located beneath the building and physical and legal constraints would prevent effective remediation.

A number of the *in situ* remedial technologies were screened out due to lack of demonstrated effectiveness, site constraints, and potential to spread contamination. For example, bioremediation was screened out because of the difficulty associated with achieving consistent distribution of nutrients and oxygen in the subsurface, because DNAPL is toxic to organisms, and because incomplete biodegradation could result in unwanted daughter products.

Surfactant flushing and steam injection were screened out because of limited effectiveness and the potential for remobilization of the residual

DNAPL and the subsequent uncontrolled migration of the DNAPL off-site or to the bedrock.

As a result of the technology screening, five remedial alternatives were identified for detailed evaluation. The five remedial alternatives were: 1) No Action; 2) Institutional actions; 3) Containment via slurry wall; 4) Ground water monitoring and contingency remedy; and 5) *In situ* air stripping and air sparging. Each of these alternatives was evaluated with respect to the following nine criteria:

Overall protection of human health and the environment. Because the estimated risks posed by current site conditions pose estimated risks to human health and ecological receptors are within acceptable guidelines, all five alternatives are equally protective of human health.

For Alternatives 2, 3, 4, and 5, deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil, and the local ordinance limiting ground water use would preclude contact with contaminated ground water. Ground water monitoring would provide a means of checking site conditions over time for each alternative. Alternative 1 does not eliminate the potential for contact with contaminated soil because it does not include institutional controls.

Compliance with SCGs. Location-and action-specific SCGs would be met by each of the five alternatives. With respect to chemical-specific SCGs, neither NYS Class GA ground water standards nor NYSDEC soil cleanup objectives would be attained in the near future by any of the five alternatives. It will not be possible for any of the alternatives to meet SCGs for decades because of the presence of DNAPL. Site conditions meet the criteria for an SCG waiver.

Long-term effectiveness and permanence. The risks posed by current and future conditions at the site are estimated to be within the acceptable guidelines set forth by the USEPA and the NCP. Alternative 1 would not limit contact with soil in the future; however, it would provide for future limits on contact with ground water through the local ordinance. For Alternatives 2, 3, 4 and 5, deed restrictions, fencing, and asphalt cover maintenance would minimize the potential for contact with contaminated soil, and the local ordinance limiting ground water use would preclude contact with contaminated ground water except during construction of the remedy for Alternatives 3 and 5. Each of these institutional controls is an adequate and reliable control for restriction of contact with soil and ground water. Ground water monitoring is an adequate and reliable means of tracking site conditions over time. Alternatives 2, 3, 4, and 5 would provide similar levels of long term effectiveness and permanence. Due to the lack of institutional controls, Alternative 1 would provide less long term effectiveness and permanence.

The presence of DNAPL at the site limits the ability of any active remedial technology to provide greater long term effectiveness and/or permanence than natural attenuation. The effectiveness evaluation presented in Section 2 demonstrates that site remediation will require a significant time period of time. Furthermore, additional mass removal activities, would not enable the site to meet SCGs in a significantly shorter period of time than natural attenuation.

Alternative 3 would reduce the rate of attenuation of the contaminants relative to the other alternatives. Alternative 4, ground water monitoring and contingency remedy, and Alternative 5, *in situ* air stripping/air sparging, would provide for some short term reduction in contaminant mass at the site to the extent that it is technically practicable.

Reduction of toxicity, mobility or volume through treatment. Alternatives 1 and 2, the no action and institutional actions alternatives, do not include active treatment technologies. However, toxicity and volume will be reduced through natural attenuation. Alternative 3 would provide for reduction of contaminant mobility with slurry wall installation, and would provide for some minimal treatment of approximately 0.2 gpm of ground water via *ex situ* air stripping with recirculated vapor, and vapor-phase carbon adsorption technologies. This treatment would generate spent carbon and solids residuals. Alternative 4 would provide for reduction of ground water contaminant toxicity, mobility and volume with localized ground water recovery in the solvent UST areas and, if necessary, in areas where the VOC concentrations exceed the trigger levels. An estimated 10-20 gpm of ground water would be treated using the same technologies and would generate similar residuals as for Alternative 3. Alternative 5 would provide for reduction of soil and ground water toxicity and volume via *in situ* air stripping and air sparging for up to 10 years. Spent vapor-phase carbon residual management would be necessary for Alternative 5.

For each of the alternatives natural attenuation of organic constituents in the subsurface is expected to continue over time. Natural attenuation of organic constituents is irreversible and is expected to reduce the toxicity and volume of contaminated soil and ground water over time. No treatment residuals are associated with natural attenuation.

Short-term effectiveness. For Alternatives 2, 3, 4, and 5 the community would be restricted from access to the site through fencing and deed restrictions and from use of ground water through the local ordinance. Alternative 1 would not provide for these institutional controls. Appropriate protective equipment would be used during the construction activities associated with each alternative for the protection of workers. Further, appropriate mitigation methods would be used to minimize contaminant transport during construction activities associated with each alternative.

With respect to RAOs, upon implementation, Alternatives 2 and 4 would provide for protection of human health and the environment, limit construction worker contact with site soils, and avoid activities which could distrub the DNAPL and cause migrattion of contaminants. Alternative 1 would provide protection of human health and the environment but would not limit construction worker contact with site soils. Alternatives 3 and 5 would not limit construction worker contact with site soils during remedy construction and could mobilize DNAPL. Alternative 5 could impact indoor air quality.

Implementability. Coordination and cooperation of the property owner at the time of remedial activities is a factor which significantly affects the implementability of each alternative. Contaminated soils are located beneath the building and the paved areas, and both of these areas are currently being used. Long-term property access agreements would be required to implement the ground water monitoring program, which is a component of each alternative.

The following components of each alternative could be readily implemented with cooperation of the property owner: fencing, asphalt cover maintenance, and ground water monitoring. Legal coordination with the local government and the property owner would be necessary to put the deed restrictions in place and maintain the local ordinance restricting ground water use. For alternatives 1, 2 and 4, additional remedial actions could be readily executed at the site if necessary. Further, ground water monitoring would provide the means to monitor the site conditions over time in each alternative.

Alternatives 1, 2, and 4 would be readily implementable with the cooperation of the property owner. For Alternative 3, site constraints, such as proximity to river, underground utilities, and above ground structures and pavement, would make the construction of the slurry wall difficult and coordination with NYSDEC would be required relative to river disturbance. This alternative would require the greatest amount of owner cooperation due to the amount of construction required. Alternative 5 requires the installation of 20 wells inside and under the building and would likewise require significant cooperation from the Owner.

For Alternative 4, the existing monitoring wells and treatment system could be easily modified to implement ground water recovery in the event that the trigger levels are exceeded. Alternatives 3 and 4 would require coordination with the WCDEF POTW for discharge of treated ground water to the POTW. POTW capacity and off-site disposal facility capacity for residuals are anticipated to be available. The air stripping/air sparging systems in Alternative 5 could be reliably installed and operated; well installation could be restricted by building use and underground utilities. Off-site disposal facility capacity for residuals is anticipated to be available.

Cost. On a 30-year present worth basis, Alternative 1 is the least expensive alternative ($550,000). Of the action alternatives, Alternative 2 is the least expensive, Alternative 3 is the most expensive on a 30 year present worth basis, and Alternative 5 is more expensive than Alternative 4.

Support agency acceptance. Supporting agency acceptance will be documented in the PAP and the ROD.

Community acceptance. Community acceptance will be documented in the ROD following the public comment period.

Five different remedial alternatives for the former ITT-Sealectro site were evaluated in this FS. Alternative 3 (containment via slurry wall) is the most expensive alternative and provides the lowest rate of contaminant mass removal. Alternative 5 (*in situ* air stripping/ air sparging) provides some short term mass removal, but is more costly and harder to implement than Alternative 4 (ground water monitoring and contingency remedy). In addition Alternative 5 could mobilize the contaminants during the installation of the remedial system. Alternative 2 (institutional controls) and Alternative 4 (ground water monitoring and contingency remedy) provide similar levels of protection of human health and the environment and meet the RAOs established for the site. Alternative 2 is less costly than Alternative 4. Alternative 4 provides for contingent ground water recovery and thus greater control and treatment of VOCs. Because of the greater VOC control provided by the contingency remedy, Alternative 4 is the recommended alternative.

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Tables

Table 2-1. *Potential chemical-specific SCGs*

Potential SCGs	Summary of Requirements
Class GA Ground Water Quality Standards (6 NYCRR 703)	These regulations provide a compilation of ambient ground water quality standards and guidance values for toxic and non-conventional pollutants for use in NYSDEC programs.
NYSDEC TAGM #4046 - Determination of Soil Cleanup Objectives and Cleanup Levels (January 24, 1994); proposed revision dated April 1995	This TAGM establishes cleanup objectives and cleanup levels for Federal Superfund, State Superfund, 1986 EQBA Title 3 and Responsible Party (RP) sites in New York State. The cleanup objectives and cleanup levels presented in TAGM #4046 are not promulgated.

Notes:

SCG: Standards, Criteria, and Guidelines
TAGM: New York State Technical and Administrative Guidance Memorandum
NYCRR: New York Code of Rules and Regulations

Table 2-2 - Comparison of Monitoring Data to Potential chemical specific SCGs for ground water

Chemical	Frequency of detection	Minimum detected conc. (ug/L)	Maximum detected conc. (ug/L)	Mean conc. (1) (ug/L)	Minimum detection limit (ug/L)	Maximum detection limit (ug/L)	Ground water standards (ug/L)	Comments
1,1,1-Trichloroethane	113 / 214	1	18000	684.4	1	500	5 (3)	Maximimum and Mean above SCG
1,1,2,2-Tetrachloroethane	1 / 214	28	28	16.9	1	500	5 (3)	Minimum and Maximum above SCG
1,1,2-Trichloroethane	8 / 214	1	5	16.8	1	500	5 (3)	Maximum and Mean above SCG
1,1-Dichloroethane	129 / 214	1	1100	38.3	1	500	5 (3)	Maximimum and Mean above SCG
1,1-Dichloroethene	63 / 214	1	670	46.9	1	500	5 (3)	Maximimum and Mean above SCG
1,2-Dichloroethane	5 / 214	1	20	16.9	1	500	5 (3)	Maximimum and Mean above SCG
1,2-Dichloroethene (total)	122 / 214	1	1100	54.3	1	500	5 (3)	Maximimum and Mean above SCG
2-Butanone	2 / 16	14	14	1.1	10	50	50 (2)	Not above SCG
Acetone	6 / 16	1	22	2.9	5	180	50 (2)	Not above SCG
Benzene	48 / 214	2	29	18.4	1	500	1 (3)	Minimum, Maximimum, and Mean abov
Bromodichloromethane	3 / 214	1	2	16.7	1	500	50 (2)	Not above SCG
Carbon Disulfide	2 / 9	0.7	4	0.9	10	50	NA	SCG not available
Chloroethane	28 / 212	1	330	20.0	1	500	5 (3)	Maximimum and Mean above SCG
Chloroform	16 / 211	1	18	17.4	1	500	7 (3)	Maximimum and Mean above SCG
Dibromochloromethane	6 / 211	1	9	17.0	1	500	50 (2)	Not above SCG
Methylene Chloride	2 / 62	1.2	2	0.5	1	82	5 (3)	Not above SCG
Tetrachloroethene	134 / 214	1	6100	423.6	1	500	5 (3)	Maximum and Mean above SCG
Toluene	5 / 214	1	31	16.9	1	500	5 (3)	Maximum and Mean above SCG
Trans-1,3-Dichloropropene	5 / 214	1	56	17.0	1	500	5 (3)	Maximum and Mean above SCG
Trichloroethene	116 / 214	1	1600	53.8	1	500	5 (3)	Maximum and Mean above SCG
Vinyl Chloride	55 / 214	1	200	27.8	1	500	2 (3)	Maximum and Mean above SCG
Xylene (total)	1 / 214	1	9.1	5.6	1	1500	5 (3)	Maximum and Mean above SCG

Notes:

(1) Mean concentrations include 1/2 the detection limit for non-detects and therefore may exceed the maximum detected concentration.

(2) Guidance Value from Division of Water Technical and Operational Guidance Series 1.1.1 Ambient Water Quality Standards and Guidance Values.

(3) Ground water quality standard from 6 NYCRR 703.

SCGs - Standards, Criteria, and Guidelines

Table 2-3. Comparison of soil sampling data to potential chemical specific SCGs for soil

Chemical	Frequency of detection	Minimum detected conc. (mg/kg)	Maximum detected conc. (mg/kg)	Mean conc. (1) (mg/kg)	Minimum detection limit (mg/kg)	Maximum detection limit (mg/kg)	Recommended soil cleanup (3) (mg/kg)	Comments
1,1,1-Trichloroethane	35 / 81	0.0008	930	14.97	0.001	8.4	0.8	Maximum and Mean above SCG
1,1,2-Trichloroethane	1 / 72	0.003	0.003	0.68	0.001	32	NA	SCG not available
1,1-Dichloroethane	21 / 80	0	46	1.62	0.001	32	0.2	Maximum and Mean above SCG
1,1-Dichloroethene	5 / 73	0.004	0.51	0.45	0.001	32	0.4	Maximum and Mean above SCG
1,2-Dichloroethane	2 / 74	0.002	4.3	0.72	0.001	32	0.1	Maximum and Mean above SCG
1,2-Dichloroethene (total)	44 / 80	0.0009	100	2.31	0.001	8.4	0.3 (2)	Maximum and Mean above SCG
2-Methylnaphthalene	7 / 41	0.038	0.36	2.28	0.37	47	36.4	Not above SCG
2-Methylphenol	1 / 41	0.26	0.26	2.29	0.37	47	0.1	Minimum, Maximum, and Mean abo
4-Methylphenol	1 / 41	0.45	0.45	2.29	0.37	47	0.9	Mean above SCG
Acetone	24 / 73	0.006	1.5	0.72	0.0012	32	0.2	Maximum and Mean above SCG
Anthracene	4 / 41	0.051	0.63	2.25	0.37	47	50	Not above SCG
Aroclor-1254	1 / 2	0.94	0.94	0.92	1.8	1.8	10	Not above SCG
Benzene	11 / 73	0.001	2.6	0.67	0.001	32	0.06	Maximum and Mean above SCG
Benzo(a)anthracene	6 / 41	0.09	3.8	2.34	0.37	47	0.224	Maximum and Mean above SCG
Benzo(a)pyrene	9 / 41	0.12	4	2.35	0.37	47	0.061	Minimum, Maximum, and Mean abo
Benzo(b)fluoranthene	10 / 41	0.1	5.7	2.41	0.37	47	1.1	Maximum and Mean above SCG
Benzo(g,h,i)perylene	3 / 41	0.067	0.24	2.28	0.37	47	50	Not above SCG
Benzo(k)fluoranthene	6 / 41	0.069	2.3	2.29	0.37	47	1.1	Maximum and Mean above SCG
Bis(2-ethylhexyl)phthalate	7 / 31	0.14	1.4	2.91	0.38	47	50	Not above SCG
Butylbenzylphthalate	1 / 41	1.1	1.1	2.31	0.37	47	50	Not above SCG
Carbon Disulfide	8 / 54	0.001	0.005	0.90	0.011	32	2.7	Not above SCG
Chloroethane	1 / 73	0.009	0.009	0.68	0.001	32	1.9	Not above SCG
Chrysene	7 / 41	0.12	3.9	2.35	0.37	47	0.4	Maximum and Mean above SCG
Copper	41 / 43	7.4	2790	196.67	3.9	4.9	25	Maximum and Mean above SCG
Di-n-butylphthalate	4 / 35	0.076	0.11	2.62	0.37	47	8.1	Not above SCG
Dibenzofuran	1 / 41	0.093	0.093	2.28	0.37	47	6.2	Not above SCG
Ethylbenzene	8 / 75	0.005	5.1	0.75	0.001	32	5.5	Not above SCG
Fluoranthene	7 / 41	0.09	8	2.47	0.37	47	50	Not above SCG
Indeno(1,2,3-cd)pyrene	5 / 41	0.07	2.6	2.30	0.37	47	3.2	Not above SCG
Methylene Chloride	12 / 76	0.001	14	0.87	0.003	32	0.1	Maximum and Mean above SCG
Methylethyl Ketone	1 / 19	6.4	6.4	1.78	0.056	9.1	0.3	Minimum, Maximum, and Mean abo
Naphthalene	4 / 41	0.13	0.23	2.28	0.37	47	13	Not above SCG
Nickel	39 / 43	10.5	121	30.52	4.8	8.9	13	Maximum and Mean above SCG
Pentachlorophenol	1 / 41	1.1	1.1	5.99	0.4	120	1	Minimum, Maximum, and Mean abo
Phenanthrene	7 / 41	0.11	3	2.36	0.37	47	50	Not above SCG
Pyrene	7 / 41	0.081	6.2	2.43	0.37	47	50	Not above SCG
Tetrachloroethene	47 / 81	0.001	1200	48.27	0.001	8.4	1.4	Maximum and Mean above SCG
Toluene	35 / 80	0.0007	130	4.90	0.001	32	1.5	Maximum and Mean above SCG
Trichloroethene	35 / 75	0.0008	24	1.17	0.001	32	0.7	Maximum and Mean above SCG
Vinyl Chloride	2 / 73	0.008	0.009	0.68	0.001	32	0.2	Mean above SCG
Xylenes (total)	14 / 77	0.009	16	1.25	0.003	32	1.2	Maximum and Mean above SCG

Notes:

(1) Mean concentrations include 1/2 the detection limit for non-detects and therefore may exceed the maximum detected concentration.

(2) Cleanup level for trans-1,2-dichloroethene.

(3) Recommended Soil Cleanup Objectives from NYSDEC TAGM #4046 entitled Determination of Soil Cleanup Objectives and Cleanup Levels dated January 14, 1994 and propose dated April 1995.

SCG - Standards, Criteria, and Guidelines

Table 2-4. *Potential location-specific SCGs*

Potential SCGs	Summary of Requirements	Actions to be Taken to Satisfy Requirements
Floodplain Management (6 NYCRR 500)	Requires permit for development in a 100-yr floodplain. Requires construction in a floodplain be resistant to flood damage, andthat construction not cause an increase in flood levels within the community.	NYSDEC approval will be obtained for construction work in the 100-year floodplain. Actual permit will not be required under Consent Order.
Hazardous Waste Facility - Floodplains (6 NYCRR Part 373-2.2)	A facility located in a 100-yr floodplain must be designed, operated, and maintained to prevent washout of any hazardous waste by a 100-yr flood.	Site work will be done to prevent washout of hazardous wastes.

Notes:

NYCRR: New York Code of Rules and Regulations
SCGs: Standards, Criteria, and Guidelines

Table 3-1. *Screening of technologies and process options for soils.*

General response action	Remedial technology	Process option	Description	Screening comments
No Action	None	Not applicable	Not applicable	Potentially applicable
Institutional Actions	Access Restrictions	Fencing	Installation of a fence surrounding the area of contamination.	Already implemented.
		Deed Restrictions	Land use restrictions for the area of contamination.	Potentially applicable
Containment Actions	Cover	Asphalt	Asphalt cover over area of contamination to restrict direct contact and reduce infiltration.	Already implemented for most areas.
		Vegetated Soil	Soil and vegetation layer over area of contamination to restrict direct contact.	Not applicable; areas of contamination beneath facility buildings and paved asphalt areas.
		Clay	Clay and soil cover over area of contamination to restrict direct contact and precipitation infiltration.	Not applicable; areas of contamination beneath facility buildings and paved asphalt areas.
		Membrane	Membrane and soil cover over area of contamination to restrict direct contact and precipitation infiltration.	Not applicable; areas of contamination beneath facility buildings and paved asphalt areas.
	Vertical Barrier	Slurry Wall	Soil- or cement-bentonite slurry wall placed around the area of contamination to restrict ground water flow through contamination.	Potentially applicable
		Sheet Piles	Sheet piles installed around the area of contamination to restrict ground water flow through contamination.	Potentially applicable

Table 3-1. *Screening of technologies and process options for soils.*

General response action	Remedial technology	Process option	Description	Screening comments
Removal Actions	Excavation	Backhoe/Crane	Removal of soil with appropriate construction machinery.	Potentially applicable; implemented as part of IRM at site.
Disposal Actions	Land Disposal	Commercial Landfill	Placement of contaminated material in an off-site landfill.	Potentially applicable; treatment to LDR treatment standards required prior to land disposal
In Situ Treatment Actions	Physical	*In Situ* Air Stripping	Use of vacuum to extract vapor-phase constituents from the unsaturated soil zone.	Potentially applicable; successfully implemented as IRM at site.
		Air Sparging	Injection of air into the saturated soil zone to volatilize constituents, which are collected in the unsaturated zone by an *in situ* air stripping system.	Potentially applicable
		Solidification/ Stabilization	In-place mixing of solidifying/stabilizing agents with soil to immobilize constituents.	Potentially applicable
		Soil Flushing	Flushing of ground water through contaminated soil zone to desorb and mobilize constituents, which are collected with a ground water recovery system.	Potentially applicable;
		Surfactant Flushing	Flushing of soil with a surfactant solution to mobilize and enhance extraction of constituents, which are collected with a ground water recovery system.	Potentially applicable
	Physical/Thermal	Steam Injection	Injection of steam into the soil to volatilize and enhance extraction of constituents, which are collected with an *in situ* air stripping system.	Potentially applicable

Table 3-1. *Screening of technologies and process options for soils.*

General response action	Remedial technology	Process option	Description	Screening comments
	Biological	Bioremediation	Addition of oxygen and nutrient sources to soil to enhance biological degradation of organic constituents by indigenous microbes.	Potentially applicable
Ex Situ Treatment Actions	Physical	*Ex Situ* Air Stripping	Use of vacuum to extract vapor-phase constituents from soil through a piping network placed throughout a soil pile.	Potentially applicable
	Biological	Bioremediation	Excavation of soil and degradation of organic constituents by biological organisms in reactor, landfarming, or composting process.	Potentially applicable
	Thermal	Incineration	Combustion of organic constituents in on-site or off-site incinerator.	Potentially applicable
		Thermal Desorption	Volatilization of organic constituents through application of low temperature heat.	Potentially applicable

Table 3-2. *Screening of technologies and process options for ground water.*

General response action	Remedial technology	Process option	Description	Screening comments
No Action	None	Not applicable	Not applicable	Potentially applicable
Institutional Actions	Access Restrictions	Ground Water Use Restriction	Restriction of the potable use of ground water from the area of contamination.	Already implemented
	Monitoring	Ground Water Monitoring	Periodic sampling and analysis of ground water.	Applicable; already implemented on quarterly basis
Containment Actions	Vertical Barrier	Slurry Wall	Soil- or cement-bentonite slurry wall placed around the area of contamination to contain ground water.	Potentially applicable
		Sheet Piles	Sheet piles installed around the area of contamination to contain ground water.	Potentially applicable
Collection Actions	Ground Water Extraction	Recovery Wells	Removal of ground water by pumping from recovery wells for hydraulic containment or mass removal.	Applicable; already implemented as ongoing IRM.
		Recovery Trench	Removal of ground water by pumping from recovery trenches for hydraulic containment or mass removal.	Potentially applicable
In Situ Treatment Actions	Physical	Air Sparging	Injection of air into the saturated soil zone to volatilize constituents, which are collected in the unsaturated zone by an *in situ* air stripping system.	Potentially applicable
	Biological	Bioremediation	Injection of oxygen and nutrient sources to the aquifer to enhance biological degradation of organic constituents by indigenous microbes.	Potentially applicable

Table 3-2. *Screening of technologies and process options for ground water.*

General response action	Remedial technology	Process option	Description	Screening comments
Ex Situ Treatment Actions	Physical	Air Stripping	Contact of air with water in countercurrent column or bulk reactor to transfer VOCs from water to air.	Applicable; already implemented as ongoing IRM at site.
		Carbon Adsorption	Adsorption of organic constituents from water or vapor to activated carbon.	Potentially applicable; already implemented for vapor treatment for ongoing IRM at site.
		Adsorptive Resins	Adsorption of organic constituents from water to commercial adsorptive resin.	Potentially applicable
		Settling	Retention of aqueous stream in tank to settle/separate light or heavy components.	Applicable; already implemented as ongoing IRM at site.
		Filtration	Separation of solids from water phase using semipermeable filter medium.	Potentially applicable
	Chemical	Chemical Oxidation	Addition of oxidation agents such as hydrogen peroxide and ultraviolet light to water to oxidize/destroy organic contaminants.	Potentially applicable
	Biological	Biological Reactor	Addition of oxygen, nutrients, and co-metabolites to ground water in a reactor to enhance co-metabolic degradation of organic constituents.	Potentially applicable
Discharge Actions	Surface Water	Sheldrake River	On-site discharge of treated ground water to Sheldrake River.	Potentially applicable
	Ground Water	Infiltration Galleries	Discharge of treated ground water to ground surface for infiltration to overburden.	Not applicable; majority of ground surface covered by buildings or pavement.

Table 3-2. *Screening of technologies and process options for ground water.*

General response action	Remedial technology	Process option	Description	Screening comments
		Recharge Wells	Discharge of treated ground water to aquifer through recharge wells.	Potentially applicable
		Irrigation	Discharge of treated ground water through sprinkle or drip method to ground surface for infiltration.	Not applicable; majority of ground surface covered by buildings or pavement.
	Off-Site Treatment Facility	Commercial Treatment Facility	Transportation of ground water to an off-site permitted facility for treatment/discharge.	Potentially applicable
		POTW	Discharge of ground water to the local sewer system/treatment plant	Applicable; already implemented as IRM at site.

Table 3-3. *Evaluation of process options for soils.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Relies solely on natural attenuation.	Readily implemented	No Capital No O&M
Institutional Actions	Access Restrictions	Fencing *	Effectively minimizes access to the site.	Already implemented	Low Capital Very Low O&M
		Deed Restrictions	Effectively minimizes access to the site.	Readily implementable	Low Capital No O&M
Containment Actions	Cover	Asphalt *	Effectively minimizes direct contact with contaminated soil.	Already implemented for most areas of the site.	Low Capital Very Low O&M
	Vertical Barrier	Slurry Wall *	Effectively contains the impacted soil and minimizes horizontal ground water migration through impacted soil.	Difficult to implement; site constraints limit ease of implementation	Medium Capital Medium O&M
		Sheet Piles	Effectively contains the contaminated soil and minimizes horizontal ground water migration through impacted soil.	Difficult to implement; site constraints limit ease of implementation	Medium Capital Medium O&M
Removal Actions	Excavation	Backhoe/Crane	Effectively removes contaminated soil.	Difficult to implement due to location of contaminated soil beneath facility buildings and paved areas.	Very High Capital No O&M

Table 3-3. *Evaluation of process options for soils.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
Disposal Actions	Land Disposal	Commercial Landfill	Effective disposal method. Minimizes constituent migration.	Difficult to implement due to above-mentioned excavation difficulty and LDR requirements.	High Capital No O&M
In Situ Treatment Actions	Physical	*In Situ* Air Stripping *	IRM/pilot study indicated ISAS: Effective for removing chlorinated organics from unsaturated soil. Potentially effective for removing DNAPL based on pilot studies.	Readily implementable; air controls likely necessary.	Medium Capital Medium O&M
		Air Sparging *	Effectively removes chlorinated organics from saturated soil. Limited effectiveness for DNAPL removal.	Readily implementable	Medium Capital Medium O&M
		Solidification/ Stabilization	Potentially effective for reduction of mobility of constituents in saturated and unsaturated soil. Bench-scale testing indicated sufficient mobility reduction unlikely. Ineffective in stabilizing DNAPL. Relatively innovative for organics.	Readily implementable	High Capital Low O&M
		Soil Flushing*	Effectively removes constituents from saturated soil zone over time. Potential effectiveness for DNAPL removal.	Readily implementable	Low Capital Medium O&M
		Surfactant Flushing	Effectively removes constituents from unsaturated and saturated soil zone. Effective for improving DNAPL extractability. Potential for uncontrolled migration of DNAPL and surfactant. Pilot study necessary.	Moderately implementable	High Capital Medium O&M

Table 3-3. *Evaluation of process options for soils.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
	Physical/ Thermal	Steam Injection	Effectively removes chlorinated organics from unsaturated soil, but has limited effectiveness on saturated soil. Effective for improving DNAPL extractability. Potential for high temperature chlorinated solvent reactions, forming toxic acid or chlorine gas. Potential for uncontrolled migration of DNAPL and surfactant. Pilot study necessary.	Moderately implementable	High Capital High O&M
	Biological	Bioremediation	Bench-scale testing indicated physical properties of soil would limit effectiveness of bioremediation at site. Limited effectiveness for DNAPL degradation.	Implementable	Medium Capital Medium O&M
Ex Situ Treatment Actions	Physical	*Ex Situ* Air Stripping	Effectively extracts volatile organics constituents from a soil pile.	Difficult to implement due to location of contaminated soil beneath facility buildings and paved areas.	Medium Capital Medium O&M
	Biological	Bioremediation	Potentially effective for destruction of chlorinated organics. Treatability study necessary.	Difficult to implement due to location of contaminated soil beneath facility buildings and paved areas.	High Capital Medium O&M
	Thermal	Incineration	Effectively destroys chlorinated organics.	Difficult to implement due to location of contaminated soil beneath facility buildings and paved areas.	High Capital Low O&M

Table 3-3. *Evaluation of process options for soils.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
		Thermal Desorption	Effectively removes chlorinated organics.	Difficult to implement due to location of contaminated soil beneath facility buildings and paved areas.	High Capital Low O&M

Notes:

* Representative process option.

Table 3-4. *Evaluation of process options for ground water.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Relies solely on natural attenuation.	Not applicable	Low Capital** No O&M
Institutional Actions	Access Restrictions	Ground Water Use Restriction *	Effectively minimizes potable use of ground water.	Already implemented	Low Capital No O&M
	Monitoring	Ground Water Monitoring *	Effective method for monitoring changes in constituent concentrations over time. Useful for evaluating remedy effectiveness.	Readily implementable	No Capital Low O&M
Containment Actions	Vertical Barrier	Slurry Wall *	Effectively reduces ground water contaminant migration.	Difficult to implement; complexities associated with building and river proximity.	Medium Capital Low O&M
		Sheet Piles	Effectively reduces ground water contaminant migration.	Difficult to implement; complexities associated with building and river proximity.	Medium Capital Low O&M
Removal Actions	Ground Water Extraction	Recovery Wells *	Effectively removes contaminated ground water.	Readily Implementable; already implemented as IRM.	Low Capital Low O&M
		Recovery Trench	Effectively removes contaminated ground water.	Moderately Implementable	Low Capital Low O&M

Table 3-4. *Evaluation of process options for ground water.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
In Situ Treatment Actions	Physical	Air Sparging *	Effectively removes chlorinated organics from saturated zone. Limited effectiveness for DNAPL removal.	Moderately implementable	Capital Medium O&M
	Biological	Bioremediation	Likely effective for destruction of chlorinated organic constituents in saturated zone. Limited effectiveness for DNAPL degradation. Treatability study necessary.	Implementable	Medium Capital Medium O&M
Ex Situ Treatment Actions	Physical	Air Stripping *	Effective for removal of volatile organic constituents.	Readily implementable; air controls likely necessary; already implemeted as part of IRM.	Low Capital Medium O&M
		Carbon Adsorption*	Effective for removal of most organic constituents. Not effective for vinyl chloride removal.	Readily implementable; carbon regeneration/ replacement required; already implemented for vapor treatment in IRM.	Low Capital High O&M
		Adsorptive Resins	Effective for removal of most organic constituents. Not effective for vinyl chloride removal.	Readily implementable; resin regeneration required.	Medium Capital Medium O&M

Table 3-4. *Evaluation of process options for ground water.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
		Settling *	Effective separation method for NAPLs.	Readily implementable; NAPL management necessary; already implemented as part of IRM.	Low Capital Low O&M
		Filtration	Effective separation method for solids.	Readily implementable; solids management necessary.	Low Capital Low O&M
	Chemical	Chemical Oxidation	Effective destruction method for organic constituents.	Readily implementable	Medium Capital Medium O&M
	Biological	Biological Reactor	Likely effective destruction method for organic constituents. Treatability testing necessary.	Implementable; sludge management necessary.	Medium Capital Medium O&M
Discharge Actions	Surface Water	Sheldrake River	Effective discharge option for treated ground water.	Readily implementable	Low Capital Low O&M
	Ground Water	Recharge Wells	Potentially effective discharge option for treated ground water.	Moderately implementable	Medium Capital Medium O&M
	Off-Site Treatment Facility	Commercial Treatment Facility	Effective off-site treatment option. Excessive transportation required.	Not readily implementable due to anticipated volumes.	Low Capital High O&M

Table 3-4. *Evaluation of process options for ground water.*

General response action	Remedial technology	Process option	Effectiveness	Implementability	Cost
		POTW *	Effective off-site treatment option. Pretreatment necessary to meet discharge limits.	Readily Implementable; already implemented as part of IRM.	Low Capital Medium O&M

Notes:

* Representative Process Option

** Low capital associated with decommissioning of the on-site ground water treatment system.

Table 4-1 *Remedial alternatives summary*

General response actions	Technology/process option	Alt 1 No action	Alt 2 Institutional actions	Alt 3 Containment via slurry wall	Alt 4 Ground water monitoring and contingency remedy	Alt 5 *In situ* air stripping/ air sparging
Soil						
No Action		X				
Institutional Actions	Fencing	X	X	X	X	X
	Deed Restrictions		X	X	X	X
Containment Actions	Asphalt Cover		X	X	X	X
	Slurry Wall			X		
Treatment Actions	*In Situ* Air Stripping					X
	In Situ Air Sparging					X
Ground Water						
No Action		X				
Institutional Actions	Ground Water Use Restriction		X	X	X	X
	Ground Water Monitoring		X	X	X	X
Containment Actions	Slurry Wall			X		
Collection Actions	Recovery Wells			X	X	
In Situ Treatment Actions	Air Sparging					X
Ex Situ Treatment Actions	Air Stripping (sparge tank)			X	X	
	Settling			X	X	
Discharge Actions	POTW			X	X	

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
			OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT		
Protection of Human Health	Estimated human health risks within acceptable guidelines under current and future study area conditions. Significant contaminant mass removed through previous IRMs. Does not provide means to limit future contact with soil. Local ordinance would minimize potential for ground water consumption. Other than five-year reviews, does not provide means to more frequently assess site conditions.	Estimated human health risks within acceptable guidelines under current andn future study area conditions. Significant contaminant mass removed through previous IRMs. Ground water monitoring provides information regarding contaminants of concern. Deed restrictions, fencing and existing asphalt pavement would minimize the potential for contact with soil. Local ordinance requiring use of the public water supply and accessibility of public water would minimize potential for ground water consumption.	Estimated human health risks within acceptable guidelines under current and future study area conditions. Significant contaminant mass removed through previous IRMs. Installation of a containment wall would minimize hydraulic connection between the ground water aquifer and the Sheldrake River by limiting ground water flow into the river. Ground water monitoring provides information regarding contaminants of concern. Deed restrictions, fencing and existing asphalt pavement would minimize the potential for contact with soil. Local ordinance requiring use of the public water supply and accessibility of public water would minimize potential for ground water consumption. The use of appropriate protection equipment during remedial activities would minimize potential threat to workers.	Estimated human health risks within acceptable guidelines under current and future study area conditions. Significant contaminant mass removed through previous IRMs. Continuation of ground water recovery and potential implementation of contingency remedy (additional ground water recovery) would reduce contaminant mass and limit contaminant migration into the Sheldrake River during operation. Ground water monitoring provides information regarding contaminants of concern. Deed restrictions, fencing and existing asphalt pavement would minimize the potential for contact with soil. Local ordinance requiring use of the public water supply and accessibility of public water would minimize potential for ground water consumption. The use of appropriate protection equipment during remedial activities would minimize potential threat to workers.	Estimated human health risks within acceptable guidelines under current and future study area conditions. Significant contaminant mass removed through previous IRMs. Implementing an *in situ* source treatment technology would reduce contaminant mass in the soil. Ground water monitoring provides information regarding contaminants of concern. Deed restrictions, fencing, and existing asphalt pavement would minimize the potential for contact with soil. Local ordinance requiring use of the public water supply and accessibility of public water would minimize potential for ground water consumption. Volatiles may potentially enter building. The use of appropriate protection equipment during remedial activities would minimize potential threat to workers.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action • **Five-Year Reviews**	Institutional Actions • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	Containment via Slurry Wall • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	Ground Water Monitoring and Contingency Remedy • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	*In Situ* Air Stripping/Air Sparging • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
Protection of Environment	Estimated human health risks within acceptable guidelines under current study area conditions. Significant contaminant mass removed through previous IRMs. Ground water discharge to Sheldrake River pose an estimated risk within acceptable guidelines .	Estimated human health risks within acceptable guidelines under current study area conditions. Significant contaminant mass removed through previous IRMs. Ground water discharge to Sheldrake River at levels representing an estimated risk within acceptable guidelines .	Estimated human health risks within acceptable guidelines under current study area conditions. Significant contaminant mass removed through previous IRMs. Slurry wall would minimize contaminant migration.	Estimated human health rrisks within acceptable guidelines under current study area conditions. Significant contaminant mass removed through previous IRMs.Continued IRM and potential implementation of the contingency remedy would reduce contaminant mass and limit contaminant migration during operation.	Estimated human health risks within acceptable guidelines under current study area conditions. Significant contaminant mass removed through previous IRMs. *In situ* air stripping/air sparging would reduce contaminant mass.
			COMPLIANCE WITH SCGs		
Chemical-Specific SCGs	Attainment of NYS Class GA ground water standard technically impractical. Attainment of NYSDEC soil cleanup objectives technically impractical. SCG waiver may be necessary.	Attainment of NYS Class GA ground water standard technically impractical. Attainment of NYSDEC soil cleanup objectives technically impractical. SCG waiver may be necessary.	Attainment of NYS Class GA ground water standard technically impractical. Attainment of NYSDEC soil cleanup objectives technically impractical. SCG waiver may be necessary.	Attainment of NYS Class GA ground water standard technically impractical. Attainment of NYSDEC soil cleanup objectives technically impractical. SCG waiver may be necessary.	Attainment of NYS Glass GA ground water standard technically impractical. Attainment of NYSDEC soil cleanup objectives technically impractical. SCG waiver may be necessary.
Location-Specific SCGs	No action would be in compliance with floodplain requirements.	Institutional actions would be conducted in a manner consistent with floodplain requirements.	Containment would be conducted in a manner consistent with floodplain requirements.	Continued IRM and contingency remedy would be conducted in a manner consistent with floodplain requirements.	*In situ* air stripping/air sparging would be conducted in a manner consistent with floodplain requirements.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
Action-Specific SCGs	None.	Activities would be conducted consistent with OSHA requirements.	Discharge of treated ground water to the POTW consistent with WCDEF permit limitation and Clean Water Act pretreatment regulations. Remedial activities would be conducted consistent with OSHA and NYS stream encroachment requirements. Treatment residuals would be disposed off-site in accordance with DOT, RCRA and NYS hazardous waste management requirements. A soil erosion and sediment control plan would be prepared in accordance with local regulations.	Discharge of treated ground water to the POTW consistent with WCDEF permit limitation and Clean Water Act pretreatment regulations. Remedial activities would be conducted consistent with OSHA requirements. Treatment residuals would be disposed off-site in accordance with DOT, RCRA and NYS hazardous waste management requirements.	Remedial activities would be conducted consistent with OSHA requirements. Treatment residuals would be disposed off-site in accordance with DOT, RCRA and NYS hazardous waste management requirements. *In situ* air stripping system air emissions would be managed as required by NYS air regulations.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
LONG-TERM EFFECTIVENESS AND PERMANENCE					
Magnitude of Residual Risk	Estimated risks associated with current and future site conditions within acceptable guidelines. Residual risk significantly reduced through previous IRMs. Technically impractical to reduce chemical concentrations to chemical-specific SCGs. Does not include controls to limit future contact with soil. Local ordinance would limit ground water consumption.	Estimated risks associated with current and future site conditions within acceptable guidelines. Residual risk significantly reduced through previous IRMs. Technically impractical to reduce residual contaminant concentrations to chemical-specific SCGs. Deed restrictions would limit disturbance/contact with soil. Local ordinance requiring use of the public water supply and accessibility of public utilities would limit ground water consumption. Locked fences and existing asphalt cover maintenance would minimize contact with soil.	Estimated risks associated with current and future site conditions within acceptable guidelines. Residual risk significantly reduced through previous IRMs. Technically impractical to reduce chemical concentrations to chemical-specific SCGs. Site-wide containment would limit horizontal migration of site contaminants. Deed restrictions would limit disturbance/contact with soil. Local ordinance requiring use of the public water supply and accessibility of public utilities would limit ground water consumption. Locked fences and existing asphalt cover maintenance would minimize contact with soil.	Estimated risks associated with current and future site conditions within acceptable guidelines. Residual risk significantly reduced through previous IRMs. Technically impractical to reduce chemical concentrations to chemical-specific SCGs. Continued IRM and potential implementation of contingency remedy would reduce contaminant mass. Deed restrictions would limit disturbance/contact with soil. Local ordinance requiring use of the public water supply and accessibility of public utilities would limit ground water consumption. Locked fences and existing asphalt cover maintenance would minimize contact with soil.	Estimated risks associated with current and future site conditions within acceptable guidelines. Residual risk significantly reduced through previous IRMs. Technically impractical to reduce chemical concentrations to chemical-specific SCGs. *In situ* air stripping/air sparging would reduce contaminant mass. Deed restrictions would limit disturbance/contact with soil. Local ordinance requiring use of the public water supply and accessibility of public utilities would limit ground water consumption. Locked fences and existing asphalt cover maintenance would minimize contact with soil.
Adequacy and Reliability of Controls	Does not included adequate or reliable controls for assessing aquifer conditions or limiting future contact with soil. Local ordinance would restrict potential contract with ground water.	Ground water monitoring is an adequate and reliable method of tracking aquifer conditions. Local ordinance requiring use of the public water supply, deed restrictions and fencing are adequate and reliable in restricting potential ingestion of or contact with soil or ground water.	Site-wide containment is considered an adequate and reliable control to limit horizontal migration of contaminants. Ground water monitoring is an adequate and reliable method of tracking aquifer conditions. Local ordinance requiring use of the public water supply, deed restrictions and fencing are adequate and reliable in restricting potential ingestion of or contact with soil or ground water.	Ground water extraction and treatment are considered an effective and reliable method of reducing contaminant mass. Ground water monitoring is an adequate and reliable method of tracking aquifer conditions. Local ordinance requiring use of the public water supply, deed restrictions and fencing are adequate and reliable in restricting potential ingestion of or contact with soil or ground water.	*In situ* air stripping and air sparging considered effective and reliable mass reduction controls. Ground water monitoring is an adequate and reliable method of tracking aquifer conditions. Local ordinance requiring use of the public water supply, deed restrictions and fencing are adequate and reliable in restricting potential ingestion of or contact with soil or ground water.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT					
Treatment Process Used and Materials Treated	Natural attenuation of organic constituents.	Natural attenuation of organic constituents.	Treatment of estimated 0.2 gpm ground water. Recovered ground water directed to POTW following on-site ground water treatment and (air stripping). Natural attenuation of organic constituents.	Increased attenuation of organic constituents during treatment. Possible treatment of estimated 10-20 gpm ground water. Recovered ground water directed to POTW following on-site ground water treatment (air stripping). Natural attenuation of organic constituents following shutdown.	*In situ* air stripping and air sparging treatment of soil and ground water. Increased attenuation of organic constituents during treatment. Natural attenuation of organic constituents following shutdown.
Amount of Hazardous Material Destroyed or Treated	Natural attenuation expected to address site-wide soil and ground water contamination.	Natural attenuation expected to address site-wide soil and ground water contamination.	Purpose of remedy is containment. Natural attenuation expected to minimally address site-wide soil and ground water contamination.	Ground water treatment is anticipated to be 10-20 gpm. Natural attenuation expected to address site-wide soil and ground water contamination.	Treatment of soil area containing VOCs for up to 5 years. Natural attenuation expected to address site-wide soil and ground water contamination.
Degree of Expected Reduction of Toxicity, Mobility or Volume	Natural attenuation expected to reduce toxicity and volume of contaminated soil and ground water.	Natural attenuation expected to reduce toxicity and volume of contaminated soil and ground water.	Reduction of contaminant mobility with slurry wall. Natural attenuation expected to minimally reduce toxicity and volume of contaminated soil and ground water.	Reduction of ground water mobility, toxicity and volume via ground water extraction. Natural attenuation expected to reduce toxicity and volume of contaminated soil and ground water.	Reduction of contaminated soil and ground water toxicity and volume via *in situ* air stripping and air sparging. Natural attenuation expected to reduce toxicity and volume of contaminated soil and ground water.
Degree to Which Treatment is Irreversible	Natural attenuation is irreversible.	Natural attenuation is irreversible.	*Ex situ* air sparging, and POTW treatment are irreversible.	*Ex situ* air sparging, and POTW treatment are irreversible.	*In situ* air stripping and air sparging are irreversible.
Type of Quantity of Residuals Remaining after Treatment	None.	None	Spent vapor-phase activated carbon and solids from ground water treatment system.	Spent vapor-phase activated carbon and solids from ground water treatment system.	Spent vapor-phase activated carbon from air emission control systems.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
			SHORT-TERM EFFECTIVENESS		
Protection of Community During Remedial Actions	Estimated risks associated with current and future site conditions within acceptable guidelines. Does not include controls to limit future contact with soil. Ground water use restricted through local ordinance.	Estimated risks associated with current and future site conditions within acceptable guidelines. Ground water use restricted through local ordinance. Community would be restricted from access to study area through fencing and deed restrictions. Monitoring will not affect community.	Estimated risks associated with current and future site conditions within acceptable guidelines. Ground water use restricted through local ordinance. Community would be restricted from access to site through fencing and deed restrictions. Monitoring will not affect community. Particulate transport would be mitigated during construction.	Estimated risks associated with current and future site conditions within acceptable guidelines. Ground water use restricted through local ordinance. Community would be restricted from access to study area through fencing and deed restrictions. Monitoring and IRM operation will not affect community.	Estimated risks associated with current and future site conditions within acceptable guidelines. Ground water use restricted through local ordinance. Community would be restricted from access to study area through fencing and deed restrictions. Monitoring will not affect community. Off-gases would be controlled as needed. Uncontrolled vapor migration could impact indoor air quality.
Protection of Workers During Remedial Activities	No worker activities.	Appropriate protective equipment would be used during monitoring activities.	Appropriate protective equipment would be used during monitoring and remedial activities.	Appropriate protective equipment would be used during monitoring and remedial activities.	Appropriate protective equipment would be used during monitoring and remedial activities.
Environmental Impacts	None.	None.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control migration to Sheldrake River.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage.	Contaminant transport during construction would be minimized through appropriate methods such as off-site drainage and dust control.
Time Until Remedial Action Objectives are Achieved	Would not provide means to limit future contact with soil. Would not exacerbate current conditions.	RAOs achieved upon implementation.	RAOs achieved upon implementation.	RAOs achieved upon implementation.	RAOs achieved upon implementation.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
			IMPLEMENTABILITY		
Ability to Construct and Operate the Technology	No construction or operation. Property owner cooperation needed for five-year reviews.	Readily implementable, provided site access readily available.	Site constraints and access make difficult implementability.	Readily implementable, provided site access readily available.	Site constraints and access make difficult implementability.
Reliability of Technology	No technology.	Reliable.	Reliable.	Reliable.	Reliable.
Ease of Undertaking Additional Remedial Actions, If Necessary	Additional remedial actions readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions not readily implemented.	Additional remedial actions readily implemented.	Additional remedial actions not readily implemented.
Ability to Monitor Effectiveness of Remedy	Other than five-year reviews, does not provide a means to monitor effectiveness.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.	Ground water monitoring would indicate changes in ground water at the study area.
Coordination With Other Agencies	Agency coordination not required.	Legal coordination with local government and property owner necessary to implement deed restrictions. Coordination with and cooperation of owner required for ground water monitoring, fencing and cover maintenance.	Legal coordination with local government and property owner necessary to implement deed restrictions. Coordination with and cooperation of owner required for ground water monitoring, fencing, cover maintenance and construction. Coordination with NYSDEC regarding river diversion needed. Coordination with POTW to implement ground water discharge.	Legal coordination with local government and property owner necessary to implement deed restrictions. Coordination with and cooperation of owner required for ground water monitoring, fencing, and cover maintenance. Coordination with NYSDEC regarding implementation. Coordination with POTW to implement ground water discharge.	At a minimum, legal coordination with local government and property owner necessary to implement deed restrictions. Coordination with and cooperation of owner required for ground water monitoring, fencing, cover maintenance, and construction. Coordination with NYSDEC regarding implementation.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
Availability of Off-Site Treatment, Storage and Disposal Services and Capacities	None required.	None required.	POTW capacity expected to be readily available. Off-site disposal/incineration facility capacity expected to be readily available for residuals.	POTW capacity expected to be readily available. Off-site disposal/incineration facility capacity expected to be readily available for residuals.	Off-site disposal/incineration facility capacity expected to be readily available for residuals.
Availability of Necessary Equipment, Specialists and Materials	None required.	Sampling equipment, sampling personnel, and analytical laboratory readily available.	Sampling equipment, sampling personnel, analytical laboratory, drilling services for well installation, and slurry wall installation services readily available.	Sampling equipment, sampling personnel, and analytical laboratory readily available.	Sampling equipment, sampling personnel, analytical laboratory, and drilling services for well installation readily available.
Availability of Prospective Technologies	None involved.	None anticipated.	Containment wall, well installation technology and treatment system upgrade technology readily available.	Treatment system upgrade technology readily available.	Well installation, air sparging, and *in situ* air stripping technology readily available.

Table 5-1. *Detailed analysis of remedial alternatives.*

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
	No Action • **Five-Year Reviews**	**Institutional Actions** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	**Containment via Slurry Wall** • **Slurry Wall** • **Limited Ground Water Recovery** • **On-site Ground Water Treatment** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Asphalt Cover** • **Five-Year Reviews**	**Ground Water Monitoring and Contingency Remedy** • **Continued Operation of the IRM** • **Additional Ground Water Recovery, if necessary** • **On-site Ground Water Treatment (upgrade existing system)** • **POTW Discharge** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**	***In Situ* Air Stripping/Air Sparging** • ***In Situ* Air Stripping** • **Air Sparging** • **Ground Water Monitoring** • **Deed Restrictions** • **Fencing** • **Existing Asphalt Cover Maintenance** • **Five-Year Reviews**
			COST		
Total Estimated Capital Costs	$102,000	$123,000	$2,700,000	$182,000*	$962,000
Total Estimated Annual O&M Costs	$10,000 (once every 5 yrs for 30 yrs)	$51,000 (years 1-5) $20,000(years 5-30)	$191,000(years 1-5) $125,000(years 5-15) $110,000(years 15-30)	$134,000 (years 1-5) $122,000 (years 5-30)	$206,000(years 1-10) $20,000(years 10-30)
Total Estimated 30-yr Present Worth Cost	$130,000	$540,000	$4,600,000	$2,100,000*	$2,400,000
			SUPPORT AGENCY ACCEPTANCE		
Supporting Agency Acceptance	Support agency acceptance will be documented in the PRAP and the ROD				
			COMMUNITY ACCEPTANCE		
Community Acceptance	Community acceptance will be documented in the ROD following the public comment period				

Notes: * Costs for Alternative 4 assume Contingency Remedy triggered. Bulk of capital costs are associated with the Contingency Remedy.

Table 5-2. *Potential alternative-specific chemical, action and location specific SCGs*

Potential SCGs	Alternative 1 no action	Alternative 2 institutional actions	Alternative 3 containment via slurry well	Alternative 4 ground water monitoring and contingency remedy	Alternative 5 *in situ* air stripping/air sparging
CHEMICAL-SPECIFIC SCGs					
Class GA Ground Water Quality Standards (6 NYCRR 703)	✓	✓	✓	✓	✓
NYSDEC TAGM #4046 - Determination of Soil Cleanup Objectives and Cleanup Levels (January 24, 1994; proposed revisions dated April 1995)	✓	✓	✓	✓	✓
LOCATION-SPECIFIC SCGs					
Floodplains (6 NYCRR Part 500)	✓	✓	✓	✓	✓
Floodplains (6 NYCRR Part 373-2.2)	✓	✓	✓	✓	✓
ACTION-SPECIFIC SCGs					
OSHA - General Industry Standards (29 CFR Part 1910)		✓	✓	✓	✓
OSHA - Safety and Health Standards (Construction Industry Standards) (29 CFR Part 1926)			✓	✓	✓
OSHA - Recordkeeping, Reporting and Related Regulations (29 CFR Part 1904)		✓	✓	✓	✓
Clean Water Act Pretreatment Regulations (40 CFR 403)			✓	✓	
DOT Rules for Hazardous Materials Transport (40 CFR 107, 171.1, 171.5)			✓	✓	✓
Stream Encroachment (6 NYCRR 608)			✓		

Table 5-2. *Potential alternative-specific chemical, action and location specific SCGs*

Potential SCGs	Alternative 1 no action	Alternative 2 institutional actions	Alternative 3 containment via slurry well	Alternative 4 ground water monitoring and contingency remedy	Alternative 5 *in situ* air stripping/air sparging
New York State Identification and Listing of Hazardous Wastes (6 NYCRR Part 371)			✓	✓	✓
New York State Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities (6 NYCRR Part 372)			✓	✓	✓
New York State Standards for Owners/Operators of Permitted Hazardous Waste Facilities (6 NYCRR Section 373-2.2)			✓	✓	✓
New York State Preparedness and Prevention (6 NYCRR Section 373-2.3)		✓	✓	✓	✓
New York State Contingency Plan and Emergency Procedures (6 NYCRR Section 373-2.4)		✓	✓	✓	✓
New York State Land Disposal Restrictions (6 NYCRR Part 376)			✓	✓	✓
New York State Air Quality Emission Limits (6 NYCRR Part 212)					✓
New York State Air Quality Standards (6 NYCRR Part 257)			✓	✓	✓
WCDEF Discharge Limitations			✓	✓	
Soil Erosion and Sediment Control			✓		

Notes: TAGM: New York State Technical and Administrative Guidance Memorandum.
NYCRR: New York Code for Rules and Regulations.

Table 5-3. *Potential action - specific SCGs*

Potential SCGs	Summary of requirements	Actions to be taken to satisfy requirements
OSHA - General Industry Standards (29 CFR Part 1910)	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are also specified.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below the concentrations specified. Workers would be trained as required by regulations.
OSHA - Safety and Health Standards (Construction Industry Standards) (29 CFR Part 1926)	These regulations specify the type of safety equipment and procedures to be followed during site remediation.	Appropriate safety equipment will be on site and appropriate procedures will be followed during remediation activities.
OSHA - Recordkeeping, Reporting, and Related Regulations (29 CFR Part 1904)	These regulations outline recordkeeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install and operate the selected remediation alternative at the site.
Clean Water Act Pretreatment Regulations (40 CFR Part 403)	Pretreatment requirements for discharge to POTWs.	Requirements will be met for any alternative involving discharge to POTW.
DOT Rules for Hazardous Materials Transport (40 CFR 107, 171.1, 171.5)	These regulations outline the Department of Transportation's rules for transporting hazardous materials.	Rules for transporting hazardous materials will be followed when transporting hazardous materials off-site.
Stream Encroachment (6 NYCRR 608)	Specifies requirements for a stream protection permit for site work conducted within 50 ft from the banks of Class C or above surface waters.	If the site work takes place within 50 ft of the banks of the stream, NYSDEC approval will be obtained. Actual permit will not be required under Consent Order.
New York State Identification and Listing of Hazardous Wastes (6 NYCRR Part 371)	Establishes procedures for identifying those solid wastes found at the site which are subject to regulations as hazardous wastes.	Ground water extracted from the site that contains a hazardous waste will be handled in accordance with New York State hazardous waste management regulations until it no longer contains such hazardous waste.
New York State Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities (6 NYCRR Part 372)	Applies to generators, transporters, and facilities in New York State. Also provides requirement for the use of the manifests and associated recordkeeping.	This regulation applies to the generation and treatment of hazardous waste.
New York State Standards for Owners/Operators of Permitted Hazardous Waste Facilities (6 NYCRR Section 373-2.2)	General facility requirements outlining general waste analysis, security measures, inspections, and training requirements.	Hazardous waste treatment facilities will be designed, constructed, and operated in accordance with these requirements. No permits required for on-site activities.
New York State Preparedness and Prevention (6 NYCRR Section 373-2.3)	These regulations outline requirements for safety equipment and spill control relative to hazardous waste treatment operation.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
New York State Contingency Plan and Emergency Procedure (6 NYCRR Section 373-2.4)	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc. at hazardous waste treatment facilities.	Plans will be developed during design of the selected alternative. Copies of the plans will be kept on site.

Table 5-3. *Potential action - specific SCGs*

Potential SCGs	Summary of requirements	Actions to be taken to satisfy requirements
New York State Land Disposal Restrictions (6 NYCRR Part 376)	Certain hazardous wastes prohibited from land disposal.	Hazardous wastes cannot be land disposed unless treatment standards are met or NYSDEC approval is obtained.
New York State Air Quality Emission Limits (6 NYCRR Part 212)	Defines percent removal required of air pollution control device based on the environmental rating associated with each contaminant emitted.	Permits are not necessary for on-site source. Remedial activities must comply with substantive requirements.
New York Air Quality Standards (6 NYCRR Part 257)	Provides air quality standards for different chemicals (including those found at the site), particles, and processes.	The emissions from the treatment processes will be controlled so as to not cause exceedance of the ambient air quality standards.
WCDEF Discharge Limitations	Establishes discharge limits for certain compounds.	Discharges to the WCDEF will not exceed the established limits.
Soil Erosion and Sediment Control (NYS Guide for Erosion and Sediment Control - NYS Soil and Water Conservation, Town of Mamaroneck Local Law - No. 8, 1992)	Specifies requirements for a soil erosion and sediment control plan if new construction is greater than 100 square feet.	A soil erosion and sediment control plan will be developed for alternatives that will effect the specified square footage of soil and sediment. The Town of Mamaroneck makes the final decision regarding applicability.

Table 5-6
ITT Sealectro, Inc.
Mamaroneck, NY Facility

Cost Estimate - Alternative 1
No Action

Feasibility Study

Item	Quantity	Unit	Unit Cost	Total Cost
I. DIRECT CAPITAL COSTS				
Decommissioning of existing ground water treatment system	Lump Sum		Lump Sum	$70,000
			Subtotal	$70,000
			TOTAL DIRECT CAPITAL COST	$70,000
II. INDIRECT CAPITAL COSTS				
Contingency (25% of Direct Capital Cost)				$17,500
Engineering (15% of Direct Capital Cost)				$10,500
Administration/Legal Fees (5% of Direct Capital Cost)				$3,500
			TOTAL INDIRECT CAPITAL COST	$31,500
			TOTAL CAPITAL COST	$101,500
III. ANNUAL OPERATING AND MAINTENANCE COSTS				
Five Year Review (costs are for five years)	Lump Sum		Lump Sum	$10,000
PRESENT WORTH O&M COSTS (FOR 30 YRS @5%)				$27,820
TOTAL ESTIMATED COST FOR ALTERNATIVE 1				$129,320
			ROUNDED TO:	$129,000

Notes:
1. Cost estimate based on R.S. Means 1955 Construction Cost Data, and O'Brien & Gere Engineers, Inc. professional experience.
2. Line items provide to form budget cost only.
3. Fencing Costs are not included, assuming that the existing fence is adequate.
4. The cost in this table were developed based upon the data currently available and several assumptions necessary to evaluate the alternatives. Because of the incomplete nature of this information and the possibility that actual conditions may vary considerably from these base assumptions, these costs are not necessarily indicative of the actual remediation costs that will be incurred. These costs should only be used for comparison of technical alternatives.

Table 5-7

ITT Sealectro, Inc.

Mamaroneck, NY Facility

Cost Estimate- Alternative 2
Institutional Actions

Feasibility Study

	Item	Quantity	Unit	Unit Cost	Total Cost
I.	**DIRECT CAPITAL COSTS**				
	Deed Restrictions	Lump Sum		Lump Sum	$10,000
	Additional Fencing	Lump Sum		Lump Sum	$5,000
	Decommissioning of existing ground water treatment system	Lump Sum		Lump Sum	$70,000
				Subtotal	$85,000
				TOTAL DIRECT CAPITAL COST	**$85,000**
II.	**INDIRECT CAPITAL COSTS**				
	Contingency (25% of Direct Capital Cost)				$21,250
	Engineering (15% of Direct Capital Cost)				$12,750
	Administration/Legal Fees (5% of Direct Capital Cost)				$4,250
				TOTAL INDIRECT CAPITAL COST	**$38,250**
				TOTAL CAPITAL COST	**$123,250**
III.	**ANNUAL OPERATING AND MAINTENANCE COSTS**				
	Long Term Ground Water Monitoring Program				
	Six Wells; quarterly for years 1 - 2; VOCs	Year 1			$26,000
		Year 2			$26,000
	Six Wells; annually for years 3 - 30; VOCs	per year			$10,000
	PRESENT WORTH LONG TERM GW MONITORING (FOR 30 YEARS, 5%)				**$174,831**
	PROJECT MANAGEMENT COSTS				
	Project Management (Years 1-5)	Lump Sum		Lump Sum	$25,000
	Project Management (Years 5-30)	Lump Sum		Lump Sum	$10,000
	PRESENT WORTH PROJECT MANAGEMENT (FOR 30 YRS @ 5%)				**$218,651**
	5 Year Review (costs are for 5 years)	Lump Sum		Lump Sum	$10,000
	PRESENT WORTH (FOR 30 YRS @ 5%)				**$27,820**
	TOTAL PRESENT WORTH O&M COSTS				**$421,303**
	TOTAL ESTIMATED COST FOR ALTERNATIVE 2				**$544,553**
				ROUNDED TO:	**$540,000**

Notes:

1. Cost estimate based on R.S. Means 1955 Construction Cost Data, and O'Brien & Gere Engineers, Inc. professional experience
2. Line items provided to form budget cost only.
3. Fencing Costs are not included, assuming that the existing fence is adequate.
4. The cost in this table were developed based upon the data currently available and several assumptions necessary to evaluate the alternatives. Because of the incomplete nature of this information and the possibility that actual conditions may vary considerabley from these base assumptions, these costs are not necessarily indicative of the actual remediation costs that will be incurred. These costs should only be used for comparision of technical alternatives.

Table 5-8

ITT Sealectro, Inc.

Mamaroneck, NY Facility

Cost Estimate- Alternative 3

Containment via Slurry Wall

Feasibility Study

	Item	Quantity	Unit	Unit Cost	Total Cost
I.	**DIRECT CAPITAL COSTS**				
	1. Site Preparation				
	Mobilization/Demobilization	Lump Sum		Lump Sum	$62,000
	Health and Safety Plan	Lump Sum		Lump Sum	$10,000
	Soil Erosion and Sediment Control Plan	Lump Sum		Lump Sum	$5,000
	Deed Restrictions	Lump Sum		Lump Sum	$10,000
				Subtotal	$87,000
	2. Site Work				
	Soil Erosion and Sediment Control	Lump Sum		Lump Sum	$2,000
	Slurry Wall Installation (7)	36,000	CF	$44	$1,584,000
	GW Recovery Well Installation (1 shallow)	Lump Sum		Lump Sum	$10,000
	Piping to Treatment Unit (Sch. 40 PVC)	720	LF	$10	$7,200
	Piping Insulation	720	LF	$5	$3,600
	Excavation for Pipe Lay	720	LF	$2	$1,440
	Bedding for Pipe Runs	40	CY	$5	$200
				Subtotal	$1,608,440
	3. Site Restoration				
	Asphalt Pavement	8,200	SF	$12.00	$98,400
	Fencing Replacement	Lump Sum		Lump Sum	$13,000
				Subtotal	$111,400
	4. Treatment				
	Upgrade Existing Piping to Hard Pipe	400	LF	$10	$4,000
	System Modification (0-5 gpm) 2 Ground Water Pumps New Compressor SS Line, Hoses Well Cover Boxes	Lump Sum		Lump Sum	$20,000
	Air Conditioner	Lump Sum			$1,000
				Subtotal	$25,000
				TOTAL DIRECT CAPITAL COST	**$1,831,840**
II.	**INDIRECT CAPITAL COSTS**				
	Contingency (25% of Direct Capital Cost)				$457,960
	Engineering (15% of Direct Capital Cost)				$274,776
	Administration/Legal Fees (5% of Direct Capital Cost)				$91,592
				TOTAL INDIRECT CAPITAL COST	**$824,328**
				TOTAL CAPITAL COST	**$2,656,168**

Table 5-8
ITT Sealectro, Inc.
Mamaroneck, NY Facility
Cost Estimate- Alternative 3
Containment via Slurry Wall

Feasibility Study

Item	Quantity	Unit	Unit Cost	Total Cost
III. ANNUAL OPERATING AND MAINTENANCE COSTS				
Ground Water Treatment System Operation	Lump Sum		Lump Sum	$52,000
Ground Water Treatment System System Maintenance	Lump Sum		Lump Sum	$15,000
Annual Cleanout	Lump Sum		Lump Sum	$5,000
Carbon replacement (4 times per year)	Lump Sum		Lump Sum	$6,400
Carbon disposal (4 times per year)	Lump Sum		Lump Sum	$6,400
Monthly compliance monitoring (VOC and Oil & Greas	Lump Sum		Lump Sum	$6,000
			ANNUAL O&M COST (not including project management)	**$90,800**
PRESENT WORTH O & M COSTS (FOR 30 YRS @ 5%)				**$1,395,778**
ANNUAL GW MONITORING COSTS				
Six Wells; quarterly for years 1 - 2; VOCs		Year 1		$26,000
		Year 2		$26,000
Six Wells; annually for years 3 - 30; VOCs		per year		$10,000
PRESENT WORTH LONG TERM GW MONITORING (FOR 30 YEARS, 5%)				**$174,831**
ANNUAL PROJECT MANAGEMENT COSTS				
Project Management (Years 1-5)	Lump Sum		Lump Sum	$75,000
Project Management (Years 5-15)	Lump Sum		Lump Sum	$25,000
Project Management (Years 15-30)	Lump Sum		Lump Sum	$10,000
PRESENT WORTH PROJECT MANAGEMENT (FOR 30 YRS @ 5%)				**$525,857**
5 Year Review (costs are for 5 years)	Lump Sum		Lump Sum	$10,000
PRESENT WORTH FIVE YEAR REVIEWS (FOR 30 YEARS @ 5%)				**$27,820**
TOTAL PRESENT WORTH O&M COSTS				**$1,949,455**
TOTAL ESTIMATED COST FOR ALTERNATIVE 3				**$4,605,623**
			ROUNDED TO:	**$4,600,000**

Notes:

1. Cost estimate based on R.S. Means 1995 Construction Cost Data, and O'Brien & Gere Engineers, Inc. professional experience.
2. Line items provided to form budget cost only.
3. Fencing Costs are not included, assuming that the existing fence is adequate.
4. Costs for mobilization were obtained from O'Brien & Gere's Manual of Policy and Procedure Instructions, January 1985.
5. The cost in this table were developed based upon the data currently available and several assumptions necessary to evaluate the alternatives. Because of the incomplete nature of this information and the possibility that actual conditions may vary considerably from these base assumptions, these costs are not necessarily indicative of the actual remediation costs that will be incurred. These costs should only be used for comparison of technical alternatives.
6. Costs assume continued discharge to the WCDEF POTW.
7. Unit cost marked up 100% due to site constraints, i.e.: restoration of the river bed and utilities replacement.

Table 5-9
ITT Sealectro, Inc.
Mamaroneck, NY Facility

Cost Estimate - Alternative 4
Ground Water Monitoring Plan and Continued Operation of Existing IRM
Contingency Remedy

Feasibility Study

	Item	Quantity	Unit	Unit Cost	Total Cost
I.	**GROUND WATER MONITORING AND CONTINUED IRM OPERATION**				
I a.	**DIRECT CAPITAL COST**				
	Deed Restrictions	Lump Sum		Lump Sum	$10,000
	Fencing	Lump Sum		Lump Sum	$5,000
				TOTAL DIRECT CAPITAL COST	**$15,000**
I b.	**INDIRECT CAPITAL COST**				
	Contingency (25% of Direct Capital Cost)				$4,000
	Engineering				$1,000
	Administration/Legeal Fees (5% of Direct Capital Cost)				$1,000
				TOTAL INDIRECT CAPITAL COST	**$6,000**
				TOTAL CAPITAL COST	**$21,000**
I c.	**ANNUAL OPERATING AND MAINTENANCE COSTS - GW EXTRACTION IRM**				
	Treatment System O&M and Cleanout	Lump Sum		Lump Sum	$70,000
	Treatment System Replacement Parts	Lump Sum		Lump Sum	$5,000
	Carbon Replacement/Disposal (1 time per year)	Lump Sum		Lump Sum	$4,000
	Monthly Compliance Monitoring (VOC and Oil & Grease)	Lump Sum		Lump Sum	$8,000
	WCDEF Permit Renewal	Lump Sum		Lump Sum	$2,000
	Quarterly WCDEF Reporting	Lump Sum		Lump Sum	$4,000
				ANNUAL O&M COST	$93,000
	PRESENT WORTH LONG TERM IRM O&M (FOR 30 YRS @ 5%)				**$1,429,638**
I d.	**ANNUAL GROUND WATER MONITORING COSTS**				
	Six Wells; quarterly for years 1 - 2; VOCs		Year 1		$26,000
			Year 2		$26,000
	Six Wells; annually for years 3 - 30; VOCs		per year		$10,000
	PRESENT WORTH LONG TERM GW MONITORING				**$174,831**
I e.	**ANNUAL PROJECT MANAGEMENT COSTS**				
	Project Management (Years 1-5)		per year		$15,000
	Project Management (Years 6-30)		per year		$5,000
	PRESENT WORTH LONG TERM PROJECT MANAGEMENT (FOR 30 YRS @ 5%)				**$120,155**
TOTAL	**PRESENT WORTH ANNUAL O&M FOR GW MONITORING AND CONTINUED IRM OPERATION**				**$1,724,624**
TOTAL	**ESTIMATED COST FOR GW MONITORING AND CONTINUED IRM OPERATION**				**$1,745,624**
				ROUNDED TO:	**$1,750,000**

Table 5-9
ITT Sealectro, Inc.
Mamaroneck, NY Facility

Cost Estimate - Alternative 4
Ground Water Monitoring Plan and Continued Operation of Existing IRM
Contingency Remedy

Feasibility Study

	Item	Quantity	Unit	Unit Cost	Total Cost
II.	**CONTINGENCY REMEDY**				
II a.	**DIRECT CAPITAL COSTS**				
	Site Preparation				
	Mobilization/Demobilization	Lump Sum		Lump Sum	$8,000
				Subtotal	$8,000
	Site Work				
	Pump Installations at MW-12, TW-1	Lump Sum		Lump Sum	$10,000
	Piping to Treatment Unit (Sch. 40 PVC)	275	LF	$10	$2,750
	Piping Insulation	275	LF	$8	$2,200
	Excavation for Pipe Lay	275	LF	$2	$550
	Bedding for Pipe Runs	15	CY	$5	$75
	Restoration	Lump Sum		Lump Sum	$5,000
				Subtotal	$20,575
	Treatment				
	Upgrade IRM System (10-20 gpm)	Lump Sum		Lump Sum	$75,000
	New Compressor				
	2 Additional Vapor Carbon Canisters				
	SS Line, Hoses				
	New Tank				
				Subtotal	$75,000
				TOTAL DIRECT CAPITAL COST	**$103,575**
II b.	**INDIRECT CAPITAL COSTS**				
	Contingency (25% of Direct Capital Cost)				$26,000
	Engineering				$25,000
	Administration/Legal Fees (5% of Direct Capital Cost)				$5,000
				TOTAL INDIRECT CAPITAL COST	**$56,000**
				TOTAL CAPITAL COST	**$159,600**
	ANNUAL OPERATING AND MAINTENANCE COSTS (ADDITIONAL BASED ON ADDING MW-12 and TW-1)				
	Pump Operation and Maintenance	Lump Sum		Lump Sum	$2,000
	Carbon Replacement/Disposal (2 times per year)	Lump Sum		Lump Sum	$12,000
				ANNUAL O&M COST	$14,000
	PRESENT WORTH CONTINGENCY REMEDY O&M (FOR YRS 5 - 30 @ 5%)				**$154,602**
	TOTAL PRESENT WORTH O&M COSTS FOR CONTINGENCY REMEDY				**$154,602**
	TOTAL ESTIMATED COST FOR CONTINGENCY REMEDY				**$314,202**
				ROUNDED TO:	**$314,000**

Table 5-9
ITT Sealectro, Inc.
Mamaroneck, NY Facility

Cost Estimate - Alternative 4
Ground Water Monitoring Plan and Continued Operation of Existing IRM
Contingency Remedy

Feasibility Study

	Item	Quantity	Unit	Unit Cost	Total Cost
III.	**SUMMARY ALTERNATIVE 4**				
	GW MONITORING AND CONTINUED IRM OPERATION				
	Total Capital Costs				$21,000
	Present Worth of O&M Costs				$1,724,624
	CONTINGENCY REMEDY				
	Total Capital Costs				$159,600
	Present Worth of O&M Costs				$154,602
	TOTAL CAPITAL COSTS ALTERNATIVE 4 (INCLUDING CONTINGENCY REMEDY)				**$180,600**
	TOTAL O&M PRESENT WORTH COSTS ALTERNATIVE 4 (INCLUDING CONTINGENCY REMEDY)				**$1,879,226**
	TOTAL ESTIMATED PRESENT WORTH COST FOR ALTERNATIVE 4 (INCLUDING CONTINGENCY REMEDY)				**$2,059,826**
				ROUNDED:	**$2,100,000**

Notes:

1. Cost estimate based on R.S. Means Construction Cost Data, present IRM Program Cost Data, vendor quotes, and O'Brien & Gere Engineers, Inc. professional experience.
2. Line items provided to form budget cost only.
3. The cost in this table were developed based upon the data currently available and several assumptions necessary to evaluate the alternatives. Because of the incomplete nature of this information and the possibility that actual conditions may vary considerably from these base assumptions, these costs are not necessarily indicative of the actual remediation costs that will be incurred. These costs should only be used for comparison of technical alternatives.
4. Costs assume continued discharge to the WCDEF POTW.
5. Pumps assumed to be electrical and powered by existing electrical supply in treatment building.
6. Annual Report submittal to NYSDEC included in I (d). above.

Table 5-10
ITT Sealectro, Inc.
Mamaroneck, NY Facility

Cost Estimate- Alternative 5
Soil Vapor Extraction System with Air Sparging

Feasibility Study

Item	Quantity	Unit	Unit Cost	Total Cost
I. DIRECT CAPITAL COSTS				
1. Site Preparation				
Mobilization/Demobilization	Lump Sum		Lump Sum	$15,000
Deed Restrictions	Lump Sum		Lump Sum	$10,000
Additional Fencing	Lump Sum		Lump Sum	$5,000
Decommissioning of the existing ground water treatment system	Lump Sum		Lump Sum	$70,000
			Subtotal	$100,000
2. Site Work				
Soil Erosion and Sediment Control	Lump Sum		Lump Sum	$5,000
Housing for Control Systems	Lump Sum		Lump Sum	$5,000
			Subtotal	$10,000
3. Source Treatment				
In situ Air Stripping System				
• Design	Lump Sum		Lump Sum	$20,000
• Extraction Wells	11	wells	$5,000	$55,000
• Extraction/sparge wells	2	wells	$10,000	$20,000
• Equipment/Materials	Lump Sum		Lump Sum	$45,000
• Electrical	Lump Sum		Lump Sum	$15,000
• Trenching (outside building)	Lump Sum		Lump Sum	$25,000
• Trenching (inside building)	Lump Sum		Lump Sum	$10,000
• Start-Up	Lump Sum		Lump Sum	$15,000
In situ Air sparging network				
• Design	Lump Sum		Lump Sum	$20,000
• Sparge Wells	9	wells	$5,000	$45,000
• Horizontal Well Placement (under building)	500	LF	$260	$130,000
• Equipment/Materials	Lump Sum		Lump Sum	$45,000
• Electrical	Lump Sum		Lump Sum	$15,000
• Trenching	Lump Sum		Lump Sum	$30,000
• Restoration	Lump Sum		Lump Sum	$5,000
• Start-Up	Lump Sum		Lump Sum	$15,000
Air Emission Controls	Lump Sum		Lump Sum	$40,000
			Subtotal	$550,000
			TOTAL DIRECT CAPITAL COST	**$660,000**
II. INDIRECT CAPITAL COSTS				
Contingency (25% of Direct Capital Cost)				$165,000
Engineering (15% of Direct Capital Cost)				$99,000
Administration/Legal Fees (5% of Direct Capital Cost)				$33,000
Update Existing Air Permit (SVES System)				$5,000
			TOTAL INDIRECT CAPITAL COST	**$302,000**
			TOTAL CAPITAL COST	**$962,000**

Table 5-10

ITT Sealectro, Inc.

Mamaroneck, NY Facility

Cost Estimate- Alternative 5

Soil Vapor Extraction System with Air Sparging

Feasibility Study

	Item	Quantity	Unit	Unit Cost	Total Cost
III.	**ANNUAL OPERATING AND MAINTENANCE COSTS - TREATMENT SYSTEM**				
	Monthly Air Compliance Monitoring (VOC)	Lump Sum		Lump Sum	$18,000
	GC Samples (2 times a month for VOCs)	Lump Sum		Lump Sum	$24,000
	Air unit carbon replacement (10,000 lbs/year)	Lump Sum		Lump Sum	$6,400
	Air unit carbon disposal (10,000 lbs/year)	Lump Sum		Lump Sum	$6,400
	System operation and maintenance	Lump Sum		Lump Sum	$50,000
				ANNUAL O&M COST TREATMENT SYSTEM (not including project management)	$104,800
	PRESENT WORTH TREATMENT SYSTEM (FOR 10 YRS @ 5%)				**$809,238**
	ANNUAL GW MONITORING COSTS				
	Six Wells; quarterly for years 1 - 2; VOCs		Year 1		$26,000
			Year 2		$26,000
	Six Wells; annually for years 3 - 30; VOCs		per year		$10,000
	PRESENT WORTH LONG TERM GW MONITORING (FOR 30 YEARS, 5%)				**$174,831**
	ANNUAL PROJECT MANAGEMENT COSTS				
	Project Management (Years 1-5)	Lump Sum		Lump Sum	$75,000
	Project Management (Years 5-15)	Lump Sum		Lump Sum	$10,000
	Project Management (Years 15-30)	Lump Sum		Lump Sum	$10,000
	PRESENT WORTH PROJECT MANAGEMENT (FOR 30 YRS @ 5%)				**$435,105**
	Five Year Review (costs are for 5 years)	Lump Sum		Lump Sum	$10,000
	PRESENT WORTH FIVE YEAR REVIEW (FOR 30 YRS @ 5%)				**$27,820**
	TOTAL PRESENT WORTH O&M COSTS				**$1,446,994**
	TOTAL ESTIMATED COST FOR ALTERNATIVE 5				**$2,408,994**
				ROUNDED TO:	**$2,400,000**

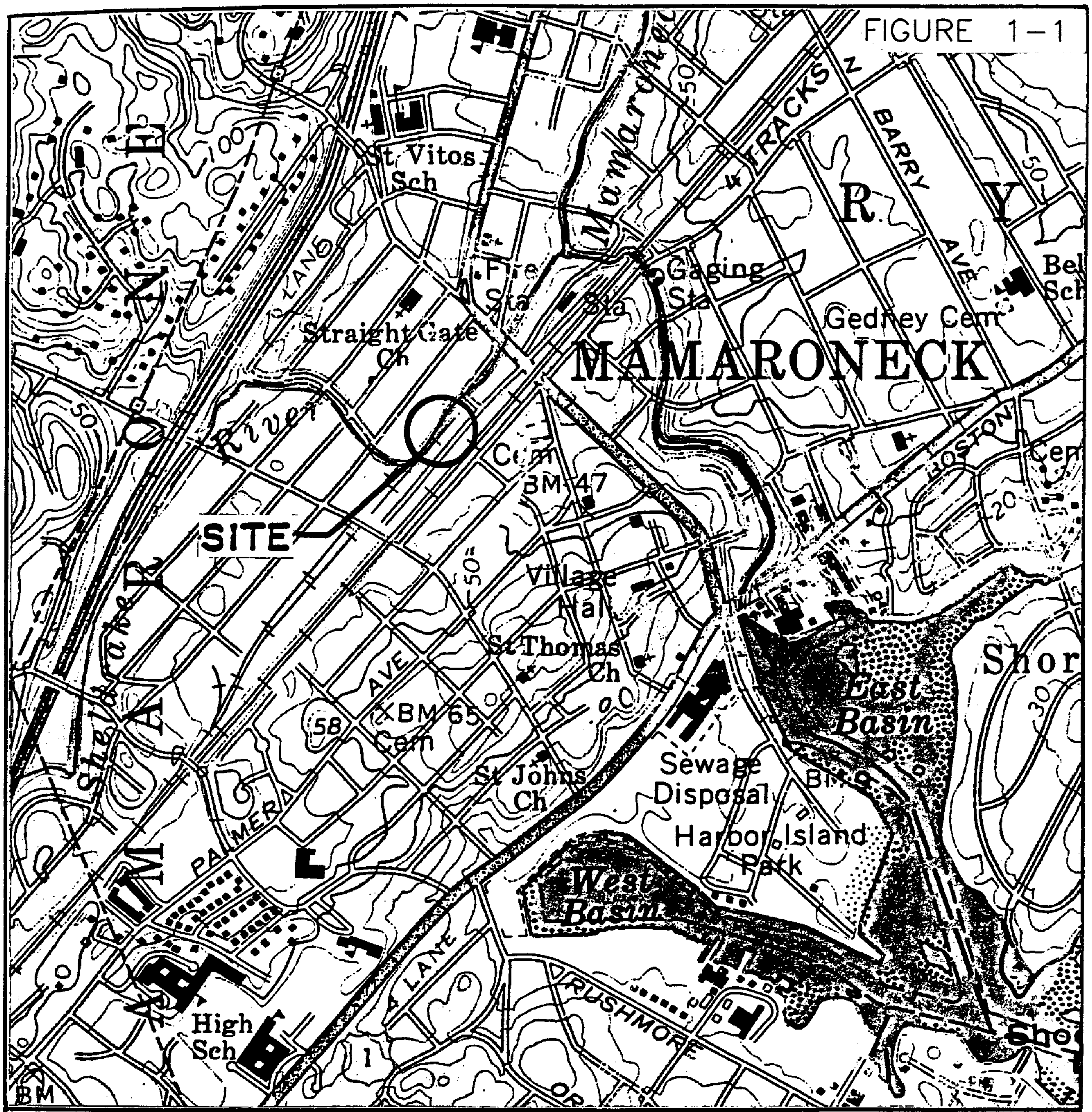
Notes:

1. Cost estimate based on R.S. Means 1995 Construction Cost Data, vendore quotes, and O'Brien & Gere Engineers, Inc. professional experience.
2. Line items provided to form budget cost only.
3. Fencing Costs are not included, assuming that the existing fence is adequate.
4. Costs for mobilization were obtained from O'Brien & Gere's Manual of Policy and Procedure Instructions, January 1985.
5. The cost in this table were developed based upon the data currently available and several assumptions necessary to evaluate the alternatives. Because of the incomplete nature of this information and the possibility that actual conditions may vary considerably from these base assumptions, these costs are not necessarily indicative of the actual remediation costs that will be incurred. These costs should only be used for comparison of technical alternatives.
6. Costs assume building demolition is not necessary.

FIGURES

Figures

FIGURE 1-1



ITT SEALECTRO
MAMARONECK, NEW YORK

QUADRANGLE LOCATION

SITE LOCATION MAP

0 1000 2000

SCALE IN FEET

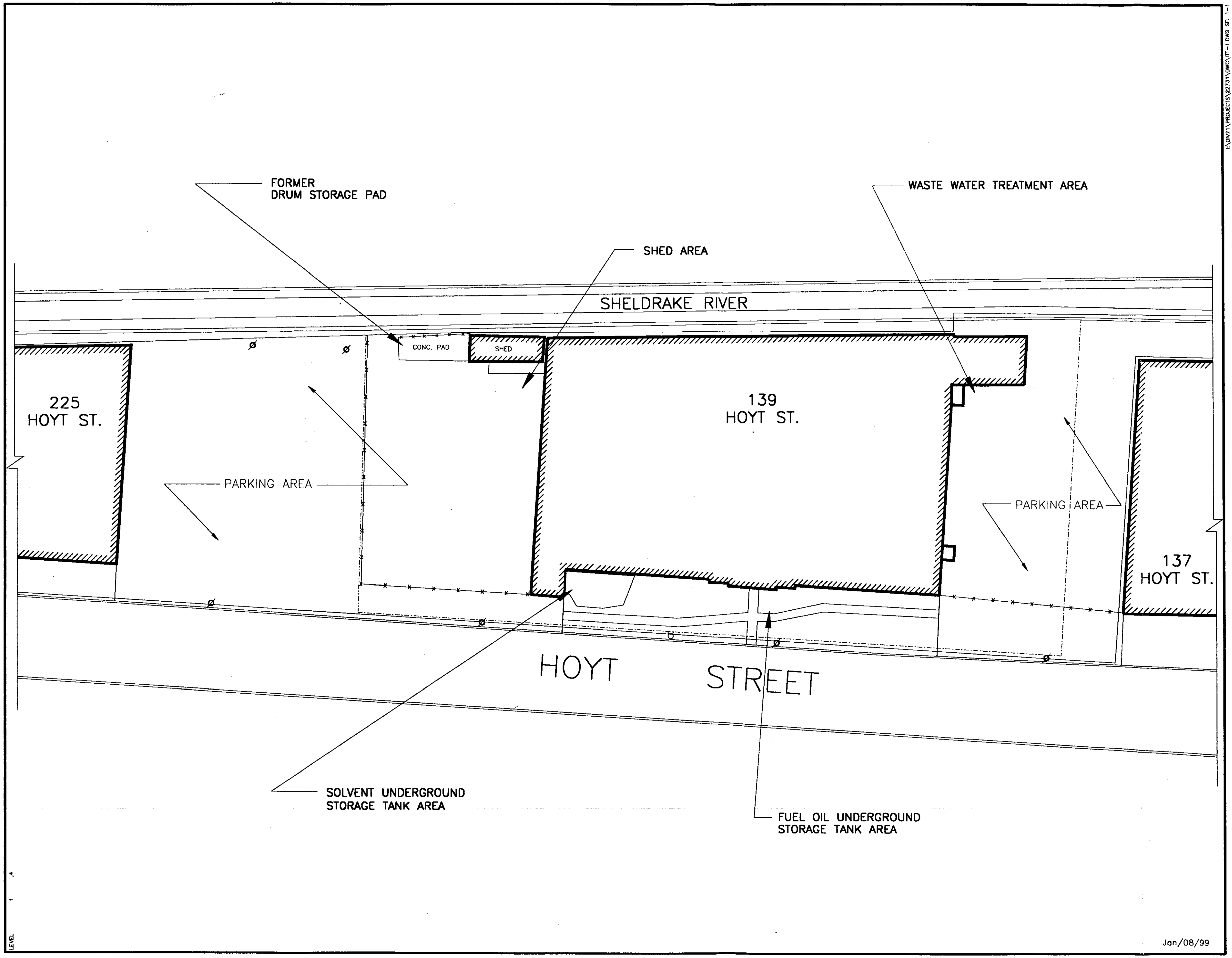
ADAPTED FROM U.S.G.S. QUAD. 7.5 MIN. QUAD. MAP, MAMARONECK, NEW YORK

3356.015.25F 1/28/93

8X11

O'BRIEN & GERE ENGINEERS, INC.

FIGURE 1-2



LEGEND

- - - - PROPERTY LINE
ø UTILITY POLE
—x—x— FENCE

ITT SEALECTRO
MAMARONECK, NEW YORK

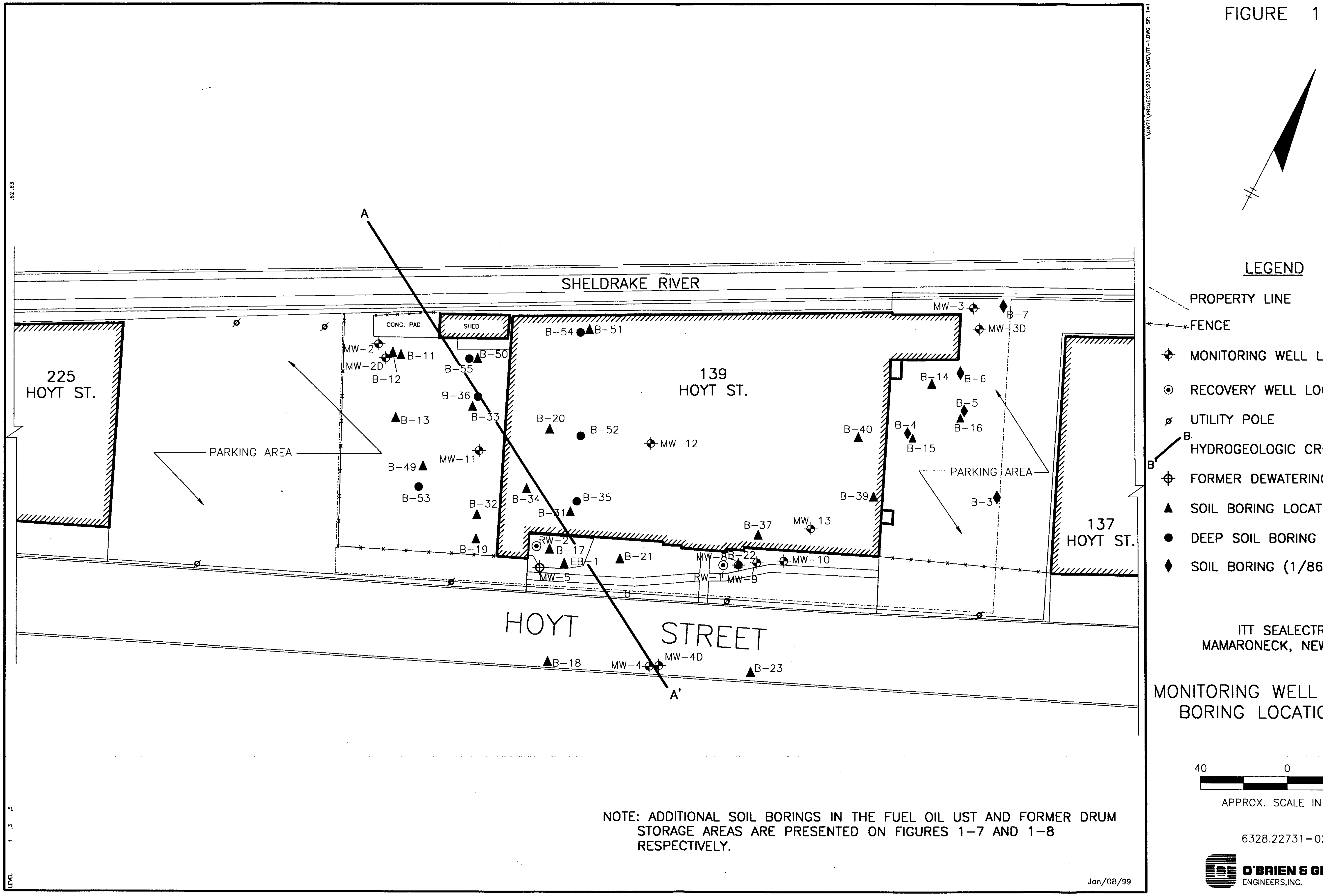
SITE BASE MAP

40 0 40
APPROX. SCALE IN FEET

6328.22731-01

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 1-3



NOTE: ADDITIONAL SOIL BORINGS IN THE FUEL OIL UST AND FORMER DRUM STORAGE AREAS ARE PRESENTED ON FIGURES 1-7 AND 1-8 RESPECTIVELY.

Jan/08/99

LEGEND

- PROPERTY LINE
- FENCE
- ⊕ MONITORING WELL LOCATION
- ⊙ RECOVERY WELL LOCATION
- ø UTILITY POLE
- B-B' HYDROGEOLOGIC CROSS SECTION
- ⊕ FORMER DEWATERING WELL
- ▲ SOIL BORING LOCATION
- ● DEEP SOIL BORING LOCATION
- ◆ SOIL BORING (1/86-2/86, OBG)

ITT SEALECTRO
MAMARONECK, NEW YORK

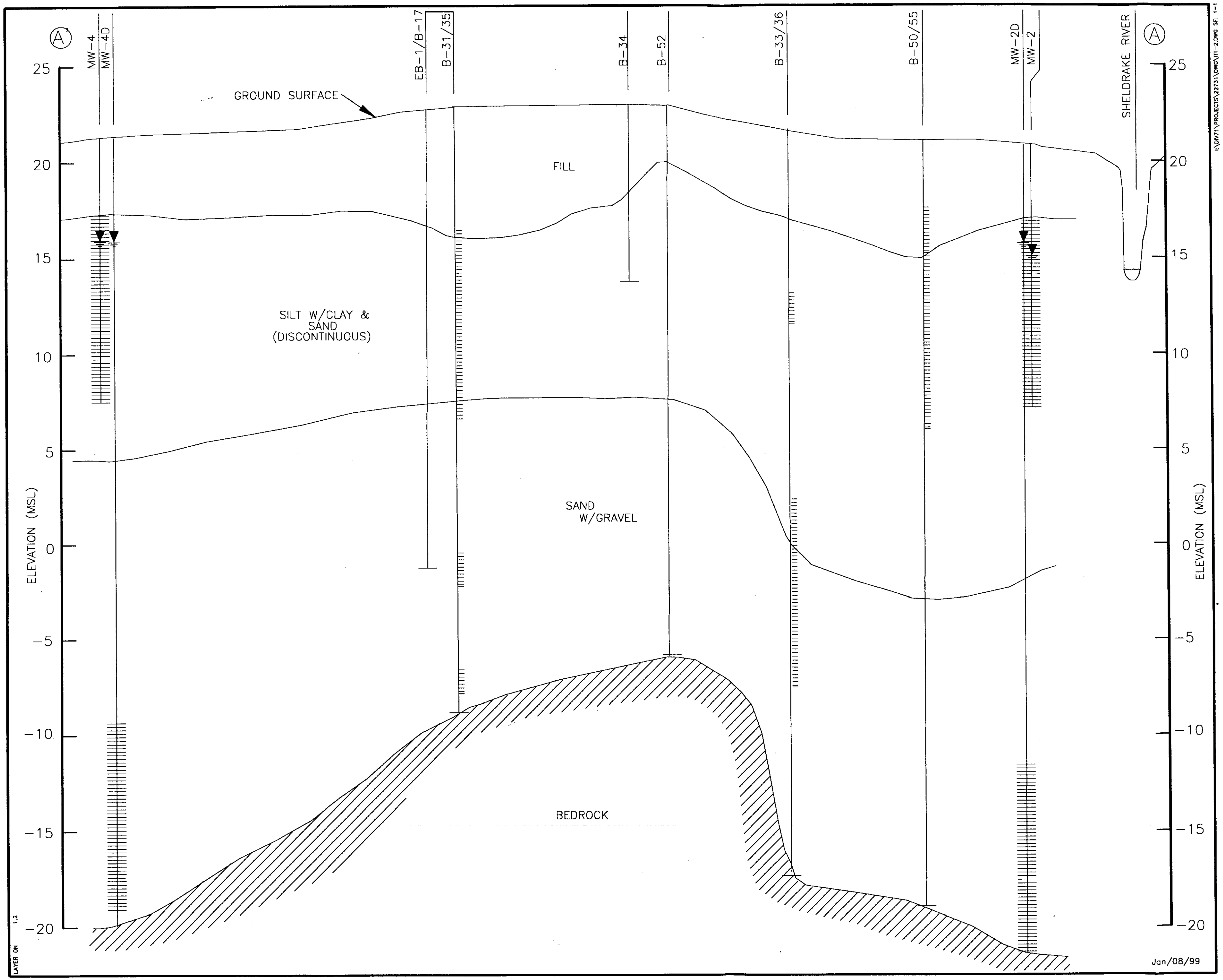
MONITORING WELL AND SOIL BORING LOCATION MAP

40 0 40
APPROX. SCALE IN FEET

6328.22731-02

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 1-4



LEGEND

- MONITORING WELL SCREENED INTERVAL
- SOIL BORING LOCATION
- ▼ GROUND WATER ELEVATION (11/17/94)
- INTERPOLATED BOUNDARY

NOTE:
VERTICAL EXAGGERATION IS 6X.

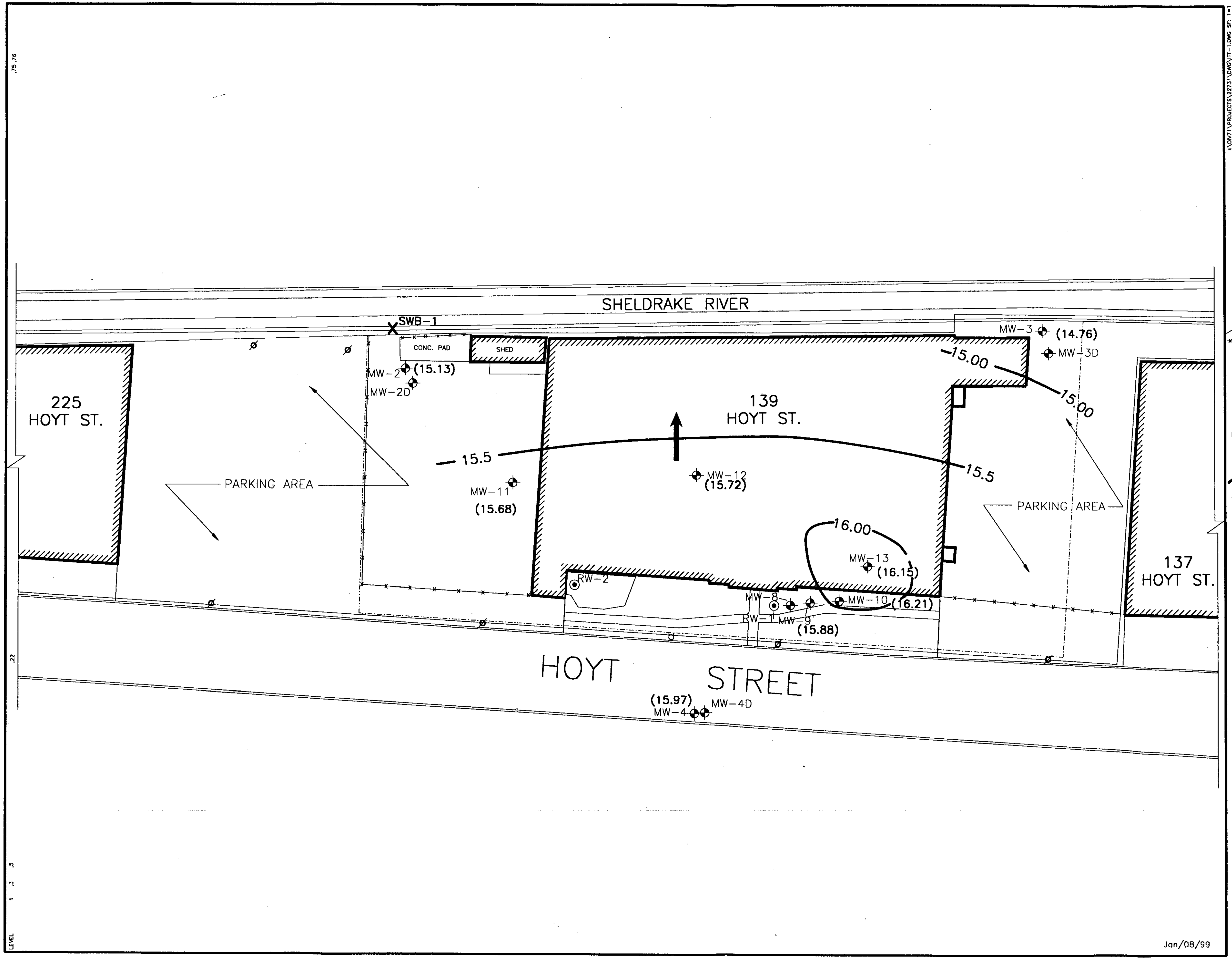
ITT SEALECTRO
MAMARONECK, NEW YORK

GENERALIZED
HYDROGEOLOGIC
CROSS SECTION A–A'

20 0 20
APPROX. HORIZ. SCALE IN FEET

6328.22731–03

O'BRIEN & GERE
ENGINEERS,INC.



LEGEND

PROPERTY LINE
FENCE
MONITORING WELL LOCATION
⊙ RECOVERY WELL LOCATION
ø UTILITY POLE
(14.76) GROUND WATER ELEVATION
15 GROUND WATER ELEVATION CONTOUR
→ GROUND WATER FLOW DIRECTION
X SURFACE WATER BENCH MARK

ITT SEALECTRO
MAMARONECK, NEW YORK

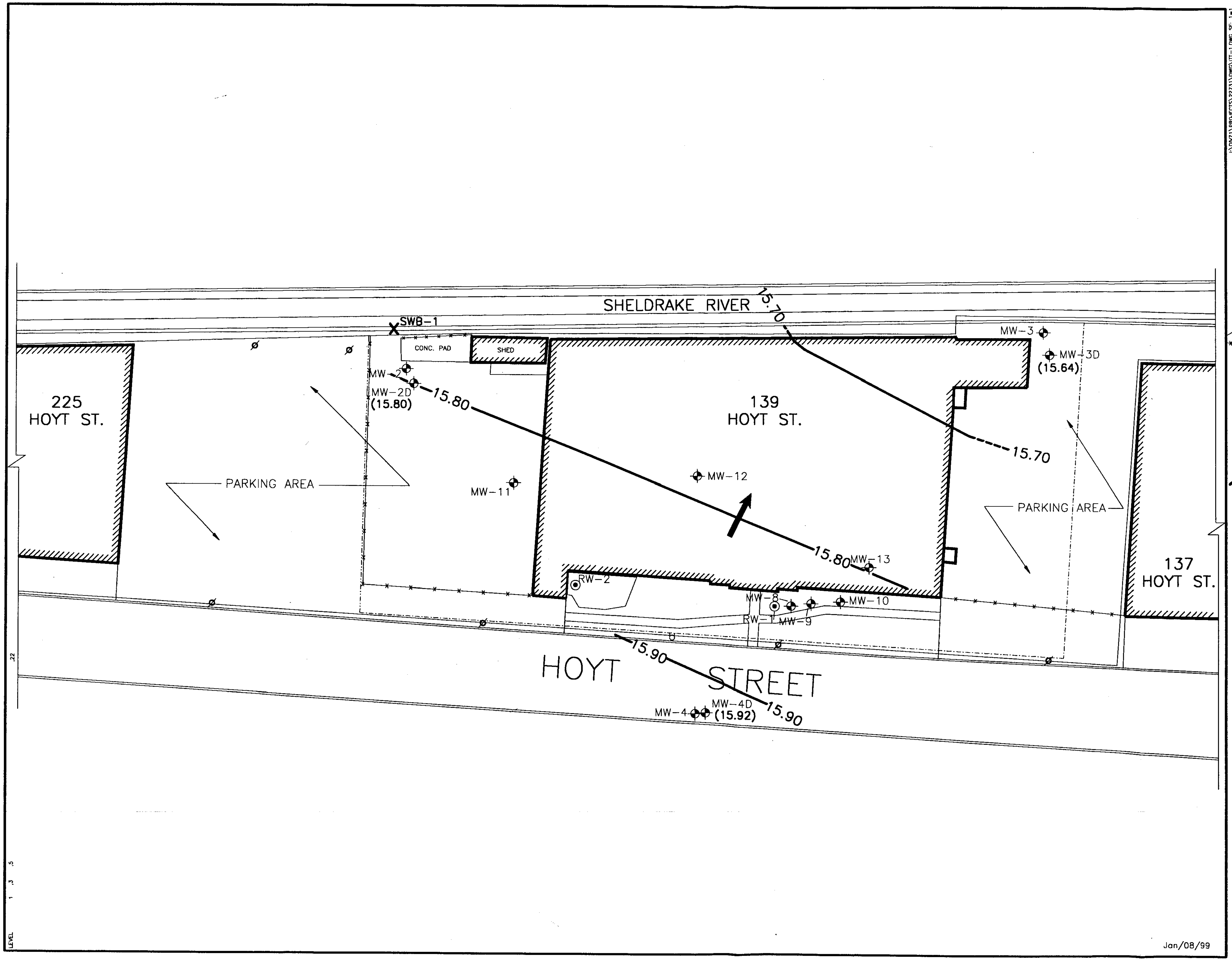
SHALLOW GROUND WATER
FLOW MAP
11/17/94

40 0 40
APPROX. SCALE IN FEET

6328.22731–04

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 1-6



LEGEND

- PROPERTY LINE
- FENCE LINE
- ⊕ MONITORING WELL LOCATION
- ⊙ RECOVERY WELL LOCATION
- ø UTILITY POLE
- (15.92) GROUND WATER ELEVATION
- 15.80 GROUND WATER ELEVATION CONTOUR
- ➚ GROUND WATER FLOW DIRECTION
- X SURFACE WATER BENCH MARK

ITT SEALECTRO
MAMARONECK, NEW YORK

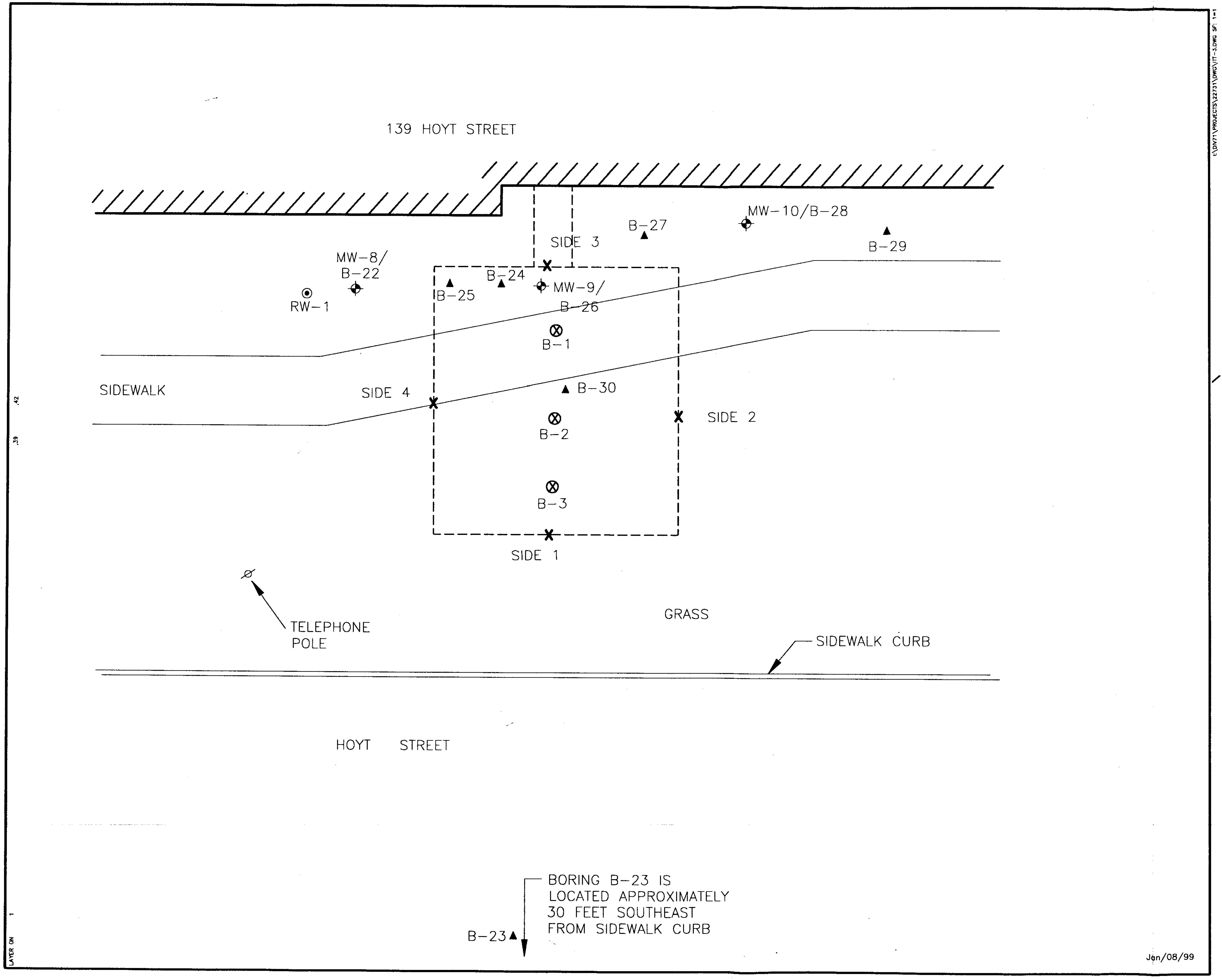
DEEP GROUND WATER
FLOW MAP
11/17/94

40 0 40
APPROX. SCALE IN FEET

6328.22731-05

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 1-7



LEGEND

- APPROXIMATE LIMITS OF EXCAVATION
- ⌖ MONITORING WELL LOCATION
- ▲ SOIL BORING LOCATION (12/92)
- ⊙ RECOVERY WELL LOCATION
- X POST EXCAVATION SIDE SOIL SAMPLE (4/92)
- ⊗ POST EXCAVATION BOTTOM SOIL SAMPLE (4/92)

ITT SEALECTRO
MAMARONECK, NEW YORK

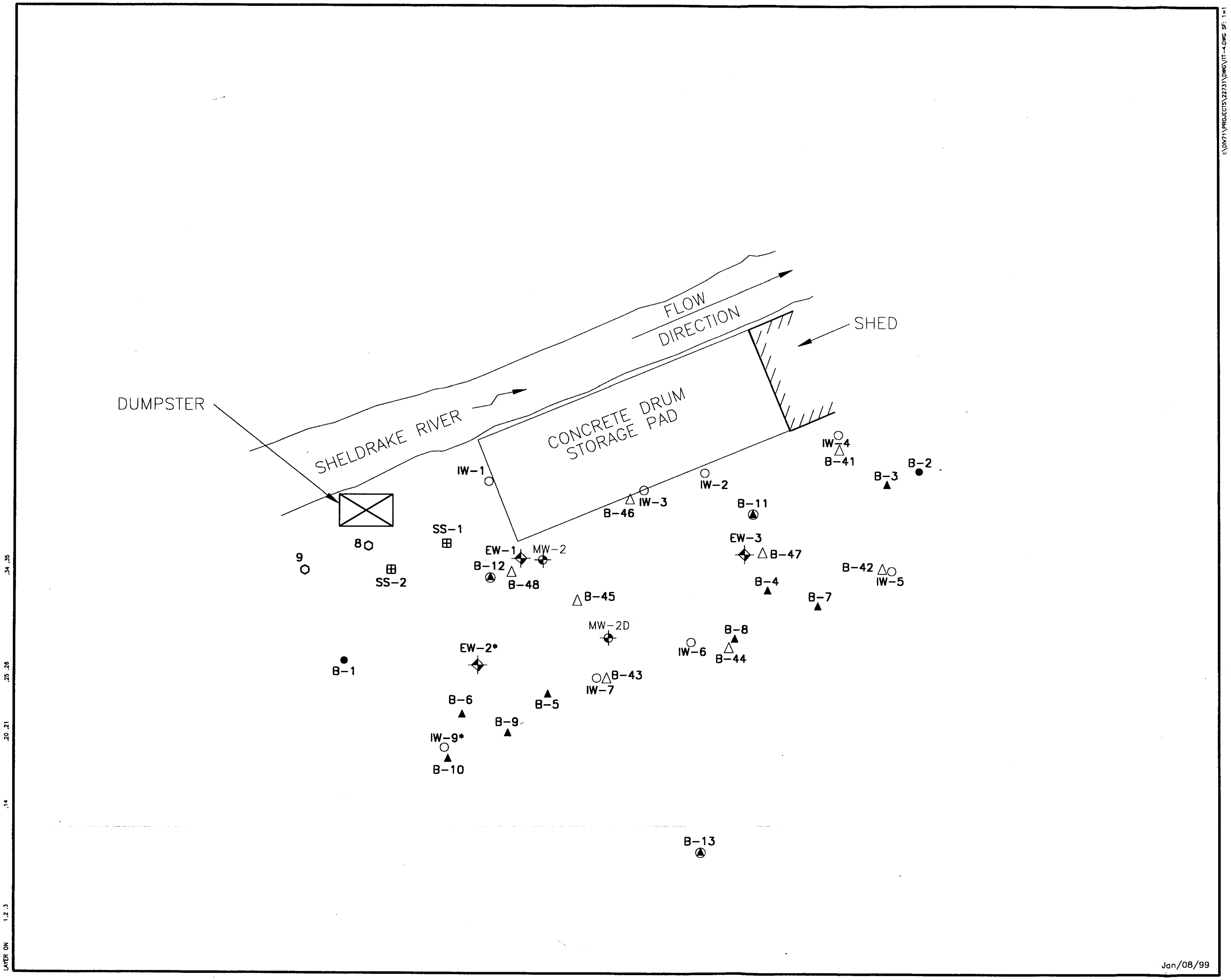
FUEL OIL UNDERGROUND STORAGE TANK AREA LOCATION MAP

5 0 5
APPROX. SCALE IN FEET

6328.22731-06

O'BRIEN & GERE
ENGINEERS,INC.

FIGURE 1-8



LEGEND

⊕	MONITORING WELL
●	SOIL BORING (6/88, TRC)
▲	SOIL BORING (8/89, OBG)
◬	SOIL BORING (1/92, OBG)
⊞	SOIL SAMPLE (8/89, OBG)
○	INLET WELL (10/91, OBG)
✦	EXTRACTION WELL (10/91, OBG)
⬡	SURFACE SOIL SAMPLE (2/86, OBG)
△	OBG SOIL BORING (12/93, OBG)
*	INLET & EXTRACTION WELLS REMOVED

ITT SEALECTRO
MAMARONECK, NEW YORK

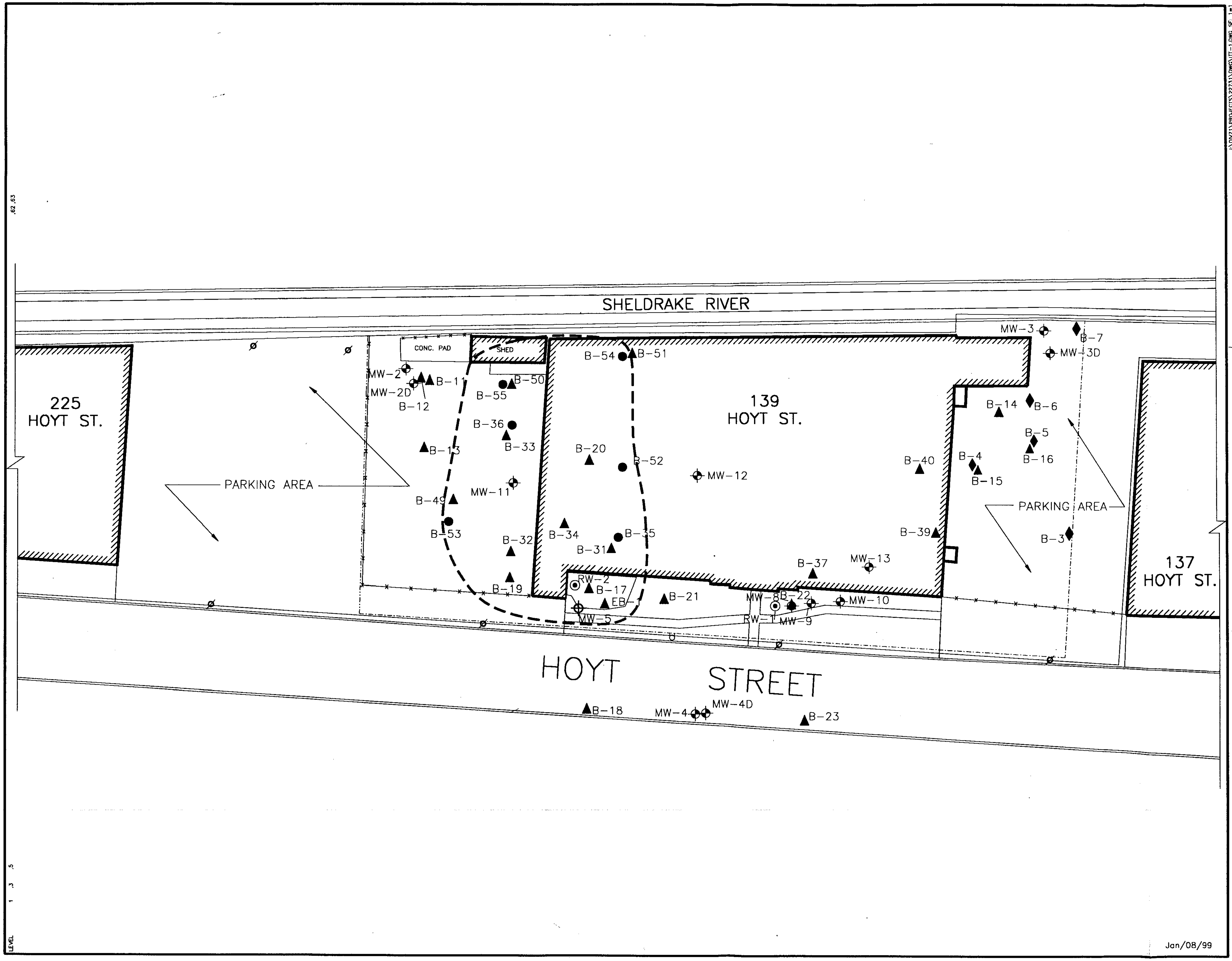
FORMER DRUM STORAGE PAD AREA LOCATION MAP

0 10 20
APPROX. SCALE IN FEET

6328.22731-07

O'BRIEN & GERE
ENGINEERS,INC.

FIGURE 3-1



LEGEND

- PROPERTY LINE
- FENCE
- ⊕ MONITORING WELL LOCATION
- ⊙ RECOVERY WELL LOCATION
- ø UTILITY POLE
- ⊕ FORMER DEWATERING WELL
- ▲ SOIL BORING LOCATION
- ● DEEP SOIL BORING LOCATION
- ◆ SOIL BORING (1/86-2/86, OBG)
- ESTIMATED EXTENT OF DNAPL

ITT SEALECTRO
MAMARONECK, NEW YORK

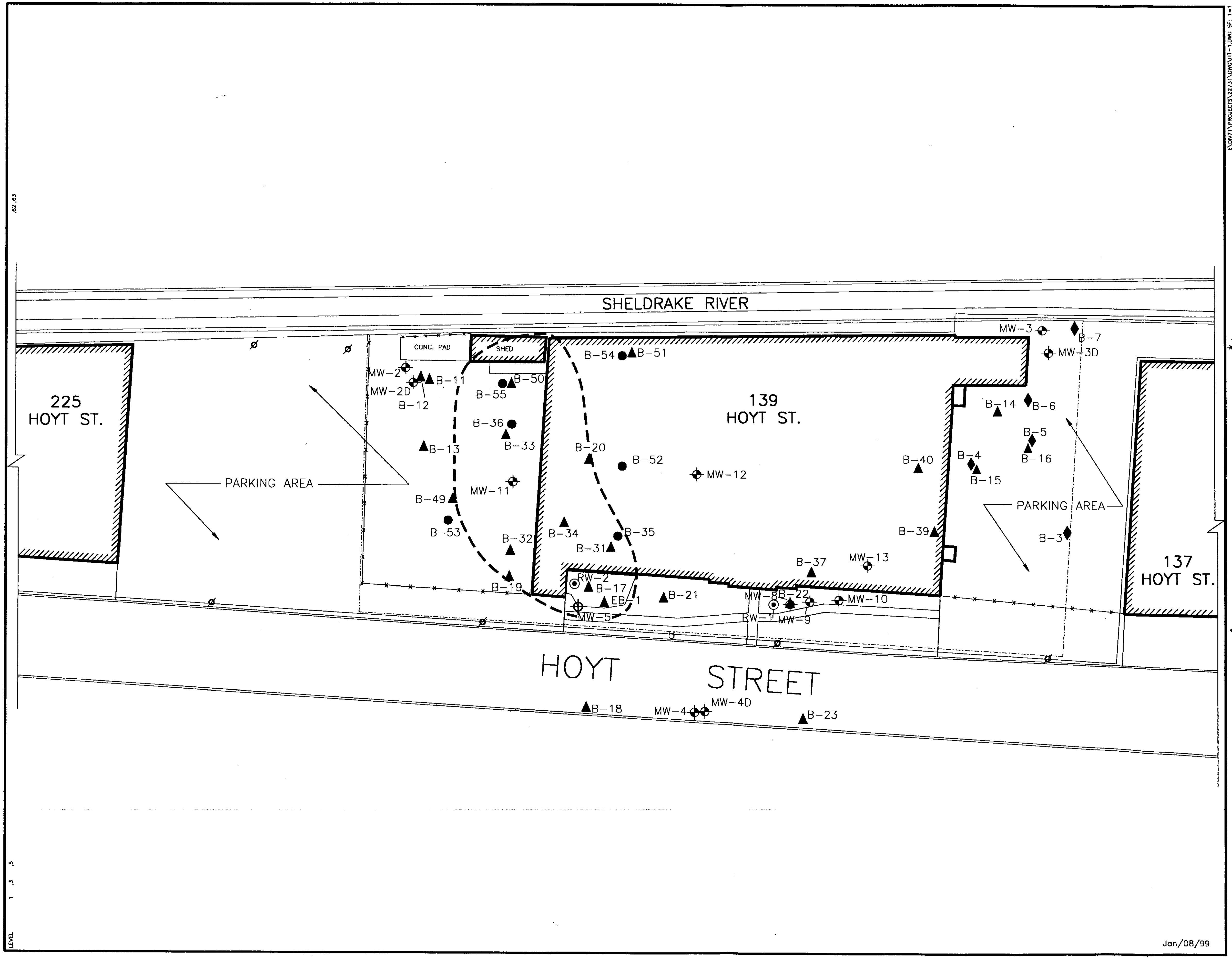
ESTIMATED EXTENT OF DNAPL (SHALLOW GROUND WATER ZONE)

40 0 40
APPROX. SCALE IN FEET

6328.22731-09

O'BRIEN & GERE
ENGINEERS,INC.

FIGURE 3-2



LEGEND

PROPERTY LINE
FENCE
⌖ MONITORING WELL LOCATION
⊙ RECOVERY WELL LOCATION
ø UTILITY POLE
⊕ FORMER DEWATERING WELL
▲ SOIL BORING LOCATION
● DEEP SOIL BORING LOCATION
◆ SOIL BORING (1/86-2/86, OBG)
ESTIMATED EXTENT OF DNAPL

ITT SEALECTRO
MAMARONECK, NEW YORK

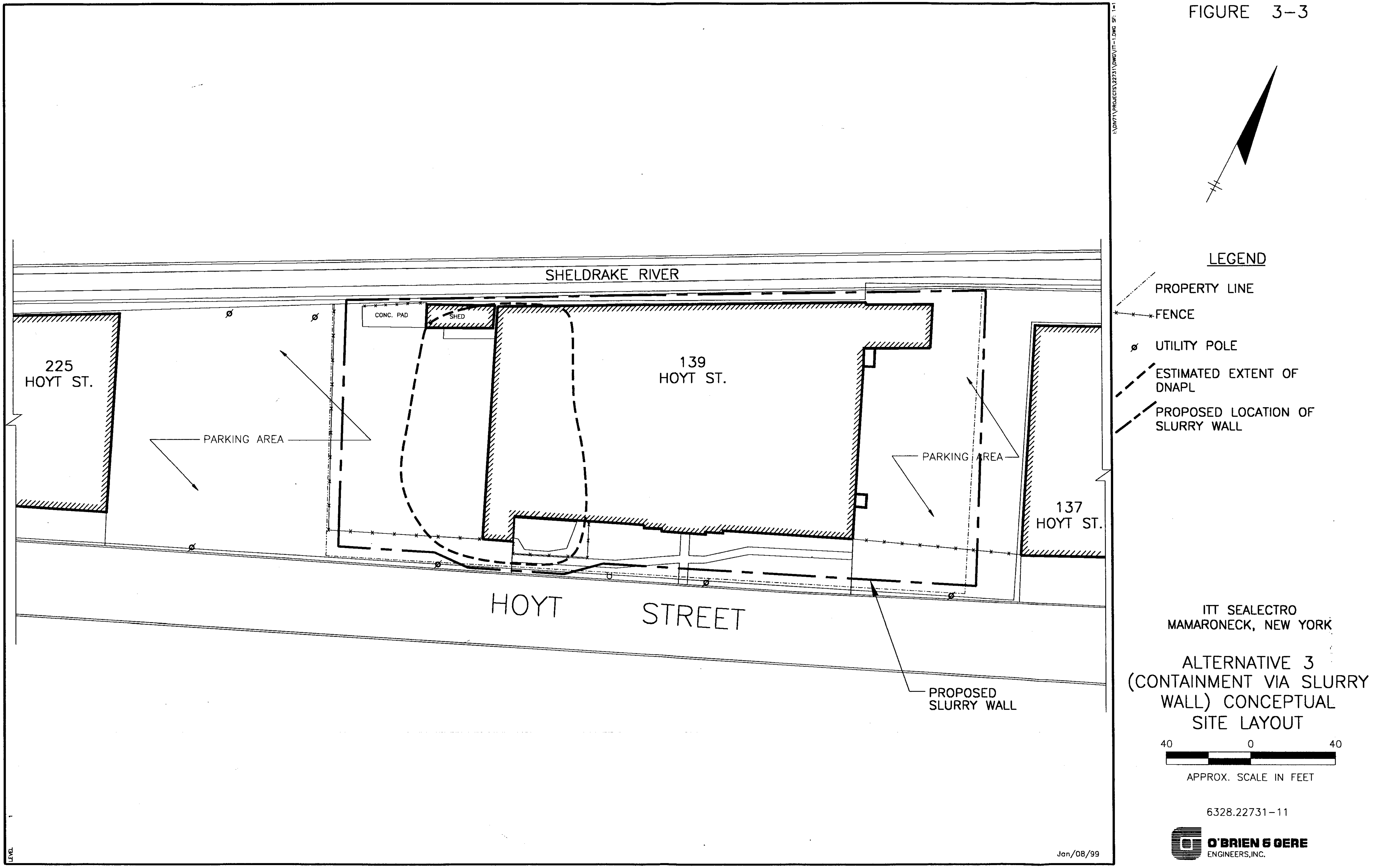
ESTIMATED EXTENT OF DNAPL (DEEP GROUND WATER ZONE)

40 0 40
APPROX. SCALE IN FEET

6328.22731-10

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 3-3



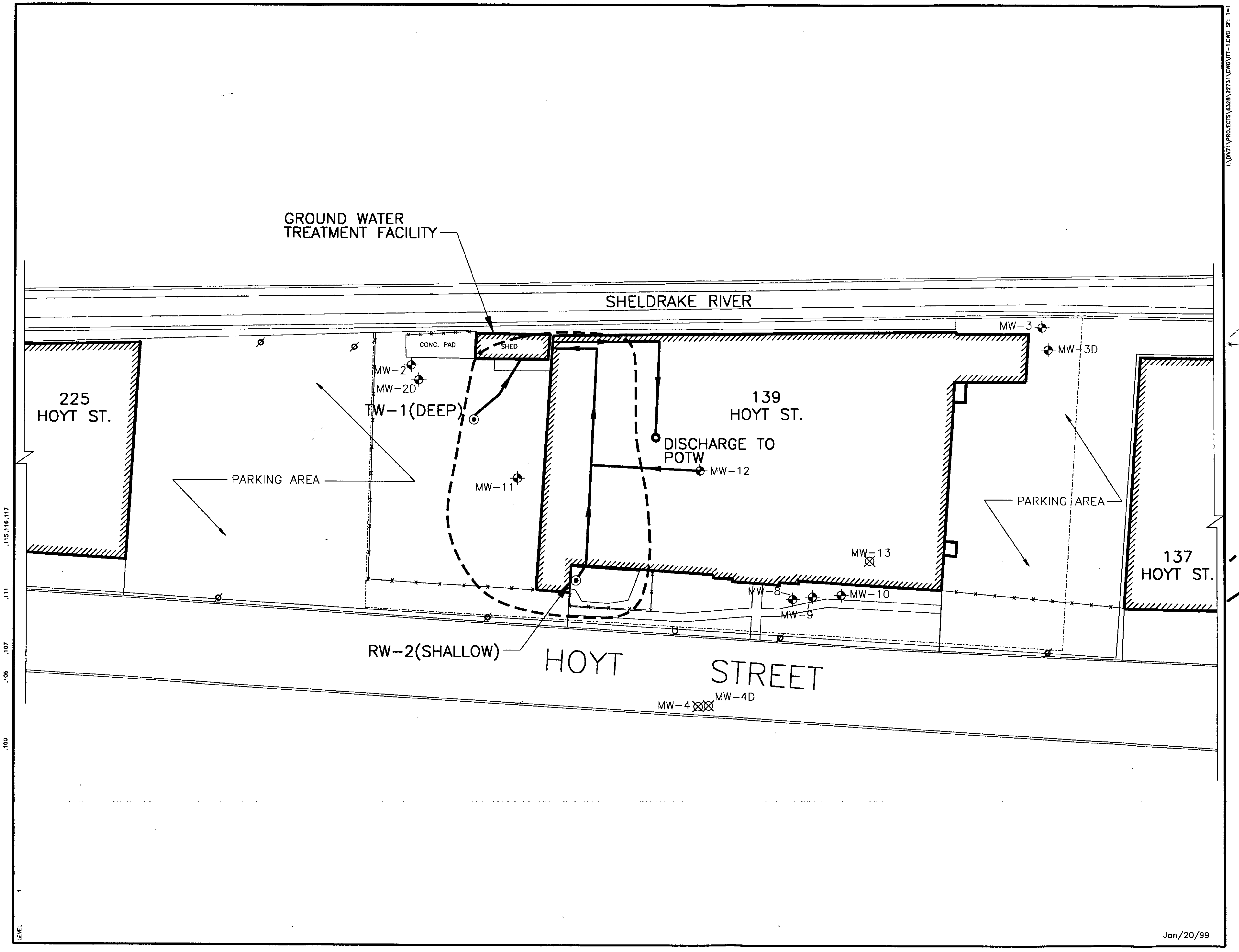
ITT SEALECTRO
MAMARONECK, NEW YORK

ALTERNATIVE 3
(CONTAINMENT VIA SLURRY
WALL) CONCEPTUAL
SITE LAYOUT

6328.22731-11

O'BRIEN & GERE
ENGINEERS, INC.

FIGURE 3-4



LEGEND

- PROPERTY LINE
- FENCE
- ø UTILITY POLE
- ⊙ EXISTING RECOVERY WELL LOCATION
- ⊕ EXISTING MONITORING WELL LOCATION
- ⊠ DECOMMISSIONED MONITORING WELL LOCATION
- ESTIMATED EXTENT OF DNAPL
- PROPOSED PIPING AND FLOW DIRECTION

ITT SEALECTRO
MAMARONECK, NEW YORK

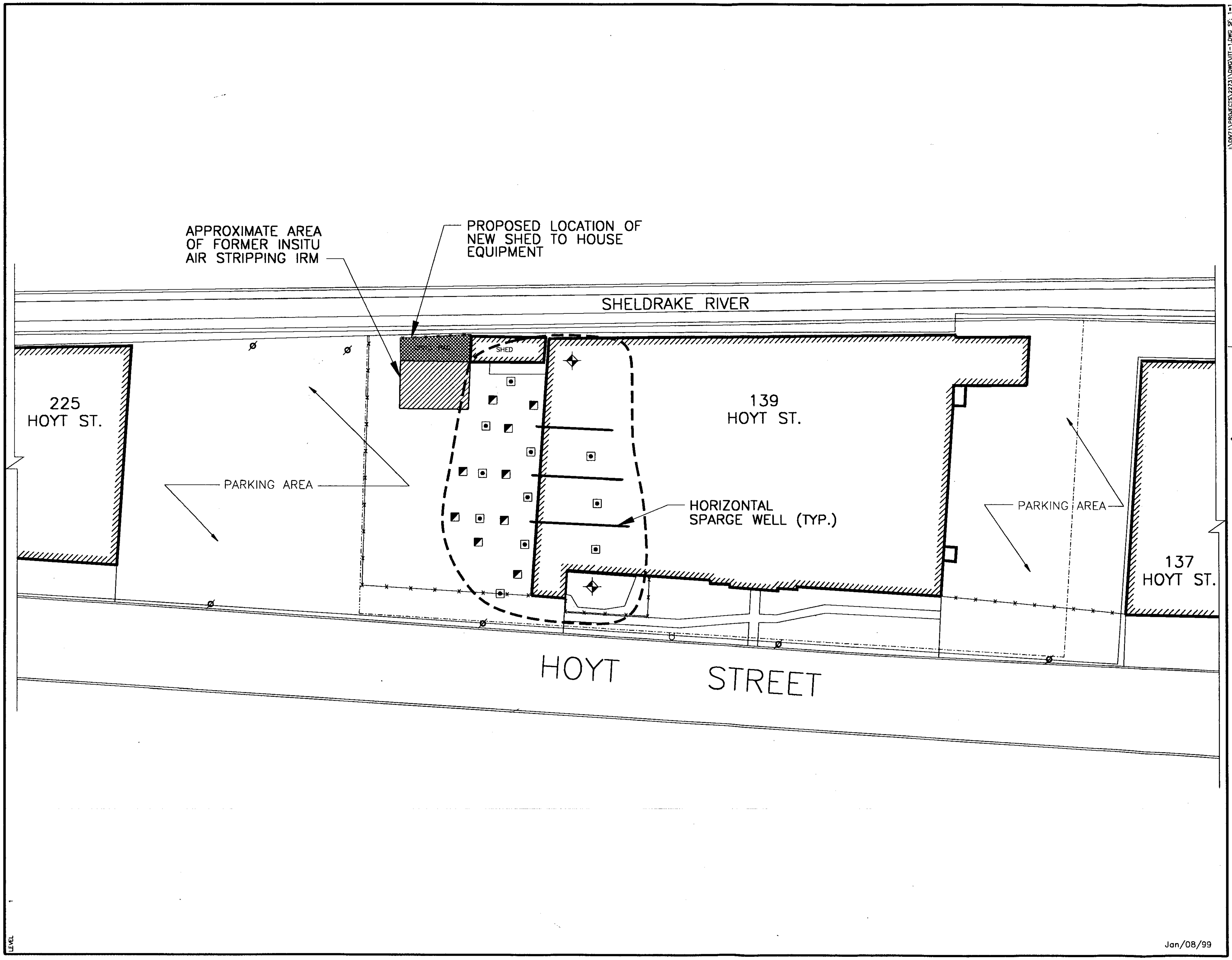
ALTERNATIVE 4
(GROUND WATER
MONITORING AND
CONTINGENCY REMEDY)

40 0 40
APPROX. SCALE IN FEET

6328.22731-12

O'BRIEN & GERE
ENGINEERS,INC.

FIGURE 3-5



ITT SEALECTRO
MAMARONECK, NEW YORK

ALTERNATIVE 5
(IN SITU AIR STRIPPING
AND AIR SPARGING)
CONCEPTUAL SITE LAYOUT

40 0 40
APPROX. SCALE IN FEET

6328.22731-13

O'BRIEN & GERE
ENGINEERS,INC.

Appendices

Appendix A

IRM effectiveness calculations

1. VOC/DNAPL Mass Summary
2. Ground Water Recovery IRM Mass Removal
3. Soil Removal IRM Mass Removal
4. Pilot In-Situ Air Stripping System Mass Removal (Parts 1 & 2)
5. Current Mass of VOC/DNAPL in Subsurface
6. Alternative Evaluation of the pre IRM DNAPL Mass Below the Ground Water Table

1. VOC/DNAPL MASS SUMMARY

Objective: This provides a summary of the subsequent tables presented in Appendix A.

August 1995

Total VOCs current	779 kg	1714 lbs	135 gal
ISAS removal *	12.3 kg	27.1 lbs	2.13 gal
Soil removal	493 kg	1085 lbs	85 gal
GW extraction (Aug 95)	307 kg	678 lbs	53.2 gal
total	1591.3 kg	3504.1 lbs	275.33 gal

* avg of 11.3 kg + 13.3 kg

Estimated original source mass = 1591.3 kg
= 3504 lbs
= 275 gal

Percent removed (August 1995)
12.3 kg + 493 kg +307 kg /1591.3 kg = 51%

Summary VOCs removed and currently at site based on October 1998 GW Extraction data

October 1998

Total VOCs current	761 kg	1675 lbs	131.9 gal
ISAS removal *	12.3 kg	27.1 lbs	2.13 gal
Soil removal	493 kg	1085 lbs	85 gal
GW extraction (Oct 98)	325 kg	717 lbs	56.3 gal
total	1591.3 kg	3504.1 lbs	275.33 gal

Percent removed (October 1998)
12.3 kg + 493 kg +325 kg /1591.3 kg = 52%

Result: The total quantity of VOCs removed as part the IRM program was calculated to be 812.3 kg (1790.1 lbs) in August 1995 with an estimated remaining mass of 779 kg (1714 lbs). The ground water extraction well was continued from August 1995 through the present. Using the updated mass of VOCs removed from the extraction well (October 1998) the total amount of VOCs removed as part of the IRM program are 830.3 kg (1829.1 lbs) with 761 kg (1675 lbs) remaining. The IRMs have been effective in reducing the quantity of VOCs at the site by 52%.

2. GROUND WATER RECOVERY IRM MASS REMOVAL

Table 1
ITT Sealectro

Quantity of VOCs removed
by ground water extraction at RW-2

Date	VOC (mg/l	Gal/Month	Mass VOCs Removed (kg)	Cum Total Mass VOCs Removed (kg)
10-Apr-92	215	64200	52.31	52.31
30-Apr-92	185	39700	27.84	80.15
12-May- 92	151	8900	5.09	85.24
17-Jun-92	124	59100	27.77	113.02
15-Jul-92	130	46100	22.71	135.73
18-Aug-92	165	47800	29.89	165.62
13-Aug-92	133	59700	30.09	195.72
17-Nov-92	88	28500	9.51	205.22
30-Dec-92	112	18300	7.77	212.99
24-Feb-93	57	32200	6.96	219.94
23-Mar-93	93	22500	7.93	227.88
22-Apr-93	87	27400	9.03	236.91
20-May-93	85	30500	9.83	246.74
16-Jun-93	77	20400	5.95	252.69
29-Jul-93	93	12500	4.41	257.09
25-Aug-93	77	2300	0.67	257.77
24-Nov-93	37	34900	4.89	262.66
14-Dec-93	23	5900	0.51	263.17
1-Jan-94	42.2	26600	4.25	267.43
25-Feb-94	1.171	24400	0.11	267.54
30-Mar-94	30.5	3400	0.39	267.93
25-Apr-94	39.3	2500	0.37	268.30
24-May-94	18	25340	1.73	270.03
30-Jun-94	16.3	33790	2.09	272.12
27-Jul-94	10.8	16350	0.67	272.79
3-Oct-94	9.5	2150	0.08	272.87
26-Oct-94	27.4	13940	1.45	274.31
21-Nov-94	62.1	13160	3.10	277.41
21-Dec-94	68.7	17270	4.50	281.91
31-Jan-95	30.3	2540	0.29	282.20
27-Feb-95	49.67	13960	2.63	284.83
28-Mar-95	55.87	17330	3.67	288.50
24-Apr-95	65.4	8790	2.18	290.67
31-May-95	63.27	56610	13.57	304.25
28-Jun-95	66.6	6240	1.58	305.82
27-Jul-95	69.44	3800	1.00	306.82
29-Aug-95	27.3	5750	0.59	307.42
27-Sept-95	56.44	3180	0.68	308.10
28-Oct-95	36	11710	1.60	309.70
30-Nov-95	2.39	11770	0.11	309.80
30-Jan-96	12.9	4540	0.22	310.03
27-Feb-96	78.4	10650	3.16	313.19
26-Mar-96	2.85	7920	0.09	313.28
22-Apr-96	53.8	3990	0.81	314.09
29-Apr-96	8.4	1830	0.06	314.15

28-May-96	1.84	8630	0.06	314.21
25-Jun-96	2.12	2790	0.02	314.23
30-Jul-96	23.31	1930	0.17	314.40
27-Aug-96	60.3	3650	0.83	315.23
24-Sep-96	51.9	4750	0.93	316.17
19-Nov-96	13.1	4980	0.25	316.42
26-Nov-96	61	2250	0.52	316.94
28-Dec-96	52	7530	1.48	318.42
30-Jan-97	14.2	8420	0.45	318.87
25-Feb-97	2.42	5110	0.05	318.92
31-Mar-97	14.28	6620	0.36	319.28
30-Apr-97	14.2	8680	0.47	319.75
28-May-97	12.5	12070	0.57	320.32
30-Jun-97	6.66	14420	0.36	320.68
29-Jul-97	26.3	6880	0.69	321.37
26-Aug-97	17	4770	0.31	321.68
25-Sep-97	24.2	1760	0.16	321.84
30-Oct-97	32.3	2400	0.29	322.13
26-Nov-97	(5)	4550	0.00	322.13
23-Dec-97	0.655	4650	0.01	322.14
29-Jan-98	(6)	210	0.00	322.14
26-Feb-98	33.98	2200	0.28	322.43
25-Mar-98	24.06	7260	0.66	323.09
26-Apr-98	70.6	1090	0.29	323.38
25-May-98	41.34	20	0.00	323.38
29-Jun-98	19	2000	0.14	323.53
28-Jul-98	51.72	3450	0.68	324.20
25-Aug-98	32.02	4890	0.59	324.80
28-Sep-98	14.4	4960	0.27	325.07
26-Oct-98	14.3	4660	0.25	325.32

VOC (mg/L) - Total VOC concentration from MW-5/RW-2
Gal/Month - Quantity of ground water pumped each month
(measurement from system totalizer)

Mass of VOCs - VOC concentration (mg/L) * Yield (gal/month) * 3.79 L/Gal / 1.0 *10-6 Kg/mg)

Result: The quantity of ground water removed by ground water extraction is 325.32 kg. Multiplying by 2.205 lb/Kg the quantity is converted to 717.33 lbs.

(5) The November 1997 influent OVC sample contained sediments and debris which resulted in elevated detection limits and non-representative results. Sediments and debris were caused by maintenance activities conducted in the recovery well during the sampling period.

(6) Sample not collected in January due to system malfunction.

3. Soil Removal IRM Mass Removal
Objective: Estimate the mass of VOCs removed by the soil removal IRM at the Solvent UST Area

Average VOC Concentration of Soils Removed From Solvent UST Area - Data presented in RI Report

Samples Removed Soil	Total VOCs (mg/kg)	
B-17 (3-9 ft)	6300	most concentrated zone
B-17 (9-11 ft)	8200	
avg	7250 mg/kg	

Confirmation Samples from Remaining Soil	
C-4	0.84
C-5	4.91
C-6	10.03
D-5	0.33
D-6	829.4
D-7	14.89
D-8	2214.3
D-9	1366.6
D-10	129.3
D-11	11.21
avg	458 mg/kg

Overall VOC avg = (7250 + 458)/2 = 3854 mg/kg

Quantity of Soil Removed

6200 lbs first phase
85 yd^3 = 2295 ft^3 second phase

assume: 120 lbs/ft^3 density of soil

2295 ft^3 x 120 lbs/ft^3 = 275,400 lbs
275,400 lbs + 6200 lbs = 281,600 lbs of soil removed
281,600 lbs soil x 1 kg/2.2 lbs = 128,000 kg of soil

Quantity of VOCs Removed

128,000 kg x 3854 mg/kg x 1 kg/1x10^6 mg = 493 kg of VOC removed
493 kg x 2.2 lbs/1 kg = 1085 lbs of VOC removed
493,000 g x 1 l/1500 g x 0.26 gal/1 l = 85 gal of VOC removed

Result: The mass of VOCs removed from the Solvent UST Area by the soil removal IRM is estimated to be 493 kg (1085 lbs).

November 27, 1995/GAS:bdm/ITTCAL3

4. Pilot In Situ Air stripping System: IRM Mass Removal (Part 1)

Objective: To evaluate the quantity of VOCs removed by the In Situ Air stripping System using the VOC concentrations from the In Situ Air stripping system emissions.

The In Situ Air stripping System IRM was completed from May 12 to Oct 6,1992. The quantity of VOCs removed, based on results of air emission laboratory testing was estimated to be 17.65 lbs from May 12 to August 12, 1992 [See Table 10 from Interim Remedial Measures Report (O'Brien & Gere, 1992)].

Table 10 indicated the In Situ Air stripping System was run for 1514 hours from May 12 to August 12, 1992 as summarized below. The information was used to extrapolate the total time that the In Situ Air stripping System was operated.

59 days @ 24 hrs		1416 hrs
7 days with partial operation	98 hrs	
26 days with no operation	0 hrs	
	Total	1514 hrs

Percentage of time system was operated from 5/12/92 to 8/12/92:

(May 12 - Aug 12) 92 days x 24 hrs = 2208 hrs

1514 hrs/2208 hrs = 69% of the time system was operated

Extrapolation of time system was operated from Aug 13 to Oct 6, 1992.

August 13 to October 6, 1992 = 61 days = 1464 hrs
assuming system operated 69% of time = 1464 hrs x 69% = 1010 hrs

Calculate total VOCs removed

total hrs system operated = 1514 + 1010 = 2524 hrs
rate of removal = 17.65 lb per 1514 hrs

extrapolating $$\frac{17.65\ \text{lb}}{x} = \frac{1514\ \text{hrs}}{2524\ \text{hrs}}$$

where x = total VOCs removed
= 29.4 lb
= 13.3 kg

Result: A total of 13.3 kg (29.4 lbs) of VOCs were removed by the In Situ Air stripping System IRM completed at the Former Drum Storage Pad.

November 27, 1995/GAS:bdm/ITTCAL11

ITT Sealectro Feasibility Study

Pilot In situ airstripping system IRM Mass Removal (Part 2)

Objective: To calculate the quantity of VOCs removed at the Former Drum Storage Pad by the In situ airstripping system IRM. The basis for this calculation is comparing the concentrations of VOCs in the soil prior to In situ airstripping system IRM to the concentrations of VOCs in soil after implementing the In situ airstripping system IRM.

Basis for Calculations

Vol of soil 30 ft x 60 ft x 6 ft = 10,800 ft^3
Avg VOC conc in soil before IRM = 20.0 mg/kg (see attached table)
Avg VOC conc in soil after IRM = 0.86 mg/kg (see attached table)

assume: 120 lbs/ft^3 density of soil
1500 g/l avg density of VOC

Before In situ Airstripping System IRM

10,800 ft^3 x 120 lbs/ft^3 x 1kg/2.2 lbs = 589,091 kg of soil
589,091 kg x 20 mg/kg x 1kg/1x10^6 mg = 11.8 kg of VOC
11.8 kg x 2.2 lbs/kg = 26 lbs of VOC
11,800 g x 1 l/1500 g x 0.26 gal/1 l = 2 gal of VOC

After In situ Airstripping System IRM

10,800 ft^3 x 120 lbs/ft^3 x 1kg/2.2 lbs = 589,091 kg of soil
589,091 kg x 0.86 mg/kg x 1kg/1x10^6 mg = 0.5 kg of VOC
0.51 kg x 2.2 lbs/kg = 1.1 lbs of VOC
510 g x 1 l/1500 g x 0.26 gal/1 l = 0.1 gal of VOC

Total Removed

11.8 kg - 0.5 kg = 11.3 kg
26 lbs - 1.1 lbs = 24.9 lbs
2 gal - 0.1 gal = 1.9 gal

Result: The quantity of VOC removed at the Former Drum Storage Pad was estimated to 11.3 kg (24.9 lb).

This calculation compares favorably to the quantity of VOCs removed using effluent air concentrations from the in situ airstripping system.

Using the effluent air quality data from the in situ airstripping system it was estimated that 13.3 kg (29.4 lbs) of VOCs were removed. An average of the two methods is 12.3 kg (27.1 lbs).

November 27, 1995/GAS:bdm/ITTCAL2

ITT Sealectro Feasibility Study

Pilot In Situ Air Stripping IRM Mass Removal (Part 2 continued)

Objective: Estimate the concentrations of VOCs in soil at the Former Drum Storage Pad Area prior to In Situ Air Stripping IRM (to 6 ft bgs). This information was obtained from Table 10 of RI Report and the Site Assessment Report dated 1986.

Program	Sample Location	Total VOC (mg/Kg)	Sample Interval
Site Assessment 1/86	SB-8	160	0.33 ft
	S-8	110	1.0 ft
	SB-9	2.6	0.33 ft
	S-9	0.86	1.0 ft
Sampling Program 8/89	B-3-1	10.7	0.5 - 1 ft
	B-4-1	ND	5 -5.5 ft
	B-5-1	0.061	5 -5.5ft
	B-6-1	1.08	2 - 2.5 ft
	B-7-2	0.393	5 - 5.5 ft
	B-8-1	0.105	5 - 5.5 ft
	B-9-1	0.27	5 - 5.5 ft
	B-10-1	ND	
	SS-1	16	1.5 -2 ft
	SS-2	2.1	1.5 - 2 ft
Soil Vapor Investigation 10/91	IW-3	1.341	0.5 -1 ft
	IW-3	76.7	2.5 - 3 ft
	IW-4	76.4	0.5 - 1 ft
	IW-4	19.04	2.5 - 3 ft
	IW-5	0.77	0.5 - 1 ft
	IW-5	0.888	2.5 - 3 ft
	IW-6	0.186	0.5 - 1 ft
	IW-6	1.455	2.5 - 3 ft
	IW-7	0.024	0.5 - 1 ft
	IW-7	0.532	2.5 - 3 ft
	EW-3	15.74	0.5 - 1 ft
	EW-3	15.15	2.5 - 3 ft

Total # of samples =26 Total VOC 512.395 mg/Kg
Total VOC AVG. 20 mg/Kg

Result: The average concentration of VOCs in the soil at the Former Drum Storage Pad prior to implementing the In Situ Air Stripping IRM was 20 mg/Kg.

November 27, 1995/GAS:bdm/ITTCAL5

ITT Sealectro Feasibility Study

Pilot In Situ Air Stripping IRM Mass Removal (Part 2 continued)

Objective: Estimate the concentrations of VOCs in soil (to 6 ft bgs) at the Former Drum Solvent Storage Pad after completing the In situ Air Stripping IRM. This information was obtained from Table 10 of the RI Report.

Sample Location	Total VOC (ppm)
B-41	0.296
B-42	0.661
B-43	0.303
B-44	4.85
B-45	0.035
B-46	0.433
B-47	0.276
B-48	0.014

Total # 8 Total VOC 6.868
Total VOC AVG. 0.86

Result: The average concentration of VOCs in soil at the Former Drum Storage Pad after completing the In Situ Air Stripping IRM was estimated to be 0.86 mg/Kg.

November 27, 1995/GAS:bdm/ITTCAL8

5. CURRENT MASS OF VOC/DNAPL IN SUBSURFACE

Objective: To quantify the mass of VOCs currently in subsurface soils in the Solvent UST and Shed Areas as of August 1995.

Shallow Zone
Areal extent: 80 ft x 115 ft = 9200 ft^2 (See Figure 10)
Contaminated thickness: 20 ft avg (From RI Report)
Volume: 9200 ft^2 x 20 ft = 184,000 ft^3

Deep Zone
Areal Extent: 60 ft x 110 ft = 6600 ft^2 (See Figure 11)
Contaminated thickness: 18 ft avg (From RI Report)
Volume: 6600 ft^2 x 18 ft = 118,800 ft^3

Mass of VOC in Soil
assume: 120 lbs/ft^3 density of soil
1500 g/l for avg density of VOCs (Mercer & Cohen, 1991)

Basis for VOC concentrations

Avg soil conc in shallow zone
arithmetic avg = 19.5 mg/kg (omitting EB-1 & B-17)
Avg soil conc in deep zone
arithmetic avg = 90 mg/kg

Shallow Zone
120 lbs/ft^3 x 184,000 ft^3 = 22,080,000 lbs of soil
22,080,000 lbs x 1 kg/2.2 lbs = 10,036,364 kg of soil
10,036,364 kg x 19.5 mg/kg x 1 kg/1x10^6 mg = 196 kg VOC
196 kg x 2.2 lbs/kg = 431 lbs of VOC
196,000 g x 1 l/1500 g = 131 l of VOC
131 l x 0.26 gal/l = 34 gal of VOC

Deep Zone
120 lbs/ft^3 x 118,800 ft^3 = 14,256,000 lbs of soil
14,256,000 lbs x 1 kg/2.2 lbs = 6,480,000 kg of soil
6,480,000 kg x 90 mg/kg x 1 kg/1x10^6 mg = 583 kg VOC
583 kg x 2.2 lbs/kg = 1283 lbs of VOC
583,000 g x 1 l/1500 g = 389 l of VOC
389 l x 0.26 gal/l = 101 gal of VOC

Result
The quantity of VOCs remaining in the Solvent UST and Shed Areas in the shallow zone is 196 kg (431 lbs) and and in the deep zone is 583 kg (1283 lbs). The total quantity of VOCs remaining in the subsurface soils at the Solvent UST and Shed Areas was estimated to be 196 kg + 583 kg = 779 kg (1714 lbs).

6. Alternative Evaluation of the Pre-IRM DNAPL Mass Below the Ground Water Table
Objective: Estimate of Original Mass of DNAPL Below Ground Water Table

Shallow Ground Water

1) Shallow ground water discharge from site

$Q = KiA$
$= 40\ ft^3/d\ (1145\ l/d)$

$K = 4.6\ gpd/ft^2\ (0.61\ ft/d)$ from RI Report
$I = 0.013$ avg from RI Report
$A = 15$ ft (thick) x 340 ft

2) Avg shallow ground water concentration at river
Total VOCs (7/91)

MW-2	385 ug/l
MW-3	1720 ug/l
avg	1053 ug/l (1.05 mg/l)

3) Mass of VOCs discharging to river

$M = QC$
$= 1145\ l/d \times 1.05\ mg/l = 1202\ mg/d\ (1.2\ g/d)$

4) Volume of ground water passing through area with NAPL

$Q = KiA$
$= 9.5\ ft^3/d\ (269\ l/d)$

$K = 0.61$ ft/d
$I = 0.013$
$A = 15$ ft x 80 ft
(80 ft = width of VOC soil)

5) Potential VOC mass that could be transported from NAPL area

$M = Q\ C_{sol}$
$= 269\ l/d \times 917\ mg/l$
$= 246{,}673\ mg/d\ (247\ g/d)$

TCA = 1500
PCE = 150
TCE = 1000
C_{sol} avg = 917 mg/l

6) Ratio of potential VOC discharge to actual discharge

$R = 1.2 g/d / 247\ g/d = 4.9 \times 10^{-3}$ (0.49%)

7) Therefore an estimated 0.49% of the shallow ground water flowing through the source area contacts and dissolves NAPL

8) If the volume of the soil in the shallow saturated source area is:

$V = LWD$
$= 115\ ft \times 80\ ft \times 15\ ft = 138{,}00\ ft^3$

9) If 0.49 % of soil contains NAPL then the volume of soil with residual NAPL is:

$V = 138{,}00\ ft^3 \times 0.49\% = 676\ ft^3\ (19.2\ m^3)$

10) Assume a residual saturation value of 0.15 (Mercer & Cohen, 1990)
Assume a porosity of 0.25

residual saturation = 0.15 x 0.25 x 1000 = 37.5 l/m^3

11) The volume of NAPL = 19.2 m^3 x 37.5 l/m^3 = 720 l (187 gal)

12) Assume an average VOC density = 1.5 Kg/l (1500g/l)

Result: Mass of shallow NAPL = 720 l x 1.5 Kg/l = 1080 kg (below gw table) = 2376 lbs

November 27, 1995/ITTCAL6

ITT Sealectro Feasibility Study

Objective: Estimate of Original Source Mass Below Ground Water Table

Deep Ground Water

1) Deep ground water discharging from site

$Q = KiA$ $\quad K = 172\ gpd/ft^2\ (23\ ft/d)$ pump test

$= 352\ ft^3/d\ (9966\ l/d)$ $\quad I = 0.0025$ RI

$A = 18\ ft \times 340\ ft$

2) Average deep ground water VOC concentration

2/19/92 earliest record

MW-2D		91 ug/l
MW-3D		807 ug/l
	avg	449 ug/l (0.45 mg/l = C)

3) Mass of VOC discharging to river

$M = QC$

$= 9966\ l/d \times 0.45\ mg/l = 4485\ mg/d\ (4.5\ g/d)$

4) Volume of ground water passing through area with NAPL

$Q = KiA$ $\quad K = 23\ ft/d$

$I = 0.0025$

$= 62\ ft^3/d\ (1759\ l/d)$ $\quad A = 18\ ft \times 60\ ft$

5) Potential Mass of VOC transported from NAPL area in ground water

$M = Q\,C_{sol}$ $\quad C_{sol} = 917\ mg/l$

$= 1759\ l/d \times 917\ mg/l$

$= 1{,}613{,}003\ mg/d\ (1613\ g/d)$

6) Ratio of actual VOC discharge to potential VOC discharge

$R = 4.5\ g/d / 1613\ g/d = 2.8 \times 10^{-3}$ (0.28%)

7) Therefore an estimated 0.28% of the deep ground water flowing through the source area contacts and dissolves NAPL

8) If the volume of the soil in the deep source area is

$V = LWD$

$= 110\ ft \times 60\ ft \times 18\ ft = 118{,}800\ ft^3$

9) If 0.28% of the source area contains NAPL then the volume of soil with NAPL is

$V = 118{,}800\ ft^3 \times 0.28\% = 333\ ft^3\ (9.4\ m^3)$

10) If residual saturation is $37.5\ l/m^3$

the volume of NAPL $= 9.4\ m^3 \times 37.5\ l/m^3 = 353\ l$ (92 gal)

11) Assume average VOC density = 1.5 Kg/l

Mass of deep NAPL = 353 l x 1.5 Kg/l = 530 kg = 1165 lbs

Summary: Total DNAPL Mass in both the Shallow and Deep Zones below Ground Water Table

1080 kg + 530 kg = 1610 kg
= 3542 lbs
187 gal + 92 gal = 279 gal

This mass of DNAPL is comparable to the mass estimated in Item 1 of this Appendix.

November 27, 1995/GAS:bdm/ITTCAL7

Appendix B

Remediation effectiveness evaluation

Effectiveness Evaluation Summary

In order to assess the effectiveness of remedial technologies to achieve chemical-specific SCGs as it relates to the site, the following evaluation has been completed. Dr. Jon Sykes of the University of Waterloo developed two equations in order to evaluate the potential effectiveness of source removal. The equations and a detailed discussion of the calculations are presented following this summary.

Figure 1a, 1b, and 1c present the expected change in site ground water quality for different remediation scenarios. Four scenarios are presented in the figure. The original site conditions with no IRMS completed is presented in each of the figures to serve as a basis of comparison. Figure 1a presents the possible range in VOC concentrations assuming a 50% removal of the original source mass. This would represent the result of the completed IRMs at the site. Figure 1b presents the possible range in VOC concentrations assuming a 75% removal of the original source mass. Figure 1c presents the possible range in VOC concentrations assuming a 95% removal of the original source mass.

Figures 1a, b, and c present the range in relative VOC concentrations in ground water at the site as a percentage of the initial site concentrations. For example, given 50% mass reduction (Figure 1a), the site ground water VOC concentration water 90 years would be expected to be between 45% and 80% of the initial concentration. The initial concentration of TCA at well MW-3 was 780 μg/l (7/31/91). The expected concentration of TCA in 90 years would be between 351 μg/l and 624 μg/l. If 95% of the mass were removed, the TCA concentration at 90 years would be between 4.5% and 10% of the initial concentration or 35 μg/l to 78 μg/l (Figure 1c), which is above the SCG of 5 ug/L.

Figures 1a, b, and c indicate that the IRM activities have already reduced time required for ground water quality to meet SCGs. Additional source removal activities at the site would be expected to further reduce the time required for ground water quality improvements. Figure 1a, b, and c present the expected impact on ground water quality assuming that 75% and 95% of the initial mass of VOCs were removed from the site.

Figures 1a, b, and c also indicate that site ground water quality will not meet ground water SCGs for an extended period of time (>100 yr). Removal of a portion of the source will reduce the ultimate period of time for ground water quality to meet SCGs. However, even assuming one could remove 95% of the original VOC mass in the subsurface ground water quality would not meet ground water SCGs for over 100 yrs (Figure 1c). As noted above, with 95% of the original mass removed, TCA concentrations at MW-3 would be between 35 μg/l and 78 μg/L, which is above the SCG of 5 μg/L.

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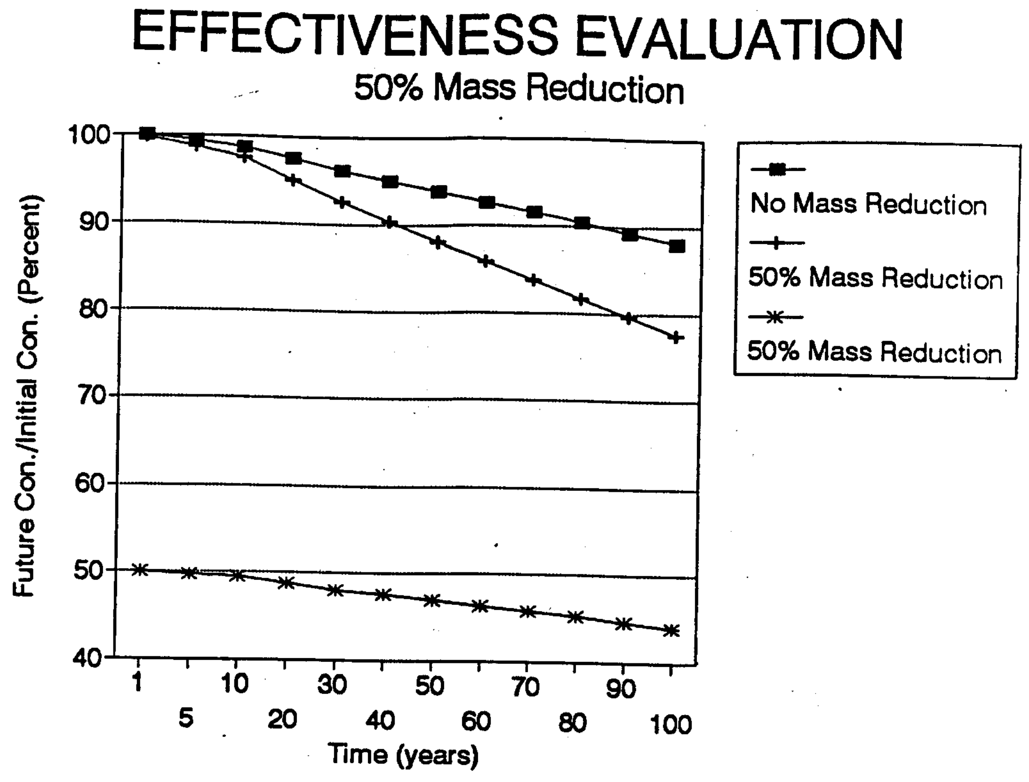
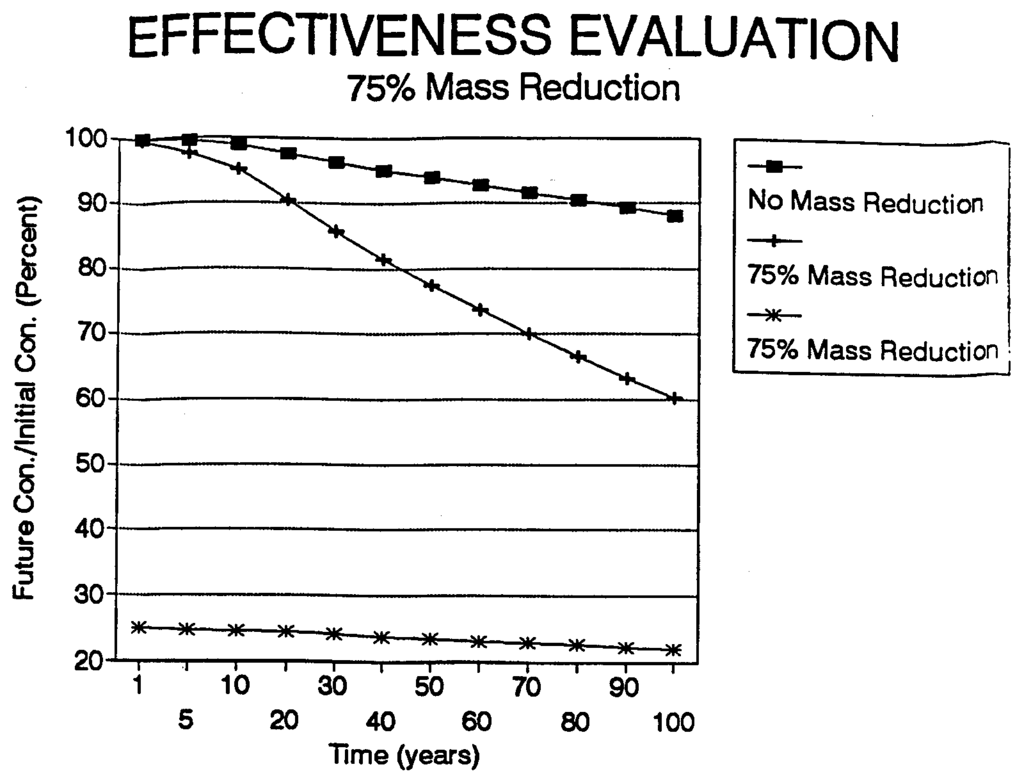


1a



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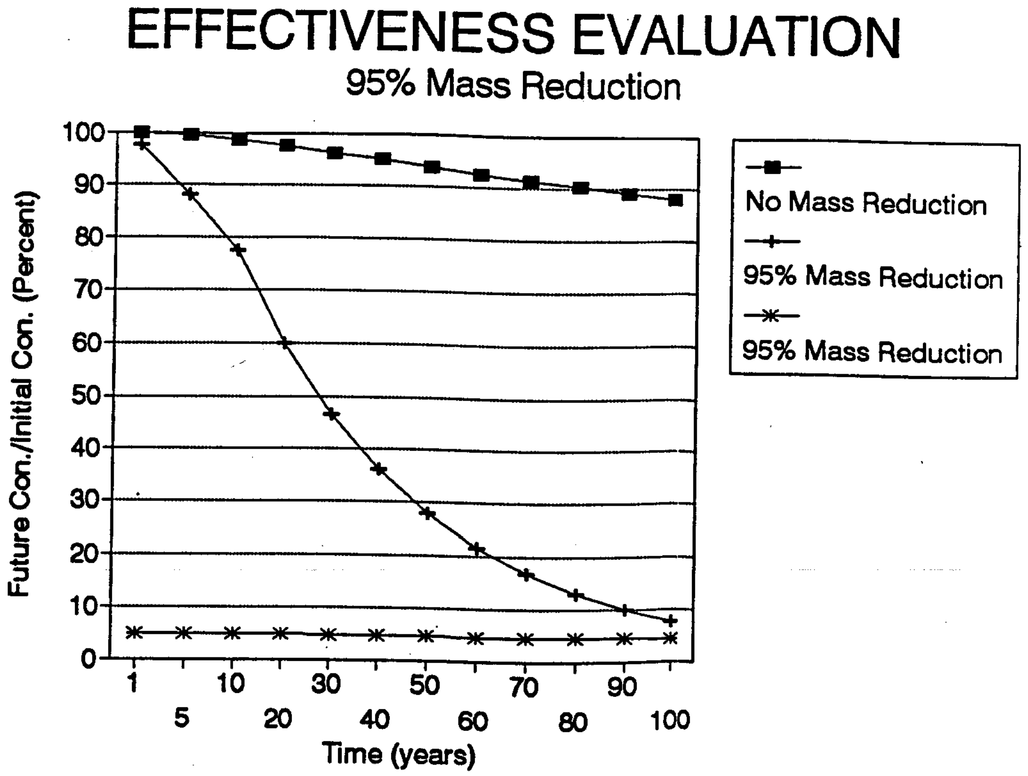

1c

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FIGURE 1

ITT SEALECTRO
MAMARONECK, NEW YORK

EFFECTIVENESS EVALUATION

3356.024-11F

O'BRIEN & GERE
ENGINEERS,INC.

EFFECTIVENESS EVALUATION

Introduction: A source of VOCs in the ground water exists on the former Sealectro site. This source is comprised of DNAPL which occurs in residual saturation in the subsurface soils. This source impacts the ground water quality and will prevent the site ground water quality from meeting ground water standards for a period of time. Some of the source material has been removed from the subsurface by IRM activities. Additional removal of source material may take place as part of the site remedial activities. This evaluation examines the potential change in ground water quality with time during site remediation.

Objective

Evaluate the possible change in the site ground water quality over time for the following scenarios: a) pre-IRM conditions with natural ground water flushing; b) post-IRM conditions (50% removal of the DNAPL) with natural ground water flushing; c) source conditions which represent removal of 75% of the original DNAPL with natural ground water flushing; and d) source conditions which represent removal of 95% of the original DNAPL with natural ground water flushing.

Method

Dr. Jon Sykes describes, in the attached text, three stages of VOC concentration during the flushing of DNAPL. The first stage is characterized by relatively constant, high mass removal rates and relatively constant VOC concentrations. During this stage the mass of residual DNAPL is high and the DNAPL would be present in both high permeable and low permeable soils. The second stage is characterized by a rapid decline in VOC concentration in the water and a corresponding decrease in the mass removal rates. During this stage the DNAPL in the high permeable zones is in the final stages of being removed. As this DNAPL disappears more water flows through the high permeable zones and does not contact the DNAPL. Therefore the overall concentration declines. At the end of the second stage the remaining DNAPL is only present in the low permeable zones. The third stage represents a long tailing period where the VOC concentration in water slowly declines over a long period of time as the DNAPL is slowly flushed from the low permeable zones. During this third stage the mass removal rate is low.

Dr. Sykes developed two equations to represent the second and third stages of VOC concentration.

Equation 1 simulates the second stage of DNAPL flushing when the VOC concentrations decline rapidly.

$C/C_o = e^{(-t'/(1-a))}$

Where: C = ground water concentration at time t

C_o = initial ground water concentration
a = percentage of mass removal

$t' = (q*C_o*t)/M$
q = ground water flux
t = time since the DNAPL was introduced to the subsurface
M = initial DNAPL mass

Equation 2 simulates the third stage of DNAPL flushing when the VOC concentrations decline slowly over a long period of time.

$$C/C_o = (1-a)e^{-t'}$$

Where:
C = ground water concentration at time t
C_o = initial ground water concentration
a = percentage of mass removal

$t' = (q*C_o*t)/M$
q = ground water flux
t = time since the DNAPL was introduced to the subsurface
M = initial DNAPL mass

These are basic, analytical equations which do not require excessive data input or complicated calculations. The equations were kept simple in order to convey the general understanding of the probable changes in ground water quality and the potential effects various degrees of remediation would have on ground water quality.

Input data from the Sealectro site were used in both equations. The results of the calculations are presented in the following tables and figures. The following input data were used:

M = 1,591,000 g (1591 kg) the estimated total VOC mass in the subsurface prior to the initiation of the IRMs (Appendix A).
q = 11,111 L/day the estimated ground water flux across the site (Appendix A).
C_o = 0.0005 g/L (500 g/L) the average total VOC concentration in ground water at the site perimeter (Appendix A).
t = varied
a = varied based upon the about 50% DNAPL removal through the IRM and assumed total DNAPL removal of 75% and 95%.

Results

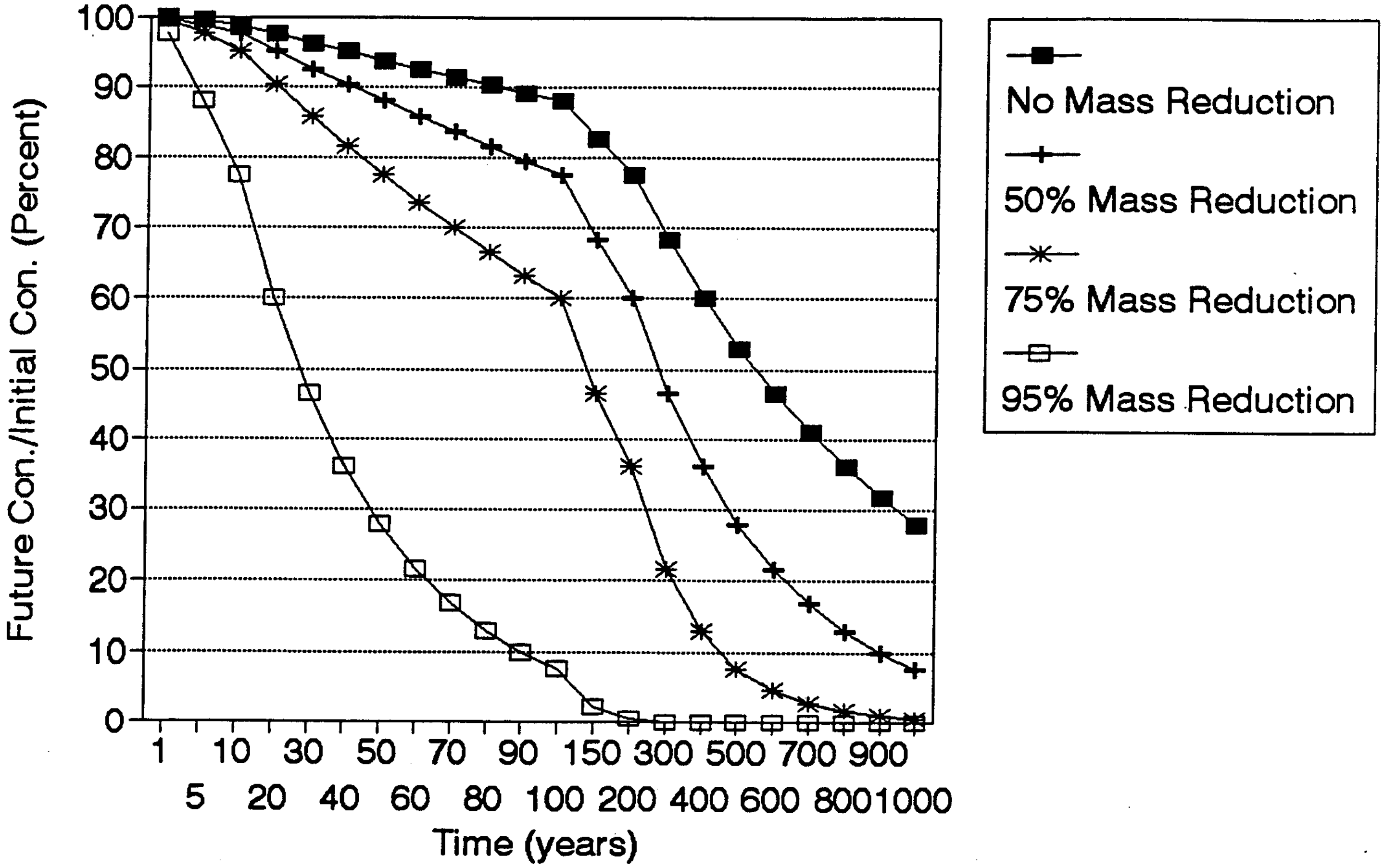
The Equation 1 figure indicates that with increasing DNAPL mass reduction the rate of decline in relative VOC concentrations in the ground water increases. This figure represents stage two which is the rapid decline in concentration. Remediation has removed much of the DNAPL in the most permeable zones and the natural flushing is rapidly removing the remaining DNAPL in the most permeable zones.

The stage 3 long tailing of ground water VOC concentrations is demonstrated in the Equation 2 figure. These data plots represent conditions where the DNAPL has been removed from the more permeable zones in the subsurface, but the DNAPL still remains in the low permeable zones and is slowly being flushed by natural ground water flow.

Combining the figures for the two equations provides an indication the possible long term changes in VOC concentrations. If the remediation does not fully remove the DNAPL from the most permeable zones then the Equation 1 data plot will more closely represent the long term changes in VOC concentrations. If the remediation does fully remove the DNAPL from the most permeable zones then the Equation 2 data plot will more closely represent the long term changes in VOC concentrations. These two data plots bracket the possible VOC concentrations given a certain degree of mass removal. For each of the figures the pre-IRM data plot is included for comparison. The resulting Effectiveness Evaluation figures represents the possible range in VOC concentrations for various mass removal scenarios at the former Sealectro site.

EFFECTIVENESS EVALUATION

Equation 1



ITT Sealectro
Effectiveness Evaluation
Equation 1
November 1995

These calculations reflect the estimated change in concentration assuming there is no initial change in concentration with source removal.

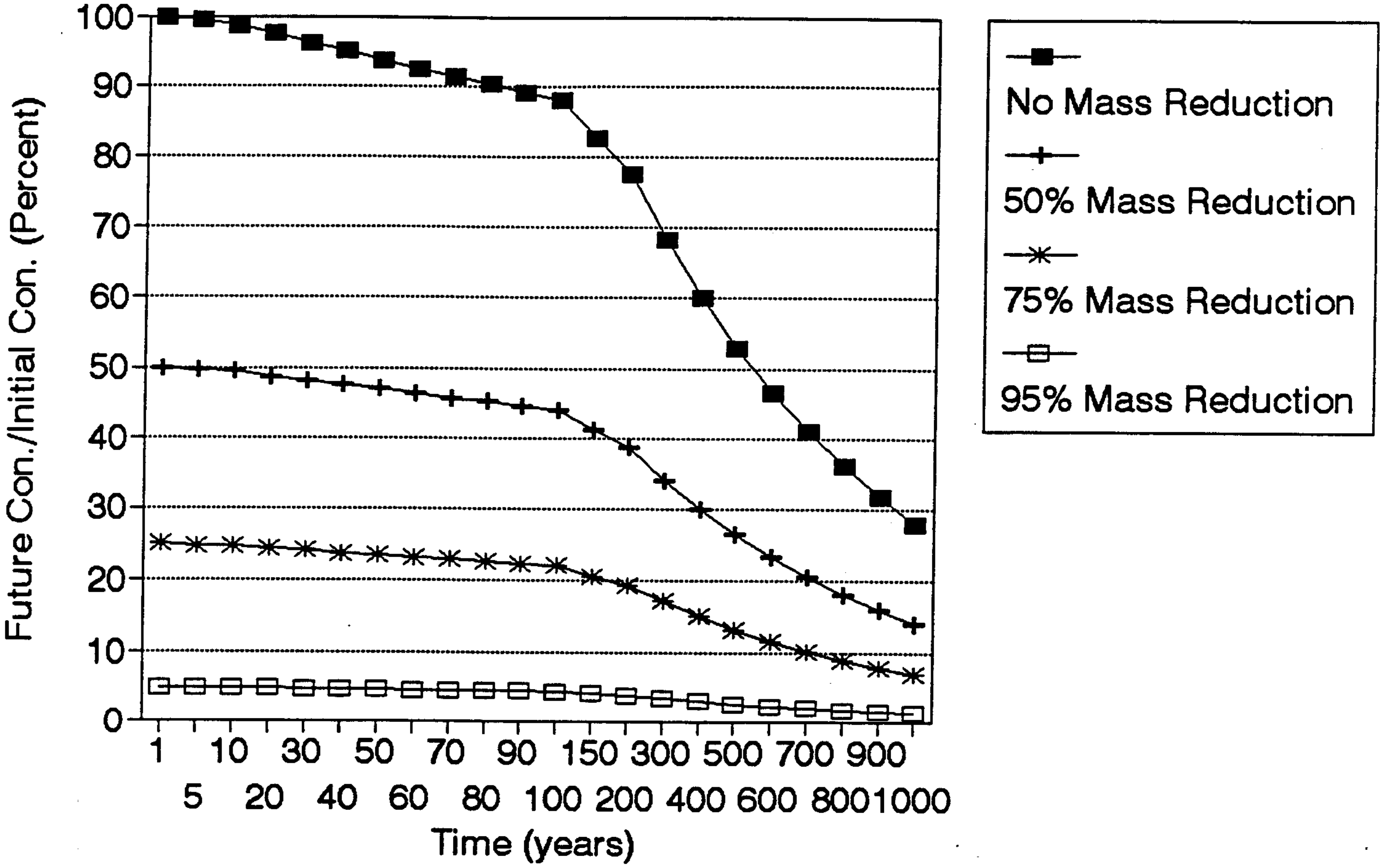
		Post IRM		
CASE	Pre IRM	50% Removal	75% Removal	95% Removal
Initial Mass (g)	1591000	1591000	1591000	1591000
Ground Water Flow (L/d)	11111	11111	11111	11111
Solubility (g/L)	0.0005	0.0005	0.0005	0.0005
Mass Removal	1	0.5	0.25	0.05
Mass Transfer Coeff.	3.49E-06	6.98E-06	1.40E-05	6.98E-05

The following are the calculated concentration ratios.

Time (yrs)	Ratio C/Co	Ratio C/Co	Ratio C/Co	Ratio C/Co
1	99.9	99.7	99.5	97.5
5	99.4	98.7	97.5	88.0
10	98.7	97.5	95.0	77.5
20	97.5	95.0	90.3	60.1
30	96.2	92.6	85.8	46.5
40	95.0	90.3	81.6	36.1
50	93.8	88.0	77.5	28.0
60	92.6	85.8	73.6	21.7
70	91.5	83.7	70.0	16.8
80	90.3	81.6	66.5	13.0
90	89.2	79.5	63.2	10.1
100	88.0	77.5	60.1	7.8
150	82.6	68.2	46.5	2.2
200	77.5	60.1	36.1	0.6
300	68.2	46.5	21.7	0.0
400	60.1	36.1	13.0	0.0
500	52.9	28.0	7.8	0.0
600	46.5	21.7	4.7	0.0
700	41.0	16.8	2.8	0.0
800	36.1	13.0	1.7	0.0
900	31.8	10.1	1.0	0.0
1000	28.0	7.8	0.6	0.0

EFFECTIVENESS EVALUATION

Equation 2



ITT Sealectro
Effectiveness Evaluation
Equation 2
November 1995

These calculations reflect the estimated change in concentration assuming there is an initial change in concentration with source removal.

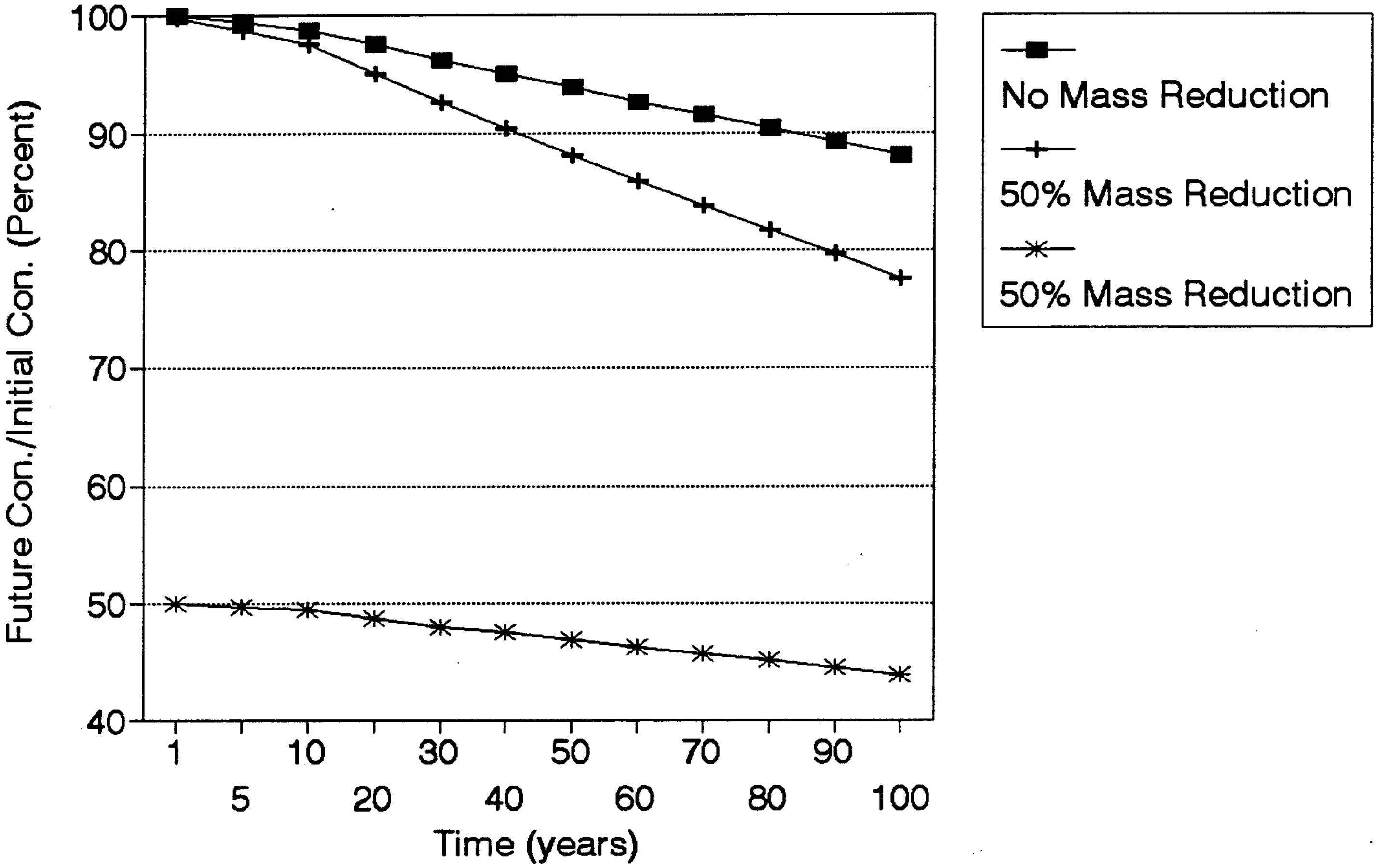
		Post IRM		
CASE	Pre IRM	50% Removal	75% Removal	95% Removal
Initial Mass (g)	1591000	1591000	1591000	1591000
Ground Water Flow (L/d)	11111	11111	11111	11111
Solubility (g/L)	0.0005	0.0005	0.0005	0.0005
Mass Removal	0	0.5	0.75	0.95
Mass Transfer Coeff.	3.49E-06	3.49E-06	3.49E-06	3.49E-06

The following are the calculated concentration ratios.

Time (yrs)	Ratio C/Co	Ratio C/Co	Ratio C/Co	Ratio C/Co
1	99.9	49.9	25.0	5.0
5	99.4	49.7	24.8	5.0
10	98.7	49.4	24.7	4.9
20	97.5	48.7	24.4	4.9
30	96.2	48.1	24.1	4.8
40	95.0	47.5	23.8	4.8
50	93.8	46.9	23.5	4.7
60	92.6	46.3	23.2	4.6
70	91.5	45.7	22.9	4.6
80	90.3	45.2	22.6	4.5
90	89.2	44.6	22.3	4.5
100	88.0	44.0	22.0	4.4
150	82.6	41.3	20.6	4.1
200	77.5	38.7	19.4	3.9
300	68.2	34.1	17.1	3.4
400	60.1	30.0	15.0	3.0
500	52.9	26.4	13.2	2.6
600	46.5	23.3	11.6	2.3
700	41.0	20.5	10.2	2.0
800	36.1	18.0	9.0	1.8
900	31.8	15.9	7.9	1.6
1000	28.0	14.0	7.0	1.4

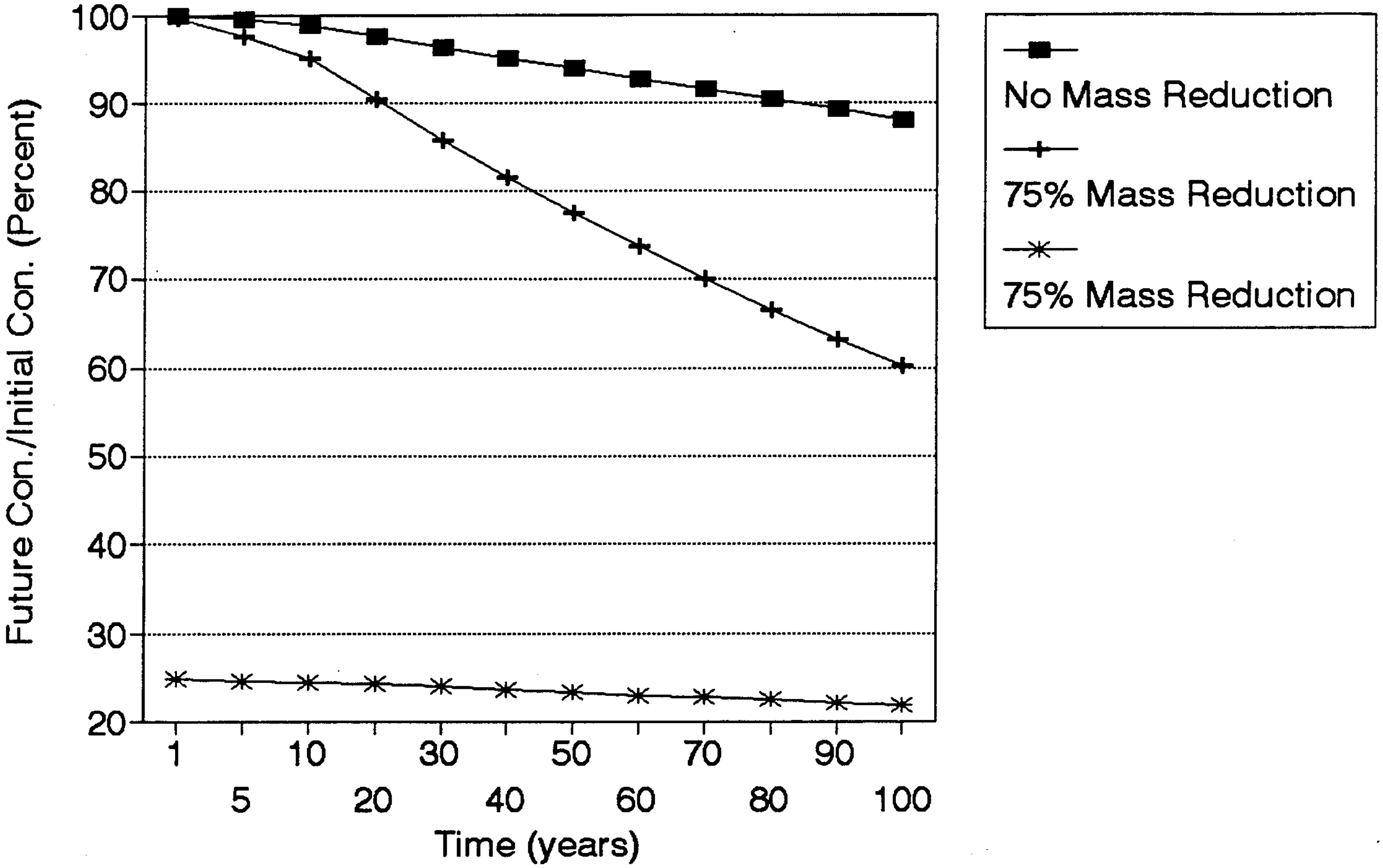
EFFECTIVENESS EVALUATION

50% Mass Reduction



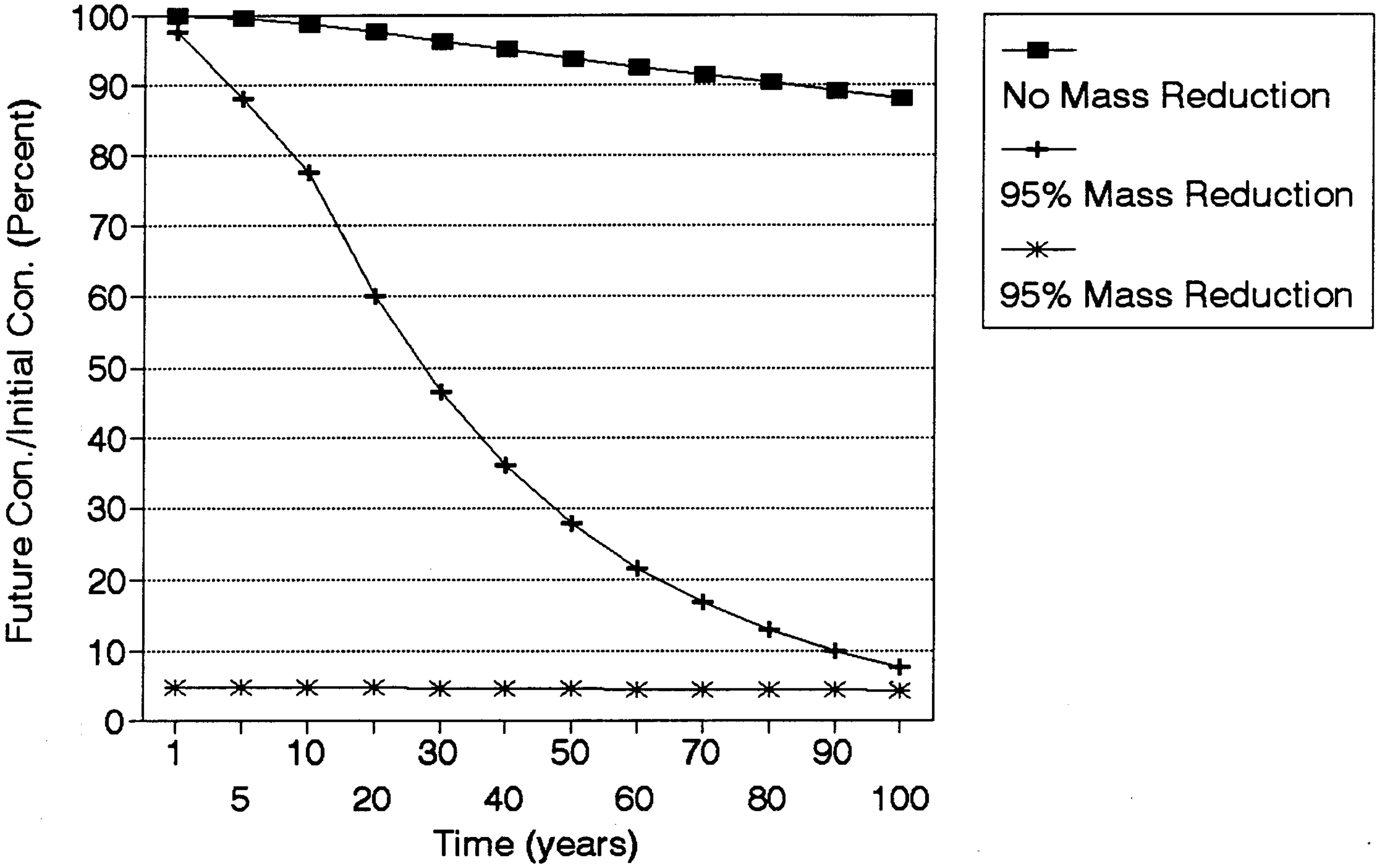
EFFECTIVENESS EVALUATION

75% Mass Reduction



EFFECTIVENESS EVALUATION

95% Mass Reduction



Impact of Unremediated NAPL:
Prediction of Groundwater Source Concentrations

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Waterloo, Ontario Canada E-mail:js@thys.uwaterloo.ca

Dissolution Models

The dissolution of NAPL residuals in porous media is a topic that has received considerable attention. Lamarche (1991) investigated the dissolution of TCE from saturated laboratory columns; the observed breakthrough curves are appended as Figures 1. Powers et. al. (1994) also investigated the dissolution of TCE from saturated laboratory columns with their observed breakthrough curves being shown in Figure 2. The breakthrough curves for both studies can be characterized by three stages. In the first stage, NAPL mass is removed from the column by dissolution with the breakthrough concentration remaining constant and at or near saturation. In the Lamarche (1991) data, this stage lasted for approximately 150 pore volumes. A decline in the breakthrough concentration was not observed until more than 85% of the initial TCE NAPL residual had been removed. The stage 1 plateau is less pronounced in the data from Powers et. al. (1994). The second stage is characterized by a drop in the breakthrough concentration from the saturation value to a concentration approximately 3 orders of magnitude less; for TCE, this concentration is still considerably higher than the MCL. In this second stage, the change in the concentration with pore volume or time can be described approximately by a log-linear relationship. That is, the log of concentration varies approximately with time. The third and final stage is characteristic of tailing. This stage is associated with less than 5% of the initial TCE NAPL residual. The tailing is more obvious in the Lamarche (1991) study.

The dissolution process and the resulting mass transfer from the NAPL residual to water phase is most commonly described using a single-resistance linear-driving-force assumption as the product of a mass transfer coefficient and a driving force. The driving force is defined as the difference of concentrations between the effective solubility limit of the NAPL component and the dissolved concentration in the aqueous phase on the interfacial layer surrounding the NAPL. The general mass conservation equation for the immobile NAPL is thus

$$\frac{d\,M^{na}}{dt} = -\lambda^{d}\, a_0\, (\, C_s - C) \tag{1}$$

where M^{na} is the mass of the NAPL phase, λ^d is the mass transfer coefficient of the NAPL phase, C_s is the solubility of the solute in the water phase, a_0 is the specific surface area of the NAPL and C is the average solute concentration in the water phase around the NAPL. Assuming that the NAPL can be described by spherical blobs having an effective diameter l_e, the specific surface area can be approximated by

$$a_0 = f^{na} \pi l_e^2 \tag{2}$$

where f^{na} is an effective area factor of the blob. The mass transfer coefficient λ^d is expressed by the Sherwood number Sh with

$$Sh = \frac{\lambda^d l_e}{D_{na}} \tag{3}$$

where D_{na} is the free liquid diffusivity of the solute. The Gilland-Sherwood correlation then relates the interphase mass transfer resistance to the molecular mass transfer resistance and relates the Sherwood number to the Schmidt number and the Reynolds number:

$$\begin{aligned} Sh &= \left[a + b \cdot Re^{\alpha} Sc^{\beta} \right] (\theta^{na})^{\gamma} \\ &= \left[a + b \cdot \left(\frac{q^w l_e}{\nu^w} \right)^{\alpha} \left(\frac{\nu^w}{D_{na}} \right)^{\beta} \right] (\theta^{na})^{\gamma} \end{aligned} \tag{4}$$

where q^w is the volumetric flux of the water phase, ν^w is the viscosity of the water, θ^{na} is the NAPL phase content and a, b, α, β and γ are empirical coefficients. Equating equations (3) and (4) then yields the mass transfer coefficient λ^d.

The mass transfer coefficient as defined by the Gilland-Sherwood correlation provides an adequate description of stage 1 and stage 2 dissolution (see for example Powers et. al., 1994); the model fails to describe the stage 3 dissolution (He, 1995). Dissolution models that include dead end pores and a distribution of the velocity within the macroscopic scale representative elementary volume (REV) provide a better description of all three dissolution stages (He, 1995).

An important parameter in the dissolution model is the effective area factor of the NAPL blobs. The distribution of the NAPL content within the pores is also an important consideration. The use of remedial alternatives other than dissolution will effect both f^{na} and θ^{na}. Alternative remedial measures include for example surfactant-enhanced aquifer flushing, in-situ chemical oxidation, air sparging and soil venting. The relationship between a remedial alternative and the parameters of the dissolution model are not known.

A Screening Model for Dissolution

Because of the complexity of the dissolution model based on the Gilland-Sherwood correlation, the failure of the model to describe all stages of dissolution, and the lack of data on the influence of remedial alternatives on the parameters that describe the dissolution of the non-remediated NAPL, a simple constant coefficient model is proposed. The purpose of the model will be to predict the solute concentration in the vicinity of the non-remediated NAPL as a result of dissolution.

Assume that the solute concentration in the water phase around the NAPL can be described by

$$\frac{dC}{dt} = -\lambda C \tag{5}$$

in which λ is a constant mass transfer coefficient describing stage 2 dissolution. The coefficient will over predict the the time that dissolution will take for stage 1 and as such it will yield environmentally conservative results.

Given $C = C_0$ at $t = 0$, equation (5) can be solved to yield

$$C = C_0 \, e^{-\lambda t} \tag{6}$$

The rate of transport of dissolved solute from the vicinity of the NAPL blobs or source can be approximated as the product of the volumetric flux q^w in contact with the NAPL blobs and the concentration C. If the initial NAPL residual mass is M^{na}_0 then

$$M^{na}_0 = q^w \int_0^\infty C_0 \, e^{-\lambda t} \, dt \tag{7}$$

which yields:

$$M^{na}_0 = \frac{q^w C_0}{\lambda} \tag{8}$$

The NAPL mass remaining at time t is thus

$$\begin{aligned} M^{na}(t) &= M^{na}_0 - q^w \int_0^t C_0 \, e^{-\lambda t} \, dt \\ M^{na}(t) &= M^{na}_0 \, e^{-\lambda t} \end{aligned} \tag{9}$$

Combining the solution of equation (9) with equation (6) gives

$$C(t) = C_0 \frac{M^{na}(t)}{M^{na}_0} \tag{10}$$

Equation (10) thus relates the source solute concentration at time t to the NAPL mass remaining at time t for the dissolution model of equation (5).

If a fraction a of the NAPL residual is remediated then the remaining NAPL mass $(1-a)M^{na}_0$ will continue to be removed by dissolution. Various bounding cases can be developed for the description of the rate at which this dissolution will occur. Prior to remediation, the solute concentration is C_0, the initial NAPL mass is M^{na}_0 and the volumetric flux contacting the NAPL is q^w.

In the first case, the remediation does not remove all of the NAPL mass associated with stage 1 dissolution. The initial solute concentration for the dissolution of the remaining residual NAPL mass $(1-a)M^{na}_0$ is thus C_0. The solute source concentration from equations (6) and (7) is thus

$$C(t) = C_0 \, e^{-\frac{q^w C_0}{(1-a)M^{na}_0} t} \tag{11}$$

The use of equation (11) assumes that the non-remediated NAPL mass can be described using the stage 2 dissolution process. The effect of the NAPL remediation is to reduce the effective mass transfer coefficient.

In the second case, a sufficient mass of NAPL is remediated such that there is a reduction in the solute concentration in the vicinity of the NAPL. In this case, the rate coefficient is defined by equation (7) and the initial source concentration for the dissolution of the non-remediated NAPL is determined using equation (10) to give

$$C(t) = (1-a) \, C_0 \, e^{-\frac{q^w C_0}{M^{na}_0} t} \tag{12}$$

This case assumes that the mass transfer coefficient is not effected by the remediation, rather, remediation acts to reduce the effective initial concentration C_0 of the dissolution process.

The two cases can be compared be substituting

$$t' = \frac{q^w C_0 t}{M^{na}_0} \tag{13}$$

into equations (11) and (12) and plotting

$$\frac{C(t)}{C_0} = e^{-\frac{t'}{(1-a)}} \tag{14}$$

and

$$\frac{C(t)}{C_0} = (1-a)\, e^{-t'} \tag{15}$$

for various remediated fractions a. The results plotted in Figure 3 illustrate the differences between the two cases. For the first case, the assumption of a higher initial solute concentration results in a more rapid decline in the source concentration. The reduction in the initial source concentration results in prolonged higher concentrations. With the exception that the developed models do not consider the tailing of the stage 3 dissolution, it is felt that the two cases presented will bound the more complex analysis provided by mass transfer modelled using the Gilland-Sherwood correlations.

References

1. Lamarche, P. 1991. Dissolution of Immiscible Organics in Porous Media, PhD thesis, Department of Civil Engineering, University of Waterloo.
2. He, Y. 1995. Averaging Method for Modelling Transport Phenomena and Dissolution of Non-Aqueous Phase Liquids in Saturated Porous Media, PhD thesis, Department of Civil Engineering, University of Waterloo.
3. Powers, S.E., L.M. Abriola, J.S. Dunkin and W.J. Weber, 1994. Phenomenological Models for Transient NAPL-Water Mass-Transfer Processes, J. of Cont. Hydrology, 16, pg 1-13.

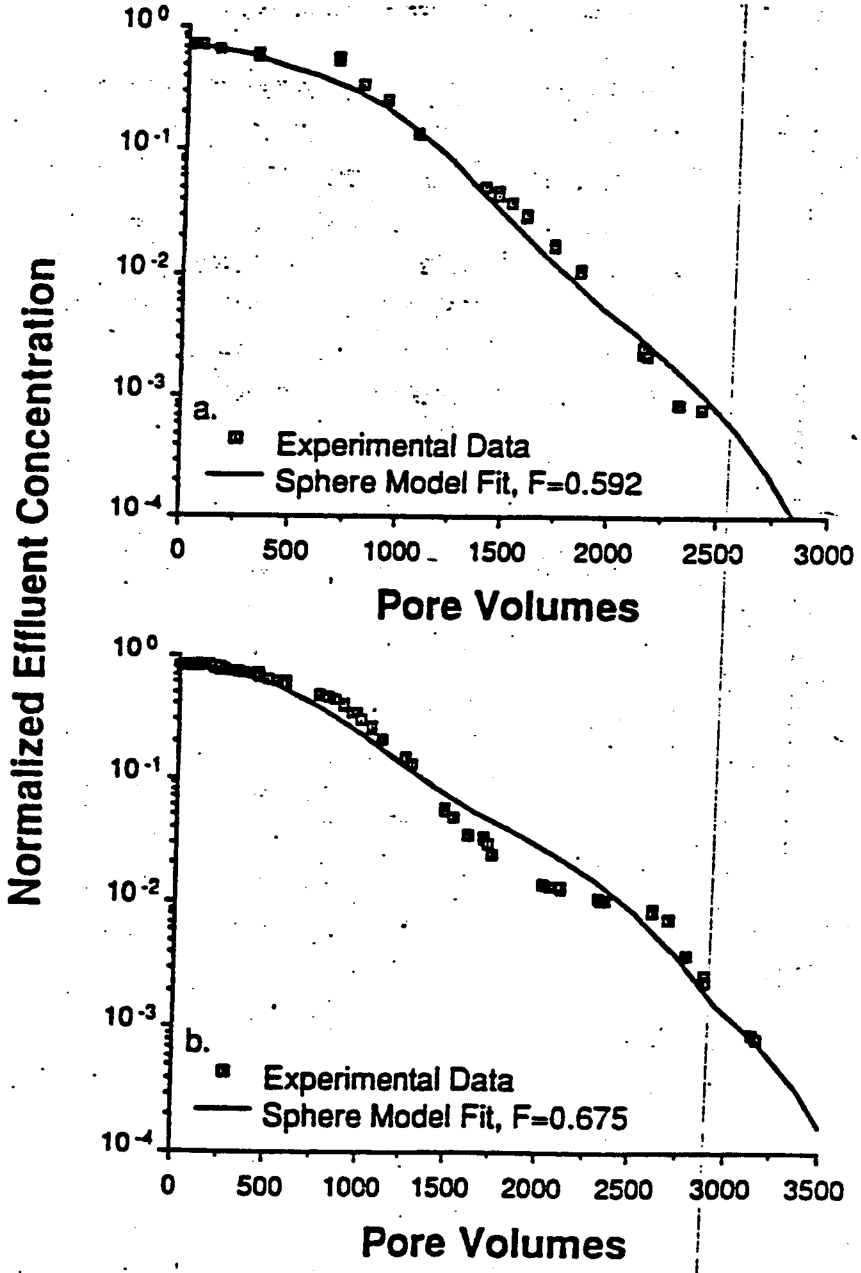


Fig. 4. Best-fit sphere model simulations of transient styrene dissolution data: (a) uniform Ottawa sand ($q = 9.1$ m day^{-1}; $\theta_n = 0.049$); and (b) graded Wagner Mix #*1* sand ($q = 8.2$ m day^{-1}; $\theta_n = 0.065$).

Figure 2 From Powers et.al. 1994.

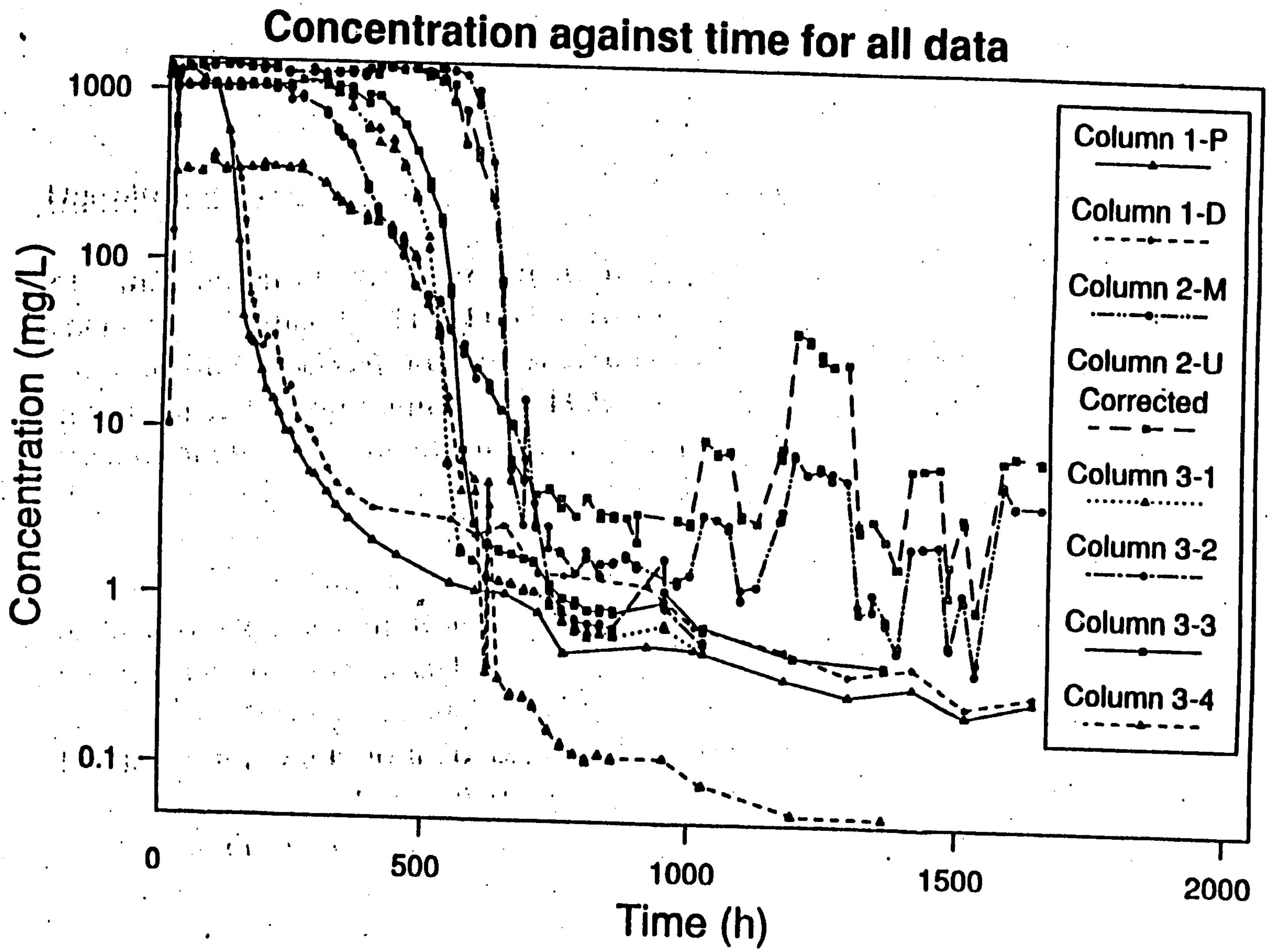


Figure 5.15: Effluent Concentration Against Time, Semi-logarithmic Plot.

Figure 1a From Lamarche (1991)

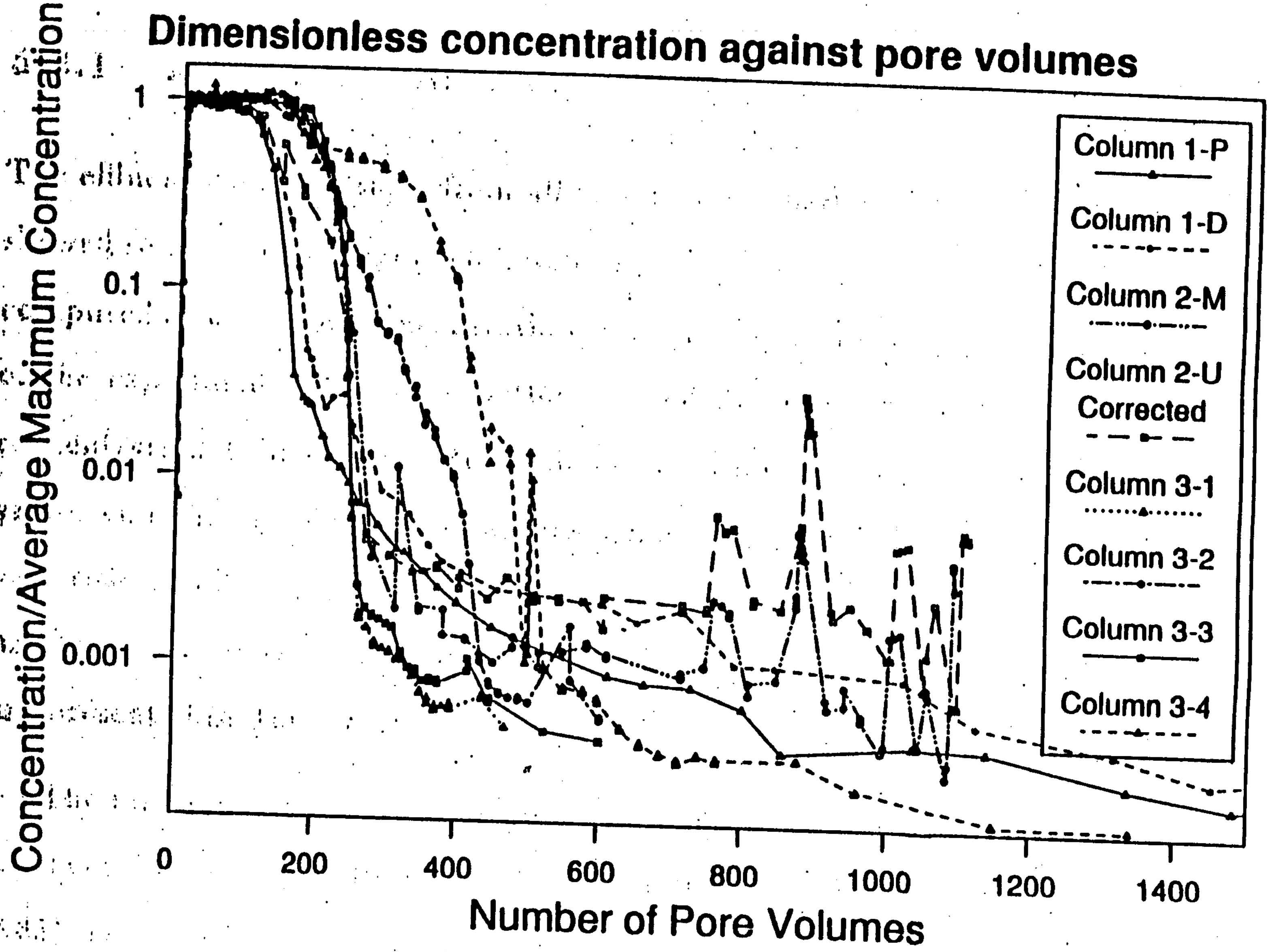
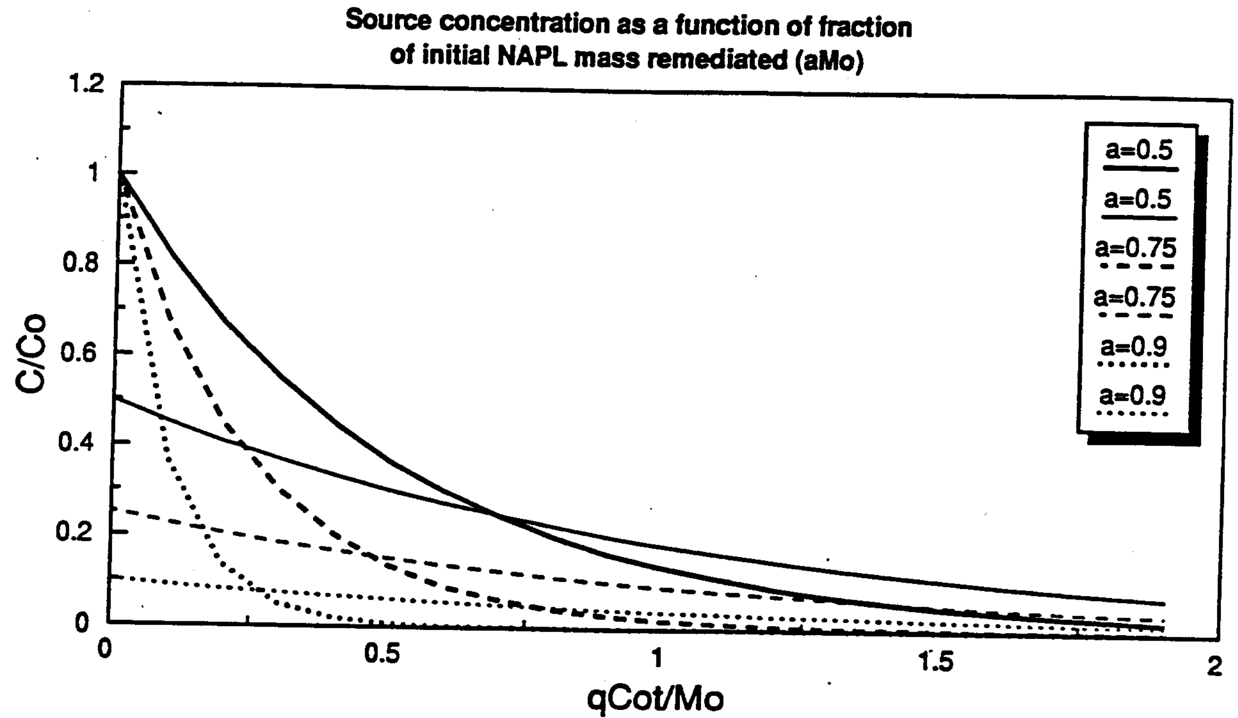


Figure 5.16: Normalized Concentration Against Pore Volumes, Semi-logarithmic Plot.

Figure 16 From Lamarche (1991)



Source concentration as a function of fraction of initial NAPL mass remediated (aMo)

Bold: C/Co=exp[-qCot/(1-a)Mo]
non-bold: C/Co=(1-a)exp[-qCot/Mo]

Figure 3

Appendix C

Ground water calculations

ITT Sealectro Feasibility Study

Objective: Calculate the total volume of ground water with VOCs at the site.

Calculations:

W = width = 330 ft (width of site)
L = length = 115 ft (from Solvent UST Area to Sheldrake River)
B = aquifer thickness = 15 ft (shallow zone) + 18 ft (deep zone)= 33 ft
n = porosity = 0.3 (Fetter, 1980)
V= Volume (ft^3)

Volume of Ground Water at Site:

$$V = WLBn = 330\text{ ft} \times 115\text{ ft} \times 33\text{ ft} \times 0.3$$
$$= 375{,}705\text{ ft}^3$$
$$= 2.8 \times 10^6\text{ gal}$$

Result: The quantity of ground water at the entire site is 375,705 ft^3 (2.8×10^6 gal)

November 27, 1995/GAS:bdm/ITTCAL9

ITT Sealectro Feasibility Study

Alternative 3: Slurry Wall

Objective: Calculate the quantity of water that is entering the site under the containment option via Slurry Wall. There are two sources of water entering the site: Infiltration through grassy area and leakage through the slurry wall.

Infiltration

Assume: no infiltration in paved areas or where building is present
Area of possible infiltration: front of building = 25 ft x 160 ft
Average precipitation: 45 in/yr = 3.75 ft/yr (RI Report)

Assume: 100% infiltration
25 ft x 160 ft x 3.75 ft/yr = 15,000 ft^3/yr
= 112,200 gal/yr
= 0.21 gal/min

Leakage through slurry wall

Q = KiA
Q = Quantity
K = Max hydraulic conductivity of slurry wall
= 1×10^{-7} cm/sec (2.121×10^{-3} gpd/ft^2)
I = hydraulic gradient across slurry wall = 0.33 (assumed)
A = area of slurry wall = L x B = 900 ft^2 * 33 ft = 29700 ft^3
L = 120 ft + 120 ft + 330 ft + 330 ft = 900 ft
B = aquifer thickness
= 15 ft (shallow zone)+ 18 ft (deep zone)= 33 ft total
Q = KiA
Q = 2.121 gpd/ft^2 x 0.33 x 29700 ft^2 = 21 gpd (0.01 gpm)

Result: Total inflow to the site under the containment option is 0.21 gpm. The quantity of ground water infiltrating the site via infiltration is 0.21 gpm and the quantity of ground water leaking past the slurry wall is estimated to be 0.01 gpm (negligible).

November 27, 1995/GAS:bdm/ITTCAL10

ITT Sealectro Feasibility Study

1) Estimate the % of soil with DNAPL below the ground water table

assume: DNAPL uniformly distributed vertically
ground water table 5-8 ft below ground

total depth = 38 ft
if ground water at 5 ft bgs (33 ft below ground water)
33 ft/38 ft = approx 87% below ground water
if ground water at 8 ft bgs (30 ft below ground water)
30 ft/ 38 ft = approx 79% below ground water
avg approx 80 - 85%

2) Estimate the volume of soil containing DNAPL

see figures 10 and 11

shallow zone (area) 80 ft x 115 ft = 9200 ft^2
assume: avg contaminated soil starts at 0 ft
volume (shallow zone) 9200 ft^2 x 20 ft = 184,00 ft^3
(6815 yd^3)

deep zone (area) 60 ft x 110 ft = 6600 ft^2
assume: deep zone 20 ft to 38 ft = 18 ft
volume (deep zone) 6600 ft^2 x 18 ft = 118,800 ft^3
(4400 yd^3)

total volume = 11,215 yd^3

3) Estimate % of contaminated soil under bldg

see figures 10 and 11

shallow zone 45 ft x 100 ft = 4500 ft^2
4500 /9200 = 49%

deep zone 25 ft x 110 ft = 2750 ft^2
2750/6600 = 42%

avg 46% of contaminated soil is under bldg

Result: The calculations indicate that approximately 80 to 85% of the DNAPL is below the ground water table encompassing 11,215 cubic yards of soil. Approximately 46% of the DNAPL below the water table is present in soils beneath the building.

November 27, 1995/GAS:bdm/ITTCAL4

Appendix D

Bench scale testing

cc: M Selang
file 3356.024 #3

MEMORANDUM

O'BRIEN & GERE ENGINEERS, INC.

To: Steve Roland
From: Pam Sheehan and Abigail Jarka
Re: ITT Sealectro, Inc, Mamaroneck NY Facility
File: 3356.024 #3
Date: August 4, 1995

cc: Lorraine Sedlak, ITT Canon
John Doerner, OBG Labs
Doug Crawford
Guy Swenson

This memo presents the results of the preliminary bench scale testing for bioremediation and solidification/stabilization technologies on soils collected from the former ITT Sealectro, Inc. facility in Mamaroneck, New York. The bench scale testing was conducted in accordance with O'Brien & Gere's proposal dated March 8, 1995. For ease of review, this memo has been subdivided into the following sections: Soil Sampling Activities, Bioremediation Bench Scale Testing, and Solidification/Stabilization Bench Scale Testing.

SOIL SAMPLING ACTIVITIES

Soil samples for bench scale testing were collected from three soil borings (B-A, B-B, and B-C) from the 20 to 28 foot soil interval as shown on Figure 1. Soil samples from the 20 to 28 foot interval were composited and submitted to Biotrol, Inc. in Eden Prairie, Minnesota for biological evaluation and OBG Laboratories, Inc. in Plymouth Meeting, Pennsylvania for solidification/stabilization screening.

BIOREMEDIATION BENCH SCALE TESTING

The purpose of the bioremediation bench scale testing was to determine if a viable bacterial population exists at the site. Three soil samples (B-A, B-B, and B-C) and one ground water sample (TW-1) were submitted to Biotrol. Physical tests performed by Biotrol included: moisture content, moisture holding capacity, and particle size distribution. Chemical analyses included: nutrient analysis (nitrogen + phosphorus), nutrient availability and precipitation, iron, hardness and pH. Microbiological characteristics included: Total Heterotroph Enumerations and Total Methanotroph Enumerations.

High numbers of heterotrophs were observed in two samples (B-B and B-C), however, in general, the total numbers of heterotrophs observed were generally low. Heterotrophs are organisms that require one or more organic compounds for growth and reproduction. The relatively low numbers of heterotrophs in these two samples may represent areas of toxicity or low concentrations of biodegradable carbon. The methanotroph count indicated high numbers of methanotrophic bacteria when cultured in the presence of methane. The presence of methanotrophs in relatively high numbers indicates that there is a potential for methane enhanced aerobic bioremediation of TCE at the site. The Biotrol study did not address the potential for anaerobic bioremediation. Biotrol's report is included as Attachment A.

In general, the results of the bench scale testing determined that chemical and microbial properties of the soil are favorable for microbial growth indicating a strong potential for methane enhanced aerobic bioremediation. However, the physical properties of the soil, identified during the benchscale testing, (ie: fine grain size and low hydraulic conductivity) are not favorable for in-situ bioremediation.

Based on the existing analytical data, the chlorinated solvents present in site soils would require treatment via anaerobic and aerobic bioremediation. PCE requires anaerobic conditions for degradation to TCE. TCE could then be degraded under methane enhanced aerobic conditions. Aerobic degradation of TCE would not result in the formation of vinyl chloride. Conceptual in-situ treatment approaches for the Sealectro site could include the following:

(A) Natural anaerobic attenuation of PCE with methane enhanced aerobic degradation in TCE or vinyl chloride plume areas. Methane and oxygen would be injected into the subsurface using sparge wells in the saturated zone. Methane enhanced bioremediation of chlorinated solvents is considered by the EPA as an innovative technology demonstrated at the pilot scale.

(B) Chlorinated solvents could be physically removed through in-situ air stripping using sparge wells in the ground water. VOCs could be collected in the vadose zone and discharged to carbon for treatment.

SOIL STABILIZATION/SOLIDIFICATION BENCH SCALE TESTING

The purpose of the stabilization/solidification bench scale test was to compare pre-stabilization leachable organics and post-stabilization leachable organics to determine net reduction of contaminant loading to the ground water after treatment. Solidification/stabilization testing was performed by O'Brien & Gere Laboratories, Inc. (OBG Laboratories) at the Plymouth Meeting, Pennsylvania laboratory.

Approximately one gallon of soil was submitted to OBG Laboratories to perform this bench scale work. Two soil samples, representative of Average VOC concentrations and High VOC concentrations, were collected and submitted for Total VOC (Method 8240) and TCLP VOCs (Method 8010/8020). The Average VOC concentration material was divided into two samples and mixed with 5% Clay and 10% Portland Cement and 10% Clay and 10% Portland Cement. The same mix parameters were used for the High VOC samples. The samples were cured for seven days and then analyzed for Total VOC (Method 8240) and TCLP VOCs (Method 8010/8020). A sample flow chart outlining this process is shown on Figure 2.

The analytical results of the stabilization/solidification bench scale testing are presented below. Laboratory data reports are included as Attachment B.

Table 1
High VOC Concentration Samples

Detected Compound	Initial Sample	Regulatory Limit (Ground Water/Soil) (mg/L/mg/kg)	Mix 5% Clay 10% Portland	Mix 10% Clay 10% Portland
Total VOC Analysis (Method 8240) (mg/kg unless otherwise noted)				
Tetrachloroethylene	55	0.005/1.4	2.7	2.3
1,1,1- Trichloroethane	6.5	0.005/0.8	<0.12	<0.12
TCLP VOC Analysis (mg/L)				
Tetrachloroethylene	2.6	0.5 (1)	0.33	0.16

(1) TCLP Regulatory Limit
Source: O'Brien & Gere Laboratories

Table 2
Average VOC Concentration Samples

Detected Compound	Initial Sample	Regulatory Limit (Ground Water/Soil) (mg/L/mg/kg)	Mix 5% Clay 10% Portland	Mix 10% Clay 10% Portland
Total VOC Analysis (Method 8240) (mg/kg unless otherwise noted)				
1,2- Dichloroethylene	0.8	0.01/0.3	<0.12	<0.12
Tetrachloroethylene	48	0.005/1.4	10	9.8
1,1,1- Trichloroethane	14	0.005/0.8	<0.12	<0.12
TCLP VOC Analysis (mg/L)				
Tetrachloroethylene	2.0	0.5 (1)	1.0	0.67

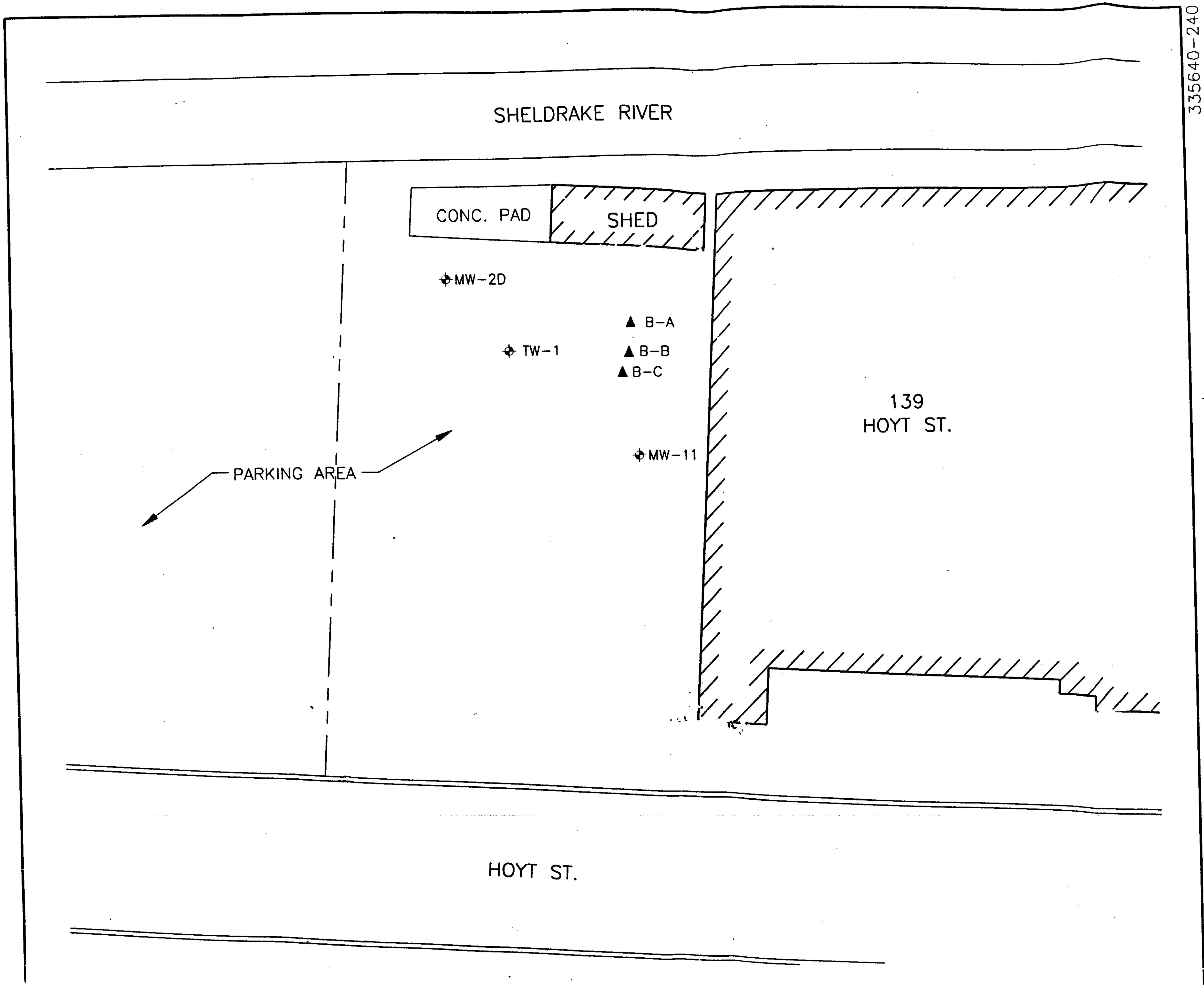
(1) TCLP regulatory limit.
Source: O'Brien & Gere Laboratories

Laboratory results indicate a reduction in leachable organics for the High VOC and the Average VOC samples for each mix tested. The percent reduction for the High VOC samples was approximately 87% for the 5% Clay/10% Portland Cement mix and 94% for the 10% Clay/10% Portland Cement mix. The percent reduction for the Average VOC samples was 50% for the 5% Clay/10% Portland Cement mix and 66% for the 10% Clay/10% Portland Cement mix. In both cases, the reduction in leachable organics was greatest for the 10% Clay/10% Portland Cement mix. However, the Average VOC sample leachable organics did not meet the TCLP Regulatory Limit of 0.5 mg/L for either mix. The differences in the percent reduction of the leachable organic levels between the High VOC and Average VOC samples could be a result of the sample preparation process.

The analytical data for the stabilization/solidification bench scale testing shows a trend of the general reduction of leachable organics with the addition of clay and portland cement. However, according to available literature in-situ stabilization/solidification is not considered a full scale process for treating organic contaminants. Prior to implementation additional treatability testing would be required.

3356-024.160\memo.500

FIGURE 1



335640-240

LEGEND

▲ SOIL BORING LOCATION

⌖ MONITORING WELL LOCATION

– – – PROPERTY LINE

ITT
SEALECTRO

SOIL BORING – BENCH SCALE TESTING

20 0 20
1" =20'

FILE NO. 3356.024

6/95

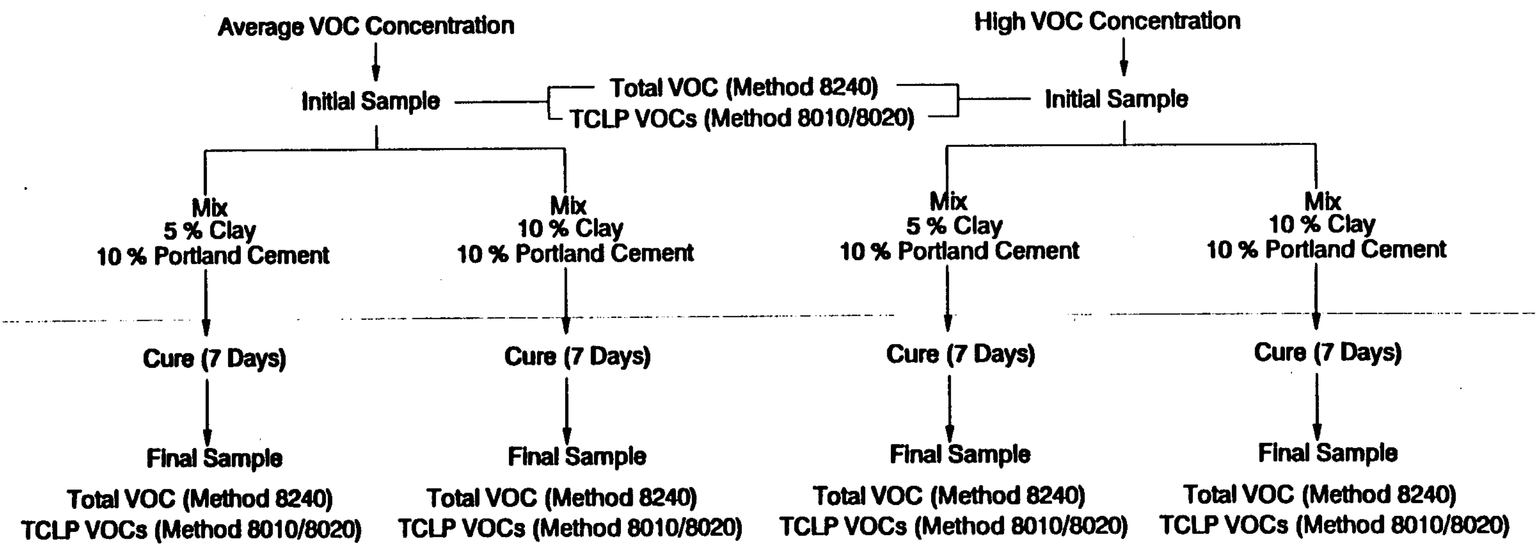
O'BRIEN & GERE ENGINEERS, INC.

FIGURE 2

ITT SEALECTRO, INC.
Mamaroneck, New York Facility

Stabilization/Solidification Preliminary Bench Scale Testing

SAMPLE FLOW CHART



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ATTACHMENT A

BIOTROL REPORT

O'BRIEN & GERE
ENGINEERS, INC.

Post-it® Fax Note 7671	Date 6/26	# of pages ▶ 8
To Abbey Jarka	From Durell Dobbins	
Co./Dept. OB&G	Co. BioTrol	
Phone # 908 225 7380	Phone # 612-942 8032	
Fax # 908 225 7931	Fax # 612 942 8526	

June 23, 1995

Dr. Durell Dobbins
BioTrol, Inc.
10300 Valley View Road
Suite 107
Eden Prairie, Minnesota 55344-3546

Re: TCE Bioscreen
File: 19-3356-020 #2

Dear Dr. Dobbins;

This letter serves as authorization for BioTrol, Inc. to conduct bioremediation laboratory screening analyses for O'Brien & Gere Engineers, Inc. (O'Brien & Gere). Authorization is limited to the scope of work provided in your letter of March 28, 1995 (attached).

It is our understanding that results will be available in 6 to 9 weeks from sample delivery. Costs for the evaluation shall not exceed $3,700 without the prior express written permission of O'Brien & Gere. Please reference file number 19-3356-020 and submit invoice to:

Ms. Abby Jarka
O'Brien & Gere Engineers
Raritan Plaza I
Edison, New Jersey 08837

If terms of this authorization are acceptable please indicate so by counter-signing both copies of this letter and returning one signed original to the above address.

We look forward to working with you on this project. If you have any questions or comments please contact Pamela Sheehan or me.

Very truly yours

Steven J. Roland

Steven J. Roland
Sr. Vice President

[illegible]
cc: Abby Jarka
Pamela Sheehan

Durell C. Dobbins

Durell C Dobbins
Chief Microbiologist
BioTrol, Inc.

BioTrol
the natural answer

Screening Evaluation for Biotreatability of Soil: ITT/Sealectro

Final Technical Report of Testing Services
BioTrol® Project #784

Post-it® Fax Note 7671	Date 6/26	# of pages ▸ 8
To Abbey Jarka	From Durell Dobbins	
Co./Dept. OB+G	Co. BioTrol	
Phone # 908 225 7380	Phone # 612-942 8032	
Fax # 908 225 7931	Fax # 612 942 8526	

Prepared for
O'Brien and Gere
Edison, New Jersey

June 23, 1995

BioTrol, Inc., 10300 Valley View Road, Suite 107, Eden Prairie, MN 55344
612/942-8032 * 612/942-8526 (fax)

Screening Evaluation for Biotreatability of Soil: ITT/Sealectro

1. Introduction

The following tests were performed by BioTrol®, Inc. for O'Brien & Gere under BioTrol Project #784. The test protocol was the Soil 1 test package as described in BioTrol's standard treatability literature.

After the following brief discussion of sample considerations, Section 3 provides the methods by which the tests were performed, Section 4 provides the results of the tests, and Section 5 provides BioTrol's interpretations of the results.

2. Samples

Samples were received by BioTrol in good condition. The soil sample designations were as follows:

B-A, B-B, B-C (composites, 20-28').

The water sample designation was:

TW-1

Microbial enumerations were performed on discrete samples. Other analyses were performed using a composite made by combining all soil samples in equal wet weight proportions. A composite of the water samples was created as well.

3. Test Methods & Interpretation Guide

The following are descriptions of the methods used in the screening study to obtain the results reported in the accompanying data sheets. The sequence in which the methods are numbered in this section of the report corresponds to the numbering sequence of the results in Section 4. This section provides guidance on how the results should be interpreted.

3.1 Soil 1 Tests

3.1.1 Physical Characteristics

A. Moisture Content

Purpose: To determine the ambient moisture of the soil as received.

Procedure: The soil moisture is driven off by overnight heating at 105°C and the loss is recorded as a percent of the soil dry weight.

B. Moisture Holding Capacity

Purpose: To determine the capacity of the soil for holding "gravitational water" under simulated field conditions.

Procedure: The soil is saturated with water in a Gooch crucible and small amount of vacuum is applied to remove the standing water and excess interstitial water, leaving the soil with as much water as it would normally retain under field conditions if well-drained.

C. Particle Size Distribution

Purpose: To characterize the soil in terms of the weight fractions of its particles.

Procedure: Soil is passed through screens having various mesh sizes according to standard methods. The results are used to determine whether the probable hydraulic conductivity of the soil is consistent with specific remedial designs.

3.1.2 Chemical Characteristics

A. Nutrients

Purpose: To determine the naturally occurring concentrations of microbial nitrogen and phosphorus sources and the concentration of organic carbon that exist in association with the soil.

Procedures: The following Table contains methods by which nutrient analyses are performed on soil.

Analyte	Method
Total Organic Carbon	SW846 9060
Total Kjeldahl Nitrogen	Methods of Soil Analysis, 2nd Ed., Modif. 31-3
Nitrate & Nitrite Nitrogen	Methods of Soil Analysis Part 2, 33-8.2, 8.3
Ammonia Nitrogen	Methods of Soil Analysis--Part 2, 33-7, 7.3
Phosphate Phosphorus	Methods of Soil Analysis 24-2.3
Soil pH	standard

B. Nutrient Availability

Purpose: To determine the bioavailability of added nitrogen and phosphorus.

Procedure: In-house. Water is spiked with a typical nutrient solution containing nitrogen and phosphorus, and the water is contacted with soil. The water is then analyzed for nutrients remaining in solution. From the concentrations of spiked and remaining nutrients the degree of sorption of nutrients is inferred. Waterborne nutrient concentrations are measured according the methods provided in the following Table.

Analyte	Method
Nitrate & Nitrite Nitrogen	SW846 353.3
Ammonia Nitrogen	APHA 417E
Phosphate Phosphorus	APHA 424F

C. Individual Parameters

Parameter	Method	Purpose
Iron	Hach Co. IR-18B	To determine the potential for aquifer plugging during operation due to iron precipitation
pH	standard	To determine whether the ambient pH is consistent with the requirements of bacteria that participate in bioremediation
Hardness	Hach Co. 16900-01	To determine the concentrations of reactive divalent cations that can contribute to operational problems
*Precipitation	BioTrol SOP	To determine whether addition of commonly added nutrient salts results in formation of precipitates

* The precipitation test is performed by adding a nutrient solution to ground water at various concentrations and watching for formation of visible precipitate. Results are reported as the highest, if any, concentration of nutrients (relative to an optimal addition) at which no precipitate is formed. The lowest concentration of nutrients tested is 5% of the presumed optimum.

3.1.3 Microbiological Characteristics: Microbial Enumerations

All microbial enumerations are performed using a Most Probable Number (MPN) technique. The original sample is serially diluted in media. Media selection is based on the environment from which the samples were obtained in order to provide a growth environment suitable for the microorganisms indigenous to that environment.

A. Total Heterotrophs

Purpose: To estimate the number of culturable microorganisms of the heterotroph class (i.e., microorganisms that utilize organic molecules to support their growth and other metabolic activities) present in the sample material as received. The results reflect the general suitability of the environment for sustaining bacterial survival.

B. Methanotrohs

Purpose: To estimate the number of culturable microorganisms present in the sample material as received that are capable of growing by utilizing methane as their source of carbon and energy. The results usually reflect the potential for methanotrophy in the site soil.

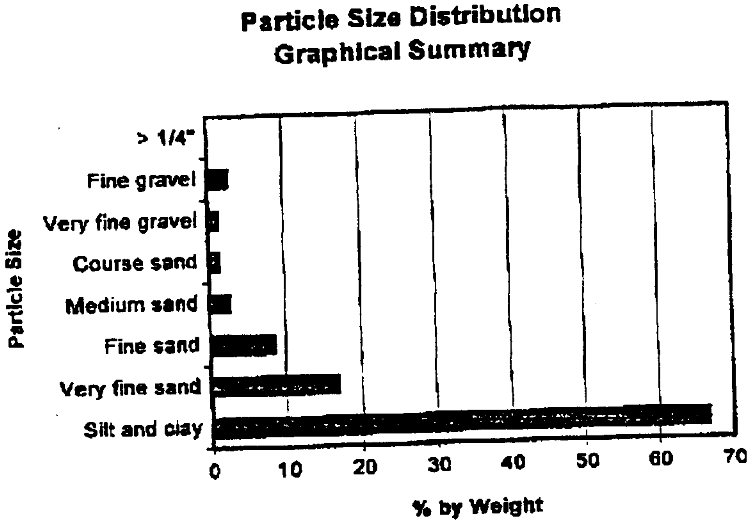
4. Data

4.1 Soil 1 Tests

4.1.1 Physical Characteristics

A. Moisture Content (% of sample dry weight)	*25.1 ± 0.8*
B. Moisture Holding Capacity (% of sample dry weight)	*31.6 ± 1.6*

C. Particle Size Distribution



4.1.2 Chemical Characteristics

A. Nutrients

Analyte	Result (mg/kg)
Total Organic Carbon	1,020
Total Kjeldahl Nitrogen	18.4
Nitrate & Nitrite Nitrogen	0.9
Ammonia Nitrogen	2.4
Phosphate Phosphorus	811

B. Nutrient Availability

Analyte	Added (mg/l)	Available (mg/L)	Available (% of added)
Nitrate & Nitrite Nitrogen	19.6	18.5	94
Ammonia Nitrogen	20.0	15.5	78
Phosphate Phosphorus	8.3	3.0	36

C. Individual Parameters

Parameter	Units	Result
Iron in Water	mg/l	< 1
Soil pH	pH	8.2
Water Hardness	mg/l	336
Precipitation	@ 50% std. nutrient load	+

4.1.3 Microbiological Characteristics: Microbial Enumerations

A.. Total Heterotrophs

Sample Designation	MPN/g
B-A (rep. 1)	1.7 X 10^3
B-A (rep. 2)	3.8 X 10^3
B-B (rep. 1)	8.6 X 10^2
B-B (rep. 2)	1.7 X 10^7
B-C (20'-24')	3.8 X 10^4
B-C (24'-28')	3.8 X 10^7

B. Total Methanotrophs (Composite)

Sample Designation	MPN/g
Acclimated CH_4+	1.39 X 10^8
Acclimated CH_4−	TNTC (> 3 X 10^4)
Unacclimated CH_4+	TNTC (> 3 X 10^4)
Unacclimated CH_4−	TNTC (> 3 X 10^5)
Uninoc. CH_4+	−
Uninoc. CH_4−	−

5. Interpretations

Physical and chemical characteristics were consistent with a fine-textured (silt or clay) soil. As received moisture was relatively low for clayey soil, as was the moisture holding capacity. The total organic carbon was typical of subsurface material while ambient sources of inorganic nitrogen and phosphorus were relatively high. The organic nitrogen concentration was unusually low. Added phosphate tended to adsorb to solids. The water was low in iron, pH was slightly alkaline, hardness was moderately high, and added nutrients tended to precipitate at high concentrations.

The numbers of total heterotrophs were generally low (consistent with fine-grained material) with two samples (one of the B-B replicates and B-C 24′-28′) showing uncharacteristically high population densities. These may represent areas of mitigated toxicity, high concentrations of biodegradable carbon or other site heterogeneities. The difference between these samples and the remaining samples was statistically significant (> 95% confidence).

The results of methanotroph enumerations were somewhat unusual. Although these samples were incubated on purified agar without added carbon, soil-inoculated plates grew microoganisms in high density, even in the absence of methane. Negative control plates showed no growth either in the presence or absence of methane, proving that the growth was not due to contaminants from the laboratory. We suspect that enough biodegradable soil organic carbon was present to enable proliferation of aerobic microorganisms in the absence of added carbon.

Unambiguously, from observation of the plates, the highest density of microorganisms was present in the methane-acclimated soil when incubated in the presence of methane. Lower, but still unusually high population densities were associated methane-acclimated plates cultured in the absence of methane. Following these were unacclimated plates cultured in the presence of methane, and then, unacclimated plates grown in the absence of methane. Although many of the resulting densities were too high to quantify using the standard test protocol, we conclude from our observations as follows:

> Incubation in the presence of methane generally increased the densities of both methanotrophs and heterotrophs (presumably due to secondary growth on metabolic products of methanotrophs).
>
> Methanotrophs were present in unacclimated samples.
>
> Population densities of methanotrophs increased upon acclimation > 10^8/g soil.

In general, because of the fine texture of this soil, it is considered a relatively poor candidate for *in situ* bioremediation because of low hydraulic conductivity. However, the chemical and microbiologicial properties of the soil are favorable. Although the capability of the native organisms to completely remove chlorinated solvents *in situ* is yet to be proven, the presence and viability of methanotrophs implies that the metabolic capability exists within this soil for removal of several chlorinated solvents.

ATTACHMENT B

LABORATORY REPORTS

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO

JOB NO. 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Solid

DATE COLLECTED 4-24,25-95

DATE RECEIVED 4-29-95

DATE ANALYZED 5-8-95

DESCRIPTION:	B-A,B-B, B-C	B-A,B-B, B-C,B-B 20-23'
SAMPLE NO:.	V5674	V5676
Benzene	<670.	<620.
Bromodichloromethane	<670.	<620.
Bromoform	<6700.	<6200.
Bromomethane	<6700.	<6200.
Carbon tetrachloride	<670.	<620.
Chlorobenzene	<670.	<620.
Chloroethane	<670.	<620.
2-Chloroethylvinyl ether	<6700.	<6200.
Chloroform	<670.	<620.
Chloromethane	<6700.	<6200.
Dibromochloromethane	<670.	<620.
1,2-Dichlorobenzene	<3300.	<3100.
1,3-Dichlorobenzene	<3300.	<3100.
1,4-Dichlorobenzene	<3300.	<3100.
Dichlorodifluoromethane	<6700.	<6200.
1,1-Dichloroethane	<670.	<620.
1,2-Dichloroethane	<670.	<620.
1,1-Dichloroethylene	<670.	<620.
1,2-Dichloroethylene (total)	<670.	800.
Dichloromethane	<670.	<620.
1,2-Dichloropropane	<670.	<620.
cis-1,3-Dichloropropylene	<670.	<620.
trans-1,3-Dichloropropylene	<670.	<620.

Authorized: Monika Santucci

Date May 26, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO JOB NO. 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Solid

DATE COLLECTED 4-24,25-95 DATE RECEIVED 4-29-95 DATE ANALYZED 5-8-95

DESCRIPTION:	B-A,B-B, B-C	B-A,B-B, B-C,B-B 20-23'
SAMPLE NO:.	V5674	V5676
Ethylbenzene	<670.	<620.
1,1,2,2-Tetrachloroethane	<670.	<620.
Tetrachloroethylene	55,000.	48,000.
Toluene	<670.	<620.
1,1,1-Trichloroethane	6500.	14,000.
1,1,2-Trichloroethane	<670.	<620.
Trichloroethylene	<670.	<620.
Trichlorofluoromethane	<670.	<620.
Vinyl chloride	<670.	<620.
Xylene (total)	<2000.	<1900.

Comments:

Methodology: USEPA-846, Update I, 3rd Ed., July 1992
Certification No.: 10155
Units: µg/kg dry weight

Authorized: Monika Santucci

Date: May 26, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Laboratory Report

CLIENT ITT SEALECTRO **JOB NO.** 3356.001.517

DESCRIPTION Mamaroneck, NY

Toxicity Characteristic Leaching Procedure MATRIX: Solid

DATE COLLECTED 4-24,25-95 **DATE RECEIVED** 4-29-95

Description	B-A,B-B B-Є	B-A,B-B B-C,B-B 20-23'			
Sample #	V5673	V5675			
TCLP Volatile Organics:					
BENZENE	<0.10	<0.10			
CARBON TETRACHLORIDE	<0.10	<0.10			
CHLOROBENZENE	<10.	<10.			
CHLOROFORM	<0.60	<0.60			
1,2-DICHLOROETHANE	<0.10	<0.10			
1,1-DICHLOROETHYLENE	<0.10	<0.10			
METHYL ETHYL KETONE	<20.	<20.			
TETRACHLOROETHYLENE	2.6	2.0	.5 limit		
TRICHLOROETHYLENE	<0.10	<0.10			
VINYL CHLORIDE	<0.10	<0.10			
Analytical Record:					
Date Extracted 5-8-95					
Date Analyzed 5-18-95					

Comments:

Certification No.: 10155

Units: mg/1

Authorized: Monika Santucci

Date: May 26, 1995

O'Brien & Gere Laboratories, Inc. an O'Brien & Gere Company
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

O'BRIEN & GERE
LABORATORIES, INC.

Laboratory Report

CLIENT ITT SEALECTRO **JOB NO.** 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Solid

DATE COLLECTED 4-24,25-95 **DATE RECEIVED** 4-29-95

	Sample #	PERCENT TOTAL SOLIDS
B-A,B-B,B-C	V5674	75.1
B-A,B-B,B-C,B-B 20-23'	V5676	81.2

Comments:

Certification No.: 10155

Units: %

Authorized: Monika Santucci

Date: May 26, 1995

CHAIN OF CUSTODY RECORD

O'BRIEN & GERE
LABORATORIES, INC.

SURVEY: ITT 85 METRO
LOCATION: MAMARONECK NY
SAMPLED BY: J M DOWSER
ORGANIZATION: O'BRIEN & GERE

STATION NUMBER	SAMPLE LOCATION	DATE COLLECTED	TIME COLLECTED	SAMPLE MATRIX	COMP. OR GRAB	NO. OF CONTAINERS	ANALYSIS REQUIRED
A, B-B, B-C	PARKING AREA BORING COMP. HIGH LEVEL VOC	4-23 95	1700	SE	C	2	TOTAL VOC TCLP VOC
B-A, B-B, B-C B-B 20-23'	PARKING AREA BORING GRAND COMP. AVG LEVEL VOC	4-23 95	1710	SE	C	1	TOTAL VOC TCLP VOC

Date collected should be 4/24, 25/95 per John Dowser. VOC's by method 8010/8020 per John Dowser

Relinquished By:	DATE 4-28 95	TIME 1730	Received By:	DATE	TI
Relinquished By:	DATE	TIME	Received By:	DATE	TI
Relinquished By:	DATE	TIME	Received by Laboratory: Barbara Pawling	DATE 5-1 95	TI 07

COMMENTS: Found intact in walk-in cooler. Temp 4°C (BPP)
PUT UP FOR EXTRACTIONS ON MONDAY 5-01-95

METHOD OF SHIPMENT:
FED-X OVERNITE TO SYRACUSE ON 4-28-95

OBG LABORATORIES, INC.
CASE FILE FORM

PROGRAM INFORMATION

Client: OBG Engs Div. ________ Ref. No. ________

Program: ITT Sealectro

Location: City/Town Mamaroneck State NY

Date Rec'd: 4-29-95 Time Rec'd: 09:43 Sampler: A Doerner

Custody Seal: ____ Intact ____ Not Intact ✓ NA

AFTER HOURS CUSTODY

RELINQUISHED BY:	DATE	TIME	RECEIVED BY SECURITY GUARD:	DATE	TIME
FEDERAL EXPRESS	4-29-95	0943	S/O ARCHIE D'EREDITA	4-29-95	0943
RELINQUISHED BY SECURITY GUARD TO COOLER:	**DATE**	**TIME**	**RECEIVED BY SAMPLE CUSTODIAN:**	**DATE**	**TIME**
S/O ARCHIE D'EREDITA	4-29-95	0950	BP Pawling	5-1-95	01:30

COMMENTS/DISCREPANCY:

Found intact in walk-in cooler - Temp 4°C

RESOLUTION/CLIENT COMMENT:

Signed: Barbara Pawling Project Manager Approval: MS

Date: 5-1-95 QA/QC Approval: ________

SAMPLE DISPOSAL

Disposal Procedure: Submitt to Hazardous Waste Office

Signed: Monika Santucci

Date: 5/30/95

O'BRIEN & GERE
LABORATORIES, INC.

After curing

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO JOB NO. 3356.001.517

DESCRIPTION Mamaroneck, NY

Stabilized Parking Area Mix MATRIX: Solid

DATE COLLECTED 5-3-95 DATE RECEIVED 5-10-95 DATE ANALYZED 5-16-95

DESCRIPTION:	HVOC-1010	HVOC-510	AVOC-510	AVOC-1010
SAMPLE NO:.	V6268	V6269	V6270	V6271
Benzene	<120.	<120.	<120.	<120.
Bromodichloromethane	<120.	<120.	<120.	<120.
Bromoform	<1200.	<1200.	<1200.	<1200.
Bromomethane	<1200.	<1200.	<1200.	<1200.
Carbon tetrachloride	<120.	<120.	<120.	<120.
Chlorobenzene	<120.	<120.	<120.	<120.
Chloroethane	<120.	<120.	<120.	<120.
2-Chloroethylvinyl ether	<1200.	<1200.	<1200.	<1200.
Chloroform	<120.	<120.	<120.	<120.
Chloromethane	<1200.	<1200.	<1200.	<1200.
Dibromochloromethane	<120.	<120.	<120.	<120.
1,2-Dichlorobenzene	<580.	<590.	<590.	<580.
1,3-Dichlorobenzene	<580.	<590.	<590.	<580.
1,4-Dichlorobenzene	<580.	<590.	<590.	<580.
Dichlorodifluoromethane	<1200.	<1200.	<1200.	<1200.
1,1-Dichloroethane	<120.	<120.	<120.	<120.
1,2-Dichloroethane	<120.	<120.	<120.	<120.
1,1-Dichloroethylene	<120.	<120.	<120.	<120.
1,2-Dichloroethylene (total)	<120.	<120.	<120.	<120.
Dichloromethane	<120.	<120.	<120.	<120.
1,2-Dichloropropane	<120.	<120.	<120.	<120.
cis-1,3-Dichloropropylene	<120.	<120.	<120.	<120.
trans-1,3-Dichloropropylene	<120.	<120.	<120.	<120.

Authorized: Monika Santucci

Date: May 30, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO **JOB NO.** 3356.001.517

DESCRIPTION Mamaroneck, NY
Stabilized Parking Area Mix **MATRIX:** Solid

DATE COLLECTED 5-3-95 **DATE RECEIVED** 5-10-95 **DATE ANALYZED** 5-16-95

DESCRIPTION:	HVOC-1010	HVOC-510	AVOC-510	AVOC-1010	
SAMPLE NO:.	V6268	V6269	V6270	V6271	
Ethylbenzene	<120.	<120.	<120.	<120.	
1,1,2,2-Tetrachloroethane	<120.	<120.	<120.	<120.	
Tetrachloroethylene	2300.	2700.	10,000.	9800.	[illegible]
Toluene	<120.	<120.	200.	180.	
1,1,1-Trichloroethane	<120.	<120.	<120.	130.	
1,1,2-Trichloroethane	<120.	<120.	<120.	<120.	
Trichloroethylene	<120.	<120.	<120.	<120.	
Trichlorofluoromethane	<120.	<120.	<120.	<120.	
Vinyl chloride	<120.	<120.	<120.	<120.	
Xylene (total)	<350.	<360.	<350.	<350.	

Comments:

Methodology: USEPA-846, Update I, 3rd Ed., July 1992
Certification No.: 10155
Units: µg/kg dry weight

Authorized: Monika Santucci
Date: May 30, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Laboratory Report

CLIENT ITT SEALECTRO
JOB NO. 3356.001.517
DESCRIPTION Mamaroneck, NY - Stabilized Parking Area
Revision of Report Dated May 30, 1995
MATRIX: Solid
Toxicity Characteristic Leaching Procedure
DATE COLLECTED 5-3-95
DATE RECEIVED 5-10-95

Description:	HVOC-1010	HVOC-510	AVOC-510	AVOC-1010
Sample #	V6272	V6273	V6274	V6275
TCLP Volatile Organics:				
BENZENE	<0.05	<0.05	<0.05	<0.05
CARBON TETRACHLORIDE	<0.05	<0.05	<0.05	<0.05
CHLOROBENZENE	<10.	<10.	<10.	<10.
CHLOROFORM	<0.60	<0.60	<0.60	<0.60
1,2-DICHLOROETHANE	<0.05	<0.05	<0.05	<0.05
1,1-DICHLOROETHYLENE	<0.07	<0.07	<0.07	<0.07
METHYL ETHYL KETONE	<20.	<20.	<20.	<20.
TETRACHLOROETHYLENE	0.16	0.33	1.0	0.67
TRICHLOROETHYLENE	<0.05	<0.05	<0.05	<0.05
VINYL CHLORIDE	<0.02	<0.02	<0.02	<0.02

Analytical Record:

Date Extracted 5-10-95
Date Analyzed 5-18-95

Comments:

Certification No.: 10155
Units: mg/l

Authorized: Monika Santucci
Date: June 5, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Laboratory Report

CLIENT ITT SEALECTRO JOB NO. 3356.001.517

DESCRIPTION Mamaroneck, NY

Stabilized Parking Area Mix MATRIX: Solid

DATE COLLECTED 5-3-95 DATE RECEIVED 5-10-95

	Sample #	PERCENT TOTAL SOLIDS
HVOC-1010	V6268	86.1
HVOC-510	V6269	84.6
AVOC-510	V6270	85.1
AVOC-1010	V6271	85.7

Comments:

Certification No.: 10155

Units: %

Authorized: Monika Santucci

Date: May 30, 1995

CHAIN OF CUSTODY RECORD

O'BRIEN & GERE
LABORATORIES, INC.

700 # 3356.024.578

SURVEY: ITT SEALECTRO	SAMPLED BY: J.M. DOERNER
LOCATION: MAMARONECK	ORGANIZATION: O'BRIEN & GERE LABS

STATION NUMBER	SAMPLE LOCATION	DATE COLLECTED	TIME COLLECTED	SAMPLE MATRIX	COMP. OR GRAB	NO. OF CONTAINERS	ANALYSIS REQUIRED
HVOC	STABILIZED PARKING AREA MIX HVOC -1010	5-03 95	1130	S	C	1	TOTAL VOC (8010/80 TCLP VOC (1311/8010/8
HVOC	STABILIZED PARKING AREA MIX HVOC - 510	5-03 95	1100	S	C	1	" " " "
AVOC	STABILIZED PARKING AREA MIX AVOC - 510	5-03 95	1215	S	C	1	" " " "
AVOC	STABILIZED PARKING AREA MIX AVOC - 1010	5-03 95	1430	S	C	1	TOTAL VOC (8010/802 TCLP VOC (1311/8010/8
BLANK	TEMPERATURE BLANK	5-09 95	1750	W	G	1	CHECK °C ON

	DATE	TIME		DATE	T
Relinquished By:	5-09-95	1800	Received By:		
Relinquished By:	DATE	TIME	Received By:	DATE	T
Relinquished By:	DATE	TIME	Received by Laboratory: Wendy Smith	DATE 5-10-95	T 10

COMMENTS:

- NEED TO EXTRACT ALL SOLID SAMPLES UPON RECEIPT ON 5-10-
- ANALYZE FOR TOTAL VOC AND TCLP VOC (8010/8020)

⊗ (STD TURNAROUND ON DATA O.K.)   Cooler Temp. @ 5°C (WS)

METHOD OF SHIPMENT:

OVERNITE TO SYRACUSE ON 5-09-95

Appendix E

Aquifer performance testing

Aquifer Performance Test and Results

As part of the FS, additional field tasks were completed to evaluate the technical viability of localized soil flushing. In order to further assess this remedial option, a six-inch diameter test ground water recovery well, designated as TW-1 was installed immediately atop bedrock (40 ft below ground surface) in April 1995 and an aquifer performance test was completed. The well is located in the vicinity of the Shed Area as indicated on the attached figure. The aquifer performance test was completed to assess the hydraulic characteristics of the deep ground water zone and its hydraulic connection with the shallow ground water zone. Water generated during the aquifer performance test was treated at the current on-site treatment system and discharged to the POTW.

The aquifer performance test was completed from May 16 through 18, 1995 at a sustained yield of 12.25 gallons per minute (gpm). A pressure transducer system was utilized to record draw-down data and recovery data. The draw-down and recovery data is attached. The AQTESOLV Computer program was used to assess the hydraulic characteristics of the deep ground water zone. The data indicate that the transmissivity of the deep ground water zone is variable and ranged between 0.1555 ft^2/min to 0.4268 ft^2/min depending upon the method used to analyze the data. The average transmissivity value was calculated to be 0.3 ft^2/min. The average hydraulic conductivity is 0.0145 ft/min (0.0073 cm/sec) assuming a 20 ft aquifer thickness. During the test, draw-down was observed in shallow wells MW-2, MW-11, MW-12, which indicate that the shallow ground water zone drains is in hydraulic connection to the deep ground water zone.

Ground water samples were collected from TW-1 and from the treatment system effluent. The results indicate that total VOC concentrations from TW-1 were relatively stable during the test and ranged between 20.04 mg/L at 6 hours to 21.55 mg/L at 24 hours. One effluent sample from the on-site treatment system was collected and the total VOCs detected was 1.401 mg/L, which is below the sewer discharge requirement of 2 mg/L. The laboratory data sheets are attached.

ITT SEALECTRO
AQUIFER PERFORMANCE TEST
MAMARONECK, NEW YORK

Draw - DowN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
PUMP TEST START										
05/16/95	09:35:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
05/16/95	09:35:17	0.25	0.97	0.00	0.00	0.00	0.00	-0.00	-0.01	0.01
05/16/95	09:35:32	0.50	2.35	-0.00	0.00	-0.01	0.00	-0.00	0.00	0.01
05/16/95	09:35:47	0.75	3.32	-0.01	0.01	0.00	0.00	-0.00	0.01	0.01
05/16/95	09:36:02	1.00	4.04	-0.00	0.00	-0.01	0.00	-0.00	0.00	0.02
05/16/95	09:36:17	1.25	4.66	-0.00	0.03	0.00	0.01	-0.01	0.01	0.01
05/16/95	09:36:32	1.50	5.13	-0.01	0.03	0.00	0.02	-0.00	0.00	0.01
05/16/95	09:36:47	1.75	5.49	-0.01	0.05	0.00	0.01	-0.01	0.00	0.01
05/16/95	09:37:02	2.00	5.81	-0.01	0.07	-0.01	0.01	-0.01	0.00	0.01
05/16/95	09:37:17	2.25	5.99	-0.01	0.08	-0.01	0.01	-0.01	0.00	0.00
05/16/95	09:37:32	2.50	6.24	-0.01	0.10	-0.01	0.01	-0.01	0.00	0.01
05/16/95	09:37:47	2.75	6.46	-0.01	0.10	-0.01	0.01	-0.01	0.00	0.01
05/16/95	09:38:02	3.00	6.53	-0.01	0.13	-0.01	0.02	-0.01	0.01	0.01
05/16/95	09:38:17	3.25	6.68	-0.01	0.15	-0.01	0.02	-0.01	0.00	0.00
05/16/95	09:38:32	3.50	6.79	-0.02	0.17	-0.01	0.03	-0.01	0.01	0.01
05/16/95	09:38:47	3.75	6.93	-0.01	0.18	-0.01	0.03	-0.01	0.01	0.01
05/16/95	09:39:02	4.00	6.97	-0.01	0.20	-0.01	0.02	-0.01	0.00	0.00
05/16/95	09:39:17	4.25	7.04	-0.01	0.22	-0.02	0.02	-0.01	0.01	0.01
05/16/95	09:39:32	4.50	7.15	-0.01	0.24	-0.02	0.02	-0.01	0.01	0.01
05/16/95	09:39:47	4.75	7.18	-0.01	0.25	-0.02	0.03	-0.01	0.01	0.00
05/16/95	09:40:02	5.00	7.18	-0.03	0.27	-0.01	0.03	-0.01	0.01	0.01
05/16/95	09:40:17	5.25	7.29	-0.01	0.28	-0.01	0.04	-0.01	0.01	0.01
05/16/95	09:40:32	5.50	7.36	-0.01	0.29	-0.02	0.04	-0.01	0.01	0.01
05/16/95	09:40:47	5.75	7.29	-0.01	0.31	-0.01	0.04	-0.01	0.01	0.01
05/16/95	09:41:02	6.00	7.33	-0.03	0.32	-0.01	0.04	-0.01	0.01	0.00
05/16/95	09:41:17	6.25	7.40	-0.01	0.32	-0.02	0.05	-0.01	0.02	0.01
05/16/95	09:41:32	6.50	7.44	-0.01	0.34	-0.02	0.05	-0.01	0.01	0.00
05/16/95	09:41:47	6.75	7.44	-0.01	0.37	-0.01	0.07	-0.01	0.01	0.01
05/16/95	09:42:02	7.00	7.47	-0.01	0.37	-0.01	0.07	-0.01	0.01	0.01
05/16/95	09:42:17	7.25	7.51	-0.01	0.40	-0.01	0.07	-0.01	0.01	0.00
05/16/95	09:42:32	7.50	7.47	-0.01	0.41	-0.02	0.08	-0.01	0.02	0.01
05/16/95	09:42:47	7.75	7.54	-0.03	0.42	-0.01	0.08	-0.01	0.01	0.01
05/16/95	09:43:02	8.00	7.54	-0.01	0.42	-0.01	0.08	-0.01	0.01	0.01
05/16/95	09:43:17	8.25	7.58	-0.01	0.46	0.00	0.09	-0.01	0.01	0.00
05/16/95	09:43:32	8.50	7.58	-0.01	0.46	-0.01	0.09	-0.01	0.01	0.01
05/16/95	09:43:47	8.75	7.54	-0.01	0.47	-0.01	0.10	-0.01	0.02	0.00
05/16/95	09:44:02	9.00	7.65	-0.01	0.48	-0.01	0.09	-0.01	0.02	0.00
05/16/95	09:44:17	9.25	7.65	-0.01	0.50	0.00	0.10	-0.01	0.02	0.01
05/16/95	09:44:32	9.50	7.62	-0.01	0.50	0.00	0.11	-0.01	0.02	0.01
05/16/95	09:44:47	9.75	7.65	-0.01	0.52	-0.01	0.10	-0.01	0.02	0.01
05/16/95	09:45:02	10.00	7.69	-0.01	0.52	-0.01	0.12	-0.01	0.02	0.01
05/16/95	09:46:02	11.00	7.69	-0.01	0.55	0.01	0.12	-0.01	0.02	0.01
05/16/95	09:47:02	12.00	7.72	-0.01	0.59	-0.01	0.09	-0.01	0.02	0.01
05/16/95	09:48:02	13.00	7.76	-0.00	0.62	-0.01	0.09	-0.01	0.03	0.00
05/16/95	09:49:02	14.00	7.76	-0.00	0.64	-0.01	0.09	0.00	0.02	-0.01
05/16/95	09:50:02	15.00	7.80	-0.01	0.65	-0.01	0.09	0.00	0.04	0.00

DRAW- DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/16/95	09:51:02	16.00	7.94	-0.04	0.66	-0.01	0.09	0.00	0.03	0.02
05/16/95	09:52:02	17.00	8.16	-0.00	0.68	-0.03	0.09	0.00	0.03	0.02
05/16/95	09:53:02	18.00	8.09	-0.00	0.70	-0.02	0.10	-0.01	0.04	0.01
05/16/95	09:54:02	19.00	7.90	-0.00	0.70	-0.01	0.10	-0.00	0.03	0.00
05/16/95	09:55:02	20.00	7.90	-0.00	0.70	-0.03	0.10	-0.00	0.03	0.00
05/16/95	09:56:02	21.00	7.90	-0.00	0.70	-0.04	0.11	0.00	0.04	0.01
05/16/95	09:57:02	22.00	7.94	0.00	0.74	-0.03	0.11	0.00	0.05	0.02
05/16/95	09:58:02	23.00	8.34	-0.00	0.74	-0.03	0.09	0.00	0.05	0.01
05/16/95	09:59:02	24.00	8.48	0.00	0.76	-0.04	0.09	0.00	0.05	0.00
05/16/95	10:00:02	25.00	8.52	0.00	0.77	-0.03	0.10	0.00	0.05	0.01
05/16/95	10:01:02	26.00	8.52	-0.00	0.77	-0.02	0.12	-0.00	0.05	0.02
05/16/95	10:02:02	27.00	8.59	-0.01	0.78	-0.02	0.13	0.00	0.05	0.01
05/16/95	10:03:02	28.00	8.59	0.00	0.79	-0.02	0.15	0.00	0.05	0.02
05/16/95	10:04:02	29.00	8.55	0.00	0.78	-0.01	0.16	0.00	0.05	0.01
05/16/95	10:05:02	30.00	8.59	0.00	0.79	-0.02	0.14	0.00	0.05	0.01
05/16/95	10:06:02	31.00	8.63	0.00	0.81	-0.02	0.15	0.00	0.05	0.01
05/16/95	10:07:02	32.00	8.59	0.01	0.81	-0.03	0.16	0.00	0.05	0.01
05/16/95	10:08:02	33.00	8.63	0.01	0.82	-0.01	0.17	0.00	0.06	0.02
05/16/95	10:09:02	34.00	8.63	0.01	0.82	-0.03	0.13	0.01	0.05	0.01
05/16/95	10:10:02	35.00	8.63	0.01	0.83	-0.04	0.11	0.01	0.06	0.01
05/16/95	10:11:02	36.00	8.66	0.01	0.83	-0.05	0.12	0.01	0.06	0.00
05/16/95	10:12:02	37.00	8.63	0.01	0.82	-0.03	0.14	-0.00	0.08	0.00
05/16/95	10:13:02	38.00	8.66	0.02	0.84	-0.04	0.13	0.01	0.08	0.00
05/16/95	10:14:02	39.00	8.66	0.01	0.83	-0.03	0.15	0.01	0.08	0.02
05/16/95	10:15:02	40.00	8.66	0.01	0.84	-0.02	0.15	0.01	0.06	0.00
05/16/95	10:16:02	41.00	8.70	0.01	0.84	-0.04	0.14	0.01	0.08	0.00
05/16/95	10:17:02	42.00	8.73	0.01	0.83	-0.04	0.11	0.01	0.08	0.00
05/16/95	10:18:02	43.00	8.70	0.02	0.86	-0.05	0.11	0.01	0.09	0.01
05/16/95	10:19:02	44.00	8.77	0.02	0.84	-0.08	0.09	0.01	0.06	0.01
05/16/95	10:20:02	45.00	8.77	0.04	0.86	-0.08	0.09	0.01	0.08	0.01
05/16/95	10:21:02	46.00	8.73	0.02	0.86	-0.08	0.11	0.01	0.09	0.02
05/16/95	10:22:02	47.00	8.77	0.02	0.88	-0.09	0.09	0.01	0.08	0.02
05/16/95	10:23:02	48.00	8.77	0.02	0.86	-0.08	0.09	0.01	0.09	0.00
05/16/95	10:24:02	49.00	8.77	0.02	0.84	-0.09	0.09	0.01	0.09	0.02
05/16/95	10:25:02	50.00	8.81	0.02	0.88	-0.10	0.08	0.01	0.09	0.01
05/16/95	10:26:02	51.00	8.77	0.03	0.84	-0.10	0.10	0.02	0.09	0.01
05/16/95	10:27:02	52.00	8.77	0.03	0.87	-0.11	0.08	0.02	0.09	0.01
05/16/95	10:28:02	53.00	8.73	0.03	0.87	-0.10	0.10	0.01	0.08	0.01
05/16/95	10:29:02	54.00	8.84	0.02	0.88	-0.11	0.10	0.01	0.09	0.01
05/16/95	10:30:02	55.00	8.81	0.02	0.88	-0.10	0.09	0.01	0.09	0.00
05/16/95	10:31:02	56.00	8.81	0.03	0.87	-0.10	0.08	0.02	0.09	-0.01
05/16/95	10:32:02	57.00	8.77	0.02	0.87	-0.11	0.05	0.02	0.09	0.00
05/16/95	10:33:02	58.00	8.88	0.03	0.87	-0.15	0.01	0.02	0.09	0.00
05/16/95	10:34:02	59.00	8.84	0.03	0.87	-0.18	0.00	0.02	0.10	0.00
05/16/95	10:35:02	60.00	8.81	0.03	0.87	-0.18	-0.01	0.02	0.10	0.00
05/16/95	10:36:02	61.00	8.84	0.03	0.87	-0.18	-0.01	0.01	0.09	0.02
05/16/95	10:37:02	62.00	8.88	0.03	0.87	-0.18	0.02	0.02	0.09	0.01

ITT SEALECTRO
AQUIFER PERFORMANCE TEST
MAMARONECK, NEW YORK

DRAW-DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/16/95	10:38:02	63.00	8.84	0.04	0.88	-0.15	0.04	0.03	0.10	0.02
05/16/95	10:39:02	64.00	8.88	0.03	0.88	-0.14	0.05	0.03	0.10	0.01
05/16/95	10:40:02	65.00	8.88	0.03	0.88	-0.11	0.05	0.03	0.10	0.02
05/16/95	10:41:02	66.00	8.92	0.03	0.89	-0.11	0.07	0.03	0.09	0.01
05/16/95	10:42:02	67.00	8.88	0.03	0.90	-0.11	0.05	0.04	0.11	0.01
05/16/95	10:43:02	68.00	8.92	0.04	0.88	-0.09	0.09	0.03	0.10	0.02
05/16/95	10:44:02	69.00	8.92	0.03	0.88	-0.06	0.11	0.03	0.09	0.01
05/16/95	10:45:02	70.00	8.92	0.03	0.88	-0.09	0.11	0.03	0.11	0.02
05/16/95	10:46:02	71.00	8.92	0.04	0.89	-0.10	0.09	0.03	0.11	0.02
05/16/95	10:47:02	72.00	8.92	0.03	0.88	-0.11	0.08	0.03	0.11	0.01
05/16/95	10:48:02	73.00	8.95	0.04	0.89	-0.11	0.10	0.03	0.11	0.01
05/16/95	10:49:02	74.00	8.92	0.04	0.89	-0.11	0.10	0.03	0.11	0.01
05/16/95	10:50:02	75.00	8.95	0.04	0.89	-0.10	0.08	0.03	0.10	0.01
05/16/95	10:51:02	76.00	8.92	0.04	0.88	-0.09	0.07	0.03	0.10	0.00
05/16/95	10:52:02	77.00	8.92	0.03	0.90	-0.12	0.08	0.03	0.11	0.01
05/16/95	10:53:02	78.00	8.95	0.04	0.89	-0.12	0.10	0.03	0.09	0.01
05/16/95	10:54:02	79.00	8.92	0.04	0.89	-0.09	0.10	0.03	0.11	0.01
05/16/95	10:55:02	80.00	8.92	0.04	0.89	-0.11	0.09	0.04	0.12	0.01
05/16/95	10:56:02	81.00	8.92	0.04	0.89	-0.15	0.05	0.03	0.10	0.01
05/16/95	10:57:02	82.00	8.92	0.04	0.90	-0.16	0.02	0.03	0.11	0.01
05/16/95	10:58:02	83.00	8.95	0.05	0.90	-0.16	0.03	0.04	0.11	0.01
05/16/95	10:59:02	84.00	8.95	0.04	0.90	-0.15	0.04	0.04	0.11	0.01
05/16/95	11:00:02	85.00	8.99	0.04	0.89	-0.15	0.03	0.03	0.11	0.00
05/16/95	11:01:02	86.00	8.99	0.04	0.90	-0.14	0.07	0.03	0.11	0.02
05/16/95	11:02:02	87.00	8.95	0.04	0.90	-0.13	0.07	0.04	0.11	0.01
05/16/95	11:03:02	88.00	8.99	0.04	0.90	-0.09	0.10	0.03	0.11	0.01
05/16/95	11:04:02	89.00	8.99	0.04	0.89	-0.10	0.13	0.03	0.11	0.02
05/16/95	11:05:02	90.00	8.95	0.04	0.90	-0.10	0.12	0.03	0.10	0.01
05/16/95	11:06:02	91.00	8.99	0.04	0.89	-0.11	0.11	0.03	0.11	0.01
05/16/95	11:07:02	92.00	8.99	0.04	0.89	-0.11	0.11	0.03	0.12	0.02
05/16/95	11:08:02	93.00	8.99	0.05	0.90	-0.12	0.07	0.03	0.13	0.02
05/16/95	11:09:02	94.00	9.02	0.05	0.89	-0.14	0.05	0.04	0.11	0.00
05/16/95	11:10:02	95.00	9.02	0.05	0.90	-0.15	0.04	0.04	0.11	0.00
05/16/95	11:11:02	96.00	9.02	0.05	0.90	-0.15	0.02	0.04	0.11	0.01
05/16/95	11:12:02	97.00	8.95	0.05	0.90	-0.15	0.00	0.04	0.11	0.01
05/16/95	11:13:02	98.00	9.02	0.05	0.90	-0.15	-0.01	0.04	0.12	0.01
05/16/95	11:14:02	99.00	8.99	0.04	0.90	-0.15	0.01	0.04	0.11	0.01
05/16/95	11:15:02	100.00	9.02	0.04	0.90	-0.16	0.00	0.03	0.11	0.01
05/16/95	11:25:02	110.00	9.10	0.04	0.90	-0.13	0.02	0.04	0.12	-0.01
05/16/95	11:35:02	120.00	9.06	0.03	0.90	-0.30	-0.13	0.05	0.12	-0.03
05/16/95	11:45:02	130.00	9.13	0.03	0.91	-0.28	-0.04	0.04	0.11	-0.02
05/16/95	11:55:02	140.00	9.13	0.04	0.91	-0.34	-0.14	0.04	0.13	-0.04
05/16/95	12:05:02	150.00	9.13	0.03	0.91	-0.32	-0.15	0.04	0.13	-0.03
05/16/95	12:15:02	160.00	9.17	0.03	0.91	-0.35	-0.13	0.04	0.13	-0.08
05/16/95	12:25:02	170.00	9.20	0.02	0.93	-0.39	-0.16	0.05	0.13	-0.05
05/16/95	12:35:02	180.00	9.17	0.02	0.91	-0.39	-0.22	0.05	0.13	-0.04
05/16/95	12:45:02	190.00	9.20	0.03	0.93	-0.40	-0.29	0.05	0.14	-0.01

ITT SEALECTRO
AQUIFER PERFORMANCE TEST
MAMARONECK, NEW YORK

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
				DRAW-DOWN						
05/16/95	12:55:02	200.00	9.24	0.04	0.93	-0.35	-0.29	0.06	0.14	0.00
05/16/95	13:05:02	210.00	9.24	0.03	0.92	-0.36	-0.39	0.04	0.14	-0.03
05/16/95	13:15:02	220.00	9.28	0.05	0.93	-0.28	-0.36	0.04	0.13	0.00
05/16/95	13:25:02	230.00	9.31	0.04	0.94	-0.30	-0.39	0.06	0.14	0.01
05/16/95	13:35:02	240.00	9.28	0.04	0.94	-0.29	-0.41	0.06	0.15	-0.02
05/16/95	13:45:02	250.00	9.31	0.02	0.93	-0.44	-0.55	0.04	0.15	-0.09
05/16/95	13:55:02	260.00	9.38	0.01	0.93	-0.53	-0.65	0.04	0.16	-0.12
05/16/95	14:05:02	270.00	9.38	0.04	0.98	-0.42	-0.53	0.09	0.15	-0.08
05/16/95	14:15:02	280.00	9.38	0.03	0.94	-0.44	-0.53	0.06	0.15	-0.08
05/16/95	14:25:02	290.00	9.46	0.02	0.93	-0.44	-0.57	0.05	0.16	-0.07
05/16/95	14:35:02	300.00	9.46	0.05	0.95	-0.41	-0.56	0.09	0.16	0.00
05/16/95	14:45:02	310.00	9.46	0.05	0.95	-0.44	-0.62	0.06	0.16	-0.01
05/16/95	14:55:02	320.00	9.46	0.05	0.98	-0.37	-0.54	0.08	0.16	0.00
05/16/95	15:05:02	330.00	9.46	0.05	0.96	-0.37	-0.54	0.07	0.17	-0.02
05/16/95	15:15:02	340.00	9.49	0.04	0.96	-0.37	-0.54	0.05	0.17	-0.03
05/16/95	15:25:02	350.00	9.57	0.04	0.99	-0.37	-0.55	0.07	0.16	-0.02
05/16/95	15:35:02	360.00	9.60	0.05	0.98	-0.36	-0.52	0.06	0.18	-0.03
05/16/95	15:45:02	370.00	9.53	0.04	0.96	-0.36	-0.51	0.06	0.18	-0.04
05/16/95	15:55:02	380.00	9.53	0.04	0.98	-0.39	-0.57	0.06	0.18	-0.04
05/16/95	16:05:02	390.00	9.57	0.04	0.98	-0.39	-0.55	0.06	0.18	-0.02
05/16/95	16:15:02	400.00	9.64	0.05	0.99	-0.40	-0.59	0.07	0.18	0.01
05/16/95	16:25:02	410.00	9.57	0.06	1.00	-0.35	-0.52	0.08	0.20	0.01
05/16/95	16:35:02	420.00	9.57	0.07	1.00	-0.38	-0.60	0.07	0.20	0.01
05/16/95	16:45:02	430.00	9.64	0.07	1.00	-0.39	-0.60	0.07	0.20	0.02
05/16/95	16:55:02	440.00	9.64	0.08	1.00	-0.40	-0.61	0.08	0.20	0.02
05/16/95	17:05:02	450.00	9.64	0.08	1.02	-0.37	-0.57	0.08	0.21	0.03
05/16/95	17:15:02	460.00	9.67	0.08	1.02	-0.34	-0.54	0.09	0.20	0.03
05/16/95	17:25:02	470.00	9.67	0.08	1.02	-0.34	-0.54	0.08	0.20	0.03
05/16/95	17:35:02	480.00	9.71	0.08	1.02	-0.32	-0.51	0.09	0.21	0.03
05/16/95	17:45:02	490.00	9.71	0.09	1.02	-0.31	-0.51	0.09	0.21	0.03
05/16/95	17:55:02	500.00	9.75	0.08	1.02	-0.30	-0.50	0.09	0.21	0.03
05/16/95	18:05:02	510.00	9.75	0.09	1.02	-0.34	-0.52	0.10	0.22	0.03
05/16/95	18:15:02	520.00	9.71	0.09	1.03	-0.32	-0.50	0.10	0.22	0.03
05/16/95	18:25:02	530.00	9.71	0.09	1.03	-0.30	-0.47	0.10	0.22	0.04
05/16/95	18:35:02	540.00	9.75	0.09	1.03	-0.28	-0.43	0.10	0.21	0.03
05/16/95	18:45:02	550.00	9.78	0.09	1.04	-0.29	-0.45	0.10	0.22	0.02
05/16/95	18:55:02	560.00	9.82	0.09	1.03	-0.31	-0.47	0.10	0.22	0.02
05/16/95	19:05:02	570.00	9.78	0.10	1.05	-0.30	-0.48	0.10	0.22	0.03
05/16/95	19:15:02	580.00	9.78	0.10	1.05	-0.34	-0.49	0.10	0.23	0.03
05/16/95	19:25:02	590.00	9.82	0.10	1.04	-0.34	-0.50	0.11	0.23	0.03
05/16/95	19:35:02	600.00	9.82	0.10	1.05	-0.32	-0.49	0.10	0.23	0.03
05/16/95	19:45:02	610.00	9.85	0.10	1.05	-0.32	-0.51	0.11	0.23	0.02
05/16/95	19:55:02	620.00	9.85	0.10	1.06	-0.34	-0.52	0.11	0.23	0.02
05/16/95	20:05:02	630.00	9.82	0.10	1.07	-0.34	-0.52	0.11	0.23	0.03
05/16/95	20:15:02	640.00	9.85	0.10	1.06	-0.35	-0.53	0.11	0.24	0.03
05/16/95	20:25:02	650.00	9.82	0.11	1.06	-0.36	-0.54	0.12	0.24	0.03
05/16/95	20:35:02	660.00	9.85	0.11	1.06	-0.35	-0.54	0.12	0.24	0.03

DRAW-DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/16/95	20:45:02	670.00	9.85	0.11	1.07	-0.35	-0.54	0.12	0.24	0.03
05/16/95	20:55:02	680.00	9.85	0.11	1.07	-0.34	-0.52	0.12	0.24	0.03
05/16/95	21:05:02	690.00	9.89	0.11	1.07	-0.31	-0.49	0.13	0.24	0.03
05/16/95	21:15:02	700.00	9.85	0.11	1.08	-0.28	-0.47	0.12	0.24	0.02
05/16/95	21:25:02	710.00	9.89	0.11	1.08	-0.30	-0.45	0.13	0.25	0.02
05/16/95	21:35:02	720.00	9.89	0.11	1.09	-0.31	-0.47	0.13	0.25	0.01
05/16/95	21:45:02	730.00	9.93	0.12	1.08	-0.31	-0.47	0.14	0.26	0.01
05/16/95	21:55:02	740.00	9.89	0.12	1.08	-0.31	-0.47	0.14	0.25	0.01
05/16/95	22:05:02	750.00	9.93	0.11	1.09	-0.31	-0.47	0.13	0.26	0.02
05/16/95	22:15:02	760.00	9.96	0.12	1.09	-0.32	-0.48	0.14	0.25	0.02
05/16/95	22:25:02	770.00	10.00	0.11	1.09	-0.31	-0.47	0.14	0.26	0.03
05/16/95	22:35:02	780.00	9.96	0.12	1.09	-0.34	-0.48	0.14	0.25	0.03
05/16/95	22:45:02	790.00	9.96	0.12	1.11	-0.31	-0.48	0.15	0.25	0.02
05/16/95	22:55:02	800.00	10.00	0.12	1.12	-0.31	-0.47	0.15	0.25	0.02
05/16/95	23:05:02	810.00	9.96	0.12	1.12	-0.30	-0.47	0.14	0.25	0.03
05/16/95	23:15:02	820.00	9.96	0.11	1.11	-0.29	-0.44	0.15	0.25	0.02
05/16/95	23:25:02	830.00	10.00	0.12	1.11	-0.30	-0.44	0.15	0.25	0.02
05/16/95	23:35:02	840.00	9.96	0.12	1.11	-0.31	-0.47	0.15	0.26	0.02
05/16/95	23:45:02	850.00	10.00	0.12	1.12	-0.31	-0.45	0.15	0.25	0.03
05/16/95	23:55:02	860.00	10.03	0.12	1.12	-0.30	-0.43	0.15	0.25	0.02
05/17/95	00:05:02	870.00	10.00	0.11	1.12	-0.29	-0.43	0.14	0.25	0.02
05/17/95	00:15:02	880.00	10.00	0.12	1.12	-0.30	-0.43	0.15	0.25	0.02
05/17/95	00:25:02	890.00	10.03	0.12	1.12	-0.30	-0.43	0.15	0.27	0.03
05/17/95	00:35:02	900.00	10.03	0.12	1.13	-0.31	-0.44	0.15	0.27	0.02
05/17/95	00:45:02	910.00	10.07	0.12	1.13	-0.30	-0.43	0.16	0.27	0.02
05/17/95	00:55:02	920.00	10.03	0.12	1.13	-0.31	-0.45	0.16	0.28	0.02
05/17/95	01:05:02	930.00	10.07	0.13	1.13	-0.32	-0.45	0.17	0.27	0.03
05/17/95	01:15:02	940.00	10.07	0.13	1.14	-0.32	-0.45	0.17	0.27	0.01
05/17/95	01:25:02	950.00	10.11	0.13	1.14	-0.31	-0.44	0.17	0.27	0.02
05/17/95	01:35:02	960.00	10.11	0.13	1.15	-0.31	-0.44	0.17	0.27	0.02
05/17/95	01:45:02	970.00	10.11	0.13	1.16	-0.29	-0.43	0.17	0.27	0.02
05/17/95	01:55:02	980.00	10.11	0.13	1.15	-0.29	-0.40	0.17	0.28	0.03
05/17/95	02:05:02	990.00	10.14	0.13	1.15	-0.29	-0.41	0.17	0.27	0.02
05/17/95	02:15:02	1000.00	10.11	0.13	1.16	-0.29	-0.41	0.17	0.28	0.02
05/17/95	02:25:02	1010.00	10.11	0.13	1.16	-0.29	-0.42	0.17	0.28	0.03
05/17/95	02:35:02	1020.00	10.11	0.13	1.16	-0.31	-0.43	0.17	0.28	0.02
05/17/95	02:45:02	1030.00	10.11	0.13	1.16	-0.31	-0.44	0.17	0.28	0.02
05/17/95	02:55:02	1040.00	10.14	0.13	1.17	-0.31	-0.43	0.17	0.27	0.02
05/17/95	03:05:02	1050.00	10.14	0.13	1.18	-0.29	-0.42	0.18	0.27	0.02
05/17/95	03:15:02	1060.00	10.14	0.13	1.16	-0.29	-0.42	0.17	0.28	0.03
05/17/95	03:25:02	1070.00	10.18	0.13	1.17	-0.29	-0.42	0.18	0.28	0.02
05/17/95	03:35:02	1080.00	10.18	0.13	1.17	-0.27	-0.40	0.17	0.27	0.02
05/17/95	03:45:02	1090.00	10.11	0.13	1.17	-0.28	-0.39	0.18	0.28	0.02
05/17/95	03:55:02	1100.00	10.21	0.13	1.17	-0.26	-0.37	0.17	0.27	0.02
05/17/95	04:05:02	1110.00	10.18	0.13	1.16	-0.26	-0.38	0.17	0.28	0.02
05/17/95	04:15:02	1120.00	10.18	0.13	1.17	-0.28	-0.38	0.18	0.27	0.02
05/17/95	04:25:02	1130.00	10.18	0.14	1.17	-0.28	-0.39	0.19	0.29	0.02

ITT SEALECTRO
AQUIFER PERFORMANCE TEST
MAMARONECK, NEW YORK

DRAW-DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/17/95	04:35:02	1140.00	10.21	0.14	1.18	-0.29	-0.39	0.18	0.29	0.02
05/17/95	04:45:02	1150.00	10.21	0.14	1.18	-0.28	-0.39	0.19	0.29	0.03
05/17/95	04:55:02	1160.00	10.21	0.13	1.19	-0.27	-0.38	0.19	0.29	0.02
05/17/95	05:05:02	1170.00	10.21	0.14	1.19	-0.27	-0.38	0.19	0.29	0.02
05/17/95	05:15:02	1180.00	10.25	0.14	1.18	-0.29	-0.37	0.19	0.30	0.02
05/17/95	05:25:02	1190.00	10.25	0.14	1.19	-0.28	-0.38	0.19	0.30	0.02
05/17/95	05:35:02	1200.00	10.29	0.14	1.20	-0.29	-0.37	0.20	0.30	0.02
05/17/95	05:45:02	1210.00	10.29	0.14	1.20	-0.27	-0.35	0.20	0.30	0.02
05/17/95	05:55:02	1220.00	10.29	0.14	1.21	-0.26	-0.34	0.19	0.30	0.02
05/17/95	06:05:02	1230.00	10.32	0.14	1.21	-0.27	-0.35	0.20	0.29	0.02
05/17/95	06:15:02	1240.00	10.32	0.14	1.20	-0.26	-0.34	0.20	0.30	0.02
05/17/95	06:25:02	1250.00	10.29	0.14	1.21	-0.26	-0.32	0.20	0.30	0.02
05/17/95	06:35:02	1260.00	10.25	0.14	1.21	-0.24	-0.32	0.20	0.29	0.03
05/17/95	06:45:02	1270.00	10.32	0.14	1.20	-0.22	-0.30	0.20	0.29	0.02
05/17/95	06:55:02	1280.00	10.29	0.14	1.21	-0.23	-0.29	0.20	0.30	0.03
05/17/95	07:05:02	1290.00	10.29	0.14	1.21	-0.22	-0.27	0.21	0.30	0.03
05/17/95	07:15:02	1300.00	10.32	0.15	1.22	-0.25	-0.30	0.21	0.29	0.02
05/17/95	07:25:02	1310.00	10.36	0.15	1.21	-0.25	-0.31	0.21	0.31	0.02
05/17/95	07:35:02	1320.00	10.36	0.14	1.22	-0.27	-0.32	0.21	0.29	0.02
05/17/95	07:45:02	1330.00	10.36	0.14	1.22	-0.25	-0.32	0.21	0.31	0.01
05/17/95	07:55:02	1340.00	10.36	0.15	1.22	-0.23	-0.29	0.21	0.30	0.02
05/17/95	08:05:02	1350.00	10.32	0.15	1.22	-0.24	-0.27	0.21	0.31	0.02
05/17/95	08:15:02	1360.00	10.32	0.14	1.23	-0.23	-0.27	0.21	0.29	0.02
05/17/95	08:25:02	1370.00	10.36	0.14	1.23	-0.23	-0.27	0.21	0.30	0.01
05/17/95	08:35:02	1380.00	10.36	0.15	1.22	-0.25	-0.28	0.21	0.30	0.02
05/17/95	08:45:02	1390.00	10.40	0.15	1.23	-0.24	-0.27	0.21	0.31	0.03
05/17/95	08:55:02	1400.00	10.40	0.14	1.25	-0.23	-0.26	0.22	0.30	0.02
05/17/95	09:05:02	1410.00	10.36	0.14	1.23	-0.23	-0.25	0.22	0.30	0.02
05/17/95	09:15:02	1420.00	10.40	0.14	1.23	-0.19	-0.23	0.21	0.31	0.02
05/17/95	09:35:02	1440.00	10.43	0.15	1.25	-0.22	-0.24	0.21	0.30	0.02
05/17/95	10:05:02	1470.00	10.43	0.14	1.25	-0.15	-0.15	0.22	0.30	0.03
05/17/95	10:35:02	1500.00	10.43	0.14	1.25	-0.17	-0.14	0.21	0.30	0.01
05/17/95	11:05:02	1530.00	10.43	0.14	1.25	-0.21	-0.18	0.21	0.31	-0.02
05/17/95	11:35:02	1560.00	10.50	0.13	1.26	-0.26	-0.22	0.22	0.31	-0.05
05/17/95	12:05:02	1590.00	10.47	0.13	1.26	-0.27	-0.24	0.22	0.31	-0.01
05/17/95	12:35:02	1620.00	10.47	0.14	1.27	-0.27	-0.27	0.22	0.31	0.00
05/17/95	13:05:02	1650.00	10.43	0.13	1.27	-0.23	-0.22	0.23	0.31	-0.04
05/17/95	13:35:02	1680.00	10.50	0.13	1.26	-0.23	-0.21	0.22	0.31	0.00

DRAW - DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/17/95	14:05:02	1710.00	10.54	0.13	1.26	-0.25	-0.22	0.22	0.30	0.00
05/17/95	14:35:02	1740.00	10.54	0.13	1.27	-0.27	-0.26	0.22	0.30	-0.01
05/17/95	15:05:02	1770.00	10.58	0.13	1.28	-0.26	-0.25	0.22	0.30	-0.01
05/17/95	15:35:02	1800.00	10.54	0.13	1.28	-0.27	-0.26	0.22	0.31	-0.01
05/17/95	16:05:02	1830.00	10.54	0.13	1.28	-0.29	-0.30	0.23	0.30	-0.02
05/17/95	16:35:02	1860.00	10.54	0.11	1.27	-0.29	-0.27	0.22	0.31	-0.10
05/17/95	17:05:02	1890.00	10.54	0.07	1.28	-0.35	-0.29	0.23	0.31	-0.20
05/17/95	17:35:02	1920.00	10.54	0.03	1.26	-0.38	-0.30	0.22	0.31	-0.26
05/17/95	18:05:02	1950.00	10.54	-0.01	1.26	-0.46	-0.29	0.22	0.29	-0.33
05/17/95	18:35:02	1980.00	10.61	-0.04	1.25	-0.53	-0.27	0.22	0.30	-0.31
05/17/95	19:05:02	2010.00	10.54	-0.04	1.23	-0.60	-0.30	0.22	0.30	-0.30
05/17/95	19:35:02	2040.00	10.61	-0.03	1.26	-0.62	-0.31	0.23	0.31	-0.26
05/17/95	20:05:02	2070.00	10.61	-0.01	1.26	-0.62	-0.34	0.23	0.31	-0.21
05/17/95	20:35:02	2100.00	10.58	0.01	1.27	-0.61	-0.34	0.24	0.31	-0.17
05/17/95	21:05:02	2130.00	10.65	0.02	1.28	-0.60	-0.35	0.24	0.31	-0.17
05/17/95	21:35:02	2160.00	10.58	0.04	1.28	-0.61	-0.38	0.24	0.31	-0.15
05/17/95	22:05:02	2190.00	10.61	0.04	1.29	-0.56	-0.36	0.25	0.33	-0.15
05/17/95	22:35:02	2220.00	10.65	0.05	1.29	-0.57	-0.38	0.25	0.33	-0.15
05/17/95	23:05:02	2250.00	10.65	0.05	1.30	-0.57	-0.39	0.25	0.33	-0.16
05/17/95	23:35:02	2280.00	10.68	0.05	1.31	-0.55	-0.39	0.25	0.33	-0.16
05/18/95	00:05:02	2310.00	10.65	0.05	1.32	-0.53	-0.35	0.24	0.31	-0.16
05/18/95	00:35:02	2340.00	10.72	0.05	1.32	-0.54	-0.37	0.26	0.33	-0.17
05/18/95	01:05:02	2370.00	10.68	0.05	1.33	-0.55	-0.36	0.26	0.33	-0.15
05/18/95	01:35:02	2400.00	10.76	0.05	1.33	-0.53	-0.36	0.26	0.33	-0.15
05/18/95	02:05:02	2430.00	10.76	0.06	1.34	-0.51	-0.36	0.25	0.33	-0.15
05/18/95	02:35:02	2460.00	10.72	0.06	1.34	-0.50	-0.34	0.26	0.31	-0.15
05/18/95	03:05:02	2490.00	10.76	0.07	1.35	-0.48	-0.32	0.26	0.34	-0.14
05/18/95	03:35:02	2520.00	10.79	0.07	1.35	-0.48	-0.30	0.26	0.34	-0.12
05/18/95	04:05:02	2550.00	10.79	0.07	1.36	-0.47	-0.30	0.26	0.34	-0.12
05/18/95	04:35:02	2580.00	10.79	0.08	1.36	-0.48	-0.30	0.26	0.34	-0.14
05/18/95	05:05:02	2610.00	10.72	0.08	1.36	-0.47	-0.30	0.26	0.34	-0.11
05/18/95	05:35:02	2640.00	10.79	0.09	1.38	-0.46	-0.30	0.26	0.34	-0.10
05/18/95	06:05:02	2670.00	10.79	0.09	1.40	-0.46	-0.30	0.26	0.34	-0.09
05/18/95	06:35:02	2700.00	10.86	0.10	1.40	-0.43	-0.29	0.27	0.36	-0.09
05/18/95	07:05:02	2730.00	10.90	0.11	1.42	-0.42	-0.28	0.27	0.36	-0.09
05/18/95	07:35:02	2760.00	10.90	0.11	1.41	-0.39	-0.24	0.28	0.35	-0.07
05/18/95	08:05:02	2790.00	10.90	0.12	1.43	-0.40	-0.26	0.28	0.36	-0.05
05/18/95	08:35:02	2820.00	10.90	0.12	1.44	-0.40	-0.24	0.28	0.36	-0.05
05/18/95	09:05:02	2850.00	10.94	0.12	1.44	-0.31	-0.16	0.27	0.35	-0.04
05/18/95	09:35:02	2880.00	10.94	0.13	1.44	-0.23	0.00	0.28	0.35	-0.04
05/18/95	10:05:02	2910.00	10.94	0.13	1.44	-0.12	0.22	0.28	0.36	-0.04
05/18/95	11:05:02	2970.00	10.94	0.09	1.44	-0.47	-0.20	0.29	0.36	-0.14
05/18/95	11:35:02	3000.00	10.90	0.10	1.45	-0.43	-0.22	0.29	0.36	-0.09
05/18/95	12:05:02	3030.00	10.97	0.12	1.46	-0.37	-0.21	0.29	0.36	-0.04
05/18/95	12:35:02	3060.00	10.97	0.14	1.47	-0.40	-0.26	0.29	0.36	-0.02
05/18/95	13:05:02	3090.00	10.97	0.14	1.48	-0.31	-0.17	0.29	0.36	-0.01

ITT SEALECTRO
AQUIFER PERFORMANCE TEST
MAMARONECK, NEW YORK

DRAW- DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/18/95	13:35:02	3120.00	11.01	0.14	1.48	-0.37	-0.22	0.27	0.36	-0.02
05/18/95	14:05:02	3150.00	11.01	0.14	1.47	-0.28	-0.15	0.27	0.35	-0.02
05/18/95	14:35:02	3180.00	11.04	0.16	1.50	-0.42	-0.30	0.29	0.38	-0.01
05/18/95	15:05:02	3210.00	11.04	0.17	1.52	-0.40	-0.35	0.29	0.37	0.01
05/18/95	15:35:02	3240.00	11.08	0.16	1.53	-0.40	-0.35	0.29	0.37	0.01
05/18/95	16:05:02	3270.00	11.12	0.17	1.41	-0.43	-0.42	0.28	0.37	0.01
05/18/95	16:35:02	3300.00	11.04	0.17	1.53	-0.42	-0.43	0.31	0.38	0.01
[illegible]ery starts * 05/18/95	17:00:00	3324.96	11.15	0.18	1.55	-0.40	-0.43	0.31	0.39	0.02
05/18/95	17:00:15	3325.21	11.12	0.18	1.54	-0.40	-0.43	0.30	0.39	0.02
05/18/95	17:00:30	3325.47	10.07	0.18	1.50	-0.41	-0.43	0.31	0.38	0.01
05/18/95	17:00:45	3325.72	8.45	0.17	1.50	-0.41	-0.44	0.31	0.39	0.01
05/18/95	17:01:00	3325.97	7.00	0.18	1.52	-0.40	-0.45	0.31	0.39	0.02
05/18/95	17:01:15	3326.22	5.88	0.18	1.53	-0.41	-0.43	0.31	0.39	0.01
05/18/95	17:01:30	3326.47	4.95	0.18	1.52	-0.40	-0.43	0.31	0.39	0.01
05/18/95	17:01:45	3326.72	4.19	0.18	1.51	-0.40	-0.43	0.31	0.39	0.01
05/18/95	17:02:00	3326.97	3.54	0.18	1.48	-0.40	-0.43	0.31	0.39	0.02
05/18/95	17:02:15	3327.22	3.07	0.18	1.46	-0.40	-0.43	0.31	0.39	0.02
05/18/95	17:02:30	3327.47	2.64	0.18	1.45	-0.40	-0.43	0.31	0.39	0.02
05/18/95	17:02:45	3327.72	2.31	0.18	1.45	-0.40	-0.43	0.31	0.38	0.02
05/18/95	17:03:00	3327.97	1.95	0.19	1.43	-0.40	-0.43	0.31	0.38	0.01
05/18/95	17:03:15	3328.22	1.73	0.19	1.41	-0.40	-0.43	0.31	0.38	0.02
05/18/95	17:03:30	3328.46	1.59	0.19	1.39	-0.40	-0.44	0.31	0.38	0.02
05/18/95	17:03:45	3328.72	1.41	0.19	1.39	-0.40	-0.43	0.31	0.39	0.02
05/18/95	17:04:00	3328.97	1.23	0.19	1.36	-0.40	-0.44	0.31	0.39	0.02
05/18/95	17:04:15	3329.21	1.12	0.19	1.33	-0.40	-0.43	0.31	0.40	0.02
05/18/95	17:04:30	3329.46	1.01	0.18	1.33	-0.40	-0.43	0.31	0.39	0.01
05/18/95	17:04:45	3329.71	0.94	0.19	1.32	-0.40	-0.43	0.31	0.38	0.01
05/18/95	17:05:00	3329.97	0.87	0.19	1.30	-0.39	-0.44	0.31	0.38	0.01
05/18/95	17:05:15	3330.22	0.83	0.18	1.27	-0.40	-0.44	0.31	0.38	0.02
05/18/95	17:05:30	3330.47	0.76	0.16	1.27	-0.40	-0.43	0.31	0.38	0.02
05/18/95	17:05:45	3330.71	0.72	0.19	1.26	-0.40	-0.45	0.31	0.38	0.01
05/18/95	17:06:00	3330.96	0.65	0.19	1.23	-0.40	-0.43	0.31	0.37	0.02
05/18/95	17:06:15	3331.22	0.65	0.19	1.20	-0.40	-0.44	0.31	0.38	0.02
05/18/95	17:06:30	3331.47	0.61	0.19	1.21	-0.40	-0.45	0.30	0.38	0.01
05/18/95	17:06:45	3331.72	0.58	0.18	1.19	-0.40	-0.44	0.30	0.38	0.02
05/18/95	17:07:00	3331.97	0.54	0.19	1.16	-0.40	-0.44	0.30	0.38	0.02
05/18/95	17:07:15	3332.22	0.54	0.19	1.16	-0.40	-0.45	0.30	0.37	0.01
05/18/95	17:07:30	3332.47	0.51	0.19	1.14	-0.40	-0.45	0.30	0.37	0.02
05/18/95	17:07:45	3332.72	0.51	0.18	1.12	-0.39	-0.45	0.31	0.37	0.01
05/18/95	17:08:00	3332.97	0.51	0.19	1.12	-0.39	-0.45	0.31	0.37	0.02
05/18/95	17:08:15	3333.21	0.51	0.19	1.11	-0.39	-0.45	0.31	0.37	0.01
05/18/95	17:08:30	3333.47	0.51	0.19	1.07	-0.40	-0.45	0.31	0.37	0.01
05/18/95	17:08:45	3333.72	0.47	0.19	1.08	-0.40	-0.47	0.31	0.37	0.02
05/18/95	17:09:00	3333.97	0.47	0.19	1.06	-0.40	-0.45	0.31	0.37	0.01
05/18/95	17:09:15	3334.21	0.43	0.18	1.06	-0.39	-0.47	0.31	0.37	0.02
05/18/95	17:09:30	3334.47	0.43	0.19	1.05	-0.39	-0.45	0.31	0.37	0.01
05/18/95	17:09:45	3334.72	0.40	0.19	1.04	-0.40	-0.45	0.31	0.37	0.02

ITT SEALECTRO
AQUIFER PERFORMANCE TEST
MAMARONECK, NEW YORK

DRAW - DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/18/95	17:10:00	3334.97	0.40	0.18	1.03	-0.39	-0.45	0.31	0.37	0.02
05/18/95	17:11:00	3335.96	0.40	0.19	0.96	-0.39	-0.47	0.31	0.37	0.01
05/18/95	17:12:00	3336.97	0.40	0.18	0.94	-0.39	-0.47	0.31	0.36	0.01
05/18/95	17:13:00	3337.97	0.36	0.18	0.92	-0.39	-0.47	0.31	0.36	0.01
05/18/95	17:14:00	3338.96	0.33	0.19	0.89	-0.38	-0.48	0.31	0.37	0.01
05/18/95	17:15:00	3339.96	0.33	0.18	0.87	-0.39	-0.48	0.31	0.36	0.02
05/18/95	17:16:00	3340.97	0.33	0.18	0.87	-0.39	-0.49	0.31	0.36	0.01
05/18/95	17:17:00	3341.96	0.29	0.19	0.84	-0.40	-0.50	0.31	0.35	0.01
05/18/95	17:18:00	3342.97	0.33	0.18	0.81	-0.40	-0.50	0.31	0.35	0.01
05/18/95	17:19:00	3343.96	0.33	0.18	0.80	-0.40	-0.51	0.31	0.34	0.01
05/18/95	17:20:00	3344.97	0.25	0.18	0.80	-0.40	-0.51	0.31	0.35	0.01
05/18/95	17:21:00	3345.97	0.33	0.18	0.78	-0.40	-0.51	0.31	0.34	0.02
05/18/95	17:22:00	3346.97	0.29	0.18	0.77	-0.40	-0.51	0.31	0.34	0.02
05/18/95	17:23:00	3347.97	0.29	0.18	0.76	-0.39	-0.50	0.31	0.33	0.02
05/18/95	17:24:00	3348.97	0.29	0.18	0.75	-0.38	-0.50	0.31	0.33	0.01
05/18/95	17:25:00	3349.96	0.25	0.18	0.75	-0.39	-0.51	0.30	0.33	0.01
05/18/95	17:26:00	3350.97	0.25	0.18	0.75	-0.37	-0.50	0.31	0.33	0.02
05/18/95	17:27:00	3351.96	0.25	0.18	0.74	-0.37	-0.51	0.30	0.34	0.02
05/18/95	17:28:00	3352.96	0.25	0.17	0.74	-0.37	-0.51	0.30	0.33	0.02
05/18/95	17:29:00	3353.96	0.29	0.17	0.73	-0.37	-0.50	0.30	0.33	0.01
05/18/95	17:30:00	3354.97	0.25	0.17	0.73	-0.37	-0.49	0.30	0.31	0.01
05/18/95	17:31:00	3355.97	0.25	0.17	0.73	-0.37	-0.49	0.30	0.31	0.02
05/18/95	17:32:00	3356.97	0.22	0.17	0.71	-0.37	-0.49	0.30	0.31	0.02
05/18/95	17:33:00	3357.96	0.25	0.16	0.71	-0.36	-0.48	0.30	0.31	0.02
05/18/95	17:34:00	3358.97	0.25	0.17	0.70	-0.35	-0.47	0.30	0.31	0.02
05/18/95	17:35:00	3359.96	0.22	0.16	0.69	-0.34	-0.47	0.30	0.31	0.01
05/18/95	17:36:00	3360.97	0.29	0.16	0.69	-0.32	-0.45	0.30	0.30	0.02
05/18/95	17:37:00	3361.97	0.25	0.17	0.69	-0.32	-0.44	0.29	0.30	0.01
05/18/95	17:38:00	3362.96	0.22	0.16	0.68	-0.31	-0.44	0.29	0.30	0.02
05/18/95	17:39:00	3363.97	0.22	0.16	0.68	-0.31	-0.43	0.29	0.30	0.01
05/18/95	17:40:00	3364.97	0.22	0.16	0.68	-0.31	-0.43	0.29	0.30	0.02
05/18/95	17:41:00	3365.96	0.25	0.16	0.68	-0.28	-0.43	0.29	0.29	0.02
05/18/95	17:42:00	3366.96	0.25	0.16	0.68	-0.31	-0.43	0.29	0.29	0.02
05/18/95	17:43:00	3367.96	0.25	0.16	0.68	-0.31	-0.43	0.28	0.28	0.01
05/18/95	17:44:00	3368.97	0.22	0.16	0.67	-0.30	-0.43	0.29	0.28	0.01
05/18/95	17:45:00	3369.96	0.25	0.16	0.68	-0.30	-0.43	0.28	0.28	0.02
05/18/95	17:46:00	3370.97	0.22	0.15	0.68	-0.30	-0.42	0.29	0.28	0.01
05/18/95	17:47:00	3371.96	0.18	0.15	0.67	-0.30	-0.42	0.28	0.29	0.02
05/18/95	17:48:00	3372.97	0.22	0.15	0.66	-0.30	-0.43	0.28	0.28	0.02
05/18/95	17:49:00	3373.97	0.22	0.15	0.66	-0.30	-0.42	0.28	0.27	0.02
05/18/95	17:50:00	3374.97	0.18	0.14	0.67	-0.30	-0.41	0.28	0.27	0.01
05/18/95	17:51:00	3375.97	0.22	0.15	0.66	-0.28	-0.41	0.28	0.27	0.01
05/18/95	17:52:00	3376.96	0.18	0.14	0.66	-0.29	-0.40	0.28	0.27	0.01
05/18/95	17:53:00	3377.96	0.22	0.14	0.66	-0.28	-0.40	0.28	0.27	0.02
05/18/95	17:54:00	3378.97	0.18	0.14	0.66	-0.29	-0.41	0.27	0.27	0.02
05/18/95	17:55:00	3379.96	0.22	0.15	0.66	-0.28	-0.40	0.28	0.27	0.01
05/18/95	17:56:00	3380.97	0.18	0.14	0.66	-0.30	-0.41	0.28	0.27	0.01

DRAW - DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/18/95	17:57:00	3381.96	0.22	0.14	0.66	-0.29	-0.41	0.28	0.27	0.01
05/18/95	17:58:00	3382.97	0.22	0.14	0.66	-0.30	-0.41	0.28	0.27	0.02
05/18/95	17:59:00	3383.96	0.22	0.14	0.65	-0.30	-0.43	0.27	0.27	0.03
05/18/95	18:00:00	3384.97	0.18	0.14	0.65	-0.30	-0.43	0.27	0.27	0.02
05/18/95	18:01:00	3385.96	0.18	0.14	0.65	-0.30	-0.42	0.27	0.27	0.01
05/18/95	18:02:00	3386.97	0.22	0.14	0.64	-0.30	-0.41	0.28	0.27	0.02
05/18/95	18:03:00	3387.97	0.18	0.14	0.64	-0.31	-0.43	0.27	0.27	0.02
05/18/95	18:04:00	3388.97	0.18	0.14	0.65	-0.31	-0.43	0.27	0.27	0.01
05/18/95	18:05:00	3389.96	0.18	0.15	0.66	-0.31	-0.45	0.27	0.27	0.01
05/18/95	18:06:00	3390.96	0.14	0.14	0.65	-0.31	-0.45	0.28	0.27	0.01
05/18/95	18:07:00	3391.97	0.22	0.14	0.65	-0.32	-0.45	0.28	0.27	0.01
05/18/95	18:08:00	3392.96	0.22	0.14	0.64	-0.35	-0.47	0.27	0.27	0.01
05/18/95	18:09:00	3393.96	0.22	0.14	0.66	-0.34	-0.45	0.28	0.26	0.01
05/18/95	18:10:00	3394.97	0.22	0.14	0.66	-0.34	-0.47	0.27	0.27	0.02
05/18/95	18:11:00	3395.97	0.18	0.13	0.65	-0.35	-0.47	0.28	0.27	0.02
05/18/95	18:12:00	3396.97	0.22	0.14	0.64	-0.35	-0.48	0.28	0.27	0.01
05/18/95	18:13:00	3397.97	0.18	0.14	0.66	-0.35	-0.47	0.28	0.27	0.02
05/18/95	18:14:00	3398.97	0.18	0.14	0.64	-0.35	-0.47	0.28	0.26	0.02
05/18/95	18:15:00	3399.96	0.18	0.14	0.65	-0.36	-0.48	0.28	0.27	0.02
05/18/95	18:16:00	3400.97	0.18	0.14	0.65	-0.35	-0.48	0.28	0.27	0.02
05/18/95	18:17:00	3401.97	0.18	0.14	0.66	-0.35	-0.48	0.28	0.27	0.02
05/18/95	18:18:00	3402.96	0.18	0.14	0.65	-0.35	-0.47	0.28	0.26	0.02
05/18/95	18:19:00	3403.96	0.18	0.14	0.65	-0.35	-0.47	0.27	0.26	0.02
05/18/95	18:20:00	3404.97	0.18	0.14	0.64	-0.35	-0.45	0.27	0.25	0.02
05/18/95	18:21:00	3405.96	0.18	0.14	0.65	-0.35	-0.45	0.27	0.25	0.02
05/18/95	18:22:00	3406.96	0.18	0.14	0.65	-0.32	-0.47	0.27	0.25	0.02
05/18/95	18:23:00	3407.96	0.22	0.14	0.65	-0.32	-0.47	0.27	0.25	0.02
05/18/95	18:24:00	3408.97	0.18	0.13	0.65	-0.35	-0.47	0.27	0.26	0.02
05/18/95	18:25:00	3409.97	0.18	0.13	0.65	-0.35	-0.47	0.27	0.25	0.02
05/18/95	18:26:00	3410.97	0.22	0.13	0.65	-0.34	-0.47	0.27	0.25	0.02
05/18/95	18:27:00	3411.96	0.18	0.14	0.65	-0.34	-0.47	0.27	0.25	0.02
05/18/95	18:28:00	3412.97	0.18	0.14	0.65	-0.34	-0.47	0.27	0.25	0.02
05/18/95	18:29:00	3413.97	0.18	0.13	0.64	-0.34	-0.47	0.27	0.25	0.02
05/18/95	18:30:00	3414.97	0.18	0.13	0.63	-0.34	-0.47	0.27	0.24	0.03
05/18/95	18:31:00	3415.97	0.18	0.13	0.64	-0.34	-0.47	0.26	0.24	0.02
05/18/95	18:32:00	3416.97	0.18	0.13	0.64	-0.35	-0.47	0.27	0.25	0.02
05/18/95	18:33:00	3417.96	0.18	0.14	0.64	-0.35	-0.47	0.26	0.25	0.02
05/18/95	18:34:00	3418.97	0.18	0.13	0.64	-0.35	-0.48	0.26	0.24	0.02
05/18/95	18:35:00	3419.96	0.18	0.14	0.63	-0.35	-0.48	0.26	0.25	0.02
05/18/95	18:36:00	3420.96	0.14	0.13	0.64	-0.35	-0.48	0.26	0.26	0.02
05/18/95	18:37:00	3421.97	0.18	0.13	0.64	-0.34	-0.48	0.27	0.24	0.03
05/18/95	18:38:00	3422.97	0.18	0.13	0.64	-0.35	-0.47	0.26	0.25	0.02
05/18/95	18:39:00	3423.96	0.18	0.13	0.63	-0.35	-0.47	0.26	0.24	0.02
05/18/95	18:40:00	3424.97	0.18	0.13	0.64	-0.35	-0.47	0.26	0.24	0.02
05/18/95	18:50:00	3434.96	0.11	0.13	0.64	-0.36	-0.49	0.27	0.24	0.02
05/18/95	19:00:00	3444.97	0.14	0.13	0.63	-0.35	-0.48	0.26	0.23	0.02
05/18/95	19:10:00	3454.97	0.14	0.13	0.63	-0.36	-0.48	0.26	0.24	0.02

DRAW - DOWN

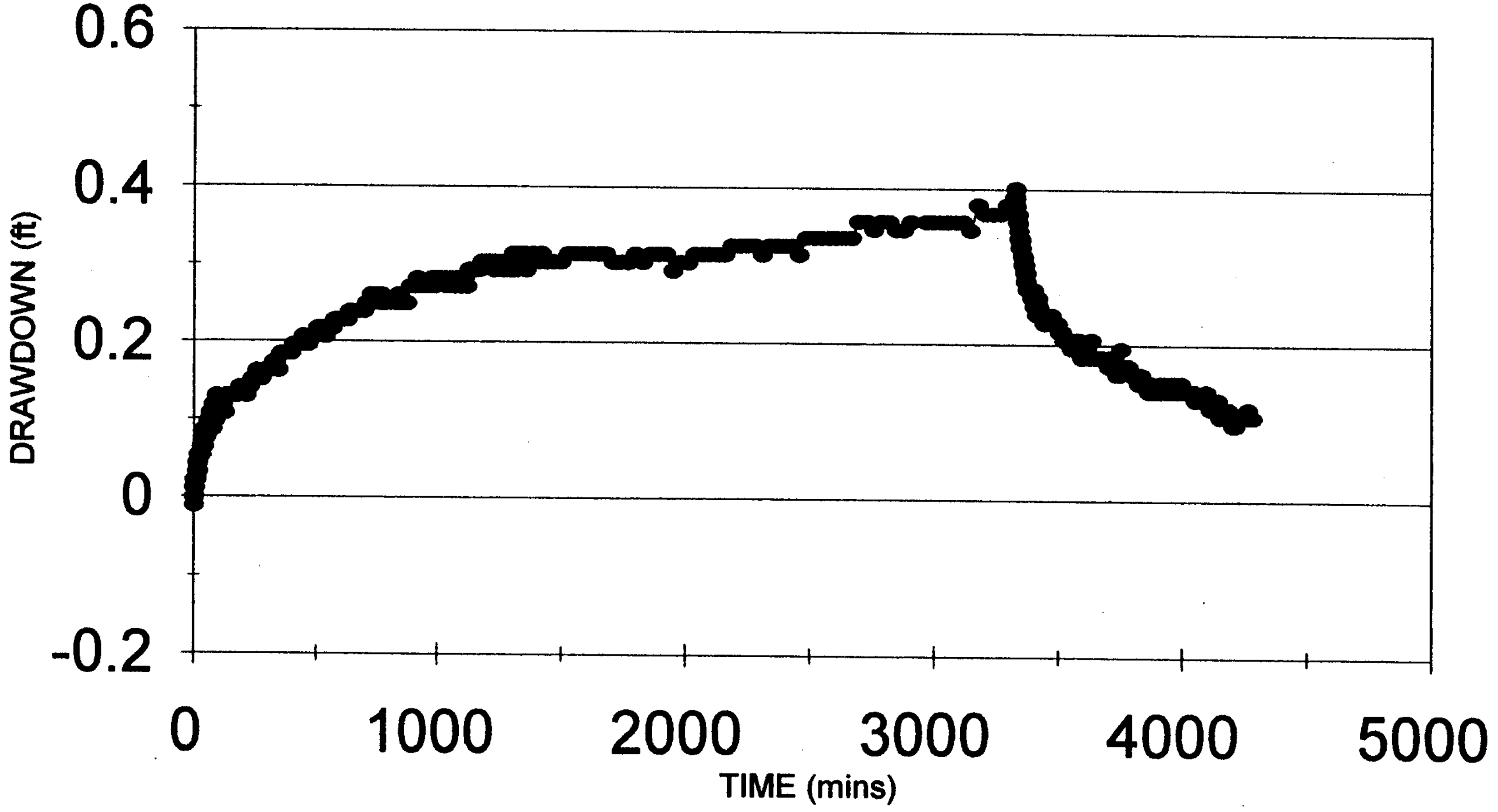
Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/18/95	19:20:00	3464.96	0.11	0.13	0.63	-0.36	-0.51	0.27	0.23	0.02
05/18/95	19:30:00	3474.97	0.14	0.12	0.63	-0.37	-0.51	0.27	0.24	0.02
05/18/95	19:40:00	3484.97	0.11	0.13	0.63	-0.36	-0.51	0.26	0.23	0.02
05/18/95	19:50:00	3494.96	0.14	0.13	0.63	-0.36	-0.52	0.26	0.23	0.02
05/18/95	20:00:00	3504.96	0.11	0.12	0.63	-0.37	-0.53	0.25	0.22	0.02
05/18/95	20:10:00	3514.97	0.11	0.12	0.63	-0.35	-0.51	0.25	0.22	0.03
05/18/95	20:20:00	3524.97	0.14	0.12	0.63	-0.35	-0.51	0.25	0.21	0.02
05/18/95	20:30:00	3534.97	0.11	0.12	0.63	-0.35	-0.51	0.25	0.21	0.02
05/18/95	20:40:00	3544.97	0.11	0.12	0.63	-0.34	-0.51	0.24	0.21	0.02
05/18/95	20:50:00	3554.96	0.11	0.12	0.62	-0.35	-0.51	0.24	0.20	0.02
05/18/95	21:00:00	3564.97	0.07	0.12	0.63	-0.35	-0.51	0.24	0.21	0.02
05/18/95	21:10:00	3574.96	0.11	0.12	0.62	-0.34	-0.49	0.24	0.20	0.02
05/18/95	21:20:00	3584.97	0.11	0.12	0.62	-0.35	-0.50	0.24	0.21	0.02
05/18/95	21:30:00	3594.96	0.11	0.12	0.61	-0.36	-0.52	0.23	0.18	0.02
05/18/95	21:40:00	3604.97	0.11	0.12	0.63	-0.35	-0.50	0.24	0.20	0.03
05/18/95	21:50:00	3614.97	0.11	0.12	0.63	-0.31	-0.49	0.24	0.20	0.02
05/18/95	22:00:00	3624.97	0.11	0.12	0.63	-0.31	-0.48	0.24	0.18	0.02
05/18/95	22:10:00	3634.97	0.11	0.13	0.63	-0.35	-0.52	0.25	0.21	0.02
05/18/95	22:20:00	3644.96	0.11	0.12	0.63	-0.37	-0.55	0.24	0.18	0.02
05/18/95	22:30:00	3654.97	0.11	0.12	0.63	-0.36	-0.55	0.23	0.18	0.02
05/18/95	22:40:00	3664.96	0.11	0.12	0.63	-0.36	-0.55	0.23	0.18	0.02
05/18/95	22:50:00	3674.96	0.11	0.12	0.63	-0.38	-0.57	0.22	0.18	0.02
05/18/95	23:00:00	3684.97	0.11	0.12	0.64	-0.37	-0.56	0.23	0.18	0.03
05/18/95	23:10:00	3694.97	0.07	0.12	0.63	-0.34	-0.54	0.23	0.18	0.02
05/18/95	23:20:00	3704.97	0.11	0.12	0.63	-0.34	-0.53	0.23	0.17	0.03
05/18/95	23:30:00	3714.97	0.11	0.12	0.64	-0.34	-0.52	0.23	0.18	0.03
05/18/95	23:40:00	3724.97	0.07	0.13	0.64	-0.32	-0.53	0.24	0.18	0.04
05/18/95	23:50:00	3734.96	0.11	0.12	0.64	-0.32	-0.51	0.22	0.16	0.03
05/19/95	00:00:00	3744.96	0.11	0.12	0.64	-0.31	-0.51	0.22	0.16	0.03
05/19/95	00:10:00	3754.96	0.07	0.13	0.64	-0.32	-0.51	0.23	0.20	0.03
05/19/95	00:20:00	3764.97	0.11	0.13	0.65	-0.34	-0.51	0.23	0.17	0.04
05/19/95	00:30:00	3774.96	0.07	0.12	0.64	-0.32	-0.50	0.23	0.17	0.03
05/19/95	00:40:00	3784.97	0.07	0.12	0.64	-0.31	-0.50	0.23	0.17	0.04
05/19/95	00:50:00	3794.97	0.07	0.12	0.64	-0.30	-0.50	0.22	0.16	0.04
05/19/95	01:00:00	3804.97	0.07	0.12	0.64	-0.31	-0.50	0.22	0.16	0.02
05/19/95	01:10:00	3814.97	0.07	0.12	0.64	-0.30	-0.49	0.22	0.16	0.04
05/19/95	01:20:00	3824.96	0.07	0.12	0.64	-0.30	-0.48	0.22	0.15	0.03
05/19/95	01:30:00	3834.97	0.11	0.12	0.65	-0.30	-0.48	0.22	0.16	0.03
05/19/95	01:40:00	3844.96	0.07	0.11	0.64	-0.29	-0.47	0.21	0.15	0.04
05/19/95	01:50:00	3854.96	0.11	0.11	0.66	-0.31	-0.49	0.21	0.15	0.04
05/19/95	02:00:00	3864.96	0.07	0.10	0.64	-0.30	-0.49	0.21	0.14	0.04
05/19/95	02:10:00	3874.97	0.04	0.11	0.64	-0.31	-0.50	0.21	0.15	0.04
05/19/95	02:20:00	3884.96	0.04	0.10	0.65	-0.30	-0.47	0.19	0.14	0.00
05/19/95	02:30:00	3894.97	0.04	0.09	0.65	-0.34	-0.49	0.20	0.14	-0.07
05/19/95	02:40:00	3904.97	0.07	0.08	0.64	-0.36	-0.48	0.20	0.14	-0.08
05/19/95	02:50:00	3914.96	0.07	0.08	0.64	-0.35	-0.49	0.21	0.15	-0.04
05/19/95	03:00:00	3924.97	0.07	0.07	0.63	-0.36	-0.49	0.20	0.15	-0.03

DRAW-DOWN

Date	Time	Elapse Time	TW-1 (ft.)	MW-2S (ft.)	MW-2D (ft.)	MW-3S (ft.)	MW-3D (ft.)	MW-11 (ft.)	MW-12 (ft.)	RIVER (ft.)
05/19/95	03:10:00	3934.96	0.07	0.08	0.64	-0.35	-0.49	0.21	0.14	-0.03
05/19/95	03:20:00	3944.96	0.07	0.07	0.64	-0.35	-0.49	0.20	0.14	-0.02
05/19/95	03:30:00	3954.97	0.07	0.08	0.64	-0.36	-0.48	0.20	0.15	-0.02
05/19/95	03:40:00	3964.97	0.07	0.08	0.64	-0.35	-0.49	0.20	0.14	-0.02
05/19/95	03:50:00	3974.97	0.07	0.08	0.65	-0.36	-0.49	0.21	0.15	-0.02
05/19/95	04:00:00	3984.97	0.07	0.08	0.65	-0.36	-0.50	0.21	0.14	-0.03
05/19/95	04:10:00	3994.97	0.07	0.08	0.65	-0.36	-0.50	0.21	0.15	-0.03
05/19/95	04:20:00	4004.96	0.07	0.08	0.66	-0.36	-0.50	0.21	0.14	-0.02
05/19/95	04:30:00	4014.97	0.07	0.08	0.65	-0.37	-0.51	0.20	0.14	-0.02
05/19/95	04:40:00	4024.97	0.04	0.07	0.65	-0.36	-0.50	0.20	0.14	-0.08
05/19/95	04:50:00	4034.96	0.07	0.05	0.64	-0.40	-0.50	0.20	0.14	-0.18
05/19/95	05:00:00	4044.96	0.04	0.01	0.65	-0.43	-0.50	0.19	0.14	-0.22
05/19/95	05:10:00	4054.96	0.04	-0.01	0.63	-0.56	-0.51	0.19	0.13	-0.26
05/19/95	05:20:00	4064.97	0.00	-0.03	0.63	-0.62	-0.52	0.19	0.13	-0.30
05/19/95	05:30:00	4074.97	0.04	-0.05	0.63	-0.68	-0.52	0.18	0.13	-0.31
05/19/95	05:40:00	4084.97	0.04	-0.06	0.62	-0.72	-0.51	0.19	0.13	-0.30
05/19/95	05:50:00	4094.96	0.04	-0.07	0.62	-0.73	-0.52	0.18	0.14	-0.33
05/19/95	06:00:00	4104.96	0.00	-0.08	0.62	-0.72	-0.54	0.19	0.13	-0.33
05/19/95	06:10:00	4114.97	0.04	-0.09	0.62	-0.74	-0.53	0.18	0.12	-0.31
05/19/95	06:20:00	4124.97	0.04	-0.09	0.61	-0.73	-0.53	0.18	0.13	-0.29
05/19/95	06:30:00	4134.96	0.04	-0.09	0.61	-0.72	-0.53	0.18	0.12	-0.28
05/19/95	06:40:00	4144.97	0.04	-0.08	0.61	-0.72	-0.53	0.18	0.13	-0.27
05/19/95	06:50:00	4154.97	0.04	-0.08	0.61	-0.67	-0.51	0.18	0.11	-0.25
05/19/95	07:00:00	4164.97	0.00	-0.08	0.61	-0.65	-0.50	0.17	0.11	-0.22
05/19/95	07:10:00	4174.97	-0.04	-0.06	0.61	-0.65	-0.51	0.18	0.12	-0.21
05/19/95	07:20:00	4184.96	0.04	-0.06	0.62	-0.66	-0.50	0.18	0.12	-0.20
05/19/95	07:30:00	4194.97	0.04	-0.06	0.63	-0.64	-0.51	0.17	0.11	-0.17
05/19/95	07:40:00	4204.97	0.04	-0.06	0.62	-0.62	-0.50	0.17	0.10	-0.18
05/19/95	07:50:00	4214.96	-0.04	-0.05	0.62	-0.62	-0.50	0.17	0.10	-0.16
05/19/95	08:00:00	4224.97	0.04	-0.05	0.61	-0.62	-0.51	0.17	0.11	-0.15
05/19/95	08:10:00	4234.97	0.04	-0.05	0.62	-0.60	-0.49	0.16	0.11	-0.15
05/19/95	08:20:00	4244.97	0.00	-0.04	0.63	-0.60	-0.50	0.17	0.11	-0.15
05/19/95	08:30:00	4254.97	0.04	-0.03	0.63	-0.60	-0.51	0.18	0.11	-0.15
05/19/95	08:40:00	4264.97	0.00	-0.03	0.63	-0.62	-0.50	0.18	0.12	-0.15
05/19/95	08:50:00	4274.96	0.04	-0.03	0.64	-0.60	-0.49	0.17	0.11	-0.15
05/19/95	09:00:00	4284.97	0.04	-0.03	0.63	-0.63	-0.50	0.17	0.11	-0.15

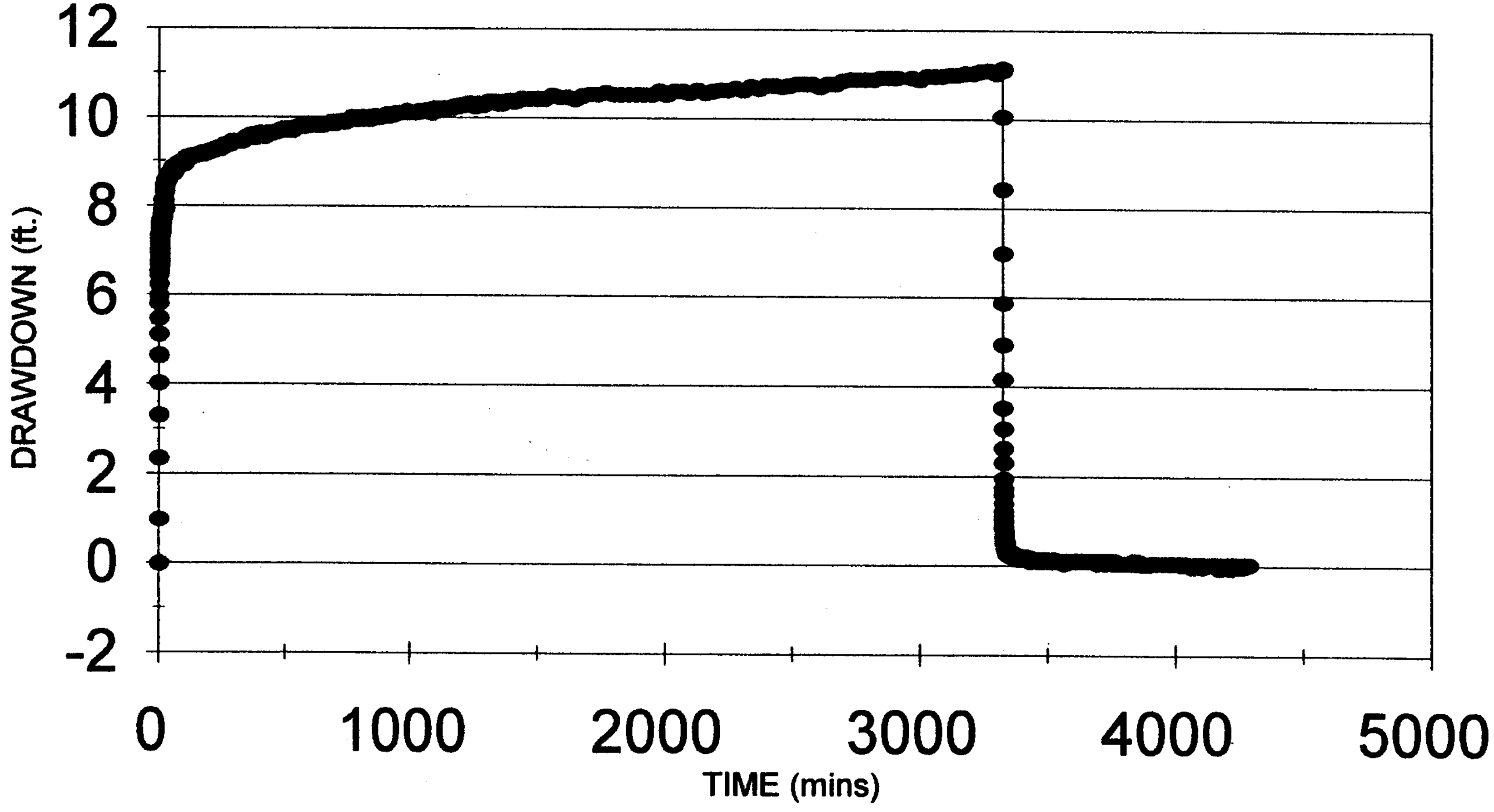
ITT SEALECTRO

PUMPTEST MW-12



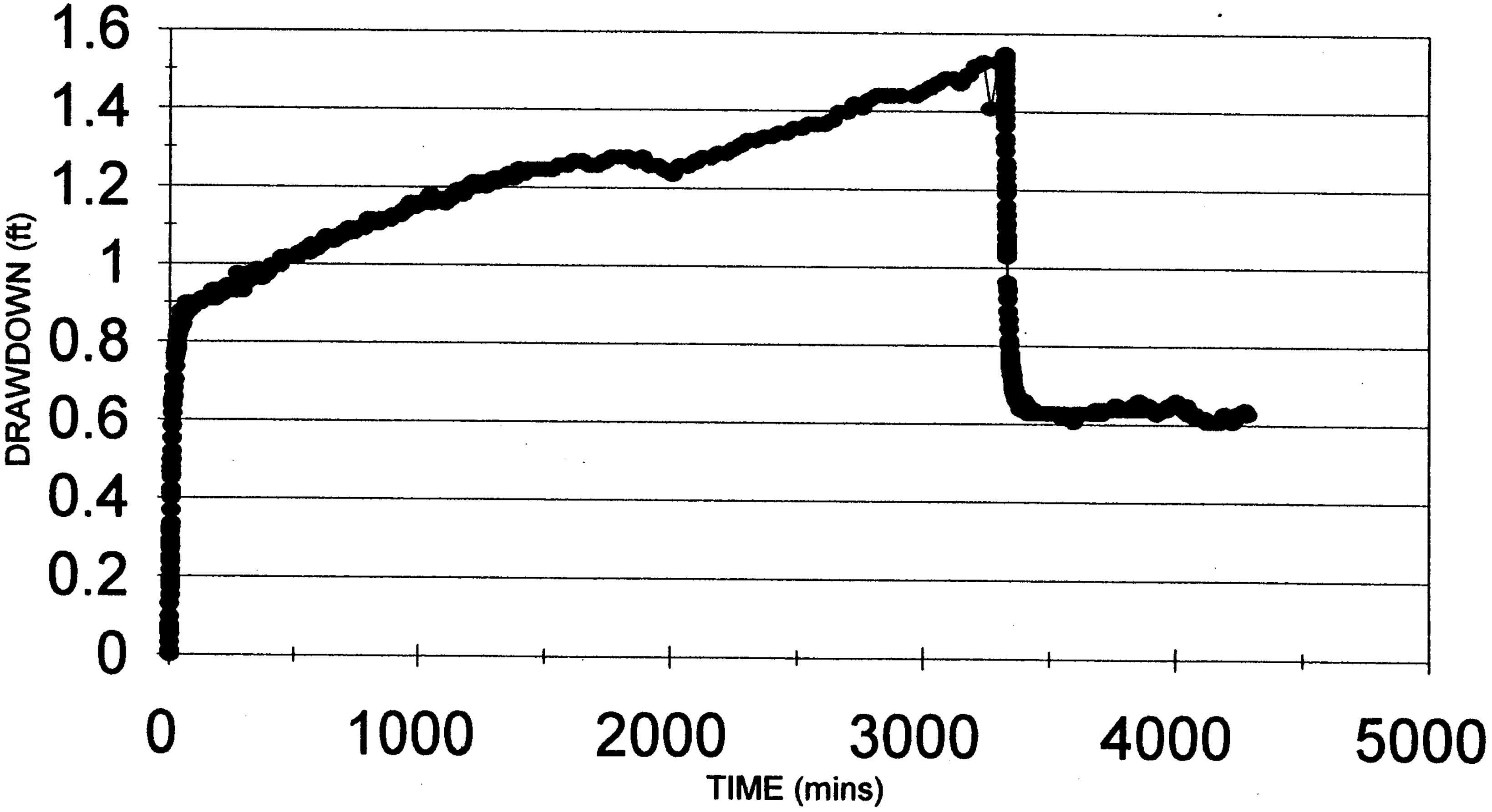
ITT SEALECTRO

PUMPTEST TW-1



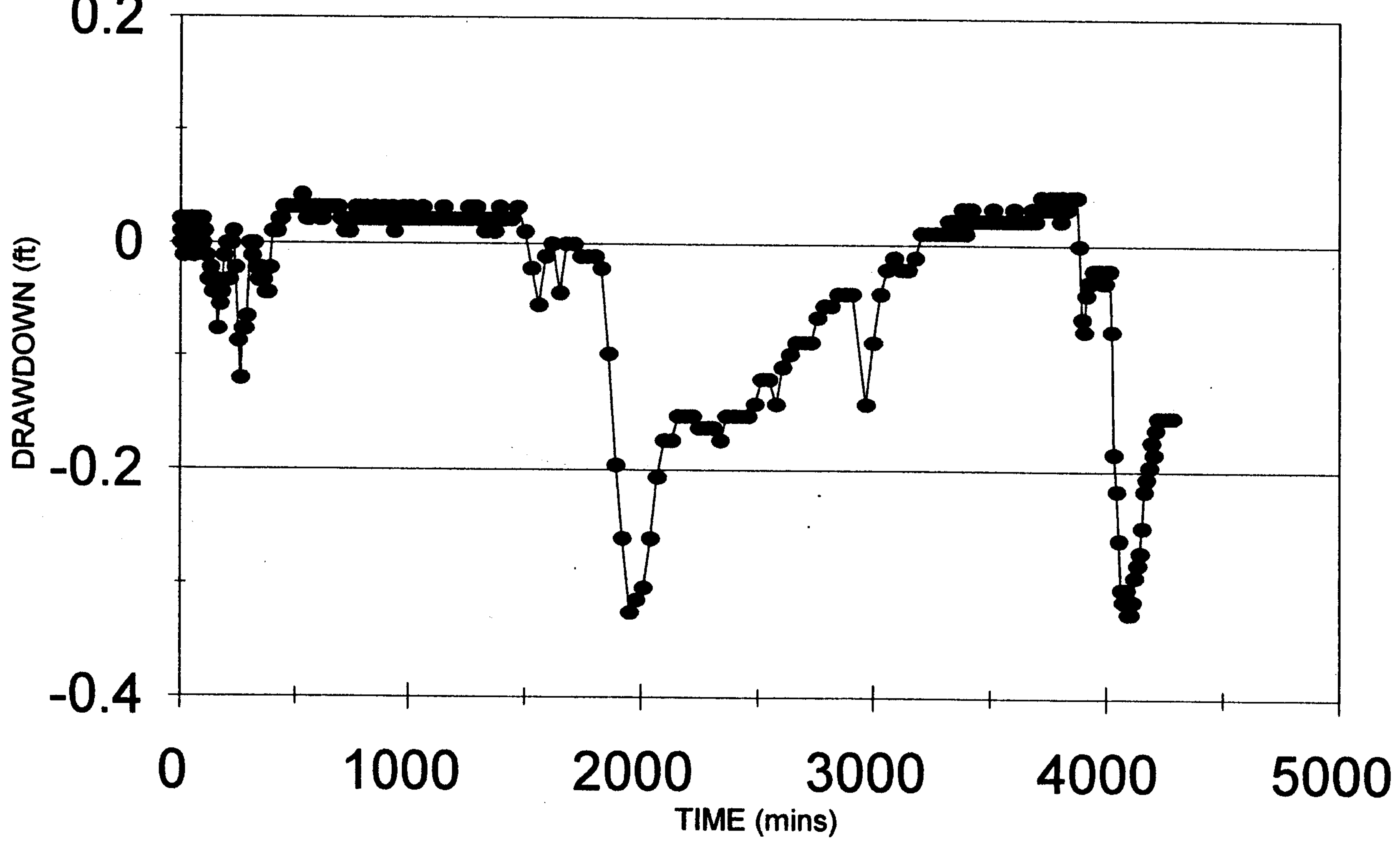
ITT SEALECTRO

PUMPTEST MW-2D



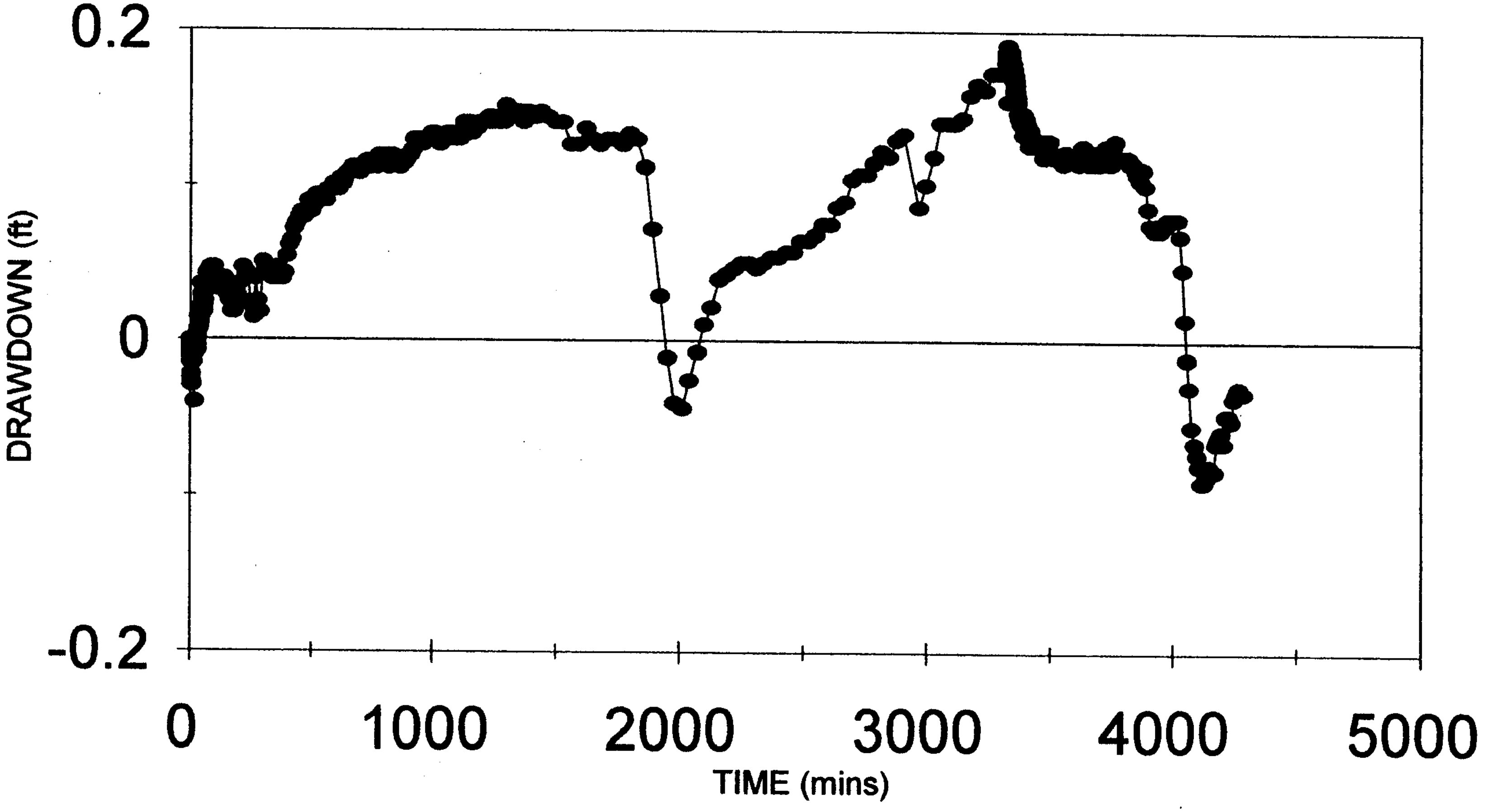
ITT SEALECTRO

PUMPTEST RIVER



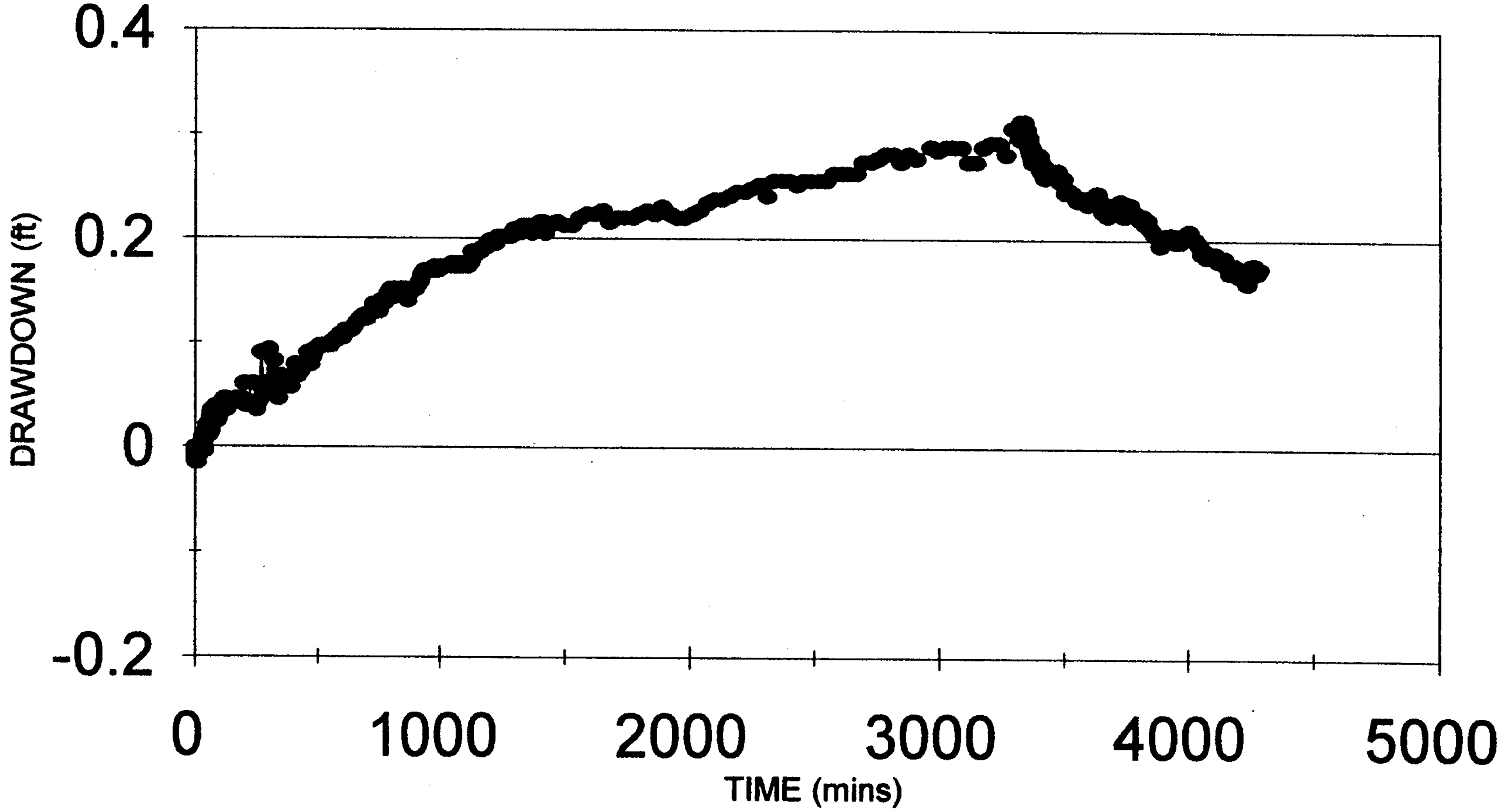
ITT SEALECTRO

PUMPTEST MW-2S



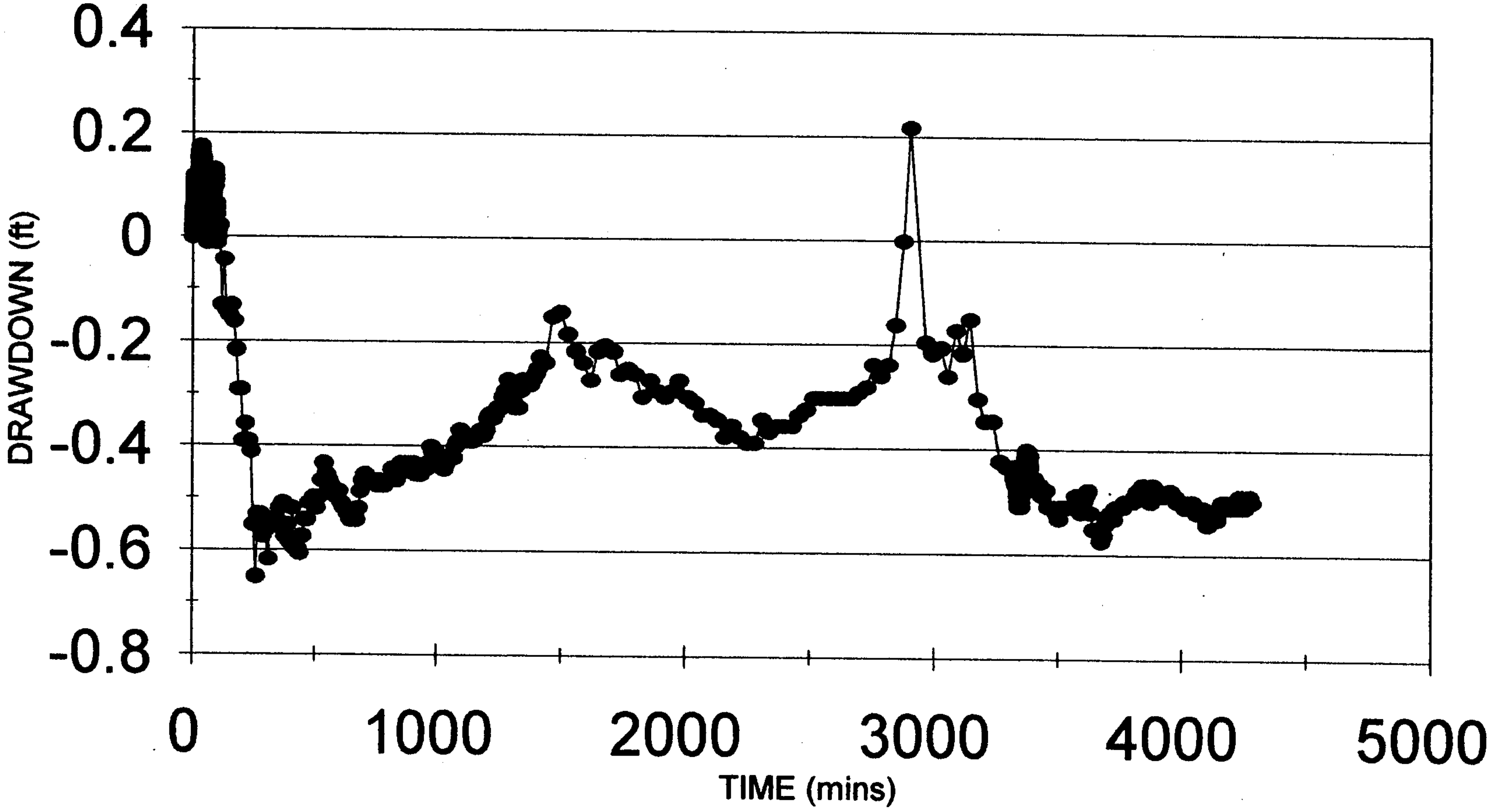
ITT SEALECTRO

PUMPTEST MW-11



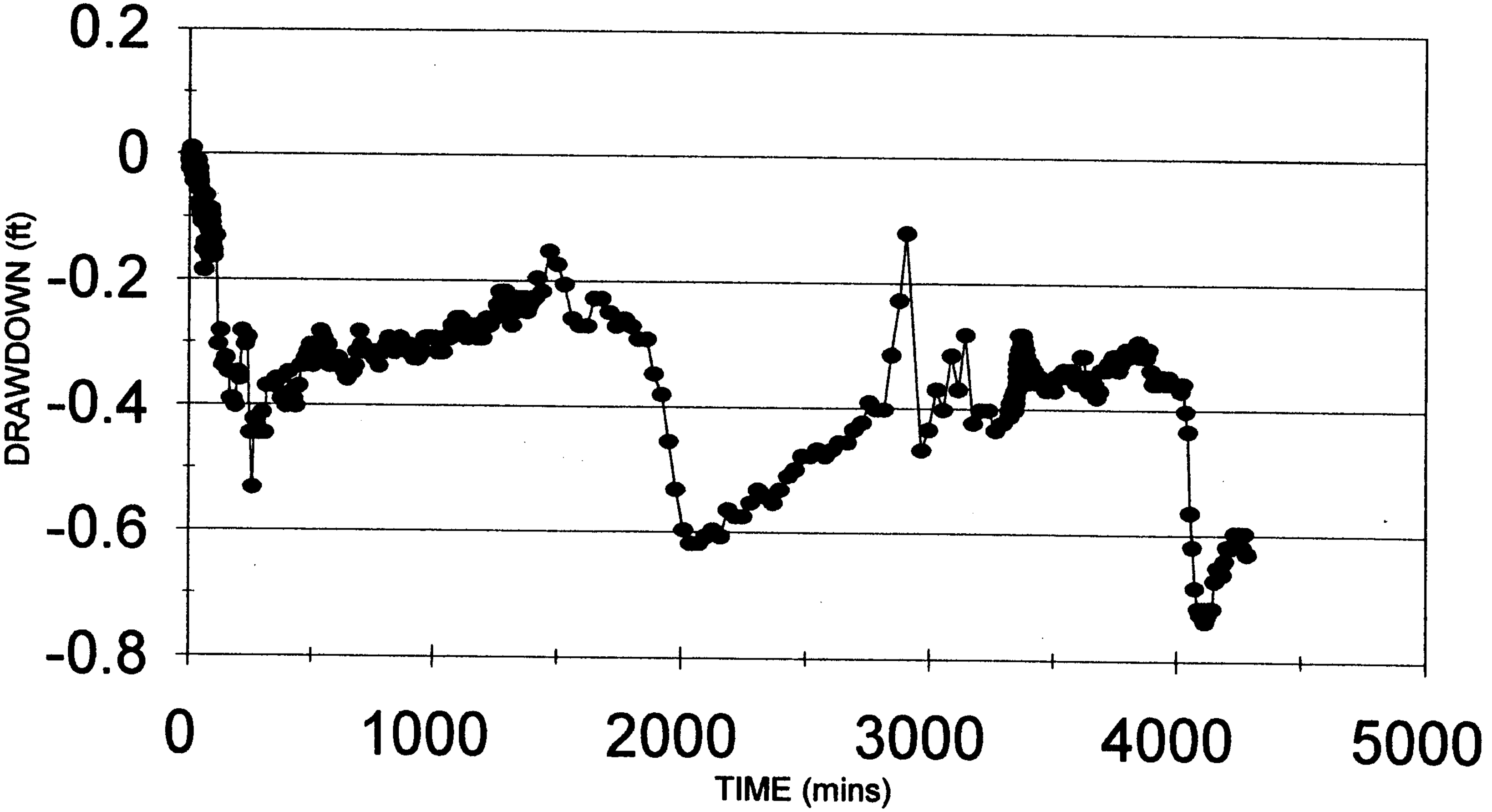
ITT SEALECTRO

PUMPTEST MW-3D



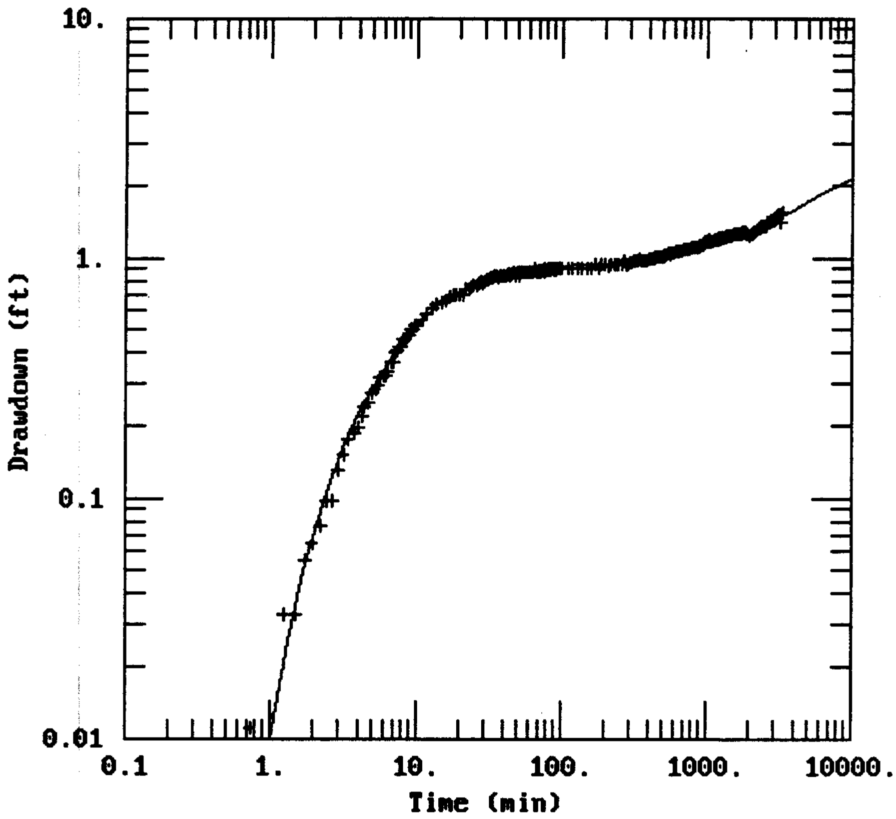
ITT SEALECTRO

PUMPTEST MW-3S



IENT: ITT SEALECTRO	**COMPANY:** O'BRIEN & GERE ENGINEERS
OCATION: MAMARONECK, NEW YORK	**PROJECT:** 3356.024

MW-2D



DATA SET:
MW2D.DAT
05/25/95

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman

PROJECT DATA:
test date: 5/95
test well: TW-1
obs. well: MW-2D

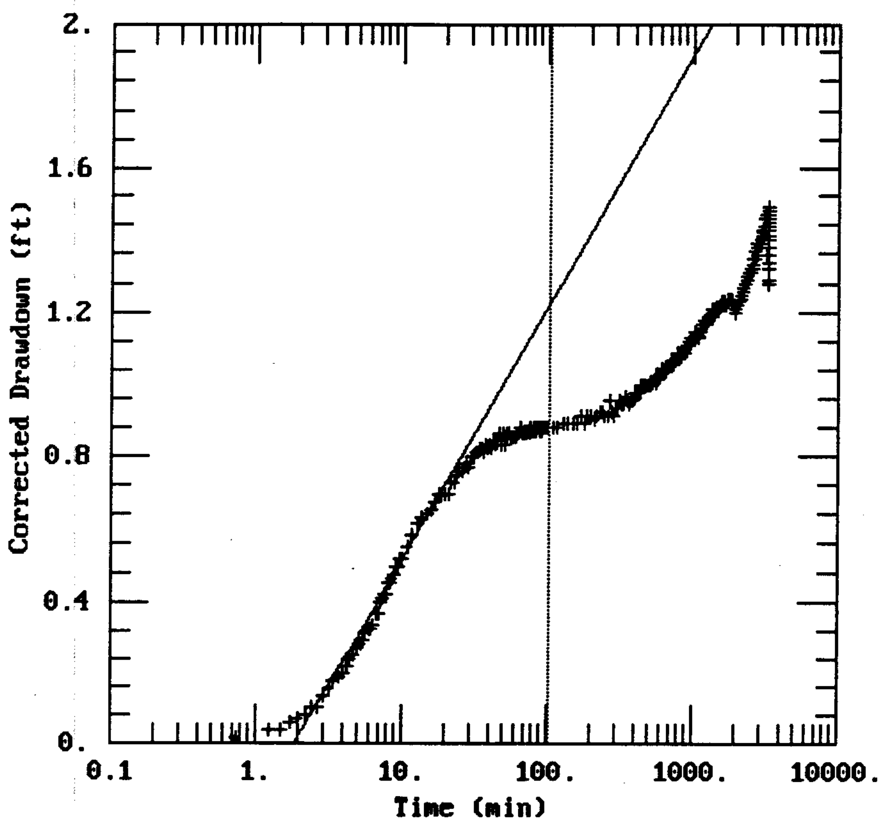
TEST DATA:
$Q = 1.63\ ft^3/min$
$r = 20.\ ft$
$r_c = 0.25\ ft$
$r_w = 0.5\ ft$
$b = 20.\ ft$

PARAMETER ESTIMATES:
$T = 0.1555\ ft^2/min$
$S = 0.004624$
$Sy = 0.7079$
$\beta = 0.2$

AQTESOLV

IENT: ITT SEALECTRO	COMPANY: O'BRIEN & GERE ENGINEERS
LOCATION: MAMARONECK, NEW YORK	PROJECT: 3356.024

MW-2D



DATA SET:
MW2D.DAT
05/23/95

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Cooper-Jacob

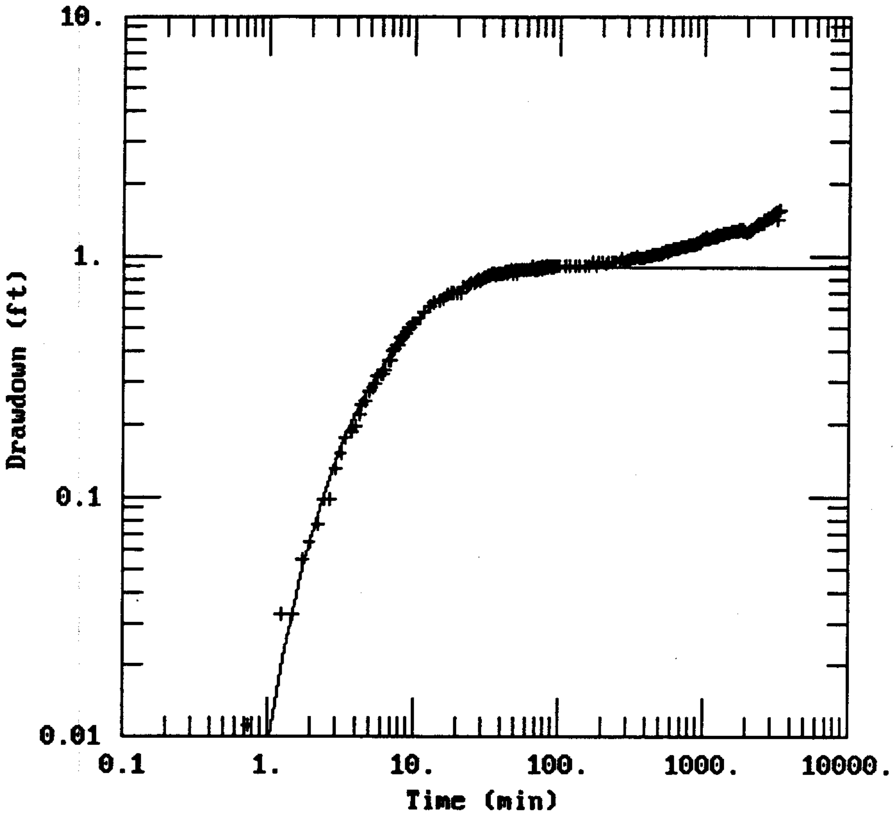
TEST DATA:
$Q = 1.63\ ft^3/min$
$r = 20.\ ft$
$r_c = 0.25\ ft$
$r_w = 0.5\ ft$
$b = 20.\ ft$

PARAMETER ESTIMATES:
$T = 0.4268\ ft^2/min$
$S = 0.004505$

AQTESOLV

IENT: ITT SEALECTRO	COMPANY: O'BRIEN & GERE ENGINEERS
LOCATION: MAMARONECK, NEW YORK	PROJECT: 3356.024

MW-2D



DATA SET:
MW2D.DAT
05/25/95

AQUIFER MODEL:
Leaky

SOLUTION METHOD:
Hantush (no stor.)

PROJECT DATA:
test date: 5/95
test well: TW-1
obs. well: MW-2D

TEST DATA:
$Q = 1.63\ ft^3/min$
$r = 20.\ ft$
$r_c = 0.25\ ft$
$r_w = 0.5\ ft$
$b = 20.\ ft$

PARAMETER ESTIMATES:
$T = 0.1789\ ft^2/min$
$S = 0.005398$
$r/B = 0.75$

AQTESOLV

O'BRIEN & GERE
LABORATORIES, INC.

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO	**JOB NO.** 3356.001.517
DESCRIPTION Mamaroneck, NY	
	MATRIX: Water

DATE COLLECTED 5-16,17-95 **DATE RECEIVED** 5-18-95 **DATE ANALYZED** 5-19-95

DESCRIPTION: **SAMPLE NO:.**	6 Hour Sample (Influent) V6804	24 Hour Sample (Influent) V6805	QC Trip Blank V6806			
Benzene	<500.	<500.	<1.			
Bromodichloromethane	<500.	<500.	<1.			
Bromoform	<5000.	<5000.	<10.			
Bromomethane	<5000.	<5000.	<10.			
Carbon tetrachloride	<500.	<500.	<1.			
Chlorobenzene	<500.	<500.	<1.			
Chloroethane	<500.	<500.	<1.			
2-Chloroethylvinyl ether	<5000.	<5000.	<10.			
Chloroform	<500.	<500.	<1.			
Chloromethane	<5000.	<5000.	<10.			
Dibromochloromethane	<500.	<500.	<1.			
1,2-Dichlorobenzene	<2500.	<2500.	<5.			
1,3-Dichlorobenzene	<2500.	<2500.	<5.			
1,4-Dichlorobenzene	<2500.	<2500.	<5.			
Dichlorodifluoromethane	<5000.	<5000.	<10.			
1,1-Dichloroethane	2300.	2200.	<1.			
1,2-Dichloroethane	<500.	<500.	<1.			
1,1-Dichloroethylene	<500.	<500.	<1.			
1,2-Dichloroethylene (total)	6000.	4900.	<1.			
Dichloromethane	<500.	<500.	<1.			
1,2-Dichloropropane	<500.	<500.	<1.			
cis-1,3-Dichloropropylene	<500.	<500.	<1.			
trans-1,3-Dichloropropylene	<500.	<500.	<1.			

Authorized: Monika Santucci

Date: June 7, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO

JOB NO. 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Water

DATE COLLECTED 5-16,17-95

DATE RECEIVED 5-18-95

DATE ANALYZED 5-19-95

DESCRIPTION:	6 Hour Sample (Influent)	24 Hour Sample (Influent)	QC Trip Blank
SAMPLE NO:.	V6804	V6805	V6806
Ethylbenzene	<500.	<500.	<1.
1,1,2,2-Tetrachloroethane	<5000.	<10,000.	<1.
Tetrachloroethylene	4100.	5900.	<1.
Toluene	<500.	<500.	<1.
1,1,1-Trichloroethane	6900.	7700.	<1.
1,1,2-Trichloroethane	<500.	<500.	<1.
Trichloroethylene	740.	850.	<1.
Trichlorofluoromethane	<500.	<500.	<1.
Vinyl chloride	<500.	<500.	<1.
Xylene (total)	<1500.	<1500.	<3.
	20040	21550	

Comments:

Methodology: USEPA-846, Update I, 3rd Ed., July 1992

Certification No.: 10155

Units: µg/l

Page 2 of 2

Authorized: Monika Santucci

Date: June 7, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Laboratory Report

CLIENT ITT SEALECTRO **JOB NO.** 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Water

DATE COLLECTED 5-16,17-95 **DATE RECEIVED** 5-18-95

Description:	6 Hour Sample (Influent)	24 Hour Sample (Influent)			
Sample #	V6804	V6805			
Total Metals:					
CALCIUM	81.	72.			
COPPER	0.02	<0.01			
IRON	1.0	1.0			
MAGNESIUM	26.	26.			
SODIUM	42.	41.			
Other Analyses:					
HARDNESS	310.	280.			
AMMONIA NITROGEN	0.14	0.14			
CHEMICAL OXYGEN DEMAND	<10.	<10.			
CHLORIDE	130.	110.			
METHYLENE BLUE ACTIVE SUBS.	<0.1	<0.1			
NITRATE NITROGEN	0.46	0.71			
NITRITE NITROGEN	<0.05	<0.05			
NITRITE-NITRATE NITROGEN	0.46	0.71			
SPECIFIC CONDUCTANCE µmho/cm	810.	810.			
TOTAL KJELDAHL NITROGEN	2.4	3.6			
TOTAL ALKALINITY	210.	210.			
TOTAL DISSOLVED SOLIDS	470.	460.			
TOTAL ORGANIC CARBON	<1.	<1.			

Comments:

Certification No.: 10155

Units: mg/l unless otherwise noted

Authorized: Monika Santucci

Date: June 7, 1995

O'Brien & Gere Laboratories, Inc., *an O'Brien & Gere Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

O'BRIEN & GERE
LABORATORIES, INC.

Laboratory Report

CLIENT ITT SEALECTRO JOB NO. 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Water

DATE COLLECTED 5-16,17-95 DATE RECEIVED 5-18-95

Description:	6 Hour Sample (Influent)	24 Hour Sample (Influent)			
Sample #	V6804	V6805			
Other Analyses (cont'd):					
TOTAL SUSPENDED SOLIDS	<5.	<5.			
PH, LABORATORY std. units	7.5	7.4			
CORROSIVITY	-0.09	0.24			

Comments: pH analyzed outside recommended 15 minute holding time.

Certification No.: 10155

Units: mg/l unless otherwise noted

Authorized: Monika Santucci

Date: June 7, 1995

O'Brien & Gere Laboratories, Inc., *an O'Brien & Gere Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

O'BRIEN & GERE
LABORATORIES, INC.

Laboratory Report

CLIENT ITT SEALECTRO
JOB NO. 3356.001.517
DESCRIPTION Mamaroneck, NY
MATRIX: Water
DATE COLLECTED 5-16,17-95
DATE RECEIVED 5-18-95

Description:	6 Hour Sample (Influent)	24 Hour Sample (Influent)			
Sample #	V6807	V6808			
Filtered Metals:					
IRON	0.30	0.05			
MANGANESE	0.40	0.44			

Comments:

Certification No.: 10155
Units: mg/l

Authorized: Monika Santucci
Date: June 7, 1995

O'BRIEN & GERE ENGINEERS, INC.

Job No. 3356-024-876
Sheet 1 of 1

Office: Syracuse
Address: 5000 Brittonfield Pkwy
Phone: 4376100

CHAIN OF CUSTODY

CLIENT: ITT Sealectro LOCATION: Mamaroneck, NY	COLLECTED BY: Peter Loretto (Signature)

SAMPLE DESCRIPTION	Date	Time	Sample Matrix[1]	Sample Type[2]	No. of Containers	ANALYSIS REQUESTED
6 hr sample (influent)	5/16/95	1530	water	grab	7	8010/8020
24 hr sample (influent)	5/17/95	0950	water	grab	7	Total Metals: Calcium, Copper, Iron, Magnesium
						and Sodium
						Filtered metals: Iron & magnesium.
						hardness corrosivity, Ammonia-Nitrogen, COD, Chloride,
			Please filter in LAB			methylene Blue Active substances, Nitrite, Nitrate, specific
						conductance, Total Kjedahl Nitrogen, Total Alkalinity
						TDS, TOC, TSS and Ph,
Trip Blank	5/17/95 ~~5/18/95~~	—	water	—	1	8010/8020

[1] Matrix = water, wastewater, air, sludge, sediment, etc.
[2] Type = grab, composite

~~Relinquished by:~~ ~~of: OBG Engineers~~	~~Date~~ ~~[illegible]~~	~~Time~~ ~~1800~~	Received by: of:	Date	Time
Relinquished by: of:	Date	Time	Received by: of:	Date	Time
Relinquished by: of:	Date	Time	Received by: of:	Date	Time
~~Use this space if shipped via courier (e.g. Fed Ex)~~ Relinquished by: of: OBG - Engineers	Date 5/17/95	Time 1800	Courier Name: ~~*Attach delivery/courier receipt to Chain of Custody~~	Date	Time
Relinquished by: of:	Date	Time	Received by: Wendy Smith of: OB+G Laboratories, Inc.	Date 5/18/95	Time 1030

jb/wpC As per attached; filtered metals are Fe + Mn.

Cooler temp. @5°C

September 17, 1990

O'BRIEN & GERE
LABORATORIES, INC.

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO JOB NO. 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Water

DATE COLLECTED 5-18-95 DATE RECEIVED 5-22-95 DATE ANALYZED 5-30-95

DESCRIPTION:	Effluent	QC Trip Blank			
SAMPLE NO:.	V6932	V6933			
Benzene	<10.	<1.			
Bromodichloromethane	<10.	<1.			
Bromoform	<100.	<10.			
Bromomethane	<100.	<10.			
Carbon tetrachloride	<10.	<1.			
Chlorobenzene	<10.	<1.			
Chloroethane	<10.	<1.			
2-Chloroethylvinyl ether	<100.	<10.			
Chloroform	<10.	<1.			
Chloromethane	<100.	<10.			
Dibromochloromethane	<10.	<1.			
1,2-Dichlorobenzene	<50.	<5.			
1,3-Dichlorobenzene	<50.	<5.			
1,4-Dichlorobenzene	<50.	<5.			
Dichlorodifluoromethane	*	<10.			
1,1-Dichloroethane	190.	<1.			
1,2-Dichloroethane	<10.	<1.			
1,1-Dichloroethylene	<10.	<1.			
1,2-Dichloroethylene (total)	650.	<1.			
Dichloromethane	<10.	<1.			
1,2-Dichloropropane	<10.	<1.			
cis-1,3-Dichloropropylene	<10.	<1.			
trans-1,3-Dichloropropylene	<10.	<1.			

Authorized: Monika Santucci

Date: June 7, 1995

O'BRIEN & GERE
LABORATORIES, INC.

Volatile Organics
Method 8010 / 8020

CLIENT ITT SEALECTRO **JOB NO.** 3356.001.517

DESCRIPTION Mamaroneck, NY

MATRIX: Water

DATE COLLECTED 5-18-95 **DATE RECEIVED** 5-22-95 **DATE ANALYZED** 5-30-95

DESCRIPTION:	Effluent	QC Trip Blank
SAMPLE NO:.	V6932	V6933
Ethylbenzene	<10.	<1.
1,1,2,2-Tetrachloroethane	<500.	<1.
Tetrachloroethylene	230.	<1.
Toluene	<10.	<1.
1,1,1-Trichloroethane	250.	<1.
1,1,2-Trichloroethane	<10.	<1.
Trichloroethylene	53.	<1.
Trichlorofluoromethane	<10.	<1.
Vinyl chloride	28.*	<1.
Xylene (total)	<30.	<3.

Comments: *The value reported for vinyl chloride may represent vinyl chloride, dichlorodifluoromethane or any combination of the two compounds.

Methodology: USEPA-846, Update I, 3rd Ed., July 1992
Certification No.: 10155
Units: µg/l

Authorized: Monika Santucci
Date: June 7, 1995

O'BRIEN & GERE ENGINEERS, INC.

Job No. ______________

Sheet ___ of ___

Office: Syracuse
Address: 5000 Brittonfield Pkwy
Phone: 4376100

CHAIN OF COUSTODY

CLIENT: ITT Sealectro LOCATION: Mamaroneck, NY	COLLECTED BY: Peter - Loretto (Signature)

SAMPLE DESCRIPTION	Date	Time	Sample Matrix[1]	Sample Type[2]	No. of Containers	ANALYSIS REQUESTED
Effluent	5/18/95	1655	water	grab	2	8010/8020
Trip Blank	5/18/95	—	water	—	1	8010/8020

Cooler temp. @ 4°C (WS)

[1] Matrix = water, wastewater, air, sludge, sediment, etc.
[2] Type = grab, composite

	Date	Time		Date	Time
Relinquished by: of: OBG Engineers	5/22/95	0800	Received by: Wendy Smith of: O'B+G Laboratories, Inc.	5/22/95	0800
Relinquished by: of:			Received by: of:		
Relinquished by: of:			Received by: of:		
Use this space if shipped via courier (e.g., Fed Ex) Relinquished by: of:			Courier Name: *Attach delivery/courier receipt to Chain of Custody		
Relinquished by: of:			Received by: of:		

/wpC

September 17, 1990

Appendix F

Ground water monitoring plan

Appendix F

Ground water monitoring plan

WORK PLAN

Ground Water Monitoring Plan

ITT Sealectro, Inc.
Mamaroneck, New York

November 1998

6328.015

WORK PLAN

Ground Water Monitoring Plan

ITT Sealectro, Inc.
Mamaroneck, New York

Guy Swenson

Guy A. Swenson, CPG
Sr. Technical Associate

November 1998

O'BRIEN & GERE
ENGINEERS, INC.

5000 Brittonfield Parkway
Syracuse, NY 13221

Contents

1. Introduction

This document presents the Ground Water Monitoring Plan for the former Sealectro, Inc. Facility (Sealectro), site # 360027, located at 139 Hoyt Street in Mamaroneck, New York. Figure 1 illustrates the location of the site. The Site is a Class 2 - Priority 3 inactive hazardous waste site as classified by the New York State Department of Environmental Conservation (NYSDEC). The Priority 3 designation indicates that the site does not pose an immediate threat to the public or the environment.

In correspondence dated January 6, 1998 and March 11, 1998, the NYSDEC proposed a Remediation Program for the site that contains two components. The first component of the program involves the preparation and implementation of a Ground Water Monitoring Plan. The plan will establish Annual Trigger Levels for monitoring the ground water quality at the site and will also describe the manner in which the ground quality data will be evaluated to determine whether a contingent remedy will be implemented. The second component is a Contingency Remedial Plan, which will be submitted to the NYSDEC by February 1, 1999. This plan will describe the type of remedy to be implemented in the event that Annual Trigger Levels are exceeded.

1.1. Project background

Multiple investigations and several interim remedial measures (IRMs) have been completed at the site to address known areas of contamination. The most recent investigation completed was the Remedial Investigation (RI). The results of the RI and previous investigations are presented in the *Remedial Investigation Report* dated December 1994 (O'Brien & Gere, 1994) and the *Remedial Investigation Report Addendum* dated July 1995 (O'Brien & Gere, 1995). The RI was subsequently approved by the NYSDEC in July 1995. The report concluded that residual dense non aqueous phase liquids (DNAPLs) are heterogeneously distributed in subsurface soils at the site. The residual DNAPLs in the soil act as a continuing source of volatile organic compounds (VOCs) to ground water.

thickness and texture, and are not laterally extensive. The unconsolidated deposit immediately atop bedrock consists of sand and gravel.

The ground water table occurs between 5 ft and 8 ft below the ground surface. The depth to water varies with seasons and stage of the Sheldrake River located immediately north of the site (see Figure 2). Two ground water zones were identified. The shallow zone occurs in the sand, silt, and clay unit while the deep zone occurs in the sand and gravel unit. Monitoring wells designated with a "D" were installed in the deep zone and while all others were installed in the shallow ground water zone. Ground water flow in both zones is north toward the Sheldrake River. An upward hydraulic gradient from the deep zone to the shallow zone, along with the good hydraulic connection between the river and wells, indicate that ground water discharges to the Sheldrake River.

1.3. Ground water quality

Several rounds of ground water samples were collected between 1988 and 1990. In July 1991 a quarterly sampling program was initiated and it continues to date; as many as 31 rounds of samples have been collected from selected monitoring wells. The monitoring well locations are illustrated on Figure 2 and total VOC concentrations are presented on Table 1. Graphs of total VOC concentration vs. time for each well are presented in Figures 3 through 8. A summary of the trends for each well is presented below:

MW-2 The concentrations of VOCs have steadily decreased since 1988. Total VOC concentrations between 1988 and 1991 ranged from 221 to 385 μg/L. Total VOCs concentrations since 1996 have ranged from 38 to 108 μg/L. The VOC concentrations in MW-2 have decreased by approximately 450% since 1991.

MW-2D Very low concentrations of VOC were detected in this well between February 1992 and February 1994. However, between February and May 1994, the VOC concentrations began to increase significantly. The maximum concentration of total VOCs detected was 7,800 μg/L in February 1995. The primary VOCs in the samples were tetrachloroethene and 1,1,1-trichloroethane. Since February 1996, the concentrations have steadily decreased and have ranged from 670 to 2,240 μg/L. An analysis of the data suggests that, during one or more of the intrusive activities conducted at the site, DNAPL may have been mobilized. The mobilization of the DNAPL may in turn have caused an increase in the dissolved VOC concentration at this well.

2. Ground water monitoring program

The overall objective of the Ground Water Monitoring Plan is to provide the methodologies that will be used to collect and analyze ground water samples, to evaluate future ground water quality data, and to determine whether the Contingency Remedial Plan should be implemented.

The Ground Water Monitoring Plan presents the following information:

- Method used to calculate Annual Trigger Levels
- Monitoring wells to be included in the plan
- Sampling frequency
- Sampling and analytical procedures
- Methods used to compare data with Annual Trigger Levels
- Reports to be submitted to NYSDEC

2.1. Method used to calculate annual trigger levels

The Ground Water Monitoring Plan identifies annual VOC concentration goals which must be met for the individual monitoring wells. These annual VOC concentration goals are based upon a trend of declining concentrations such that by year 30, the VOC concentration goals will be equivalent to New York State Ground Water Standards. The year-by-year VOC concentration goals have been termed Annual Trigger Levels in this monitoring plan. Each monitoring well will be assigned Annual Trigger Levels that start upon initiation of the monitoring plan and continue to year 30. The method used to calculate these Annual Trigger Levels is discussed below.

Prior to the calculation of the Annual Trigger Levels, the existing ground water quality data were evaluated to identify those compounds considered representative of actual ground water conditions. Table 2 summarizes, on a well by well basis, the New York State Class GA Ground Water Standard, the maximum concentration of the individual VOCs detected, the number of samples collected, the number of times a compound was detected, the percent of sampling events in which each compound was detected, and the percent of the total VOC concentrations that each compound comprises. For

The monitoring wells will be sampled quarterly for 2 years following NYSDEC's approval of this monitoring plan. After this 2-year period, the sampling frequency will be reduced to one sampling event per year. The site quarterly ground water monitoring data will be reviewed and a calendar quarter will be selected for subsequent annual sampling. The quarter selected for annual sampling will be presented to the NYSDEC for their approval.

It is likely that the total VOC concentrations in a number of wells will drop below 100 ppb during the 30-year monitoring period. In the event that the annual total VOC concentrations remain below 100 ppb for a two-year period, ITT may petition NYSDEC to reduce the frequency of the monitoring for those wells from annual to once every five years. A summary of the sampling frequency is provided in the following:

Year	**Sampling Frequency**
1-2	Quarterly
3-30	Annual

Should a sample result appear anomalous, ITT may choose to resample the monitoring well in order to confirm the result. The results of the confirmation sample will be submitted to the NYSDEC within 60 days of the date of the receipt of the original sample results. If the confirmation sample result is inconsistent with the original sample, ITT and the NYSDEC will jointly decide how the data will be compared to the Annual Trigger Levels.

In the event that the individual VOC concentrations at a monitoring well meet or are below New York State ground water quality standards for VOCs for two consecutive years, then ITT may petition the NYSDEC to discontinue the monitoring at that well. Similarly, if new guidance becomes available during the implementation of the Ground Water Monitoring Plan, ITT may petition the NYSDEC to apply the new guidance to the site. Any other modifications to the sampling frequency will be presented to the NYSDEC for their approval.

Ground water from well RW-2 will be sampled once a year for VOCs and the results will be provided to the NYSDEC, for informational purposes, in the annual report. When monitoring wells MW-2, MW-2D, MW-3, MW-3D, and MW-12 have each met the criteria which allow the Ground Water Monitoring Plan to be discontinued, ITT will discuss with the NYSDEC whether the ground water quality of RW-2 necessitates additional actions before site closure.

goals. Based upon the results of the comparison, the report will provide a recommendation regarding the need to implement the Contingency Remedial Plan. If appropriate, the report will provide recommendations for modifying the sampling frequency or discontinuing monitoring at selected well locations.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

				FIELD DUP													
SAMPLE ID:	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2	MW-2
COLLECTED:	6/88	8/89	7/31/91	7/31/91	10/24/91	2/19/92	4/15/92	8/12/92	11/5/92	2/17/93	5/24/93	8/19/93	11/9/93	2/15/94	6/1/94	8/23/94	11/21/94
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
Benzene	ND	29	17	15	16	ND	ND	17	11	8	10	22	ND	7 J	14	2	13
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
Chloroethane	ND	18	2	2	2	NA	NA	5	3	8	3	ND	ND	ND	1	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1 +	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	123	63	47	42	32	22	60	46	22	22	ND	35	14	17	16	11	18
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	20	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	NA	ND	63	55	61	19	ND	24	37	33	18	32	13	19	14	18	14
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	31	ND	ND	ND	1
1,1,1-Trichloroethane	94	16	ND	ND	ND	ND	ND	ND	ND	4	3	ND	ND	ND	2	5	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	4	3	2	2	2	ND	ND	ND	ND	1	1	ND	ND	ND	1	9	3
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA
Vinyl Chloride	ND	200	120	120	120	ND	130	100	100	81	88	120	130	1 J	61	18	78
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	3	3	1	11.1	1	1	ND	ND	ND	ND	ND	NA	ND	ND	ND
Total VOCs	221	385	251	236	233	41	190	192	173	157	143	209	188	44	109	64	127

Notes:
All vales reported in ug/l (ppb), unless noted otherwise.
J - Indicates an estimated value.
D - Identified in analyses at secondary dilution factor.
NA - Not analyzed
ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
6/88 samples collected by TRC.
+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID: COLLECTED:	MW-2 2/27/95	MW-2 5/31/95	MW-2 8/29/95	MW-2 11/30/95	MW-2 2/27/96	MW-2 5/30/96	MW-2 8/27/96	MW-2 11/26/96	MW-2 2/25/97	MW-2 5/28/97	MW-2 8/26/97	MW-2 11/26/97	MW-2 2/26/98	MW-2 5/28/98	MW-2 8/24/98
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	8	9	14	4	5	5	9	10	5	5	4	ND	4	5	7
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	15	14	16	12	22	15	12	18	33	8	7	21	15	18	18
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	12	9	11	8	10	8	8	10	7	7	5	7	6	6	6
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	3	2	ND	1	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	51	39	100	46	38	39	52	54	53	35	22	80	42	47	51
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	ND	ND	3.1	ND	ND	ND	ND	ND	5.8	ND	ND	ND	ND	ND	ND
Total VOCs	89	73	141	71	75	69	81	92	98	55	38	108	67	76	82

Notes:
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J - Indicates an estimated value.
D - Identified in analyses at secondary dilution factor.
NA - Not analyzed
ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
6/88 samples collected by TRC.
+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID: COLLECTED:	MW-2D 2/19/92	MW-2D 2/19/92	MW-2D 4/15/92	MW-2D 8/12/92	MW-2D 11/5/92	MW-2D 2/17/93	MW-2D 5/24/93	MW-2D 8/19/93	MW-2D 10/9/93	MW-2D 2/15/94	MW-2D 6/2/94	MW-2D 8/23/94	MW-2D 11/21/94	MW-2D 2/27/95	MW-2D 5/31/95	MW-2D 8/29/95	MW-2D 11/30/95	MW-2D 2/27/96	MW-2D 5/30/96	MW-2D 8/27/96
Acetone	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND	5	ND	ND	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	5	6	ND	1	2	1	1	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	22	24	ND	10	8	4	4	7	5	5 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	28	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	24	28	ND	10	8	2	4	9	10	8 J	710	1600	3300	6500	5900	4800	3800	1700	1100	1300
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	22	27	ND	4	3	3	3	18	5	4 J	94	260	680	1300	1200	790	280	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	18	20	25	9	6	2	5	8	7	8 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	11	10.9	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total VOCs	91	110	53	34	27	12	28	44	27	25	804	1860	3980	7800	7100	5590	4080	1700	1100	1300

Notes:
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NA - Not analyzed
ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
6/88 samples collected by TRC.
+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID:	MW-2D	MW-2D	MW-2D	MW-2D	MW-2D	MW-2D	MW-2D	MW-2D
COLLECTED:	11/26/96	2/25/97	5/28/97	8/26/97	11/26/97	2/26/98	5/28/98	8/24/98
Acetone	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	ND	ND	ND
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	1200	1200	1400	1000	670	2100	1100	1600
Toluene	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	130	110	ND	140	84	62
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA
Total VOCs	1200	1200	1530	1110	670	2240	1184	1662

Notes:
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ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
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+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID:	MW-3	MW-3	MW-3	MW-3	MW-3DL	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3	MW-3
COLLECTED:	6/88	7/31/91	10/24/91	2/19/92	2/19/92	4/15/92	8/12/92	11/5/92	2/17/93	5/24/93	8/19/93	10/9/93	6/1/94	8/24/94	11/21/94	2/27/95	5/31/95	8/29/95	11/30/95
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	1 J	ND	ND	ND	1	1	ND	ND	ND	ND	2	ND	ND	ND	ND	ND
Dibromochloromethane	9	2 J	ND	ND	ND	ND	4 J	2 J	ND	ND	1	ND	ND	2	ND	ND	ND	ND	ND
1,1-Dichloroethane	154	300	280	220	150	150	20	23	4	170	30	80	31	4	67	5	17	80	46
1,2-Dichloroethane	6	ND	ND	ND	ND	17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2
1,1-Dichloroethene	343	550	670	410	290	200	32	33	2	310	62	190	63	1	160	7	35	140	90
1,2-Dichloroethene (total)	NA	49	47	34	24	5.9	5	6	ND		6	14	6	4	16	1	3	16	12
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	2 J	ND	ND	ND	ND	4 J	2 J	ND	ND	1	ND	ND	ND	ND	ND	4	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	12	8	6	ND	4	5	2	ND	5	ND	ND	11	ND	3	6	12	9
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	129	780	610	530	340	90	40	43	8	240	57	130	50	16	120	10	26	120	55
1,1,2-Trichloroethane	ND	2 J	ND	10	ND	ND	4 J	2 J	ND	ND	1	ND	ND	ND	ND	1	1	ND	5
Trichloroethene	21	35	36	28	20	41	3	3	ND	15	5	ND	4	2	14	1	4	12	9
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	ND	NA	NA	ND	ND	ND	NA	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	NA	1	ND	11.3	NA	1	1	1	ND	ND	ND	1	1.3	1.1	NA	ND	ND	ND	ND
Total VOCs	662	1720	1655	1241	830	503.9	116	120	17	735	168	414	154	42	377	28	96	380	228

Notes:
All vales reported in ug/l (ppb), unless noted otherwise.
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NA - Not analyzed
ND - Not detected.
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
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2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID: COLLECTED:	MW-3 2/27/96	MW-3 5/30/96	MW-3 8/27/96	MW-3 11/26/96	MW-3 2/25/97	MW-3 5/28/97	MW-3 8/26/97	MW-3 11/26/97	MW-3 2/26/98	MW-3 5/28/98	MW-3 8/24/98
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	6
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	8	32	110	68	16	4	53	16	ND	6	40
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	18	71	230	140	37	8	110	34	2	18	87
1,2-Dichloroethene (total)	1	5	19	ND	2	ND	ND	3	ND	ND	6
Dichloromethane	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	2	5	11	ND	5	2	11	6	1	3	18
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	13	39	ND	65	23	8	60	17	3	7	42
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	ND	3	12	ND	ND	ND	ND	3	ND	ND	6
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total VOCs	42	159	382	273	83	22	234	79	6	34	205

Notes:
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Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID:	MW-3D	MW-3DDL	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D	MW-3D
COLLECTED:	2/19/92	2/19/92	4/15/92	4/15/92	8/12/92	11/5/92	2/17/93	5/24/93	8/19/93	10/9/93	6/1/94	8/24/94	11/21/94	2/27/95	5/31/95	8/29/95	11/30/95	2/27/96	5/30/96	8/27/96
Acetone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	16	ND	ND	29	12	25	38	27	18	2	21	39	27	9	6	5	3	3	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	19	9	71	81	17	19	41	13	18	4	11	ND	ND	6	8	5	1	3	ND	ND
1,2-Dichloroethene (total)	13	6	ND	ND	15	27	44	13	11	4	9	10	ND	4	2	4	3	1	ND	ND
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	420	320	190	190	150	150	140	82	60	55	32	ND	11	19	16	19	15	6	4	5
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	330	220	57	65	370	370	470	170	210	61	74	220	110	48	29	48	12	7	5	9
1,1,2-Trichloroethane	ND	ND	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	9	5	17	17	ND	17	15	ND	ND	3	4	ND	ND	5	3	2	3	1	1	ND
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	ND	ND	ND	1.2	NA	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	ND	ND	ND	9.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	12	NA	1	1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total VOCs	807	560	337.4	392.3	564	608	748	305	317	129	157	269	148	90	64	83	37	21	10	14

Notes:
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D - Identified in analyses at secondary dilution factor.
NA - Not analyzed
ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
6/88 samples collected by TRC.
+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID: COLLECTED:	MW-3D 11/26/96	MW-3D 2/25/97	MW-3D 5/28/97	MW-3D 8/26/97	MW-3D 11/26/97	MW-3D 2/26/98	MW-3D 5/28/98	MW-3D 8/24/98
Acetone	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	2	2	2	3	ND	2	1	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	2	ND	1	2	ND	2	2	ND
1,2-Dichloroethene (total)	1	1	1	ND	ND	ND	ND	ND
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	30	5	6	6	3	5	3	3
Toluene	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	9	6	6	4	1	2	1	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	1	2	2	2	1	2	1	ND
2-Butanone	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA
Total VOCs	45	16	18	17	5	13	8	3

Notes:
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J - Indicates an estimated value.
D - Identified in analyses at secondary dilution factor.
NA - Not analyzed
ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
6/88 samples collected by TRC.
+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID:	MW-11	MW-11DL	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11	MW-11
COLLECTED:	2/15/94	2/15/94	6/1/94	8/24/94	11/21/94	2/27/95	5/31/95	8/29/95	11/30/95	2/27/96	5/30/96	8/27/96	11/26/96	2/25/97	5/28/97	8/26/97	11/26/97	2/26/98	5/28/98	8/24/98
Acetone	22	21 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	20	14 J	ND	ND	3	8	4	5	3	6	3	2	2	3	ND	3	ND	2	1	2
Bromodichloromethane	ND	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	330 D	330 D	ND	ND	2	17	14	13	10	4	2	4	ND	2	ND	3	ND	3	4	3
Chloroform	ND	ND	14	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	69	46 J	15	7	11	5	3	2	3	4	14	2	8	3	ND	5	7	3	2	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethene (total)	9 J	6 J	77	66	8	14	3	1	4	9	13	2	18	11	ND	10	16	6	3	2
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	26	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	2 J	ND	88	81	3	4	5	1	3	3	4	ND	3	3	ND	2	7	2	2	ND
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	6 J	33 J	28	13	2	5	4	3	4	5	5	ND	5	5	ND	4	9	2	1	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	6 J	5 J	51	53	7	8	7	2	8	8	11	2	14	9	ND	8	16	3	3	ND
2-Butanone	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	ND	2 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	18	12 J	ND	ND	2 *	2 *	ND	ND	ND	ND	ND	ND	3	1	ND	1	3	3	ND	ND
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total VOCs	482	469	273	236	38	63	40	27	35	39	52	12	53	37	0	36	84	24	16	7

Notes:
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NA - Not analyzed
ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
6/88 samples collected by TRC.
+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID:	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12	MW-12
COLLECTED:	2/15/94	6/1/94	8/24/94	11/21/94	2/27/95	5/31/95	8/29/95	2/27/96	2/27/96	8/27/96	11/26/96	2/25/97	5/28/97	8/26/97	11/26/97	2/26/98	5/28/98	8/24/98
Acetone	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ND	1	2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	2 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	130	ND	ND	ND	ND
Chloroform	6 J	18	15	7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	10	1	ND	15	74	63	ND	ND	ND	ND	ND	ND	ND	1100	ND	200	290	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	5	33	34	ND	340	ND	ND	ND	ND	500	100	630	520	400	670
1,2-Dichloroethene (total)	48	20	15	56	210	210	450	1100	ND	ND	ND	720	1100	1100	720	600	640	890
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethene	6 J	4	3	8	51	200	650	4600	2400	5200	2400	6100	5400	940	3700	2200	2100	5900
Toluene	ND	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	20	3	3	4	21	320	2000	13000	7400	14000	7800	18000	17000	3000	12000	8300	6400	15000
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	75	50	34	32	57	59	150	650	ND	810	ND	ND	1600	650	1200	910	730	1100
2-Butanone	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	3 J	ND	ND	4 *	11 *	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total VOCs	168	97	72	132	457	886	3250	19690	9800	20010	10200	24820	25600	7020	18250	12730	10560	23560

Notes:
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NA - Not analyzed
ND - Not detected
▨ Compound is detected.

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
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4/92 samples analyzed using GC/MS methods (8010/8020).
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+ - Elevated detection limit due to matrix interference.
2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table 1
ITT SEALECTRO
MAMARONECK, NY

GROUND WATER VOLATILE ORGANIC DATA SUMMARY

SAMPLE ID: COLLECTED:	MW-13 2/15/94	MW-13DU 2/15/94	MW-13 6/1/94	MW-13 8/23/94	MW-13 11/21/94	MW-13 2/27/95	MW-13 5/31/95	MW-13 8/29/95	MW-13 2/27/96	MW-13 5/30/96	MW-13 8/27/96	MW-13 11/26/96
Acetone	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA*
Benzene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Bromodichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Carbon Disulfide	0.7 J	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA*
Chloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Chloroform	ND	ND	ND	9	ND	ND	ND	ND	ND	ND	ND	NA*
Dibromochloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
1,1-Dichloroethane	24	25	ND	ND	4	2	1	9	2	1	4	NA*
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
1,1-Dichloroethene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
1,2-Dichloroethene (total)	ND	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	NA*
Dichloromethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Trans-1,3-Dichloropropene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
1,1,2,2-Tetrachloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Tetrachloroethene	ND	ND	1	ND	ND	1	ND	ND	ND	ND	ND	NA*
Toluene	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
1,1,1-Trichloroethane	ND	3 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
1,1,2-Trichloroethane	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Trichloroethene	2 J	2 J	2	3	2	2	1	2	ND	ND	1	NA*
2-Butanone	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA*
2-Hexanone	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA*
Methylene Chloride	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA*
Styrene	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA*
Vinyl Chloride	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Xylene (total)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA*
Total Petroleum Hydrocarbon (mg/kg)	NA	NA	ND	ND	ND	ND	ND	1	ND	ND	ND	NA*
Total VOCs	26.7	30	3	12	6	6	2	11	2	1	5	--

Notes:
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J - Indicates an estimated value.
D - Identified in analyses at secondary dilution factor.
NA - Not analyzed
ND - Not detected
▨ Compound is detected.
* - Well abandoned 11/14/96

2/92 samples analyzed using GC/MS method (8240).
Other samples analyzed using Method 8010/8020 by OBG Labs.
2/94 Samples analyzed using GC/MS Method (NYSDEC ASP-91-1).
4/92 samples analyzed using GC/MS methods (8010/8020).
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2/94 Samples validated by H2M Labs, Inc.
2/92 and 4/92 samples validated by O'Brien & Gere Engineers, Inc.

Table
ITT Sealectro
Evaluation of Representative VOCs

Monitoring Well	Compound	NYS Class GA Standard (ug/L)	Maximum Concen. (ug/L)	# of Events Compound Detected	# of Events Compound Analyzed	% of Sampling Events Compound Detected	% of Total
MW-2	**Benzene**	1	29	26	30	87	4.5
	Chloroethane	5	18	8	31	26	2.8
	Chloroform	7	1	1	31	3	0.2
	1,1-Dichloroethane	5	123	30	31	97	19.0
	1,2-Dichloroethane	5	20	1	31	3	3.1
	1,2-Dichloroethene (total)	5	63	28	30	93	9.8
	trans-1,3-Dichloropropene	5	56	1	31	3	8.7
	Toluene	5	31	2	31	6	4.8
	1,1,1-Trichloroethane	5	96	6	31	19	14.9
	Trichloroethene	5	9	14	31	45	1.4
	Vinyl Chloride	2	200	29	31	94	31.0
	Total		646				100.0
	Total Representative Compound	***28***	***538***				
MW-2D	Benzene	1	10	2	27	7	0.1
	1,1-Dichloroethane	5	6	7	27	26	0.1
	1,2-Dichloroethene (total)	5	24	9	27	33	0.3
	1,1,2,2-Tetrachloroethane	5	28	1	27	4	0.4
	Tetrachloroethene	5	6500	26	27	96	82.4
	1,1,1-Trichloroethane	5	1300	20	27	74	16.5
	Trichloroethene	5	25	9	27	33	0.3
	Total		7893				100.0
	Total Representative Compound	***25***	***7855***				
MW-3	**Chloroform**	7	6	5	29	17	0.3
	Dibromochloromethane	—	9	6	29	21	0.5
	1,1-Dichloroethane	5	300	28	29	97	15.8
	1,2-Dichloroethane	0.6	17	3	29	10	0.9
	1,1-Dichloroethene	5	670	29	29	100	35.3
	1,2-Dichloroethene (total)	5	49	22	28	79	2.6
	Methylene Chloride	5	4	2	28	7	0.2
	trans-1,3-Dichloropropene	0.4	3	4	29	14	0.2
	Tetrachloroethene	5	18	21	29	72	0.9
	1,1,1-Trichloroethane	5	780	28	29	97	41.1
	Trichloroethene	5	41	20	29	69	2.2
	Total		1897				***100.0***
	Total Representative Compound	***38***	***1893***				
MW-3D	Benzene	5	1	1	26	4	0.1
	Chloroethane	5	4	1	26	4	0.4
	1,1-Dichloroethane	5	39	22	26	85	3.6
	1,1-Dichloroethene	5	81	21	26	81	7.4

able
Sealectro
Evaluation of Representative VOCs

Monitoring Well	Compound	NYS Class GA Standard (ug/L)	Maximum Concen. (ug/L)	# of Events Compound Detected	# of Events Compound Analyzed	% of Sampling Events Compound Detected	% of Total
	1,2-Dichloroethene (total)	5	44	18	26	69	4.0
	Tetrachloroethene	5	420	26	26	100	38.6
	1,1,1-Trichloroethane	5	470	25	26	96	43.2
	Trichloroethene	5	17	21	26	81	1.6
	Methylene Chloride	5	1.2	1	26	4	0.1
	Vinyl Chloride	2	2	1	26	4	0.2
	Xylene	5	9.1	1	26	4	0.8
	Total		1088.3				*100.0*
	Total Representative Compound	*30*	*1071*				
MW-11	Acetone	--	22	1	19	5	2.9
	Benzene	1	20	15	19	79	2.7
	Bromodichloroemethane		1	1	19	5	0.1
	Chloroethane	5	330	14	19	74	43.8
	Chloroform	7	15	2	19	11	2.0
	1,1-Dichloroethane	5	69	17	19	89	9.2
	1,2-Dichloroethene (total)	5	77	19	19	100	10.2
	Dichloromethane	5	26	1	19	5	3.4
	Tetrachloroethene	5	88	16	19	84	11.7
	1,1,1-Trichloroethane	5	33	16	19	84	4.4
	Trichloroethene	5	53	17	19	89	7.0
	Methylene Chloride	5	2	1	18	6	0.3
	Vinyl Chloride	2	18	8	19	42	2.4
	Total		754		19		*100.0*
	Total Representative Compound	*40*	*703*				
MW-12	**Bromodichloromethane**	--	2	2	18	11	0.0
	Chloroethane	5	130	2	18	11	0.5
	Chloroform	7	18	4	18	22	0.1
	1,1-Dichloroethane	5	1100	8	18	44	3.8
	1,1-Dichloroethene	5	630	10	18	56	2.2
	1,2-Dichloroethene (total)	5	1100	15	18	83	3.8
	Tetrachloroethene	5	6100	18	18	100	21.3
	Toluene	5	1	1	18	6	0.0
	1,1,1-Trichloroethane	5	18000	18	18	100	62.7
	Trichloroethene	5	1600	15	18	83	5.6
	Vinyl Chloride	2	11	3	18	17	0.0
	Total		28692				*100.0*
	Total Representative Compound	*44*	*28691*				

Bold Compounds are representative of site conditons and are used to calculate the starting and end points of each decay curve.

Table 3
ITT Sealectro
Monitoring Well Representative Compounds

	MW-2	MW-2D	MW-3	MW-3D	MW-11	MW-12
Benzene	✓				✓	
Bromodichloroethethane						✓
Chloroethane	✓				✓	✓
Chloroform			✓		✓	✓
Dichromochloromethane			✓			
1,1-Dichloroethane	✓	✓	✓	✓	✓	✓
1,2-Dichloroethane			✓			
1,1-Dichloroethene			✓	✓		✓
1,2-Dichloroethene (total)	✓	✓	✓	✓	✓	✓
Methylene Chloride					✓	
trans 1,3-Dichloropropene			✓			
tetrachloroethene		✓	✓	✓	✓	✓
1,1,1-Trichloroethane	✓	✓	✓	✓	✓	✓
Trichloroethene	✓	✓	✓	✓	✓	✓
Vinyl Chloride	✓				✓	✓

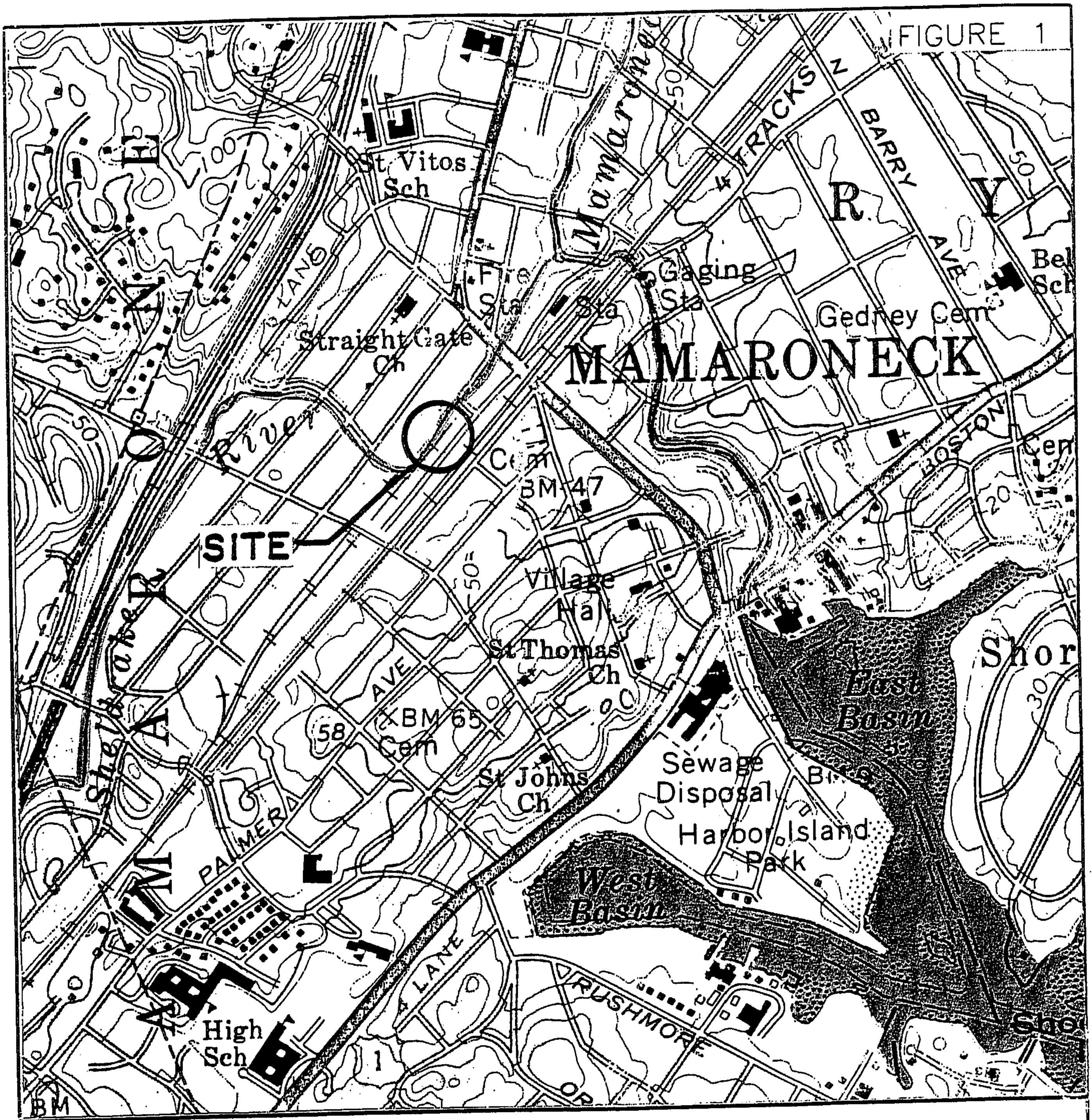
Table 4
ITT Sealectro

Reportable VOCs and Detection Limits
(USEPA Method 8021)

Compound	Dectection Limit
Benzene	<1
Bromodichloromethane	<1
Bromoform	<10
Carbon tetrachloride	<10
Chlorobenzene	<1
Chloroethane	<1
2-Chloroethylvinyl ether	<1
Chloroform	<10
Chloromethane	<1
Dibromochloromethane	<10
1,2-Dichlorobenzene	<5
1,3-Dichlorobenzene	<5
1,4-Dichlorobenzene	<5
Dichlorodifluoromethane	<10
1,1-Dichloroethane	<1
1,2-Dichloroethane	<1
1,1-Dichloroethylene	<1
cis-1,2-Dichloroethylene	<1
trans-1,2-Dichloroethylen	<1
Dichloromethane	<1
1,2-Dichloropropane	<1
cis-1,3-Dichloropropylene	<1
trans-1,3-dichloropropylene	<1
Ethylbenzene	<1
1,1,2,2-Tetrachloroethane	<1
Tetrachloroethylene	<1
Toluene	<1
1,1,1-Trichloroethane	<1
1,2,2-Trichloroethane	<1
Trichloroethylene	<1
Trichlorofluoromethane	<1
Vinyle Chloride	<1
Xylenes	<3

Notes:
Concentrations in ug/L.

FIGURE 1



ITT SEALECTRO
MAMARONECK, NEW YORK

SITE LOCATION MAP

0 1000 2000

SCALE IN FEET

ADAPTED FROM U.S.G.S. QUAD. 7.5 MIN. QUAD. MAP, MAMARONECK, NEW YORK

1/28/93

3356.015.25F

8X11

O'BRIEN & GERE
ENGINEERS, INC.

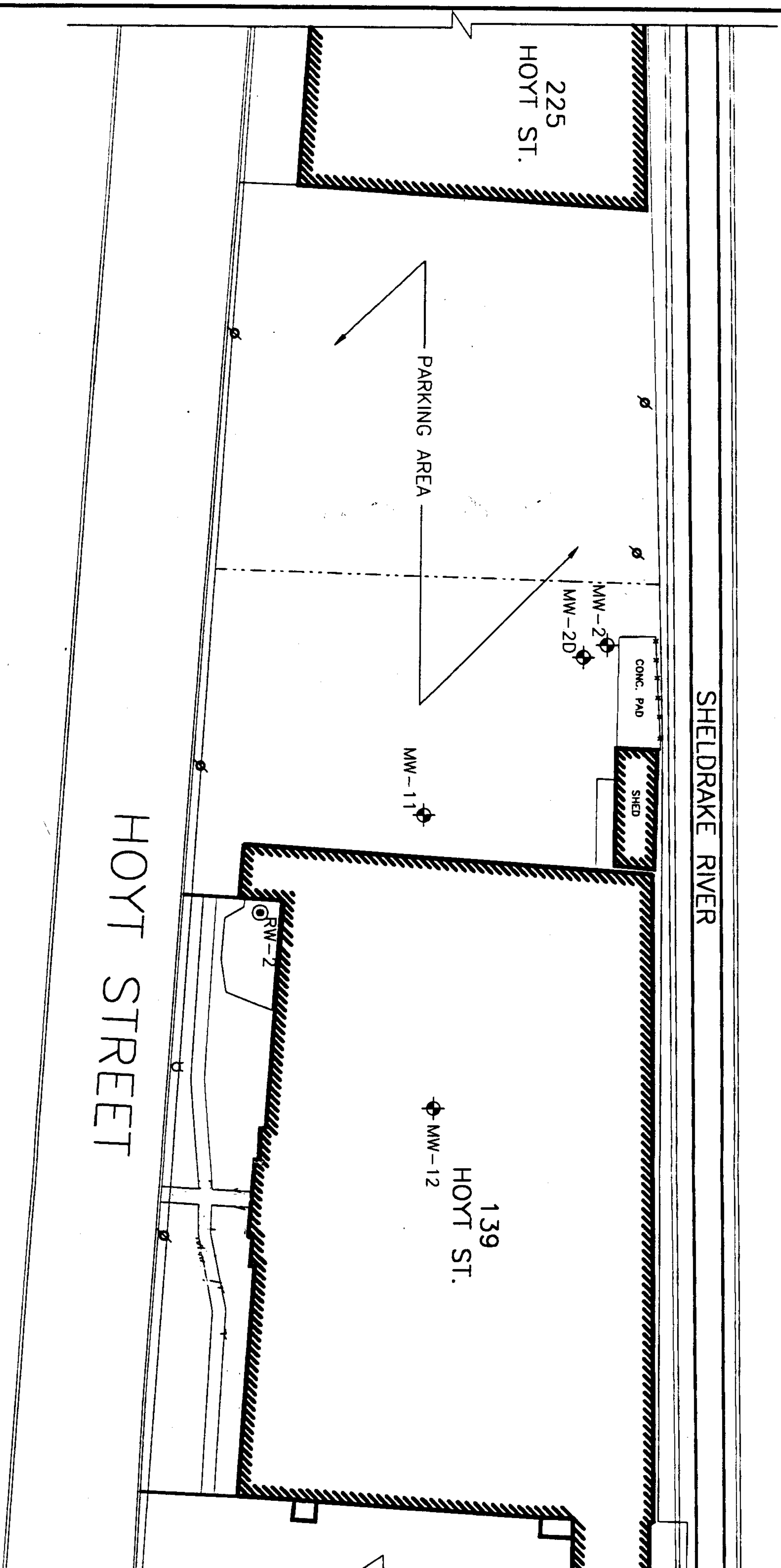
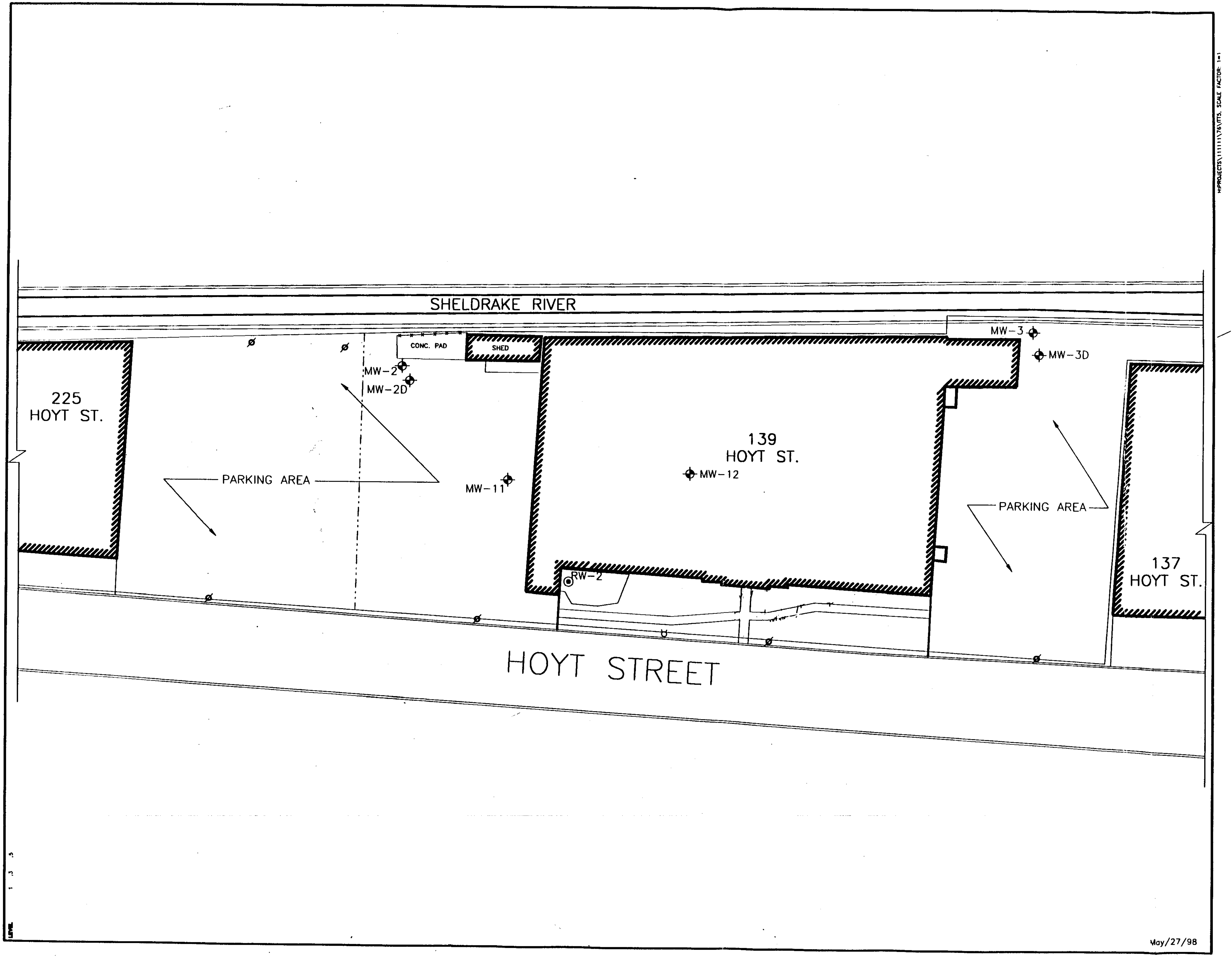

225
HOYT ST.
PARKING AREA
MW-2
MW-2D
CONC. PAD
SHED
MW-11
SHELDRAKE RIVER
RW-2
HOYT STREET
MW-12
139
HOYT ST.

FIGURE 2

ITT SEALECTRO
MAMARONECK, NEW YORK



LEGEND

-·- PROPERTY LINE

⊕ MONITORING WELL LOCATION

⊙ RECOVERY WELL LOCATION

ø UTILITY POLE

MONITORING WELL LOCATION MAP

40 0 40

APPROX. SCALE IN FEET

3356.015-34F

O'BRIEN & GERE ENGINEERS,INC.

FIGURE 3

Total VOC Conc vs Time (MW-2)
ITT Sealectro

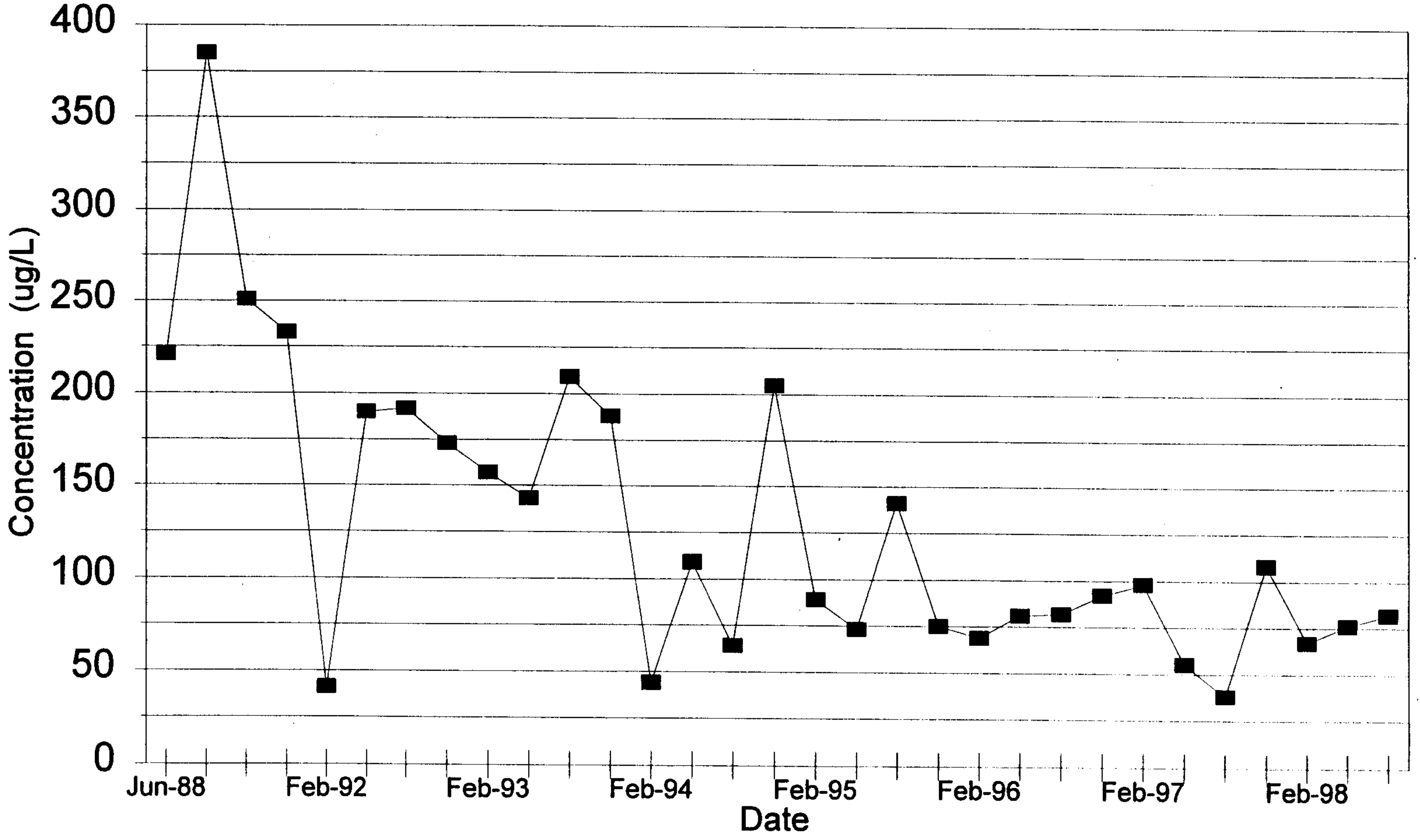


FIGURE 4

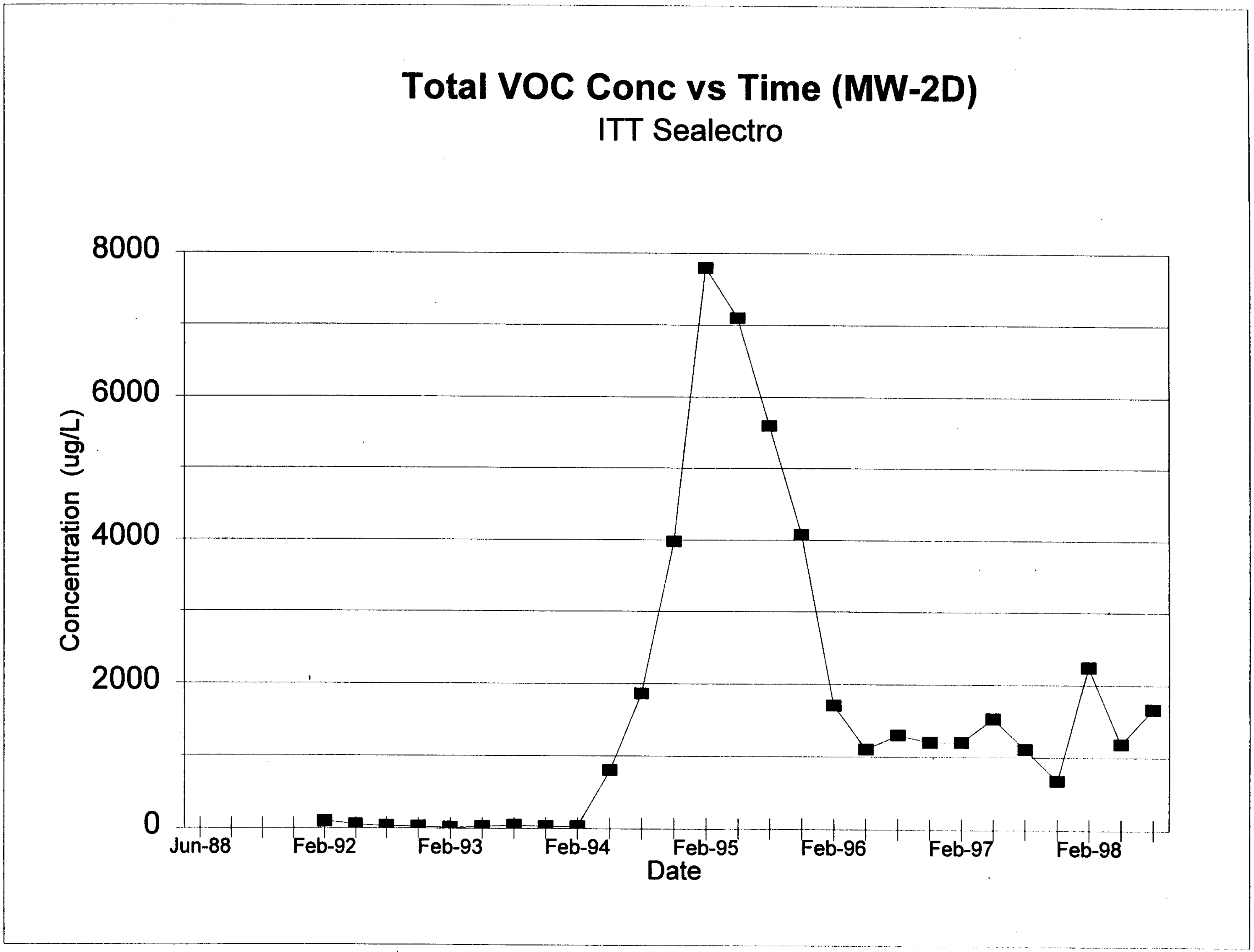

Total VOC Conc vs Time (MW-2D)
ITT Sealectro
Concentration (ug/L)
8000
6000
4000
2000
0
Jun-88
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Date

FIGURE 5

Total VOC Conc vs Time (MW-3)

ITT Sealectro

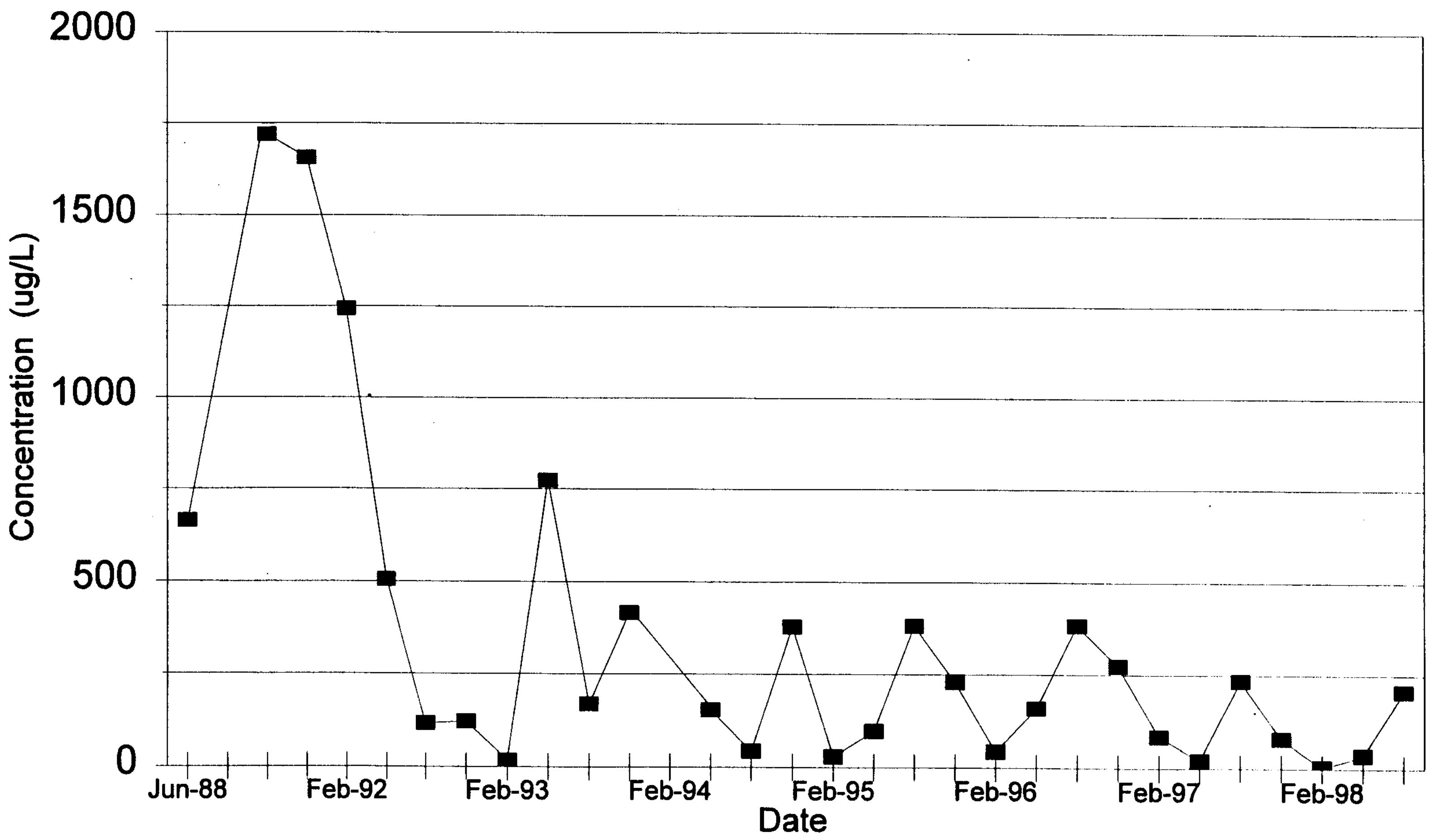


FIGURE 6

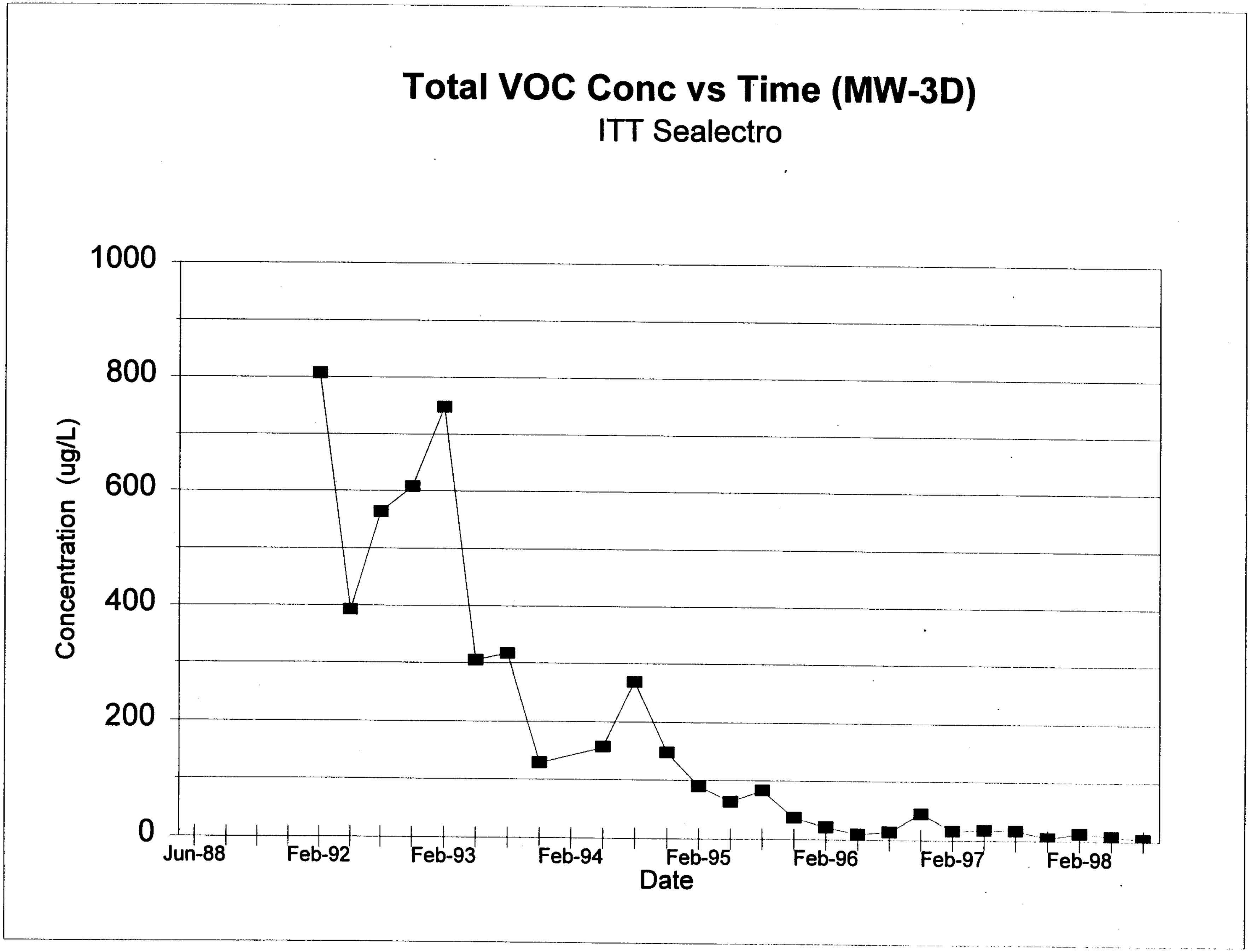
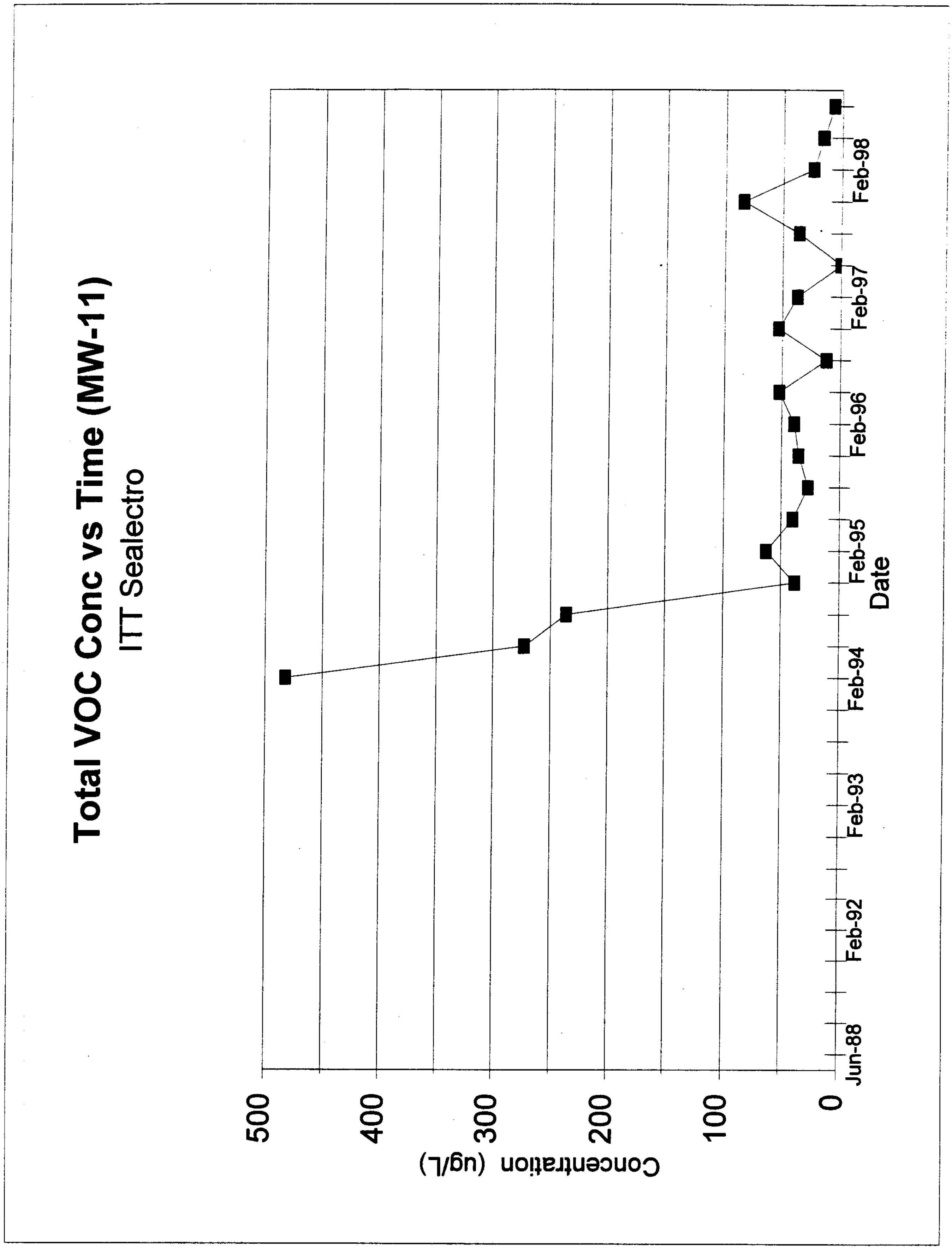

Total VOC Conc vs Time (MW-3D)
ITT Sealectro
Concentration (ug/L)
1000
800
600
400
200
0
Jun-88
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Date

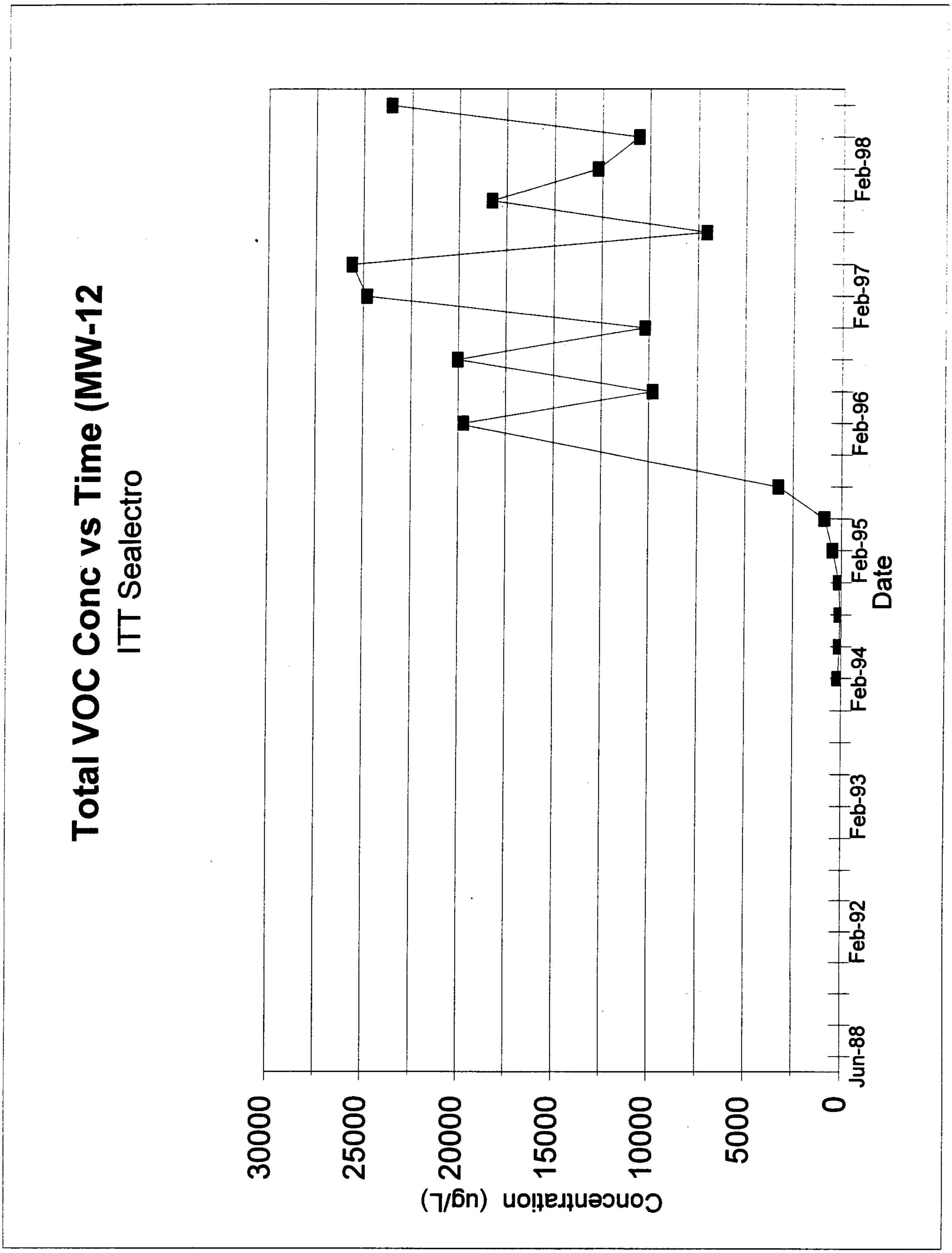
FIGURE 7



Total VOC Conc vs Time (MW-11)

ITT Sealectro

FIGURE 8



Total VOC Conc vs Time (MW-12
ITT Sealectro
Concentration (ug/L)
30000
25000
20000
15000
10000
5000
0
Jun-88
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Date

Annual Trigger Levels
MW-2

Year	Annual Trigger Levels
0	538
1	488
2	442
3	400
4	363
5	329
6	298
7	270
8	245
9	222
10	201
11	182
12	165
13	149
14	135
15	123
16	111
17	101
18	91
19	83
20	75
21	68
22	62
23	56
24	51
25	46
26	42
27	38
28	34
29	31
30	28

Concentrations in ug/L

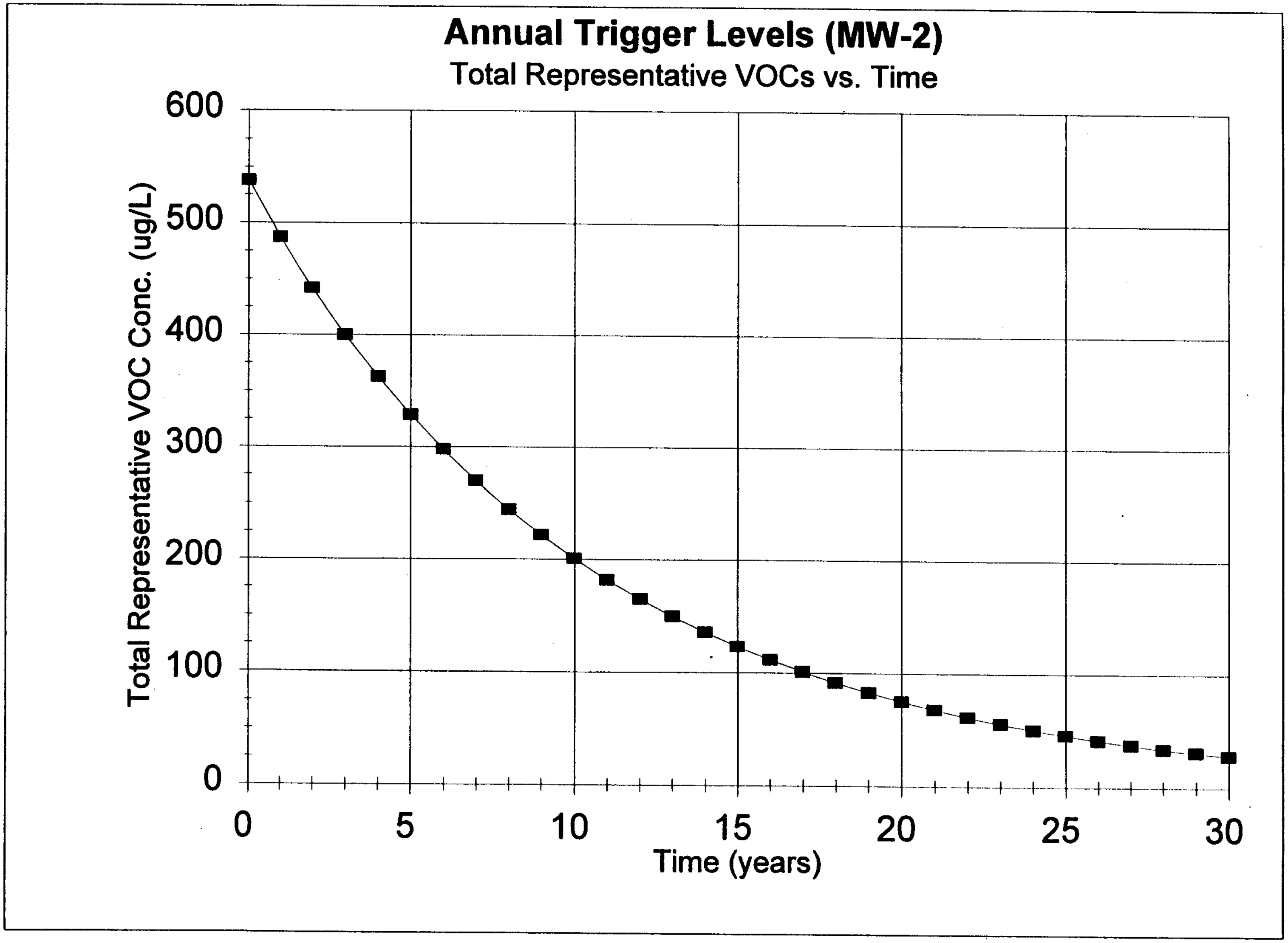


FIGURE 9

Representative compounds include benzene, chloroethane, 1,1-dichloroethane, 1,2-dichloroethene(total),1,1,1-trichloroethane, trichloroethene and vinyl chloride.

Annual Trigger Levels
MW-2D

Year	Annual Trigger Levels
0	7855
1	6485
2	5354
3	4420
4	3649
5	3013
6	2487
7	2053
8	1695
9	1400
10	1155
11	954
12	788
13	650
14	537
15	443
16	366
17	302
18	249
19	206
20	170
21	140
22	116
23	96
24	79
25	65
26	54
27	44
28	37
29	30
30	25

Concentrations in ug/L

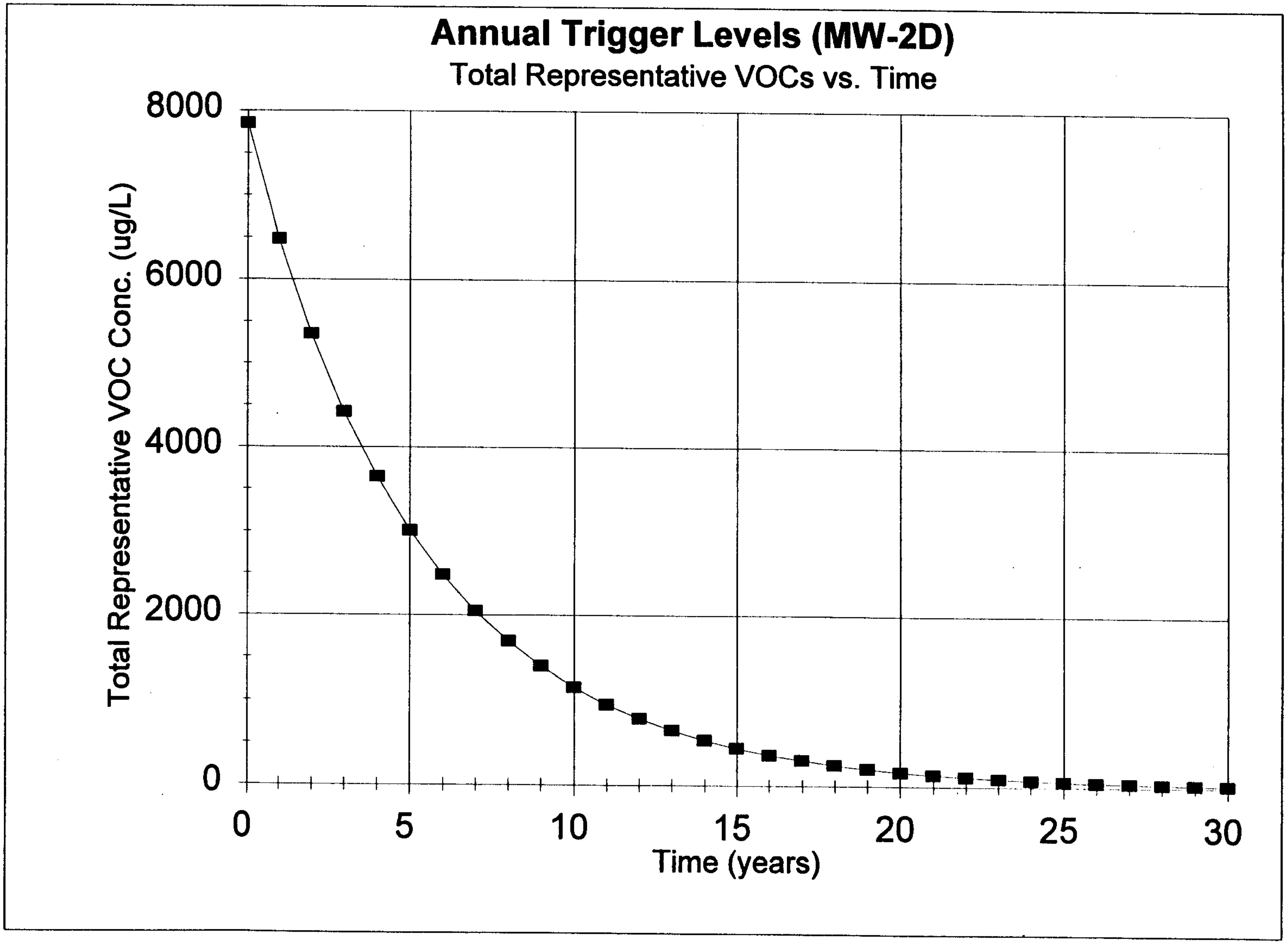


FIGURE 10

Representative compounds include 1,1-dichloroethane, 1,2-dichloroethene(total), tetrachloroethene, 1,1,1-trichloroethane, and trichloroethene

Annual Trigger Levels
MW-3

Year	Annual Trigger Levels
0	1893
1	1662
2	1459
3	1281
4	1124
5	987
6	866
7	760
8	668
9	586
10	514
11	452
12	396
13	348
14	306
15	268
16	235
17	207
18	181
19	159
20	140
21	123
22	108
23	95
24	83
25	73
26	64
27	56
28	49
29	43
30	38

Concentrations in ug/L

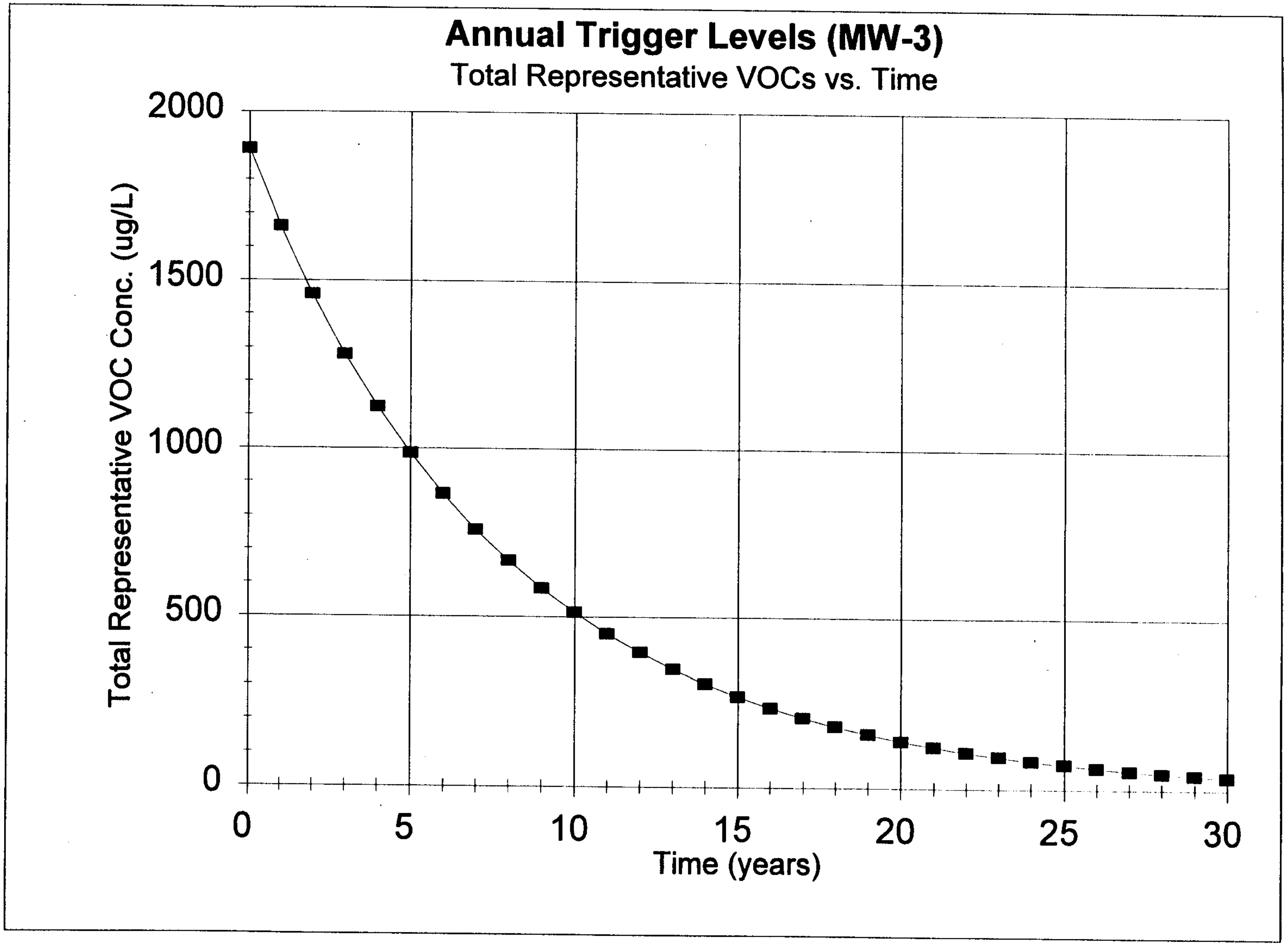


FIGURE 11

Representative compounds include chloroform, dibromochloromethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, trans-1,3-dichloropropene, tetrachloroethene, 1,1,1- trichloroethane, and trichloroethene.

Annual Trigger Levels
MW-3D

Year	Annual Trigger Levels
0	1071
1	951
2	844
3	749
4	665
5	590
6	524
7	465
8	413
9	366
10	325
11	289
12	256
13	227
14	202
15	179
16	159
17	141
18	125
19	111
20	99
21	88
22	78
23	69
24	61
25	54
26	48
27	43
28	38
29	34
30	30

Concentrations in ug/L

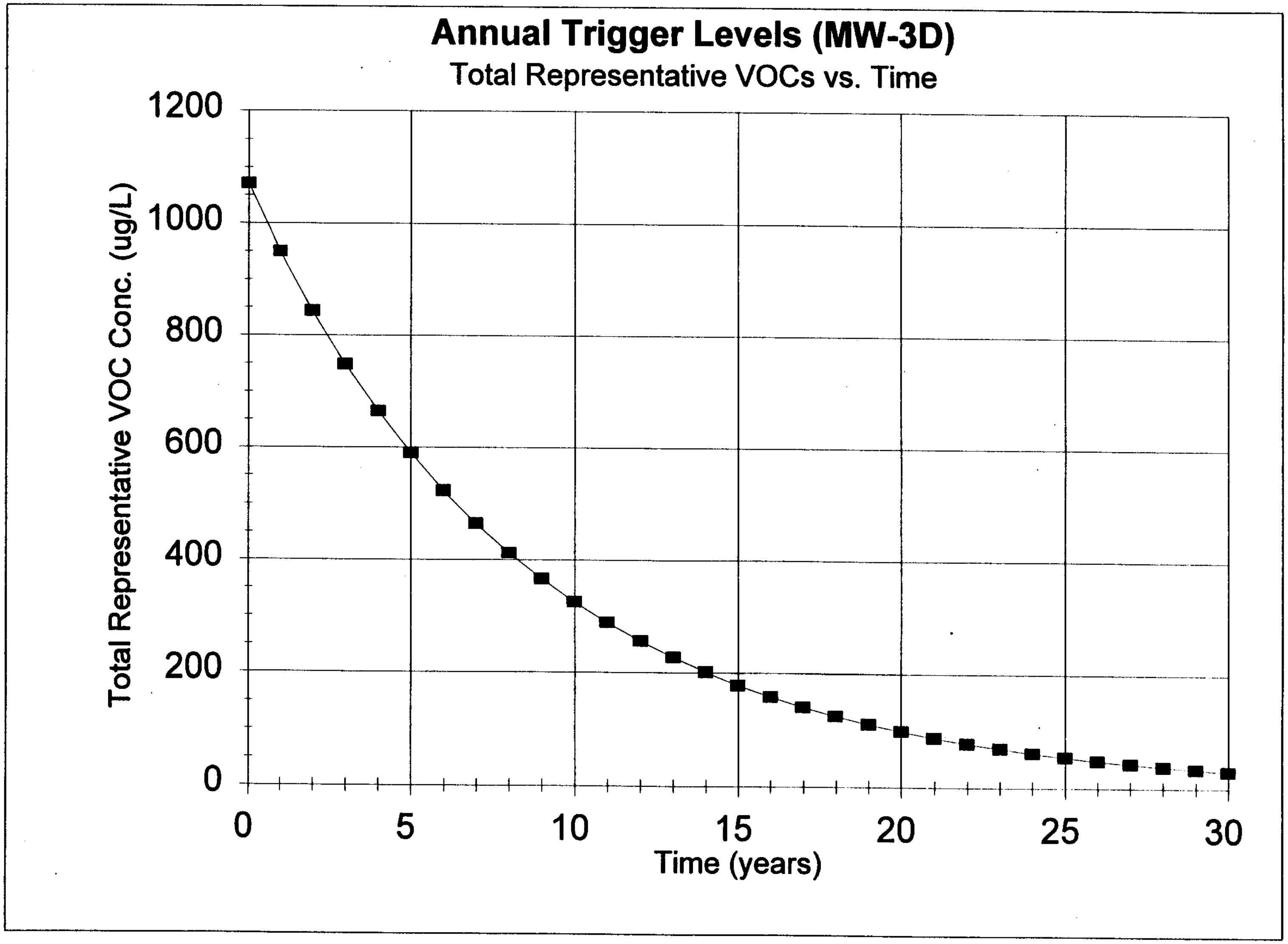


FIGURE 12

Representative compounds include 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene (total), tetrachloroethene, 1,1,1-trichloroethane, and trichloroethene.

Annual Trigger Levels
MW-11

Year	Annual Trigger Levels
0	703
1	639
2	581
3	528
4	480
5	436
6	396
7	360
8	327
9	297
10	270
11	246
12	223
13	203
14	185
15	168
16	152
17	139
18	126
19	114
20	104
21	95
22	86
23	78
24	71
25	64
26	59
27	53
28	48
29	44
30	40

Concentrations in ug/L

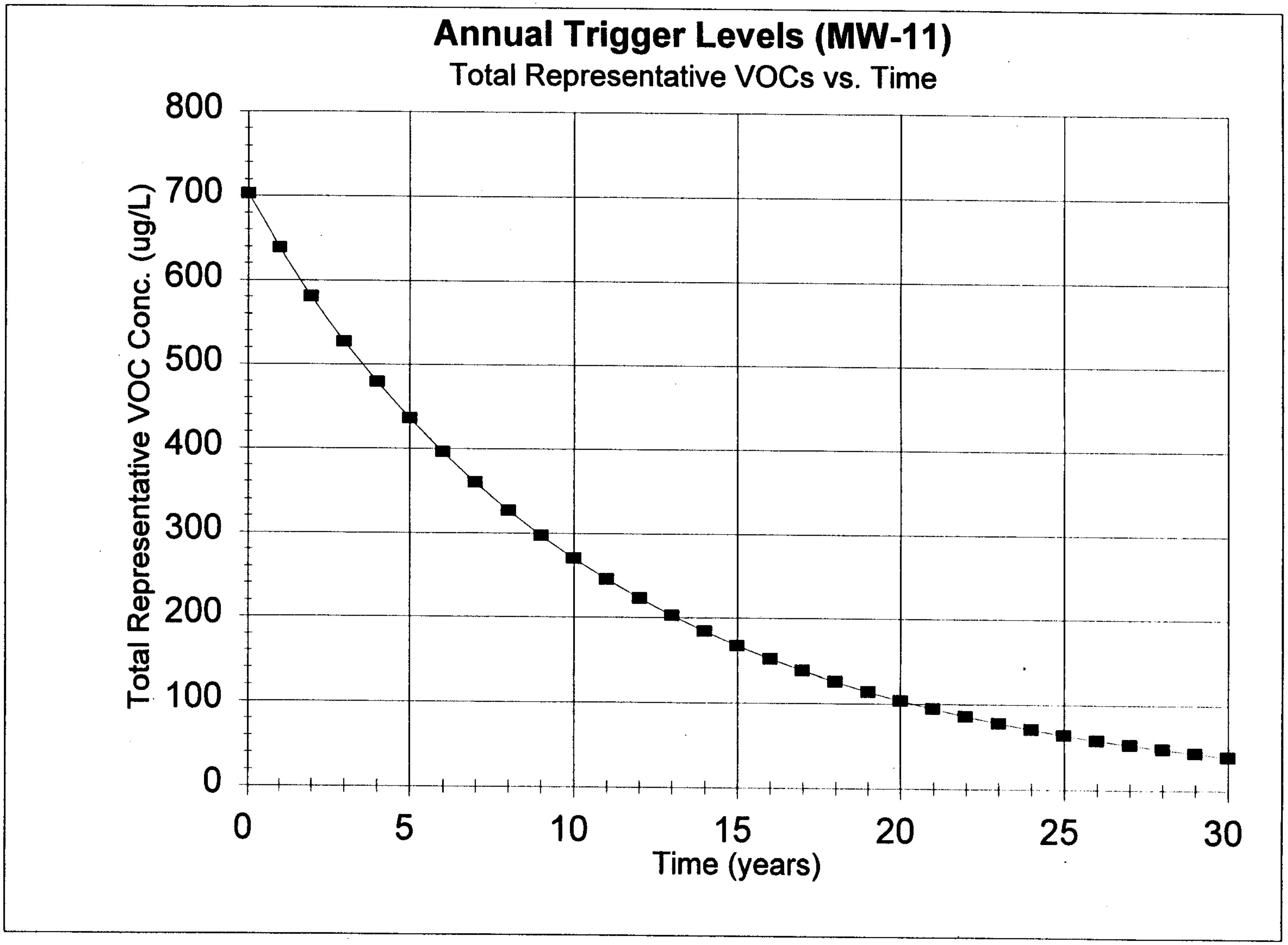

Annual Trigger Levels (MW-11)
Total Representative VOCs vs. Time

FIGURE 13

Representative compounds include benzene, chloroethane, 1,1-dichloroethane, 1,2-dichloroethene, tetrachloroethene, 1,1,1- trichloroethane, trichloroethene, methylene chloride, and vinyl chloride.

Annual Trigger Levels
MW-12

Year	Annual Trigger Levels
0	28691
1	23117
2	18626
3	15008
4	12092
5	9743
6	7850
7	6325
8	5096
9	4106
10	3309
11	2666
12	2148
13	1731
14	1394
15	1124
16	905
17	729
18	588
19	474
20	382
21	307
22	248
23	200
24	161
25	130
26	104
27	84
28	68
29	55
30	44

Concentrations in ug/L

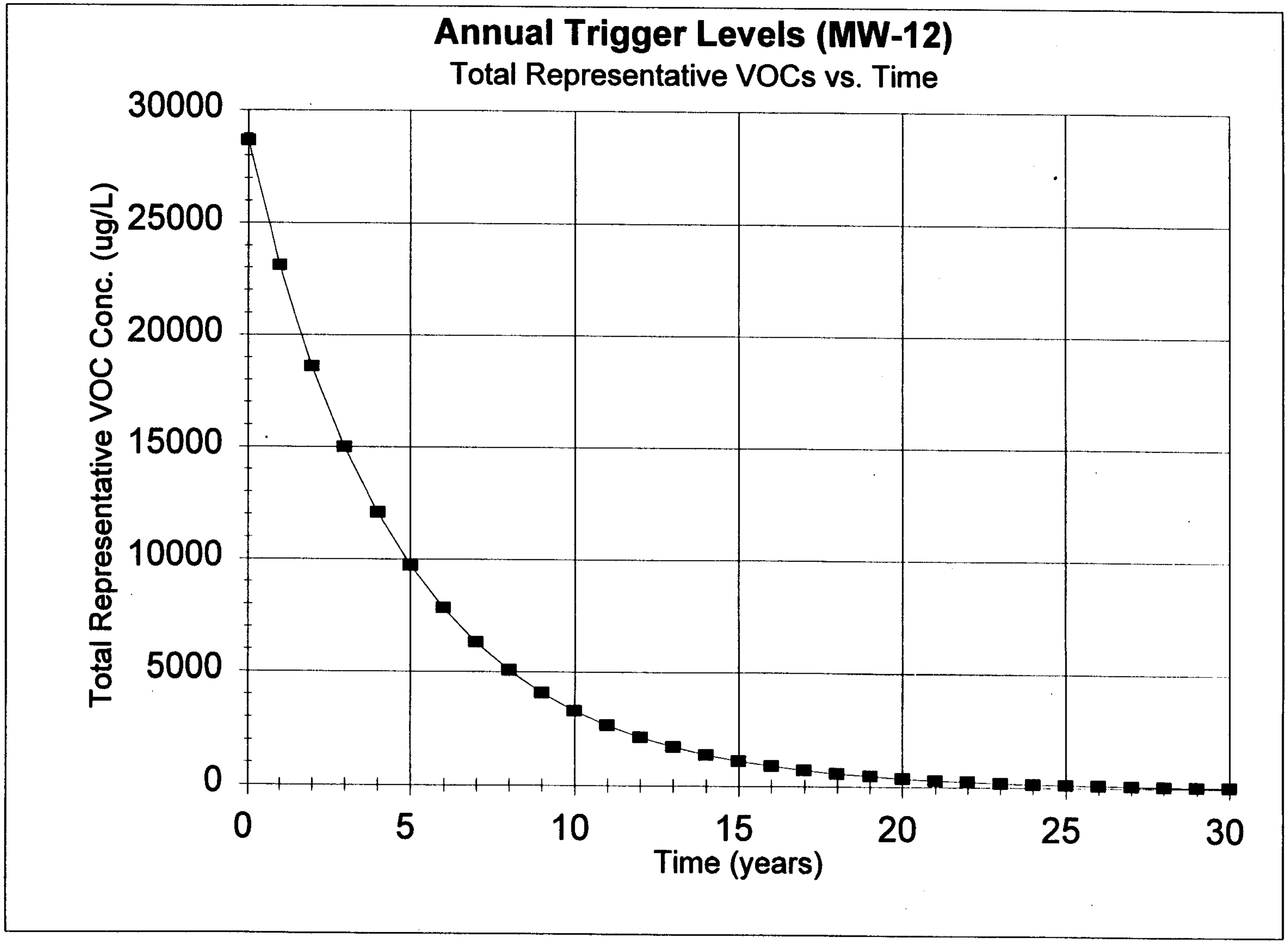

Annual Trigger Levels (MW-12)
Total Representative VOCs vs. Time

FIGURE 14

Representative compounds include bromodichloromethane, chloroethane, chloroform, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene (total), tetrachloroethe
1,1,1-trichloroethane, trichloroethylene, and vinyl chloride.

APPENDIX A

Total VOC Concentrations at RW-2

Table 1
ITT Sealectro

Quantity of VOCs removed
by ground water extraction at RW-2

Date	VOC (mg/l)	Gal/Month	Mass VOCs Removed (kg)	Cum Total Mass VOCs Removed (kg)
10-Apr-92	215	64200	52.31	52.31
30-Apr-92	185	39700	27.84	80.15
12-May- 92	151	8900	5.09	85.24
17-Jun-92	124	59100	27.77	113.02
15-Jul-92	130	46100	22.71	135.73
18-Aug-92	165	47800	29.89	165.62
13-Aug-92	133	59700	30.09	195.72
17-Nov-92	88	28500	9.51	205.22
30-Dec-92	112	18300	7.77	212.99
24-Feb-93	57	32200	6.96	219.94
23-Mar-93	93	22500	7.93	227.88
22-Apr-93	87	27400	9.03	236.91
20-May-93	85	30500	9.83	246.74
16-Jun-93	77	20400	5.95	252.69
29-Jul-93	93	12500	4.41	257.09
25-Aug-93	77	2300	0.67	257.77
24-Nov-93	37	34900	4.89	262.66
14-Dec-93	23	5900	0.51	263.17
1-Jan-94	42.2	26600	4.25	267.43
25-Feb-94	1.171	24400	0.11	267.54
30-Mar-94	30.5	3400	0.39	267.93
25-Apr-94	39.3	2500	0.37	268.30
24-May-94	18	25340	1.73	270.03
30-Jun-94	16.3	33790	2.09	272.12
27-Jul-94	10.8	16350	0.67	272.79
3-Oct-94	9.5	2150	0.08	272.87
26-Oct-94	27.4	13940	1.45	274.31
21-Nov-94	62.1	13160	3.10	277.41
21-Dec-94	68.7	17270	4.50	281.91
31-Jan-95	30.3	2540	0.29	282.20
27-Feb-95	49.67	13960	2.63	284.83
28-Mar-95	55.87	17330	3.67	288.50
24-Apr-95	65.4	8790	2.18	290.67
31-May-95	63.27	56610	13.57	304.25
28-Jun-95	66.6	6240	1.58	305.82
27-Jul-95	69.44	3800	1.00	306.82
29-Aug-95	27.3	5750	0.59	307.42
27-Sept-95	56.44	3180	0.68	308.10
28-Oct-95	36	11710	1.60	309.70
30-Nov-95	2.39	11770	0.11	309.80
30-Jan-96	12.9	4540	0.22	310.03
27-Feb-96	78.4	10650	3.16	313.19
26-Mar-96	2.85	7920	0.09	313.28
22-Apr-96	53.8	3990	0.81	314.09
29-Apr-96	8.4	1830	0.06	314.15

Table 1
ITT Sealectro

Quantity of VOCs removed by ground water extraction at RW-2

Date	VOC (mg/l)	Gal/Month	Mass VOCs Removed (kg)	Cum Total Mass VOCs Removed (kg)
28-May-96	1.84	8630	0.06	314.21
25-Jun-96	2.12	2790	0.02	314.23
30-Jul-96	23.31	1930	0.17	314.40
27-Aug-96	60.3	3650	0.83	315.23
24-Sep-96	51.9	4750	0.93	316.17
19-Nov-96	13.1	4980	0.25	316.42
26-Nov-96	61	2250	0.52	316.94
28-Dec-96	52	7530	1.48	318.42
30-Jan-97	14.2	8420	0.45	318.87
25-Feb-97	2.42	5110	0.05	318.92
31-Mar-97	14.28	6620	0.36	319.28
30-Apr-97	14.2	8680	0.47	319.75
28-May-97	12.5	12070	0.57	320.32
30-Jun-97	6.66	14420	0.36	320.68
29-Jul-97	26.3	6880	0.69	321.37
26-Aug-97	17	4770	0.31	321.68
25-Sep-97	24.2	1760	0.16	321.84
30-Oct-97	32.3	2400	0.29	322.13
26-Nov-97	(5)	4550	0.00	322.13
23-Dec-97	0.655	4650	0.01	322.14
29-Jan-98	(6)	210	0.00	322.14
26-Feb-98	33.98	2200	0.28	322.43
25-Mar-98	24.06	7260	0.66	323.09
26-Apr-98	70.6	1090	0.29	323.38
25-May-98	41.34	20	0.00	323.38
29-Jun-98	19	2000	0.14	323.53
28-Jul-98	51.72	3450	0.68	324.20
25-Aug-98	32.02	4890	0.59	324.80
28-Sep-98	14.4	4960	0.27	325.07
26-Oct-98	14.3	4660	0.25	325.32

(5) The November 1997 influent VOC sample contained sediments and debris which resulted in elevation detection limits and non-representative results. Sediments and debris were caused by maintenance activities conducted in the recovery well during the sampling period.

(6) Sample not collected in January due to system malfunction.

APPENDIX B

Ground Water Sampling Protocol

MONITORING WELL SAMPLING PROCEDURES

The following procedures will be used to obtain representative ground water samples at the site. A low volume pump may be used to evacuate monitoring wells containing more than a few gallons of water.

Sampling Procedures (BAILER)

1. Identify the well and record the location on the Ground Water Sampling Field Log (attached) or in a field book.

2. Put on a new pair of disposable gloves.

3. Cut a slit in the center of a clean plastic sheet, and slip it over the well creating a clean surface onto which the sampling equipment can be positioned. If surface conditions (snow, mud, etc.) create a hazardous or otherwise unacceptable working condition using the plastic, alternate methods must be used to maintain the cleanliness and integrity of the sampling equipment.

4. Using an electric water level indicator graduated to 0.01 feet, measure the depth to the water table and the depth of the well. Record this information on the Ground Water Sampling Field Log. Clean the well depth probe and rinse it with distilled water after each use.

5. Compute the volume of water in the well, and record this volume on the Ground Water Sampling Field Log

6. Attach enough new, clean polypropylene rope to a disposable Teflon bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill it one-half full. The purpose of this is to observe the physical appearance of the ground water and to recover any oily film which may be present at the ground water surface.

7. Pull the bailer out of the well keeping the polypropylene rope off the ground or on the plastic sheet. Empty the ground water from the bailer into a clean glass container and observe its appearance. Record the physical appearance on the Ground Water Sampling Field Log.

   If a bailer is used to purge the well, then proceed with Step 8. If a pump is used to purge the well, then refer to the pump procedures section of this Appendix.

8. Initiate bailing the well from the top of the water table making certain to keep the

polypropylene rope off the ground or on the plastic sheet. The quantity of water removed from the well should be recorded. Water bailed from the monitoring wells will be containerized, placed in Recovery Sump (RW-2) and will be treated by the on-site system.

9. Continue bailing the well until a minimum of three volumes of ground water in the well has been removed, or until the well is bailed dry. Measurements of pH, temperature, conductivity will be collected after each well volume is removed. If the readings of pH, temperature, and conductivity have not stabilized after removal of three well volumes, purging will continue until the readings stabilize, or a maximum of five well volumes, whichever comes first. Sampling will be performed within approximately 1 hour of final purge. Record this information on the Ground Water Sampling Field Log.

10. Remove the sampling bottles from their transport containers, and prepare the bottles for receiving samples. Inspect all labels to ensure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling. Always fill the containers labeled "volatiles" (40 ml VOA bottles) first.

11. To minimize agitation of the water in the well, initiate sampling by lowering the bottom disposable Teflon bailer slowly into the well making certain to submerge it only far enough to fill it completely.

12. If the sample bottles cannot be filled quickly, keep them cool with the caps on until they are filled. The vials labeled "volatiles" should be filled from one bailer, then securely capped. To avoid agitation, carefully fill the 40 ml VOA vials. Cap the VOA vials, turn each vial upside down, gently tap, and check for air bubbles. If properly filled, there should not be visible air bubbles.

13. Record the physical appearance of the ground water observed during sampling on the Ground Water Sampling Field Log.

14. After the last sample has been collected, record the date and time. Fill a beaker with water from the surface of the water table and measure and record the pH, specific conductivity, and temperature. Follow the procedures outlined in the equipment operation manuals. Record this information on the Ground Water Sampling Field Log. The beaker must then be rinsed with distilled water prior to reuse.

15. Begin the Chain of Custody Record.

16. Replace the well cap, and lock the well protection assembly before leaving the well

location.

17. Place the polypropylene rope, gloves, disposable bailer, and plastic sheeting into a plastic bag for disposal.

Purging Procedures (PUMP)

If a centrifugal pump is used to purge the well prior to sampling, the procedures will be modified as follows:

1. Prepare the pump for operation. Place a disposable polyethylene foot valve on new polyethylene tubing. Clean the tubing with distilled water as it is placed into the well.

2. Connect the polyethylene tubing to the Centrifugal pump. Prime the centrifugal pump using potable water. Estimate pump discharge rate using either a flow meter or timing the fill rate of a container of known volume. Pumping should continue until a sufficient volume of water has been removed, as specified in Step 10. Water pumped from monitoring wells will be containerized and placed in the Recovery Sump (RW-2). The pump will be used only to evacuate the monitoring well. A disposable Teflon bailer will be used to collect samples.

3. Proceed to Step 11 of the sampling procedures for collection of samples using a bailer.

GROUND WATER SAMPLING FIELD LOG

SAMPLE LOCATION: ITT Sealectro **WELL NUMBER:**

Sampled By: **Date:** **Weather:** Sunny

Sample Equipment: **Evacuation Equipment:**

A. WATER TABLE

Well Depth:
(below top of inner casing) ______ **ft.**
Depth to water table:
(below top of inner casing) ______ **ft.**
Length of water column(LWC) ______ **ft.**

Well Elevation:
(Rel. Mean Sea Level) ______
Water table elevation
(Rel. Mean Sea Level) ______

2" diameter wells = 0.163 x (LWC) = ______ **gallons**
4" diameter wells = 0.653 x (LWC) = ______ **gallons**
6" diameter wells = 1.469 x (LWC) = ______ **gallons**

B. WELL EVACUATION DATA

		Well Volumes					
	Initial	**1**	**2**	**3**	**4**	**5**	**Sample**
Start Time							
End Time							
Gallons Purged							
Spec. Conduc. (ms/c							
pH							
Temp (C)							
Turbidity (NTU)							
Dissolved Oxygen							
Salinity (%)							

Appearance at start: ______
Appearance at end: ______

Other Observations: ______

Depth to water after purging: ______ **ft. (below top of innner casing)**
Amount of water removed: ______ **gallons**
Depth to water before sampling: ______ **ft. (below top of innner casing)**

Parameters Sampled For: **Sample Time:** ______
VOC/TPH

NOTES: **Field blank collected at this well**

Exhibit 1

USEPA OSWER Directive 9200.4-14

7/31/95

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20450

MEMORANDUM

SUBJECT: Superfund Groundwater RODs: Implementing Change This Fiscal Year

FROM: Elliott P. Laws
Assistant Administrator

TO: Regional Administrators, Regions I - X
Director, Waste Management Division
Regions I, VI, V, VII
Director, Emergency and Remedial Response Division
Region II
Director, Hazardous Waste Management Division
Regions III, VI, VIII, IX
Director Hazardous Waste Division
Region X
Director, Environmental Services Division
Region I, VI, VII

At the recent meeting of Waste Management Division Directors in Kansas City, we discussed the importance of consistent national implementation of the Superfund program. We stressed in particular, Records of Decision (RODs) that you are planing to sign this fiscal year for sites with groundwater contamination.

During our meeting, we discussed the fundamental changes that have occurred in the program's approach to sites with contaminated groundwater where contamination may be "technically impracticable" to restore to drinking water standards (e.g., where contaminants such as dense non-aqueous phase liquids (DNAPLs) warrant our use of a waiver of Federal and/or State clean-up standards (ARARs)). Based on the information now available on the special problems associated with DNAPL sites, OSWER expects that Technical Impracticability (TI) waivers will generally be appropriate for these sites. These situations demand a flexible, phased approach to groundwater remediation such as use of interim RODs, "no action" alternatives, natural attenuation, TI waivers, etc.

To reiterate a major point of our discussion, I expect each Region to employ the TI waiver in appropriate remedy selection documents this fiscal year. I am concerned with preliminary data, indicating that about 30 out of 90 groundwater RODs planned for this fiscal year address sites with DNAPLs, but fewer than 10 TI waivers of ARARs have been planned for these RODs to date. I am concerned that these RODs may not fully reflect the current state of information about sites with DNAPLs present.

Beginning immediately, RODs addressing DNAPL contamination that do not follow the policy in favor of TI waivers at such sites must include written justification for that departure from this policy. If you feel the data are incomplete on whether a TI waiver is justified, or that there is insufficient time this fiscal year to coordinate ROD changes, I am directing you to utilize an interim ROD or to postpone signing the ROD until the data becomes available and/or sufficient coordination among Federal/State/Tribal/community/PRP/other stakeholders can occur. I will adjust regional Superfund accomplishment planning targets accordingly.

Our Superfund policy guidances recognize that we can protect our groundwater resources and, at many sites, remediate large quantities of contaminated groundwater. However, they also identify situations, such as those described above, where technical, time, and cost limitations demand a more limited approach. I want to be sure you are taking command of these critical groundwater remedy selection decisions at both Federal facility and non-Federal facility Superfund sites. I have asked the Headquarters Superfund Regional Coordinators to follow up with Regional staff on this and other key remedy selection issues (land use designation, presumptive remedies, and adherence to lead policy) over the next few weeks.

Please contact me or Steve Luftig at (703) 603-6560 if you have any questions concerning these critical consistency issues.

cc: Steve Herman
Tim Fields
Jim Mathews
Jerry Clifford
Earl Sale
Mike Shapiro
Walt Kovalick
Steve Luftig
Jim Woolford