SHIELD
ENVIRONMENTAL ASSOCIATES, INC.

Semiannual Monitoring Report
February 1999
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

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1.0 Introduction

This *Semiannual Monitoring Report* has been prepared for the Carroll and Dubies (C&D) Superfund Site on behalf of the Carroll and Dubies Superfund Site Potentially Responsible Parties (PRP) Group, by Shield Environmental Associates Inc. (Shield).

This report documents field activities, presents analytical data, and analyzes the data from field work completed between February 9 and February 19, 1999. The documents used as guidance for the field activities were:

- *Field Sampling and Analysis Plan Addendum* (Shield 1998)
- *Final Remedial Design Work Plan Addendum* (Shield 1998a)
- *Quality Assurance Project Plan Addendum* (Shield 1998b)
- *Remedial Action Work Plan, Appendix B, Health and Safety Plan* (Shield 1998c)

Historical data from the *Addendum to Supplemental Hydrogeologic Remedial Investigation* (Remediation Technologies Inc. [RETEC] 1995) and *Preliminary Remedial Investigation Results* (Blasland, Bouck, & Lee, Inc. [BB&L] 1992) have been incorporated into this report.

The remedial activities for this site are separated into two operable units. Operable Unit 1 (OU-1) addresses source control through the remediation of the lagoons. Operable Unit 2 (OU-2) addresses groundwater impacts and remediation. This report covers OU-2 activities only.

A Record of Decision (ROD) for OU-2 was signed by the U.S. Environmental Protection Agency (U.S. EPA) in September 1996. The major components of the selected remedy in the ROD are:

- Monitored natural attenuation of organic contaminants in the groundwater
- Implementation of institutional controls

- Monitoring of the groundwater to evaluate groundwater quality and ensure effectiveness of the remedy
- Water and sediment sampling in Gold Creek

1.1 Site Location and History

The C&D Superfund Site is located in the Town of Deerpark in Orange County, New York (Figure 1). The three-acre site is approximately 3,000 feet northeast of the Port Jervis, New York city limits. In 1971, the site began operating as a disposal facility. Liquid industrial wastes were received from approximately 1971 to 1979. The facility also accepted septic waste and municipal sewage sludge, which were placed into site lagoons until 1989. The majority of wastes disposed of at the site were municipal sewage sludge and septic wastes. Figure 2 shows the details of the site.

The site is situated in the Neversink Valley. An active sand and gravel quarry, an inactive landfill (City of Port Jervis Landfill), and remnants of the former Delaware and Hudson Canal and towpath occupy surrounding areas. Gold Creek lies approximately 1,500 feet to the east, and the Neversink River is located approximately 2,000 feet beyond Gold Creek.

1.2 Site Hydrogeology

Subsurface investigations at the site (BB&L 1992) have delineated three hydrostratigraphic units. The uppermost units have been identified as Pleistocene Age glacial outwash underlain by glacial till (RETEC 1995). The underlying bedrock is the Middle Devonian age Mahantango Formation, the uppermost unit of the Hamilton Group. The outwash unit is generally described as a medium brown, fine- to coarse-grained sand with inclusions of gravel and some cobbles. Color variations include reddish-brown and brownish gray. Very few logs indicate the presence of silt. Where silt is mentioned, it is usually as a trace amount. The till unit is generally described as dark gray, orangish brown, or dark brown silt and sand. Trace amounts of gravel and small sand lenses are reported. The bedrock is generally described as gray, dark gray or black competent shale with horizontal fractures (MW-3) and non-oriented dips of 30 degrees (BW-1) (BB&L, 1992).

Groundwater flow across the site is to the southeast with Gold Creek as the base level, based on the groundwater and surface water elevations. The gradient is very low, with the exception of the western edge of the site, near the bedrock valley wall, in the vicinity of monitoring wells OW-15 and OW-10. Section 3.1 discusses groundwater elevations in greater detail.

1.3 Baseline Groundwater Quality

Previous sampling events (RETEC 1995) have shown that the groundwater at the site has been impacted by organic compounds at concentrations that exceed the Federal Maximum Contaminant Level (MCL) or New York State Department of Environmental Conservation (NYSDEC) water quality standards and guidance values (SGV) for groundwater, or both. Appendices A and B contain summaries of organic analytes that have been detected in groundwater.

Based on the findings of the remedial investigation/feasibility study (RI/FS) and the selected remedy, inorganic constituents are not part of the ongoing sampling and will not be discussed in this report.

In the outwash or outwash/till, the area down gradient of Lagoons 1 and 2 has been impacted by benzene, 1,2-dichloroethene, trichloroethene, and tetrachloroethene. With the exception of OW-13, the area immediately down gradient of former Lagoons 3 and 4 has not been impacted above MCLs or SGVs. OW-13 contains concentrations of benzene, vinyl chloride, and 1,2-dichloroethene that exceed standards. The major area of impact within the outwash/till interval lies down gradient of former Lagoons 6, 7, and 8. Contaminants that have exceeded standards include benzene, xylenes, isophorone, vinyl chloride, phenol, naphthalene, bis(2-chloroethoxy) methane, ethylbenzene, and chlorobenzene.

Within the till and bedrock there were no organic compounds reported above the MCLs or SVGs.

1.4 Work Plan Variations

During this round of field activities, the minor variations from the work plans are listed below, followed by a brief explanation:

- Monitoring wells OW-12, OW-14, and OW-20 were plugged and abandoned - The abandonment of monitoring wells OW-12, OW-14, and OW-20 was necessary for OU-1 construction activities, to eliminate the possibility of the wells becoming damaged and acting as potential conduits for contamination. OW-10 and OW-11, both close to the former OW-12 and OW-14, will provide coverage in this area. OW-21 is downgradient from the former OW-20 and will provide monitoring coverage.

Disposable ?
Re-used ?

- Daily field blanks were not collected - Seven trip blanks (one each per sample cooler) were analyzed along with the groundwater, surface water, and sediment samples, although daily field blanks were not collected. The failure to collect field blanks was an oversight on the part of the sampling team. However, since the sample collection was done in cold weather and there were no earthmoving activities in progress, it is unlikely that volatile or semivolatile organics were present in the ambient air.

- An equipment blank was not collected during sediment sampling - Since the sediment samples were collected directly with the sample jar, an equipment blank was not necessary.

- Laboratory-selected samples were used for matrix spike/matrix spike duplicates (MS/MSDs) rather than samples from the site - Selection of samples by the laboratory for MS/MSD analysis is an acceptable quality control practice. Samples selected by the laboratory for MS/MSD analysis serve the same quality assurance function as site-specific MS/MSD samples, which is to evaluate the effect of the sample matrix on analytical results. MS/MSD results were within specified quality control limits.

- Ferrous iron was analyzed in the laboratory rather than in the field - The laboratory method for analysis of ferrous iron uses the same reagent chemistry as the Hach® field kit, and the appropriate holding times were met. Therefore, the results are comparable to what would be expected using field analysis.

- Hydrochloric acid (HCl) was added to the volatile organic analysis (VOA) vials by the laboratory before shipment, rather than by the field team - The use of pre-preserved VOA vials did not compromise the data as all samples were at a pH of ≤2 as tested at the laboratory upon arrival. Placement of acid in the VOA bottles by the laboratory before shipment to the field, rather than sample acidification in the field, is the more common practice today. It eliminates the need by the field team to transport and handle a concentrated acid.

2.0 Initial Sampling Event Preparation Activities

Several field activities were conducted prior to sampling activities, including a well survey, selected well abandonment, redevelopment of network monitoring wells, and installation of dedicated sampling pumps. These activities are described in the following sections.

2.1 Well Survey

A site survey was completed by a New York State Registered Professional Land Surveyor. This survey was performed to establish baseline coordinates and locate site features in support of both OU-1 and OU-2 activities. Control was established locally on the ground. The ground control was tied with two local survey monuments for global longitude, latitude, and elevation through first-order dual-frequency global positioning system (GPS) instrumentation.

Each monitoring well horizontal location was surveyed to the center of the protective steel cap. Three elevations were measured for each monitoring well. For monitoring wells with above-grade completions, these elevations included the top of the protective cover, the top of the polyvinyl chloride (PVC) riser pipe at the marked measuring point, and the ground elevation. For monitoring wells completed as flush-mount wells, these elevations included top of the flush-mount cover (ground surface), top of the internal locking steel cap, and the top of the PVC riser pipe at the marked measuring point. In the case of TW-3, the well had already been abandoned at the time of the survey so the center point of the hole was surveyed for horizontal and vertical coordinates.

The elevations are based on the 1988 National Geodetic Vertical Datum. The use of this vertical datum, as opposed to the 1929 datum used in previous surveys, accounts for the difference in top of casing elevations between this and previous reports. The average change in monitoring well top of casing elevations from earlier surveys to this survey is minus 0.69 foot.

It was noted during the survey that a domestic type water well is located approximately 15 feet south southwest of MW-5, on what is believed to be City of

Port Jervis property. When asked about the well, Mr. Joe Carroll recalled that a developer installed the well several years ago, but that it has never been used.

2.2 Well Abandonment

A total of 12 monitoring wells were abandoned between February 9, 1999 and February 19, 1999. In accordance with the *Final Remedial Design Work Plan*, the TW series wells and the BW series wells were abandoned. None of the wells that were abandoned were found to be damaged. Monitoring wells MW-3 and MW-5 were also abandoned because they were not part of the monitoring network. Monitoring well MW-2 was previously abandoned in 1990 by Blasland & Bouck Engineers, P.C. The location of this abandoned well was surveyed along with the other abandoned wells in February 1999. Monitoring wells OW-12, OW-14, and OW-20 were also abandoned to facilitate construction during the OU-1 remedial action. Table 1 summarizes the details of monitoring well abandonment.

The wells were abandoned in one of two methods. Prior to initiating either method, the PVC well casing was tremie-grouted to the surface with a five percent (5%) bentonite grout. For single-cased wells, the protective steel cover and pad were pulled. For double-cased wells, the protective steel cover was cut off flush with the surface after drilling and plugging were completed.

All of the wells that were single-cased were abandoned by overdrilling with 4¼-inch hollow-stem augers. The lead auger was equipped with a steel center guide to keep the boring centered on the well casing. A reamer was attached at the base of the center guide to keep the augers from filling with cuttings. The boring was advanced to the total depth of the well or until refusal was encountered. Refusal was defined as advancing the boring less than 6 inches in 30 minutes. The minimum depth reached by overdrilling was 20 feet in TW-3. As the augers were removed, the borehole was grouted through the augers. Initially, grout was tremmied into the augers to the surface. Then as the augers were removed and the grout level fell, additional grout was placed in the augers. This procedure was repeated until the final auger was removed. The top of the hole was then grouted flush with the surrounding ground surface.

For doubled-cased wells (BW-1 and OW-20), the wells were drilled out with a roller bit. The wells were outer cased with 5-inch inside diameter (ID) steel casing. The inner casing was 2-inch ID PVC. A 3⅞-inch roller bit was used.

Drilling was completed to total depth or refusal as defined above. The drill string was removed from the well and the boring was tremmie grouted to the surface.

All water used for drilling and mixing of grout was obtained from the City of Port Jervis Department of Public Works fire hydrant located at 1 Franklin Street.

All wastewater generated as drilling fluid or from decontamination of drilling equipment was containerized in drums, labeled, and stored on site. This water will be treated through the on-site water treatment system during OU-1 activities. All drill cuttings were placed on poly sheeting and covered. This soil, along with the surface protective casings, will be disposed of during OU-1 activities.

2.3 Redevelopment of Network Monitoring Wells

The wells identified for the monitoring network (Table 2) were redeveloped as described below, before the dedicated pumps were installed and groundwater samples collected. Redevelopment of the wells was deemed necessary because the wells had not been sampled since April 1995. Redevelopment removed accumulated sediment and helped ensure that the maximum screen interval was clean and open.

Prior to redevelopment, each well was measured for depth to water and total depth with a Solinst® water level measuring probe. The measured total depth was compared to historical data for confirmation that the well was open to total depth. The protective steel casing, concrete pad, and PVC casing were visually inspected for signs of damage. The visual inspection, along with the total depth data, was used to determine that the structural integrity of the well was not compromised.

Monitoring well OW-22, which was installed in the old City of Port Jervis Landfill, was hand-developed using a new disposal bailer. The well was surged with the bailer and water removed for a period of two hours. The well did not bail dry. An odor, similar to raw sewage, was reported during development and a sheen was observed on the water recovered. This was the only well with a noticeable odor, which may be due attributable to its location. OW-22 groundwater quality has potentially been affected by both the lagoons and the landfill.

The remaining wells were developed using a Waterra® inertial pump system. The Waterra system is comprised of a motorized unit with a reciprocating arm that moves up and down in line with the well casing. Before placing the pump, the total depth and sediment thickness was measured in each well. Then a piece of a one-half-inch high-density polyethylene (HDPE) black roll tubing with a foot valve at the bottom was lowered to just above the bottom of the well casing and attached to the reciprocating arm. New tubing and a new foot valve were used for each well to eliminate the possibility of cross contamination. The motor was turned on and the motion of the tubing acted as a piston pump, surging the well and removing water at the same time. The strokes per minute of the motor were adjusted to achieve a pumping rate between 20 and 25 gallons per hour. Each well was pumped for two hours. The discharge was clear when redevelopment was complete. The depth to the bottom of the well was measured again after redevelopment, to check that the sediment had been removed.

All redevelopment water was containerized in drums, labeled, and stored on site. This water will be treated through the on-site water treatment system during OU-1 activities.

2.4 Installation of Dedicated Sampling Pumps

After the network monitoring wells were developed, dedicated sampling pumps were installed in the wells. The pumps are pneumatically operated bladder pumps manufactured by QED Environmental Systems, Inc. The bodies of the pumps are constructed of PVC with Teflon® internals.

The pumps were pre-assembled, individually packaged, and labeled by the manufacturer specifically for the well in which they were to be installed. The assembly included the pump body, discharge and air supply tubing cut to length, and the pump cap. Each pump unit had with it a certificate declaring that the pump had been tested for U.S. EPA priority pollutant volatile and semivolatile compounds and the pump was found to be free of contaminants. Copies of the pump certificates and supporting analytical data packages are included in Appendix C.

The pumps were carried to the wells in the factory packaging. A new pair of latex gloves was put on by the installer before unwrapping the pump. Immediately upon unwrapping the pump, it was inserted into the well. Special care was taken to ensure that the pump body, tubing, and cap did not contact the ground.

Installation of the pump required a minimum of approximately 0.3 foot of clearance between the top of the PVC riser and the cover for the cap and fittings. Because of this clearance requirement, the PVC riser had to be cut down in some wells. The installation of the pumps occurred after the wells were surveyed. To determine the change in elevation for the groundwater level measuring point, a measurement was first made from the top of the PVC at the survey point to a straight edge placed across the open top of the protective steel casing or flush mount. The pump was inserted and the cap seated on the PVC riser. A second measurement was then made from the top of the cap to the reference straight edge. The difference was added to the survey elevation. For the wells where the PVC riser needed to be trimmed, the initial measurement was made as above. The PVC riser was then cut off and the pump installed. A second measurement was made to the reference straight edge. The difference was then subtracted from the survey elevation. The adjustments made to the survey elevations are shown in Appendix D. The final measuring point elevations have been used to determine groundwater elevations.

3.0 Semiannual Monitoring Activities

This section outlines the procedures used for field sampling and monitoring activities, including measurement of groundwater elevations, collection of groundwater samples, measurement of field parameters in groundwater, surface water sampling, and sediment sampling. The results and interpretation of the semiannual monitoring program are provided in Section 4.0.

3.1 Groundwater Elevations

Groundwater elevations were determined based on measured depths to water from the adjusted reference point elevations before sampling began. The depth to groundwater was measured using a Solinst® water-level meter and recorded to the 1/100th of a foot.

→ [illegible]

3.2 Monitoring Well Sample Collection

Dedicated low flow purging and sampling pumps were installed and utilized to sample the monitoring wells. After stabilization procedures were completed for each monitoring well, groundwater samples were taken directly from the ⅜-inch inner diameter Tygon® tubing dedicated to each respective well pump.

All monitoring wells maintained 0.3 foot of drawdown or less during purging and stabilization except OW-15. Depth to water exceeded the maximum drawdown of 0.3 foot during pre-sampling stabilization of OW-15; however, the pump discharge rate was maintained within the required less than 250 milliliters per minute (mL/min) range.

During purging of each monitoring well, temperature, dissolved oxygen (DO), redox potential, specific conductance, pH, and turbidity were monitored and recorded in the field notebook in 5-minute or greater intervals. The wells were pumped for periods ranging from 25 to 51 minutes, until most field parameters stabilized. The goal was for three consecutive readings of field parameters within the following ranges:

- ±0.1 for pH
- ±3% for specific conductance (conductivity)
- ±10 millivolts (mV) for redox potential (redox)
- ±10% for DO → larger range
- ±10% for turbidity → tight

A range was not established for temperature, however, consistent temperature readings were also utilized as an indication that a monitoring well had reached stabilization.

Specific conductance, pH, and temperature all reached stabilization by achieving three consecutive readings within the established ranges. However, in a number of cases, redox, DO, and turbidity did not reach the recommended stability ranges for three consecutive readings, indicating that for future sampling, the purge period should be extended.

Groundwater purged from the majority of monitoring wells in preparation for sampling was relatively clear and contained little to no detectable sediment-suspended particles. A strong sewage-like odor was detected during stabilization and sampling of OW-22, installed in the old City of Port Jervis Landfill. In addition to an odor, a sheen was observed on the groundwater in the purge water container. These conditions are potentially attributable to the landfill as well as the lagoons. A similar sheen, potentially attributable to the landfill, was also observed during purging and sampling of OW-21; however, no odor was detected.

All groundwater samples were collected at a flow rate between 100 and 250 mL/min. The drawdown rate during sampling did not exceed 0.3 foot, except in OW-15. The low flow sampling pumps allowed all samples to be collected with minimal turbulence.

Samples submitted for volatile organic compound (VOC) analysis were preserved with one-to-one (1:1) HCl that had been placed in the vials by the analytical laboratory.

3.3 Groundwater Field Parameters

Groundwater field parameters were measured with a YSI Model 6920 flow-through cell calibrated daily prior to sampling activities. Field parameters measured and recorded included:

- Temperature (°Celsius [C])
- DO (milligrams per liter [mg/L])
- Redox potential (mV)
- pH (standard units)
- Specific conductance (umhos/cm)
- Turbidity (nephelometric turbidity units [NTU])

Temperature

A range for temperature fluctuations was not established in the *Field Sampling and Analysis Plan Addendum* (Shield 1998); however, protocol for future semiannual monitoring events will be a maximum fluctuation of 1°C for three consecutive readings. Fluctuations of temperature were less than 1°C for a minimum of three consecutive readings, prior to sampling all of the monitoring wells. Groundwater temperatures ranged from about 8 to 12°C.

Dissolved Oxygen

DO concentrations stabilized for a minimum of three consecutive measurements within the recommended ±10% range in monitoring wells OW-13 and MW-1. DO concentrations did not reach the stabilization requirements in the remaining monitoring wells prior to sampling, which may have affected the reliability of the readings. DO is an important parameter in the interpretation of natural attenuation trends. DO readings across the site ranged from 1.26 to 5.76 mg/L.

Redox

Redox stabilized within the recommended ±10 mV range for three consecutive measurements for monitoring wells MW-1, OW-5, OW-10, OW-13, OW-15, OW-19, and OW-22. The remaining monitoring wells did not reach the recommended stabilization for redox potential prior to sampling, which may have affected the reliability of the readings in the affected wells. Redox is also an important parameter in the interpretation of natural attenuation trends. A wide range of redox readings were found in the wells, varying from -33 to 261.6 mV.

pH

A minimum of three consecutive readings for pH within the recommended +0.1 range was achieved for all monitoring wells prior to sampling. Groundwater samples were within the pH 5 to 6 range.

Specific Conductance

A minimum of three consecutive readings for specific conductance was achieved within the recommended ±3% range for all monitoring wells prior to sampling. Specific conductance varied from greater than 1,500 umhos/cm to less than 150 umhos/cm across the site.

Turbidity

The turbidity function on the YSI Model 6920 Meter flow-through cell malfunctioned during stabilization of OW-21. The meter consistently exhibited a reading of 1,389.9 NTU. After sampling of OW-21 was completed, attempts to clean the optics with deionized water did not result in a reading other than 1,389.9 NTU. Despite being cleaned and recalibration attempted twice, the meter continued to display a turbidity reading of 1,389.9 NTU on subsequent stabilizations performed on monitoring wells OW-13 and OW-16. For most of the monitoring wells where turbidity readings were attainable, the turbidity was less than 100 NTU.

Turbidity readings stabilized within the recommended ±10% for a minimum of three consecutive measurements prior to sampling in monitoring wells OW-5, OW-10, OW-15, and OW-22. Turbidity readings did not stabilize for a minimum of three consecutive readings prior to sampling the remaining monitoring wells.

3.4 Surface Water Sampling

Two surface water samples were collected from Gold Creek. These samples are identified as SW-1, the downstream sample, and SW-2, the upstream sample. The survey stake from previous sampling at the SW-2 location was found and the sample was collected at the same spot. The survey stake for the downstream location from the previous sampling event was not found, therefore another location was selected in approximately the same area. The SW-1 and SW-2 locations were surveyed and are indicated in Figure 2.

Samples were collected in accordance with the *Field Sampling and Analysis Plan* for VOCs and semivolatile organic compounds (SVOCs), except that the SVOCs container was used to collect the samples at each location rather than a separate container. Water was transferred to the VOC sample vial from the SVOC container. The SVOC bottle was placed back into the water, and the bottle was filled. The sample bottles were labeled appropriately and placed in a cooler with ice.

3.5 Sediment Sampling

Two sediment samples were collected from Gold Creek. These samples, identified as Sed 1 and Sed 2, are identified in Figure 2, and coincide with surface sample locations SW-1 and SW-2. The samples were collected at the sediment/water interface.

The sampling protocol calls for the sample to be collected with a stainless steel trowel or scoop, decontaminated in accordance with the procedures outlined in the *Field Sampling and Analysis Plan Addendum.* The acetone, which is a step in the decontamination procedure, was spilled in transit to the site and was therefore not available. Since proper decontamination could not be done, the samples were collected directly into the sample containers. The sample jar was opened and carefully scraped along the sediment surface until full, penetrating to a depth of approximately one inch. Excess water was drained from the sample jar before replacing the lid. The sample bottles were then labeled appropriately and placed in a cooler with ice. A rinsate (equipment) blank was not collected because the samples were collected directly into the sample jars.

4.0 Sampling Results

4.1 Groundwater Elevations

The groundwater elevations for this sampling round are presented in Table 2. Figure 3 shows site monitoring wells, and Figure 4 shows the groundwater elevation contours.

[illegible]

The groundwater flow direction is toward the southeast in the direction of Gold Creek. The average gradient is 0.0005 foot per foot (ft/ft), excluding monitoring wells OW-15 and OW-10, where the average gradient is 0.0936. The steeper gradient on the western side of the site is due to the depth to bedrock along the valley wall. It is known that the bedrock elevation in the vicinity of OW-15 is shallower than across the rest of the site (RETEC 1995). The bedrock elevation at OW-15 is approximately 433 feet, which is at or above the groundwater elevation of most of the wells. As the depth to bedrock increases towards the valley floor, the alluvial fill increases and the groundwater gradient flattens to reflect the surface topography.

4.2 Groundwater Quality

The groundwater analytical results from the February 1999 sampling event confirm the prior indications that groundwater at the site has been impacted by organic compound concentrations that exceed either MCLs or SGVs, or both. Groundwater analytical data from the February 1999 sampling event are presented in Tables 3 and 4. Historical data of detected organic compounds have been combined with the most recent data and are presented in Appendices A (VOCs) and B (SVOCs). Appendix E includes the laboratory analytical reports for this sampling episode, and the complete electronic files from the laboratory in disk format.

VOCs are the primary class of constituents of concern in groundwater at this site. The concentrations of VOCs in site monitoring wells for this semiannual monitoring event have been reviewed in comparison to results from previous sampling events. Although variations in concentrations are seen from well to well for individual constituents, the results for this monitoring event confirm concentration ranges and distributions that have been observed in the past.

Figure 5 shows a comparison of benzene concentrations in monitoring network wells during April 1995 and February 1999. Concentrations varied, but were comparable between the two sampling events at individual wells. In some wells, such as MW-4 and OW-18, concentrations were lower in 1999. In other wells, for example, MW-1 and OW-15, benzene was detected in low concentrations where it had not been previously detected, due to lower reporting limits.

Figure 6 illustrates a similar comparison for chlorinated aliphatic VOCs, represented by summary values for 1,2-dichloroethene, trichloroethene, and tetrachloroethene. It is reasonable to sum the concentrations of these compounds for comparison purposes because tetrachloroethene can degrade in groundwater to trichloroethene and 1,2-dichloroethene, and trichloroethene can degrade to 1,2-dichloroethene. There were variations from well to well, and more detections in low concentrations in 1999 because of lower reporting limits, but overall, concentrations were similar.

SVOCs are not a major concern in groundwater, and were detected in relatively low concentrations in only six of the monitoring network wells. However, as with VOCs, SVOC concentrations in samples collected in February 1999 were comparable to previously reported concentrations. Figure 7 shows a comparison of results for OW-1, where the highest concentrations and largest number of SVOCs have been detected, between September 1994 and February 1999. (Reporting limits for September 1994 were too high for a meaningful comparison.) Note that concentrations were variable but similar.

The analytical data were compared to the results projected in the modeling that was completed as part of the FS (RETEC 1996). The modeling indicated that no change would occur in the concentrations of benzene and tetrachloroethene until after removal of the lagoons. As shown in Figures 5 and 6, the concentrations within the plumes and the extent of impacts are relatively constant. Within three months following completion of the OU-1 remedial action, the routine groundwater sampling will commence. The results of these future sampling episodes will be compared to the modeling and, if necessary, the model will be recalibrated.

4.2.1 Volatile Organic Compounds

Thirteen VOCs were detected in various wells during this sampling event (Table 3). The detected compounds and concentrations are shown by well in Figure 8. Monitoring wells MW-1, OW-8, and OW-16 did not contain VOCs at concentrations greater than MCLs or SGVs. Other monitoring wells within the network exceeded MCLs or SGVs for one or more VOC. The principle nonchlorinated VOC was benzene; 1,2-dichloroethene was the chlorinated VOC that was detected most frequently and in the highest concentrations. The greatest variety and highest concentrations of VOCs were detected in monitoring wells downgradient of former Lagoons 6, 7, and 8.

4.2.2 Semivolatile Organic Compounds

Six different SVOCs were detected in various wells during this sampling event (Table 4). The detected compounds and concentrations are shown by well in Figure 9. SVOC concentrations during this sampling round were consistent with previous results. SVOCs exceeded SGVs in OW-10 (phenol, 1,2-dichlorobenzene, naphthalene) and OW-13 (phenol, dimethylphthalate), and an MCL in OW-2 (bis[2-ethylhexyl]phthalate).

4.2.3 Monitored Natural Attenuation Parameters

Field measurements and laboratory analyses were performed on groundwater samples collected during this semiannual monitoring program. This information was collected to develop baseline evidence that natural attenuation processes, through biodegradation and other physical and chemical processes, are occurring that will reduce contaminant concentrations in groundwater over time. Both aerobic and anaerobic biodegradation can occur, depending on site conditions.

The chemical and physical parameters measured as part of this monitoring program and the steady state of the groundwater plume show that natural attenuation is already occurring at the site. The steady-state plume indicates that the rate of natural attenuation is equaling the leaching rate from the lagoons. Once wastes and contaminated soils that act as source material are removed, concentrations of organic constituents in groundwater will decrease due to natural attenuation. The combination of source control and natural attenuation are thus important for the overall remediation of this site.

The field parameters, summarized in Table 5, were measured during monitoring well sample collection using a multi-parameter instrument. A comparison of these results to April 1995 results are provided in Appendix F. The field parameters of most interest for natural attenuation monitoring are DO and redox. Table 6 summarizes the results of laboratory analysis of natural attenuation parameters, including:

- Alkalinity
- Chloride
- Ferrous iron
- Nitrate
- Sulfate
- Sulfide
- Total organic carbon (TOC)
- Ethane/ethene
- Methane

A comparison of these results to April 1995 results are provided in Appendix G.

General Observations

U.S. EPA has provided final guidance on tracking and interpreting natural attenuation trends in groundwater (U.S. EPA 1999). Table 7 is an adaptation of a table presented at a U.S. EPA symposium (Weidermeier 1996) that is useful in data interpretation. The contaminant plume at the C&D site is relatively complex, in that it shows impacts from chlorinated VOCs, nonchlorinated VOCs, and organic carbon as lagoon leachate. The general observations from this first round of natural attenuation data are:

- Several parameters indicate that reductive dechlorination of chlorinated VOCs may be occurring (presence of chlorinated daughter products, presence of ethane/ethene and methane within the plume, elevated chloride concentrations downgradient of the lagoons, redox readings less than 50 mV within the plume). Reductive dechlorination occurs under anaerobic conditions.

- Indicators of reductive dechlorination are most consistently found in association with the Lagoon 8 portion of the contaminant plume, which contains both benzene and chlorinated VOCs. The Lagoon 2 portion of the plume contains mainly chlorinated VOCs.
- All monitoring wells were found to have DO readings greater than 1 mg/L, which is indicative of aerobic conditions, under which reductive dechlorination will not occur.

There are potential explanations for this apparent contradiction in findings. First, it may be that the elevated DO concentrations were transient, resulting from early spring recharge to groundwater through infiltration of rain and snow melt. Second, it is possible that different biodegradation processes, i.e., both aerobic and reductive dechlorination, are happening in different areas of the plume, and these trends will be more apparent with additional rounds of data. Third, it was noted during sample collection that stable DO readings were not achieved in a number of cases; in future sampling rounds, an extended purge time may result in stable DO readings that are more consistent with other data trends.

In summary, this and future natural attenuation data sets will continue to be evaluated against the most recent U.S. EPA guidance, to develop an understanding of trends and conditions. In the following paragraphs, the results for the individual natural attenuation parameters are summarized.

Dissolved Oxygen

DO readings in all monitoring wells were greater than 1 mg/L, indicative of aerobic conditions, but otherwise no trends were observed. MW-1, the background well, had a DO reading of 1.87 mg/L, and monitoring wells within and downgradient of the most impacted areas had DO values ranging from 1.26 to 5.76 mg/L.

Redox

A reductive dechlorination pathway is possible when redox readings are 50 mV or less. Nine of the 14 monitoring wells exhibited redox readings less than 50 mV; these wells were generally located within and downgradient of the Lagoon 8 portion of the contaminant plume.

Alkalinity

Alkalinity greater than two times the background concentration may be indicative of the ultimate oxidation of vinyl chloride to CO_2. Vinyl chloride is a degradation product of other chlorinated VOCs. For this evaluation, the alkalinity value of 150 mg/L for MW-1 was considered background. Alkalinity greater than 300 mg/L was found in OW-10, OW-13, and OW-22, all downgradient of Lagoons 6, 7, and 8. Vinyl chloride was detected during this sampling round in OW-13 and OW-22. The presence of vinyl chloride and elevated CO_2 concentrations in these wells indicates that more highly chlorinated VOCs are being degraded to vinyl chloride and, ultimately, to CO_2.

Chloride

Elevated chloride concentrations (greater than two times the background concentration in MW-1), indicative of reductive dechlorination, were found in MW-4, OW-5, and OW-13, and in OW-19, all wells where chlorinated VOCs and degradation products have been detected.

Ferrous Iron

Ferrous iron is generated when ferric iron is used as an electron acceptor under anaerobic conditions. Ferrous iron concentrations greater than 1 mg/L may be indicative of reductive dechlorination. Ferrous iron concentrations greater than 1 mg/L were measured in all monitoring wells except MW-1, and OW-2, OW-5, and OW-6, downgradient of Lagoons 1 and 2. The elevated ferrous iron concentrations were generally found downgradient of Lagoons 6, 7, and 8.

Nitrate

Low nitrate concentrations (less than 1 mg/L) potentially indicate the occurrence of anaerobic degradation processes and reductive dechlorination. Nitrate concentrations of 1 mg/L or less were found in all wells except MW-1, the background well, and OW-5 and OW-6, at the downgradient edge of the Lagoon 2 contaminant plume. The relatively high nitrate concentrations in OW-2 and OW-5 are probably a result of sewage and septage wastes in Lagoon 2.

Sulfate/Sulfide

Sulfate is an electron acceptor under anaerobic, strongly reducing conditions; sulfide is produced under these conditions. Relatively low sulfate (less than 20 mg/L), combined with detectable sulfide (greater than 1 mg/L) may be indicative of this reductive dechlorination pathway. Although sulfate concentrations less than 20 mg/L were measured in several wells, no sulfide was detected, indicating that sulfate is probably not being used as an electron acceptor.

TOC

Organic carbon, as measured by TOC, provides a carbon and energy source for biodegradation, and can drive dechlorination. Although TOC was not measured in any well at the "rule of thumb" concentration of 20 mg/L or greater, concentrations significantly greater than the background concentration of 2 mg/L (MW-1) were found in OW-10, OW-13, OW-18, OW-19, and OW-22, all downgradient of Lagoon 8.

Ethane/Ethene

These compounds are daughter products of vinyl chloride. Detectable concentrations are indicative of degradation of vinyl chloride and more highly chlorinated compounds. Detectable concentrations were found in OW-10, OW-13, OW-15, OW-18, OW-19, OW-21, and OW-22, all downgradient of Lagoon 8.

Methane

Methane is an ultimate reductive dechlorination daughter product. It was measured at concentrations greater than 1 mg/L (1,000 ug/L) in MW-4, downgradient of the Lagoon 8 and Lagoon 2 plume areas, and in OW-10, OW-13, OW-15, OW-18, OW-19, and OW-22, all downgradient of Lagoon 8.

4.3 Surface Water Quality

Two surface water samples were collected during this sampling event. Methylene chloride was the one VOC detected in the upstream sample SW-2 at a concentration of 0.15 ug/L. This result was qualified as "J," for an estimated concentration below the reporting limit, and as "B," because it was also detected in the method blank. The concentration of 0.15 ug/L is well below the SGV and MCL of 5 ug/L. There were no detections of SVOCs in either of the surface water samples.

4.4 Sediment Quality

Two sediment samples were collected during this sampling event. Analytical results for detected constituents are provided in Table 8. VOCs were not detected in the downstream sample, Sed 1. Acetone and 2-butanone were detected in Sed 2 at the estimated concentrations of 140 and 50 ug/kg, respectively. Historically, acetone was detected in both the upstream and downstream sediment samples at concentrations of 76 and 58 ug/kg, respectively. The differences in acetone concentrations between this sampling round and previous rounds are not appreciable. The detection of 2-butanone is a first-time occurrence.

The only SVOC detected in sediments during this and the previous sampling events is di-n-butyl phthalate. It was detected during both sampling events (September 1994 and February 1999) in the upstream (Sed 2) and downstream (Sed 1) locations. The upstream estimated concentration in February 1999 was 370 ug/kg, compared to 220 ug/kg in September 1994. The downstream estimated concentration was 77 ug/kg, compared to 190 ug/kg. The February 1999 concentrations were estimated because the value was less than the method reporting limit and greater than the instrument detection limit.

5.0 Summary and Conclusions

The 14 monitoring network wells were sampled between February 16 and February 18, 1999. Samples were collected for laboratory analysis of TCL VOCs and SVOCs and natural attenuation parameters. Natural attenuation field parameters were monitored and recorded. Two surface water samples and two sediment samples were collected and analyzed for TCL VOCs and SVOCs. All laboratory analytical samples were analyzed by Quanterra Environmental Services, North Canton, Ohio.

In addition to the standard sampling activities, several one-time activities occurred. These activities included the redevelopment of the monitoring network wells, installation of dedicated sampling pumps, plugging and abandonment of 12 monitoring wells, and resurveying of the monitoring wells.

The overall concentrations of VOCs in groundwater have not changed significantly since 1995. Chlorinated VOCs are present downgradient of Lagoons 2 and 8. Nonchlorinated VOCs, primarily benzene, are most prevalent in the Lagoon 8 area. SVOCs, while present, are not a significant contributor to groundwater impacts. These findings are consistent with previously completed predictive modeling (RETEC 1995). The fact that concentrations are not increasing, and that contaminants are not migrating, is evidence that natural attenuation is occurring. That is, the rate of degradation approximately equals the rate of release of contaminants from the lagoons to groundwater.

Natural attenuation parameters indicate that natural attenuation is occurring. Although additional monitoring rounds would be required to ascertain specific mechanisms and trends, there is already substantial evidence of ongoing natural attenuation processes, which includes:

- The presence of 1,2-dichloroethene, chloroethane, and vinyl chloride, degradation products of tetrachloroethene and trichloroethene
- The presence of ethene/ethane and methane, which are the ultimate degradation products of chlorinated VOCs

- Elevated chloride concentrations in and downgradient of impacted zones, evidence of the release of chloride associated with the degradation of chlorinated VOCs

- Redox values that indicate reductive dechlorination can occur

- Patterns of occurrence of alkalinity, ferrous iron, nitrate, and TOC, that support the premise that natural attenuation is occurring in groundwater downgradient of the lagoons

Low concentrations of VOCs and SVOCs were detected in sediment and surface water samples collected from Gold Creek, including methylene chloride, acetone, and di-n-butyl phthalate, all common laboratory artifacts. In all cases, detected constituents were higher in upstream samples than in downstream samples. These results indicate either an upstream source, or laboratory artifacts, or both.

6.0 Recommendations

It is recommended that the groundwater, surface water, and sediment sampling program continue on a semiannual basis. The next sampling event will occur three months after the completion of the OU-1 remedial action. A waiting period between the completion of source removal and groundwater sampling is necessary so that groundwater conditions can equilibrate.

Evaluation of analytical data will continue to determine the effect of source removal on groundwater and document the effectiveness of natural attenuation. During future sampling, the stabilization time will be increased during monitoring well sampling to achieve stabilization of DO and redox, which are important natural attenuation parameters.

7.0 References

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Tables

Table 1
Well Abandonment Data
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

Well No.	Total Depth	Date Abandoned	Depth Reached	Abandonment Method	Comments
MW-3	49'	02/11/99	36'	HSA	Auger refusal at 36'
MW-5	44'	02/15-16/99	44'	HSA	
TW-2	62'	02/09-10/99	63'	HSA	
TW-3	61'	02/09; 02/11/99	20'	HSA	Auger refusal at 20'
BW-1	42'	02/18/99	40'	RB	Bit refusal at 40'
BW-2	78'	02/10-11/99	62'	HSA	Auger refusal at 62'
BW-3	80'	02/16-17/99	62'	HSA	Auger refusal at 62'
BW-4	80'	02/17/99	48'	HSA	Auger refusal at 48'
BW-5	87'	02/17-18/99	61'	HSA	Auger refusal at 61'
OW-12	63'	02/12/99	41'	HSA	Auger refusal at 41'
OW-14	42'	02/15/99	42'	HSA	
OW-20	44'	02/19/99	44'	RB	

Notes:

HSA - Hollow-stem augers, 4¼" inside diameter with center guide and reamer
RB = 3⅞" roller bit inside steel-cased wells

Table 2
Monitoring Network Wells
Groundwater Elevation Data, February 1999
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

Well No.	Top of Casing Elevation	Screened Interval	Depth to Groundwater	Groundwater Elevation
MW-1	469.39	28.5 - 43.5	31.92	437.47
MW-4	470.13	35.3 - 50.3	37.95	432.18
OW-2	472.33	30.0 - 47.0	40.25	432.08
OW-5	459.85	25.5 - 45.4	27.87	431.98
OW-6	464.40	31.4 - 51.4	32.37	432.03
OW-8	464.63	34.6 - 54.6	32.52	432.11
OW-10	472.68	30.5 - 40.5	28.62	444.06
OW-13	458.00	24.8 - 34.8	26.16	431.84
OW-15	471.89	22.0 - 32.0	11.20	460.69
OW-16	453.90	18.0 - 28.0	22.25	431.65
OW-18	444.57	11.0 - 21.0	13.07	431.50
OW-19	438.69	5.0 - 15.0	7.50	431.19
OW-21	467.46	37.1 - 47.1	35.89	431.57
OW-22	467.10	38.0 - 48.0	35.56	431.54

Notes:

Top of casing elevations surveyed by Maser Consulting P.A.

Data reported in feet; elevations relative to mean sea level; 1988 National Geodetic Vertical Datum

NR - Not Recorded

Table 3
Summary of Detected Groundwater Volatile Organic Compounds
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

TARGET COMPOUND LIST
Volatile Compounds

Compound	NYSDEC SGV (ug/L)	Federal MCL (ug/L)	MW-1 2-18-99	MW-4 2-18-99	OW-2 2-17-99	OW-2D 2-17-99	OW-5 2-18-99	OW-6 2-18-99	OW-8 2-18-99
Vinyl Chloride	2 (S)	2	<2.0	<2.0	<10	<14	<3.3	<2.0	<2.0
Chloroethane	5 (S)*	NA	<2.0	<2.0	<10	<14	<3.3	<2.0	<2.0
Methylene Chloride	5 (S)*	5	<1.0	<1.0	3.6 J,B	5.2 J,B	1.3 J,B	3.7 B	0.15 J,B
Carbon Disulfide	NA	NA	<1.0	<1.0	<5.0	<7.1	<1.7	<1.0	0.17 J
1,1-Dichloroethane	5 (S)*	NA	<1.0	<1.0	<5.0	<7.1	<1.7	<1.0	<1.0
1,2-Dichloroethene (total)	5 (S)*	70	<1.0	9.8	130	170	33	7.8	<1.0
Trichloroethene	5 (S)*	5	<1.0	0.20 J	22	23	5.4	4.6	<1.0
Benzene	1 (S)	5	0.66 J	5.7	<5.0	<7.1	0.67 J	<1.0	0.32 J
Tetrachloroethene	5 (S)*	5	<1.0	0.16 J	86	110	7.8	20	<1.0
Toluene	5 (S)*	1,000	<1.0	0.16 J	<5.0	<7.1	<1.7	<1.0	<1.0
Chlorobenzene	5 (S)*	NA	0.40 J	0.20 J	<5.0	<7.1	0.20 J	<1.0	<1.0
Xylenes (Total)	5 (S)*	10,000	<1.0	<1.0	<5.0	<7.1	<1.7	<1.0	<1.0

Table 3 (continued)
Summary of Detected Groundwater Volatile Organic Compounds

TARGET COMPOUND LIST
Volatile Compounds

Compound	NYSDEC SGV (ug/L)	Federal MCL (ug/L)	OW-10 2-16-99	OW-13 2-16-99	OW-15 2-16-99	OW-16 2-16-99	OW-18 2-17-99	OW-19 2-17-99	OW-21 2-16-99	OW-22 2-17-99
Vinyl Chloride	2 (S)	2	<400	48 J	1.5 J	<2.0	<3.3	10	0.89 J	4.2 J
Chloroethane	5 (S)*	NA	<400	<67	<2.0	<2.0	1.0 J	6.1	<2.0	<5.0
Methylene Chloride	5 (S)*	5	100 J,B	18 J,B	<1.0	<1.0	1.0 J,B	0.16 J,B	<1.0	1.1 J,B
Carbon Disulfide	NA	NA	<200	<33	<1.0	<1.0	<1.7	<1.0	<1.0	<2.5
1,1-Dichloroethane	5 (S)*	NA	<200	<33	0.25 J	<1.0	<1.7	0.27 J	<1.0	<2.5
1,2-Dichloroethene (total)	5 (S)*	70	<200	52	0.38 J	<1.0	0.54 J	3.3	0.26 J	2.4 J
Trichloroethene	5 (S)*	5	<200	<33	<1.0	<1.0	<1.7	0.14 J	<1.0	<2.5
Benzene	1 (S)	5	1900	490	1.1	<1.0	4.7	5.8	5.8	46
Tetrachloroethene	5 (S)*	5	<200	<33	<1.0	<1.0	<1.7	<1.0	<1.0	<2.5
Toluene	5 (S)*	1,000	25 J	7.6 J	<1.0	<1.0	<1.7	0.16 J	<1.0	0.87 J
Chlorobenzene	5 (S)*	NA	23 J	<33	0.52 J	<1.0	3.4	7.1	0.11 J	8.0
Xylenes (Total)	5 (S)*	10,000	<200	<33	<1.0	<1.0	1.1 J	<1.0	<1.0	3.5

Notes:

NA	Not applicable; no criteria specified
MCL	Maximum Concentration Limit for drinking/groundwater
<	Analyte not detected at reporting limit
SGV	Water Quality Standards (S) and Guidance (G) Values for groundwater

*The principal organic contaminant (POC) standard for groundwater of 5 ug/L applies to this substance.

Concentrations detected at or above regulatory limit
Analyte detected less than regulatory limit, or analyte detected but no regulatory criteria specified

Table 4
Summary of Detected Groundwater Semivolatile Organic Compounds
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

TARGET COMPOUND LIST
Semivolatile Compounds

Compound	NYSDEC SGV (ug/L)	Federal MCL (ug/L)	MW-1 2-18-99	MW-4 2-18-99	OW-2 2-17-99	OW-2D 2-17-99	OW-5 2-18-99	OW-6 2-18-99	OW-8 2-18-99
Phenol	1 (S)	NA	<10	<10	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	3 (S)	1	<10	<10	<10	<10	<10	<10	<10
Naphthalene	10 (G)	NA	<10	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene	NA	NA	<10	<10	<10	<10	<10	<10	<10
Diethyl phthalate	50 (G)	5	<10	<10	<10	<10	<10	<10	<10
bis(2-Ethylhexyl) phthalate	5 (S)	6	<10	<10	11	<10	3.2 J	<10	<10

Table 4 (continued)
Summary of Detected Groundwater Semivolatile Organic Compounds

TARGET COMPOUND LIST Semivolatile Compounds										
Compound	**NYSDEC SGV (ug/L)**	**Federal MCL (ug/L)**	**OW-10 2-16-99**	**OW-13 2-16-99**	**OW-15 2-16-99**	**OW-16 2-16-99**	**OW-18 2-17-99**	**OW-19 2-17-99**	**OW-21 2-16-99**	**OW-22 2-17-99**
Phenol	1 (S)	NA	12	5.6 J	<10	<10	<10	<10	<10	<10
1,2-Dichlorobenzene	3 (S)	1	4.9 J	<10	<10	<10	<10	<10	<10	<10
Naphthalene	10 (G)	NA	13	<10	<10	<10	<10	<10	<10	<10
2-Methylnaphthalene	NA	NA	21	<10	<10	<10	<10	<10	<10	<10
Diethyl phthalate	50 (G)	5	12	5.2 J	<10	<10	<10	<10	<10	<10
bis(2-Ethylhexyl) phthalate	5 (S)	6	<10	<10	<10	<10	<10	<10	4.7 J	4.3 J

Notes:

NA	Not applicable; no criteria specified
MCL	Maximum Concentration Limit for drinking/groundwater
<	Analyte not detected at reporting limit
SGV	Water Quality Standards (S) and Guidance (G) Values for groundwater

Concentrations detected at or above regulatory limit

Analyte detected less than regulatory limit, or analyte detected but no regulatory criteria specified

Table 5
Field Monitoring Data, February 1999
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

Well ID	Sample Date	Pumping Start Time	Beginning DTW	Time	Temp. °C	DO (mg/L)	Redox (mV)	SpC (umhos/cm)	pH	Turb (NTU)	Depth to Water (ft)
OW-15	2/16/99	08:58	11.20	09:25	11.32	1.83	-7.4	406.0	5.77	88.5	12.49
				09:30	10.99	2.93	-13.8	394.0	5.77	142.00	NR
				09:35	10.86	1.57	-18.5	386.0	5.77	143.6	12.17
				09:49	10.98	1.26	-21.2	384.0	5.78	143.3	12.10
OW-10	2/16/99	10:48	28.62	11:01	11.99	3.82	1.2	743.00	5.94	87.2	28.78
				11:06	11.94	2.79	-6.8	744.00	5.94	68.0	28.78
				11:11	11.67	2.34	-11.5	740.00	5.93	60.2	28.80
				11:16	11.91	1.67	-16.0	737.00	5.94	61.9	28.78
				11:21	12.33	1.77	-20.3	737.00	5.95	67.4	28.79
				11:26	12.38	2.08	-22.0	732.00	5.95	68.1	28.80
OW-21	2/16/99	12:15	35.89	12:25	11.98	3.55	-6.2	615.00	6.07	171.2	35.89
				12:30	11.90	2.44	-14.2	620.00	6.00	1389.3(1)	35.89
				12:39	12.00	4.64	-4.4	623.00	5.98	1389.9	35.89
				12:44	11.95	1.57	-18.9	625.00	5.98	1389.9	35.89
				12:49	11.94	1.77	-23.1	625.00	5.98	1389.7	35.89
OW-13	2/16/99	13:52	26.16	14:07	12.05	4.61	11.9	855.00	5.95	NA	26.17
				14:12	11.83	3.98	8.5	855.00	5.94	NA	26.18
				14:17	11.77	3.61	6.3	855.00	5.93	NA	26.19
				14:22	11.74	3.59	5.9	855.00	5.94	NA	26.18

Table 5 (continued)
Field Monitoring Data, February 1999

Well ID	Sample Date	Pumping Start Time	Beginning DTW	Time	Temp. °C	DO (mg/L)	Redox (mV)	SpC (umhos/cm)	pH	Turb (NTU)	Depth to Water (ft)
OW-16	2/16/99	15:19	22.25	15:36	11.01	3.30	101.7	283.00	5.95	NA	22.23
				15:41	10.97	3.15	107.8	285.00	5.85	NA	22.25
				15:46	10.90	1.94	124.0	270.00	5.68	NA	22.25
				15:51	10.88	2.04	133.6	262.00	5.61	NA	22.24
				15:56	10.82	1.44	141.0	255.00	5.51	NA	22.23
OW-22	2/17/99	09:45	35.56	10:00	10.06	6.78	-19.4	776.00	5.91	20.60	35.56
				10:05	10.22	3.93	-28.3	780.00	5.87	15.00	35.56
				10:10	10.19	3.47	-30.9	780.00	5.87	13.70	35.55
				10:15	10.28	3.20	-33.0	780.00	5.87	13.80	35.56
OW-18	2/17/99	12:02	13.07	12:15	9.24	13.57	-10.8	743.00	6.06	64.90	13.30
				12:20	9.47	6.36	-17.2	750.00	6.02	67.80	13.24
				12:25	9.49	4.84	-22.6	746.00	6.01	73.00	13.19
				12:30	9.86	5.76	-27.9	758.00	6.00	60.00	13.25
OW-19	2/17/99	13:42	7.50	13:50	8.50	9.79	-2.0	974.00	5.97	38.3	7.53
				13:55	9.01	3.52	-18.6	1018.00	5.95	23.0	7.52
				14:00	9.02	3.31	-20.0	1018.00	5.95	25.3	7.52
				14:08	9.02	2.28	-28.6	1018.00	5.94	29.3	7.54
OW-2	2/17/99	16:10	40.25	16:21	9.28	7.81	119.1	401.00	5.66	15.90	40.26
				16:26	9.34	3.43	145.2	393.00	5.32	13.00	40.26
				16:31	9.38	3.14	149.3	391.00	5.29	12.20	40.26
				16:36	9.53	3.84	157.4	384.00	5.25	10.10	40.25

Table 5 (continued)
Field Monitoring Data, February 1999

Well ID	Sample Date	Pumping Start Time	Beginning DTW	Time	Temp. °C	DO (mg/L)	Redox (mV)	SpC (umhos/cm)	pH	Turb (NTU)	Depth to Water (ft)
MW-1	2/18/99	08:36	31.92	09:00	9.93	2.48	257.6	408.00	5.92	136.50	32.29
				09:06	9.21	1.95	259.3	409.00	5.91	276.10	32.10
				09:11	8.57	1.83	260.9	405.00	5.90	415.80	32.08
				09:16	8.16	1.87	261.6	409.00	5.89	543.10	32.07
OW-8	2/18/99	10:04	32.52	10:14	11.00	5.20	135.0	193.00	6.46	123.00	32.52
				10:19	11.16	2.42	70.0	197.00	6.33	63.90	32.52
				10:24	11.26	1.70	46.0	199.00	6.38	50.00	32.52
				10:29	11.27	1.43	32.8	201.00	6.27	38.70	32.52
OW-6	2/18/99	11:16	32.37	11:34	9.69	8.40	181.2	132.00	5.96	18.60	32.38
				11:39	10.13	2.66	201.5	131.00	5.47	19.50	32.37
				11:44	10.37	2.32	207.2	132.00	5.41	14.90	32.38
OW-5	2/18/99	12:19	27.87	12:29	9.39	7.81	274.7	520.00	5.50	11.10	27.86
				12:34	9.99	3.25	273.1	544.00	5.46	13.40	27.87
				12:39	10.05	3.55	270.3	549.00	5.47	12.00	27.87
				12:44	10.11	2.50	270.6	549.00	5.44	10.90	27.87
MW-4	2/18/99	13:25	37.95	13:37	10.23	5.34	40.3	1581.00	6.22	62.40	38.00
				13:44	10.33	4.46	24.5	1569.00	6.23	45.30	38.00
				13:50	10.38	4.13	22.5	1549.00	6.21	43.00	38.00

(1)Turbidity probe malfunctioned. Attempted recalibration twice; failed.

NR - Not Recorded

NA - Not Analyzed

Table 6
Natural Attenuation Analytical Parameters
February 1999
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

Well ID	Date	Alkalinity (mg/L)	Chloride (mg/L)	Ferrous Iron (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Sulfide (mg/L)	TOC (mg/L)	Ethane (ug/L)	Ethene (ug/L)	Methane (ug/L)
MW-1	02/18/99	150	14	<0.05	7.7	22	<0.5	2	<0.5	<0.5	120 B,D
MW-4	02/18/99	290	330	15.0	0.08 J	28	<0.5	4	<0.5	<0.5	1,400 B,D
OW-2	02/17/99	45	14	<0.05	9.6	87	<0.5	1	<0.5	<0.5	0.49 J,B
OW-5	02/18/99	42	81	<0.05	5.0	12	<0.5	1	<0.5	<0.5	0.45 J,B
OW-6	02/18/99	<5.0	3	<0.05	0.1	28	<0.5	<1	<0.5	<0.5	0.49 J,B
OW-8	02/18/99	75	3	9.6	<0.1	13	<0.5	0.6 J	<0.5	<0.5	6.0 B
OW-10	02/16/99	340	21	55.2	0.03 J	<5	<0.5	13	9.0	0.12 J	2,900 B,D
OW-13	02/16/99	370	44	17.5	0.02 J	31	<0.5	7	3.2	18	1,300 B,D
OW-15	02/16/99	140	5	23.6	<0.1	20	<0.5	4	3.2	0.17 J	3,800 B,D
OW-16	02/16/99	75	12	0.15	0.2	38	<0.5	1	<0.5	<0.5	0.81 B
OW-18	02/17/99	220	20	24.1	0.1	7 J,G	<0.5	9	1.6	<0.5	3,100 B,D
OW-19	02/17/99	140	94	43.8	<0.1	10	<0.5	9	2.9	<0.5	2,800 B,D
OW-21	02/16/99	250	28	28.6	<0.1	40	<0.5	3	0.96	0.28 J	260 B,D
OW-22	02/17/99	350	22	47.1	0.003 J	<5	<0.5	9	6.9	2.7	3,400 B,D

Notes:

B - Method blank contamination. The associated method blank contains the target analyte at a reportable level.
D - Result was obtained from the analysis of a dilution.
G - Elevated reporting limit. The reporting limit is elevated due to matrix interference.
J - Estimated result; result is less than the reporting limit.
TOC - Total organic carbon

Table 7
Parameters for Preliminary Monitored Natural Attenuation Screening

Analyte	Concentration in Most Contaminated Zone	Interpretation
Oxygen	<0.5 mg/L	Tolerated; suppresses reductive dechlorination at higher concentrations
Oxygen	>1 mg/L	Vinyl chloride may be oxidized aerobically, but reductive dechlorination will not occur
Nitrate	<1 mg/L	May compete with reductive pathway at higher concentrations
Iron (II)	>1 mg/L	Reductive pathway possible
Sulfate	<20 mg/L	May compete with reductive pathway at higher concentrations
Sulfide	>1 mg/L	Reductive pathway possible
Methane	>0.1 mg/L	Ultimate reductive daughter product
	>1 mg/L	Vinyl chloride accumulates
	<1 mg/L	Vinyl chloride oxidizes
Oxidation reduction potential	<50 mV against Ag/AgCl	Reductive pathway possible
pH	5 < pH <9	Tolerated range for reductive pathway
DOC	>20 mg/L	Carbon and energy source; drives dechlorination; can be natural or anthropogenic
Temperature	>20°C	At T >20°C, biochemical process is accelerated
Carbon dioxide	>2x background	Ultimate oxidative daughter product
Alkalinity	>2x background	Results from interaction of carbon dioxide with aquifer minerals
Chloride	>2x background	Daughter product of organic chlorine; compare chloride in plume to background conditions
Hydrogen	>1 nM	Reductive pathway possible; vinyl chloride may accumulate
Hydrogen	<1 nM	Vinyl chloride oxidized
Volatile fatty acids	>0.1 mg/L	Intermediates resulting from biodegradation of aromatic compounds; carbon and energy source
BTEX	>0.1 mg/L	Carbon and energy source; drives dechlorination
Perchloroethene		Material released
Trichloroethene		Material released or daughter product of perchloroethene
Dichloroethene		Material released or daughter product of trichloroethene; if amount of cis-1,2-dichloroethene is greater than 80% of total dichloroethene, it is likely a daughter product of trichloroethene
Vinyl chloride		Material released or daughter product of dichloroethenes
Ethene/Ethane	<0.1 mg/L	Daughter product of vinyl chloride/ethene
Chloroethane		Daughter product of vinyl chloride under reducing conditions
1,1,1-trichloroethane		Material released
1,1-dichloroethene		Daughter product of trichloroethene or chemical reaction of 1,1,1-trichloroethane

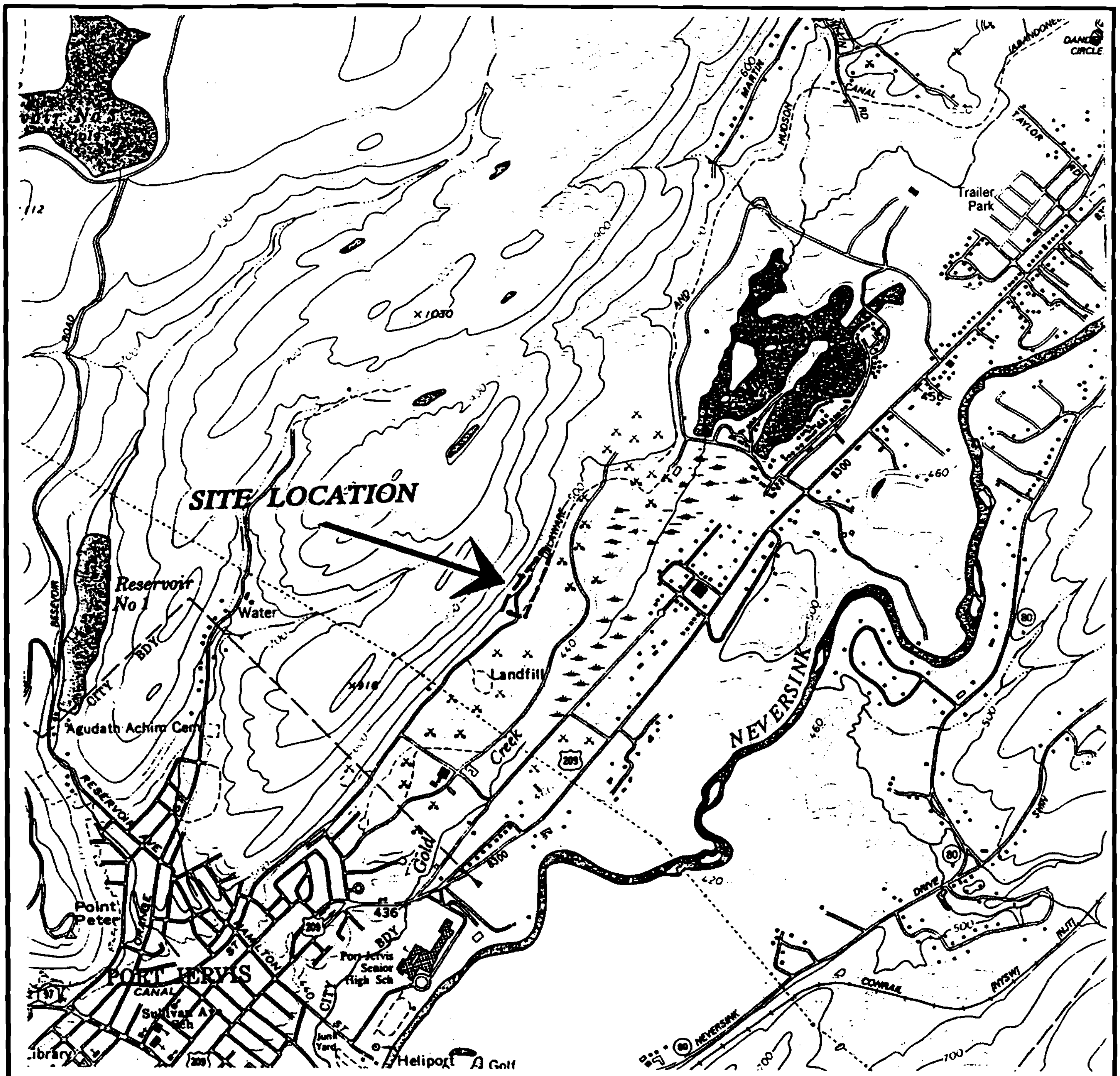
Source: Weidermeier, et al., 1996

Table 8
Detected Sediment Volatile and Semivolatile Organic Compounds (ug/kg)
Carroll and Dubies Superfund Site
Town of Deerpark, Orange County, New York

TARGET COMPOUND LIST **Volatile Compounds**				
Compound	**SED 1**		**SED 2**	
	09/27/94	**02/18/99**	**09/27/94**	**02/18/99**
2-Butanone	<20	<28	<23	50 J
Acetone	58	<28	76	140 J
TARGET COMPOUND LIST **Semivolatile Compounds**				
Di-n-butyl phthalate	190 J,B	77 J	220 J,B	370 J

Notes:
< = Not detected at the method detection limit.
J = Estimated result. Result is less than reporting limit.
B = Method blank contamination. The associated method blank contains the analyte at a reportable level.
Pre-1999 results from RETEC 1995.

Figures



– – – – Approximate Site Boundary

SOURCE: USGS Topographic Quadrangle Map
Port Jervis North Quadrangle - 1991

-N-

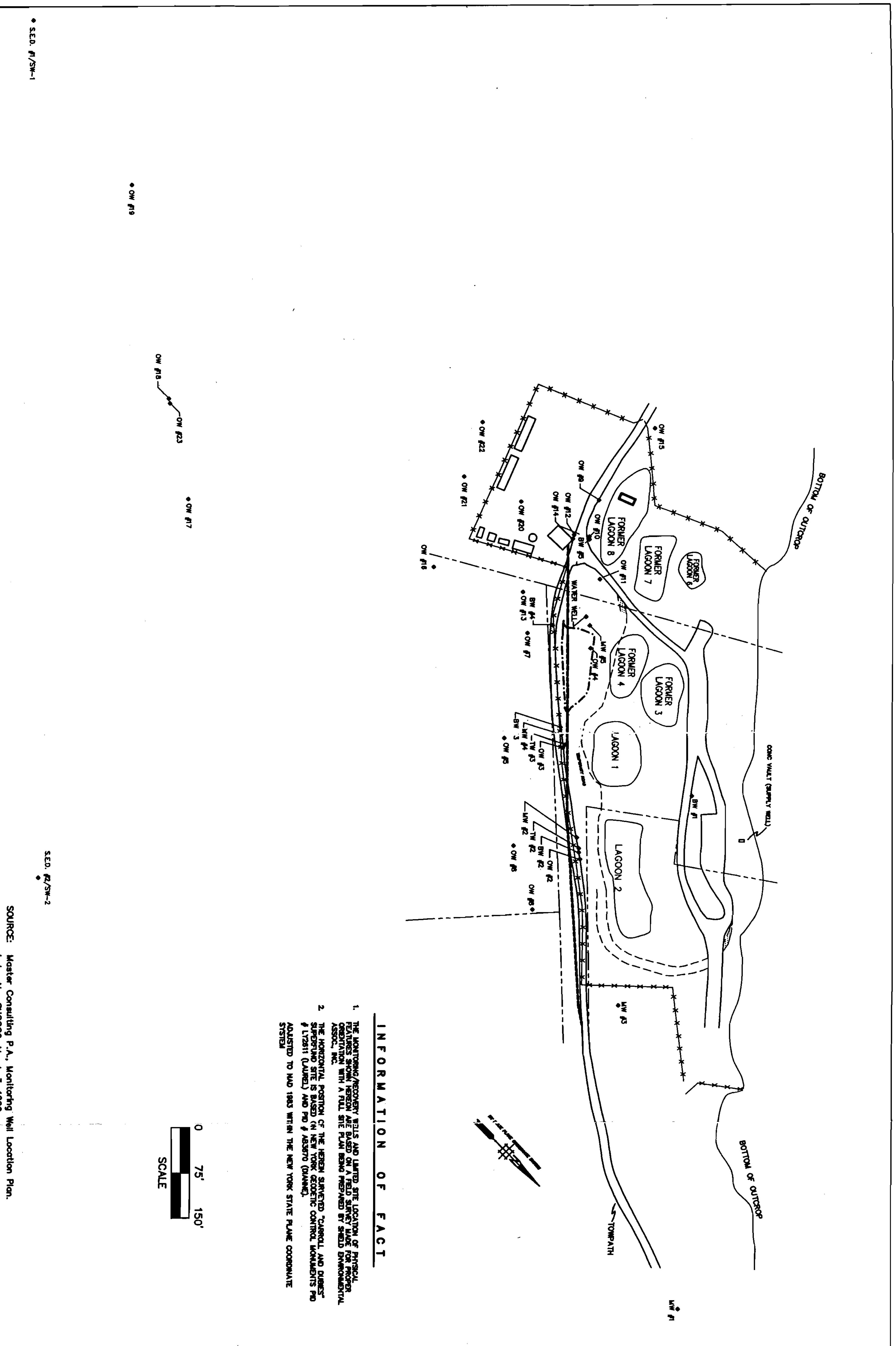
0 1,000' 2,000'
SCALE

DATE: 3/25/99
DRAWN BY: P.D.H.
APPROVED BY: C.L.P.
CLIENT NO.: 698–0110

FIGURE 1

SITE LOCATION MAP
CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK
ORANGE COUNTY, NEW YORK

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA



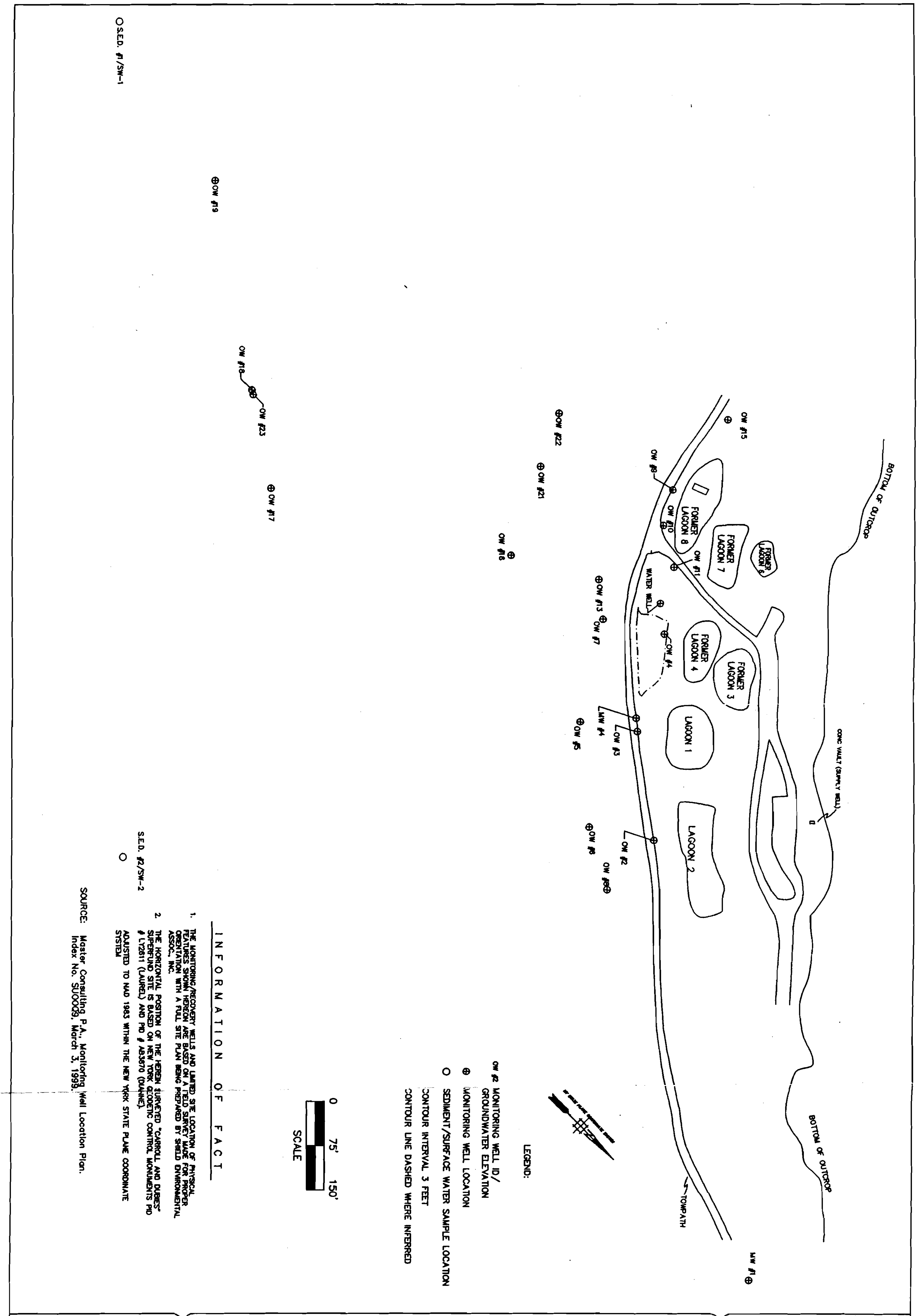
INFORMATION OF FACT

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AB3670 (DIANNE). ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

SOURCE: Master Consulting P.A., Monitoring Well Location Plan. Index No. SU0009, March 3, 1999.

DATE: 5/13/99	FIGURE 2
DRAWN BY: P.D.H.	SITE PLAN
APPROVED BY: C.L.P.	CARROLL AND DUBIES SUPERFUND SITE
CLIENT NO.: 698-0110	TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA



LEGEND:

OW #2 MONITORING WELL ID/ GROUNDWATER ELEVATION

⊕ MONITORING WELL LOCATION

○ SEDIMENT/SURFACE WATER SAMPLE LOCATION

CONTOUR INTERVAL 3 FEET

CONTOUR LINE DASHED WHERE INFERRED

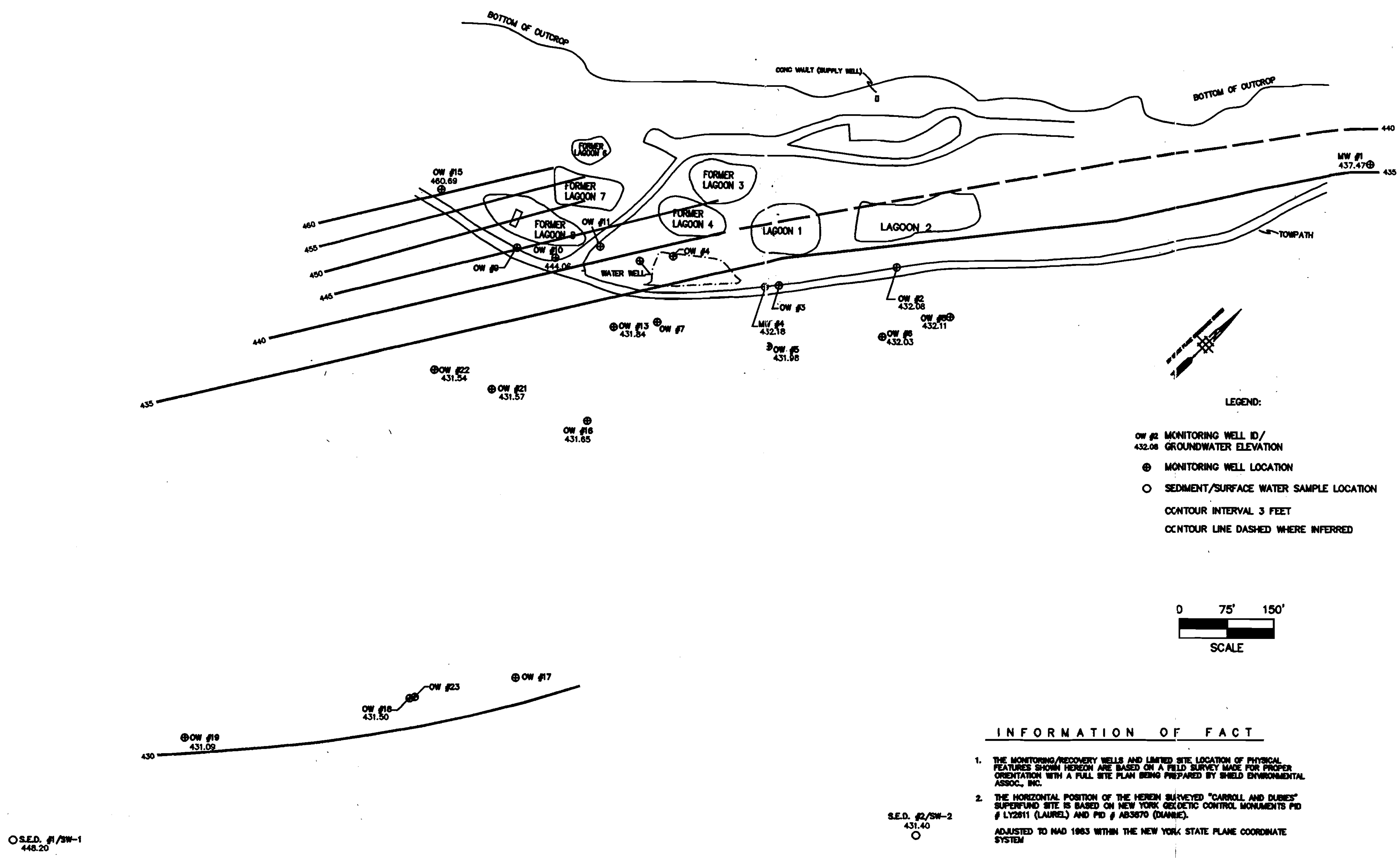
INFORMATION OF FACT

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AB3670 (DUANNE).
ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

SOURCE: Master Consulting P.A., Monitoring Well Location Plan. Index No. SU0009, March 3, 1999.

DATE: 5/26/99	FIGURE 3	*SHIELD*
DRAWN BY: P.D.H.	MONITORING WELL LOCATIONS – FEBRUARY 1999	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: C.L.P.	CARROLL AND DUBIES SUPERFUND SITE	PITTSBURGH, PENNSYLVANIA
CLIENT NO.: 698-0110	TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK	

80110-



INFORMATION OF FACT

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AB3670 (DIANNE).

ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

SOURCE: Master Consulting P.A., Monitoring Well Location Plan. Index No. SUOOQ9, March 3, 1999.

DATE: 5/26/99
DRAWN BY: P.D.H.
APPROVED BY: C.L.P.
CLIENT NO.: 698-0110

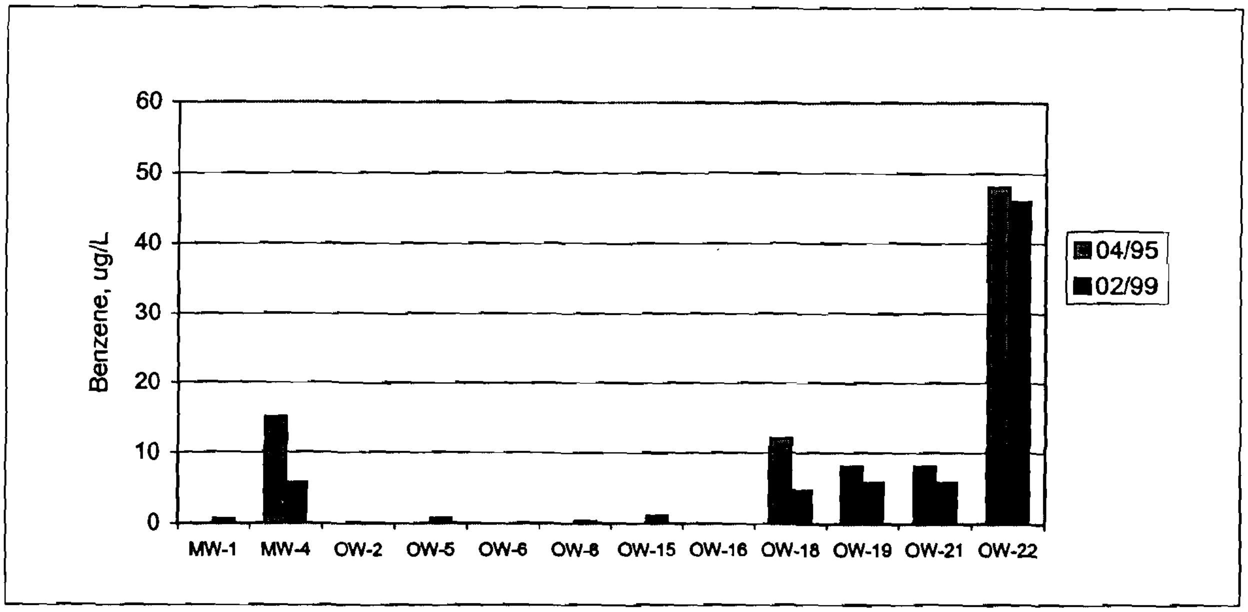
FIGURE 4

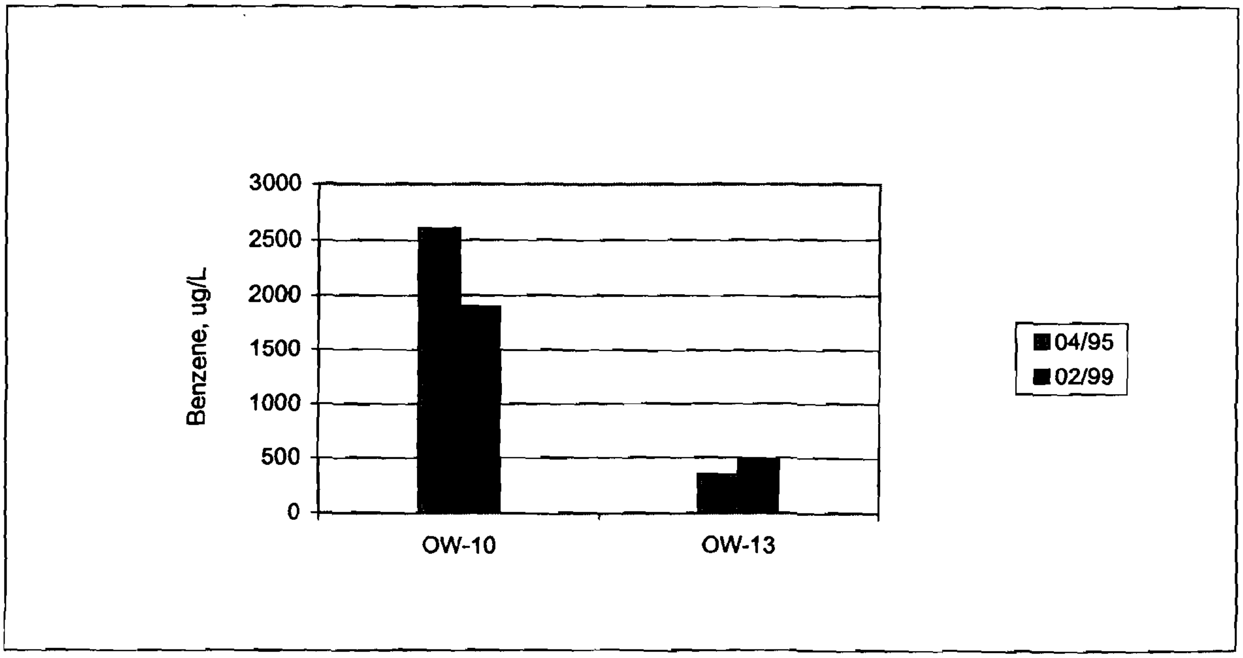
GROUNDWATER CONTOUR MAP – FEBRUARY 1999

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA

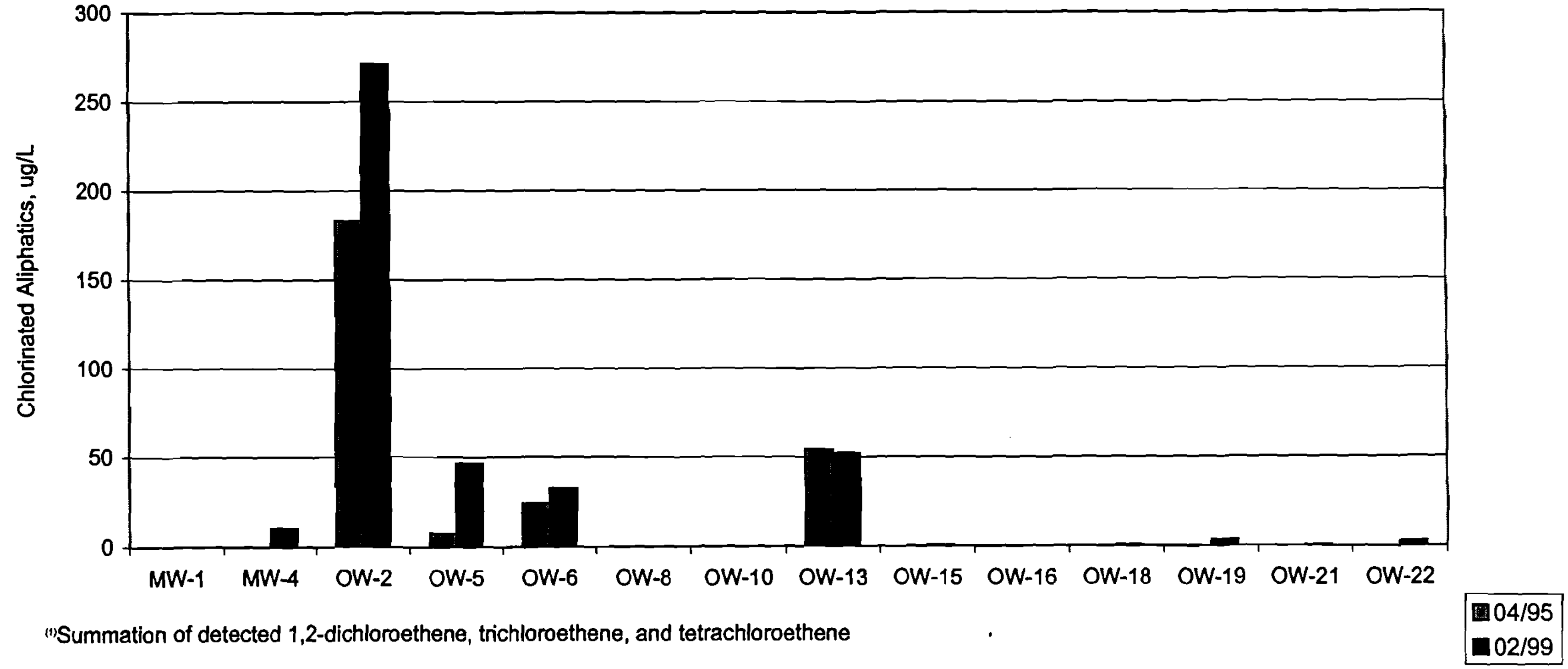
Figure 5
A Comparison of Benzene Concentrations in Monitoring Network Wells, 1995 and 1999





X:Projects/698-0110/Figure 5.xls

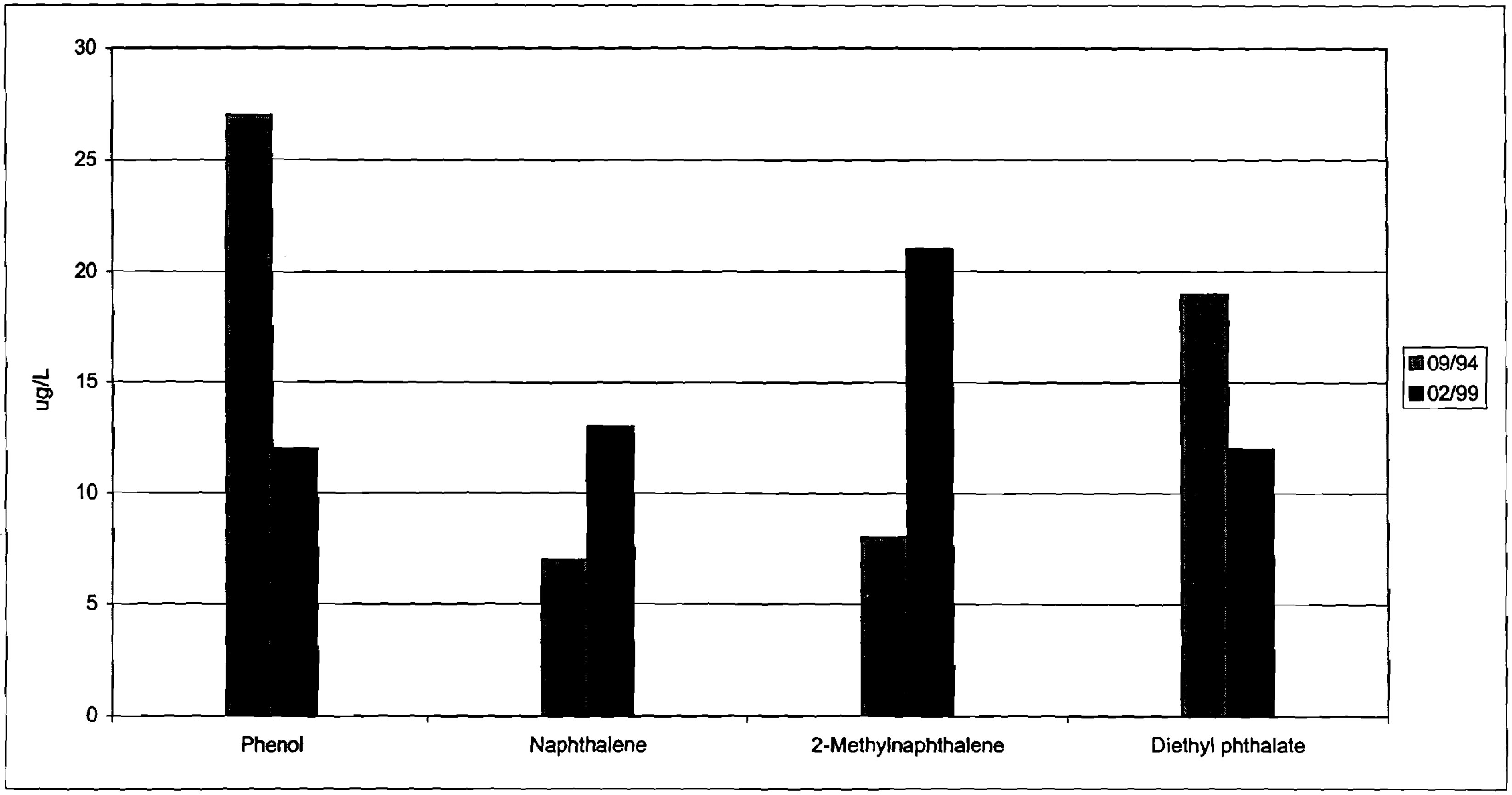
Figure 6
A Comparison of Representative[(1)] Chlorinated Aliphatic Concentrations in Monitoring Network Wells, 1995 and 1999



[(1)]Summation of detected 1,2-dichloroethene, trichloroethene, and tetrachloroethene

X:Projects/698-0110/Figure 6.xls

Figure 7
A Comparison of SVOC Concentrations
in OW-1, 1994 and 1999



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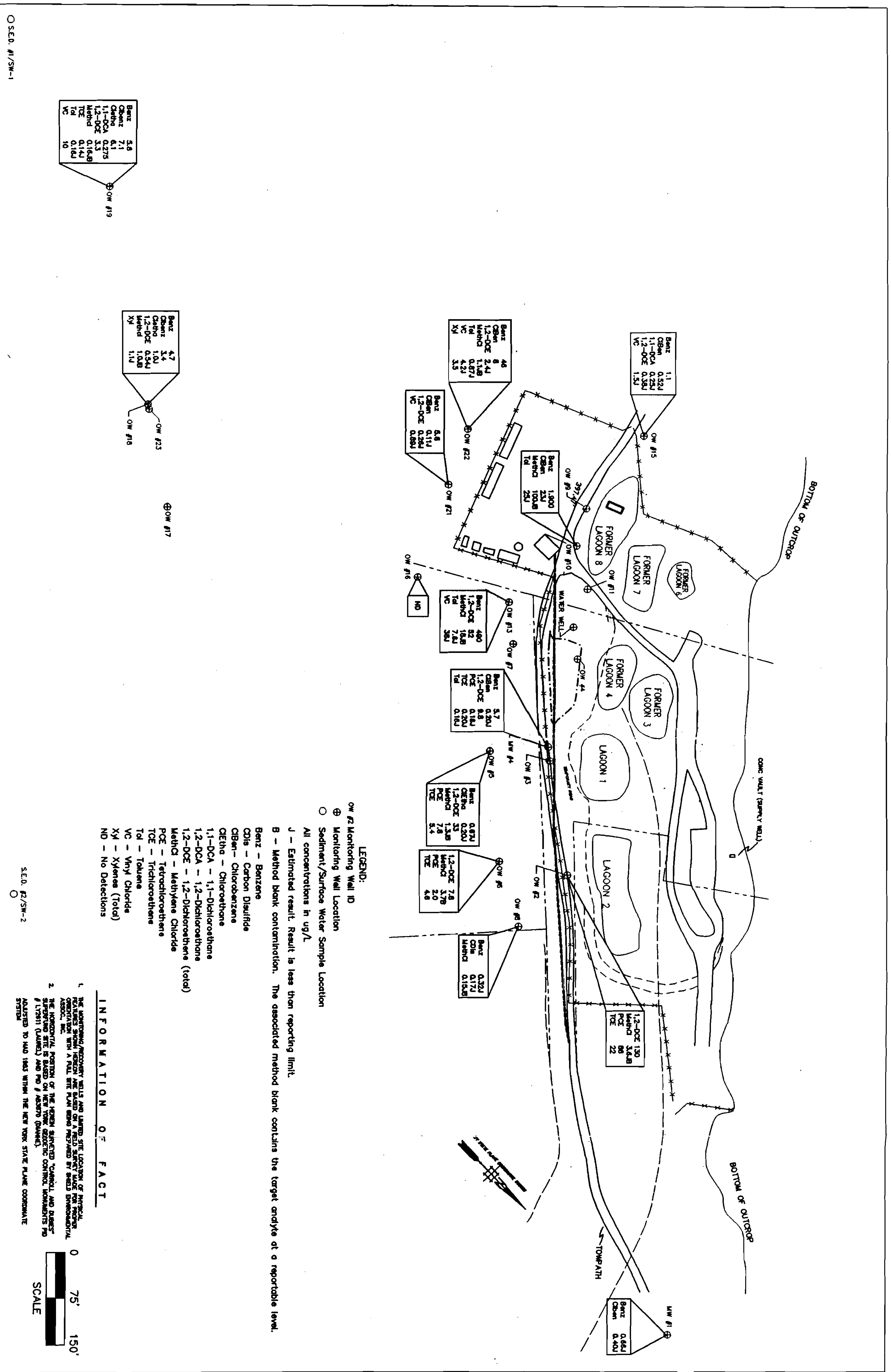


LEGEND:

OW #2 Monitoring Well ID

⊕ Monitoring Well Location

○ Sediment/Surface Water Sample Location

All concentrations in ug/L

J - Estimated result. Result is less than reporting limit.

B - Method blank contamination. The associated method blank contains the target analyte at a reportable level.

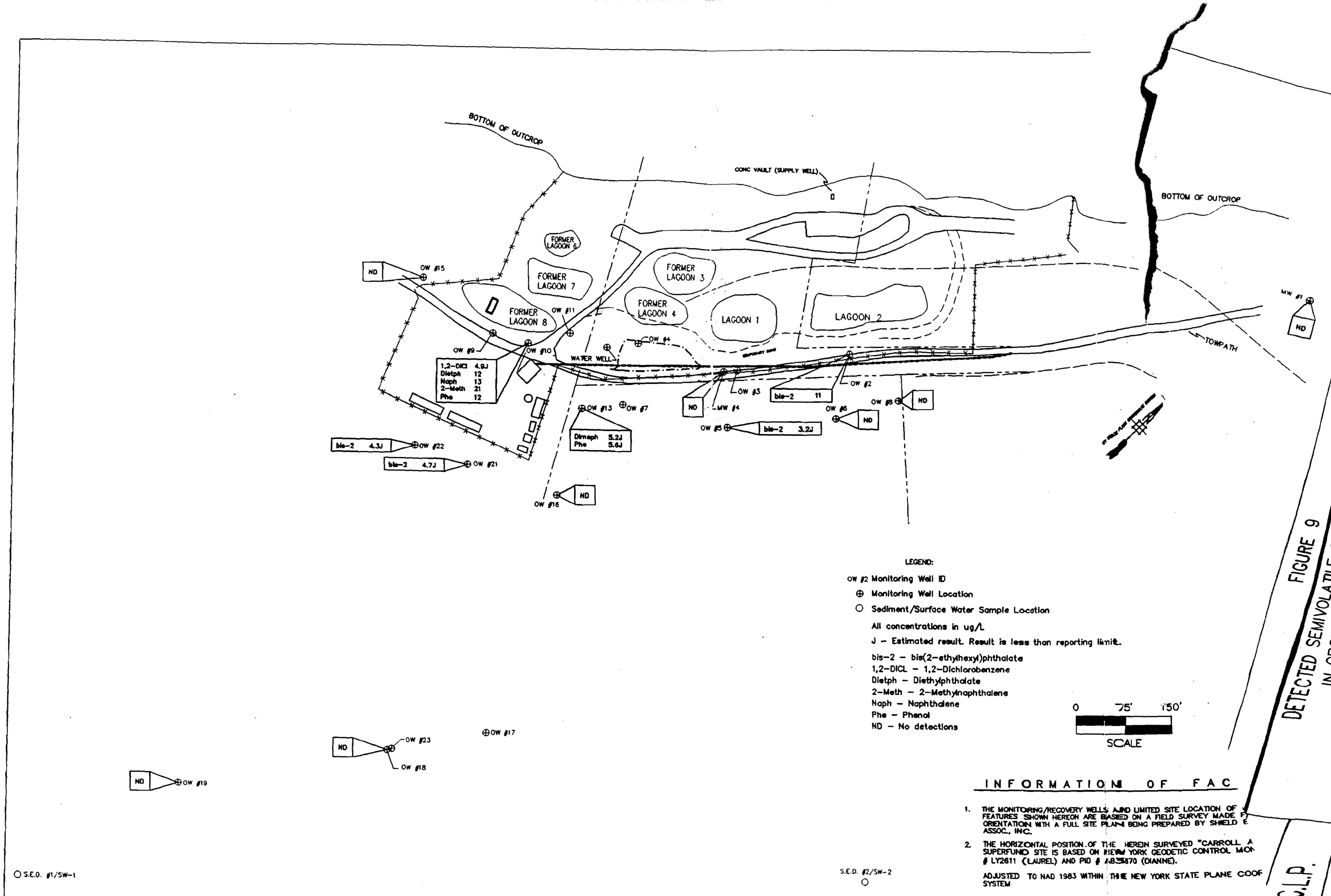
Benz - Benzene
CDls - Carbon Disulfide
ClBen- Chlorobenzene
ClEtha - Chloroethane
1,1-DCA - 1,1-Dichloroethane
1,2-DCA - 1,2-Dichloroethane
1,2-DCE - 1,2-Dichloroethene (total)
MethCl - Methylene Chloride
PCE - Tetrachloroethene
TCE - Trichloroethene
Tol - Toluene
VC - Vinyl Chloride
Xyl - Xylenes (Total)
ND - No Detections

INFORMATION OF FACT

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF PHYSICAL FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE FOR PROPER ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD ENVIRONMENTAL ASSOC., INC.
2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL AND DUBIES" SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MONUMENTS PID # LY2611 (LAUREL) AND PID # AB3970 (DIANNE).
ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COORDINATE SYSTEM

SOURCE: Master Consulting P.A. Monitoring Well Location Plan. Index No. SU0009, March 3, 1999.

DATE: 5/26/99	FIGURE 8	SHIELD ENVIRONMENTAL ASSOCIATES, INC. PITTSBURGH, PENNSYLVANIA
DRAWN BY: P.D.H.	DETECTED VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER - FEBRUARY 1999	
APPROVED BY: C.L.P.	CARROLL AND DUBIES SUPERFUND SITE TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK	
CLIENT NO.: 698-0110		



LEGEND:

OW #2 Monitoring Well ID

⊕ Monitoring Well Location

○ Sediment/Surface Water Sample Location

All concentrations in ug/L

J – Estimated result. Result is less than reporting limit.

bis-2 – bis(2-ethylhexyl)phthalate
1,2-DICL – 1,2-Dichlorobenzene
Dietph – Diethylphthalate
2-Meth – 2-Methylnaphthalene
Naph – Naphthalene
Phe – Phenol
ND – No detections

0 75' 150'
SCALE

INFORMATION OF FAC

1. THE MONITORING/RECOVERY WELLS AND LIMITED SITE LOCATION OF FEATURES SHOWN HEREON ARE BASED ON A FIELD SURVEY MADE F ORIENTATION WITH A FULL SITE PLAN BEING PREPARED BY SHIELD E ASSOC., INC.

2. THE HORIZONTAL POSITION OF THE HEREIN SURVEYED "CARROLL A SUPERFUND SITE IS BASED ON NEW YORK GEODETIC CONTROL MON # LY2611 (LAUREL) AND PID # AB3870 (DIANNE).

ADJUSTED TO NAD 1983 WITHIN THE NEW YORK STATE PLANE COOF SYSTEM

SOURCE: Master Consulting P.A., Monitoring Well Location Plan. Index No. SU00G9, March 3, 1999.

FIGURE 9

DETECTED SEMIVOLATILE ORGANIC COMPOUNDS IN GROUNDWATER – FEBRUARY 1999

CARROLL AND DUBIES SUPERFUND SITE
TOWN OF DEERPARK, ORANGE COUNTY, NEW YORK

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
PITTSBURGH, PENNSYLVANIA

BY: C.L.P.

JENT NO.: 698-0110