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REMEDIAL INVESTIGATION/ FEASIBILITY STUDY REPORT

VOLUME I - REMEDIAL INVESTIGATION

Harmon Railroad Yard Wastewater Treatment Area
Operable Unit II
NYSDEC Site No.: 3-60-010

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ERM

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LIST OF ACRONYMS

ASP	-	*Analytical Services Protocol*
Conrail	-	*Consolidated Rail Corporation*
ERM	-	*Environmental Resources Management*
GW	-	*Ground Water*
MS/MSD	-	*Matrix Spike/Matrix Spike Duplicate*
MW	-	*Monitoring Well*
MTA	-	*Metropolitan Transportation Authority*
NAPL	-	*Non Aqueous Phase Liquid*
NEI	-	*Nytest Environmental Inc.*
NYSDEC	-	*New York State Department of Environmental Conservation*
NYSDOH	-	*New York State Department of Health*
OU	-	*Operable Unit*
PCB	-	*Polychlorinated Biphenyls*
PID	-	*Photo-Ionization Detector*
RCRA	-	*Resource Conservation and Recovery Act*
RI/FS	-	*Remedial Investigation/Feasibility Study*
SVOC	-	*Semi-Volatile Organic Compounds*
TAGM	-	*Technical and Administrative Guidance Memorandum*
TCL/TAL	-	*Target Compound List/Target Analyte List*
TOC	-	*Total Organic Carbon*
TPH	-	*Total Petroleum Hydrocarbons*
UST	-	*Underground Storage Tanks*
VOC	-	*Volatile Organic Compounds*

Section 1

Section 1

1.0 *INTRODUCTION*

ERM-Northeast, on behalf of Metro-North Railroad Company (Metro-North), has prepared this Remedial Investigation/Feasibility Study Report (RI/FS) for Operable Unit II (OU-II) at the Harmon Railroad Yard in Croton-on-Hudson, New York. OU-II represents an extension of RI/FS activities associated with Operable Unit I (OU-I), the "Harmon Lagoon", and focuses on portions of Metro-North's Harmon Yard in Croton-on-Hudson, New York which may have been impacted by the lagoon. The OU-II work focused on: subsurface conditions in the area of the Old Wastewater Treatment Plant and former lagoon; the former discharge line from the Old Wastewater Treatment Plants; and Croton Bay. These OU-II areas are collectively referred to as the "Site". This work was conducted pursuant to a Stipulation of Discontinuance between the New York State Department of Environmental Conservation (NYSDEC) and Metro-North and the September 1992 NYSDEC Record of Decision (ROD) for the Harmon Railroad Yard Wastewater Treatment Area.

The ROD divided the remediation of Harmon Yard into two operable units, Operable Unit I (OU-I) and Operable Unit II (OU-II). OU-I constituted the remediation of: (1) the lagoon and pond system (the "lagoon"); (2) soils above the seasonal high ground water table adjacent to the lagoon; and (3) the contaminated components of the Old Wastewater Treatment Plant (the "Old Plant). In addition, other components of the Old Plant have been decommissioned for operational reasons, as described in the Decommissioning and Demolition Plan for the Old Wastewater Treatment Plant (ERM, 1994a).

OU-II consists of five components potentially affected by past releases from the Old Plant and lagoon. These components are: 1) ground water;

2) non-aqueous phase liquid (NAPL) (if present); 3) soil; 4) sediment; and 5) surface water. The use of the term NAPL throughout this work plan is intended to apply to NAPLs which exhibit a specific gravity less than water and consequently float on the water table surface.

The ground water component of OU-II is that portion of the saturated zone which may have been impacted by discharges from the Site including possible impacts to surface water. The NAPL component of OU-II is any separate phase hydrocarbon layer which may be present on the water table surface which is attributed to the former wastewater lagoon. The soil component of OU-II represents soil adjacent to the former discharge line which conveyed wastewater to the outfall point at Croton Bay which may have been affected by any NAPL layer or any seepage of chemicals from this line. The sediment component of OU-II is any sediment in Croton Bay or the Hudson River which may have been adversely impacted by discharges and/or releases from the Site. The surface water component of OU-II is any surface water in Croton Bay or the Hudson River which may have been adversely impacted by discharges and/or releases from the Site.

A number of investigations have been conducted in the past at and near the Wastewater Treatment Area. These investigations are described in a series of documents prepared by Fred C. Hart Associates, Inc., McLaren/Hart Environmental Engineering Corporation, and ERM. These documents include:

- Site Operations Plan, Harmon Lagoon - Fred C. Hart Associates, Inc., April 8, 1988;
- Remedial Investigation Report, Harmon Lagoon - Fred C. Hart Associates, Inc., November 27, 1989;

- Endangerment Assessment - Fred C. Hart Associates, Inc., December 28, 1989;
- Product Investigation Report, Harmon Lagoon - Fred C. Hart Associates, Inc., November 20, 1990;
- Ground Water Sampling Report, Harmon Lagoon - McLaren/Hart Environmental Engineering Corporation, May 22, 1991.
- Revised Feasibility Study - McLaren Hart Environmental Engineering, February 1992;
- Remedial Investigation Report for Croton Point Sanitary Landfill, Croton-on-Hudson, NY - Charles R. Velzy Associates, Inc., June 1992.

The results of these investigations, characterizing the soil, ground water, surface water and sediment quality at the Site, are described in detail in Section 2.0 of the OU-II RI/FS Work Plan (ERM, 1994b).

1.1 *PURPOSE AND ORGANIZATION OF THE REPORT*

The purpose of this report is to describe the results of the Remedial Investigation (RI), Risk Assessment (RA) and Feasibility Study (FS) for potential remedial actions to be taken at the OU-II Site.

This report has been organized into nine major sections. The content of each section is briefly described below.

Section 1.0 introduces information related to the OU-II Site and the performance of the RI, RA and FS conducted by ERM for the OU-II Site. The history of the OU-II Site, a summary of its physical characteristics, and past response actions are also presented.

Section 2.0 contains a detailed description of the purpose, procedures, and results of the field activities implemented at the Site for each of the four media: NAPL around the former lagoon; soil along the former discharge line; sediment in Croton Bay; and ground water in the vicinity of the former lagoon.

Section 3.0 addresses the nature and extent of environmental conditions at the OU-II Site, and characterizes the NAPL, soil, surface water and sediment, and groundwater.

Section 4.0 presents a Risk Assessment, evaluating potential risks to human health and the environment and potential ecological impacts arising from certain past releases from the Old Plant.

Sections 5.0 through 8.0 contain the Feasibility Study. The FS defines remedial objectives, screens technologies to meet the objectives and develops/evaluates remedial alternatives to achieve the objectives. The FS also identifies a preferred remedial alternative for consideration.

1.2 BACKGROUND INFORMATION

1.2.1 Site Description

The Harmon Railroad Yard is located in the Village of Croton-on-Hudson, New York, and is bounded by Route 9 on the east and Croton Point Park to the west (Figure 1-1). The yard is approximately 100 acres in size. Harmon Railroad Yard has been an active rail yard for over 100 years.

The Site is an approximately 7.5-acre fenced area at the Harmon Railroad Yard which is part of the approximate 100 acre railroad yard (Figure 1-2). The Harmon Railroad Yard has been operated by Metro-North since 1983 for maintenance operations where repairs are made on commuter train cars and diesel and electric motors.

1.2.2 *Site History*

In 1980, polychlorinated biphenyls (PCBs) were discovered in the effluent discharge from the Old Plant. The source of PCBs was identified as the maintenance areas where empty transformers were given a final rinse by Conrail, a predecessor railroad. The rinseate from this activity contained residual PCBs and was conveyed to the equalization lagoon. Since the treatment process was not capable of removing PCBs, residual PCBs were found in the Old Plant, its appurtenances, the lagoon and the pond. Once the source of the problem was discovered, the rinsing operation at the maintenance area was discontinued and the affected areas of the shop, the conveyance pipelines and the wet well were cleaned by Paul M. Mallon Company under the supervision of NYSDEC. Portions of the Old Plant and the equalization lagoon and pond were not remediated. At that time, Conrail contracted with O.H. Materials Co., (OHM) of Findlay, Ohio to furnish, install and operate the OHM Plant to ensure that subsequent discharges from the wastewater treatment area did not contain PCBs.

In 1985, Metro-North constructed the New Treatment Plant at the Site. The New Treatment Plant processes influent wastewater streams from the wet well which are received from the maintenance areas of the yard. Effluent from the New Treatment Plant discharges to Croton Bay pursuant to a new New York State Pollution Discharge Elimination System (SPDES) permit. The Old Plant and its associated appurtenances were dismantled and decommissioned as part of the OU-I remedial action.

NYSDEC first placed the Harmon Railroad Yard on the state registry of Inactive Hazardous Waste Disposal Sites in 1985. At that time, the Harmon Railroad Yard was classified as a 2A, a temporary classification assigned to sites with inadequate and/or insufficient data for inclusion in any other classification. In December of 1988, at the request of Metro-North, NYSDEC split the Harmon Railroad Yard into two separate sites. The Old Plant and lagoon was designated as one site and was reclassified as a 2. Hart Environmental Management Corporation, on behalf of Metro-North, initiated a RI/FS project at the Old Plant and lagoon at that time.

After the RI/FS project was completed, a ROD was issued by the NYSDEC. As previously mentioned, the ROD separated the Old Plant and lagoon area into two operable units designated OU-I and OU-II. A remedial design was completed for OU-I and the remedial action was completed in May 1996. This RI/FS addresses OU-II. The remedial design, remedial action, and other response actions are discussed below in Section 1.3.

1.2.3 *Summary of Physical Characteristics*

1.2.3.1 *Geology*

The OU-II Site is located on the northwestern edge of the Croton Point peninsula. Croton Point is approximately two miles long and extends south into the Hudson River. The geology of the peninsula, as summarized by Hart (1989) and Charles R. Velzy (1992) from a variety of sources, indicates that historical sand hills up to 60 feet high once occupied the peninsula. The hills were removed by sand mining and to make way for railyard operations.

The geologic origin of Croton Point is believed to extend back 10,000 years to a river delta with sediments of sand, silt and clay deposited in a post-glacial lake. The stratigraphy on the peninsula consists of bedrock overlain by lacustrine silts and clays, deltaic silts and clays and deltaic sands. This upward coarsening sequence was then cut into valleys for the Hudson and Croton Rivers by glacial ice. These soils are typical of those developed by glacial outwash, and are reportedly deep, excessively drained, coarse-textured, highly permeable sand and gravel.

The following description of subsurface characteristics at the OU-II Site is based on Site-specific data collected during the OU-I and OU-II RIs. A total of 99 soil borings were installed during these RIs. Their locations are shown on Figure 2-1. The boring logs compiled during drilling activities are presented in Appendix A.

The soils encountered during drilling activities were uniform across the Site. The soils consist primarily of brown very fine to coarse sands and gravels. Black soils were encountered in the northwestern portion of the lagoon and were mixed with coarse gravels. These black soils and coarse gravel are believed to have been part of lagoon berm construction materials and likely stained from the NAPL formerly present in the lagoon. Hence, the soils in this area are not thought to be representative of native subsurface materials.

Bedrock was not encountered in any of the borings, which extended to a maximum of approximately 16 feet below grade. Based on test boring data reported by Hart (1989), the depth to bedrock is thought to exceed 200 feet in the vicinity of the OU-II Site.

1.2.3.2 Hydrogeology

Water table elevation data was collected at previously existing monitoring wells and newly installed OU-II monitoring wells at varying intervals between December 1994 and June 1996. The data are discussed in Section

2.4.2 and Section 3.4, and summarized in Tables 2-3 and Table 2-10 of this report. The data indicate that shallow ground water beneath the Site flows to the northwest towards Haverstraw Bay. Depth to ground water during the period of record ranged from approximately seven feet to 16 feet below grade. The elevation of the water table has varied from approximately three feet to 10 feet above mean sea level during the period of record.

1.2.3.3 *Surface Water*

The major surface water bodies in the vicinity of Croton Point are the Hudson and Croton Rivers. The Hudson River in the area of Croton Point is tidal estuary where conditions are brackish (Charles R. Velzy, 1992). The Site lies approximately 100 ft. southeast of Haverstraw Bay which is a part of the lower reaches of the Hudson River.

At the time of the field investigation, the former lagoon contained ponded water which has since been removed as part of the OU-I remedial action. At present, a paved storage area occupies the location of the Old Plant and former lagoon. Surface water in the vicinity of the paved storage area drains to a catch basin, which feeds into a new stormwater discharge line. Pursuant to the current SPDES permit, this stormwater flow passes through an oil/water separator and discharges into Croton Bay in the vicinity of the railroad bridge on the southern end of the Harmon Railroad Yard.

1.3 *SUMMARY OF PAST RESPONSE ACTIONS*

Two response actions have been conducted in this area of the Site. They are:

- NAPL removal in the vicinity of the lagoon as an Interim Remedial Measure (IRM) for OU-I; and
- implementation of the selected OU-I remedial action for the former Lagoon (i.e., removal of the Old Plant and closure of the lagoon).

This section provides a summary of these previous response actions.

1.3.1 *NAPL Removal in the Vicinity of the Lagoon*

At the request of NYSDEC, a NAPL investigation was conducted in 1990 to: (1) evaluate NAPL observed in the vicinity of the lagoon; and (2) develop a NAPL recovery IRM for this area. The results of this investigation were submitted to NYSDEC in the Product Investigation Report, Harmon Lagoon, Croton-on-Hudson, New York, prepared by Fred C. Hart Associates, Inc. (Hart), 20 November 1990 (Hart, 1990).

Four monitoring wells were evaluated during the 1990 NAPL investigation. Three of these wells, WB-2, WB-4 and WB-5, were installed during the 1989 OU-I RI, and the remaining well, WB-9, was installed in August 1990 to monitor the area downgradient of the lagoon. The NAPL investigation entailed:

- collection of water level and NAPL measurements;
- product baildown testing to estimate the recharge rate of the monitoring wells;
- analysis of NAPL samples collected from WB-2, WB-4, WB-5 and WB-9, Inc. , by Oil Test, Inc., for metals and physical parameters; and
- GC/MS fingerprint analysis of NAPL samples collected from WB-2, WB-4, WB-5 and WB-9, by YWC, Inc..

NAPL was observed in monitoring wells WB-2 and WB-5 during the 1989 OU-I RI and in monitoring wells WB-2, WB-4, WB-5 and WB-9 during the 1990 NAPL investigation. Recharge rates of 1.5 gal/day, 0.08 gal/day and 1.03 gal/day were observed in monitoring wells WB-2, WB-4 and WB-5, respectively, during the NAPL baildown testing in 1989.

Using the information collected during the 1989 OU-I RI and the 1990 NAPL investigation, interim NAPL recovery systems were proposed for this area of the Site. Monitoring wells WB-2, WB-5 and WB-9 were selected for NAPL removal based on the consistent presence of NAPL in these wells and their favorable recharge rates. Although NAPL was observed in monitoring well WB-4, this well was not identified for NAPL removal due to its poor recharge rate.

In January 1991, the interim NAPL removal systems were installed in monitoring wells WB-2, WB-5 and WB-9. Due to a number of factors, the NAPL removal systems operated intermittently, collecting approximately 79, 171 and 223 gallons of NAPL from WB-2, WB-5 and WB-9, respectively, during the period from January 1991 through May 1992 (Hart, 1991; Hart, 1992).

The analytical results provided by Oil Test, Inc. and YWC, Inc. for the NAPL samples collected during the 1990 NAPL investigation are presented and discussed in Section 3.1. These analyses lend insight to the chemical and physical characteristics of NAPL and similarities between the NAPL encountered in the four monitoring wells.

1.3.2 *Lagoon Closure*

The remedy for OU-I, as outlined in the ROD, included the following components:

- Installation of sheeting around the perimeter of the former lagoon area prior to the removal of sludge.
- Removal of lagoon sludge and incineration at an off-Site Toxic Substances Control Act (TSCA)-permitted stationary incinerator.
- Disposal of soils from Zone A containing more than 10 milligrams per kilogram (mg/kg) PCBs but less than 50 mg/kg PCBs at an off-Site Resources Conservation and Recovery Act (RCRA)-permitted landfill.
- Excavation and relocation of low level (i.e., greater than 0.5 mg/kg and less than 10 mg/kg) PCB-contaminated Zone A soils in the remediated lagoon area.
- Placement of a low permeability liner over the remediated lagoon area to ensure at least two feet separation between seasonal high ground water and backfill soil.
- Placement of uncontaminated soil in the remediated lagoon.
- Placement of a low permeability cover over the low level PCB-contaminated Zone A soil that is relocated into the remediated lagoon area and the uncontaminated soil that is placed in the remediated lagoon area.
- Enhancement of the existing NAPL recovery system.
- Decontamination, demolition and proper disposal of the Old Wastewater Treatment Plant.

In response to a requirement of the NYSDEC Bureau of Spill Prevention and Response, recovery wells, piezometers, and air sparging and vacuum extraction piping components were incorporated in the OU-I Remedial Design and were installed within the former lagoon during OU-I construction activities. The NYSDEC is currently evaluating a 13 December 1995 proposal by Metro-North to activate the ground water pumping wells installed within the remediated lagoon area in order to maintain hydraulic ground water control, to continue ground water monitoring and to perform an ASTM Risk Based Corrective Action (RBCA) risk assessment using past and future ground water monitoring data. An ASTM RBCA analysis was performed for the entire Harmon Yard, as reported in the Harmon Yard

"Remediation Plan" (ERM, 1996), submitted to and approved by the NYSDEC Bureau of Spill Prevention and Response. Based on the results of ground water quality sampling performed in 1989 and under this OU-II study (i.e., extremely low concentrations of organic compounds in ground water), and in response to concerns expressed by the Croton/Ossining PCB Citizens Committee at a meeting on 21 November 1995, Metro-North has also proposed that the air sparging and vapor extraction system installed in the remediated lagoon area not be activated.

As of the writing of this report, the OU-I component of the Site remediation has been completed. Key milestones of the OU-I remediation are summarized in Table 1-1 for reference purposes.

Section 2

Section 2

2.0 REMEDIAL INVESTIGATION

2.1 NAPL DELINEATION AROUND THE FORMER LAGOON

2.1.1 Purpose

The purpose of the task was to delineate the extent of NAPL on the ground water surface in the area of the former lagoon. Since NAPL was found in a number of monitoring wells around the lagoon, temporary wells were used to determine the areal extent of NAPL. The temporary well installation proceeded as an iterative program, extending to adjacent off-site areas when necessary, until the extent of NAPL in each area was fully delineated. In addition to the temporary wells, six test borings were installed at locations around the former lagoon to check whether NAPL was present in areas not previously investigated.

2.1.2 Procedures

2.1.2.1 Test Boring

Six test borings (TB-1 through TB-6) were advanced between 1 December 1994 and 7 December 1994 at the locations shown in Figure 2-1. The test borings were advanced to just below the ground water table. At each test boring, continuous split spoon sampling was conducted down to the capillary fringe (the subsurface soil interval immediately above the water table) utilizing a hollow stem auger drilling rig. Subsurface soil samples were collected with decontaminated standard two-inch split spoons driven in accordance with ASTM standards for penetration Test and Split-Barrel Sampling of Soils (ASTM D-1586-84). Upon retrieval and opening of the split spoons, ambient volatile organic measurements were collected with an organic vapor analyzer (OVA) or a photo-ionization detector

(PID). The physical characteristics of the soil samples were also recorded in a log. The logs included descriptions of volatile organic readings, odor, penetration resistance, recovery, grain size, color, staining or visible presence of NAPL and moisture content.

Samples of soil corresponding to the interval beginning at the capillary fringe and extending through the top of the water table were analyzed in the field for Total Petroleum Hydrocarbons (TPH) with an HNU-Hanby Field Test Kit. Soil samples from these intervals in five of the six borings had indications of hydrocarbons.

The HNu-Hanby system for TPH analysis is a self-contained test kit. The Hanby Method was documented in an EPA report on field measurement techniques (USEPA, 1990). In this report, EPA found that the method provided quantitative results with high levels of precision and accuracy. Typical minimum detection limits are one part per million each for BTEX (benzene, toluene, ethylbenzene and xylene), unleaded gasoline, diesel fuel and crude oil. The on-site test was completed in approximately 10 minutes.

The test procedure is as follows: first, a five-gram soil sample (approximately two milliliters (ml)) is placed in a beaker. A 10-ml ampoule of solvent is added to the soil which is agitated for three minutes. After allowing the soil to settle, the solvent is poured into a screw-top test tube to the 4.2 ml mark. One 10-ml vial of color development catalyst is added and the test tube is vigorously shaken for three minutes. Lastly, the hue and intensity of the resulting product are compared to color standards to determine the contaminant type and concentration. If a mixture of components exist in the soil, the resulting color will reflect their presence. A mixture of aromatic compounds may interfere with one another resulting in a color and intensity that are not expected. Weathered product components and high concentrations (greater than 800 ppm for No. 2 fuel oil) will also produce skewed results. Generally, the results are adequate to determine the most contaminated sample.

At five of the six test boring locations, both the physical characteristics and the Hanby Method indicated that hydrocarbons were present. As a result, a temporary well was installed at each of the five locations to determine if NAPL was present in sufficient volume to accumulate as a separate phase on the ground water surface.

2.1.2.2 *Temporary Well Installation*

The temporary well installation program of the OU-II RI was conducted in two phases. The first phase was conducted from 22 November 1994 through 18 January 1995 and involved on-site temporary well installations. The second phase, involving the off-site installation of temporary wells was conducted in February and April, 1996. Table 2-1 summarizes each on-site and off-site temporary well installation completed during the course of this RI. The table notes those temporary installations which were converted to permanent wells and those which were abandoned.

Temporary well installations were abandoned as part of the OU-I remedial action. Those temporary well installations which were not abandoned during implementation of the OU-I remedial action were backfilled with a bentonite cement grout in accordance with NYSDEC TAGM HWR 89-4032 regarding drill cuttings. Also, some temporary wells were fitted with protective casings to avoid damage during the OU-I remedial action.

The installation of temporary wells began near the four known areas of NAPL around the former wastewater lagoon. The designation of these NAPL areas, along with the existing monitoring well which defines the area, are:

- L1 WB-9
- L2 WB-4
- L3 WB-2
- L4 WB-5

Temporary wells were installed at these four locations at increasing distances from the existing monitoring wells until NAPL associated with the former wastewater lagoon was not encountered.

The locations of the four NAPL areas and the temporary wells installed are shown on Figure 2-1. All the initial temporary well casings were installed in one area at one time. The intent was to install the temporary well casings in as short a time frame as possible so that the initial screening step could be completed relatively quickly. Continuous split spoon sampling was conducted utilizing the same procedures as previously described for the six test borings and for 13 of the temporary well installations. At the remaining locations, as noted in Table 2-1, the temporary wells were installed by drilling to a pre-determined depth and "dropping" the well casing into the borehole. This technique was employed for many of the off-site temporary wells, near the extent of the NAPL areas, where adequate subsurface information had already been obtained.

After soil sampling, a two-inch PVC temporary well casing was installed in the borehole. The temporary well casing was constructed of 10 feet of slotted PVC and five to 10 feet of riser pipe and was installed such that the screened interval straddled the water table. A sufficient amount of the annular space surrounding the casing was backfilled with graded sand to ensure that the casing was stable inside the boring (Figure 2-2), and the drilling rig then moved to another location to install additional temporary wells/borings. The casings were left in place for a minimum of eight to 12 hours. The eight- to 12-hour time frame was based on NAPL recharge rates ranging from 0.003 gallons per hour to 0.06 gallons per hour as reported in the 1990 Fred C. Hart Product Investigation Report. Based on these rates, eight to 12 hours was deemed adequate to establish the existence of NAPL in the temporary wells.

After approximately eight to 12 hours of equilibration, water level and NAPL thickness measurements were collected from each well. Water level and product thickness measurements in the temporary well casings were obtained with an electronic interface probe accurate to 0.01 feet. All water level measurements were taken from the top of each temporary casing and was recorded in a bound field notebook. All measuring equipment was decontaminated between wells using an Alconox and water solution and a tap water rinse.

Following the installation of the initial temporary wells, the NAPL thickness measurements from each temporary well was plotted on a map. In areas where NAPL was identified, another set of temporary well casings were installed at a distance of 10 to 100 feet radiating outward from the first set. The appropriate distance was selected based upon the thickness of the NAPL in the first set of wells. The precise spacing was determined in the field. When an NYSDEC field representative was present during installation of temporary wells, the representative was consulted in the selection of interval spacing. After installation of each round of temporary wells, water level and NAPL measurements were obtained.

This iterative process of temporary well installation was continued in each area until the extent of each NAPL plume was defined (i.e., no NAPL present). NAPL delineation concluded only after consultation with the NYSDEC project manager. At the conclusion of both phases of NAPL delineation, a map was prepared to show the location and extent of the NAPL plume in each defined area (see Section 3.1.1).

2.1.2.3 *NAPL Testing*

Representative samples of NAPL were collected from several select temporary wells. Samples were collected from eight on-site wells in March 1995 (WB-2, WB-2-1A, WB-4, WB-4-4A, WB-5, WB-9, TB-1-1A1A and TB-6-1B1B) , two off-site wells in March 1996 (OS-C and OS-F) and one off-site well (OS-O) and one on-site well (WB-9-3C2A).in May 1996. All samples were analyzed for PCBs.

Four of the samples collected in March 1995 (WB-2-1A, WB-4-4A, TB-1-1A1A and TB-6-1B1B) and the two samples collected in May 1996 (WB-9-3C2A and OS-O) were also submitted to Worldwide Geosciences, Inc. for fingerprint analysis via gas chromatography. The purpose of the fingerprint analysis was to ascertain signature characteristics regarding the type of petroleum hydrocarbons in each NAPL sample. These signature characteristics were then evaluated to determine the type of NAPL; NAPL similarities; and differences both within and between each NAPL plume. If, for example, NAPL from two different source areas merge, the composition of the NAPL would change accordingly. Similarly, two seemingly discrete areas of NAPL adjacent to one another which have the same signature characteristics could indicate a single plume and necessitate additional temporary well installations.

Each NAPL sample was collected utilizing a bottom loading disposable polyethylene bailer. The bailer was lowered into the temporary well with a dedicated polypropylene cord and the sample was retrieved. Each sample was then placed in its appropriate sample container, placed on ice and sent to Nytest Environmental, Inc. (NEI) via overnight courier for analysis with chain of custody documentation maintained throughout.

2.1.2.4 *Baildown Testing*

Baildown testing was conducted on the four monitoring well which have historically contained product (WB-2, WB-4, WB-5, and WB-9) as well as two other wells (MW-1 and WB-7) identified during monitoring activities at the Site. This involved the estimation of actual product thickness through the graphical evaluation of depth to product (DTP), depth to water (DTW), and apparent product thickness over time as measured during recovery of liquid in the monitoring well. Specifically, Gruszczenski's (1987) method was used where both product and water were bailed from the wells until no further reduction of apparent product thickness could be achieved, then the recovery of both DTW and DTP were measured over time. The time intervals were similar to those used during in-situ permeability tests and measurements were made until readings stabilized.

During recovery, the product level approached the original static level. However, the product/water interface initially rose then fell at some point during recovery. This fall represented the displacement of water by the over accumulation of product in the well. According to Gruszczenski the distance from this point where the depth to water changes from a positive to negative slope (inflection point) and the measured stabilized top of product is considered to be the actual mobile NAPL thickness in the formation. The results of the baildown test were used to determine if the NAPL could be easily removed from the formation, and provided an accurate indication of NAPL thickness within the formation.

2.1.3 *Results*

The test borings, temporary well installations and NAPL testing were conducted at various time intervals between 1 November 1994 and 24 June 1996. Extensive subsurface information was collected during this time. The subsurface geologic characteristics are contained in boring logs for test borings and temporary wells from which split-spoon samples were collected. The boring logs can be found in Appendix A.

The subsurface soils were also subjected to field testing for TPH using the Hanby kit. TPH results of a number of subsurface soil intervals at 20 boring or temporary well locations are provided in Table 2-2. These locations are representative of the four NAPL areas and sections in between these areas.

A summary of fluid level measurements collected from the on-site and off-site temporary well locations is provided in Table 2-3. This table reflects both ground water and NAPL elevations (when present) to yield a NAPL thickness for each period of measurement. NAPL thickness measurements for two selected time periods (18 January 1995 and 24 June 1996) are shown in Figures 2-3 and 2-3.5, respectively. The GC fingerprint signature exercise is also useful in evaluating differences or similarities between the NAPL in the four areas.

The reported PCB concentrations in the 12 NAPL samples are summarized in Table 2-4. The reported results range from non-detect to

23 milligrams per kilogram (mg/kg) (parts per million (ppm)). The laboratory data and data validation reports are provided in Appendix B.

Baildown tests were conducted on the six selected monitoring wells on January 11, 12 and 17, 1995. These data are used in the FS to determine NAPL percent recovery to illustrate the magnitude of recoverable NAPL. The data and analysis are discussed in Section 5.2.1. The associated data and data plots are included in Appendix C.

2.2 *SOIL INVESTIGATION ALONG FORMER DISCHARGE LINE*

2.2.1 *Purpose*

The purpose of the soil characterization task was to determine the quality of the soil in the area adjacent to the former discharge line which conveyed wastewater from the Old Treatment Plant to the outfall point at Croton Bay. These soil samples were collected from borings installed adjacent to the former discharge line.

2.2.2 *Procedures*

Soil sampling adjacent to the former discharge line was conducted from January 26, 1995 through February 6, 1995. Soil borings were installed on either side of the discharge pipe and spaced at approximately 100 foot intervals (Figure 2-4). The soil borings were installed with a Geoprobe drive point sampling device. One soil sample was collected from just above the water table at the capillary fringe. The approximate depth to ground water along the alignment of the discharge line was ascertained from the existing monitoring wells in the Yard as well as any other relevant investigations that were completed at the time the OU-II RI was implemented.

Multiple Geoprobe samples were driven at several locations to obtain a sufficient volume of sample. Soil samples were placed in laboratory supplied glassware and the bottles were stored on ice prior to shipment by courier to NEI. NEI is part of the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program and was approved by NYSDOH for the analysis of soil and ground water samples via NYSDEC Analytical Services Program (ASP) protocols.

The soil samples were analyzed for Target Compound List (TCL) parameters by NYSDEC 1991 ASP analytical methods. Quality control samples, including matrix spikes (MS), matrix spike duplicates (MSD), duplicate samples and field blanks were also collected during this program. A total of 62 soil samples, along with four matrix spike (MS) and matrix spike duplicates (MSD), four duplicate samples and seven field blanks were collected. All duplicate samples were homogenized prior to sampling.

All of the soil samples were also analyzed for total organic carbon (TOC) and approximately 30 percent of the samples were analyzed for grain size distribution. The samples were analyzed for TOC by EPA Method 9060 and the grain size analysis was conducted via dry sieve according to ASTM D422 (Standard Method for Particle Size Analysis of Soils).

Upon completion, the borings were backfilled as described in Section 2.1.2.2. All Geoprobe and sampling equipment was cleaned between each boring using an Alconox and water solution and a tap water rinse.

2.2.3 *Results*

A summary of the physical descriptions of each of the soil samples collected along the former discharge line, along with the respective intervals, is provided in Table 2-5. The occurrence of coarse materials in many of these samples suggests the presence of backfill and hence, shows that the Geoprobe technique was successful in reaching along side the discharge line.

The analytical results of the soil samples are contained in Table 2-6. Only those constituents which were identified in at least one sample are summarized on this table. The laboratory data and data validation reports are contained in Appendix D.

2.3 *SEDIMENT AND SURFACE WATER INVESTIGATION*

2.3.1 *Purpose*

Croton Bay sediments were sampled to ascertain whether any discharges from the former discharge line resulted in residual organic compounds or inorganic constituents in this medium. At the same time, surface water samples were also collected to determine if any correlation existed between the sediment chemistry and surface water.

2.3.2 *Procedures*

The sediment sampling approach sought to determine whether organic compounds or inorganic constituents were present in areas of Croton Bay previously determined to have elevated TPH levels in sediment. As described in the RI Work Plan, previous data suggested a particular pattern of elevated TPH in sediment in the vicinity of the former discharge line outfall. This information was used to develop the sediment investigation component of OU-II. Sediment samples were collected from Croton Bay to delineate the three previously defined areas of TPH. The samples were collected in a radial pattern outward from the former discharge outfall pipe. If field personnel observed any oil sheens or seeps during sampling, the sediment samples were biased to these locations. Sample locations were biased towards the observed worst case (i.e., oil seeps and oil sheens).

Sediment samples were collected by using a sediment corer. A representative portion of each core was placed in laboratory supplied glassware.

The sediment sampling effort was conducted on 23 March 1995 at low tide at six locations within Croton Bay. These approximate locations are shown in Figure 2-5. At each location, a sediment core approximately four feet long was collected. Each sediment core was collected at the zero to two-foot depth interval. This resulted in a total of six sediment samples. The original intent was to collect two samples at each location. However, the sediment was very runny, and the coring device could retain only enough material to complete one sample. It was determined in the field, in conjunction with the NYSDEC representative, that the samples being retained were representative of the material present, and that one sample at each location would be sufficient.

The sediment samples were analyzed for TCL/TAL parameters and TOC. Additionally, a representative portion of each sediment sample was subjected to grain size analyses. These samples were also accompanied with the appropriate QA/QC samples which consisted of one MS, one MSD, one duplicate sample and one field blank.

In addition to the sediment samples collected directly from Croton Bay, one grab sample of stockpiled sediment was also obtained for laboratory analysis. This stockpiled sediment was dredged from the area of Croton Bay near the railroad bridge just to the east of the outfall of the former discharge line. The sediment was dredged as part of a bridge structure rehabilitation program and originated from around piers and abutments. The exact sample location is not known. This stockpiled sediment sample was analyzed for the same parameters as the Croton Bay sediment samples.

Two surface water samples were collected at low tide at the location indicated in Figure 2-5. The samples were collected by lowering each bottle into the water and allowing it to fill slowly so as to avoid overfilling, preventing the loss of any preservative. The first sample collected was unfiltered and was analyzed for TCL/TAL parameters. This sample was accompanied by the appropriate QA/QC samples which consisted of one MS, one MSD, and one duplicate. No field blank was collected for this sample since there was no sampling equipment utilized during its collection. The second surface water sample collected was filtered in the field utilizing a portable compressor pump and disposable Nalgene filters. This sample was analyzed for TCL base neutral analysis, TCL pesticides and PCBs, and TAL parameters. There were no QA/QC analysis accompanying this sample except for one trip blank.

Following collection of the samples, the bottles were stored on ice and shipped by courier to NEI.

2.3.3 *Sediment and Surface Water Results*

The results of the sediment and surface water sampling are summarized in Table 2-7. Once again, only those constituents found in at least one sample are presented in the table. The laboratory analytical and data validation reports for the sediment sampling can be found in Appendix E and for the surface water in Appendix F.

2.4 *INVESTIGATION OF GROUND WATER IN THE VICINITY OF THE FORMER WASTEWATER LAGOON*

2.4.1 *Purpose*

The purpose of the ground water investigation was to update and expand upon existing information on ground water quality and flow in the vicinity of the former wastewater lagoon. The existing information was obtained as part of the OU-I RI. These objectives were achieved by collecting water level measurements and ground water samples for laboratory analysis from the existing shallow and deep monitoring wells, and any new wells installed during the NAPL delineation task.

2.4.2 *Procedures*

The initial scope in the RI Work Plan contemplated the installation of six test borings and 15 additional temporary wells. These new wells and 18 existing monitoring wells would constitute the measuring and sampling points to achieve the objectives of the ground water investigation.

This scope was modified when more temporary wells than were anticipated in the RI Work Plan were actually installed during NAPL delineation. There were 68 more temporary monitoring wells installed during NAPL delineation than initially anticipated. These additional temporary wells resulted from an extension of the NAPL delineation from the perimeter of the former lagoon. At that time, a decision was made, in conjunction with Metro-North and NYSDEC, to use some of the temporary monitoring wells to obtain ground water elevation measurements and collect samples for laboratory analysis.

The temporary wells used to obtain water level measurements and samples were surveyed and developed to ensure they were in hydraulic communication with the surrounding water-bearing zone. These temporary wells were in locations consistent with those permanent monitoring wells anticipated in the RI Work Plan. Hence, they were suitable candidates to replace these permanent wells.

Ten wells were incorporated into the ground water sampling program and were sampled once. Again, in conjunction with Metro-North and NYSDEC, a decision to perform a second sampling, provided for in the RI Work Plan, was to be determined from the results of the initial sampling. Since the results were consistent with the two prior sets of ground water sampling results obtained from existing monitoring wells, a subsequent round of ground water sampling was not required for characterization.

The following sections explain the monitoring well selection and sampling efforts along with the information regarding ground water flow and quality.

2.4.2.1 *Monitoring Well Selection/Installation/Sampling*

A monitoring well network of 61 wells was maintained in the area of the former lagoon. Eighteen of these wells are preexisting permanent monitoring wells; 43 wells are temporary wells installed during the NAPL delineation phase of the investigation. As discussed above, these have been preserved and substitute for the originally proposed permanent monitoring wells. Of the 61 wells in the network, 14 wells contained NAPL and 47 wells did not contain NAPL. The 47 non-NAPL wells were incorporated into the ground water monitoring program for water level measurements and as potential sampling points.

Prior to the initiation of monitoring, all 61 wells were re-developed by either centrifugal or submersible pump. The redevelopment occurred from 10 January through 18 January 1995. This was done to ensure removal of any fine materials and, as is the case for the existing monitoring wells, to restore the hydraulic properties of the surrounding water-bearing zone.

The equipment used to develop the wells was decontaminated prior to use and between each well utilizing an Alconox and water wash and tap water rinse. The re-development of the wells involved purging until a reduction of the turbidity of the well water to 50 Nephelometric Turbidity Units (NTUs) or less was obtained. A portable turbidity meter was used to measure the turbidity of the ground water. If the turbidity of the ground water could not be reduced to 50 NTUs, the field team leader, in consultation with the NYSDEC field representative, when present, documented the problem, recorded the turbidity measurement achieved and considered the well developed. Temperature and pH readings were also collected.

After approval by the NYSDEC and following modification to the Order on Consent Case # 3-1548/8807 dated November 9, 1990, all development water was conveyed to the former wastewater lagoon, including the water collected during the re-development of the four NAPL wells. Following development, the wells were allowed to equilibrate for eight to 12 hours prior to initiation of monitoring.

A total of 10 wells were incorporated into the ground water sampling program. The 10 wells included seven existing wells and three temporary wells. The original intention as stated in the RI Work Plan was to sample 14 wells which would be representative of ground water conditions at the Site. However, in order for a well to be included in the ground water sampling program, it had to be accessible, free of damage, and could not contain NAPL. The selected wells met these criteria and although fewer in number than originally proposed, were deemed to be representative of ground water conditions at the Site. The well selection process was carried out in the field with the approval of the NYSDEC representative present.

The sampling was conducted on 11 April 1995. Prior to the collection of ground water samples, a round of water level measurements was collected so that the liquid volume in each well could be calculated. A total of three to five well casing volumes were removed from each well prior to the acquisition of the ground water samples. The purge water was containerized/conveyed to the lagoon following modification of the existing previously referenced Order of Consent.

The ground water samples were collected with dedicated disposable high density polyethylene bottom-loading bailers, suspended by a polypropylene cord. All sampling equipment was properly decontaminated prior to use according to the procedures outlined in Section 2.1.2.2.

The samples were poured from the bailer into laboratory-prepared sample bottles and the bottles were stored in a cooler on ice. The coolers were sent by courier to NEI within 24 hours of sample collection. A total of 10 samples were collected. These samples were accompanied with the appropriate QA/QC sample which included, one MS, one MSD, one duplicate and one field blank. All samples were properly identified, logged and shipped under full chain-of-custody procedures.

2.4.2.2 *Ground Water Elevation and Flow*

Water level information was obtained from 47 wells around the former lagoon. These wells were located by a NYS licensed surveyor (Charles H. Sells Inc.) and shown on the Site base map. Additionally, a measuring point elevation was determined for each well so that ground water elevation and flow information could be expressed to a common datum. Ground water level data from wells with NAPL were not included in the ground water flow maps.

2.4.3 *Ground Water Sampling and Flow Results*

The ground water level information summarized in Table 2-9 was used to develop ground water flow maps indicating the direction of flow in the area of the former lagoon. Two specific periods of measurement were selected for this illustration. These were 18 January 1995 and 24 June 1996. The ground water flow maps for these two time periods are shown in Figures 2-7 and 2-8, respectively. These maps show ground water flow in the shallow water bearing zone predominantly to the northwest.

The ground water sampling results are summarized in Table 2-8. Only constituents detected in one or more monitoring wells are summarized on this table. The laboratory analytical data and validation results can be found in Appendix F. As previously mentioned, the tests results from this round of sampling were consistent with previous test results of ground water from samples collected in the area of the former lagoon (see discussion in Section 3.4.2). Consequently, pursuant to the understanding reached with Metro-North and NYSDEC, only one round of samples was collected under the OU-II RI/FS.

Section 3

Section 3

3.0 *DESCRIPTION OF ENVIRONMENTAL CONDITIONS*

This section evaluates the results presented in the preceding section. The evaluation considers environmental setting, physical and analytical data, and background information to describe environmental conditions at the Site. These include the nature and extent of NAPL around the former lagoon, chemical constituents found in the soil along the former discharge line and sediment at the Croton Bay outfall, and occurrence of chemical constituents in ground water in the vicinity of the former lagoon in comparison to historic data.

3.1 *NAPL AROUND THE FORMER LAGOON*

3.1.1 *NAPL Monitoring and Delineation of Extent*

As part of the NAPL delineation task of the OU-II RI, NAPL monitoring has been conducted at wells in the vicinity of the lagoon since November 1994. Monitoring data has been collected both at previously existing monitoring wells, and at temporary and permanent monitoring wells installed for the OU-II RI. The monitoring data, summarized as depth to NAPL and NAPL thickness, were presented in Table 2-3.

In order to determine the extent of NAPL in ground water in the vicinity of the lagoon, two NAPL thickness maps were prepared. The first map, shown in Figure 2-3, shows NAPL thickness measurements recorded on 18 January 1995. This date was chosen as representative of existing conditions in the early part of the OU-II RI implementation because at that time, the majority of the temporary well installations had been completed, and represents one of the most complete monitoring rounds. The second map, shown in Figure 2-3.5, shows NAPL thickness measurements recorded on 24 June 1996. This date represents the most recent NAPL monitoring data collected. All wells that could be located and gauged were monitored. This data represents the most complete and recent round available, including temporary wells installed after 18 January 1995.

As discussed earlier and illustrated in Figure 3-0, NAPL generally occurs in four general areas in the vicinity of the lagoon: 1) L1 - to the northwest in the vicinity of wells TB-1 and WB-9; 2) L2 - to the north in the vicinity of well WB-4; 3) L3 - to the northeast in the vicinity of well WB-2; and 4) L4 - to the southeast in the vicinity of wells TB-6 and WB-5.

The general extent of NAPL in the four main areas identified above is essentially the same in January 1995 and June 1996. During the period from January 1995 to June 1996, additional temporary wells were installed in NAPL areas L1 and L4. These wells were placed along the boundary of the Site and in adjacent off-site areas.

3.1.2 *NAPL Thickness*

The thickness of NAPL in the temporary wells has varied over time. The trend of increasing NAPL thickness in certain temporary monitoring wells during the early periods of measurement appear to be the result of preferential accumulation in the well casing. Also, variations in NAPL thickness seem to occur as a result of fluctuations in the ground water table. The following describes the occurrence of NAPL in each of the four previously defined areas.

3.1.2.1 *NAPL Area L1*

This area is defined by well WB-9 and associated temporary monitoring wells located to the northwest of the former lagoon. The extent of NAPL in this area is defined by temporary and permanent monitoring wells on the east side of the Westchester County access road leading to the former New York Central Railroad Company property and the Half Moon Bay Development. There are also four off-site wells (MW-C, MW-B, OS-N and OS-O) on the west side of this access road which assisted in describing the extent of NAPL in this area.

Only one temporary well on the west side of the access road (OS-O) was found to contain NAPL. Since on-site temporary wells in NAPL area L1 area were found to contain PCBs, a sample of NAPL was collected from temporary well OS-O for PCB analysis. The test results, previously presented in Table 2-4, indicated that no PCBs were present in NAPL in OS-O.

The available data was evaluated to ascertain the potential for NAPL to migrate, regardless of the NAPL sources on the west or east side of the access road. The migration potential was evaluated based on ground water flow direction, physical features and NAPL thickness variations.

The direction of ground water flow in this area , as shown in Figures 2-7 and 2-8 is toward the northwest. However, since the former lagoon has been closed, the probable NAPL source has been removed. Moreover, any hydraulic influence exerted by the open lagoon has also been eliminated by closure of the lagoon.

The access road would also be inclined to limit the ability for NAPL to migrate as a result of the compacting of subsurface soil during its construction. Hence, the movement of the finite volume of NAPL in the L1 area would likely be obstructed as a result of the road.

There is, however, a storm drain piping network in the vicinity of this road. The storm water piping network is shown in Figure 3-0. This portion of the storm water network includes piping which extends to the west toward the Hudson River. As part of the RI, the location and invert elevations of the catch basins in this storm water network were determined. The survey indicates that storm water flows northeasterly along the road to a point beyond the Site property boundary. At that point, storm water in the system is conveyed to piping that trends westerly toward an outfall near the Hudson River.

A comparison of the ground water level and NAPL elevations to the invert elevations of the catch basins indicate that the storm water network in the vicinity of NAPL area L1 is above the ground water and NAPL. Therefore, it will not act as a preferential, artificial pathway.

The NAPL thickness measurements in WB-9, summarized in Table 2-3, show a decreasing trend over time. Figure 3-2 summarizes NAPL thickness versus ground water elevations for WB-9. This figure shows that NAPL is thickest when the ground water level is depressed. This is likely due to NAPL presence in the pore space of soil above the water table which is able to drain under gravity and accumulate on the depressed ground water surface.

3.1.2.2 *NAPL Area L2*

This area is defined by well WB-4 and associated temporary monitoring wells located north of the former lagoon. This NAPL area is limited in size and had low levels of PCBs.

The direction of ground water flow in this area , as shown in Figures 2-7 and 2-8 is westerly. Given the ground water flow direction and the limited size of this area, the finite volume of NAPL does not likely pose a migration threat.

The NAPL thickness measurements in WB-4, summarized in Table 2-3 show a decreasing trend over time. Figure 3-2 summarizes NAPL thickness versus ground water elevations for WB-4-4A. This figure shows that NAPL is thickest when the ground water level is depressed. As with the NAPL in area L1, this is likely due to NAPL in excess of residual saturation draining from the subsurface soils as the ground water level drops, subsequently accumulating on the lower ground water table.

3.1.2.3 NAPL Area L3

This area is defined by well WB-2 and associated temporary monitoring wells located to the northeast of the former lagoon. This NAPL area is limited in size and contains low levels of PCBs.

Given that the majority of the wells in NAPL Area L3 contain NAPL, the direction of ground water flow could not be determined. However, based on the limited data available, the direction of ground water flow in this area, as shown in Figures 2-7 and 2-8 is away from the lagoon. Given the ground water flow direction and the limited size of this area, the finite volume of NAPL also does not likely pose a migration threat.

The NAPL thickness measurements in WB-2, summarized in Table 2-3, show a fairly consistent level over time. Figure 3-2 summarizes NAPL thickness versus ground water elevations for WB-2-1A. This figure shows that NAPL is thickest when the ground water level is depressed. As with the NAPL in areas L1 and L2, this is likely due to NAPL in excess of residual saturation draining from the subsurface soils as the ground water level drops, subsequently accumulating on the lower ground water table.

3.1.2.4 *NAPL Area L4*

This area is defined by well WB-5 and TB-6 and associated temporary monitoring wells located to the southeast of the former lagoon. The extent of NAPL in this area is defined by temporary and permanent monitoring wells on either side of a roadway on Westchester County (WC) property. This area represents the largest accumulation of NAPL and contained the highest reported levels of PCBs (PCB concentrations in WB-5 have ranged from a high of 119 mg/kg in 1991 to 23 J mg/kg in 1995). The off-site wells in this area were placed on either side of WC property roadway.

Five of the eight off-site temporary wells on the north side of the roadway on WC property were found to contain NAPL. The largest thickness of NAPL in these off-site temporary wells was measured in OS-F ($\approx$ 3 feet). However, the five off-site temporary wells placed on the other side of the roadway did not exhibit any NAPL.

The available data was evaluated to ascertain the potential for NAPL to migrate. The migration potential was evaluated based on ground water flow direction, physical features and NAPL thickness variations.
As discussed in Section 3.1.2.3 for NAPL Area L3, the direction of ground water flow in this area, as shown in Figure 2-8, is toward the lagoon. Therefore, NAPL delineation likely defines the upgradient extent of NAPL in this area. NAPL probably moved in this direction in response to hydraulic influences when the former lagoon was open. Now that the former lagoon is closed, to the extent NAPL can migrate, the direction would be toward the northwest.

Similar to NAPL area L1, the roadway would also be inclined to limit the ability for any NAPL to move opposite to the ground water flow direction as a result of the compacting of subsurface soil during its construction. On the downgradient end, NAPL movement should be impeded by the sheet piling installed around the former lagoon as part of the OU-I remedial action. Hence, movement of the NAPL volume in L4 is probably constrained.

The NAPL thickness measurements in WB-5 and TB-6-1B-1B, summarized in Table 2-3, show a slight increasing trend over time. The increasing NAPL thickness at these points is likely due, in part, to preferential accumulation in the well casings. Figure 3-2 summarizes NAPL thickness versus ground water elevations for WB-5. This figure shows that NAPL is thickest when the ground water level is depressed. This is likely due to NAPL in excess of residual saturation draining from the subsurface soils as the ground water level drops, subsequently accumulating on the lower ground water table.

3.1.2.5 *Outlier NAPL Wells*

MW-9, located off-site, to the north of the former lagoon is considered an outlier NAPL well. MW-9 contains a NAPL layer that is not very thick (the maximum thickness recorded is 0.12 feet in June 1996). MW-9 is located to the northeast of the former lagoon area, and is closest to NAPL areas L2 and L3. In addition to its location to the northeast of the former lagoon, MW-9 is considered an outlier well because there are several permanent and temporary wells located between L2 and L3 which do not contain NAPL. This indicates that the source of the NAPL in MW-9 is not the former lagoon.

3.1.3 *NAPL Sampling and PCB Analysis*

3.1.3.1 *Chemical Characteristics*

As discussed in Section 2.1.2.3, representative samples of NAPL have been collected during the implementation of the OU-II RI. Select NAPL samples were analyzed for PCBs. These data were summarized in Table 2-4.

NAPL samples from four of the wells, WB-2, WB-4, WB-5 and WB-9 were also collected in February and June 1991 as part of the Product Investigation conducted by Hart. A comparison of the OU-II and historical PCB analytical data is presented in Table 3-1.

The detection limits for the recent PCB analyses were generally an order of magnitude lower than those in 1991. Consequently, low levels of PCBs were identified in NAPL areas L1 (WB-9) and L3 (WB-2) where they had not previously been detected. The presence of PCBs in NAPL areas L2 (WB-4) and L4 (WB-5) were reaffirmed in the most recent sampling. However, in both instances the PCB concentrations were less than previously reported.

3.1.3.2 *Fingerprint Analysis*

Representative NAPL samples were collected on 26 March 1995 from four monitoring wells at the OU-II Site. These wells and the areas they represent are: TB-1-1A1A (L1); WB-4-4A (L2); WB-2-1A (L3); TB-6-1B1B (L4). The samples were analyzed by Worldwide Geoscience (appendix N) using high resolution capillary gas chromatography. The purpose of this testing was to determine the parent NAPL type and to correlate these samples with one another and previously analyzed NAPL samples from this Site.

All four NAPL samples were found to have signature characteristics representative of severely biodegraded diesel fuels indicating long exposure times for the NAPL in the environment. The gas chromatographic signature of WB-4-4A (L2) sample indicates a severely biodegraded diesel. This sample was distinctly different from the other three NAPL samples and from previously analyzed NAPL samples. The overall signature characteristics of the three remaining NAPL samples from L1, L3 and L4 were found to be more similar to each other than different.

The NAPL samples from areas L1, L2 and L3 were found to be severely biodegraded with probable exposure times for these samples estimated to be greater than 20 years. A significant level of biodegradation is indicated for the NAPL sample from L4, approximated as an exposure time of 15 to 19 years. According to the evaluation completed by Worldwide Geosciences, progressive diesel losses over a period of time from a consistent source is probably the best explanation of both the overall similarity and the differences observed in the signatures of NAPL from areas L1, L3 and L4 (Worldwide Geosciences, 1995). The suggestion of progressive diesel losses over a period of time is consistent with the fact that OU-II NAPL had originated from wastes discharged to the wastewater equalization lagoon, which received a complex mixture of wastes over a period of time, including fuel oil, lubricating oil, PCBs and other materials from the Maintenance of Equipment Shop and other Yard areas.

Two additional samples from off-site wells in NAPL Area L1 were taken from well OS-O and WB-9-3C2A on 4 June 1996 and 27 June 1996, respectively. The samples were also analyzed by Worldwide Geoscience (Worldwide Geosciences, 1996) using high resolution capillary gas chromatography. The purpose of this testing was to determine the parent NAPL type and to correlate these samples with one another, with the on-site samples from NAPL Area L1, and previously analyzed NAPL samples from this Site.

Both off-site NAPL samples were found to have signature characteristics representative of severely biodegraded diesel fuels indicating long exposure times for the NAPL in the environment. The off-site NAPL samples were both collected from wells located on former New York Central Railroad Company property located northwest of the Harmon Yard OU-II Site. The gas chromatographic signature of the two samples are virtually identical, indicating a common source or loss event for both the OS-O and WB-9-3C-2A samples. These samples did not contain any detectable concentrations of PCBs and both samples show a comparable small, subordinate lubricant contribution to the NAPL. The exposure time for these NAPL samples was approximated at greater than 20 years. The overall signature characteristics of these two NAPL samples were different from previously analyzed NAPL samples collected from wells located on the Harmon Yard OU-II Site.

The fingerprint of the two off-site and four on-site NAPL samples were also compared to the fingerprint of seven NAPL samples collected in 1994 from wells located in other Harmon Yard areas not related to the OU-II. The seven NAPL samples were part of the Harmon Yard investigation (ERM, 1995) performed by Metro-North under the direction of NYSDEC Division of Spills Management, now the Division of Environmental Remediation.

According to Worldwide Geosciences, the four NAPL samples collected as part of OU-II in 1995 and two NAPL samples collected in 1996 are unrelated to the 1994 NAPL Harmon Yard samples. The gas chromatographic signatures of the 1994 Harmon Yard NAPL samples did not match those of the 1995 or 1996 OU-II Site NAPL samples. Differences between NAPL samples collected in 1995 and 1996, as part of OU-II, and those collected in 1994 from areas within Harmon Yard establish that the yard is not a source of NAPL in the four areas around the former lagoon.

3.2 *SOIL ALONG THE FORMER DISCHARGE LINE*

The soil along the former discharge line that connected the old treatment plant to the outfall at Croton Bay was investigated to ascertain whether chemicals in treated wastewater were discharged to surrounding soil. In accordance with the Stipulation of Discontinuance (NYSDEC, 1994a) and the ROD for OU-I (NYSDEC, 1992), any PCB-contaminated soils around the former discharge line would be presumed to originate from the former lagoon.

As shown in Table 2-6 and Table 3-2, the only PCB compound detected in the soils along the former discharge line was Aroclor-1260. Therefore, "PCBs" and "total PCBs", as used in this discussion, refers to Aroclor-1260 only.

PCBs were detected in seven of the 62 soil samples collected along the former discharge line. The concentrations of PCBs ranged from 15 micrograms per kilogram (µg/kg) to 68 µg/kg. All of the detected concentrations are below the OU-I remedial goal of 10 mg/kg. As such, the soil along the former discharge line does not require remediation.

The quality of soil collected along the former discharge line for parameters other than PCBs were compared to soil data obtained during the Harmon Yard investigation. The purpose of that investigation was to evaluate the impacts of NAPL on soil and ground water at Harmon Yard. Toward that end, the Harmon Yard investigation focused on known NAPL areas and other areas of concern. A summary of the OU-II and Harmon Yard soil data, including the number of samples collected, frequency of detection for each parameter and the range of concentrations detected, is presented in Table 3-2.

All the volatile organic compounds (VOCs) detected in soil along the former discharge line during the OU-II investigation, with the exception of 4-methyl-2-pentanone, were present in soil characterized as part of the Harmon Yard investigation. This one exception was found in only one soil sample along the former discharge line. Moreover, its reported concentration was even below the NYSDEC Recommended Soil Cleanup Objective (HWR-94-4046, Revised April 1995) for this constituent.

The semi-volatile organic compounds (SVOCs) detected in the soils along the former discharge line during the OU-II investigation are the same as those identified during the Harmon Yard investigation. The range in SVOC concentrations detected in both investigations was also similar. Among the compounds with the highest frequency of detection during both studies were 2-methylnaphthalene, phenanthrene, and pyrene. These three compounds are related to fuel oil.

There were 19 pesticides detected in the soils along the former discharge line during the OU-II investigation. All but two of them were among the 18 pesticides detected during the Harmon Yard investigation. One of the two, delta-BHC, was detected in only one of the 62 OU-II soil samples. Methoxychlor, however, was detected in 13 of the 62 samples. In any event, all the reported pesticide concentrations in soil along the former discharge line were below their respective NYSDEC Recommended Soil Cleanup Objectives.

Total organic carbon (TOC) was measured in all of the samples collected for OU-II and the Harmon Yard investigation. The range of TOC concentrations among soils along the former discharge line was 2073 mg/kg to 282,481 mg/kg. These concentrations are consistent with the 640 mg/kg to 630,000 mg/kg range detected during the Harmon Yard investigation. This indicates a carbon content of 0.2 percent to 28 percent.

In summary, there were no PCBs in soil from around the former discharge line at concentrations which exceeded the OU-I ROD remedial goal of 10 mg/kg. The suite of organic compounds in soil samples from along the former discharge line were similar to those found in soils during the Harmon Yard investigation. Many of these compounds can be associated with fuel oil. Based on the above, the soil along the former discharge line can be eliminated from the OU-II RI/FS and addressed along with the remainder of Harmon Yard under the jurisdiction of the former NYSDEC Division of Spills Management, now the Division of Environmental Remediation.

3.3 *SEDIMENT AND SURFACE WATER IN CROTON BAY*

ERM collected sediment samples from six locations in Croton Bay. Samples SD-1, SD-2 and SD-3 were collected closest to the outfall pipe, in an area where elevated total petroleum hydrocarbons (TPH) in sediment along with occasional oil sheens and seeps have been previously observed. Samples SD-4, SD-5 (and SEDDUP, a duplicate of SD-5) and SD-6 were collected further from the outfall in a transition zone between areas of higher and lower TPH in sediment. In addition, one sediment sample, designated OUTFALL, was collected from a stockpile of sediments dredged from Croton Bay during the implementation of the OU-II investigation.

One surface water sample was collected in Croton Bay. A duplicate surface water sample and filtered fraction for SVOCs, pesticides/PCBs and inorganics was also analyzed.

The sampling locations are shown in Figure 2-5. The sediment and surface water sampling results are presented in Table 2-7.

3.3.1 *Description of OU-II Sampling Results*

Sediment Quality

To place the OU-II sediment data in perspective, the results were compared to data from two separate sources. One source is sediment sample results from the Croton Point Sanitary Landfill Remedial Investigation (Croton Point RI) (Charles R. Velzy Associates, Inc., 1992). There were 52 sediment samples collected at 23 locations in Croton Bay, Haverstraw Bay, Croton Marsh tidal Streams and other surface waters in the vicinity of runoff areas of the Croton Landfill in 1988 and 1989 (Phase I) and 1991 (Phase II). In addition, a background station was established in the Iona Island Marsh, upriver of the landfill.

The OU-II data were compared to Croton Point RI samples collected at the locations closest to the outfall area. These were stations 1 through 7 and station 24. A summary of the sediment sampling results from OU-II, the Croton Point RI and the Iona Marsh background sample is presented in Table 3-3.

There were seven VOCs detected in the OU-II sediment samples. Many of these same VOCs were present in the Croton Point sediment samples and the background sample. The reported VOC concentrations in all these samples were in the part per billion (ppb) range and generally of similar magnitude amongst each sample set.

There were 17 SVOCs detected in the OU-II sediment samples. The majority of these SVOCs were reported at concentrations higher than observed either in the Croton Point samples or at Iona Marsh. A majority of these SVOCs are fuel oil related, consistent with the prior finding of TPH in sediment. Of the three SVOCs not likely related to fuel oil, dibenzofuran and bis(2-ethylhexyl)phthalate were present in sediment from the Croton Point RI and Iona Marsh.

There were eleven pesticide compounds found in the OU-II Croton Bay samples. The pesticide concentrations detected in the OU-II Croton Bay sediment and OUTFALL samples ranged from 0.86 µg/kg to 86 µg/kg. There were no reported pesticides in sediment samples collected as part of the Croton Point RI or in Iona Marsh.

There were three PCB compounds identified in the OU-II Croton Bay and OUTFALL samples. The PCB concentrations detected in these samples ranged from 43 J µg/kg to 610 J µg/kg. PCBs were reported in sediment samples that were collected as part of the Croton Point RI and Iona Marsh activities. The PCB concentration in only one the OU-II sediment samples was identified as being higher than the concentrations reported from the Croton Point RI and less than the concentration reported in the Iona Marsh sediment sample.

Inorganic constituents were present in all sediment samples collected from Croton Bay. These same inorganics were also present in sediment samples from the Croton Point RI and Iona Marsh. The one noted exception was antimony which was not reported in either the Croton Point RI or Iona Marsh samples. Most of the inorganic constituents in sediment samples from Croton Bay were found at similar or slightly lower levels than those reported in samples from the Croton Point RI or Iona Marsh. In cases where the Croton Bay sediment samples exhibited higher inorganic concentrations, they were of the same order of magnitude (with the exception of mercury) as the Croton Point and Iona Marsh sediment sample results. The highest mercury concentration (360 µg/kg) was found in the OUTFALL stockpile sample. This material is no longer in Croton Bay as it was removed as part of capital construction.

All organic compounds and inorganic constituents described above which were detected at greater concentrations in the OU-II Croton Bay sediment and surface water than in the Croton Point Landfill or Iona Marsh sediment will be addressed in the Risk Assessment in Section 4.0.

Surface Water Quality

One VOC was detected in the surface water samples. 4-Methyl-2-pentanone was detected at a concentration of 18 µg/l. This compound had not been detected in any of the sediment samples. There were no SVOCs detected in the surface water sample. However, two phthalates (diethylphthalate and di-n-butylphthalate) were detected in the duplicate sample, designated SURDUP, and the filtered sample, designated SURFIL. However, both these compounds were reported at concentrations below the CRDL and only one (di-n-butyl phthalate) was also present in the sediment. Finally, no pesticides or PCBs were detected in the surface water samples.

Twelve inorganic constituents were detected in the unfiltered surface water sample SURUNF. All of these inorganics, with the exception of silver, had been detected in the sediment samples. Seven inorganic constituents were detected in the filtered surface water sample SURFIL. Those constituents which were not detected in the filtered sample were likely present in the unfiltered samples in particulate form. Of the inorganic constituents present in the filtered and unfiltered sample, the reported concentrations were of the same order of magnitude in both samples.

3.4 *GROUND WATER IN VICINITY OF THE FORMER LAGOON*

3.4.1 *Ground Water Elevation And Flow*

Depth to ground water was determined via measurements collected at varying intervals over the 18-month course of this investigation. This information was summarized in Table 2-9 and consists only of wells that have never contained NAPL. Ground water table elevations were calculated for wells where the measuring point elevation was available. The ground water table elevations were contoured for 18 January 1995 and presented in Figure 2-7 while the measurements for 24 June 1996 were presented in Figure 2-8.

A comparison of the ground water level data over time shows that the ground water levels remained fairly consistent during the implementation of the OU-II RI. The ground water flow maps indicate the principal direction of ground water flow to the northwest. In the early stages of the former lagoon operation, ground water flow was likely radial from the center of the lagoon as a result of discharges to the lagoon from the wastewater treatment plant.

3.4.2 *Ground Water Quality*

3.4.2.1 *Description of Current Conditions*

There were 10 ground water samples and one duplicate sample collected on 11 April 1995 from eight shallow and two deep ground water monitoring wells. The sampling results were presented in Table 2-8.

The recent ground water data indicate the presence of VOCs, SVOCs and inorganic constituents in ground water at the former lagoon. The VOCs were detected at trace concentrations below the contract required detection limit (CRDL), with the exception of chlorobenzene. However, chlorobenzene, which was detected at 672 μg/l in WB2-1B and 38 μg/l in WB-3, was also found in the blank associated with each of these samples.

The SVOCs were detected in all of the monitoring wells sampled. However, the majority of SVOC concentrations in the eight shallow wells were below the CRDL. The highest SVOC detected concentration was 140 μg/l of 2-methylnaphthalene. This, along with most of the SVOC compounds, are components of fuel oil.

The deep wells contained fewer SVOCs. Bis(2-ethylhexyl)phthalate was detected in both deep wells at concentrations of 12 μg/l in WB-2D and 270 μg/l in WB-7D.

No pesticides or PCBs were detected in any of the wells during the April 1995 sampling event.

All of the inorganic constituents analyzed for were detected above the CRDL in the ground water samples, with the exception of beryllium and cadmium.

3.4.2.2 *Comparison to Historical Ground Water Quality Data*

Six of the ground water wells sampled as part of the OU-II investigation in April 1995 (four shallow and two deep) had been installed as part of previous investigations at the former lagoon. An initial round of ground water samples was collected from those six wells during the 1989 RI at the lagoon (Hart, 1989). A second round of samples was collected in October 1990 to confirm the findings of the first round (1991). These historic data are useful in evaluating trends in concentrations of compounds in ground water in the vicinity of the former lagoon over time. The recent ground water results for these wells which were sampled in the past are summarized in Table 3-5. This table includes the historic ground water quality for those wells.

Three VOCs were detected among the six wells sampled during the 1989, 1990 and 1995 sampling rounds. All detected concentrations of two of the VOCs were below the CRDL. Chlorobenzene concentrations exhibit a decreasing trend from the 1989 to 1995 sampling rounds (although the 1995 data was qualified because chlorobenzene was also detected in the associated blank).

There were 11 SVOCs common to the six wells sampled from 1989 to 1995. Many of the compounds detected consistently occurred at concentrations below the CRDL. Other SVOCs occurred at concentrations close to the detection limit, such as naphthalene and 2-methylnaphthalene.

Those SVOCs identified in shallow and deep ground water in the three sampling events were either below the CRDL, unchanged, or exhibited a decrease over time. The exception was bis(2-ethylhexyl)phthalate, particularly in well WB-7D during the three sampling rounds. This compound is not related to fuel oil or diesel fuel. It can be introduced via the sample collection or laboratory procedures. For example, in the 1989 sampling event, the bis(2-ethylhexyl)phthalate ground water data was qualified due to contamination in the field blank.

There were no pesticides or PCBs detected in any of the six wells in 1989. In 1990, PCBs were not detected but pesticides were identified in ground water. The occurrence of pesticides in ground water in the 1990 sampling event was attributed by Hart to analytical procedures employing lower detection limits. However, there were no pesticides or PCBs detected in the most recent 1995 sampling round using similarly low detection limits as used in 1990.

The concentrations of inorganics in the shallow and deep ground water zones were fairly similar and relatively low during all three rounds of sampling. The inorganics concentrations in the shallow ground water samples showed more variability than the inorganic concentrations in the deep ground water samples.

3.4.2.3 *Comparison to Background Ground Water Quality Data*

The ground water data from the 1995 sampling event is compared to New York State standards (for those constituents with published values) in Table 3-5. The comparison of these data to the New York State ground water standards represents a conservative screening evaluation since ground water in the area of the former lagoon is not used as a drinking water source. Ground water in the vicinity of the former lagoon, which exhibits impacts from organic compounds and inorganic constituents, ultimately moves toward the Hudson River. The potential discharge of ground water to the river is evaluated in Section 4.0.

The New York State standards are compared to the 95 percent upper confidence interval (95% CI) concentration for each organic compound and inorganic constituent reported in at least one ground water sample. The 95% CI was calculated using data from all wells. Non-detects (ND) were incorporated into the 95% CI by assuming one half the detection limit was present in the sample.

The comparison in Table 3-5 indicates that the 95% CI concentration in ground water for only two VOCs, two SVOCs and eight inorganic constituents were present in ground water in the area of the former lagoon in excess of NYS standards. The two VOCs and one SVOC are related to petroleum products. The other SVOC (bis(2-ethylhexyl)phthalate) is an anomalous concentration when compared to historic results.

The inorganic constituents in ground water at the former lagoon were also found in ground water samples collected from monitoring wells installed as part of the Yard Investigation. The levels of those constituents in ground water at the lagoon tended to be higher than in the yard. In particular, iron and manganese concentrations in ground water at the former lagoon exceeded New York State standards and were elevated in comparison to the concentrations in Harmon Yard. This is likely due to the close proximity of the ground water samples at the former lagoon to the four NAPL areas. NAPL is a food source for indigenous bacteria in the subsurface. As bacteria populations grow and consume NAPL, they also consume oxygen dissolved in ground water. As the dissolved oxygen in ground water is depleted, geochemical conditions change and promote dissolution of iron and manganese from subsurface soils into ground water. Hence, iron and manganese concentrations generally increase in close proximity to NAPL plumes.

The comparison of recent ground water data to New York State standards indicates relatively few organic compounds present above their respective standards. Similarly, the inorganic constituents in ground water, including those which are present above a New York State standard, are similar to the constituents found in Harmon Yard. Moreover, some of the inorganics are present at levels as a direct result of NAPL around the former lagoon. Since the ground water in the immediate vicinity of the lagoon is not used as a potable water source, the drinking water pathway is not complete. Consequently, the few instances of organic compounds or inorganic constituents which exceed the New York State standards do not represent an adverse environmental condition.

Section 4

4.0 *RISK ASSESSMENT*

4.1 *MEDIA TO BE EVALUATED*

The purpose of this risk assessment is to evaluate the potential risks to human health and the environment from the media impacted by activities at the former lagoon. The potentially impacted media include soil, sediment, non-aqueous phase liquids (NAPL), ground water, and surface water. The method for evaluation of each of these media is discussed below.

4.1.1 *Soil*

As discussed in Section 3.2 of this report, soil sampled along the former discharge line contained PCBs at levels less than 10 mg/kg and detectable concentrations of various VOCs, SVOCs, and pesticides which were also detected during the Harmon Yard Field Investigation. In accordance with the NYSDEC directive with respect to the ROD for OU-I, any PCB-contaminated soils around the former discharge line would be presumed to originate from the former lagoon. The OU-I remedial goal for PCBs was 10 mg/kg. Since the PCB concentration of all soil samples collected along the former discharge line was less than the PCB remedial goal of 10 mg/kg, soil along the former discharge line has been eliminated as a media of interest for OU-II. Instead, soil along the former discharge line, which contained chemicals similar to those detected in the Yard during the Field Investigation, will be addressed under the jurisdiction of the former NYSDEC Division of Spill Management, now the Division of Environmental Remediation, along with other Harmon Yard soil.

4.1.2 *Sediment*

As described in Section 3.3, *Sediment in Croton Bay*, six sediment samples were collected in Croton Bay in the vicinity of the outfall pipe as part of the OU-II RI/FS. These sediment samples contained VOCs, SVOCs, pesticides, and inorganic constituents. Section 4.3 evaluates the potential risks associated with the Croton Bay sediments that were sampled in the OU-II RI.

In addition to the sediment samples collected in the vicinity of the outfall pipe, one sediment sample, designated OUTFALL, was collected from a stockpile of sediment dredged from Croton Bay during the implementation of the OU-II investigation. This material is no longer in Croton Bay as it was removed as part of capital construction. This sample will not be evaluated in the risk assessment.

4.1.3 *NAPL*

As described in Section 3.1 of this report, NAPL generally occurs in four areas in the vicinity of the former lagoon, Areas L1 through L4. Section 4.2 evaluates the potential risks to human health and the enviroment that maybe posed by the NAPL in these four areas. Analysis of NAPL samples collected during the OU-I RI characterized these NAPL samples as severely biodegraded diesel fuels ranging in age from 15 to 19 years in one NAPL area to over 20 years in other NAPL areas.

The organic compounds that comprise the NAPL collected in the OU-II RI samples are primarily petroleum-related materials and are less dense than water (i.e., have a specific gravity less than that of water). VOCs, specifically benzene, toluene, ethylbenzene, and xylenes, are the mobile and water soluble organic compounds found in petroleum but typically constitute a very small fraction of diesel fuel. The presence of these compounds in diesel fuel, although slight, decreases even further over time through volatilization and natural biodegradation and the SVOCs in diesel fuel are relatively insoluble in water. This is consistent with the very low concentrations of VOCs and SVOCs detected in ground water during the OU-II RI/FS, as discussed and evaluated in Section 3.4.2.1. In addition, PCBs have been detected in at least one NAPL sample collected from each of the four NAPL areas. PCBS have not been detected in ground water.

Overall, NAPL that is believed to have originated from the former wastewater equalization lagoon has migrated less than 200 feet from the lagoon in the 15 to over 20 years that the chemical data indicates it has been present on the water table in this area. Further migration of this NAPL is unlikely due to the compacted soil believed to have been used in the construction of the off-site perimeter road that surrounds the former lagoon area. Moreover, the fact that OU-II NAPL is overlain by 10 to 20 feet of unsaturated soil, the standard procedures used by Metro-North to govern subsurface work throughout Harmon Yard and the proximity of this NAPL to the remediated OU-I former lagoon area virtually eliminates the risk that this NAPL will be exposed or disturbed in the future.

In addition, Section 4.4 will demonstrate that NAPL constituents that may have dissolved into ground water during this period do not pose unacceptable risks to human health or the environment. Section 4.2 concludes that there are no existing NAPL exposure pathways and, consequently, there are no unacceptable risks to human health or the environment currently posed by OU-II NAPL.

The existing data was used in Section 4.2 to demonstrate the following: (1) exposures to OU-II NAPL and to OU-II NAPL constituents have not occurred in the past; (2) there are no OU-II NAPL or OU-II NAPL constituent exposures at the current time; and (3) it is very unlikely that such exposures will occur in the future. However, the ROD for OU-I (NYSDEC, 1992) concluded that there is a risk that OU-II NAPL could migrate in the future and could lead to exposures and to unacceptable risks. Section 4.2 assesses the possible risks to human health and the environment that NAPL located above the water table in the vicinity of the former lagoon could pose in the unlikely event this material were to migrate or be exposed in the future.

4.1.4 *Ground Water*

As described in Section 3.4 of this report, 10 ground water samples and one duplicate sample were collected for the OU-II RI/FS. VOCs, SVOCs, and inorganic constituents were detected in the ground water samples. Section 4.3 presents the evaluation of the potential risks to human health and the environment associated with ground water in the vicinity of the former lagoon.

4.1.5 *Surface Water*

As described in Section 3.3 of this report, one surface water sample was collected in Croton Bay in the vicinity of the outfall pipe. One VOC and several inorganic constituents were detected in the surface water sample.

Surface water sampling only characterizes surface water conditions at a single point in time. Surface water is a dynamic system and can be expected to change constantly. Therefore, in this risk assessment the potential risks to surface water are assessed by evaluating surface water as a potential receptor of chemicals from sediment and ground water as described in Sections 4.3 and 4.4, respectively.

4.2 *EVALUATION OF POTENTIAL RISKS ASSOCIATED WITH NAPL IN THE VICINITY OF THE FORMER LAGOON*

This section evaluates the potential risks to human health and the environment that may be posed by the NAPL present above the water table in the areas around the former lagoon. The purpose of this evaluation is to establish the overall degree of hazard to human health and the environment which may arise from exposure to this NAPL in its current state or from exposures that may occur if this NAPL or the constituents in this NAPL migrate off-site.

The Stipulation of Discontinuance (NYSDEC, 1994a) defines the NAPL component of OU-II, referred to in this and subsequent sections of this RI/FS report as OU-II NAPL, as the separate hydrocarbon layer resulting from past releases from the former wastewater equalization lagoon which is present on the water table surface and extends hydrogeologically downgradient of the lagoon. As discussed later in this RI/FS in Section 5.2, OU-II NAPL is defined as the four discrete areas of NAPL located around the former lagoon area. Although these four areas, referred to as NAPL Areas L1 through L4, are located around the former lagoon, they are all considered to be downgradient of the lagoon, due to the radial ground water flow patterns that existed during the operation of the lagoon, as discussed later in this RI/FS in Section 5.2. Remediation of the lagoon, which included, among other work, the installation of subsurface sheeting around the former lagoon system, was completed in May 1996. This sheeting has been left in place as part of the lagoon remediation.

Potential risks related to the presence of chemicals in environmental media at a site are a function of the source, usually defined as the concentration of chemicals in various environmental media, the pathways by which these chemicals can migrate and the potential receptors that may be exposed to these chemicals either in its current state or after they have migrated. Typically, a quantitative risk assessment is performed when the concentrations of specific chemicals in environmental media are known. Quantitative human health risk assessments provide: (1) an estimate (or probability) of the number of excess cancer risks due to an exposure to each carcinogenic chemical present in environmental media; and (2) a hazard ratio, which provides a numerical index of the difference between acceptable and unacceptable exposure levels, for each noncarcinogenic chemical in environmental media. For example, a quantitative risk assessment is presented for OU-II ground water in Section 4.4.

Information that identifies the specific chemicals present in OU-II NAPL and the concentration of those chemicals in OU-II NAPL is extremely limited. As discussed in Section 3.1.3.2, the NAPL present in areas around the former lagoon (i.e., OU-II NAPL) has been characterized as primarily diesel fuel. Diesel fuel is a petroleum hydrocarbon material and petroleum products are complex mixtures of organic chemicals. The components of petroleum products, even in virgin form, vary significantly by the source of the crude oil, the process used to refine the crude oil, the season during which the crude oil was refined and other factors. The variation in the complexity of petroleum products is even greater if they have been subject to volatilization, biodegradation and other environmental factors.

The NAPL around the lagoon is believed to have originated from the former wastewater equalization lagoon, where it was subject to volatilization and biodegradation. Even in its present location in subsurface soil above the water table, the NAPL has continued to undergo biodegradation and adsorption. As discussed in Section 3.1.3.2, the NAPL samples from all four NAPL areas were found to be severely biodegraded diesel fuel, ranging in age from 15 to over 20 years, which predates Metro-North's inception.

Laboratory analysis of petroleum products to determine the concentration of specific organic constituents is extremely difficult and rarely accurate. The concentrations of certain compounds not related to petroleum, such as PCBs and inorganic constituents, can be determined with an acceptable degree of accuracy but the concentration of the majority of volatile and semi-volatile organic compounds that comprise petroleum cannot be determined with the degree of accuracy required for a quantitative risk assessment. Since it was not possible to accurately determine the concentration of the specific organic compounds that comprise the petroleum products in OU-II NAPL, a quantitative assessment of the risks posed by OU-II NAPL to human health and the environment could not be performed.

However, the information that is available to define OU-II NAPL is sufficient to perform a qualitative assessment of the potential risks posed by OU-II NAPL. A qualitative risk assessment can only conclude whether an exposure pathway exists and whether the source could pose unacceptable risks to potential receptors through those exposure pathways.

The facts used in this qualitative risk assessment include information regarding: (1) the typical constituents found in diesel fuel, which comprises the majority of the NAPL found above the water table around the former lagoon; (2) the concentration of PCBs detected in OU-II NAPL; (3) the impact this material has had on other environmental media at Harmon Yard (i.e., ground water); (4) the potential NAPL migration pathways in this area; and (5) the potential for receptors (for example, the Hudson River, construction workers) to be exposed to OU-II NAPL.

The source of potential risks (i.e., OU-II NAPL) is described in Section 4.2.1. Section 4.2.2 describes the potential migration pathways and receptors and associated risks for OU-II NAPL. A summary of the potential OU-II NAPL pathways and receptors and the qualitative assessment of the potential risks associated with these pathways and receptors is presented in Section 4.2.3. Conclusions regarding the potential risks associated with NAPL and related regulatory requirements and an outline of the remedial action objectives needed to address these risks are presented in Section 4.2.4.

4.2.1 *Source (OU-II NAPL) Characterization*

Section 3.1.3.2 describes OU-II NAPL as a severely biodegraded diesel fuel, ranging in age from 15 to 19 years in NAPL Area L4 to over 20 years in NAPL areas L1 and L2. The NYSDEC Spill Technology and Remediation Series (STARS) Memo #1, *Petroleum-Contaminated Soil Guidance Policy* (NYSDEC, 1992a) contains a list (see Table 2 of STARS Memo #1) of 30 organic compounds which the NYSDEC considers to be the primary fuel oil compounds of concern. The primary volatile organic compounds included on this list are benzene, toluene, ethylbenzene and xylene (i.e., "BTEX") and the primary semi-volatile organic compounds included on this list are polycyclic aromatic hydrocarbons (i.e., "PAHs").

Typically, BTEX compounds represent only a small fraction of virgin fuel oil and environmental losses through volatilization, biodegradation, and adsorption usually reduce the relatively low concentrations of these compounds even further. Since OU-II NAPL has been subject to volatilization in the former lagoon when it was first discharged and has undergone severe biodegradation since that time, BTEX compounds would not be expected to be present in OU-II NAPL.

This is consistent with the low concentrations of these compounds detected in OU-II ground water. As discussed in Section 4.4 (see Table 4-

6), toluene was not detected in ground water, benzene and ethylbenzene were detected at maximum concentrations of 5 μg/l and total xylenes were detected at a maximum concentration of 9 μg/l. These volatile organic compounds are highly mobile in the environment and if they were present in OU-II NAPL to any great extent they would have been detected in ground water at significantly higher concentrations. As a result, the majority of the chemicals that comprise OU-II NAPL are in all likelihood the semi-volatile organic compounds typically found in fuel oil, such as PAHs. These compounds (i.e., petroleum-related SVOCs) are not very mobile in the environment and typically do not dissolve into ground water. As discussed in Section 4.4 (see Table 4-6), the concentrations of petroleum-related SVOCs in ground water were relatively low.

NAPL samples collected in 1995 as part of the OU-II remedial investigation were analyzed for PCBs. In addition, an interim NAPL removal system, as described in Section 1.3.1, was installed by Metro-North in these NAPL areas prior to the 1992 NYSDEC ROD (NYSDEC, 1992). As discussed in Section 5.2.1.4, operation of this NAPL recovery system has been discontinued since work began on the OU-I remediation of the former lagoon area. The NAPL that was recovered by this system was sampled and analyzed for PCBs and for TCLP parameters prior to the off-site disposal of this recovered NAPL.

The 1995 PCB data from the OU-II NAPL sampling and the NAPL characterization work performed in 1990 and 1991 is summarized on Figure 3-1 and in Table 3-1 and is discussed in Section 3.1.3.1. PCBs were detected in at least one NAPL sample collected from each of the four NAPL areas. The maximum PCB concentration detected in each NAPL area are as follows:

NAPL Area	*Maximum PCB Concentration Detected*	*Monitoring Well*	*Year*
L1	7.2 mg/kg	WB-9	1995
L2	19.0 mg/kg	WB-4	1991
L3	3.8 mg/kg	WB-2-1A	1995
L4	119.0 mg/kg	WB-5	1991

The TCLP data collected in 1991 for NAPL recovered by the interim NAPL recovery system was used to characterize this material prior to off-site disposal. The regulatory impact of these results is discussed in Section 5.2.1.4 and the TCLP results are presented in that section in Table 5-2. This table shows that none of the organic compound TCLP parameters, including petroleum-related compounds such as benzene, were present above the detection limit. Three inorganic constituent TCLP parameters (i.e., arsenic, chromium and lead) were detected in concentrations above the TCLP regulatory limit in one or more samples. The remaining inorganic constituent TCLP parameters were either not present or were present in concentrations below the TCLP regulatory level.

The distribution of OU-II NAPL is discussed in Section 5.2.1.1. OU-II NAPL is present around the former lagoon area in four separate discrete areas, identified as NAPL Areas L1, L2, L3 and L4. The volume of NAPL present in these four areas is estimated in Section 5.2.1.1 to total approximately 153,000 gallons. The horizontal extent of NAPL is discussed in Section 5.2.1.1 and shown on Figure 3-0. The horizontal extent of NAPL in each NAPL area and the NAPL thickness measurements for the monitoring wells within each NAPL area are shown on Figures 5-1 through 5-4 for NAPL Areas L1 through L4, respectively.

To summarize, there is approximately 153,000 gallons of NAPL located in four areas around the lagoon. The majority of this OU-II NAPL is a severely biodegraded diesel fuel consisting primarily of semi-volatile organic compounds. PCBs are present to some extent in the NAPL from each of these four areas. OU-II NAPL also contains inorganic constituents (i.e., arsenic, chromium and lead) in concentrations that have in the past exceeded the TCLP regulatory level for these parameters.

4.2.2 *Potential OU-II NAPL Exposure Pathways, Receptors and Risks*

As discussed in Section 3.1.3.2, OU-II NAPL has been characterized as a severely biodegraded diesel fuel ranging in age from 15 years to over 20 years. As discussed in Section 5.2.1.1 and summarized in Section 6.2, NAPL has been observed in off-site monitoring wells in only one NAPL area (i.e., NAPL Area L4) and the extent of this off-site section is limited to a 100 foot by 20 foot off-site area in NAPL Area L4 that is located on Westchester County property adjacent to Harmon Yard.

Overall, OU-II NAPL that is believed to have originated from the former wastewater equalization lagoon has migrated less than 200 feet from the lagoon in the 15 to over 20 years that the chemical data indicates it has been present on the water table in this area. This is consistent with the high viscosity of the OU-II NAPL, which is primarily diesel fuel, as noted in the ROD for OU-I (NYSDEC, 1992). As discussed in Section 5.2.1.1, further migration of OU-II NAPL is unlikely due to the compacted soil believed to have been used in the construction of the off-site perimeter road that surrounds the former lagoon area, as shown on Figures 5-1 and 5-4. Moreover, the fact that OU-II NAPL is overlain by 10 to 20 feet of unsaturated soil, the standard procedures discussed in Section 6.2.3 that are used by Metro-North to govern subsurface work throughout Harmon Yard and the proximity of OU-II NAPL to the remediated OU-I former lagoon area virtually eliminates the risk that OU-II NAPL will be exposed or disturbed in the future. In addition, Section 4.4 discusses the limited effects that OU-II NAPL and the former lagoon have had on ground water in this area.

To summarize, OU-II NAPL has migrated less than 200 feet from the former lagoon area over the 15 to 20 years it has been present in this area and, as discussed in Section 4.4, NAPL constituents that may have dissolved into ground water during this period do not pose unacceptable risks to human health or the environment. In conclusion, there are no existing NAPL exposure pathways and, consequently, there are no unacceptable risks to human health or the environment currently posed by OU-II NAPL.

The existing data clearly demonstrates the following: (1) exposures to OU-II NAPL and to OU-II NAPL constituents have not occurred in the past; (2) there are no OU-II NAPL or OU-II NAPL constituent exposures at the current time; and (3) it is very unlikely that such exposures will occur in the future. However, the ROD for OU-I (NYSDEC, 1992) concluded that there is a risk that OU-II NAPL could migrate in the future, and could lead to exposures and to unacceptable risks. In response, this section assesses the possible risks OU-II NAPL could pose in the unlikely event this material were to migrate or be exposed in the future.

Three potential (i.e., future) exposure pathways and possible receptors for OU-II NAPL were identified. Although these exposures have not occurred in the past, there is a possibility, however remote, that these exposure scenarios could occur in the future and that they would pose unacceptable risks to human health and the environment. The potential exposure pathways and possible receptors for OU-II NAPL are:

- Ground Water: OU-II NAPL constituents could dissolve into ground water and migrate with ground water off-site, i.e., beyond the Harmon Yard property boundary.
- Surface Water: OU-II NAPL could migrate as dissolved constituents in ground water or as a separate (i.e., liquid) phase to off-site receptors and possibly to the Hudson River.
- Direct Contact: OU-II NAPL could be exposed if the unsaturated soil above it was removed or if dewatering was performed for a construction project in the former lagoon area.

These exposure pathways, receptors and potential risks are discussed in the following subsections.

4.2.2.1 *Potential OU-II NAPL Exposure Pathways, Receptors and Risks: Ground Water*

The effects that OU-II NAPL and the former wastewater equalization lagoon have had on ground water in this area are assessed later in this report in Section 4.4. The existing concentrations of chemicals in OU-II ground water were used to assess the potential risks for the five potential OU-II ground water exposure pathways: (1) inhalation of chemicals from ground water that have migrated into indoor air; (2) inhalation of chemicals from ground water that have migrated into outdoor air; (3) recreational exposures, defined as direct contact with and incidental ingestion of surface water containing chemicals from ground water; (4) ingestion by humans of fish from surface water containing chemicals from ground water; and (5) effects on aquatic life in surface water containing chemicals from ground water. The information presented in Section 4.4 demonstrates that these exposure pathways do not pose any unacceptable risks to human health or the environment (i.e., no adverse impacts to aquatic life would be expected).

As discussed in Section 4.4, there are no current or possible future uses of ground water in and downgradient of the OU-II area. The area downgradient of OU-II is noted as the former New York Central Railroad Company property on Figure 3-0 and other site plans in this report. The size of this property is limited and covers the less than 100 foot distance from the Harmon Yard property boundary to the shore of the Hudson River. As discussed in Section 6.3.3 with respect to use restrictions, there are no public or private water supply wells located downgradient of Harmon Yard, i.e., between Harmon Yard and the Hudson River. The shallow aquifer on the former New York Central Railroad Company property is located adjacent to and is influenced by the Hudson River. The yield of this aquifer is low and the salinity of the Hudson River in this area prevents the use of this aquifer as a potential water supply source. In addition, the shallow aquifer south of OU-II, which is the only other property adjacent to OU-II that is not operated by Metro-North, is adjacent to and influenced by the Croton Point Landfill, which is a NYSDEC Inactive Hazardous Waste Disposal site. The ROD (NYSDEC, 1993a) for the Croton Point Landfill site requires that deed restrictions be implemented for this site that restrict the future use of ground water in this area.

Although the lagoon has been remediated, it is possible that chemicals from OU-II NAPL could dissolve into ground water at a higher rate than they have in the past, resulting in an increase in the concentration of NAPL-related chemicals in OU-II ground water. This is an unlikely but theoretically possible exposure. Since, as discussed earlier, OU-II NAPL constituents are almost all semi-volatile organic compounds, volatilization of NAPL constituents in ground water into indoor or outdoor air and the resulting potential for inhalation pathways will not occur. However, semi-volatile organic compounds in OU-II NAPL, such as PCBs and PAHs, could dissolve into ground water.

Since, as discussed above, there are no current or future potential uses (i.e., pathways or receptors) for ground water at and downgradient of the OU-II Site, there are no unacceptable risks related to the presence of OU-II NAPL constituents in ground water. The only potential exposure pathway for OU-II NAPL constituents in ground water would result from the discharge of this ground water to the Hudson River. The potential surface water exposures are the recreational exposures and effects on aquatic life evaluated in Section 4.4. Section 4.2.2.2, below, discusses the potential pathways, receptors and risks that could occur if OU-II NAPL constituents in ground water were to migrate to surface water (i.e., the Hudson River).

4.2.2.2 *Potential OU-II NAPL Exposure Pathways, Receptors and Risks: Surface Water*

OU-II NAPL could migrate as dissolved constituents in ground water or as a separate (i.e., liquid) phase to off-site receptors and possibly to the Hudson River. As discussed earlier, OU-II NAPL is primarily comprised of semi-volatile organic compounds. PCBs have also been detected in OU-II NAPL. Although PCBs have not been detected in ground water, a number of semi-volatile organic compounds typically associated with diesel fuel have been detected in ground water. In addition, the presence of some of the metals detected in ground water may be the result of the biological activity in soil that usually occurs when NAPL is present. This biological activity tends to cause metals that are naturally present in soil in an insoluble form to mobilize and become soluble in ground water.

OU-II ground water eventually migrates to the Hudson River and, at present, the concentration of all of the chemicals in OU-II ground water, including chemicals that are or may be related to OU-II NAPL, do not pose unacceptable risks to human health or the environment. However, OU-II NAPL constituents could theoretically dissolve into ground water at a higher rate than they have in the past, causing an increase in the concentration of these constituents in OU-II ground water. The migration of this ground water to the Hudson River would then cause an increase in the concentration of these chemicals in surface water, increasing the possibility that exposures to surface water would pose unacceptable risks. Although the likelihood of OU-II NAPL constituents dissolving into ground water and raising surface water concentrations to unacceptable levels is remote, this is a potential exposure pathway that could lead to an unacceptable risk. These risks would be related to recreational exposures, defined as direct contact and incidental ingestion by people swimming in the Hudson River in this area. As noted in Section 4.4, swimming in the Hudson River has recently been reinstated in nearby Croton Park.

OU-II NAPL constituents in ground water discharged to the Hudson River could also result in adverse impacts to aquatic life and to human health through the ingestion of fish. The likelihood that these surface water exposure pathways (i.e., recreational exposures, aquatic life and ingestion of fish) will pose unacceptable risks is remote because the amount of water in the Hudson River is significantly greater than the amount of ground water that migrates to the Hudson River. Although this dilution reduces the likelihood of an unacceptable risk from OU-II NAPL constituents in ground water that have migrated to surface water, this migration pathway, the potential receptors and associated risks are at least theoretically possible.

It is also possible for OU-II NAPL to migrate along a pathway above the water table to the Hudson River as a separate (i.e., liquid) phase. As previously discussed, OU-II NAPL is believed to have been present in this area for 15 to over 20 years and has migrated less than 200 feet from the former lagoon area over this period. The boundary of the OU-II Site closest to the Hudson River is adjacent to the former New York Central

Railroad Company property. The closest NAPL area to this property is NAPL Area L1. As discussed in Section 5.2.1.1 and as shown on Figure 5-1, the off-site monitoring wells closest to this NAPL area do not contain NAPL. This data demonstrates that OU-II NAPL has not migrated off-site toward this property and the Hudson River. Although migration of this NAPL is highly unlikely, this pathway is at least theoretically possible. This highly unlikely but theoretically possible migration pathway for OU-II NAPL could pose unacceptable risks to human health and the environment.

As discussed earlier in the introduction to this section (Section 4.2), accurate concentrations of the specific constituents present in OU-II NAPL other than PCBs are not available. As a result, a quantitative assessment of the risks posed by these potential pathways to the receptors described above cannot be performed. This qualitative assessment of risks, then, can only conclude that the following exposure pathways are at least theoretically possible and that they may pose unacceptable risks to receptors:

- Although it is highly unlikely, OU-II NAPL constituents in ground water could theoretically migrate to the Hudson River, resulting in unacceptable risks to aquatic life and to human health.

- Although it is highly unlikely, OU-II NAPL could theoretically migrate as a separate (i.e., liquid) phase across the adjacent former New York Central Railroad Company property to the Hudson River, resulting in unacceptable risks to human health and the environment.

With respect to direct contact with NAPL containing PCBs that may be exposed as a separate phase, NYSDEC (NYSDEC, 1994c) and USEPA (USEPA, 1990a) guidance recommend a maximum concentration of PCBs in surface soil for residential exposures of 1 mg/kg. As discussed in Section 5.2.1.2 and earlier in this section, PCBs have been detected in OU-II NAPL in concentrations exceeding 1 mg/kg. If exposure to this NAPL were to occur and PCB concentrations in this NAPL were above 1 mg/kg, the resulting direct contact risk may be above acceptable levels. According to USEPA guidance (USEPA, 1990a), direct contact exposures to materials, such as OU-II NAPL, that contain PCBs in concentrations of 1 mg/kg or greater pose a potential carcinogenic risk of greater than 1.0×10^{-6}. The National Contingency Plan (NCP, 1990) considers cumulative carcinogenic risks from 1.0×10^{-4} to 1.0×10^{-6} to be acceptable and USEPA guidance (USEPA, 1991) recommends that remedial actions are generally not warranted if cumulative carcinogenic site risks are less than 1.0×10^{-4}. Since OU-II NAPL that contains PCBs in concentrations of 1.0 mg/kg or greater would pose a carcinogenic risk of 1.0×10^{-6} and this risk is within the acceptable 1.0×10^{-4} to 1.0×10^{-6} acceptable USEPA risk range, exposure to OU-II NAPL containing PCBs in concentrations exceeding 1.0 mg/kg may or may not pose unacceptable risks.

4.2.2.3 *Potential OU-II NAPL Exposure Pathways, Receptors and Risks: Direct Contact*

OU-II NAPL in its present state within the Harmon Yard property boundary could be exposed if the unsaturated soil above it was removed or if dewatering was performed for a construction project in the former lagoon area. As discussed in Section 5.2.1.1, a limited amount of OU-II NAPL has migrated approximately 20 feet onto Westchester County property from NAPL Area L4. The remaining off-site monitoring wells (i.e., off-site wells not associated with NAPL Area L4) adjacent to the Harmon Yard property boundary did not contain NAPL.

As discussed in Section 6.2, NAPL is present in this area at a depth of 10 to 20 feet below ground surface. As a result, excavation and other subsurface activities that would encounter NAPL would physically undermine the adjacent Harmon Yard property and, as a result, would require Metro-North permission and active cooperation. This information was used in Section 6.2 to conclude that the standard procedures used by Metro-North for construction projects at Harmon Yard, including excavation and dewatering, would adequately address the potential exposures related to this pathway. In addition, Section 6.2 discusses the fact that Best Management Practices (BMPs) being developed for Metro-North for the Environmental Studies Project ("Environmental Studies at Major Metro-North Railroad Yards") will formalize these existing Metro-North procedures for construction projects involving subsurface work such as excavation and dewatering.

However, OU-II NAPL could migrate further off-site as a separate (i.e., liquid) phase to areas for which construction work would not require Metro-North's permission and cooperation. As discussed earlier in Section 4.2.2.2, OU-II NAPL is believed to have been present in the OU-II Site area for 15 to over 20 years and has not migrated more than 200 feet from the former lagoon. Although highly unlikely, OU-II NAPL could migrate to the adjacent off-site property. Direct contact exposures to OU-II NAPL in off-site areas, then, could occur under the following scenarios: (1) if subsurface unsaturated soil above the NAPL was removed, exposing OU-II NAPL; or (2) if a construction project in these off-site areas were to require excavation and dewatering. Construction workers involved in this work, if not properly protected, would then be exposed to OU-II NAPL. In addition, direct contact exposure to or environmental impacts from OU-II NAPL removed during dewatering operations could occur if this material was not properly treated and disposed. Although existing data clearly indicates that it is very unlikely that OU-II NAPL will migrate a significant distance from the Harmon Yard property boundary, this exposure pathway, although extremely unlikely, is at least theoretically possible. As previously discussed, a qualitative assessment of the risks posed by these potential pathways cannot be performed. This qualitative risk assessment, then, can only conclude that although it is extremely unlikely, it is at least theoretically possible that OU-II NAPL can migrate beyond the Harmon Yard property boundary as a separate (i.e., liquid) phase and that subsurface construction work, including excavation and dewatering, could pose unacceptable direct contact risks to workers involved in the construction and to the environment, if workers are not adequately protected or if the NAPL removed during construction is not properly treated and disposed.

4.2.3 *Summary of Potential OU-II NAPL Pathways, Receptors and Risks*

The existing data clearly demonstrates that exposures to OU-II NAPL and to NAPL constituents have not occurred in the past and that it is very unlikely that such exposures will occur in the future. However, the ROD for OU-I (NYSDEC, 1992) concluded that there is a risk that OU-II NAPL could migrate in the future which could lead to exposures and to unacceptable risks. Of the three potential pathways identified for OU-II NAPL (i.e., ground water, surface water and direct contact), only two pathways are, although remote, at least theoretically possible. As discussed in Section 4.2.2.1, there are no unacceptable risks related to the presence of petroleum-related semi-volatile organic compounds and inorganic constituents related to OU-II NAPL in ground water at and downgradient of the OU-II Site since there are no current or future uses (i.e., no exposure pathways or receptors) for this ground water.

However, the remaining two potential exposure pathways for OU-II NAPL (i.e., surface water and direct contact) were found to be at least theoretically possible and as a result, could pose unacceptable risks to human health and the environment. The two potential exposure pathways, receptors and associated risks for OU-II NAPL are:

Surface Water: Although it is highly unlikely that the following potential surface water pathways will occur, they are at least theoretically possible. These highly unlikely but theoretically possible surface water pathways are as follows:

- OU-II NAPL constituents in ground water could migrate to the Hudson River, resulting in unacceptable risks to recreational swimmers, to aquatic life and to human health through the ingestion of fish from an increase in the concentration of NAPL constituents in surface water.

- OU-II NAPL could migrate as a separate (i.e., liquid) phase across the adjacent former New York Central Railroad Company property to the Hudson River, resulting in unacceptable risks to: (1) recreational swimmers, to aquatic life and to human health through the ingestion of fish, resulting from an increase in the concentration of NAPL constituents in surface water; (2) to residents, swimmers and other occasional visitors from direct contact with OU-II NAPL discharged to the shore of the Hudson River; and (3) to construction workers and others involved in subsurface work on the adjacent former New York Central Railroad Company property (as described below).

Direct Contact: Although highly unlikely, it is at least theoretically possible for construction workers and others to have direct contact exposure to OU-II NAPL. This exposure scenario assumes that OU-II NAPL can migrate a significant distance (e.g., 100 feet) from the Harmon Yard property boundary as a separate (i.e., liquid) phase. If this were to occur, subsurface construction work, including excavation and dewatering, could pose unacceptable direct contact risks to workers involved in the construction and to the environment, if the NAPL removed during construction is not properly treated and disposed.

The following section presents conclusions regarding the potential risks associated with NAPL and related regulatory requirements and an outline of the remedial action objectives needed to address these risks.

4.2.4 *OU-II NAPL Risks and Remedial Action Objectives*

This qualitative risk assessment for OU-II NAPL concluded that there are potential exposure pathways that, although remote, are at least theoretically possible and that these exposure pathways could pose unacceptable risks to human health and the environment. As previously discussed, specific chemical concentration data for OU-II NAPL is not available and, as a result, the level of risk that would be posed by OU-II NAPL exposures cannot be determined. However, the concentration of one of the specific constituents of OU-II NAPL, i.e., PCBs, is available. The concentration of PCBs in OU-II NAPL has exceeded 1.0 mg/kg in NAPL samples collected in 1990, 1991 and 1995. The NYSDEC (NYSDEC, 1994c) and USEPA (USEPA, 1990a) consider PCB concentrations greater than 1.0 mg/kg to present unacceptable risks to human health. In addition, NAPL consisting of diesel fuel, which is the primary component of OU-II NAPL, typically contains relatively high concentrations of petroleum-related semi-volatile organic compounds.

Because of the dilution posed by the Hudson River, it is very unlikely that ground water containing dissolved OU-II NAPL constituents that discharges to the Hudson River would pose an unacceptable risk to human health or the environment. Although the likelihood of this scenario is extremely remote, given the stability of OU-II NAPL over the

15 to 20+ years this material has been present in this area, it is at least theoretically possible for OU-II NAPL to migrate as a separate (i.e., liquid) phase across the adjacent former New York Central Railroad Company property to the Hudson River. OU-II NAPL that could then be exposed on the shore of the Hudson River or encountered during a construction project on this adjacent property would probably pose unacceptable risks to human health or the environment. As a result, this qualitative risk assessment concludes that at least some of the theoretically possible OU-II NAPL exposure pathways would pose unacceptable risks to human health or the environment.

Both the ROD for OU-I (NYSDEC, 1992) and the Stipulation of Discontinuance (NYSDEC, 1994a) require that unacceptable risks to human health and the environment that may be posed by OU-II NAPL be addressed in this feasibility study.

The New York State statute and federal regulations that govern the presence of NAPL are discussed in Section 5.2.1.4. Section 5.2.1.4 concludes that the removal of OU-II NAPL is required by the following: (1) the 1992 ROD for OU-I; (2) Article 12 of the New York State Navigation Law; and (3) the NCP at 40 CFR 300, Subpart D (Operational Response Phases for Oil Removal). These statutes and regulations also provide guidance on the manner in which NAPL is to be removed and the extent to which NAPL removal efforts are to be pursued. In addition, the federal regulations governing releases from underground storage tanks (40 CFR 280.64) also provide guidance regarding the manner in which NAPL is to be removed. Although the federal underground storage tank regulations are not directly applicable to OU-II NAPL, the source of which is the former lagoon and not underground storage tanks, this guidance is considered relevant and appropriate to the removal of OU-II NAPL.

Overall, these statutes and regulations recognize the technical limitations inherent in the removal of NAPL and do not advocate aggressive technologies designed to totally remove all NAPL. This approach is consistent with the ROD for OU-I which recommends recovering "free product to the extent practical to further eliminate the potential threat" from NAPL. OU-II NAPL does not at the present time pose unacceptable risks to human health or the environment and although it is theoretically possible, it is very unlikely that any of the potential OU-II NAPL exposures will occur and pose unacceptable risks to human health or the environment in the future. As a result, the approach to NAPL removal outlined in the OU-I ROD and in relevant New York State statutes and federal regulations (i.e., removal of NAPL to the extent practical) is more than adequate for the level of risk posed by OU-II NAPL.

This approach to NAPL removal is described in the New York Oil Spill, Control, and Compensation Act, Article 12 of the New York State Navigation Law, New York Consolidated Laws Service, 1977, as amended. This statute (Section 171) gives first priority to minimizing environmental damage and establishes NAPL containment as a requirement and NAPL removal as a possible additional task (Section 176.1). This statute defines the approach to the cleanup and removal of NAPL that is considered to be proper to include containment, removal <u>or</u> the use of "reasonable measures" to prevent or mitigate damages (Section 172.4). The removal of all NAPL by any available means is not presented as a goal of response actions for NAPL.

This statute also requires that cleanup and removal of NAPL be performed in accordance with the National Contingency Plan (NCP, 1990). The NCP at 40 CFR 300.310(b) requires that, "as appropriate", NAPL be removed and its effects mitigated and states at 40 CFR

300.320(a)(4) that NAPL removal is being properly conducted when the cleanup is fully sufficient to minimize or mitigate threats.

Overall, Article 12 of the New York State Navigation Law and the NCP require that potential threats or risks posed by NAPL be minimized or mitigated but do not require actions to eliminate any potential threats or risks related to NAPL. This is consistent with the low level of risk currently posed by OU-II NAPL. As a guideline, the federal underground storage tank regulations dealing with the release of NAPL (40 CFR 280.64) establishes the abatement of NAPL migration as a minimum objective for the design of a NAPL removal system. These regulations also require that NAPL removal be performed in a manner that minimizes the spread of NAPL constituents into previously uncontaminated zones and that NAPL recovery technologies that are appropriate for the hydrogeologic conditions at the site be used. Similarly, these underground storage tank regulations do not establish the removal of NAPL by any means as a goal of remedial actions for NAPL.

To summarize, OU-II NAPL may pose unacceptable risks to human health or the environment if certain theoretically possible but highly unlikely exposure scenarios were to occur in the future. The removal of NAPL is required by New York State law and by federal regulations and the overall approach to NAPL removal outlined in these statutes and regulations is to minimize or mitigate, but not necessarily eliminate, risks related to NAPL and that reasonable measures should be used to remove NAPL to the extent practical. The potential risks related to OU-II NAPL and the overall approach to NAPL removal contained in the statutes and regulations dealing with NAPL clearly indicate that the objective of remedial actions considered for OU-II NAPL should focus on the need to prevent further migration of OU-II NAPL off-site or direct contact with OU-II NAPL in its present state and to actively remove the OU-II NAPL that is presently located almost entirely within the boundaries of Harmon Yard. These risk-based guidelines and relevant regulatory requirements are used in Section 5.2.1.5 to develop the remedial action objectives for OU-II NAPL.

4.3 *EVALUATION OF POTENTIAL RISKS ASSOCIATED WITH CROTON BAY SEDIMENTS*

This section evaluates the potential risks associated with Croton Bay sediments that were sampled in the OU-II RI. The purpose of the sediment evaluation is to establish the overall degree of hazard to human health and the environment which may arise from exposure to organic compounds and inorganic constituents in sediment. The sediment evaluation was conducted in accordance with the NYSDEC's Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1993a).

The sediment evaluation is divided into seven steps. These seven steps are briefly described below.

In the first step, background information pertaining to the sediment evaluation is provided, including a description of the area under investigation. The background information is provided in Section 4.3.1.

Second, the potential exposure pathways by which humans and biota could be exposed to organic compounds or inorganic constituents in sediment are identified. The exposure pathways for the sediment sampled during the OU-II RI are identified in Section 4.3.2.

In the third step, the chemicals of concern in sediment are identified. This screening step eliminates organic compounds and inorganic constituents which are not detected above background levels or which are otherwise not expected to result in a significant adverse impact to humans or the environment. Section 4.3.3 presents the chemicals of concern selected for the OU-II sediment evaluation.

In the fourth step, NYSDEC and other applicable criteria are identified. This step is described in Section 4.3.4.

In the fifth step, exposure point concentrations for each chemical of concern are compiled from monitoring data. This step is described in Section 4.3.5.

In the sixth step, the potential exposures are qualitatively evaluated by comparing the exposure point concentrations to the NYSDEC sediment criteria, where available. This step is described in Section 4.3.5.

The conclusions of the evaluation of potential risks to human health and the environment from sediment samples collected during the OU-II RI are presented in Section 4.3.7.

4.3.1 *Background Information*

Figure 2-5 shows the location of the sediments sampled in the OU-II RI. As shown in this figure, the sediments are located adjacent to the former discharge line outfall to Croton Bay. An ecological risk assessment (ERA) was conducted in conjunction with the Croton Point Landfill (CPLF) Remedial Investigation (RI) Report (WCDPW, 1992a) and the CPLF Feasibility Study (FS) (WCDPW, 1992b). The ERA was presented as Appendix B to the CPLF FS. It focused on identifying potential adverse effects of organic compounds and inorganic constituents on the flora and fauna in the study area. The CPLF ERA evaluated four habitat types: Croton Marsh, the Hudson River, woodlands, and fields. The habitat near the former discharge line outfall to Croton Bay is part of the Croton Marsh habitat described in the CPLF ERA. Figure 3-1.5 of this report illustrates the former discharge line outfall to Croton Bay with respect to CPLF and Croton Marsh. The close proximity of the Croton Bay area studied as part of OU-II to the CPLF and Croton Marsh makes a re-evaluation of this habitat redundant. Thus, a detailed description of the Ecological Setting (Section B.3.2), Habitat Evaluation (Section B.3.3), and Endangered, Threatened, or Special Concern Species (Section B.3.4) for the area currently under investigation is provided in the CPLF ERA and those sections are incorporated by reference into this report. The texts of these sections are provided in Appendix H of this report.

4.3.2 *Identification of Potential Exposure Pathways*

Potential ecological receptors for exposure to organic compounds and inorganic constituents in sediment include terrestrial wildlife and aquatic life. Exposure to terrestrial wildlife occurs when animals feed in areas affected by chemicals of concern. In the case of avian species, the potential exists for the bioaccumulation of chemicals within a food-chain through ingestion of aquatic life. In contrast, aquatic life impacts were considered through direct or indirect exposure to chemicals in sediment. These pathways were also evaluated as part of the CPLF ERA. Humans are also identified as potential receptors for exposure to chemicals of concern in sediment. Specifically, the potential for chemicals in sediment to bioaccumulate in aquatic life which is then ingested by humans was evaluated. This pathway was also evaluated in the CPLF Human Health Risk Assessment.

Therefore, the potential exposure pathways for sediment in Croton Bay (OU-II) which were evaluated include:

- Exposure to terrestrial life (bioaccumulation);

- Exposure to aquatic life; and
- Exposure to humans (bioaccumulation).

4.3.3 Identification of Chemicals of Concern

Due to the relatively limited number (6) of Croton Bay sediment samples that were collected during the OU-II RI, all reported organic compounds and inorganic constituents were considered as chemicals of potential concern in this evaluation.

In order to evaluate the risks associated with chemicals of concern in sediment from OU-II and not other sources, chemicals were eliminated from consideration if the maximum values detected in the samples were near (within 5%) or below background concentrations obtained from: (1) a background sampling location presented in the Croton Point Landfill (CPLF) RI/FS; and (2) sediment samples collected in Croton Marsh as part of the CPLF RI/FS. The background sampling location presented in the CPLF RI/FS is Iona Marsh, located approximately 10 miles upstream along the Hudson River.

A comparison of the OU-II Croton Bay sediment concentrations to these background concentrations is presented in Table 4-1. The elimination of chemicals of concern from further consideration based on a comparison to background concentrations and the subsequent identification of chemicals of concern in OU-II Croton Bay sediment is presented below.

<u>VOCs</u>

Of the seven VOCs detected in Croton Bay sediment during the OU-II RI, acetone, carbon disulfide and toluene were detected at concentrations near or below background. Therefore, these compounds were not evaluated further.

SVOCs

Of the 17 SVOCs detected in Croton Bay sediment samples during the OU-II RI, the following compounds were detected at levels below background:

fluoranthene	chrysene	benzo(a)pyrene
pyrene	benzo(b)fluoranthene	ideno(1,2,3-d)pyrene
benzo(a)anthracene	benzo(k)fluoranthene	

Therefore, these compounds were not evaluated further.

PCB Compounds

Two Aroclor compounds (i.e., PCBs) were detected in sediment at the outfall, Aroclor-1248 and Aroclor-1260. Aroclor-1260 was detected below background levels. Therefore, this compound was eliminated from further evaluation in sediment.

Inorganic Constituents

Of the inorganic constituents detected in Croton Bay sediment samples that were collected during the OU-II RI, only beryllium was detected below background concentrations. Therefore, this compound is not evaluated further.

Summary

Based on the above review, the chemicals of concern identified for the sediment in Croton Bay that was evaluated as part of the OU-II RI are as follows:

benzene	carbazole	mercury
2-butanone	aluminum	nickel
carbon tetrachloride	arsenic	potassium
chlorobenzene	barium	sodium
2-methyl napthalene	cadmium	vanadium
3-nitroanaline	calcium	zinc
acenapthene	chromium	Aroclor 1248
dibenzofuran	cobalt	alpha-BHC
bis(2ethyl-	copper	heptachlor epoxide
hexyl)phthalate	iron	4,4'-DDE
fluorene	lead	4,4'-DDD
phenanthrene	magnesium	4,4'-DDT
anthracene	manganese	endrin aldehyde

4.3.4 *Identification of Applicable Criteria*

In order to assess potential adverse effects to terrestrial and aquatic life and to human health from exposure to sediment, concentrations of chemicals of concern identified in the Croton Bay sediment were compared to the sediment criteria presented in the NYSDEC Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1993a). The NYSDEC guidance provides sediment criteria for non-polar organic compounds and inorganic constituents. Chemicals of concern for which NYSDEC criteria were not available were compared to the National Atmospheric and Oceanic Administration Screening Guidelines, where available (NOAA, 1994).

Organic Compounds

The NYSDEC guidance identifies four levels of protection for non-polar organic compounds in sediment. These are:

A. Protection of human health from toxic effects of bioaccumulation;
B. Protection of aquatic life from acute toxicity;
C. Protection of aquatic life from chronic toxicity; and
D. Protection of wildlife from toxic effects of bioaccumulation.

The sediment criteria for non-polar organic compounds are derived from an equilibrium partitioning methodology. These criteria are derived from the New York State water quality and guidance criteria, EPA water quality criteria, and proposed water quality criteria for the protection of human health and piscivorous wildlife from bioaccumulative affects. NYSDEC provides criteria for fresh water, salt water or both. The Hudson River in the vicinity of Harmon Yard is classified as SB by NYSDEC (NYSDEC, 1996a). SB waters are suitable for primary and secondary contact recreation and fishing as well as fish propagation and survival (6 NYCRR 701.11). As discussed in the CPLF RI/FS, the salinity of the Hudson River and Croton Marsh varies with the seasons and is dependent on freshwater influx (WCDPW, 1992b). The salt water sediment criteria are used in the evaluation of sediment samples collected in the OU-II RI. The NYSDEC sediment criteria for non-polar organic compounds are shown in Table 4-2.

Sediment criteria for polar organic compounds are not provided by NYSDEC. The NYSDEC guidance recommends that for polar organic compounds, contaminant concentrations in pore water should be compared directly to surface water quality criteria. NYSDEC Surface Quality Standards are not available for any of the chemicals of concern for which NYSDEC sediment criteria were not available.

Exposure point concentrations of organic chemicals of concern for which there are no NYSDEC sediment criteria were compared to the NOAA Screening Guidelines, where available. The NOAA Screening Guidelines are expressed as either the Effects Range-Low (ER-L) or the Effects Range-M (ER-M). The ER-L and ER-M are at the low and midway points, respectively, of a range of concentrations at which effects have been observed and reported in a survey of 85 reports of biological and chemical data regarding impacts to aquatic life in sediment (NOAA, 1994).

As described in Section 2.3, one surface water sample was collected as part of the OU-II RI. The results of this sample are discussed in conjunction with the comparison of chemicals of concern in sediment to applicable criteria in the Section 4.3.6.

Inorganic Constituents

According to the NYSDEC guidance, the primary concern for metals in sediment is toxicity to benthic organisms. However, the bioaccumulation of metals in organisms is highly variable and difficult to predict. Therefore, the guidance suggests that a better alternative is to identify adverse ecological effects. The guidance provides two levels of protection as a basis of sediment quality screening criteria for potential impacts to benthic organisms. These are: (1) the Lowest Observable Effect Level (LOEL); and (2) the Severe Effect Level. The LOEL and Severe Effect Levels for the inorganic chemicals of concern are shown in Table 4-3. The LOEL indicates a level of metals in sediment that can be tolerated by the majority of benthic organisms, but still causes toxicity to a few species. The Severe Effect Level indicates a metals concentration at which pronounced disturbance of the sediment dwelling community can be expected. According to the NYSDEC guidance, if the concentration is greater than the lowest effect level but less than the severe effect level concentration, the sediment is considered to be contaminated, with moderate impacts to benthic life. If the concentration is greater than the severe effect level, the sediment is contaminated and significant harm to benthic aquatic life is anticipated.

NOAA Screening Guidelines were not available for any of the inorganic consitunets of concern for which NYSDEC sediment criteria were not available.

4.3.5 *Identification of Exposure Point Concentrations*

The potential exposures to chemicals of concern in OU-II Croton Bay sediment were estimated using an average concentration contacted at the exposure point over the exposure period. To provide a conservative estimate of the average concentration, the 95 percent upper confidence limit (UCL) on the arithmetic mean chemical concentration was used. For evaluation of potential adverse impacts to sediment, the exposure point concentrations for each chemical of concern was then compared to the applicable sediment criteria for each exposure pathway.

The NYSDEC criteria for the evaluation of organic compounds in sediment are presented in micrograms per gram of organic carbon (ug/gOC) as shown in Table 4-2. Therefore, the concentrations of organic chemicals of concern in OU-II Croton Bay sediment were converted to ug/gOC by dividing by the sample-specific organic carbon content. The 95 percent UCL on the arithmetic mean was then calculated for each chemical of concern to estimate the exposure point concentration in ug/gOC.

All qualified data was included in the estimation of exposure point concentrations with the exception of results qualified with U, which indicated that the compound was analyzed for but not detected, and N, which indicates a sample spike recovery was not within control limits. If a sample was marked UJ it was not considered a reported value because the compound was not detected. The J in a UJ qualifier simply indicates that the detection limit was biased low so the detection limit is estimated and not exact. If a chemical of concern was not detected in a particular sample, a value of one-half the detection limit was used for that sample to calculate the 95 percent UCL on the mean. For both organic and inorganic constituents, if the 95 percent UCL on the mean exceeded the maximum reported concentration, the maximum reported concentration was considered the exposure point concentration.

4.3.6 *Comparison of Exposure Point Concentrations to Applicable Criteria*

Exposure point concentrations for the chemicals of concern were compared to the NYSDEC sediment criteria for non-polar organic compounds and inorganic constituents. As described in Section 4.3.4, the sediment criteria for non-polar organic compounds includes criteria for the protection of human health through bioaccumulation, aquatic life (acute and chronic toxicity), and wildlife through bioaccumulation. The criteria for inorganic chemicals are based on potential impacts to aquatic life. Exposure point concentrations of organic chemicals of concern for which NYSDEC criteria were not avialable were compared to NOAA Screening Guidelines, where available. The results of this comparison are presented in Table 4-2 and 4-3 for organics and Table 4-4 for inorganics and are discussed in this section.

Organics

The five organic chemicals of concern whose exposure point concentrations exceeded the NYSDEC criteria include four pesticides and a PCB compound, as listed below:

Aroclor-1248
heptachlor epoxide
4,4'-DDE
4,4'-DDD
4,4'-DDT

The chemicals listed above exceeded the human health and/or wildlife bioaccumulation criteria. None of the organic chemicals of concern exceeded the NYSDEC benthic aquatic life acute or chronic toxicity criteria.

Some organic chemicals are not persistent in sediments. The NYSDEC guidance identifies the octanol/water partition coefficient (Kow) as a useful indicator for predicting soil adsorption. The guidance indicates that chemicals with $\log_{10}$Kow of less than 3.0 can be expected to be non-persistent in sediment. Each of the organic chemicals of concern listed above as exceeding the NYSDEC criteria has a $\log_{10}$Kow greater 3.0. Therefore, these compounds can be considered relatively persistent in sediments.

It should be noted, however, that while these compounds may be considered persistent, none of these compounds were detected in the surface water sample obtained in Croton Bay in the vicinity of the sediment samples that were collected near the former discharge line outfall as part of the OU-II investigation. Therefore, while the presence of these compounds may contribute to adverse impacts on humans and/or wildlife through bioaccumulation, surface water quality does not appear to have been impacted by these compounds. NOAA Screening Guidelines were available for three of the organic chemicals of concern for which no NYSDEC were available. These chemicals are 2-methylnaphthalene, flourene, and anthracene, all PAHs. A comparison of the exposure point concentrations of these chemicals to the NOAA Screening Guidelines is provided in Table 4-3. The exposure point concentration of each of the three chemicals exceed both the NOAA ER-L and ER-M values.

Flourene and anthracene are also considered persistent although none of the three PAH chemicals were detected in the surface water sample obtained in Croton Bay in the vicinity of the sediment samples that were collected near the former discharge line outfall as part of the OU-II investigation. Therefore, while the presence of these compounds may contribute to adverse impacts on aquatic life, surface water quality does not appear to have been impacted by these compounds.

Four pesticide compounds, one PCB compound, and three PAH compounds have been identified as having potential adverse impacts on human health and/or wildlife through bioaccumulation or on aquatic life. As shown in Table 2-7, the maximum concentrations of each of these compounds was detected in Sample SD-4, SD-5, and SD-6. With the exception of the pesticide compunds, the PCB compound and the PAHs were also detected samples collected during the CPLF RI.

Inorganics

As shown in Table 4-4, the inorganics (metals) whose exposure point concentrations exceeded the NYSDEC sediment criteria for inorganics are as follows:

arsenic;	lead;	zinc; and
cadmium;	manganese;	iron.
chromium;	mercury;	
copper;	nickel;	

With the exception of arsenic, cadmium, iron, and manganese, the exposure point concentration of these metals exceeded both the Severe

Effect Level and the LOEL. The exposure point concentrations of arsenic, cadmium, iron, and manganese exceeded the LOEL only.

The CPLF RI identified several of the same inorganic constituents as chemicals of concern in sediment, including:

cadmium;
chromium;
copper;
lead; and
mercury.

The presence of these inorganic constituents in CPLF sediment at concentrations above background and relevant criteria are a potential source for the same constituents in sediment in Croton Bay.

The locations of the CPLF sediment locations closest to Harmon Yard and the Croton Bay OU-II sediment area (Stations 1-7 and 24) are shown in Figure 3-1.5 of this report. A review of these sample locations indicates that each of the OU-II inorganic consituents chemicals of concern which exceeded the NYSDEC sediment criteria (cadmium, copper, lead, manganese, mercury, and zinc) was also detected in sediment samples collected during both phases of the CPLF RI. Concentrations of these metals detected during the CPLF RI also exceeded NYSDEC's sediment criteria at one or more of the stations closest to Harmon Yard and the Croton Bay OU-II sediment area. Exceedances were most common at Stations 3, 4, 5, 6, and 7 (WCDPW, 1992b).

As shown in Tables 2-7, the highest concentrations of inorganics in OU-II sediment and the OU-II samples containing the greatest number of chemicals that exceeded the LOEL and Severe Effect Level were samples SD-4, SD-5, and SD-6. The location of these samples is shown in Figure 2-5 of this report. Similarly, the highest concentrations of organic chemicals of concern were detected in Samples SD-4, SD-5, and SD-6. These samples are further from the outfall than OU-II RI samples SD-1, SD-2, and SD-3 indicating that a significant amount of the chemicals of concern may originate from a different source, such as the CPLF.

The inorganic chemicals of concern for OU-II sediment which were also detected in surface water in the OU-II outfall area are:

aluminum;	iron;	mercury;
barium;	lead;	potassium;
cadmium;	magnesium;	sodium; and
calcium;	manganese;	zinc.

These inorganic constituents were also detected in Croton Bay surface water samples taken near the CPLF with the exception of cadmium and mercury. For each inorganic constituent detected at both the OU-II and the CPLF sampling locations within Croton Bay, the maximum concentrations of these constituents in surface water samples collected as part of the CPLF RI exceed the maximum concentrations detected in the surface water sample near OU-II. A comparison of the surface water concentrations at the OU-II and the CPLF sampling locations is shown in Table 4-5. The comparison of sediment and surface water concentrations from the CPLF and the OU-II investigations indicates that concentrations of inorganics in surface water and sediment near the OU-II outfall can not be related to the former discharge line outfall and may, in fact, be influenced by the CPLF.

Evaluation of Chemicals of Concern For Which Sediment Criteria Values Are Not Available

Several of the chemicals of concern in sediment were not evaluated because sediment criteria or guidance values were not available. However, because these chemicals were present in concentrations greater than background, further evaluation is necessary. These chemicals are:

2-butanone;	endrin aldehyde;	magnesium;
3-nitrolaniline;	aluminum;	potassium;
dibenzofuran;	barium;	sodium; and
carbazole;	calcium;	vanadium.
alpha-BHC;	cobalt;	

Of the organic compounds listed above, the octanol/water coefficients (i.e., $\log_{10}$Kow) for carbazole, alpha-BHC, and endrin aldehyde exceed 3.0. Therefore, these compounds can be considered to be persistent in the environment. Octanol/water coefficients (i.e., $\log_{10}$Kow) values for 2-butanone, 3-nitroaniline, and dibenzofuran are not available.

None of the organic compounds were detected in the surface water sample obtained from Croton Bay near the former discharge line outfall as part of the OU-II RI. Therefore, while the presence of these compounds may contribute to adverse impacts on benthic aquatic life or on human and/or wildlife bioaccumulation via sediment, surface water quality does not appear to have been impacted by these chemicals.

While the presence of the inorganic constituents above background levels may indicate that these constituents are Site-related, aluminum, barium, calcium, magnesium, potassium, and sodium were also detected in surface water near OU-II and in surface water near the CPLF at higher concentrations, with the exception of calcium. Cobalt was not detected in the OU-II RI surface water samples. Therefore, as discussed above, the presence of inorganic constituents in Croton Bay surface water and sediment can not be linked to the former discharge line outfall and may, in fact, be influenced by CPLF.

4.3.7 *Conclusions*

A comparison of the chemicals of concern in sediment to applicable criteria indicates that there are several organic and inorganic constituents that may be contributing to adverse impacts on human health and/or wildlife through bioaccumulation and to benthic aquatic life. The following chemicals of concern exceeded the NYSDEC or NOAA sediment criteria:

<u>Organics</u>

Aroclor-1248;
heptachlor epoxide;
4,4'-DDE;
4,4'-DDD;
4,4'-DDT;
2-methylnaphthalene;
flourene; and
anthracene.

Inorganics

arsenic;	iron;	nickel;
cadmium;	lead;	zinc; and
chromium;	manganese;	iron.
copper;	mercury;	

There were no NYSDEC or NOAA sediment criteria available for the evaluation of the following compounds:

2-butanone;	endrin aldehyde;	magnesium;
3-nitrolaniline;	aluminum;	potassium;
dibenzofuran;	barium;	sodium; and
carbazole;	calcium;	vanadium.
alpha-BHC;	cobalt;	

The CPLF ERA included a comparison of sediment concentrations to then-current NYSDEC sediment criteria or NOAA sediment guidance values. It identified adverse impacts to terrestrial life and aquatic life through exposure to landfill-related organic compounds and inorganic constituents in sediment in Croton Marsh. In addition, a macrobenthos sampling study also identified the potential for adverse effects to benthic life as a result of sediment quality. The results of the sampling in the tidal streams in Croton Marsh, including the eastern tidal stream (closest to the OU-II area), showed indications of stress, i.e., fewer species, more individuals, low diversity, and evenness index values. Furthermore, organic enrichment of the surface water and sediment and an improvement in the biological health of the benthic community, with distance from the landfill, suggested a possible landfill influence.

The CPLF ERA identified an unacceptable risk to terrestrial wildlife, specifically for the kingfisher (bird) through estimation of ingestion of fish and surface water. The estimated concentrations of chemicals ingested were obtained from actual fish tissue and surface water sampling. The assessment of impacts to the kingfisher indicated that the majority of the risk were due to exposure to iron, magnesium and aluminum in fish and surface water.

Unacceptable risks to humans through ingestion of fish which may bioaccumulate chemicals of concern in sediment were also identified in the CPLF study.

Therefore, it has been established that the area to the west of the former discharge line outfall near the Croton Point Landfill has been adversely impacted by landfill activities. Furthermore, the sediment in Croton Bay has potentially been influenced by CPLF, former wastewater lagoon discharges, and/or other sources in the Hudson River. In particular, PAH compounds, Arochlor 1248 and inorganic constituents detected in sediment samples collected during the OU-RI may be completely or partially related to sources other than the former discharge line outfall, such as the CPLF.

None of the organic chemicals of concern in sediment were detected in the surface water sample collected in Croton Bay during the OU-II RI. Therefore, while the presence of these compounds may contribute to adverse impacts on human and/or wildlife bioaccumulation via sediment, surface water quality does not appear to have been impacted by these chemicals.

Many of the inorganic chemicals of concern in sediment were also detected in the OU-II surface water sample. However, of the OU-II inorganic chemicals of concern that were also detected in surface water samples collected for the CPLF RI, the maximum concentrations detected in the CPLF RI exceed the concentrations in the OU-II surface water sample, with the exception of calcium. Therefore, the presence of inorganic constituents in Croton Bay surface water and sediment samples collected during the OU-II RI may be partially or completely related to activities at the CPLF.

4.4 *EVALUATION OF POTENTIAL RISKS ASSOCIATED WITH GROUND WATER IN THE VICINITY OF THE FORMER LAGOON*

The purpose of this section is to evaluate the potential risks associated with ground water in the vicinity of the former lagoon. The assessment of potential risks is based on the information presented in Section 3.4 of this report. The purpose of this evaluation is to establish the overall degree of hazard posed by existing conditions. This baseline risk assessment of ground water is then used as a benchmark against which proposed remedial alternatives can be evaluated in the Feasibility Study.

The evaluation of potential risks associated with ground water in the vicinity of the former lagoon is divided into five steps. First, potential exposure pathways by which humans and aquatic life could be exposed to chemicals in OU-II ground water are identified. Both current and projected future exposure pathways are considered. The exposure pathways identified for ground water are discussed in Section 4.4.1.

In the second step, the chemicals of concern in ground water for each complete exposure pathway are identified. This screening step eliminates chemicals which are not expected to result in significant risk (e.g., chemicals which are essential nutrients). Section 4.4.2 presents the chemicals of concern selection process for ground water.

In the third step, potential exposures are quantitatively evaluated. For each potential exposure pathway, exposure point concentrations for each of the chemicals of concern are compiled from monitoring data or calculated on the basis of environmental fate models. Average daily intakes via each potential exposure pathway are then calculated based on the exposure point concentrations. This step is outlined in Section 4.4.3.

The fourth step consists of a toxicity assessment of the chemicals of concern. In this step, health-based acceptable intakes or reference doses (for noncarcinogens) and potency factors (for carcinogens) are compiled or derived in order to evaluate the average daily intakes projected in Step 3. The toxicity assessment for the ground water risk assessment is outlined in Section 4.4.4.

The fifth and final step, risk characterization, uses projected average daily intakes and health-based acceptable daily intakes and potency factors to quantitatively evaluate and characterize the risk associated with ground water. Pathways for which risk could not be calculated were evaluated through comparison of exposure point concentrations to relevant criteria for the protection of human health and the environment. Section 4.4.5 contains a summary of the risk characterization step for ground water.

This risk assessment was performed in accordance with applicable USEPA guidance, including:

- Risk Assessment Guidance for Superfund, Vol. 1: Human Health Evaluation Manual, Part A (USEPA, 1989);
- Exposure Factors Handbook, Review Draft (USEPA, 1995a);
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (USEPA, 1991a);
- Dermal Exposure Assessment: Principles and Applications, Interim Report (USEPA, 1992).

4.4.1 *Identification of Potential Exposure Pathways*

This risk assessment evaluates potential exposure to organic compounds and inorganic constituents detected in ground water samples collected during the OU-II RI/FS. These potential exposures provide the basis for a subsequent estimate of human health and environmental risks.

Possible exposure pathways are evaluated by considering the following components: (1) the source and mechanism of chemical release; (2) whether a retention or transport medium is present; (3) the point of potential human or aquatic life contact with the affected medium (referred to as the exposure point); and (4) the exposure route (e.g., ingestion) at the exposure point. If these criteria are met, the exposure pathway is considered complete and follow-up evaluation performed.

The data collected during the OU-II RI/FS has shown that the ground water beneath the site contains low levels of volatile organic chemicals (VOCs), semi-volatile organics (SVOCs), and inorganic constituents in a variety of concentrations. The VOCs and SVOCs detected with the most frequency were predominantly petroleum-related compounds, including benzene, toluene, ethylbenzene, xylenes, naphthalene, 2-methylnaphthalene, acenapthene, flourene, and phenanthrene. No PCBs were detected in any of the ground water samples. Ground water quality data is summarized in Table 2-11.

Figures 2-7 and 2-8 show ground water flow directions at the Site for two different periods. As shown in these figures, the principal direction of ground water flow is toward the northwest. Early stages of former lagoon operations probably resulted in radial flow from the lagoon as a result of hydraulic influences. The primary northwesterly ground water flow direction from the former lagoon indicates migration toward the Hudson River.

The on-site area to the northwest of the former lagoon is owned by Metro-north while off-site areas are former New York Central Railroad Company property. The area to the south and southwest of the former lagoon, where radial flow likely influenced movement of ground water, is owned by Westchester County. All the off-site areas are currently undeveloped. In fact, the Croton Point Sanitary Landfill, a NYSDEC Inactive Hazardous Waste Disposal Site, is located on Westchester County property southwest of the former lagoon. This landfill site has been capped and an active landfill gas venting system has been installed and is currently operating. Because of the limited amount of property between Harmon Yard and the landfill and because of the landfill remedy, it is highly unlikely that this vacant property will be developed in the future.

Although the off-site areas designated as former New York Central Railroad Company property west of the lagoon and Half Moon Bay are currently undeveloped, the possibility exists for development to occur in the future. Therefore, the risk assessment must consider possible exposure pathways that could arise from ground water migration toward the Hudson River which moves beneath the former New York Central Railroad Company property west of the lagoon and Half-Moon Bay (referred to as "private undeveloped property").

The potential transport mechanisms and exposure pathways for ground water include:

- inhalation of volatilized chemicals from ground water in enclosed spaces (buildings);
- inhalation of volatilized chemicals from ground water in outdoor air;
- direct contact (ingestion, inhalation, and dermal absorption) with ground water through residential and commercial use;
- direct contact with ground water that has discharged to surface water; and
- exposure of aquatic life to ground water that has discharged to surface water.

Each of these five potential ground water exposure pathways are evaluated below to determine whether the exposure pathway is complete. If the potential exposure pathway is complete, the pathway is carried forward to the risk assessment. If the potential exposure pathway is not complete, the pathway is eliminated from further evaluation.

Inhalation of Volatilized Chemicals from Ground Water in Enclosed Spaces (Buildings)

As described in Section 3.4 of this report, low levels of VOCs were detected in ground water during the OU-II RI. Despite the relatively low concentration, there is the potential for these chemicals to volatilize, migrate upwards through soil, enter buildings through foundation cracks, and result in indoor air inhalation exposures.

Under current and projected future conditions, the Metro-North employees who occupy buildings at Harmon Yard are potential receptors. As discussed above, ground water in the vicinity of the OU-II lagoon flows northwest toward the Hudson River. As ground water moves toward the river it flows private undeveloped property. Therefore, another potential exposure pathway which is evaluated considers that chemicals in ground water could then volatilize into indoor air resulting in inhalation exposures to any future residents that occupy any newly constructed buildings on the private property. As discussed below, industrial workers (i.e., Metro-North employees at Harmon Yard) and possible future residential occupants of any structures on the private undeveloped property are the potential receptors for chemicals in ground water originating at OU-II via and exposure pathway of volatilization into enclosed spaces (buildings).

Inhalation of Volatilized Chemicals from Ground Water into Outdoor Air

VOCs in ground water at and downgradient of OU-II may volatilize and migrate upward through the soil resulting in inhalation exposures to individuals outdoors on and adjacent to Harmon Yard. Dissolved VOCs in ground water may also migrate with ground water to the adjacent surface water (i.e., the Hudson River) where they would then volatilize from surface water into outdoor air. The potential receptors that may be exposed to VOCs that may migrate from ground water to outdoor air from Harmon Yard ground water are:

- Metro-North employees;
- possible future residents of structures on the private undeveloped property; and
- recreational fisherman in the Hudson River.

While the potential exists for on-site workers, possible future residents, and recreational fishermen to be exposed to volatilized chemicals in outdoor air, the evaluation of the potential exposure of on-site Metro-North workers and possible future residents of structures on the private undeveloped property to VOCs in indoor air represents a far more conservative exposure scenario (higher exposures), as explained below. Therefore, the more conservative indoor air exposure scenario will be evaluated first. If this scenario results in unacceptable risks, exposures from outdoor air will also be quantified.

For a given concentration of a VOC in ground water, an estimation of the resulting concentration in indoor air using standard volatilization models would be higher than an estimated concentration in outdoor air. The estimated concentration in indoor air would be higher due to the potential for chemicals to become trapped indoors and conservative assumptions regarding building ventilation rates. Chemicals present in outdoor air are dispersed more readily due to wind. Furthermore, the potential exposure times for on-site workers and any future residents for indoor air are equal to or greater than that for outdoor air. Therefore, indoor air exposures for on-site workers and any future residents are greater than outdoor air exposures. Similarly, exposure by recreational fisherman will be lower than those for the indoor air scenario for any future residents.

A volatilization model from the American Society for Testing and Materials (ASTM) Standard Guide for Risk-Based Corrective Action at Petroleum Release Site (RBCA) (ASTM, 1995) predicts identical concentrations in indoor air from volatilization of chemicals in either surface water or ground water. However, the source concentrations for fisherman (surface water) would be significantly lower than those for residents (ground water) because of the significant dilution that occurs when ground water discharges from Harmon Yard to the Hudson River.

Finally, the potential exposure time for recreational fishermen to VOCs in outdoor air would be less than or equal to the exposure time for indoor air for any future residents. Standard exposure parameters conservatively assume that a resident stays in the same dwelling for 30 years, 350 days per year. Recreational fisherman would represent a subset of the residential population and would be expected to be exposed for less time than a residential receptor. Therefore, exposure to recreational fishermen would be lower than the indoor air scenario for any future residents.

Since the potential exposure of on-site Metro North workers and any future residents to VOCs from ground water in indoor air is more conservative than the potential exposures in outdoor air by on-site workers, any future residents, or recreational fisherman, the outdoor scenarios will not be evaluated initially in this risk assessment. If, however, the evaluation of indoor air exposures of on-site Metro North workers and any future residents to VOCs indicates an unacceptable risk, exposure to VOCs from ground water in outdoor will be evaluated.

Residential and Commercial Use of Ground Water

In order to identify potential direct contact ground water receptors through residential and commercial use of ground water, a well search of the Site vicinity was conducted(ERM, 1996a, Appendix B). The well search did not identify any public supply or private wells located downgradient of Harmon Yard, i.e., between Harmon Yard and the Hudson River. The nearest public supply well is located more than two miles to the northeast (upgradient) of the site. Local residents on Croton Point are served by the Village of Croton-on-Hudson Water Supply System. The well field supplying the village system is located on the mainland upgradient of the Site. A fire protection water supply well, which supplies ground water for non-potable uses, is located within the boundaries of Harmon Yard. The fire protection water supply well is located to northeast of the former lagoon. Ground water from the lagoon area flows in the northwesterly direction and discharges to the Hudson river. Therefore, it is unlikely that ground water from the lagoon area could reach the vicinity of the fire protection well. As described in the *Remediation Plan*(ERM, 1996a) for Harmon Yard, the fire protection well is screened in a semiconfined aquifer (197 to 204 feet below mean sea level (MSL)) and there is little, if any, hydraulic communication between the aquifer in which the fire protection water supply well is screened and the shallow aquifer (screened 15 to 20 feet below MSL) evaluated during the 1995 *Field Investigation*(ERM, 1995) and the OU-II RI/FS. Therefore, because ground water does not flow in the direction of the water supply well and since the aquifer in which the fire protection water supply well is screened and the shallow aquifer are not connected, the potential pathway for human exposure to chemicals of concern ground water from beneath the lagoon is not complete. Therefore, this exposure will not be evaluated in this assessment.

Discharge of Chemicals in Ground Water to Surface Water

As described above, ground water from Harmon Yard discharges to the Hudson River. The Hudson River in the vicinity of Harmon Yard is classified as SB by NYSDEC (NYSDEC, 1996a). SB waters are suitable for primary and secondary contact recreation and fishing as well as fish propagation and survival (6 NYCRR 701.11). Therefore, the primary receptors of concern are expected to be recreational users, aquatic life, and humans ingesting fish caught from the river.

Recreational activities along the Hudson River, such as swimming, boating or fishing, may occur near the Site. In fact, there is a beach on the north side of Croton Point in the Hudson River. If organic compounds or inorganic constituents were to reach the Hudson River, such recreational users may come in contact with surface water, leading to exposure. Exposure to organic compounds or inorganic constituents could occur by absorption through the skin or via incidental ingestion of small amounts of surface water. Swimmers would likely receive the greatest exposure to surface water and, therefore, will be the population evaluated in this risk assessment.

Though the organic compounds and inorganic constituents detected in the on-site ground water are not expected to bioaccumulate to any significant degree, impacts to aquatic life and ingestion of fish by humans can potentially occur and therefore these pathways will be evaluated further in this risk assessment.

Conclusion

Four potential pathways of concern are identified for which further evaluation is required:

- inhalation of volatilized chemicals in indoor air (commercial and industrial worker exposure pathways: Metro-North employees and any future residents: private undeveloped property);
- discharge of ground water to surface water and direct contact with recreational swimmers;
- discharge of ground water to surface water and human ingestion of fish; and

- discharge of ground water to surface water and impacts to aquatic life.

4.4.2 *Identification of Chemicals of Concern*

This section evaluates the chemicals that were detected during the OU-II RI to determine which are chemicals of concern for the pathways identified above. Three of the four pathways above are pathways for human exposure and the fourth pathway is for exposure of aquatic life. Because the toxicity of chemicals is different for humans than for aquatic life, the chemicals of concern for these two types of receptors are evaluated separately below.

4.4.2.1 *Chemicals of Concern for Evaluation of Potential Health Risks*

At sites where a number of chemicals have been detected, USEPA guidance on human health risk assessment suggests reducing the number of chemicals which warrant a complete and thorough evaluation, through the selection of chemicals of concern or indicator chemicals.

Due to the large number of chemicals that were detected in ground water and the limited number of samples, a concentration/toxicity screen was conducted to identify which chemicals are most likely to contribute significantly to risks calculated for the human health exposure scenarios identified in Section 4.4.1. This procedure is based on the premise that concentration and toxicity are the primary factors driving the risk assessment of potential exposure scenarios. This procedure was conducted in accordance with current EPA risk assessment methodology (USEPA, 1989a).

Elimination of chemicals through the concentration/toxicity screen allows the risk assessment to focus on the "most significant" chemicals. In the screening procedure, each chemical that was detected in ground water was scored according to its concentration and toxicity to obtain a risk factor (concentration multiplied by toxicity factor for carcinogens, divided by toxicity factor for noncarcinogens). The concentrations used in the screening process were the maximum concentrations of chemicals detected in ground water. The toxicity factors used were the most conservative of either the oral or inhalation toxicity values for both noncarcinogens (reference doses) and carcinogens (potency factors). Chemical-specific risk factors were summed to obtain the total risk factor for all noncarcinogenic and carcinogenic chemicals of potential concern. The ratio of the risk factor for each chemical to the total noncarcinogenic or carcinogenic risk factor approximates the relative risk for each chemical in ground water. Chemicals that have very low risk ratios compared with the ratios of other chemicals were eliminated from the risk assessment. As recommends in RAGS, chemicals with a risk ratio less than 0.01 or 1 percent were eliminated from further consideration as potential chemicals of concern (EPA, 1989a).

The results of the concentration/toxicity screen are shown in Table 4-6. As shown in Table 4-6, ten chemicals have risk ratios greater than 0.01 These chemicals are: bis (2-ethylhexyl) phthalate, aluminum, arsenic, barium, beryllium, chromium, copper, iron, manganese, and vanadium. Therefore, these ten chemicals are identified as chemicals of concern for human exposures to ground water.

There were several chemicals detected in ground water for which published toxicity factors were not available. These chemicals were 2-methylnapthalene, phenanthrene, lead, calcium, potassium, sodium, and magnesium. Calcium, potassium, sodium, and magnesium are essential human nutrients. Therefore, these chemicals were eliminated from further evaluation as potential chemicals of concern for risk to human health.

EPA has established an action level for lead in ground water of 15 ppb. The maximum concentration of lead in ground water samples collected during the OU-II RI/FS (968 ppb) exceeds 15 ppb. Therefore, this chemical is added to the list of chemicals of concern for OU-II ground water. Since there are no toxicity factors for calculating human exposures to lead available, the only human exposure routes for which lead can be evaluated is the ground water discharge to surface water exposure route for human consumption of fish. For this pathway, in the absence of an Ambient Water Quality Criteria, exposure point concentrations in surface water are compared to the action level for lead in ground water.

The remaining two potential chemicals of concern , 2-methylnapthalene and phenanthrene, will not be evaluated for potential human health risks due to the lack of toxicity data available for these compounds.

Bis (2-ethylhexyl) phthalate, aluminum, arsenic, barium, beryllium, chromium, copper, iron, lead, manganese, and vanadium have been identified as chemicals of concern to human health for ground water. Therefore, these chemicals are expected to drive the risk assessment of potential exposures to humans. However, these ground water constituents are not volatile. Two pathways for volatile constituents were identified in Section 4.4.1. Therefore, in order to enable the evaluation of the potential exposure pathways that include volatilization of chemicals from ground water, an additional concentration/toxicity screen was conducted of the VOCs detected in ground water to identify volatile chemicals of concern to be carried through the human health risk assessment in all of the potential exposure pathways including those that include volatilization.

The results of the VOC concentration/toxicity screen are shown in Table 4-7. In the VOC screening procedure the chemicals with the highest noncarcinogenic and carcinogenic risk ratios, respectively, were chosen for additional chemicals of concern. For both noncarcinogenic and carcinogenic effects, three chemicals likely represent the majority of the risk associated with VOCs. Benzene and chlorobenzene represent approximately 44 and 47 percent, respectively, of the noncarcinogenic risks associated with VOCs in ground water. Chloromethane and benzene represent approximately 42 and 58 percent, respectively, of the carcinogenic risks associated VOCs in ground water. Therefore, benzene, chloromethane, and chlorobenzene were chosen as additional chemicals of concern for ground water.

It should be noted that the risk factors developed in this screening procedure (concentration multiplied by potency factor for carcinogens or the inverse of the reference dose for noncarcinogens) are used only for the reduction of the number of chemicals carried through the risk assessment and have no meaning outside of the context of the screening.

Summary

Fourteen chemicals of concern have been identified for the evaluation of human health risks associated with ground water. The thirteen chemicals of concern are listed below:

- bis (2-ethylhexyl) phthalate;
- aluminum;
- arsenic;
- barium;
- beryllium;
- chromium;
- copper;
- iron;
- lead;
- manganese;
- vanadium;
- benzene;
- chloromethane; and
- chlorobenzene.

4.4.2.2 Chemicals of Concern for Evaluation of Potential Impacts to Aquatic Life

Impacts to aquatic life will be evaluated through comparison to relevant criteria for the protection of aquatic life. Relevant criteria include the NYSDEC Surface Water Quality Standards (NYSDEC, 1993b), the federal Ambient Water Quality Standards (USEPA, 1992a), and the Region III BTAG Screening Levels for impacts to aquatic life (USEPA, 1995a). All chemicals detected in ground water will be evaluated for potential impacts to aquatic life unless there are no relevant criteria available for evaluation of particular chemicals. Of the chemicals detected in ground water, aquatic life criteria are not available for the following compounds: chloromethane, carbazole, dibenzofuran, calcium, manganese, magnesium, potassium, sodium, and vanadium. Therefore, these compounds will not be evaluated for potential impacts to aquatic life.

4.4.3 *Estimation of Exposure Point Concentrations and Calculation of Intakes*

In this section, exposures to each of the chemicals of concern for each of the exposure pathways identified as potentially significant in Section 4.4.1 are quantitatively assessed. Exposure point concentrations are calculated for each exposure pathway based on ground water data collected during the OU-II RI/FS. Average daily intakes are then calculated for each exposure pathway based on the exposure point concentrations. The intakes for each pathway are evaluated in Section 4.4.5. As described in Section 4.4.1, the exposure pathways to be quantitatively evaluated are:

- inhalation of volatilized chemicals in indoor air (commercial and industrial worker exposure pathways: Metro-North employees; and any future residents: private undeveloped property);
- discharge of ground water to surface water and direct contact with recreational swimmers;
- discharge of ground water to surface water and human ingestion of fish; and

- discharge of ground water to surface water and impacts to aquatic life.

4.2.3.1 Indoor Air Exposure to On-Site Workers and Any Future Residents

As mentioned in Section 4.4.1, if volatilization of chemicals of concern in ground water were to occur, the potentially exposed populations would be Metro-North employees and any future residents that may occupy structures built on the private undeveloped property. Three chemicals of concern were identified for this exposure pathway were: chloromethane, benzene, and chlorobenzene.

In order to estimate a representative concentration of chemicals of concern in ground water, the 95 percent upper confidence limit (UCL) on the arithmetic mean of all ground water samples (1 round, 10 samples) collected during the OU-II investigation was calculated (USEPA, 1989a). In accordance with EPA policy, the mean was calculated by using a proxy value of one-half the detection limit for samples in which a chemical was not detected. The sampling results are summarized in Table 2-11. Table 4-8 presents the maximum detected concentration in ground water and the 95% UCL on the mean. The 95% UCL is calculated from on-site sampling data and is conservatively used to evaluate on-site as well as off-site exposures.

Since indoor air monitoring was beyond the scope of this project, concentrations of chemicals of concern in indoor air were estimated based upon the 95% UCL ground water exposure point concentrations. The American Society for Testing and Materials (ASTM) Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release

Sites (RBCA) was used for this estimation (ASTM, 1995). The guide presents an equation for estimating concentrations of volatile organics in indoor air using the following equation:

Conc. indoor air (mg/m^3) = Conc. in ground water (mg/l) x VF(mg/m^3)/(mg/l)

where VF is a chemical-specific volatilization factor that relates enclosed-space air and dissolved ground water concentrations. Ground water concentrations as discussed above, are shown in Table 4-8.

The volatilization factor is based upon the following assumptions:

- chemical concentrations in ground water are constant;
- partitioning between chemicals in ground water and vapors at the ground water table are in equilibrium;
- vapor- and liquid-phase diffusion through the capillary fringe, vadose zone, and cracks in the structure's foundation is in steady-state;
- there is no loss of chemical as it diffuses upward toward the ground surface; and
- once the chemical vapors enter the indoor air, steady well-mixed dispersion occurs. (ASTM, 1995).

VF for the three chemicals of concern evaluated in this pathways was calculated using the following formula and corresponding ASTM default values:

$$VF\ (mg/m^3) / (mg/l) = \frac{H \times (D^{eff}_{ws}/L_{GW}) / (ER \times L_B) \times 10^3\ (L/m^3)}{1 + (D^{eff}_{ws}/L_{GW}) / (ER \times L_B) + (D^{eff}_{ws}/L_{GW}) / (D_{crack}/L_{crack})n}$$

where:

VF = volatilization factor

H = henry's Law Constant, unitless, cm3-H_20/cm^3-air

D^{eff}_{ws} = effective diffusion coefficient between ground water and soil surface, cm^2/s

= $(h_{cap}+h_v)[h_{cap}/D^{eff}_{cap} + h_v/D^{eff}_s]^{-1}$

h_{cap} = thickness of capillary fringe, 5 cm

h_v = thickness of vadose zone, 295 cm

D^{eff}_{cap} = Effective diffusion through capillary fringe, cm^2/s

= $D_{air}(\theta_{acap}^{3.33}/\theta_T^2) + D_{wat}(1/H)(\theta_{wcap}^{3.33}/\theta_T^2)$

D_{air} = diffusion coefficient in air, chemical-specific, cm^2/s

D_{wat} = diffusion coefficient in water, chemical-specific, cm^2/s

θ_{acap} = volumetric air content in capillary fringe soils, 0.038 cm^3-air/cm^3-soil

θ_{wcap} = volumetric water content in capillary fringe soils, 0.342 cm^3- H_20/cm^3-soil

θ_T = total soil porosity, 0.38 cm^3/ cm^3-soil

D^{eff}_s = effective diffusion coefficient in soil based on vapor-phase concentration, cm^2/s

= $D_{air}(\theta_{as}^{3.33}/\theta_T^2) + D_{wat}(1/H)(\theta_{ws}^{3.33}/\theta_T^2)$

θ_{as} = volumetric air content in vadose zone soils, 0.26 cm^3 air/cm^3-soil

θ_{ws} = volumetric water content in vadose zone soils, 0.12 cm^3-H_20/cm^3-soil

L_{GW} = depth to ground water, cm =$h_{cap}+h_v$

ER = enclosed space air exchange rate, 0.00014/s

L_B = enclosed space volume/infiltration area ratio , 200 cm

D_{crack} = effective diffusion coefficient through foundation cracks, cm^2/s = $D_{air}(\theta_{acrack}^{3.33}/\theta_T^2) + D_{wat}(1/H)(\theta_{wcrack}^{3.33}/\theta_T^2)$

θ_{acrack} = volumetric air content in foundation/walls, 0.26 cm^2-air/ cm^2-total volume

θ_{wcrack} = volumetric water content in foundation/walls, 0.12 cm^2- H_20/cm^2-total volume

L_{crack} = foundation or wall thickness, cm

n = areal fraction of cracks in foundation/walls, 0.01 cm^2-cracks/cm^2-total area

The standard default factors provided in the ASTM guidance were used to derive chemical-specific volatilization factors. It should be noted that the ASTM guidance is designed as a screening tool which makes many conservative assumptions. More site-specific refinement of the assumptions could be made if the screening was indicative of a public health problem.

Table 4-9 shows the calculated volatilization factors along with estimated indoor air levels for each of the three VOCs identified as chemicals of concern in ground water.

To determine intake levels through the inhalation of indoor air by both on-site workers and nearby residents, scenarios were developed by making assumptions consistent with USEPA risk assessment guidelines and site-specific characteristics. Annual average daily intakes were calculated using the following equation (USEPA, 1989):

$$\text{Average Daily Intake (mg/kg/day)} = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

where:

CA = Concentration of Contaminant in Indoor Air (mg/m^3)
IR = Inhalation Rate (m^3/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (days)

The concentration of VOCs in indoor air (CA) was the value calculated using the ASTM methodology, as described above. The assumptions used for the other values are described below. Concentrations predicted in indoor air are from on-site data. Concentrations in ground water and indoor air at Half Moon Bay are expected to be lower.

Inhalation Rate (IR)- USEPA guidance suggests that when inhalation exposures are not continuous throughout the day that an inhalation rate based upon activity patterns be used. For workers in an light industrially zoned site, an inhalation rate corresponding to moderate activity (20 m3/day) was assumed (USEPA, 1995). For residents of the Half Moon Bay development, an inhalation rate corresponding to residential activity patterns (15 m^3/day) was assumed (US EPA, 1995).

Exposure Frequency (EF) - The average worker is assumed to be at the Site for 250 days per year (USEPA, 1991a). The average resident is assumed to be at his or her residence for 350 days per year (USEPA, 1991a).

Exposure Duration (ED) - It is conservatively assumed that an average worker will work at a facility on this Site for 25 years (USEPA, 1991a). It is conservatively assumed that an average resident will live at the same residence for 30 years (US EPA, 1991a).

Body Weight (BW) - Consistent with US EPA guidance, an average body weight for adult men and women is assumed to be 70 kg (USEPA, 1995a). The body weight for a child up to 6 years old is conservatively assumed to be 30 kg.

Averaging Time (AT) - For carcinogens, the US EPA recommends that the exposure be averaged over a lifetime, 70 years, or 25550 days. For noncarcinogenic effects, the exposure duration (in days) should be used as the averaging time (USEPA, 1991a).

The average daily intake levels for on-site workers and any future residents from inhalation of indoor air are provided in 4-9. The intake levels are evaluated in terms of risks to human health in Section 4.4.5, Risk Characterization.

4.4.3.2 Recreational Exposure to Surface Water

For the purposes of this risk assessment, recreational activities, such as swimming, boating, or fishing on this portion of the Hudson River are considered possible presently and in the future. As discussed in Section 4.4.1, during such activities dermal contact and incidental ingestion of surface water are the primary routes of exposure. Swimming would lead to the greatest exposure and, therefore, will be the representative exposure scenario for recreational users. Both dermal and incidental ingestion routes of exposure are evaluated in this section. All of the chemicals of concern identified in Section 4.4.2.1, with the exception of lead, were identified for evaluation of thid pathway. Lead could not be evaluated for this pathway because there are no published oral or dermal reference doses or potency factors available for this constituent.

As described above, ground water discharges to surface water (i.e. the Hudson River) where it is diluted significantly. However, for the purposes of evaluating the potential risks associated with recreational surface water contact, it was conservatively assumed that the 95% UCL concentration in ground water is the concentration in surface water to which recreational users would be exposed. This is a very conservative assumption because it does not take into account any attenuation of organic compounds or inorganic constituents before the ground water reaches surface water, nor does it take into account dilution, volatilization and degradation of these once released to surface water.

4.4.3.2.1 *Dermal Absorption from Surface Water*

Average daily exposure to contaminants in surface water via dermal absorption were calculated for each of the chemicals of concern using the following equation (USEPA, 1989):

For inorganics:

$$\text{Average Daily Dose (mg/kg/day)} = \frac{CW \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:

CW = Concentration of Contaminant in Surface Water (mg/l)
SA = Skin Surface Area Available for Contact (cm^2)
PC = Chemical-specific Dermal Permeability Constant (cm/hr) (inorganics only)
ET = Exposure Time (hours/event)
EF = Exposure Frequency (event/year)
ED = Exposure Duration (years)
CF = Volumetric Conversion Factor for Water (1 liter/1000 cm^3)
BW = Body Weight (kg)
AT = Averaging Time (days)

The assumptions used in assigning values to each of these variables are provided below.

Concentration of Contaminant in Surface Water (CW) - For each chemical, the 95% UCL on the arithmetic mean in ground water was used as the surface water concentration.

Skin Surface Area (SA) - Since swimming is the activity used in this scenario, it was assumed that the skin surface area of a whole adult body was exposed (US EPA, 1992). Total body surface area can vary between 17,000 cm^2 to 23,000 cm^2 with a mean reported to be about 20,000 cm^2 (US EPA, 1995). To be conservative, a skin surface area of 23,000 cm^2 was assumed to be available for contact.

Dermal Permeability Constant (PC) (inorganics only)- This is a predicted constant for inorganics that represents the partitioning of a chemical in water across the skin. Table 4-10 shows the PC values used in this risk assessment for the chemicals of concern as provided in USEPA guidance (US EPA, 1992b).

Exposure Time (ET) - For each day of swimming, it was assumed that an individual would be in contact with the water for a total of 0.5 hours (USEPA, 1992b).

Exposure Frequency (EF) - It was assumed that an individual may swim in the vicinity of the site five days per year (USEPA, 1992b).

Exposure Duration (ED) - Since the potentially exposed population may reside in the area, the USEPA's recommended duration for residential exposures (30 years) is used. This value represents the national upper-bound time (90th percentile) at any one residence (US EPA, 1991a).

Body Weight (BW) - Consistent with US EPA guidance, an average body weight for adult men and women is assumed to be 70 kg (US EPA, 1995).

Averaging Time (AT) - For carcinogens, the USEPA recommends that the exposure be averaged over a lifetime. Therefore, the averaging time for carcinogens is 70 years or 25,550 days. For noncarcinogens (or noncarcinogenic properties of carcinogens), the averaging time is the same as the total years of exposure (30 years or 10,950 days) (USEPA, 1989a).

For organics:

$$\text{Average Daily Dose (mg/kg/day)} = \frac{CW \times DA_{day} \times SA \times EF \times ED \times CF}{BW \times AT}$$

where:

CW = Concentration of Contaminant in Surface Water (mg/l)
SA = Skin Surface Area Available for Contact (cm^2)
DA_{day} = Dose Absorbed per Unit Area Per Day ($mg/cm^2/day$)
(organics only) =

If $t_{event} < t^*$, then: $DAday = 2KpCW(6\tau t_{event}/\pi)1/2$
If $t_{event} > t^*$, then $DAday = KpCW[(t_{event}/1+B) + 2\tau(1+3B/1+B)]$

Kp = Chemical specific dermal permeability coefficient (cm/hr) (organics only)
t_{event} = duration of the event (hours/day)
t^*, B, τ = chemical specific parameters for modeling DA_{day}

EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
CF = Volumetric Conversion Factor for Water (1 liter/1000 cm^3)
BW = Body Weight (kg)
AT = Averaging Time (days)

The chemical concentration in surface water (CW), skin surface area (SA), exposure frequency (EF), exposure duration (ED), body weight (BW), and averaging time (AT) are all the same as described above for dermal contact with inorganics in surface water. Assumptions used in assigning values to the remaining variables are provided below.

Dose Absorbed per Unit Area per Day (DA_{day}) - This is a predicted dose per day of an organic chemical based on the partitioning of the chemicals in water across the skin. The DA_{day} is calculated from a model which is based on the chemical-specific permeability coefficient from water (Kp), the duration of the event (tevent), and the concentration of the organic chemical in water. The remaining parameters for the model (t*, B, and τ) are chemical-specific and were obtained from the USEPA's Dermal Exposure Assessment: Principles and Applications (USEPA, 1992b). Table 4-10 shows the DA_{day} values for the organic chemicals of concern.

t_{event} - For each day of swimming, it was assumed that an individual would be in contact with the water for a total of 0.5 hours (USEPA, 1992b).

The resulting average daily doses from dermal absorption of surface water chemicals of concern (both inorganic and organic) are presented in Table 4-10 and evaluated in Section 4.4.5.

4.4.3.2.2 *Incidental Ingestion of Surface Water*

The average daily intake due to the incidental ingestion of surface water while swimming can be calculated using the following equation (USEPA, 1989a):

$$\text{Average Daily Intake} = \frac{CW \times CR \times ET \times EF \times ED}{BW \times AT}$$

where:

CW = Concentration of Contaminant in Surface Water (mg/l)
CR = Contact Rate (liters/hour)
ET = Exposure Time (hours/event)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (days)

The chemical concentration in surface water (CW), exposure time (ET), exposure frequency (EF), exposure duration (ED), body weight (BW), and averaging time (AT) are all the same as described above for dermal contact with surface water. Assumptions used in assigning a value to the contact rate, the remaining variable, is provided below.

Contact Rate (CR) - The US EPA recommends using a contact rate of 50 ml per hour of exposure for incidental ingestion from swimming (US EPA, 1989a). Therefore, this value was used.

The results of the quantification of exposure to chemicals in surface water from incidental ingestion while swimming are provided in Table

4-10. The health significance of these results are discussed in Section 4.4.5, the Risk Characterization.

4.4.3.3 *Human Consumption of Fish*

As discussed in Section 4.4.1, if organic compounds and inorganic constituents in ground water were to reach the Hudson River, it is possible that fish would be affected. Therefore, the consumption of affected fish is a possible human pathway of exposure.

The concentrations of chemicals of concern in ground water will be diluted after ground water has migrated to the Hudson River and is mixed with the surface water present in the river. The rate at which chemicals of concern in northern Harmon Yard ground water will dilute after mixing with surface water in the Hudson River was calculated in the *Harmon Yard Remediation Plan* (ERM, 1996). This rate of dilution or dilution factor was based on mass balance that was calculated using the following information:

- the amount of ground water that migrates from the northern portion of Harmon Yard to the Hudson River on a daily basis; and
- the amount of surface water in the Hudson River that flows past the northern portion of Harmon Yard on a daily basis.

This mass balance was performed using an equation provided in the USEPA Superfund Exposure Assessment Manual (USEPA, 1988) to determine the dilution provided by the receiving surface water body (i.e., the Hudson River). The dilution factor for northern Harmon Yard ground water and the Hudson River was computed to be 77,033 as shown in Appendix E of the *Harmon Yard Remediation Plan* (ERM, 1996). The dilution factor for OU-II ground water to the Hudson River would be about 4 to 8 times higher than the dilution factor developed for the Harmon Yard *Remediation Plan* because the discharge length for OU-II ground water to the Hudson River is about 4 to 8 times less than the discharge length for northern Harmon Yard ground water. However, for the purpose of this report, dilution from OU-II ground water is conservatively estimated using the diultion factor developed for the northern Harmon Yard.

The exposure point concentrations for ingestion of fish were calculated using the maximum detected concentrations of the chemicals of concern in ground water and the dilution factor of 77,033 for northern Harmon Yard. The resulting surface water exposure point concentrations for the chemicals of concern are shown on Table 4-11.

Because the degree of bioaccumulation in fish is difficult to measure, a specific exposure scenario was not developed to evaluate this pathway of exposure. Instead, the US Ambient Water Quality Standards (AWQS) (USEPA, 1992a) are used to evaluate the potential adverse impacts associated with ingestion of fish from surface water that has received ground water. This evaluation is presented in Section 4.4.5, Risk Characterization.

4.4.3.4 *Potential Risks to Aquatic Life*

The surface water exposure point concentrations for the evaluation of potential risks to aquatic life were also derived using the dilution factor described above in Section 4.4.3.3 for ground water discharging to the Hudson River. Exposure point concentrations were calculated for all chemicals of concern identified for this exposure pathway in Section 4.4.2.2. The exposure point concentrations are shown in Table 4-12.

The potential impacts to aquatic life from OU-II ground water discharging to the Hudson River were evaluated by comparing the predicted surface water exposure point concentrations to the NYSDEC Surface Water Quality Criteria (SWQS) (NYSDEC, 1993b)for the protection of aquatic life. This evaluation is described in Section 4.4.5, Risk Characterization.

4.4.4 *Toxicity Assessment*

The purpose of the toxicity assessment is to compile relevant toxicity values for the chemicals of concern at the Site. These toxicity values are then used to determine whether the intakes calculated in Section 4.4.3 are acceptable. The toxicity values are specific to the route of exposure (e.g., oral, dermal or inhalation) and the nature of the adverse effect (noncarcinogenic or carcinogenic).

Toxicity values are only evaluated for human health exposures for which intakes will be calculated. These exposures are the inhalation exposures for on-site workers and any future residents occupying structures built on the private undeveloped property and the recreational swimming exposures. The human ingestion of fish and impact to aquatic life exposures will be evaluated by comparison of exposure point concentrations to relevant criteria.

The specific steps involved in the toxicity assessment are (US EPA, 1989a):

(1) Identify exposure periods for which toxicity values are needed;
(2) Determine toxicity values for noncarcinogenic effects;
(3) Determine toxicity values for carcinogenic effects.

Each of these steps is described below.

4.4.4.1 Identification of Exposure Periods for which Toxicity Values are Needed

Toxicity values are dependent upon the period over which exposure occurs. Typically, three exposure periods are considered: (1) chronic (exposures between seven years and a lifetime); (2) subchronic (exposures between two weeks and seven years); and (3) acute (exposure periods of less than two weeks). Because all of the exposure pathways of concern from ground water are expected to occur over a period of more than seven years, chronic toxicity values are used in this assessment.

4.4.4.2 Determination of Toxicity Values for Noncarcinogenic Effects

A reference dose, or RfD, is the most appropriate toxicity value to use in evaluating noncarcinogenic effects resulting from chronic or subchronic exposures (USEPA, 1989a). RfDs represent an estimate of the daily intake of a chemical which is likely to be without appreciable risk of an adverse effect. The USEPA has published chronic RfDs for exposures via ingestion and inhalation for a number of chemicals.

RfDs for dermal exposure are not available since dermal toxicity data are limited. For this reason, oral RfDs are typically used to evaluate dermal exposures. However, dermal exposures are estimated as absorbed doses so the toxicity factors must also be expressed as absorbed doses. Therefore, for certain chemicals, it is necessary in the risk characterization step to ensure that the site exposure estimate and the toxicity value for comparison are both expressed as absorbed doses or both expressed as intakes. In the absence of any information on absorption of the substance, an oral absorption efficiency can be assumed. The oral absorption efficiency is then used to calculate the absorbed dose. For noncarcinogens, the oral absorption efficiency is multiplied by the oral RfD. For chemicals for which oral absorption efficiencies were not available, a relatively conservative assumption of five percent is used to estimate the absorbed dose. (USEPA, 1989a)

The following hierarchy of references, as recommended by the USEPA, are used in identifying appropriate RfDs (USEPA, 1989a):

- Integrated Risk Information System (IRIS)
- Health Effects Assessment Summary Tables (HEAST)
- EPA-NCEA Superfund Health Risk Technical Support Center.

The RfDs used in this risk assessment are presented in Table 4-12. Toxicological profiles for all chemicals of concern are provided in Appendix I of this report. These profiles provide information on toxicology and physical and chemical properties affected fate and transport of these chemicals.

4.4.4.3 Determination of Toxicity Values for Carcinogenic Effects

Unlike noncarcinogenic effects, cancer-producing agents have not demonstrated a threshold, i.e., a dose below which there is a zero probability of a carcinogenic response. Accordingly, RfDs are not determined for carcinogenic effects. In order to evaluate carcinogenic effects, U. S. EPA uses a two-part evaluation in which the substance is first assigned a weight-of-evidence classification, and then a cancer potency factor (PF) is calculated.

The US EPA classification system for weight-of-evidence consists of a five-category approach, listed below.

Group A - Human carcinogen (sufficient evidence from epidemiological studies).

Group B - Probable human carcinogen.

Group B1 - Limited evidence of carcinogenicity in humans from epidemiological studies.

Group B2 - Sufficient evidence of carcinogenicity in animals; inadequate or no evidence of carcinogenicity in humans.

Group C - Possible human carcinogen (limited evidence of carcinogenicity in animals in the absence of human data).

Group D - Not classified (inadequate evidence of animal carcinogenic activity).

Group E - Negative evidence of carcinogenicity for humans (no evidence for carcinogenicity in at least two adequate animal tests in different species or in both epidemiological and animal studies).

The potency factor or slope factor is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime. The potency factor is used in risk assessment to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen.

As is the case with RfDs, potency factors have already been developed by the USEPA for a number of chemicals. The US EPA recommends using the same hierarchy of references listed above to identify appropriate potency or slope factors. Table 4-13 presents a list of the carcinogenic chemicals of concern associated with ground water, their potency factors as listed in the above references, their classifications for evidence of carcinogenicity, the type of cancer caused (for Group A carcinogens), and the basis and source of the potency factor.

As is the case with RFDs, PFs are also dependent upon the route of exposure. Though inhalation PFs are available, dermal PFs have not been determined. Therefore, oral PFs will be used to evaluate the dermal route of exposure. As described above for noncarcinogens, for certain chemicals, it is necessary to ensure that the Site exposure estimate and the toxicity value for comparison are both expressed as absorbed doses or both expressed as intakes. In the absence of any information on absorption of the substance, an oral absorption efficiency can be assumed. The oral absorption efficiency is then used to calculate the absorbed dose. For carcinogens, the oral absorption efficiency is divided by the potency factor to find the absorbed dose.

For chemicals for which oral absorption efficiencies are not available, a relatively conservative assumption of five percent is used to estimate the absorbed dose (EPA, 1989a)

The RfDs and potency factors identified in this section are used in the following section to quantitatively evaluate the risk associated with the chemicals of concern in soil at the Site.

4.4.5 *Risk Characterization*

This section characterizes the risks associated with the potential exposure pathways identified for ground water. Section 4.4.5.1 discusses the human health pathways for which intakes were calculated and risks were quantified. Section 4.4.5.2 discusses the risk characterization of the potential exposure of humans to chemicals of concern through the ingestion of fish. Finally, Section 4.4.5.2 characterizes the potential adverse impact to aquatic life from ground water discharges to the Hudson River.

4.4.5.1 *Risk Characterization of Inhalation of Volatiles And Recreational Swimming Exposure pathways*

In the final phase of the risk assessment process, a comparison is made between projected daily intakes and acceptable levels (RfD) for noncarcinogens and between calculated risks and target risks for potential carcinogens. The methodology used is summarized below.

Noncarcinogenic health effects are evaluated by comparing the average daily intake (calculated in Section 4.4.4.3) with the relevant reference dose (RfD). A Hazard Ratio is then calculated for each chemical. The Hazard Ratio is the ratio of expected intake to the reference dose (RfD). This ratio provides a numerical indicator of the difference between acceptable and unacceptable exposure levels. Any single chemical with an exposure level greater than the RfD will result in a Hazard Ratio that exceeds unity (1.0).

A Hazard Ratio greater than 1.0 indicates the possibility of a health hazard to the exposed population. As the value exceeds unity, there exists an increasing likelihood of an adverse response. To assess the overall potential for noncarcinogenic effects posed by multiple chemicals, the Hazard Ratios for all chemicals of concern are summed for each potential exposure pathway. This sum is termed the Hazard Index. The USEPA warns that this can overestimate the potential for adverse effects because not all chemicals induce the same effect by the same mechanism.

For potential carcinogens, risks are estimated as probabilities. The excess cancer risk due to exposure to each chemical for each exposure pathway is estimated as follows:

$$\text{Estimated Increased Lifetime Cancer Risk} = \underset{(mg/kg/day)^{-1}}{\text{PF}} \times \underset{(mg/kg/day)}{\text{Average Daily Intake}}$$

As described in Section 5.0, the potency factor (PF) is a 95% UCL on the probability of response per unit intake of a chemical over a lifetime. EPA uses the general 10^{-4} to 10^{-6} risk range as a "target range" within which the agency strives to manage risks as part of a Superfund cleanup (USEPA, 1989a). An added risk of concern of one in a million (1×10^{-6}) is generally used as the point of departure for calculating risks. The total risk posed by multiple chemicals may be evaluated by summing the risks for all chemicals for each exposure route. In general, EPA considers that remedial action is not warranted if the cumulative carcinogenic risk is less than 10^{-4}.

Tables 4-13 and 4-14 present noncarcinogenic risks and carcinogenic risks, respectively for each of the potential human health exposure pathways for which intakes were calculated in the risk assessment (inhalation of indoor air and surface water swimming). A comparison of these risks to the Hazard Index of 1.0 and the excess lifetime cancer risk range of 10^{-4} to 10^{-6} is discussed in more detail in the following sections.

4.4.5.1.1 *Indoor Air Exposure to On-Site Workers and Any Future Residents*

<u>Noncarcinogenic Effects</u>

Table 4-14 presents the risk calculations for the inhalation of indoor air by on-site commercial workers and possible future residents that may occupy structures built on the private undeveloped property. As shown in this table, the individual Hazard Ratio values for the chemicals of concern for this pathway are well below unity, as is the pathway Hazard Index. Therefore, no adverse impacts to on-site workers or possible future residents would be expected based on noncarcinogenic properties and current concentrations of chemicals in ground water.

Carcinogenic Effects

As shown in Table 4-14, none of the chemicals had an individual carcinogenic risk of greater than 1 x 10^{-6}. The total potential upperbound estimated carcinogenic risk for inhalation by workers and possible future residents of all the chemicals evaluated in indoor air were 1.5 x 10^{-7} and 6 x 10^{-7} , respectively.

The calculated risks to on-site workers and any future residents that may occupy structures built on the private undeveloped property arising from volatilization from ground water to indoor air are below the target range of 10^{-4} to 10^{-6} for carcinogens and the Hazard Index of 1.0 for noncarcinogens. Therefore, there is no need to assess further any risks associated with exposure to volatiles in outdoor air.

4.4.5.1.2 *Recreational Exposure to Surface Water*

Two routes of exposure were evaluated in this exposure pathway: dermal contact and incidental ingestion. The estimated risks for each route of exposure are considered separately and then together for a total pathway evaluation.

Noncarcinogenic Effects

Both the individual Hazard Indices for dermal contact and incidental ingestion and the total Hazard Index for the swimming exposure pathway are provided in Table 4-14. As can be seen from the table, all of the Hazard Quotients and the Hazard Indices are below unity. As well, if the Hazard Indices for each route of exposure are combined, the total surface water swimming pathway Hazard Index is also below 1.0 (approximately 1.0×10^{-2}). Therefore, no adverse noncarcinogenic impacts to recreational users of the Hudson River are expected to occur as a result of contact with ground water from OU-II that has discharged to surface water.

Carcinogenic Effects

As shown in Table 4-15, the total upperbound estimated risk for dermal contact and incidental ingestion, considering the chemicals individually as well as collectively, is below 1.0×10^{-6}. The total excess lifetime cancer risk associated with surface water swimming pathway (both dermal contact and incidental ingestion) is 7.9×10^{-8}. Therefore, no unacceptable risks to recreational users are expected to occur as a result of contact with ground water that has discharged to surface water based on the potential carcinogenic properties of chemicals.

4.4.5.1.3 *Summary*

As previously noted, the risks calculated for the pathways evaluated did not exceed the target range of 10^{-4} to 10^{-6} for carcinogens or a Hazard Index of 1.0 for noncarcinogens. In this section, the risks from all pathways combined will be estimated. Table 4-14 provides a summation of all Hazard Indexes from the pertinent exposure pathways. The total Hazard Index was 3.3×10^{-2}, still well below unity. Therefore, it does not appear that adverse noncarcinogenic effects are a concern even if an individual was both a future resident and a recreational swimmer, although the exposure parameters for these potential receptors overlap making the summation overly conservative and unrealistic.

Table 4-15 evaluates carcinogenic risks across all exposure pathways. Total risks were estimated at $6.8x10^{-7}$. This total estimated cancer risk is still below a 1.0×10^{-6} indicating that risks to an individual who was both a future resident and a recreational swimmer would not be a public health concern, although the exposure parameters for these potential receptors overlap making the summation overly conservative and unrealistic.

4.4.5.2 *Risk Characterization of Human Consumption of Fish*

Because the degree of bioaccumulation in fish is difficult to measure, a specific exposure scenario was not developed to evaluate this pathway of exposure. Instead, the US Ambient Water Quality Standards (AWQS) (USEPA, 1992a) are used to evaluate the potential adverse impacts associated with ingestion of fish from surface water that has received ground water from the former lagoon.

There are no NYSDEC Surface Water Quality Standards for the evaluation of human ingestion of aquatic organisms. All thirteen chemicals of concern identified in Section 4.4.2.1 are evaluated for this exposure scenario. The Hudson River in the vicinity of Harmon Yard is classified as SB by NYSDEC. As discussed earlier, SB waters are suitable for primary and secondary contact recreation and fishing as well as fish propagation and survival. For the purpose of this evaluation, predicted surface water concentrations are compared to the human health criteria based on the consumption of aquatic organisms only since the water is not used for drinking.

Table 4-11 compares the surface water exposure point concentrations to the AWQC. As shown in Table 4-11, the surface water concentrations for the chemicals of concern are well below the standards. Based on the information presented in this section, no adverse impacts to humans from ingestion of fish are expected to result from chemicals in OU-II ground water discharging to surface water.

4.4.5.3 *Risk Characterization of Potential Impacts to Aquatic Life*

The potential impacts to aquatic life from ground water discharging to the Hudson River was evaluated by comparing the predicted surface water exposure point concentrations to the NYSDEC Surface Water Quality Criteria (SWQS) (NYSDEC, 1993b) for the protection of aquatic life. For the purposes of this assessment, the appropriate SWQS were the Class SB Salt Water Chronic and Acute Standards for impacts to aquatic life. Class A Fresh Water Chronic and Acute Standards were used when Class SB Standards were not available.

The results of the comparison between exposure point concentrations and SWQS are presented in Table 4-12. As shown in Table 4-12, the predicted surface water concentrations are well below the standards. Therefore, no adverse impacts to aquatic life are expected to result from chemicals in ground water discharging to surface water.

4.4.6 *Uncertainty*

The carcinogenic and noncarcinogenic risk estimates presented in this report are not intended to be calculations of absolute risk to individuals who reside near or frequent the Harman Railroad yard. Uncertainties in the risk assessment data prevent exact determination of risk to receptor populations. The goal of the risk assessment is provide reasonable, conservative risk estimates to guide decision-making. By using standardized methodology guidelines, in particular, Risk Assessment Guidance for Superfund (RAGS) (USEPA, 1989a), and standardized default exposure factors provided in EPA (1991a) risk assessments for Superfund sites provided a basis for determining whether remediation needs to be considered.

Risk is a function of exposure and toxicity. Therefore, uncertainties in characterizing either of these lead to uncertainties in risk estimates.

Toxicological data used in human health risk assessments can be limited. Much of the data used to generate health criteria are derived from animal studies. Uncertainties result given that:

- Both endpoints of toxicity (effect or target organ) and the does at which effect are observed are extrapolated from animals to humans;
- Results of short-term exposure studies are used to predict the effects of long-term exposures;
- Results of studies using high doses are used to predict effects from exposures to low doses usually expected at hazardous water sites; and

- Effects exhibited by homogeneous populations of animals (or humans) are used to predict effect in heterogeneous populations with variable sensitivities (the young, elderly, or infirm).

EPA and other regulator agencies attempt to account for these sources of uncertainty by including uncertainty factors in the determination of health criteria such as RfDs. In addition, the weight of evidence for carcinogenic effects are specified for each classified carcinogen. These qualifiers have been discussed in the Toxicity chapter, Section 4.4.4, of this report.

While their are many uncertainties associated with the risk assessment process, some uncertainties particular to this analysis are identified below.

4.4.6.1 *Toxicity Factors*

Risks are calculated for dermal exposure to surface water through recreational swimming. Most toxicity factors are based on an administered (oral) dose for use with exposures estimated as intakes. However, dermal exposures are estimated as absorbed doses so the toxicity factors must also be expressed as absorbed doses. Therefore, for certain chemicals, it is necessary in the risk characterization step to ensure that the Site exposure estimate and the toxicity value for comparison are both expressed as absorbed doses or both expressed as intakes.

In the absence of any information on absorption of the substance, RAGs recommends assuming an oral absorption efficiency. The oral absorption efficiency is then used to calculate the absorbed dose. For noncarcinogens, the oral absorption efficiency is multiplied by the oral RfD. For carcinogens, the oral absorption efficiency is divided by the potency factor to find the absorbed dose. For chemicals for which oral absorption efficiencies were not available, a relatively conservative assumption of five percent was used to estimate the absorbed doses. (USEPA, 1989a)

Use of a five percent oral absorption efficiency for all chemicals resulted in an overly conservative estimate of dermal absorption for the chemicals of concern at the Site. This is especially true for the organic chemicals of concern for which absorption is likely close to complete. Therefore, the calculated risks associated with dermal exposure to ground water would be lower if actual information were available on the absorption efficiencies of the chemicals of concern.

4.4.6.2 Risk Characterization

Chemical-specific risks are generally assumed to be additive. This oversimplifies the fact that some chemicals are thought to act synergistically (1+1>2) while others act antagonistically (1+1<2). The overall effect of these mechanisms on multi-chemical, multi-media risk estimates is difficult to determine by the effects are usually assumed to balance. In this risk assessment, the potential risks for any future residential exposure and the recreational swimming exposure were summed to present a total risk to a potential future resident of the private undeveloped property who would also swim regularly in the Hudson River near Croton Point. Summing these two exposure results in an overly conservative representation of potential risks associated with ground water because some of the exposure factors overlap resulting in double exposure which are not possible. For example, a resident could not be occupying a residential structure for 350 days per year, 24 hours per day, and also swimming in the Hudson River during those hours.

4.4.7 *Conclusions*

The baseline risk assessment of ground water in the area of the former lagoon evaluated four potential pathways for exposure to human health and the environment. These pathways included:

- inhalation of volatilized chemicals in indoor air (commercial and industrial worker exposure pathways: Metro-North employees and any future residents: private undeveloped property);
- discharge of ground water to surface water and direct contact with recreational swimmers;
- discharge of ground water to surface water and human ingestion of fish; and
- discharge of ground water to surface water and impacts to aquatic life.

The risk assessment indicates chemicals of concern in ground water represent an excess lifetime cancer risk below the 10^{-4} to 10^{-6} target range for carcinogens and below the acceptable Hazard Index of 1.0 for noncarcinogens. Moreover, the risk assessment concludes that ground water discharges to surface water (Hudson River) will not adversely impact the environment. These conclusions apply to both current and future use, based upon current site conditions.

It should be acknowledged that in completing this risk assessment many assumptions were made which contributes a degree of uncertainty to the risk assessment. However, in making these assumptions, conservative estimates were used (e.g., exposure parameters). In addition, there are also inherent uncertainties in toxicity data (e.g., toxicological data being extrapolated from animals to humans and short-term exposure studies to predict the effects of long-term exposure).

The US EPA has built in several safety factors in establishing cancer potency factors, reference doses, and models for assessing lifetime risk. These safety factors are designed to be protective of public health, even sensitive sub-populations. Thus, the estimated risks calculated in risk assessments tend to be overestimated rather than underestimated, thereby considered conservative in terms of public health.

TABLES

Table 1-1
Milestones of the OU-I Remedial Action
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Date	Action
10 March 1993	Pre-Design Test Boring Work Plan submitted to NYSDEC
15 April 1993	Final draft of the Remedial Design Work Plan submitted to NYSDEC
23 June 1993	Final Remedial Design Work Plan submitted to NYSDEC
11 August 1993	Sampling and Decommissioning Plan for the Old Wastewater Treatment Plant submitted to NYSDEC
8 November 1993	Preliminary Design submitted to NYSDEC
18 January 1994	Pre-Design Test Boring Data Summary Report submitted to NYSDEC
25 February 1994	Decommissioning and Demolition Plan for the Old Wastewater Treatment Plant submitted to NYSDEC
8 March 1994	Proposed Remedial Approach for the lagoon component of OU-I submitted to NYSDEC
29 April 1994	Pre-Final Design (90% complete) documents submitted to NYSDEC
July and August 1994	Final Design (100% complete) submitted to NYSDEC
August and September 1994	Bids solicited for Site remediation and Sludge Incineration Contracts
December 1994	Construction contracts for OU-I awarded
29 April 1996	Substantial Completion of the OU-I remediation
May 1996	Final inspection and completion of the OU-I remediation

Table 2-1
Monitoring Wells Installed for NAPL Investigation
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Test Boring/ Monitoring Well No.	Temporary Well No.	Date Installed	Split-Spoon Samples Collected?	Protective Casing Installed?	Date Monitored	NAPL Detected?	Abandoned or Permanent
TB-1		12/1/94	Yes	No	1/18/95	Yes	Abandoned
	TB-1-1A	12/20/94	No	No	1/18/95	Yes	Abandoned
	TB-1-1A1	12/21/94	No	No	1/18/95	Yes	Abandoned
	TB-1-1A1A	1/3/95	No	Yes	1/18/95	Yes	Permanent
	TB-1-1A1B	1/5/95	No	No	1/18/95	No	Abandoned
	TB-1-2A	12/19/94	No	No	1/18/95	Yes	Abandoned
	TB-1-2B	12/20/94	No	No	1/18/95	Yes	Abandoned
	TB-1-2C	12/20/94	No	No	1/18/95	Yes	Abandoned
	TB-1-2D	12/20/94	No	No	1/18/95	Yes	Abandoned
	TB-1-2D1	12/21/94	No	No	1/18/95	Yes	Abandoned
	TB-1-2D2	12/21/94	No	No	1/18/95	Yes	Abandoned
	TB-1-2D2A	12/22/94	No	Yes	1/18/95	Yes	Permanent
	TB-1-2D2B	12/22/94	No	Yes	1/18/95	No	Permanent
	TB-1-3A	12/19/94	No	No	1/18/95	No	Abandoned
	TB-1-4A	12/20/94	No	No	1/18/95	No	Abandoned
TB-2		12/1/95	Yes	No	1/18/95	No	Abandoned
TB-3		12/2/95	Yes	No	1/18/95	No	Abandoned
TB-4		12/7/95	Yes	No	1/18/95	No	Abandoned
TB-5		12/7/95	Yes	No	1/18/95	No	Abandoned
TB-6		12/7/94	Yes	Yes	1/18/95	Yes	Permanent
	TB-6-1A	12/12/94	No	No	1/18/95	Yes	Abandoned
	TB-6-1B	12/13/94	No	No	1/18/95	Yes	Abandoned
	TB-6-1B1	12/14/94	No	Yes	1/18/95	Yes	Permanent
	TB-6-1B1A	12/15/94	No	No	1/18/95	No	Abandoned
	TB-6-1B1B	12/15/94	No	Yes	1/18/95	Yes	Permanent
	TB-6-1B1B1	12/22/94	No	Yes	1/18/95	No	Permanent
	TB-6-1C	12/14/94	No	No	1/18/95	No	Abandoned
	TB-6-2A	12/13/94	No	No	1/18/95	Yes	Abandoned
	TB-6-3A	12/13/94	No	Yes	1/18/95	No	Permanent
WB-2		(1)		Yes	1/18/95	Yes	Permanent
	WB-2-1A	11/22/94	Yes	No	1/18/95	Yes	Permanent
	WB-2-1B	12/8/94	No	No	1/18/95	No	Permanent
	WB-2-1B1	1/3/95	No	No	1/18/95	No	Abandoned
	WB-2-1C	12/9/94	No	No	1/18/95	No	Abandoned
	WB-2-2A	11/22/94	No	No	1/18/95	Yes	Permanent
	WB-2-2B	12/9/94	No	No	1/18/95	No	Abandoned
	WB-2-2C	12/9/94	No	No	1/18/95	No	Abandoned
	WB-2-3A	11/22/94	Yes	No	1/18/95	No	Abandoned
	WB-2-3A1	12/12/94	No	No	1/18/95	No	Permanent

Table 2-1
Monitoring Wells Installed for NAPL Investigation
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Test Boring/ Monitoring Well No.	Temporary Well No.	Date Installed	Split-Spoon Samples Collected?	Protective Casing Installed?	Date Monitored	NAPL Detected?	Abandoned or Permanent
	WB-2-4A	11/23/94	Yes	No	1/18/95	Yes	Abandoned
	WB-2-4B	12/12/94	No	No	1/18/95	No	Permanent
WB-4		(1)		Yes	1/18/95	Yes	Permanent
	WB-4-1A	11/29/94	Yes	Yes	1/18/95	Yes	Permanent
	WB-4-2A	11/29/94	Yes	No	1/18/95	Yes	Abandoned
	WB-4-3A	11/29/94	Yes	No	1/18/95	No	Abandoned
	WB-4-4A	11/30/94	Yes	Yes	1/18/95	Yes	Permanent
	WB-4-4B	12/8/94	No	Yes	1/18/95	Yes	Permanent
	WB-4-4C	12/8/94	No	No	1/18/95	No	Abandoned
	WB-4-4D	12/8/94	No	No	1/18/95	No	Abandoned
WB-5		(1)		Yes	1/18/95	Yes	Permanent
	WB-5-1A	11/28/94	Yes	Yes	1/18/95	Yes	Permanent
	WB-5-1A1	1/6/95	No	No	1/18/95	No	Abandoned
	WB-5-2A	12/6/94	Yes	No	1/18/95	Yes	Abandoned
	WB-5-2B	12/15/94	No	No	1/18/95	No	Abandoned
	WB-5-3A	12/6/94	Yes	No	1/18/95	Yes	Abandoned
	WB-5-3B	12/12/94	No	No	1/18/95	No	Abandoned
	WB-5-3B1	12/13/94	No	No	1/18/95	Yes	Abandoned
	WB-5-3B2	12/13/94	No	Yes	1/18/95	Yes	Permanent
	WB-5-3B3	12/14/94	No	No	1/18/95	No	Abandoned
	WB-5-3C	12/12/94	No	No	1/18/95	Yes	Abandoned
	WB-5-3C1	12/14/94	No	Yes	1/18/95	Yes	Permanent
	WB-5-3E	12/14/94	No	No	1/18/95	Yes	Abandoned
	WB-5-4A	12/6/94	Yes	No	1/18/95	Yes	Abandoned
WB-6E		2/7/96	No	Yes	6/24/96	Yes	Permanent
WB-9		(1)		Yes	1/18/95	Yes	Permanent
	WB-9-1A	11/30/94	Yes	No	1/18/95	Yes	Permanent
	WB-9-1B	12/15/94	No	No	1/18/95	No	Abandoned
	WB-9-1C	12/16/94	No	No	1/18/95	No	Abandoned
	WB-9-2A	12/1/94	Yes	No	1/18/95	No	Permanent
	WB-9-3A	12/1/94	Yes	No	1/18/95	Yes	Abandoned
	WB-9-3B	12/16/94	No	No	1/18/95	Yes	Abandoned
	WB-9-3C	12/16/94	No	No	1/18/95	Yes	Abandoned
	WB-9-3C1	1/5/95	No	No	1/18/95	Yes	Permanent
	WB-9-3C2	1/6/95	No	No	1/18/95	Yes	Permanent
	WB-9-3C2A	2/7/96	No	Yes	6/24/96	Yes	Permanent
	WB-9-4A	2/7/96	No	Yes	6/24/96	Yes	Permanent
	WB-9-FC-1	2/7/96	No	Yes	6/24/96	Yes	Permanent
OS-A		2/6/96	No	Yes	6/24/96	No	Permanent
OS-B		2/6/96	No	Yes	6/24/96	Yes	Permanent

Table 2-1
Monitoring Wells Installed for NAPL Investigation
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Test Boring/ Monitoring Well No.	Temporary Well No.	Date Installed	Split-Spoon Samples Collected?	Protective Casing Installed?	Date Monitored	NAPL Detected?	Abandoned or Permanent
OS-C		2/6/96	No	Yes	6/24/96	Yes	Permanent
OS-D		2/6/96	No	Yes	6/24/96	Yes	Permanent
OS-E		2/6/96	No	Yes	6/24/96	Yes	Permanent
OS-F		2/6/96	No	Yes	6/24/96	Yes	Permanent
OS-FS		2/7/96	No	Yes	6/24/96	No	Permanent
OS-G		2/6/96	No	Yes	6/24/96	No	Permanent
OS-H		2/6/96	No	Yes	6/24/96	No	Permanent
OS-I		4/30/96	No	Yes	6/24/96	No	Permanent
OS-J		4/30/96	No	Yes	6/24/96	No	Permanent
OS-K		4/30/96	No	Yes	6/24/96	No	Permanent
OS-L		4/30/96	No	Yes	6/24/96	No	Permanent
OS-M		5/1/96	No	Yes	6/24/96	No	Permanent
OS-N		5/1/96	No	Yes	6/24/96	No	Permanent
OS-O		5/1/96	No	Yes	6/24/96	Yes	Permanent

Notes:
(1) Wells installed by Fred C. Hart Inc. as part of Harmon Lagoon Remedial Investigation (Fred C. Hart,Inc., 1989).

Table 2-2
TPH Results for Temporary Borings
Harmon Railroad Yard Wastewtaer Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	NAPL Area	Date Analyzed	Sampling Interval (ft.)	Color	Result (1) (ppm)
WB-2-1A	L3	11/22/94	7-9	Black	>750
			9-11	Black	>750
			11-13	White with slight brown tint.	50
WB-2-2A	L3	11/22/94	9-11	Black	>750
			11-13	White with slight brown tint.	50
WB-2-3A	L3	11/22/94	7-9	Medium brown	750
			9-11	Black	>750
			11-13	Black	>750
WB-2-4A	L3	11/23/94	5 (2)	White	0
			10 (2)	Black	>750
			15 (2)	Pale gray	NR
WB-4-1A	L2	11/29/94	3-5	Dark brown	750
			5-7	Dark gray	>750
			11-13	White	0
			13-15	White	0
WB-4-2A	L2	11/29/94	3-5	White with slight brown tint	50
			5-7	Brown	500
			9-11	Dark brown	750
			11-13	Dark brown	750
WB-4-3A	L2	11/29/96	5-7	White	0
			7-9	NR	NR
			9-11	Brown	500
WB-4-4A	L2	11/30/94	3-5	Reddish brown	>750
			7-9	White	0
			9-11	Light brown	250
			11-13	Black with purple hue	>750
WB-5-1A	L4	11/28/94	7-9	Black	>750
			9-11	Light brown	100 (3)
			11-13	White with slight brown tint	50 (3)
WB-5-2A	L4	12/5/94	3-5	White	0
			7-9	Black with purple hue	>750
			9-11	Light brown	100
			11-13	Medium light brown	250

Table 2-2
TPH Results for Temporary Borings
Harmon Railroad Yard Wastewtaer Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	NAPL Area	Date Analyzed	Sampling Interval (ft.)	Color	Result (1) (ppm)
WB-5-3A	L4	12/5/94	3-5	Very dark brown	>750
			5-7	Black with purple hue	>750
			7-9	Dark brown	750
WB-5-4A	L4	12/5/94	3-5	Dark brown	>750
			5-7	Black	>750
			7-9	Black	>750
			11-13	Black	>750
			13-15	Light brown	50
WB-9-1A	L1	11/30/94	1-3	Medium brown	500
			3-5	Dark brown	750
			7-9	Medium brown	500
WB-9-2A	L1	12/1/94	3-5	Medium brown	500
			5-7	Dark gray	>750
			7-9	Black	>750
WB-9-3A	L1	12/1/94	3-5	Light brown	250
			5-7	Light to medium brown	250-500
			7-9	Black	>750
TB-1	L1	12/1/94	7-9	NR	NR
TB-2		12/1/94	NR	NR	NR
TB-3		12/2/94	3-5	White	0
			5-7	Black with reddish hue	>750
			7-9	Dark gray	>750
TB-4	L4	12/7/95	3-5	Black	>750
			5-7	Dark brown	>750
			7-9	Black with purplish red hue	>750
TB-6	L4	12/7/94	1-3	White	0
			7-9	Black	>750
			11-13	White with light brown tint	50

Notes:

(1) Hanby test results are approximate concentrations and are prone to subjective interpretation.

(2) Samples collected from cuttings. Depths are approximate.

(3) Presence of water in sample may be diluting solutions, Hanby results may not be indicative of actual concentrations.

NR - Not Recorded

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
On-Site Wells						
WB-2	12/2/94	19.06	13.60	12.58	6.48	1.02
WB-2	12/9/94	19.06	13.11	12.47	6.59	0.64
WB-2	12/16/94	19.06	13.10	12.35	6.71	0.75
WB-2	12/21/94	19.06	13.34	12.44	6.62	0.90
WB-2	1/3/95	19.06	13.60	12.62	6.44	0.98
WB-2	1/12/95	19.06	13.54	12.52	6.54	1.02
WB-2	1/18/95	19.06	13.75	12.57	6.49	1.18
WB-2	6/3/96	19.06	13.59	12.52	6.54	1.07
WB-2	6/10/96	19.06	13.02	12.01	7.05	1.01
WB-2	6/24/96	19.06	12.80	11.93	7.13	0.87
WB2-1A	11/23/94	20.41	14.46			
WB2-1A	11/29/94	20.41	14.88	14.14	6.27	0.74
WB2-1A	12/2/94	20.41	14.56	14.02	6.39	0.54
WB2-1A	12/9/94	20.41	14.48	13.90	6.51	0.58
WB2-1A	12/14/94	20.41	14.22	13.80	6.61	0.42
WB2-1A	12/16/94	20.41	14.35	13.78	6.63	0.57
WB2-1A	12/21/94	20.41	14.81	13.86	6.55	0.95
WB2-1A	1/3/95	20.41	15.19	13.98	6.43	1.21
WB2-1A	1/12/95	20.41	15.06	13.95	6.46	1.11
WB2-1A	1/18/95	20.41	15.03	13.99	6.42	1.04
WB2-1A	6/3/96	20.41	15.12	14.02	6.39	1.10
WB2-1A	6/10/96	20.41	14.44	13.41	7.00	1.03
WB2-1A	6/24/96	20.41	14.23	13.35	7.06	0.88
WB2-1B	12/9/94	20.55	14.11			
WB2-1B	12/14/94	20.55	14.04			
WB2-1B	12/16/94	20.55	13.98			
WB2-1B	12/21/94	20.55	14.14	14.08	6.47	0.06
WB2-1B	1/3/95	20.55	14.29			
WB2-1B	1/12/95	20.55	14.20			
WB2-1B	1/18/95	20.55	14.25			
WB2-1B	6/3/96	20.55	14.32			
WB2-1B	6/10/96	20.55	10.68	10.66	9.89	0.02
WB2-1B	6/24/96	20.55	10.63	10.56	9.99	0.07
WB2-2A	11/23/94	19.83	13.83			
WB2-2A	11/29/94	19.83	13.60	13.58	6.25	0.02
WB2-2A	12/2/94	19.83	13.48	13.46	6.37	0.02
WB2-2A	12/9/94	19.83	13.43	13.31	6.52	0.12
WB2-2A	12/14/94	19.83	13.42	13.21	6.62	0.21
WB2-2A	12/16/94	19.83	13.50	13.20	6.63	0.30
WB2-2A	12/21/94	19.83	13.75	13.29	6.54	0.46
WB2-2A	1/3/95	19.83	14.02	13.46	6.37	0.56
WB2-2A	1/12/95	19.83	13.81	13.40	6.43	0.41
WB2-2A	1/18/95	19.83	13.89	13.46	6.37	0.43
WB2-2A	6/10/96	19.83	13.46	12.87	6.96	0.59
WB2-2A	6/24/96	19.83	13.28	12.80	7.03	0.48
WB2-3A1	12/14/94	18.96	12.40			
WB2-3A1	12/21/94	18.96	12.46			
WB2-3A1	1/3/95	18.96	12.65			
WB2-3A1	1/12/95	18.96	12.61			
WB2-3A1	1/18/95	18.96	12.64			

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
WB2-3A1	2/20/95	18.96	13.96	12.70	6.26	1.26
WB2-3A1	6/3/96	18.96	13.02	12.65	6.31	0.37
WB2-3A1	6/10/96	18.96	13.22	11.98	6.98	1.24
WB2-3A1	6/24/96	18.96	12.87	11.92	7.04	0.95
WB2-4A	11/29/94	19.84	13.60			
WB2-4A	12/2/94	19.84	13.49	13.47	6.37	0.02
WB2-4A	12/9/94	19.84	13.70	13.31	6.53	0.39
WB2-4A	12/14/94	19.84	13.58	13.25	6.59	0.33
WB2-4A	12/16/94	19.84	13.70	13.21	6.63	0.49
WB2-4A	12/21/94	19.84	14.05	13.31	6.53	0.74
WB2-4A	1/3/95	19.84	14.17	13.46	6.38	0.71
WB2-4A	1/12/95	19.84	14.01	13.40	6.44	0.61
WB2-4A	1/18/95	19.84	14.10	13.44	6.40	0.66
WB2-4A	2/20/95	19.84	14.52	13.59	6.25	0.93
WB2-4B	12/14/94	17.33	10.77			
WB2-4B	12/16/94	17.33	10.76			
WB2-4B	12/21/94	17.33	10.85			
WB2-4B	1/3/95	17.33	11.03			
WB2-4B	1/12/95	17.33	10.98			
WB2-4B	1/18/95	17.33	11.01			
WB2-4B	2/20/95	17.33	11.23	11.18		0.05
WB2-4B	6/10/96	17.33	COULD NOT LOCATE			
WB2-4B	6/24/96	17.33	NOT GAUGED			
WB-4	12/2/94	18.88	13.29	12.45	6.43	0.84
WB-4	12/9/94	18.88	13.31	12.40	6.48	0.91
WB-4	12/14/94	18.88	13.05	12.21	6.67	0.84
WB-4	12/16/94	18.88	13.02	12.20	6.68	0.82
WB-4	12/21/94	18.88	13.09	12.32	6.56	0.77
WB-4	1/3/95	18.88	13.15	12.50	6.38	0.65
After Product Baildown Test	1/12/95	18.88	12.73	12.51	6.37	0.22
WB-4	1/18/95	18.88	12.60	12.50	6.38	0.10
WB-4	6/3/96	18.88	12.63	12.51	6.37	0.12
WB-4	6/10/96	18.88	NOT GAUGED			
WB-4	6/24/96	18.88	NOT GAUGED			
WB4-2A	12/2/94	19.05	12.72			
WB4-2A	12/9/94	19.05	13.64			
WB4-2A	12/16/94	19.05	12.50			
WB4-2A	12/21/94	19.05	12.60			
WB4-2A	1/3/95	19.05	12.75	12.73	6.32	0.02
WB4-2A	1/12/95	19.05	12.73	12.71	6.34	0.02
WB4-2A	1/18/95	19.05	12.70	12.68	6.37	0.02
WB4-4A	12/2/94	20.24	13.98	13.97	6.27	0.01
WB4-4A	12/9/94	20.24	13.79			
WB4-4A	12/14/94	20.24	13.73	13.63	6.61	0.10
WB4-4A	12/16/94	20.24	13.72	13.65	6.59	0.07
WB4-4A	12/21/94	20.24	14.15	13.81	6.43	0.34
WB4-4A	1/3/95	20.24	14.35	13.87	6.37	0.48
WB4-4A	1/18/95	20.24	14.30	13.84	6.40	0.46
WB4-4A	6/3/96	20.24	14.29	13.79	6.45	0.50

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
WB4-4A	6/10/96	20.24	WELL NOT LOCATED			
WB4-4A	6/24/96	20.24	WELL NOT LOCATED			
WB4-4B	12/8/94	20.66	14.25			
WB4-4B	12/9/94	20.66	14.22			
WB4-4B	12/14/94	20.66	14.50	SHEEN		
WB4-4B	12/16/94	20.66	14.03			
WB4-4B	12/21/94	20.66	14.20	14.19	6.47	0.01
WB4-4B	1/3/95	20.66	14.35	14.32	6.34	0.03
WB4-4B	1/12/95	20.66	14.33	14.30	6.36	0.03
WB4-4B	1/18/95	20.66	14.31	14.27	6.39	0.04
WB4-4B	6/3/96	20.66	14.48	14.45	6.21	0.03
WB4-4B	6/10/96	20.66	WELL NOT LOCATED			
WB4-4B	6/24/96	20.66	WELL NOT LOCATED			
WB-5	12/2/94	17.65	11.76	11.16	6.49	0.60
WB-5	12/9/94	17.65	11.61	10.94	6.71	0.67
WB-5	12/16/94	17.65	11.97	11.17	6.48	0.80
WB-5	12/22/94	17.65	12.51	10.98	6.67	1.53
WB-5	1/6/95	17.65	12.47	11.17	6.48	1.30
WB-5	1/11/95	17.65	12.21	11.08	6.57	1.13
WB-5	1/18/95	17.65	12.22	10.99	6.66	1.23
WB-5	6/3/96	17.65	COULD NOT GAUGE			
WB-5	6/10/96	17.65	COULD NOT GAUGE, WELL BROKEN			
WB5-1A	11/29/94	18.75	12.20			
WB5-1A	12/2/94	18.75	11.99			
WB5-1A	12/6/94	18.75	12.02			
WB5-1A	12/9/94	18.75	11.91			
WB5-1A	12/14/94	18.75	11.88			
WB5-1A	12/16/94	18.75	11.95			
WB5-1A	12/22/94	18.75	12.10	12.07	6.68	0.03
WB5-1A	1/6/95	18.75	13.11	12.16	6.59	0.95
WB5-1A	1/12/95	18.75	13.10	12.12	6.63	0.98
WB5-1A	1/18/95	18.75	13.22	12.06	6.69	1.16
WB5-1A	6/3/96	15.96	10.18	9.02	6.94	1.16
WB5-1A	6/10/96	15.96	9.36	8.71	7.25	0.65
WB5-1A	6/24/96	15.96	9.25	8.48	7.48	0.77
WB5-1A1	1/12/95	17.59	11.05			
WB5-1A1	1/18/95	17.59	11.03			
WB5-1A1	2/20/95	17.59	12.57	11.21	6.38	1.36
WB5-2A	12/6/94	18.11	11.45			
WB5-2A	12/9/94	18.11	11.78	11.27	6.84	0.51
WB5-2A	12/14/94	18.11	11.98	11.20	6.91	0.78
WB5-2A	12/16/94	18.11	12.38	11.23	6.88	1.15
WB5-2A	12/22/94	18.11	12.76	11.38	6.73	1.38
WB5-2A	1/6/95	18.11	12.73	11.60	6.51	1.13
WB5-2A	1/12/95	18.11	12.62	11.52	6.59	1.10
WB5-2A	1/18/95	18.11	13.20	11.45	6.66	1.75
WB5-2A	2/20/95	18.11	13.35	11.72	6.39	1.63
WB5-3A	12/6/94	17.31	10.52			
WB5-3A	12/9/94	17.31	11.11	10.50	6.81	0.61

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
WB5-3A	12/14/94	17.31	11.53	10.39	6.92	1.14
WB5-3A	12/16/94	17.31	11.73	10.46	6.85	1.27
WB5-3A	12/22/94	17.31	12.16	10.61	6.70	1.55
WB5-3A	1/6/95	17.31	12.20	10.75	6.56	1.45
WB5-3A	1/12/95	17.31	12.03	10.71	6.60	1.32
WB5-3A	1/18/95	17.31	11.98	10.73	6.58	1.25
WB5-3A	2/20/95	17.31	12.50	10.97	6.34	1.53
WB5-3B	12/14/94	14.40	8.69	7.38	7.02	1.31
WB5-3B	12/16/94	14.40	8.87	7.55	6.85	1.32
WB5-3B	12/22/94	14.40	9.35	7.76	6.64	1.59
WB5-3B	1/6/95	14.40	9.22	7.87	6.53	1.35
WB5-3B	1/12/95	14.40	9.15	7.84	6.56	1.31
WB5-3B	1/18/95	14.40	9.15	7.85	6.55	1.30
WB5-3B	2/20/95	14.40	8.17	8.12	6.28	0.05
WB5-3B1	12/14/94	16.72	10.06			
WB5-3B1	12/16/94	16.72	10.70	10.00	6.72	0.70
WB5-3B1	12/22/94	16.72	11.64	10.12	6.60	1.52
WB5-3B1	1/6/95	16.72	11.70	10.23	6.49	1.47
WB5-3B1	1/12/95	16.72	11.60	10.15	6.57	1.45
WB5-3B1	1/18/95	16.72	11.45	10.24	6.48	1.21
WB5-3B1	2/20/95	16.72	12.58	10.24	6.48	2.34
WB5-3B2	12/14/94	15.66	8.93			
WB5-3B2	12/16/94	15.66	8.97	8.96	6.70	0.01
WB5-3B2	12/22/94	15.66	9.18			
WB5-3B2	1/6/95	15.66	9.44	9.30	6.36	0.14
WB5-3B2	1/12/95	15.66	9.35	9.21	6.45	0.14
WB5-3B2	1/18/95	15.66	9.49	9.21	6.45	0.28
WB5-3B2	6/10/96	17.99	CASING BENT			
WB5-3C	12/14/94	15.07	9.37	8.16	6.91	1.21
WB5-3C	12/16/94	15.07	9.68	8.21	6.86	1.47
WB5-3C	1/6/95	15.07	10.29	8.52	6.55	1.77
WB5-3C	1/12/95	15.07	10.13	8.52	6.55	1.61
WB5-3C	1/18/95	15.07	10.14	8.43	6.64	1.71
WB5-3C	2/20/95	15.07	10.88	8.66	6.41	2.22
WB5-3C1	12/14/94	14.93	8.11			
WB5-3C1	12/16/94	14.93	9.22	8.11	6.82	1.11
WB5-3C1	12/22/94	14.93	10.15	8.22	6.71	1.93
WB5-3C1	1/6/95	14.93	10.05	8.40	6.53	1.65
WB5-3C1	1/12/95	14.93	10.05	8.33	6.60	1.72
WB5-3C1	1/18/95	14.93	9.76	8.30	6.63	1.46
WB5-3C1	6/3/96	13.13	6.72	6.27	6.86	0.45
WB5-3C1	6/10/96	13.13	6.93	6.00	7.13	0.93
WB5-3C1	6/24/96	13.13	7.12	5.83	7.30	1.29
WB5-3E	12/16/94	16.45	9.72	9.67	6.78	0.05
WB5-3E	1/6/95	16.45	11.30	9.89	6.56	1.41
WB5-3E	1/18/95	16.45	10.76	9.80	6.65	0.96
WB5-3E	2/20/95	16.45	11.89	10.05	6.40	1.84
WB5-4A	12/6/94	18.81	12.22			

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
WB5-4A	12/9/94	18.81	12.11			
WB5-4A	12/14/94	18.81	12.05			
WB5-4A	12/16/94	18.81	12.10			
WB5-4A	12/22/94	18.81	12.25			
WB5-4A	1/6/95	18.81	12.82	12.36	6.45	0.46
WB5-4A	1/12/95	18.81	12.99	12.28	6.53	0.71
WB5-4A	1/18/95	18.81	13.50	12.54	6.27	0.96
WB5-4A	2/20/95	18.81	14.26	12.33	6.48	1.93
WB-5D	6/3/96	17.62	12.47	11.17	6.45	1.30
WB-5D	6/10/96	17.62	10.99			
WB-5D	6/24/96	17.62	10.89			
WB-7	6/3/96	12.34	COULD NOT ACCESS			
WB-7	6/10/96	12.34	9.33	5.65	6.69	3.68
WB-7	6/24/96	12.34	9.18	5.52	6.82	3.66
WB-9	12/2/94	13.45	11.58	10.60	2.85	0.98
WB-9	12/9/94	13.45	11.72	10.18	3.27	1.54
WB-9	12/16/94	13.45	12.11	9.61	3.84	2.50
WB-9	12/21/94	13.45	12.11	9.59	3.86	2.52
WB-9	1/3/95	13.45	11.37	9.77	3.68	1.60
WB-9	1/13/95	13.45	11.45	9.82	3.63	1.63
WB-9	1/18/95	13.45	10.70	9.88	3.57	0.82
WB-9	6/3/96	13.45	10.72	9.90	3.55	0.82
WB-9	6/10/96	13.45	10.74	9.77	3.68	0.97
WB-9	6/24/96	13.45	10.49	9.64	3.81	0.85
WB9-1A	12/2/94	14.67	11.90			
WB9-1A	12/9/94	14.67	12.30	11.50	3.17	0.80
WB9-1A	12/14/94	14.67	12.28	10.95	3.72	1.33
WB9-1A	12/16/94	14.67	11.34	10.84	3.83	0.50
WB9-1A	12/21/94	14.67	PDI	10.88	3.79	PDI
WB9-1A	1/3/95	14.67	11.98	11.00	3.67	0.98
WB9-1A	1/13/95	14.67	11.84	11.02	3.65	0.82
WB9-1A	1/18/95	14.67	11.75	11.01	3.66	0.74
WB9-1A	2/20/95	14.67	12.43	11.42	3.25	1.01
WB9-1A	6/10/96	14.67	10.92	10.85	3.82	0.07
WB9-1A	6/24/96	14.67	11.01	10.75	3.92	0.26
WB9-3A	12/2/94	13.52	10.75			
WB9-3A	12/9/94	13.52	10.35			
WB9-3A	12/14/94	13.52	10.72	9.95	3.57	0.77
WB9-3A	12/16/94	13.52	10.63	9.85	3.67	0.78
WB9-3A	12/21/94	13.52	10.98	9.81	3.71	1.17
WB9-3A	1/3/95	13.52	11.07	9.90	3.62	1.17
WB9-3A	1/13/95	13.52	11.08	9.94	3.58	1.14
WB9-3A	1/18/95	13.52	10.14	9.93	3.59	0.21
WB9-3A	2/20/95	13.52	10.26	10.06	3.46	0.20
WB9-3B	12/16/94	15.07	11.26			
WB9-3B	12/21/94	15.07	11.35			
WB9-3B	1/3/95	15.07	11.53	11.46	3.61	0.07
WB9-3B	1/13/95	15.07	11.86	11.50	3.57	0.36
WB9-3B	1/18/95	15.07	11.99	11.48	3.59	0.51

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
WB9-3B	2/20/95	15.07	12.23	11.85	3.22	0.38
WB9-3C	12/16/94	13.30	9.75			
WB9-3C	12/21/94	13.30	9.60			
WB9-3C	1/3/95	13.30	10.06	9.70	3.60	0.36
WB9-3C	1/13/95	13.30	9.95	9.75	3.55	0.20
WB9-3C	1/18/95	13.30	10.03	9.75	3.55	0.28
WB9-3C	2/20/95	13.30	11.41	10.26	3.04	1.15
WB9-3C1	1/5/95	14.40	10.70			
WB9-3C1	1/6/95	14.40	11.01			
WB9-3C1	1/13/95	14.40	10.99			
WB9-3C1	1/18/95	14.40	11.02	11.00	3.40	0.02
WB9-3C1	6/10/96	13.30	7.65	7.34	5.96	0.31
WB9-3C1	6/24/96	13.30	COULD NOT LOCATE			
WB9-3C2	1/5/95	13.45	11.11			
WB9-3C2	1/6/95	13.45	10.95	10.10	3.35	0.85
WB9-3C2	1/13/95	13.45	10.91	10.03	3.42	0.88
WB9-3C2	1/18/95	13.45	10.85	10.02	3.43	0.83
WB9-3C2	6/3/96	13.45	10.80	10.00	3.45	0.80
WB9-3C2	6/24/96	11.41	8.90	8.35	3.06	0.55
WB9-4A	2/7/96	11.64	7.33			
WB9-4A	2/27/96	11.64	10.73		11.64	
WB9-4A	3/19/96	11.64	10.96	10.95	0.69	0.01
WB9-4A	5/1/96	11.64	9.65	9.20	2.44	0.45
WB9-4A	5/8/96	11.64	8.16	7.63	4.01	0.53
WB9-4A	6/3/96	11.64	8.12	7.62	4.02	0.50
WB9-4A	6/10/96	11.64	8.85	8.01	3.63	0.84
WB9-4A	6/24/96	11.64	8.80	7.85	3.79	0.95
WB9-3C-2A	2/7/96	10.90	7.85			
WB9-3C-2A	2/27/96	10.90	9.31	9.30	1.60	0.01
WB9-3C-2A	3/19/96	10.90	10.14	9.51	1.39	0.63
WB9-3C-2A	5/1/96	10.90	7.90	7.49	3.41	0.41
WB9-3C-2A	5/8/96	10.90	7.80	6.88	4.02	0.92
WB9-3C-2A	6/3/96	10.90	DESTROYED			
WB9-3C-2A	6/10/96	10.90	8.25	7.25	3.65	1.00
WB9-3C-2A	6/24/96	10.90	8.25	6.95	3.95	1.30
WB9-FC-1	2/7/96	12.18	8.35			
WB9-FC-1	2/27/96	12.18	11.29	10.60	1.58	0.69
WB9-FC-1	3/19/96	12.18	11.61	10.80	1.38	0.81
WB9-FC-1	5/1/96	12.18	8.73	8.03	4.15	0.70
WB9-FC-1	5/8/96	12.18	8.90	8.19	3.99	0.71
WB9-FC-1	6/3/96	12.18	8.87	8.13	4.05	0.74
WB9-FC-1	6/10/96	12.18	9.42	8.59	3.59	0.83
WB9-FC-1	6/24/96	12.18	9.25	8.45	3.73	0.80
WB-6E	2/7/96	14.18	9.25			
WB-6E	2/27/96	14.18	13.15	12.69	1.49	0.46
WB-6E	3/19/96	14.18	13.50	12.90	1.28	0.60
WB-6E	5/1/96	14.18	9.72	9.60	4.58	0.12
WB-6E	5/8/96	14.18	9.84	9.21	4.97	0.63

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
WB-6E	6/3/96	14.18	COULD NOT LOCATE			
WB-6E	6/10/96	14.18	10.33	9.64	4.54	0.69
WB-6E	6/24/96	14.18	9.96	9.48	4.70	0.48
TB-1	12/2/94	19.46	16.70			
TB-1	12/9/94	19.46	16.70	16.34	3.12	0.36
TB-1	12/14/94	19.46	16.35	15.94	3.52	0.41
TB-1	12/16/94	19.46	16.29	15.86	3.60	0.43
TB-1	12/20/94	19.46	16.36	15.80	3.66	0.56
TB-1	12/21/94	19.46	16.36	15.81	3.65	0.55
TB-1	12/22/94	19.46	16.47	15.81	3.65	0.66
TB-1	1/3/95	19.46	16.46	15.92	3.54	0.54
TB-1	1/13/95	19.46	16.64	15.98	3.48	0.66
TB-1	1/18/95	19.46	16.53	15.96	3.50	0.57
TB1-1A	12/21/94	19.54	16.14	16.10	3.44	0.04
TB1-1A	12/22/94	19.54	16.32	16.08	3.46	0.24
TB1-1A	1/3/95	19.54	16.95	16.14	3.40	0.81
TB1-1A	1/13/95	19.54	17.03	16.08	3.46	0.95
TB1-1A	1/18/95	19.54	16.99	16.16	3.38	0.83
TB1-1A	2/20/95	19.54	17.22	16.99	2.55	0.23
TB1-1A1	12/22/94	17.45	14.81	13.81	3.64	1.00
TB1-1A1	1/3/95	17.45	14.84	13.92	3.53	0.92
TB1-1A1	1/13/95	17.45	14.74	13.95	3.50	0.79
TB1-1A1	1/18/95	17.45	14.70	13.93	3.52	0.77
TB1-1A1	2/20/95	17.45	15.20	14.27	3.18	0.93
TB1-1A1A	1/3/95	14.44	12.46			
TB1-1A1A	1/6/95	14.44	12.18	11.15	3.29	1.03
TB1-1A1A	1/13/95	14.44	12.13	10.98	3.46	1.15
TB1-1A1A	1/18/95	14.44	12.08	10.96	3.48	1.12
TB1-1A1A	6/10/96	12.58	9.25	8.50	4.08	0.75
TB1-1A1A	6/24/96	12.58	8.00	7.48	5.10	0.52
TB1-1A1B	1/5/95	15.64	12.57			
TB1-1A1B	1/6/95	15.64	12.26			
TB1-1A1B	1/13/95	15.64	12.19			
TB1-1A1B	1/18/95	15.64	12.17			
TB1-1A1B	2/20/95	15.64	14.45	12.46	3.18	1.99
TB1-2A	12/20/94	21.36	18.45	17.72	3.64	0.73
TB1-2A	12/21/94	21.36	18.25	17.72	3.64	0.53
TB1-2A	12/22/94	21.36	18.35	17.73	3.63	0.62
TB1-2A	1/3/95	21.36	18.38	17.85	3.51	0.53
TB1-2A	1/13/95	21.36	18.50	17.90	3.46	0.60
TB1-2A	1/18/95	21.36	18.42	17.85	3.51	0.57
TB1-2A	2/20/95	21.36	18.85	18.18	3.18	0.67
TB1-2B	12/21/94	21.81	18.27			
TB1-2B	12/22/94	21.81	18.27			
TB1-2B	1/3/95	21.81	18.58	18.35	3.46	0.23
TB1-2B	1/13/95	21.81	18.92	18.37	3.44	0.55
TB1-2B	1/18/95	21.81	18.92	18.36	3.45	0.56

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
TB1-2D	12/21/94	21.50	18.03	17.94	3.56	0.09
TB1-2D	12/22/94	21.50	18.10	17.97	3.53	0.13
TB1-2D	1/3/95	21.50	18.70	18.00	3.50	0.70
TB1-2D	1/18/95	21.50	NOT GAUGED			
TB1-2D	2/20/95	21.50	18.72	18.36	3.14	0.36
TB1-2D1	12/22/94	22.13	18.50			
TB1-2D1	1/3/95	22.13	19.25	18.61	3.52	0.64
TB1-2D1	1/13/95	22.13	19.24	18.67	3.46	0.57
TB1-2D1	1/18/95	22.13	19.18	18.64	3.49	0.54
TB1-2D1	2/20/95	22.13	19.80	18.96	3.17	0.84
TB1-2D2	12/22/94	21.18	18.15	17.68	3.50	0.47
TB1-2D2	1/3/95	21.18	18.39	17.66	3.52	0.73
TB1-2D2	1/13/95	21.18	18.28	17.71	3.47	0.57
TB1-2D2	1/18/95	21.18	18.45	17.68	3.50	0.77
TB1-2D2	2/20/95	21.18	18.83	18.01	3.17	0.82
TB1-2D2A	12/22/94	21.40	COULD NOT RECORD			
TB1-2D2A	1/3/95	21.40	18.08	17.90	3.50	0.18
TB1-2D2A	1/13/95	21.40	18.46	17.92	3.48	0.54
TB1-2D2A	1/18/95	21.40	18.49	17.98	3.42	0.51
TB1-2D2B	12/22/94	14.02	10.70			
TB1-2D2B	1/3/95	14.02	10.55			
TB1-2D2B	1/13/95	14.02	10.59			
TB1-2D2B	1/18/95	14.02	10.58			
TB1-2D2B	6/10/96	12.30	9.30	8.60	3.70	0.70
TB1-2D2B	6/24/96	12.30	9.00	8.40	3.90	0.60
TB-3	12/9/94	14.09	9.41			
TB-3	12/14/94	14.09	9.06			
TB-3	12/16/94	14.09	9.04			
TB-3	1/3/95	14.09	9.22			
TB-3	1/13/95	14.09	9.15			
TB-3	1/18/95	14.09	8.94			
TB-3	2/20/95	14.09	9.93	9.71	4.38	0.22
TB-6	12/9/94	15.60	10.50			
TB-6	12/14/94	15.60	9.14	8.84	6.76	0.30
TB-6	12/16/94	15.60	9.63	8.88	6.72	0.75
TB-6	12/22/94	15.60	10.63	8.98	6.62	1.65
TB-6	1/6/95	15.60	10.94	9.14	6.46	1.80
TB-6	1/12/95	15.60	10.55	9.13	6.47	1.42
TB-6	1/18/95	15.60	10.33	9.07	6.53	1.26
TB-6	6/3/96	15.60	COULD NOT GAUGE (FILLED WITH WATER)			
TB-6	6/10/96	15.60	COULD NOT REMOVE CAP			
TB6-1A	12/14/94	15.14	9.44	8.35	6.79	1.09
TB6-1A	12/16/94	15.14	9.66	8.40	6.74	1.26
TB6-1A	12/22/94	15.14	10.18	8.62	6.52	1.56
TB6-1A	1/6/95	15.14	10.33	8.71	6.43	1.62
TB6-1A	1/12/95	15.14	10.28	8.68	6.46	1.60
TB6-1A	1/18/95	15.14	10.04	8.62	6.52	1.42
TB6-1A	2/20/95	15.14	11.10	8.77	6.37	2.33

Table 2-3
NAPL Thickness Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
TB6-1B	12/14/94	14.27	8.78	7.44	6.83	1.34
TB6-1B	12/16/94	14.27	9.42	7.45	6.82	1.97
TB6-1B	12/22/94	14.27	9.93	7.67	6.60	2.26
TB6-1B	1/6/95	14.27	9.77	7.85	6.42	1.92
TB6-1B	1/12/95	14.27	9.72	7.75	6.52	1.97
TB6-1B	1/18/95	14.27	9.21	7.73	6.54	1.48
TB6-1B	2/20/95	14.27	10.04	7.99	6.28	2.05
TB6-1B1	12/14/94	14.89	8.49	8.19	6.70	0.30
TB6-1B1	12/16/94	14.89	9.86	8.15	6.74	1.71
TB6-1B1	12/22/94	14.89	10.81	8.37	6.52	2.44
TB6-1B1	1/6/95	14.89	11.12	8.40	6.49	2.72
TB6-1B1	1/12/95	14.89	10.65	8.38	6.51	2.27
TB6-1B1	1/18/95	14.89	10.33	8.33	6.56	2.00
TB6-1B1	6/3/96	14.89	DESTROYED			
TB6-1B1	6/24/96	14.89	COULD NOT LOCATE			
TB6-1B1A	12/16/94	17.86	11.34			
TB6-1B1A	12/22/94	17.86	11.58			
TB6-1B1A	1/6/95	17.86	11.67	11.66	6.20	0.01
TB6-1B1A	1/12/95	17.86	11.58	11.57	6.29	0.01
TB6-1B1A	1/18/95	17.86	11.54			
TB6-1B1A	2/20/95	17.86	12.02	11.75	6.11	0.27
TB6-1B1B	12/16/94	17.15	12.73	10.45	6.70	2.28
TB6-1B1B	12/22/94	17.15	13.11	10.73	6.42	2.38
TB6-1B1B	1/6/95	17.15	12.88	10.83	6.32	2.05
TB6-1B1B	1/12/95	17.15	12.94	10.74	6.41	2.20
TB6-1B1B	1/18/95	17.15	12.68	10.68	6.47	2.00
TB6-1B1B	6/3/96	15.53	COULD NOT GAUGE (FILLED WITH WATER)			
TB6-1B1B	6/10/96	15.53	11.25	8.45	7.08	2.80
TB6-1B1B	6/24/96	15.53	10.95	8.21	7.32	2.74
MW-1S	6/3/96	13.26	9.60	5.90	7.36	3.70
MW-1S	6/10/96	13.26	8.87	5.84	7.42	3.03
MW-1S	6/24/96	13.26	8.32	5.21	8.05	3.11
Off-Site Wells						
WEST OF LAGOON						
OS-O	5/1/96	18.43				
OS-O	5/8/96	18.43	14.78			
OS-O	5/13/96	18.43	15.50	14.49	3.94	1.01
OS-O	6/3/96	18.43	15.53	15.09	3.34	0.44
OS-O	6/10/96	18.43	15.23	14.85	3.58	0.38
OS-O	6/24/96	18.43	15.09	14.70	3.73	0.39
MW-A	10/25/95	17.37	14.53	14.20	3.17	0.33
MW-A	6/3/96	17.37	16.27	15.27	2.10	1.00
MW-A	6/10/96	17.37	15.83	14.99	2.38	0.84
MW-A	6/24/96	17.37	15.80	14.98	2.39	0.82
MW-9	10/25/95	17.70	9.39			
MW-9	6/3/96	17.70	LOCATED, COULD NOT ACCESS			

Table 2-3

NAPL Thickness Measurements

Harmon Railroad Yard Wastewater Treatment Area Operable Unit II

Croton-on-Hudson, New York

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Depth to NAPL (ft.)	NAPL Elevation	NAPL Thickness (ft.)
MW-9	6/10/96	17.70	10.35	10.23	7.47	0.12
MW-9	6/24/96	17.70	10.29	10.18	7.52	0.11
SOUTH OF LAGOON						
OS-B	2/7/96	18.19	7.65			
OS-B	2/27/96	18.19	10.52			
OS-B	3/19/96	18.19	10.61			
OS-B	5/1/96	18.19	11.35	10.67	7.52	0.68
OS-B	5/8/96	18.19	11.44	10.78	7.41	0.66
OS-B	5/13/96	18.19	11.43	10.83	7.36	0.60
OS-B	6/3/96	18.19	11.95	11.23	6.96	0.72
OS-B	6/10/96	18.19	11.85	11.14	7.05	0.71
OS-B	6/24/96	18.19	11.57	10.95	7.24	0.62
OS-C	2/7/96	17.51	7.15			
OS-C	2/27/96	17.51	10.45	9.82	7.69	0.63
OS-C	3/19/96	17.51	10.78	9.50	8.01	1.28
OS-C	5/1/96	17.51	11.45	10.05	7.46	1.40
OS-C	5/8/96	17.51	11.56	10.09	7.42	1.47
OS-C	5/13/96	17.51	11.50	10.12	7.39	1.38
OS-C	6/3/96	17.51	12.00	10.55	6.96	1.45
OS-C	6/10/96	17.51	11.90	10.48	7.03	1.42
OS-C	6/24/96	17.51	11.65	10.31	7.20	1.34
OS-D	2/7/96	16.84	7.28			
OS-D	2/27/96	16.84	9.30	9.27	7.57	0.03
OS-D	3/19/96	16.84	9.32			
OS-D	5/1/96	16.84	9.52			
OS-D	5/8/96	16.84	9.59			
OS-D	5/13/96	16.84	9.64			
OS-D	6/3/96	16.84	10.20	10.06	6.78	0.14
OS-D	6/10/96	16.84	10.02	9.99	6.85	0.03
OS-D	6/24/96	16.84	9.90	9.82	7.02	0.08
OS-E	2/7/96	17.82	7.95			
OS-E	2/27/96	17.82	10.46			
OS-E	3/19/96	17.82	10.49	10.46	7.36	0.03
OS-E	5/1/96	17.82	11.50	10.63	7.19	0.87
OS-E	5/8/96	17.82	11.02	10.63	7.19	0.39
OS-E	5/13/96	17.82	11.10	10.68	7.14	0.42
OS-E	6/3/96	17.82	11.70	11.07	6.75	0.63
OS-E	6/10/96	17.82	11.69	11.01	6.81	0.68
OS-E	6/24/96	17.82	11.55	10.87	6.95	0.68
OS-F	2/7/96	18.00	10.35	8.05	9.95	2.30
OS-F	2/27/96	18.00	13.99	10.43	7.57	3.56
OS-F	3/19/96	18.00	13.99	10.41	7.59	3.58
OS-F	5/1/96	18.00	13.81	10.50	7.50	3.31
OS-F	5/8/96	18.00	13.88	10.57	7.43	3.31
OS-F	5/13/96	18.00	13.90	10.62	7.38	3.28
OS-F	6/3/96	18.00	Not Encount.	11.00		
OS-F	6/10/96	18.00	13.90	10.96	7.04	2.94
OS-F	6/24/96	18.00	TB	10.80	7.20	

Table 2-4
PCB Concentrations in NAPL
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	WB-2		WB-21A		WB-4		WB4-4A		WB-5		DUP OF WB-5		WB-9	
NAPL Area	L3		L3		L2		L2		L4		L4		L1	
Date Collected	3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95	
PCB COMPOUNDS (in mg/kg)														
Aroclor 1242	2.2	J	2.4	J	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.3	J
Aroclor 1248	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ
Aroclor 1254	1.0	UJ	1.0	UJ	2.9	J	1.0	UJ	23.0	J	21.0	J	4.9	J
Aroclor 1260	1.4	J	1.4	J	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ
TOTAL	3.6		3.8		2.9				23.0		21.0		7.2	

Sample Number	TB1-1A1A		TB6-1B1		OS-C		OS-F		OS-O		WB-9-3C2A	
NAPL Area	L1		L4		L4		L4		L1 Outlier		L1	
Date Collected	3/23/95		3/23/95		3/19/96		3/19/96		5/31/96		5/31/96	
PCB COMPOUNDS (in mg/kg)												
Aroclor 1016	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1221	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1232	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1242	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1248	1.0	UJ	1.0	UJ	1.3	J	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1254	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1260	1.9	J	1.4	J	1.4	J	1.0	J	2.5	U	1.0	UJ
TOTAL	1.9		1.4		2.7		1.0					

QUALIFIERS

U - Indicates that the compound was analyzed for but was not detected.

J - Indicates an estimated value. The compound meets the identification criteria but the result is < than the sample quantitation limit but > than zero.

UJ - The laboratory reported these values as non-detect, but during data validation analysis of the MS/MSD suggested that there was a potential low bias and the presence or absence of these compounds cannot be confirmed.

Table 2-5
Former Discharge Line Soil Sampling Log
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Date Sampled	Depth Sampled	Description
E-1	1/26/95	7-9'	Brown very fine SAND
W-2	1/26/95	7-9'	Brown, grey very fine SAND, ODOR
E-3	1/26/95	7-9'	Brown very fine SAND and GRAVEL
W-4	1/26/95	9.5-11.5'	Brown very fine SAND and GRAVEL
E-5	1/27/95	7-9'	Brown very fine SAND and GRAVEL
E-6	1/26/95	7-9'	Brown very fine SAND and GRAVEL
W-6A	1/27/95	7-9'	Brown fine SAND and GRAVEL, trace silt
W-7	1/26/95	7-9'	Brown fine SAND and GRAVEL
E-8	1/27/95	7-9'	Brown fine SAND and SILT
W-9	1/27/95	7-9'	Brown very fine SAND and SILT
E-10	1/27/95	7-9'	Very fine SAND and GRAVEL
W-11	1/27/95	7-9'	Brown fine SAND, trace silt
E-12	1/27/95		Location abandoned due to repeated refusals
W-13	1/27/95	7-9'	Brown fine SAND
E-14	1/30/95	7-9'	Brown fine to medium SAND
E-15	1/30/95	7-9'	Brown medium to coarse SAND and GRAVEL
W-16	1/30/95	7-8'	Medium to coarse brown SAND
E-17	1/30/95	7-9'	Brown medium to coarse SAND
W-18			Inaccessible
W-19	1/30/95	5-7'	Brown medium to coarse SAND
W-20	1/30/95	6-8'	Brown medium to coarse SAND
E-21	1/31/95	5-7'	Brown medium to coarse SAND
W-22	1/31/95	5-7'	Brown medium to coarse SAND
E-23	1/31/95	5-7'	Brown medium to coarse SAND
W-24	1/31/95	5-7'	Dark brown to black medium to coarse SAND and GRAVEL (fill material)
E-25	1/31/95	5-7'	Black and brown medium to coarse SAND and GRAVEL
W-26	1/31/95	4-6'	Black and brown medium to coarse SAND and GRAVEL
E-27	1/31/95	4-6'	4-5' - Black med. - coarse SAND and GRAVEL; 5-6' - Brown fine to medium SAND
W-28	1/31/95	4-6'	Medium to coarse brown SAND, trace gravel
E-29	1/31/95	4-6'	Brown coarse SAND and GRAVEL
E-30	2/1/95	2-4'	Brown and black coarse SAND and GRAVEL, STAINED and ODOR
W-31	2/1/95	2-4'	Brown and black coarse SAND and GRAVEL, STAINED and ODOR
E-32	2/1/95	2-4'	Black coarse SAND and GRAVEL, trace clay, STAINED and ODOR
W-33	2/1/95	2-4'	Coarse black SAND and GRAVEL
E-34	2/1/95	2-4'	Black coarse SAND and GRAVEL, STAINED and ODOR
W-35	2/1/95	2-4'	Black coarse SAND and GRAVEL, STAINED and ODOR
E-36	2/1/95	2-4'	Black coarse SAND and GRAVEL, and tan clay, STAINED and ODOR
W-37	2/1/95	2-4'	Black coarse SAND and CLAY, STAINED and ODOR
E-38	2/2/95	2-4'	Black coarse SAND and GRAVEL
W-39	2/1/95	2-4'	Black coarse SAND and GRAVEL
E-40	2/1/95	4-7'	Black coarse SAND and GRAVEL, STAINED and ODOR
W-41	2/2/95	2-4'	Medium to coarse orange SAND
E-42	2/2/95	1-3'	Medium to coarse orange SAND
W-43	2/2/95	1-3'	Medium to coarse orange SAND

Table 2-5
Former Discharge Line Soil Sampling Log
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Date Sampled	Depth Sampled	Description
E-44	2/2/95	1-3'	Black coarse SAND and GRAVEL, STAINED and ODOR
W-45	2/2/95	1-3'	Black coarse SAND and GRAVEL, STAINED and ODOR
E-46	2/2/95	1-3'	Black coarse SAND and GRAVEL
W-47	2/2/95	1-3'	Black coarse SAND and GRAVEL, STAINED and ODOR
E-48	2/2/95	1-3'	Black coarse SAND and GRAVEL, STAINED and ODOR
W-49	2/2/95	1-3'	Black coarse SAND and GRAVEL
E-50	2/2/95	1-3'	Black coarse SAND and GRAVEL
W-51	2/2/95	1-3'	Black coarse SAND and GRAVEL
E-52	2/3/95	2-4'	Black coarse SAND and GRAVEL, STAINED and ODOR
W-53	2/3/95	2-4'	Black coarse SAND and GRAVEL, STAINED and ODOR
E-54	2/3/95	2-4'	Black coarse SAND and GRAVEL, STAINED and ODOR
W-55	2/3/95	2-4'	Black coarse SAND and GRAVEL, some STAINING, no odor
E-56	2/3/95	2-4'	Black coarse GRAVEL and SAND
W-57	2/3/95	2-4'	Black coarse SAND and GRAVEL
E-58	2/3/95	2-4'	Black coarse SAND and GRAVEL, STAINED, no odor
W-59	2/3/95	3-5'	Black coarse SAND and GRAVEL, STAINED and ODOR
W-60	2/3/95	3-5'	Black, brown fine to coarse SAND, trace gravel, some Stain, no odor
W-61	2/6/95	2-4'	Brown fine to medium SAND, no stain, no odor
W-62	2/6/95	2-4'	Brown medium to coarse SAND, ODOR
W-63	2/6/95	2-4'	Brown medium to coarse SAND
W-64	2/6/95		Abandoned due to refusal

Table 2

Summary of Soil Sampling Results

Harmon Railroad Yard Wastewater Treatment Area Operable Unit II

Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-1		W-2		E-3		W-4		DUP 1 (Dup. of W-4)		E-5		E-6		W-6A		W-7		E-8	
Depth		7-9'		7-9'		7-9'		9.5-11.5'				7-9'		7-9'		7-9'		7-9'		7-9'	
Date Collected		1/26/95		1/26/95		1/26/95		1/26/95				1/27/95		1/26/95		1/27/95		1/26/95		1/27/95	
Volatile Organic Compounds, in µg/kg																					
Acetone	200																				
4-Methyl-2-Pentanone	1,000																				
Toluene	1,500	2	J					10	J	4	J			6	J			1	J		
Ethylbenzene	5,500																				
Xylene (total)	1,200							1	J												
Total TICs				19600	J											26	J			43	J
Semi-Volatile Organics, in µg/kg																					
4-Methylphenol	900																				
2,4-Dimethylphenol	NA																				
Naphthalene	13,000					71	J														
2-Methylnaphthalene	36,400			6811	J	60	J														
Acenaphthylene	41,000																				
Acenaphthene	50,000			1500	J																
Dibenzofuran	6,200																				
Fluorene	50,000			2100	J	41	J														
Phenanthrene	50,000			5600	J	120	J							62	J						
Anthracene	50,000					39	J														
Carbazole	NA																				
Di-n-butylphthalate	8,100																				
Fluoranthene	50,000	70	J			40	J							91	J						
Pyrene	50,000	69	J			63	J							77	J						
Benzo (a) anthracene	224 or MDL													42	J						
Chrysene	400	47	J											50	J						
bis (2-Ethylhexyl) phthalate	50,000													54	J	37	J				
Benzo (b) fluoranthene	224 or MDL																				
Benzo (k) fluoranthene	224 or MDL																				
Benzo (a) pyrene	61 or MDL																				
Indeno (1,2,3-cd) pyrene	3,200																				
Benzo (g,h,i) perylene	50,000																				

Table 2-6
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-1		W-2		E-3		W-4		DUP 1 (Dup. of W-4)		E-5		E-6		W-6A		W-7		E-8	
Depth		7-9'		7-9'		7-9'		9.5-11.5'				7-9'		7-9'		7-9'		7-9'		7-9'	
Date Collected		1/26/95		1/26/95		1/26/95		1/26/95				1/27/95		1/26/95		1/27/95		1/26/95		1/27/95	
Total TICs		220	J	252400	J	894	J	1017	J	1059	J	1260	J	14508	J	722	J	2289	J	2224	J
Pesticides (in µg/kg)																					
alpha-BHC	110			3.1	PJ																
beta-BHC	200																				
delta-BHC	300																				
Heptachlor	100			2.7	PJ																
Aldrin	41																				
Heptachlor epoxide	20																				
Endosulfan I	900																				
Dieldrin	44																				
4,4'-DDE	2,100																				
Endrin	100			4.1	PJ																
Endosulfan II	900																				
4,4'-DDD	2,900																				
Endosulfan sulfate	1,000																				
4,4'-DDT	2,100																				
Methoxychlor	< 10,000																				
Endrin ketone	NA	5.4																			
Endrin aldehyde	NA																				
alpha-Chlordane	Total = 540																				
gamma-Chlordane	Total = 540																				
PCB COMPOUNDS (in µg/kg)																					
Aroclor-1260								37	J	15	PJ			22	J			29	J		
Total (surface)	1,000																				
Total (subsurface)	10,000																				
Total Organic Carbon (in mg/kg)		2909		8613		5393		9098		4370		5875		6521		5546		6114		7055	
Grain Size																					

Table 2
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	W-9		E-10		W-11		W-13		E-14		E-15		W-16		E-17		E-19		W-20	
Depth		7-9'		7-9'		7-9'		7-9'		7-9'		7-9'		7-8'		7-9'		5-7'		6-8'	
Date Collected		1/27/95		1/27/95		1/27/95		1/27/95		1/30/95		1/30/95		1/30/95		1/30/95		1/30/95		1/30/95	
Volatile Organic Compounds, in µg/kg																					
Acetone	200																				
4-Methyl-2-Pentanone	1,000																				
Toluene	1,500																				
Ethylbenzene	5,500											27									
Xylene (total)	1,200											150									
Total TICs		20	J	8	J	15	J	21	J	6	J	1100	J	5250	J	198	J	18	J		
Semi-Volatile Organics, in µg/kg																					
4-Methylphenol	900																				
2,4-Dimethylphenol	NA																				
Naphthalene	13,000											800	J								
2-Methylnaphthalene	36,400											4200				57	J				
Acenaphthylene	41,000																				
Acenaphthene	50,000											510	J								
Dibenzofuran	6,200																				
Fluorene	50,000											840	J								
Phenanthrene	50,000			52	J							1200	J			54	J				
Anthracene	50,000																				
Carbazole	NA																				
Di-n-butylphthalate	8,100																				
Fluoranthene	50,000															72	J				
Pyrene	50,000															76	J				
Benzo (a) anthracene	224 or MDL			40	J											46	J				
Chrysene	400			58	J											61	J				
bis (2-Ethylhexyl) phthalate	50,000	37	J	39	J																
Benzo (b) fluoranthene	224 or MDL																				
Benzo (k) fluoranthene	224 or MDL																				
Benzo (a) pyrene	61 or MDL																				
Indeno (1,2,3-cd) pyrene	3,200																				
Benzo (g,h,i) perylene	50,000																				

Table 2

Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	W-9		E-10		W-11		W-13		E-14		E-15		W-16		E-17		E-19		W-20	
Depth		7-9'		7-9'		7-9'		7-9'		7-9'		7-9'		7-8'		7-9'		5-7'		6-8'	
Date Collected		1/27/95		1/27/95		1/27/95		1/27/95		1/30/95		1/30/95		1/30/95		1/30/95		1/30/95		1/30/95	
Total TICs		1661	J	2166	J	1753	J	1170	J	2960	J	147000	J			83	J	500	J	92	J
Pesticides (in µg/kg)																					
alpha-BHC	110																				
beta-BHC	200																				
delta-BHC	300																				
Heptachlor	100																				
Aldrin	41																				
Heptachlor epoxide	20																				
Endosulfan I	900																				
Dieldrin	44											2.1	JP								
4,4'-DDE	2,100											2.4	JP								
Endrin	100																				
Endosulfan II	900																				
4,4'-DDD	2,900																				
Endosulfan sulfate	1,000																				
4,4'-DDT	2,100																				
Methoxychlor	< 10,000																				
Endrin ketone	NA																				
Endrin aldehyde	NA																				
alpha-Chlordane	Total = 540																				
gamma-Chlordane	Total = 540																				
PCB COMPOUNDS (in µg/kg)																					
Aroclor-1260																		21	J		
Total (surface)	1,000																				
Total (subsurface)	10,000																				
Total Organic Carbon (in mg/kg)		4227		3600		5244		4926		2819		6350		3084		9674		8879		8638	
Grain Size																					

Table

Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-21		W-22		DUP 2 (Dup. of W-22)		E-23		W-24		E-25		W-26		E-27		W-28		E-29	
Depth		5-7'		5-7'				5-7'		5-7'		5-7'		4-6'		4-6'		4-6'		4-6'	
Date Collected		1/31/95		1/31/95				1/31/95		1/31/95		1/31/95		1/31/95		1/31/95		1/31/95		1/31/95	
Volatile Organic Compounds, in µg/kg																					
Acetone	200																				
4-Methyl-2-Pentanone	1,000																				
Toluene	1,500									2	J			4	J						
Ethylbenzene	5,500																				
Xylene (total)	1,200											2	J	10	J						
Total TICs		118	J							7	J	10	J	21	J	308	J			1323	J
Semi-Volatile Organics, in µg/kg																					
4-Methylphenol	900									38	J										
2,4-Dimethylphenol	NA									44	J			190	J						
Naphthalene	13,000									720		930		2700		1000		300	J	85	J
2-Methylnaphthalene	36,400									1000		1400		4300		1600		500		110	
Acenaphthylene	41,000									140	J										
Acenaphthene	50,000																				
Dibenzofuran	6,200									260	J	340	J	1200	J	460		140	J		
Fluorene	50,000									50	J										
Phenanthrene	50,000									520		540		2100		670		260	J	160	J
Anthracene	50,000									120	J										
Carbazole	NA									95	J	51	J	200	J	65	J				
Di-n-butylphthalate	8,100																				
Fluoranthene	50,000									700		81	J	900	J	170	J	170	J		
Pyrene	50,000									690		120	J	870	J	210	J	190	J		
Benzo (a) anthracene	224 or MDL									360	J	72	J	470	J	120	J	99	J		
Chrysene	400									570		120	J	740	J	200	J	140	J		
bis (2-Ethylhexyl) phthalate	50,000																				
Benzo (b) fluoranthene	224 or MDL									580		55	J	530	J	120	J	130	J		
Benzo (k) fluoranthene	224 or MDL									400		40	J	380	J	99	J	94	J		
Benzo (a) pyrene	61 or MDL									340	J	48	J	290	J	79	J	71	J		
Indeno (1,2,3-cd) pyrene	3,200									200	J							43	J		
Benzo (g,h,i) perylene	50,000									170	J							44	J		

Table
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-21		W-22		DUP 2 (Dup. of W-22)		E-23		W-24		E-25		W-26		E-27		W-28		E-29	
Depth		5-7'		5-7'				5-7'		5-7'		5-7'		4-6'		4-6'		4-6'		4-6'	
Date Collected		1/31/95		1/31/95				1/31/95		1/31/95		1/31/95		1/31/95		1/31/95		1/31/95		1/31/95	
Total TICs		962	J	1223	J	1511	J	650	J	6530	J	8150	J	29460	J	10560	J	4290	J	13200	J
Pesticides (in µg/kg)																					
alpha-BHC	110																				
beta-BHC	200																				
delta-BHC	300																				
Heptachlor	100									1.9	PJ	2.8	PJ	4.4	PJ	2.9	PJ	1.6	J		
Aldrin	41																			3.3	
Heptachlor epoxide	20									2.3	PJ	2.5	PJ								
Endosulfan I	900																				
Dieldrin	44																				
4,4'-DDE	2,100																				
Endrin	100									7.7	YJ	5.3	PJ	15	PJ	8.9				4.5	PJ
Endosulfan II	900													9.3	PJ						
4,4'-DDD	2,900																				
Endosulfan sulfate	1,000																				
4,4'-DDT	2,100									7.2	PYJ					10		3.9	YJ		
Methoxychlor	< 10,000									13	JP	18	JP	65	J	25	PJ				
Endrin ketone	NA															7.2	PJ				
Endrin aldehyde	NA																				
alpha-Chlordane	Total = 540																				
gamma-Chlordane	Total = 540																				
PCB COMPOUNDS (in µg/kg)																					
Aroclor-1260										51								17	JP		
Total (surface)	1,000																				
Total (subsurface)	10,000																				
Total Organic Carbon (in mg/kg)		5846		5589		5477		10757		79790		42605		216024		92785		26130		4242	
Grain Size																					

Table
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-30		W-31		E-32		W-33		E-34		W-35		E-36		W-37		E-38		W-39	
Depth		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'	
Date Collected		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/2/95		2/1/95	
Volatile Organic Compounds, in µg/kg																					
Acetone	200											37	B								
4-Methyl-2-Pentanone	1,000																				
Toluene	1,500					13	J														
Ethylbenzene	5,500																				
Xylene (total)	1,200					83	J					9 J	J	17							
Total TICs		3110	J	1429	J	1964	J	2520	J	7870	J	1580	J	1631	J	7720	J	38500	J	16	J
Semi-Volatile Organics, in µg/kg																					
4-Methylphenol	900																				
2,4-Dimethylphenol	NA																				
Naphthalene	13,000			1700	J											870	J			520	J
2-Methylnaphthalene	36,400	2500	J	2900	J	19000		2800	J	77000	D	32000		14000		1100	J	6800		980	J
Acenaphthylene	41,000																				
Acenaphthene	50,000																				
Dibenzofuran	6,200			820	J											620	J				
Fluorene	50,000									7500						500	J	4700		810	J
Phenanthrene	50,000	3200	J	3800	J	5100		9500		13000		9200		3700	J	2300	J	6500		1000	J
Anthracene	50,000			630	J			1100	J	1400	J	1200	J			660	J				
Carbazole	NA																				
Di-n-butylphthalate	8,100																				
Fluoranthene	50,000	2100	J	3600	J	930	J	5000		4200		11000		580	J	4800		1500	J	1100	J
Pyrene	50,000	2900	J	3900		1200	J	5200		4200		13000		700	J	5200	J	1900	J	1400	J
Benzo (a) anthracene	224 or MDL			1700	J			2200	J	1800	J	5800				2200	J	600	J	580	J
Chrysene	400			1900	J	540	J	2400	J	1800	J	6500				2500	J	710	J	710	J
bis (2-Ethylhexyl) phthalate	50,000																				
Benzo (b) fluoranthene	224 or MDL			1700	J	490	J	2000	J	1100	J	5300				2600	J	480	J	680	J
Benzo (k) fluoranthene	224 or MDL			770	J			1400	J	1100	J	2800	J			1000	J	570	J		
Benzo (a) pyrene	61 or MDL			1300	J			1600	J	910	J	3000	J			1500	J	400	J	400	J
Indeno (1,2,3-cd) pyrene	3,200			760	J			1000	J	590	J	1600	J			980	J				
Benzo (g,h,i) perylene	50,000			870	J			1100	J	630	J	1500	J			980	J				

Table
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-30		W-31		E-32		W-33		E-34		W-35		E-36		W-37		E-38		W-39	
Depth		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'		2-4'	
Date Collected		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/1/95		2/2/95		2/1/95	
Total TICs		272700	J	37840	J	822000	J	609000	J	454000	J	524000	J	322900	J	28360	J	421600	J	94900	J
Pesticides (in µg/kg)																					
alpha-BHC	110					4.3	PJ														
beta-BHC	200					5.3	PJ														
delta-BHC	300																				
Heptachlor	100							3.2	PJ	7										4.4	
Aldrin	41	3.9	JP					4	JP									10	PJ		
Heptachlor epoxide	20			3.5	JP													6.1	PJ		
Endosulfan I	900																				
Dieldrin	44																				
4,4'-DDE	2,100																				
Endrin	100							12	PJ			19	PJ					22	PJ		
Endosulfan II	900																	5.6	JP		
4,4'-DDD	2,900					6.3	JP														
Endosulfan sulfate	1,000																				
4,4'-DDT	2,100	25				9.6	PJ	6.2	JP	9.6	PJ	6.6	JP					13	PJ		
Methoxychlor	< 10,000	23	JP	33	JP	28	JP					34	JP								
Endrin ketone	NA	10		18	PJ	6.9	JP	9.9		9.8	PJ										
Endrin aldehyde	NA																				
alpha-Chlordane	Total = 540																				
gamma-Chlordane	Total = 540																				
PCB COMPOUNDS (in µg/kg)																					
Aroclor-1260																					
Total (surface)	1,000																				
Total (subsurface)	10,000																				
Total Organic Carbon (in mg/kg)		40611		39440		48885		51051		282481		46941		43317		24929		38799		23977	
Grain Size																					

Table
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-40		W-41		E-42		W-43		DUP 3 (Dup. of W-43)		E-44		W-45		E-46		W-47	
Depth		4-7'		2-4'		1-3'		1-3'		1-3'		1-3'		1-3'		1-3'		1-3'	
Date Collected		2/1/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95	
Volatile Organic Compounds, in µg/kg																			
Acetone	200											1	J						
4-Methyl-2-Pentanone	1,000																		
Toluene	1,500							1	J					1	J				
Ethylbenzene	5,500																		
Xylene (total)	1,200							11	J	31	J								
Total TICs		1434	J					7590	J	31900	J	1110	J	7150	J	1094	J	909	J
Semi-Volatile Organics, in µg/kg																			
4-Methylphenol	900																		
2,4-Dimethylphenol	NA																		
Naphthalene	13,000	500	J																
2-Methylnaphthalene	36,400	850	J					1900	J	1700	J			1100	J	440	J	1000	J
Acenaphthylene	41,000													670	J				
Acenaphthene	50,000	480	J					1700	J	1500	J	3900		740	J				
Dibenzofuran	6,200																		
Fluorene	50,000							2600	J	2300	J	6600		1400	J				
Phenanthrene	50,000	1100	J					9700		6200		9600		3800	J			470	J
Anthracene	50,000							1100	J					420	J				
Carbazole	NA																		
Di-n-butylphthalate	8,100																		
Fluoranthene	50,000	1600	J					9600		3400	J	2400	J	2500	J			670	J
Pyrene	50,000	1800	J					9700		3900	J	5000		2900	J			770	J
Benzo (a) anthracene	224 or MDL	870	J					3800	J	1400	J	880	J	1400	J			470	J
Chrysene	400	1100	J					4000		1500	J	1100	J	1600	J			580	J
bis (2-Ethylhexyl) phthalate	50,000		J	260	J	56	J												
Benzo (b) fluoranthene	224 or MDL	1100	J					3100	J	1100	J	860	J	1200	J			710	J
Benzo (k) fluoranthene	224 or MDL	560	J					2700	J	1400	J	560	J	1700	J				
Benzo (a) pyrene	61 or MDL	620	J					2400	J	870	J	610	J	1100	J			380	J
Indeno (1,2,3-cd) pyrene	3,200	430	J					1700	J	700	J	560	J	890	J				
Benzo (g,h,i) perylene	50,000	440	J					1700	J	710	J	580	J	880	J			390	J

Table [illegible]6
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-40		W-41		E-42		W-43		DUP 3 (Dup. of W-43)		E-44		W-45		E-46		W-47	
Depth		4-7'		2-4'		1-3'		1-3'		1-3'		1-3'		1-3'		1-3'		1-3'	
Date Collected		2/1/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95		2/2/95	
Total TICs		98700	J	120	J	760	J	193500	J	183600	J	278000	J	152800	J			10990	J
Pesticides (in µg/kg)																			
alpha-BHC	110																		
beta-BHC	200																		
delta-BHC	300																		
Heptachlor	100																		
Aldrin	41							10	PJ	7.6	PJ							5.2	PJ
Heptachlor epoxide	20															2.9	J		
Endosulfan I	900																		
Dieldrin	44																		
4,4'-DDE	2,100																		
Endrin	100																		
Endosulfan II	900									9.5	PJ	11	PJ	24	J	7.7	PJ	5.9	JP
4,4'-DDD	2,900																		
Endosulfan sulfate	1,000									8.7	PJ								
4,4'-DDT	2,100							22	J	37	PJ	14	PJ	48	PJ				
Methoxychlor	< 10,000																		
Endrin ketone	NA							53	J	20	PJ	20	PJ						
Endrin aldehyde	NA																		
alpha-Chlordane	Total = 540							8.9	J										
gamma-Chlordane	Total = 540																		
PCB COMPOUNDS (in µg/kg)																			
Aroclor-1260																		68	JP
Total (surface)	1,000																		
Total (subsurface)	10,000																		
Total Organic Carbon (in mg/kg)		39862		6146		3371		9947		35098		54504		172764		18985		39505	
Grain Size																			

Table 2-6
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-48		W-49		E-50		W-51		E-52		W-53		E-54		W-55		E-56	
Depth		1-3'		1-3'		1-3'		1-3'		2-4'		2-4'		2-4'		2-4'		2-4'	
Date Collected		2/2/95		2/2/95		2/2/95		2/2/95		2/3/95		2/3/95		2/3/95		2/3/95		2/3/95	
Volatile Organic Compounds, in µg/kg																			
Acetone	200			17	J							6	J						
4-Methyl-2-Pentanone	1,000	130	J																
Toluene	1,500	88	J																
Ethylbenzene	5,500																		
Xylene (total)	1,200	140	J																
Total TICs		48300	J	6300	J			51100	J	80500	J	77	J	15060	J				
Semi-Volatile Organics, in µg/kg																			
4-Methylphenol	900																		
2,4-Dimethylphenol	NA																		
Naphthalene	13,000			160	J							200	J	220	J	150	J	190	J
2-Methylnaphthalene	36,400			290	J	43	J	6800	J	980	J	280	J	360	J	330	J	420	J
Acenaphthylene	41,000											340	J	200	J	76	J	140	J
Acenaphthene	50,000			310	J			10000		690	J			240	J				
Dibenzofuran	6,200			210	J			5800	J	370	J	190	J					120	J
Fluorene	50,000			410	J			13000		900	J			260	J			120	J
Phenanthrene	50,000			1000	J			34000		2300		660	J	680	J	160	J	1500	
Anthracene	50,000			230	J			6900	J	530	J	220	J	300	J			210	J
Carbazole	NA																		
Di-n-butylphthalate	8,100			200	J														
Fluoranthene	50,000	3600	J	220	J			3800	J	500	J	1600	J	1400	J	240	J	2100	
Pyrene	50,000	7000		240	J			3200	J	630	J	1300	J	1300	J	250	J	1400	
Benzo (a) anthracene	224 or MDL	1400	J					980	J	230	J	840	J	690	J	150	J	680	J
Chrysene	400	1600	J					1400	J	280	J	1000	J	810	J	210	J	820	
bis (2-Ethylhexyl) phthalate	50,000																		
Benzo (b) fluoranthene	224 or MDL	1700	J					960	J	280	J	810	J	580	J	210	J	490	J
Benzo (k) fluoranthene	224 or MDL	950	J					1100	J	250	J	1000	J	800	J	180	J	490	J
Benzo (a) pyrene	61 or MDL	880	J					840	J	230	J	720	J	670	J	170	J	390	J
Indeno (1,2,3-cd) pyrene	3,200	800	J							190	J	490	J	390	J	120	J	170	J
Benzo (g,h,i) perylene	50,000	840	J							190	J	200	J	280	J	110	J	140	J

Table 2-6
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	E-48		W-49		E-50		W-51		E-52		W-53		E-54		W-55		E-56	
Depth		1-3'		1-3'		1-3'		1-3'		2-4'		2-4'		2-4'		2-4'		2-4'	
Date Collected		2/2/95		2/2/95		2/2/95		2/2/95		2/3/95		2/3/95		2/3/95		2/3/95		2/3/95	
Total TICs		625000	J	44370	J			400300	J	87300	J	16120	J	65300	J	4420	J	5340	J
Pesticides (in µg/kg)																			
alpha-BHC	110																		
beta-BHC	200							2.2	PJ										
delta-BHC	300																		
Heptachlor	100			2.3						3.8	PJ			2.8	PJ			1.7	JP
Aldrin	41	8.4	PJ																
Heptachlor epoxide	20									1	JP								
Endosulfan I	900	2.4	PJ																
Dieldrin	44																		
4,4'-DDE	2,100			4.9	PJ														
Endrin	100			7.3	PJ	7.3	PJ											5.9	PJ
Endosulfan II	900					4.8	PJ												
4,4'-DDD	2,900			4.3															
Endosulfan sulfate	1,000	5.1	PJ																
4,4'-DDT	2,100	6.2	J							3.7	PJ			3.7	JP	2.2	JP		
Methoxychlor	< 10,000					23	PJ					20	JP	25	PJ	12	JP	15	JP
Endrin ketone	NA	5.5	JP			3.4	JP	3.9	J										
Endrin aldehyde	NA																	3.9	PJ
alpha-Chlordane	Total = 540																		
gamma-Chlordane	Total = 540																		
PCB COMPOUNDS (in µg/kg)																			
Aroclor-1260																			
Total (surface)	1,000																		
Total (subsurface)	10,000																		
Total Organic Carbon (in mg/kg)		44329		9898		85598		115647		47073		54038		86576		24373		18904	
Grain Size																			

Table 2-6
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	W-57		E-58		W-59		W-60		W-61		W-62		DUP-4 (Dup. of W-62)		W-63	
Depth		2-4'		2-4'		3-5'		3-5'		2-4'		2-4'		2-4'		2-4'	
Date Collected		2/3/95		2/3/95		2/3/95		2/3/95		2/6/95		2/6/95		2/6/95		2/6/95	
Volatile Organic Compounds, in µg/kg																	
Acetone	200											20	J	29	J	8	J
4-Methyl-2-Pentanone	1,000																
Toluene	1,500																
Ethylbenzene	5,500																
Xylene (total)	1,200																
Total TICs		31700	J	50500	J	60133	J	8430	J	2037	J	16000	J	22600	J	4050	J
Semi-Volatile Organics, in µg/kg																	
4-Methylphenol	900																
2,4-Dimethylphenol	NA																
Naphthalene	13,000																
2-Methylnaphthalene	36,400			8200		2700	J					3900	J	3100	J	450	J
Acenaphthylene	41,000																
Acenaphthene	50,000	1900	J	2500	J	3000	J					5200	J	4400	J	590	J
Dibenzofuran	6,200	1100	J	1500	J							3200	J	2700	J		
Fluorene	50,000	2600	J	3300	J	3300	J					6800	J	6700	J	710	J
Phenanthrene	50,000	6700	J	9000		7700	J					15000		15000		1600	J
Anthracene	50,000	900	J	1000	J							1800	J	1600	J		
Carbazole	NA																
Di-n-butylphthalate	8,100																
Fluoranthene	50,000									86	J	910	J	860	J	710	J
Pyrene	50,000							1400	J	80	J	1200	J	1300	J	670	J
Benzo (a) anthracene	224 or MDL																
Chrysene	400															390	J
bis (2-Ethylhexyl) phthalate	50,000																
Benzo (b) fluoranthene	224 or MDL																
Benzo (k) fluoranthene	224 or MDL															400	J
Benzo (a) pyrene	61 or MDL																
Indeno (1,2,3-cd) pyrene	3,200																
Benzo (g,h,i) perylene	50,000																

Table 2-6
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	Recommended Soil Cleanup Objectives	W-57		E-58		W-59		W-60		W-61		W-62		DUP-4 (Dup. of W-62)		W-63	
Depth		2-4'		2-4'		3-5'		3-5'		2-4'		2-4'		2-4'		2-4'	
Date Collected		2/3/95		2/3/95		2/3/95		2/3/95		2/6/95		2/6/95		2/6/95		2/6/95	
Total TICs		316100	J	375900	J	472200	J	190100	J	5950	J	503000	J	441100	J	99600	J
Pesticides (in µg/kg)																	
alpha-BHC	110																
beta-BHC	200											2.1	PJ	2.1	PJ		
delta-BHC	300											1.3	JP	1.8	JP		
Heptachlor	100															1.6	JP
Aldrin	41																
Heptachlor epoxide	20																
Endosulfan I	900																
Dieldrin	44			2.7	JP												
4,4'-DDE	2,100																
Endrin	100																
Endosulfan II	900																
4,4'-DDD	2,900											4.1	PJ				
Endosulfan sulfate	1,000							7.2	J			2.9	JP				
4,4'-DDT	2,100			7								4.7	PJ				
Methoxychlor	< 10,000																
Endrin ketone	NA																
Endrin aldehyde	NA																
alpha-Chlordane	Total = 540																
gamma-Chlordane	Total = 540							3.5	JP			2.1	PJ	1.5	JP		
PCB COMPOUNDS (in µg/kg)																	
Aroclor-1260																	
Total (surface)	1,000																
Total (subsurface)	10,000																
Total Organic Carbon (in mg/kg)		11972		29766		20833		20704		2073		48387		122902		19254	
Grain Size																	

Table 2-6
Summary of Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

NOTES:

Detection limits are provided in Appendix D.

ORGANIC QUALIFIERS

[ ]	Blanks indicate that the compound was analyzed for but was not detected, and detection limit is not specified.
U	Indicates that the compound was analyzed for but was not detected.
J	Indicates an estimated value. The compound meets the identification criteria but the result is less than the sample quantitiation limit but greater than zero.
P	Indicates a pesticide/Aroclor target analyte where there is greater than 25% difference for detected concetrations between the two GC columns.
B	Indicates that the compound is found in the associated blank as well as the sample.
Y	Indicates that the pesticide is suspect due to possible interference from PCB compounds.
--	Indicates no guideline available for that compound.
D	Indicates that the compound was identified in an analysis at a secondary dilution factor.

NYSDEC recommended soil cleanup objective as provided in *NYSDEC Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels,* HWR-90-4046, NYSDEC, 24 January 1994 {a revised TAGM was proposed in April 1995 - when applicable, these revised soil cleanup objectives were cited and used}.

Table 2-7
Summary of Sediment and Surface Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	SD-1		SD-2		SD-3		SD-4		SD-5		SEDDUP		SD-6		OUTFALL		SURUNF	
Depth Collected	0-2'		0-2'		0-2'		0-2'		0-2'		(Dup. of SD-5)		0-2'		Stockpile			
Date Collected	3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/24/94		3/23/95	
VOLATILE ORGANIC COMPOUNDS	in µg/kg)																(in µg/l)	
Acetone	69	J	2	J	17	J	56	J	98	J	69	J	45	J	12	UJ	10	U
Carbon Disulfide	18	UJ	16	UJ	15	UJ	26	U	22	U	3	J	20	UJ	12	U	10	U
2-Butanone	22	J	16	UJ	15	UJ	22	J	35		23	J	15	J	12	UJ	10	U
Carbon Tetrachloride	18	UJ	16	UJ	15	UJ	26	U	22	U	20	J	22	U	12	U	10	U
Benzene	2	J	16	U	15	U	26	U	3	J	4	J	20	U	12	U	10	U
4-Methyl-2-Pentanone	18	U	16	U	15	U	26	U	22	U	20	UJ	20	UJ	12	U	18	
Toluene	4	J	16	U	2	J	26	U	3	J	6	J	2	J	12	U	10	U
Chlorobenzene	18	U	16	U	15	U	26	U	80		220	J	20	UJ	12	U	10	U
Total TICs	3310	J	28	J	1770	J	2500	J	3690	J	2140	J	3980	J	90	J		
SEMI-VOLATILE ORGANICS	in µg/kg)																(in µg/l)	
2-Methylnaphthalene	6200	U	1000	U	1000	U	17000	U	23000		24000		13000	U	340	J	10	U
3-Nitroaniline	15000	U	2500	UJ	2400	J	41000	UJ	36000	UJ	33000	UJ	31000	UJ	4000	U	25	U
Acenaphthene	2600	J	1000	U	1000	U	3300	J	2300	J	2100	J	13000	U	1300	J	10	U
Dibenzofuran	1700	J	1000	U	1000	U	2500	J	2000	J	2000	J	13000	U	1200	J	10	U
Diethylphthalate	6200	U	1000	U	1000	U	17000	U	15000	U	14000	U	13000	U	1600	U	10	U
Fluorene	2900	J	1000	U	1000	U	5800	J	4200	J	3600	J	1700	J	810	J	10	U
Phenanthrene	5100	J	310	J	640	J	17000	J	10000	J	8700	J	5100	J	2300		10	U
Anthracene	2400	J	1000	U	190	J	3700	J	2200	J	14000	U	13000	U	880	J	10	U
Carbazole	1600	J	1000	UJ	1000	UJ	1900	J	15000	U	14000	U	13000	U	1600	U	10	U
Di-n-butylphthalate	6200	U	1000	U	1000	U	17000	U	15000	U	14000	U	13000	U	1600	U	10	U
Fluoranthene	5100	J	760	J	1600		1900	J	1800	J	1400	J	13000	U	3800		10	U
Pyrene	4200	J	710	J	1300		2100	J	1800	J	1400	J	13000	U	2700		10	U
Benzo (a) anthracene	1600	J	370	J	740	J	17000	U	15000	U	14000	U	13000	U	1300	J	10	U
Chrysene	2000	J	430	J	830	J	17000	U	15000	U	14000	U	13000	U	1300	J	10	U
bis (2-Ethylhexyl) phthalate	730	J	1000	U	1000	U	17000	U	15000	U	14000	U	13000	U	200	J	10	U
Benzo (b) fluoranthene	1300	J	340	J	680	J	17000	U	15000	U	14000	U	13000	U	1200	J	10	U
Benzo (k) fluoranthene	1300	J	310	J	530	J	17000	U	15000	U	14000	U	13000	U	1100	J	10	U
Benzo (a) pyrene	1100	J	320	J	570	J	17000	U	15000	U	14000	U	13000	U	960	J	10	U
Indeno (1,2,3-cd) pyrene	630	J	160	J	280	J	17000	U	15000	U	14000	U	13000	U	240	J	10	U

Table 2-7
Summary of Sediment and Surface Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	SD-1		SD-2		SD-3		SD-4		SD-5		SEDDUP		SD-6		OUTFALL		SURUNF	
Depth Collected	0-2'		0-2'		0-2'		0-2'		0-2'		(Dup. of SD-5)		0-2'		Stockpile			
Date Collected	3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/24/94		3/23/95	
Total TICs	300000	J	6970	J	9960	J	917000	J	928000	J	544000	J	431000	J	51240	J	153	J
PESTICIDE ORGANICS	in µg/kg)																(in µg/l)	
alpha-BHC	6	PJ	2.7	UJ	2.5	UJ	14	PJ	5.3	PJ	3.5	U	4.7	PJ	3.1	PJ	0.051	U
beta-BHC	3.1	UJ	2.7	UJ	2.5	UJ	4.4	U	3.8	UJ	3.5	U	3.3	U	2.4	J	0.051	U
Heptachlor epoxide	3.1	UJ	2.7	UJ	2.5	UJ	9.5	PYJ	3.8	UJ	3.5	U	3.3	U	0.86	JP	0.051	U
Dieldrin	6.1	UJ	2.7	UJ	4.9	UJ	8.5	U	7.3	UJ	6.7	U	6.5	U	5.1	PJ	0.10	U
4,4'-DDE	6.1	UJ	4.1	JP	4.9	UJ	18	PJ	18	J	19		86	PJ	3.1	J	0.10	U
Endrin	5.9	PUJ	5.2	UJ	4.9	UJ	8.5	U	7.3	UJ	6.7	U	6.5	U	6.1	J	0.10	U
4,4'-DDD	6.4	PYJ	5.2	UJ	4.9	UJ	8.5	U	15	PYJ	16	YJ	6.5	U	2.7	JP	0.10	U
4,4'-DDT	6.1	UJ	5.2	UJ	4.9	UJ	27	PYJ	7.3	UJ	8.5	PYJ	6.5	U	4.1	PJ	0.10	UJ
Endrin aldehyde	6.1	UJ	11	PJ	10	PJ	13	PJ	7.3	UJ	6.7	U	6.5	U	1.9	JP	0.10	U
alpha-Chlordane	3.1	UJ	2.7	UJ	2.5	UJ	4.4	U	3.8	UJ	3.5	U	3.3	U	0.92	JP	0.051	U
gamma-Chlordane	3.1	UJ	2.7	UJ	2.5	UJ	4.4	U	3.8	UJ	3.5	U	3.3	U	1.7	JP	0.051	U
PCB COMPOUNDS	(in µg/kg)																(in µg/l)	
Aroclor-1242	61	U	52	U	49	U	85	UJ	73	U	67	U	65	U	87		1.0	U
Aroclor-1248	130		140		94		610	J	190	PJ	260		120				1.0	U
Aroclor-1260	96		43	J	75	PJ	180	PJ	120		130	PJ	80				1.0	U
INORGANIC CONSTITUENTS	in mg/kg)																(in µg/l)	
Aluminum	9810	*J	9570	*J	6620	*J	17900	J*	11500	*J	13200	J*	12500	*J	6430		84.9	B
Antimony	13.6	U	10.9	U	9.8	U	30.7	BJ	16.8	U	15.6	U	13	U	48.2	N*J	38	U
Arsenic	15.1	JN	4.3	JSN	4.2	JSN	11.7	JSN	10	JN	9.3	JN	8.2	JN	8.1		5	U
Barium	108		52.3	B	141		118		79.4	B	81.8	B	89.4		58.6	EJ	32.9	B
Beryllium	1	B	0.68	B	0.62	B	1	B	0.69	B	0.8	B	1.1	B	0.8	U	1	U
Cadmium	1.8	J	1.1	BJ	0.51	U	4.7	J	1.4	BJ	3.8	J	0.69	U	1.2	UJ	2	U
Calcium	11500	*J	4420	*J	7410	J*	8670	J*	7070	J*	4320	J*	5570	J*	9600		26600	
Chromium	65.8	EN*J	46.1	JEN*	31.1	JEN*	316	JEN*	178	JEN*	170	JEN*	86.8	JEN*	55.7	N*J	5	U
Cobalt	12.4	B	7.8	B	7	B	15.2	B	10.8	B	12.1	B	12.2	B	7.7	B	7	U
Copper	216	N*J	59.6	JN*	60.2	JN*	173	JN*	122	JN*	118	JN*	128	JN*	69.7	*	4	U
Iron	36600	*	21200	*	17600	*	35500	*	29600	*	29500	*	31300	*	53000	*J	1080	
Lead	480	J	87.7	J	136	J	189	J	157	J	129	J	136	J	274	*J	3.3	

Table 2-7
Summary of Sediment and Surface Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	SD-1		SD-2		SD-3		SD-4		SD-5		SEDDUP		SD-6		OUTFALL		SURUNF	
Depth Collected	0-2'		0-2'		0-2'		0-2'		0-2'		(Dup. of SD-5)		0-2'		Stockpile			
Date Collected	3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/23/95		3/24/94		3/23/95	
Magnesium	7210		5650		5000		7580		6070		5800		6240		6010		8170	J*
Manganese	593	*	331	*	315	*	564	*	691	*	648	*	861	*	NA		99.2	
Mercury	0.76		1.6		0.89		9.1		12.4		11.9		2.9		360	NJ	0.2	
Nickel	37.4		27.3		13.5		40		25.1		33.2		19.9		25.4	J	27	U
Potassium	2290		1960		1290		3390		1420	B	2210		2300		1630		5400	
Silver	2.2	UJ	1.7	UJN	1.5	UJN	3.1	UJN	2.7	UJN	2.5	UJN	2.1	UJN	1.3	U	9.4	B
Sodium	677	B	570	B	535	B	920	B	1020	B	1060	B	693	B	315	B	32500	J*
Vanadium	35.5		27.3		19		56.2		34.6		38.6		38.7		15.4		15	U
Zinc	380	J	130	JN*	189	JN*	430	JN*	297	JN*	275	JN*	253	JN*	271	N*J	14.9	B
MISCELLANEOUS																		
Total Organic Carbon (mg/kg)	239678	J	25100	J	15604	J	141596	J	132717	J	81371		91247	J	NA		NA	
Percent Solids (%)	54.1		63.8		66.6		38.6		45.2		55.3		50.7		NA		NA	

Table 2-7
Summary of Sediment and Surface Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	SURDUP (Dup. of SURUNF)		SURFIL	
Depth Collected				
Date Collected	3/23/95		3/23/95	
VOLATILE ORGANIC COMPOUNDS				
Acetone	10	U		
Carbon Disulfide	10	U		
2-Butanone	10	U		
Carbon Tetrachloride	10	U		
Benzene	10	U		
4-Methyl-2-Pentanone	10			
Toluene	10	U		
Chlorobenzene	10	U		
Total TICs				
SEMI-VOLATILE ORGANICS				
2-Methylnaphthalene	10	U	10	U
3-Nitroaniline	25	U	25	U
Acenaphthene	10	U	10	U
Dibenzofuran	10	U	10	U
Diethylphthalate	1	J	2	J
Fluorene	10	U	10	U
Phenanthrene	10	U	10	U
Anthracene	10	U	10	U
Carbazole	10	U	10	U
Di-n-butylphthalate	10	U	2	J
Fluoranthene	10	U	10	U
Pyrene	10	U	10	U
Benzo (a) anthracene	10	U	10	U
Chrysene	10	U	10	U
bis (2-Ethylhexyl) phthalate	10	U	10	U
Benzo (b) fluoranthene	10	U	10	U
Benzo (k) fluoranthene	10	U	10	U
Benzo (a) pyrene	10	U	10	U
Indeno (1,2,3-cd) pyrene	10	U	10	U

Table 2-7
Summary of Sediment and Surface Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	SURDUP (Dup. of SURUNF)		SURFIL	
Depth Collected				
Date Collected	3/23/95		3/23/95	
Total TICs	76	J	222	J
PESTICIDE ORGANICS				
alpha-BHC	0.053	U	0.054	U
beta-BHC	0.053	U	0.054	U
Heptachlor epoxide	0.053	U	0.054	U
Dieldrin	0.11	U	0.11	U
4,4'-DDE	0.11	U	0.11	U
Endrin	0.11	U	0.11	U
4,4'-DDD	0.11	U	0.11	U
4,4'-DDT	0.11	UJ	0.11	UJ
Endrin aldehyde	0.11	U	0.11	U
alpha-Chlordane	0.053	U	0.054	U
gamma-Chlordane	0.053	U	0.054	U
PCB COMPOUNDS				
Aroclor-1242	1.1	U	1.1	U
Aroclor-1248	1.1	U	1.1	U
Aroclor-1260	1.1	U	1.1	U
INORGANIC CONSTITUENTS				
Aluminum	131	B	24	U
Antimony	38	U	38	U
Arsenic	5	U	5	U
Barium	30.6	B	37.6	B
Beryllium	1	U	1	U
Cadmium	2.9	BJ	2	U
Calcium	30000		30000	
Chromium	5	U	5	U
Cobalt	7	U	7	U
Copper	4	U	4	U
Iron	1140		690	
Lead	3.4		3	UW

Table 2-7
Summary of Sediment and Surface Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	SURDUP (Dup. of SURUNF)		SURFIL	
Depth Collected				
Date Collected	3/23/95		3/23/95	
Magnesium	13700	J*	9390	J*
Manganese	125		146	
Mercury	0.2	U	0.2	U
Nickel	27	U	27	U
Potassium	5620		4640	B
Silver	6	U	6	U
Sodium	85600	J*	47300	J*
Vanadium	15	U	15	U
Zinc	5	U	5	U
MISCELLANEOUS				
Total Organic Carbon (mg/kg)	NA		NA	
Percent Solids (%)	NA		NA	

Table 2-7
Summary of Sediment and Surface Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

ORGANIC QUALIFIERS

U	Indicates that the compound was analyzed for but was not detected.
J	Indicates an estimated value. The compound meets the identification criteria but the result is less than the sample quantitiation limit but greater than zero.
P	Indicates a pesticide/Aroclor target analyte where there is greater than 25% difference for detected concetrations between the two GC columns.
B	Indicates that the compound is found in the associated blank as well as the sample.
E	Indicates compounds whose concentrations exceeded the calibration range of the GC/MS instrument for that specific analysis.
D	Indicates all compounds identified in an analysis at a secondary dilution factor.

INORGANIC QUALIFIERS

B	The concentration is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).
U	Indicates that the compound was analyzed for but not detected.
E	The reported value is estimated because of the presence of interference.
N	Spiked sample recovery not within control limits.
S	The reported value was determined by Method of Standard Addition (MSA)
*	Duplicate analysis not within control limits.
W	Post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.

SD	Indicates a sediment sample.
SURUNF	Indicates an unfiltered OU-II Croton Bay surface water sample.
SURFIL	Indicates a filtered OU-II Croton Bay surface water sample.
SURDUP	Indicates a duplicate of the unfiltered OU-II Croton Bay surface water sample.

Table 2-8
Summary of Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	NYS Ground Water Standards[1]	WB-1		DUP1 (Dup.WB-1)		WB-2D		WB2-1B		WB-3		WB4-1A	
Date Collected	and Guidance Values[2]	4/11/95		4/11/95		4/11/95		4/11/95		4/11/95		4/11/95	
VOLATILE ORGANIC COMPOUNDS (in µg/l)													
Chloromethane	—	10	U	10	U	10	U	10	U	10	U	10	U
1,2-Dichloroethene (total)		10	U	10	U	10	U	10	U	10	U	10	U
Benzene	0.7	10	U	10	U	10	U	10	U	10	U	10	U
Chlorobenzene	5	10	U	10	U	10	U	62	B	38	B	10	U
Ethylbenzene	5	10	U	10	U	10	U	2	J	10	U	10	U
Xylene (total)	5	10	U	10	U	1	J	9	J	10	U	1	J
Total TICs								384	J	12	J	636	J
SEMI-VOLATILE ORGANICS (in µg/l)													
1,3-Dichlorobenzene	5	10	U	10	U	10	U	1	J	10	U	10	U
1,4-Dichlorobenzene	4.7 **	10	U	10	U	10	U	4	J	2	J	10	U
1,2-Dichlorobenzene	4.7 **	10	U	10	U	1	J	5	J	2	J	10	U
Naphthalene	10 *	10	U	10	U	10	U	10	U	10	U	7	J
2-Methylnaphthalene	—	10	U	10	U	10	U	410	D	10	U	15	
Acenaphthene	—	10	U	10	U	10	U	15		10	U	2	J
Dibenzofuran	—	25	U	10	U	10	U	13		2	J	10	U
Fluorene	50 *	10	U	10	U	10	U	21		2	J	5	J
Phenanthrene	50 *	10	U	10	U	10	U	41		10	U	5	J
Anthracene	50 *	10	U	10	U	10	U	4	J	10	U	10	U
Carbazole		10	U	10	U	10	U	10	U	10	U	10	U
Fluoranthene	50 *	10	U	10	U	10	U	4	J	10	U	10	U
Pyrene	50 *	10	U	10	U	10	U	4	J	10	U	10	U
bis (2-Ethylhexyl) phthalate	50 *	10	U	1	J	12		2	J	3	J	1	J
Total TICs		33	J	31	J	65	J	422	J	81	J	289	J
INORGANIC COMPOUNDS (in µg/l)													
Aluminum	100	4490	*J	3900	J*	316	J*	38900	*J	1190	J*	17000	*J
Arsenic	25	5	UJW	5	UW	5	U	47.2		13.8		6.1	B
Barium	1,000	351		318		282		1400		305		1620	
Beryllium	3 *	1	U	1	U	1	U	3.2	B	1	U	1	B
Cadmium	10	5	UJ	5	UJ	5	UJ	5	UJ	5	UJ	5	UJ
Calcium		244000	JE	238000	JE	124000	JE	143000	JE	158000	JE	509000	JE
Chromium	50	1920	JN*	1120	JN*	17.9	JN*	60.3	JN*	9	BJN	29.6	JN*
Cobalt		11	U	11	U	11	U	112		11	U	43.7	B
Copper	200	159	J*	27.6	J*	32.5	J*	178	J*	39.8	J*	141	J*
Iron	500 **	20700	J*	15500	J*	1300	J*	256000	J*	13000	J*	83700	J*
Lead	25	3.8	JW*	3.2	JW*	3	U*	84.8	JS*	3	U*	52.5	JS*
Magnesium	35,000 *	49900		47600		41900		59600		33200		144000	
Manganese	500 **	537	JE	383	JE	5060	JE	7240	JE	1400	JE	5550	JE
Mercury	2	0.2	U	0.2	U	0.2	U	0.2		0.2	U	0.25	
Nickel		311		214		66		143		33	U	67.3	
Potassium		8170		8500		4010	B	13200		6100		14600	
Silver	50	7	U	7	U	7	U	7	U	7	U	7	U
Sodium	20,000	460000		458000		35800		125000		7670		982000	
Vanadium	14	19.9	B	16.7	B	8	U	209		8	U	86.6	
Zinc	300	72.9		55.4		6	U	282	U	6	U	116	
Cyanide	100	10	U	10	U	10	U	10		10	U	10	U

Table 2-8
Summary of Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	NYS Ground Water Standards[1]	WB-6		WB-7D		WB-8		WB9-2A		MW-2S	
Date Collected	and Guidance Values[2]	4/11/95		4/11/95		4/11/95		4/11/95		4/11/95	
VOLATILE ORGANIC COMPOUNDS (in µg/l)											
Chloromethane	—	10	U	10	UJ	10	U	8	J	10	U
1,2-Dichloroethene (total)		10	U	10	U	10	U	1	J	10	U
Benzene	0.7	10	U	10	U	2	J	3	J	1	J
Chlorobenzene	5	10	U	2	J	10	U	10	U	10	U
Ethylbenzene	5	10	U	10	U	10	U	10	U	10	U
Xylene (total)	5	10	U	10	U	10	U	10	U	10	U
Total TICs								7	J	5	J
SEMI-VOLATILE ORGANICS (in µg/l)											
1,3-Dichlorobenzene	5	10	U	10	U	10	U	10	U	20	U
1,4-Dichlorobenzene	4.7 **	10	U	10	U	10	U	10	U	20	U
1,2-Dichlorobenzene	4.7 **	10	U	4	J	2	J	4	J	3	J
Naphthalene	10 *	10	U	10	U	10	U	10	UJ	20	U
2-Methylnaphthalene	—	10	U	10	U	10	U	2	J	20	U
Acenaphthene	—	10	U	10	U	10	U	10	U	20	U
Dibenzofuran	—	10	U	15		10	U	2	J	15	J
Fluorene	50 *	10	U	21		10	U	2	J	25	
Phenanthrene	50 *	10	U	10	U	10	U	10	U	20	U
Anthracene	50 *	10	U	10	U	10	U	10	U	20	U
Carbazole		10	U	3	J	10	U	10	U	20	U
Fluoranthene	50 *	10	U	10	U	10	U	10	U	20	U
Pyrene	50 *	10	U	10	U	10	U	10	U	20	U
bis (2-Ethylhexyl) phthalate	50 *	2	J	270	D	1	J	10	U	20	U
Total TICs		86	J	360	J	126	J	327	J	217	J
INORGANIC COMPOUNDS (in µg/l)											
Aluminum	100	3740	J*	54.5	BJ*	17100	J*	82900	J*	4020	J*
Arsenic	25	5	UJW	5	U	5	U	20.4		5.4	B
Barium	1,000	215		378		356		184	B	192	B
Beryllium	3 *	1	U	1	U	1	U	3.8	B	1	U
Cadmium	10	5	UJ	5	UJ	5	UJ	5	UJ	5	UJ
Calcium		38200	JE	168000	JE	145000	JE	128000	JE	114000	JE
Chromium	50	355	JN*	9.5	BJN	51.6	JN*	143	JN*	15.8	JN*
Cobalt		11	U	11	U	58.6		49.7	B	16.9	B
Copper	200	80.7	J*	9	U*	76.9	J*	1820	J*	40.9	J*
Iron	500 **	9100	J*	340	J*	32900	J*	124000	J*	22500	J*
Lead	25	42.3	JS*	3.6	J*	10.7	J*	968		3.8	JW*
Magnesium	35,000 *	9300		40900		69100		62700		34400	
Manganese	500 **	165	JE	5440	JE	3170	JE	3930	JE	15000	JE
Mercury	2	0.2	U	0.2	U	0.2	U	0.45		0.2	U
Nickel		197		33	U	147		150		79.2	
Potassium		4600	B	4590	B	6500		10200		3210	B
Silver	50	7	U	7	U	7	U	7	U	7	BJ
Sodium	20,000	1130000		108000		59600		77800		33000	
Vanadium	14	12.8	B	8	U	44	B	266		11.6	B
Zinc	300	51.8		6	U	76.8		528		19.2	B
Cyanide	100	14		10	U	10	U	10	U	10	U

Table 2-8
Summary of Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

ORGANIC QUALIFIERS

- U Indicates that the compound was analyzed for but was not detected.
- J Indicates an estimated value. The compound meets the identification criteria but the result is less than the sample quantitation limit but greater than zero.
- P Indicates a pesticide/Aroclor target analyte where there is greater than 25% difference for detected concetrations between the two GC columns.
- B Indicates that the compound is found in the associated blank as well as the sample.
- E Indicates compounds whose concentrations exceeded the calibration range of the GC/MS instrument for that specific analysis.
- D Indicates all compounds identified in an analysis at a secondary dilution factor.

INORGANIC QUALIFIERS

- B The concentration is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).
- U Indicates that the compound was analyzed for but not detected.
- E The reported value is estimated because of the presence of interference.
- N Spiked sample recovery not within control limits.
- S The reported value was determined by Method of Standard Addition (MSA)
- * Duplicate analysis not within control limits.
- W Post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.

NOTES:

NYSDEC ambient water quality standards and guidance values (November, 1991)
-- indicates no standard or guideline value available for that compound.
* indicates water quality guidance value rather than water quality standard.
** applies to the sum of 1,2-dichlorobenzene and 1,4-dichlorobenzene
*** applies to the sum of iron and manganese

New York ground water standards, as referenced in the NYSDEC *Division of Water Technical and Operational Guidance Series(1.1.1) Ambient Water Quality Standards and Guidance Values*, dated 22 October 1996 (TOGS 1.1.1), are provided. The ground water standards presented in TOGS 1.1.1 are comprised of: (a) the New York State water quality standards for ground water, provided in NYCRR Part 703; and (b) the New York Department of Health (NYSDOH) public drinking water standards, provided in Part 5 of the State Sanitary Code. [The majority of NYSDOH drinking water standards for organic chemicals are based on the general standards for principal organic contaminants (POCs) and unspecified organic contaminants (UOCs). The general standards for POCs and UOCs are 5 μg/l and 50 μg/l, respectively.] The Part 703 water quality standards are the primary source for the New York ground water standards presented in TOGS 1.1.1. However, for chemicals that do not have a Part 703 water quality, the (NYSDOH) public drinking water standard is provided as the New York ground water standard in TOGS 1.1.1.

[2] A ground water standard is not provided in TOGS 1.1.1 for this chemical. Instead, a guidance value is provided.

NR - A ground water standard is not provided for the chemical in TOGS 1.1.1 and the chemical is not regulated by the NYSDOH POC ground water standard.

ND - A standard defined by "ND" means not detectable by the analytical tests specified or approved pursuant to Part 700.

Table 2-9
Water Level Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Water Table Elevation
On-Site Wells				
WB-1	6/3/96	19.69	COULD NOT ACCESS	
WB-1	6/10/96	19.69	12.20	7.49
WB-1	6/24/96	19.69	12.14	7.55
WB2-1B1	1/6/95	21.18	14.76	6.42
WB2-1B1	1/12/95	21.18	14.75	6.43
WB2-1B1	1/18/95	21.18	14.71	6.47
WB2-1B1	2/20/95	21.18	14.92	6.26
WB2-1C	12/9/94	17.38	10.90	6.48
WB2-1C	12/14/94	17.38	10.72	6.66
WB2-1C	12/16/94	17.38	10.78	6.60
WB2-1C	12/21/94	17.38	10.88	6.50
WB2-1C	1/3/95	17.38	11.08	6.30
WB2-1C	1/12/95	17.38	10.99	6.39
WB2-1C	1/18/95	17.38	11.05	6.33
WB2-1C	2/20/95	17.38	11.22	6.16
WB2-2B	12/9/94	17.75	11.62	6.13
WB2-2B	12/14/94	17.75	11.10	6.65
WB2-2B	12/16/94	17.75	11.12	6.63
WB2-2B	12/21/94	17.75	11.21	6.54
WB2-2B	1/3/95	17.75	11.41	6.34
WB2-2B	1/12/95	17.75	11.34	6.41
WB2-2B	1/18/95	17.75	11.42	6.33
WB2-2B	2/20/95	17.75	11.55	6.20
WB2-2C	12/9/94	17.78	11.30	6.48
WB2-2C	12/14/94	17.78	11.17	6.61
WB2-2C	12/16/94	17.78	11.15	6.63
WB2-2C	12/21/94	17.78	11.25	6.53
WB2-2C	1/3/95	17.78	11.44	6.34
WB2-2C	1/12/95	17.78	11.38	6.40
WB2-2C	1/18/95	17.78	11.44	6.34
WB2-2C	2/20/95	17.78	11.59	6.19
WB2-3A	11/23/94	20.45	14.57	5.88
WB2-3A	11/29/94	20.45	14.27	6.18
WB2-3A	12/2/94	20.45	14.13	6.32
WB2-3A	12/9/94	20.45	13.99	6.46
WB2-3A	12/14/94	20.45	13.90	6.55
WB2-3A	12/21/94	20.45	13.94	6.51
WB2-3A	1/3/95	20.45	14.14	6.31
WB2-3A	1/12/95	20.45	14.09	6.36
WB2-3A	1/18/95	20.45	14.14	6.31
WB2-3A	2/20/95	20.45	14.30	6.15
WB-2D	6/3/96		COULD NOT GAUGE	
WB-2D	6/10/96		12.04	
WB-2D	6/24/96		11.95	
WB-3	6/3/96	20.02	13.30	6.72
WB-3	6/10/96	20.02	CASING BENT	

Table 2-9
Water Level Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Water Table Elevation
WB-3	6/24/96	20.02	13.10	6.92
WB4-1A	12/2/94	21.00	14.73	6.27
WB4-1A	12/9/94	21.00	12.62	8.38
WB4-1A	12/14/94	21.00	12.49	8.51
WB4-1A	12/16/94	21.00	14.47	6.53
WB4-1A	12/21/94	21.00	14.65	6.35
WB4-1A	1/3/95	21.00	14.75	6.25
WB4-1A	1/12/95	21.00	14.74	6.26
WB4-1A	1/18/95	21.00	14.70	6.30
WB4-1A	6/3/96	21.00	14.70	6.30
WB4-1A	6/10/96	21.00	NOT GAUGED	
WB4-1A	6/24/96	21.00	NOT GAUGED	
WB4-3A	12/2/94	20.07	13.77	6.30
WB4-3A	12/9/94	20.07	14.62	5.45
WB4-3A	12/14/94	20.07	14.50	5.57
WB4-3A	12/16/94	20.07	13.48	6.59
WB4-3A	12/21/94	20.07	13.63	6.44
WB4-3A	1/3/95	20.07	13.67	6.40
WB4-3A	1/12/95	20.07	13.69	6.38
WB4-3A	1/18/95	20.07	13.68	6.39
WB4-3A	2/20/95	20.07	14.93	5.14
WB4-4C	12/8/94	20.43	14.00	6.43
WB4-4C	12/9/94	20.43	13.98	6.45
WB4-4C	12/14/94	20.43	13.82	6.61
WB4-4C	12/16/94	20.43	13.83	6.60
WB4-4C	12/21/94	20.43	13.93	6.50
WB4-4C	1/3/95	20.43	14.09	6.34
WB4-4C	1/12/95	20.43	14.05	6.38
WB4-4C	1/18/95	20.43	14.04	6.39
WB4-4C	2/20/95	20.43	14.28	6.15
WB4-4D	12/8/94	20.02	13.60	6.42
WB4-4D	12/9/94	20.02	13.52	6.50
WB4-4D	12/14/94	20.02	13.44	6.58
WB4-4D	12/16/94	20.02	13.41	6.61
WB4-4D	12/21/94	20.02	13.56	6.46
WB4-4D	1/3/95	20.02	13.69	6.33
WB4-4D	1/12/95	20.02	13.61	6.41
WB4-4D	1/18/95	20.02	13.65	6.37
WB4-4D	2/20/95	20.02	13.90	6.12
WB5-2B	12/16/94	16.74	9.90	6.84
WB5-2B	12/22/94	16.74	10.04	6.70
WB5-2B	1/6/95	16.74	10.20	6.54
WB5-2B	1/12/95	16.74	10.15	6.59
WB5-2B	1/18/95	16.74	10.10	6.64
WB5-2B	2/20/95	16.74	10.41	6.33
WB5-3B3	12/16/94	14.82	8.12	6.70
WB5-3B3	12/22/94	14.82	8.31	6.51
WB5-3B3	1/6/95	14.82	8.46	6.36
WB5-3B3	1/12/95	14.82	8.38	6.44

Table 2-9
Water Level Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Water Table Elevation
WB5-3B3	1/18/95	14.82	8.35	6.47
WB5-3B3	2/20/95	14.82	8.55	6.27
WB-6D	6/3/96	12.09	COULD NOT LOCATE	
WB-6D	6/10/96	12.09	6.23	5.86
WB-6D	6/24/96	12.09	NOT GAUGED	
WB-7D	6/3/96	13.10	6.79	6.31
WB-7D	6/10/96	13.10	7.00	6.10
WB-7D	6/24/96	13.10	6.88	6.22
WB-8	6/3/96	12.65	COULD NOT GAUGE	
WB-8	6/10/96	12.65	8.29	4.36
WB-8	6/24/96	12.65	8.19	4.46
WB9-1B	12/16/94	15.44	11.63	3.81
WB9-1B	12/21/94	15.44	11.55	3.89
WB9-1B	1/3/95	15.44	11.65	3.79
WB9-1B	1/13/95	15.44	11.70	3.74
WB9-1B	1/18/95	15.44	11.71	3.73
WB9-1B	2/20/95	15.44	11.99	3.45
WB9-1C	12/16/94	15.92	11.90	4.02
WB9-1C	12/21/94	15.92	12.04	3.88
WB9-1C	1/3/95	15.92	12.13	3.79
WB9-1C	1/13/95	15.92	12.18	3.74
WB9-1C	1/18/95	15.92	12.17	3.75
WB9-1C	2/20/95	15.92	12.52	3.40
WB9-2A	12/2/94	13.89	8.86	5.03
WB9-2A	12/9/94	13.89	8.81	5.08
WB9-2A	12/14/94	13.89	8.70	5.19
WB9-2A	12/16/94	13.89	8.59	5.30
WB9-2A	12/21/94	13.89	8.82	5.07
WB9-2A	1/3/95	13.89	8.79	5.10
WB9-2A	1/13/95	13.89	8.84	5.05
WB9-2A	1/18/95	13.89	8.81	5.08
WB9-2A	6/3/96	11.14	COULD NOT LOCATE	
WB9-2A	6/10/96	11.14	CASING BENT	
WB9-2A	6/24/96	11.14	NOT GAUGED	
WB-10	6/3/96	13.06	CASING BENT	
TB1-2C	12/21/94	22.21	18.27	3.94
TB1-2C	12/22/94	22.21	18.27	3.94
TB1-2C	1/3/95	22.21	18.36	3.85
TB1-2C	1/13/95	22.21	18.40	3.81
TB1-2C	1/18/95	22.21	18.40	3.81
TB1-2C	2/20/95	22.21	18.69	3.52
TB1-3A	12/20/94	19.86	15.72	4.14
TB1-3A	12/21/94	19.86	15.68	4.18
TB1-3A	12/22/94	19.86	15.67	4.19
TB1-3A	1/3/95	19.86	15.73	4.13
TB1-3A	1/13/95	19.86	15.80	4.06

Table 2-9
Water Level Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Water Table Elevation
TB1-3A	1/18/95	19.86	15.80	4.06
TB1-3A	2/20/95	19.86	16.06	3.80
TB1-4A	12/21/94	17.43	13.52	3.91
TB1-4A	12/22/94	17.43	13.53	3.90
TB1-4A	1/3/95	17.43	13.59	3.84
TB1-4A	1/13/95	17.43	13.61	3.82
TB1-4A	1/18/95	17.43	13.58	3.85
TB1-4A	2/20/95	17.43	13.91	3.52
TB-2	12/2/94		9.05	
TB-2	12/9/94		9.03	
TB-2	12/14/94		8.80	
TB-2	12/16/94		8.81	
TB-2	1/3/95		9.09	
TB-2	1/13/95		9.06	
TB-2	1/18/95		8.96	
TB-2	2/20/95		3.92	
TB-4	12/9/94	13.94	7.34	6.60
TB-4	12/14/94	13.94	7.17	6.77
TB-4	12/16/94	13.94	7.26	6.68
TB-4	1/3/95	13.94	7.39	6.55
TB-4	1/13/95	13.94	7.40	6.54
TB-4	1/18/95	13.94	7.17	6.77
TB-4	2/20/95	13.94	7.75	6.19
TB6-1B1B1	1/6/95	24.97	18.82	6.15
TB6-1B1B1	1/12/95	24.97	18.73	6.24
TB6-1B1B1	1/18/95	24.97	18.69	6.28
TB6-1B1B1	6/24/96	19.11	COULD NOT LOCATE	
TB6-1C	12/14/94	17.39	10.78	6.61
TB6-1C	12/16/94	17.39	10.80	6.59
TB6-1C	12/22/94	17.39	10.99	6.40
TB6-1C	1/6/95	17.39	11.13	6.26
TB6-1C	1/12/95	17.39	11.03	6.36
TB6-1C	1/18/95	17.39	11.03	6.36
TB6-1C	2/20/95	17.39	11.25	6.14
TB6-2A	12/14/94	14.57	7.73	6.84
TB6-2A	12/16/94	14.57	7.85	6.72
TB6-2A	12/22/94	14.57	8.07	6.50
TB6-2A	1/6/95	14.57	8.21	6.36
TB6-2A	1/12/95	14.57	8.15	6.42
TB6-2A	1/18/95	14.57	8.09	6.48
TB6-2A	2/20/95	14.57	8.30	6.27
TB6-3A	12/14/94	15.26	8.52	6.74
TB6-3A	12/16/94	15.26	8.57	6.69
TB6-3A	12/22/94	15.26	8.78	6.48
TB6-3A	1/6/95	15.26	8.92	6.34
TB6-3A	1/12/95	15.26	8.86	6.40
TB6-3A	1/18/95	15.26	8.82	6.44
TB6-3A	6/3/96	13.46	DESTROYED	

Table 2-9
Water Level Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Water Table Elevation
MW-2S	6/3/96	12.76	COULD NOT LOCATE	
MW-2S	6/24/96	12.76	DESTROYED	
MW-3S	6/24/96	12.84	8.31	4.53
Off-Site Wells				
WEST OF LAGOON				
OS-N	5/1/96	16.69		
OS-N	5/8/96	16.69	12.76	3.93
OS-N	5/13/96	16.69	12.77	3.92
OS-N	6/3/96	16.69	13.37	3.32
OS-N	6/24/96	16.69	13.03	3.66
MW-B	10/25/95	16.51	6.65	9.86
MW-B	6/3/96	16.51	16.35	0.16
MW-B	6/10/96	16.51	16.24	0.27
MW-B	6/24/96	16.51	6.22	10.29
MW-C	10/25/95	19.68	15.18	4.50
MW-C	6/3/96	19.68	COULD NOT LOCATE	
MW-C	6/10/96	19.68	16.12	3.56
MW-C	6/24/96	19.68	16.00	3.68
MW-D	10/25/95	19.93	13.62	6.31
MW-D	6/3/96	19.93	14.08	5.85
MW-D	6/10/96	19.93	13.44	6.49
MW-D	6/24/96	19.93	13.35	6.58
MW-10	10/25/95	16.93	11.10	5.83
MW-10	6/3/96	16.93	LOCATED, COULD NOT ACCESS	
MW-10	6/10/96	16.93	11.05	5.88
MW-10	6/24/96	16.93	10.98	5.95
SOUTH OF LAGOON				
OS-A	2/7/96	17.66	7.55	10.11
OS-A	2/27/96	17.66	9.96	7.70
OS-A	3/19/96	17.66	10.05	7.61
OS-A	5/1/96	17.66	10.19	7.47
OS-A	5/8/96	17.66	10.32	7.34
OS-A	5/13/96	17.66	10.30	7.36
OS-A	6/3/96	17.66	10.76	6.90
OS-A	6/10/96	17.66	10.66	7.00
OS-A	6/24/96	17.66	10.44	7.22
OS-FS	2/7/96	17.67	7.40	10.27
OS-FS	2/27/96	17.67	9.77	7.90
OS-FS	3/19/96	17.67	9.81	7.86
OS-FS	5/1/96	17.67	10.00	7.67
OS-FS	5/8/96	17.67	10.08	7.59
OS-FS	5/13/96	17.67	10.03	7.64
OS-FS	6/3/96	17.67	10.45	7.22
OS-FS	6/10/96	17.67	10.38	7.29
OS-FS	6/24/96	17.67	10.29	7.38
OS-G	2/7/96	17.56	7.30	10.26

Table 2-9
Water Level Measurements
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Monitoring Well No.	Date Monitored	Meas. Point Elevation	Depth to Water (ft.)	Water Table Elevation
OS-G	2/27/96	17.56	9.92	7.64
OS-G	3/19/96	17.56	9.69	7.87
OS-G	5/1/96	17.56	9.73	7.83
OS-G	5/8/96	17.56	9.98	7.58
OS-G	5/13/96	17.56	9.99	7.57
OS-G	6/3/96	17.56	10.62	6.94
OS-G	6/10/96	17.56	10.53	7.03
OS-G	6/24/96	17.56	10.42	7.14
OS-H	2/7/96	15.61	5.20	10.41
OS-H	2/27/96	15.61	6.90	8.71
OS-H	3/19/96	15.61	7.02	8.59
OS-H	5/1/96	15.61	6.85	8.76
OS-H	5/8/96	15.61	7.35	8.26
OS-H	5/13/96	15.61	7.20	8.41
OS-H	6/3/96	15.61	8.49	7.12
OS-H	6/10/96	15.61	8.32	7.29
OS-H	6/24/96	15.61	8.00	7.61
OS-I	5/1/96	15.93	8.44	7.49
OS-I	5/8/96	15.93	8.59	7.34
OS-I	5/13/96	15.93	8.56	7.37
OS-I	6/3/96	15.93	9.14	6.79
OS-I	6/10/96	15.93	9.00	6.93
OS-I	6/24/96	15.93	8.80	7.13
OS-J	5/1/96	15.79	8.37	7.42
OS-J	5/8/96	15.79	8.51	7.28
OS-J	5/13/96	15.79	8.53	7.26
OS-J	6/3/96	15.79	9.04	6.75
OS-J	6/10/96	15.79	8.92	6.87
OS-J	6/24/96	15.79	8.74	7.05
OS-K	5/1/96	16.21	8.94	7.27
OS-K	5/8/96	16.21	9.01	7.20
OS-K	5/13/96	16.21	9.03	7.18
OS-K	6/3/96	16.21	9.52	6.69
OS-K	6/10/96	16.21	9.39	6.82
OS-K	6/24/96	16.21	9.25	6.96
OS-L	5/1/96	16.71	9.14	7.57
OS-L	5/8/96	16.71	9.47	7.24
OS-L	5/13/96	16.71	9.50	7.21
OS-L	6/3/96	16.71	10.08	6.63
OS-L	6/10/96	16.71	10.01	6.70
OS-L	6/24/96	16.71	9.86	6.85
OS-M	5/1/96	16.23		
OS-M	5/8/96	16.23	8.21	8.02
OS-M	5/13/96	16.23	8.03	8.20
OS-M	6/3/96	16.23	8.80	7.43
OS-M	6/10/96	16.23	8.74	7.49
OS-M	6/24/96	16.23	8.64	7.59

Table 3-1
Comparison of OU-II and Historical PCB Concentrations in NAPL
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	WB-2						WB-2-1A		WB-4						WB4-4A		WB-5					
Date Collected	7/90		2/22/91		3/23/95		3/23/95		7/90		6/13/91		3/23/95		3/23/95		7/90		2/22/91		3/23/95	
PCB COMPOUNDS (in mg/kg)																						
Aroclor 1242	–		12	U	2.2	J	2.4	J	–		–		1.0	UJ	1.0	UJ	–		12.0	U	1.0	UJ
Aroclor 1248	–		12	U	1.0	UJ	1.0	UJ	–		–		1.0	UJ	1.0	UJ	–		12.0	U	1.0	UJ
Aroclor 1254	–		12	U	1.0	UJ	1.0	UJ	–		19.0		2.9	J	1.0	UJ	–		119.0		23.0	J
Aroclor 1260	–		12	U	1.4	J	1.4	J	–		–		1.0	UJ	1.0	UJ	–		12.0	U	1.0	UJ
TOTAL					3.6		3.8				19.0		2.9						119.0		23.0	

Sample Number	DUP OF WB-5		WB-9						TB-1-1A1A		TB-6-1B1		OS-C		OS-F		OS-O		WB-9-3C2A	
Date Collected	3/23/95		8/90		2/22/91		3/23/95		3/23/95		3/23/95		3/19/96		3/19/96		5/31/96		5/31/96	
PCB COMPOUNDS (in mg/kg)																				
Aroclor 1016	1.0	UJ	–		12.0	U	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1221	1.0	UJ	–		12.0	U	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1232	1.0	UJ	–		12.0	U	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1242	1.0	UJ	–		12.0	U	2.3	J	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1248	1.0	UJ	–		12.0	U	1.0	UJ	1.0	UJ	1.0	UJ	1.3	J	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1254	21.0	J	–		12.0	U	4.9	J	1.0	UJ	1.0	UJ	1.0	UJ	1.0	UJ	2.5	U	1.0	UJ
Aroclor 1260	1.0	UJ	–		12.0	U	1.0	UJ	1.9	J	1.4	J	1.4	J	1.0	J	2.5	U	1.0	UJ
TOTAL	21.0						7.2		1.9		1.4		2.7		1.0					

QUALIFIERS

U - Indicates that the compound was analyzed for but was not detected.

J - Indicates an estimated value. The compound meets the identification criteria but the result is < than the sample quantitation limit but > than zero.

UJ - The laboratory reported these values as non-detect, but during data validation analysis of the MS/MSD suggested that there was a potential low bias and the presence or absence of these compounds cannot be confirmed.

– indicates that the compound was not analyzed for.

Table 3
Comparison of OU-II and Yard Investigation Soil Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

	Yard Investigation 1994 (1)					OU-II 1995				
	No. of Samples	No. of Detections	Frequency of Detection	Minimum (ug/kg)	Maximum (ug/kg)	No. of Samples	No. of Detections	Frequency of Detection	Minimum (ug/kg)	Maximum (ug/kg)
Volatile Organic Compounds, in µg/kg										
Methylene Chloride	33	1	3%	3.00	3	62	0	0%		
Acetone	33	1	3%	120B	120B	62	6	10%	1	37
Carbon Disulfide	33	4	12%	2.00	3	62	0	0%		
1,2-Dichloroethene (total)*	33	1	3%	7.00	7	62	0	0%		
2-Butanone	33	1	3%	82B	82B	62	0	0%		
1,1,1-Trichloroethane	33	1	3%	3.00	3	62	0	0%		
Trichloroethene	33	1	3%	3.00	3	62	0	0%		
Benzene	33	6	18%	6.00	210	62	0	0%		
4-Methyl-2-Pentanone	NR					62	1	2%	130	130
2-Hexanone	33	2	6%	4.00	28	62	0	0%		
Tetrachloroethene	33	1	3%	6.00	6	62	0	0%		
1,1,2,2-Tetrachloroethane	33	2	6%	1.00	2	62	0	0%		
Toluene	33	14	42%	2.00	3800B	62	9	15%	1	88
Chlorobenzene	33	1	3%	2.00	2	62	0	0%		
Ethylbenzene	33	9	27%	3.00	2800	62	1	2%	27	27
Xylene (total)	33	12	36%	4.00	39000	62	7	11%	1	150
Semi-Volatile Organics, in µg/kg										
1,2-Dichlorobenzene	33	1	3%	200	200	62	0	0%		
Naphthalene	33	16	48%	63	27000	62	17	27%	71	2700
2-Methylnaphthalene	33	24	73%	51	96000	62	37	60%	43	77000
Acenaphthylene	33	9	27%	36	870	62	6	10%	76	670
Acenaphthene	33	15	45%	28	5200	62	15	24%	240	10000
Dibenzofuran	33	19	58%	60	7200	62	15	24%	120	5800
Fluorene	33	9	27%	43	12000	62	21	34%	41	13000
Pentachlorophenol	33	1	3%	8000	8000	62	0	0%		
Phenanthrene	33	27	82%	26	25000	62	39	63%	52	34000
Anthracene	33	22	67%	30	2800	62	18	29%	39	6900
Carbazole	33	11	33%	37	3400	62	4	6%	51	200
Di-n-butylphthalate	33	12	36%	71	360	62	1	2%	200	200
Fluoranthene	33	19	58%	28	5600	62	35	56%	40	11000
Pyrene	33	27	82%	26	7000	62	36	58%	63	13000
Benzo (a) anthracene	33	16	48%	37	4300	62	27	44%	40	5800
Chrysene	33	17	52%	48	3900	62	30	48%	47	6500
bis (2-Ethylhexyl) phthalate	33	4	12%	45	190	62	6	10%	37	260
Di-n-octylphthalate	33	1	3%	530	530	62	0	0%		
Benzo (b) fluoranthene	33	13	39%	31	3800	62	25	40%	55	5300
Benzo (k) fluoranthene	33	12	36%	140	4500	62	23	37%	40	2800

Table 3

Comparison of OU-II and Yard Investigation Soil Sampling Results

Harmon Railroad Yard Wastewater Treatment Area Operable Unit II

Croton-on-Hudson, NY

	Yard Investigation 1994 (1)					OU-II 1995				
	No. of Samples	No. of Detections	Frequency of Detection	Minimum (ug/kg)	Maximum (ug/kg)	No. of Samples	No. of Detections	Frequency of Detection	Minimum (ug/kg)	Maximum (ug/kg)
Benzo (a) pyrene	33	11	33%	92	3500	62	24	39%	48	3000
Indeno (1,2,3-cd) pyrene	33	11	33%	57	1200	62	17	27%	43	1700
Dibenz (a,h) anthracene	33	8	24%	35	480	62	0	0%		
Benzo (g,h,i) perylene	33	10	30%	42	1600	62	18	29%	44	1700
Total TICs									92	822000
Pesticides (in µg/kg)										
alpha-BHC	33	10	30%	0.53	5.3	62	2	3%	3.1	4.3
beta-BHC	33	1	3%	0.20	0.2	62	3	5%	2.1	5.3
delta-BHC	NR					62	1	2%	1.3	1.8
gamma-BHC (Lindane)	33	14	42%	0.61	10	62	0	0%		
Heptachlor	33	3	9%	0.31	4.4	62	14	23%	1.6	7
Aldrin	33	7	21%	0.53	15	62	7	11%	3.3	10
Heptachlor epoxide	33	19	58%	0.72	13	62	6	10%	1	6.1
Endosulfan I	33	8	24%	0.64	12	62	1	2%	2.4	2.4
Dieldrin	33	10	30%	0.50	45	62	2	3%	2.1	2.7
4,4'-DDE	33	10	30%	0.24	16	62	2	3%	2.4	4.9
Endrin	33	23	70%	1.50	89	62	12	19%	4.1	22
Endosulfan II	33	27	82%	0.37	120	62	7	11%	4.8	24
4,4'-DDD	33	16	48%	1.10	15	62	3	5%	4.1	6.3
Endosulfan sulfate	33	1	3%	6.90	6.9	62	3	5%	2.9	8.7
4,4'-DDT	33	13	39%	1.70	29	62	18	29%	2.2	48
Methoxychlor	NR					62	13	21%	12	65
Endrin ketone	33	13	39%	0.69	35	62	12	19%	3.4	53
Endrin aldehyde	33	14	42%	1.80	85	62	1	2%	3.9	3.9
alpha-Chlordane	33	2	6%	3.00	3.8	62	1	2%	8.9	8.9
gamma-Chlordane	33	8	24%	10	0.39	62	2	3%	1.5	3.5
PCB COMPOUNDS (in µg/kg)										
Aroclor-1248	33	2	6%	29	65	62	0	0%		
Aroclor-1254	33	2	6%	27	81	62	0	0%		
Aroclor-1260	33	17	52%	5.2	280	62	7	11%	15	68
Total (surface)										
Total (subsurface)										
Total Organic Carbon (in mg/kg)	33	33	100%	640.00	630000	62	62	100%	2073	282481
Grain Size???										

Notes:

(1) ERM-Northeast, 1995. Field Investigation Report, Harmon Railroad Yard. April 1995.

NR - Not Reported on Summary Table, assume there were no detections.

Table 3

Comparison of OU-II, Croton Point Landfill, and Background Sediment Data
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

	Croton Point Sanitary Landfill RI					Iona Marsh	OU-II Croton Bay Sediment					OUTFALL
	No. of Samples	No. of Detections	Frequency of Detection	Minimum (1) (ug/kg)	Maximum (2) (ug/kg)		No. of Samples	No. of Detections	Frequency of Detection	Minimum (1) (ug/kg)	Maximum (2) (ug/kg)	(ug/kg)
VOLATILE ORGANIC COMPOUNDS (in μg/kg)												
Acetone	18	2	11%	4	260	64	6	6	100%	2	98	12 U
Carbon Disulfide	18	1	6%	ND	7	ND	6	0	0%	15 UJ	26U	12 U
2-Butanone	18	1	6%	3.5	23	0.026	6	4	67%	15	35	12 UJ
Carbon Tetrachloride	18	0	0%	ND	ND	ND	6	0	0%	15 UJ	26 U	12 U
Benzene	18	0	0%	ND	ND	ND	6	2	33%	2	3	12 U
Toluene	18	3	17%	2.5	92	ND	6	4	67%	2	4	12 U
Chlorobenzene	18	0	0%	ND	ND	ND	6	1	17%	80	80	12 U
SEMI-VOLATILE ORGANICS (in μg/kg)												
2-Methylnaphthalene	18	0	0%	ND	ND	130	6	1	17%	23000	23000	340
3-Nitroaniline	18	0	0%	ND	ND	ND	6	1	17%	2400	2400	4000 U
Acenaphthene	18	0	0%	ND	ND	160	6	3	50%	2300	3300	1300
Dibenzofuran	18	0	0%	ND	ND	120	6	3	50%	1700	2500	1200
Fluorene	18	1	6%	ND	160	210	6	4	67%	1700	5800	810
Phenanthrene	18	9	50%	72	1200	1400	6	6	100%	310	17000	2300
Anthracene	18	3	17%	80	270	880	6	4	67%	190	3700	880
Carbazole	18	0	0%	ND	ND	ND	6	2	33%	1600	1900	1600 U
Fluoranthene	18	10	56%	99	2200	5200	6	5	83%	760	5100	3800
Pyrene	18	10	56%	97	2100	4000	6	5	83%	710	4200	2700
Benzo (a) anthracene	18	9	50%	100	1200	2700	6	3	50%	370	1600	1300
Chrysene	18	9	50%	63	1300	2200	6	3	50%	430	2000	1300
bis (2-Ethylhexyl) phthalate	18	4	22%	85	1300	390	6	1	17%	730	730	200
Benzo (b) fluoranthene	18	7	39%	48	960	1600	6	3	50%	340	1300	1200
Benzo (k) fluoranthene	18	7	39%	100	960	1400	6	3	50%	310	1300	1100
Benzo (a) pyrene	18	9	50%	93	1200	1600	6	3	50%	320	1100	960
Indeno (1,2,3-cd) pyrene	18	9	50%	120	670	1100	6	3	50%	160	630	240
PESTICIDE ORGANICS (in μg/kg)												
alpha-BHC	18	0	0%	ND	ND	ND	6	4	67%	4.7	14	3.1
beta-BHC	18	0	0%	ND	ND	ND	6	0	0%	2.5 U	4.4 U	2.4
Heptachlor epoxide	18	0	0%	ND	ND	ND	6	1	17%	9.5	9.5	0.86
4,4'-DDE	18	0	0%	ND	ND	ND	6	4	67%	4.1	86	3.1
Endrin	18	0	0%	ND	ND		6	0	0%	4.9 U	8.5 U	6.1
4,4'-DDD	18	0	0%	ND	ND	ND	6	2	33%	6.4	15	2.7

Table 3

Comparison of OU-II, Croton Point Landfill, and Background Sediment Data
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

	Croton Point Sanitary Landfill RI					Iona Marsh	OU-II Croton Bay Sediment					OUTFALL
	No. of Samples	No. of Detections	Frequency of Detection	Minimum (1) (ug/kg)	Maximum (2) (ug/kg)		No. of Samples	No. of Detections	Frequency of Detection	Minimum (1) (ug/kg)	Maximum (2) (ug/kg)	(ug/kg)
4,4'-DDT	18	0	0%	ND	ND	ND	6	1	17%	27	27	4.1
Endrin aldehyde	18	0	0%	ND	ND	ND	6	3	50%	10	13	1.9
alpha-Chlordane	18	0	0%				6	0	0%	2.5 U	6.5 U	0.92
PCB COMPOUNDS (in µg/kg)												
Aroclor-1242	18	0	0%				6	0	0%	49 U	85 U	87
Aroclor-1248	18	1	6%	40	540	ND	6	6	100%	94	610	40 UJ
Aroclor-1260	18	0	0%	ND	ND	1300	6	6	100%	43	180	40 UJ
INORGANIC CONSITUENTS (in mg/kg, ppm)												
Aluminum	18	11	61%	740	11700	9475	6	6	100%	6620	17900	6430
Antimony	18	1	6%	246	246	NR	6	1	17%	30.7	30.7	48.2
Arsenic	18	11	61%	1	11	9.1	6	6	100%	4.2	15.1	8.1
Barium	18	11	61%	15	157	68.3	6	6	100%	52.3	141	58.6
Beryllium	18	11	61%	1.6	7.3	3.8	6	6	100%	0.62	1.1	0.8 U
Cadmium	18	8	44%	0.5	4.4	ND	6	4	67%	1.1	4.7	1.2 U
Calcium	18	11	61%	1110	8040	2900	6	6	100%	4420	11500	9600
Chromium	18	11	61%	7.5	68	60.6	6	6	100%	31.1	316	55.7
Cobalt	18	10	56%	1	17	9.4	6	6	100%	7	15.2	7.7
Copper	18	11	61%	19	126	62.8	6	6	100%	59.6	216	69.7
Iron	18	11	61%	7690	34300	26950	6	6	100%	17600	36600	53000
Lead	18	11	61%	15	170	87.9	6	6	100%	87.7	480	274
Magnesium	18	11	61%	2040	7640	5080	6	6	100%	5000	7580	6010
Manganese	18	11	61%	64	720	312	6	6	100%	315	861	NA
Mercury	18	9	50%	0.1	13	0.72	6	6	100%	0.76	12.4	360
Nickel	18	11	61%	7.5	48	19.2	6	6	100%	13.5	40	25.4
Potassium	18	11	61%	279	2100	707	6	6	100%	1290	3390	1630
Sodium	18	10	56%	159	1690	463	6	6	100%	535	1020	315
Vanadium	18	11	61%	8.9	46	34.2	6	6	100%	19	56.2	15.4
Zinc	18	11	61%	59	323	258	6	6	100%	130	430	271

Notes:

(1) Concentration listed is the minimum detected concentration.

(2) Concentration listed is maximum detected concentration.

Detection limits for certain compounds were higher in some samples than the highest concentration in other samples.

Table 3-4
Evaluation of Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

	OU-II 1995						
	No. of Samples	No. of Detections	Frequency of Detection	Minimum (µg/l)	Maximum (µg/l)	95% CI (µg/l)	NYS STD (1) (µg/l)
VOLATILE ORGANIC COMPOUNDS (in µg/l)							
Chloromethane	11	1		8	8	6	50
1,2-Dichloroethene (total)	11	1	9%	1	1	1	5
Benzene	11	3	27%	1	3	3	0.7
Chlorobenzene	11	3	27%	2	62	26	5
Ethylbenzene	11	1	9%	2	2	2	5
Xylene (total)	11	3	27%	1	9	6	15 (2)
SEMI-VOLATILE ORGANICS (in µg/l)							
1,3-Dichlorobenzene	11	1	9%	1	1	1	5
1,4-Dichlorobenzene	11	2	18%	2	4	4	4.7
1,2-Dichlorobenzene	11	7	64%	1	5	4	4.7
Naphthalene	11	1	9%	7	7	7	50
2-Methylnaphthalene	11	3	27%	2	410	126	50
Acenaphthene	11	2	18%	2	15	8	50
Dibenzofuran	11	5	45%	2	15	11	50
Fluorene	11	5	45%	2	25	15	50
Phenanthrene	11	2	18%	5	41	16	50
Anthracene	11	1	9%	4	4	4	50
Carbazole	11	1	9%	3	3	3	5
Fluoranthene	11	1	9%	4	4	4	50
Pyrene	11	1	9%	4	4	4	50
bis (2-Ethylhexyl) phthalate	11	8	73%	1	270	83	50
INORGANIC COMPOUNDS (i	11						
Aluminum	11	11	100%	54.5	82900	33158	
Arsenic	11	5	45%	5.4	47.2	19	25
Barium	11	11	100%	184	1620	853	1000
Beryllium	11	3	27%	1	3.8	2	3
Calcium	11	11	100%	38200	509000	256001	
Chromium	11	11	100%	9	1920	628	50
Cobalt	11	5	45%	16.9	112	53	
Copper	11	10	91%	27.6	1820	600	200
Iron	11	11	100%	340	256000	106294	300
Lead	11	9	82%	3.2	968	303	15
Magnesium	11	11	100%	9300	144000	76734	35000
Manganese	11	11	100%	165	15000	7408	300
Mercury	11	3	27%	0.2	0.45	0	2
Nickel	11	9	82%	66	311	176	
Potassium	11	11	100%	3210	14600	10009	
Silver	11	1	9%	7	7	7	50
Sodium	11	11	100%	7670	1130000	561642	20000
Vanadium	11	8	73%	11.6	266	125	250
Zinc	11	7	64%	19.2	528	219	300
Cyanide	11	2	18%	10	14	8	100

Notes:

CI - Confidence Interval

NYS STD - New York State Standard

(1) The standards noted in this column were derviced from the 6NYCRR Part 703.5, 15 September 1991 and 10 NYCRR Part 5, Subpart 5.1, 6 January 1993.

(2) The reference standard is 5 µg/l for each xylene isomer.

Table 3-5
Comparison of OU-II and Historical Ground Water Sampling Results Harmon Railroad Yard Wastewater Treatment Area Operable Unit II Croton-on-Hudson, NY

Sample Number	NYS Ground Water Standards[1] and	WB-1						WB-2D						WB-3					
Date Collected	Guidance Values[2]	1989		1990		4/11/95		1989		1990		4/11/95		1989		1990		4/11/95	
VOLATILE ORGANIC COMPOUNDS (in µg/l)																			
Benzene	0.7			5	U	10	U			5	U	10	U			5	U	10	U
Chlorobenzene	5			5	U	10	U	11		10		10	U	170		70		38	B
Xylene (total)	5					10	U					1	J	ND		5	U	10	U
Total TICs																		12 J	
SEMI-VOLATILE ORGANICS (in µg/l)																			
1,4-Dichlorobenzene	4.7 **		U			10	U	1	Q	11	U	10	U		U			2	J
1,2-Dichlorobenzene	4.7 **		U			10	U	10	Q	6	Q	1	J		U			2	J
Naphthalene	10 *		U		X	10	U					10	U		U	11	U	10	U
2-Methylnaphthalene	--		U		X	10	U	U		11	U	10	U		U	11	U	10	U
Dibenzofuran	--		U		X	25	U		U	11	U	10	U		U	4	Q	2	J
Fluorene	50 *		U		X	10	U		U	11	U	10	U		U	4	Q	2	J
Phenanthrene	50 *		U		X	10	U		U	11	U	10	U		U	11	U	10	U
Carbazole						10	U					10	U					10	U
Butylbenzylphthalate	50 *		U			10	U					10	U		U	11	U	10	UJ
bis (2-Ethylhexyl) phthalate	50 *	2	Q	120		10	U		UFB	11	U	12			U	11	U	3	J
Di-n-octylphthalate	50 *		U			10	UJ					10	U		U			10	U
PESTICIDES/PCBs (in µg/l)																			
Heptachlor	ND			0.056	U	0.050	U			0.055	U	0.050	U	0.3	U	0.11		0.050	U
Heptachlor epoxide	ND			0.056	U	0.050	U	0.3	U	0.055	U	0.050	U	0.3	U	0.054	U	0.050	U
4,4'-DDE	ND			0.11	U	0.10	U	0.6	U	0.11	U	0.10	U	0.6	U	0.11	U	0.10	U
Endosulfan II	0.009			0.11	U	0.10	U			0.11	U	0.10	U	0.6	U	0.11	U	0.10	U
4,4'-DDD	ND			0.11	U	0.10	U	0.6	U	0.24		0.10	U			0.11	U	0.10	U
INORGANIC COMPOUNDS (in µg/l)																			
Aluminum	100		U	26.7		4490	*J	231		35.7	Q	316	J*		U	50.8	Q	1190	J*
Antimony	3 *			20.8		47	UJ			14.1	U	47	UJ			14.1	U	47	UJ
Arsenic	25		U	13		5	UJW			0.80	Q	5	U	6	Q	16.2		13.8	
Barium	1,000	178	Q	282		351		241		199	Q	282		290		249		305	
Cadmium	10	2.1	Q			5	UJ	1.2	Q			5	UJ	1.9	Q			5	UJ
Calcium		287000		676000		244000	JE	113000		112000		124000	JE	174000		148000		158000	JE
Chromium	50		U			1920	JN*		U			17.9	JN*		U			9	BJN*
Cobalt				3	U	11	U		U	13.5	Q	11	U			3.2	Q	11	U
Copper	200					159	J*					32.5	J*					39.8	J*

Table 3-5
Comparison of OU-II and Historical Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	NYS Ground Water Standards[1] and	WB-1						WB-2D						WB-3					
Date Collected	Guidance Values[2]	1989		1990		4/11/95		1989		1990		4/11/95		1989		1990		4/11/95	
Iron	500 ***	602		110	U	20700	J*	52.5		110	U	1300	J*	6600		16400		13000	J*
Lead	25		U	1	U	3.8	JW*		U	1	U	3	U*		U	1	U	3	U*
Magnesium	35,000 *	49500		96400		49900		39400		34400		41900		27400		25200		33200	
Manganese	500 **	191		150	J	537	JE	2590		3600	J	5060	JE	3800		3420	J	1400	JE
Mercury	2	0.21	FB			0.2	U	0.39				0.2	U	0.78	FB			0.2	U
Nickel		485		117		311		43.6		34.8	Q	66			U	9.9	Q	33	U
Potassium		10500		16500		8170		6680		3620	Q	4010	B	8050		6580		6100	
Selenium	10			1.8	Q	5	UJWN					5	UJN			80	U	5	UJN
Silver	50			1.8	U	7	U			3.80		7	U			1.8	U	7	U
Sodium	20,000	423000		1640000		460000				36100		35800		12000		9640		7670	
Thallium	4 *		U	12	Q	5	U			0.74	U	5	U		U	0.74	U	5	U
Vanadium	14			3.2	Q	19.9	B			2.3	U	8	U			8.4	Q	8	U
Zinc	300	26.7		480	U	72.9		30.3	FB	480	U	6	U		U	480	U	6	U
Cyanide	100					10	U					10	U					10	U

Table 3-5
Comparison of OU-II and Historical Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	NYS Ground Water Standards[1] and	WB-6						WB-7D						WB-8					
Date Collected	Guidance Values[2]	1989		1990		4/11/95		1989		1990		4/11/95		1989		1990		4/11/95	
VOLATILE ORGANIC COMPOUNDS (in µg/l)																			
Benzene	0.7			5	U	10	U			2	Q	10	U			2	Q	2	J
Chlorobenzene	5			5	U	10	U			4	Q	2	J	6		6		10	U
Xylene (total)	5			5	U	10	U					10	U		ND	5	U	10	U
Total TICs																			
SEMI-VOLATILE ORGANICS (in µg/l)																			
1,4-Dichlorobenzene	4.7 **		U			10	U		U		X	10	U		U			10	U
1,2-Dichlorobenzene	4.7 **		U			10	U		U		X	4	J		U			2	J
Naphthalene	10 *		U		X	10	U					10	U		U	11		10	U
2-Methylnaphthalene	–	13	Q		X	10	U	3	Q		X	10	U		U	11		10	U
Dibenzofuran	–		U		X	10	U	14	Q	23	J	15			U	11	U	10	U
Fluorene	50 *	5	Q		X	10	U	26		40	J	21			U	11	U	10	U
Phenanthrene	50 *	3	Q		X	10	U		U	3	Q	10	U		U	11	U	10	U
Carbazole						10	U					3	J					10	U
Butylbenzylphthalate	50 *		U		X	10	U					10	U		U	4	Q	10	U
bis (2-Ethylhexyl) phthalate	50 *		U		X	2	J	57	FB		X	270	D	19	Q	11	U	1	J
Di-n-octylphthalate	50 *		U			10	UJ					10	UJ	3	Q			10	UJ
PESTICIDES/PCBs (in µg/l)																			
Heptachlor	ND	0.3	U	0.062	U	0.050	U			0.068	U	0.050	U	0.1	U	0.06	U	0.050	U
Heptachlor epoxide	ND	0.3	U	0.062	U	0.050	U	0.1	U	0.20		0.050	U	0.1	U	0.06	U	0.050	U
4,4'-DDE	ND	0.6	U	0.12	U	0.10	U	0.2	U	0.17		0.10	U	0.2	U	0.11	U	0.10	U
Endosulfan II	0.009	0.6	U	0.12	U	0.10	U			0.14	U	0.10	U	0.2	U	0.18		0.10	U
4,4'-DDD	ND			0.12	U	0.10	U	0.2	U	0.14	U	0.10	U			0.11	U	0.10	U
INORGANIC COMPOUNDS (in µg/l)																			
Aluminum	100		U	37	Q	3740	J*		U	43.2	Q	54.5	BJ*		U	45.7	Q	17100	J*
Antimony	3 *			14.1	U	47	UJ			18.8	Q	47	UJ			14.8	Q	47	UJ
Arsenic	25		U	3.6	Q	5	UJW			1.8	Q	5	U		U	1.4	Q	5	U
Barium	1,000	64.4	Q	85.6	Q	215		182	Q	262		378		158	Q	210		356	
Cadmium	10		U			5	UJ	1.4	Q			5	UJ		U			5	UJ
Calcium		65000		28600		38200	JE	94100		116000		168000	JE	101000		111000		145000	JE
Chromium	50		U			355	JN*	10				9.5	BJN*		U			51.6	JN*
Cobalt				3.00	U	11	U		U	8.9	Q	11	U			17.8	Q	58.6	
Copper	200					80.7	J*					9	U*					76.9	J*

Table 3-5

Comparison of OU-II and Historical Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

Sample Number	NYS Ground Water Standards[1] and	WB-6						WB-7D						WB-8					
Date Collected	Guidance Values[2]	1989		1990		4/11/95		1989		1990		4/11/95		1989		1990		4/11/95	
Iron	500 ***		U	110	U	9100	J*	176		5.8		340	J*	80.7	Q	228		32900	J*
Lead	25		U	1.00	U	42.3	JS*		U	1	U	3.6	J*		U	17	U	10.7	J*
Magnesium	35,000 *	13200		5920		9300		42900		47000		40900		40500		51700		69100	
Manganese	500 **	887		228	J	165	JE	1130		3590	J	5440	JE	2180		2930	J	3170	JE
Mercury	2	0.35	FB			0.2	U		U			0.2	U		UFB			0.2	U
Nickel			U	6.7	U	197		64.4		56.5		33	U	60.1		52.6		147	
Potassium		1810	Q	2510	Q	4600	B	100000		13500		4590	B	5070		4130	Q	6500	
Selenium	10			0.80	U	10	UN					5	UJN			0.8	U	5	UJN
Silver	50			1.8	U	7	U			3.9	Q	7	U			3.8	Q	7	U
Sodium	20,000	19600		308000		1130000				61600		108000		62600		76200		59600	
Thallium	4 *		U	0.74	U	5	UJW			1.4	Q	5	U		U	0.74	U	5	U
Vanadium	14			3.2	Q	12.8	B			2.3	U	8	U			2.3	U	44	B
Zinc	300		U	480	U	51.8		46.2	FB	480	U	6	U	48.1		480	U	76.8	
Cyanide	100					14						10	U					10	U

Notes:

(1) Fred C. Hart Associates, Inc., 1989. Remedial Investigation Report, Harmon Lagoon, Croton-on-Hudson, New York, 27 November 1989.

(2) McLaren-Hart, 1991. Ground Water Sampling Report, Harmon Lagoon, Croton-on-Hudson, New York. 22 May 1991.

Table 3-5
Comparison of OU-II and Historical Ground Water Sampling Results
Harmon Railroad Yard Wastewater Treatment Area Operable Unit II
Croton-on-Hudson, NY

X	Data unusable
U	Indicates that the compound was analyzed for but was not detected.
J	Indicates an estimated value. The compound meets the identification criteria but the result is less than the sample quantitiation limit but greater than zero.
P	Indicates a pesticide/Aroclor target analyte where there is greater than 25% difference for detected concetrations between the two GC columns.
B	Indicates that the compound is found in the associated blank as well as the sample.
E	Indicates compounds whose concentrations exceeded the calibration range of the GC/MS instrument for that specific analysis.
D	Indicates all compounds identified in an analysis at a secondary dilution factor.

INORGANIC QUALIFIERS

FB	Invalid due to Field Blank contamination
B	The concentration is less than the Contract Required Detection Limit (CRDL) but greater than or equal to the Instrument Detection Limit (IDL).
U	Indicates that the compound was analyzed for but not detected.
E	The reported value is estimated because of the presence of interference.
N	Spiked sample recovery not within control limits.
S	The reported value was determined by Method of Standard Addition (MSA)
*	Duplicate analysis not within control limits.
W	Post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.

NOTES:

NYSDEC ambient water quality standards and guidance values (November, 1991)

-- indicates no standard or guideline value available for that compound.

* indicates water quality guidance value rather than water quality standard.

** applies to the sum of 1,2-dichlorobenzene and 1,4-dichlorobenzene

*** applies to the sum of iron and manganese

New York ground water standards, as referenced in the NYSDEC *Division of Water Technical and Operational Guidance Series(1.1.1) Ambient Water Quality Standards and Guidance Values,* dated 22 October 1996 (TOGS 1.1.1), are provided. The ground water standards presented in TOGS 1.1.1 are comprised of: (a) the New York State water quality standards for ground water, provided in NYCRR Part 703; and (b) the New York Department of Health (NYSDOH) public drinking water standards, provided in Part 5 of the State Sanitary Code. [The majority of NYSDOH drinking water standards for organic chemicals are based on the general standards for principal organic contaminants (POCs) and unspecified organic contaminants (UOCs). The general standards for POCs and UOCs are 5 $\mu g/l$ and 50 $\mu g/l$, respectively.] The Part 703 water quality standards are the primary source for the New York ground water standards presented in TOGS 1.1.1. However, for chemicals that do not have a Part 703 water quality, the (NYSDOH) public drinking water standard is provided as the New York ground water standard in TOGS 1.1.1.

[1] A ground water standard is not provided in TOGS 1.1.1 for this chemical. Instead, a guidance value is provided.

NR - A ground water standard is not provided for the chemical in TOGS 1.1.1 and the chemical is not regulated by the NYSDOH POC ground water standard.

ND - A standard defined by "ND" means not detectable by the analytical tests specified or approved pursuant to Part 700.

TABLE 4-1
COMPARISON OF HARMON YARD CROTON BAY OU-II, CROTON POINT LANDFILL (CPLF), AND BACKGROUND SEDIMENT DATA
HARMON YARD OU-II RI/FS

CHEMICALS DETECTED IN SEDIMENT	HARMON YARD OU-II NO. OF SAMPLES	HARMON YARD OU-II 95% UCL (1)	CROTON POINT LANDFILL, CROTON MARSH 95% UCL (2)	IONA MARSH BACKGROUND SAMPLE, CPLF RI/FS (3)
VOLATILE ORGANIC COMPOUNDS (in µg/kg)				
Acetone	6	76	79	64
Carbon Disulfide	6	3	7*	ND
2-Butanone	6	27	18	0.026
Carbon Tetrachloride	6	12	ND	ND
Benzene	6	4	ND	ND
Toluene	6	6	20	ND
Chlorobenzene	6	113	ND	ND
SEMI-VOLATILE ORGANICS (in µg/kg)				
2-Methylnaphthalene	6	14259	72*	130
3-Nitroaniline	6	2400	ND	ND
Acenaphthene	6	3300	ND	160
Dibenzofuran	6	2500	42*	120
Fluorene	6	4298	160*	210
Phenanthrene	6	11406	520	1400
Anthracene	6	3700	175	880
Carbazole	6	1900	ND	ND
Fluoranthene	6	4777	1096	5200
Pyrene	6	4512	982	4000
Benzo (a) anthracene	6	1600	554	2700
Chrysene	6	2000	634	2200
bis (2-Ethylhexyl) phthalate	6	730	571	390
Benzo (b) fluoranthene	6	1300	514	1600
Benzo (k) fluoranthene	6	1300	469	1400
Benzo (a) pyrene	6	1100	566	1600
Indeno (1,2,3-cd) pyrene	6	630	365	1100
PESTICIDE ORGANICS (in µg/kg)				
alpha-BHC	6	9	ND	ND
Heptachlor epoxide	6	5	ND	ND
4,4'-DDE	6	48	ND	ND
4,4'-DDD	6	10	ND	ND
4,4'-DDT	6	16	ND	ND
Endrin aldehyde	6	11	ND	ND
PCB COMPOUNDS (in µg/kg)				
Aroclor-1248	6	383	139	ND
Aroclor-1260	6	139	ND	1300
INORGANIC CONSTITUENTS (in mg/kg, ppm)				
Aluminum	6	14703	7486	9475
Arsenic	6	12	6	9.1
Barium	6	123	62	68.3
Beryllium	6	1	5	3.8
Cadmium	6	3	2	ND
Calcium	6	9424	4368	2900
Chromium	6	208	48	60.6
Cobalt	6	14	10	9.4
Copper	6	176	82	62.8
Iron	6	34786	23974	26950
Lead	6	311	84	87.9
Magnesium	6	7062	5336	5080
Manganese	6	728	382	312
Mercury	6	9	3	0.72
Nickel	6	37	26	19.2
Potassium	6	2784	1268	707
Sodium	6	996	957	463
Vanadium	6	46	32	34.2
Zinc	6	374	204	258

* Maximum detected concentration. Detection limit not available to calculate 95% UCL.

NOTES

(1) If 95% UCL exceeds the maximum reported concentration, the maximum reported value is shown.

(2) Values represent the 95% UCL on the mean for concentrations detected in sediment samples in Croton Marsh

(3) Westchester County Department of Public Works, Remedial Investigation Report for Croton Point Sanitary Landfill, June 1993.

[shaded box] Exceeds Croton Point Landfill and background sediment sample concentrations.

Table 4-2
Comparison of OU-II Croton Bay Sediment Data to NYSDEC Sediment Criteria (1)
Organic Chemicals of Concern
Harmon Yard OU-II RI/FS

	95% UCL OU-II	*NYSDEC SALT WATER SEDIMENT CRITERIA (ug/gOC)*			
CHEMICAL OF	*SEDIMENT*	*HUMAN HEALTH*	*BENTHIC AQUATIC LIFE TOXICITY*		*WILDLIFE*
CONCERN	*DATA (4)*	*BIOACCUMULATION*	*ACUTE*	*CHRONIC*	*BIOACCUMULATION*
VOLATILE ORGANIC COMPOUNDS (ug/gOC)					
2-Butanone	0.37				
Carbon Tetrachloride	0.25	0.6 (3)			
Benzene	0.02	0.6 (3)			
Chlorobenzene	1.52		34.6 (3)	3.5 (3)	
SEMI-VOLATILE ORGANICS (in ug/gOC)					
2-Methylnaphthalene	177.31				
3-Nitroaniline	153.81				
Acenaphthene	25.81			240	
Dibenzofuran	24.58				
Fluorene	38.93				
Phenanthrene	99.47			160	
Anthracene	26.13				
Carbazole	13.42				
Bis (2-Ethylhexyl) phthalate	3.05			199.5 (4)	
PESTICIDE ORGANICS (in ug/gOC)					
alpha-BHC	0.08				
Heptachlor epoxide	0.07	0.008	1.3	0.09	0.03
4,4'-DDE	0.34	0.01			
4,4'-DDD	0.15	0.01			
4,4'-DDT	0.15	0.01	130	1	
Endrin aldehyde	0.43				
PCB COMPOUNDS (in ug/gOC)					
Aroclor-1248	5.25	0.0008	13803.8	41.4	1.4

ug/gOC = microgram per gram organic carbon
(1) NYSDEC's Technical Guidance for Screening Contaminated Sediments (NYSDEC, 1993).
(2) 95% Upper Confidence Level on the mean of reported concentrations (ug/kg) divided by the sample-specific organic carbon content (mgOC/kg) and a conversion factor.
If 95%UCL exceeded maximum reported concentration, maximum reported concentration is shown.
(3) NYSDEC Criteria is for both fresh water and salt water.
(4) NYSDEC criteria for fresh water. Salt water criteria not available.
Note: Blank cells indicate no NYSDEC criteria available
[shaded] 95% UCL OU-II sediment concentration exceeds NYSDEC sediment criteria.

Table 4-3
Comparison of OU-II Croton Bay Sediment Data to NOAA Screening Guidelines
Organic Chemicals of Concern for Which NYSDEC Sediment Criteria are Not Available
Harmon Yard OU-II RI/FS

CHEMICAL OF CONCERN	*95% UCL OU-II SEDIMENT DATA (1)*	*NOAA SCREENING GUIDELINES*	
		ER-L (ug/kg)	*ER-M (ug/kg)*
2-Methylnaphthalene	14259	70	670
Fluorene	4298	19	540
Anthracene	5711	85.3	1100

(1) If 95%UCL exceeded maximum reported concentration, maximum reported concentration is shown.
Note: Blank cells indicate no NYSDEC criteria available
[shaded] 95% UCL OU-II sediment concentration exceeds NOAA guideline.

Table 4-4
Comparison of OU-II Croton Bay Sediment Data to NYSDEC Sediment Criteria
Inorganic Chemicals of Concern
Harmon Yard OU-II RI/FS

CHEMICAL OF CONCERN	*95% UCL OU-II SEDIMENT DATA (1) (mg/kg)*	*NYSDEC SEDIMENT CRITERIA (2)*	
		LOEL (3) (mg/kg)	*SEVERE EFFECT LEVEL (mg/kg)*
Aluminum	*14703*		
Arsenic	*12*	6	33
Barium	*123*		
Cadmium	*3*	0.6	9
Calcium	*9424*		
Chromium	*208*	26	110
Cobalt	*14*		
Copper	*176*	16	110
Iron	*34786*	20000	40000
Lead	*311*	31	110
Magnesium	*7062*		
Manganese	*728*	460	1100
Mercury	*9*	0.15	1.3
Nickel	*37*	16	50
Potassium	*2715*		
Sodium	*982*		
Vanadium	*43*		
Zinc	*1760*	120	270

Notes:
[shaded] Exceeds NYSDEC sediment criteria.
Blank cells indicate no sediment criteria available..
(1) If 95%UCL exceeded maximum reported concentration, maximum reported concentration is shown.
(2) NYSDEC, Technical Guidance for Screening Contaminated Sediments, November 1993.
(3) LOEL= Lowest Observable Effects Level

Table 4-5
Comparison of Harmon Yard OU-II and Croton Point Landfill (CPLF) Surface Water Data
Inorganics
Harmon Yard OU-II RI/FS

INORGANIC CONSTITUENTS	*MAXIMUM CONCENTRATION IN OU-II RI - SPRING 1995*		*MAXIMUM CONCENTRATION IN CPLF RI- SPRING 1989 (1)*
Aluminum	131	B	729
Barium	37.6	B	258
Cadmium	2.9	BJ	ND
Calcium	30000		26700
Iron	1140		2200
Lead	3.4		18
Magnesium	13700	J*	44600
Manganese	146		414
Mercury	0.2		ND
Potassium	5620		11800
Silver	9.4	B	<10
Sodium	85600	J*	104000
Zinc	14.9	B	296

All concentrations shown in ug/L.
B: The concentration is lessl than the Contract Required Detection Limit (CRDL) but greater than of equal to the Instrument Detection Limit (IDL).
J: Indicates an estimated value.
U: Indicates that the compound was anlayzed for but not detected.
* Duplicate analysis not within control limits.
(1) Westchester County Department of Public Works, Remedial Investigation Report for Croton Point Sanitary Landfill, June 1993.

Table 4-6

Concentration/Toxicity Screen of Potential Chemicals of Concern in Ground Water

Metro-North Harmon Yard OU-II RI/FS

POTENTIAL CHEMICAL OF CONCERN	MAXIMUM DETECTED CONCENTRATION IN GROUND WATER	*Toxicity Values*		*Risk Factors (RF)*		*Risk Ratios (RR)*	
		Reference Dose (mg/kg/day)	*Carcinogenic Potency Slope (mg/kg/day)-1*	*Non- Carc. RF =Max. x 1/Reference Dose*	*Carc. RF = Max. x Potency Factor*	*Non-Carc.RR = Non-Carc.RF / Non-Carc. RF Sum*	*Carc. RR = Carc. RF / Carc. RF Sum*
VOLATILE ORGANIC COMPOUNDS (in µg/l)							
Chloromethane	8		1.30E-02		0.10		0.001
1,2-Dichloroethene (total)	5	9.00E-03		5.56E+02		0.000	
Benzene	5	1.71E-03	2.90E-02	2.92E+03	0.15	0.001	0.002
Chlorobenzene	62	2.00E-02		3.10E+03		0.001	
Ethylbenzene	5	1.00E-01		5.00E+01		0.000	
Xylene (total)	9	2		4.50E+00		0.000	
SEMI-VOLATILE ORGANICS (in µg/l)							
1,3-Dichlorobenzene	10	8.90E-02		1.12E+02		0.000	
1,4-Dichlorobenzene	10	2.29E-01	2.40E-02	4.37E+01	0.24	0.000	0.003
1,2-Dichlorobenzene	5	9.00E-02		5.56E+01		0.000	
Naphthalene	10	4.00E-02		2.50E+02		0.000	
2-Methylnaphthalene	410						
Acenaphthene	15	6.00E-02		2.50E+02		0.000	
Dibenzofuran	15	4.00E-03		3.75E+03		0.002	
Fluorene	25	4.00E-02		6.25E+02		0.000	
Phenanthrene	41						
Anthracene	10	3.00E-01		3.33E+01		0.000	
Carbazole	10		2.00E-02		0.20		0.002
Fluoranthene	10	4.00E-02		2.50E+02		0.000	
Pyrene	10	3.00E-02		3.33E+02		0.000	
bis (2-Ethylhexyl) phthalate	270	2.00E-02	1.40E-02	1.35E+04	4	0.006	0.041
INORGANIC CONSTITUENTS (in µg/l)							
Aluminum	82900	1		8.29E+04		0.036	
Arsenic	47	3.00E-04	1.5	1.57E+05	71	0.069	0.773
Barium	1620	7.00E-02		2.31E+04		0.010	
Beryllium	4	5.00E-03	4.30E+00	7.60E+02	16	0.000	0.178
Calcium	509000						
Chromium	1920	5.00E-03		3.84E+05		0.168	
Cobalt	112	6.00E-02		1.87E+03		0.001	
Copper	1820	4.00E-02		4.55E+04		0.020	
Iron	256000	3.00E-01		8.53E+05		0.373	
Lead	968						
Magnesium	144000						
Manganese	15000	2.30E-02		6.52E+05		0.285	
Mercury	0.45	3.00E-04		1.50E+03		0.001	
Nickel	311	2.00E-02		1.56E+04		0.007	
Potassium	14600						
Silver	7	5.00E-03		1.40E+03		0.001	
Sodium	1130000						
Vanadium	266	7.00E-03		3.80E+04		0.017	
Zinc	528	3.00E-01		1.76E+03		0.001	
Cyanide	14	2.00E-02		7.00E+02		0.000	
				Sum	Sum		
				2285757.39	91.61		

Table 4-7
Concentration/Toxicity Screen of Volatile Organic Compounds (VOCs) in Ground Water
Metro-North Harmon Yard OU-II RI/FS

POTENTIAL VOLATILE CHEMICAL OF CONCERN	MAXIMUM DETECTED CONCENTRATION IN GROUND WATER (ug/L)	Toxicity Values		Screening Factors (SF)		Screening Ratios (SR)	
		Noncarcinogenic Reference Dose (mg/kg/day)	Carcinogenic Potency Slope (mg/kg/day)-1	Noncarc. SF = Max. x 1/Reference Dose	Carc. SF = Max x Potency Slope	Noncarc. SR = Noncarc. SF/ Noncarc. SF Sum	Carc. SR = Carc. SF/ Carc. SF Sum
Chloromethane	8		1.30E-02		0.10		0.418
1,2-Dichloroethene (total)	5	9.00E-03		555.56		0.084	
Benzene	5	1.71E-03	2.90E-02	2923.98	0.15	0.441	0.582
Chlorobenzene	62	2.00E-02		3100.00		0.467	
Ethylbenzene	5	1.00E-01		50.00		0.008	
Xylene (total)	9	2		4.50		0.001	
SUM				6634.03	0.25		

Table 4-8
Maximum and 95% Upper Confidence Level on the Arithmetic Mean Concentrations of Chemicals of Concern in Ground Water (For Evaluation of Human Health Risks)
Metro-North Harmon Yard OU-II RI/FS

CHEMICAL OF CONCERN	*MAXIMUM DETECTED CONCENTRATION*	*UPPER 95% CONFIDENCE LEVEL ON THE MEAN (1)*
Volatile Organic Compounds (ug/L)		
Chloromethane	8	6
Benzene	3	3
Chlorobenzene	62	26
Semi-Volatile Organic Constituents (ug/L)		
bis (2-Ethylhexyl) phthalate	270	83
Inorganic Constituents (ug/L)		
Aluminum	82900	33158
Arsenic	47	19
Barium	1620	853
Beryllium	4	2
Chromium	1920	628
Copper	1820	600
Iron	256000	106294
Lead	968	303
Manganese	15000	7408
Vanadium	266	125

1 - Values represent the 95% upper confidence level (UCL) on the mean.
If UCL exceeds the maximum reported value, the maximum reported value is shown.

TABLE 4-9
Quantification of Exposure to Volatilized Ground Water Chemicals of Concern in Indoor Air
Metro-North Harmon Yard OU-II RI/FS

Industrial Exposure

Chemicals of Concern	Concentration in Ground Water (mg/l)	Volatilization Factor (mg/m3-air/ mg/l-water)	Predicted Indoor Air Concentration (mg/m3)	Inhalation Rate (m3/day)	Exposure Frequency (days)	Exposure Duration (years)	Body Weight (kg)	Averaging Time		Average Daily Intake		Carcinogenic Potency Factor (mg/kg/d)-1	Non-carcinogenic Reference Dose (mg/kg/d)	Carcinognic Excess Lifetime Risk	Non-carcinogenic Hazard Ratio
								Carcinogenic Averaging Time (days)	Non-carcinogenic (days)	Carcinogenic (mg/kg/day)	Non-carcinogenic (mg/kg/day)				
chloromethane	6.0E-03	5.61E-02	3.37E-04	20.0	250	25	70	25550	9125	2.35E-05	6.59E-05	6.30E-03	–	1.48E-07	–
benzene	3.0E-03	6.64E-03	1.99E-05	20.0	250	25	70	25550	9125	1.39E-06	3.90E-06	1.71E-03	2.90E-02	2.38E-09	1.34E-04
chlorobenzene	2.6E-02	3.97E-03	1.03E-04	20.0	250	25	70	25550	9125	7.21E-06	2.02E-05	–	5.71E-03	–	3.54E-03
													Industrial Subtotal	Excess Lifetime Risk 1.51E-07	Hazard Index 3.67E-03

Future Residential Exposure

Chemicals of Concern	Concentration in Ground Water (mg/l)	Volatilization Factor (mg/m3-air/ mg/l-water)	Predicted Indoor Air Concentration (mg/m3)	Inhalation Rate (m3/day)	Exposure Frequency (days)	Exposure Duration (years)		Body Weight (kg)		Averaging Time		Average Daily Intake		Carcinogenic Potency Factor (mg/kg/d)-1	Non-carcinogenic Reference Dose (mg/kg/d)	Carcinognic Excess Lifetime Risk	Non-carcinogenic Hazard Ratio
						Child	Adult	Child	Adult	Carcinogenic Averaging Time (days)	Non-carcinogenic (days)	Carcinogenic (mg/kg/day)	Non-carcinogenic (mg/kg/day)				
chloromethane	6.0E-03	1.40E-01	8.40E-04	15.0	350	6	24	30	70	25550	2190	9.37E-05	4.03E-04	6.30E-03	–	5.90E-07	–
benzene	3.0E-03	1.66E-02	4.98E-05	15.0	350	6	24	30	70	25550	2190	5.55E-06	2.39E-05	1.71E-03	2.90E-02	9.50E-09	8.23E-04
chlorobenzene	2.6E-02	9.90E-03	2.57E-04	15.0	350	6	24	30	70	25550	2190	2.87E-05	1.23E-04	–	5.71E-03	–	2.16E-02
															Residential Subtotal	Excess Lifetime Risk 6.00E-07	Hazard Index 2.24E-02

Note: Intakes are estimate for a six year child-hood exposure for non-carcinogens and over a 70-year lifetime (6years child, 24 years adult) for carcinogens.

TABLE 4-10

Quantification of Exposure to Chemicals of Concern in Surface Water While Swimming

Metro North Harmon Yard OU-II RI/FS

Incidental Ingestion

Chemical of Concern	Concentration in Ground Water (ug/L)	Concentration in Ground Water (mg/L)	Contact Rate (L/hr)	Exposure Time(2) (hr/event)	Exposure Frequency (2) (events/yr)	Exposure Duration (years)	Body Weight (kg)	Averaging Time: Carcinogenic Averaging Time (days)	Averaging Time: Non-carcinogenic (days)	Average Daily Intake: Carcinogenic (mg/kg/day)	Average Daily Intake: Non-carcinogenic (mg/kg/day)	Carcinogenic Potency Factor (mg/kg/d)-1	Non-carcinogenic Reference Dose (mg/kg/d)	Carcinognic Excess Lifetime Risk	Non-carcinogenic Hazard Ratio
aluminum	33158.0	3.32E+01	0.05	0.5	5	30	70	25550	10950	6.95E-05	1.62E-04	–	1		1.6E-04
arsenic	19.4	1.94E-02	0.05	0.5	5	30	70	25550	10950	4.06E-08	9.47E-08	1.5	0.0003	6.1E-08	3.2E-04
barium	853.4	8.53E-01	0.05	0.5	5	30	70	25550	10950	1.79E-06	4.17E-06	–	0.07		6.0E-05
beyllium	1.9	1.89E-03	0.05	0.5	5	30	70	25550	10950	3.96E-09	9.24E-09	4.3	0.005	1.7E-08	1.8E-06
chromium	628.0	6.28E-01	0.05	0.5	5	30	70	25550	10950	1.32E-06	3.07E-06	–	5.0E-03		6.1E-04
copper	599.9	6.00E-01	0.05	0.5	5	30	70	25550	10950	1.26E-06	2.93E-06	–	4.00E-02		7.3E-05
iron	106293.8	1.06E+02	0.05	0.5	5	30	70	25550	10950	2.23E-04	5.20E-04	–	3.00E-01		1.7E-03
manganese	7408.0	7.41E+00	0.05	0.5	5	30	70	25550	10950	1.55E-05	3.62E-05	–	5.0E-03		7.2E-03
vanadium	124.9	1.25E-01	0.05	0.5	5	30	70	25550	10950	2.62E-07	6.11E-07	–	7.00E-03		8.7E-05
chloromethane	6.0	6.00E-03	0.05	0.5	5	30	70	25550	10950	1.26E-08	2.94E-08	1.3E-02		1.6E-10	
benzene	3.0	3.00E-03	0.05	0.5	5	30	70	25550	10950	6.29E-09	1.47E-08	2.9E-02		1.8E-10	
chlorobenzene	26.0	2.60E-02	0.05	0.5	5	30	70	25550	10950	5.45E-08	1.27E-07	–	2.0E-02		6.4E-06
bis 2-ethylhexyl phthalate	83.0	8.30E-02	0.05	0.5	5	30	70	25550	10950	1.74E-07	4.06E-07	0.014	2.0E-02	2.4E-09	2.0E-05
														Excess Cancer	Hazard Index
													Incidental Ingestion Subtotal	8.06904E-08	1.0E-02

Dermal Absorption

Chemical of Concern	Ground Water Exposure Point Concentration (mg/L)	Skin Surface Area Available (cm2)	Dermal Permeability Constant(1) (cm/hr)	Converson Factor (L/cm3)	Exposure Time (hr/event)	Exposure Frequency (events/yr)	Exposure Duration (years)	Body Weight (kg)	Averaging Time: Carcinogenic Averaging Time (days)	Averaging Time: Non-carcinogenic (days)	Average Daily Dose: Carcinogenic (mg/kg/day)	Average Daily Dose: Non-carcinogenic (mg/kg/day)	Carcinogenic Potency Factor (mg/kg/d)-1 (3)	Non-carcinogenic Reference Dose (mg/kg/d) (3)	Carcinognic Excess Lifetime Risk	Non-carcinogenic Hazard Ratio
Inorganics																
aluminum	3.32E+01	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	3.20E-08	7.46E-08	–	0.05		1.5E-06
arsenic	1.94E-02	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	1.87E-11	4.36E-11	30	0.000015	5.6E-10	2.9E-06
barium	8.53E-01	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	8.23E-10	1.92E-09	–	0.0035		5.5E-07
beyllium	1.89E-03	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	1.82E-12	4.25E-12	86	0.005	1.6E-10	8.5E-10
chromium	6.28E-01	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	6.06E-10	1.41E-09	–	2.5E-04		5.7E-06
copper	6.00E-01	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	5.79E-10	1.35E-09	–	2.00E-03		6.7E-07
iron	1.06E+02	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	1.03E-07	2.39E-07	–	1.50E-02		1.6E-05
manganese	7.41E+00	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	7.14E-09	1.67E-08	–	2.3E-03		7.2E-06
vanadium	1.25E-01	2.3E+04	0.001	1.0E-06	0.5	5	30	70	25550	10950	1.20E-10	2.81E-10	–	3.50E-04		8.0E-07

Organics			Absorbed Dose/ Day(1) (mg/cm2/day)	Kp (cm/hr)	tau (hr)	tau*	B	Conversion Factor (L/cm3)	tau event	Exposure Frequency (events/yr)	Exposure Duration (years)	Body Weight (kg)	Averaging Time: Carcinogenic Averaging Time (days)	Averaging Time: Non-carcinogenic (days)	Average Daily Dose: Carcinogenic (mg/kg/day)	Average Daily Dose: Non-carcinogenic (mg/kg/day)	Carcinogenic Potency Factor (mg/kg/d)-1 (3)	Non-carcinogenic Reference Dose (mg/kg/d) (3)	Carcinognic Excess Lifetime Risk	Non-carcinogenic Hazard Ratio
chloromethane	6.0E-03	2.3E+04	2.2E-11	4.2E-03	1.8E-01	4.3E-01	8.1E-04	1.0E-06	0.50	5	30	70	25550	10950	4.2E-11	9.8E-11	2.6E-01	–	1.1E-11	
benzene	3.0E-03	2.3E+04	6.3E-11	2.1E-02	2.6E-01	6.3E-01	1.3E-02	1.0E-06	0.50	5	30	70	25550	10950	1.2E-10	2.8E-10	5.8E-01	–	7.0E-11	
chlorobenzene	2.6E-02	2.3E+04	1.4E-09	4.1E-02	4.3E-01	1.0E+00	6.9E-02	1.0E-06	0.50	5	30	70	25550	10950	2.6E-09	6.1E-09	–	1.0E-03		6.1E-06
bis 2-ethylhexyl phthalate	8.3E-02	2.3E+04	2.5E-08	3.3E-02	2.1E+01	1.0E+02	1.3E+01	1.0E-06	0.50	5	30	70	25550	10950	4.7E-08	1.1E-07	0.014	1.0E-03	6.6E-10	1.1E-04
																			Excess Cancer	Hazard Index
																		Dermal Subtotal	1.5E-09	1.5E-04

(1) Dermal Exposure Assessment Principles and Applications (EPA, 1992). p. 5-49.

(2)Dermal Exposure Assessment Principles and Applications (EPA, 1992). p.8-8.

(3) Toxicity Factors modified for absorbed dose where necessary.

Note: Intakes estimated for adult exposure for both carcinogens and non-caricnogens. Most conservative exposure due to skin-surface area factor for adults.

Table 4-11
Predicted Concentrations in Surface Water from OU-II Ground Water
Comparison to Federal Ambient Water Quality Criteria for Human Ingestion of Organisms
Metro-North Harmon Yard OU-II RI/FS

Chemical of Concern in Ground Water	*Maximum Ground Water Concentration at OU-II*	*Predicted Concentration in Hudson River Based on Dilution Factor*	*Federal Ambient Water Quality Criteria (Human Ingestion of Organisms) (1)*
Volatile Organics			
chloromethane	8	1.0E-04	1.4 (3)
benzene	3	3.9E-05	71
chlorobenzene	62	0.001	21,000
Semi-Volatile Organics			
bis(2-ethylhexyl) phthalate	270	0.004	4.8 (2)
Inorganics			
aluminum	82900	1.076	37000 (3)
arsenic	47.2	0.001	0.14
barium	1620	0.021	1000 (3)
beryllium	3.8	0.0000	0.06
chromium	1920	0.025	3,400
copper	1820	0.024	1500 (2)
iron	256000	3.323	300 (3)
lead	968	0.013	50 (3)
manganese	15000	0.195	100
vanadium	266	0.003	260 (3)

All concentrations in ug/l.

(1) USEPA, 1992. 40 CFR Part 131.

(2) No water quality criteria available. Value shown is EPA Region 3 Risk-Based Concentration for tap water.

(3) Value is based on ingestion of water and organisms.

Table 4-12
Predicted Concentrations of OU-II Ground Water Discharging to Surface Water and Comparison to NYSDEC Surface Water Quality Standards
Metro-North Harmon Yard OU-II RI/FS

Chemical of Concern in Ground Water	*Maximum Ground Water Concentration at OU-II*	*Concentrations in Hudson River Due to Discharge of OU-II*	*NYSDEC Surface Water Quality Standard(1)*
Date Collected			
VOLATILE ORGANIC COMPOUNDS (in µg/l)			
Chloromethane	8	0.0001	NA
1,2-Dichloroethene (total)	5	0.0001	22400 (3)
Benzene	5	0.0001	700 (2)
Chlorobenzene	62	0.0008	5
Ethylbenzene	5	0.0001	430 (3)
Xylene (total)	9	0.0001	6000 (4)
SEMI-VOLATILE ORGANICS (in µg/l)			
1,3-Dichlorobenzene	10	0.0001	5
1,4-Dichlorobenzene	10	0.0001	5
1,2-Dichlorobenzene	5	0.0001	5
Naphthalene	10	0.0001	2350 (3)
2-Methylnaphthalene	410	0.0053	300(4)(3)
Acenaphthene	15	0.0002	710 (2)
Dibenzofuran	25	0.0003	NA
Fluorene	25	0.0003	300(4)(3)
Phenanthrene	41	0.0005	4.6 (2)
Anthracene	10	0.0001	300(4)(3)
Carbazole	10	0.0001	NA
Fluoranthene	10	0.0001	16
Pyrene	10	0.0001	300(4)(3)
bis (2-Ethylhexyl) phthalate	270	0.0035	0.6
INORGANIC CONSTITUENTS (in µg/l)			
Aluminum	82900	1.0762	100
Arsenic	47	0.0006	63
Barium	1620	0.0210	1000
Beryllium	4	0.0000	11
Calcium	509000	6.6076	NA
Chromium	1920	0.0249	54
Cobalt	112	0.0015	5
Copper	1820	0.0236	2.9
Iron	256000	3.3233	300
Lead	968	0.0126	8.6
Magnesium	144000	1.8693	NA
Manganese	15000	0.1947	10 (4)
Mercury	0.45	0.0000	0.025
Nickel	311	0.0040	7.1
Potassium	14600	0.1895	NA
Silver	7	0.0001	2.3(2)
Sodium	1130000	14.6690	NA
Vanadium	266	0.0035	10000 (4)
Zinc	528	0.0069	66
Cyanide	14	0.0002	1

(1) 6NYCRR 703.5. Standard shown is for impacts to aquatic life. If Class SB Standard is not available, the most conservative class standard for aquatic life is shown.
(2)NYSDEC Criteria not available. Federal ambient water quality criteria for impact to aquatic life.
(3) Acute criteria for all dichloroethenes
(4) EPA REgion III BTAG Screening Level for impacts to marine aquatic life.

Table 4-13
Toxicity Values for Chemicals of Concern in OU-II Ground Water
Metro North Harmon Yard OU-II RI/FS

	Carcinogenic Effects				Noncarcinogenic Effects				
Chemicals of Concern	*Oral Potency Factor (mg/kg-day)* $^{-1}$	*Inhalation Potency Factor (mg/kg-day)* $^{-1}$	*Classification of Weight of Evidence for Carcinogenicity*	*Potency Factor Basis/ Source*	*Oral Reference Dose (mg/kg-day)*	*Inhalation Reference Dose (mg/kg-day)*	*Chronic Effect of Concern*	*RfD Basis/ RfD Source*	*Uncertainty/ Modifying Factors*
ORGANICS									
chloromethane	1.30E-02	6.30E-03	C	HEAST	—	–	–	–	–
benzene	2.90E-02	2.90E-02	A	IRIS	—	1.71E-03	Not available.	EPA-NCEA	–
chlorobenzene	—	—	D		2.00E-02	5.71E-03	Hystopathologic changes in liver.	Oral/IRIS, Inhal/HEAST	1000/1
bis (2-ethylhexyl) phthalate	1.40E-02	—	B2	IRIS	2.00E-02	—	Increased relative liver weight	IRIS	1000/1
INORGANICS									
Aluminum	–	NA	D		1	NA	–	EPA-NCEA	–
Arsenic	1.50E+00	NA	A	IRIS	3.00E-04	NA	Hyperpigmentation, keratosis, and possible vascular complications.	IRIS	3/1
Barium	–	NA	D		7.00E-02	NA	Increased blood pressure.	IRIS	3/1
Beryllium	4.3	NA	B2	IRIS	5.00E-03	NA	No adverse effects.	IRIS	100/1
Chromium(VI)	–	NA	A	IRIS	5.00E-03	NA	Tissue Accumulation	IRIS	500/1
Copper	–	NA	D	–	4.00E-02	NA	–	EPA_NCEA	
Lead	—	NA	B2	–	—	NA	Neurological Effects	IRIS	1/1 oral, 1000/1 inhal.
Manganese	–	NA	D	IRIS	2.30E-02	NA	Neurological Effects	IRIS	1/1
Vanadium	–	NA	D	–	7.00E-03	NA	–	HEAST	100/1

NA-Not Applicable. No inhalation pathways for metals were identified for evaluation.

Table 4-14 *Summary of Noncarcinogenic Risks for All Exposure Pathways*
Metro North Harmon Yard OU-II RI/FS

Inhalation of Volatiles from Ground Water in Indoor Air
Future Residents

Chemical of Concern	Intake Noncarcinogenic (mg/kg/day)	Noncarcinogenic RfD(inhalation) (mg/kg/d)	Noncarcinogenic Hazard Ratio
chloromethane	4.0E-04	--	--
benzene	2.4E-05	2.9E-02	8.2E-04
chlorobenzene	1.2E-04	5.7E-03	2.2E-02
		Hazard Index	2.24E-02

On-Site Workers

Chemical of Concern	Intake Noncarcinogenic (mg/kg/day)	Noncarcinogenic RfD(oral) (mg/kg/d)	Noncarcinogenic Hazard Ratio
chloromethane	6.6E-05	--	--
benzene	3.9E-06	2.9E-02	1.3E-04
chlorobenzene	2.0E-05	5.7E-03	3.5E-03
		Hazard Index	3.67E-03

Recreational Swimming Exposures
Incidental Ingestion

Chemical of Concern	Intake Noncarcinogenic (mg/kg/day)	Noncarcinogenic RfD(oral) (mg/kg/d)	Noncarcinogenic Hazard Ratio
aluminum	1.62E-04	1	1.62E-04
arsenic	9.47E-08	0.0003	3.16E-04
barium	4.17E-06	0.07	5.96E-05
beyllium	9.24E-09	0.005	1.85E-06
chromium	3.07E-06	5.0E-03	6.14E-04
copper	2.93E-06	4.00E-02	7.34E-05
iron	5.20E-04	3.00E-01	1.73E-03
manganese	3.62E-05	5.0E-03	7.25E-03
vanadium	6.11E-07	7.00E-03	8.73E-05
chloromethane	2.94E-08	--	--
benzene	1.47E-08	--	--
chlorobenzene	1.27E-07	2.0E-02	6.36E-06
bis(2-ethylhexyl) phthalate	4.06E-07	2.0E-02	2.03E-05
		Subtotal	1.0E-02

Dermal Absorption

Chemical of Concern	Intake Noncarcinogenic (mg/kg/day)	Noncarcinogenic RfD(o) (mg/kg/d) (1)	Noncarcinogenic Hazard Ratio
aluminum	7.46E-08	0.05	1.49E-06
arsenic	4.36E-11	0.000015	2.90E-06
barium	1.92E-09	0.0035	5.49E-07
beyllium	4.25E-12	0.005	8.50E-10
chromium	1.41E-09	2.5E-04	5.65E-06
copper	1.35E-09	2.00E-03	6.75E-07
iron	2.39E-07	1.50E-02	1.59E-05
manganese	1.67E-08	2.3E-03	7.25E-06
vanadium	2.81E-10	3.50E-04	8.03E-07
chloromethane	9.77E-11	--	--
benzene	2.83E-10	--	--
chlorobenzene	6.15E-09	1.0E-03	6.15E-06
bis(2-ethylhexyl) phthalate	1.10E-07	1.0E-03	1.10E-04
		Subtotal	1.5E-04

Hazard Index, Recreational Swimming 1.0E-02

Total Hazard Index	***Inhalation by Future Residents and Rereational Swimming***	***3.3E-02***

(1) Reference doses may have been modified for dermal absorption.

Table 4-15 *Summary of Carcinogenic Risks for All ExposurePathways*
Metro North Harmon Yard OU-II RI/FS

Inhalation of Volatiles from Ground Water in Indoor Air
Future Residents

Chemicals of Concern	Intake Carcinogenic (mg/kg/day)	Carcinogenic PF (inhalation) (mg/kg/d)-1	Carcinogenic Risk
chloromethane	9.37E-05	6.30E-03	5.90E-07
benzene	5.55E-06	1.71E-03	9.50E-09
chlorobenzene	2.87E-05	--	--

Excess Lifetime Cancer Risk (Residential) *6.0E-07*

On-Site Industrial Workers

Chemicals of Concern	Intake Carcinogenic (mg/kg/day)	Carcinogenic PF (inhalation) (mg/kg/d)-1	Carcinogenic Risk
chloromethane	2.4E-05	6.30E-03	1.5E-07
benzene	1.4E-06	1.71E-03	2.4E-09
chlorobenzene	7.2E-06	--	--

Excess Lifetime Cancer Risk (On-Site Worker) *1.5E-07*

Recreational Swimming
Incidental Ingestion

Chemical of Concern	Intake Carcinogenic (mg/kg/day)	Carcinogenic PF(oral) (mg/kg/d)-1	Carcinogenic Risk
aluminum	6.95E-05	--	--
arsenic	4.06E-08	1.50E+00	6.09E-08
barium	1.79E-06	--	--
beyllium	3.96E-09	4.30E+00	1.70E-08
chromium	1.32E-06	--	--
copper	1.26E-06	--	--
iron	2.23E-04	--	--
manganese	1.55E-05	--	--
vanadium	2.62E-07	--	--
chloromethane	1.26E-08	1.30E-02	1.64E-10
benzene	6.29E-09	2.90E-02	1.82E-10
chlorobenzene	5.45E-08	--	--
bis(2-ethylhexyl) phthalate	1.74E-07	1.40E-02	
		Subtotal	7.8E-08

Dermal Absorption

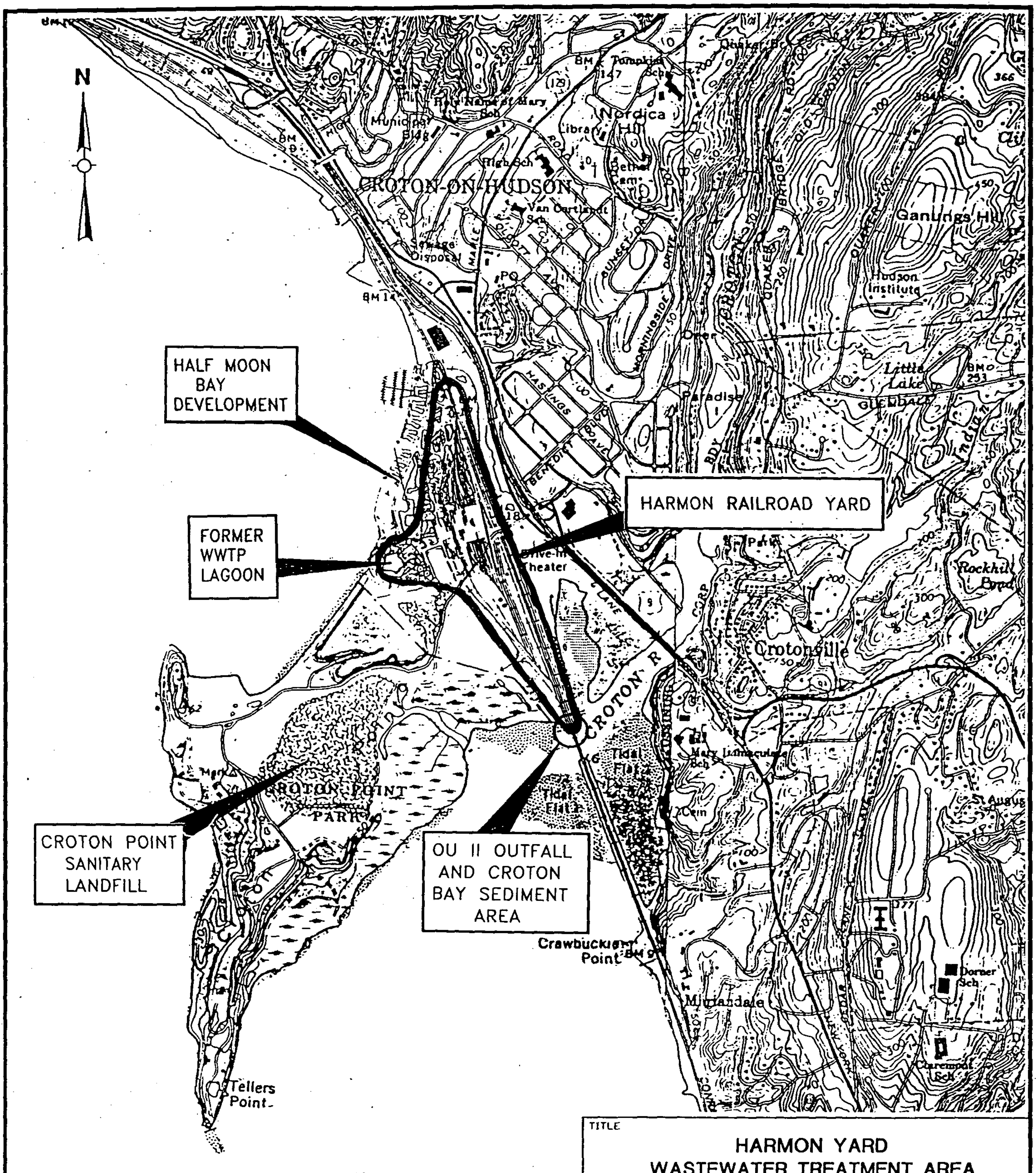
Chemical of Concern	Intake Carcinogenic (mg/kg/day)	Carcinogenic PF(oral) (mg/kg/d)-1(1)	Carcinogenic Risk
aluminum	3.20E-08	--	--
arsenic	1.87E-11	3.00E+01	5.60E-10
barium	8.23E-10	--	--
beyllium	1.82E-12	8.60E+01	1.57E-10
chromium	6.06E-10	--	--
copper	5.79E-10	--	--
iron	1.03E-07	--	--
manganese	7.14E-09	--	--
vanadium	1.20E-10	--	--
chloromethane	4.19E-11	2.60E-01	1.09E-11
benzene	1.21E-10	5.80E-01	7.02E-11
chlorobenzene	2.64E-09	--	--
bis(2-ethylhexyl) phthalate	4.73E-08	1.40E-02	
		Subtotal	8.0E-10

Excess Lifetime Cancer Risk, Recreational Swimming *7.9E-08*

Total Excess Lifetime Cancer Risk	*Inhalation by Future Residents and Recreational Swimming*	*6.8E-07*

(1) Potency factors may have been modified for dermal absorption.

FIGURES



HARMON YARD
WASTEWATER TREATMENT AREA
OPERABLE UNIT II
SITE LOCATION MAP

PREPARED FOR

METRO-NORTH COMMUTER RAILROAD

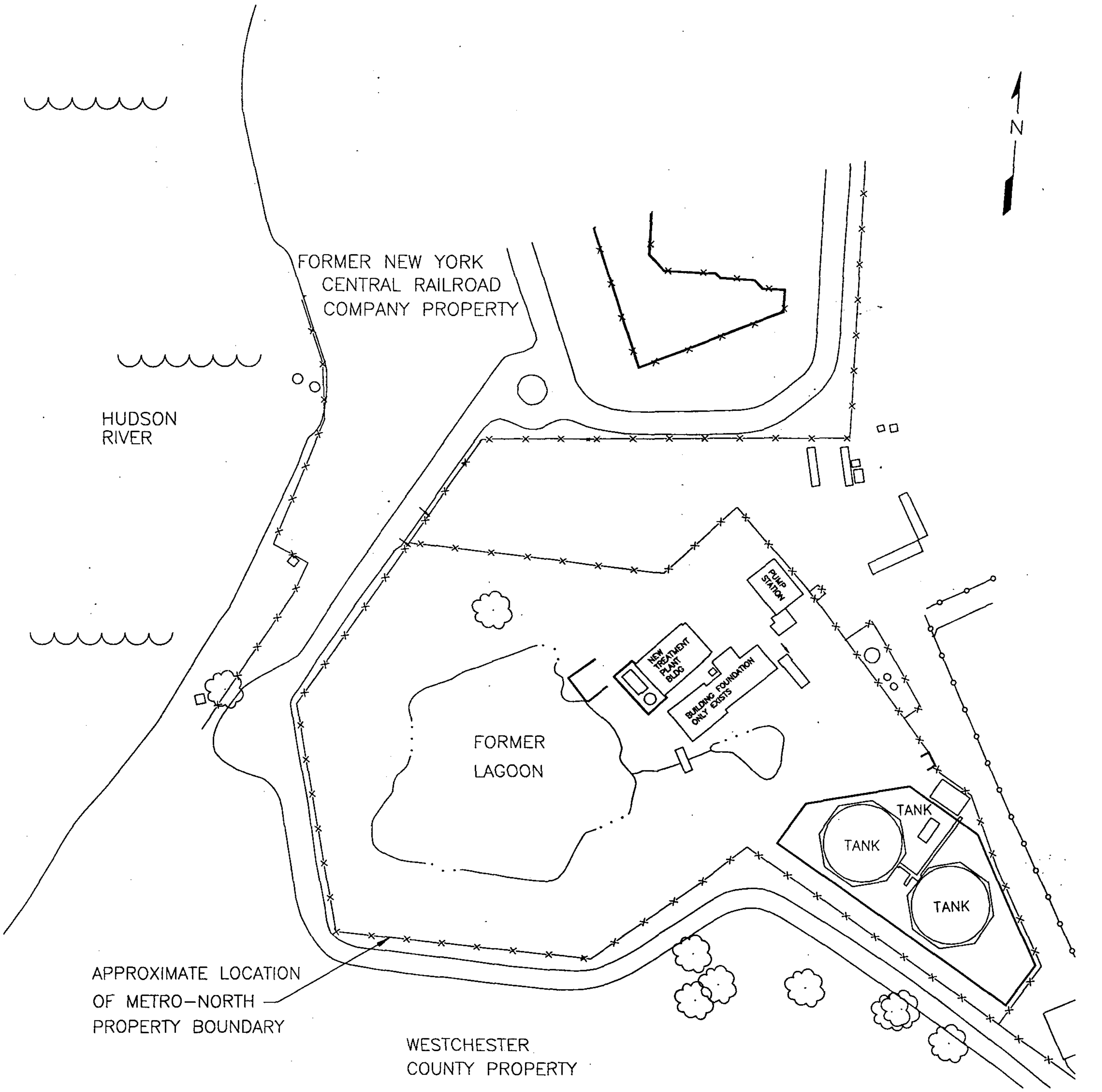
ERM-Northeast
Environmental Resources Management

DRAWN:	JOB NO:	FILE NAME:	SCALE	DATE	FIGURE
Y.Z.	680.003.02	GEN-V	1" =2000'	8/30/96	1-1

NOTE:

OPERABLE UNIT II (OU II) OF THE HARMON YARD WASTEWATER TREATMENT AREA SITE (NYSDEC SITE No. 3-60-010) CONSIST OF THE FORMER LAGOON AREA, THE CROTON BAY OUTFALL AREA AND THE DISCHARGE LINE THAT CONNECTS THEM

SOURCE: U.S.G.S. Quadrangle Map, HAVERSTRAW and OSSINING, N.Y.



NOTE:

FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

0 40 80
GRAPHIC SCALE IN FEET

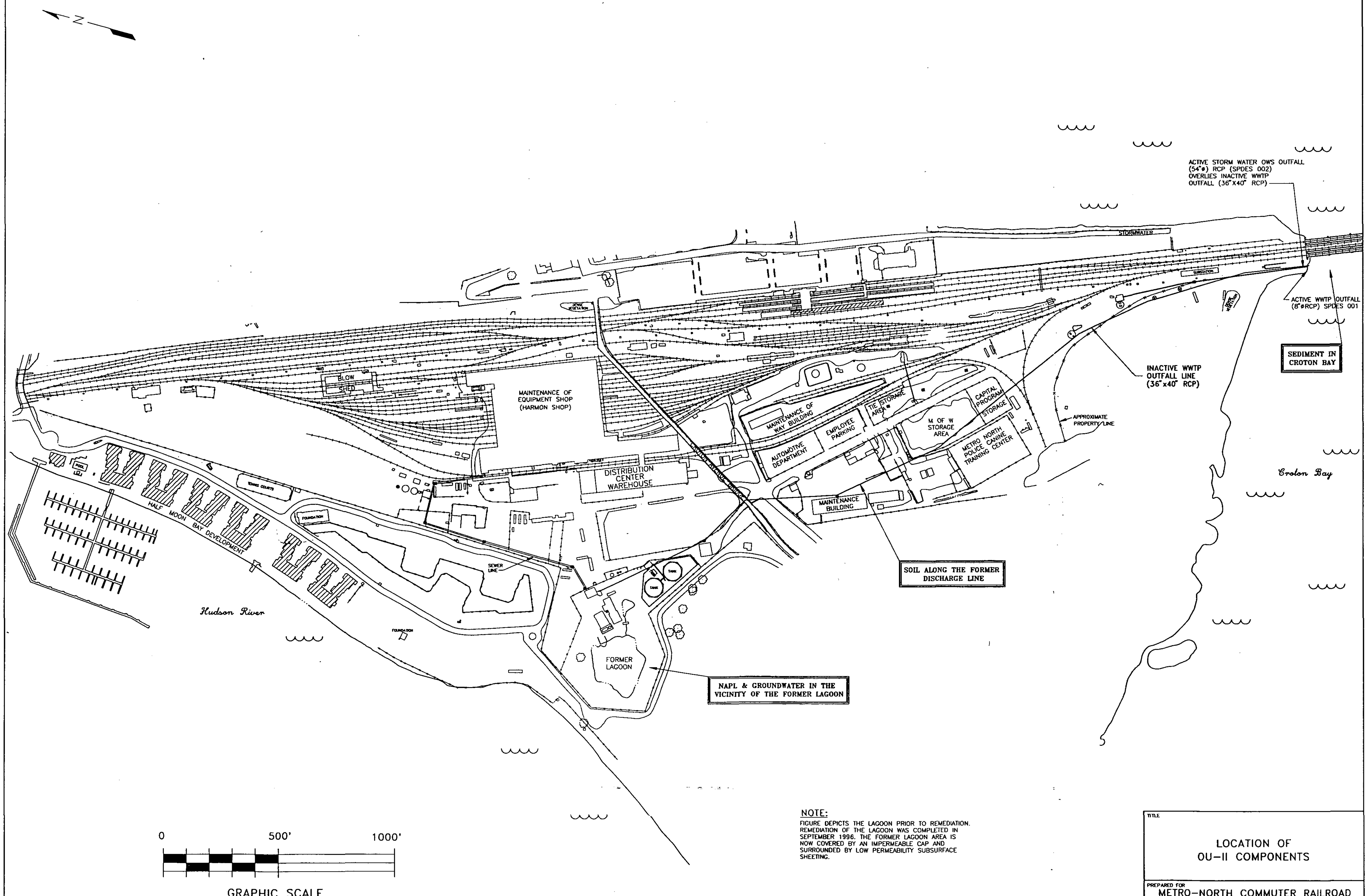
TITLE

HARMON YARD WASTEWATER TREATMENT AREA

PREPARED FOR
METRO–NORTH COMMUTER RAILROAD

ERM–Northeast
Environmental Resources Management
ERM

DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
Y.Z.	680.003.02	6800032D	GRAPHIC	1/21/97	1–2



NOTE:
FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

TITLE

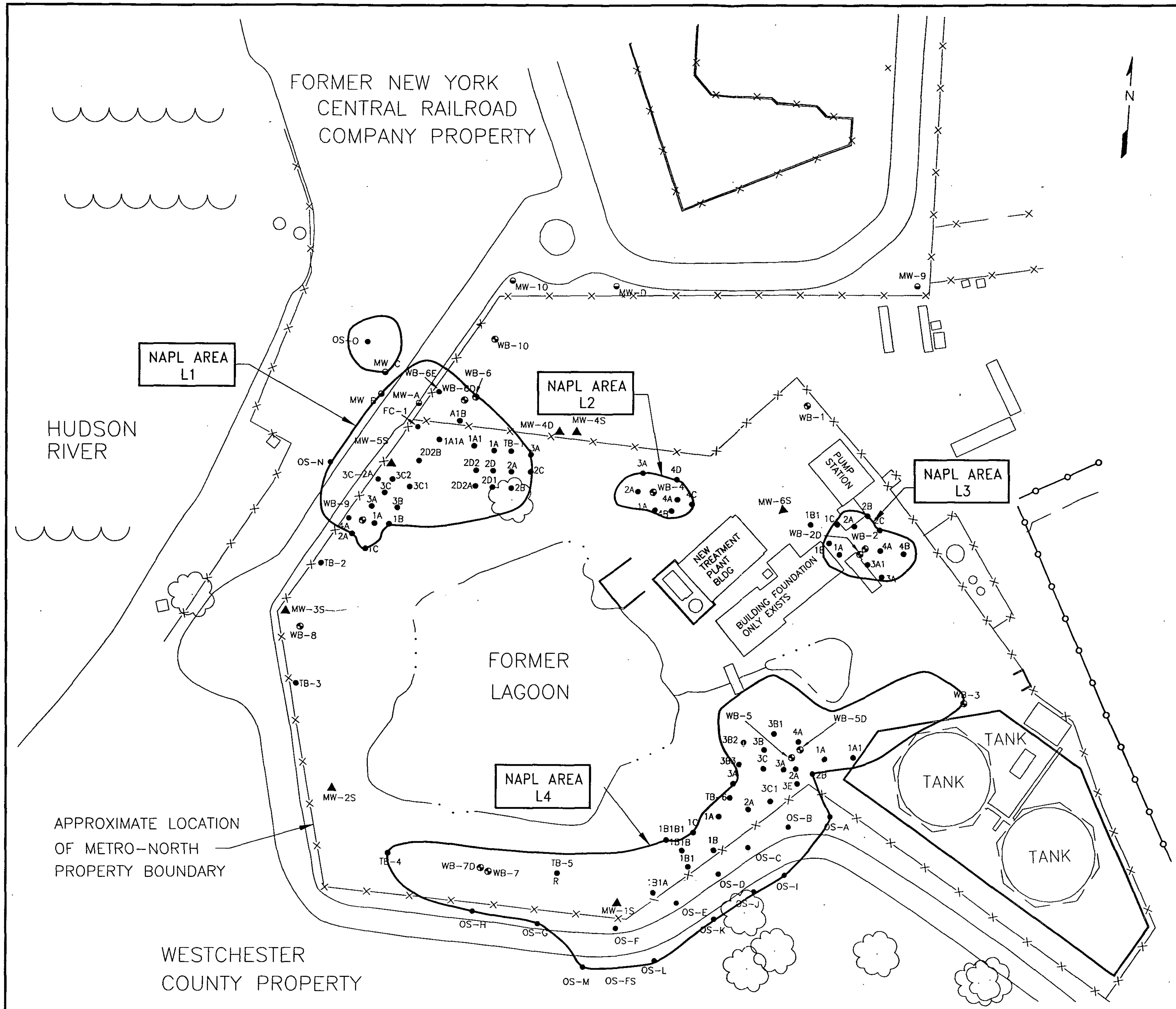
LOCATION OF
OU–II COMPONENTS

PREPARED FOR
METRO–NORTH COMMUTER RAILROAD
HARMON RAILROAD YARD

ERM–Northeast
ERM

SCALE	FIGURE
GRAPHIC	2–0
DATE 1/22/97	

DRAWN: Y.Z. | JOB NO.: 680.003.02 | FILE NAME: 6800032F



LEGEND

- ⊗ = MONITORING WELLS INSTALLED FRED C. HART, INC.
- ● = TEMPORARY WELLS/BORINGS INSTALLED BY ERM-NORTHEAST
- ▲ = MONITORING WELLS INSTALLED BY METCALF & EDDY
- ⊖ = OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER

NOTE:

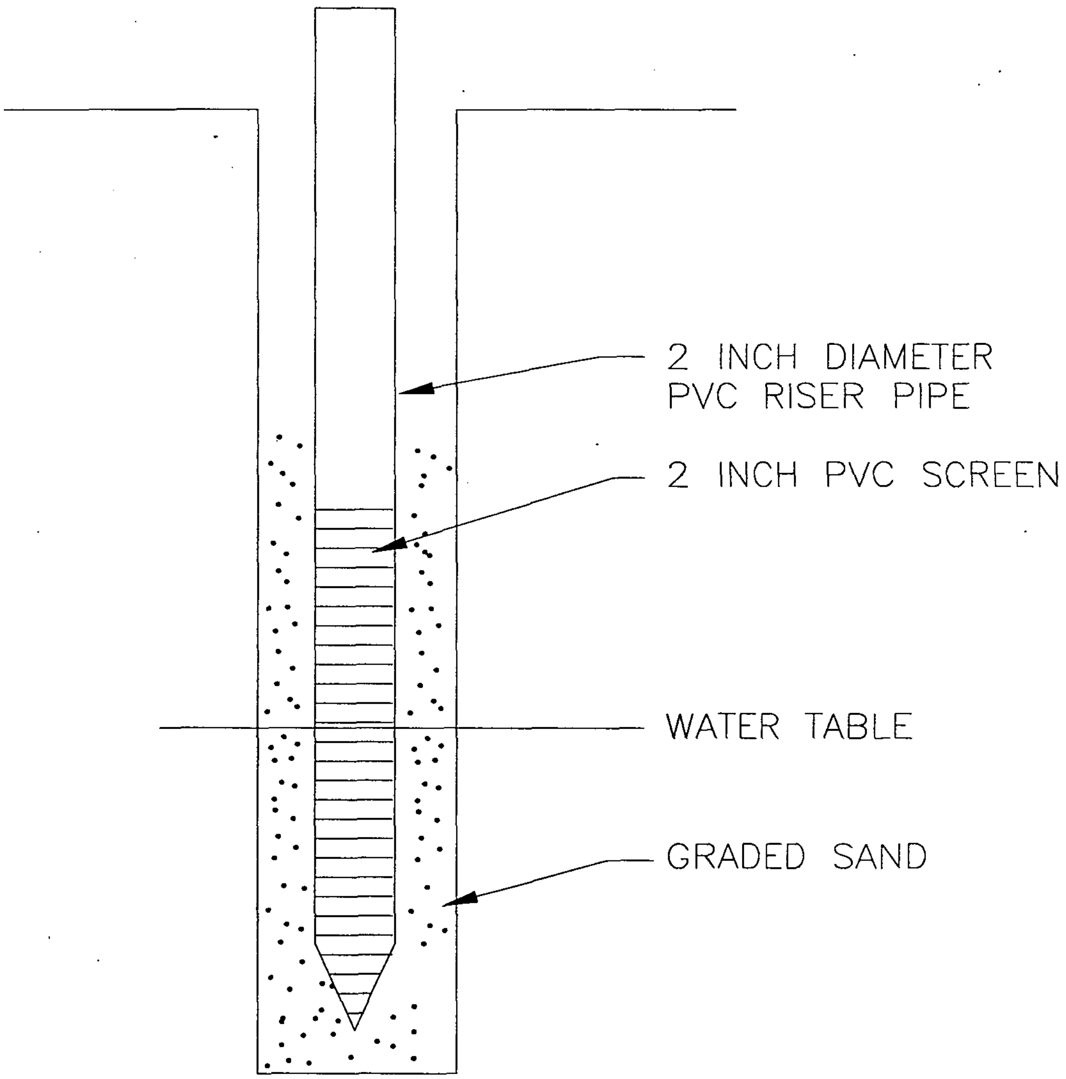
FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

FIGURE SHOWS THE LOCATIONS ALL OF THE WELLS INSTALLED AS PART OF THE OU-II RI; PREVIOUS FRED C. HART AND METCALF AND EDDY INVESTIGATIONS; AND OFF-SITE INVESTIGATIONS PERFORMED BY THE OFF-SITE PROPERTY OWNER SINCE FEBRUARY 1995 MANY OF THE WELLS HAVE EITHER BEEN DESTROYED OR REMOVED.

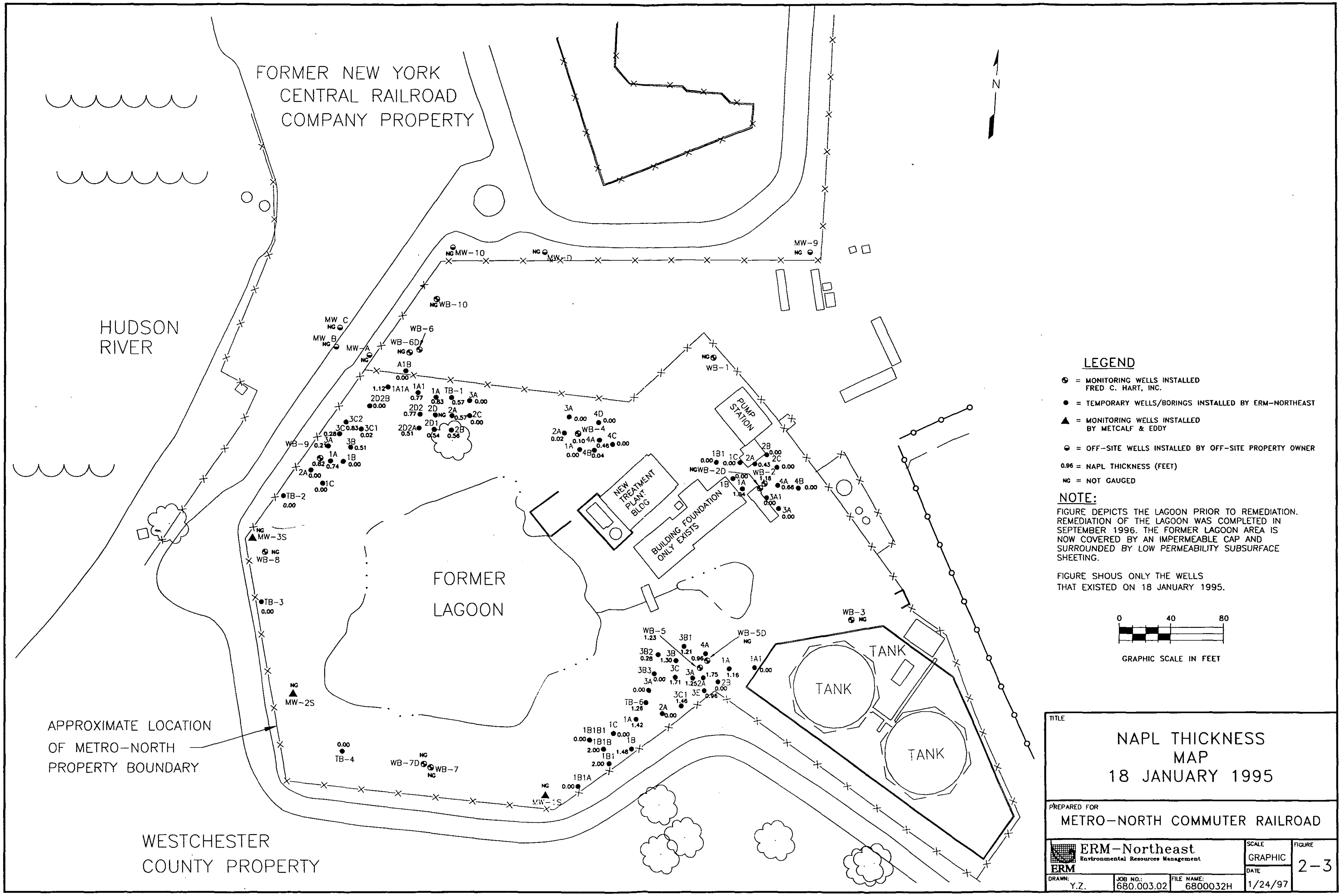
0 40 80

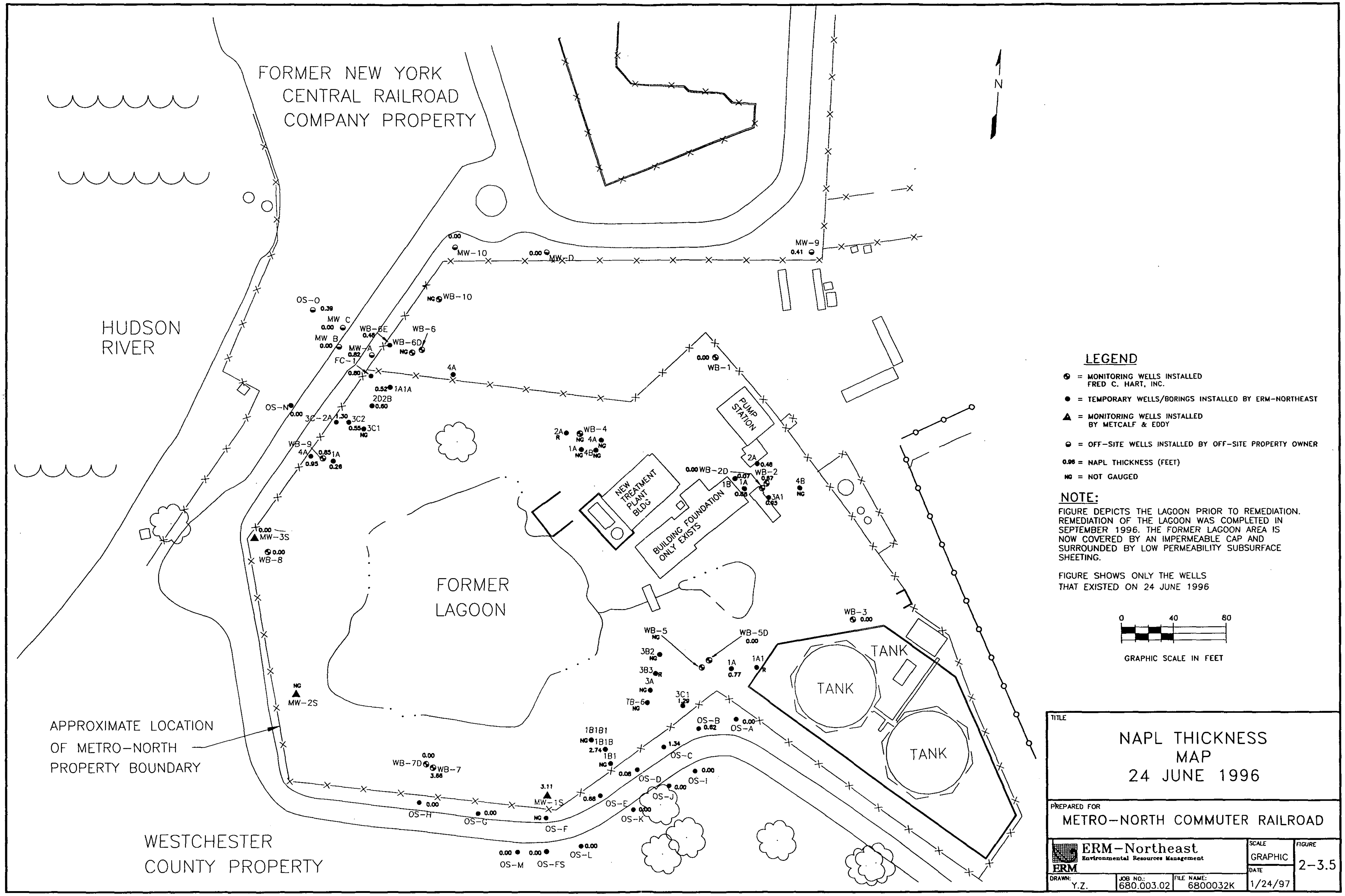
GRAPHIC SCALE IN FEET

TITLE			
MONITORING AND NAPL DELINEATION WELL LOCATIONS			
PREPARED FOR: METRO-NORTH COMMUTER RAILROAD			
ERM-Northeast, Environmental Resources Management		SCALE: GRAPHIC	FIGURE: 2-1
DRAWN: Y.Z.	JOB NO.: 680.003.02	FILE NAME: MET-CK96	DATE: 1/24/97

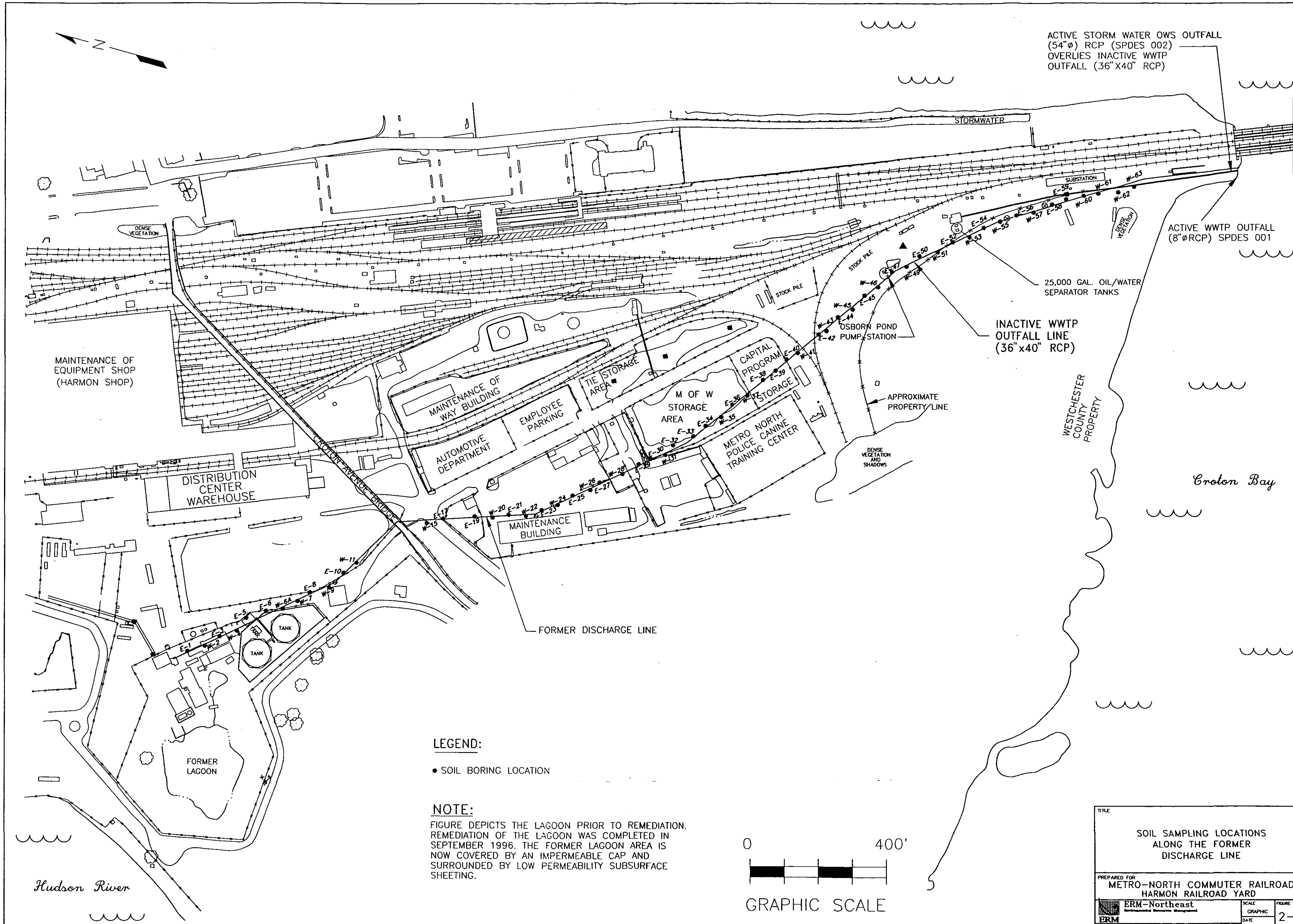


TITLE TEMPORARY WELL CASING CONSTRUCTION HARMON YARD				
PREPARED FOR METRO-NORTH COMMUTER RAILROAD				
ERM-Northeast Environmental Resources Management ERM			SCALE NTS	FIGURE 2-2
DRAWN: S.G./Y.Z.	JOB NO.: 680.003.02	FILE NAME: FIG3-7	DATE 1/21/97	


FORMER NEW YORK CENTRAL RAILROAD COMPANY PROPERTY
HUDSON RIVER
FORMER LAGOON
NEW TREATMENT PLANT BLDG
BUILDING FOUNDATION ONLY EXISTS
PUMP STATION
TANK
TANK
TANK
APPROXIMATE LOCATION OF METRO-NORTH PROPERTY BOUNDARY
WESTCHESTER COUNTY PROPERTY
N
MW-10
MW-9
MW C
MW B
MW-A
WB-10
WB-6
WB-6D
WB-1
WB-9
WB-4
WB-2
WB-2D
WB-8
MW-3S
TB-1
TB-2
TB-3
TB-4
TB-6
WB-3
WB-5
WB-5D
WB-7
WB-7D
MW-2S
LEGEND
= MONITORING WELLS INSTALLED FRED C. HART, INC.
= TEMPORARY WELLS/BORINGS INSTALLED BY ERM-NORTHEAST
= MONITORING WELLS INSTALLED BY METCALF & EDDY
= OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER
0.96 = NAPL THICKNESS (FEET)
NG = NOT GAUGED
NOTE:
FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.
FIGURE SHOUS ONLY THE WELLS THAT EXISTED ON 18 JANUARY 1995.
0 40 80
GRAPHIC SCALE IN FEET
TITLE
NAPL THICKNESS MAP 18 JANUARY 1995
PREPARED FOR
METRO-NORTH COMMUTER RAILROAD
ERM-Northeast
Environmental Resources Management
ERM
DRAWN: Y.Z.
JOB NO.: 680.003.02
FILE NAME: 6800032H
SCALE GRAPHIC
DATE 1/24/97
FIGURE 2-3



FORMER NEW YORK CENTRAL RAILROAD COMPANY PROPERTY
HUDSON RIVER
N
FORMER LAGOON
NEW TREATMENT PLANT BLDG
BUILDING FOUNDATION ONLY EXISTS
PUMP STATION
TANK
TANK
TANK
APPROXIMATE LOCATION OF METRO-NORTH PROPERTY BOUNDARY
WESTCHESTER COUNTY PROPERTY
MW-10
MW-D
MW-9
WB-10
WB-1
WB-6E
WB-6
WB-6D
MW C
MW B
MW-A
FC-1
OS-O
OS-N
1A1A
2D2B
4A
3C-2A
3C2
3C1
WB-9
WB-4
WB-2D
WB-2
WB-3
WB-5
WB-5D
MW-3S
WB-8
MW-2S
WB-7D
WB-7
MW-1S
OS-A
OS-B
OS-C
OS-D
OS-E
OS-F
OS-FS
OS-G
OS-H
OS-I
OS-J
OS-K
OS-L
OS-M
TB-6
LEGEND
= MONITORING WELLS INSTALLED FRED C. HART, INC.
= TEMPORARY WELLS/BORINGS INSTALLED BY ERM-NORTHEAST
= MONITORING WELLS INSTALLED BY METCALF & EDDY
= OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER
0.96 = NAPL THICKNESS (FEET)
NG = NOT GAUGED
NOTE:
FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.
FIGURE SHOWS ONLY THE WELLS THAT EXISTED ON 24 JUNE 1996
0 40 80
GRAPHIC SCALE IN FEET
TITLE
NAPL THICKNESS MAP 24 JUNE 1996
PREPARED FOR
METRO-NORTH COMMUTER RAILROAD
ERM-Northeast
Environmental Resources Management
ERM
DRAWN: Y.Z.
JOB NO.: 680.003.02
FILE NAME: 6800032K
SCALE GRAPHIC
DATE 1/24/97
FIGURE 2-3.5



LEGEND:

• SOIL BORING LOCATION

NOTE:

FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

TITLE

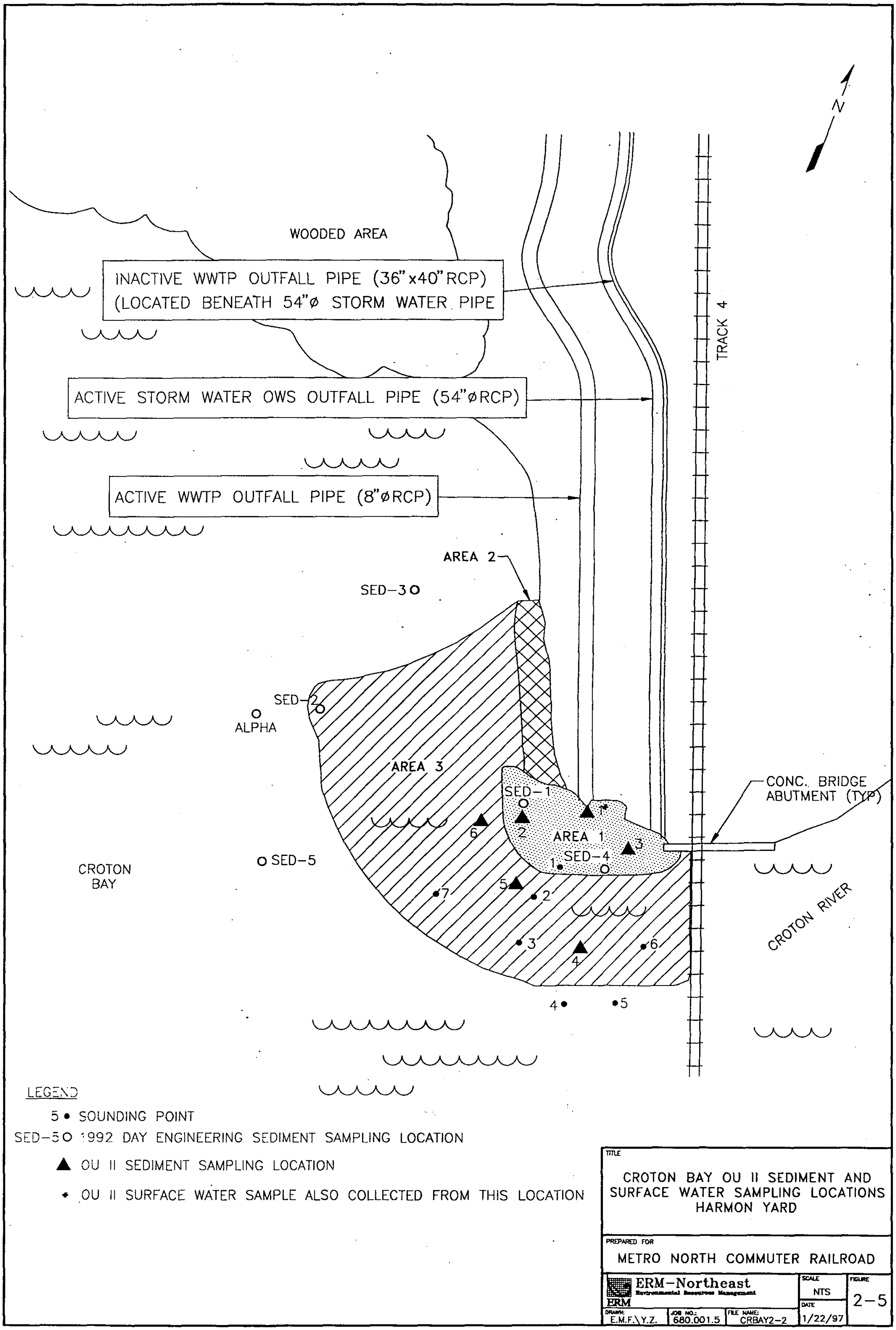
SOIL SAMPLING LOCATIONS ALONG THE FORMER DISCHARGE LINE

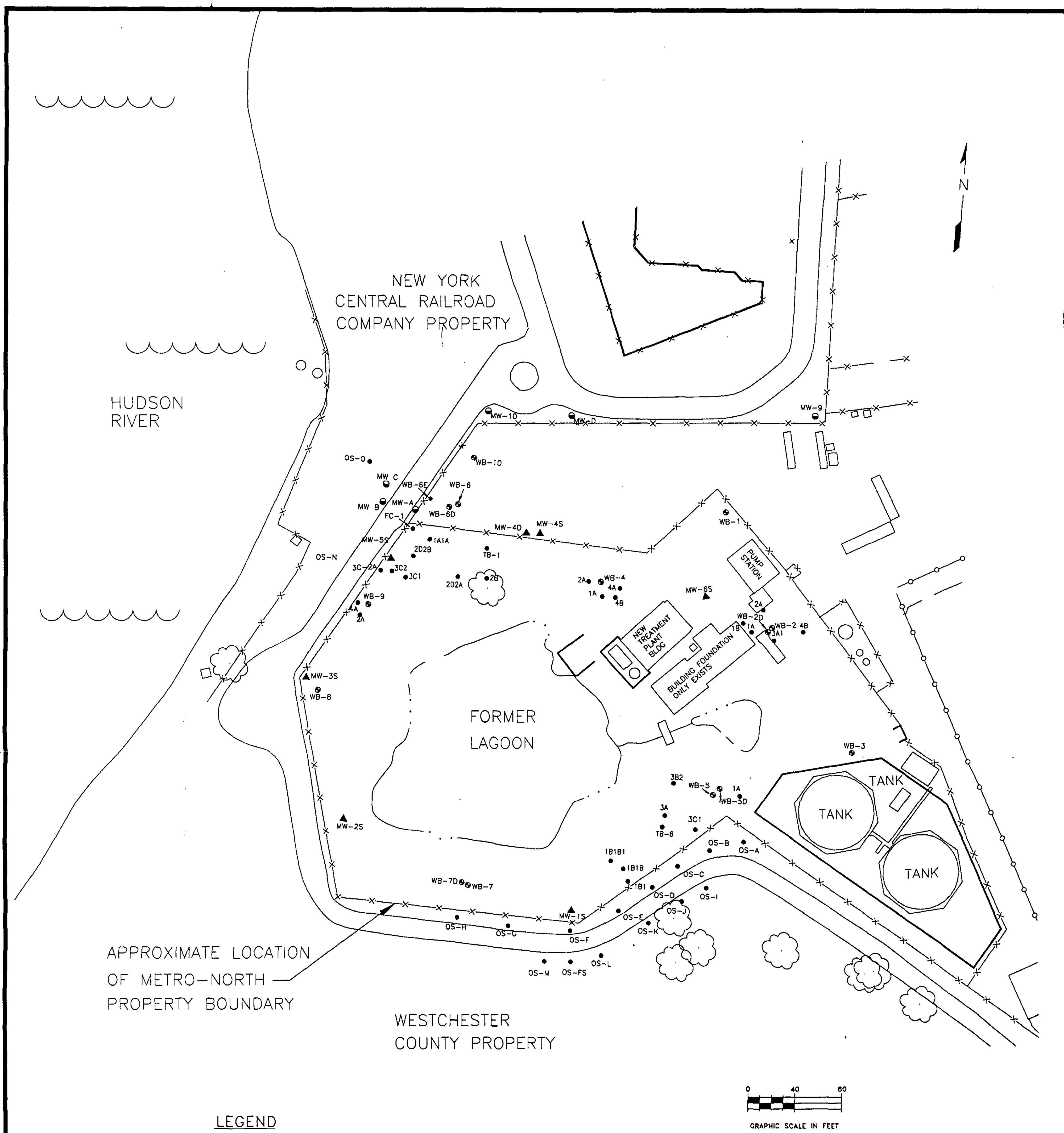
PREPARED FOR

METRO-NORTH COMMUTER RAILROAD
HARMON RAILROAD YARD

ERM-Northeast

DRAWN: Y.Z.	JOB NO.: 680.003.02	FILE NAME: 68000328	SCALE: GRAPHIC / DATE: 1/22/97	FIGURE: 2-4


WOODED AREA
INACTIVE WWTP OUTFALL PIPE (36"x40"RCP)
(LOCATED BENEATH 54"ø STORM WATER PIPE
ACTIVE STORM WATER OWS OUTFALL PIPE (54"øRCP)
ACTIVE WWTP OUTFALL PIPE (8"øRCP)
TRACK 4
AREA 2
SED-3
SED-2
ALPHA
AREA 3
SED-1
AREA 1
SED-4
SED-5
CROTON BAY
CONC. BRIDGE ABUTMENT (TYP)
CROTON RIVER
LEGEND
5 • SOUNDING POINT
SED-5 O 1992 DAY ENGINEERING SEDIMENT SAMPLING LOCATION
▲ OU II SEDIMENT SAMPLING LOCATION
* OU II SURFACE WATER SAMPLE ALSO COLLECTED FROM THIS LOCATION
TITLE
CROTON BAY OU II SEDIMENT AND SURFACE WATER SAMPLING LOCATIONS HARMON YARD
PREPARED FOR
METRO NORTH COMMUTER RAILROAD
ERM-Northeast
Environmental Resources Management
SCALE NTS
FIGURE 2-5
DRAWN: E.M.F.\Y.Z.
JOB NO.: 680.001.5
FILE NAME: CRBAY2-2
DATE 1/22/97



LEGEND

- ⊕ = MONITORING WELLS INSTALLED FRED C. HART, INC.
- ● = TEMPORARY WELLS/BORINGS INSTALLED BY ERM-NORTHEAST
- ▲ = MONITORING WELLS INSTALLED BY METCALF & EDDY
- ◒ = OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER

NOTE:
FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

TITLE

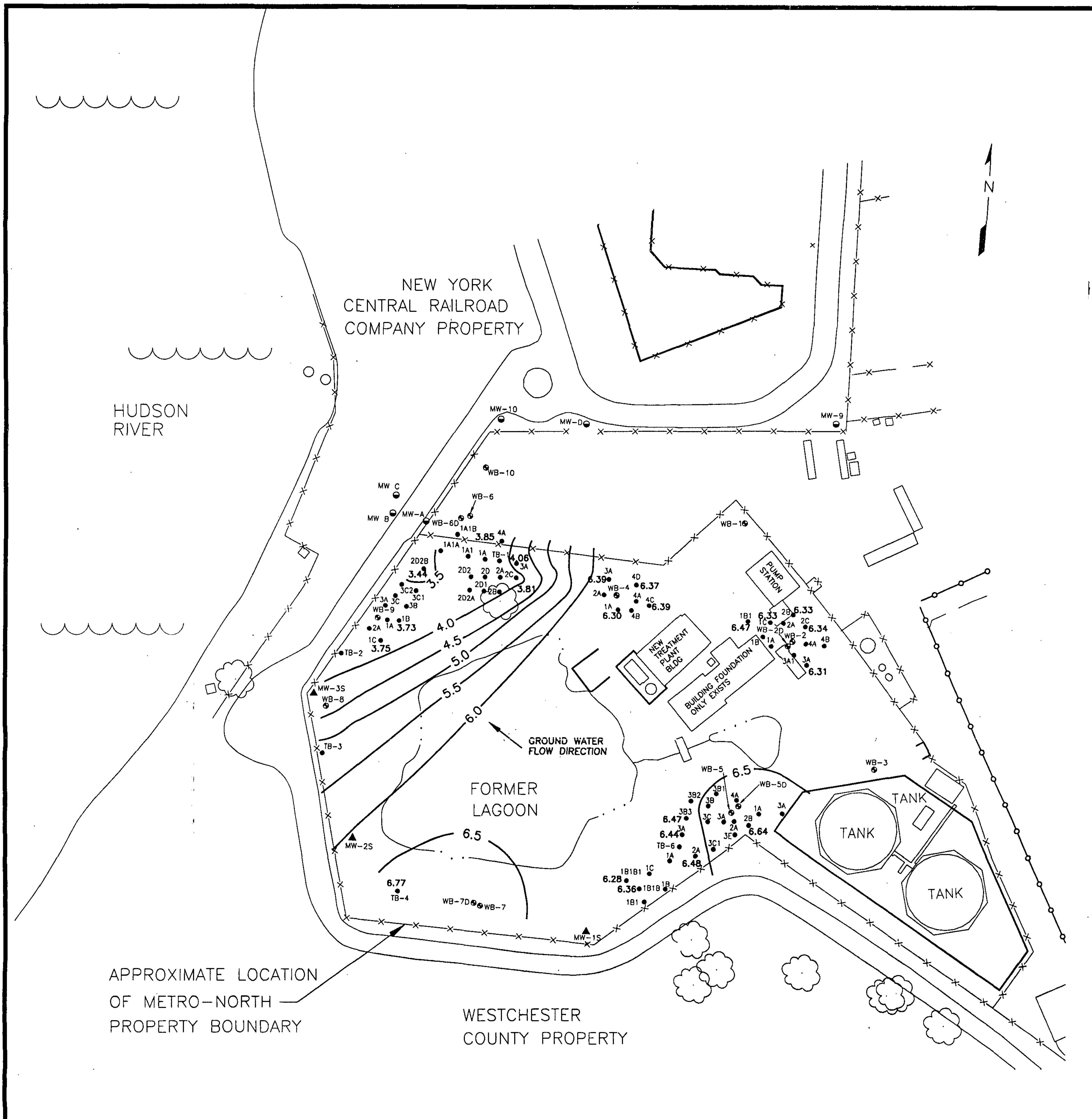
GROUND WATER MONITORING WELL LOCATIONS

PREPARED FOR
METRO-NORTH COMMUTER RAILROAD

ERM ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
GRAPHIC	2-6
DATE	
9/03/96	

DRAWN:	JOB NO.:	FILE NAME:
Y.Z.	680.003.02	PLANT



LEGEND

- ⊕ = MONITORING WELLS INSTALLED FRED C. HART, INC.
- ● = TEMPORARY WELLS/BORINGS INSTALLED BY ERM-NORTHEAST
- ▲ = MONITORING WELLS INSTALLED BY METCALF & EDDY
- ⊖ = OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER
- 6.31 = WATER TABLE ELEVATION (FEET ABOVE MSL)
- —— 4.0 —— = WATER TABLE CONTOUR

NOTE:

FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

THIS FIGURE SHOWS ONLY THE WELLS THAT EXISTED ON 18 JANUARY 1995

0 40 80
GRAPHIC SCALE IN FEET

TITLE

GROUND WATER FLOW MAP 18 JANUARY 1995

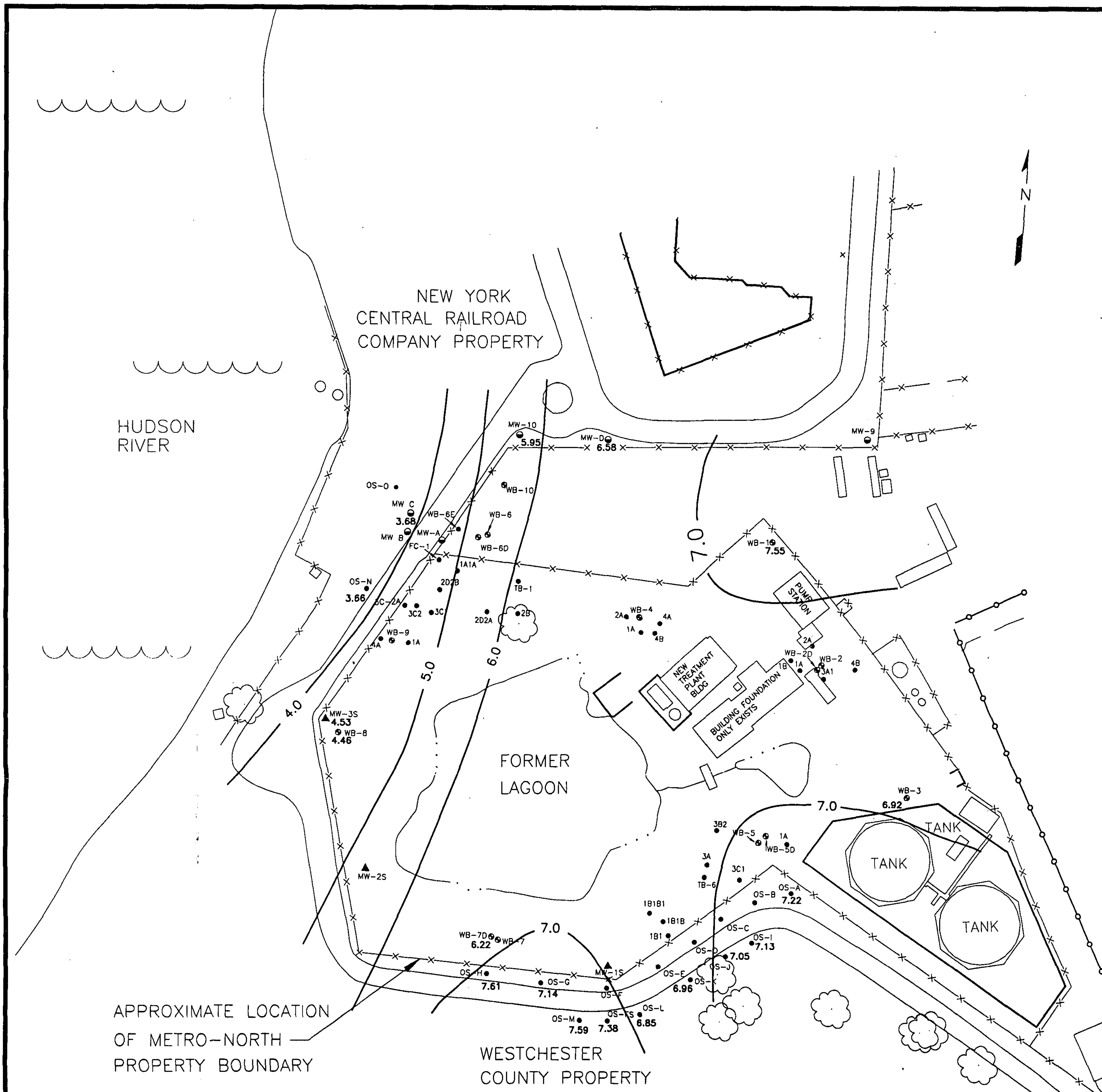
PREPARED FOR

METRO-NORTH COMMUTER RAILROAD

ERM-Northeast
Environmental Resources Management
ERM

SCALE	FIGURE
GRAPHIC	2-7

DRAWN:	JOB NO.:	FILE NAME:	DATE
Y.Z.	680.003.02	6800032N	1/24/97



LEGEND

- ⊕ = MONITORING WELLS INSTALLED FRED C. HART, INC.
- ● = TEMPORARY WELLS/BORINGS INSTALLED BY ERM–NORTHEAST
- ▲ = MONITORING WELLS INSTALLED BY METCALF & EDDY
- ◒ = OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER
- 7.59 = WATER TABLE ELEVATION (FEET ABOVE MSL)
- ——4.0—— = WATER TABLE CONTOUR

NOTE:

FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

THIS FIGURE SHOWS THE WELLS THAT EXISTED ON 24 JUNE 1996

0 40 80
GRAPHIC SCALE IN FEET

TITLE

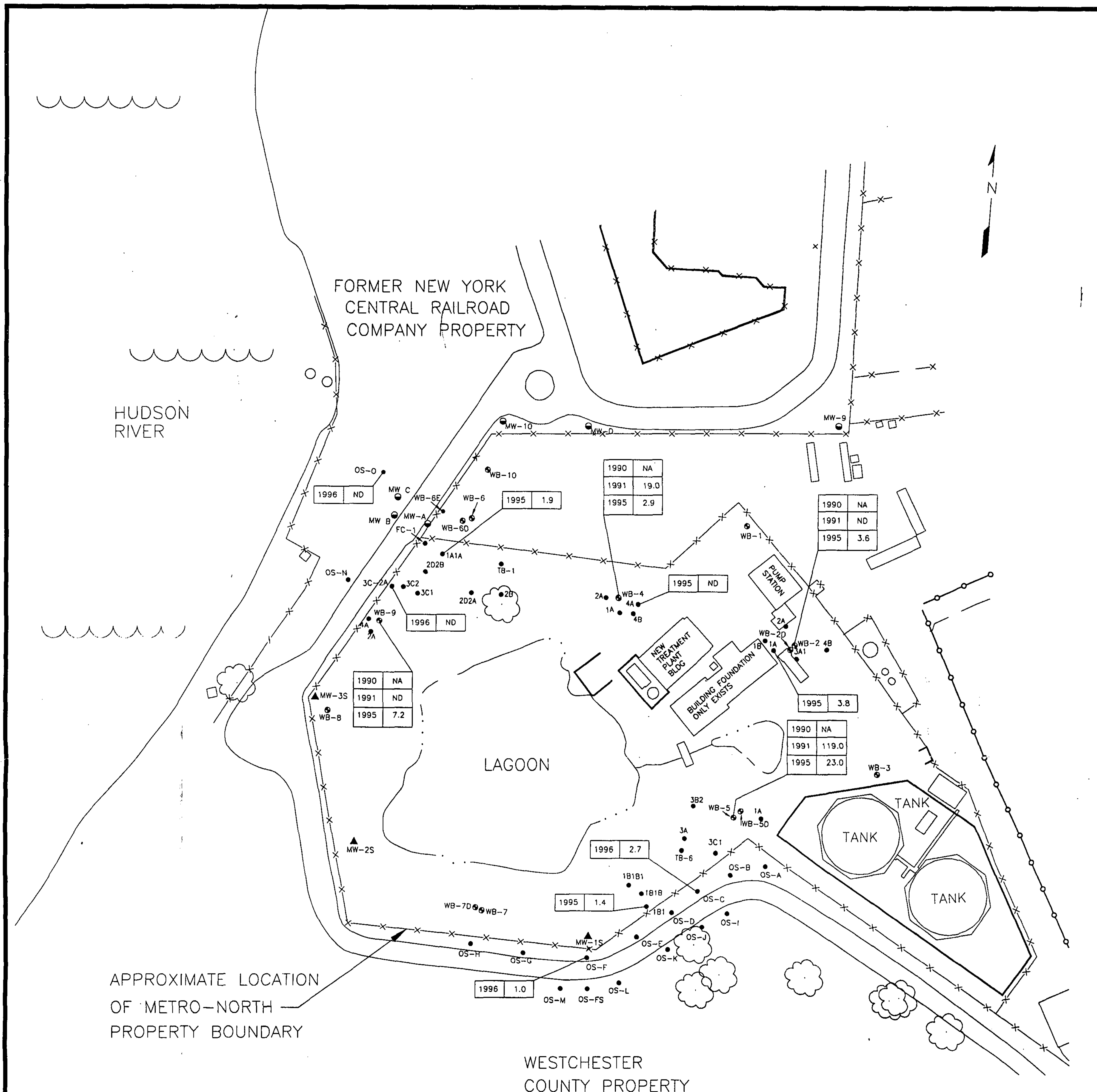
GROUND WATER FLOW MAP 24 JUNE 1996

PREPARED FOR
METRO–NORTH COMMUTER RAILROAD

ERM–Northeast
Environmental Resources Management
ERM

SCALE	FIGURE
GRAPHIC	2–8
DATE	
1/24/97	

DRAWN:	JOB NO.:	FILE NAME:
Y.Z.	680.003.02	6800032M



LEGEND

- ◉ = MONITORING WELLS INSTALLED FRED C. HART, INC.
- ● = TEMPORARY WELLS/BORINGS INSTALLED BY ERM-NORTHEAST
- ▲ = MONITORING WELLS INSTALLED BY METCALF & EDDY
- ◒ = OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER
- NA = NOT ANALYZED
- ND = NOT DETECTED

NOTE:

1. FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.
2. PCB CONCENTRATION IN MILLIGRAM PER KILOGRAM (MG/KG)

TITLE

TOTAL PCB CONCENTRATIONS IN NAPL

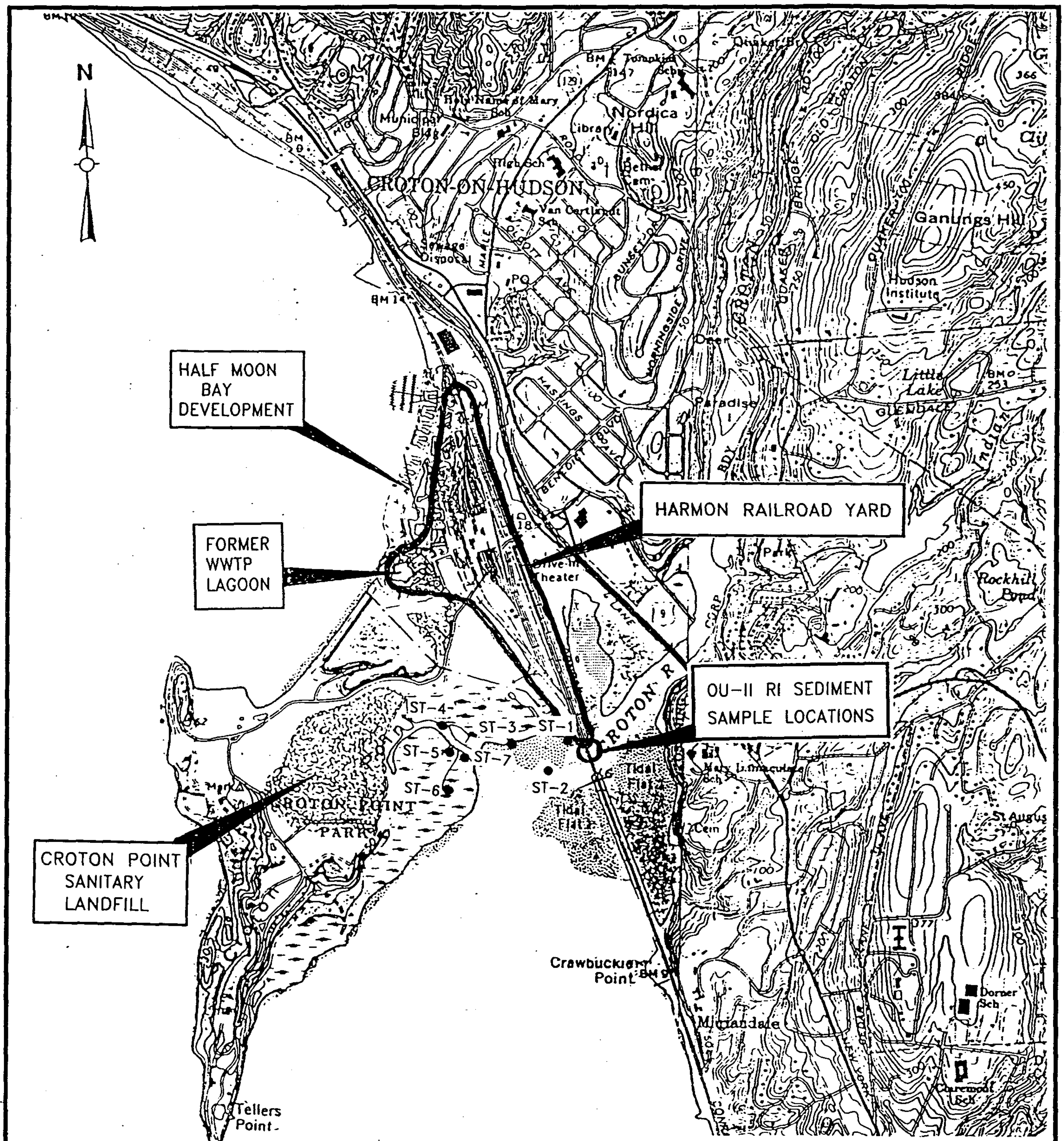
PREPARED FOR

METRO-NORTH COMMUTER RAILROAD

ERM-Northeast
Environmental Resources Management
ERM

SCALE	FIGURE
GRAPHIC	3-1
DATE	
1/24/97	

DRAWN:	JOB NO.:	FILE NAME:
Y.Z.	680.003.02	6800032L.



TITLE

CROTON POINT LANDFILL RI SEDIMENT SAMPLING LOCATIONS

PREPARED FOR

METRO-NORTH COMMUTER RAILROAD

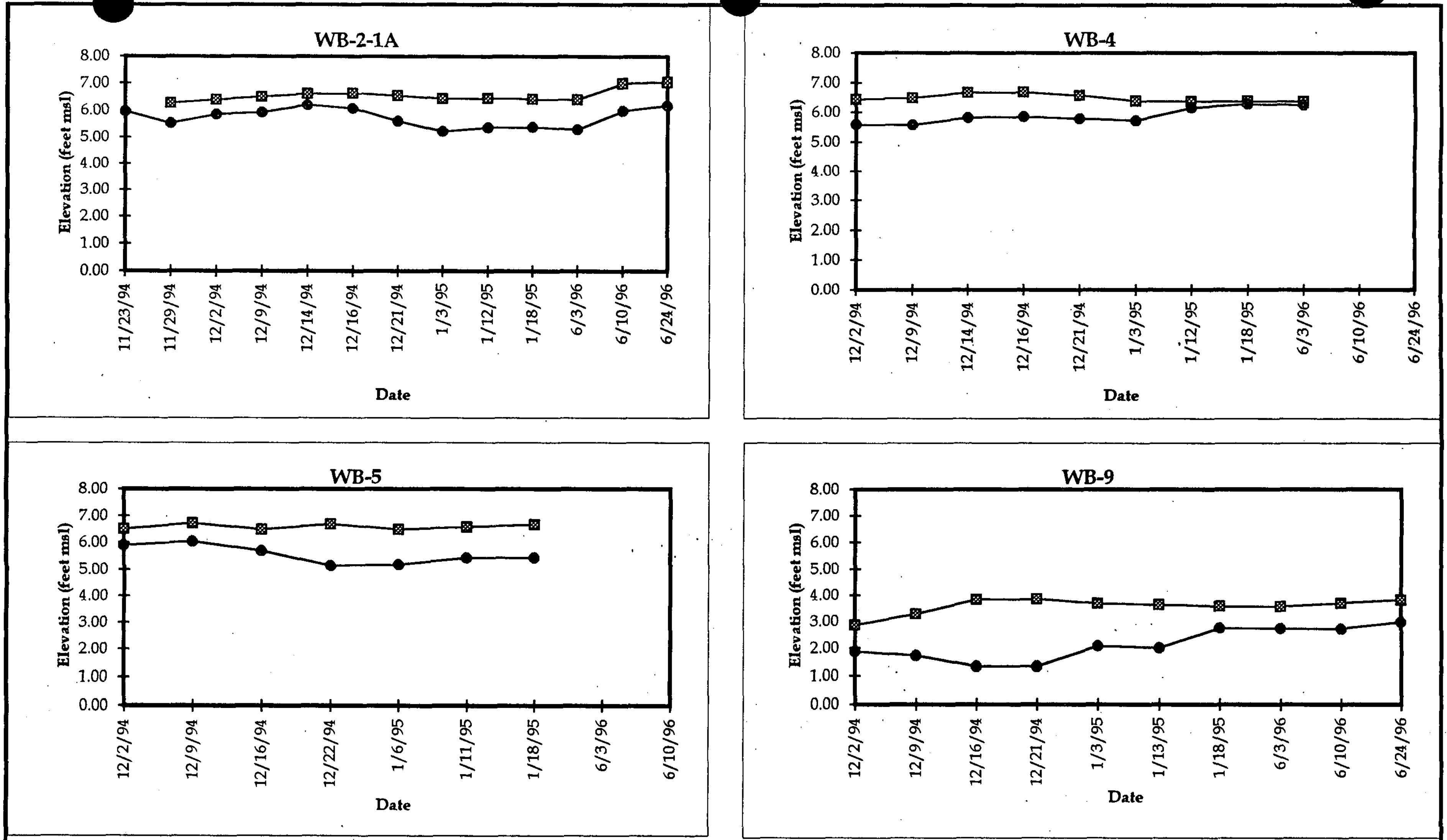
ERM-Northeast
Environmental Resources Management
ERM

SCALE	FIGURE
1" =2000'	3-1.5
DATE 8/30/96	

DRAWN:	JOB NO.:	FILE NAME:	
Y.Z.	680.003.02	GEN-V	8/30/96

LEGEND:

ST-1 – CROTON POINT SEDIMENT SAMPLING LOCATIONS CLOSEST TO OU-II SEDIMENT SAMPLING LOCATIONS.

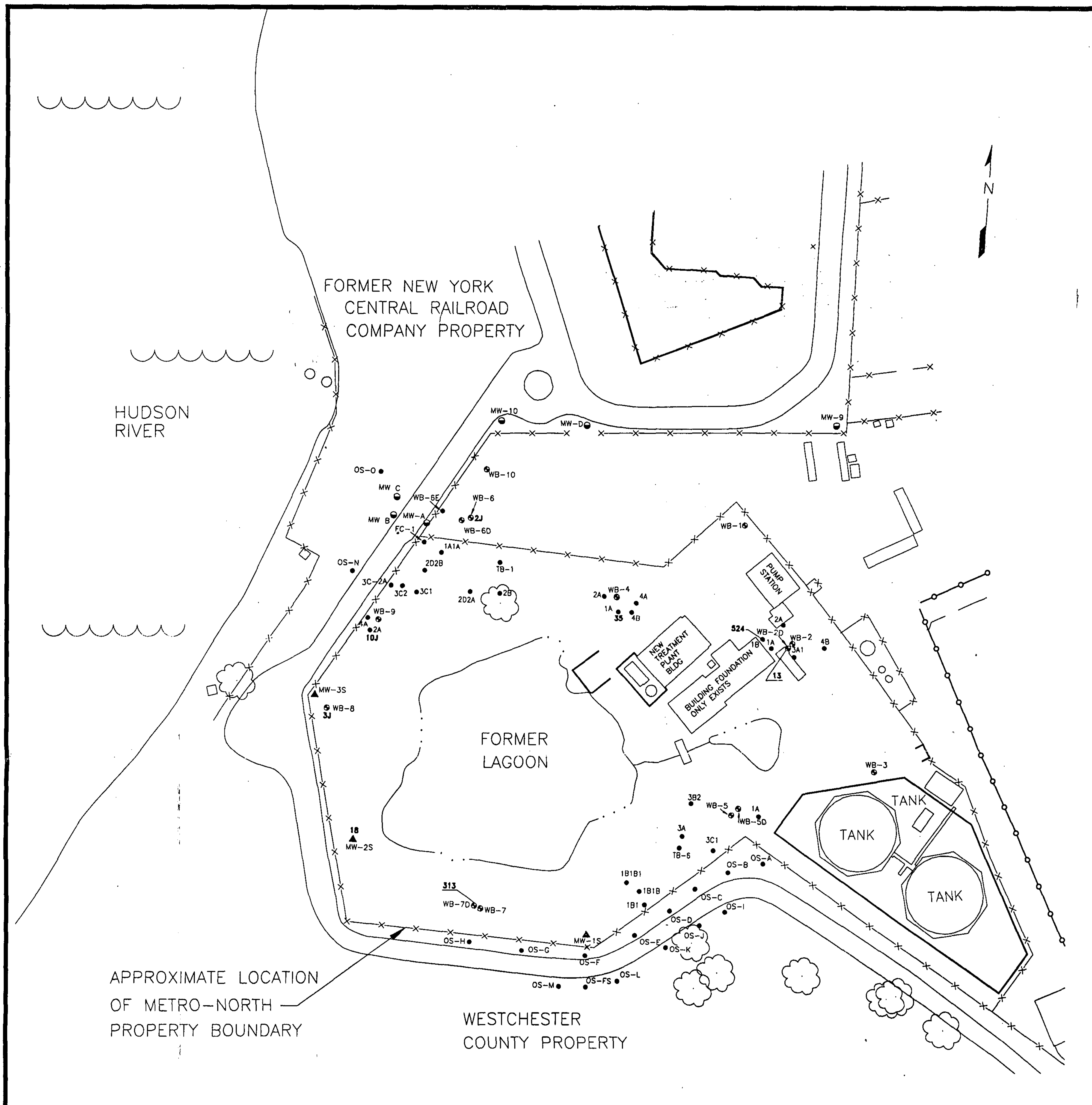


LEGEND

- NAPL
- Water Table

TITLE			
NAPL THICKNESS vs. GROUND WATER ELEVATION			
PREPARED FOR: METRO-NORTH COMMUTER RAILROAD			
ERM	JOB NO. 680003	SCALE NTS	FIGURE 3-2
	FILENAME FIG3-2.XLS	DATE 1/9/96	

C:\files\metro\680003\report\tables\FIG3-2.XLS



LEGEND

- = MONITORING WELLS INSTALLED FRED C. HART, INC.
- = TEMPORARY WELLS/BORINGS INSTALLED BY ERM-NORTHEAST
- ▲ = MONITORING WELLS INSTALLED BY METCALF & EDDY
- = OFF-SITE WELLS INSTALLED BY OFF-SITE PROPERTY OWNER
- 18 = TOTAL SEMI-VOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATION IN MG/L

NOTE:
FIGURE DEPICTS THE LAGOON PRIOR TO REMEDIATION. REMEDIATION OF THE LAGOON WAS COMPLETED IN SEPTEMBER 1996. THE FORMER LAGOON AREA IS NOW COVERED BY AN IMPERMEABLE CAP AND SURROUNDED BY LOW PERMEABILITY SUBSURFACE SHEETING.

0 40 80
GRAPHIC SCALE IN FEET

TITLE TOTAL SVOC CONCENTRATIONS IN GROUND WATER				
PREPARED FOR METRO-NORTH COMMUTER RAILROAD				
ERM ERM-Northeast Environmental Resources Management			SCALE GRAPHIC	FIGURE 3-3
			DATE 1/24/97	
DRAWN: Y.Z.	JOB NO.: 680.003.02	FILE NAME: 6800032P		

Appendices

APPENDIX A

BORINGS LOGS

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01				Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 15.96'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/01/94 / Date Completed: 12/01/94			Water: 16.53'	Top of Riser Elevation
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.57'	NA

DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
2	1	1	8,8, 8,10	1300	0	All brown and black very fine SAND and SILT, trace GRAVEL. No odor and dry.
3–4	2	1.5	7,10, 11,13	1302	0	All brown and black fine to medium SAND and GRAVEL and broken rock. No odor and dry.
5–6	3	NR	15,12, 8,13	1305	0	All black and white coarse SAND and GRAVEL. No odor and dry.
7–8	4	1	15,12, 8,6	1308	0	All black coarse SAND and GRAVEL. No odor and dry.
9–10	5	0.8	6,8, 4,5	1311	34	Same as above. Odor and product saturated.
11–12	6	0.8	4,4, 3,3	1315	32.5	Same as above. Odor present and product saturated.
13–14	7	1	8,6, 3,4	1316	Not Recorded	Same as above. Product saturated.
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

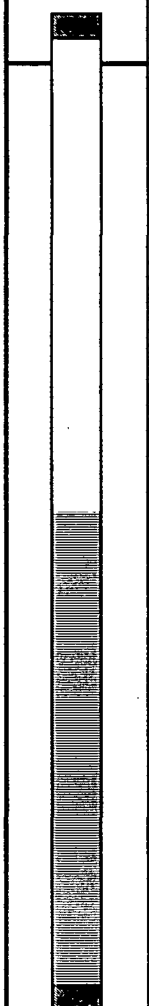
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-1A

Project Name & Location METRO - NORTH, HARMON YARDS		Project Number 680.003.01	
Drilling Company AQUIFER DRILLING AND TESTING		Driller MARK ARATO	
Method HOLLOW STEM AUGER	Date Started 12/20/94		Date Completed 12/20/94
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN		

Product/ Water Level(s) (DBC)		
Date	Time	Levels
01/18/95		Product: 16.16' Water: 16.99' Pthk: 0.83'

Site Elevation Datum
Ground Elevation NA
Top of Steel Cap Elevation NA
Top of Riser Elevation NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
LEGEND: - Backfill - Screen - End/ Top cap	21						
	22						
	23						
	24						
	25						

NR - Not Recorded Pthk - Product Thickness DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1- 1A1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 13.93'	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 12/21/94 Date Completed: 12/21/94			Water: 14.70'	Top of Riser Elevation NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.77'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
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LEGEND:	21						
- Backfill	22						
- Screen	23						
- End/ Top cap	24						
	25						

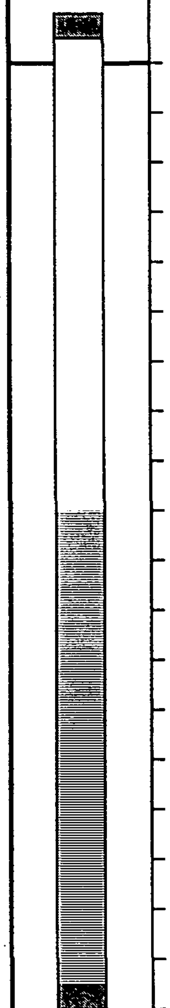
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1- 1A1A

Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01	Product/ Water Level(s) (DBC)			Site Elevation Datum
		Date	Time	Levels	Ground Elevation NA
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO	01/18/95		Product: 10.96'	Top of Steel Cap Elevation NA
Method HOLLOW STEM AUGER	Date Started 01/03/95 / Date Completed 01/03/95			Water: 12.08'	Top of Riser Elevation
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.12'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
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	10						
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	20						
LEGEND: - Backfill - Screen - End/ Top cap	21						
	22						
	23						
	24						
	25						

NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1- 1A1B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 01/05/95; Date Completed: 01/05/95			Water: 12.17'	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
	1						
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LEGEND:	21						
- Backfill	22						
- Screen	23						
- End/ Top cap	24						
	25						

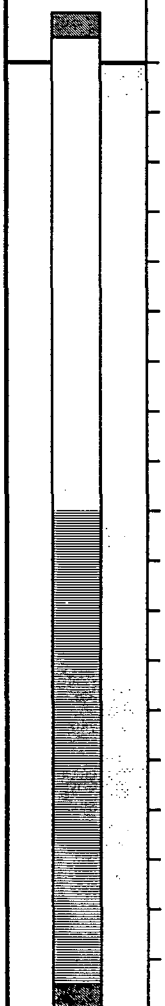
NR - Not Recorded | Pthk - Product Thickness | DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2A

Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01	Product/ Water Level(s) (DBC)			Site Elevation Datum
		Date	Time	Levels	Ground Elevation NA
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO	01/18/95		Product: 17.85'	Top of Steel Cap Elevation NA
Method HOLLOW STEM AUGER	Date Started 12/19/94 Date Completed 12/19/94			Water: 18.42'	Top of Riser Elevation
Completion Depth: 22.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.57'	NA



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
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LEGEND:
- Backfill
- Screen
- End/ Top cap

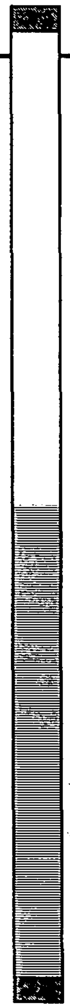
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 18.36'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 18.92'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/20/94; Date Completed: 12/20/94			Pthk: 0.56'	Top of Riser Elevation: NA
Completion Depth: 25.00'	ERM-Northeast Geologist: ERIC ARNESEN				



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
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LEGEND:
- Backfill
- Screen
- End/ Top cap

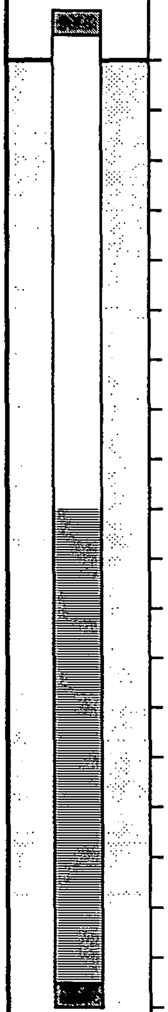
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 16.16'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 16.99'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/20/94 — Date Completed: 12/20/94			Pthk: 0.83'	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN				



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
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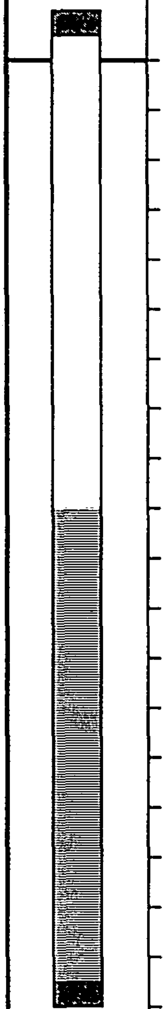
LEGEND:
- Backfill
- Screen
- End/ Top cap

NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2D

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 18.02'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/20/94; Date Completed: 12/20/94			Water: 18.73'	Top of Riser Elevation: NA
Completion Depth: 22.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.71'	



DEPTH (ft below grade)	No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						Refer to log of TB-1 for soil description.
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LEGEND:
- Backfill
- Screen
- End/ Top cap

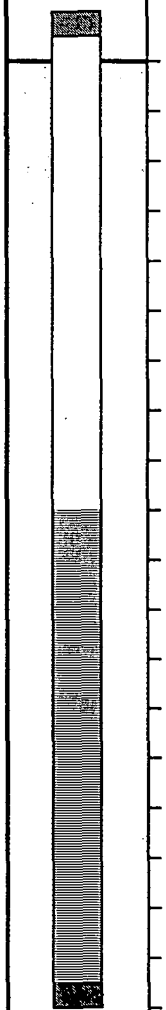
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2D1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 18.64'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 19.18'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/21/94; Date Completed: 12/21/94			Pthk: 0.54'	Top of Riser Elevation: NA
Completion Depth: 22.00'	ERM-Northeast Geologist: ERIC ARNESEN				



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
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LEGEND:
- Backfill
- Screen
- End/ Top cap

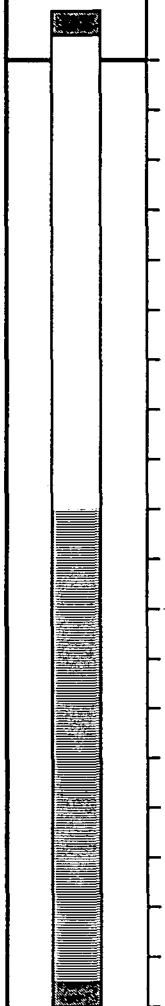
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2D2

Project Name & Location: METRO - NORTH, HARMON YARDS	Project Number: 680.003.01	Product/ Water Level(s) (DBC) Date: 01/18/95	Time	Levels: Product: 17.86' Water: 18.45' Pthk: 0.77'	Site Elevation Datum — Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO				Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/21/94; Date Completed: 12/21/94				Top of Riser Elevation: NA
Completion Depth: 22.00'	ERM-Northeast Geologist: ERIC ARNESEN				



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
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	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

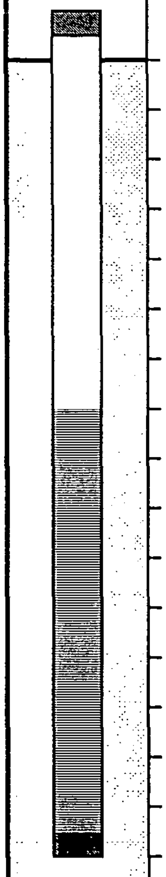
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2D2A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 17.98'	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 12/22/94; Date Completed: 12/22/94			Water: 18.49'	Top of Riser Elevation NA
Completion Depth: 25.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.51'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
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	15						
	16						
LEGEND:	17						
- Backfill	18						
- Screen	19						
- End/ Top cap	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

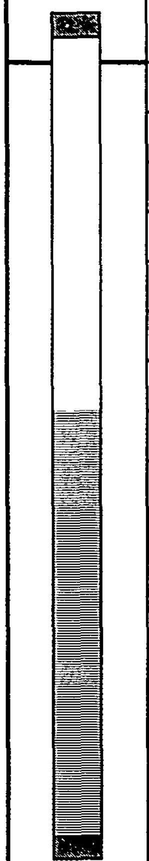
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-2D2B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/22/94; Date Completed: 12/22/94			Water: 18.69'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	



LEGEND:
- Backfill
- Screen
- End/ Top cap

DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						Refer to log of TB-1 for soil description.
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25						

Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-3A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/19/94; Date Completed: 12/19/94			Water: 15.80'	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
	1						
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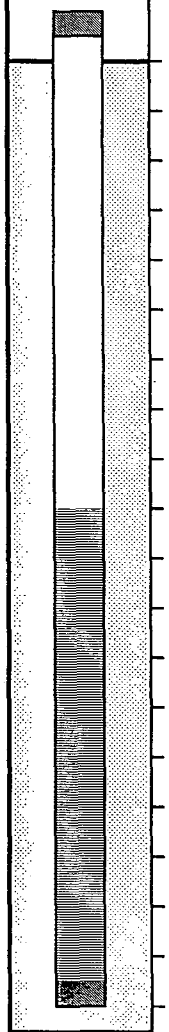
	25						



LEGEND:
- Backfill
- Screen
- End/ Top cap

NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-1-4A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: ---	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 13.58'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/20/94; Date Completed: 12/20/94			Pthk: ---	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN				

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-1 for soil description.
	1						
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	20						
LEGEND: - Backfill - Screen - End/ Top cap	21						
	22						
	23						
	24						
	25						

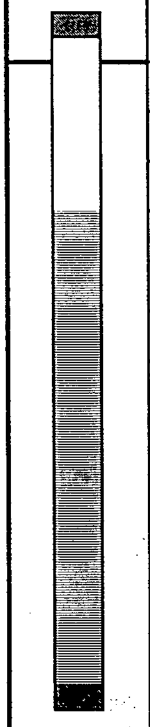
NR - Not Recorded Pthk - Product Thickness DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-2

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/01/95; Date Completed: 12/01/95			Water: 8.96'	Top of Riser Elevation: NA
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1	1	NR	2,3, 2,1	1429	0	All brown very fine SAND and SILT. No odor and dry.
	2						
	3	2	1.5	2,2, 2,2	1431	0	Same as above. No odor and dry.
	4						
	5	3	1.6	8,9, 3,2	1433	0	Top 1.2' same as above. Bottom 0.4' gray very fine SAND and SILT. No odor and dry.
	6						
	7	4	NR	9,8, 2,2	1434	0	All gray very fine SAND, little GRAVEL., trace SILT. No odor and wet.
	8						
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	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

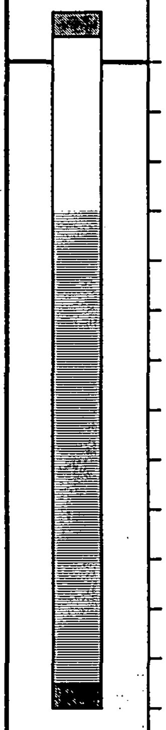
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-3

Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01		
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO		
Method HOLLOW STEM AUGER	Date Started 12/02/95	Date Completed 12/02/95	
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN		

Product/ Water Level(s) (DBC)		
Date	Time	Levels
01/18/95		Product: --- Water: 8.94' Pthk: "---

Site Elevation Datum
Ground Elevation NA
Top of Steel Cap Elevation NA
Top of Riser Elevation NA



LEGEND:
- Backfill
- Screen
- End/ Top cap

DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
2	1	1.8	10,12, 12,13	955	0	Top 1.6' light brown silty CLAY. Bottom 0.2' light brown fine SAND, some SILT. No odor and dry.
3						
4	2	2	12,14, 10,11	959	0	Same as above bottom 0.2'. No odor and dry.
5						
6	3	2	20,18, 13,12	1003	28.8	Light brown very fine SAND, trace SILT. Mid 0.5' Light brown clayey SILT. Bottom 0.5' dark brown SILT. Slight odor and dry.
7						
8	4	2	4,4, 3,2	1005	16.1	Top 1.0' light brown very fine SAND, trace SILT. Mid 0.6' brown clayey SILT. Bottom 0.4' grayish brown very fine SAND, trace SILT. Slight odor and wet.
9						
10	5	2	4,4, 3,4	1011	0	Top 1.6' gray brown very fine SAND, trace SILT. Bottom 0.4' gray fine to very fine SAND. No odor and wet.
11						
12						
13						
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Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-4

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: --	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/07/94 Date Completed: 12/07/94			Water: 7.17'	Top of Riser Elevation: NA
Completion Depth: 13.00'	ERM-Northeast Geologists: ERIC ARNESEN			Pthk: --	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1	1	1.8	8,9, 10,23	1137	0	All brown very fine SAND, trace SILT. No odor and dry.
	2						
	3	2	1.8	10,12, 12,23	1145	49	Top 1.0' Same as above. Bottom 0.8' Gray very fine SAND, trace SILT. Slight odor and dry.
	4						
	5	3	1.5	8,9, 9,8	1147	111	Top 1.0' gray very fine SAND, trace SILT. Bottom 0.5' dark gray SILT and very fine SAND. Stong odor and damp.
	6						
	7	4	1	10,12, 14,10	1150	101	All gray clayey SILT and fine to coarse SAND, trace GRAVEL. Strong odor and wet. Sheen on sample.
	8						
	9						
	10						
	11						
	12						
	13						
	14						
LEGEND: - Backfill - Screen - End/ Top cap	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF BORING:
TB-5

Project Name & Location	Project Number	Date & Time Started	Date & Time Completed	
METRO-NORTH HARMON YARD	680.003.01	12/07/94 10:55	12/07/94 11:15	
Drilling Company	Driller	Sampler(s)	Sampler Hammer	Drop
AQUIFER DRILLING AND TESTING	MARK ARATO	ERIC ARNESEN	130 LBS.	
Drilling Equipment	Method	Elevation & Datum	Completion Depth	Rock depth
	HOLLOW STEM AUGER	NOT APPLICABLE	11.00'	
ERM-Northeast Geologist/Engineer ERIC ARNESEN				

DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft.)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION	REMARKS
0							
1							
2	1	1	10,10, 10,10	1055	0	All brown very fine SAND, trace SILT. No odor and dry.	
3							
4	2	1	12,10, 8,12	1058	0	All dark brown medium to fine SAND, trace SILT. No odor and damp.	
5							
6	3	2	10,10, 8,10	1101	0	All grayish brown fine to medium SAND, trace SILT. No odor and damp.	
7							
8	4	2	8,9, 9,12	1105	0	Top 1.0' Same as above. Bottom 1.0' light brown SILT. No odor and moist.	
9							
10	5	2	10,12, 12,14	1115	0	All brown SILT. No odor and wet.	
11							
12							
13							
14							
15							
16							
17							
18							
19							
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22							
23							
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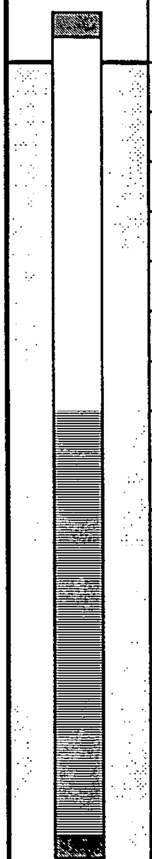
25							

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 9.07'	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 10.33'	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 12/07/94; Date Completed: 12/07/94			Pthk: 0.26'	Top of Riser Elevation NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN				



DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1–2	1	1.5	8,6, 5,12	757	37	Top 0.5' brown SILT, trace very fine SAND. Bottom 1.0' gray SILT, trace very fine SAND. No odor and dry.
3–4	2	2	8,6, 8,8	800	43	All grayish brown SILT. No odor and damp.
5–6	3	1	6,8, 9,8	803	187	All gray SILT, trace very fine SAND. Slight odor and dry.
7–8	4	2	6,12, 12,10	805	81.6	All dark gray SILT, trace very fine SAND. Strong odor and damp.
9–10	5	2	6,12, 12,10	813	203	Description not recorded. Strong odor and moist.
11–12	6	2	8,10, 11,10	818	132	Same as above. Strong odor and wet. Sheen evident on sample.
13						
14						
15						
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18						
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21						
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23						
24						
25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-1A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: 8.62'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/13/94 / Date Completed: 12/13/94			Water: 10.04'	Top of Riser Elevation: NA
Completion Depth:	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.42'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
	2						
	3						
	4						
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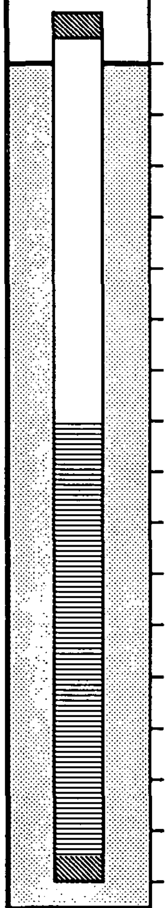
	25						



LEGEND:
- Backfill
- Screen
- End/ Top cap

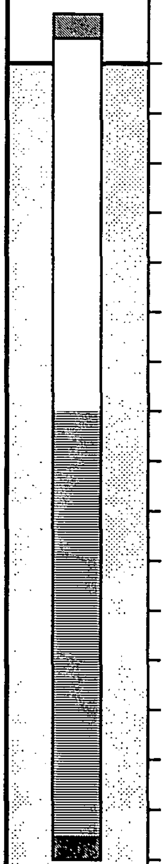
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-1B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 7.73'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/13/94; Date Completed: 12/13/94			Water: 9.21'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.49'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
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	15						
	16						
	17						
LEGEND:	18						
- Backfill	19						
- Screen	20						
- End/ Top cap	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

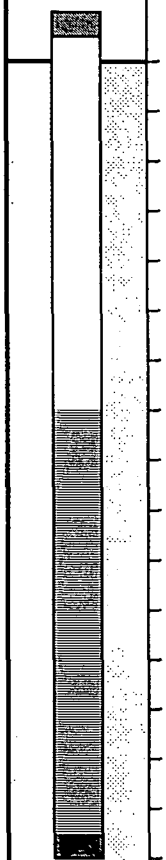
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-1B1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 8.33'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/14/94 Date Completed: 12/14/94			Water: 10.33'	Top of Riser Elevation
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 2.00'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
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	11						
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	15						
	16						
	17						
LEGEND:	18						
- Backfill	19						
- Screen	20						
- End/ Top cap	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

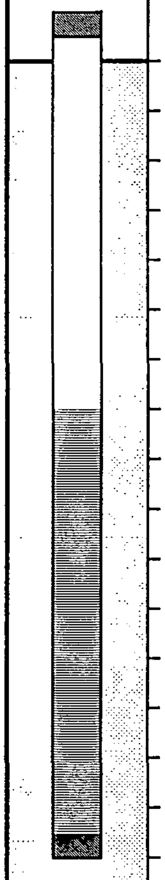
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-1B1A

Project Name & Location: METRO - NORTH, HARMON YARDS	Project Number: 680.003.01		
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		
Method: HOLLOW STEM AUGER	Date Started: 12/15/94	Date Completed: 12/15/94	
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN		

Product/ Water Level(s) (DBC)			
Date	Time	Levels	
01/18/95		Product:	---
		Water:	11.54'
		Pthk:	---

Site Elevation Datum	
Ground Elevation	NA
Top of Steel Cap Elevation	NA
Top of Riser Elevation	NA



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

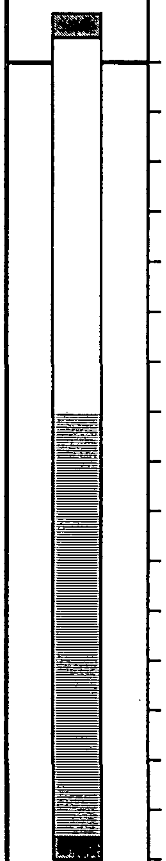
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-1B1B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 10.68'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/15/94; Date Completed: 12/15/94			Water: 12.68'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 2.00'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
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	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
LEGEND: - Backfill - Screen - End/ Top cap	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

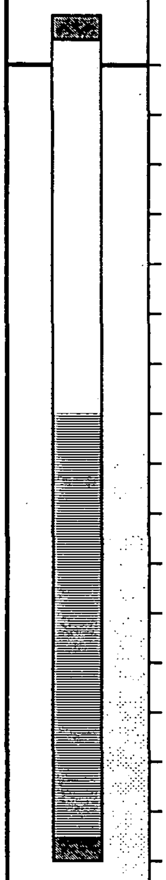
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-1B1B1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation
Drilling Company	Driller	01/18/95		Product:	NA
AQUIFER DRILLING AND TESTING	MARK ARATO			---	Top of Steel Cap Elevation
Method: HOLLOW STEM AUGER	Date Started: 12/22/94 / Date Completed: 12/22/94			Water: 18.69'	NA
Completion Depth: 25.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	Top of Riser Elevation: NA



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
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	10						
	11						
	12						
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	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

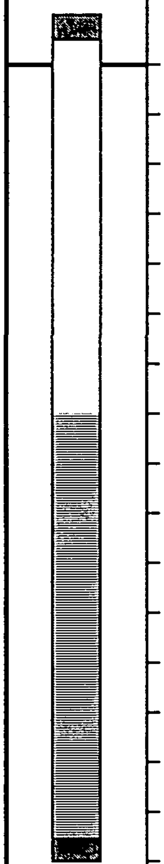
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-1C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/14/94; Date Completed: 12/14/94			Water: 11.03'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
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	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
LEGEND: - Backfill - Screen - End/ Top cap	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

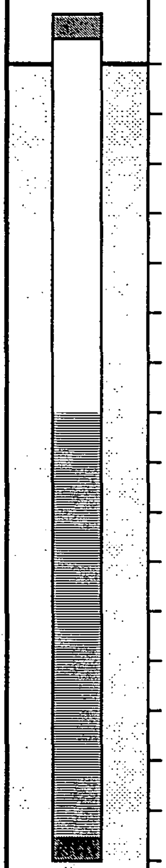
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-2A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 8.62'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/13/94; Date Completed: 12/13/94			Water: 10.04'	Top of Riser Elevation
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.42	NA



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
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	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: TB-6-3A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/13/94; Date Completed: 12/13/94			Water: 8.82'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of TB-6 for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
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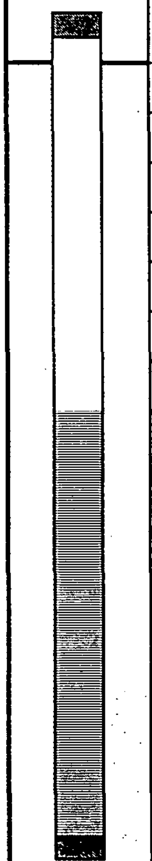


LEGEND:
- Backfill
- Screen
- End/ Top cap

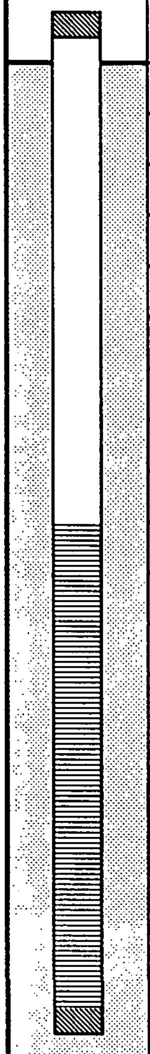
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-1A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: 13.99'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 11/22/94 / Date Completed: 11/22/94			Water: 15.03'	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.04'	



LEGEND:
- Sand pack
- Riser
- Screen
- End/ Top cap

DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
	1	1.5	8,8,	838	0	Top 0.3' brown fine to medium SAND.
2			8,15			Mid 0.3' black fine SAND.
						Bottom 0.9 ' light brown and orange fine to medium SAND.
3						No odor and dry.
	2	1	6,7,	842	0	Top 0.2' orange fine SAND.
4			8,9			Bottom 0.8' tan fine SAND.
						No odor and dry.
5						
	3	2	5,8,	845	0	All fine orange brown SAND.
6			7,5			No odor and dry.
7						
	4	1.2	6,7,	921	16.3	Top 0.8' orange brown SAND with black and dark brown striations.
8			9,7			Bottom 0.4' gray fine SAND.
						Slight odor and damp.
9						
	5	1	8,9,	939	24.9	All fine gray SAND.
10			9,9			Slight odor and damp.
11						
	6	2	8,9,	944	17.7	Same as above.
12			9,11			Strong odor and moist.
13						
	7	2	8,11,	951	31.9	Same as above.
14			11,10			Strong odor and wet.
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Pthk - Product Thickness

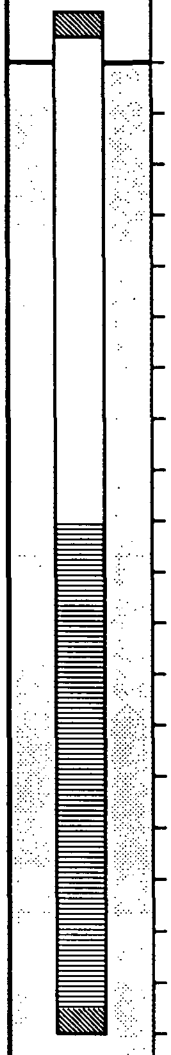
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-1B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/8/94; Date Completed: 12/8/94			Water: 14.25'	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log for WB-2-1A for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Sand pack
- Riser
- Screen
- End/ Top cap

Pthk - Product Thickness

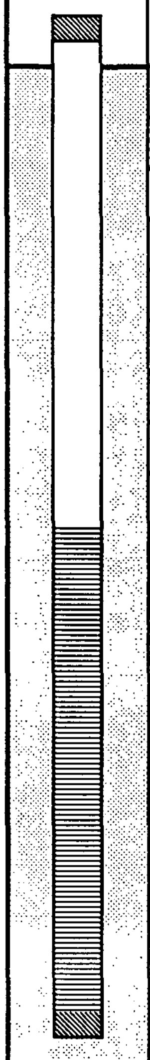
DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-1B1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 1/3/95; Date Completed: 1/3/95			Water: 14.71'	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log for WB-2-1A for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						



LEGEND:
- Sand pack
- Riser
- Screen
- End/ Top cap

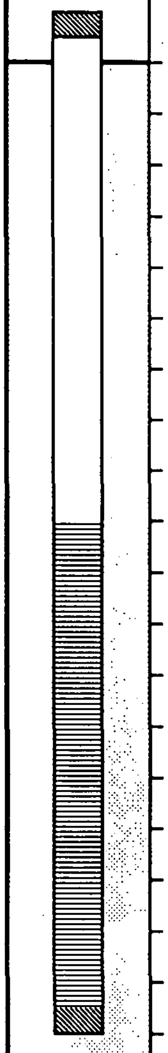
Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-1C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/9/94 / Date Completed: 12/9/94			Water: 11.44'	Top of Riser Elevation
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log WB-2-1A for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
LEGEND: - Sand pack - Riser - Screen - End/ Top cap	21						
	22						
	23						
	24						
	25						

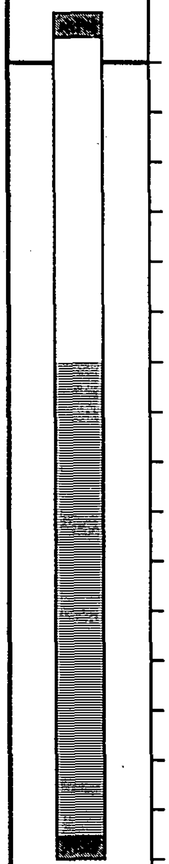
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-2A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 13.46'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 11/22/94 / Date Completed: 11/22/94			Water: 13.89'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.43'	



DEPTH (ft below grade)	No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
2	1	0.6	2,2, 1,2	1139	0	All brown fine SAND, trace GRAVEL. No odor and dry.
3						
4	2	NR	NR	1140	0	Same as above. No odor and dry.
5						
6	3	NRy	7,6, 5,6	1145	Not Recorded	
7						
8	4	1	3,4, 5,4	1148	0	Top 0.5' Light brown fine SAND. Bottom 0.5' Brown fine SAND. No odor and dry.
9						
10	5	1.5	8,8, 12,12	1201	53	All brown fine SAND. Slight odor and damp.
11						
12	6	2	6,8, 10,11	1209	17.6	Same as above. Slight odor and wet. Sheen on sample.
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

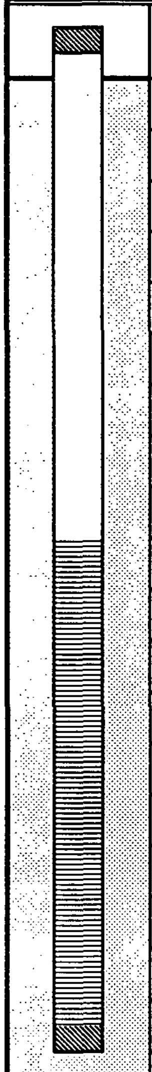
LEGEND:
- Backfill
- Screen
- End/ Top cap

NR - Not Recorded NRy - No Recovery Pthk - Product Thickness DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-2B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/9/94 / Date Completed: 12/9/94			Water: 11.42'	Top of Riser Elevation: NA
Completion Depth:	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to logWB-2-1A for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
LEGEND:	21						
- Sand pack	22						
- Riser	23						
- Screen	24						
- End/ Top cap	25						

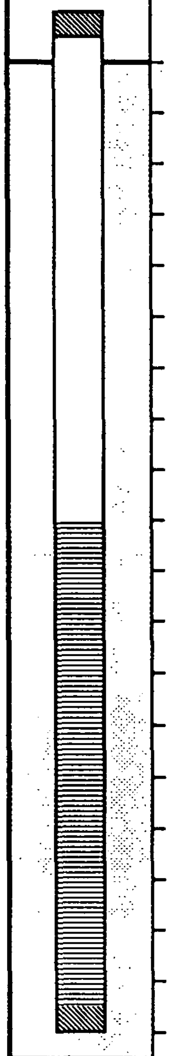
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-2C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/9/94 Date Completed: 12/9/94			Water: 11.44'	Top of Riser Elevation: NA
Completion Depth: 19.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to logWB-2-1a for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
LEGEND: - Sand pack - Riser - Screen - End/ Top cap	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

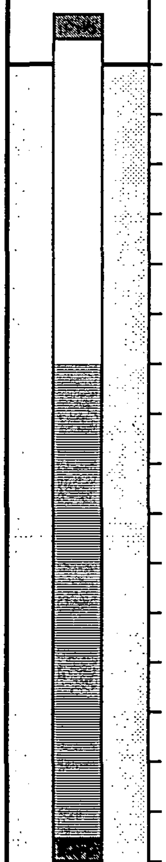
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-3A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: --	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 14.14'	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started 11/22/94; Date Completed 11/22/94			Pthk: --	Top of Riser Elevation NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN				



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	1–2	1	1	8,7, 9,2	1320	0	All brown fine SAND and GRAVEL. No odor and dry.
	3–4	2	0.5	4,2, 2,4	1324	0	Same as above. No odor and dry.
	5–6	3	1.8	4,3, 5,3	1330	0	All light brown fine SAND. No odor and dry.
	7–8	4	1	2,3, 4,3	1331	12	Same as above. No odor and dry.
	9–10	5	1	4,4, 5,6	1335	16.2	All gray fine SAND. Slight odor.
	11–12	6	1.2	8,7, 6,7	1350	25.6	Same as above. Some clay layering. Slight odor and wet.
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

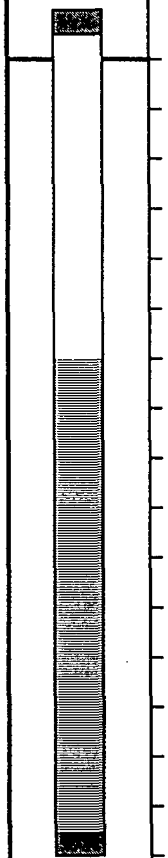
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-3A1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: --	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/12/94 / Date Completed: 12/12/94			Water: 14.14'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log WB2-3A for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

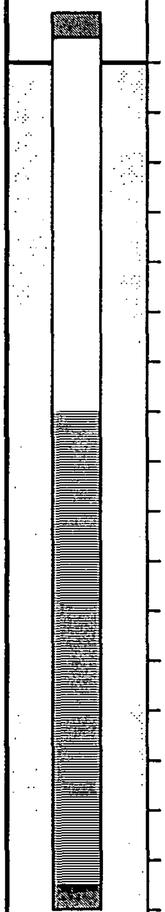
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-4A

Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01		Product/ Water Level(s) (DBC)			Site Elevation Datum
			Date	Time	Levels	Ground Elevation NA
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO		01/18/95		Product: 13.44'	Top of Steel Cap Elevation NA
Method HOLLOW STEM AUGER	Date Started 11/23/94	Date Completed 11/23/94			Water: 14.10'	Top of Riser Elevation
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: 0.66'	NA



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION (logged from cuttings)
	0						
	1						
	2						
	3						
	4						
	5				900		Brown fine SAND. No odor and dry.
	6						
	7						
	8						
	9						
	10				928		Gray fine SAND. Slight odor and moist.
	11						
	12						
	13						
	14						
	15				936		Same as above. Slight odor and wet.
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

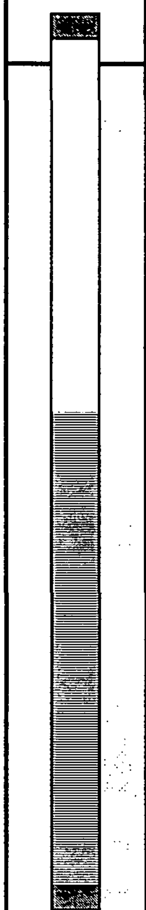
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-2-4B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/12/94 Date Completed: 12/12/94			Water: 11.01'	Top of Riser Elevation
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	NA



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION (logged from cuttings)
	0						Refer to log WB-2-4A for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

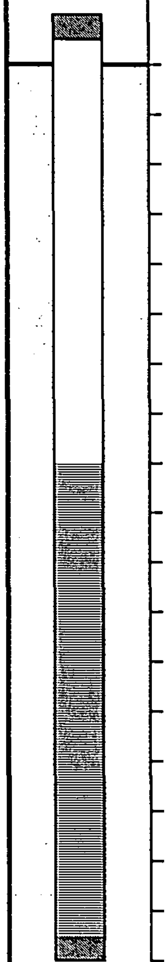
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-4-1A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 11.45'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 13.20'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 11/29/94 · Date Completed: 11/29/94			Pthk: 1.75'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN				



DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
2	1	1.8	10,12, 15,18	1015	0	All brown and orange very fine SAND, some SILT. Slight odor and dry.
3						
4	2	1.5	30,23, 28,18	1019	0	All gray very fine SAND and SILT. CLAY lenses in lower 0.5' Slight odor and damp.
5						
6	3	1.2	4,6, 4,5	1026	38.5	Top 0.8' Same as above. Bottom 0.4' Brown silty CLAY. Slight odor and damp.
7						
8	4	1.5	7,7, 8,10	1029	5.2	Top 1.2' brown silty CLAY. Bottom 0.3' Gray very fine SAND, some SILT. Slight odor and damp.
9						
10	5	1.9	5,5, 10,11	1037	Not Recorded	Top 0.4' Gray very fine SAND and SILT, little CLAY. Mid 1.0' Gray and brown silty CLAY. Bottom 0.5' Gray very fine to fine SAND, trace SILT. No odor and dry.
11						
12	6	1	15,14, 16,17	1043	0	Top 0.5' gray very fine SAND and SILT. Bottom 0.5' gray very fine SAND and SILT and CLAY. No odor and damp.
13						
14	7	1	7,6, 4,3	1058	0	Top 0.3' gray very fine SAND and SILT Bottom 0.7' gray fine SAND. No odor and wet.
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

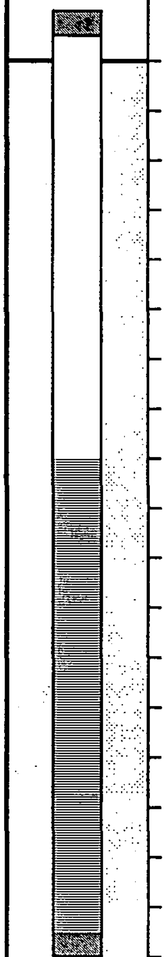
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-4-2A

Project Name & Location	Project Number		Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01		Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		01/18/95		Product: 12.68'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 11/29/94	Date Completed: 11/29/94			Water: 12.70'	Top of Riser Elevation: NA
Completion Depth: 18'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: 0.02'	



LEGEND:
- Backfill
- Screen
- End/ Top cap

DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
	1	1	9,7, 5,7	1340	0	All brown very fine SAND and SILT. No odor and dry.
2						
3						
	2	1.2	8,7, 9,12	1342	0	Top 0.6' brown very fine to fine SAND, trace SILT. Mid 0.2' black very fine SAND and SILT. Bottom 0.4' Same as top 0.6' No odor and dry.
4						
5						
	3	2	14,16, 16,18	1346	31.3	All gray clayey SILT. Slight odor and damp.
6						
7						
	4	1	10,15, 22,30	1350	7	Top 0.7' gray and brown clayey SILT. Bottom 0.3' brown silty CLAY. Slight odor and dry.
8						
9						
	5	2	10,8, 11,12	1406	11.6	Top 1.2' gray silty CLAY. Bottom 0.8' gray very fine SAND, trace SILT. Slight odor and damp.
10						
11						
	6	1.8	8,17, 17,15	1409	0	Top 1.4' gray silty CLAY. Bottom 0.4' gray clayey SILT. No odor and wet.
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Pthk - Product Thickness

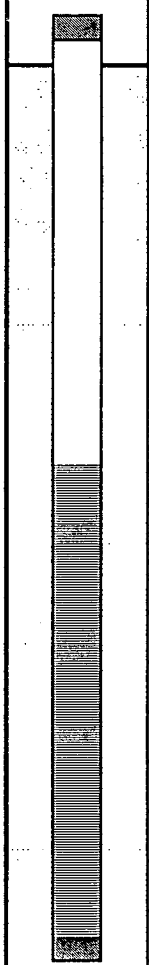
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-4-3A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started 11/29/94 · Date Completed 11/29/94			Water: 13.68	Top of Riser Elevation
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	NA



LEGEND:
- Backfill
- Screen
- End/ Top cap

DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1–2	1	1.6	4,5, 4,6	1211	0	Top 1.2' Brown fine SAND. Bottom 0.4' orange and brown fine to medium SAND. No odor and dry.
3–4	2	1	5,5, 6,5	1215	0	All gray very fine SAND, some CLAY, trace SILT. Slight odor and damp.
5–6	3	2	8,10, 12,15	1223	0	Top 1,7' gray silty CLAY. Bottom 0.3' brown very fine SAND, trace SILT. No odor and damp.
7–8	4	1	10,10, 10,10	1223	0	All brown gray very fine SAND, some SILT, little CLAY. No odor and dry.
9–10	5	1	7,8, 15,17	1228	0	Top- 0.6' brown silty CLAY. Bottom 0.4' gray very fine SAND, trace SILT. No odor and moist.
11–12	6	1.5	3,5, 11,10	1240	0	All gray very fine SAND, trace SILT. No odor and wet. Sheen on sample.
13						
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Pthk - Product Thickness

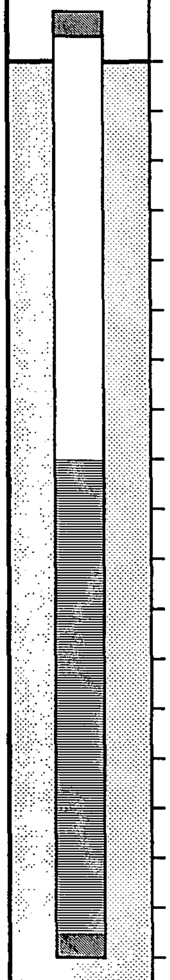
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-4-4A

Project Name & Location	Project Number		Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01		Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		01/18/95		Product: 13.84'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 11/30/94	Date Completed: 11/30/94			Water: 14.30'	Top of Riser Elevation
Completion Depth: 18.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: 0.46'	NA



DEPTH (ft below grade)	No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1	1	1.5	10,18, 15,25	830	4.5	Top 1.0' brown and gray very fine SAND, trace SILT. Mid 0.3' black very fine SAND. Bottom 0.2' gray very fine SAND, trace SILT. Slight odor and dry.
2						
3	2	1.5	15,15, 17,20	835	0	Top 1.3' brown gray very fine SAND, trace SILT. Bottom 0.2' gray silty CLAY. No odor and dry.
4						
5	3	1.8	5,6, 5,8	848	0	Top 0.9' gray clayey SILT. Bottom 0.9' light brown silty CLAY. Slight odor and damp.
6						
7	4	1.5	5,10, 10,12	851	0	Top 1.0' same as above bottom 0.9' Bottom 0.5' gray very fine SAND, trace SILT. No odor and damp.
8						
9	5	1.5	8,9, 12,12	901	0	Top 0.5' orange brown silty CLAY. Bottom 1.0' gray very fine SAND, trace SILT. No odor and dry.
10						
11	6	2	8,9, 6,7	904	6.8	All gray fine SAND, some SILT. Slight odor and wet No odor and wet.
12						
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20						
21						
22						
23						
24						
25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

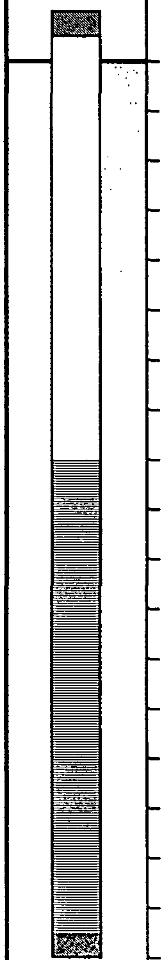
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-4-4B

Project Name & Location	Project Number		Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01		Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		01/18/95		Product: 14.27'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/08/94	Date Completed: 12/08/94			Water: 14.31'	Top of Riser Elevation
Completion Depth: 18.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: 0.04'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log WB-4C for soil description.
	1						
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	3						
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	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
LEGEND:	20						
- Backfill	21						
- Screen	22						
- End/ Top cap	23						
	24						
	25						

Pthk - Product Thickness

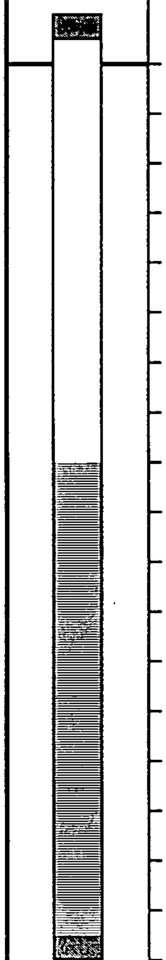
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-4-4C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/08/94; Date Completed: 12/08/94			Water: 14.01'	Top of Riser Elevation: NA
Completion Depth: 18.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log WB-4C for soil description.
	1						
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	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-4-4D

Project Name & Location METRO - NORTH, HARMON YARDS		Project Number 680.003.01	
Drilling Company AQUIFER DRILLING AND TESTING		Driller MARK ARATO	
Method HOLLOW STEM AUGER	Date Started 12/08/94	Date Completed 12/08/94	
Completion Depth: 18.00'	ERM-Northeast Geologist: ERIC ARNESEN		

Product/ Water Level(s) (DBC)		
Date	Time	Levels
01/18/95		Product: ---
		Water: 13.65'
		Pthk: ---

Site Elevation Datum	
Ground Elevation	NA
Top of Steel Cap Elevation	NA
Top of Riser Elevation	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log WB-4C for soil description.
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
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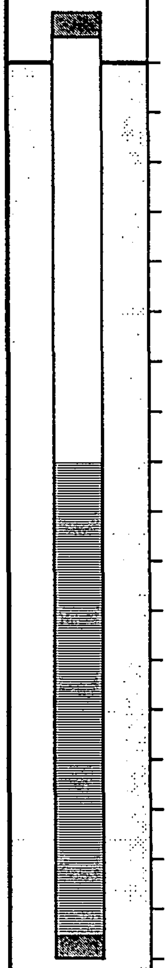


LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

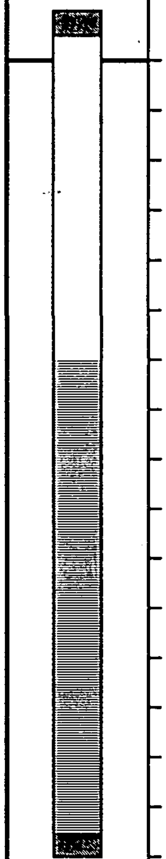
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-1A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 12.06'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 13.22'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 11/28/94; Date Completed: 11/28/94			Pthk: 1.24'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN				



DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
1–2	1	1.8	10,12, 11,8	1108	0	All light brown very fine SAND with gray striations throughout. No odor and dry.
3–4	2	1	5,7, 7,9	1110	4.5	Top 0.7' same as above. Bottom 0.3' gray fine to medium SAND. Silght odor and dry.
5–6	3	1	6,7, 10,12	1121	15.6	Same as above bottom 0.3'. Odor and dry.
7–8	4	1	15,15, 15,15	1124	20	All gray fine SAND. Odor and dry.
9–10	5	1	12,14, 17,16	1136	20.7	All gray SILT. Odor and damp.
11–12	6	2	17,6, 9,10	1141	20	Same as above. Odor and wet.

Depth scale: 0–25 ft.

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

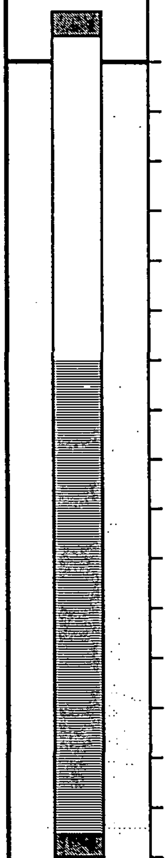
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-1A1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	NA
Method: HOLLOW STEM AUGER	Date Started: 01/06/95; Date Completed: 01/06/95			Water: 11.03'	Top of Steel Cap Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	Top of Riser Elevation: NA



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-1A for soil description.
	1						
	2						
	3						
	4						
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	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

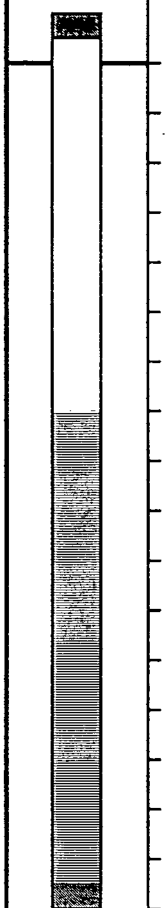
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-2A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 11.45'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/06/94 Date Completed: 12/06/94			Water: 13.20'	Top of Riser Elevation
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.75'	NA



LEGEND:
⬜ - Backfill
▤ - Screen
▩ - End/ Top cap

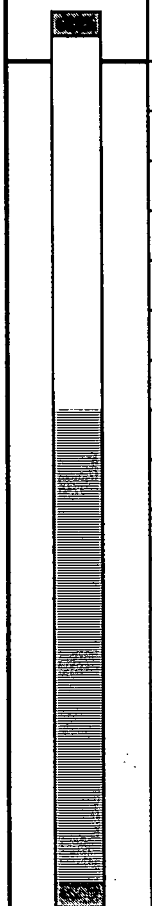
DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
	1	1.5	6,8,	1205	17.7	Top 0.5' dark brown SILT, some very fine SAND.
2			10,15			Bottom 1.0' very light brown very fine SAND, some SILT.
						No odor and dry.
3						
	2	1.5	10,10,	1208	18	All very light brown SILT, trace very fine SAND.
4			7,10			No odor and dry.
5						
	3	1.5	10,10,	1212	25.3	Top 1.0' brown SILT.
6			10,10			Mid 0.3' gray medium SAND.
						Bottom 0.2' gray SILT.
7						Slight odor and dry.
	4	1.5	12,14,	1215	49.4	Top 0.2' brown SILT, trace very fine SAND.
8			15,18			Bottom 1.3' gray SILT trace very fine SAND.
						Strong odor and dry.
9						
	5	1.5	10,11,	1222	54	All same as above bottom 1.3'
10			14,12			Odor and damp.
11						
	6	2	6,8,	1224	Not	Same as above.
12			10,8		Recorded	Strong odor and wet.
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

Pthk - Product Thickness
DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-2B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: ---	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 10.10'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/15/94 / Date Completed: 12/15/94			Pthk: ---	Top of Riser Elevation: NA
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN				



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log for WB-5-2A for soil description.
	1						
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	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

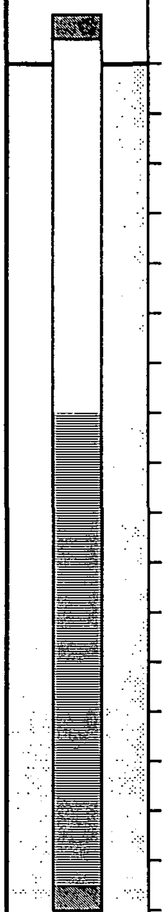
ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3A

Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01		
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO		
Method HOLLOW STEM AUGER	Date Started 12/06/94	Date Completed 12/06/94	
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN		

Product/ Water Level(s) (DBC)			Site Elevation Datum
Date	Time	Levels	Ground Elevation NA
01/18/95		Product: 10.73'	Top of Steel Cap Elevation NA
		Water: 11.98'	Top of Riser Elevation
		Pthk: 1.25'	NA



LEGEND:
- Backfill
- Screen
- End/ Top cap

DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1–2	1	1.5	6,8, 7,6	1025	14.4	All light brown very fine SAND and SILT. No odor and dry.
3–4	2	1.7	8,8, 8,9	1028	35.9	Top 0.3' same as above. Mid 1.0' grayish brown very fine SAND and SILT, trace coarse SAND. Bottom 0.4' gray clayey SILT. Odor and damp.
5–6	3	1	8,7, 8,6	1032	39.5	Top 0.2' brown and gray very fine SAND and SILT. Mid 0.3' gray silty CLAY. Bottom 0.5' gray medium SAND. Odor and dry.
7–8	4	1.5	6,8, 8,7	1040	72	Top 0.2' same as above bottom 0.5' Bottom 1.3' gray SILT with CLAY lenses. Strong odor and damp.
9–10	5	1	12,11, 15,17	1041	37	All gray very fine SAND and SILT. Odor and wet. Sheen on sample.
11–12	6	NR	7,10, 11,13	1045	30.7	Same as above. Strong odor and wet. Product evident on sample.
13–14	7	NR	14,11, 11,10	828	83.2	Same as above. Strong odor and wet. Sheen on sample.
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

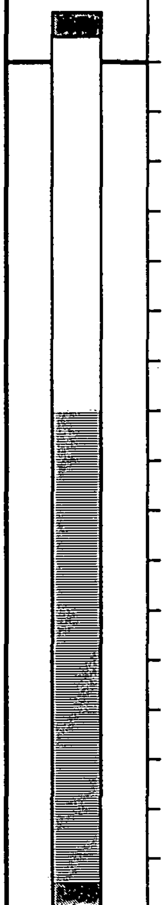
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/12/94; Date Completed: 12/12/94			Water: 8.53'	Top of Riser Elevation: NA
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-3A for soil description.
	1						
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	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
LEGEND: - Backfill - Screen - End/ Top cap	19						
	20						
	21						
	22						
	23						
	24						
	25						

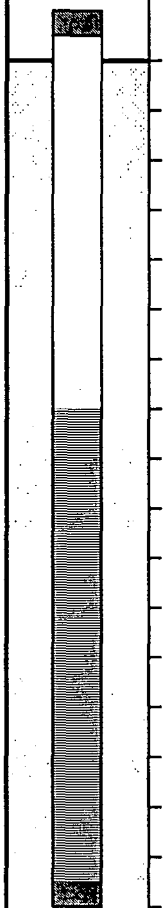
NR - Not Recorded Pthk - Product Thickness DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3B1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01				Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 10.24'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/13/94 / Date Completed: 12/13/94			Water: 11.45'	Top of Riser Elevation
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.21'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-3A for soil description.
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	13						
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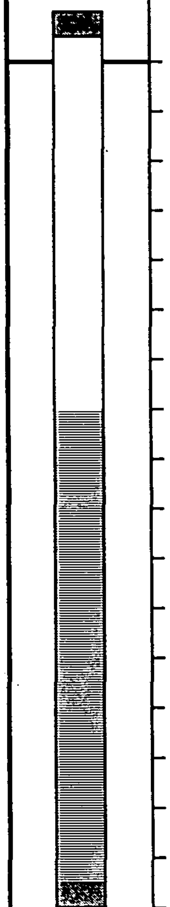
	15						
	16						
	17						
	18						
LEGEND:	19						
- Backfill	20						
- Screen	21						
- End/ Top cap	22						
	23						
	24						
	25						

NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3B2

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 9.21'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 9.49'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/13/94; Date Completed: 12/13/94			Pthk: 0.28'	Top of Riser Elevation: NA
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN				

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco- very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-3A for soil description.
	1						
	2						
	3						
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	6						
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	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
LEGEND:	19						
- Backfill	20						
- Screen	21						
- End/ Top cap	22						
	23						
	24						
	25						

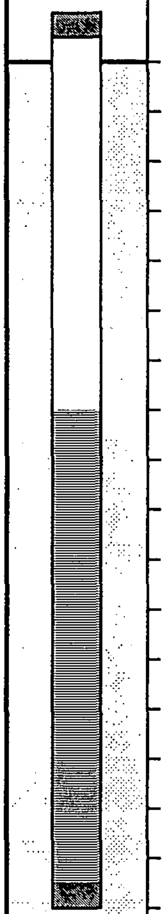
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3B3

Project Name & Location	Project Number		Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01		Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/14/94	Date Completed: 12/14/94			Water: 8.35'	Top of Riser Elevation
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: ---	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-3A for soil description.
	1						
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LEGEND:	19						
- Backfill	20						
- Screen	21						
- End/ Top cap	22						
	23						
	24						
	25						

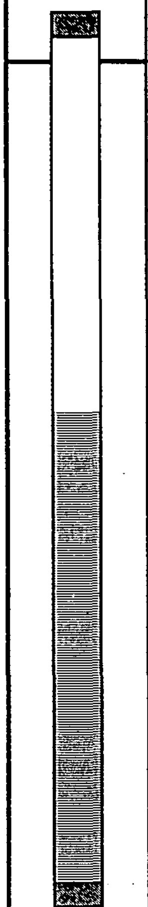
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	01/18/95		Product: 8.43'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 10.14'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/12/94; Date Completed: 12/12/94			Pthk: 1.71'	Top of Riser Elevation: NA
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN				

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-3A for soil description.
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	18						
LEGEND: - Backfill; - Screen; - End/ Top cap	19						
	20						
	21						
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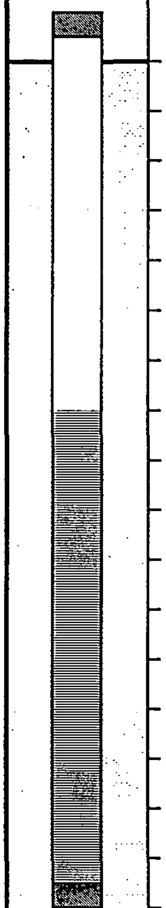
	23						
	24						
	25						

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3C1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 8.30'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/14/94; Date Completed: 12/14/94			Water: 9.76'	Top of Riser Elevation: NA
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 1.46'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-3A for soil description.
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LEGEND: - Backfill - Screen - End/ Top cap	19						
	20						
	21						
	22						
	23						
	24						
	25						

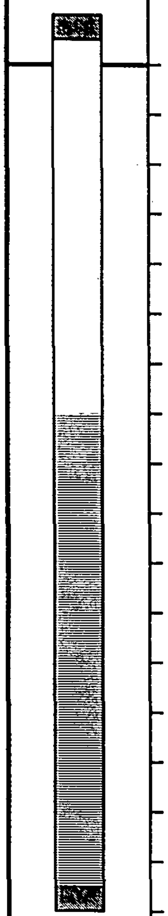
NR - Not Recorded Pthk - Product Thickness DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-3E

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 9.80'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/14/94; Date Completed: 12/14/94			Water: 10.76'	Top of Riser Elevation
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.96'	NA



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-5-3A for soil description.
	1						
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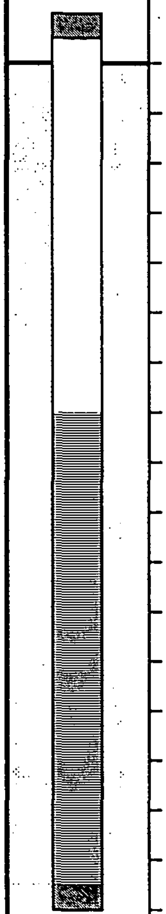
NR - Not Recorded   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-5-4A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 12.54'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/06/94; Date Completed: 12/06/94			Water: 13.50'	Top of Riser Elevation: NA
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.96'	



DEPTH (ft below grade)	No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
2	1	2	12,15 17,18	753	27.8	Top 0.5' black medium to fine SAND, trace GRAVEL. Mid 1.0' dark brown very fine SAND and SILT. Bottom 0.5' lightbrown clayey SILT. No odor and dry.
3						
4	2	1.5	20,22, 18,23	758	38.9	All brownish gray very fine SAND, trace SILT. Slight odor and dry.
5						
6	3	1	16,18, 20,18	809	128	Same as above. Strong odor and dry.
7						
8	4	1	13,11, 11,13	812	105	All gray fine SAND, trace SILT. Strong odor and dry.
9						
10	5	1.3	13,20, 20,22	820	107	All gray very fine SAND and SILT. Strong odor and dry.
11						
12	6	1.5	13,15, 16,18	822	136	Same as above. Strong odor and damp.
13						
14	7	NR	14,11, 11,10	828	83.2	Same as above. Strong odor and wet. Sheen on sample.
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

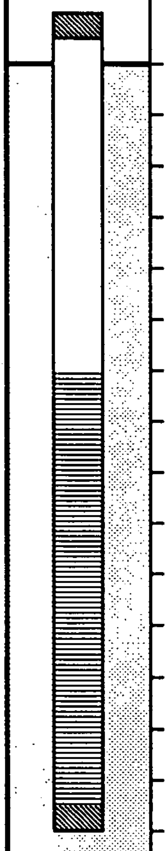
NR - Not Recorded Pthk - Product Thickness DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-6E

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: 9.48'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 2/7/96; Date Completed: 2/7/96			Water: 9.96'	Top of Riser Elevation: NA
Completion Depth: 15.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.48'	



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
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	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

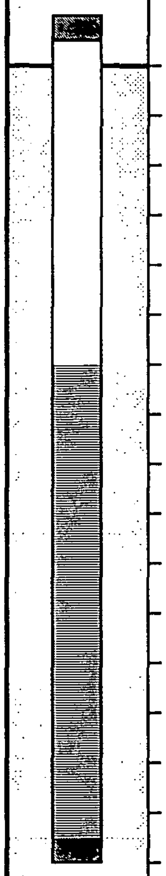
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-1A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 11.01'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 11/30/94 Date Completed: 11/30/94			Water: 11.75'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.74'	



DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
1-2	1	1	10,10, 12,10	1215	0	Top 0.6' orange brown fine SAND. Bottom 0.4' black fine to coarse SAND, trace GRAVEL. No odor and dry.
3-4	2	1	7,8, 12,15	1218	0	Same as above bottom 0.4'. No odor and dry.
5-6	3	0.4	8,10, 11,8	1225	0	Same as above. No odor and damp.
7-8	4	0.5	3,6, 6,8	1227	0	Black and Brown coarse SAND and GRAVEL. No odor and damp.
9-10	5	NRy	13,12, 10,25	1240	Not Recorded	
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

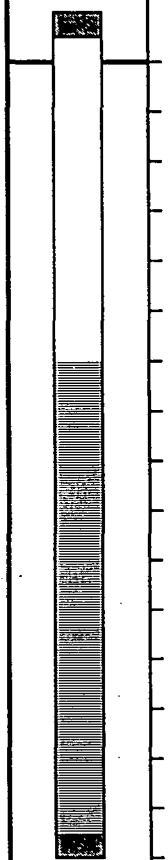
NRy - No recovery   Pthk - Product Thickness   DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-1B

			Product/ Water Level(s) (DBC)			Site Elevation Datum
Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01		Date	Time	Levels	Ground Elevation NA
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO		01/18/95		Product: ---	Top of Steel Cap Elevation NA
Method HOLLOW STEM AUGER	Date Started 12/15/94	Date Completed 12/15/94			Water: 11.71'	Top of Riser Elevation NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: ---	



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log Of WB-9-1A for soil description.
	1						
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	3						
	4						
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	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

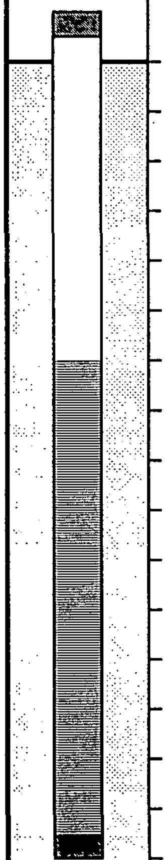
NRy - No recovery | Pthk - Product Thickness | DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-1C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: ---	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/16/94; Date Completed: 12/16/94			Water: 12.17'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ---	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-9-1A for soil description.
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	10						
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	17						
LEGEND: - Backfill; - Screen; - End/ Top cap	18						
	19						
	20						
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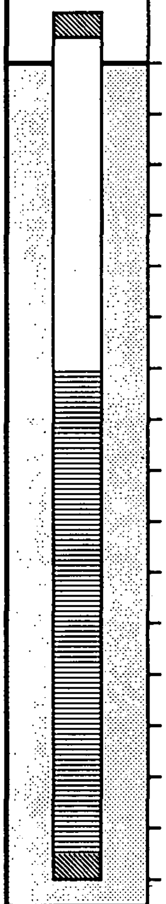
	22						
	23						
	24						
	25						

NRy - No recovery | Pthk - Product Thickness | DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-2A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: --	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/1/94; Date Completed: 12/1/94			Water: 8.81	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	



DEPTH (ft below grade)	No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
0						
1						
	1	0.5	12,10,	831	0	All black coarse SAND and GRAVEL and SILT.
2			11,13			No odor and dry.
3						
	2	0.8	8,8,	833	0	All black and orange coarse SAND and GRAVEL.
4			12,13			No odor and dry.
5						
	3	1	8,10,	836	15.8	All black coarse SAND and GRAVEL.
6			8,7			Slight odor and dry.
7						
	4	1	7,6,	838	24	All black coarse SAND and GRAVEL and SILT.
8			8,5			Odor and product saturated.
9						
	5	NRy	15'	849	Not	Wood in tip of spoon.
10			100/6"		Recorded	
11						
12						
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18						
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20						
21						
22						
23						
24						
25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

NRy - No Recovery   Pthk - Product Thickness   DBC - Depth below PVC casing

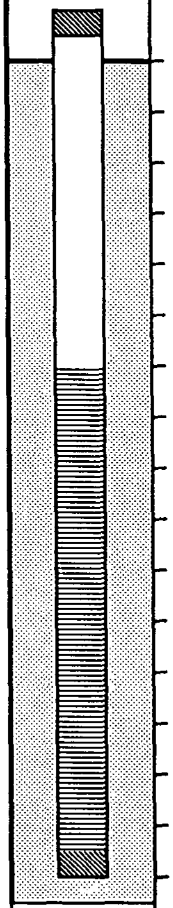
ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-3A

Project Name & Location: METRO - NORTH, HARMON YARDS	Project Number: 680.003.01		
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		
Method: HOLLOW STEM AUGER	Date Started: 12/1/94	Date Completed: 12/1/94	
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN		

Product/ Water Level(s) (DBC)			Site Elevation Datum
Date	Time	Levels	Ground Elevation: NA
1/18/95		Product: 9.93'	Top of Steel Cap Elevation: NA
		Water: 10.14'	Top of Riser Elevation: NA
		Pthk: 0.21'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1–2	1	1	5,6, 8,6	1000	0	All black and brown coarse SAND and SILT, trace GRAVEL. No odor and dry.
	3–4	2	1.5	5,6, 8,5	1002	0	All black coarse SAND and GRAVEL and broken rock. No odor and dry.
	5–6	3	1	10,10, 10,5	1004	28.5	Same as above. Odor and oil saturated
	7–8	4	0.2	3,4, 5,4	1008	28.9	Same as above. Odor and oil saturated.
	9–10	5	1.5	10,8, 7,5	1009	16.1	Same as above. Oil saturated.
	11						
	12						
	13						
	14						
	15						
	16						
	17						
LEGEND: - Backfill - Screen - End/ Top cap	18						
	19						
	20						
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	23						
	24						
	25						

Pthk - Product Thickness

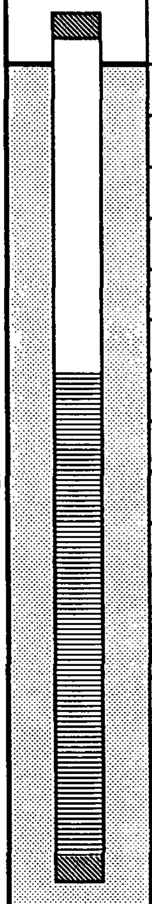
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-3B

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	1/18/95		Product: 11.48'	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 11.99'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/16/94; Date Completed: 12/16/94			Pthk: 0.51'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN				

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-9-3A for soil description.
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LEGEND: - Backfill - Screen - End/ Top cap	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

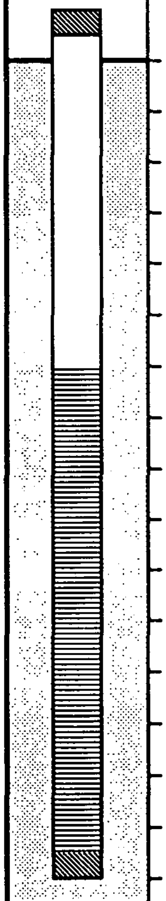
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-3C

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: 9.75'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 12/16/94 / Date Completed: 12/16/94			Water: 10.03'	Top of Riser Elevation
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.28'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-9-3A for soil description.
	1						
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	14						
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	17						
LEGEND: - Backfill - Screen - End/ Top cap	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

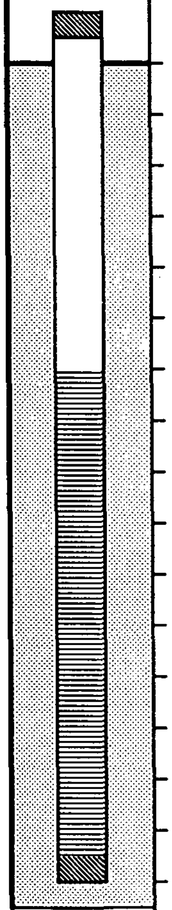
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-3C1

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	1/18/95		Product: 11.00'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 1/5/95; Date Completed: 1/5/95			Water: 11.02'	Top of Riser Elevation: NA
Completion Depth:	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.02'	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-9-3A for soil description.
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LEGEND:	18						
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Pthk - Product Thickness

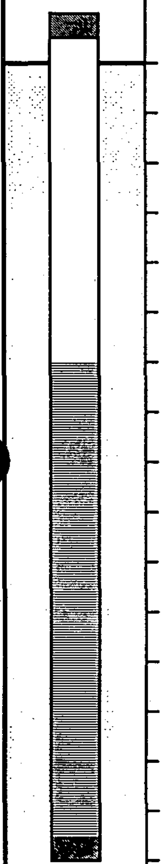
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-3C2

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	01/18/95		Product: 10.02'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 01/06/95; Date Completed: 01/06/95			Water: 10.85'	Top of Riser Elevation: NA
Completion Depth: 16.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: 0.83'	



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
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Pthk - Product Thickness

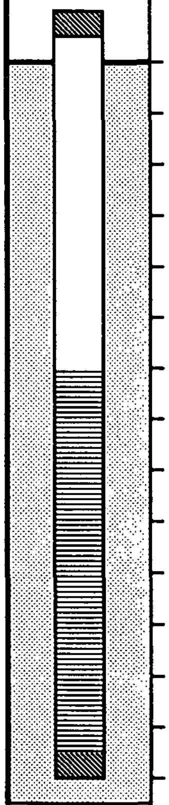
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-3C-2A

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	6/24/96		Product: 6.95'	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 8.25'	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 1/7/96 Date Completed: 1/7/96			Pthk: 1.30'	Top of Riser Elevation NA
Completion Depth: 14.00'	ERM-Northeast Geologist: ERIC ARNESEN				

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-9-3A for soil description.
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Pthk - Product Thickness

DBC - Depth below PVC casing

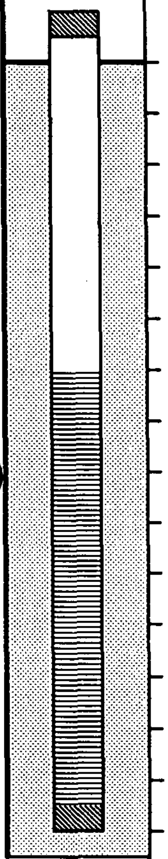
ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-4A

Project Name & Location: METRO - NORTH, HARMON YARDS	Project Number: 680.003.01
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO
Method: HOLLOW STEM AUGER	Date Started: 1/7/96 — Date Completed: 1/7/96
Completion Depth: 15.00'	ERM-Northeast Geologist: ERIC ARNESEN

Product/ Water Level(s) (DBC)		
Date	Time	Levels
6/24/96		Product: 7.85' Water: 8.80' Pthk: 0.95'

Site Elevation Datum	
Ground Elevation	NA
Top of Steel Cap Elevation	NA
Top of Riser Elevation	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						Refer to log of WB-9-3A for soil description.
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Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: WB-9-FC-1

Project Name & Location	Project Number		Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01		Date	Time	Levels	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		6/24/96		Product: 8.45'	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 2/7/96	Date Completed: 2/7/96			Water: 9.25'	Top of Riser Elevation
Completion Depth: 14.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: 0.80'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
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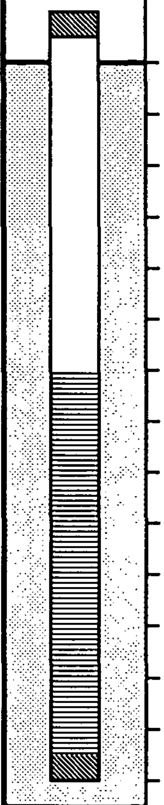


LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

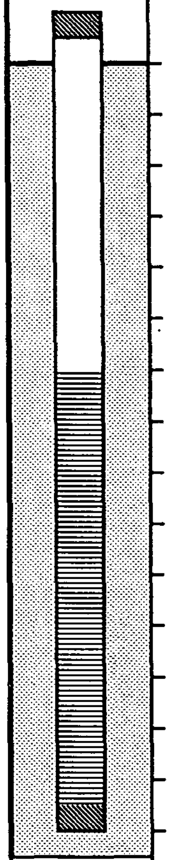
ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-A

Project Name & Location	Project Number		
METRO - NORTH, HARMON YARDS	680.003.01		
Drilling Company	Driller		
AQUIFER DRILLING AND TESTING	MARK ARATO		
Method	Date Started	Date Completed	
HOLLOW STEM AUGER	2/6/96	2/6/96	
Completion Depth:	ERM-Northeast Geologist:		
15.00'	ERIC ARNESEN		

Product/ Water Level(s) (DBC)			Site Elevation Datum
Date	Time	Levels	Ground Elevation
6/24/96		Product:	NA
		--	Top of Steel Cap Elevation
		Water:	NA
		10.44'	Top of Riser Elevation
		Pthk:	
		--	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
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Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

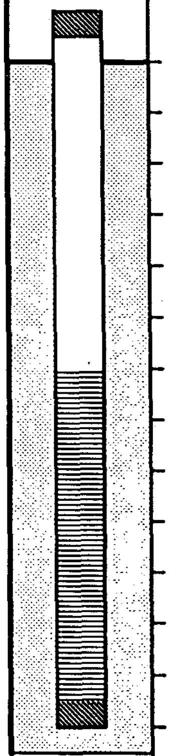
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-B

Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01		
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO		
Method HOLLOW STEM AUGER	Date Started 2/6/96	Date Completed 2/6/96	
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN		

Product/ Water Level(s) (DBC)		
Date	Time	Levels
6/24/96		Product: 10.95' Water: 11.57' Pthk: 0.62'

Site Elevation Datum
Ground Elevation NA
Top of Steel Cap Elevation NA
Top of Riser Elevation NA



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
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Pthk - Product Thickness

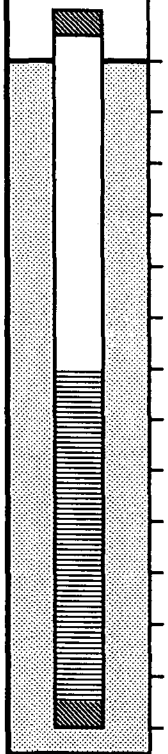
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-C

Project Name & Location METRO - NORTH, HARMON YARDS		Project Number 680.003.01	Product/ Water Level(s) (DBC)			Site Elevation Datum
			Date	Time	Levels	Ground Elevation NA
Drilling Company AQUIFER DRILLING AND TESTING		Driller MARK ARATO	6/24/96		Product: 10.31'	Top of Steel Cap Elevation NA
Method HOLLOW STEM AUGER	Date Started 2/6/96	Date Completed 2/6/96			Water: 11.65'	Top of Riser Elevation
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: 1.34'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
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Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-D

Project Name & Location	Project Number
METRO - NORTH, HARMON YARDS	680.003.01

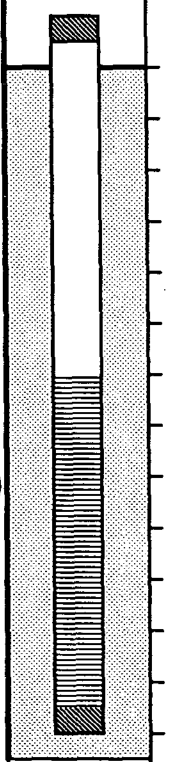
Drilling Company	Driller
AQUIFER DRILLING AND TESTING	MARK ARATO

Method	Date Started	Date Completed
HOLLOW STEM AUGER	2/6/96	2/6/96

Completion Depth:	ERM-Northeast Geologist:
	ERIC ARNESEN

Product/ Water Level(s) (DBC)		
Date	Time	Levels
6/24/96		Product: 9.82' Water: 9.90' Pthk: 0.08'

Site Elevation Datum	
Ground Elevation	NA
Top of Steel Cap Elevation	NA
Top of Riser Elevation	NA



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
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Pthk - Product Thickness

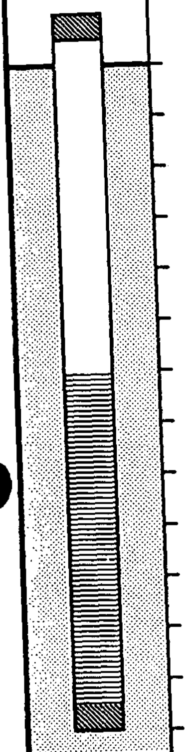
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-E

Project Name & Location	Project Number	Product/ Water Level(s) (DBC) Date	Time	Levels	Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	6/24/96		Product: 10.87'	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 11.55'	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 2/6/96 Date Completed: 2/6/96			Pthk: 0.68'	Top of Riser Elevation NA
Completion Depth:	ERM-Northeast Geologist: ERIC ARNESEN				

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
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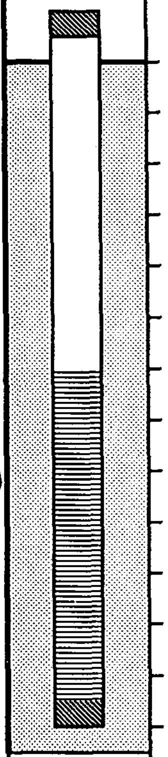
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-F

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: 10.80'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 2/6/96 / Date Completed: 2/6/96			Water: TB	Top of Riser Elevation: NA
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: ??	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
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Pthk - Product Thickness

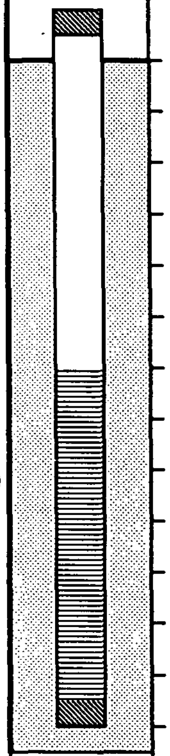
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-FS

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: --	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 2/7/96; Date Completed: 2/7/96			Water: 10.29'	Top of Riser Elevation: NA
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
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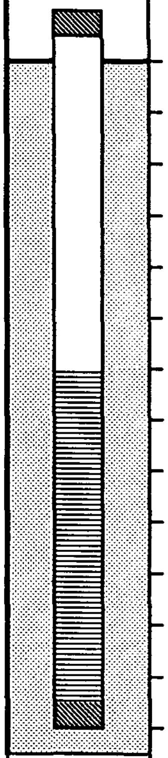
Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-G

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: --	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 2/6/96 Date Completed: 2/6/96			Water: 10.42'	Top of Riser Elevation NA
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	



LEGEND:
- Backfill
- Screen
- End/ Top cap

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
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Pthk - Product Thickness

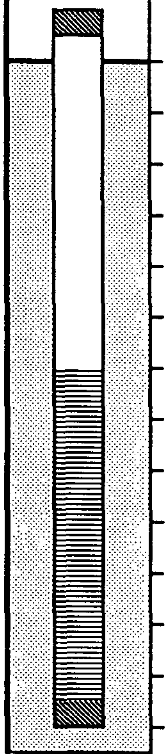
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-H

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: --	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 2/6/96; Date Completed: 2/6/96			Water: 8.00'	Top of Riser Elevation: NA
Completion Depth: 13.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
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Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-I

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: --	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 4/30/96; Date Completed: 4/30/96			Water: 8.80'	Top of Riser Elevation: NA
Completion Depth: 15.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
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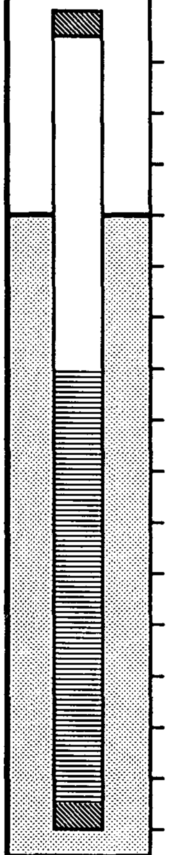
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						



LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

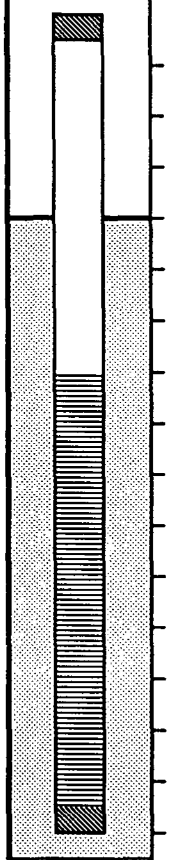
ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-J

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: --	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 4/30/96 / Date Completed: 4/30/96			Water: 8.74'	Top of Riser Elevation
Completion Depth: 15.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						



LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

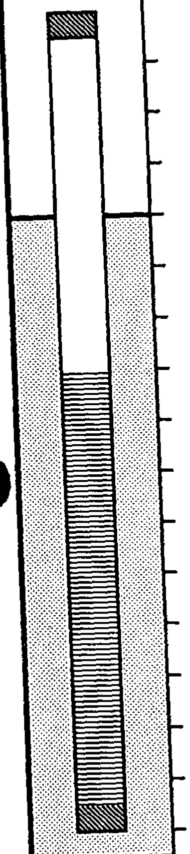
ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-K

Project Name & Location: METRO - NORTH, HARMON YARDS	Project Number: 680.003.01	Product/ Water Level(s) (DBC)			Site Elevation Datum	
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	Date	Time	Levels	Ground Elevation: NA	
Method: HOLLOW STEM AUGER	Date Started: 4/30/96; Date Completed: 4/30/96	6/24/96		Product: --	Top of Steel Cap Elevation: NA	
Completion Depth: 15.00'	ERM-Northeast Geologist: ERIC ARNESEN			Water: 9.25'	Top of Riser Elevation: NA	
				Pthk: --		

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						



LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

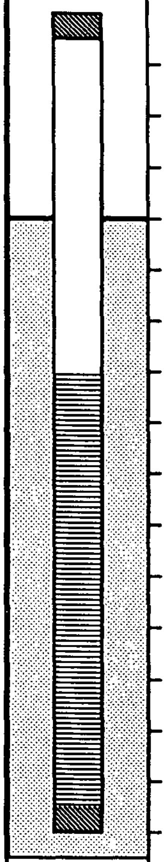
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-L

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01	Date	Time	Levels	Ground Elevation NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO	6/24/96		Product: --	Top of Steel Cap Elevation NA
Method: HOLLOW STEM AUGER	Date Started: 4/30/96 Date Completed: 4/30/96			Water: 9.86'	Top of Riser Elevation
Completion Depth: 15.00'	ERM-Northeast Geologist: ERIC ARNESEN			Pthk: --	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
LEGEND: - Backfill - Screen - End/ Top cap	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

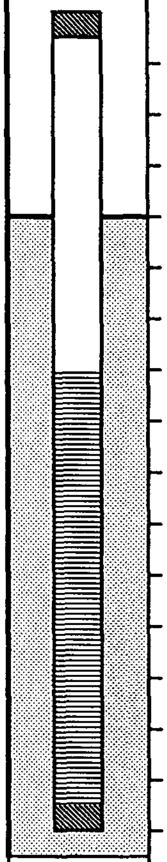
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-M

Project Name & Location METRO - NORTH, HARMON YARDS	Project Number 680.003.01		Product/ Water Level(s) (DBC)			Site Elevation Datum
			Date	Time	Levels	Ground Elevation
Drilling Company AQUIFER DRILLING AND TESTING	Driller MARK ARATO		6/24/96		Product: --	NA
Method HOLLOW STEM AUGER	Date Started 5/1/96	Date Completed 5/1/96			Water: 8.64'	Top of Steel Cap Elevation NA
Completion Depth: 15.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: --	Top of Riser Elevation NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Recovery (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
LEGEND: - Backfill - Screen - End/ Top cap	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

Pthk - Product Thickness

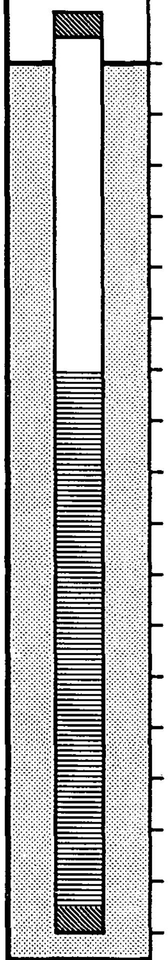
DBC - Depth below PVC casing

ERM-Northeast

175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-N

Project Name & Location	Project Number	Product/ Water Level(s) (DBC)			Site Elevation Datum
		Date	Time	Levels	
METRO - NORTH, HARMON YARDS	680.003.01	6/24/96		Product: --	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO			Water: 13.03	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 5/1/96; Date Completed: 5/1/96			Pthk: --	Top of Riser Elevation: NA
Completion Depth: 17.00'	ERM-Northeast Geologist: ERIC ARNESEN				



WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						

LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

ERM-Northeast
175 Froehlich Farm Blvd., Woodbury, New York 11797

LOG OF NAPL OBSERVATION WELL: OS-O

Project Name & Location	Project Number		Product/ Water Level(s) (DBC)			Site Elevation Datum
METRO - NORTH, HARMON YARDS	680.003.01		Date	Time	Levels	Ground Elevation: NA
Drilling Company: AQUIFER DRILLING AND TESTING	Driller: MARK ARATO		6/24/96		Product: 14.70'	Top of Steel Cap Elevation: NA
Method: HOLLOW STEM AUGER	Date Started: 5/1/96	Date Completed: 5/1/96			Water: 15.09'	Top of Riser Elevation
Completion Depth: 18.00'	ERM-Northeast Geologist: ERIC ARNESEN				Pthk: 0.39'	NA

WELL CONSTR.	DEPTH (ft below grade)	SAMPLES No.	Reco-very (ft)	Blow per 6 in.	Time	HNU/ OVA (ppm)	SOIL DESCRIPTION
	0						
	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
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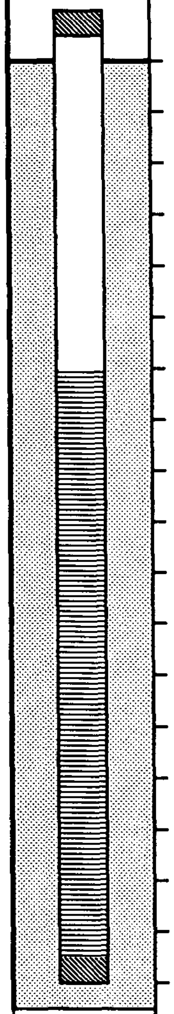
	16						
	17						
	18						
	19						
	20						
	21						
	22						
	23						
	24						
	25						



LEGEND:
- Backfill
- Screen
- End/ Top cap

Pthk - Product Thickness

DBC - Depth below PVC casing

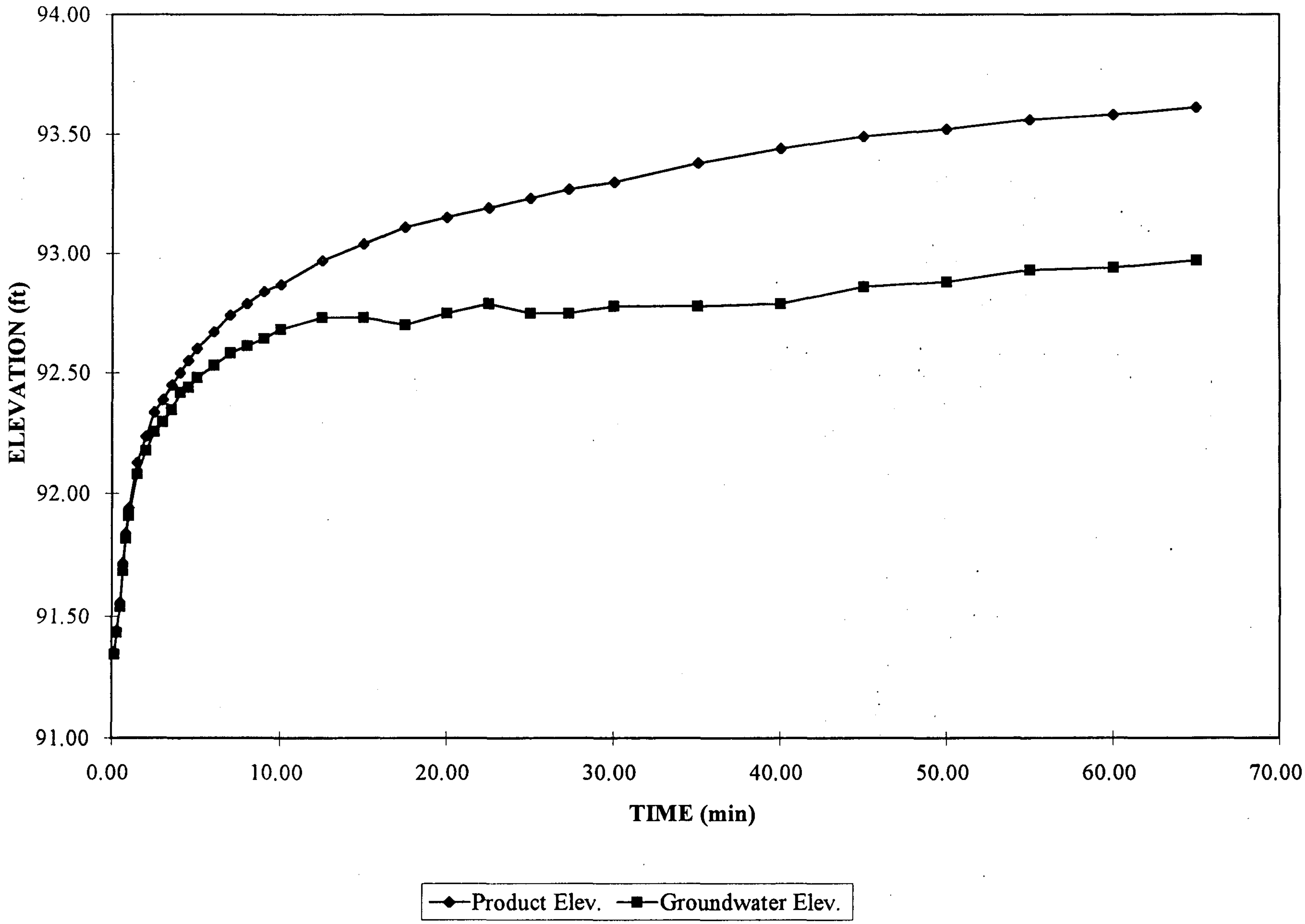
APPENDIX C

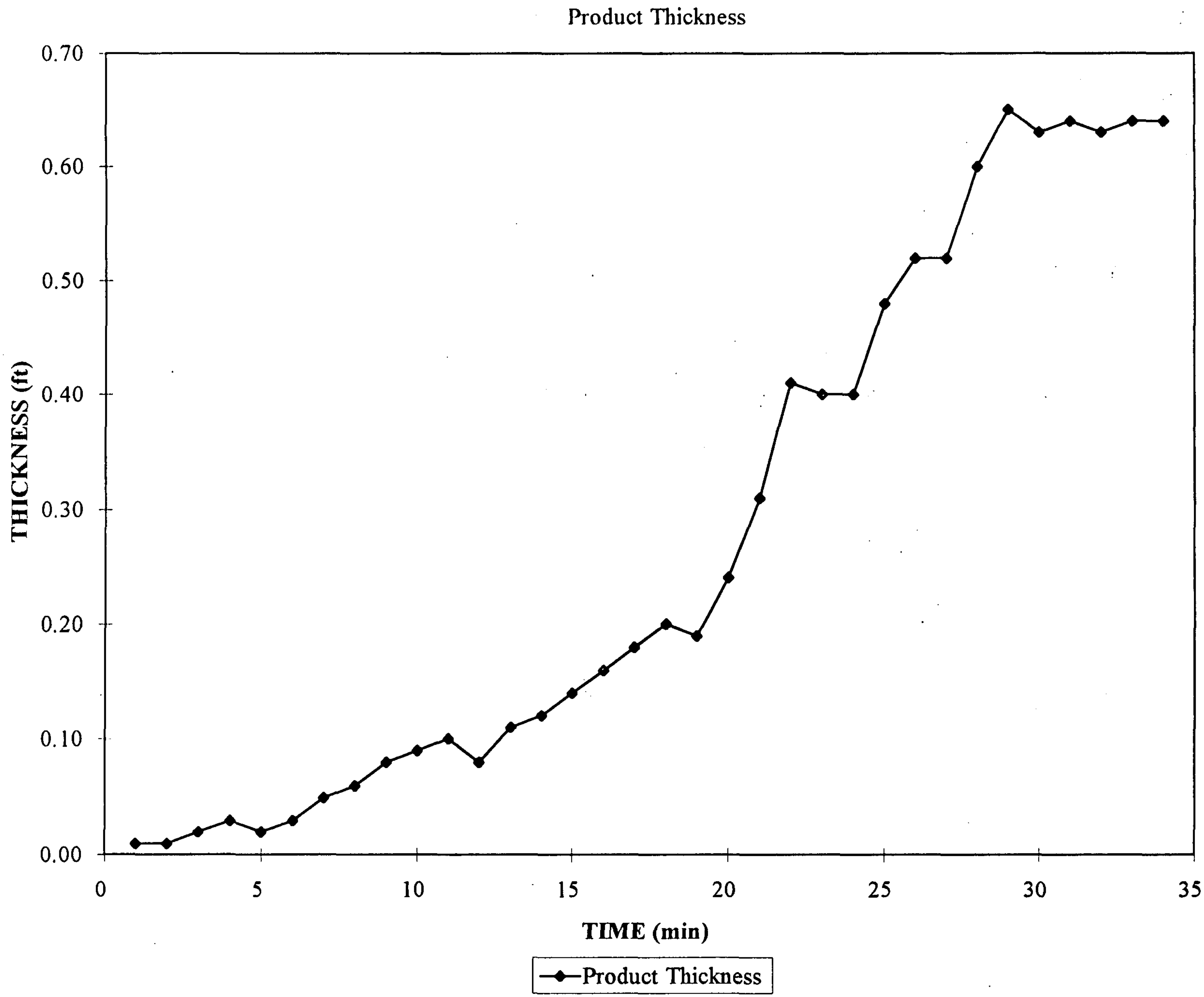
BAILDOWN TEST DATA

BAIL DOWN TEST
CONDUCTED ON JANUARY 12, 1995
MONITORING WELL MW-1S

ELAPSED TIME (min)	DEPTH TO PRODUCT (ft)	DEPTH TO WATER (ft)	PRODUCT THICKNESS (ft)	PRODUCT ELEVATION (ft)	WATER ELEVATION (ft)
PRIOR TO TEST	12.51	13.21	0.70		
MEASUREMENTS FOLLOWING PRODUCT REMOVAL					
0.16	8.65	8.66	0.01	91.35	91.34
0.33	8.56	8.57	0.01	91.44	91.43
0.50	8.44	8.46	0.02	91.56	91.54
0.66	8.28	8.31	0.03	91.72	91.69
0.83	8.16	8.18	0.02	91.84	91.82
1.00	8.06	8.09	0.03	91.94	91.91
1.50	7.87	7.92	0.05	92.13	92.08
2.00	7.76	7.82	0.06	92.24	92.18
2.50	7.66	7.74	0.08	92.34	92.26
3.00	7.61	7.70	0.09	92.39	92.30
3.50	7.55	7.65	0.10	92.45	92.35
4.00	7.50	7.58	0.08	92.50	92.42
4.50	7.45	7.56	0.11	92.55	92.44
5.00	7.40	7.52	0.12	92.60	92.48
6.00	7.33	7.47	0.14	92.67	92.53
7.00	7.26	7.42	0.16	92.74	92.58
8.00	7.21	7.39	0.18	92.79	92.61
9.00	7.16	7.36	0.20	92.84	92.64
10.00	7.13	7.32	0.19	92.87	92.68
12.50	7.03	7.27	0.24	92.97	92.73
15.00	6.96	7.27	0.31	93.04	92.73
17.50	6.89	7.30	0.41	93.11	92.70
20.00	6.85	7.25	0.40	93.15	92.75
22.50	6.81	7.21	0.40	93.19	92.79
25.00	6.77	7.25	0.48	93.23	92.75
27.30	6.73	7.25	0.52	93.27	92.75
30.00	6.70	7.22	0.52	93.30	92.78
35.00	6.62	7.22	0.60	93.38	92.78
40.00	6.56	7.21	0.65	93.44	92.79
45.00	6.51	7.14	0.63	93.49	92.86
50.00	6.48	7.12	0.64	93.52	92.88
55.00	6.44	7.07	0.63	93.56	92.93
60.00	6.42	7.06	0.64	93.58	92.94
65.00	6.39	7.03	0.64	93.61	92.97

BAILDOWN TEST MW-1S GROUNDWATER AND PRODUCT ELEVATION VS. TIME



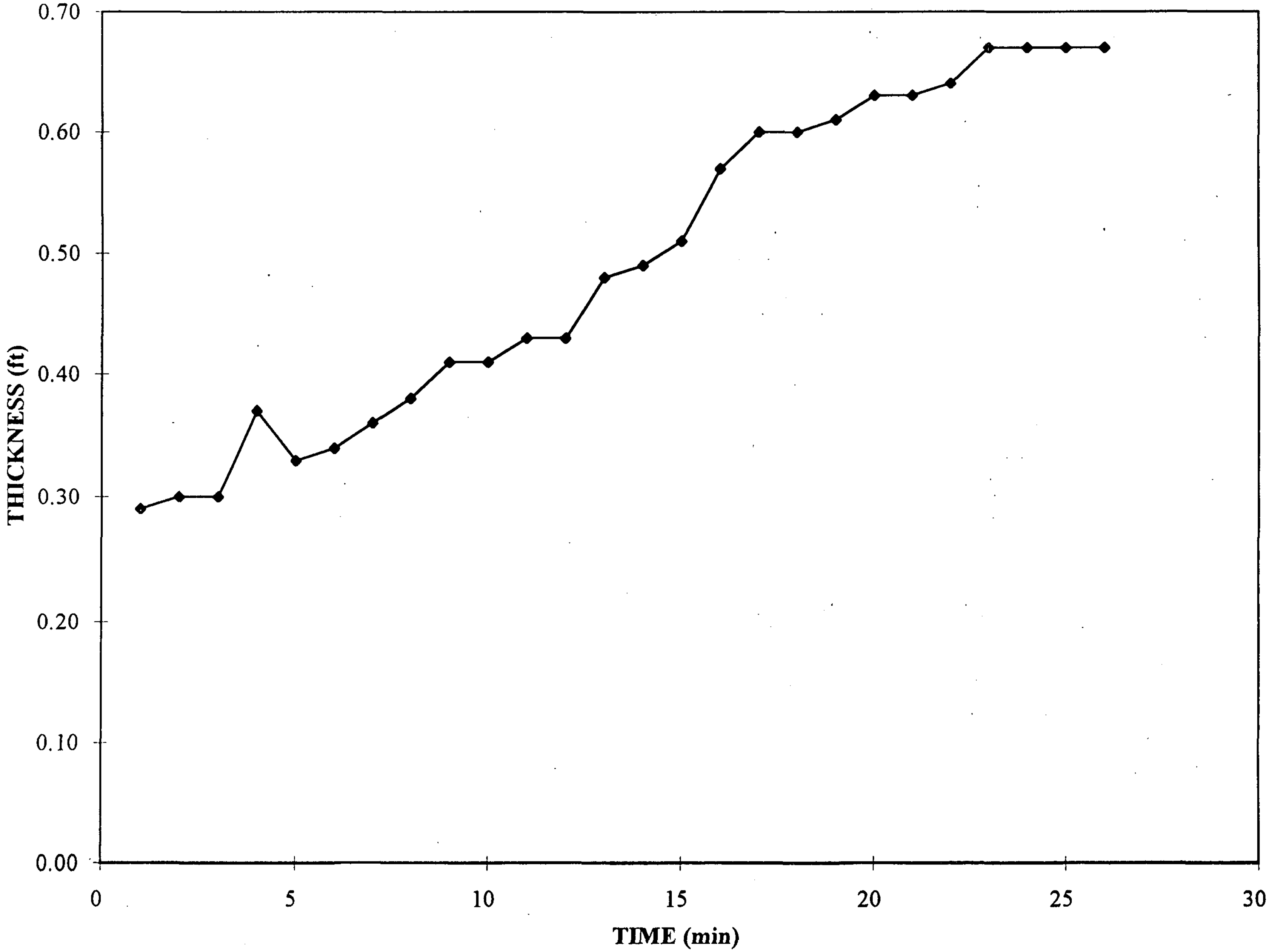


Product Thickness
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
THICKNESS (ft)
0
5
10
15
20
25
30
35
TIME (min)
Product Thickness

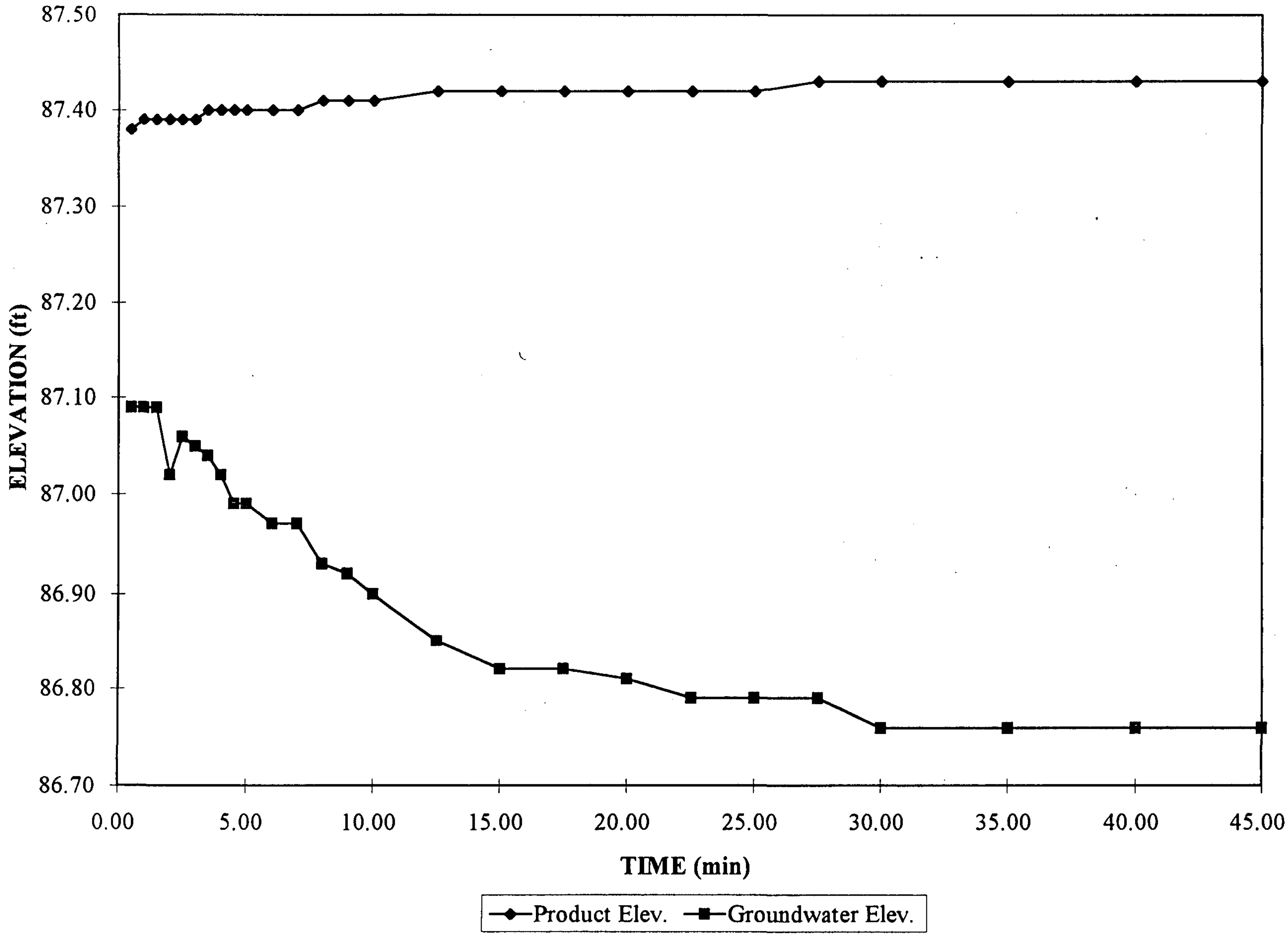
BAIL DOWN TEST
CONDUCTED ON JANUARY 11, 1995
MONITORING WELL WB-2

ELAPSED TIME (min)	DEPTH TO PRODUCT (ft)	DEPTH TO WATER (ft)	PRODUCT THICKNESS (ft)	PRODUCT ELEVATION (ft)	WATER ELEVATION (ft)
PRIOR TO TEST	12.54	13.48	0.94		
MEASUREMENTS FOLLOWING PRODUCT REMOVAL					
0.50	12.62	12.91	0.29	87.38	87.09
1.00	12.61	12.91	0.30	87.39	87.09
1.50	12.61	12.91	0.30	87.39	87.09
2.00	12.61	12.98	0.37	87.39	87.02
2.50	12.61	12.94	0.33	87.39	87.06
3.00	12.61	12.95	0.34	87.39	87.05
3.50	12.60	12.96	0.36	87.40	87.04
4.00	12.60	12.98	0.38	87.40	87.02
4.50	12.60	13.01	0.41	87.40	86.99
5.00	12.60	13.01	0.41	87.40	86.99
6.00	12.60	13.03	0.43	87.40	86.97
7.00	12.60	13.03	0.43	87.40	86.97
8.00	12.59	13.07	0.48	87.41	86.93
9.00	12.59	13.08	0.49	87.41	86.92
10.00	12.59	13.10	0.51	87.41	86.90
12.50	12.58	13.15	0.57	87.42	86.85
15.00	12.58	13.18	0.60	87.42	86.82
17.50	12.58	13.18	0.60	87.42	86.82
20.00	12.58	13.19	0.61	87.42	86.81
22.50	12.58	13.21	0.63	87.42	86.79
25.00	12.58	13.21	0.63	87.42	86.79
27.50	12.57	13.21	0.64	87.43	86.79
30.00	12.57	13.24	0.67	87.43	86.76
35.00	12.57	13.24	0.67	87.43	86.76
40.00	12.57	13.24	0.67	87.43	86.76
45.00	12.57	13.24	0.67	87.43	86.76

MONITORING WELL WB-2 PRODUCT RECOVERY VS. TIME



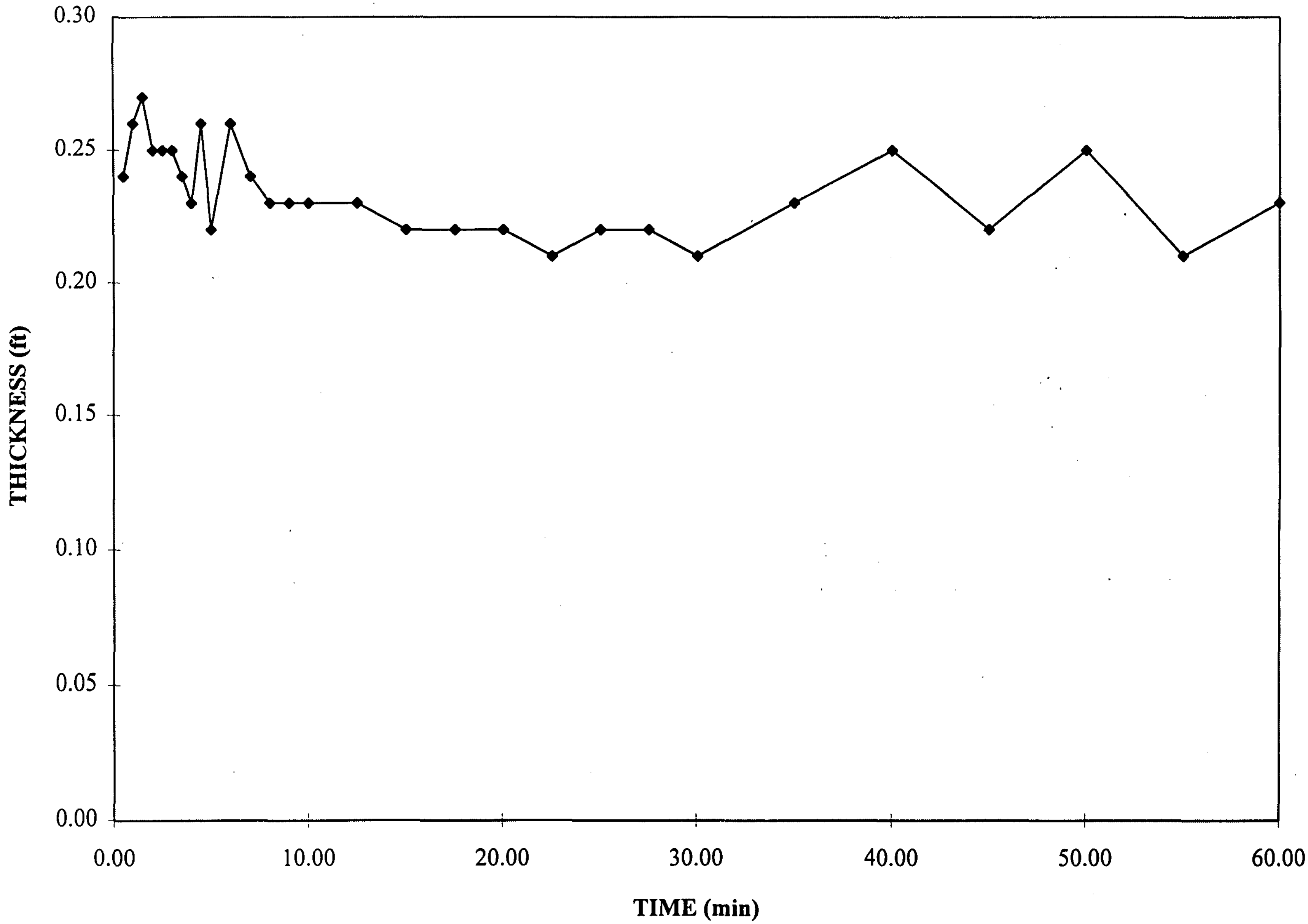
BAILDOWN TEST WB-2 PRODUCT AND GROUND WATER ELEVATIONS VS. TIME

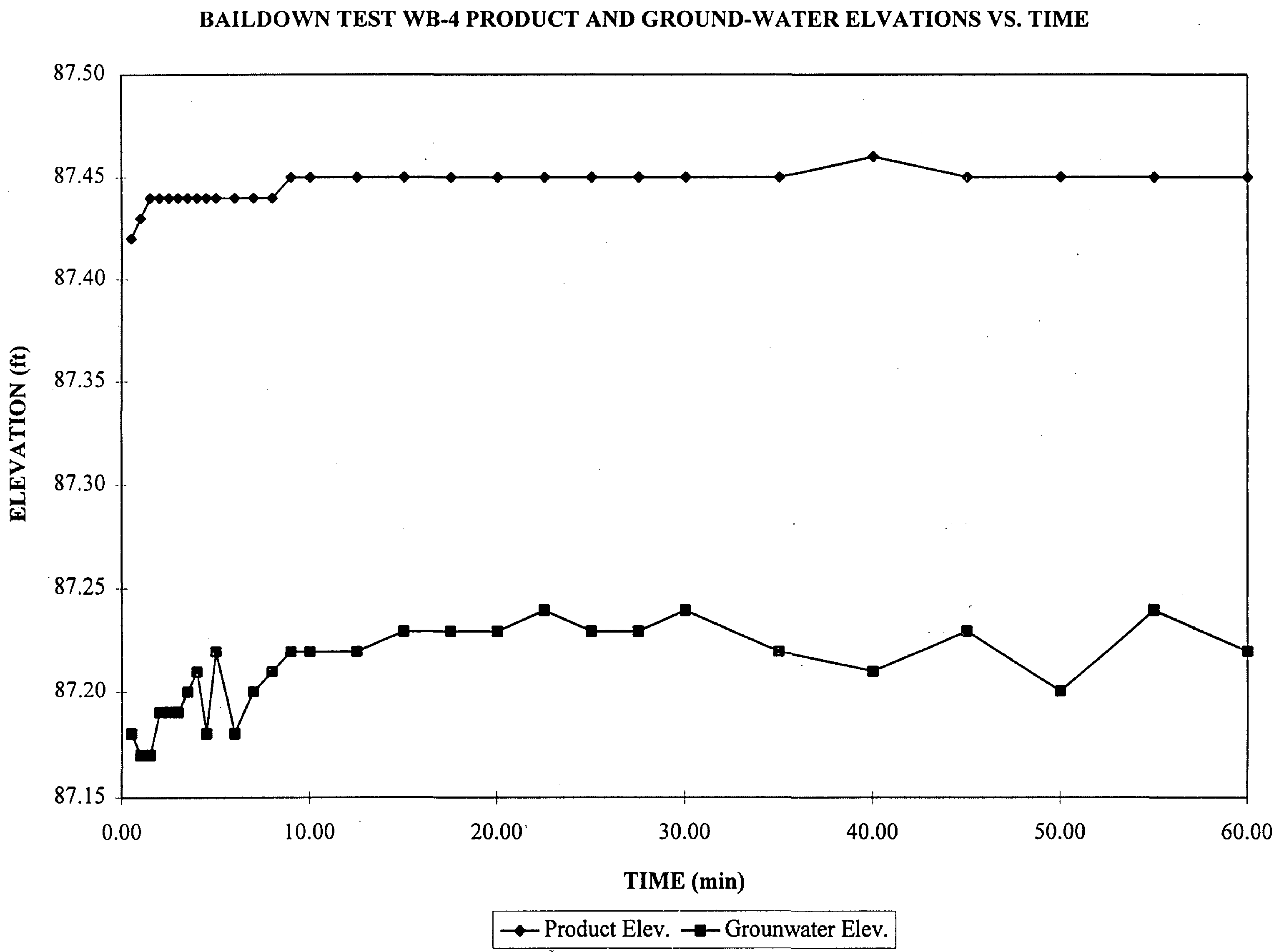


BAIL DOWN TEST
CONDUCTED ON JANUARY 11, 1995
MONITORING WELL WB-4

ELAPSED TIME (min)	DEPTH TO PRODUCT (ft)	DEPTH TO WATER (ft)	PRODUCT THICKNESS (ft)	PRODUCT ELEVATION (ft)	WATER ELEVATION (ft)
PRIOR TO TEST	12.51	13.21	0.70		
MEASUREMENTS FOLLOWING PRODUCT REMOVAL					
0.50	12.58	12.82	0.24	87.42	87.18
1.00	12.57	12.83	0.26	87.43	87.17
1.50	12.56	12.83	0.27	87.44	87.17
2.00	12.56	12.81	0.25	87.44	87.19
2.50	12.56	12.81	0.25	87.44	87.19
3.00	12.56	12.81	0.25	87.44	87.19
3.50	12.56	12.80	0.24	87.44	87.20
4.00	12.56	12.79	0.23	87.44	87.21
4.50	12.56	12.82	0.26	87.44	87.18
5.00	12.56	12.78	0.22	87.44	87.22
6.00	12.56	12.82	0.26	87.44	87.18
7.00	12.56	12.80	0.24	87.44	87.20
8.00	12.56	12.79	0.23	87.44	87.21
9.00	12.55	12.78	0.23	87.45	87.22
10.00	12.55	12.78	0.23	87.45	87.22
12.50	12.55	12.78	0.23	87.45	87.22
15.00	12.55	12.77	0.22	87.45	87.23
17.50	12.55	12.77	0.22	87.45	87.23
20.00	12.55	12.77	0.22	87.45	87.23
22.50	12.55	12.76	0.21	87.45	87.24
25.00	12.55	12.77	0.22	87.45	87.23
27.50	12.55	12.77	0.22	87.45	87.23
30.00	12.55	12.76	0.21	87.45	87.24
35.00	12.55	12.78	0.23	87.45	87.22
40.00	12.54	12.79	0.25	87.46	87.21
45.00	12.55	12.77	0.22	87.45	87.23
50.00	12.55	12.80	0.25	87.45	87.20
55.00	12.55	12.76	0.21	87.45	87.24
60.00	12.55	12.78	0.23	87.45	87.22

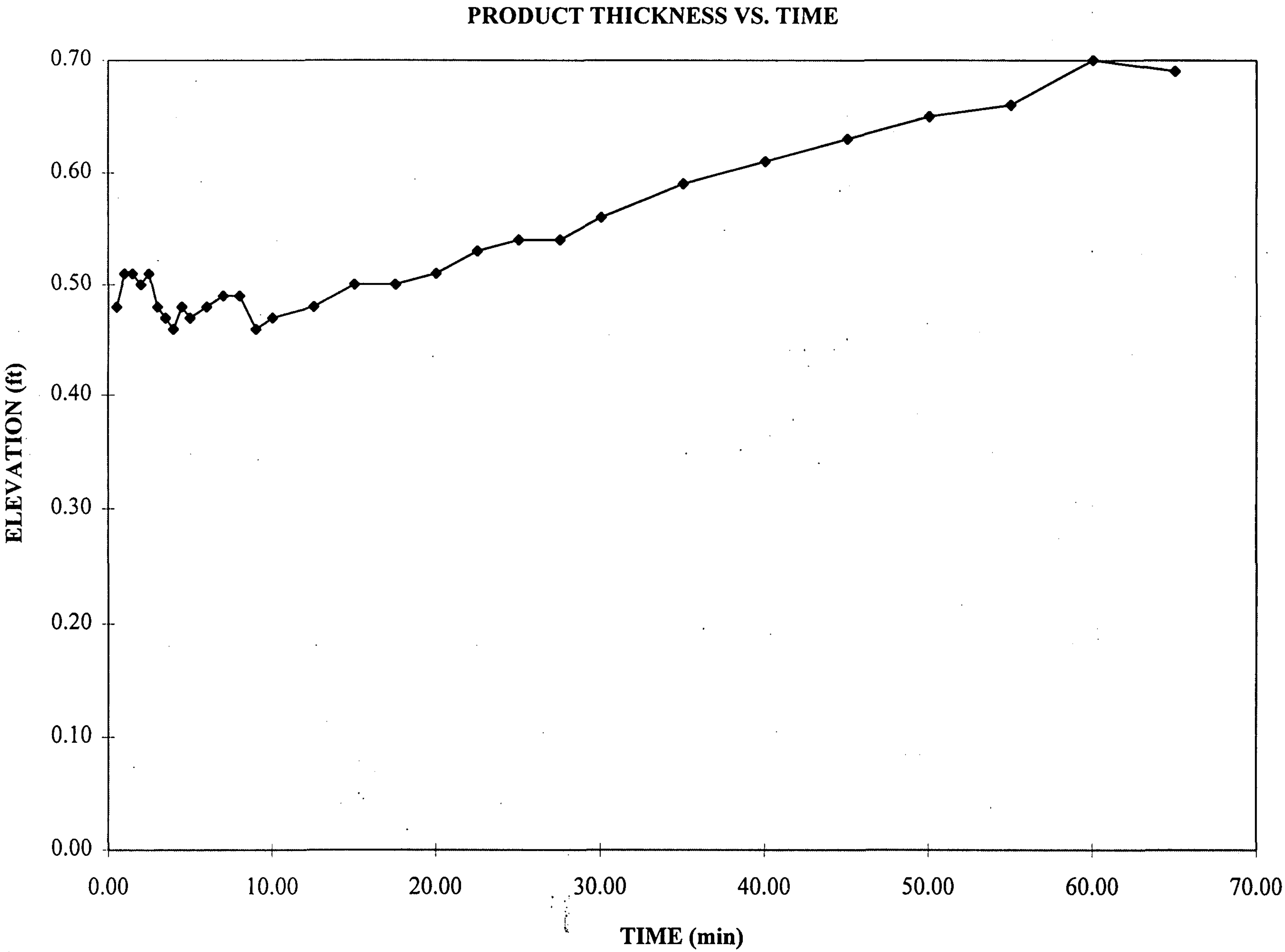
PRODUCT THICKNESS VS. TIME

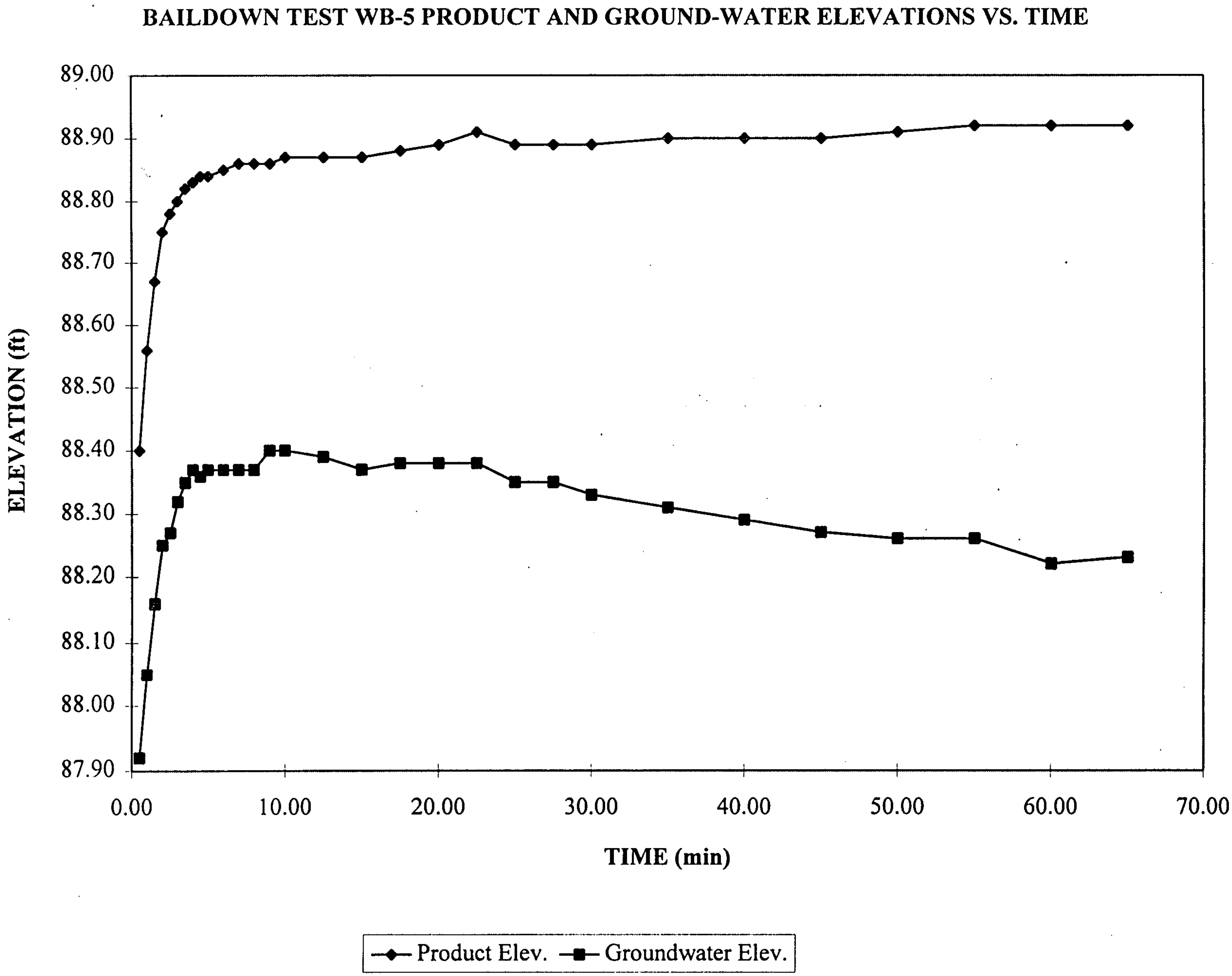



BAILDOWN TEST WB-4 PRODUCT AND GROUND-WATER ELVATIONS VS. TIME
ELEVATION (ft)
87.50
87.45
87.40
87.35
87.30
87.25
87.20
87.15
0.00
10.00
20.00
30.00
40.00
50.00
60.00
TIME (min)
Product Elev.
Grounwater Elev.

BAIL DOWN TEST
CONDUCTED ON JANUARY 12, 1995
MONITORING WELL WB-5

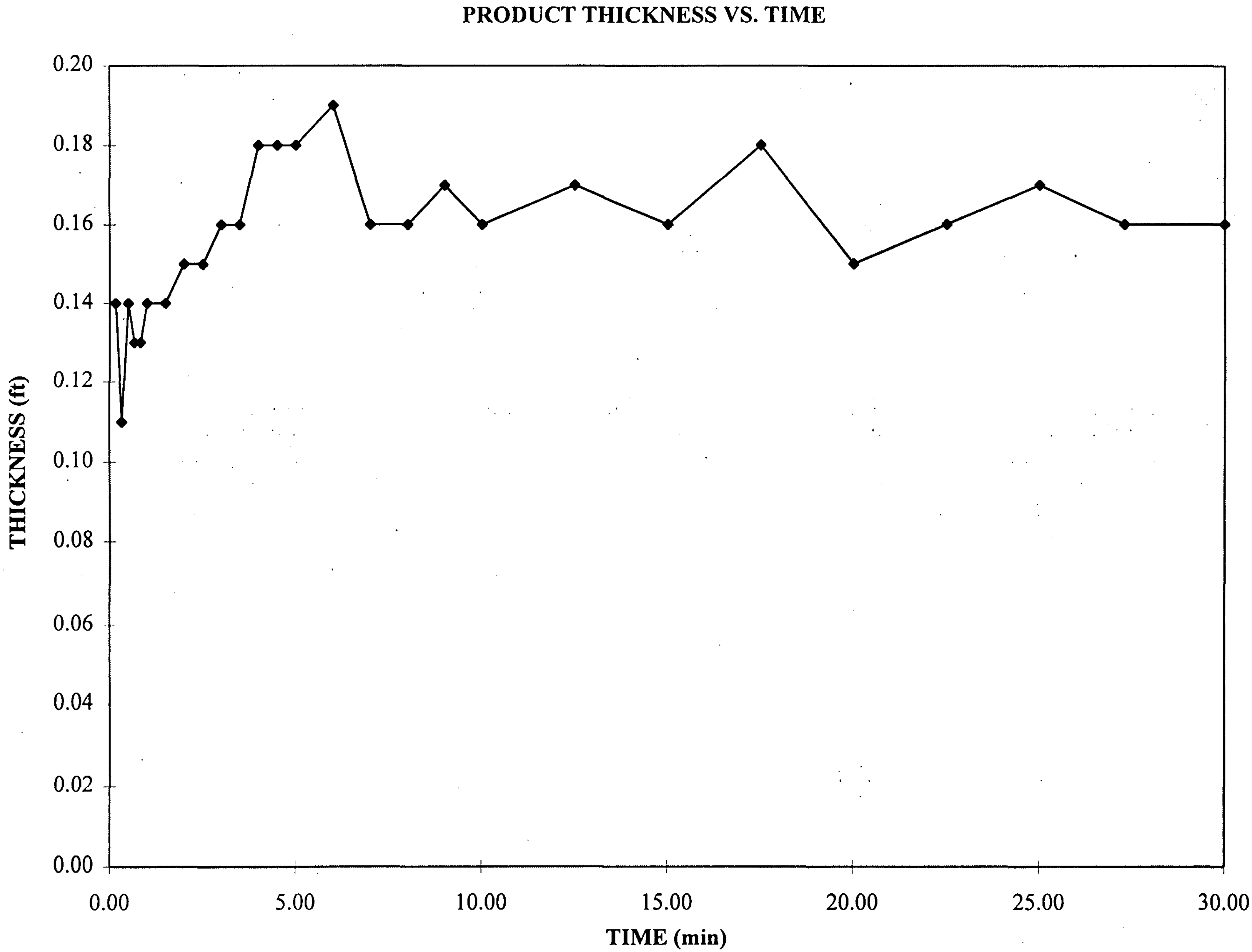
ELAPSED TIME (min)	DEPTH TO PRODUCT (ft)	DEPTH TO WATER (ft)	PRODUCT THICKNESS (ft)	PRODUCT ELEVATION (ft)	WATER ELEVATION (ft)
PRIOR TO TEST	11.08	12.21	1.13		
MEASUREMENTS FOLLOWING PRODUCT REMOVAL					
0.50	11.60	12.08	0.48	88.40	87.92
1.00	11.44	11.95	0.51	88.56	88.05
1.50	11.33	11.84	0.51	88.67	88.16
2.00	11.25	11.75	0.50	88.75	88.25
2.50	11.22	11.73	0.51	88.78	88.27
3.00	11.20	11.68	0.48	88.80	88.32
3.50	11.18	11.65	0.47	88.82	88.35
4.00	11.17	11.63	0.46	88.83	88.37
4.50	11.16	11.64	0.48	88.84	88.36
5.00	11.16	11.63	0.47	88.84	88.37
6.00	11.15	11.63	0.48	88.85	88.37
7.00	11.14	11.63	0.49	88.86	88.37
8.00	11.14	11.63	0.49	88.86	88.37
9.00	11.14	11.60	0.46	88.86	88.40
10.00	11.13	11.60	0.47	88.87	88.40
12.50	11.13	11.61	0.48	88.87	88.39
15.00	11.13	11.63	0.50	88.87	88.37
17.50	11.12	11.62	0.50	88.88	88.38
20.00	11.11	11.62	0.51	88.89	88.38
22.50	11.09	11.62	0.53	88.91	88.38
25.00	11.11	11.65	0.54	88.89	88.35
27.50	11.11	11.65	0.54	88.89	88.35
30.00	11.11	11.67	0.56	88.89	88.33
35.00	11.10	11.69	0.59	88.90	88.31
40.00	11.10	11.71	0.61	88.90	88.29
45.00	11.10	11.73	0.63	88.90	88.27
50.00	11.09	11.74	0.65	88.91	88.26
55.00	11.08	11.74	0.66	88.92	88.26
60.00	11.08	11.78	0.70	88.92	88.22
65.00	11.08	11.77	0.69	88.92	88.23


PRODUCT THICKNESS VS. TIME
ELEVATION (ft)
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
TIME (min)

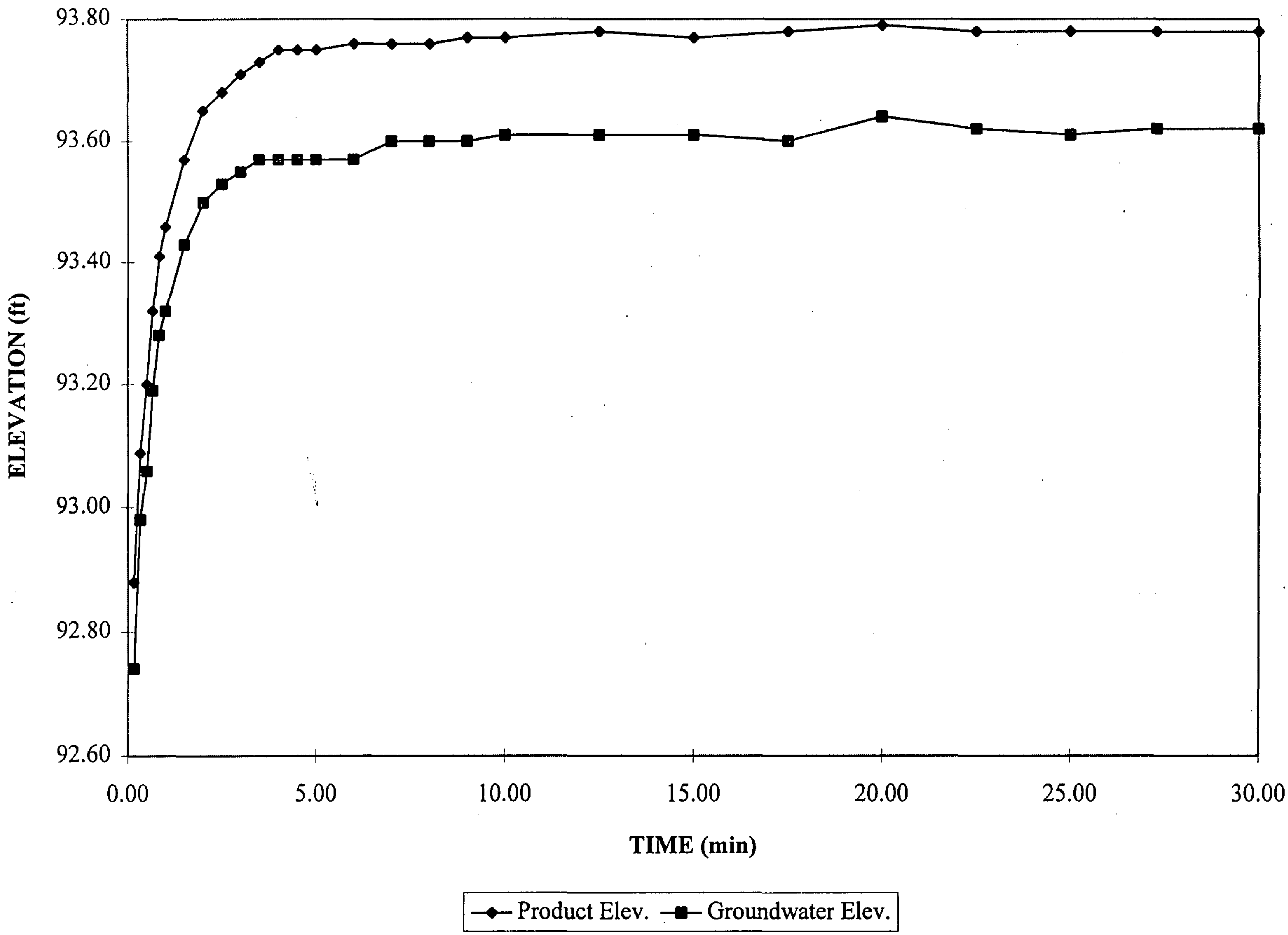

BAILDOWN TEST WB-5 PRODUCT AND GROUND-WATER ELEVATIONS VS. TIME
ELEVATION (ft)
89.00
88.90
88.80
88.70
88.60
88.50
88.40
88.30
88.20
88.10
88.00
87.90
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
TIME (min)
Product Elev.
Groundwater Elev.

BAIL DOWN TEST
CONDUCTED ON JANUARY 17, 1995
MONITORING WELL WB-7

ELAPSED TIME (min)	DEPTH TO PRODUCT (ft)	DEPTH TO WATER (ft)	PRODUCT THICKNESS (ft)	PRODUCT ELEVATION (ft)	WATER ELEVATION (ft)
PRIOR TO TEST	NR	NR	NR		
MEASUREMENTS FOLLOWING PRODUCT REMOVAL					
0.16	7.12	7.26	0.14	92.88	92.74
0.33	6.91	7.02	0.11	93.09	92.98
0.50	6.80	6.94	0.14	93.20	93.06
0.66	6.68	6.81	0.13	93.32	93.19
0.83	6.59	6.72	0.13	93.41	93.28
1.00	6.54	6.68	0.14	93.46	93.32
1.50	6.43	6.57	0.14	93.57	93.43
2.00	6.35	6.50	0.15	93.65	93.50
2.50	6.32	6.47	0.15	93.68	93.53
3.00	6.29	6.45	0.16	93.71	93.55
3.50	6.27	6.43	0.16	93.73	93.57
4.00	6.25	6.43	0.18	93.75	93.57
4.50	6.25	6.43	0.18	93.75	93.57
5.00	6.25	6.43	0.18	93.75	93.57
6.00	6.24	6.43	0.19	93.76	93.57
7.00	6.24	6.4	0.16	93.76	93.60
8.00	6.24	6.40	0.16	93.76	93.60
9.00	6.23	6.40	0.17	93.77	93.60
10.00	6.23	6.39	0.16	93.77	93.61
12.50	6.22	6.39	0.17	93.78	93.61
15.00	6.23	6.39	0.16	93.77	93.61
17.50	6.22	6.40	0.18	93.78	93.60
20.00	6.21	6.36	0.15	93.79	93.64
22.50	6.22	6.38	0.16	93.78	93.62
25.00	6.22	6.39	0.17	93.78	93.61
27.30	6.22	6.38	0.16	93.78	93.62
30.00	6.22	6.38	0.16	93.78	93.62

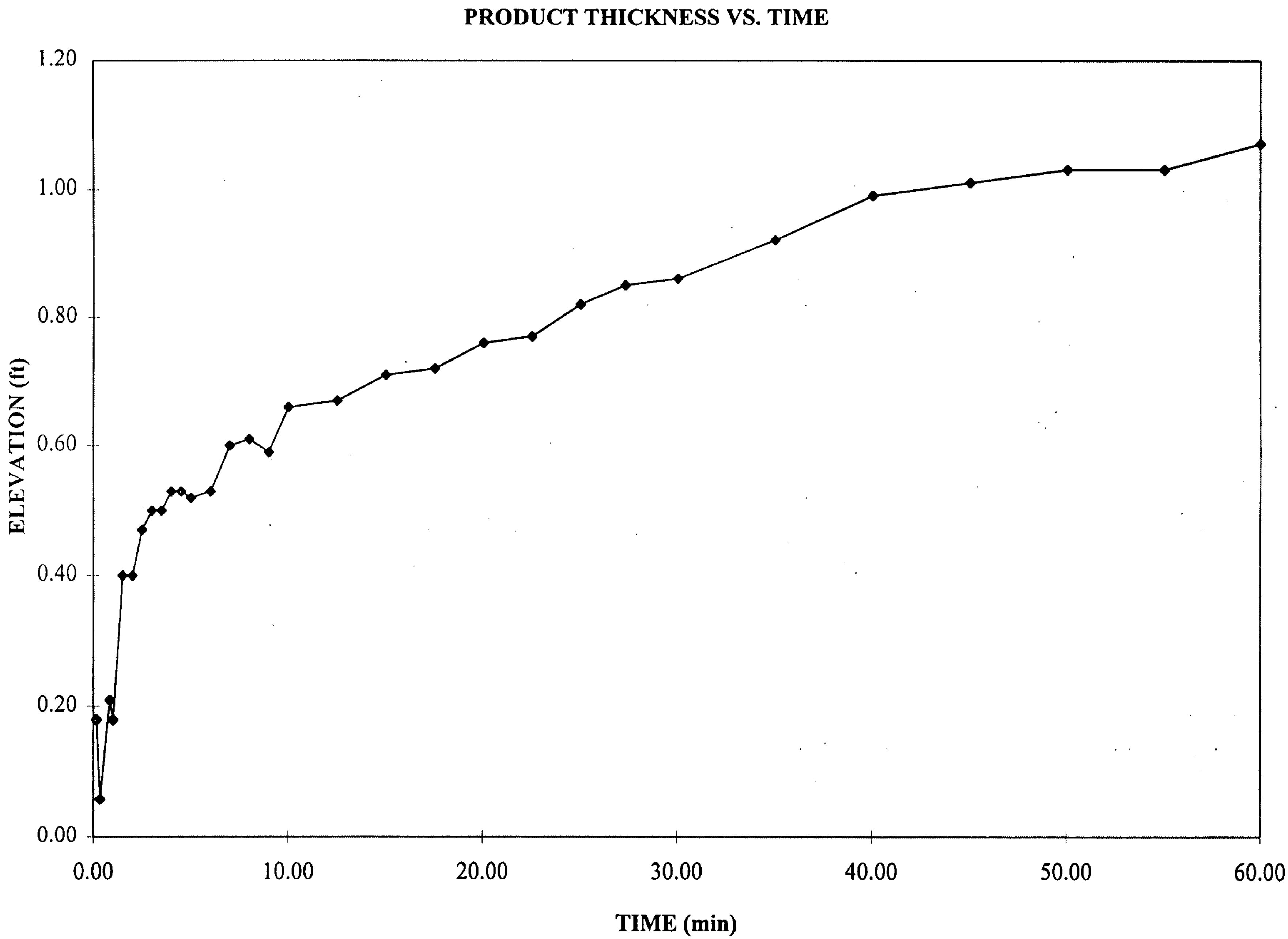

PRODUCT THICKNESS VS. TIME
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
THICKNESS (ft)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
TIME (min)

BAILDOWN TEST WB-7 GROUNDWATER AND PRODUCT ELEVATIONS VS. TIME

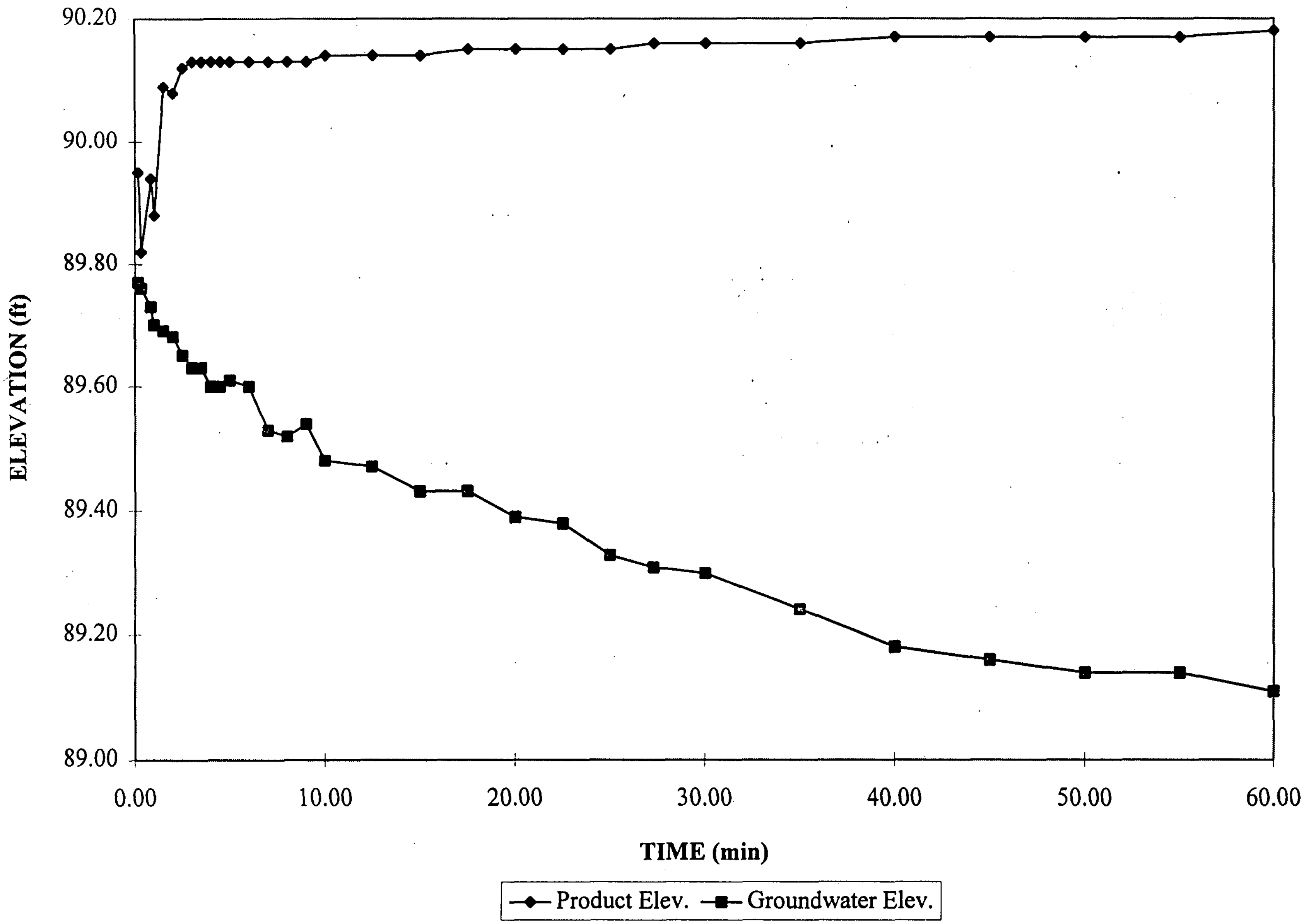


BAIL DOWN TEST
CONDUCTED ON JANUARY 12, 1995
MONITORING WELL WB-9

ELAPSED TIME (min)	DEPTH TO PRODUCT (ft)	DEPTH TO WATER (ft)	PRODUCT THICKNESS (ft)	PRODUCT ELEVATION (ft)	WATER ELEVATION (ft)
PRIOR TO TEST	9.76	11.57	1.81		
MEASUREMENTS FOLLOWING PRODUCT REMOVAL					
0.16	10.05	10.23	0.18	89.95	89.77
0.33	10.18	10.24	0.06	89.82	89.76
0.83	10.06	10.27	0.21	89.94	89.73
1.00	10.12	10.30	0.18	89.88	89.70
1.50	9.91	10.31	0.40	90.09	89.69
2.00	9.92	10.32	0.40	90.08	89.68
2.50	9.88	10.35	0.47	90.12	89.65
3.00	9.87	10.37	0.50	90.13	89.63
3.50	9.87	10.37	0.50	90.13	89.63
4.00	9.87	10.40	0.53	90.13	89.60
4.50	9.87	10.40	0.53	90.13	89.60
5.00	9.87	10.39	0.52	90.13	89.61
6.00	9.87	10.40	0.53	90.13	89.60
7.00	9.87	10.47	0.60	90.13	89.53
8.00	9.87	10.48	0.61	90.13	89.52
9.00	9.87	10.46	0.59	90.13	89.54
10.00	9.86	10.52	0.66	90.14	89.48
12.50	9.86	10.53	0.67	90.14	89.47
15.00	9.86	10.57	0.71	90.14	89.43
17.50	9.85	10.57	0.72	90.15	89.43
20.00	9.85	10.61	0.76	90.15	89.39
22.50	9.85	10.62	0.77	90.15	89.38
25.00	9.85	10.67	0.82	90.15	89.33
27.30	9.84	10.69	0.85	90.16	89.31
30.00	9.84	10.70	0.86	90.16	89.30
35.00	9.84	10.76	0.92	90.16	89.24
40.00	9.83	10.82	0.99	90.17	89.18
45.00	9.83	10.84	1.01	90.17	89.16
50.00	9.83	10.86	1.03	90.17	89.14
55.00	9.83	10.86	1.03	90.17	89.14
60.00	9.82	10.89	1.07	90.18	89.11


PRODUCT THICKNESS VS. TIME
1.20
1.00
0.80
0.60
0.40
0.20
0.00
ELEVATION (ft)
0.00
10.00
20.00
30.00
40.00
50.00
60.00
TIME (min)

BAILDOWN TEST WB-9
PRODUCT AND GROUND-WATER ELEVATION VS. TIME



APPENDIX H

BACKGROUND INFORMATION FOR SEDIMENT ANALYSIS

B.3.2 Ecological Setting

Croton Point is a peninsula that extends about 2 miles into the Hudson River from the eastern shore at approximately River Mile 34. The site is located southwest of the Village of Croton-on-Hudson. Croton Point was formed by deltaic deposition of glacial outwash in a post-glacial lake that formerly existed in the Hudson Valley. Croton Point is predominantly comprised of sand and clay material. The depth to bedrock is estimated to be approximately 200 feet (Rotfeld - Wehran, 1980). At present, the area surrounding the landfill on Croton Point includes woodlands or grassy fields. There are also some parks and private residences in the area. The marsh lies directly to the south of the landfill, and there are rocky beaches along the western edge of Croton Point (Figure 6.1-2 in the RI report).

Croton Point, which comprises an area of about 500 acres, is bordered by Croton Bay to the south, Haverstraw Bay to the north, and the Hudson River proper to the west (see Figure 6.1-2 in the RI report). Croton Bay, a shallow embayment (average depth 1 to 5 ft. at mean low water; National Oceanographic and Atmospheric Administration (NOAA), 1989) at the upper end of the Tappan Zee, receives an influx of fresh water from the Croton River. The southern fringe of Croton Point is bordered by Croton Marsh and adjacent tidal mudflats, which are indicative of the low-energy environment of the southern shoreline. The tidal amplitude between high and low mean water is approximately 3 ft. (NOAA, 1989).

The salinity of the Hudson River and Croton Marsh varies with the seasons, and is dependent on freshwater influx. During the low-flow periods of the Hudson River in late summer and early fall, the salt front may progress as far upriver as Newburgh Bay (River Mile 60). Under these conditions, the salinity in Croton Bay and its adjacent marshes may reach as high as 15 to 20 parts per thousand (ppt). During the high flow periods of spring, the salt front may reach only as far as the Tappan Zee or Haverstraw Bay, at which time the salinity of Croton Marsh may range from < 1 to 5 ppt (Limburg et al., 1986).

B.3.3 Habitat Evaluation

Numerous habitats exist in the vicinity of the Croton Point Landfill. The four primary habitat in the vicinity of the landfill which will be evaluated in this assessment include Croton Marsh, the Hudson River (i.e., Croton Bay and Haverstraw Bay, and the Hudson River proper), woodlands, and open fields surrounding the landfill.

Croton Marsh

Croton Marsh consists of about 40 acres of tidally influenced, brackish-water wetlands. Several dendritic channels exist throughout the marsh, most of which are dewatered during low tide. The predominance of mud (i.e., greater than 90% silt and clay) in the sediments of the drainage channels of the marsh reflects the low energy environment of this marsh.

Vegetation

As recently as 10 years ago, the narrow-leaved cattail community (Typha angustifolia) dominated the vegetation of Croton Marsh. Since then, the cattail community has been largely displaced by purple loosestrife (Lythrum salicaria); and subsequently the marsh has become dominated by the common reed (Phragmites australis) (WESTON, 1990). Most recently, it appears that cattails are making a strong comeback.

During a wetlands survey that was conducted in Croton Marsh during the fall of 1988 and spring of 1989 (WESTON, 1990), a total of 80 species of macroflora were identified and are listed in Table B-9. The study showed that approximately 82% of the marsh was dominated by the common reed. Other species commonly found with the common reed include jewelweed (Impatiens capensis) and false climbing buckwheat (Polygonum scandens). Vegetation communities which exist in the marsh include a marsh mallow/bulrush (Hibiscus palustris/Scirpus spp.) community, a marsh mallow community, a mixed marsh community, a cordgrass (Spartina spp.) community, a cattail community, and a spike rush/marsh fleabane

Table B-9 (Continued)
Croton Marsh Vegetation List

Scientific Name		Common Name
Cyperaceae (con't)	*C. hormathodes*	Marsh straw sedge
	C. rivularis	Shining cyperus
	C. erythrorhizos	Red-rooted cyperus
	C. stringosus	Straw-colored cyperus
	C. speciosus	Michaux's cyperus
	C. engelmanii	Engleman's cyperus
	Scirpus americanus	Three square rush
	S. validus	Great bullrush
	S. olneyi	Olney's bullrush
	S. robustus	Salt marsh bullrush
	Eleocharis olivacea	Bright green spike-rush
	E. intermedia	Matted spike-rush
	E. calra	Spike-rush
	E. acicularis	Needle spike-rush
Araceae		(Arum Family)
	Peltandra virginica	Arrow arum
Lemnaceae		(Duckweed Family)
	Lemna sp.	Duckweed
Juncaceae		(Rush Family)
	Juncus canadensis	Canada rush
	J. accuminatus	Sharp fruited rush
	J. effusus	Common bog rush
Urticaceae		(Nettle Family)
	Boehmeria cylindrica	False nettle
Polygonaceae		(Buckwheat Family)
	Polygonum pensylvanicum	Pennsylvania smartweed
	P. hydropiperoides	Mild water pepper
	P. punctata	Dotted smartweed

Table B-9 (Continued)
Croton Marsh Vegetation List

Scientific Name		Common Name
Gentianaceae		(Gentian Family)
	Sabattia campanulata	Slender marsh pink
Apocynaceae		(Dogbane Family)
	Apocynum sibiricum	Clasping-leaved dogbane
	Amsonia amsonsia	Amsonia
Asclepiadaceae		(Milkweed Family)
	Asclepias incarnata	Swamp milkweed
Boraginaceae		(Borage Family)
	Verbena hastata	Blue vervian
Solanaceae		(Nightshade Family)
	Solanum spp.	Nightshade
Scrophulariaceae		(Figwort Family)
	Gratiola neglecta	Hedgehyssop
	Limosella subulata	Mudwort
	Lobelia cardinalis	Cardinal flower
Rubiaceae		(Madder Family)
	Galium palustre	Bedstraw
	Galium tinctorium	Dye bedstraw
Compositae		(Thistle Family)
	Eupatorium perfoliatum	Boneset
	E. serotinum	Late flowering through wort
	Mikania scandens	Climbing hempweed
	Solidago rugosa	Goldenrod
	Bidens laevis	Smooth wort bur-marigold
	Aster subulatus	Annual salt marsh aster
	Pluchea purpurascens	Marsh-fleabane

Table B-10
Fish Species Found at Croton Point

Common Name	Scientific Name
American eel	*Anguilla rostrata*
Blueback herring	*Alosa aestivalis*
Atlantic menhaden	*Brevoortia tyrannus*
Alewife	*Alosa pseudoharengus*
Gizzard shad	*Dorosoma cepedianum*
American shad	*Alosa sapidissima*
Bay anchovy	*Anchoa mitchilli*
Rainbow smelt	*Osmerus mordax*
Redfin pickerel	*Esox americanus americanus*
Chain pickerel	*Esox niger*
Common carp	*Cyprinus carpio*
Goldfish	*Carassius auratus*
Golden shiner	*Notemigonus crysoleucas*
Satinfin shiner	*Notropis analostanus*
Emerald shiner	*Notropis atherinoides*
Spottail shiner	*Notropis hudsonius*
White sucker	*Catostomus commersoni*
White catfish	*Ictalurus catus*
Brown bullhead	*Ictalurus nebulosus*
Atlantic needlefish	*Strongylura marina*
Atlantic tomcod	*Microgadus tomcod*
Banded killifish	*Fundulus diaphanus*
Mummichog	*Fundulus heteroclitus*
Inland silverside	*Menidia beryllina*
Rough silverside	*Membras martinica*
Atlantic silverside	*Menidia menidia*
Fourspine stickleback	*Apeltes quadracus*
Threespine stickleback	*Gasterasteus aculeatus*

Table B-11
Birds of Croton Point and Adjacent Areas

Common Name	Scientific Name	Upland[1]	Croton Marsh	Croton Bay
Double-Crested Cormorant	*Phalacrocorax auritus*			X
Great Blue Heron	*Ardea herodias*		X	
Snowy Egret	*Egretta thula*		X	
Cattle Egret	*Bubulcus ibis*		X	
Least Bittern	*Ixobrychus exilis*		X	
Tundra Swan	*Cygnus columbianus*			X
Mute Swan	*Cygnus olor*			X
Canada Goose	*Branta canadensis*			X
American Black Duck	*Anas rubripes*		X	X
Mallard	*Anas platyrhyncos*		X	X
American Wigeon	*Anas americana*		X	X
Greater Scaup	*Aythya marila*			X
Blue-Winged Teal	*Anas discors*		X	X
Turkey Vulture	*Cathartes aura*	X	X	X
Northern Harrier	*Circus cyaneus*	X	X	
Osprey	*Pandion haliaetus*			X
American Kestrel	*Falco sparverius*	X	X	
Merlin	*Falco columbarius*	X	X	
Virginia Rail	*Rallus limicola*		X	
Common Snipe	*Gallinago gallinago*		X	
Common Sandpiper	*Actitis hypoleucos*		X	
Greater Yellowlegs	*Tringa melanoleuca*		X	
Killdeer	*Charadrius vociferus*	X		
Spotted Sandpiper	*Actitis macularia*		X	
Mourning Dove	*Zenaida macroura*	X		
Belted Kingfisher	*Ceryle alcyon*		X	
Downy Woodpecker	*Picoides pubescens*	X		

diverse wildlife community due to the proximity to water and high nutrient levels provided by constant flushing and replenishment leading to extensive primary and secondary productivity. A list of mammals, amphibians, and reptiles compiled from observations made during the 1988 and 1989 surveys at Croton Marsh is presented in Table B-12 (WESTON, 1990). These species represent field sightings as well as tracks, feces, nests, and burrows. Also presented are species expected to be found in the marsh based upon earlier reports and publications (Ecological Analysts, 1977; Boyce Thompson Institute, 1975; USDA Forest Service, 1987; Cleary, 1985).

Hudson River

From its source in northern New York State, the Hudson River flows 315 river miles where it discharges into the upper New York Bay. Croton Point is located in the lower Hudson River at approximately River Mile 34. At this point, the river is estuarine (Limburg et al., 1986). Evaluation of the Hudson River for this assessment includes Haverstraw Bay, Croton Bay, and the Hudson River proper located directly north, south, and west of Croton Point, respectively.

Aquatic Life

The Haverstraw Bay - Tappan Zee area of the Hudson River is an important nursery and feeding area for large populations of estuarine dependent fish. An abundant supply of planktonic organisms is available in this low salinity area of the Hudson River. This critical zone of low salinity moves up and down the river varying in length according to the volume of freshwater moving downstream. Croton Point is located within the critical zone during much of the summer growing season (Boyce Thompson Institute, 1975). Examples of resident fish species that rely on benthic invertebrates as well as detritus associated with sediments as a food resource include carp, mummichogs, golden shiner, pumpkinseed sunfish, and smallmouth bass. Some of the migrant species collected in the area feed within the water column rather than on benthos, and include blueblack herring, shad, striped bass,

Table B-12 (Continued)
Mammals, Reptiles, and Amphibians of the Croton Marsh

Common Name	Scientific Name	Expected	Observed
Eastern Garter Snake	*Thamnophis sirtalis*	X	
Eastern Worm Snake	*Carphophis amoenus*	X	
Eastern Ribbon Snake	*Thamnophis sauritus*	X	
Northern Black Racer	*Coluber constrictor*	X	
<u>Amphibians</u>			
Red-Spotted Newt	*Notophthalmus viridescens*	X	
American Toad	*Bufo americanus*	X	X
Northern Spring Peeper	*Hyla crucifer*	X	
Bullfrog	*Rana catesbeiana*	X	

Mixed hardwoods were reported as comprising about one-fifth of the wooded areas on the site, covering 29 acres. Species observed in the open canopy were primarily white oak, red oak, chestnut oak, and red maple, with sassafras, mockernut hickory, and black birch in association. An understory included sapling maple, red oak, hackberry, and sassafras (Ecological Analysts, 1977).

Pure stands of white pine were reported as comprising approximately one-tenth of the wooded areas on the site, covering 15 acres (Ecological Analysts, 1977).

Terrestrial Wildlife

During the sampling activities at Croton Point, a list was compiled of 23 bird species observed in upland areas, including the woodlands (Table B-11).

In addition to the avian species, there are a number of mammals that would be expected to use the woodlands for feeding, breeding, and cover. A list of mammals that were observed in the Croton Marsh area during sampling activities is presented in Table B-12. In addition, mammals that would be expected to be found in the area based on information in earlier reports are also presented (Ecological Analysts, 1977; Boyce Thompson Institute, 1975; USDA Forest Service, 1987; Cleary, 1985).

Fields

Vegetation

Investigations conducted during the summer of 1977 reported that 14% of the cover type at Croton Point consisted of a Reed Grass-Shrub Type located at the eastern corner of the study area. The vegetation in this area consisted of a relatively sparse, open canopy of trees. The more dominant form of vegetation was the dense shrub layer, which includes species such as staghorn sumac, common elder, and chokecherry. In addition, there were open

B.3.4 Endangered, Threatened, or Special Concern Species

Of the plant and animal species that were either observed or expected at the site (see Subsection B.3.3), there were some birds, mammals, reptiles, and plants that were listed as endangered, threatened, or of special concern by the State of New York. However, none of these species were listed as a federal or global concern. One bird species, the osprey (Pandion haliaetus), which was observed over Croton Bay, is listed as threatened in New York. A threatened species is defined as a native species likely to become an endangered species within the foreseeable future in New York. However, it should be noted that the osprey has a fairly large home range, and no osprey nesting areas were observed on or adjacent to the landfill site. The least bittern (Ixobrychus exilis) and the sedge wren (Cistothorus platensis), both of which were sighted in Croton Marsh, are listed as bird species of special concern. A species of special concern is defined as a native species for which a welfare concern or risk of endangerment has been documented (New York Title 6, Chapter I, Part 182).

The New England cottontail (Sylvilagus floridanus), although not observed during the most recent activities at the site, is expected at the site and is listed as a species of special concern. There are two reptiles, also expected at the site, the wood turtle (Clemmys insculpta), and the worm snake (Carphophis amoenus), which are listed as species of special concern.

There were 7 plant species that were observed in Croton Marsh that appear on the New York Rare Plant Status List or the Watch List (NYSDEC, 1990), and are presented in Table B-13.

Table B-13 (Continued)
Plants of Croton Marsh on the New York Rare Plant Status List

- New York State Plant Legal Status

The following categories are defined in regulation 6NYCRR part 193.3 and apply to New York State Environmental Conservation Law Section 9-1503.

E = Endangered species: listed species are those with:

- 5 or fewer extant sites, or
- Fewer than 1,000 individuals, or
- Restricted to fewer than 4 U.S.G.S. 7½ minute topographical maps, or
- Species listed as endangered by the U.S. Department of the Interior, as enumerated in the Code of Federal Regulations, 50 CFR 17.11.

R = Rare: listed species have:

- 20 to 35 extant sites, or
- 3,000 to 5,000 individuals statewide

U = Unprotected: currently without state legal status.

- NHP List

Y = Yes, a taxon on the New York Natural Heritage Program rare plant status list.

W = Watch list, a taxon that may be rare or declining in New York, more data is needed before including it on the rare plant status list.

APPENDIX I
TOXICITY PROFILES FOR CHEMICALS OF CONCERN IN GROUND WATER

Aluminum

Aluminum occurs naturally in the soil and makes up about 8% of the earth's crust. Many types of foods contain aluminum because they are grown in soil that contains aluminum. Aluminum is used to make antacids, antiperspirants, and other drug store items (ATSDR, 1990a).

Exposure to aluminum is usually not harmful. People have been eating it in their food for many years without any ill effects. Factory workers who breathe large amounts of aluminum dusts can have lung problems such as coughing or changes that show up in chest x-rays; however, there are no reported cases of cancer or mortality due to aluminum. Animals have not had harmful effects even after breathing very large amounts of aluminum. Some animals died, however, when they were given very large amounts of aluminum in water. Large amounts of aluminum have also been shown to be harmful to unborn and developing animals (ATSDR, 1990a).

The USEPA has not established an MCL for aluminum.

Arsenic

Exposure to inorganic arsenic has long been known to result in adverse health impacts. Ingestion of arsenic has been observed to cause skin abnormalities, including the appearance of dark and light spots on the skin, and small "corns" on the palms, soles and trunk. Although these abnormalities may not directly impact on human health, they may ultimately progress to skin cancer (ATSDR, 1991a). Systemic health effects resulting from inhalation of inorganic arsenic are similar to those resulting from ingestion of inorganic arsenic. These effects are usually mild. Of greater concern is the increased potential risk for developing lung cancer which has been observed following occupational exposures (ATSDR, 1991a).

The Carcinogen Assessment Group of the USEPA has classified arsenic as a group A carcinogen (Human Carcinogen). This classification is based on sufficient evidence indicating that exposure to inorganic arsenic compounds via inhalation has resulted in increased lung cancer mortality and exposure via ingestion has lead to increased mortality from multiple internal organ cancers and increased skin cancer incidence (USEPA, 1996).

There is some evidence that small doses of arsenic are essential components of the human diet. Animals under restricted arsenic intake have been observed to not gain weight normally, become pregnant less frequently and have small offspring. However, no cases of arsenic deficiency in humans have ever been reported (ATSDR, 1991a).

The USEPA has promulgated an MCL of 0.05 mg/l for arsenic in drinking water (USEPA, 1996).

Barium

Barium is abundant in nature and has been found in plant and animal tissues. Some foods, such as Brazil nuts, seaweed, fish and certain plants, may contain high levels of barium. Some water contains low levels of barium from natural deposits. Barium is used in the production of paints, bricks, tiles, and rubber, and in the manufacture of ceramic, glass, and insect and rat poisons. It is also used as an aid to x-ray diagnosis. Barium is most commonly found as barium sulfate and barium carbonate in soil and water (ATSDR, 1990b).

The toxicity of barium compounds depends on their solubility. The soluble compounds are absorbed and small amounts are accumulated in the skeleton. Barium is found in low concentrations in the lung, kidney, spleen, muscle, heart, brain and liver. Occupational poisoning from barium is uncommon, but a benign pneumoconiosis (baritosis) may result form inhalation of barium sulfate dust and barium carbonate. Baritosis is not incapacitating and is usually reversible upon cessation of exposure. Accidental poisoning from ingestion of soluble barium slats has caused gastroenteritis, muscular paralysis, decreased pulse rate and ventricular fibrillation (Casarett and Doull, 1986). The USEPA has classified barium as Group D (not classified) regarding carcinogenic status.

The USEPA has promulgated an MCL of 2 mg/L for barium (USEPA, 1996).

Benzene

Benzene is a highly volatile aromatic hydrocarbon occurring in the environment by both natural processes (i.e., volcanoes, forest fires) and human activities (petroleum sources). Benzene occurs naturally in crude oil and is also a byproduct of oil refining processes. Benzene is an important component of gasoline, especially because of its anti-knock characteristics. For this reason, the concentration of aromatics, such as benzene, in unleaded fuels has increased, with percentage by volume of benzene in unleaded gasoline as high as 1-2%. Benzene is also a major industrial chemical and because of its wide use, benzene ranks in the top

3\20 in production volume for chemicals produced in the U.S. (ATSDR, 1993a).

Benzene is used as a chemical intermediate in the manufacture of other chemicals, such as styrene (for styrofoam and other plastics), cumene (for various resins), and cyclohexane (for nylon and synthetic fibers), (ATSDR, 1993a). Benzene is also used for the manufacturing of some drugs, pesticides, detergents, lubricants, dyes, solvents, and cleaning products.

Benzene is ubiquitous in the atmosphere at concentrations ranging from 2.8 to 20 ppb. Atmospheric emission of benzene is from gasoline vapors, automobile exhaust, chemical production and user facilities (ATSDR, 1993a). Benzene is also found in tobacco, consequently tobacco smoke is another source to the air. Releases of benzene to air account for the majority of all environmental releases. Another mode of environmental release is to water and soil from industrial discharges, landfill leachate, and gasoline leaks from underground storage tanks (ATSDR, 1993a).

Benzene is highly volatile (vapor pressure of 95 mmHg at 25°C) and also is significantly soluble in water (water solubility of 1780 mg/L at 25°C), (ATSDR, 1993a). The Henry's law constant for benzene (5.5×10^{-3} atm.m^3/mole at 20°C) suggests that benzene will partition to the atmosphere from surface water (Mackay and Leinonen, 1975 as cited in ATSDR, 1993a). Benzene released to soil surfaces partitions to the atmosphere through volatilization, to surface water through runoff, and to groundwater as a result of leaching (ATSDR, 1993a). Due to benzene's relatively low organic carbon sorption coefficient, it is considered to be moderately to highly mobile in soil.

Benzene undergoes microbial degradation under aerobic conditions in surface water and groundwater with reported half-lives of 16 and 28 days, respectively (ATSDR, 1993a). Benzene is also biodegraded in soil under aerobic conditions. The microbial degradation process initially metabolizes the benzene to dihydrodiols which ultimately gets metabolized to carbon dioxide. In the atmosphere the most important degradation process for benzene is its reaction with hydroxyl radicals, which are photochemically produced and are present in higher concentration in polluted air.

The general population is exposed to benzene primarily by inhalation of contaminated air (especially in heavy traffic areas and around gasoline stations). Another significant exposure pathway is by smoking tobacco products and exposure to side stream smoke (passive smoking). Exposure to benzene can also result from ingestion of contaminated food and water. Using contaminated tap water can also be a source of inhalation exposure since benzene can volatilize from water. Occupational exposure levels to benzene can be quite high, particularly in the petroleum and rubber tire industry. Other jobs that may involve exposure to benzene include steel workers, printers, shoe makers, laboratory technicians and gas station employees (ATSDR, 1993a).

Like many solvents, benzene is a CNS depressant and also an eye and skin irritant. Acute benzene exposure may cause blood disorders, hemorrhaging, immunosuppression and death. People who breathe benzene for long periods may undergo damage to bone marrow, the tissue that forms blood cells.

Epidemiological and animal studies indicate that benzene is a cancer causing chemical. Benzene is considered to be human carcinogen by EPA, OSHA, the World Health Organization (WHO), and the International Agency for Research on Cancer (IARC), (ATSDR, 1993a). Based on human epidemiological studies, long-term exposure to high levels of benzene in air can cause leukemia (cancer of the tissues that form white blood cells). The EPA has confirmed the weight-of-evidence classification for carcinogenicity of benzene as Group A, known human carcinogen, based on sufficient human evidence supported by a sufficient level of animal study evidence (USEPA, 1996).

There is some epidemiological evidence that long term high level exposure to benzene by women may cause damage to reproductive organs. Although a direct correlation was not made, some women workers exposed to high levels of benzene for months had irregular menstrual periods and showed a decrease in size of the ovaries. Currently, it is not known what effects exposure to benzene might have on a developing human fetus, however, studies with pregnant animals show that breathing benzene has adverse effects o the developing fetus (ATSDR 1993a).

Beryllium

Beryllium can be found in a variety of compounds which may either be soluble or insoluble in water. Exposure to beryllium can occur by breathing air, eating food or drinking water which contains beryllium. It is not likely to enter the body in significant quantities by skin contact. Beryllium is present naturally in some foods such as carrots and corn. Beryllium also occurs naturally in tobacco and can be inhaled in cigarette smoke. Exposure to high levels of beryllium and beryllium compounds, including beryllium oxide, may occur in the workplace. Ingested beryllium enters the bloodstream, is removed by the kidneys and excreted within several days. Inhaled beryllium may take months to several years before it is transferred from the lungs to the bloodstream and then removed from the body (ATSDR, 1991b).

Inhalation of beryllium can result in damage to the lungs. Inhalation of large amounts of beryllium over a short period can result in reddening and swelling of the lungs (acute beryllium disease). Hypersensitivity or allergy to beryllium can also occur, in which white cells accumulate around the beryllium and form granulomas (chronic beryllium disease). Exposure to smaller amounts of soluble or insoluble beryllium for long periods of time can result in weakness and shortness of breath. Swallowing beryllium has not been reported to cause effects in humans because very little beryllium can move from the stomach and intestines into the bloodstream. Beryllium contact with skin that has been scraped or cut can cause rashes or ulcers.

The USEPA has classified beryllium as Group B2, probably human carcinogen. This classification is based on induction of lung cancer via inhalation in rats and monkeys and induction of osteosarcomas in rabbits via intravenous and intramedullary injection. The USEPA has established a proposed MCL of 0.001 mg/l for beryllium (USEPA, 1996).

Chloromethane

Chloromethane is a clear, colorless gas (vapor) that is difficult to smell. It is a naturally occurring chemical that is made in large amounts in the oceans and is produced by some plants, rotting wood and the burning of coal. Chloromethane is also produced industrially, but most of it is destroyed during use. It is used mainly in the production of other chemicals such as silicones, agricultural chemicals and butyl rubber. Chloromethane was also used as a refrigerant in the past, but this use was taken over when newer chemicals were developed such as Freon (ATSDR, 1990c).

Since chloromethane is continuously released into the atmosphere from oceans and biomass, a very low concentration is always present. When present in water, chloromethane will evaporate rapidly. Chloromethane will evaporate from the soil surface, but if present in a landfill or waste site, it may move downward and get into ground water (ATSDR, 1990c).

Chloromethane is ubiquitous in air at low levels, with outside concentrations ranging from less than 0.001 ppm to 0.003 ppm. It is also present in some lakes and streams and has been found in drinking water (chlorinated supplies) at very low levels. You could be exposed to levels somewhat higher than background levels, if you live near a hazardous waste site or a source of industrial release. Occupational workers using chloromethane are the population most likely to be exposed to elevated levels. Chloromethane can enter your body through the lungs if you breathe it in or through the digestive tract if you drink water containing it (ATSDR, 1990c).

Almost all of the chloromethane that you breathe in or drink rapidly enters the bloodstream from the lungs or the digestive tract and then it or its breakdown products go to organs such as the liver, kidneys and brain. The portion of the chloromethane that does not get changed in your body leaves in the air you breathe out, and the breakdown products gets excreted via the urine. If the levels are high enough (over a million times the levels found in outside air), brief exposures to chloromethane can have serious effects on the nervous system, including convulsions, coma, and death. Animals studies have indicated harmful liver, kidney, and nervous system effects occurring after they were exposed to air containing high levels of chloromethane (100,000 times natural levels) for a few hours each day for 1 or more days. In long-term exposure experiments, animals that breathed air containing chloromethane grew at a lower rate, were less fertile, had increase lose of fetuses and gave birth to less developed offspring. Studies indicate that male mice that breathed air containing chloromethane for 2 years developed tumors in their kidneys, but female mice and male and female rats did not develop tumors. At this time, it is not known whether chloromethane could cause sterility, miscarriages, birth defects, or cancer in humans (ATSDR, 1990c).

According to EPA's guidelines for assessment of carcinogenic risk, chloromethane has been classified in Group C, possible human carcinogen (USEPA, 1995a). This classification is for compounds which have limited evidence from animal studies and inadequate or no data in humans in terms of carcinogenicity.

Chlorobenzene

Chlorobenzene is colorless liquid with an almond-like odor. The compound does not occur widely in nature, but is manufactured for use as a solvent and is used in the production of other chemicals. The production of chlorobenzene has decreased over the years due to replacement by other solvents (i.e., cumene for the production of phenol) and due to the cessation of DDT production for which chlorobenzene was needed as an intermediate in its synthesis. The current primary uses of chlorobenzene are as a solvent for pesticide formulations, diisocyanate manufacturing, degreasing automobile parts, and for the production of nitrochlorobenzene (ATSDR, 1990d).

Since chlorobenzene is used as a solvent and as an intermediate in chemical manufacturing industry, some of it is released to the environment in water and air discharges. Chlorobenzene absorbs moderately to soil and is biodegraded comparatively rapidly. With a moderate index of bioaccumulation, chlorobenzene was found in almost every individual tested for it in the U.S. (ATSDR, 1990d).

There is potential for humans to be exposed to chlorobenzene by breathing contaminated air, by drinking water or eating food contaminated with chlorobenzene, or by getting contaminated soil on the skin. These exposures are most likely to occur in the workplace or in the vicinity of chemical waste sites. Occupational exposure occurs primarily through breathing the chemical. When chlorobenzene enters your body, most of it is expelled from the lungs in the air we breathe out and in urine (ATSDR, 1990d).

Workers exposed to high levels of chlorobenzene complained of headaches, numbness, sleepiness, nausea, and vomiting. However, it is not known if chlorobenzene alone was responsible for these health effects since the workers may have also been exposed to other chemicals at the same time. Mild to severe depression of functions of parts of the nervous system is a common response to exposure to a wide variety of industrial solvents. In animals, exposure to high concentrations of chlorobenzene affects the brain, liver, and kidneys, with physical symptoms such as unconsciousness, tremors and restlessness observed. The chemical can cause severe injury to the liver and kidneys, though data indicate that chlorobenzene does not affect reproduction or cause birth defects. Studies in animals have shown that chlorobenzene can produce liver nodules, providing some but not clear evidence of cancer risk (ATSDR, 1990d).

According to EPA's guidelines for assessment of carcinogenic risk, chlorobenzene has been classified in Group D, not classifiable (USEPA, 1996). This classification is for compounds which have inadequate human and animal evidence of carcinogenicity.

Chromium

Chromium is a naturally occurring element found in rocks, animals, plants, soil, and in volcanic dust and gases. Chromium is present in the environment in several different forms, the most common being metallic chromium (0), trivalent chromium (III), and hexavalent chromium (VI). Chromium III occurs naturally in the environment and is an essential nutrient required by the human body to promote the action of insulin in body tissues so that sugar, protein and fat can be used by the body. Chromium (0) is a steel-gray solid with a high melting point used mainly for making steel and other alloys. Chromium (III) and (VI) forms are primarily produced by the chemical industry and used for chrome plating, the manufacture of dyes, leather tanning, wood preserving and in smaller amounts in drilling muds, rust and corrosion inhibitors, textiles and toner for copying machines (ATSDR, 1993b).

Chromium enters the air, water and soil mostly in the chromium (III) and (VI) forms as a result of natural processes and human activities. Stainless steel welding, and chemical manufacturing can increase chromium (VI) levels in air. Waste streams from electroplating can discharge chromium (VI) and leather tanning can dishrag chromium (III) and (VI) into waterways. The levels of both chromium (III) and (VI) in soil increase mainly from disposal of commercial products containing chromium, chromium waste from industry, and coal ash from electric utilities. In air, chromium compounds are present mostly as fine dust particles, which eventually settles over land and water. Although most of the chromium in water binds to dirt and other materials and settles to the bottom, a small amount may dissolve in the water. Soluble chromium compounds can remain in water for years before settling to the bottom, however fish do not bioaccumulate much chromium in their bodies from water. Chromium in soil can dissolve in water and can move deeper in the soil or to ground water. The movement of chromium in soil depends on the type and condition of the soil (i.e., aerobic or anaerobic conditions) and other environmental factors such as redox potential and pH of the soil (ATSDR, 1993b).

People can be exposed to chromium by breathing air, drinking water, or eating food containing chromium or through skin contact. The level of chromium in air and water is generally low (less than 2 ppb of chromium (III) in drinking water. For the general population, eating foods that contain chromium is the most likely route of exposure. Chromium (III) occurs naturally in many fresh vegetables, fruits, meat, yeast, and grain. Additionally, various methods of processing, storage, and preparation can alter the chromium content of food. People who work in industries that process or use chromium or chromium compounds can be exposed to higher levels of chromium. Humans may also be exposed to higher levels of chromium if you use tobacco products, since tobacco contains chromium (ATSDR, 1993b).

Chromium (III) is an essential nutrient that helps the body use sugar, protein, and fat. Most people in the U. S. take in enough chromium (III) in the food they eat to cover the recommended daily intake of 50 to 200 ug for adults. Occupational worker results have indicated that breathing in high levels (greater than 2 ug/m3) of chromium (VI) can cause irritation to the nose, such as, runny nose, sneezing, itching, nosebleeds, ulcers, and holes in the nasal septum. Long-term exposure to chromium has been associated with lung cancer in workers exposed to levels in air that were 100 to 1000 times higher than those found in the natural environment. Lung cancer may occur long after exposure to chromium has ended. Chromium (VI) is believed to be primarily responsible for the increased lung cancer rates observed in workers (ATSDR, 1993b).

Accidental ingestion of chromium (VI) have caused stomach upsets and ulcers, convulsions, kidney and liver damage and even death. Workers handling liquids or solids that have chromium (VI) in them have developed skin ulcers. Some people have been found to be extremely sensitive to chromium (VI) or chromium (III). Exposure to metallic chromium is less common and little is known how it affects human health. In animals that breathed high levels of chromium, harmful effects on the respiratory system and a lower ability to fight disease were noted. However, it is not known if similar effects could occur in humans or if chromium can lower a person's ability to fight disease. Although animal study results indicate birth defects and decreased sperm count in mice exposed to high levels of chromium, there is no reliable information that any form of chromium has harmful effects on reproduction or causes birth defects in humans (ATSDR, 1993b).

Because some chromium (VI) compounds have been associated with lung cancer in workers and caused cancer in animals, the Department of Health and Human Services has determined that certain chromium (VI) compounds (calcium chromate, chromium trioxide, lead chromate, sodium dichromate, strontium chromate, and zinc chromate) are known carcinogens. According to EPA's guidelines for assessment of carcinogenic risk, chromium (VI) has been classified in Group A, human carcinogen and chromium (0) and chromium (III) in Group D, not classifiable (USEPA, 1996).

Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate, or di(2-ethylhexyl)phthalate (DEHP), is a synthetic chemical that is added to plastics to make them flexible. DEHP is present in a wide variety of plastic products and is an ingredient in paints, flexible tubing, and plastic bags. When DEHP is released to soil, it usually does not move very far away from where it was released. When released to water, DEHP dissolves very slowly into groundwater or surface waters that contact it. DEHP is not highly volatile and thus does not tend to migrate in air (ATSDR, 1991c).

Most of what is known about the health effects of DEHP comes from animal studies, especially studies in rats and mice. Breathing DEHP does not appear to have serious harmful effects. Studies in rats have shown that DEHP in the air has no effect on lifespan or the ability to reproduce. Dermal absorption through the skin is unlikely to be significant. There have been no studies of workers exposed to DEHP that indicate it causes cancer in humans. However, eating high doses of DEHP for a long time resulted in liver cancer in rats and mice. Exposure of animals to DEHP has also resulted in decreased fertility and structural and functional changes in the kidney (ATSDR, 1991c).

EPA has classified DEHP as Group B2, probable human carcinogen. The MCL for this chemical is 0.006 mg/l (USEPA, 1995b).

Lead

Lead is a naturally occurring bluish-gray metal found in small amounts in the earth's crust. Metallic lead does not dissolve in water and does not burn, however some natural and man-made substances containing lead can burn. Lead is used in the production of some types of batteries, ammunition, in some kinds of metal products (such as sheet lead, solder, and pipes) and in ceramic glazes. Some chemicals containing lead, such as tetraethyl lead and tetramethyl lead, are used as gasoline additives, however the use of these chemicals in gasoline is much less than is used to be because the producers of these additives in the U.S. stopped making them in early 1991. Lead containing chemicals are also used in the formulation of paint. The amount of lead added to paints and ceramic products, caulking, gasoline additives, and solder has been reduced in recent years because of lead's harmful effects in humans and animals. Lead is also used in roofing, radiation shields for protection against X-rays, medical equipment, electronic equipment, jet turbine engine blades, and military tracking systems (ATSDR, 1993c).

Human activities, such as use of "leaded" gasoline and lead paint, have spread lead and substances that contain lead to all parts of the environment. Lead can be found in air, drinking water, rivers, lakes, oceans, dust, and soil. Since the EPA has limited the use of "leaded" gasoline, the amount of lead released into the air has significantly decreased in recent years. The release of lead to air is now less than the release of lead to soil. Most of the lead in inner city soils comes from landfills and leaded paint. Landfills contain waste from lead ore mining, ammunition manufacturing, and from other industrial activities such as battery production. Very little lead goes directly into water. Lead binds with soil particles, therefore movement of lead from soil particles into ground water is unlikely unless there are acidic conditions present (ATSDR, 1993c).

People living near hazardous waste sites can be exposed to lead and chemicals that contain lead by breathing air, drinking water, eating foods, or swallowing or touching dust/dirt that contains lead. For people who do not live near hazardous waste sites, most exposure to lead occurs by eating foods that contain lead, occupationally in brass/bronze foundries, or in areas where leaded paints exist. A significant source of lead exposure can be from lead leaching off pipes, solder, brass faucets under acidic water conditions. Eating lead-based paint chips or dust (pica behavior in preschool age children) is another way you can be exposed to lead. These two routes of exposure are particularly relevant to children in lower-income urbanized populations. For occupationally exposed individuals, the predominant route of exposure is the inhalation of lead particles (ATSDR, 1993c).

Exposure to lead can be particularly dangerous for unborn children because of their great sensitivity (blood-brain barrier not well established) during development. Exposure to lead can also be a significant problem for young children because they swallow more lead through normal mouthing activity, take more of the lead that they swallow into their bodies, and are more sensitive to its effects. Exposure to lead has been found to result in anemia, and cardiovascular and neurological effects. Adverse impacts on human health are the same whether lead enters the body through ingestion of inhalation. Exposure of young children has been found to result in lower Intelligence Quotient (IQ) scores and reduced growth. Lead absorbed by the mother can be transferred to the fetus, resulting in pre-term birth, reduced birth weight and decreased IQ in the infant. Middle-aged men exposed to lead may exhibit increased blood pressure. High exposure to lead can cause damage to the brain and kidneys in both children and adults and cause abortion in the female and damage to the male reproductive system (ATSDR, 1993c).

Recent studies have also indicated that lead is a carcinogen. The EPA has classified lead as Group B2, probable human carcinogen, based on evidence from animal studies (USEPA, 1996). Rats and mice who have ingested large doses of lead have developed kidney tumors, however this does not mean that lead causes cancer in humans. Occupational studies have not clearly indicated an increased carcinogenic risk following exposure to lead (ATSDR, 1993c).

Manganese

Manganese is a silver-colored metal which is not found as a pure metal. It is used to make steel and also in the production of batteries and in some ceramics, pesticides and fertilizers. Low level exposures may occur from manganese present in air, water, soil and food. Higher than normal exposures are possible in factories where manganese metal is produced or in ambient air near coal and oil-burning facilities (ATSDR, 1992).

Manganese may be released to the environment by industrial discharges to rivers, where it can get transported as dissolved salts and as suspended sediments. In water manganese may undergo oxidation at elevated pH and is also subject to microbial metabolism (ATSDR, 1992).

Manganese is a nutritionally required element needed in trace quantities. Under normal conditions, gastrointestinal absorption of manganese is relatively low. Because manganese is a normal component of the human diet, the body tends regulate how much manganese is retained (ATSDR, 1992).

Individuals inhaling high levels of manganese, which is expected to only occur in occupational settings, may exhibit symptoms of manganism. Symptoms of manganism include mental and emotional disturbances and lack of control over body movements. Lung irritation may also result from breathing manganese dust. However, lung irritation may occur following inhalation of many types of dust particles. Impotency has also been reported as manifestation of manganese toxicity (ATSDR, 1992).

It is not certain whether ingestion of manganese can cause effects similar to inhalation of manganese dust. Humans have reported symptoms similar to manganism following ingestion of water containing high levels of manganese. However, it is not certain if the effects were due to exposure only to manganese (ATSDR, 1992).

The U.S. EPA has classified manganese as Group D (not classified) regarding carcinogenicity (USEPA, 1996).

Vanadium

Vanadium is a natural element in the earth which is used in making steel as well as rubber, plastic, ceramics, and certain other chemicals. It occurs naturally in fuel oils and coal. In the environment it is usually combined with other elements such as oxygen, sodium, sulfur, or chloride (ATSDR, 1990e).

Inhalation of large amounts of vanadium dusts for short or long periods results in lung irritation, sore throat, and red irritated eyes. Ingestion of vanadium has not been studied extensively in humans. Some minor birth defects (such as slightly smaller offspring) occurred when female rats drank vanadium in water when they were pregnant (ATSDR, 1990e).

The USEPA has classified vanadium as Group D (not classified) regarding carcinogenic status. No MCL has been established for vanadium (USEPA, 1996).

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APPENDIX N

WORLDWIDE GEOSCIENCE REPORTS

WORLDWIDE GEOSCIENCES, INC.

6100 Corporate Drive
Suite 320
Houston, Texas 77036
Phone: 713 / 988-9401
FAX: 713 / 988-8784

June 20, 1995

Ms. Colleen Kovarik
ERM - Northeast
175 Froehlich Farm Blvd.
Woodbury, NY 11797

Dear Ms. Kovarik:

Enclosed is our report on the free product samples submitted from the Metro North site. Again, the sample signatures indicate severely biodegraded diesel as the product present. These diesel signatures do not correlate with previously analyzed diesels submitted in 1994 from the Metro North site.

My notes indicate there was a question on whether these free products could be reused as diesel. Diesels require a minimum normal paraffin level to attain the combustion characteristics needed in a diesel engine. The normal paraffin proportions are indirectly reflected in the diesel specifications as the cetane number. The cetane number is the diesel equivalent of the octane number for gasoline. The absence of normal paraffins in these free product samples indicate they would not be suitable for reuse as diesel.

If there are any questions please do not hesitate to contact us. We appreciate being of service to ERM.

Sincerely yours,

Neil F. Petersen

Neil F. Petersen

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CHARACTERIZATION OF FREE PRODUCT SAMPLES METRO NORTH SITE

PREPARED FOR
ERM - NORTHEAST
JUNE 1995

CHARACTERIZATION OF FREE PRODUCT SAMPLES
METRO NORTH SITE

SUMMARY

Four free product samples were analyzed by high resolution capillary gas chromatography to determine the parent product type and to correlate these samples with one another and previously analyzed free product samples from this site.

All four free products are severely biodegraded diesels indicating long exposure times for the free products. The WB-4&4A sample is distinctly different from the other three product samples submitted and from previously analyzed product samples analyzed from the Metro North site on the basis of an absence of prominent non-isoprenoid peaks. The remaining three free samples analyzed do show prominent non-isoprenoid peaks similar to previously analyzed samples. However, the previously analyzed samples all show high proportions of IP19 (pristane), while the WB2-1A, TB1-1A1A, and TB6-1B1B samples show low proportions of IP19. Different diesels again are indicated for the free product samples analyzed.

INTRODUCTION

Four free product samples from the above titled site were received at the offices of Worldwide Geosciences via Federal Express overnight delivery on March 27, 1995. Sample TB1-1A1A was contained in a single, six ounce, glass jar. Each of the remaining three samples were contained in duplicate, six ounce, glass jars. All samples were packed in a cardboard box with ice used as a preservative. Sample identifications as per the attached chain of custody form and their assigned laboratory numbers are as follows:

Sample ID	Laboratory No.
TB6-1B1B	50329005
WB2-1A	50329006
WB-4+4A	50329007
TB1-1A1A	50329008

Worldwide Geosciences was requested to characterize the samples in terms of product type, provide any indications of age, and determine whether the samples correlated with one another.

Each sample was analyzed as received by high resolution capillary gas chromatography using a 30 meter DB1 column with a flame ionization detector (FID). A Perkin-Elmer Autosystem was utilized. The analysis procedure follows the analytical procedures of ASTM Method D-3328, but modified to reflect current instrumentation. Two procedural methods are routinely used for product characterization. One provides better resolution of the gasoline range hydrocarbons but has a more limited carbon number range. This is Method 1 as defined in the procedural description provided in Appendix II. The second method is routinely used to characterize products heavier than gasoline. The gasoline range hydrocarbons are compressed as a result of a more rapid increase in column temperature. This is Method 2 as described in Appendix II. These samples were analyzed under Method 2 conditions on April 2, 1995.

Display copies of the chromatograms, both labeled and unlabeled, are incorporated into the report as Appendix I. A full-scale display in which all the peaks have been kept onscale for accurate visualization of the relative proportions of the hydrocarbons present is provided. Also included in Appendix I is a table listing the abbreviations used to identify peaks on the chromatograms and their corresponding names.

RESULTS

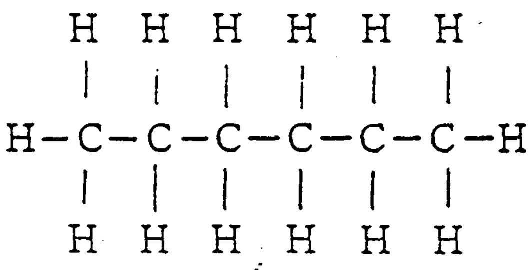
In discussing the compositional characteristics of the samples analyzed and analog signatures, the various peaks present in the chromatograms will be referred to in terms of the hydrocarbons they represent. As a general aid to visualizing the types of hydrocarbons involved, Figure 1 is presented to illustrate the main classes of hydrocarbons.

Figure 2 provides a comparison of the chromatographic signatures of the three most common petroleum fuels (gasoline, kerosene, and diesel) analyzed under comparable chromatographic conditions. Current standard grade diesel and #2 fuel oil are normally interchangeable products. The most prominent hydrocarbon type present in kerosenes, diesels, and other middle distillate products is the normal paraffins. The normal paraffins are straight chain molecules in which all the carbon atoms are attached in an end to end manner. Normal hexane in Figure 1 is an example of a normal paraffin.

FIGURE 1
TYPES OF HYDROCARBONS

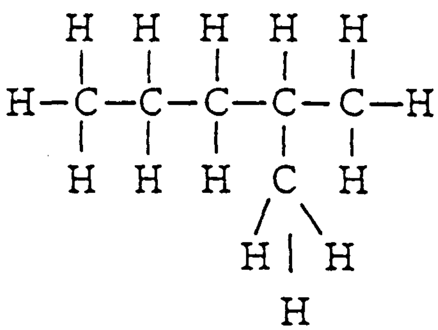
SATURATES

CARBON ATOMS CONNECTED BY SINGLE BONDS
PARAFFINS OR ALKANES
NORMAL PARAFFINS OR ALKANES
STRAIGHT CHAINS



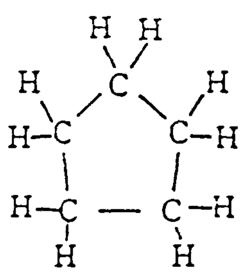
NORMAL HEXANE (NC6)

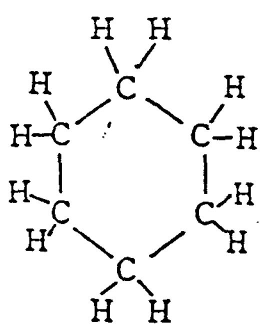
ISO-PARAFFINS OR ALKANES
BRANCHED CHAIN PARAFFINS

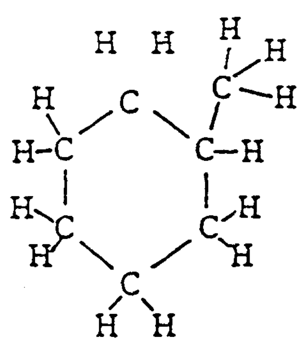


2METHYL PENTANE (2MP)

NAPTHENES OR CYCLOPARAFFINS OR CYCLOALKANES
RING OR CYCLIC STRUCTURE







CYCLOPENTANE (CCP)

CYCLOHEXANE (CH)

METHYLCYCLOHEXANE (MCH)

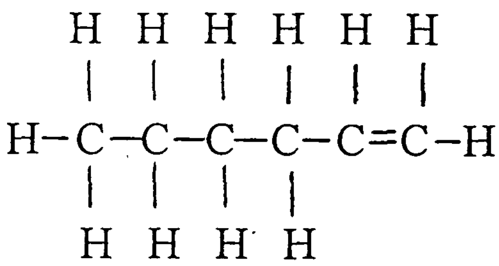
FIGURE 1 (CONT.)
TYPES OF HYDROCARBONS

UNSATURATES

HAVE ONE OR MORE CARBON DOUBLE BONDS

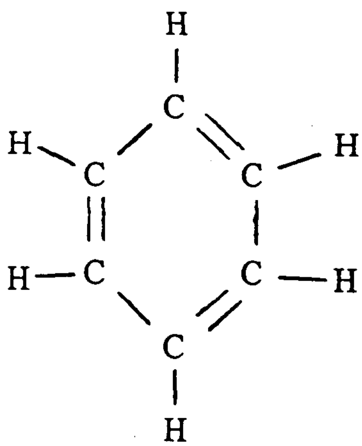
OLEFINS OR ALKENES

CAN BE STRAIGHT CHAIN, BRANCHED CHAIN, OR CYCLIC

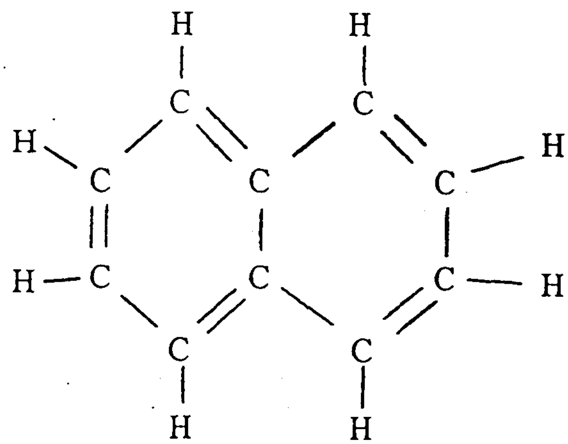


NORMAL HEXENE

AROMATICS



BENZENE



NAPHTHALENE

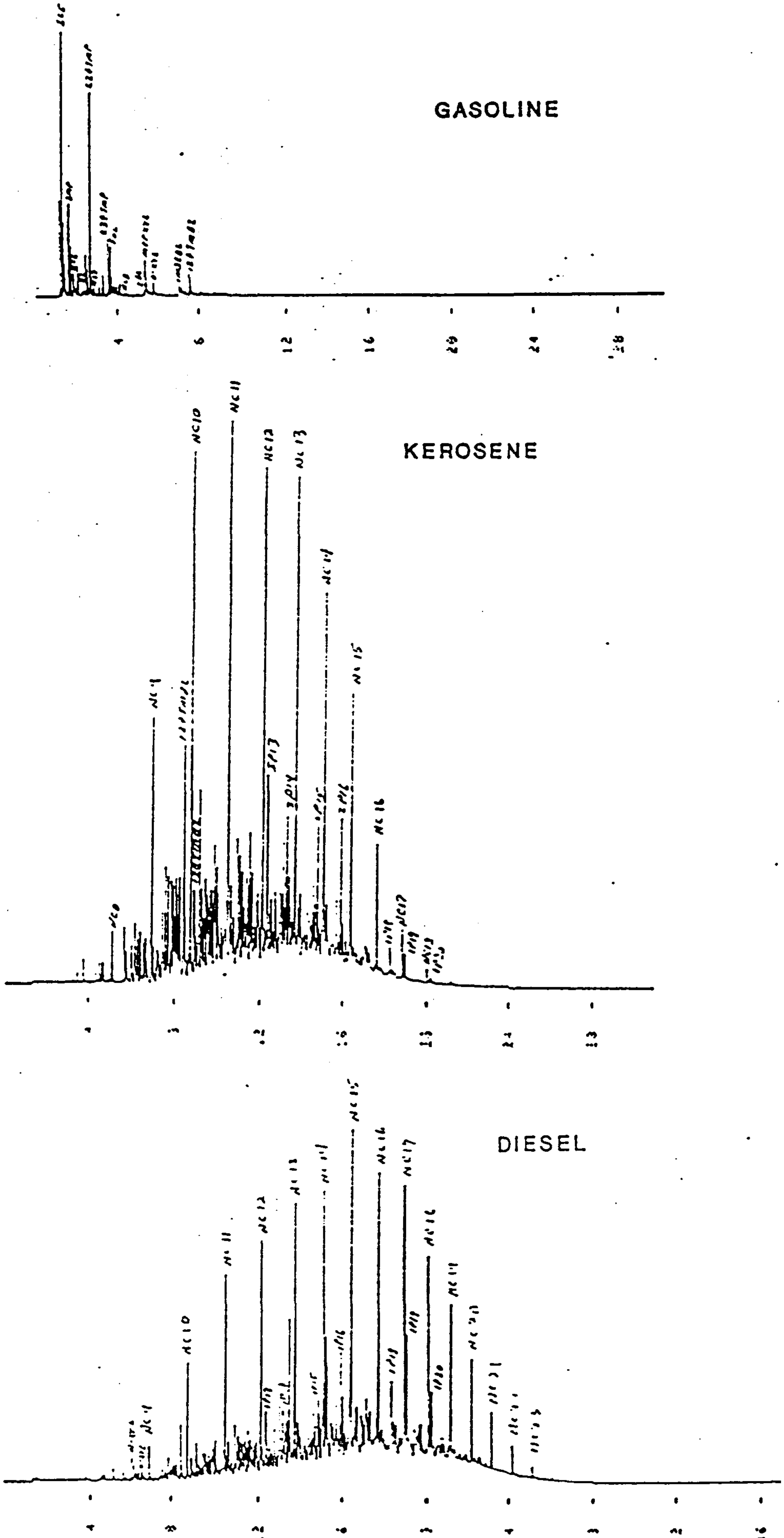


FIGURE 2: CHROMATOGRAPHIC SIGNATURES OF GASOLINE, KEROSENE, AND

Although there is considerable overlap in the carbon number range of kerosenes, and diesels, both the overall carbon number distribution and the normal paraffin distribution is offset to higher carbon numbers in diesels than in kerosenes. Diesels and kerosenes can also be differentiated based on their isoprenoid proportions. The isoprenoids represent a unique type of branched chain or isoparaffin in which a side methyl (CH3) group is attached to every fourth carbon atom of the main carbon chain. The 2 methylpentane structure in Figure 1 is an example of an isoparaffin with a single side methyl group. The isoprenoids are annotated on the chromatograms with an IP designation followed by the number of carbon atoms in the molecule. The isoprenoids represent the second most prominent individual hydrocarbon type present in kerosenes and diesels. In kerosene products, the lower carbon number isoprenoids (IP13, IP14, IP15, and IP16) strongly predominate over the higher carbon number isoprenoids (IP18, IP19, and IP20). In diesels, the higher carbon number isoprenoids are present at more equal proportions to the lower carbon number isoprenoids or exceed them.

Normal paraffins not only are the most prominent individual hydrocarbon type present in kerosenes and diesels, but also are the hydrocarbon type most easily metabolized by anaerobic bacteria. As a result normal paraffins will be preferentially lost or consumed as biodegradation progresses with increasing exposure time. Severely biodegraded samples of diesels or kerosenes in which the normal paraffins have been completely consumed can be differentiated in terms of parent product type on the basis of their isoprenoid proportions. The relative proportions of the more resistant isoprenoids and other subordinate hydrocarbon peaks can also be used as a means of correlating both fresh and biodegraded kerosenes and diesels to one another.

The change in signature characteristics which occurs as a result of biodegradation is illustrated in Figures 3 and 4. Figure 3 compares the signature of a kerosene as analyzed and artificially degraded by whiting out the normal paraffins. Figure 4 provides a similar comparison for a diesel. As the vertically prominent normal paraffin peaks are lost, the underlying baseline rise or hump becomes an increasingly prominent feature of the chromatographic signature. This baseline rise or hump represents a complex mixture of individual hydrocarbons which are not present in sufficient individual abundance to elute as discrete peaks.

Gasoline is a lighter fuel than kerosenes or diesels. Gasoline also shows a distinctly different hydrocarbon type assemblage than kerosenes and diesels. Due to differences in the combustion characteristics of automotive

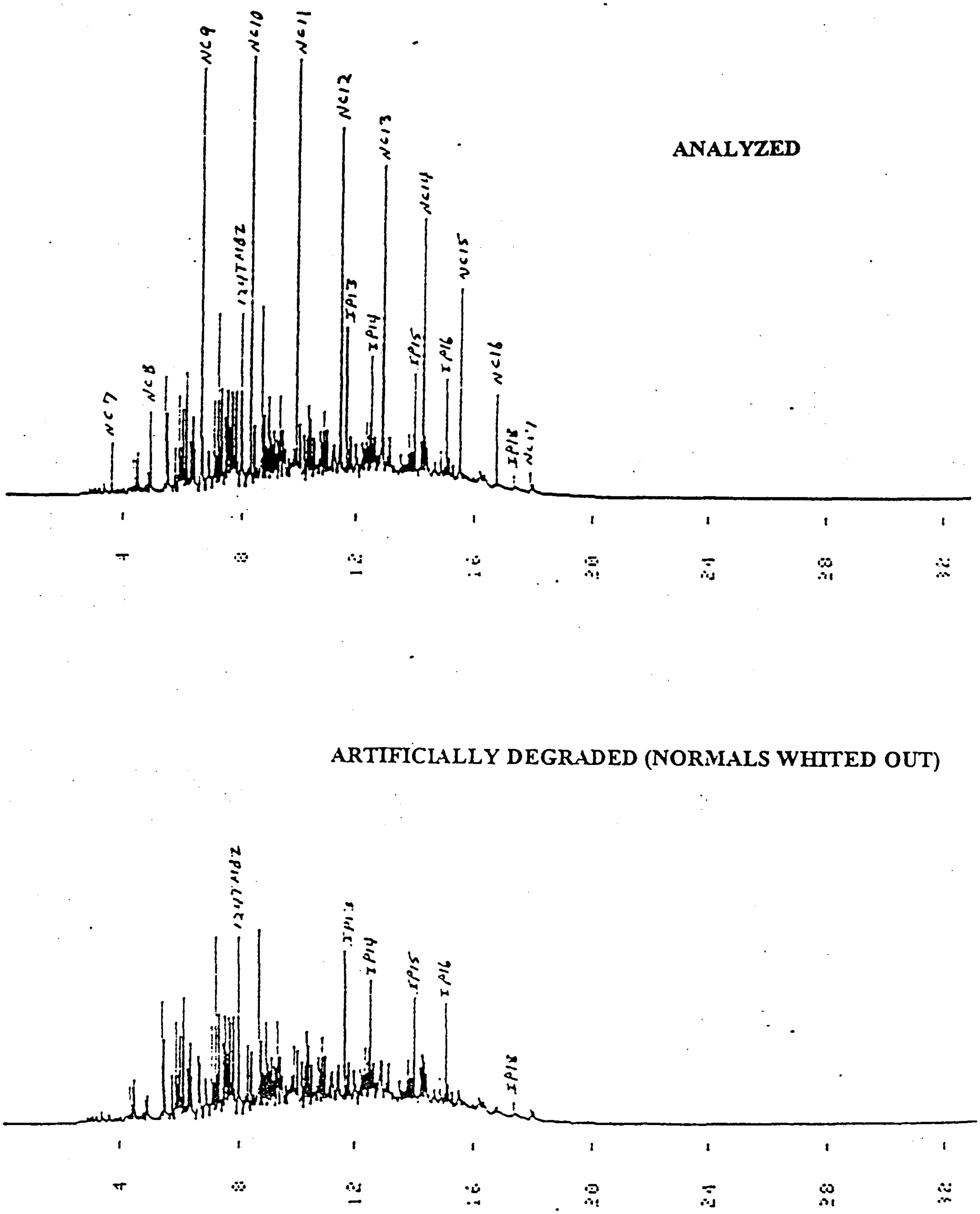


FIGURE 3: CHROMATOGRAPHIC SIGNATURE OF CHEVRON JET A AS ANALYZED AND ARTIFICIALLY DEGRADED (NORMALS WHITED OUT)

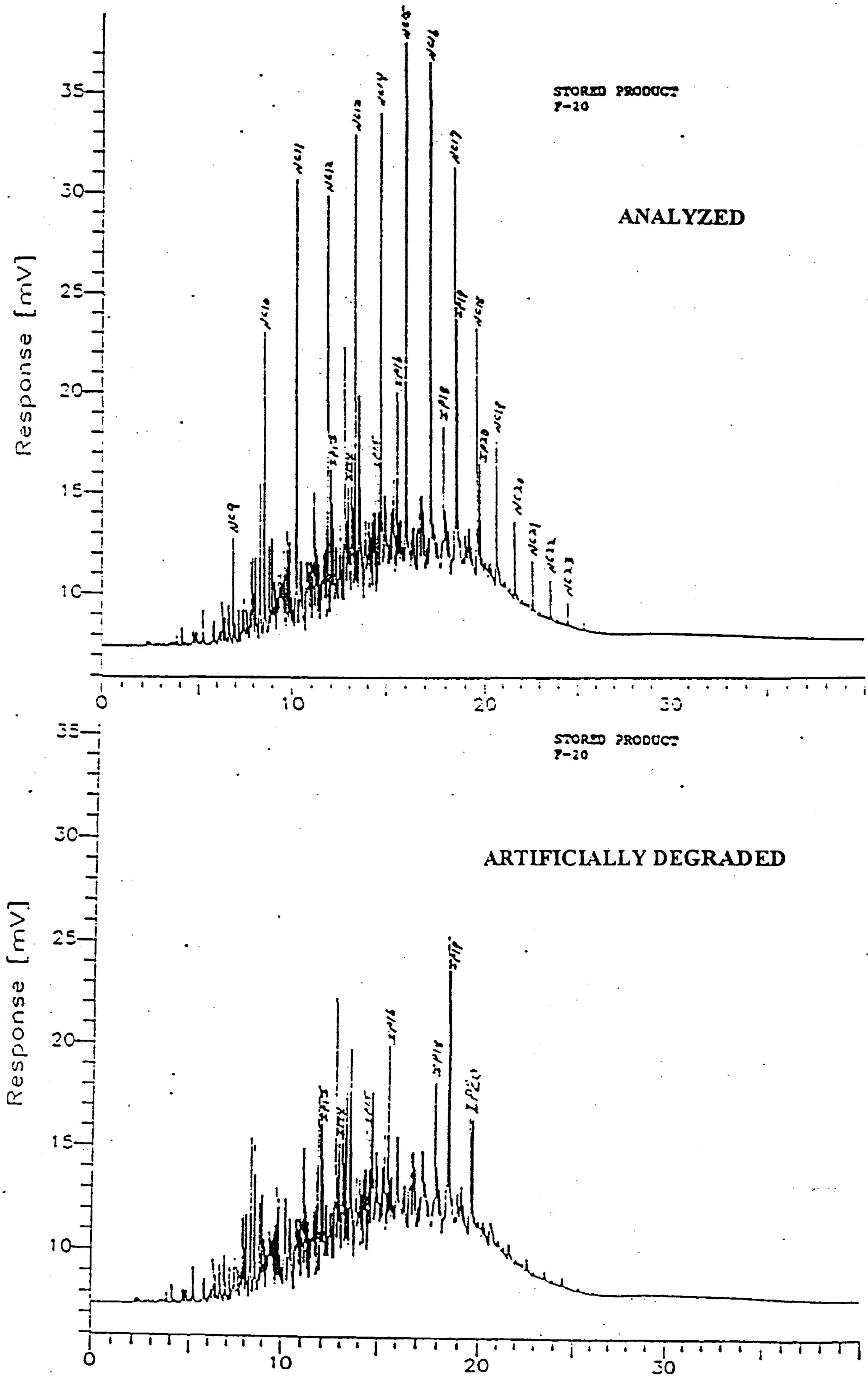


FIGURE 4: CHROMATOGRAPHIC SIGNATURE OF STORED DIESEL AS ANALYZED AND ARTIFICIALLY DEGRADED (NORMALS WHITED OUT)

engines, normal paraffins are not a desirable constituent of gasolines. The predominant hydrocarbon types present in gasoline are mutibranched isoparaffins and aromatics.

All four free products submitted have signatures which represent severely biodegraded diesels. However, a single loss of diesel is not indicated. Figure 5 compares the chromatographic signature of the WB-4&4A product sample and the signature of a diesel product sample. The overall carbon number distribution is consistent with diesel as the parent product. The absence of normal paraffins in the WB-4&4A sample signature indicates the diesel present is severely biodegraded. The isoprenoids are the most prominent individual hydrocarbon type present.

The remaining three samples show different isoprenoid proportions, indicating the diesel present in these samples is not related to the WB-4&4A sample. The remaining three free product sample signatures show lower proportions of IP18 and IP19. In the WB-4&4A signature, the IP19 peak exceeds the IP15 peak. In the remaining three product signatures (Figure 6), the IP19 peak equals or is lower than the IP13 peak. These three samples also can be discriminated from each other on the basis of their subordinate peak assemblages. The non-isoprenoid peak assemblages present in these three samples are also more prominent compared to the isoprenoids than in the WB-4&4A sample signature.

The overall signature characteristics of the remaining three product samples (TB6-1B1B, WB2-1A, and TB1-1A1A) are more similar than different. However, there are sufficient differences in the peak assemblages that a single loss of diesel is not indicated. Additionally, these three samples show differences in the normal paraffin proportions. The TB6 sample signature shows the highest contribution of normal paraffins to the free products. However, the normal paraffins are present at comparable or lower proportions compared to the isoprenoids and other non-normal paraffin peaks. A severe level of biodegradation is indicated for the TB6 sample. The WB-2 and TB-1 sample signatures show greater losses of normal paraffins or are more severely biodegraded. The TB6 and WB2 signatures show a prominent peak eluting between the IP14 and NC13 peaks. This peak is not prominent in the TB1 signature. Progressive losses over a period of time of diesel from a consistent source is probably the best explanation of both the overall similarity and the differences observed in the signatures of the TB6, WB2, and TB1 samples.

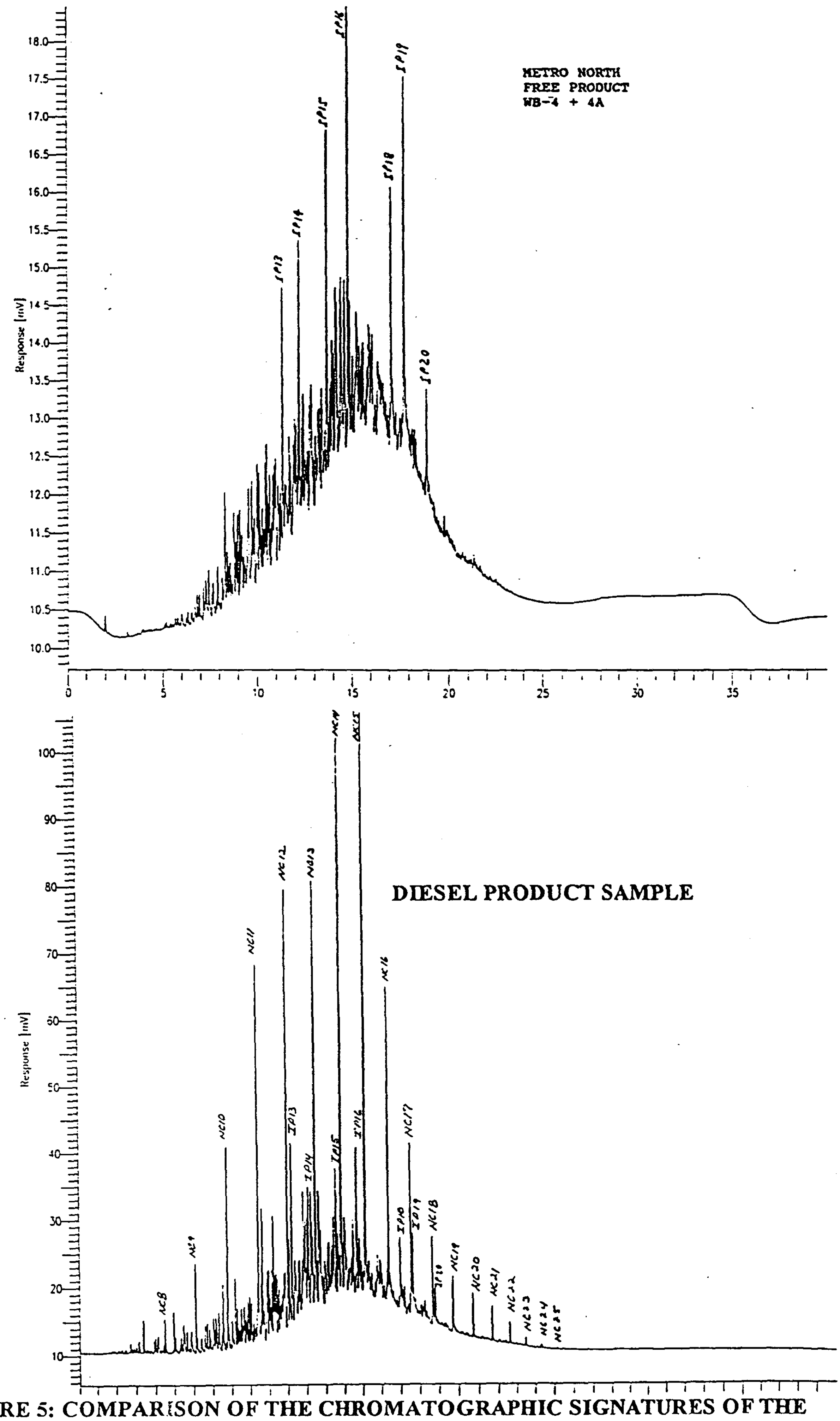


FIGURE 5: COMPARISON OF THE CHROMATOGRAPHIC SIGNATURES OF THE

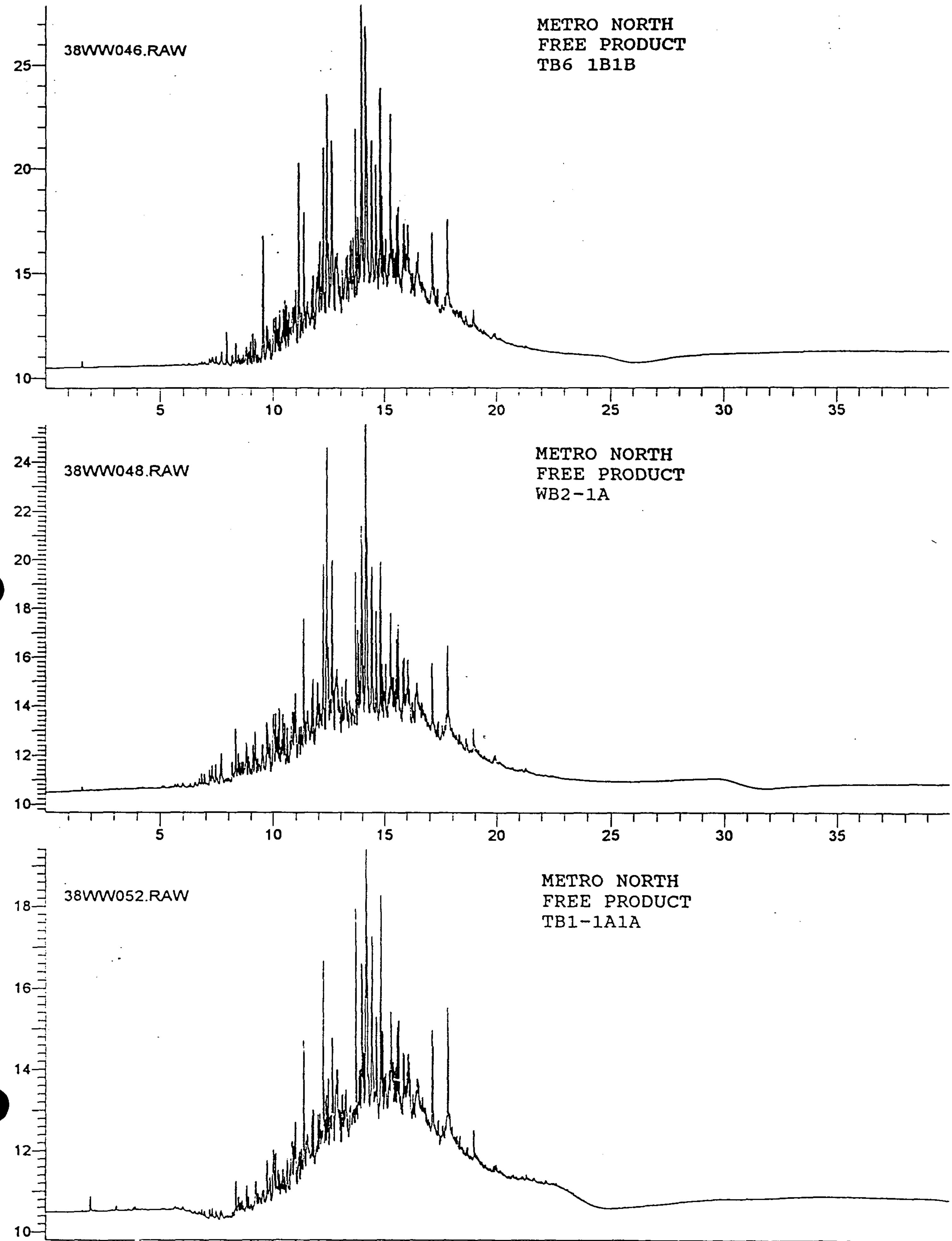


FIGURE 6: CHROMATOGRAPHIC SIGNATURES OF THE

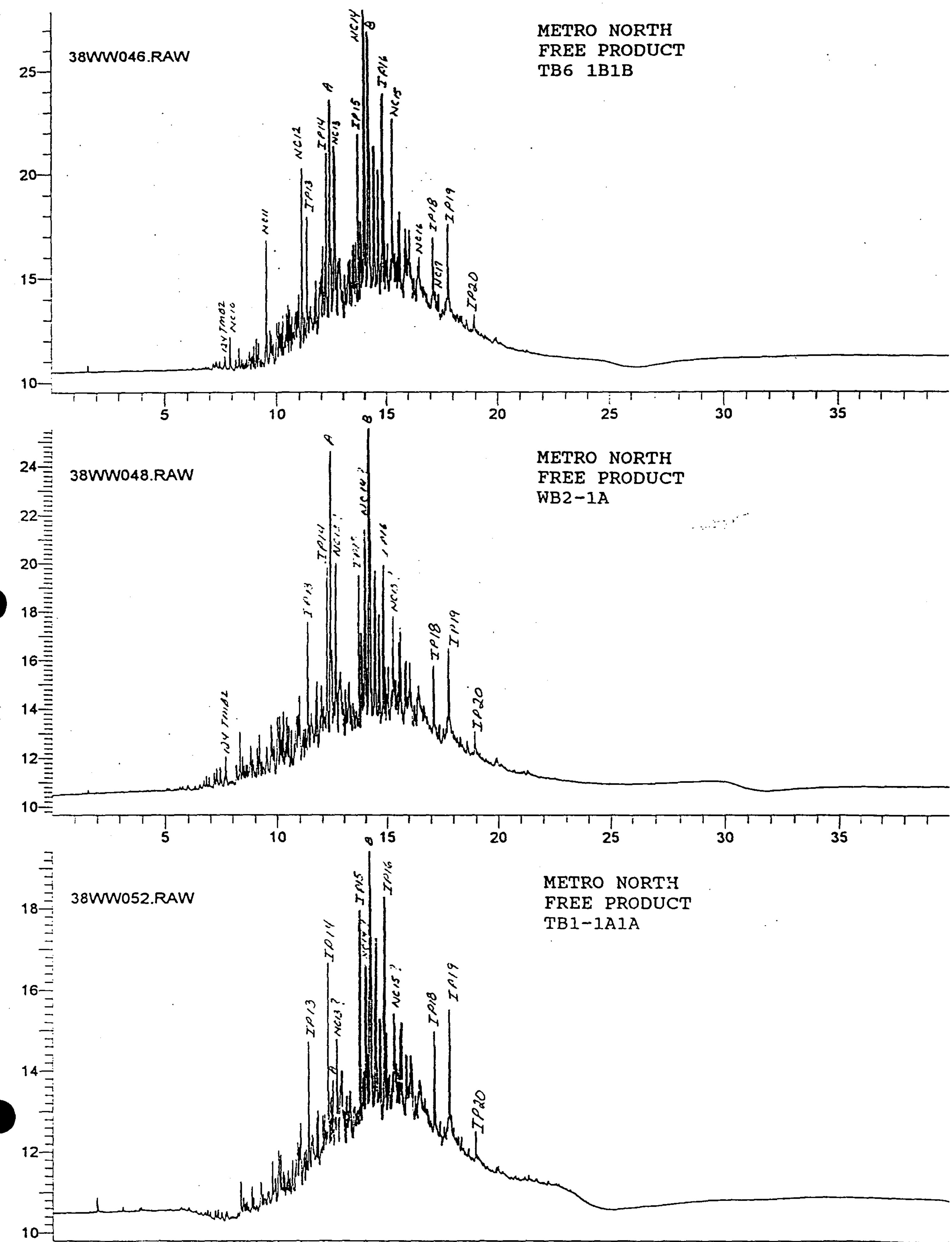


FIGURE 6: CHROMATOGRAPHIC SIGNATURES OF THE TB6-1B1B, WB2-1A, AND

Compared to samples previously analyzed in 1994 from the Metro North site, these four samples are unrelated to the previously analyzed free products. The DC-B4 and EQ-B1 samples are minimally biodegraded. The WB-4&4A signature does not show prominent nonisoprenoid peaks in the IP14 to IP16 range. All of the previously analyzed biodegraded free products do. The LMS-GW1, SMW-6, and MET-O sample signatures show a prominent Peak A between IP14 and NC13 and a prominent Peak B between IP15 and IP16 as the WB2 and TB6 signatures show. However, the LMS-GW1, SMW-6, and MET-O sample signatures all also show an IP19 peak that at least equals the IP16 peak. The low IP19 peak proportions present in the WB2 and TB6 signatures were not previously observed. This difference is illustrated in Figure 7, which compares the WB2 sample signature with the signature of the LMS-GW1 sample.

The LMS-GW5 and Osbourne Pond free products show a prominent Peak B between IP15 and IP16, but no prominent Peak A as the TB1 sample signature shows. However, the LMS-GW5 and Osbourne Pond free product signatures also show an IP19 peak that at least equals the IP16 Peak. The low IP19 peak proportion present in the TB1 signature was not previously observed. This difference is illustrated in Figure 8, which compares the TB1 sample signature with the signature of the LMS-GW5 sample signature.

The free product samples from this site had previously been ranked in terms of degradation level or exposure time. The four currently analyzed free products are added to this ranking. Christensen and Larsen (1993) have correlated diesel degradation level with exposure time as reflected in the NC17 to IP19 proportions. Our experience has been that starting proportions of NC17 to IP19 in diesels are more variable than they indicate and that degradation rate can be more variable than they indicate. However, despite these exceptions their indicated degradation rates are in agreement with the majority of sites on which we have independently established dates for losses. Ranking of the Metro North samples by degradation level and indicated exposure time is as follows:

Sample	Degrad. Level	NC17/IP19	Exposure Time
DC-B4	Minimal	1.2	8-11 years
EQ-B1	Moderate	0.6	13-17 years
TB6-1B1B	Significant	0.2	15-19 years
SMW-6	Significant	0.09	17-22 years

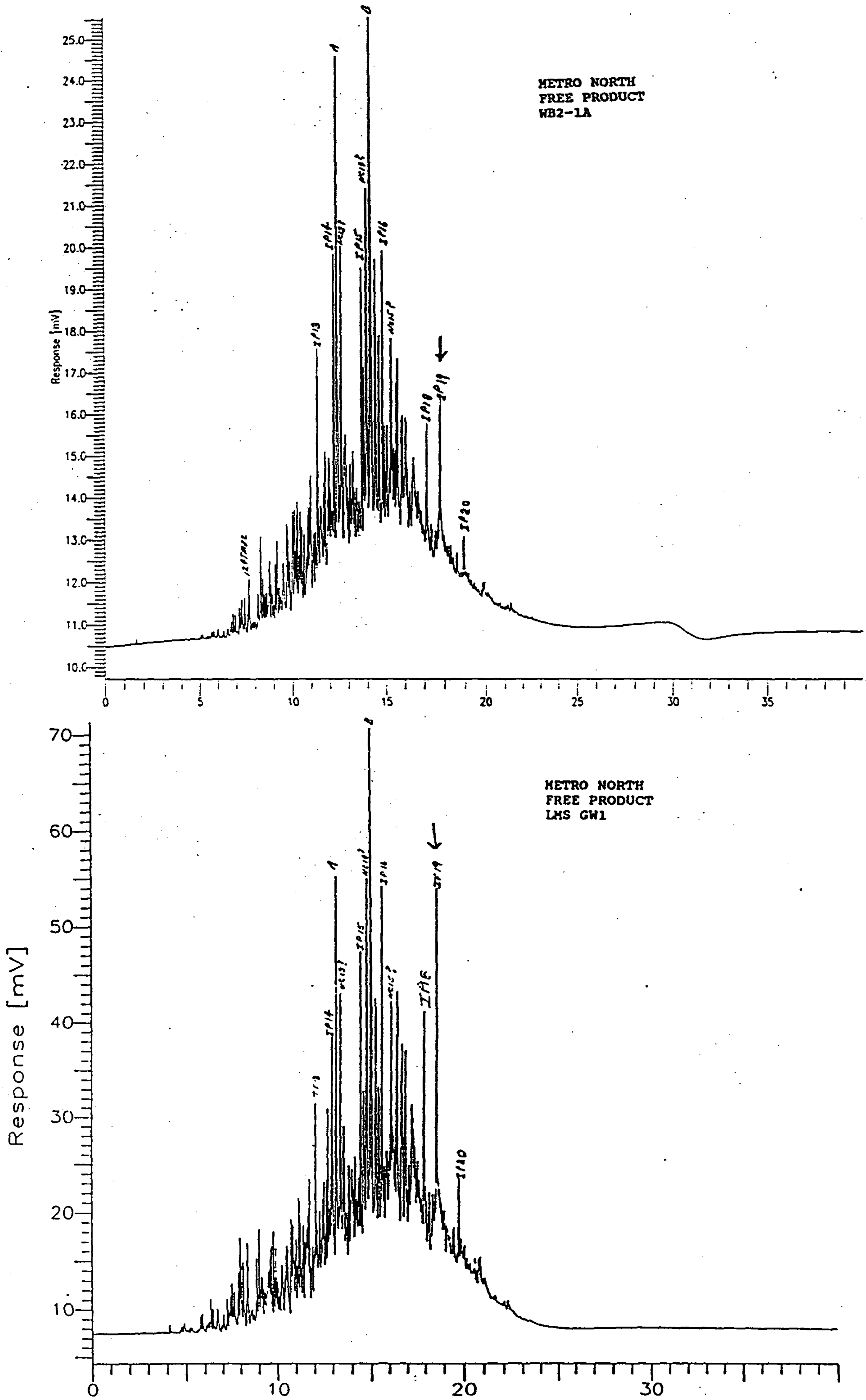


FIGURE 7: COMPARISON OF THE CHROMATOGRAPHIC SIGNATURES OF THE

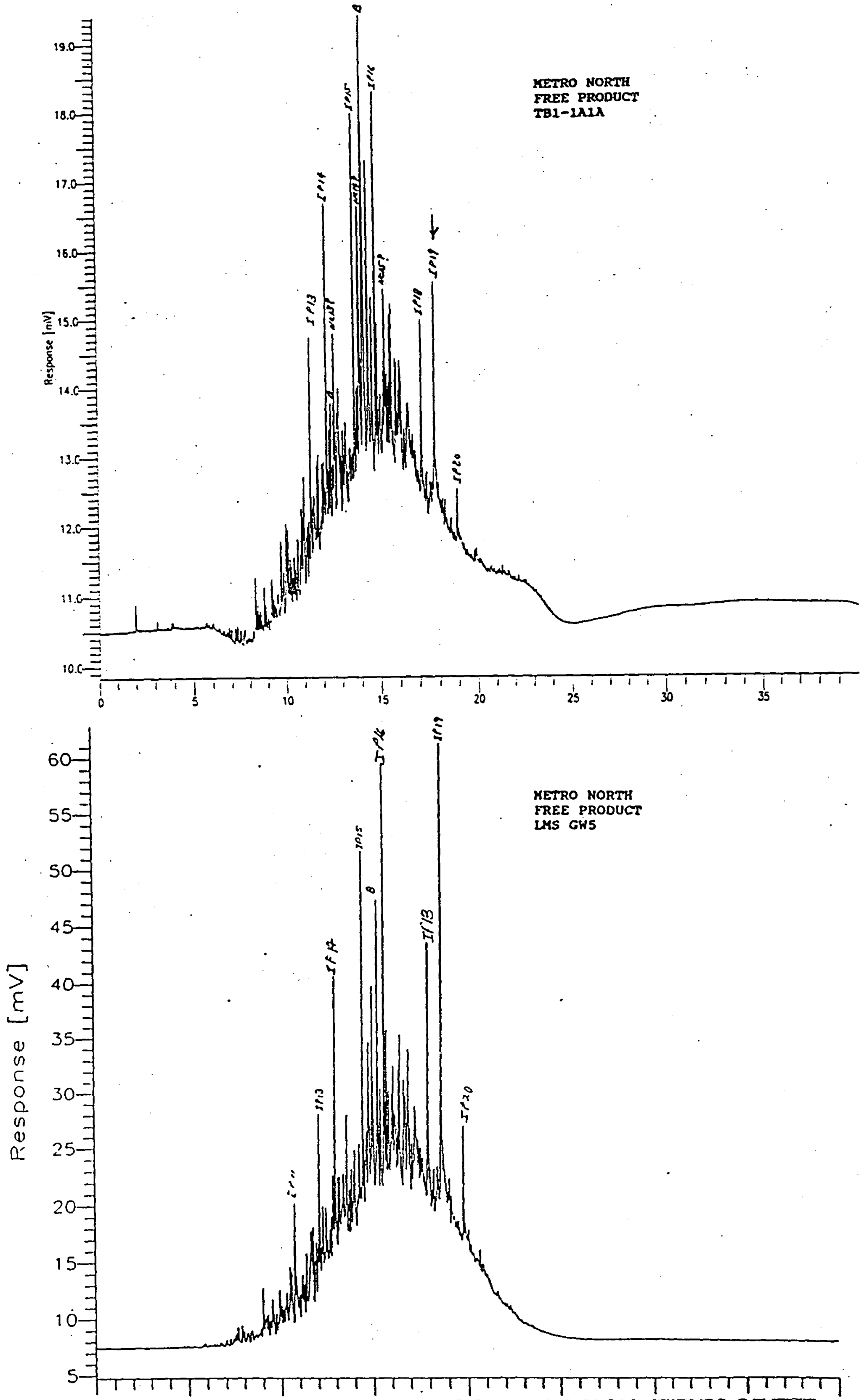


FIGURE 8: COMPARISON OF THE CHROMATOGRAPHIC SIGNATURES OF THE TB1-1A1A SAMPLE AND THE

Sample	Degrad. Level	NC17/IP19	Exposure Time
MET-O	Severe	0.0	>20 years
LMS GW1	Severe	0.0	>20 years
LMS GW5	Severe	0.0	>20 years
Osbourne	Severe	0.0	>20 years
TB1-1A1A	Severe	0.0	>20 years
WB2-1A	Severe	0.0	>20 years
WB4-4A	Severe	0.0	>20 years

Based on information previously provided that the LMS-GW1 and LMS-GW5 samples were obtained from wells which had been installed approximately 5 years prior to the 1994 samples and probably were undisturbed for that period of time, it is possible that these free products may have experienced accelerated rates or levels of biodegradation.

REFERENCES

Christensen, L.B. and T. Larsen (1993) Method for determining the age of diesel oil spills in the soil: Ground Water Mon. & Remed., Vol.13, No. 4, p. 142-149.

ERM-Northeast
Environmental Resources Management
ERM 175 Froehlich Farm Boulevard • Woodbury, New York 11797 • (516) 921-4300 • Telefax (516) 921-6679 • (516) 921-5637

ERM-Northeast
Chain of Custody

Project Name / No. Metro North OU II - 680003
Project Coordinator / Contact Colleen Kwarik, Jim Perazzo
Sampler(s) CK, KW, EH
Bottles Supplied By chem
Sheet No.

Type and No. of Containers

Date	Time	Comp.	Grab	Sample Identification	Soil	Water	Total No. of Containers	GC Fingerprint								Analysis Requested
3/23			✓	TB6 1B1B			2 CK	✓								to determine Age -
3/23			✓	WB2-1A			2 CK	✓								and compare other
3/23			✓	WB-4 + 4A			2 CK	✓								product samples to
3/23			✓	TB1-1A1A			1	✓								each other for origin

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time	Reason for Transfer
Colleen Kwarik	3/24/95 12:00	Augustine [illegible]	3/27/95 8:00	

APPENDIX I

DISPLAY CHROMATOGRAMS

ABBREVIATIONS USED TO IDENTIFY PEAKS

ABBREVIATIONS	HYDROCARBON
C1	METHANE
C2	ETHANE
C3	PROPANE
IC4	ISOBUTANE
NC4	NORMAL BUTANE
ETH	ETHANOL
22C3	2 2 DIMETHYL PROPANE
IC5	ISOPENTANE
NC5	NORMAL PENTANE
MeC2	METHYLENE CHLORIDE
22DMB	2 2 DIMETHYL BUTANE
23DMB	2 3 DIMETHYL BUTANE
2MP	2 METHYLPENTANE
3MP	3 METHYLPENTANE
NC6	NORMAL HEXANE
22DMP	2,2 DIMETHYLPENTANE
MCP	METHYLCYCLOPENTANE
24DMP	2,4 DIMETHYLPENTANE
BZ	BENZENE
CH	CYCLOHEXANE
2MH	2 METHYLHEXANE
23DMP	2,3 DIMETHYLPENTANE
3MH	3 METHYLHEXANE
T13DMCP	T13DIMETHYLCYCLOPENTANE
C13DMCP	C13DIMETHYLCYCLOPENTANE
224TMP	2,2,4 TRIMETHYLPENTANE(PRINCIPAL ISO-OCTANE)
NC7	NORMAL HEPTANE
234TMP	2,3,4 TRIMETHYLPENTANE(ISO-OCTANE)
MCH	METHYLCYCLOHEXANE
TOL	TOLUENE
23DMH	2,3 DIMETHYLHEXANE
2MC7	2METHYLHEPTANE
3MC7	3METHYLHEPTANE
224TMH	2,2,4 TRIMETHYLHEXANE
223TMH	2,2,3 TRIMETHYLHEXANE
NC8	NORMAL OCTANE
EBZ	ETHYL BENZENE
M+P XYL	META AND PARA XYLENES
O XYL	ORTHO XYLENE
NC9	NORMAL NONANE
N-PROPYL BZ	NORMAL PROPYL BENZENE
1M3EBZ	1METHYL3ETHYLBENZENE
135TMBZ	1,3,5 TRIMETHYLBENZENE
1M2EBZ	1METHYL2ETHYLBENZENE

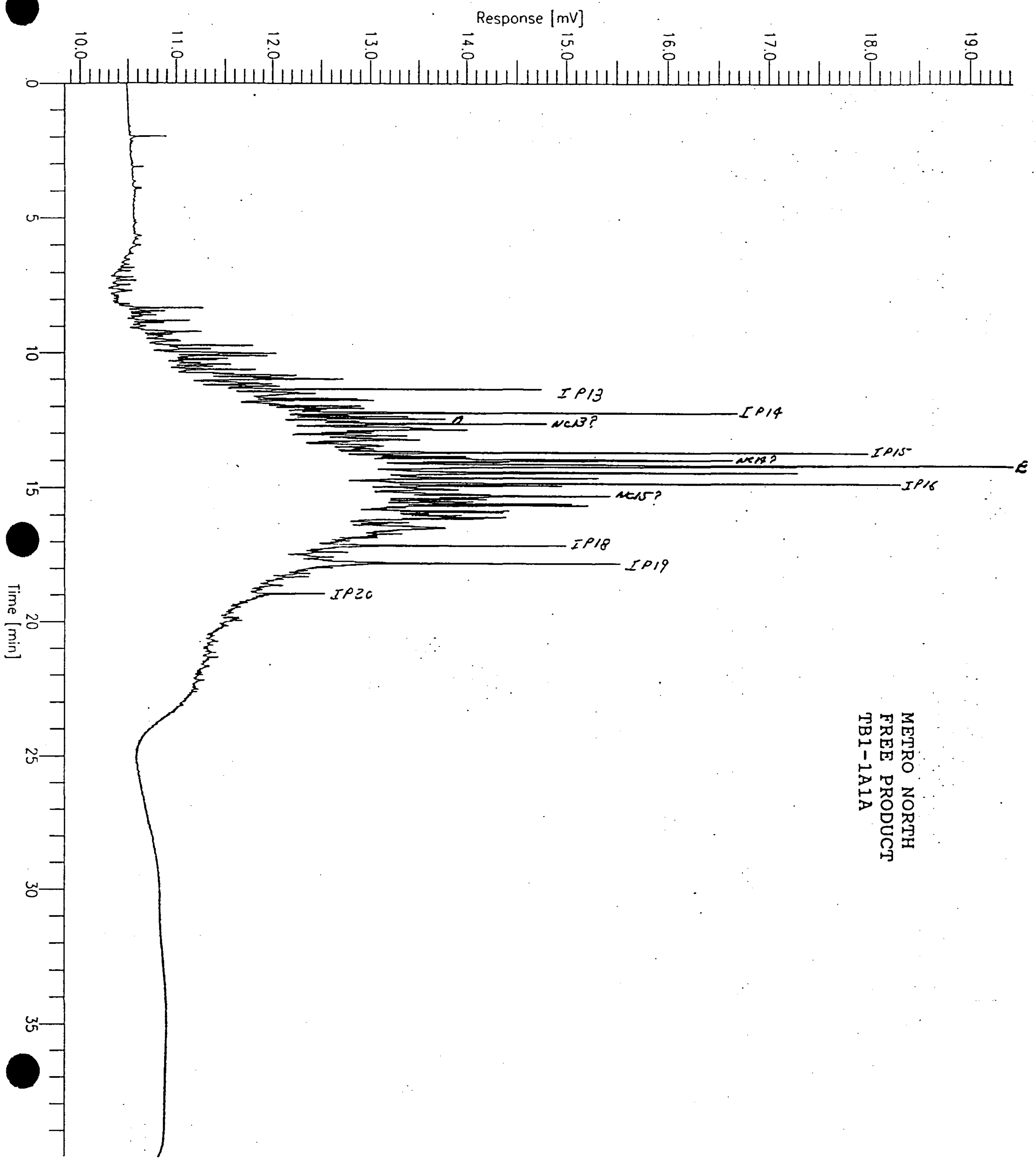
ABBREVIATIONS USED TO IDENTIFY PEAKS

ABBREVIATIONS	HYDROCARBON
124TMBZ	1,2,4 TRIMETHYLBENZENE
NC10	NORMAL DECANE
123TMBZ	1,2,3 TRIMETHYLBENZENE (TERT BUTYL BENZENE COELUTES AT THIS POSITION)
NAPH	NAPHTHALENE
2M.NAPH	2METHYL NAPHTHALENE
1M.NAPH	1METHYL NAPHTHALENE

NC____ Normal paraffin with number of carbon atoms in molecule shown
IP____ Isoprenoid iso-paraffin with number C atoms in molecule shown

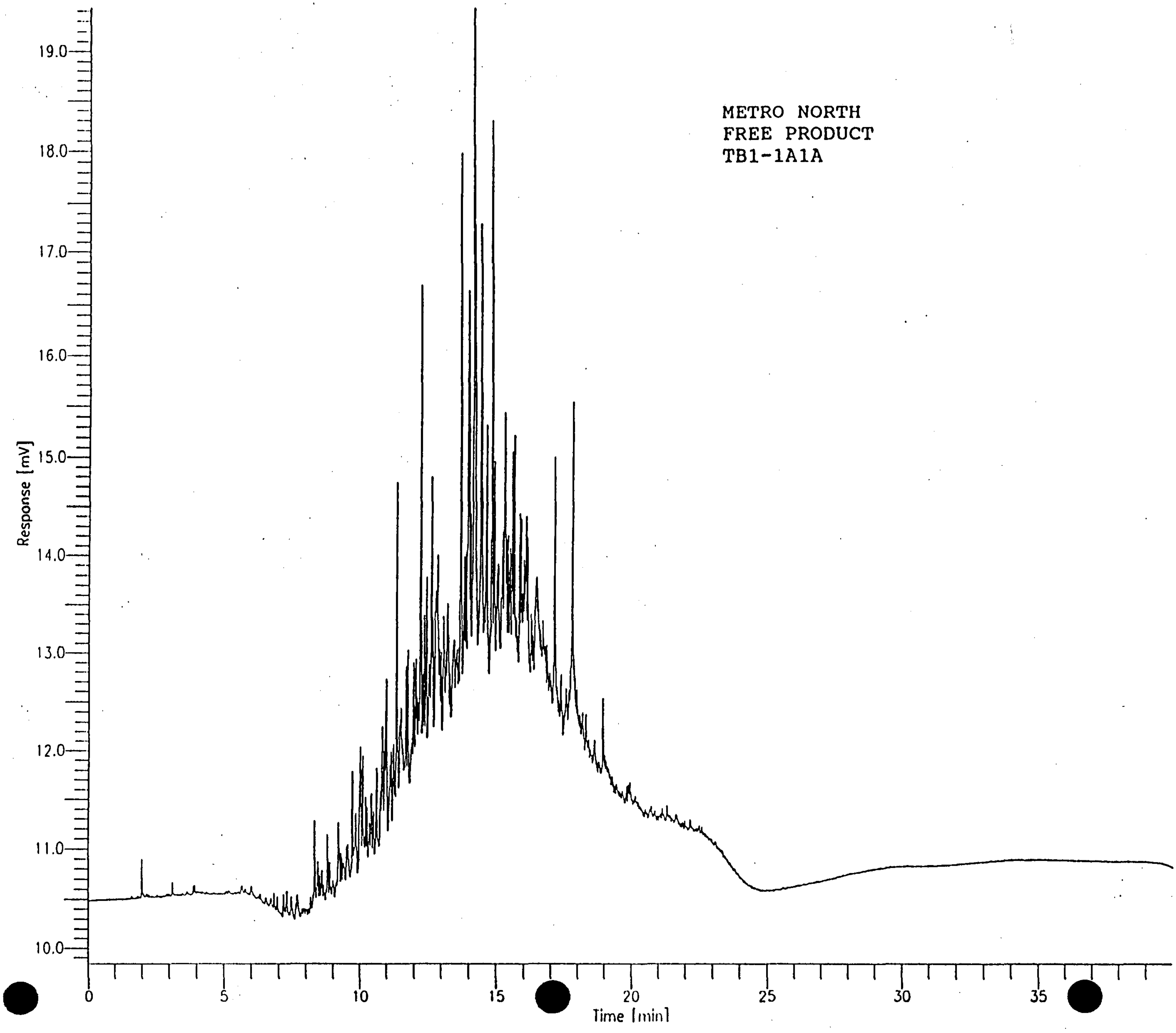
Sample Name : 95065 TB1-1A-1A 10s
FileName : C:\TC4\8WWG\38WW052.raw
Method : WWG2
Start Time : 0.00 min End Time : 40.00 min
Scale Factor: 1.0 Plot Offset: 10 mV

Sample #: 50329008
Date : 4/5/95 04:06 PM
Time of Injection: 4/3/95 03:44 AM
Low Point : 9.84 mV High Point : 19.43 mV
Plot Scale: 9.6 mV



METRO NORTH
FREE PRODUCT
TB1-1A1A

Sample Name : 95065 TB1-1A-1A 10s   Sample #: 50329008   Page 1 of 1
FileName : C:\TC4\8WWG\38WW052.raw   Date : 4/5/95 04:06 PM
Method : WWG2   Time of Injection: 4/3/95 03:44 AM
Start Time : 0.00 min   End Time : 40.00 min   Low Point : 9.84 mV   High Point : 19.43 mV
Scale Factor: 1.0   Plot Offset: 10 mV   Plot Scale: 9.6 mV

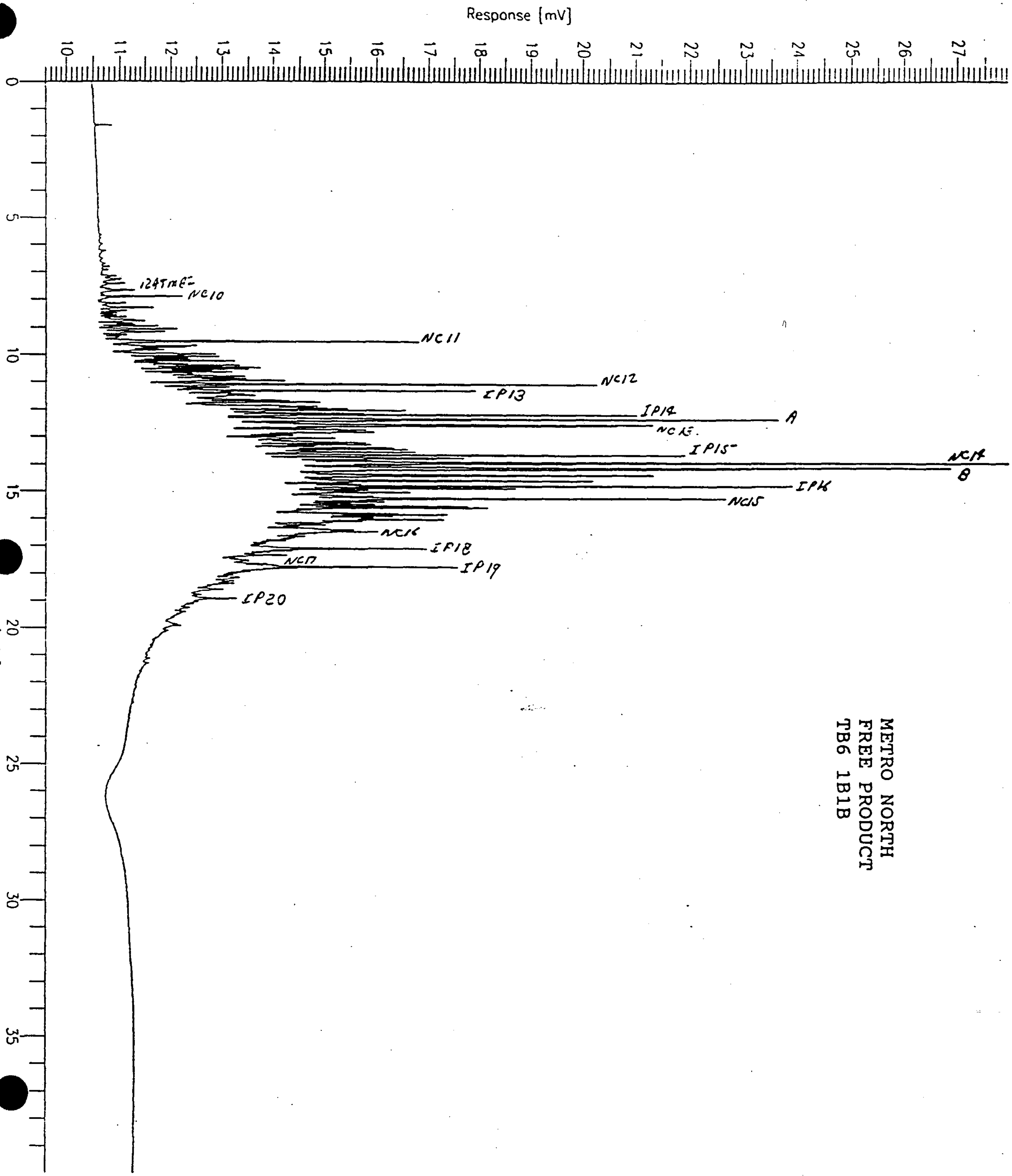


Sample Name : 95065 TB-6-1B-1B 10s
FileName : C:\TC4\8WWG\38WW046.raw
Method : WWG2
Start Time : 0.00 min
Scale Factor: 1.0

End Time : 40.00 min
Plot Offset: 10 mV

Sample #: 50329005
Date : 4/5/95 04:04 PM
Time of Injection: 4/2/95 09:11 PM
Low Point : 9.60 mV
Plot Scale: 18.3 mV

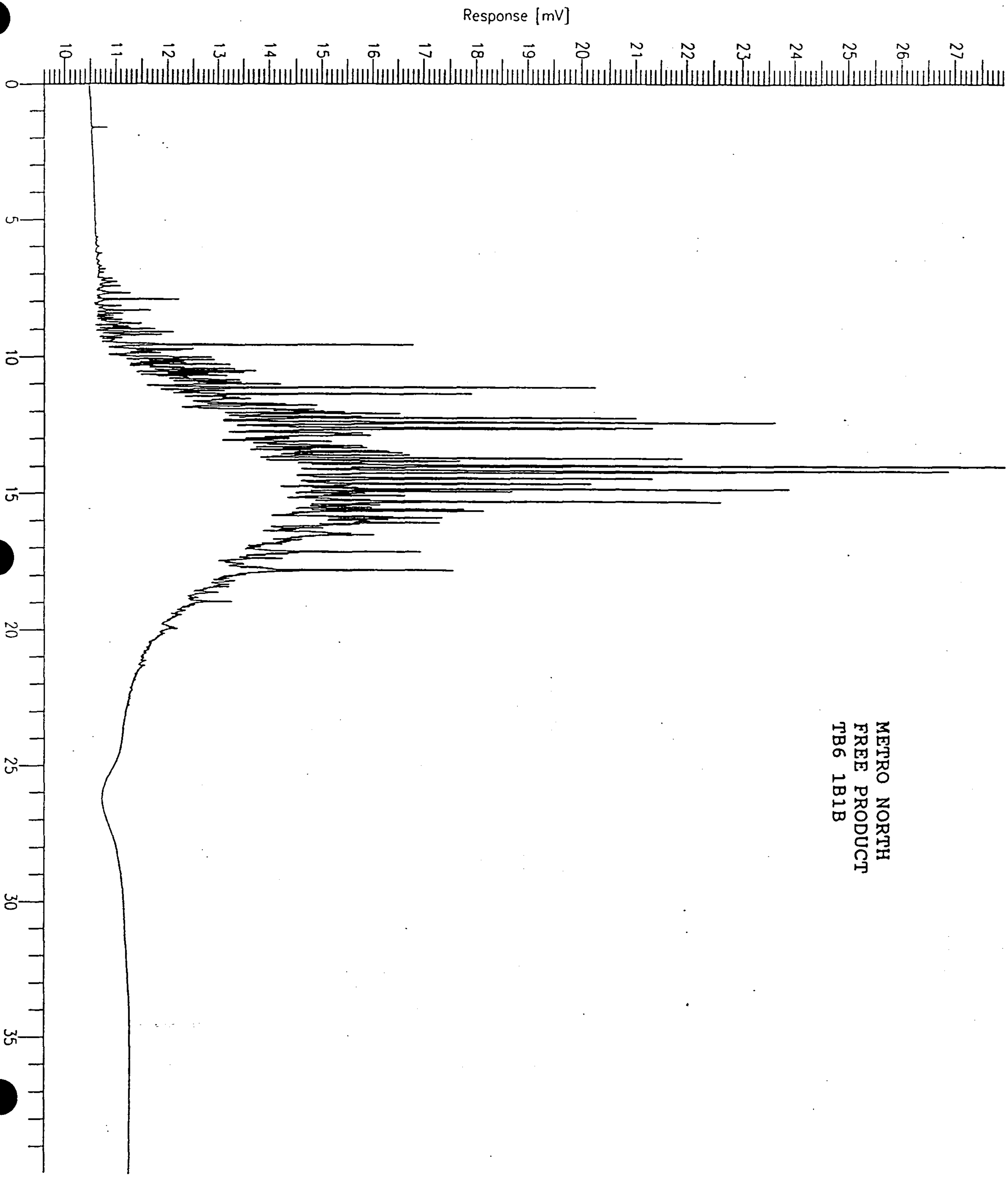
High Point : 27.93 mV



METRO NORTH
FREE PRODUCT
TB6 1B1B

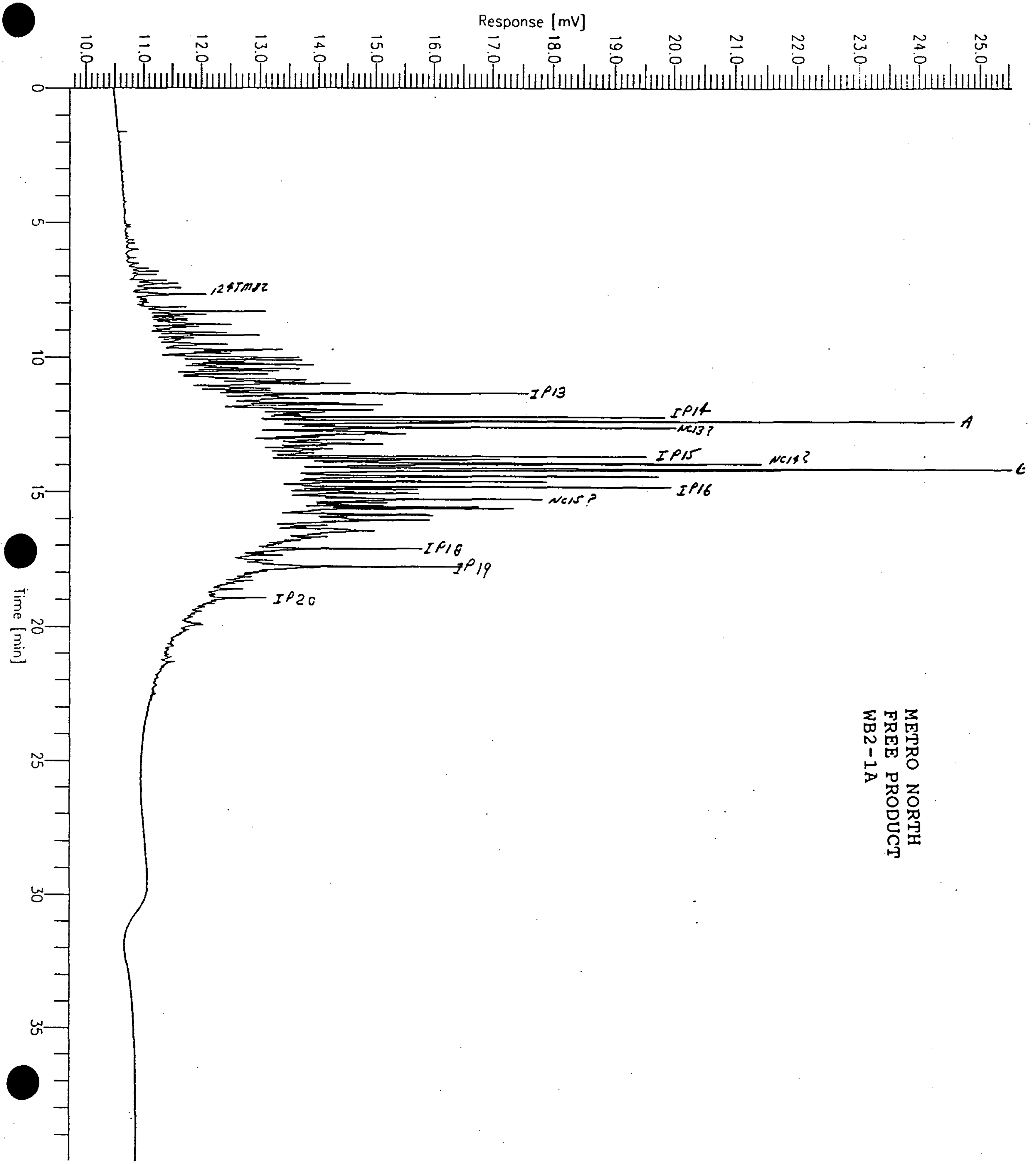
Sample Name : 95065 TB-6-1B-1B 10s
FileName : C:\TC4\8WWG\38WW046.raw
Method : WWG2
Start Time : 0.00 min End Time : 40.00 min
Scale Factor: 1.0 Plot Offset: 10 mV

Sample #: 50329005
Date : 4/5/95 04:04 PM
Time of Injection: 4/2/95 09:11 PM
Low Point : 9.60 mV High Point : 27.93 mV
Plot Scale: 18.3 mV



Sample Name : 95065 WB2-1A 10s
FileName : C:\TC4\8WWG\38WW048.raw
Method : WWG2
Start Time : 0.00 min End Time : 40.00 min
Scale Factor: 1.0 Plot Offset: 10 mV

Sample #: 50329006
Date : 4/5/95 04:05 PM
Time of Injection: 4/2/95 11:22 PM
Low Point : 9.72 mV High Point : 25.57 mV
Plot Scale: 15.8 mV

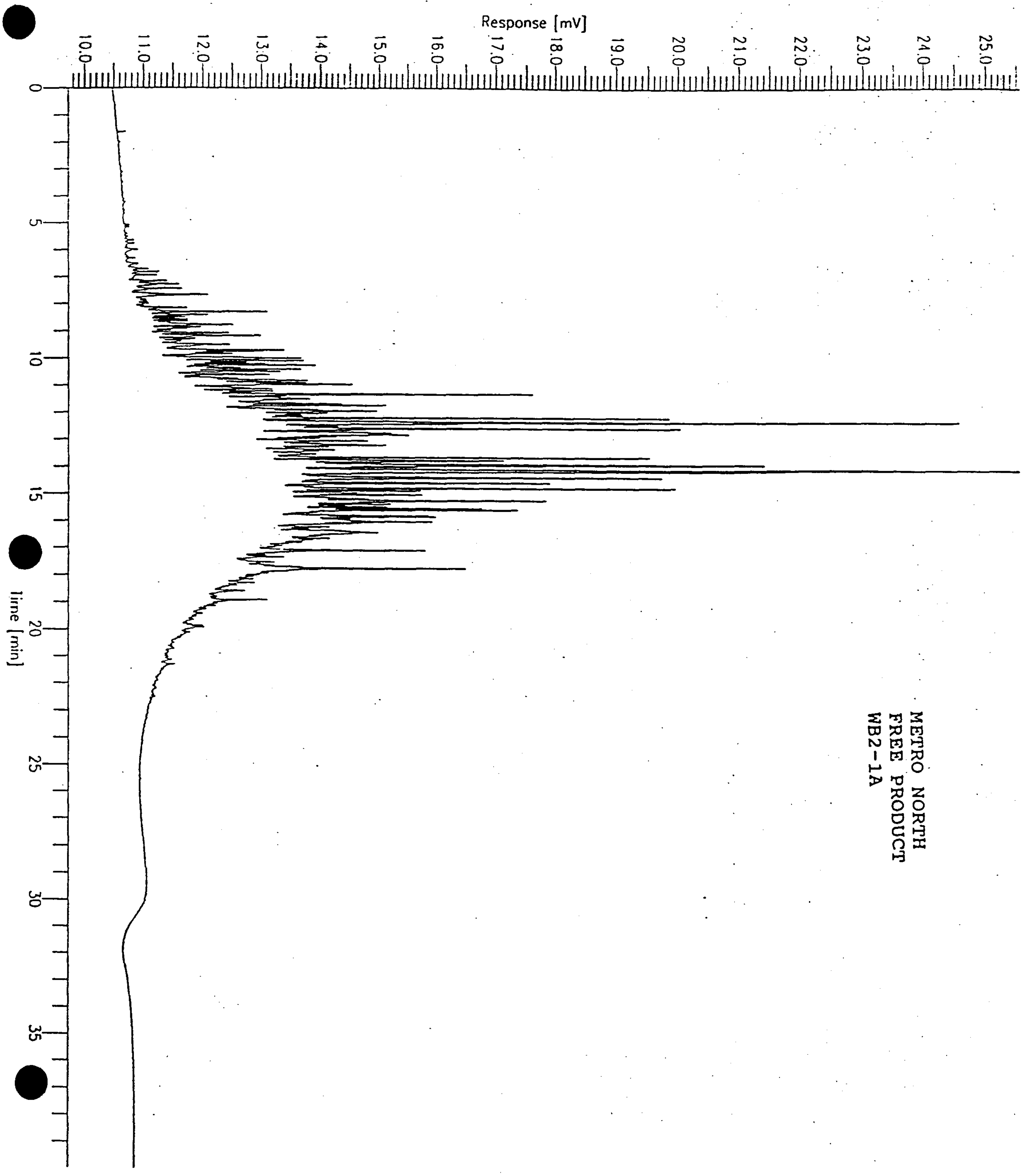


Sample Name : 95065 WB2-1A 10s
FileName : C:\TC4\8WWG\38WW048.raw
Method : WWG2
Start Time : 0.00 min
Scale Factor: 1.0

End Time : 40.00 min
Plot Offset: 10 mV

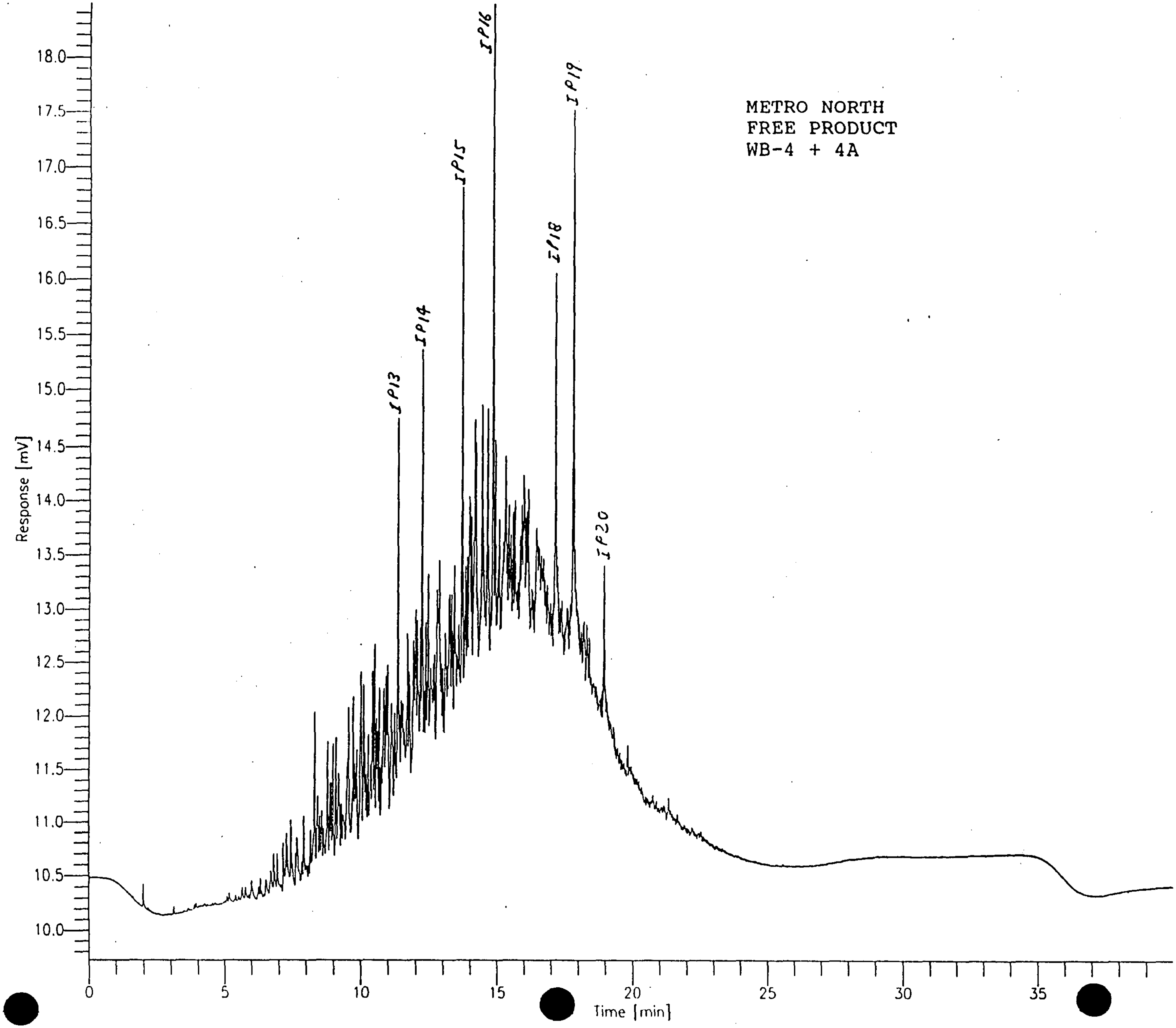
Sample #: 50329006
Date : 4/5/95 04:05 PM
Time of Injection: 4/2/95 11:22 PM
Low Point : 9.72 mV
Plot Scale: 15.8 mV

High Point : 25.57 mV



Sample Name : 95065 WB4-4A 10s
FileName : C:\TC4\8WWG\38WW050.raw
Method : WWG2
Start Time : 0.00 min End Time : 40.00 min
Scale Factor: 1.0 Plot Offset: 10 mV

Sample #: 50329007
Date : 4/5/95 04:05 PM
Time of Injection: 4/3/95 01:33 AM
Low Point : 9.72 mV High Point : 18.49 mV
Plot Scale: 8.8 mV

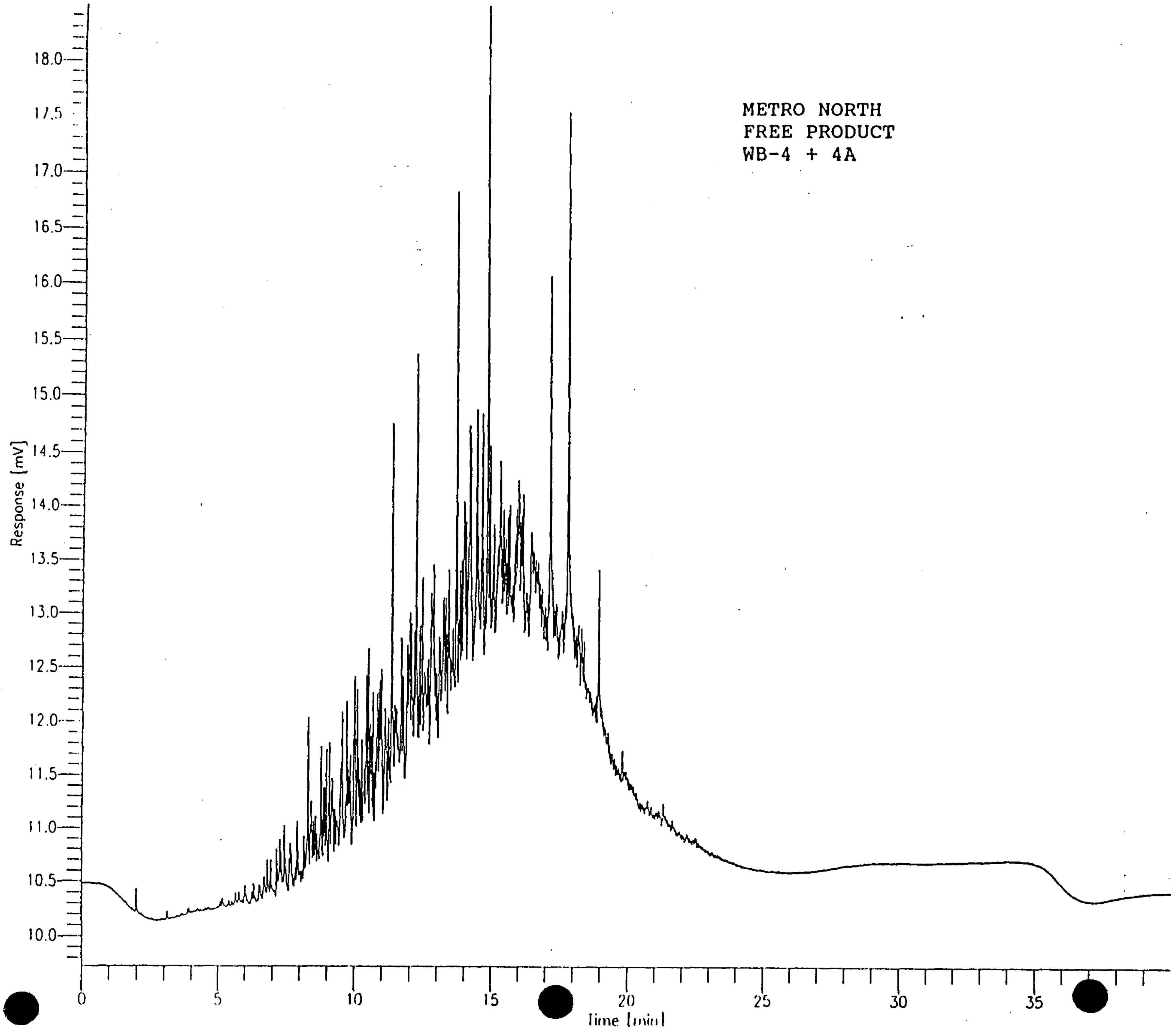


Sample Name : 95065 WB4-4A 10s
FileName : C:\TC4\8WAG\38WW050.raw
Method : WAG2
Start Time : 0.00 min
Scale Factor: 1.0

End Time : 40.00 min
Plot Offset: 10 mV

Sample #: 50329007
Date : 4/5/95 04:05 PM
Time of Injection: 4/3/95 01:33 AM
Low Point : 9.72 mV
Plot Scale: 8.8 mV

Page 1 of 1
High Point : 18.49 mV



APPENDIX II

OPERATING CONDITIONS

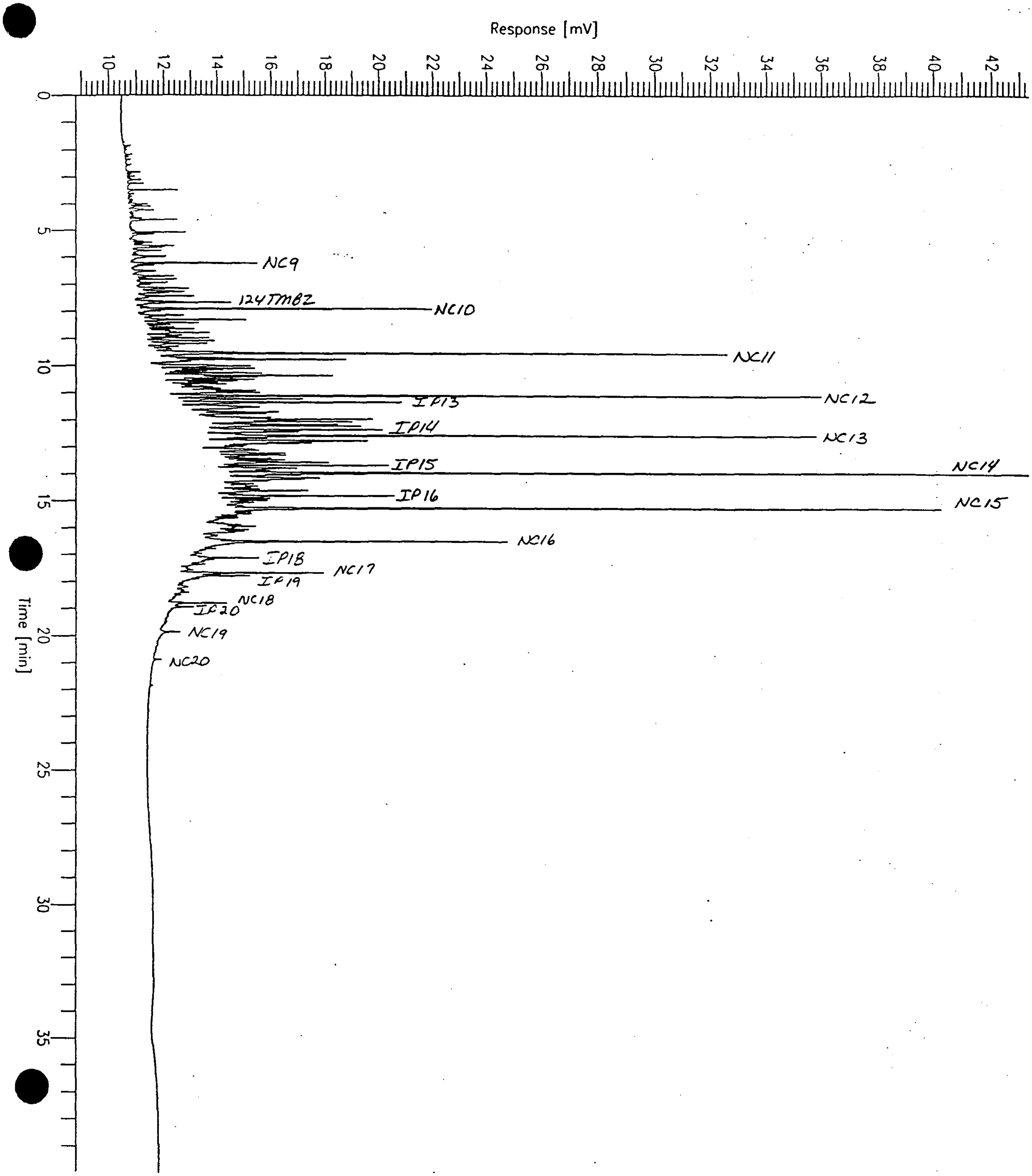
GC OPERATING CONDITIONS

Instrument:	Perkin-Elmer Autosystem
Column:	30m*0.25mm ID*0.25u Methyl Silicon, Restek Rtx-1 (Cat# 10138, Fused Silica Column; Bonded, Non-Polar, Silicone Based Polymer Liquid Phase)
Carrier Gas:	Helium Linear Velocity = 30 cm/sec Column Pressure 16.9 psig.
Injection Port:	Split/Splitless Type Temperature 300 deg C
Detector:	Flame Ionization Type Temperature 300 deg C Range 1, Attn.4

	Method 1	**Method 2**	**Method 3**	**Method 4**
Injection Type	Split	Split	Splitless	Splitless
Acronym	5/s	10/s	5/sl	10/sl
Split Vent	On	On	Off	Off
Split Vent Time,min	---	---	0.5	0.5
Split Rate ml/min	100	100	100	100
Initial Temp, deg C	30	30	30	30
Initial Time, min	5	1	5	1
Ramp Rate, deg C/min	5	10	5	10
Final Temp, deg C	300	300	300	300
Final Time, min	0	15	0	15
Run Time, min	59	43	59	43

Sample Name : Diesel Std. 10s
FileName : C:\TC4\8WWG\38WW042A.RAW
Method : WWG2.MTH
Start Time : 0.00 min End Time : 40.00 min
Scale Factor: 1.0 Plot Offset: 9 mV

Sample #:
Date : 4/6/95 10:17 AM
Time of Injection: 4/2/95 04:48 PM
Low Point : 8.80 mV High Point : 43.35 mV
Plot Scale: 34.5 mV

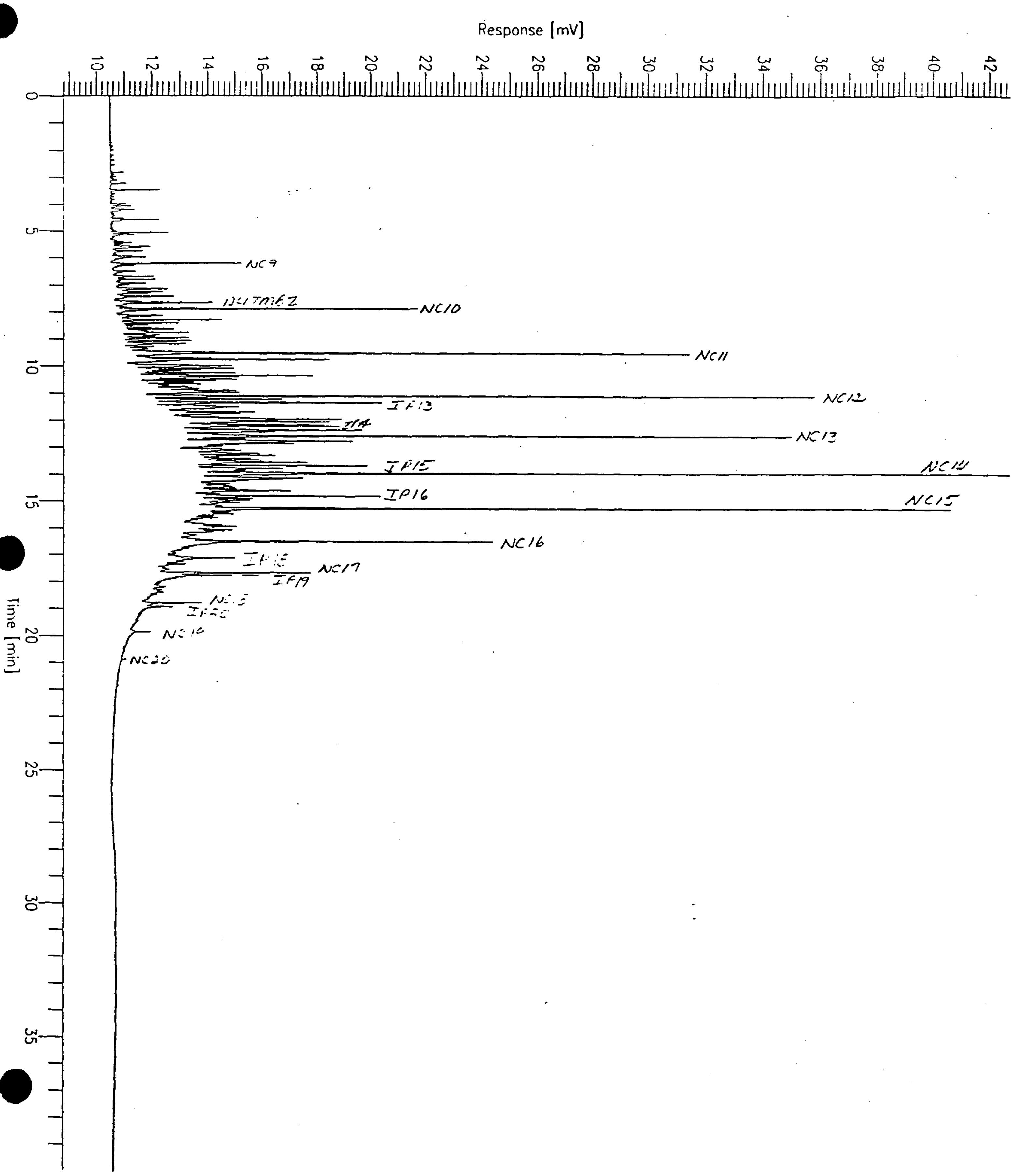


Sample Name : Diesel Std. 10s
FileName : C:\TC4\8WWG\38WW042.raw
Method : WWG2
Start Time : 0.00 min
Scale Factor: 1.0

End Time : 40.00 min
Plot Offset: 9 mV

Sample #:
Date : 4/5/95 04:03 PM
Time of Injection: 4/2/95 02:09 PM
Low Point : 8.77 mV
Plot Scale: 34.0 mV

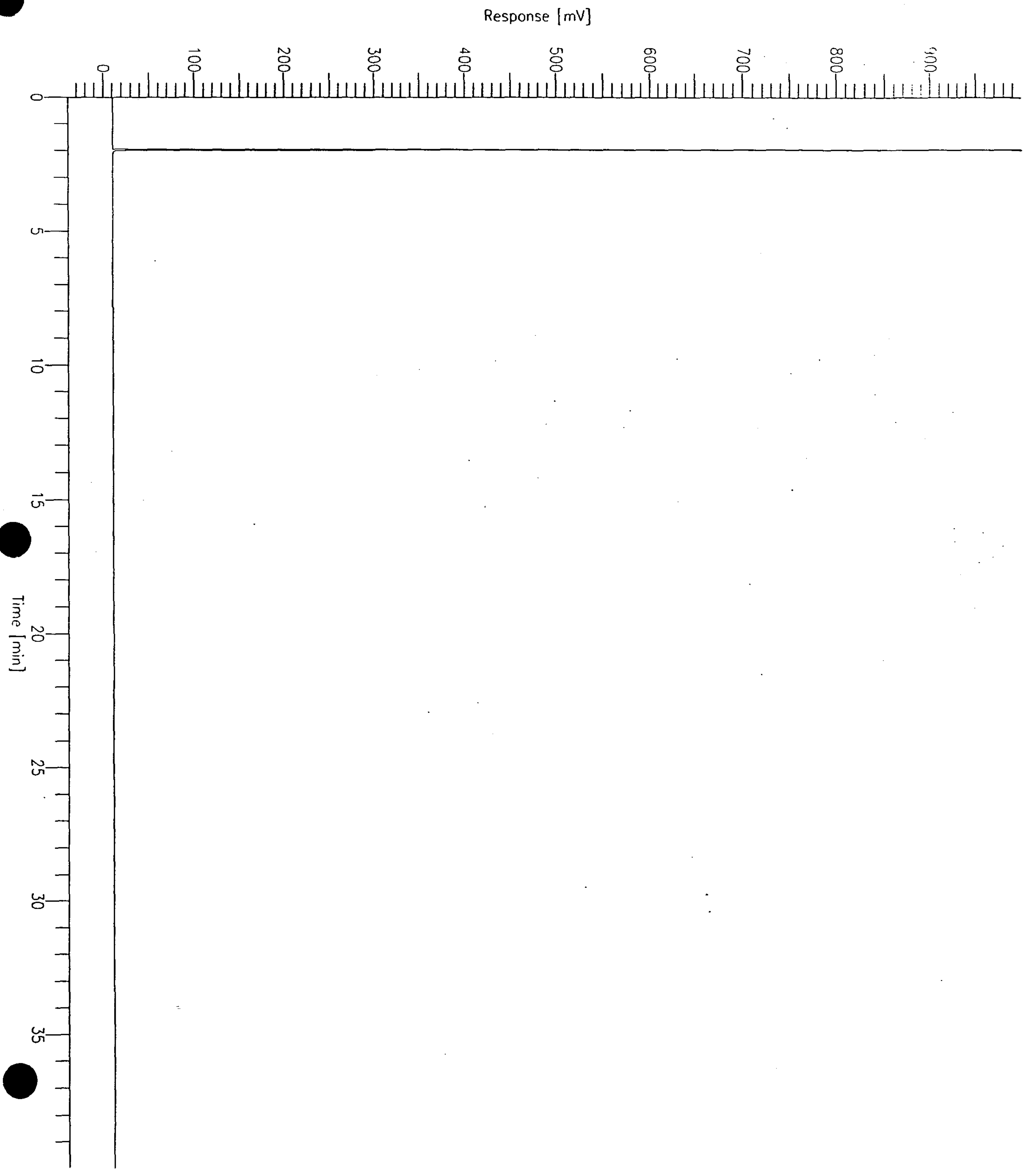
High Point : 42.76 mV



WORLD WIDE GEOSCIENCES - II

Sample Name : Solvent Blank 10s
FileName : C:\TC4\8WWG\38WW045.raw
Method : WWG2
Start Time : 0.00 min End Time : 40.00 min
Scale Factor: 1.0 Plot Offset: -39 mV

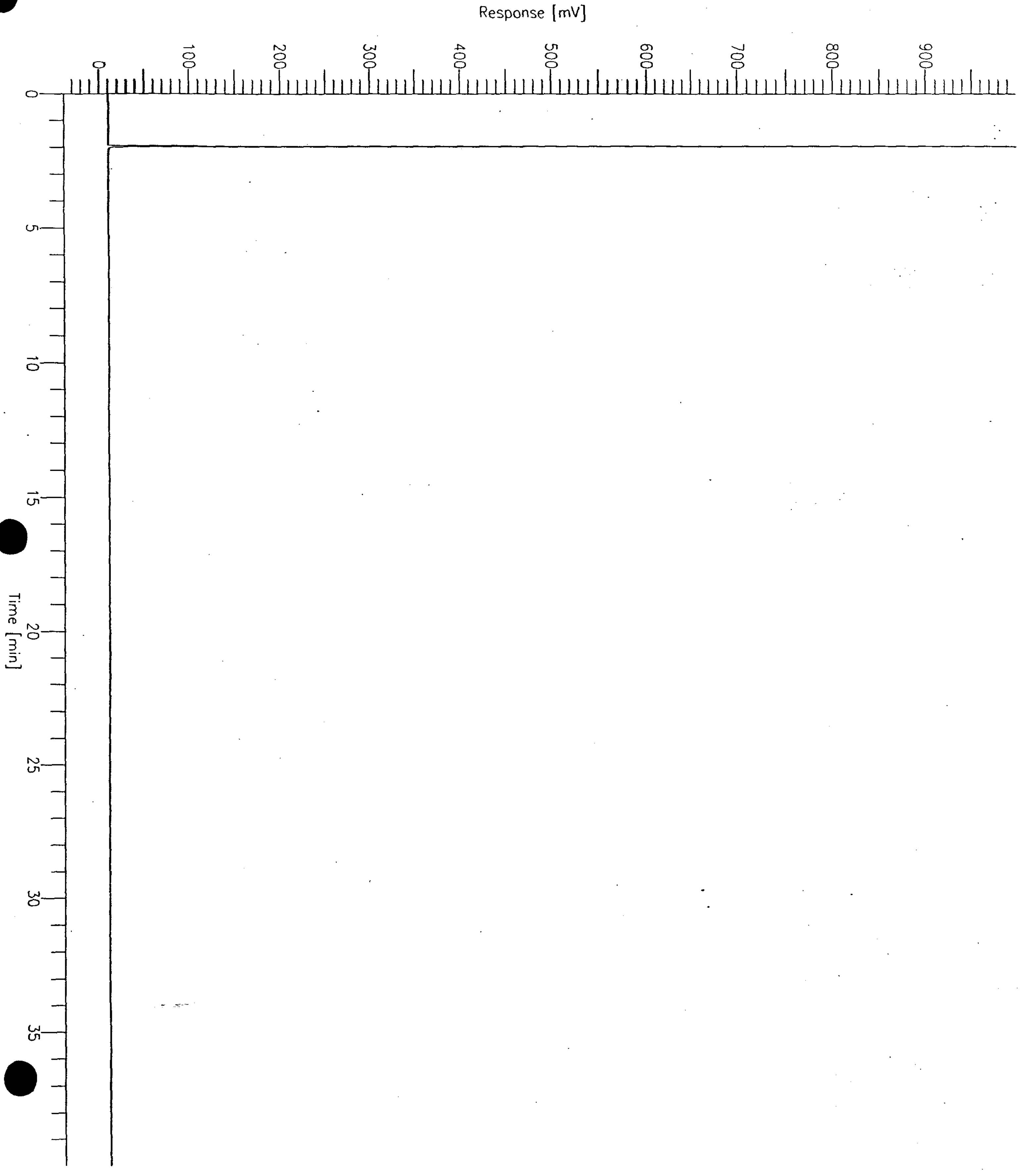
Sample #:
Date : 4/5/95 04:04 PM
Time of Injection: 4/2/95 08:05 PM
Low Point : -39.20 mV High Point : 1000.00 mV
Plot Scale: 1039.2 mV



WORLD WIDE GEOSCIENCES - II

Sample Name : Solvent Blank 10s
FileName : C:\TC4\8WWG\38WW047.raw
Method : WWG2
Start Time : 0.00 min   End Time : 40.00 min
Scale Factor: 1.0   Plot Offset: -39 mV

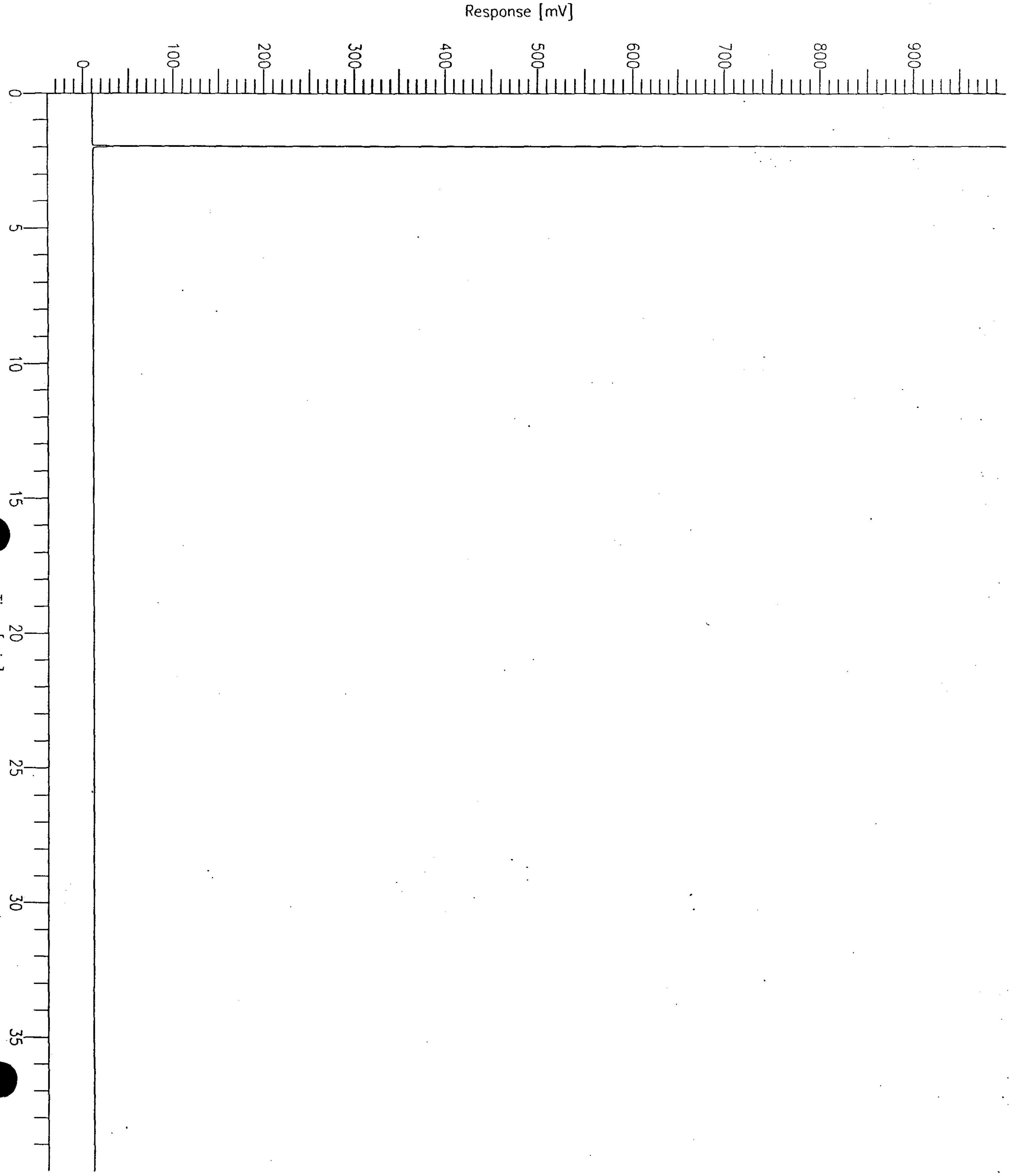
Sample #:
Date : 4/5/95 04:04 PM
Time of Injection: 4/2/95 10:16 PM
Low Point : -39.18 mV   High Point : 1000.00 mV
Plot Scale: 1039.2 mV



WORLD WIDE GEOSCIENCES - II

Sample Name : Solvent Blank 10s
FileName : C:\TC4\8WWG\38WW049.raw
Method : WWG2
Start Time : 0.00 min End Time : 40.00 min
Scale Factor: 1.0 Plot Offset: -39 mV

Sample #:
Date : 4/5/95 04:05 PM
Time of Injection: 4/3/95 12:28 AM
Low Point : -39.04 mV High Point : 1000.00 mV
Plot Scale: 1039.0 mV



WORLDWIDE
GEOSCIENCES, INC.

6100 Corporate Drive
Suite 320
Houston, Texas 77036
Phone: 713 / 988-9401
FAX: 713 / 988-8784

August 14, 1996

Ms. Colleen Kovarik
ERM - Northeast
175 Froehlich Farm Blvd.
Woodbury, NY 11797

Dear Ms. Kovarik:

Enclosed is our report on the free product samples submitted from your Metro North project site. The two submitted samples, OS-O and WB9-3C2A, show virtually identical signatures indicating a common diesel source for both samples and comparable levels of biodegradation. Both samples also show a similar small, subordinate lubricant contribution. The lubricant may have been separately introduced or inherent to the diesel product. The chromatographic signatures of these two samples were compared to the previously analyzed samples from the Metro North source. The OS-O and WB9-3C2A samples do not correlate with previously analyzed samples from this site.

If there are any questions please do not hesitate to contact us. We appreciate being of service to ERM.

Sincerely yours,

Neil F. Petersen

Neil F. Petersen

WORLDWIDE
GEOSCIENCES, INC.

6100 Corporate Drive
Suite 320
Houston, Texas 77036
Phone: 713 / 988-9401
FAX: 713 / 988-8784

CHARACTERIZATION OF PRODUCT SAMPLES
METRO NORTH SITE

PREPARED FOR
ERM - NE
AUGUST 1996

CHARACTERIZATION OF PRODUCT SAMPLES
METRO NORTH SITE

SUMMARY

Two free product samples, identified as OS-O and WM9-3C2A, were analyzed by high resolution capillary gas chromatography to determine the parent product type and to correlate these samples with one another and previously analyzed free product samples from this site.

The two free products are severely biodegraded diesels indicating long exposure times for both free products. The signature characteristics of the two samples are virtually identical indicating a common source or loss event for both the OS-O and WM9-3C2A samples. Both samples also show a comparable small, subordinate lubricant contribution to the free products. The lubricant could have been separately introduced or could represent waste oil added to the diesel, which was not uncommon in the past. The OS-O and WM9-3C2A samples do not correlate with past free product samples from this site.

INTRODUCTION

One product sample from the Metro North site was received at the offices of Worldwide Geosciences on June 5, 1996 via Federal Express overnight delivery. The sample was contained in a single, liter, amber, glass bottle which was packed in an insulated cooler with ice used as a preservative. Field sample identification as per the attached chain of custody form and it's assigned laboratory number is as follows:

Sample Identification	Laboratory No.
OS-O	60607003

One free product sample from the Metro North site was received at the offices of Worldwide Geosciences on June 28, 1996 via Federal Express overnight delivery. The sample was contained in a single, pint, glass jar which was packed in an insulated cooler. Field sample identification as per the attached chain of custody form and it's assigned laboratory number is as follows:

Sample Identification	Laboratory No.
WB9-3C2A	60703002

Worldwide Geosciences was requested to characterize these samples and correlate the chromatographic signatures of these samples with free product samples previously analyzed from this site.

The samples were analyzed by high resolution capillary gas chromatography using a 30 meter DB1 column with a flame ionization detector (FID). A Perkin-Elmer Autosystem was utilized. The analysis procedure follows the analytical procedures of ASTM Method D3328, but modified to reflect current instrumentation. Two procedural methods are routinely used for product characterization. One provides better resolution of the gasoline range hydrocarbons, but has a more limited carbon number range. This is Method 1 as defined in the procedural description provided in Appendix II. The second method is routinely used to characterize products heavier than gasoline. The gasoline range hydrocarbons are compressed as a result of a more rapid increase in column temperature. This is Method 2 as described in Appendix II. The OS-O sample was analyzed under Method 2 conditions on June 4, 1996. The WB9-3C2A sample was analyzed under Method 2 conditions on July 8, 1996.

The only difference in operating conditions between Methods 1 and 2, which are used for actual product samples, and between Methods 3 and 4 is in the injection conditions. When products are run neat, or as received, a split injection method is used and if the hydrocarbons are in solvent phase a splitless injection system is used.

Display copies of the chromatograms, both labeled and unlabeled, are incorporated into the report as Appendix I. A full-scale display in which all the peaks have been kept onscale for accurate visualization of the relative proportions of the hydrocarbons present is provided. Also included in Appendix I is a table listing the abbreviations used to identify peaks on the chromatograms and their corresponding names.

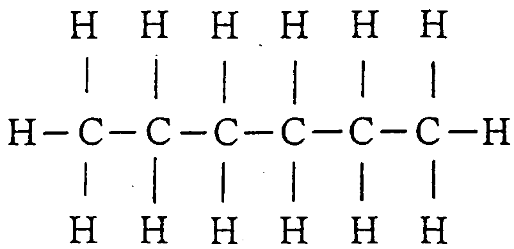
RESULTS

In discussing the compositional characteristics of the samples analyzed and analog signatures, the various peaks present in the chromatograms will be referred to in terms of the hydrocarbons they represent. As a general aid to visualizing the types of hydrocarbons involved, Figure 1 is provided to

FIGURE I
TYPES OF HYDROCARBONS

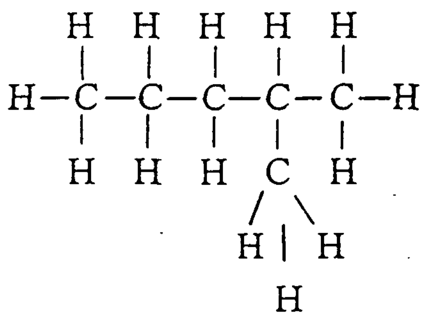
SATURATES

CARBON ATOMS CONNECTED BY SINGLE BONDS
PARAFFINS OR ALKANES
NORMAL PARAFFINS OR ALKANES
STRAIGHT CHAINS



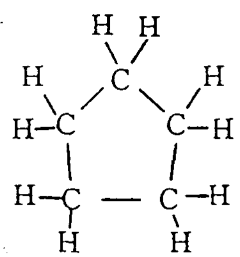
NORMAL HEXANE (NC6)

ISO-PARAFFINS OR ALKANES
BRANCHED CHAIN PARAFFINS

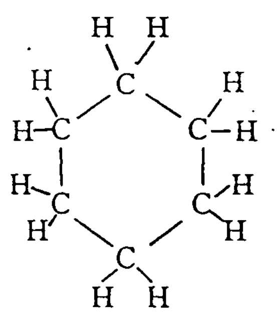


2METHYL PENTANE (2MP)

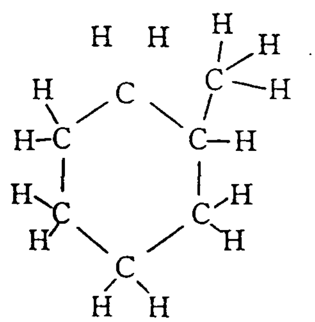
NAPTHENES OR CYCLOPARAFFINS OR CYCLOALKANES
RING OR CYCLIC STRUCTURE



CYCLOPENTANE
(CCP)



CYCLOHEXANE
(CH)



METHYLCYCLOHEXANE
(MCH)

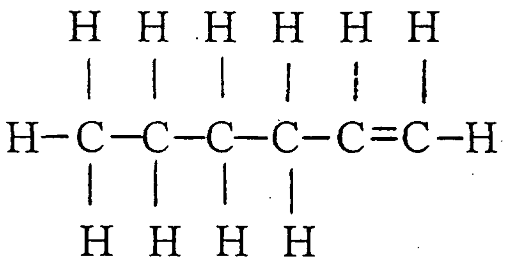
FIGURE 1 (CONT.)
TYPES OF HYDROCARBONS

UNSATURATES

HAVE ONE OR MORE CARBON DOUBLE BONDS

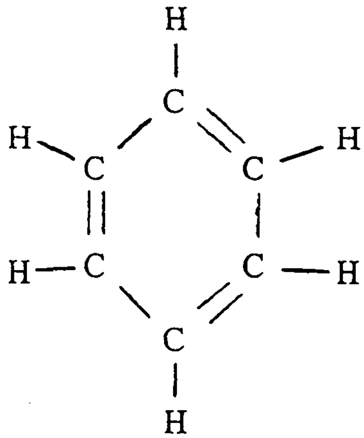
OLEFINS OR ALKENES

CAN BE STRAIGHT CHAIN, BRANCHED CHAIN, OR CYCLIC

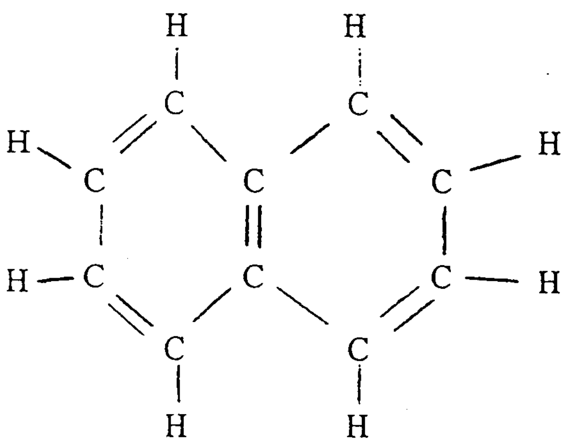


NORMAL HEXENE

AROMATICS



BENZENE



NAPHTHALENE

illustrate the main classes of hydrocarbons.

Figure 2 provides a comparison of the chromatographic signatures of the three most common petroleum fuels (gasoline, kerosene, and diesel) analyzed under comparable chromatographic conditions. Standard grade diesel and #2 fuel oil are similar products. The most prominent hydrocarbon type in kerosenes, diesels, and other middle distillate products is the normal paraffins. The normal paraffins are straight chain molecules in which all the carbon atoms are attached to one another in an end to end manner. The structure of normal hexane in Figure 1 is an example of a normal paraffin. Although there is considerable overlap in the carbon number range of kerosenes and diesels, both the overall carbon number distribution and the normal paraffin distribution is offset to higher carbon numbers in diesels than in kerosenes. Diesels and kerosenes can also be differentiated based on their isoprenoid proportions. The isoprenoids are the second most prominent individual hydrocarbon type in middle distillate fuels. The isoprenoids represent a unique type of branched chain or isoparaffin in which a side methyl (CH3) group is attached to every fourth carbon atom of the main carbon chain. The 2 methylpentane structure in Figure 1 is an example of an isoparaffin with a single side methyl group. The isoprenoids are annotated on the chromatograms with an IP designation followed by the number of carbon atoms in the molecule. In kerosene products, the lower carbon number isoprenoids (IP13, IP14, IP15, and IP16) strongly predominate over the higher carbon number isoprenoids (IP18, IP19, and IP20). In diesels, the higher carbon number isoprenoids are present at more equal proportions to the lower carbon number isoprenoids and in some cases may predominate.

Normal paraffins not only are the most prominent individual hydrocarbon type present in kerosenes and diesels, but also are the hydrocarbon type most easily metabolized by anaerobic bacteria. As a result, normal paraffins will be preferentially lost or consumed as biodegradation progresses with increasing exposure time. Severely biodegraded samples of diesels or kerosenes in which the normal paraffins have been completely consumed can be differentiated in terms of parent product type on the basis of their isoprenoid proportions. The relative proportions of the more resistant isoprenoids and other subordinate hydrocarbon peaks can also be used as a means of correlating both fresh and biodegraded kerosenes and diesels to one another.

The change in signature characteristics which occurs as a result of biodegradation is illustrated in Figures 3 and 4. Figure 3 compares the signature of a kerosene as analyzed and artificially degraded by whiting out

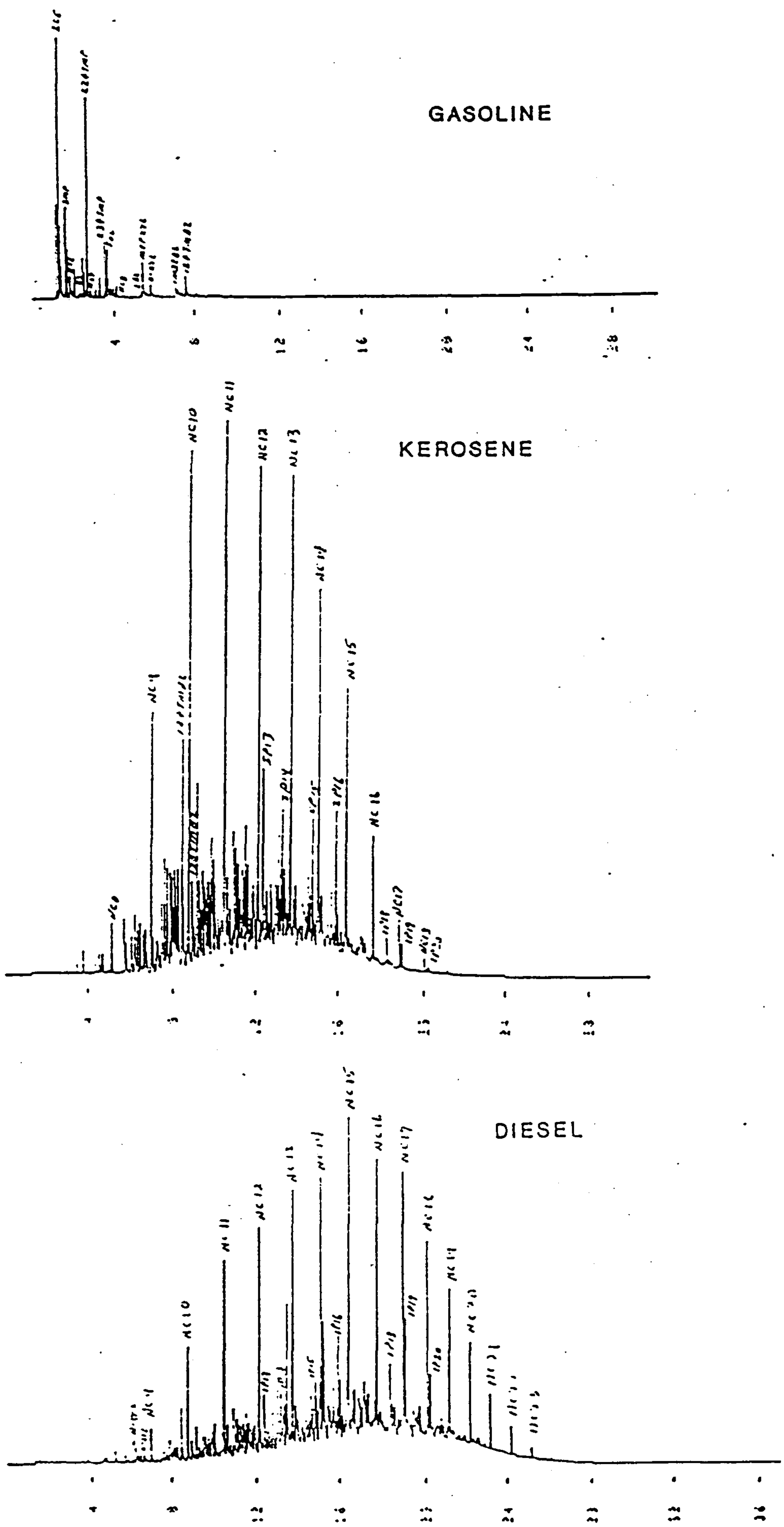
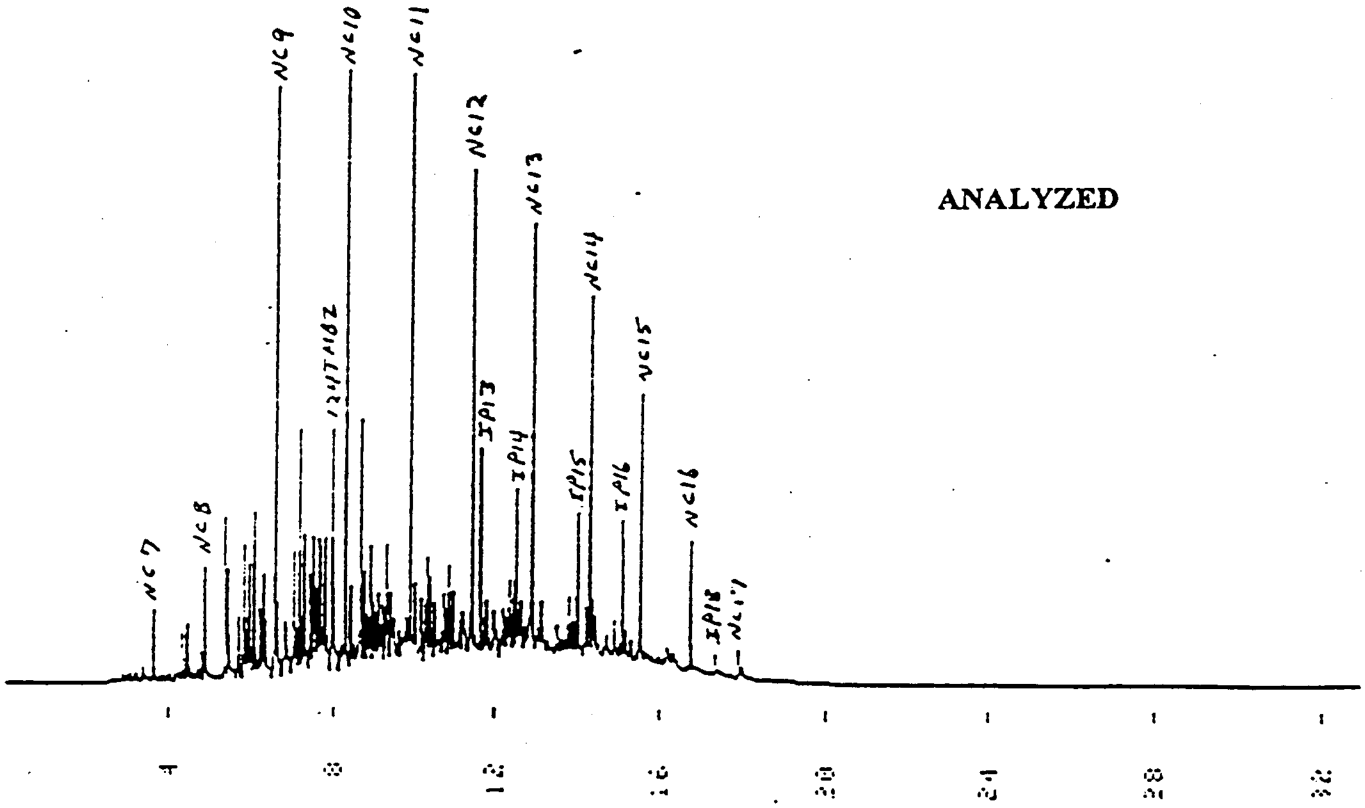


FIGURE 2: CHROMATOGRAPHIC SIGNATURES OF GASOLINE, KEROSENE, AND

ANALYZED



ARTIFICIALLY DEGRADED (NORMALS WHITED OUT)

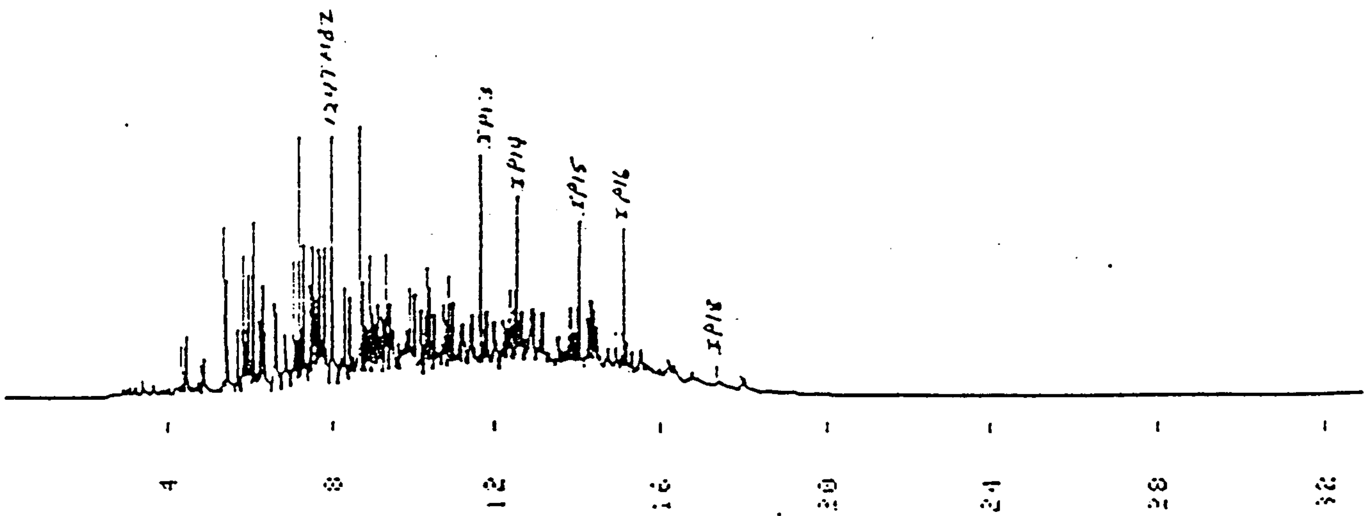
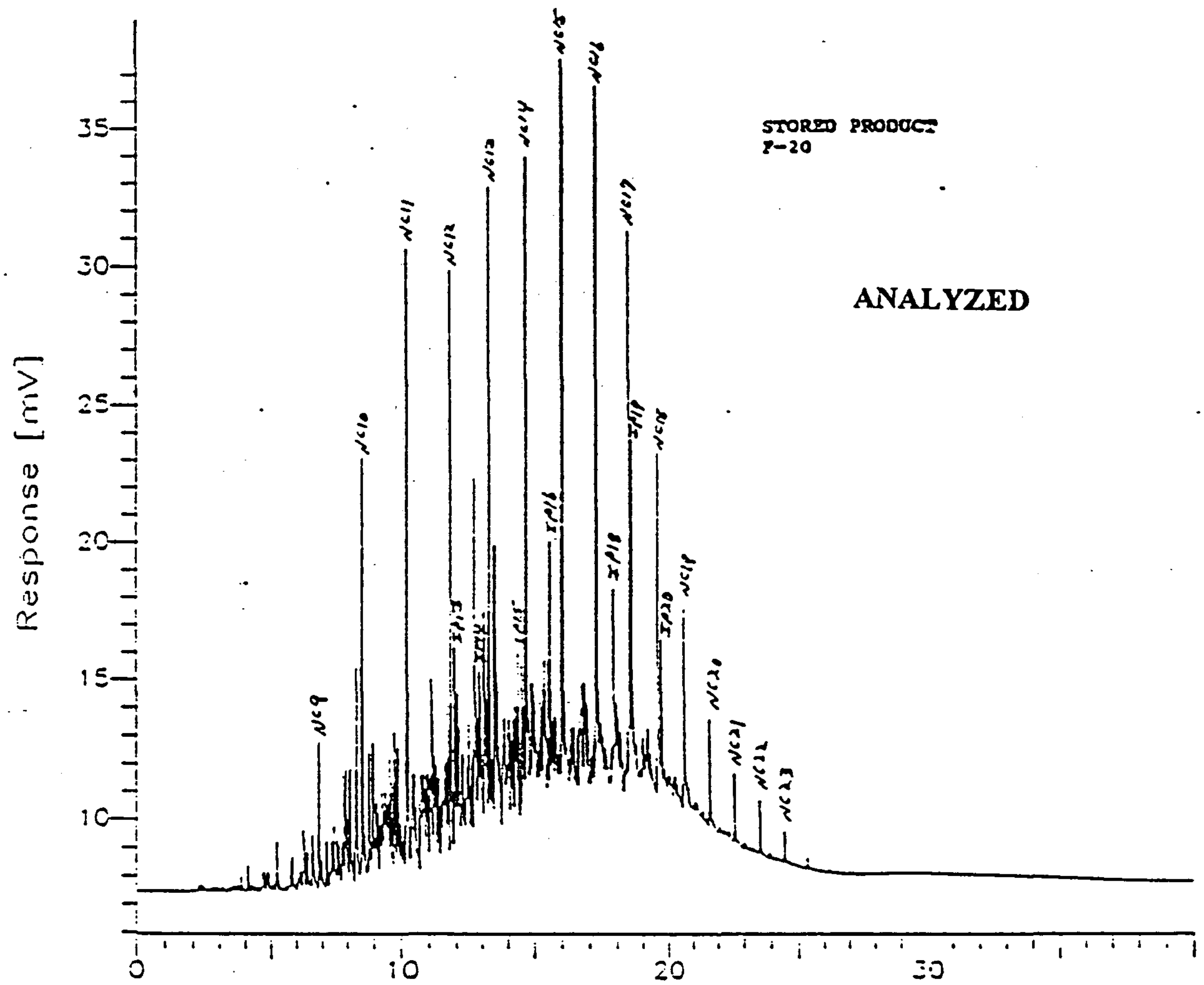


FIGURE 3: CHROMATOGRAPHIC SIGNATURE OF CHEVRON JET A AS ANALYZED AND ARTIFICIALLY DEGRADED (NORMALS WHITED OUT)



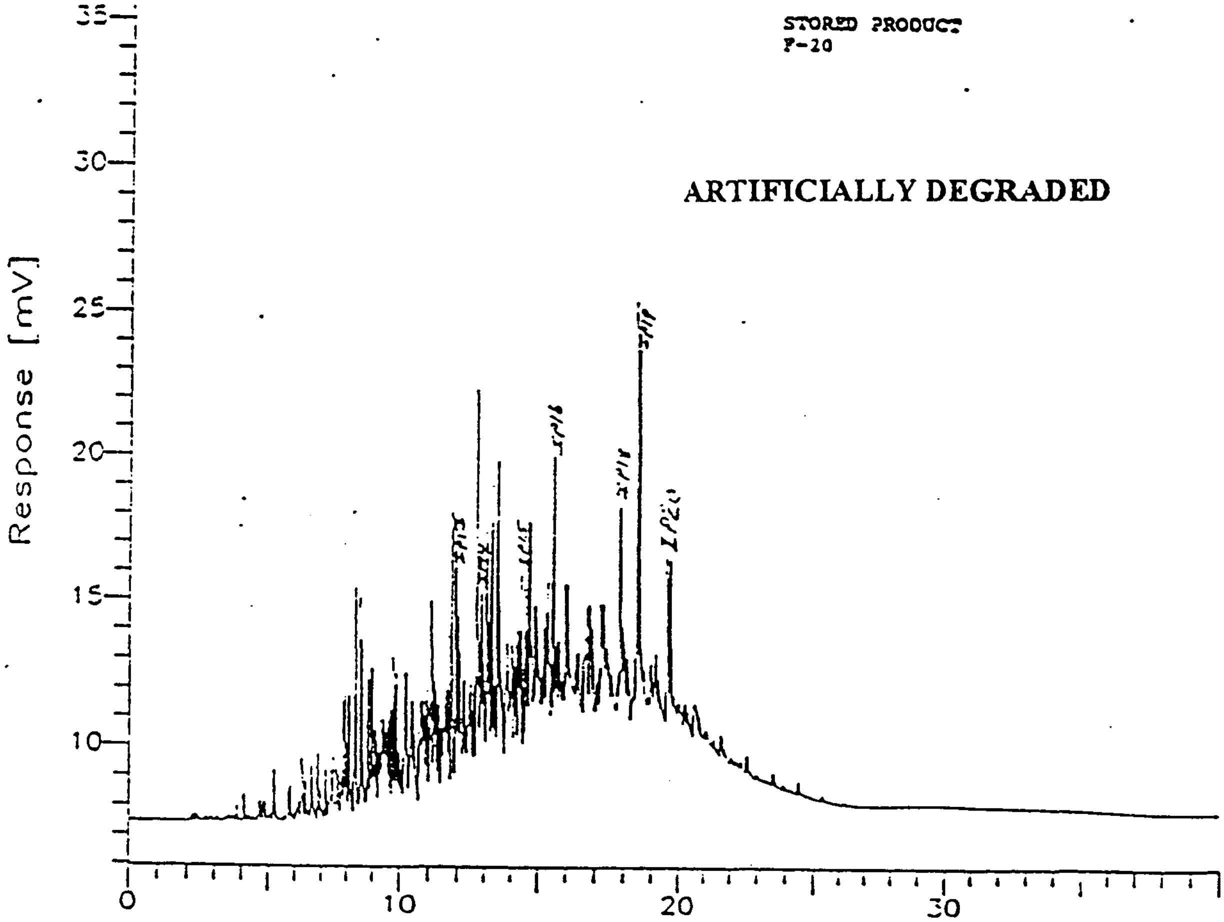


FIGURE 4: CHROMATOGRAPHIC SIGNATURE OF STORED DIESEL AS

the normal paraffins. Figure 4 provides a similar comparison for a diesel product sample. As the vertically prominent normal paraffin peaks are lost, the underlying baseline rise or hump becomes an increasingly prominent feature of the chromatographic signature. This baseline rise or hump represents a complex mixture of individual hydrocarbons which are not present in sufficient individual abundance to elute as discrete peaks.

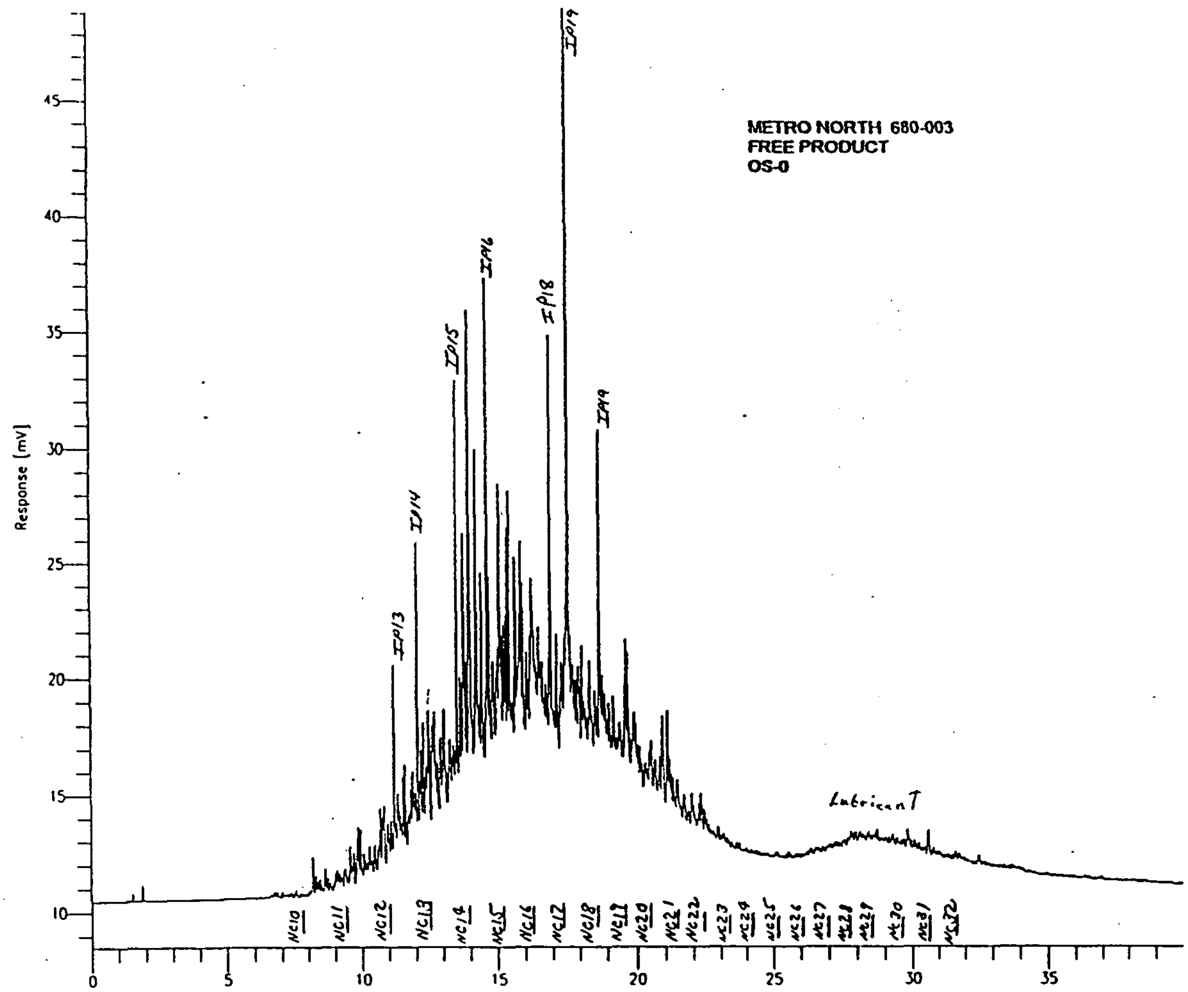
Gasoline is a lighter fuel than kerosenes or diesels. Gasoline also shows a distinctly different hydrocarbon type assemblage than kerosenes and diesels. Due to differences in the combustion characteristics of automotive engines, normal paraffins are not a desirable constituent of gasolines. The predominant hydrocarbon types present in gasoline are multibranched isoparaffins and aromatics.

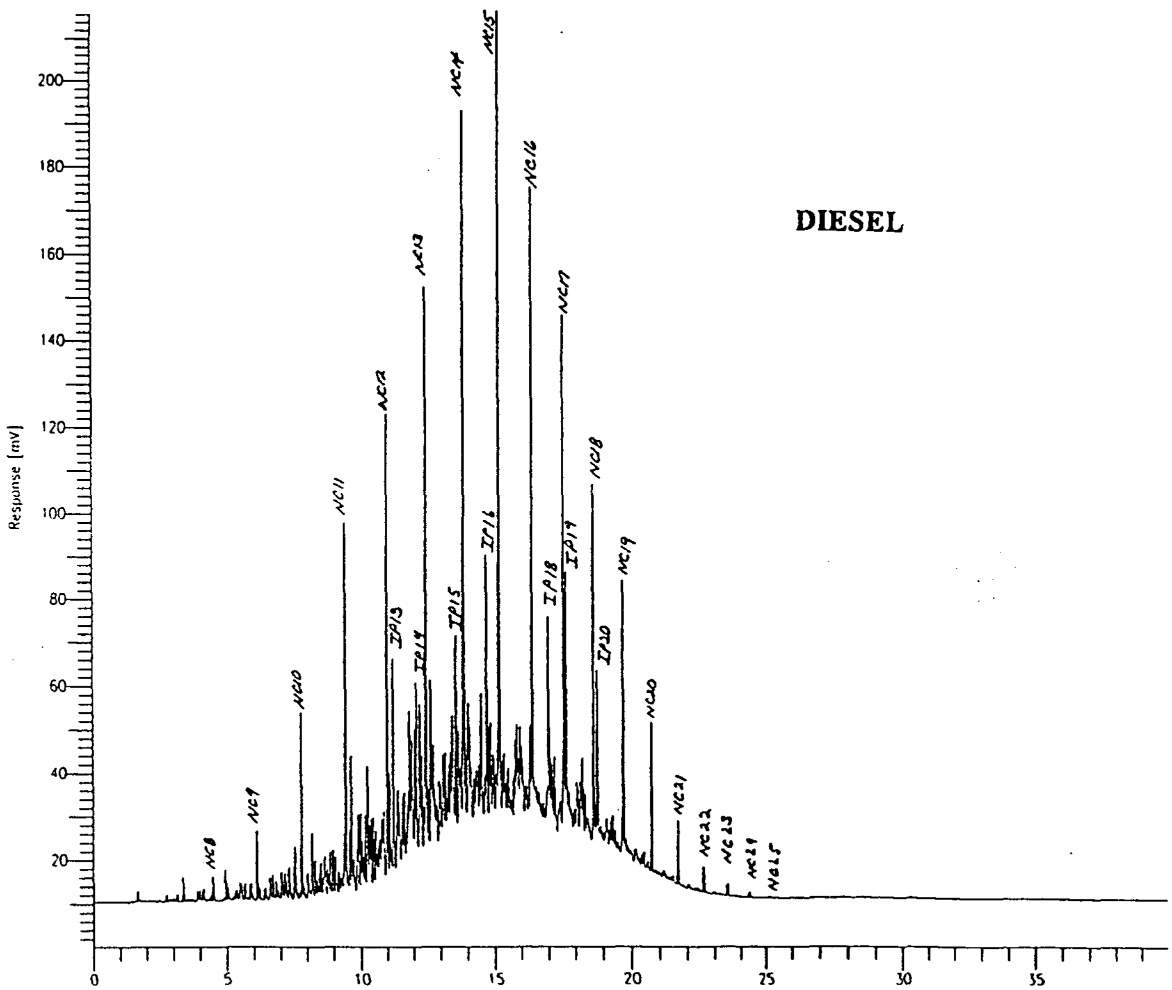
Both the OS-O and WB9-3C2A free products submitted have signatures which represent severely biodegraded diesels.

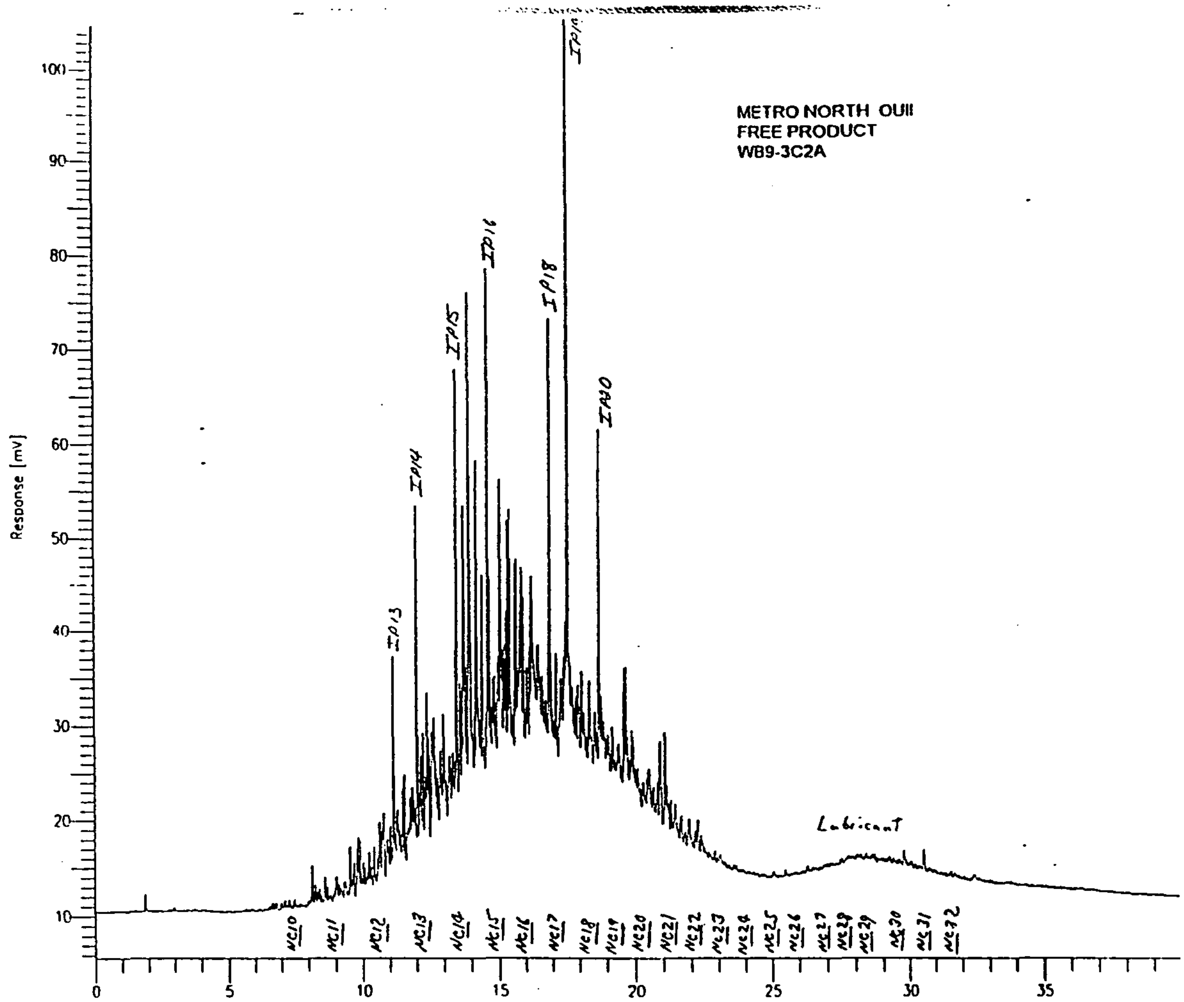
Figure 5 compares the chromatographic signature of the OS-O product sample with the signature of a diesel product sample. The overall carbon number distribution is consistent with diesel as the parent product. The absence of normal paraffins in the OS-O sample signature indicates the diesel present is severely biodegraded. The isoprenoids are the most prominent individual hydrocarbon type present in the OS-O sample signature.

The OS-O sample signature also shows a small subordinate baseline rise or hump in the C26 to C35 range of the signature. This subordinate baseline rise or hump is indicative of a lubricant or waste oil contribution to the product. This contribution may indicate a separate contribution of a lubricant or waste oil to the free product. The lubricant or waste oil contribution is low enough that it also could inherently be associated with the diesel or fuel oil. Addition of waste oils to fuels used in large boilers was a relatively common practice in the past.

The second free product sample submitted, WB9-3C2A shows a nearly identical chromatographic signature. This is illustrated in Figure 6, which compares the OS-O and WB9-3C2A signatures. The isoprenoid distributions or proportions of the two samples are nearly identical. The non-isoprenoid subordinate peak assemblages are also very similar for the two samples. Both samples show a similar absence of normal paraffins and both samples also show a comparable small subordinate lubricant or waste oil contribution to the signature. A common source is indicated for the OS-O and WB9-3C2A samples.


METRO NORTH 680-003
FREE PRODUCT
OS-0
Response [mV]
IP13
IP14
IP15
IP16
IP18
IP19
Lubricant
NC10
NC11
NC12
NC13
NC14
NC15
NC16
NC17
NC18
NC19
NC20
NC21
NC22
NC23
NC24
NC25
NC26
NC27
NC28
NC29
NC30
NC31
NC32


DIESEL
Response [mV]
NC8
NC9
NC10
NC11
NC12
NC13
NC14
NC15
NC16
NC17
NC18
NC19
NC20
NC21
NC22
NC23
NC24
NC25
IP13
IP14
IP15
IP16
IP18
IP19
IP20



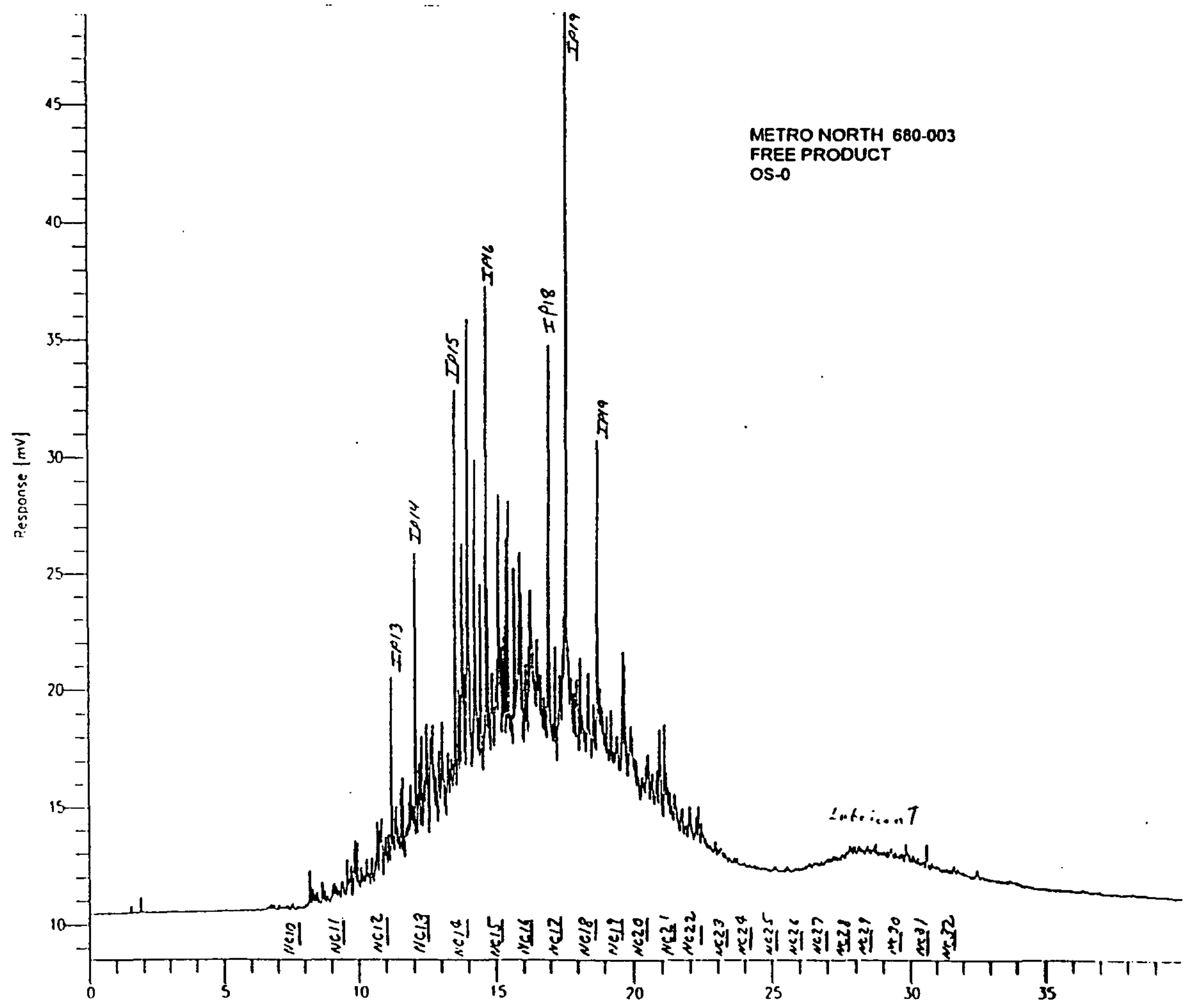


FIGURE 6: COMPARISON OF THE CHROMATOGRAPHIC SIGNATURES OF THE WB9-

The chromatographic signatures of these two samples were correlated to previously analyzed samples from the Metro North site. In the OS-O and WB9-3C2A sample signatures, the 19 carbon isoprenoid (IP19) is the most prominent individual peak in the signatures. The following Metro North samples, which also are severely biodegraded, show different isoprenoid distributions and consequently, would not be related to the OS-O and WB9-3C2A samples:

WB4-4A	LMS-GW5
TB6-1B1B	SMW6
TB6-1A1A	MET-0
WB2-1A	LMS-GW1

The chromatographic signatures of the WB9-3C2A and OS-O samples are closest in characteristics to the previously analyzed Osbourne Pond sample. Figure 7 compares the chromatographic signatures of the OS-O sample and the Osbourne Pond sample analyzed in 1994. The Osbourne Pond sample signature also shows a comparable predominance of IP19. However, the two samples show differences in their isoprenoid proportions and in non-isoprenoid subordinate peaks indicating they are not related. In the OS-O sample, the IP20 peak is present at higher proportions compared to the IP18 and IP19 peaks than in the Osbourne Pond sample. Additionally, the IP20 peak approximately equals the IP13 peak in the Osbourne Pond sample signature, and significantly exceeds the IP13 peak in the OS-O sample signature. The Osbourne Pond sample was not derived from the same diesel as the OS-O and WB9-3C2A samples. The Osbourne Pond sample also does not show a lubricant contribution, either introduced separately or inherent to the diesel.

A small subordinate lubricant contribution had been previously found in the SMW-6 sample. Figure 8 compares the chromatographic signature of the SMW-6 sample signature and the OS-O sample signature. The baseline rise or hump associated with the lubricant contribution in the two samples differs. A common lubricant contribution is not indicated between these samples.

The previously analyzed DC-B4 and EQ-B1 samples were only minimally to moderately biodegraded and consequently are unrelated to the OS-O and WB9-3C2A samples.

The free product samples from this site had previously been ranked in terms of degradation level or exposure time. The two currently analyzed free

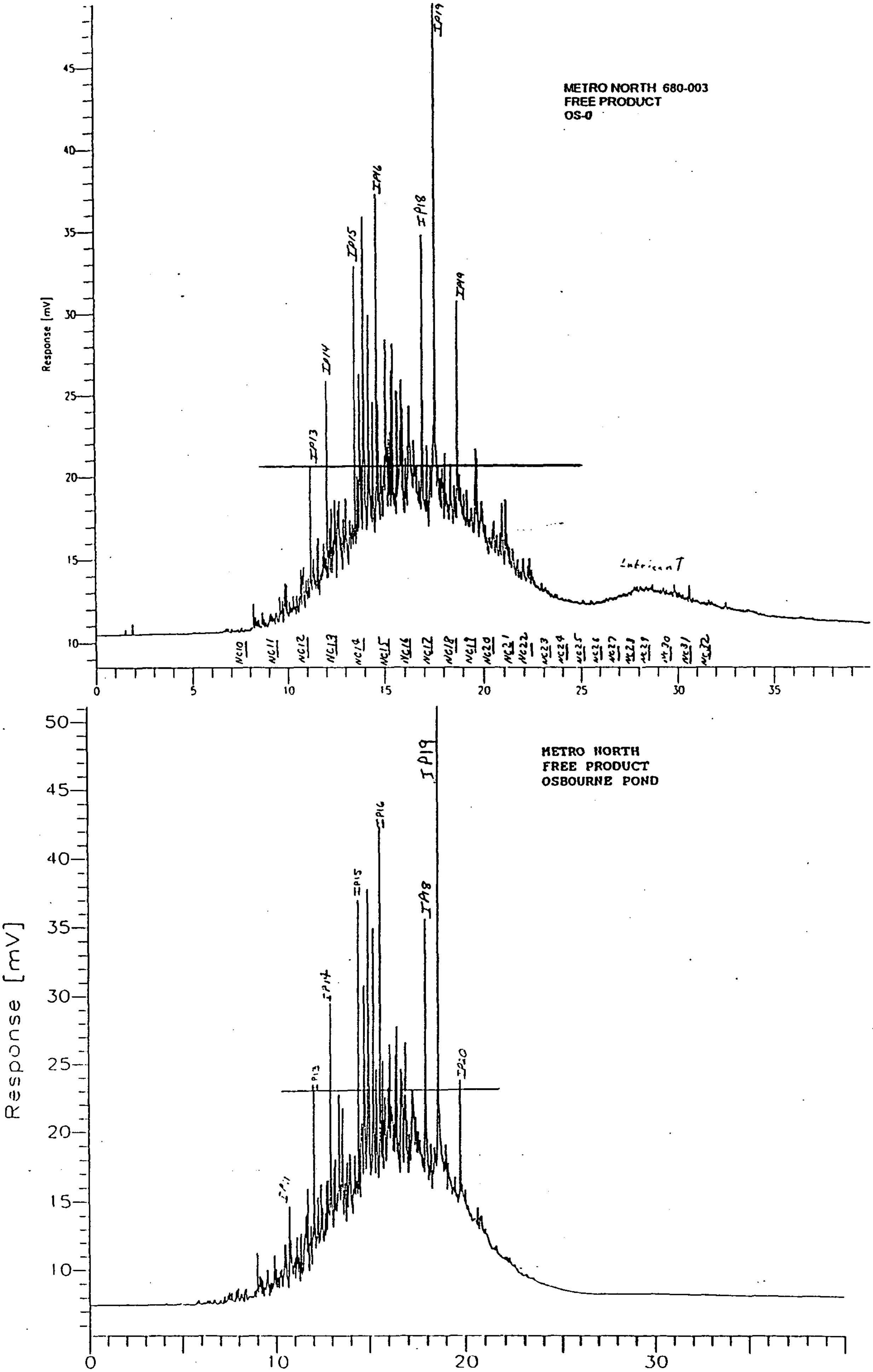
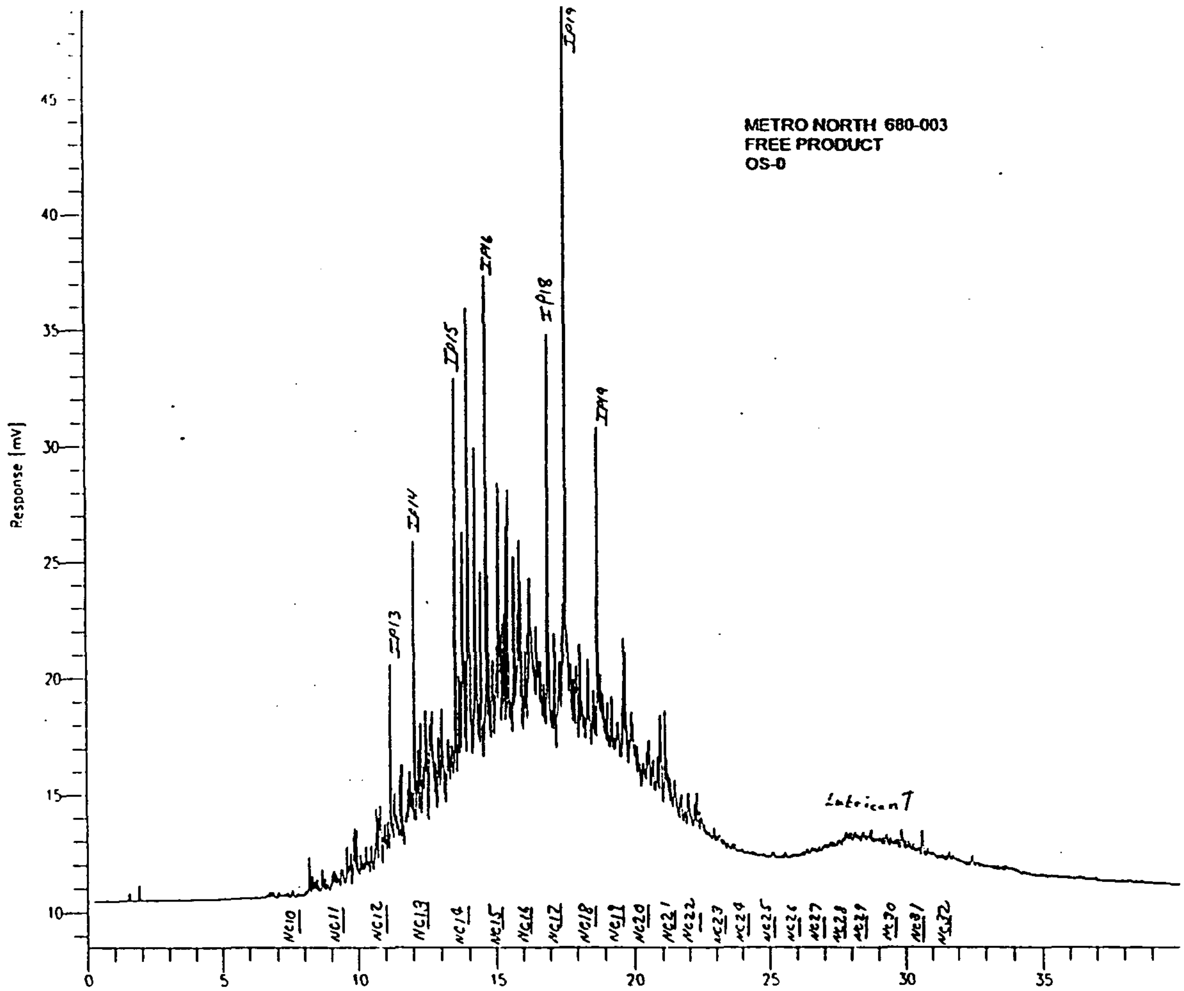


FIGURE 7: COMPARISON OF THE CHROMATOGRAPHIC SIGNATURES OF THE OS-0



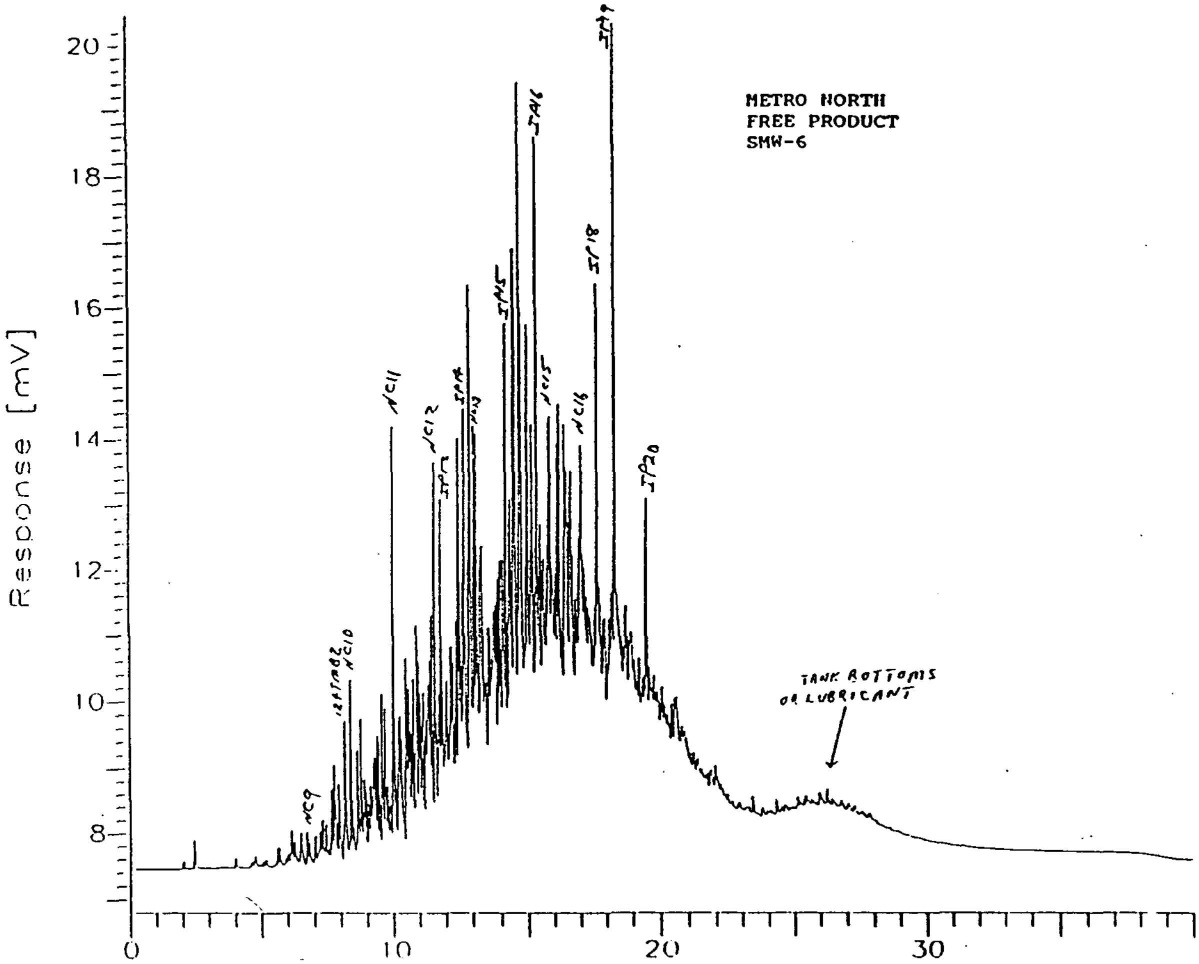


FIGURE 8: COMPARISON OF THE CHROMATOGRAPHIC SIGNATURES OF THE OS-0

products are added to this ranking in Table I. Christensen and Larsen (1993) have correlated diesel degradation level with exposure time as reflected in the NC17 to IP19 proportions. Our experience has been that starting proportions of NC17 to IP19 in diesels are more variable than they indicate and that degradation rate can be more variable than they indicate. However, despite these exceptions their indicated degradation rates are in agreement with the majority of sites on which we have independently established dates for losses.

Based on information previously provided that the LMS-GW1 and LMS-GW5 samples were obtained from wells which had been installed approximately 5 years prior to the 1994 samples and probably were undisturbed for that period of time, it is possible that these free products may have experienced accelerated rates or level of biodegradation.

REFERENCES

Christensen, L. B. and T. Larsen (1993) Method for determining the age of diesel oil spills in the soil: Ground Water Mon. & Remed., Vol. 13, No. 4, p. 142-149.

TABLE I

DEGRADATION LEVEL OF METRO NORTH PRODUCT SAMPLES

Sample	Degrad. Level	NC17/IP19	Exposure Time
DC-B4	Minimal	1.2	8-11 years
EQ-B1	Moderate	0.6	13-17 years
TB6-1B1B	Significant	0.2	15-19 years
SMW-6	Significant	0.09	17-22 years
MET-O	Severe	0.0	>20 years
LMS GW1	Severe	0.0	>20 years
LMS GW5	Severe	0.0	>20 years
Osbourne	Severe	0.0	>20 years
TB1-1A1A	Severe	0.0	>20 years
WB2-1A	Severe	0.0	>20 years
WB4-4A	Severe	0.0	>20 years
OB-0	Severe	0.0	>20 years
WB-3C2A	Severe	0.0	>20 years

ERM-Northeast
Environmental Resources Management
ERM 175 Froehlich Farm Boulevard • Woodbury, New York 11797 • (516) 921-4300 • Telefax (516) 921-6679 • (516) 921-5637

ERM-Northeast
Chain of Custody

Project Name / No. Metro North 630-003
Project Coordinator / Contact Colleen Kowalik / Dan Perazzo
Sampler(s) EA
Bottles Supplied By
Sheet No. 1 of 1

Type and No. of Containers

Date	Time	Comp.	Grab	Sample Identification	Soil	Water	Total No. of Containers										Analysis Requested
6/3/96			X	OS. O		✓	1										GC fingerprint -
																	AGE determination
																	Comparison to samples
																	Analyzed in 6/20/95
																	Worldwide report
																	Please provide a report
																	in the next week or
																	two (if possible)

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time	Reason for Transfer
Colleen Kowalik	6/4/96 4 pm	Fed-Express	6/4/96 pm	-
Fed-Express	6/5/96 8:3?	[signature]	6/5/96 AM	-

ERM-Northeast

175 Froehlich Farm Boulevard • Woodbury, New York 11797 • (516) 921-4300 • Telefax (516) 921-5679 • (516) 921-5637

Chain of Custody

Project Name / No. METRO-NORTH OU II
Project Coordinator / Contact ERIC ARNESEN
Sampler(s) ERIC ARNESEN
Bottles Supplied By NA
Sheet No. 1

Type and No. of Containers

Date	Time	Comp.	Grab	Sample Identification	Soil	Product	Total No. of Containers	CLEAR GLASS JAR									Analysis Requested
6/27/96	1330		✓	WB7-302A		✓	1										GC FINGERPRINT AGE DETERMINATION COMPARISON TO SAMPLES ANALYZED 6/20/95 WORLD WIDE REPORT PLEASE PROVIDE REPORT IN NEXT WEEK OR TWO.

Relinquished By (Signature)	Date/Time	Received By (Signature)	Date/Time	Reason for Transfer
[signature]	6/27/96/1100	Fed-Ex	6/27/96	
Fed-Ex	6/28/96/830	[signature]	6/28/96	

Copies: Sampler - White; Laboratory - Yellow

APPENDIX I

DISPLAY CHROMATOGRAMS

ABBREVIATIONS USED TO IDENTIFY PEAKS

ABBREVIATIONS	HYDROCARBON
C1	METHANE
C2	ETHANE
C3	PROPANE
IC4	ISOBUTANE
NC4	NORMAL BUTANE
ETH	ETHANOL
22C3	2 2 DIMETHYL PROPANE
IC5	ISOPENTANE
NC5	NORMAL PENTANE
MeC2	METHYLENE CHLORIDE
22DMB	2 2 DIMETHYL BUTANE
23DMB	2 3 DIMETHYL BUTANE
2MP	2 METHYLPENTANE
3MP	3 METHYLPENTANE
NC6	NORMAL HEXANE
22DMP	2,2 DIMETHYLPENTANE
MCP	METHYLCYCLOPENTANE
24DMP	2,4 DIMETHYLPENTANE
BZ	BENZENE
CH	CYCLOHEXANE
2MH	2 METHYLHEXANE
23DMP	2,3 DIMETHYLPENTANE
3MH	3 METHYLHEXANE
T13DMCP	T13DIMETHYLCYCLOPENTANE
C13DMCP	C13DIMETHYLCYCLOPENTANE
224TMP	2,2,4 TRIMETHYLPENTANE(PRINCIPAL ISO-OCTANE)
NC7	NORMAL HEPTANE
234TMP	2,3,4 TRIMETHYLPENTANE(ISO-OCTANE)
MCH	METHYLCYCLOHEXANE
TOL	TOLUENE
23DMH	2,3 DIMETHYLHEXANE
2MC7	2METHYLHEPTANE
3MC7	3METHYLHEPTANE
224TMH	2,2,4 TRIMETHYLHEXANE
223TMH	2,2,3 TRIMETHYLHEXANE
NC8	NORMAL OCTANE
EBZ	ETHYL BENZENE
M+P XYL	META AND PARA XYLENES
O XYL	ORTHO XYLENE
NC9	NORMAL NONANE
N-PROPYL BZ	NORMAL PROPYL BENZENE
1M3EBZ	1METHYL3ETHYLBENZENE
135TMBZ	1,3,5 TRIMETHYLBENZENE
1M2EBZ	1METHYL2ETHYLBENZENE

ABBREVIATIONS USED TO IDENTIFY PEAKS

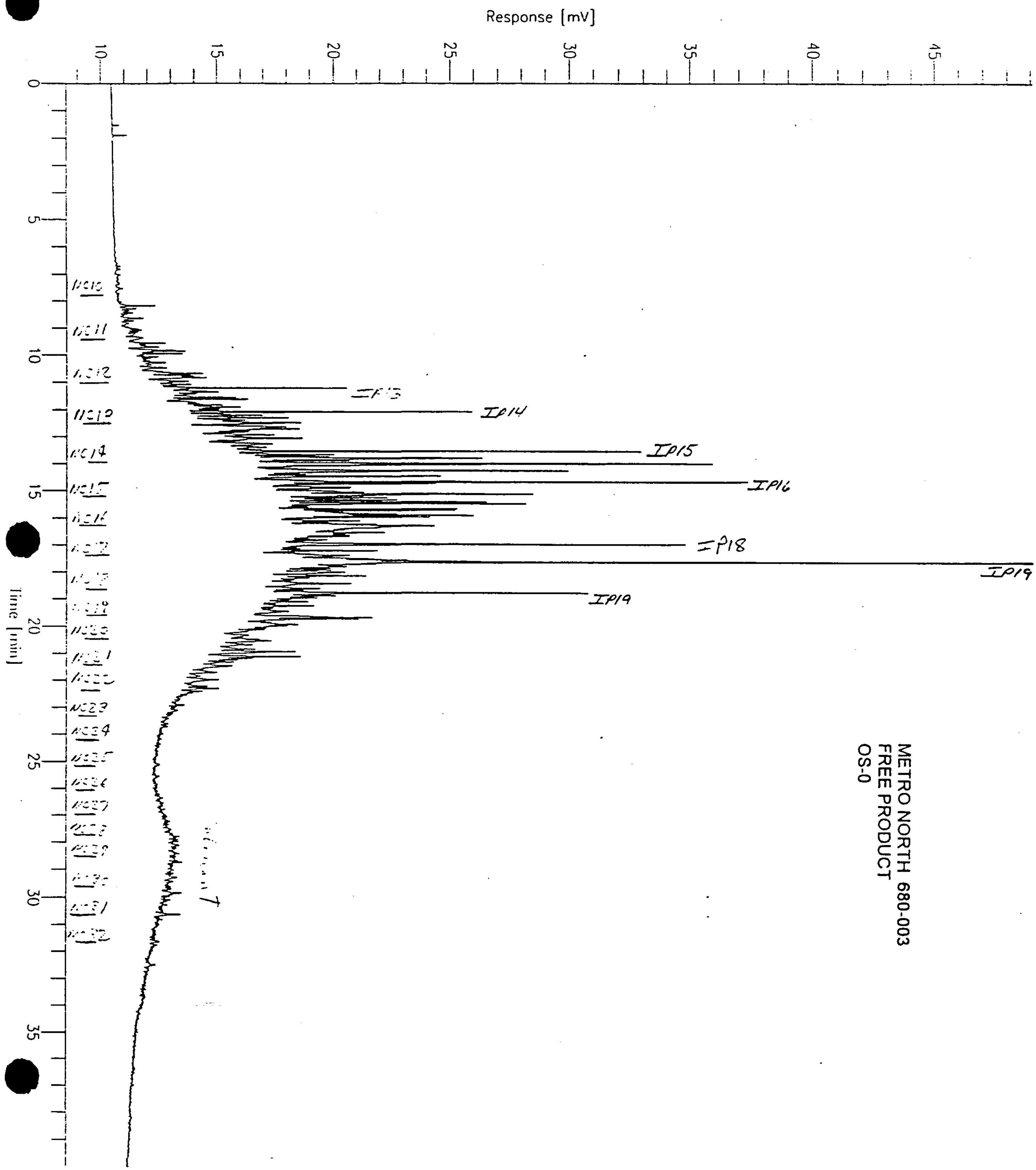
ABBREVIATIONS	HYDROCARBON
124TMBZ	1,2,4 TRIMETHYLBENZENE
NC10	NORMAL DECANE
123TMBZ	1,2,3 TRIMETHYLBENZENE (TERT BUTYL BENZENE COELUTES AT THIS POSITION)
NAPH	NAPHTHALENE
2M.NAPH	2METHYL NAPHTHALENE
1M.NAPH	1METHYL NAPHTHALENE

NC____ Normal paraffin with number of carbon atoms in molecule shown
IP____ Isoprenoid iso-paraffin with number C atoms in molecule shown

Sample Name : 96097 OS-O 10S
FileName : C:\TC41\4WWG\54WW016.raw
Method : WWG2
Start Time : 0.00 min
End Time : 40.00 min
Scale Factor: 1.0
Plot Offset: 9 mV

Sample #: 60607003
Date : 6/12/96 01:09 AM
Time of Injection: 6/4/96 09:44 AM
Low Point : 8.52 mV
Plot Scale: 40.6 mV

High Point : 49.10 mV



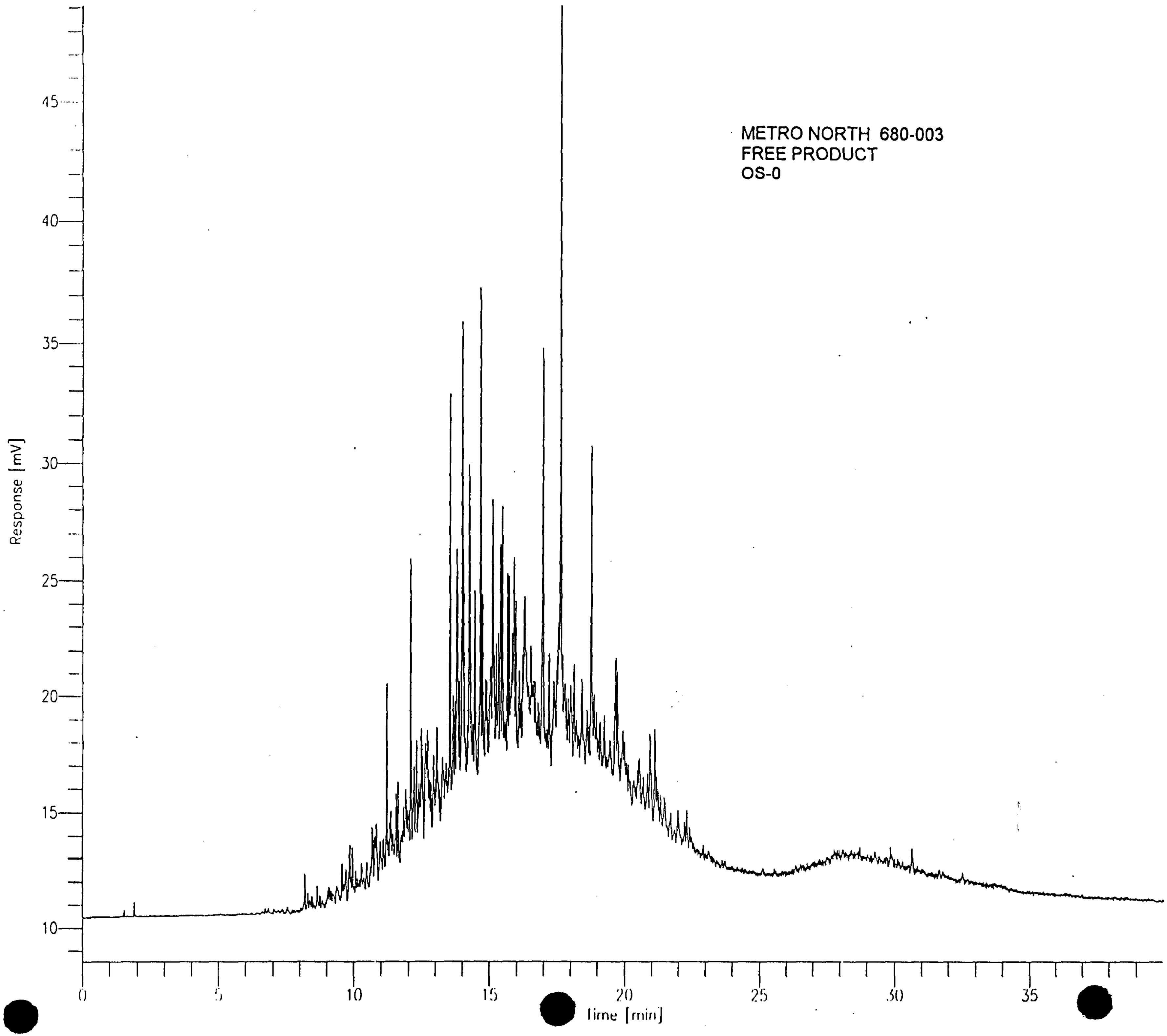
Sample Name : 96097 OS-0 10S
FileName : C:\TC4I\4WWG\54WW016.raw
Method : WWG2
Start Time : 0.00 min
Scale Factor: 1.0

End Time : 40.00 min
Plot Offset: 9 mV

Sample #: 60607003
Date : 6/12/96 01:09 AM
Time of Injection: 6/4/96 09:44 AM
Low Point : 8.52 mV
Plot Scale: 40.6 mV

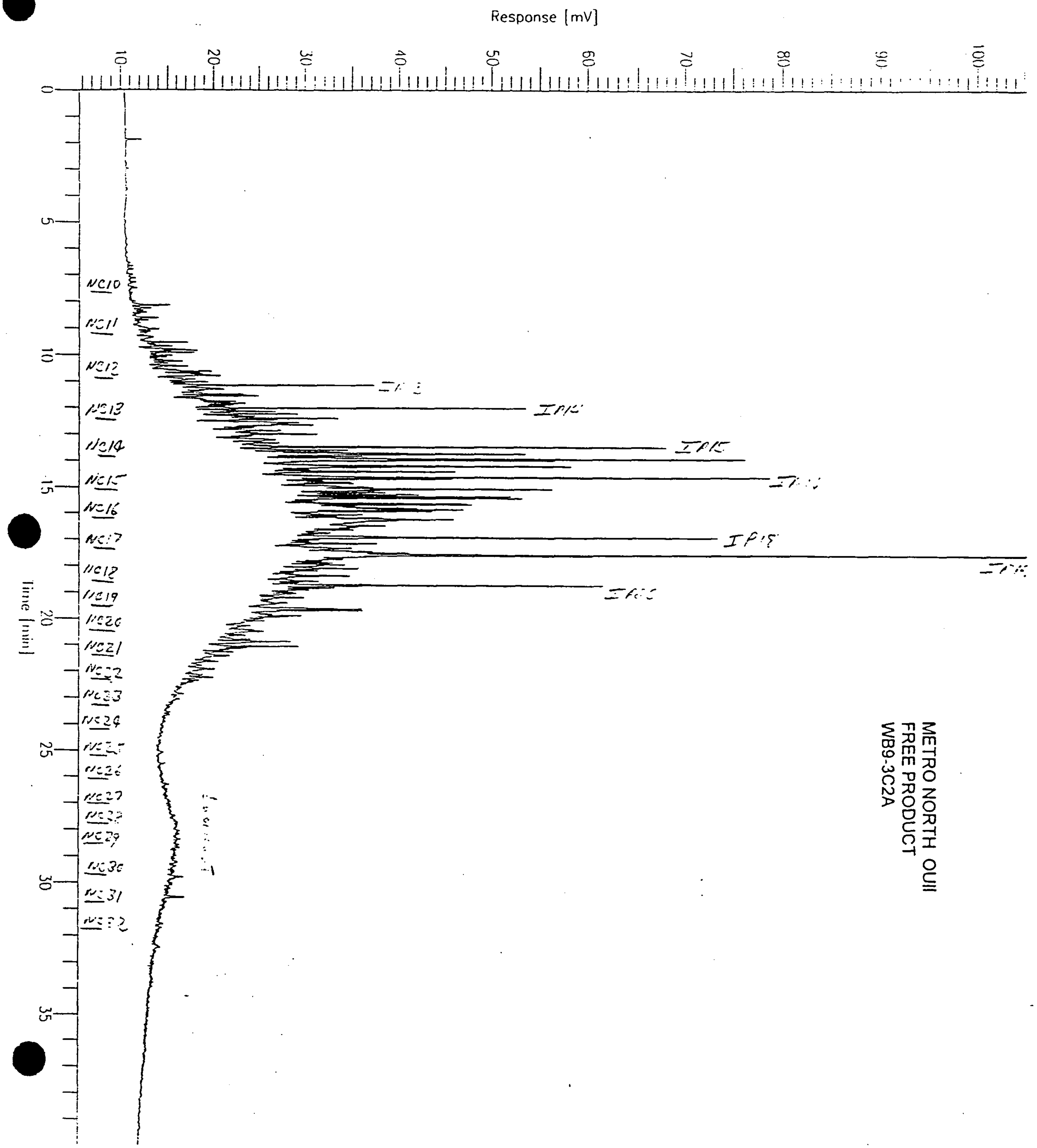
High Point : 49.10 mV

Page 1 of 1

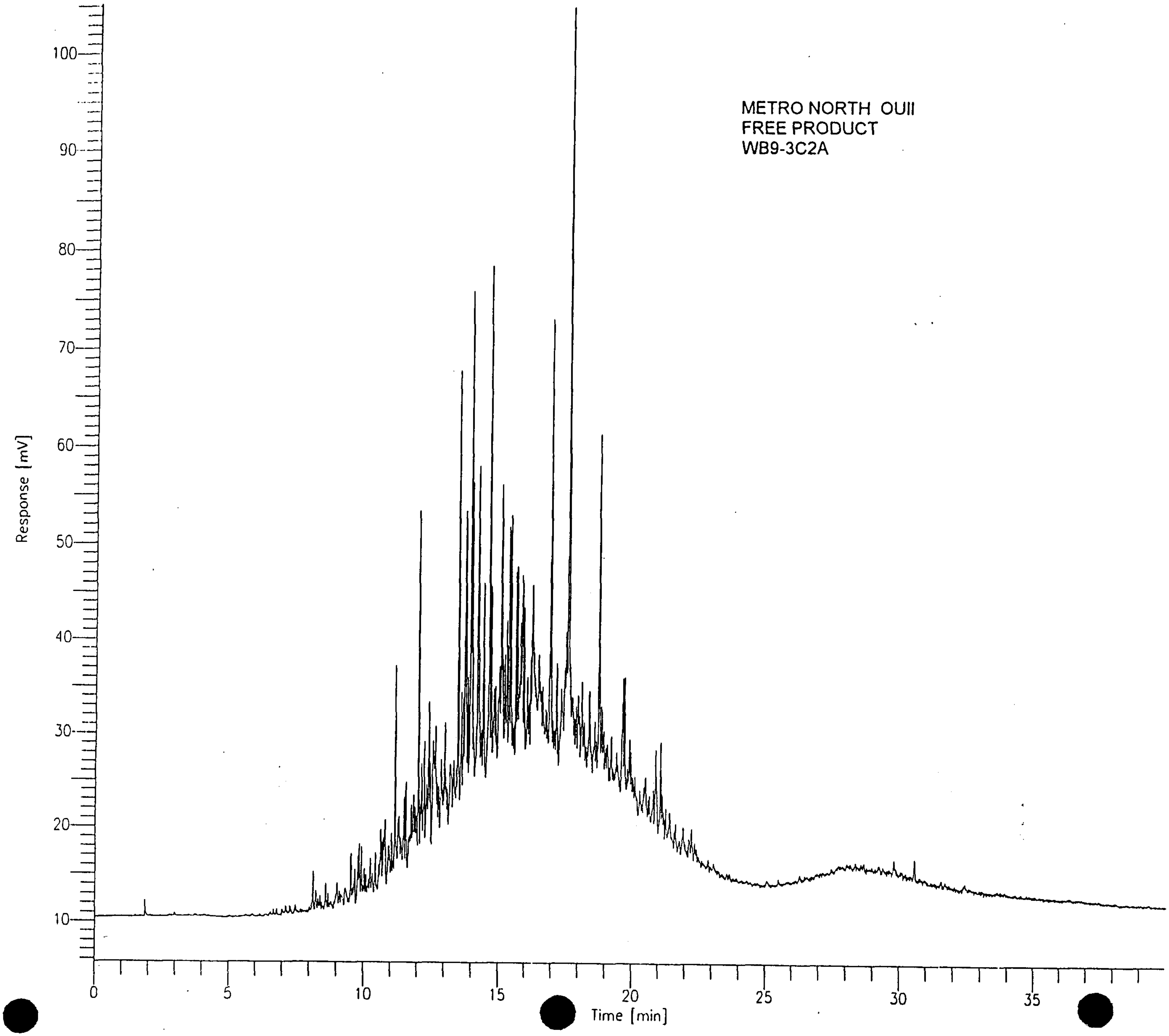


Sample Name : 96097B WB9-3C2A 10S
FileName : C:\TC41\4WWG\54WW036.raw
Method : WWG2
Start Time : 0.00 min   End Time : 40.00 min
Scale Factor: 1.0   Plot Offset: 6 mV

Sample #: 60703002
Date : 7/8/96 08:53 PM
Time of Injection: 7/8/96 02:40 PM
Low Point : 5.67 mV   High Point : 105.28 mV
Plot Scale: 99.6 mV



Sample Name : 96097B WB9-3C2A 10S   Sample #: 60703002   Page 1 of 1
FileName : C:\TC41\4WWG\54WW036.raw   Date : 7/8/96 08:53 PM
Method : WWG2   Time of Injection: 7/8/96 02:40 PM
Start Time : 0.00 min   End Time : 40.00 min   Low Point : 5.67 mV   High Point : 105.28 mV
Scale Factor: 1.0   Plot Offset: 6 mV   Plot Scale: 99.6 mV



APPENDIX II

OPERATING CONDITIONS

GC OPERATING CONDITIONS

Instrument: Perkin-Elmer Autosystem

Column: 30m*0.25mm ID*0.25u Methyl Silicon, Restek Rtx-1
(Cat# 10138, Fused Silica Column; Bonded,
Non-Polar, Silicone Based Polymer Liquid Phase)

Carrier Gas: Helium
Linear Velocity = 30 cm/sec
Column Pressure 16.9 psig.

Injection Port: Split/Splitless Type
Temperature 300 deg C

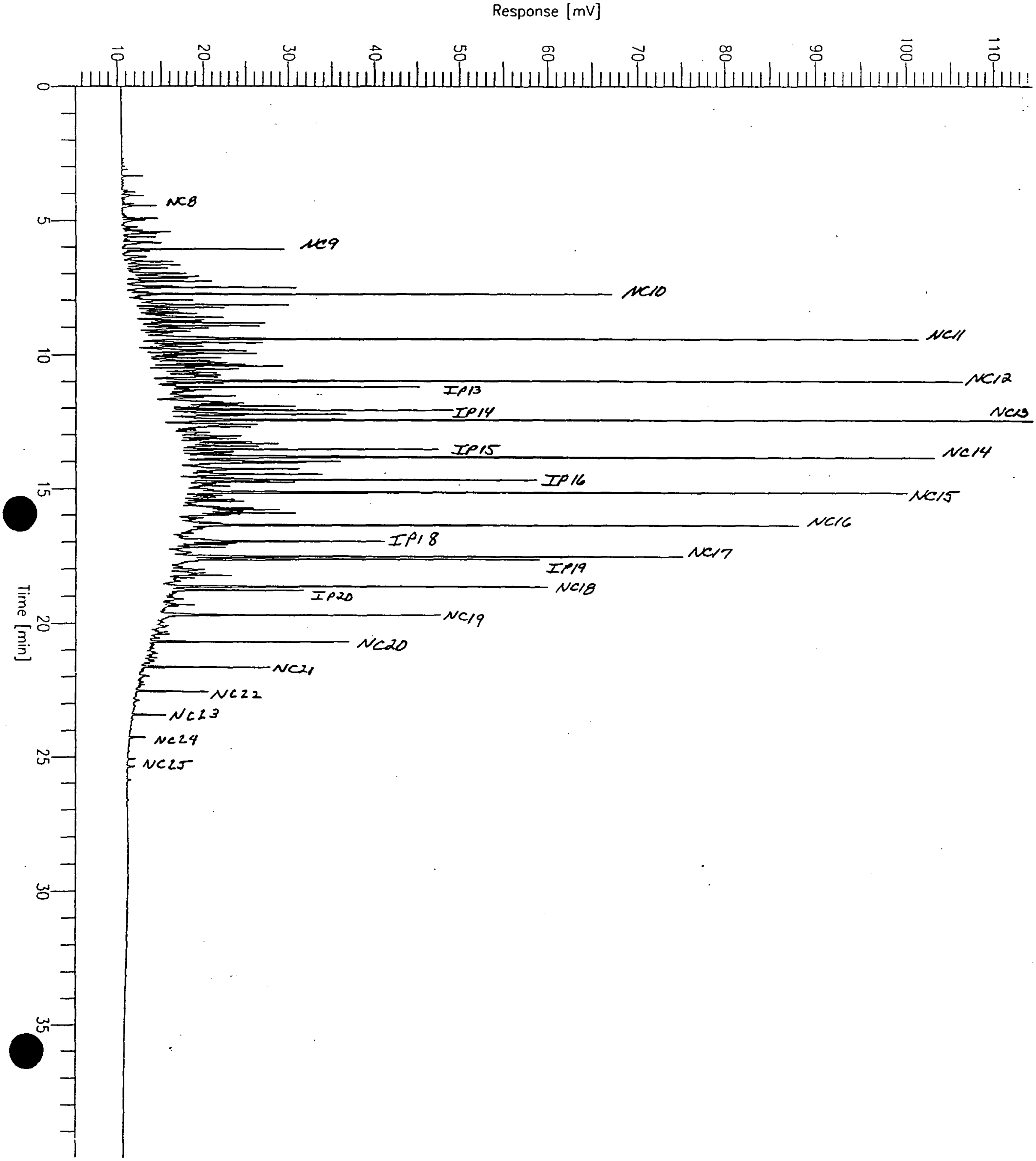
Detector: Flame Ionization Type
Temperature 300 deg C
Range 1, Attn.4

	Method 1	Method 2	Method 3	Method 4
Injection Type	Split	Split	Splitless	Splitless
Acronym	5/s	10/s	5/sl	10/sl
Split Vent	On	On	Off	Off
Split Vent Time,min	---	---	0.5	0.5
Split Rate ml/min	100	100	100	100
Initial Temp, deg C	30	30	30	30
Initial Time, min	5	1	5	1
Ramp Rate, deg C/min	5	10	5	10
Final Temp, deg C	300	300	300	300
Final Time, min	0	15	0	15
Run Time, min	59	43	59	43

WORLD WIDE GEOSCIENCES - II

Sample Name : #2 FUEL OIL 10S
FileName : C:\TC41\4WWG\54WW015.raw
Method : WWG2
Start Time : 0.00 min   End Time : 40.00 min
Scale Factor: 1.0   Plot Offset: 5 mV

Sample #:
Date : 6/12/96 01:09 AM
Time of Injection: 6/4/96 08:52 AM
Low Point : 5.24 mV   High Point : 114.57 mV
Plot Scale: 109.3 mV



WORLD WIDE GEOSCIENCES - II

Sample Name : D2 10S
FileName : C:\TC41\4WWG\54WW034.raw
Method : WWG2
Start Time : 0.00 min
End Time : 40.00 min
Scale Factor: 1.0
Plot Offset: -0 mV

Sample #:
Date : 7/8/96 08:53 PM
Time of Injection: 7/8/96 12:49 PM
Low Point : -0.15 mV
High Point : 220.86 mV
Plot Scale: 221.0 mV