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A MEMBER OF THE ENVIRONMENTAL RESOURCES MANAGEMENT GROUP

METRO-NORTH COMMUTER RAILROAD

Proposed Remedial Approach
Former Lagoon Area
Harmon Railroad Yard Wastewater Treatment Area
Operable Unit 1
Croton-on-Hudson, New York

8 March 1994

Prepared For:

Metro-North Commuter Railroad
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New York, New York 10017

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ERM

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EXECUTIVE SUMMARY

This document outlines the conceptual elements of a comprehensive remedial approach to the former wastewater equalization lagoon component of Operable Unit No. I (OU-I) of the New York State Inactive Hazardous Waste Site (Site No. 3-60-010) located at the Harmon Railroad Yard, Croton-On-Hudson, New York. The proposed remedial approach presented in this document complies with the remedy as described in the Record of Decision (ROD) issued by the New York State Department of Environmental Conservation (NYSDEC) Division of Hazardous Waste Remediation (DHWR) in September, 1992. The remedial approach for the lagoon which is presented in this document, however, simultaneously addresses residual petroleum hydrocarbons to satisfy potential requirements of the NYSDEC Bureau of Spill Prevention and Response. The conceptual remedial approach described in this document is the basis for Metro-North Commuter Railroad (Metro-North) moving forward with the final remedial design for remediation of OU-I.

The ROD for OU-I identified remedial requirements for sludge and for four soil zones: Zone A, Zone B1, Zone B2 and Zone C. Zone A refers to surface soil (i.e., top two feet) in the area adjacent to the lagoon. Zone B1 refers to subsurface soil (i.e., greater than two feet) beneath Zone A. Zone B2 refers to the unsaturated soil beneath the sludge in the lagoon and Zone C refers to the saturated soil beneath the lagoon sludge.

The ROD requires the following remedial actions to be undertaken as part of OU-I: (1) off-site incineration of all lagoon sludge; (2) off-site landfill disposal of all soil (i.e., Zones A, B1, B2 and C) containing PCBs in concentrations greater than 10 mg/kg; (3) placement of a liner in the remediated lagoon area; (4) relocation of Zone A soil containing PCBs in concentrations between 0.5 to 10 mg/kg above the liner in the remediated lagoon area; and (5) placement of a cover over the relocated Zone A soil. Proposed remedial actions to respond to ROD requirements for OU-I not related to the lagoon (i.e., decommissioning and demolition of the Old Wastewater Treatment Plant) were defined in other submittals to NYSDEC (ERM-Northeast 1993b; ERM-Northeast 1994c) and are not addressed in this document.

A Pre-Design Test Boring Program was implemented at the lagoon to assess the quality of: (1) Zone B1 soil; and (2) Zone B2 and Zone C soil. A total of 14 test borings were drilled: 2 borings were drilled in Zone B1 and 12 borings were drilled from 14 to 26 feet below grade in Zone B2 and Zone C soil. A total of six soil samples were collected from the two Zone B1 soil borings. A total of 72 soil samples were collected from the 12 Zone B2 and C soil borings.

Data from the soil borings and from ground water level measurements in adjacent wells indicate that the volume of Zone B2 soil is relatively small, especially during periods of high seasonal ground water. The Zone B2 and C soil encountered during the boring program contained visual and olfactory signs of petroleum. This soil was comprised of fine to coarse sand and gravel intermixed with ash and concrete and brick fragments. An organic peat layer was encountered in most of the 12 borings drilled in the lagoon area. Soil samples collected from borings drilled in Zones B2 and C were analyzed for: 10 target VOCs; 8 target SVOCs, including PCBs; 8 target inorganics; and total petroleum hydrocarbons (TPH). In addition, 6 of the Zone B2 and C soil samples were analyzed using the Toxicity Characteristics Leaching Procedure (TCLP). Soil samples collected from Zone B1 were analyzed for

2 target SVOCs (i.e., 2-methylnapthalene and PCBs) and 1 inorganic constituent (i.e., magnesium). The potential volume of Zone B1 soil is similarly limited since the horizontal extent of Zone B1 soil is defined to extend no further than the limit of Zone A soil defined in Figure A-5 of the ROD.

The analytical results from the soil boring program indicate that none of the Zone B1, B2 or C soil samples contained Polychlorinated Biphenyls (PCBs) in concentrations exceeding the 10 mg/kg ROD cleanup level. The predominant parameters in Zone B2 and C soil samples were aromatic volatile organic compounds (VOCs) and polynuclear aromatic hydrocarbons (PAHs). Both the aromatic VOCs and the PAHs identified in these soil samples are consistent with petroleum products or their derivatives. This is consistent with the TPH results and the visual and olfactory signs of petroleum products observed during drilling.

Based on the data, the NYSDEC Division of Hazardous Waste Remediation has concluded that soil in Zones B1, B2 and C do not require remediation pursuant to the remedy as described in the ROD. However, due to the presence of petroleum hydrocarbons in Zone B2 and C soil, the NYSDEC Division of Hazardous Waste Remediation is consulting with the NYSDEC Bureau of Spill Prevention and Response concerning presence of petroleum hydrocarbons in Zone B2 and Zone C soil and the disposition of soil in these zones. Any additional requirements imposed by the NYSDEC Bureau of Spill Prevention and Response for Zone B2 and C soil would, for logistical reasons, have to be finalized prior to the implementation of the ROD component of OU-I (e.g., sludge removal, liner and cover installation, Zone A soil relocation). The proposed remedial approach described in this document was developed to simultaneously address ROD requirements and any potential requirements of the NYSDEC Bureau of Spill Prevention and Response.

The proposed remedial approach consists of ten components to address Division of Hazardous Waste Remediation ROD requirements and any potential Bureau of Spill Prevention and Response petroleum-related requirements. The ten remedy components and the NYSDEC regulatory program which each component addressees are as follows:

Remedy Component	NYSDEC Regulatory Program
1. Sludge Incineration	Division of Hazardous Waste Remediation
2. PCB Soil Disposal	Division of Hazardous Waste Remediation
3. Liner	Division of Hazardous Waste Remediation
4. Zone A Soil Removal and Relocation	Division of Hazardous Waste Remediation
5. Backfill	Division of Hazardous Waste Remediation
6. Cover	Division of Hazardous Waste Remediation
7. Grouted Sheeting	Primary: Division of Hazardous Waste Remediation Secondary: Bureau of Spill Prevention and Response
8. Ground Water and NAPL Recovery Wells	Bureau of Spill Prevention and Response
9. Piezometers	Bureau of Spill Prevention and Response
10. Air Sparging and Vacuum Extraction System	Bureau of Spill Prevention and Response

The remedy would remove all sludge and soil containing PCBs in concentrations above the ROD cleanup levels for off-site disposal. Only a limited amount of Zone A soil containing PCBs in concentrations above the ROD cleanup level would be removed for off-site disposal. Zone B2 and C soil would remain in place and be contained by the following remedy components: (1) grouted sheeting; (2) liner system; (3) relocated low level (i.e., less than 10 mg/kg) PCB Zone A soil and uncontaminated backfill soil; and (4) cover system.

The remedy also includes the installation of the wells, piping and crushed stone components of the following contingency methods: (1) ground water and NAPL recovery wells; (2) piezometers; and (3) the piping and crushed stone components of an air sparging and vacuum extraction system. These contingency methods would, if activated, provide remediation and additional containment of Zone B2 and C soil. The NAPL recovery wells would be activated if a recoverable amount of floating product accumulated in the NAPL recovery wells.

The ground water recovery wells would be activated based on ground water quality to be characterized through the implementation of the OU-II Remedial Investigation and Feasibility Study (RI/FS) Work Plan. The OU-II RI/FS is designed to investigate the potential impact of the Old Wastewater Treatment Plant and the lagoon on ground water and surface water and on sediment in the Hudson River. The purpose of the ground water recovery wells would be to lower ground water elevations within the remediated lagoon area relevant to ground water levels in the aquifer surrounding the lagoon so as to maintain hydraulic control. The ability of the ground water recovery wells to maintain hydraulic control would be monitored using the piezometers to be installed as part of the remedy. The air sparging and vacuum extraction system would be activated if required under future NYSDEC petroleum-related programs or if the containment components of the remedy are not effective in preventing future impacts to ground water.

The existing ground water data indicate the presence of dissolved organic compounds and inorganic constituents. The dissolved organic compounds are indicative of petroleum hydrocarbons, but the reported concentrations do not suggest a notable impact to ground water, despite the fact that the lagoon has been unlined, uncovered and in operation for most of its twenty year history. Moreover, the majority of the data indicate that the concentration of organic compounds and inorganic constituents are higher in the monitoring wells upgradient of the lagoon. This data supports the conclusion that the residual organic compounds and inorganic constituents in Zone B2 and C soil are not having a notable impact on the ground water quality in the vicinity of the lagoon. Consequently, this proposed remedial approach will be more than adequate to protect existing ground water quality and to collect any free product which may accumulate on the water table surface beneath the lagoon area.

1.0 *INTRODUCTION*

This document outlines the conceptual elements of a comprehensive remedial approach to the former wastewater equalization lagoon component of Operable Unit No. I (OU-I) of the New York State Inactive Hazardous Waste Site (Site No. 3-60-010) located at the Harmon Railroad Yard, Croton-On-Hudson, New York. It's location is shown in Figure 1-1.

The former wastewater equalization lagoon consists of an approximately 1.4 acre lagoon and adjacent pond system. Use of the term lagoon in this document refers to the entire 1.4 acre lagoon and pond system. The lagoon and adjacent areas are shown in Figure 1-2.

The proposed remedial approach presented in this document incorporates elements to ensure compliance with the remedy as described in the Record of Decision (ROD) issued by the New York State Department of Environmental Conservation (NYSDEC) Division of Hazardous Waste Remediation (DHWR) in September, 1992. Other components of OU-I (i.e., enhancement of the existing free-product recover system and demolition of the Old Wastewater Treatment Plant) will be performed in accordance with the ROD as described in Sections 2.5 and 2.6 of the Preliminary Design Report (ERM-Northeast 1993c). Hence, these other components of the OU-I remedy are not discussed in this document but are addressed in separate documents submitted to the NYSDEC (ERM-Northeast 1993b; ERM-Northeast 1994c). The remedial approach for the lagoon which is presented in this document, however, simultaneously addresses the PCB-driven requirements of the ROD as well as any potential requirements of the NYSDEC Bureau of Spill Prevention and Response related to the presence of petroleum hydrocarbons in Zone B2 and Zone C soil.

The conceptual remedial approach described in this document is the basis for Metro-North Commuter Railroad (Metro-North) moving forward with the final remedial design for remediation of OU-I. The conceptual remedial elements represent the approach to remediation of the lagoon which Metro-North proposes to implement in order to meet its obligations to the NYSDEC Division of Hazardous Waste Remediation and the Bureau of Spill Prevention and Response.

1.1 COMPREHENSIVE REMEDIAL APPROACH OBJECTIVES

The basic objective of the remedial approach is to integrate engineering components during the cleanup of the lagoon in order to comply with the remedy described in the ROD for OU-I and comply with any potential remedial requirements that the NYSDEC deems necessary to address residual petroleum hydrocarbons. The conceptual remedial approach was formulated after the decision of the NYSDEC that remediation of chemicals present in soil below the former waste water lagoon would require approval of two separate sections within the agency: the Division of Hazardous Waste Remediation and the Bureau of Spill Prevention and Response.

The ROD for OU-I identified remedial requirements for sludge and for four soil zones, defined as follows (refer to Figure 1-3):

Zone A. Zone A soil refers to the top two feet of surface soil and containing Polychlorinated Biphenyls (PCBs) in concentrations in excess of 0.5 mg/kg. The horizontal extent of Zone A soil, based on the results of the 1989 Remedial Investigation (RI) report (Hart 1989), were defined in Figure A-5 of the ROD. The horizontal boundary of Zone A soil presented in Figure A-5 of the ROD has been modified slightly and is shown on Figure 1-4. The modification consisted of a minor extension of the horizontal boundary of Zone A soil shown in the ROD figure in order to create straighter boundaries that are easier to physically excavate and control in the field.

Zone B1. Zone B1 soil is defined in the ROD as the unsaturated subsurface soil (i.e., at a depth greater than two feet) beneath Zone A extending down to the seasonal high ground water table (refer to Figure 1-3). The ROD requires disposal of soil in Zone B1 containing PCBs in concentrations greater than 10 mg/kg at an off-site landfill. None of the Zone B1 soil samples collected and analyzed as part of the Pre-Design Test Boring Program discussed in Section 2.0 contained PCBs in concentrations greater than 10 mg/kg. As a result, the NYSDEC Division of Hazardous Waste Remediation has decided that there is no need to remove Zone B1 soil and this proposed remedial approach does not include any additional actions regarding Zone B1 soil.

Zone B2. Zone B2 soil is defined in the ROD as the unsaturated soil beneath the lagoon sludge extending down to the seasonal high ground water table (refer to Figure 1-3). The ROD requires disposal of soil in Zone B2 containing PCBs in concentrations greater than 10 mg/kg at an off-site landfill. None of the Zone B2 soil samples collected and analyzed as part of the Pre-Design Test Boring Program discussed in Section 2.0 contained PCBs in concentrations greater than 10 mg/kg. As a result, the NYSDEC Division of Hazardous Waste Remediation has decided that there is no need to remove Zone B2 soil based on the remedy described in the ROD. The elements of the proposed remedial approach discussed in Section 3.2 are designed to address any potential remedial requirements of the Bureau of Spill Prevention and Response related to the presence of petroleum hydrocarbons in Zone B2 soil.

However, the quantity of Zone B2 soil when ground water is at a seasonal high level is limited. The seasonal high ground water level was approximated to be 6.9 feet above mean sea level (MSL). Refer to Section 3.2 of the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a). This elevation (i.e., 6.9 feet above MSL) when shown on the lagoon cross-sections presented in Section 2.0 demonstrates that little, if any, Zone B2 soil is present. As a result, the elements of this proposed remedial approach designed to address any potential requirements of the Bureau of Spill Prevention and Response primarily relates to the saturated soil in Zone C containing petroleum hydrocarbons.

Zone C. The ROD defines Zone C soil as the saturated soil below Zone B2 soil (refer to Figure 1-3). As discussed above, most of the soil beneath the sludge is Zone C soil. The ROD requires disposal of soil in Zone C containing PCBs in concentrations greater than 10 mg/kg at an off-site landfill. None of the Zone C soil samples collected and analyzed as part of the Pre-Design Test Boring Program discussed in Section 2.0 contained PCBs in concentrations greater than 10 mg/kg. As a result, the NYSDEC Division of Hazardous Waste Remediation has decided that there is no need to remove Zone C soil based on the remedy described in the ROD. The elements of the proposed remedial approach discussed in Section 3.2 are designed to address any potential remedial requirements of the Bureau of Spill Prevention and Response related to the presence of petroleum hydrocarbons in Zone C soil.

The NYSDEC Division of Hazardous Waste Remediation has imposed remedial requirements on Metro-North, under the ROD for OU-I, which involve the removal of sludge which is currently present in the former wastewater lagoon and contains PCBs. Once removed, the sludge will be transported off-site via rail for incineration at a TSCA permitted facility.

Additionally, in accordance with the ROD and as described above, the remedy will address surface soil around the former wastewater lagoon where PCB concentrations are in excess of 0.5 mg/kg (i.e., Zone A soil).

As discussed above, the soils beneath the sludge in the former wastewater lagoon, defined as Zone B2 (unsaturated soils) and Zone C (saturated soils) in the ROD, do not contain PCBs in excess of the cleanup levels specified in the ROD for subsurface soil (i.e., 10 mg/kg). Hence, the NYSDEC Division of Hazardous Waste Remediation has decided that the ROD does not require remediation of these soils. However, the soils in Zone B2 and C were found to contain chemicals that are primarily related to petroleum hydrocarbons. The presence of these residual petroleum hydrocarbons in Zone B2 and C soil fall under the authority of the NYSDEC Bureau of Spill Prevention and Response.

Therefore, this document describes the elements of a conceptual remedial approach that: (1) complies with the NYSDEC Division of Hazardous Waste Remediation decision regarding the requirements of the ROD to address PCBs; and (2) satisfies any NYSDEC Bureau of Spill Prevention and Response requirements with respect to the residual petroleum hydrocarbons which will remain in Zone B2 and Zone C soil after sludge removal and closure of the former wastewater lagoon has been completed.

1.2 ORGANIZATION OF DOCUMENT

The remainder of this document is devoted to a summary of data and a description of the conceptual elements of this proposed remedial approach to the former wastewater lagoon. These are covered in Sections 2.0 and 3.0 of this document. Section 2.0 summarizes the Zone B1, B2 and C soil data from the pre-design test boring program. Section 3.0 lists the key components of this proposed remedial approach and identifies the NYSDEC regulatory program each component is designed to address. In particular, Section 3.1

describes the elements of this remedial approach that are intended to comply with the remedy described in the ROD in accordance with the requirements imposed by the NYSDEC Division of Hazardous Waste Remediation. Section 3.2 describes the components of the remedial program that will address the NYSDEC Bureau of Spill Prevention and Response requirements related to the petroleum hydrocarbons that are present in Zone B2 and Zone C soils. Section 3.3 provides a summary of existing ground water information in support of this proposed remedial approach.

2.0 PRE-DESIGN TEST BORING DATA SUMMARY

A Pre-Design Test Boring (PDTB) program was implemented at the lagoon in July 1993. The results were presented in the Pre-Design Test Boring Program Data Summary (ERM-Northeast 1994a). The primary purpose of this program was to assess the quality of soil beneath the sludge (Zones B2 and C). Additionally, soil quality beneath the surface and outside the footprint of the lagoon (referred to as Zone B1 soil) was also assessed as part of the PDTB program.

A total of 14 test borings were drilled during the PDTB program. Two of these borings were drilled outside the footprint of the lagoon to a depth of eight feet below grade. Six samples were collected from these two borings and used to assess the quality of Zone B1 soil. The remaining 12 borings were drilled within the lagoon to depths ranging from 14 to 26 feet below grade. A total of 72 samples were collected from these 12 borings and used to assess the quality of Zone B2 and C soil.

The locations of the borings installed during the PDTB program, along with the existing monitoring well network in the area of the lagoon, are shown in Figure 2-1.

2.1 SUBSURFACE LITHOLOGY

The composition of the subsurface was described based on the collection of soil samples from the three soil horizons (Zones B1, B2 and C). A series of geologic cross-sections, whose locations are shown in Figure 2-2, are based on the subsurface soil characteristics encountered during the drilling of borings in the lagoon. These cross-sections are presented in Figures 2-3, 2-4 and 2-5. In addition to the geologic characteristics, the interpolated seasonal high and low ground water levels are also shown on these cross-sections.

2.1.1 *Zone B1 Lithology*

The upper two feet of soils encountered in the two borings drilled outside the footprint of the lagoon were comprised of sand and gravel with a trace of clay and/or silt. An organic, vegetative layer was present in the upper two inches of this interval. These two borings are designated E.5 and F.5 on Figure 2-1.

The two to eight foot depth interval in these two borings was comprised of sand and gravel mixed with concrete, brick and coal fragments. The materials encountered in the six to eight foot depth interval indicated that Zone B1 is composed of fill at these locations.

2.1.2 *Delineation of Zones B2 and C*

Observations during the boring program indicate that the depth of Zone B2 soil varies as the ground water table fluctuates from season to season. Since the drilling program took place during the summer months, it is likely that the maximum thickness of unsaturated soil beneath the sludge in the lagoon was encountered. Therefore, the only soil beneath the sludge which is unsaturated throughout the year is soil which is above the seasonal high ground water table. The volume of soil which remains unsaturated throughout the year is relatively small, as indicated by the interpolated seasonal high ground water level shown in Figures 2-3, 2-4 and 2-5.

The seasonal high ground water level was approximated to be 6.9 feet above mean sea level (MSL). This approximation was based on a comparison of ground water level measurements from perimeter monitoring wells (WB-4, WB-5, WB-7 and WB-8) during June and October 1989, June and August 1990 and July 1993. (A positive value implies an elevation above MSL while a negative value is below MSL). The highest measurement obtained during this period was from WB-5 (6.9 feet above MSL) in June 1990. Conversely, the lowest ground water elevation measurement obtained during this period was observed in July 1993 in WB-8 (3.3 feet above MSL).

The above ground water level data suggest that Zone B2 may fluctuate over a 3.6 foot interval during the year from an approximate elevation of 6.9 feet above MSL to 3.3 feet above MSL. Therefore, the physical characteristics of the subsurface beneath the lagoon do not allow for a straight forward distinction between Zones B2 and C.

2.1.3 *Zones B2 and C Lithology*

The physical characteristics of the subsurface soils beneath the lagoon are graphically depicted in the geologic cross-sections shown in Figures 2-3, 2-4 and 2-5. These cross-sections are labelled A-A', B-B' and C-C', respectively.

Soil samples collected from the 12 borings drilled within the footprint of the lagoon indicate the sludge layer ranges from approximately four feet above MSL to grade (generally between 9 and 10 feet above MSL). *{Note: A limited number of borings installed during the RI encountered sludge at approximately two feet above MSL.}* The sludge is deepest in the northern central and southern central part of the lagoon. This corresponds to the depiction of the sludge thickness in the Feasibility Study (McLaren/Hart 1992) which shows two conical depressions in these two areas of the lagoon where the sludge has accumulated. It also indicates that in some areas, a portion of the sludge ($\approx$ 3 to 5 feet) is below the expected seasonal high ground water level (6.9 feet above MSL).

Generally, the subsurface materials which were encountered beneath the sludge in the lagoon contained visual and olfactory signs of petroleum. These materials were comprised of fine to coarse sand and gravel intermixed with ash and concrete and brick fragments. The materials were a maximum of 18 feet thick in the test borings drilled along the northern cross-section line extending down to approximately 13 feet below MSL (-13 MSL). The thickness of these materials decreased from north to south across the lagoon. In fact, these materials were observed to be a maximum of only 13 feet thick along the southern cross-section line, extending down to 7 feet below MSL (-7 feet MSL).

The geologic logs indicate the materials beneath the sludge in the lagoon tend to grade to a finer particle size toward the east. This gradation is shown in sections A-A' and B-B'. Additionally, there was less obvious petroleum presence (visual and olfactory), as well as ash, concrete and bricks, in subsurface samples obtained from test borings in the eastern section of the lagoon and the pond. The silt and clay content of the subsurface materials also increased in the eastern borings.

An organic peat layer was encountered beneath the materials under the sludge at many of test boring locations. This peat layer was more consistently identified in the western-most test borings in the lagoon. The peat appeared to contain more sands and silt toward the east. In some test borings (B8, B9, B10, B11 and B12) there was little or no indication of peat.

The surface of the peat appears to slope downward from south to north across the lagoon. This may explain why some of the shallower test borings in the north part of the lagoon and pond did not encounter this layer. One test boring (B1) was advanced below the peat, encountering a fine to medium sand mixed with silt and clay.

2.2 *LABORATORY ANALYSES*

The soil samples were analyzed for target parameters for each of the three soil horizons (Zones B1, B2 and C). These target parameters were developed in conjunction with the NYSDEC Division of Hazardous Waste Remediation. The target parameters in each chemical category for each zone were:

ZONE B1

<u>Volatile Organics</u>	<u>Semi-Volatile Organics</u>	<u>Inorganics</u>
None	2-Methylnaphthalene PCBs	Magnesium

ZONE B2 AND C

<u>Volatile Organics</u>	<u>Semi-Volatile Organics</u>	<u>Inorganics</u>
Ethylbenzene	Naphthalene	Barium
Benzene	1,2-Dichlorobenzene	Cadmium
Toluene	Fluorene	Chromium
Xylenes	Phenanthrene	Copper
Trichloroethene	Fluoranthene	Lead
Chlorobenzene	Dibenzofuran	Magnesium
Dichloroethene	2-Methylnaphthalene	Manganese
Chloroform	PCBs	Mercury
Tetrachloroethene		
Acetone		

As previously mentioned, six samples were analyzed for target volatile organic compounds (VOCs), target semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs) and target inorganics to assess Zone B1 soil. There were 72 soil samples collected from Zone B2 and C and analyzed for target SVOCs, PCBs, target inorganics, and total petroleum hydrocarbons (TPH). The target VOC analysis was performed on 71 of the Zone B2 and C samples while six of the samples were analyzed for toxicity characteristics leaching procedure (TCLP). This latter TCLP analysis was intended to assess whether the soils in Zone B2 and C exhibited the characteristics of a RCRA hazardous waste.

2.3 SUBSURFACE SOIL ANALYTICAL RESULTS

The validated analytical data for subsurface soil samples from the two test borings drilled outside the footprint of the lagoon are indicative of the chemical quality of Zone B1 soil. The validated analytical data for subsurface soils collected below the lagoon constitute the majority of the data. These sample results represent the chemical quality of Zone B2 and C soils.

2.3.1 *Zone B1 Soil Sample Results*

The two test borings drilled to characterize the chemical quality of Zone B1 soil, designated E.5 and F.5, are shown in Figure 2-1. The six samples collected from these two borings were analyzed for the respective target parameter mentioned above.

2.3.1.1 *Target Semi-Volatile Organic Compound (SVOC)*

A summary of the validated target SVOC data is contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-1). The results show that 2-Methylnaphthalene was present in each successive two foot interval from two to eight feet below grade. The concentration of the SVOC ranged from an estimated value of 150 μg/kg to an estimated value of 690 μg/kg.

2.3.1.2 *Target Polychlorinated Biphenyls (PCBs)*

A summary of the validated target PCB data is also contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-1). The results indicate that PCBs were below laboratory detection limits in all the samples collected between the two and eight foot depth interval in the test borings. The detection limits ranged from 36 μg/kg to 41 μg/kg which are considerably below the ROD cleanup level for PCBs in subsurface soil (ROD, page 6) of 10,000 μg/kg (10 mg/kg).

2.3.1.3 *Target Inorganic Constituent*

A summary of the validated target inorganic data is also contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-1). The results show that magnesium was present in each successive two foot interval from two to eight feet below grade. The concentration of magnesium ranged from 1980 mg/kg to 5530 mg/kg.

2.3.2 *Zone B2 and C Soil Sample Results*

The 12 borings drilled within the lagoon, designated B-1 through B-12, are also shown in Figure 2-1. The 72 samples collected from these 12 borings were analyzed for the respective target parameters mentioned above (71 for target VOCs) with the exception that only six samples were analyzed for TCLP.

2.3.2.1 *Target Volatile Organic Compounds (VOCs)*

A summary of the validated target VOC data is contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-2). All the target VOCs, except chloroform, were detected in at least one of the samples. The aromatic hydrocarbons toluene, ethylbenzene and xylene (total) were the predominantly detected VOC constituents. Ethylbenzene was detected in approximately 45% of the samples while toluene and xylene (total) were found in approximately 80% of the samples. The remaining VOCs were present in less than 15% of the samples.

2.3.2.2 *Target Semi-Volatile Organic Compounds (SVOCs)*

A summary of the validated target SVOC data is contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-3). All the target SVOCs were detected in at least one of the samples. The target SVOCs, 2-methylnaphthalene, dibenzofuran, fluorene and phenanthrene were the predominantly detected constituents. These SVOCs were identified in 85%, 74%, 78% and 88% of the samples, respectively. Of the remaining target SVOCs, fluoranthene was detected in 38% of the samples while 1,2-

dichlorobenzene and naphthalene were found in approximately 15% and 14% of the samples, respectively.

2.3.2.3 *Target Polychlorinated Biphenyls (PCBs)*

A summary of the validated target PCB data is contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-4). The 72 subsurface soil samples were analyzed for seven PCB aroclors. These were aroclors 1016, 1221, 1232, 1242, 1248, 1254 and 1260. Aroclor 1254 was the only PCB detected in the samples, identified in 82% of the samples. However, all of the reported PCB aroclor 1254 concentrations were below the ROD specified cleanup level of 10 mg/kg.

2.3.2.4 *Target Inorganic Constituents*

A summary of the validated target inorganic data is contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-5). All eight target inorganic constituents were found in one or more of the samples. Barium, chromium, copper, magnesium and manganese were found in virtually all the samples which were analyzed. Lead was detected in approximately 65% of the samples while cadmium and mercury were present in 21% and 10% of the samples, respectively.

2.3.2.5 *Total Petroleum Hydrocarbons (TPH)*

A summary of the TPH data is contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-6). There was measurable TPH in 66 of the 72 samples analyzed ($\approx$ 92%). The detected concentrations ranged from 30 mg/kg to 83,000 mg/kg. In most instances, the TPH levels decrease with increasing depth.

2.3.2.6 *Toxicity Characteristics Leaching Procedure (TCLP)*

The TCLP analyses were added to the PDTB program after the samples had already been collected and sent to the designated laboratory. Consequently, the holding times for these samples were exceeded. Nevertheless, the analyses were performed and can be relied upon as a reasonable indication of the hazardous characteristics of soil in Zones B2 and C.

A summary of the validated TCLP data is contained in the Pre-Design Test Boring Data Summary Report (ERM-Northeast 1994a, Table 4-7). The TCLP data indicate that the subsurface soils are not a RCRA characteristic hazardous waste.

2.4 *SOIL DATA EVALUATION AND REGULATORY CONCLUSIONS*

The PDTB soil data indicated that none of the samples exhibited PCBs above the cleanup level specified in the ROD for OU-I. The predominant parameters that were identified in the samples were aromatic VOCs and a class of SVOCs commonly referred to as polynuclear aromatic hydrocarbons (PAHs). Both the aromatic VOCs and PAHs identified in the samples are consistent with petroleum products or their derivatives. This assessment is consistent with the TPH results and observations during drilling which confirm that the soil beneath the lagoon (Zones B2 and C) has been impacted predominantly by the release of petroleum hydrocarbons.

Based on the PDTB data, the NYSDEC Division of Hazardous Waste Remediation concluded that the soil contained in Zone B1 did not require remediation pursuant to the ROD for OU-1. Additionally, the NYSDEC Division of Hazardous Waste Remediation concluded that since the soil in Zone B2 and C did not contain PCBs in excess of the stated cleanup level (10 mg/kg), no remediation was required pursuant to the ROD for OU-1. However, due to the presence of petroleum hydrocarbons in Zone B2 and C soil, the NYSDEC Division of Hazardous Waste Remediation has referred the disposition of soil in Zones B2 and C to the NYSDEC Bureau of Spill Prevention and Response.

The PDTB soil data permitted the NYSDEC Division of Hazardous Waste Remediation to determine the scope of the remedial action to comply with the remedy described in the ROD for OU-I. The elements of that remedial action are described in Section 3.1 of this document. However, any additional requirements imposed by the NYSDEC Bureau of Spill Prevention and Response for addressing Zones B2 and C soils would, for logistical reasons, have to be finalized prior to the implementation of the OU-1 remedy. Therefore, Section 3.2 of this document outlines the components of this proposed remedial approach which address Zones B2 and C soil in order to comply with any requirements that may be imposed by the NYSDEC Bureau of Spill Prevention and Response.

3.0 COMPREHENSIVE REMEDIAL APPROACH: KEY ELEMENTS

The key elements of the comprehensive remedial approach proposed by Metro-North for the former wastewater lagoon at the Site and the NYSDEC regulatory program which each element addresses (i.e., Division of Hazardous Waste Remediation or Bureau of Spill Prevention and Response) are as follows:

1. **Sludge Incineration.** Removal of sludge and transportation via rail for incineration at an off-site TSCA-approved facility. {Division of Hazardous Waste Remediation}

2. **PCB Soil Disposal.** Removal of Site soil containing PCBs in concentrations greater than 10 mg/kg and transportation via rail for disposal at an off-site RCRA Subtitle D landfill. The only Site soil containing PCBs in concentrations greater than 10 mg/kg is located in Zone A. {Division of Hazardous Waste Remediation}

3. **Liner Requirements.** Placement of a low permeability liner over the remediated lagoon area. {Division of Hazardous Waste Remediation}

4. **Zone A Soil Relocation.** Relocation of Zone A soil containing PCBs in concentrations from 0.5 mg/kg to 10 mg/kg to the remediated lagoon area. {Division of Hazardous Waste Remediation}

5. **Backfill Requirements.** Placement of uncontaminated soil (backfill) over relocated Zone A soil to existing grade or to a proposed subgrade, depending on the future use of the remediated lagoon area. {Division of Hazardous Waste Remediation}

6. **Cover Requirements.** Placement of a low permeability cover over the relocated Zone A soil and other backfill soil in the remediated lagoon area. {Division of Hazardous Waste Remediation}

7. **Grouted Sheeting.** Installation of grouted sheeting around the perimeter of the sludge to provide slope stability during sludge removal and to provide hydraulic control of ground water beneath the lagoon. {Primary: Division of Hazardous Waste Remediation (slope stability); Secondary: Bureau of Spill Prevention and Response (hydraulic control)}

8. **Recovery Wells.** Installation of ground water and non-aqueous phase liquid (NAPL) recovery wells to: (1) provide additional hydraulic control of ground water beneath the lagoon, if needed based on the results of the Operable Unit II Remedial Investigation and Feasibility Study (OU-II RI/FS); and (2) to remove product, if accumulation of NAPL occurs after well installation. {Bureau of Spill Prevention and Response}

9. **Piezometers.** Installation of piezometers inside and outside of sheeting to measure ground water levels if ground water recovery wells are activated to provide hydraulic control. {Bureau of Spill Prevention and Response}

10. **Air Sparging and Vacuum Extraction Piping Components.** Installation of: (1) air sparging piping and headers; and (2) vacuum extraction system components, including crushed stone and piping. Activation of this system will depend on the need, if any, to reduce the concentration of petroleum related chemicals in Zone B2 and Zone C soil. {Bureau of Spill Prevention and Response}

These remedial components are described in more detail in Section 3.1 (Division of Hazardous Waste Remediation requirements) and Section 3.2 (Bureau of Spill Prevention and Response requirements). The components of the proposed remedial approach are also shown on the typical cross-section presented as Figure 3-1.

3.1 REMEDY COMPONENTS REQUIRED BY THE ROD (DHWR)

The components of the remedy required by the Division of Hazardous Waste Remediation for the former wastewater lagoon at the Site are defined in the September 1992 ROD. These components have been incorporated into the proposed remedial approach and are described below in Sections 3.1.1 through 3.1.7.

3.1.1 Sludge Incineration

The ROD calls for incineration of lagoon sludge at an off-site stationary incinerator that is permitted under the Toxic Substances and Control Act (TSCA). In response, the proposed remedial approach includes the excavation and transportation via rail to one or more of the off-site TSCA-permitted incinerators identified in Section 3.7.1 of the Preliminary Design Report (ERM-Northeast 1993c). Pre-acceptance sludge samples have been analyzed by each of the TSCA-permitted incinerators. The sludge from the lagoon has been accepted by all facilities for incineration.

Vertical sheeting will be installed at the outer perimeter of the sludge. The outer perimeter or horizontal extent of the sludge was determined in the field and surveyed in October 1993. The sheeting will facilitate sludge removal by stabilizing the soil and buildings adjacent to the lagoon and, with the addition of certain modifications (grouting and extended depth) described later in this document in Section 3.1.7, will also provide hydraulic control of ground water beneath the lagoon. Information collected from the Pre-Design Test Boring

Program and surface elevation information collected during a land survey completed in October 1993 were used to estimate that approximately 4,500 cubic yards of sludge will require removal for off-site incineration.

The horizontal extent of the sludge will be determined by the sheeting. The vertical extent of the sludge will be defined based on the results of the Pre-Design Test Boring Program and on sludge depth information collected during the RI (see Appendix A). The procedures to be used to remove and dispose of sludge is defined in Section 3.2 of the Preliminary Design Report (ERM-Northeast 1993c).

3.1.2 PCB Soil Disposal

The ROD calls for disposal of soil containing PCBs in concentrations greater than 10 mg/kg at an off-site TSCA-permitted landfill. The RI and pre-design sampling of the four soil zones at the Site (i.e., Zones A, B1, B2 and C) demonstrated that none of the soil in Zones B1, B2 or C contained PCBs in concentrations greater than 10 mg/kg. The NYSDEC has decided that based on the existing data, the ROD does not require removal of soil from these soil zones (i.e., Zones B1, B2 and C).

The only Site soil containing PCBs in concentrations greater than 10 mg/kg is located in Zone A. (See Figure 1-4.) Two Zone A surface (0 to 9 inches) soil samples from the 1989 RI (Hart 1989) sampling (i.e., sample F-5 at 18 mg/kg and sample F-6 at 26 mg/kg) and one Zone A surface (0 to 9 inches) soil sample from a 1992 pre-design investigation (i.e., sample G-4 at 12 mg/kg) contained PCBs in concentrations greater than 10 mg/kg. The extent of Zone A soil containing PCBs in concentrations greater than 10 mg/kg has been initially delineated as shown on Figure 1-4 and will be verified as part of this proposed remedial approach during the pre-construction confirmation sampling described in Section 3.3.1 of the Preliminary Design Report (ERM-Northeast 1993c).

In accordance with the ROD, all Zone A soil found to contain PCBs in concentrations exceeding 10 mg/kg will be excavated and transported via rail for disposal at one or more of the off-site RCRA Subtitle D landfills identified in Section 3.7.3 of the Preliminary Design Report (ERM-Northeast 1993c). Any soil containing PCBs in concentrations exceeding 50 mg/kg will be disposed of in a TSCA-permitted landfill.

3.1.3 Liner Requirements

The ROD calls for the placement of a clay liner over the remediated lagoon area to ensure that Site soils are separated from high ground water by at least two feet. As discussed in the Remedial Design and Remedial Action Work Plan (ERM-Northeast 1993a) and the Preliminary Design Report (ERM-Northeast 1993c), this proposed remedial approach will satisfy this requirement with the installation of a liner system comprised of the following elements (see Figure 3-1), described from the bottom (i.e., adjacent to the remaining Zone B2 soil) to the top of the liner system:

- Remaining Zone B2 soil is to be regraded to provide a level surface for liner installation. It is estimated that the surface of the regraded Zone B2 soil after regrading will be at an approximate elevation of 7 feet above MSL. This elevation also represents the seasonal high ground water level recorded at the Site. Refer to Section 2.0 for discussion of ground water levels. As discussed in Section 1.1 of this document and as shown on the cross-sections in Section 2.0 (i.e., Figures 2-3, 2-4 and 2-5), little, if any, Zone B2 soil is present during periods of high ground water levels.

- A layer of uncontaminated soil will (approximately two feet thick) be placed over the regraded Zone B2 soil. The thickness of this uncontaminated soil layer will vary based on the final elevation of the regraded Zone B2 soil (approximately 7 feet above MSL). The surface of this uncontaminated soil layer will be at an approximate elevation of 9 feet above MSL.

- A layer of crushed stone approximately two feet in thickness will be placed above the regraded Zone B2 and Zone C soil. This two foot thick layer of crushed stone above the regraded Zone B2 and Zone C soil, in addition to the perforated piping to be installed within this layer, will also function as part of the vacuum extraction system described later in Section 3.2.3. The surface of this crushed stone layer will be at an approximate elevation of 11 feet above MSL.

- An impermeable geomembrane liner will be placed above the crushed stone layer. A 40 mil high density polyethylene (HDPE) liner will be used as the impermeable geomembrane material. As discussed in Section 2.9 of the Preliminary Design Report (ERM-Northeast 1993c), HDPE is used in the design of the liner in place of clay because, in comparison to clay, HDPE is less permeable, easier to install, and more resistant to the chemicals present in soil that is to remain in the remediated lagoon area. In addition, as shown in Table 3-1 of the Preliminary Design Report (ERM-Northeast 1993c), the liner design using HDPE presented here is less costly than a liner design using clay. A geotextile layer will be placed between the liner and the crushed stone to protect the liner from the crushed stone.

- A one foot thick layer of uncontaminated fill will be placed above the HDPE liner. This layer will primarily serve to protect the HDPE liner during the placement of additional fill material and relocated Zone A soil.

The liner will be installed over the lagoon area presently occupied by sludge and will extend to the interior surface of the sheeting. This area will be circumscribed by the installation of sheeting. This sheeting will be installed prior to the removal of sludge and the placement of the liner system. The sheeting is to be installed for structural reasons, i.e., to ensure that perimeter soil and wastewater treatment plant buildings adjacent to the lagoon are not disturbed during sludge removal and the regrading of Zone B2 and Zone C soil. As described in Section 3.1.7, the design of this sheeting will be modified to also provide hydraulic control of the saturated Zone C soil to remain in the remediated lagoon area. These design modifications include an increase in the depth of the sheeting and the use of grouted sheeting.

The liner components described above will be installed within the confines of the sheeting described in Section 3.2.1. The horizontal extent of the liner, then, will extend over the area presently occupied by the sludge in the lagoon and the adjacent pond.

3.1.4 Relocation of Zone A Soil

The ROD calls for the excavation, placement and consolidation of surface soil containing low (i.e., less than 10 mg/kg) concentrations of PCBs in the remediated lagoon area. This proposed remedial approach satisfies this requirement by including the excavation of Zone A soil containing PCBs in concentrations ranging from 0.5 mg/kg to 10 mg/kg, as shown on Figure 1-4 and the relocation of this excavated Zone A soil to the remediated lagoon area. Refer to typical cross-section, Figure 3-1. The remediated lagoon area is defined here as the lagoon area after the sheeting is installed, Zone B2 and Zone C soil has been regraded and the liner system has been installed.

The horizontal extent of Zone A soil containing PCBs in concentrations greater than 0.5 mg/kg, based on the results of the 1989 RI (Hart 1989), were defined in Figure A-5 of the ROD (also refer to Figure 1-4 of this report). The ROD also defined the top two feet of soil as the vertical extent of Zone A soil. The horizontal extent of Zone A soil containing PCBs in concentrations greater than 0.5 mg/kg will be defined as part of this proposed remedial approach during the pre-construction confirmation sampling described in Section 3.3.1 of the Preliminary Design Report (ERM-Northeast 1993c).

3.1.5 *Backfill Requirements*

Uncontaminated fill will be placed between the relocated Zone A soil and the cover system described in Section 3.1.6. It was estimated that the regrading of Zone B2 and Zone C soil, the installation of the liner (i.e., two feet of crushed stone, HDPE liner, and one foot of uncontaminated fill) and the relocation of Zone A soil will raise the elevation of the remediated lagoon area to approximately 13 feet above MSL. The elevation of the ground surface surrounding the lagoon is approximately 19 feet above MSL. In order to ensure that storm water does not remain standing over the remediated lagoon area, approximately 6 feet of additional soil (i.e., 19 feet vs. 13 feet above MSL) must be added to raise the surface elevation of this area.

Approximately two feet of this additional soil will be installed as part of the cover system described in Section 3.1.6. As a result, approximately 12,000 cubic yards of uncontaminated fill will be placed between the relocated Zone A soil and the bottom of the cover system in order to obtain final grade. The term uncontaminated fill means a well graded soil which is certified to be uncontaminated by the supplier and is obtained from an off-site source.

3.1.6 *Cover Requirements*

The ROD calls for the placement of a clay cover over the low level PCB soil that is to be placed in the remediated lagoon area. As discussed in the Remedial Design and Remedial Action Work Plan (ERM-Northeast 1993a) and the Preliminary Design Report (ERM-Northeast 1993c), this proposed remedial approach will satisfy this requirement with the installation of a cover system comprised of the following elements (see Figure 3-1) described from the bottom (i.e., in contact with backfill soil described in Section 3.1.5) to the top (surface) of the cover system:

- The uncontaminated backfill soil used to bring the remediated lagoon area to within approximately two feet of final grade will be graded to a one to three percent slope to the perimeter of the remediated lagoon area.

- A protective non-woven geotextile will be placed above the regraded uncontaminated fill layer followed by the installation of an impermeable geomembrane liner (i.e., 40 mil HDPE). As shown on Figure 3-1, the liner will be extended horizontally over and at least five feet beyond the sheeting to be installed at the perimeter of the lagoon (see Section 3.1.7). This liner will also be installed at a one to three percent slope.

- A drainage net constructed of HDPE and topped with a non-woven geotextile will be installed above the impermeable HDPE liner described above. Storm water that infiltrates to the drainage net from the surface asphalt layer (described below) will collect in the drainage net and will flow along the top of the liner to subsurface soil located beyond the perimeter of the remediated lagoon area (i.e., beyond the sheeting).

- An 24 inch thick layer of uncontaminated fill material will be placed over the drainage net. This fill layer will be graded to conform to the requirements of the final grade. An HDPE geogrid will be placed within this fill layer to improve the bearing capacity of the asphalt pavement described below. The geogrid will dissipate surface loading forces to provide additional support to the asphalt pavement and to prevent impacts to the impermeable HDPE liner.

- The cover system will then be completed by the installation of a six inch thick asphalt pavement over the remediated lagoon area. The asphalt pavement will consist of a base layer of crushed stone, a layer of binder course asphalt and a wearing or surface course of asphalt. The asphalt pavement will divert more precipitation away from the drainage net and HDPE liner, and from the remediated lagoon area, than would a topsoil and vegetative cover.

- The final asphalt surface of the lagoon area, and the underlying drainage net located above the geomembrane cap, will be sloped to control surface water runoff. All precipitation which falls on the asphalt pavement or infiltrates to the impermeable cap and drainage net will be transferred via a combination of drainage swales and conveyance piping and discharged to the Hudson River. The appropriate modifications to the existing Harmon Yard State Pollution Discharge Elimination System (SPDES) stormwater discharge permit (or, if necessary, a new permit) will be requested from the NYSDEC with the Pre-Final Design Submittal.

This cover system will be installed beyond the horizontal extent of the remediated lagoon area. The cover will serve to divert most if not all precipitation from the Zone A soil to be relocated to the remediated lagoon area and from the Zone B2 and Zone C soil that is to remain in place. The cover will divert precipitation from the remediated lagoon area in two ways: (1) most of the precipitation falling on the area will be diverted by the asphalt pavement to be installed as the surface of the cover; and (2) precipitation that does infiltrate into the 24 inches of uncontaminated fill to be installed as part of the cover will be diverted by the 40 mil HDPE liner and drainage net. In this way, precipitation will be diverted to the surface and subsurface soil located beyond the perimeter of the remediated lagoon area.

3.1.7 *Sheeting Requirements (Design Modifications)*

Vertical sheeting will be installed at the outer perimeter of the sludge in both the lagoon and the adjacent pond. The outer perimeter or horizontal extent of the sludge was determined in the field and surveyed in October 1993. This surveyed delineation of sludge and the location of the sheeting will be shown on the final design drawings. The horizontal extent of sludge and the sheeting location will be approved by the NYSDEC Site representative prior to driving the sheeting.

The sheeting will be driven to the approximate depth of the peat layer or the fine sand, silt with clay layer located beneath the lagoon area. These layers (see cross-sections, Figures 2-3, 2-4, and 2-5) were identified during the Pre-Design Test Boring Program. The peat and the fine sand, silt with clay layers typically exhibit a lower permeability than the Zone B2 and Zone C soil lithology, i.e., the fine to coarse sand and gravel. The sheeting installation will incorporate a grouting technique that will prevent or significantly reduce the movement of ground water through the sheeting.

The sheeting will facilitate sludge removal by stabilizing the soil and buildings adjacent to the lagoon. This work is required to comply with ROD requirements for sludge removal (Division of Hazardous Waste Remediation). By including certain design modifications, installation of the sheeting will also satisfy any potential requirements of the Bureau of Spill Prevention and Response. The design modifications include the use of grouting and the increase in the depth of the sheeting. The purpose of these design modifications is to contain the petroleum hydrocarbons in Zone B2 and Zone C soil by providing a barrier to the potential migration of the chemicals to ground water downgradient of the lagoon. Although the sheeting is not designed to completely encapsulate Zone B2 and Zone C soil, it will significantly decrease the movement of ground water through this soil. The sheeting provides a physical barrier to ground water movement. Upgradient shallow aquifer ground water (refer to Section 3.3.1) will move horizontally around the sheeting to continue its general flow direction toward the Hudson River. The ground water in Zone C soil will remain in place, unless the ground water recovery wells described in Section 3.2.1 are activated to maintain hydraulic control.

As discussed in Section 3.3, the concentration of organic compounds and inorganic constituents in ground water were higher in ground water monitoring wells that were hydraulically upgradient of the lagoon than in wells downgradient of the lagoon. This data is used in Section 3.3 to conclude that the chemicals present in Zone B2 and Zone C soil are not having a notable impact on ground water quality in the vicinity of the lagoon.

3.2 *REMEDY COMPONENTS TO ADDRESS PETROLEUM HYDROCARBONS*

As discussed in Section 2.4, Zone B2 and Zone C soil did not contain PCBs in concentrations above the ROD cleanup level of 10 mg/kg but did contain aromatic VOCs and a class of SVOCs commonly referred to as PAHs, both of which are consistent with petroleum products or their derivatives. As a result, the Division of Hazardous Waste Remediation concluded that Zone B2 and Zone C soil did not require remediation pursuant to the ROD for OU-I but are coordinating decisions regarding potential remedial requirements for this soil to the Bureau of Spill Prevention and Response. This section outlines the components of the proposed remedial approach that are designed to comply with any remedial requirements for Zone B2 and Zone C soil that may be imposed by the Bureau of Spill Prevention and Response. The components of the remedy designed to address petroleum hydrocarbons in this soil are:

- ground water and NAPL recovery wells (Section 3.2.1);
- piezometers (Section 3.2.2); and
- air sparging and vacuum extraction piping components (Section 3.2.3).

3.2.1 Ground Water and NAPL Recovery Wells

As shown in Figure 3-1, the proposed remedial approach includes the installation of ground water and NAPL recovery wells within the remediated lagoon area to be circumscribed by the sheeting described in Section 3.1.7. The number, spacing and location of these wells will be defined during final design. The well screens will be placed to intersect the high and low seasonal ground water tables.

The wells will be designed to recover both ground water and NAPL. NAPL, also known as floating product, was not encountered in the lagoon area during the Pre-Design Test Boring Program. However, the presence of total petroleum hydrocarbon (TPH) concentrations described in Section 2.3.2.5 are an indication that floating product may accumulate in wells installed in this area. The wells will be installed through the liner components, the backfill soil and the cover components, as shown in Figure 3-1. The wells will be connected through a series of header pipes to a central collection point.

The wells are to be installed as a contingency only. Ground water and NAPL recovery pumps will not be installed at this time. The need to activate the NAPL recovery component of these wells will depend on whether a recoverable quantity of NAPL accumulates in these wells after the remedy has been completed. The decision to activate these NAPL recovery wells would be made by the NYSDEC Bureau of Spill Prevention and Response in conjunction with Metro-North. Activation includes the design, installation and operation of NAPL recovery systems (i.e., pumps and associated mechanical, electrical and instrumentation equipment) and storage systems where recovered NAPL would accumulate and be tested prior to disposal.

The need, if any, to activate the ground water recovery wells will depend on the results of the OU-II Remedial Investigation and Feasibility Study (RI/FS). This work is defined in the OU-II RI/FS Work Plan (ERM-Northeast 1994b) submitted to the NYSDEC Division of Hazardous Waste Remediation. One of the purposes of the OU-II RI/FS is to investigate the possible impact of past releases from the lagoon on ground water.

The ground water recovery wells would be activated if: (1) it is determined that the hydraulic control provided by the sheeting, liner and cover components of the lagoon remedy need to be enhanced; or (2) in the unlikely event that the results of the OU-II RI/FS determine that the chemicals in Zone B2 and Zone C soil are impacting ground water in the lagoon area. The decision to activate these ground water recovery wells would be made by the NYSDEC Division of Hazardous Waste Remediation or the Bureau of Spill Prevention and Response, in conjunction with Metro-North. Activation includes the design, installation and operation of: (1) ground water recovery systems (i.e., pumps and associated mechanical, electrical and instrumentation equipment); and (2) ground water treatment and discharge.

The only remedial goal for which these ground water recovery wells will be designed and operated is to provide hydraulic control of ground water beneath Zone B2 soil and within Zone C soil. Hydraulic control would be provided by maintaining ground water within the limits of the remediated lagoon area (i.e., within the area circumscribed by the sheeting) at a level lower than that of ground water in soil adjacent to the lagoon. Monitoring the ability of the ground water recovery wells to maintain this hydraulic control would be performed through the use of piezometers, described below.

3.2.2 Piezometers

Piezometers, or hydraulic monitoring wells, will be used to measure the effectiveness of ground water recovery wells in maintaining hydraulic control should activation of ground water recovery wells be required. Hydraulic monitoring would be performed if, for the reasons discussed earlier in Section 3.2.1, the NYSDEC, in conjunction with Metro-North, decides that activation of ground water recovery wells is necessary. The number, spacing and location of piezometers to be installed for hydraulic monitoring will be determined during final design. The piezometers will be installed near the sheeting and will be installed in pairs, i.e., one piezometer will be installed on the inside of the sheeting and one piezometer will be installed on the outside of the sheeting.

The piezometers will be two inches in diameter and of appropriate length to intersect the water table. If ground water recovery is to be designed and operated, a method for measuring water levels in the piezometers will be determined at that time. The results of the hydraulic monitoring will be used to determine if the rate of pumping from the ground water recovery wells needs to be adjusted to maintain ground water levels within the sheeting at a level lower than ground water levels in soil adjacent to the lagoon.

3.2.3 Air Sparging and Vacuum Extraction Piping Components

The proposed remedial approach includes the installation of piping for an air sparging and vacuum extraction system. A two foot thick layer of crushed stone is also included as part of the vacuum extraction system. The piping and crushed stone components of this system, as shown in Figure 3-1, will be installed as a contingency to provide remediation of the chemicals in Zone B2 and Zone C soil in the unlikely event that it is determined that those soils are impacting ground water. The decision to activate this system would be made by the NYSDEC Bureau of Spill Prevention and Response in conjunction with Metro-North based on future remediation requirements.

Activation of the air sparging component of this system includes the design, installation and operation of one or more compressors to provide compressed air to the air sparging wells. Activation of the vacuum extraction component of this system includes the design, installation and operation of one or more blowers to impart a vacuum to the crushed stone layer and perforated piping.

The need, if any, for air pollution controls would be determined through the pilot testing of the combined air sparging and vacuum extraction system. This pilot testing would be performed if the NYSDEC, in conjunction with Metro-North, decides to activate the system.

As described earlier, the primary approach to remediation of the petroleum hydrocarbons in Zone B2 and Zone C soil is the containment provided by the use of the sheeting, liner and cover components of the remedy, and, if necessary, by the activation of the ground water recovery system described in Section 3.2.1. The piping and crushed stone components of the air sparging and vacuum extraction system are included in the proposed remedial approach as an additional contingency measure and would be activated if one or two of the following conditions occur:

1. the NYSDEC adopts and retroactively applies to petroleum spill sites a requirement that the concentration of petroleum hydrocarbons in saturated and unsaturated soil be reduced; or

2. the containment measures described above are not effective in preventing future impacts to ground water.

Air sparging operates by injecting air into the saturated zone of an aquifer. Chemicals in soil are removed in one of two ways. They are either volatilized into the air bubbles introduced by the sparging system or they are metabolized by microbes naturally present in soil. The latter refers to the biological activity, or bioremediation, that is enhanced by the addition of oxygen to the subsurface soil by the sparging system. The reduction in the ground water concentration of these chemicals caused by the sparging system and the physical agitation of soil and chemicals in the saturated zone also increases the rate at which chemicals desorb from soil particles.

Air sparging also increases the mixing of ground water in the saturated zone, thus increasing the surface area available for organic compounds to volatilize from ground water. The volatilized organic compounds and the by-products of bioremediation (i.e., primarily carbon dioxide) are transported by the continuous flow of air in the saturated zone to the overlying vadose zone soil. The two foot thick layer of crushed stone and the perforated piping to be installed above Zone B2 soil would remove these chemicals from the unsaturated zone.

Air sparging, if activated, will remove the aromatic VOCs detected in Zone B2 and Zone C soil (refer to Section 2.3.2.1) by volatilizing the compounds into the air phase where they will be removed by the vacuum extraction system components. The concentration of SVOCs, primarily PAHs, and other petroleum hydrocarbon compounds, will be reduced through the bioremediation that will be enhanced by the addition of oxygen (air sparging). Methods to measure the effectiveness of the air sparging and vacuum system would be determined if and when the decision is made to activate this system.

3.3 *SUMMARY OF EXISTING GROUND WATER DATA*

This section of the document discusses the existing ground water data developed from the monitoring wells at the lagoon. The discussion considers both ground water flow and ground water quality.

There have been two ground water sampling events conducted at the lagoon. The initial ground water sampling event was conducted in July 1989 during the remedial investigation and was described in the RI Report (Hart 1989). A subsequent ground water sampling event was conducted in October 1990 (McLaren/Hart 1991). In addition, the estimated ground water flow directions in the shallow and deep portions of the aquifer beneath the lagoon were determined in July 1989 and August 1990.

3.3.1 *Shallow Ground Water Flow*

Measurements collected during the RI in July 1989 indicated that shallow ground water flow beneath the lagoon is generally towards the north-northwest direction, although localized variations in flow direction are present. A shallow ground water flow map is provided in Figure 3-2. It was surmised that the localized variations were due to minimal recharge in the paved areas on the western portion of the lagoon area or possibly some slow recharge from the lagoon (at the time of measurement, the lagoon still received surface water flow) which created a minor mound on the eastern side of the lagoon.

At the time of measurement, the surface water level in the lagoon was higher than the shallow ground water. The low permeability of the lagoon sludge probably prevented significant flow between the lagoon and the shallow ground water zone. However, the limited recharge from the lagoon to the shallow water table may have been enough to create a small mound, particularly where the lagoon sludge is in direct contact with the ground water table.

Another set of shallow ground water level measurements was collected from all of the wells in August 1990. The shallow ground water flow map constructed from the 1990 data is shown in Figure 3-3. The shallow ground water flow map for August 1990 appears somewhat different from the 1989 shallow ground water flow map. Although the general ground water flow direction is still north-northwest, the equipotential lines (contour lines of equal ground water elevation) are more uniform and do not suggest any mounding on the upgradient (south-southeast) side of the lagoon.

3.3.2 *Deeper Ground Water Flow*

The ground water flow in the deeper portions of the water table zone beneath the lagoon is based on measurements collected from four monitoring wells.

These wells are WB-2D, WB-5D, WB-6D and WB-7D. These wells are constructed with five foot lengths of screen placed approximately 30 feet into the ground water zone.

The ground water measurements collected from the four deep wells during the RI in July 1989 are shown in the flow map presented in Figure 3-4. The map indicates that the predominant direction of ground water flow in this deeper zone to be toward the north-northwest, similar as observed in the shallow zone. The flow direction in this deeper zone is more uniform than observed in the shallow zone, absent any of the local variations in the shallow zone caused by the presence of the lagoon.

A second set of ground water level measurements from the four deeper wells was collected in August 1990. A map depicting ground water flow in this deeper zone during the 1990 sampling event is shown in Figure 3-5. The interpretation of ground water flow direction in the deeper zone during August 1990 appears to have changed by approximately 90° from the representation in July 1989. The direction of ground water flow in the deeper zone in 1990 appears to be toward the southwest.

The differences in the observed direction of ground water flow in the deeper zones during these two periods of measurements is due wholly to a significant difference between the July 1989 and August 1990 ground water level measurement in WB-5D. The 1989 and 1990 ground water level data from the other three deeper monitoring wells (WB-7D, WB-6D and WB-2D) were fairly consistent. The reason for the dissimilar measurements in WB-5D in 1989 and 1990 is unknown at this time. However, future scheduled water level monitoring of these deeper wells should resolve the discrepancy.

3.3.3

Vertical Ground Water Flow

At each of the four deep monitoring well locations, there is also a shallow well. The vertical potential for ground water flow can be assessed by comparing the ground water level measurements in the shallow and deep wells at a particular location.

The ground water measurements collected from locations where there is both a shallow and deeper monitoring well suggest that, in general, the vertical ground water flow gradient in the area of the lagoon is upward. Given the proximity of the Hudson River to the lagoon area, ground water flow is expected to move upward and discharge to the Hudson River. This upward ground water flow gradient is significant since it will inhibit the downward migration of any dissolved organic compounds or inorganic constituents from shallower to deeper ground water zones.

3.3.4 *Ground Water Quality*

As previously mentioned, there were two separate ground water sampling events conducted in the area of the lagoon. The first sampling event involved the 12 wells installed during the RI in July 1989. The second sampling event also involved these 12 wells, in addition to WB-9 and WB-10 which were installed in October 1990.

Since floating product was present in two wells (WB-2 and WB-5) during the first round of sampling and four wells in the second round (WB-2, WB-4, WB-5 and WB-9), it was difficult to ensure that no product was introduced into the ground water sample. In fact, the presence of SVOCs and PCBs in water samples collected during both rounds of sampling were attributable to the presence of product in the samples.

3.3.4.1 *Volatile Organic Compounds (VOCs)*

VOCs were detected in the ground water wells during both rounds of sampling. In 1989, chlorobenzene was detected in four of the eight shallow wells in concentrations up to 170 ug/l. The highest concentrations were present in WB-2, WB-3 and WB-5, all hydraulically upgradient of the lagoon. Xylenes were detected in two shallow wells (WB-4 and WB-5) in concentrations of 10 and 42 ug/l, both of which are upgradient of the lagoon.

Chlorobenzene was also detected in all four deep wells in concentrations ranging from 11 to 64 ug/l. The highest concentration was reported in the upgradient well WB-5D. 1,2 Dichloroethene was also detected in two deep wells (WB-5D and WB-6D) at concentrations of 8 and 11 ug/l. Essentially, the same compounds at the same concentrations were detected during the 1990 sampling event.

The distribution of VOCs in the shallow and deep ground water indicate that higher concentrations were found in the hydraulically upgradient wells. Hence, it was concluded in the RI that the lagoon was probably not the source of the VOCs.

3.3.4.2 *Semi-Volatile Organic Compounds (SVOCs)*

During the 1989 sampling event, the SVOCs 2-methylnaphthalene, bis(2-ethylhexyl)phthalate and 1,2 dichlorobenzene were detected in the shallow ground water. The concentrations of these three SVOCs ranged from ND to 27 ug/l, 91 ug/l and 17 ug/l, respectively. The highest concentrations of these three SVOCs were found in WB-2 and WB-5 and may have been related to minor amounts of product being collected with the ground water sample. In any case, both WB-2 and WB-5 are upgradient of the lagoon. Essentially, the same SVOCs were found during the 1990 sampling event. However, several additional SVOCs were found in WB-5 during the 1990 sampling. These additional SVOCs were also attributed to minor amounts of product being collected with this ground water sample.

Several SVOCs were also detected in the deep wells during both rounds of sampling. In 1989, 1,2 dichlorobenzene and fluorene were detected and in 1990, fluorene and dibenzofuran were detected. The concentrations of these compounds ranged from ND to 37 ug/l, values which are close to the detection limit for these compounds.

3.3.4.3 Pesticides and Polychlorinated Biphenyls (PCBs)

During the 1989 sampling event, no pesticides were detected in any of the wells, and Aroclor 1254 was only detected in shallow well WB-5, which is upgradient of the lagoon. This ground water sample was thought to have been cross-contaminated by the floating product and was re-sampled. No PCBs were detected in the re-sample. During the 1990 sampling event, PCBs were again detected in the ground water sample from WB-5 again but were not detected in any of the other wells. As noted during the 1989 round of sampling, the shallow ground water sample collected from WB-5 was most likely contaminated by the overlying oil layer during collection. In contrast to the 1989 data, the following pesticides were detected in the ground water in 1990: heptachlor (ND to 0.11 ug/l), endosulfan II (ND to).18 ug/l), heptachlor epoxide (ND to 0.2 ug/l), 4,4'DDD (ND to 0.24 ug/l) and 4,4'DDE (ND to 0.25 ug/l). The differences in the pesticide concentrations between 1989 and 1990 is due in large part to the reported 1990 concentrations being below the stated detection limit for the 1989 sample analyses.

3.3.4.4 Inorganics

The concentrations of inorganics in the shallow and deep ground water zones were fairly similar during the two ground water sampling events. The inorganic concentrations in the shallow ground water samples showed more variability than the inorganic concentrations in the deep ground water samples. The highest concentrations of inorganics were generally found in WB-1 and WB-4 on the northern and upgradient side of the lagoon, although some inorganic concentrations were highest in WB-7 adjacent to the landfill. Certain inorganics, like manganese and iron, were uniformly distributed in the shallow zone. The distribution of inorganics suggests that there may be both an upgradient and a side-gradient source of these constituents to ground water.

3.3.5 *Occurrence of Floating Product*

During the RI, floating product was found in two monitoring wells at the lagoon. Subsequently, a product investigation was performed in the summer of 1990 to evaluate the characteristics and the distribution of the product. The original purpose of the product investigation was to evaluate the potential connection between product on an adjacent property and product found in the two wells at the lagoon. The investigation later focused on the presence of product in the area surrounding the lagoon. The investigation included the following tasks: well inspection, well installation, water level measurements, product thickness measurements, product sampling and analysis and product removal.

During the RI, floating product was consistently found in the two upgradient wells, WB-2 and WB-5, and therefore, a manual bailing program was initiated to remove the product from these wells and to determine the recharge rate of the product to the wells. After testing the existing monitoring wells, two additional wells were installed to further evaluate the distribution of product downgradient of the lagoon. One well, WB-9, was installed downgradient of the lagoon, while the other well WB-10, was installed cross-gradient. Floating product was discovered at WB-9. The wells which contained product, WB-2, WB-4, WB-5 and WB-9, were sampled and the samples were analyzed for physical and chemical petroleum characteristics.

The investigation provided the following information:

- The floating product was located in two wells upgradient of the lagoon, WB-2 and WB-5, one well on the side of the lagoon, WB-4, and one well downgradient of the lagoon, WB-9.

- Samples of product from WB-2, WB-4, WB-5 and WB-9 underwent a spectrochemical analysis and physical property analysis as part of the product investigation. The results of this analysis suggested that the composition of the product in WB-2, WB-4 and WB-5 was similar and that the product probably originated from the same source. The data also suggested that the composition of the product in WB-9 was different and the source of the product was probably different as well. Subsequently, a gas chromatographic analysis of the product samples was conducted and this data suggested that all of the product samples originated from the same source. The lack of consistency in the analytical results, in conjunction with the fact that two of the wells that contained product were located upgradient of the lagoon, made it difficult to draw any conclusions regarding the source of the product in the wells around the lagoon.

- The product was recharging into wells WB-2 and WB-5 at a rate of 1.5 gals/day and 1.03 gals/day, respectively. The product recharge rate measured at well WB-4 was extremely low. The product recharge rate for well WB-9 was not estimated.

- The recharge rates suggested the need for an interim removal action plan. An interim removal action program was initiated to recover free product from wells WB-2, WB-5 and WB-9. The basic recovery system consisted of a pump, a control panel and a storage tank at each of the well locations. The interim floating product recovery system has recovered approximately 210 gallons since its installation in 1991.

3.3.6 *Summary Evaluation*

The direction of ground water flow, in both the shallow and deeper saturated zone beneath the lagoon is toward the Hudson River. Additionally, as ground water moves horizontally, it also tends to move upward, discharging to the Hudson River. The ground water quality indicates the presence of dissolved organic compounds. Also, ground water samples indicate the presence of inorganics, particularly iron, magnesium and manganese.

Although the dissolved organic compounds in ground water are indicative of petroleum hydrocarbons, the reported concentrations do not suggest a notable impact to ground water quality. Moreover, the majority of data indicate that the higher reported dissolved organic compounds in ground water, as well as the concentration of inorganic constituents, are present in monitoring wells hydraulically upgradient of the lagoon.

The above data support a conclusion that the residual organic compounds and inorganic constituents in Zone B2 and C soils beneath the sludge in the lagoon are not having a notable impact on the ground water quality in the vicinity of the lagoon. Consequently, this proposed remedial approach will be more than adequate to protect existing ground water quality and collect any free product which may accumulate on the water table surface beneath the lagoon area.

REFERENCES

LIST OF REFERENCES

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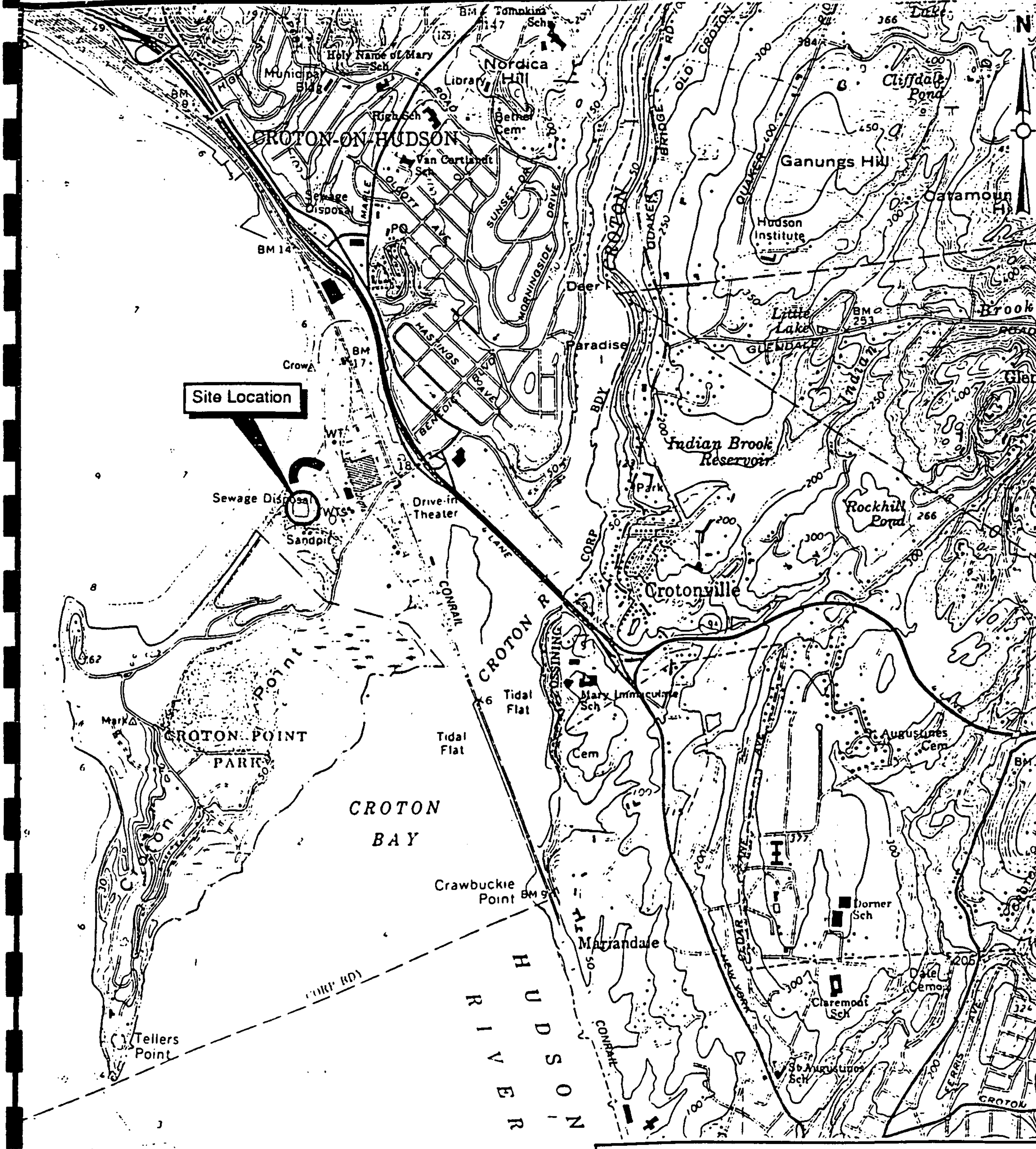
2. ERM-Northeast 1993b	Sampling and Decommissioning Plan for the Old Wastewater Treatment Plant, Harmon Railroad Yard Wastewater Treatment Area, Croton-on-Hudson, New York, ERM-Northeast, 11 August 1993.
3. ERM-Northeast 1993c	Preliminary Design Report, Harmon Railroad Yard Wastewater Treatment Area, Croton-on-Hudson, New York, ERM-Northeast, 8 November 1993.
4. ERM-Northeast 1994a	Pre-Design Test Boring Program Data Summary, Harmon Yard Wastewater Treatment Area, Croton-On-Hudson, New York, ERM-Northeast, 18 January 1994.
5. ERM-Northeast 1994b	Remedial Investigation and Feasibility Study Work Plan, Operable Unit II, Harmon Railroad Yard, Croton-on-Hudson, New York, ERM-Northeast, 27 January 1994.
6. ERM-Northeast 1994c	Decommissioning and Demolition Plan for the Old Wastewater Treatment Plant, Harmon Railroad Yard, Croton-on-Hudson, New York, ERM-Northeast, 25 February 1994.
7. Hart 1989	Remedial Investigation Report, Harmon Lagoon, Croton-On-Hudson, New York, Fred C. Hart Associates, Inc., November 27, 1989.
8. McLaren/Hart 1991	Groundwater Sampling Report, Harmon Lagoon, Croton-On-Hudson, New York, McLaren/Hart Environmental Engineering Corporation, May 1991.
9. McLaren/Hart 1992	Feasibility Study, Harmon Lagoon, Croton-On-Hudson, McLaren/Hart Environmental Engineering Corporation, Revision No. 1, February 1992.

FIGURES



SOURCE: U.S.G.S. Quadrangle Maps, Haverstraw and Ossining, NY

SCALE: 1" = 2000'

TITLE

SITE VICINITY MAP

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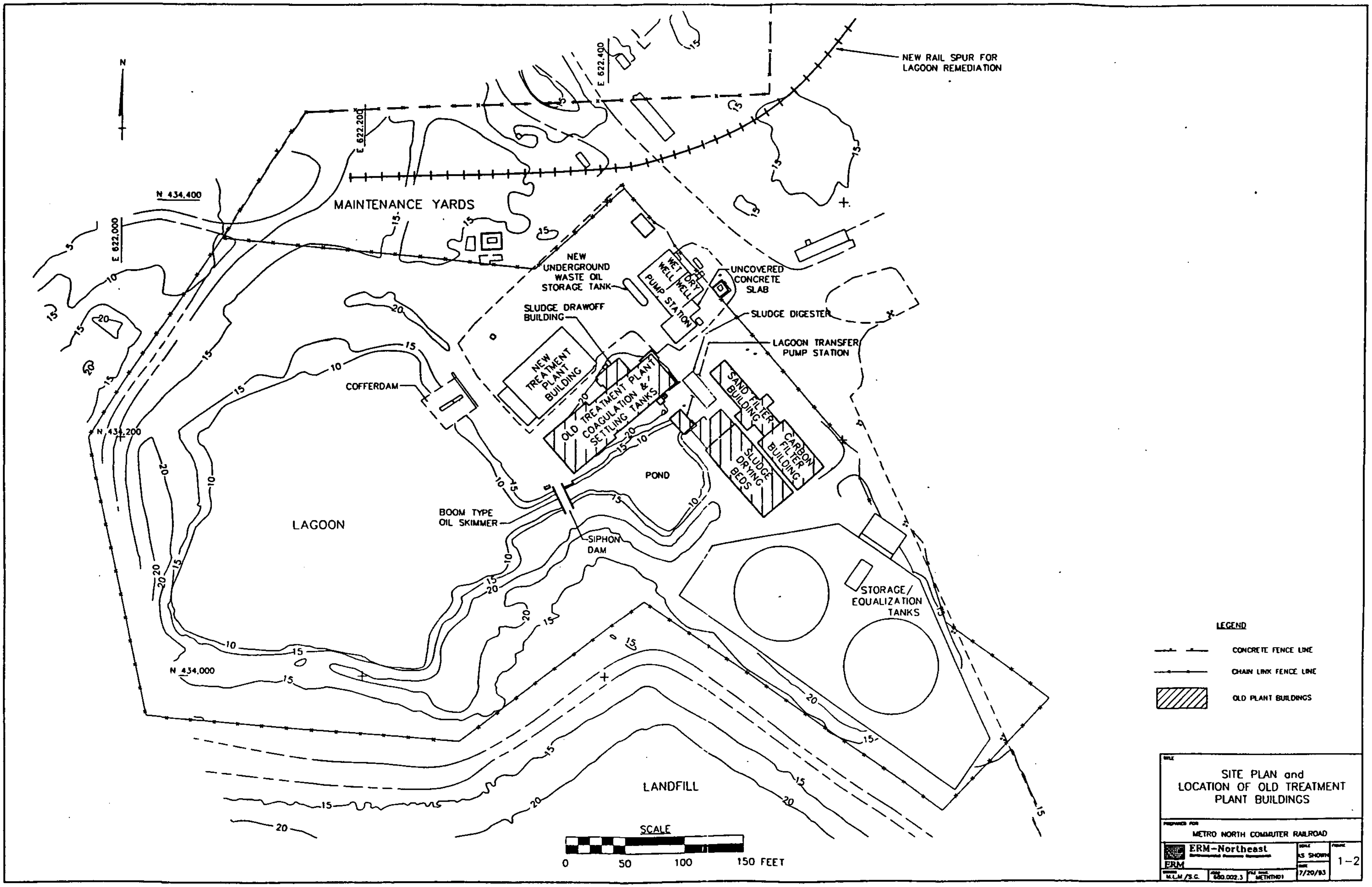
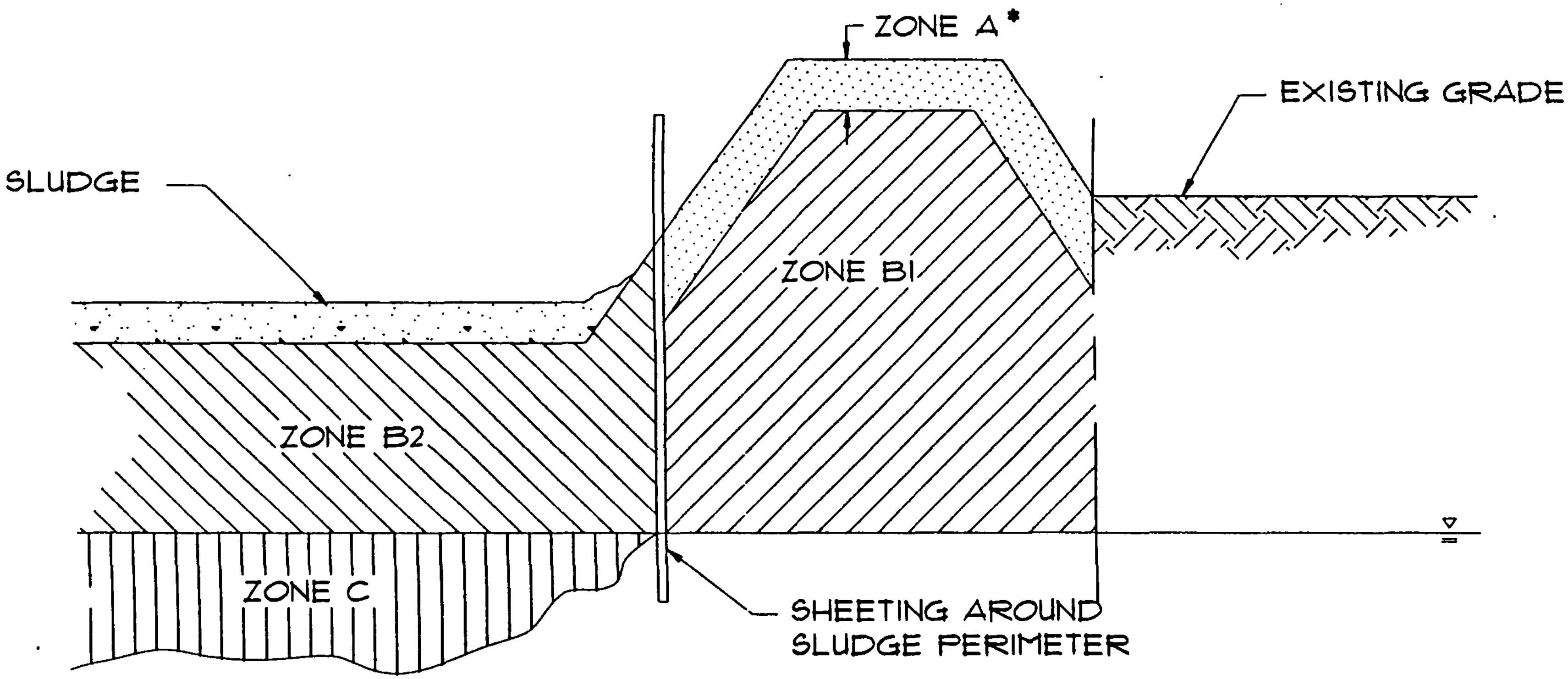
SCALE	FIGURE
Noted	1-1
DATE 9/1993	


N
E 622,400
NEW RAIL SPUR FOR
LAGOON REMEDIATION
E 622,200
N 434,400
E 622,000
MAINTENANCE YARDS
NEW UNDERGROUND WASTE OIL STORAGE TANK
WET WELL
DRY WELL
PUMP STATION
UNCOVERED CONCRETE SLAB
SLUDGE DIGESTER
SLUDGE DRAWOFF BUILDING
LAGOON TRANSFER PUMP STATION
NEW TREATMENT PLANT BUILDING
OLD TREATMENT PLANT COAGULATION & SETTLING TANKS
SAND FILTER BUILDING
CARBON FILTER BUILDING
SLUDGE DRYING BEDS
COFFERDAM
N 434,200
POND
LAGOON
BOOM TYPE OIL SKIMMER
SIPHON DAM
STORAGE/ EQUALIZATION TANKS
N 434,000
LANDFILL
SCALE
0 50 100 150 FEET
LEGEND
CONCRETE FENCE LINE
CHAIN LINK FENCE LINE
OLD PLANT BUILDINGS
SITE PLAN and LOCATION OF OLD TREATMENT PLANT BUILDINGS
METRO NORTH COMMUTER RAILROAD
ERM-Northeast
ERM
AS SHOWN
1-2
7/20/93
M.L.M./S.G.
680.002.3
METNTHD1



<u>Note</u>:

- * The horizontal limits of Zone A soil are defined in Figure A-5 of the ROD ("Surficial Limits of Soil in Zone A").

TITLE

Schematic Diagram (Cross-Section) of the Location of Soil Zones A, B1, B2 and C Harmon Yard Wastewater Equalization Lagoon

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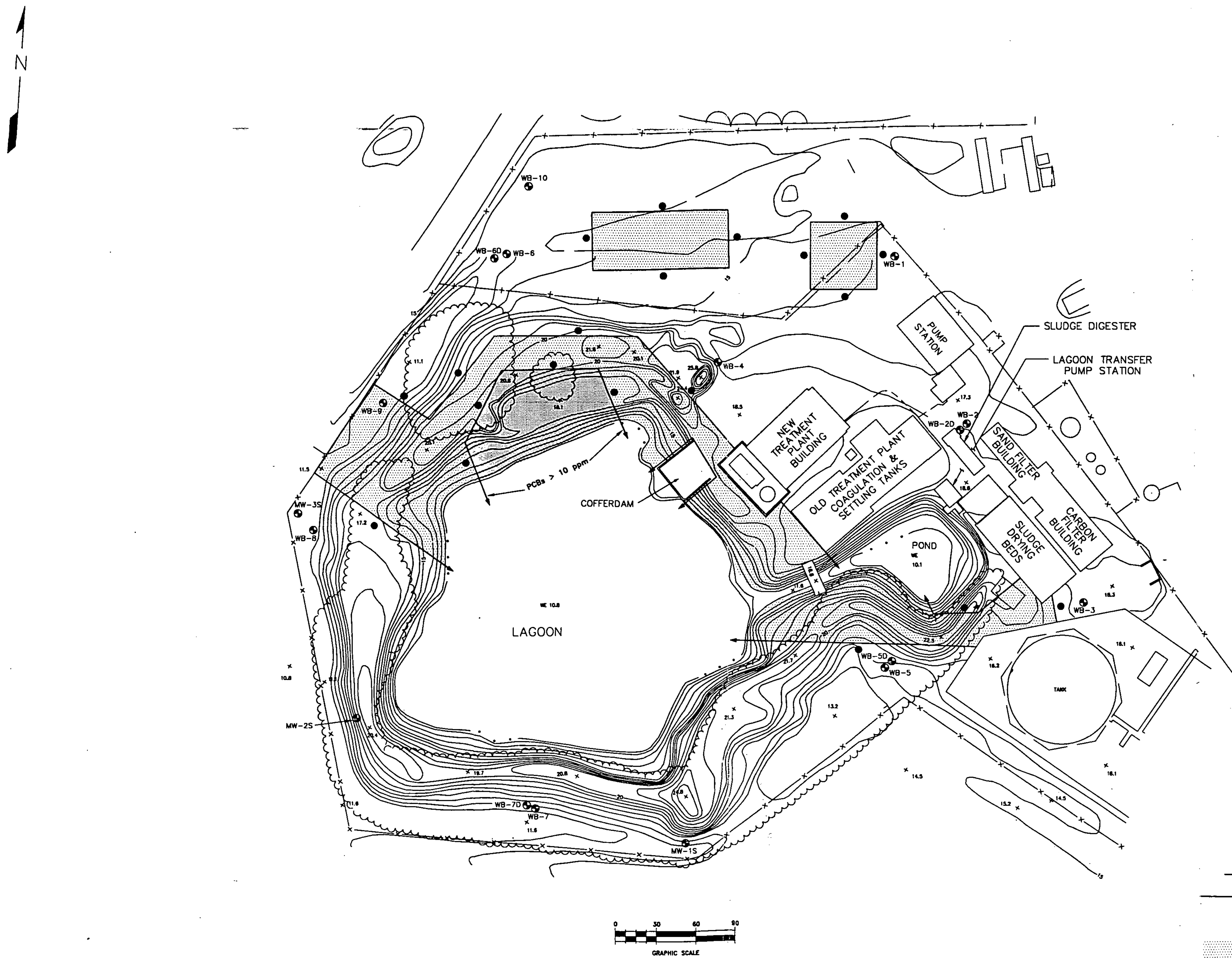
DRAWN:	JOB NO.:	FILE NAME:	SCALE	DATE	FIGURE
GV/RH		METRO1	NTS	1/15/93	1-3



LEGEND

- ● = PROPOSED PCB DELINEATION SAMPLE LOCATION
- → = BOUNDARY EXTENDS TO SLUDGE LIMIT, WHICH HAS NOT BEEN SURVEYED
- — = HORIZONTAL EXTENT OF ZONE A SOIL (FIGURE A-3, ROD)
- ⊗ = GROUND WATER MONITORING WELL
- = HORIZONTAL EXTENT OF ZONE A SOIL CONTAINING PCBs IN CONCENTRATIONS RANGING FROM 0.5 MG/KG TO 10.0 MG/KG
- = HORIZONTAL EXTENT OF ZONE A SOIL CONTAINING PCBs IN CONCENTRATIONS EXCEEDING 10.0 MG/KG

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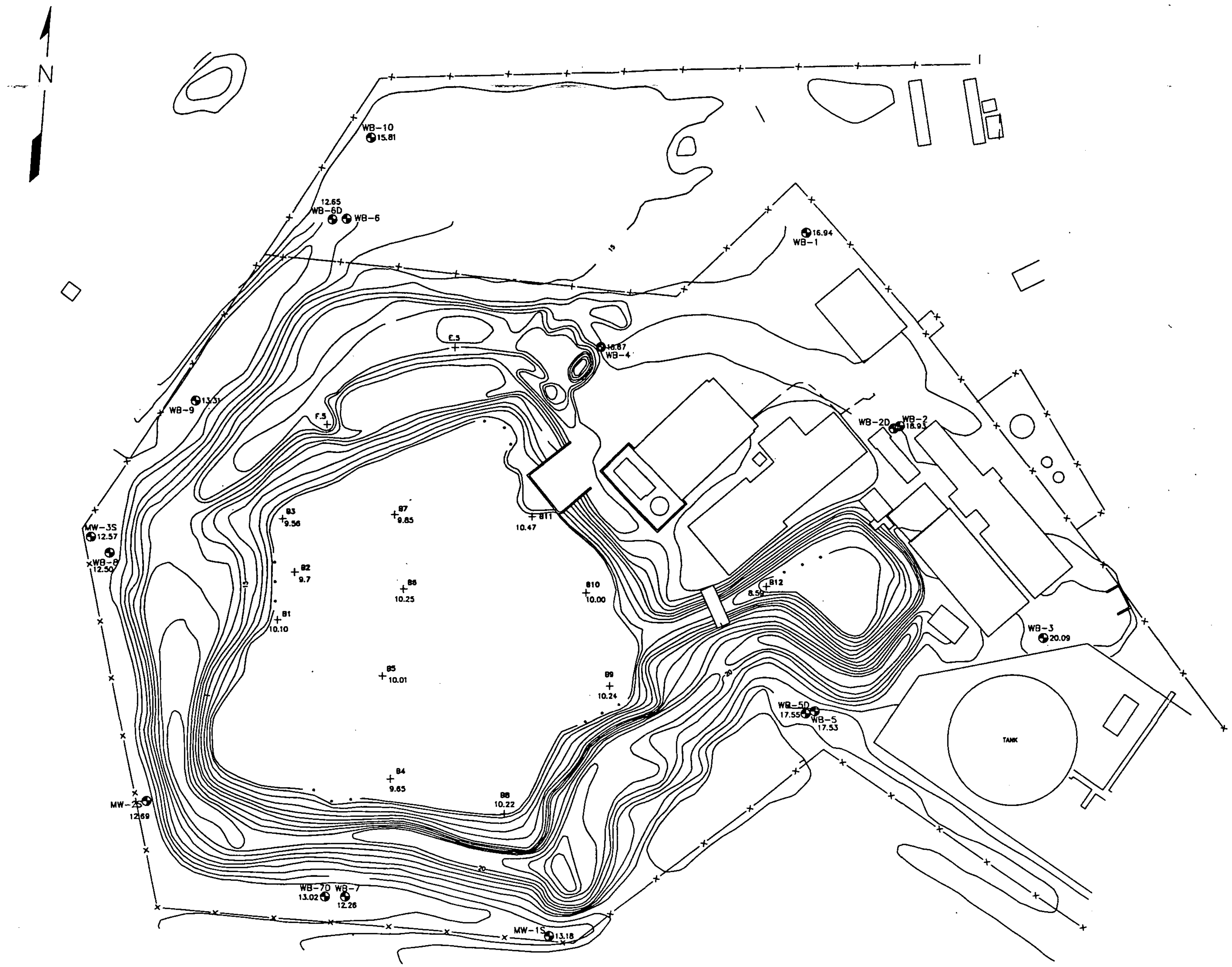
HORIZONTAL EXTENT OF ZONE A SOIL AND PCB CONFIRMATION SAMPLE LOCATIONS

PROJECT ENGINEER	RJR 9/16/93
DRAWN	S.G.\E.M.
DATE	MAR. 2, 1994
SCALE	GRAPHIC
JOB NO.	680.002.3
FILE NAME	ZONE-A
DRAWING NO.	1-4



LEGEND

- MONITORING WELL
- B6 TEST BORING DESIGNATION
- \+ TEST BORING LOCATION
- 10.25 TEST BORING ELEVATION (MSL)

0 30' 60'
SCALE IN FEET

NOTE: LOCATION AND ELEVATION OF BORING B2 ARE ESTIMATED, SINCE THE BORING LOCATION WAS NOT ACCESSIBLE AT TIME OF SURVEY.

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

METRO-NORTH COMMUTER RAILROAD

HARMON RAILROAD YARD WASTEWATER TREATMENT AREA REMEDIATION

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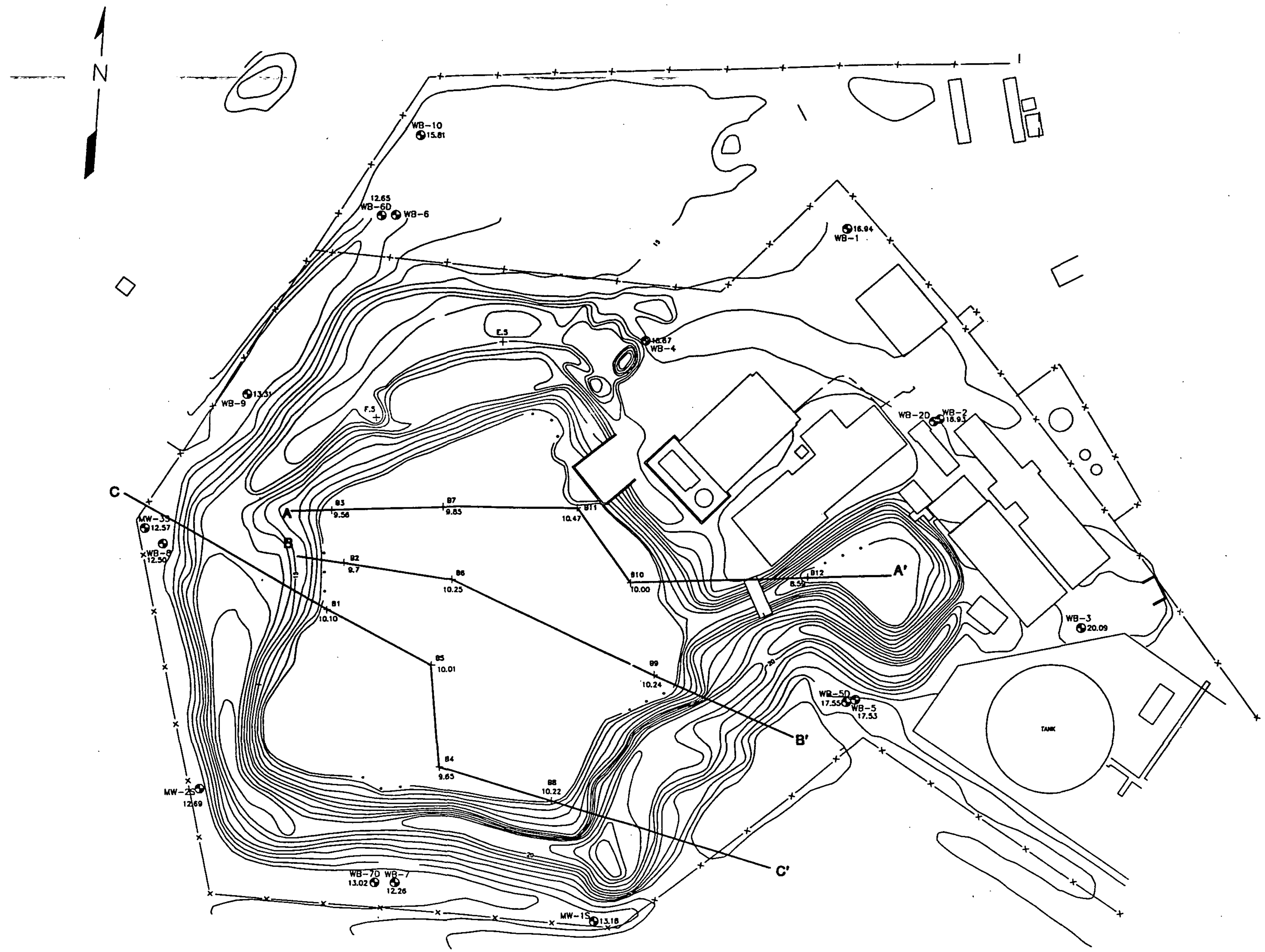
CHECKED		DATE
DESIGN ENGINEER		
PROJECT ENGINEER	RJR	9/16/93
PROJECT MANAGER		
APPROVED		
APPROVED		

TEST BORING LOCATIONS
PRE-DESIGN TEST BORING PROGRAM
HARMON YARD WASTEWATER LAGOON

DRAWN: E.M.	DATE: MAR. 2, 1994	REVISED DATE
SCALE: GRAPHIC	JOB NO.: 680.002.5	FILE NAME: PRE-05-B

DRAWING NO. 2-1
REV. NO.
SHEET OF



LEGEND

- MONITORING WELL
- B6 TEST BORING DESIGNATION
- \+ TEST BORING LOCATION
- 10.25 TEST BORING ELEVATION (MSL)

0 30' 60'
SCALE IN FEET

NOTE: LOCATION AND ELEVATION OF BORING B2 ARE ESTIMATED, SINCE THE BORING LOCATION WAS NOT ACCESSIBLE AT TIME OF SURVEY.

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HARMON RAILROAD YARD WASTEWATER TREATMENT AREA REMEDIATION

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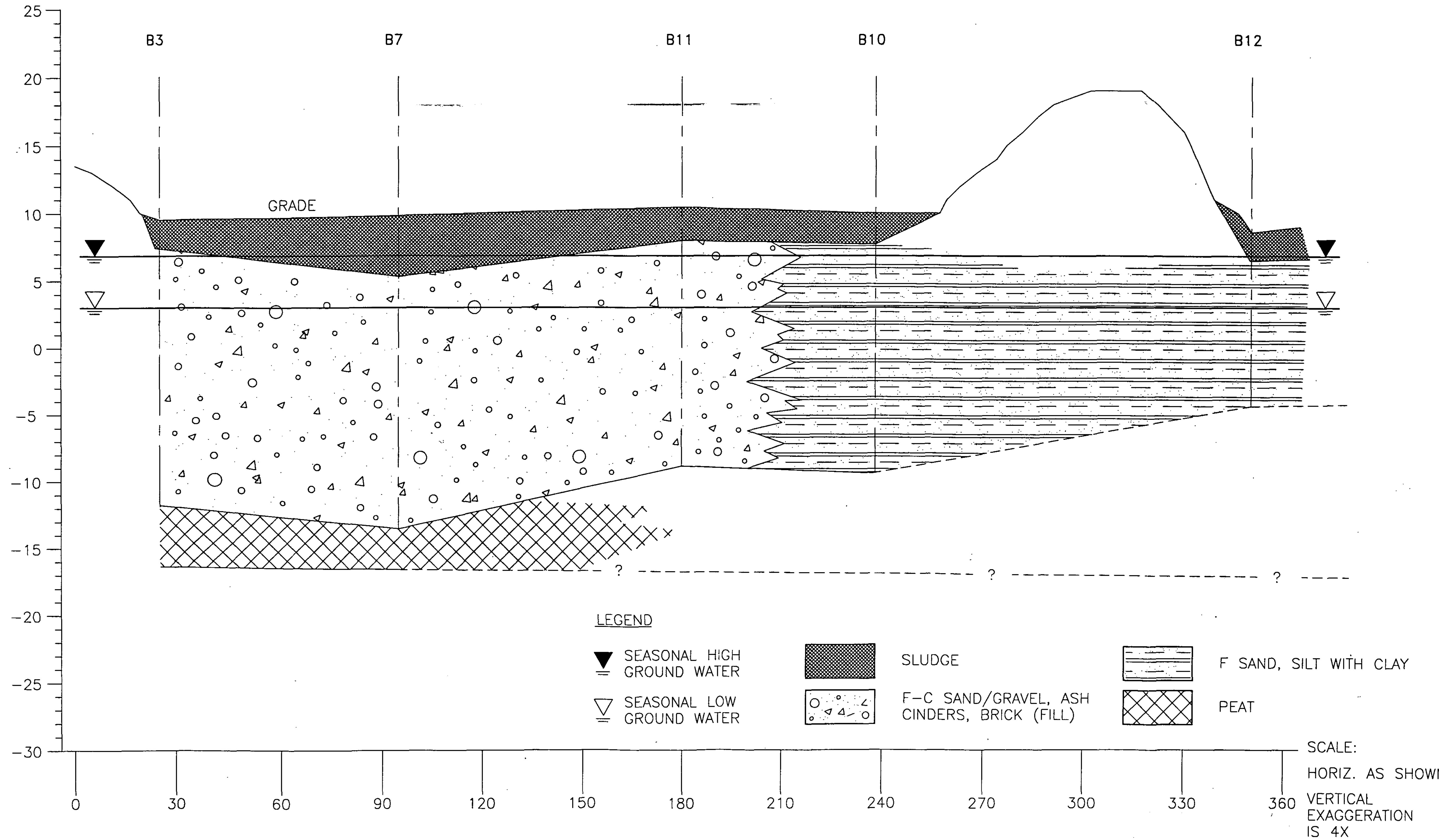
PROJECT ENGINEER	RJR	9/16/93

CROSS-SECTIONS A-A', B-B' & C-C'
LOCATION MAP
PRE-DESIGN TEST BORING PROGRAM
HARMON YARD WASTEWATER LAGOON

DRAWN	DATE	SCALE	JOB NO.	FILE NAME	DRAWING NO.
E.M./S.P.	MAR. 2, 1994	GRAPHIC	680.002.5	X-SECT	2-2



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

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HARMON RAILROAD YARD WASTEWATER TREATMENT AREA REMEDIATION

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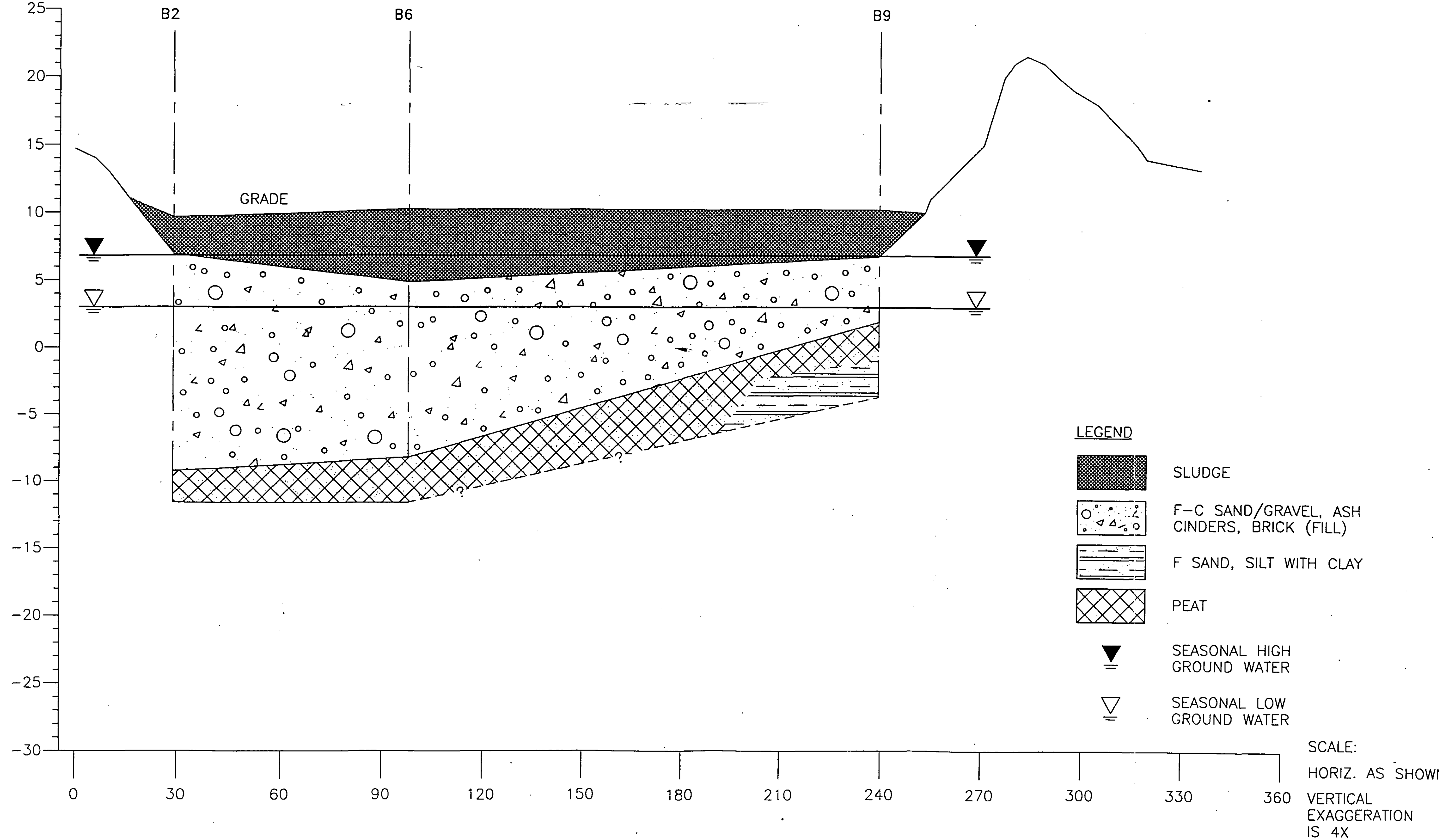
CHECKED / DATE / DESIGN ENGINEER / PROJECT ENGINEER / PROJECT MANAGER / APPROVED / APPROVED

CROSS-SECTION A-A'
PRE-DESIGN TEST BORING PROGRAM
HARMON YARD WASTEWATER LAGOON

DRAWN	DATE	REVISION DATE	DRAWING NO.
S.P.\E.M.	MAR. 2, 1994		2-3
SCALE	JOB NO.	FILE NAME	SHEET OF
NOTED	680.002.5	SEC-AA	



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

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HARMON RAILROAD YARD WASTEWATER TREATMENT AREA REMEDIATION

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CROSS-SECTION B-B'
PRE-DESIGN TEST BORING PROGRAM
HARMON YARD WASTEWATER LAGOON

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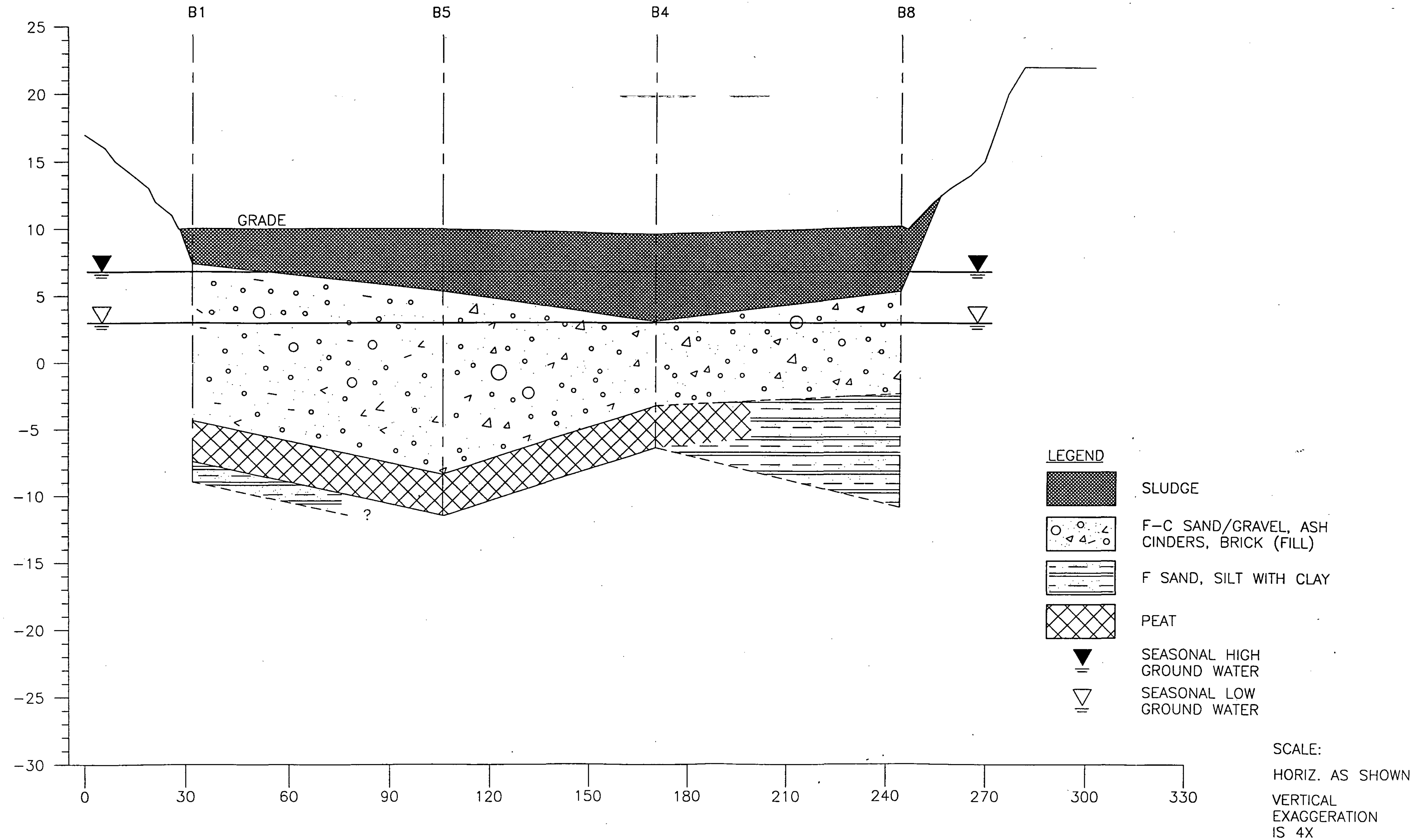
DRAWN	S.P.\E.M.
DATE	MAR. 2, 1994
SCALE	NOTED
JOB NO.	680.002.5
FILE NAME	SEC-BB



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

METRO-NORTH COMMUTER RAILROAD

HARMON RAILROAD YARD WASTEWATER TREATMENT AREA REMEDIATION

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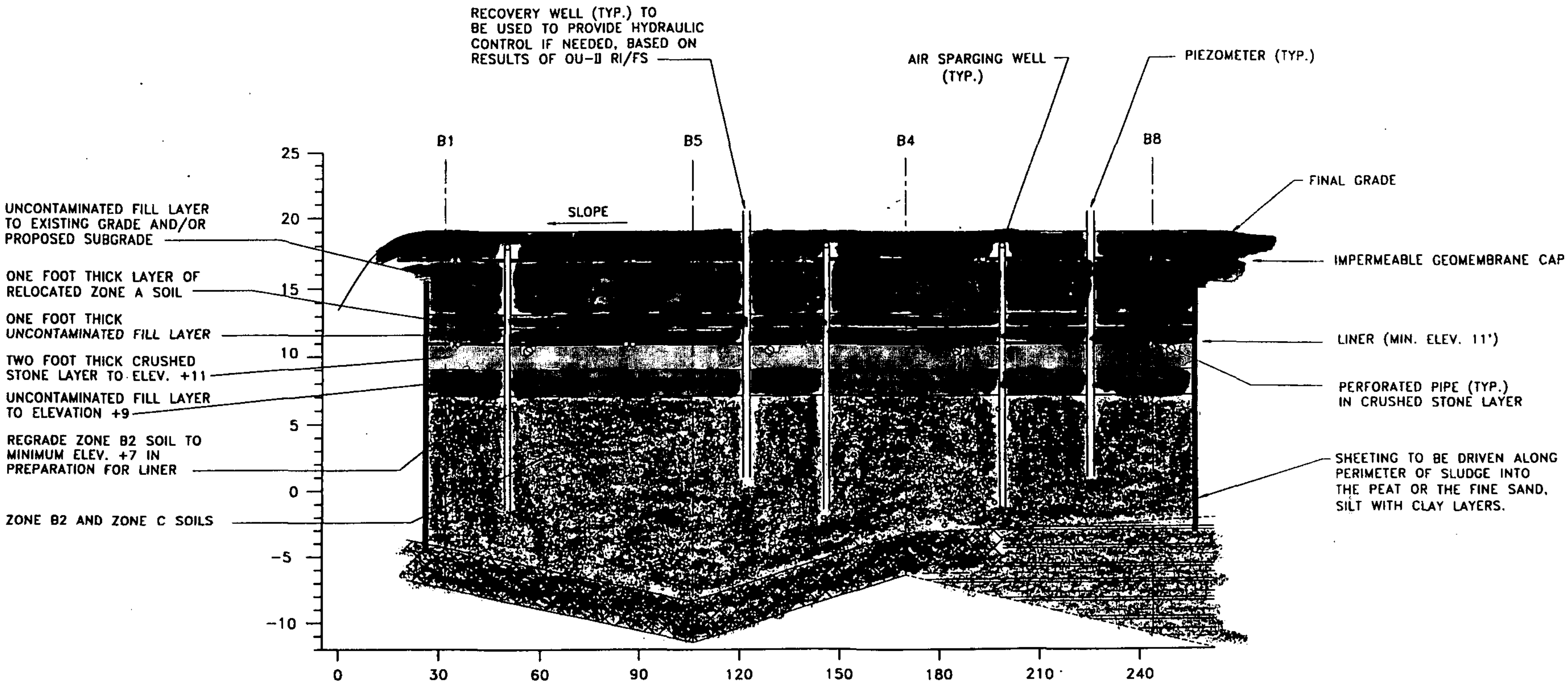
CROSS-SECTION C-C'
PRE-DESIGN TEST BORING PROGRAM
HARMON YARD WASTEWATER LAGOON

DRAWN	S.P.\E.M.
DATE	MAR. 2, 1994
SCALE	NOTED
JOB NO.	680.002.5
FILE NAME	SEC-CC
DRAWING NO.	2-5



LEGEND

B1 LOCATION OF PRE-DESIGN TEST BORING

F-C SAND/GRAVEL, ASH CINDERS, BRICK (FILL)

F SAND, SILT WITH CLAY

PEAT

SCALE:
AS SHOWN

HORIZONTAL = LINEAR FEET

VERTICAL = SCALE REPRESENTS FEET ABOVE MEAN SEA LEVEL
VERTICAL EXAGGERATION IS 4X

SOURCE: TYPICAL CROSS-SECTION SHOWN HERE ADAPTED FROM FIGURE 3-4 OF PRE-DESIGN TEST BORING DATA SUMMARY REPORT (ERM NORTHEAST 1994a)

METRO-NORTH COMMUTER RAILROAD

HARMON RAILROAD YARD WASTEWATER TREATMENT AREA REMEDIATION

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ERM

TYPICAL CROSS-SECTION
PROPOSED REMEDIAL APPROACH
HARMON YARD FORMER WASTEWATER LAGOON

S.P.\E.M. | MAR. 3, 1994
NOTED | 680.002.4 | XSEC-294

3-1

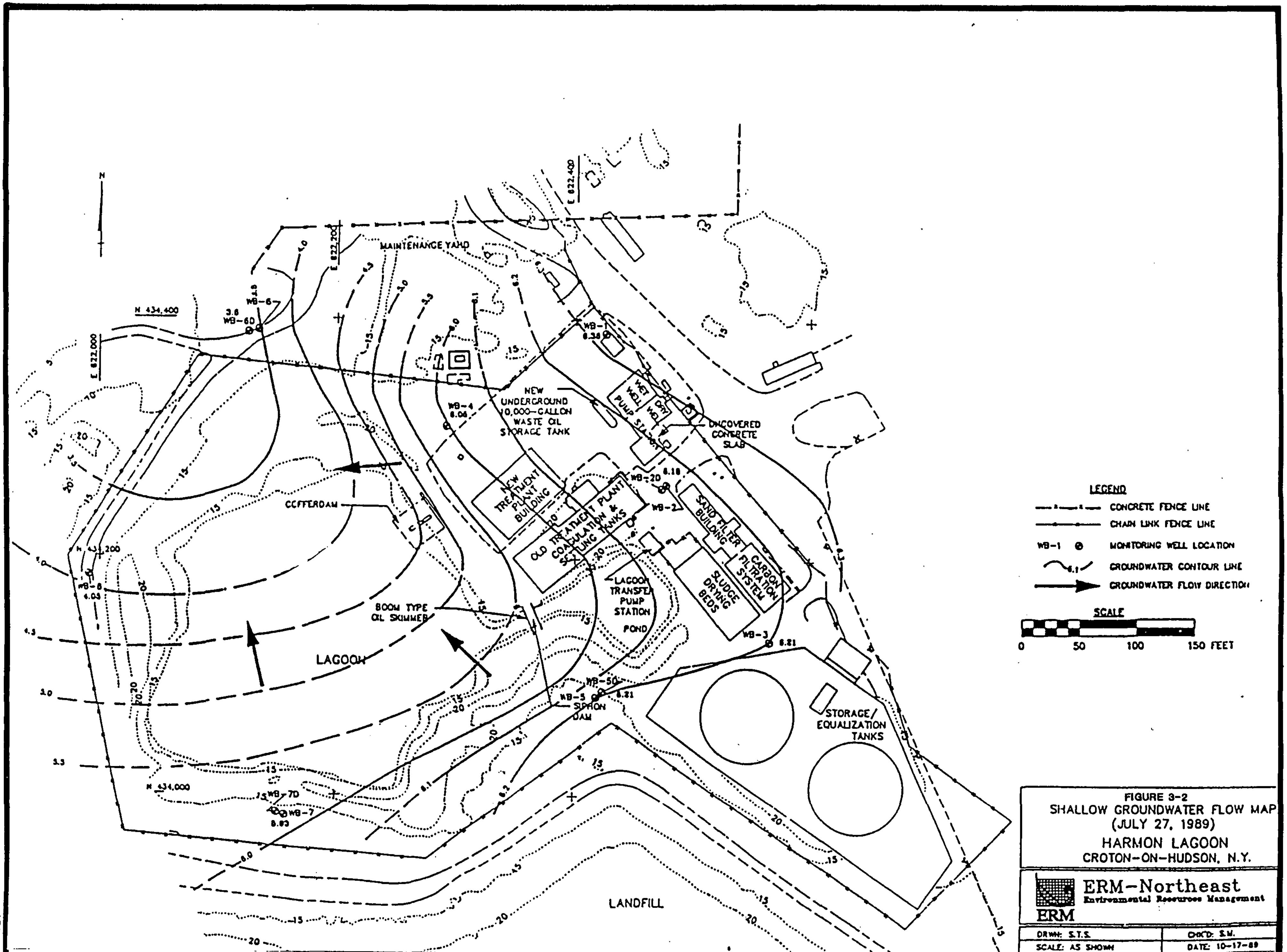


FIGURE 3-2
SHALLOW GROUNDWATER FLOW MAP
(JULY 27, 1989)
HARMON LAGOON
CROTON-ON-HUDSON, N.Y.

ERM-Northeast
Environmental Resources Management
ERM

DRWN: S.T.S.	CHK'D: S.M.
SCALE: AS SHOWN	DATE: 10-17-89

146821

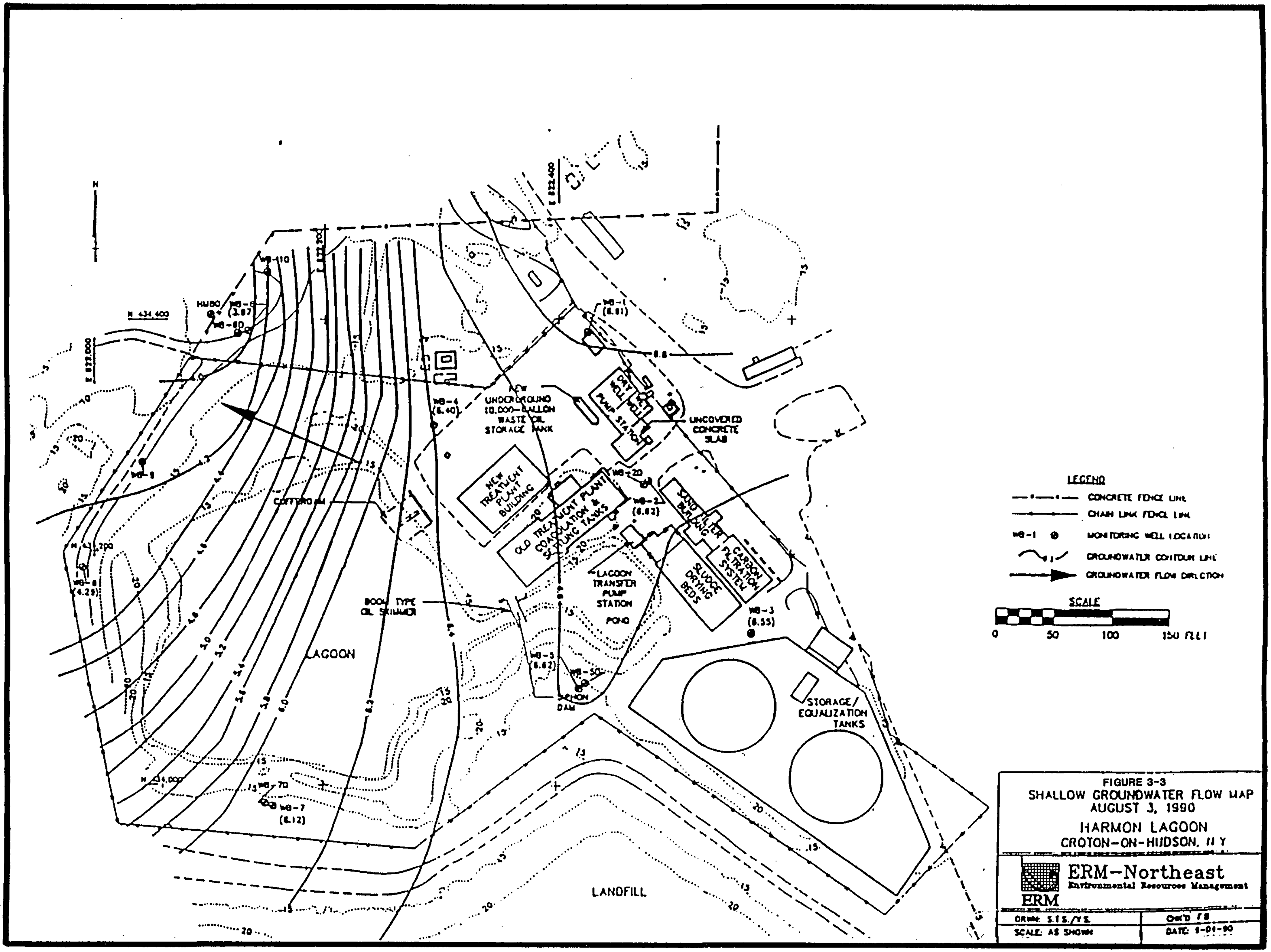


FIGURE 3-3
SHALLOW GROUNDWATER FLOW MAP
AUGUST 3, 1990
HARMON LAGOON
CROTON-ON-HUDSON, N.Y.

148621

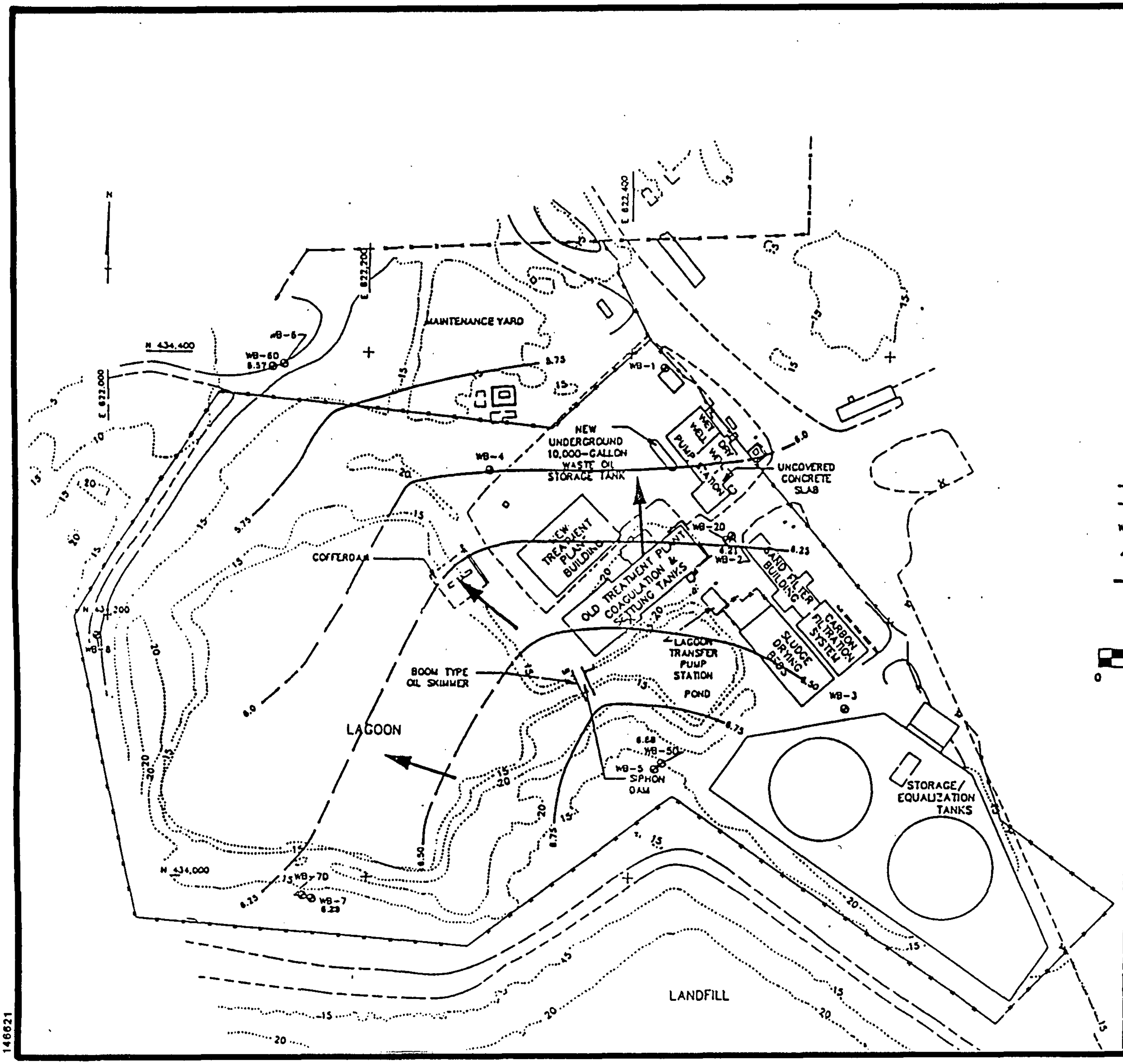
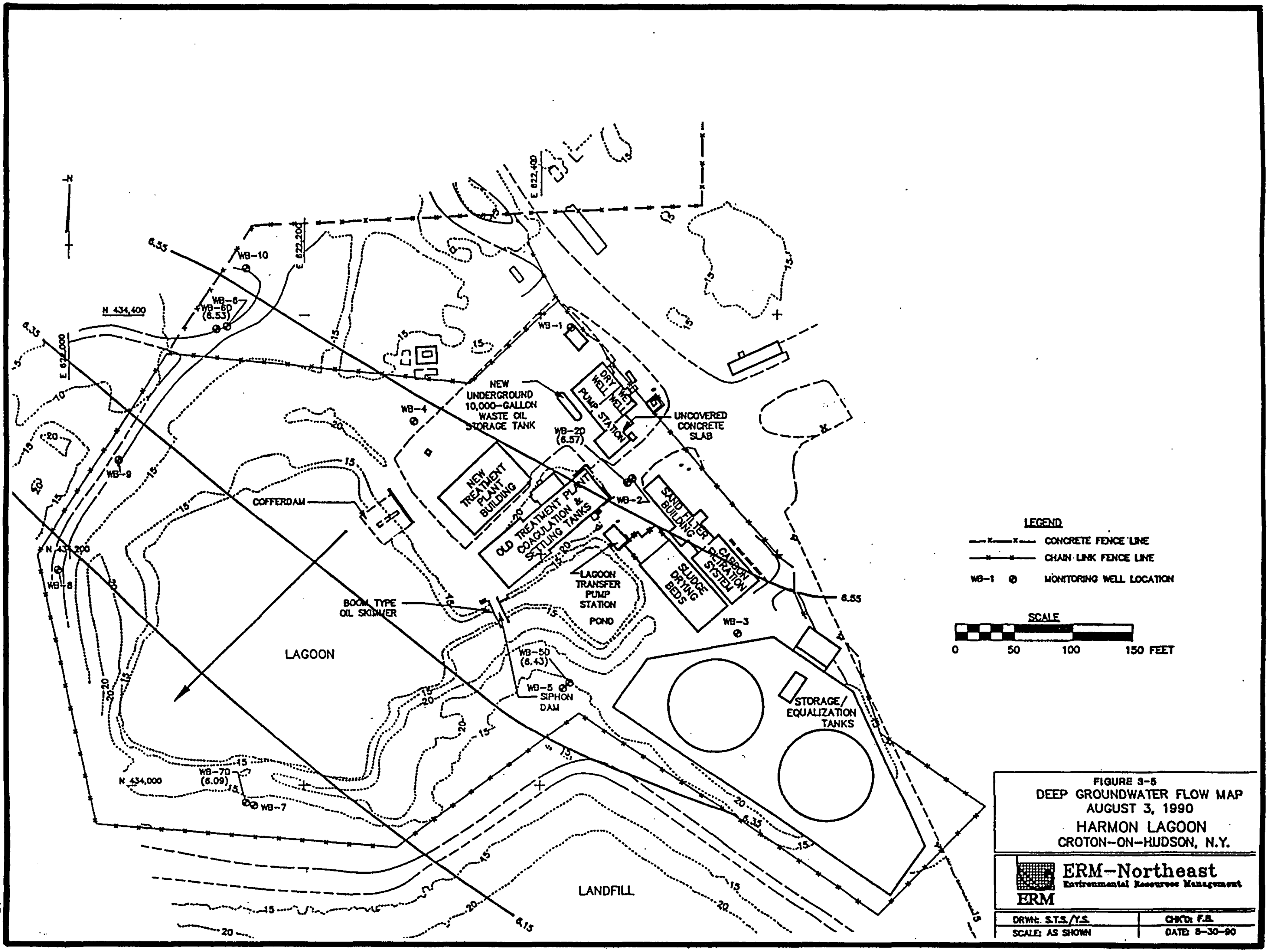


FIGURE 3-4
DEEP GROUNDWATER FLOW MAP
(JULY 27,1989)
HARMON LAGOON
CROTON-ON-HUDSON, N.Y.

ERM-Northeast
Environmental Resources Management
ERM

DRWN: S.T.S.	CHK'D: S.M.
SCALE: AS SHOWN	DATE: 10-17-89

148621


N
WB-10
E 622,200
E 622,400
N 434,400
WB-6
WB-6D
(6.53)
E 622,000
6.55
6.35
6.15
WB-1
WB-4
WB-9
WB-8
N 434,200
WB-2
WB-2D
(6.57)
WB-3
WB-5
WB-5D
(6.43)
WB-7
WB-7D
(6.09)
N 434,000
NEW UNDERGROUND 10,000-GALLON WASTE OIL STORAGE TANK
DRY WELL
WET WELL
PUMP STATION
UNCOVERED CONCRETE SLAB
NEW TREATMENT PLANT BUILDING
OLD TREATMENT PLANT COAGULATION & SETTLING TANKS
SAND FILTER BUILDING
CARBON FILTRATION SYSTEM
SLUDGE DRYING BEDS
COFFERDAM
LAGOON TRANSFER PUMP STATION
POND
BOOM TYPE OIL SKIMMER
LAGOON
SIPHON DAM
STORAGE/ EQUALIZATION TANKS
LANDFILL
LEGEND
CONCRETE FENCE LINE
CHAIN LINK FENCE LINE
WB-1 MONITORING WELL LOCATION
SCALE
0
50
100
150 FEET
FIGURE 3-5
DEEP GROUNDWATER FLOW MAP
AUGUST 3, 1990
HARMON LAGOON
CROTON-ON-HUDSON, N.Y.
ERM-Northeast
Environmental Resources Management
ERM
DRWN: S.T.S./Y.S.
CHK'D: F.B.
SCALE: AS SHOWN
DATE: 8-30-90

146821