New York City Department of Environmental Protection

Site Management Plan

Pelham Bay Landfill
Bronx, New York
NYSDEC Index # 2-03-001

March 31, 2008

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LIST OF ACRONYMS

Acronym	Definition
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
ASP	Analytical Services Protocol
AST	Aboveground Storage Tank
BRA	Baseline Risk Assessment
CAMP	Community Air Monitoring Plan
CCR	Closure and Final Remediation Construction Certification Report
C/D	Construction and Demolition
cfm	Cubic feet per minute
CLP	Contract Laboratory Program
COC	Certificate of Completion
CSM	Conceptual Site Model
CSO	Combined Sewer Overflow
DER	Division of Environmental Remediation
DSHM	Division of Solid & Hazardous Materials
DUSR	Data Usability Summary Report
ECs	Engineering Controls

EC/IC Plan	Engineering and Institutional Control Plan
Ecotest	Ecotest Laboratories, Inc.
EIFC	Emission Isolation Flux Chamber
ELI	Environmental Laboratories, Inc.
ft	Feet
ft bls	Feet below land surface
HASP	Health and Safety Plan
HDPE	High Density Polyethylene
HRS	Hazard Ranking System
ICs	Institutional Controls
IRM	Interim Remedial Measure
LEL	Lower Explosive Limit
mg/kg	Milligrams per kilogram
MSL	Mean Sea Level
NAPL	Non-Aqueous Phase Liquid
NYCDEP	New York City Department of Environmental Protection
NYCDOS	New York City Department of Sanitation
NYCDPR	New York City Department of Parks and Recreation
NYCSS	New York City Sewer System

NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OM&M	Operation, Maintenance and Monitoring
Order on Consent	Consent Order
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
POTW	Publicly Owned Treatment Works
PVC	Polyvinyl Chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
RCP	Reinforced Concrete Pipe
Registry	New York State Registry of Inactive Hazardous Waste Disposal Sites
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SCO	Soil Cleanup Objective
Site	Pelham Bay Landfill

SMP	Site Management Plan
SoMP	Soil Management Plan
SRI	Supplemental Remedial Investigation
SSF	State Superfund Program
SVOC	Semi-Volatile Organic Compound
TAL	Target Analyte List
TCL	Target Compound List
ug/kg	Micrograms per kilogram
ug/L	Micrograms per liter
URS	URS Corporation
USEPA	Unites States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WCCI	Woodward-Clyde Consultants, Inc.

1. Introduction and Description of Remedial Program

This Site Management Plan (SMP) was prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC) Region 2, Division of Environmental Remediation (DER) draft generic template for the development of a SMP. This section of the SMP describes the purpose of the SMP, provides Site background information, and describes the remedial investigation findings and remedial actions.

1.1 Introduction

This document is required for fulfillment of Remedial Action at the Pelham Bay Landfill (hereafter referred to as the "Site") under the New York State (NYS) Inactive Hazardous Waste Disposal Site Remedial Program (State Superfund Program [SSF]) administered by NYSDEC. The Site was remediated in accordance with an Order on Consent (Consent Order) Index # 2-03-001, Site # 2-03-001, which was originally issued in 1985 and was updated on April 17, 1990, and the Record of Decision (ROD), which was issued on August 31, 1993.

1.1.1 General

On December 16, 1985, the City of New York entered into a Consent Order with the NYSDEC requiring that remedial measures be implemented for final closure of the 81 acre property located in the Bronx, a Borough of New York City, New York. On April 17, 1990, the City of New York entered into a Consent Order with the NYSDEC that updated the 1985 Consent Order and addressed the funding, site investigation and remediation requirements of Title 3 of the Environmental Quality Bond Act. The 1990 Consent Order also required that a Remedial Investigation/Feasibility Study (RI/FS) be conducted at the Site. The boundary of this 81-acre SSF Site is more fully described in Appendix A – Metes and Bounds. A map of the Site location is shown on Figure 1. The Site boundary is shown on Figure 2.

After completion of the remedial work described in the ROD, some contamination, which is hereafter referred to as 'residual waste materials', was left in the subsurface at this Site. For the purposes of this SMP, residual waste materials are defined as municipal solid waste that may be commingled with hazardous materials (see Section 1.2.2). This SMP was prepared to manage residual waste materials at the Site in perpetuity or until extinguishment of the requirement by the NYSDEC. Remedial Action work on the Site began in January 1992, and was completed in October 1998.

Reports associated with the Site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State. An extensive search was conducted to obtain the necessary documents for the preparation of this SMP. Based on the results of the document search conducted, a Remedial Action Work Plan was not prepared for the Site. Therefore, the ROD is referenced in lieu of the Remedial Action Work Plan in this SMP. The Site is being remediated in accordance with the selected remedy presented in the ROD (NYSDEC 1993).

This SMP was prepared by ARCADIS, on behalf of the New York City Department of Environmental Protection (NYCDEP), in accordance with the requirements in the NYSDEC Region 2 DER draft generic template for the development of a SMP (NYSDEC 2007), dated May 2007, ECL 27-1318, and the guidelines provided by NYSDEC. This SMP addresses the means for implementation of Institutional Controls (ICs) and Engineering Controls (ECs), which are required by the ROD (NYSDEC 1993) and Deed Restriction for the Site.

1.1.2 Purpose

The Site contains residual waste materials left after completion of the Remedial Action performed under the SSF. ECs have been incorporated into the Site remedy to provide proper management of residual waste materials in the future and to ensure protection of public health and the environment. A Site-specific Deed Restriction will be recorded with the Bronx County Clerk that provides an enforceable means to ensure the continued and proper management of residual waste materials and protection of public health and the environment. It requires strict adherence to all ECs and all ICs placed on this Site by NYSDEC, by the grantor of the Deed Restriction, and any and all successors and assigns of the grantor. ICs provide restrictions on Site usage and mandate operation, maintenance, monitoring and reporting measures for all ECs and ICs. This SMP includes the methods necessary to ensure compliance with all ECs and ICs required by the ROD and Deed Restriction for residual waste materials at the Site. The SMP has been approved by the NYSDEC, and compliance with this SMP is required by the grantor of the Deed Restriction and grantor's successors and assigns. This plan is subject to change by NYSDEC.

Site management is the last phase of the remedial process and is triggered by the approval of the Closure and Final Remediation Construction Certification Report (CCR) (URS Corporation 2002) by NYSDEC. In a letter dated June 6, 2007, the NYSDEC approved the CCR. A Certificate of Completion (COC) was not issued by the NYSDEC for this Site, and, therefore, is not relevant to the Site. The SMP continues in perpetuity or until extinguished in accordance with 6 NYCRR Part 375. It is the responsibility of the Deed Restriction grantor, and its successors and assigns to ensure that all Site Management responsibilities under this plan are performed.

The SMP provides a detailed description of all procedures required to manage residual waste materials at the Site following the completion of the Remedial Action in accordance with the NYS Consent Order (NYSDEC 1990) with the NYSDEC. This includes: (1) development, implementation, and management of all Engineering and Institutional Controls; (2) development and implementation of monitoring systems and a Monitoring Plan; (3) development of a plan to operate and maintain all treatment, collection, containment, or recovery systems (including, where appropriate, preparation of an Operation and Maintenance Manual); (4) submittal of Site Management Reports, performance of inspections and certification of results, and demonstration of proper communication of Site information to NYSDEC; and (5) defining criteria for termination of treatment system operation.

To address these needs, this SMP includes four plans: (1) an Engineering and Institutional Control Plan for implementation and management of ECs/ICs; (2) a Monitoring Plan for implementation of Site Monitoring; (3) an Operation and Maintenance Plan for implementation of remedial collection, containment, treatment, and recovery systems; and (4) a Site Management Reporting Plan for submittal of data, information, recommendations, and certifications to NYSDEC.

Site Management activities, reporting, and ECs/ICs certification will be scheduled on a certification period basis. The certification period will be annually.

Important notes regarding this SMP are as follows:

- This SMP defines Site-specific implementation procedures as required by the ROD and Deed Restriction.
- The Consent Order (Index # 2-03-001; Site # 2-03-001) for the Site requires conformance with this SMP, and therefore, serves as a contractual binding authority under which this SMP is to be implemented. The SSF law itself also requires the preparation of a SMP (formerly known as an Operation, Maintenance and Monitoring Plan) in ECL 27-1318. Therefore, the Consent Order is a binding contract and the SSF law is

statutory authority under which this SMP is required and is to be implemented.

- At the time this report was prepared, the SMP and all Site documents related to Remedial Investigation and Remedial Action are maintained at the NYSDEC Region 2 offices in Long Island City. At the time of SMP submission (March 2008), the Site documents can also be found in the repositories established for this project, including:

1) Bronx Community Board #10
3165 East Tremont Avenue
Bronx, NY 10461
(718) 892-1161

2) Pelham Bay Branch Library
3060 Middletown Road
Bronx, NY 10461
(718) 792-6744

3) City Island Branch Library
320 City Island Avenue
Bronx, NY 10464
(718) 885-1703

4) New York City Department of Environmental Protection
Office of Community Partnerships
59-17 Junction Boulevard
Flushing, NY 11373
(718) 595-3496

1.2 Site Background

This section of the SMP describes the Site location, Site history, and geological conditions.

1.2.1 Site Location and Description

The Site is located at 301 Shore Road (40° 51'23" latitude, 73° 48'52" longitude) in the County of the Bronx (New York City), New York and is identified as Block 4335 and Lot 1 on the New York City Tax Map. The Site is an approximately 81-acre area bounded by the Hutchinson River to the north and east, Eastchester Bay to the east and south, Pelham Bay Park to the southwest, and the Bruckner Boulevard Extension to the northwest (see Figure 1). The boundary of the Site is more fully described in Appendix A – Metes and Bounds.

The Site borders Eastchester Bay, which is a tidally affected, saline water body. As such, the groundwater system beneath the Site is also tidally affected (i.e., two high and two low tides per 24-hour period), resulting in bay water entering and mixing with natural groundwater beneath the Site, followed by drainage to the bay.

1.2.2 Site History

Prior to November 1963, the area now containing the Site was a partially wooded, grassy area of approximately 25 acres, which was owned and operated by the New York City Department of Parks and Recreation (NYCDPR). The New York City Department of Sanitation (NYCDOS) assumed management responsibility for the Site in the early 1960's when construction and operation of the Site as a municipal solid waste disposal facility began. Prior to landfill operations, the area that eventually became the Site was created by constructing earthen dikes in stages into Eastchester Bay. The dikes were constructed parallel to the U.S. Pier and Bulkhead line on the east side of the landfill. The earthen dike construction is described in detail in the Final RI Report prepared by Woodward-Clyde Consultants, Inc. (WCCI) in April 1993 (WCCI 1993a). Aerial photographs for this period reveal that, within three years, a seawall had been constructed and the landfill encroached over 55 acres into Eastchester Bay (WCCI 1993a).

The Site began operation as a municipal solid waste disposal facility on November 18, 1963 mainly to handle the waste disposal needs of the Bronx. The Site reportedly received garbage, rubbish, street cleanings, commercial waste, construction and demolition debris, and household waste. Hazardous materials may also have been disposed at the Site. During testimony on May 6, 1982 before a Senate Committee on Crime, a driver/dispatcher for the Hudson Oil Refining Company indicated that waste oil sludges, metal plating wastes, lacquer, and solvents were illegally disposed of at several New York City landfills from 1974 to 1980, including the Site. The exact disposal quantities and locations of those wastes are unknown. It was reported that the volumes ranged from 11,000 gallons to 55,000 gallons per week in 1974 (NYSDEC 1993).

The Site has remained inactive since December 31, 1978 when landfill operations ceased and in 1982 the landfill was covered with a final layer of soil. Subsequent to this, WCCI conducted a Phase I Preliminary Investigation of the Site for the NYSDEC.

This investigation included development of a draft Hazard Ranking System (HRS) score of 13.1 for the Site. Problems such as steep slopes, landfill odors, and limited security measures were noted during the investigation (WCCI 1993a).

In 1983, the Site was listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites (Registry) as a Class 3 site. In 1984, the Registry designation for the Site changed to a Class 2a due to insufficient data. On December 16, 1985, the NYSDEC and the City of New York signed a Consent Order requiring that remedial measures be implemented for final closure of the Site. In 1987, the Registry designation for the Site was changed to a Class 2 based on information that was provided to the NYSDEC regarding the disposal of hazardous waste.

In October 1988, to minimize the impact on public health and the environment, the NYCDOS implemented several temporary remedial actions at the Site. These actions included constructing french drains to collect leachate, rehabilitating parts of the on-site road, installing additional fencing around the landfill perimeter, re-grading and seeding portions of the Site, constructing a riprap swale on the east edge of the landfill, and constructing a conduit from a leachate seep on the east edge of the landfill into Eastchester Bay (WCCI 1993a).

Between 1980 and 1991, numerous investigations were conducted at the Site to investigate the impact of the Site on public health and the environment. These investigations are summarized in the RI Report (WCCI 1993a).

In 1990, a lawsuit was filed by the New York Coastal Fisherman's Association against New York City for violations of the Federal Clean Water Act. As a result of this litigation, a Permanent Injunction was issued requiring the City of New York to take measures to prevent leachate from the Site entering Eastchester Bay. This resulted in the design and construction of an Interim Remedial Measure (IRM), which was called the "150 Day Leachate Collection System," the "150 Day System," and/or the "150 Day IRM". The 150 Day System consisted of five 20,000-gallon storage tanks, five interceptor wells, a force-main that conveys the discharge from the interceptor wells and a nearby sump to the storage tanks, and expansion of the existing french-drain system. This 150 Day System was implemented during 1991 and 1992 to comply with the Permanent Injunction and to reduce threats to public health and the environment due to leachate releases from the Site. The IRM is referred to as the "150 Day System", because it was required to be constructed within 150 days (NYSDEC 1993).

On April 17, 1990, the NYSDEC and the City of New York signed a Consent Order that updated the 1985 Consent Order and addressed the funding, site investigation and remediation requirements of Title 3 of the Environmental Quality Bond Act. The 1990 Consent Order also required that a RI/FS be conducted at the Site.

The NYCDOS was responsible for the management of the Site until February 1991. After February 1991, responsibility for the management of the Site was transferred to the NYCDEP. The RI/FS was conducted in 1992 and 1993. A Supplemental RI (SRI) was conducted in 1993. The RI and SRI Reports were prepared by WCCI in April 1993 (WCCI 1993a) and June 1993 (WCCI 1993b), respectively. The FS Report was prepared by WCCI in June 1993 (WCCI 1993c).

A Baseline Risk Assessment (BRA) Report, dated June 1, 1993 (WCCI 1993d), was prepared by WCCI that consisted of a Human Health Evaluation (Volume I) and an Ecological Evaluation (Volume II). Based on the pre-site remediation exposure pathways that were evaluated, the Human Health Evaluation concluded that the only current use exposure pathway that may pose a potential long-term health concern is the exposure of landfill workers and youth trespassers to contaminated soils. However, based on the analysis presented in this risk assessment, the evaluation concluded that both the risks and the populations exposed are so low that no additional cases of cancer would result even if no remediation were to be implemented. The analysis also indicated that adverse non-carcinogenic health effects were not expected to occur.

On August 31, 1993, the NYSDEC issued the ROD for the Site. A description of the ROD-required remedy is provided in Section 1.4 of this SMP.

The ROD-required remedial design and remedy construction was completed between 1994 and 1998, and post-closure operation, maintenance and monitoring (OM&M) activities have been performed at the Site from 1999 to the present.

1.2.3 Geological Conditions

Several of the objectives of the RI were to assess the physical characteristics of the Site waste/refuse pile, assess the characteristics of the native soils beneath the waste/refuse pile, evaluate bedrock lithologies and structures beneath and around the Site, and identify landfill waste/refuse and geologic features that may affect groundwater/leachate flow (WCCI 1993a).

As described in WCCI 1993a, the RI drilling activities were conducted between May and July 1992. A total of twenty-six monitoring wells and fourteen piezometers were installed during the drilling program. In addition, two test borings were advanced during the drilling program. Twenty of the monitoring wells were installed at the perimeter of the Site, five monitoring wells were installed at off-site locations, and one monitoring well was installed near the middle of the landfill (i.e., interior of the landfill). In general, soil cores were collected during drilling activities using split-barrel samplers (i.e., split-spoon samples) or undisturbed thin-walled tube samples (i.e., Shelby tube samples). Rock cores were collected using NX size rock coring techniques with a 10-foot single core barrel. The geologic investigation methods are described in detail in the RI Report, along with a detailed description of the regional geology. A summary of the regional geology of the subject area is summarized below.

Based on material types found at the Site during the RI, four stratigraphic units have been identified (WCCI 1993a). These units from top (youngest) to bottom (oldest) are:

1. Fill
2. Riprap
3. Glacial Till
4. Bedrock (Hartland Formation)

The fill unit was apparently dumped directly onto the bedrock and glacial sediments of the Eastchester Bay and a portion of the riprap containment wall. The fill consists of a wide variety of materials which includes rock fragments, sand, silt, clay, organic matter, various types of plastic (trash bags being most common), rubber (including tires and tubes), newspaper, paper, cardboard, styrofoam, glass, coal and slag fragments, ash, various types of steel (including rebar and bed springs) and aluminum (cans being most common), hardened resins, wood, string, rope, and cloth fragments. A former NYCDOS employee recalls "lots of cars" being dumped in the landfill. Observations of drill cuttings also revealed that in some deeper portions of borings the fill is apparently reduced by biological action, because it consists of a dense, black, odoriferous sludge with fragments of non-biodegradable material. The mound of fill has a maximum observed thickness of approximately 135 feet (ft) at the locations of Piezometers PZ-3 and PZ-5, and it thins radially outward towards the edges of the landfill (WCCI 1993a). Figure 3 shows the locations of the monitoring wells and piezometers that were installed during the RI.

The riprap unit is present along the southern, eastern, and a portion of the northern perimeters of the Site as a containment/protective seawall. The seawall was constructed on top of the natural bedrock and sands, gravels, and silts of Eastchester

Bay. It may be as high as 35 ft in some areas with approximately 10 to 12 ft exposed above the Bronx datum. The riprap consists of large (commonly about 3 to 6 ft across), angular, rectangular-shaped boulders of apparently locally derived schists, gneisses, and marbles which have been interlocked to create the seawall. Interstitial cobbles, gravels, and sands are present in the riprap (WCCI 1993a).

The glacial till unit of the Wisconsinian glaciation is a heterogeneous, unsorted, non-stratified, unconsolidated deposit of non-uniform thickness that unconformably overlies bedrock. The till unit consists of tan, brown, gray to black sands with cobbles, gravel, silt, and clay. The till is present in nearly all drilling locations with thicknesses varying from 0 ft at Piezometer PZ-1 and Monitoring Well MW-119 to a maximum of about 51 ft at Monitoring Well MW-125B (WCCI 1993a).

Drilling conducted as part of the 1989-1991 investigation at the Site by WCCI revealed a recent organic black silt, generally restricted to the southern portion of the Site, that overlies the glacial till. Additional locations of the organic silt were found during the RI drilling program at the Site. These locations and the respective approximate silt thicknesses are: Monitoring Wells MW-106, 2 ft; MW-107, 4 ft; MW-108, 6 ft; MW-111, 3 ft; MW-117, 2 ft; MW-122, 2 ft; Piezometers CB-1, 1.5 ft; CP-1, 2 ft; and, CP-2, 2.5 ft. WCCI (1993a) concluded that there was no evidence to suggest that this organic silt horizon is traceable laterally (for any substantial distance), and, therefore, does not represent a confining zone.

Bedrock information was obtained by WCCI from the bedrock geologic map of Bronx County, aerial photographs, observations during drilling, examination of cores recovered during installation of monitoring wells and piezometers, drilling of test borings on the Site, and reconnaissance mapping of rock outcrops immediately adjacent to the landfill. Approximately 64.5 ft of vertical coring was conducted at seven different locations on, or immediately adjacent to, the Site. Based on this information, the bedrock underlying the Site is part of the Hartland Formation's Pelham Bay Member and consists of undifferentiated schists, gneisses, amphibolites, and pegmatities. Additionally, the bedrock surface under the Site is highly irregular. A local northeast-southwest trending bedrock high passes through the center and extends beneath the entire landfill. Bedrock elevations decrease towards the northwest and southeast, away from the local high. Maximum depth to the top of bedrock in the landfill area is approximately 40 ft below the Bronx datum. Observed bedrock types include fine to coarse grained schist, schistose gneiss, amphibolite, and non-foliated pegmatite. Mineralogy is predominantly quartz, feldspar, and biotite, with lesser amounts of garnet, muscovite, and amphibole, and minor amounts of chlorite, magnetite, and pyrite. Examination of rock cores collected during the RI revealed slight to moderate weathering of bedrock. Observations during drilling indicate that an approximately 3 to 4 ft thick, moderately to deeply weathered zone occurs at the top of the bedrock. However, this weathered zone can range from approximately 0 ft (Monitoring Wells MW-114B, MW-124B, and MW-129B) to 8.5 ft (Monitoring Well MW-117B) and 15.5 ft (Piezometer PZ-1B) thick (WCCI, 1993a).

A geologic fence diagram is shown on Figure 4. The geologic fence diagram was prepared based on the geologic cross-sections presented in the RI Report (i.e., cross-sections B-B' [Figure 3-4] and E-E' [Figure 3-7]), and shows the stratigraphic units along the southern and eastern perimeters of the Site (i.e., along Eastchester Bay), which is the primary groundwater discharge boundary for the Site; the referenced geologic cross-sections from the RI Report are provided in Appendix B of this SMP.

The regional hydrogeology of the project area is described in detail in the RI Report (WCCI 1993a) and is summarized below. Groundwater at the Site occurs in the fill, glacial till, and bedrock units beneath the Site. Water level monitoring and groundwater modeling conducted during the RI indicated that groundwater movement is almost radial from the center of the Site with most of the groundwater present in the fill and till due to precipitation infiltration.

During the RI, water-level measurements were collected from monitoring wells that are screened in the unconsolidated materials (i.e., fill and glacial till units) on August 4, August 12, and November 5, 1992. The August 4 and November 5, 1992 synoptic water-level measurement events were conducted during low tide and the August 12, 1992 synoptic water-level measurement event was conducted during high tide. Groundwater flow maps were prepared based on the data collected during these three synoptic water-level measurement events, and are provided as Figures 5 through 7 of this SMP. These data/figures provide information regarding pre-remedial action (or "Baseline") conditions. The direction of groundwater flow in the fill and glacial till units is toward Eastchester Bay from the center and northern part of the Site, and toward the tidal wetland areas beyond Pelham Parkway in the western part of the Site. Groundwater that flows onto the Site from the southwest is believed to be diverted either east or west before it flows onto much of the Site (WCCI 1993a).

Based on water-level measurement data collected on August 1, 2007 (i.e., post-remedy conditions), the depth to water at the Site ranges from approximately 5 to 25 feet below the monitoring well measuring points. In an attempt to collect representative water levels for the Site, ARCADIS implemented a continuous water-level monitoring study between August 13 and 17, 2007. An average water-level elevation for each monitoring well location was calculated by averaging all of the data collected in each well during the continuous water-level monitoring study. The average water-level elevations for the week of August 13 through 17, 2007 is presented in Table 1. A groundwater flow map was prepared based on the August 2007 average water-level elevations, and is provided as Figure 8 of this SMP.

As shown on Figure 8, groundwater flow at the site is from the cut-off wall, located along the southwestern property boundary, radially outward towards Eastchester Bay. The direction of groundwater flow is consistent with the Baseline (RI) synoptic water level elevations (Figures 5 through 7). Figure 8 also shows that the cut-off wall and the associated trenches are effective in reducing the flow of groundwater into the landfill. In addition, the cut-off wall also prevents any groundwater/leachate from the Site flowing into Pelham Bay Park.

1.3 Description of Remedial Investigation Findings

The SMP and all Site documents, including the Remedial Investigation, are maintained by the NYSDEC (or successor agency). At the time of publication, these reports can be found at the Region 2 NYSDEC offices in Long Island City, New York.

1.3.1 Summary of Remedial Investigation Findings

The Final RI Report was submitted on April 14, 1993 and a SRI Report was submitted on June 1, 1993. The purposes of the RI were to investigate the nature and extent of contamination at the Site, and to assess the hazards to human health and the environment that may be attributable to Site-related contaminants. Additionally, the RI was designed to augment previous studies and move forward the selection of a remedial action alternative in a timely and cost effective manner. The objective of the SRI was to fill data gaps in the RI by investigating off-site shallow soils (WCCI 1993b).

The conceptual site model (CSM) developed for the Site (based on the results of the RI [WCCI 1993a] and SRI [WCCI 1993b] reports) is summarized below. The CSM illustrates the different transport mechanisms by which landfill-derived constituents may enter the surrounding environment. The three major pathways for transport from the landfill are the groundwater pathway, the surface water pathway, and the air pathway; these pathways are described below and are illustrated on Figure 5-1 of the RI Report (copy in Appendix C of this SMP). The data from the RI and SRI that support the CSM are summarized in Sections 1.3.1.1 through 1.3.1.4 of this SMP.

As part of the CSM developed in the RI Report (WCCI 1993a), the landfill (i.e., waste/refuse materials) was identified as the source of the constituents in the groundwater/leachate that exceeded NYSDEC Groundwater Standards and surface water discharge limitations. Hazardous materials may also have been disposed at the Site (see Section 1.2.2 of this SMP). Prior to capping (i.e., installation of the Landfill Cover System), precipitation that infiltrated into the landfill percolated through the waste/refuse materials and resulted in the generation of leachate and impacts to the shallow groundwater system (i.e., groundwater in the unconsolidated materials). In addition, constituents leached from the waste/refuse materials that are in contact with the shallow groundwater system (including tidally-influenced water from Eastchester Bay [bay water], which enters and drains from the groundwater system at the Site during high and low tide, respectively). The shallow groundwater below the landfill, which contains constituents exceeding NYSDEC Groundwater Standards, flows northeast, east, and south toward Eastchester Bay. Shallow groundwater also flows northwest and west toward the tidal wetlands.

Surface "leachate" seeps were identified and classified, during the RI, and described in the CSM as being representative of shallow groundwater flow and not as a separate perched water flow system. The seeps occurred as part of the shallow groundwater flow system where lateral groundwater flow in the fill discharged onto the land surface. Seeps occurred primarily in the riprap wall where high permeability channels were created due to the open structure of the rock. The seeps along the riprap wall were generally visible only at low tide.

The CSM developed for the Site also classified groundwater flow in the bedrock as distinct from the shallow groundwater system. Groundwater entering the bedrock beneath the Site is limited to locations where a downward vertical gradient is present between the overburden and the bedrock. The downward migration of groundwater into the bedrock is also limited by the upper weathered zone of the bedrock, where present, due to its low permeability and hydraulic conductivity. Groundwater flow and constituent migration through fractures is the predominant pathway in the bedrock. Based on the examination of rock cores that were collected during the RI, major fracture zones were present at a limited number of drilling locations and the extent of fracturing decreased with depth. Therefore, the likelihood of deep (greater than 100 feet) contamination from the vertical migration of constituents through interconnected fractures was believed to be minimal, and for this reason, the bedrock flow pathway was believed to be minor when compared to the shallow groundwater horizontal flow pathway.

Additionally, the surficial soil of the Site and limited areas of exposed waste/refuse materials were identified in the RI and CSM as potential sources of contamination for surface water runoff prior to the installation of the impermeable final cover. Most of the surface water runoff that left the Site was likely to flow into the surrounding surface water of Eastchester Bay. Constituents that entered Eastchester Bay could be subsequently transported further from the landfill by tidal currents and physical transport processes (e.g., dispersion), sediment adsorption and transport, and food chain transfer. Based on a comparison of shallow off-site soil sample data to on-site and background soil sample data, the SRI indicated that overland or surface water transport of constituents from the landfill to soils off site was a minor to non-existent pathway. Based on the results of the RI (WCCI 1993a) and SRI (WCCI 1993b), there were no specific areas of concern (AOCs) identified in soil. Hot spots, or areas of grossly contaminated soils, were not found on site or off site during the RI and SRI (see Section 1.3.1.1 of this SMP).

The CSM also identified the Site as a source of volatile organic compounds (VOCs) in air prior to the installation of the Landfill Gas Management and Flare System. The Site generates methane and other byproduct gases from the decomposition of organic matter deposited in the landfill. Vapors are also generated from the volatilization of VOCs in the municipal waste. The gaseous compounds migrate both horizontally and vertically through the fill. Gases that migrate horizontally move into the surrounding soil and ultimately discharge to the atmosphere. Gases that migrate vertically will directly discharge to the atmosphere. The RI indicated that methane emissions were measured that exceeded background levels and that gaseous compounds were migrating vertically through the soil cover and being released to the atmosphere. However, data collected indicated that off-site horizontal migration of soil gas was not occurring. This is consistent with and supported by visual observations of healthy vegetation off site, the limited perimeter and flux chamber sampling results, and the results of previous studies.

Below is a summary of Remedial Investigation/Supplemental Remedial Investigation findings:

1.3.1.1. Soil

This section of the SMP summarizes the RI (WCCI 1993a) and SRI (WCCI 1993b) soil findings; specifically, the analytical results for soil samples collected from RI soil borings and the analytical results for soil samples collected during the SRI. Soil samples were also collected for laboratory analysis from air monitoring station locations and the former community garden during the RI. The analytical results for the soil samples collected from air monitoring station locations and the former community garden are summarized in the RI Report.

During the RI, the soil analytical data were compared to the reference station data (i.e., Soil Samples SB-124S1 and SB-124S2), which were selected to reflect natural or background conditions. In general, exceedances of the reference station results were detected in both on-site and off-site soil samples. During the SRI, the soil analytical data were compared to the background samples (i.e., Soil Samples SRI-10 through SRI-13) that were collected during the SRI. The background samples served as a reference standard for the SRI soil samples.

In summary, results of the RI/SRI indicated the following with respect to soil:

- Hot spots, or areas of grossly contaminated soils, were not found on-site or off-site during the RI and SRI.

- Semi-volatile organic compounds (SVOCs) (primarily polycyclic aromatic hydrocarbons [PAHs]) were detected in the majority of the RI soil boring soil samples, and the concentrations of SVOCs in the RI on-site and off-site surface soil samples exceed the reference (i.e., background) levels at many locations. Additionally, SVOCs, especially PAHs, were determined to be ubiquitous in the Pelham Bay area, and similar SVOCs and concentrations were detected in the SRI on-site, off-site, and background soil samples. Total SVOC concentrations ranging from 45 micrograms per kilogram (ug/kg) to 227,300 ug/kg were detected in the RI soil boring and SRI soil samples.

- Pesticides (primarily 4,4'-DDD; 4,4'-DDE; and 4,4'-DDT) were detected in the majority of the RI soil boring soil samples, with total pesticides detected at concentrations ranging from 1.1 ug/kg to 2,676 ug/kg. The highest concentrations were detected in off-site soil samples collected from the Monitoring Well MW-123 soil boring location, which is located in Pelham Bay Park. Pesticides were nearly absent in the SRI on-site, off-site, and background soil samples. One pesticide (i.e., 4,4-DDT at a concentration of 180 ug/kg) was detected in one SRI soil sample.

- Inorganics (i.e., metals) were detected in the majority of the RI soil boring soil samples and were determined to be ubiquitous in the Pelham Bay area. The concentrations of all inorganic analytes in SRI off-site soil samples are generally similar to concentrations in SRI background soil samples.

Concentrations of zinc (up to 1,710 milligrams per kilogram [mg/kg]) were detected in the Historic Leachate Seep Area (Area 1) SRI soil samples. The source of this zinc is uncertain. The inorganics concentration ranges are presented in Table 4-4 from the RI Report and Table 6 from the SRI Report (copies of these Tables are provided in Appendix D of this SMP).

- VOCs were not detected in the majority of the RI soil boring soil samples. Where present, 2-propanone (acetone) was the primary VOC detected in soil samples. Total VOC concentrations ranging from 11 ug/kg to 3,713 ug/kg were detected in eight of the RI soil boring soil samples. VOCs were nearly absent in the SRI on-site, off-site, and background soil samples. One VOC (i.e., acetone at a concentration of 91 ug/kg) was detected in one SRI soil sample.

- Polychlorinated biphenyls (PCBs) were not detected in the majority of the RI soil boring soil samples. Total PCBs were detected at concentrations ranging from 130 ug/kg to 430 ug/kg in eight of the RI soil boring soil samples. PCBs were not detected in any of the SRI soil samples.

- A connection between constituents detected in Area 2 upgradient (on-site) and downgradient (off-site) Surface Water Runoff Channel soil samples could not be established during the SRI.

Tables and figures from the RI Report and SRI Report summarizing the soil sample analytical results are provided in Appendix D of this SMP. A summary of the VOCs, SVOCs, pesticides and PCBs, and inorganics analytical results for the RI soil boring soil samples is presented in Tables 4-1 through 4-4 from the RI Report and Tables 2, 3, 5, and 6 from the SRI Report. Figures 4-1 through 4-4 from the RI Report and Figures 7 through 12 from the SRI Report show the soil sample locations and analytical results.

The RI and SRI were conducted prior to NYSDEC's development of Soil Cleanup Objectives (SCOs) in 6 NYCRR Part 375-6, as these regulations did not become effective until December 14, 2006. Since the RI and SRI were conducted prior to NYSDEC's development of SCOs, and since the remedy for the Site, as set forth in the ROD (1993) did not involve any soil excavation activities (i.e., construction of an impermeable final cover with all residual waste materials left in the subsurface at the Site), SCOs are not applicable and are not discussed further in this SMP.

The results of shallow on-site soil sample analysis indicate that, although there are exceedances of reference (background) concentrations, there are no areas of gross surface soil contamination. As discussed previously in the CSM, a comparison of shallow off-site soil sample data to on-site and background soil sample data shows that the concentrations of analytes in off-site soils (with the exception of zinc) are generally below or consistent with on-site and background soil samples. This indicates that overland or surface water transport of constituents from the landfill to soils off site was a minor to non-existent pathway. The chemical composition of off-site soils adjacent to the landfill, on the basis of similarities with the background samples, are consistent with a typical urban environment.

1.3.1.2. On-Site and Off-Site Groundwater

This section of the SMP summarizes the RI groundwater findings and the analytical results for groundwater samples collected from monitoring wells during the RI (i.e., pre-remedial action). Although the "leachate" seeps occur as part of the shallow groundwater flow system, the analytical results for leachate seep samples are discussed in Section 1.3.1.3 of this SMP because the seeps were sampled separate from groundwater.

In summary, results of the RI indicated the following with respect to groundwater:

- The landfill is the source of constituents in the groundwater that exceed NYSDEC Groundwater Standards and surface water discharge limitations.

- The shallow groundwater below the landfill, which contains constituents exceeding NYSDEC Groundwater Standards, flows northeast, east, and south toward Eastchester Bay. Shallow groundwater also flows northwest and west toward the tidal wetlands.

- Inorganics and conventional leachate parameters were detected in all of the RI groundwater samples. The inorganics and conventional leachate parameters concentration ranges are presented in Tables 4-22 and 4-23, respectively, from the RI Report (copies of these Tables are provided in Appendix E of this SMP).

- VOCs were detected in the majority of the RI groundwater samples, with monocyclic aromatic hydrocarbons being the primary VOCs detected. Total VOC concentrations ranged from 2 micrograms per liter (ug/L) to 2,120 ug/L.

- Pesticides were detected in the majority of the RI groundwater samples, with concentrations ranging from 0.0063 ug/L to 2.1 ug/L. The majority of detected pesticide concentrations are estimated because they were detected below the Contract Required Detection Limit. In addition, the majority of detected pesticide concentrations could not be verified during data validation.

- SVOCs were detected in approximately half of the RI groundwater samples, with total SVOC concentrations ranging from 2 ug/L to 505 ug/L.

- Cyanide was detected in five groundwater samples, with concentrations ranging from 10.8 ug/L to 267 ug/L.

- PCBs were detected in only one of the RI groundwater samples. PCB-1016 was detected at a concentration of 0.84 ug/L and PCB-1260 was detected at a concentration of 1 ug/L.

Tables from the RI Report summarizing the groundwater sample analytical results are provided in Appendix E of this SMP. A summary of the VOCs, SVOCs, pesticides and PCBs, inorganics, and conventional leachate parameters analytical results for the groundwater samples collected from monitoring wells is presented in Tables 4-19 through 4-23 from the RI Report. Table 4-33 from the RI Report presents a comparison of monitoring well groundwater samples to NYSDEC Groundwater Standards prior to the remedy. Table 4-34 from the RI Report presents a summary of compounds that exceed NYSDEC Groundwater Standards prior to the remedy.

Figures from the RI Report summarizing the groundwater sample analytical results are provided in Appendix E of this SMP. Figures 4-17 through 4-20 from the RI Report show the groundwater sample locations and analytical results. Figures 4-25A and 4-25B from the RI Report show a comparison of constituent levels to NYSDEC Groundwater Standards and surface water discharge limitations prior to the remedy.

1.3.1.3. On-Site and Off-Site Leachate Seeps

This section of the SMP summarizes the RI leachate seeps findings and the analytical results for leachate seep samples collected from the seeps during the RI.

In summary, the results of the RI indicated the following with respect to leachate:

- The landfill is the source of constituents in the leachate that exceed NYSDEC Groundwater Standards and surface water discharge limitations.

- The leachate seeps occur as part of the shallow groundwater flow system, which flows northeast, east, and south toward Eastchester Bay. Shallow groundwater also flows northwest and west toward the tidal wetlands.

- Inorganics and conventional leachate parameters were detected in all of the RI leachate seep samples. The inorganics and conventional leachate parameters concentration ranges are presented in Tables 4-27 and 4-28, respectively, from the RI Report (copies of these Tables are provided in Appendix F of this SMP).

- VOCs were detected in the majority of the RI leachate seep samples, with monocyclic aromatic hydrocarbons being the primary VOCs that were detected. Total VOC concentrations ranged from 2 ug/L to 235 ug/L.

- Pesticides were detected in the majority of the RI leachate seep samples, with concentrations ranging from 0.0099 ug/L to 1.5 ug/L. The majority of detected pesticide concentrations are estimated. In addition, the majority of detected pesticide concentrations could not be verified during data validation.

- SVOCs were detected in approximately half of the RI leachate seep samples, with total SVOC concentrations ranging from 8 ug/L to 106 ug/L.

- Cyanide was detected in only one of the RI leachate seep samples at a concentration of 20.4 ug/L.

- PCBs were detected in only one of the RI leachate seep samples, with PCB-1016 detected at a concentration of 0.88 ug/L.

Tables from the RI Report summarizing the leachate seep sample analytical results are provided in Appendix F of this SMP. A summary of the VOCs, SVOCs, pesticides and PCBs, inorganics, and conventional leachate parameters analytical results for the leachate seep samples collected from the seeps is presented in Tables 4-24 through 4-28 from the RI Report. Table 4-33 from the RI Report presents a comparison of seep samples to NYSDEC Groundwater Standards prior to the remedy. Table 4-34 from the RI Report presents a summary of compounds that exceed NYSDEC Groundwater Standards prior to the remedy.

Figures from the RI Report summarizing the leachate seep sample analytical results are provided in Appendix F of this SMP. Figures 4-21 through 4-25 from the RI Report show the leachate seep sample locations and analytical results. Figure 4-25A from the RI Report shows a comparison of constituent levels to NYSDEC Groundwater Standards and surface water discharge limitations prior to the remedy.

1.3.1.4. On-Site and Off-Site Soil Vapor

This section of the SMP summarizes the analytical results for soil gas samples collected during the RI. As part of the RI, a perimeter soil gas evaluation was conducted to measure the levels of methane and hydrogen sulfide that may be leaving the perimeter of the Site. In addition, three fissures (VENT-1, VENT-1A, and VENT-2) located near the top of the landfill were surveyed.

Furthermore, to quantify the soil gas emissions from the Site, gaseous emissions were monitored on site using Emission Isolation Flux Chambers (EIFCs). The soil gas emission monitoring program consisted of seven (7) on-site sampling locations (AM-A through AM-G) and one (1) off-site sampling location (AM-1).

In summary, results of the RI indicated the following with respect to soil vapor:

- The landfill is the source of methane and other byproduct gases from the decomposition of organic matter deposited in the landfill.
- Methane emissions were measured that exceeded background levels and gaseous compounds were migrating vertically through the soil cover and being released to the atmosphere.
- Off-site horizontal migration of soil gas was not occurring. This was consistent with and supported by visual observations of healthy vegetation off site, the

limited perimeter and flux chamber sampling results, and the results of previous studies.

- Methane was the primary gas being emitted from the landfill. Other VOCs were being emitted from the landfill, but the emissions were low relative to methane emissions. Some of the methane that was measured at off-site ambient air quality monitoring locations likely originated from the landfill.

- Of the seven soil gas sample locations, only three locations (SG92-3, SG92-4, and SG92-5) situated in the northeast area of the Site had methane emissions that exceeded background levels. The percent of the lower explosive limit (LEL) at these locations ranged from 10 percent to greater than 100 percent. Soil gas measurements collected from off-site locations (SG92-6 and SG92-7) indicated that only background levels of methane were present.

- Hydrogen sulfide readings in soil gas samples did not exceed background levels and ranged from 0.0 to 1.2 ppm. Hydrogen sulfide was only detected at one soil gas emission monitoring location (AM-C), which was located in an outwash area along the southern slope of the landfill where the landfill cover had been eroded and fissures in the landfill surface were visible.

- Ammonia was only detected in sample AM-A, which was collected over the leachate seep along the northwest slope of the landfill.

- Hydrogen cyanide was not detected at any of the soil gas sampling locations.

- Of the 50 VOCs and SVOCs analyzed, 28 compounds were detected in the soil gas.

A summary of the perimeter soil gas survey results and the EIFC compound emission rates are presented in Tables 4-79 and 4-80, respectively, from the RI Report (copies of these Tables are provided in Appendix G of this SMP).

The EIFC compound emission sample locations and the perimeter soil gas survey sample locations are shown on Figures 2-2 and 2-14, respectively, from the RI Report (copies of these Figures are provided in Appendix G of this SMP).

1.3.1.5. Underground Storage Tanks

There were no underground storage tanks (USTs) located at the Site.

1.3.1.6. Other Environmental Media

Other environmental media (e.g., surface water, sediment, and biota) were investigated during the RI. The data and findings associated with these media are discussed in detail in the RI Report. A summary of the data and findings are not discussed in this SMP because there are no ECs/ICs, monitoring activities, or operation and maintenance activities associated with these media.

1.4 Description of Remedial Actions

The Site was remediated in accordance with the selected remedy presented in the NYSDEC-issued ROD dated August 1993 and the IRM/150 Day System that was implemented to comply with the November 1991 Permanent Injunction. As discussed previously, a Remedial Action Work Plan was not prepared for the Site.

Below is a summary of the Remedial Actions required and implemented at the Site:

1. Conduct a remedial design program to verify the components of the conceptual design and provide the details necessary for the construction of the Remedial Action.

2. Regrade the Site to provide proper site drainage and minimize erosion.

3. Install and maintain an actively vented impermeable final cover, consistent with 6 NYCRR Part 360 regulations for Solid Waste Management Facilities, to minimize surface infiltration of precipitation, to collect gases generated by the waste material, and to prevent human exposure to residual waste materials. The major elements of the Landfill Cover System (as it is referred to herein) include (top to bottom) a vegetated topsoil layer, a barrier (soil) protection layer, a drainage layer, and a geomembrane.

4. Install a geosynthetic gas venting layer below the geomembrane on the top portion of the landfill.

5. Install and operate an active gas collection system to collect gases from the landfill and convey them through piping to a flare station located at the base of the landfill (referred to herein as the Landfill Gas Management and Flare System).

6. Install and operate a Groundwater/Leachate Management System consisting of: 1) a cut-off wall and an upgradient collector drain along the southwestern edge of the Site adjacent to Pelham Bay Park, 2) a downgradient collector drain along the southwestern edge of the Site (on the landfill side of the cut-off wall), and, 3) the replacement of a portion of the aboveground leachate force main (installed as part of the 150-day leachate collection system) with an underground force main.

7. Install a Stormwater Management System including drainage ditches, subdrains, conveyance piping, manholes, baffled outlets, inlet/outlet structures, sedimentation basins, and outfalls.

8. Construct additional on-site groundwater extraction wells, as needed. Implementation of this remedy component was deferred to future, if determined to be needed.

9. Limitation of Site usage to reduce the risk of the Remedial Action being damaged or compromised. Limitations include fencing to limit Site access and use, recording of a Deed Restriction to prevent future exposure to residual waste materials remaining at the Site and limit end use to passive recreational, and restricting use of on-site groundwater so that it will not be used as a potable water supply source (a copy of the Deed Restriction is provided in Appendix H).

10. Development and implementation of a post-closure OM&M program, of which this Site Management Plan is a part, to provide for long term management of residual waste materials.

Remedial activities completed at the Site were conducted in accordance with the NYSDEC-issued ROD for the Pelham Bay Landfill (August 1993) and the IRM/150 Day System. The ROD is included in Appendix I (this is the digital file of the ROD).

1.4.1 Removal of Contaminated Materials from the Site

Removal of residual waste materials from the Site was not part of the Remedial Action. Consistent with 6 NYCRR Part 360 and the ROD, residual waste materials were left in the subsurface and capped. Leachate collected at the Site is conveyed via underground pipeline to the Hunts Point Water Pollution Control Plant for treatment. Details of the leachate management system are provided in Section 1.4.2 of this SMP.

1.4.2 On-Site and Off-Site Treatment Systems

A CCR was prepared by URS Corporation (URS) and submitted in October 2002, an electronic copy of which is provided in Appendix J of this SMP. The purpose of the CCR was to describe the design, construction, inspection, and certification of the closure and final remediation of the Site.

Remedial systems (not necessarily treatment systems) associated with the Site include the following:

- Landfill Cover System.
- Groundwater and Leachate Management Systems (discussed separately below).
- Landfill Gas Management and Flare System.
- Stormwater Management System.

The Landfill Cover System was installed to minimize surface infiltration of precipitation and to facilitate the collection of gases generated by the waste material. A typical cross-section for the Landfill Cover System is shown on Figure G-5 from the CCR (see

Appendix J of this SMP). The Landfill Cover System is comprised of the following elements (bottom to top):

- Sub-base layer (9-inch thick);
- Gas venting layer;
- High density polyethylene (HDPE) geomembrane liner (60 mil thick);
- Double-sided geocomposite drainage layer;
- Barrier protection layer (24-inch thick); and,
- Vegetated topsoil layer (6-inch thick).

The groundwater component of the Groundwater and Leachate Management System included the construction of a low-permeability (soil-bentonite) vertical barrier cut-off wall and collector drain (located on the park side of the cut-off wall) to control groundwater gradients. The cut-off wall, approximately 1,300 ft in length, was installed along the southern and southwestern property boundaries of the Site between the landfill and Pelham Bay Park. Figure G-1 from the CCR shows the location of the cut-off wall (see Appendix J of this SMP). The cut-off wall was constructed using slurry trench methods and was backfilled with a mixture of existing soils and bentonite which produced a low permeability backfill material. The wall was installed to depths ranging from approximately 6 to 14 ft below land surface (ft bls), and terminates at the top of the underlying bedrock surface. The cut-off wall is approximately 3 to 5 ft wide. Figure G-2 from the CCR shows a typical section through the cut-off wall (see Appendix J of this SMP). Figure G-6 from the CCR shows the layout of the Groundwater and Leachate Management System (see Appendix J of this SMP).

A groundwater collection drain (the upgradient collection drain) was constructed on the Pelham Bay Park side of the cut-off wall. The upgradient drain was designed to intercept groundwater flowing from Pelham Bay Park toward the landfill and divert the flow via a buried 8-inch diameter HDPE pipe (slotted and solid) to an existing storm sewer, which outlets directly to Eastchester Bay. Currently, fourteen (14) groundwater monitoring wells are used to measure groundwater elevations. There are thirteen (13) wells within the limits of the landfill. There is an additional one (1) well (MW-117) outside the landfill in Pelham Bay Park. Monitoring Wells MW-117B, MW-121, MW-124, MW-124B, and MW-126 were previously part of the groundwater elevation measurement monitoring well network; however, off-site Monitoring Wells MW-117B, MW-124, and MW-124B (located in Pelham Bay Park) cannot be located and on-site Monitoring Wells MW-121 and MW-126 were abandoned, pursuant to NYSDEC approval, in June 2007 (see Section 3.3.1 of this SMP). In addition, six (6) cut-off wall piezometers were installed as part of the cut-off wall construction (three (3) on the landfill side and three (3) on the Pelham Bay Park side). These were installed to monitor the groundwater and leachate levels on either side of the cut-off wall, upgradient and downgradient, respectively.

The leachate component of the Groundwater and Leachate Management System is comprised of a number of separate components installed over the 10-year construction period of the landfill remediation, and consists of the following:

- Downgradient Collection Drain, Collection Manholes, and Collection Sumps;
- Curtain Drain;
- Lift Stations Nos. 1 and 2;
- Leachate Storage Tanks; and,
- Force Main Discharge (to the Hunts Point Water Pollution Control Plant).

The downgradient collector drains are located: (1) on the landfill (or downgradient) side of the cut-off wall; and, (2) on the northwestern perimeter of the Site, and consist of 8-inch diameter slotted HDPE pipes embedded in sand and gravel. The collector drains intercept leachate migrating from the landfill, ultimately directing the leachate into Collection Sump D-1. This flow discharges into a New York City sewer manhole at Burr Avenue via an off-site force main. Figure G-3 from the CCR shows the leachate collection system schematic diagram (see Appendix J of this SMP). Five (5) 20,000-gallon reinforced fiberglass aboveground leachate storage tanks, originally constructed as part of the IRM/150 Day System to store leachate on site, are now used to store leachate during rain events, when direct pumping to the Burr Avenue sewer manhole is not permitted. A telemetric communication system has been constructed in order to control the discharge of leachate into the Burr Avenue combined sewer system. Storm events which create a combined sewer overflow condition will be detected by a high level sensor located on Brush Avenue just south of the intersection with Bruckner Boulevard, causing leachate pumping to cease until normal sewer flow rates resume.

The Landfill Gas Management and Flare System is comprised of two main components: the landfill gas collection system and the blower/gas flare system. These combined systems work together to collect, monitor, and control gas emissions associated with the landfill. Figure G-1 from the CCR shows the layout of the landfill gas collection system and the location of the gas flare system (see Appendix J of this SMP).

The principal components of the Landfill Gas Management and Flare System are:

- Twenty-two (22) gas extraction wells, consisting of 4-inch diameter polyvinyl chloride (PVC) perforated and solid piping extending into the refuse. Each well head includes am isolation valve and fitting for pressure gauges and a flexible hose connection to a 3-inch diameter solid polyethylene pipe which conveys the extracted landfill gas to the gas transmission header (see Figure G-1 from the CCR – Appendix J of this SMP).

- Transmission headers originating at a high point on the east side of the landfill and sloping continuously around the landfill to a low point adjacent to the blowers and flare station at the base of the landfill. The transmission header is constructed of solid HDPE pipe;

- A gas venting layer (single-sided geocomposite and 9-inch sub-base soils) and horizontal collection piping which conveys the gas that may accumulate near the surface of the landfill to the transmission headers;

- Horizontal collection piping around the periphery of the landfill conveys that gas that may accumulate at the base of the landfill to the flaring station. This limits off-site migration of the gas;

- A gas/condensate separator located adjacent to the landfill gas flare station. As condensate is the liquid that forms in the landfill gas collection system when the gas cools, it is considered to be a leachate. The landfill gas/condensate separator is connected to an 8-inch diameter HDPE inspection pipe riser, which allows the condensate to flow by gravity, through double wall containment piping, to Manhole D-2 of the downgradient leachate collection drain system; and,

- Flare station blowers that are able to convey up to 1,500 cfm of landfill gas for oxidation via combustion in the 7-foot diameter by 40-foot high enclosed gas flare stack.

The Stormwater Management System is designed to convey runoff from a 25-year, 24-hour event (approximately 6 inches of rain in a 24-hour period) within the drainage swales, stormwater collection piping, and sedimentation ponds. Stormwater runoff on the landfill surface is collected by drainage swales located alongside the access roads, which transfer the runoff to buried 24-inch diameter corrugated HDPE pipes. At the base of the landfill, runoff in the pipes is discharged through concrete baffled outlets, and is then conveyed via perimeter drainage swales to one of three sedimentation ponds located at the base of the landfill. An infiltration drainage trench, including 6-inch diameter corrugated HDPE piping (sub-drain piping), is also part of the stormwater system. The drainage trenches collect water which has infiltrated from the top of the Landfill Cover System down to the geocomposite drainage layer. The water is transported by sub-drain piping to the stormwater collection manholes, which ultimately discharges into Eastchester Bay. Figure G-4 from the CCR shows the layout of the stormwater management system (see Appendix J of this SMP).

1.4.3 Residual Waste Materials

As discussed previously, removal of residual waste materials from the Site was not part of the Remedial Action. Consistent with 6 NYCRR Part 360 and the ROD (1993), residual waste materials were left in the subsurface and capped. The landfill rises from Eastchester Bay to the east and Pelham Bay Park to the west, with slopes averaging around 20 percent, to a maximum elevation of approximately 135 feet (WCCI 1993a). A Residual Waste Materials Zone Map is shown on Figure 9 and shows the landfill footprint and the topography of the Site. According to the ROD (NYSDEC 1993), the Site operated as a landfill from November 18, 1963 to December 31, 1978, and handled mainly the waste disposal needs of the Bronx. The landfill mound has a top elevation of approximately 130 feet above mean sea level (MSL); the bottom of the waste is at approximately 10 feet MSL. The estimated volume of the landfill, including waste and cover soils and assuming that no waste was placed below 10 feet MSL, was calculated to be approximately 8,130,000 cubic yards (WCCI 2005).

Since the RI and SRI were conducted prior to NYSDEC's development of SCOs, and since the remedy involved the construction of a Landfill Cover System with all residual waste materials left in the subsurface at the Site, SCOs are not applicable.

An 8-foot high chain link security fence surrounds the perimeter of the Site and limits access to the Site to prevent human exposure to residual waste materials remaining at the Site.

As discussed previously, for the purposes of this SMP, residual waste materials are defined as municipal solid waste that may be commingled with hazardous materials. The Residual Waste Materials Zone is comprised of these materials and is defined by the top elevation and limits of the landfill. The top of the Residual Waste Materials Zone is capped with a Landfill Cover System, which also serves as a demarcation layer.

1.4.4 Engineering and Institutional Controls

Since residual waste materials are present at this Site, ECs and ICs will be implemented to protect public health and the environment in the future. The Controlled Property has six primary ECs. These are:

- A Landfill Cover System consisting (bottom to top) of a sub-base layer, a gas venting layer, a HDPE geomembrane liner, a double-sided geocomposite drainage layer, a barrier protection layer, and a vegetated topsoil layer.

- A Groundwater and Leachate Management System with the groundwater component consisting of a low-permeability vertical barrier cut-off wall and a collector drain (located on the park side of the cut-off wall) to control groundwater gradients.

- A Groundwater and Leachate Management System with the leachate component consisting of a downgradient collector drain, collection manholes and collection sumps, a curtain drain, lift stations, and a force main discharging to Hunts Point Water Pollution Control Plant.

- A Landfill Gas Management and Flare System that includes the landfill gas collection system and the blower/gas flare system.

- A Stormwater Management System consisting of drainage swales, stormwater collection piping, and sedimentation ponds.

- Ancillary Systems such as access roads and fencing.

A series of ICs are required to implement, maintain and monitor these ECs. The Consent Order (1990) and Deed Restriction requires compliance with these ICs. These ICs consist of the following:

- All ECs must be operated and maintained as specified in this SMP.

- All ECs on the Controlled Property (the Site) must be inspected and certified at a frequency and in a manner defined in this SMP.

- Groundwater, leachate, stormwater, landfill gas, and other environmental or public health monitoring must be performed as defined in this SMP.

- Data and information pertinent to Site Management for the Controlled Property must be reported at the frequency and in a manner defined in this SMP.

- On-Site environmental monitoring devices, including but not limited to, groundwater monitor wells, landfill gas extraction wells, perimeter landfill gas monitoring wells, and stormwater outlet points, must be protected and replaced or properly abandoned, as directed by the NYSDEC, to ensure continued functioning in the manner specified in this SMP.

The Controlled Property has a series of ICs in the form of Site restrictions. Adherence to these ICs is required under the Deed Restriction. Site restrictions that apply to the Controlled Property are:

- Use of groundwater underlying the Controlled Property is prohibited.

- Limitation of Site usage to reduce the risk of the Remedial Action being damaged or compromised and to prevent future exposure to residual waste materials remaining at the Site.

- Fencing to limit Site access and use.

- All future activities on the Controlled Property that will disturb capped residual waste materials are prohibited unless they are conducted in accordance with the soil management provisions in this SMP.

- The Controlled Property may potentially be used for passive recreational activities (e.g., birdwatching, nature trails) at some time in the future if the NYCDEP elected, provided the long-term ECs and ICs included in the SMP remain in use.

These ECs/ICs should achieve the Site-specific remedial goals defined in the ROD (1993) as described below:

- Close the Site in conformance with Applicable or Relevant and Appropriate Requirements (ARARs).

- Treatment and/or containment of the Site such that, to the extent technically feasible, the concentration of contaminants is reduced to below acceptable levels of risk or to within discharge limits.

- Ensure that remedial activities do not increase the potential for the migration of contamination to the groundwater, surface water, and ambient air.

- Protect people who perform recreational activities in Pelham Bay Park from the harmful effects of contaminants in the air, soil, and water.

- Prevent significant adverse environmental impacts on the surrounding flora and fauna caused by contaminant release from the landfill.

- Control and treat landfill gas.

2. Engineering and Institutional Control Plan

This section of the SMP provides the Engineering and Institutional Control Plan (EC/IC Plan).

2.1 Introduction

This section provides a summary of the ECs/ICs implemented at the Site and describes the purpose of the EC/IC Plan.

2.1.1 General

Remedial activities completed at the Site were conducted in accordance with the NYSDEC-issued ROD for the Pelham Bay Landfill (August 1993) and per the requirements of 6 NYCRR Part 360, Solid Waste Management Facilities, effective December 31, 1988 and revised May 28, 1991. A summary of the remedial strategies and ECs/ICs implemented at the Site are as follows:

- Installation, operation, and maintenance of a Groundwater and Leachate Management System, which consists of:
    - A vertical barrier cut-off wall and an upgradient (groundwater) collector drain along the southwestern perimeter of the Site adjacent to Pelham Bay Park.
    - Downgradient leachate collection drains along portions of the southern and southwestern perimeters of the Site (landfill side of the cut-off wall).
    - Leachate conveyance system including manholes, lift stations, and automated controls.
    - An off-site leachate force-main.
- Installation, operation, and maintenance of an active gas collection system (i.e., the Landfill Gas Management and Flare System) to collect gas from the landfill, prevent uncontrolled release of gas to the atmosphere, and convey the gas collected through piping to a flare station located at the base of the landfill for treatment.

- Construction, operation, and maintenance of a flare station capable of treating up to 1500 cubic feet per minute (cfm) of landfill gas for oxidation via combustion.

- Construction and maintenance of a Stormwater Management System, which includes drainage ditches, sub-drains, conveyance piping, manholes, baffled outlets, inlet/outlet structures, sedimentation basins and outfalls.

- Re-grading of the Site to provide proper drainage and minimize erosion.

- Construction and maintenance of an actively vented impermeable final cover (Landfill Cover System), consistent with NYCRR Part 360 regulations to minimize surface infiltration of precipitation and to collect gases generated by the waste. Maintenance of the Landfill Cover System is performed to prevent human exposure to residual waste materials remaining under the Site. The major elements of the final cover include a vegetated top soil layer, barrier protection layer, geocomposite drainage layer, geomembrane gas/water barrier layer, single side geocomposite gas venting layer, and a 9-inch thick sub-base soil layer installed over the re-graded waste.

- Limitation of Site usage to reduce the risk of the Remedial Action being damaged or compromised. Limitations include fencing to limit Site access and use, recording of a Deed Restriction to prevent future exposure to residual waste materials remaining at the Site and limit end use to passive recreational, and restricting use of on-site groundwater so that it will not be used as a potable water supply source.

- Construction and maintenance of ancillary systems, such as access roads and fencing, installed to limit disturbance of the Remedial Action.

Details of the Groundwater and Leachate Management Systems, the Landfill Gas Management and Flare System, the Stormwater Management System, the Landfill Cover System, and the ancillary systems are discussed below and included in the OM&M Manual (i.e., Volume I [revised in January 2005], Volumes IIA [November 1996], IIB [November 1996], IIC [November 1996], and Volume III [November 1996]), an electronic copy of which is provided in Appendix K of this SMP.

Since residual waste materials and groundwater containing constituents that exceed NYSDEC Groundwater Standards exists beneath the Site, ECs/ICs are required to protect human health and the environment. This EC/IC Plan describes the procedures for the implementation and management of all ECs/ICs at the Site. The EC/IC Plan is one component of the SMP and is subject to revision by NYSDEC.

2.1.2 Purpose

The purpose of the EC/IC Plan is to provide the following information:

- A description of all ECs/ICs on the Site.
- The basic operation and intended role of each implemented EC/IC.
- A description of the key components of the ICs created as stated in the Deed Restriction.
- A description of the features that should be evaluated during each annual inspection and compliance certification period.
- A description of plans and procedures to be followed for implementation of ECs/ICs, such as the implementation of the Soil Management Plan (SoMP) for the safe handling of residual waste materials that may be disturbed during maintenance activities at the Site.
- Any other provisions necessary to identify or establish methods for implementing the ECs/ICs required by the Site remedy, as determined by the NYSDEC and as expressed in the ROD (1993).

2.2 Engineering Control Components

This section discusses the engineering control systems installed at the Site for closure and final remediation of the Pelham Bay Landfill, and the criteria for termination of those engineering control systems and completion of remedial activities at the Site.

2.2.1 Engineering Control Systems

The selected remedy described in the ROD (1993) was chosen because it is protective of human health and the environment, complies with State and Federal requirements that are legally applicable or relevant and appropriate to the remedial action, and was cost effective. The remedy utilizes permanent solutions and appropriate technologies to collect and treat most of the groundwater containing constituents exceeding NYSDEC Groundwater Standards. The engineering control systems constructed at the Site include a Groundwater and Leachate Management System, a Landfill Gas Management and Flare System, a Stormwater Management System, a Landfill Cover System, and ancillary systems. A description of the "Conceptual Remedial Approach", "System Design and Installation", and "System OM&M" for each system is provided below.

2.2.1.1. Landfill Cover System

Conceptual Remedial Approach

Exposure to the residual waste materials at the Site is prevented by the Landfill Cover System built on-Site. This Landfill Cover System is comprised of four major components: geomembrane, geocomposite, barrier protection material and vegetated topsoil layer. Figure 2-1 of Volume I of the OM&M Manual (Appendix K of this SMP) and Figure G-5 of the CCR (Appendix J of this SMP) show the NYSDEC-approved design for each remedial cover type used on this Site.

System Design and Installation

The Landfill Cover System is comprised of the following elements, presented in order (bottom to top) (see Figure G-5 of the CCR [Appendix J of this SMP]):

- Sub-base layer (9-inch thick).
- Gas venting layer.
- HDPE geomembrane liner (60 mil thick).
- Double-sided geocomposite drainage layer.
- Barrier protection layer (24-inch thick).
- Vegetated topsoil layer (minimum 12-inch thick).

Sub-Base Layer

A soil sub-base layer was placed on top of the existing daily landfill cover to provide a smooth subgrade on which to place the geomembrane. The specified thickness of the sub-base layer is nine (9) inches. The soil consists of on-site cover soil material and imported soil free from debris, landfill waste and frozen material. All imported soil had a maximum particle size of one (1) inch.

Gas Venting Layer

At the top portion of the landfill, a geosynthetic gas venting layer was installed above the soil sub-base layer. The gas venting layer is comprised of a single-sided geocomposite (which consists of a geotextile, heat-bonded to one side of a drainage geonet), crushed stone-filled trenches, and corrugated and perforated HDPE horizontal gas collection pipes. The layer is connected, via solid HDPE pipes, to the remainder to the active gas collection system.

On the side slopes, the gas venting system consists of a 9-inch thick layer of soils underlying the geomembrane. The purpose of the gas venting layers is to collect the gases at the surface of the landfill and channel them to the active gas collection system. The gas venting system is intended to passively vent to the atmosphere only during construction and again after the active gas venting system is decommissioned.

HDPE Geomembrane Liner

The geomembrane liner consists of a 60-mil thick textured HDPE geomembrane on the side slopes of the landfill, and a 60-mil thick smooth HDPE geomembrane on the top portion of the landfill. The purpose of the geomembrane is to prevent rainfall infiltration into the landfill and landfill gas migration into the atmosphere.

During the installation of geocomposite material and barrier protection layer, approximately 13.5 acres of geomembrane liner was damaged by high winds during the period February 26, 1996 through March 1, 1996. Extensive testing on the liner that remained was conducted to set the limits of the damaged areas. Portions of the liner were removed and tested at the Site and samples were sent to the lab for confirmation. All liner materials that exhibited results that did not meet the requirement of the Contract were removed and installation of new, replacement liner was completed by the Summer of 1996.

Double-Sided Geocomposite Drainage Layer

A geocomposite drainage layer, consisting of geotextiles, heat-bonded to both sides of a drainage geonet, underlies the loamy soil barrier protection layer. The purpose of the geocomposite layer is to collect water infiltration through the soil layer and divert it to the infiltration drainage trenches, where it is transported through a sub-drain pipe system to the stormwater sedimentation ponds (described in Section 2.2.1.3).

Barrier Protection Layer

The barrier protection layer is a 24-inch thick loamy soil protective barrier, which protects the geomembrane layer from infiltration of stormwater, frost, exposure to the elements, and pressure from heavy surface loads. The barrier protection layer is composed of existing cover soil and natural soil borrow fill that meets the classification of SP-SM, SM, SC or ML and has a specified maximum particle size of three (3) inches.

Vegetated Topsoil Layer

The topsoil layer was constructed to support vegetative growth over the landfill surface and consists of a minimum 6-inch thick soil layer having a loamy texture. The 6-inch thick topsoil layer was placed during the Fall of 1996. Seeding, as per the contract specifications, was performed immediately after top-soil installation activities were completed.

Due to unsatisfactory vegetative growth during the Spring of 1997, pH testing of the topsoil material was performed. These tests indicated that the high pH (low acidity) levels of the in-place topsoil may have hindered the establishment of the desired vegetative growth. To increase acidity, sulfur was applied to the topsoil surface in July 1997. Tests taken afterward indicated that topsoil pH levels had been lowered, but had not consistently reached the desired pH range of 7-8. Therefore, additional sulfur was applied to the existing soil and mixed to lower pH of the existing soil. After mixing and testing the pH of the soil was lowered, 6 inches of new topsoil was spread over the existing soil throughout the entire landfill.

During the Spring and Fall of 1999 the landfill was landscaped using new soil, new seed and a new landscaper. The new soil was hydro-seeded and straw mulch was used to cover the seeds for protection from the sun and also as a moisture retention barrier. As of May 2002, Pelham Bay Landfill has produced adequate vegetative growth for the purpose of reducing the erosion potential of the Site.

Additionally, 26 planting islands were constructed as an integral component of the landfill final cover system. These islands are approximately 2.5 feet in depth and are planted with a mixture of trees and shrubs.

A SoMP is included in Section 2.3.2 of this EC/IC Plan and outlines the procedures required in the event the Landfill Cover System and underlying solid waste are disturbed.

System OM&M

Procedures for operating and maintaining the Landfill Cover System are included in the Operation and Maintenance Plan (Section 4 of this SMP); procedures for monitoring the system are included in the Monitoring Plan (Section 3 of this SMP). The Monitoring Plan also addresses severe condition inspections in the event that a severe condition, which may affect controls at the Site, has occurred.

2.2.1.2. Groundwater and Leachate Management System

Conceptual Remedial Approach

The Groundwater and Leachate Management System consists of three main components: the groundwater management system, the leachate collection and disposal system, and a vertical barrier cut-off wall. Based on the hydrogeology and historic site investigations results, it was determined that a vertical barrier cut-off wall was required to be installed along portions of the southern and southwestern perimeters of the Site.

To prevent groundwater flowing onto the Site from "mounding" in front of the vertical barrier cut-off wall, a groundwater collector drain is required to lower the water table and transmit the groundwater away from the cut-off wall. Therefore, the groundwater management system includes a groundwater collector drain, installed parallel to the cut-off wall and located on the upgradient side of the cut-off wall, to collect clean groundwater and divert the groundwater into the Eastchester Bay.

The leachate collection and disposal system was designed for the removal of leachate from the Site to protect the groundwater from contamination and limit discharges into the surrounding environment, including Pelham Bay Park and Eastchester Bay. The leachate collection and disposal system consists of several individual collection drains located on the downgradient side of the cut-off wall, a section of leachate collection drains along the southern and southwestern perimeters of the Site, a curtain drain located near the northwest corner of the Site, and a series of manholes, pumping stations, lift stations and force mains. The leachate collection system is an active system that uses an automated control system to transfer the collected leachate to the Hunts Point Water Pollution Control Plant for treatment. During heavy rain events, the collected leachate is transferred to a set of five (5) on-site aboveground storage tanks. The leachate is temporarily stored in the tanks until normal sewer flow rates resume, at which time the leachate is transferred to the Hunt's Point Water Pollution Control Plant for treatment.

A plan view of the Groundwater and Leachate Management System is shown on Figure 2-6 of Volume I of the OM&M Manual (Appendix K).

System Design and Installation

The Groundwater and Leachate Management System for the Site consists of a vertical barrier cut-off wall (i.e., a soil-bentonite slurry wall), a leachate collection system and force main, leachate collection pumping units, and a controls system. These are described in further detail below. Detailed design information is included in Volumes I through III of the OM&M Manual (Appendix K) and the October 2002 CCR (Appendix J).

Cut-Off Wall

To install a vertical barrier cut-off wall for groundwater management, the slurry trench method was used, which included the emplacement of a soil-bentonite mixture along portions of the southern and southwestern perimeters of the Site. A typical section diagram of the cut-off wall is shown on Figure G-2 of the CCR (Appendix J). Details of the cut-off wall are described below:

- A 3-foot wide, 1,276-foot long slurry trench was excavated to bedrock in accordance with Contract Documents. As the trench was excavated, bentonite slurry was pumped into the trench. Typical physical and chemical properties of the soil bentonite backfill, as well as completed design mix testing, are shown in Appendix A (A-3 Slurry Wall Backfill Design Mix) of the CCR (Appendix J).

- Flexible wall permeability tests were performed on six (6) piston tube samples taken from the backfill material at locations chosen by the Resident Engineer staff. When the laboratory results on the piston samples confirmed that the required permeability was achieved, the cut-off wall was deemed acceptable.

- In October 1994, a concrete cap was installed over the cut-off wall. Piezometer wells were installed on both sides of the cut-off wall for monitoring of groundwater, as follows:

    - Fourteen (14) groundwater monitoring wells are currently used to measure upgradient and downgradient groundwater elevations. Within the landfill property there are thirteen (13) wells, and there is one (1) additional well outside the landfill in Pelham Bay Park.

    - Six (6) cut-off wall piezometers were installed as part of the cut-off wall construction, three (3) on the landfill side and three (3) on the Park side. They are monitored to confirm the cut-off wall design intent of maintaining an inward hydraulic gradient.

Leachate Collection Trench

The leachate collection trench excavation and piping was predominantly concentrated along the southern and southwestern perimeters of the Site. Excavated areas were backfilled using crushed stone base material. The method of backfill placement did not disturb or damage collector drain trench piping, force main or other utilities in the trenches. Aggregate and backfill gradation information is provided in Volume IIA of the OM&M Manual (Appendix K).

Collector Drain Systems

In August and September of 1994, pipes, manholes, associated electrical conduits, sumps, and pumps were installed for two collector drain systems: (1) upgradient (groundwater) and (2) downgradient (leachate). The Contract Drawings, as well as subsurface information available from the design phase, indicated bedrock at elevations below actual bedrock elevations. As a result, the invert elevations and associated slopes of the two collector drains were changed (raised), within allowable limits, at various locations to account for actual field conditions. The collector drain trenches were backfilled with Select Backfill Type A and Aggregate Type C. Aggregate and backfill gradation information is provided in Volume IIA of the OM&M Manual (Appendix K).

The leachate collector drain consists of an 8-inch diameter slotted HDPE pipe embedded in sand and gravel. The leachate collector drain intercepts leachate migrating from the Site and the pipe diverts the flow to one of the two lift stations located at either end of the drain. The leachate is conveyed to Collection Sump D-1, and then discharged to the New York City sewer system (NYCSS) via an off-site force main.

The curtain drain consists of perforated HDPE pipe embedded in gravel. The curtain drain collects leachate from the west side of the Site and discharges by gravity to Lift Station No.1. The leachate is conveyed to Collection Sump D-1, and then discharged to the New York City sewer system (NYCSS) via an off-site force main.

The groundwater collector drain consists of an 8-inch diameter HDPE pipe (slotted and solid). The groundwater collector drain intercepts groundwater flowing from Pelham Bay Park toward the Site and diverts the groundwater into Eastchester Bay.

Construction for IRM Force Main Upgrades

The 150-Day IRM System, which remained active during the Remedial Action period of construction, was located near the entrance to the Site and consisted of a leachate extraction system and five (5) aboveground storage tanks (ASTs), each having 20,000-gallon storage capacity.

An upgrade (extension) to the existing IRM force main was completed from the Site to the sewer at Burr Avenue and a connection from the force main to the existing Collection Sump D-1 was made. The off-site force main sections crossing underneath the Bruckner Expressway (I-95) entrance and exit ramps were installed by jacking method as described under Contract HP-877. The upgraded, below grade force main, along with its associated electrical conduits, pumps, and ancillary structures, replaced the existing above grade IRM force main. The upgraded force main (referred to as the force main herein) was connected to the existing pumping wells and discharge location, as described below.

For pipe bedding, well-graded crushed stone or crushed gravel was used, which met the requirements of ASTM C33, Gradation 67. For Crushed Stone Base material, hard and durable particles of crushed stone or gravel were used conforming to Section 703-02 of the New York State Department of Transportation (NYSDOT) Standard Specifications. Field quality control for Pipe Bedding and Crushed Stone Base consisted of a sieve analysis which was specified and performed at frequencies of one (1) per 200 linear feet conforming to ASTM Cl36.

Leachate Collection Pumping Units

Pumps are used to transport the leachate from the leachate collection system to the force main, and then to the NYCSS. The pumps are located at Lift Station No.1, Lift Station No.2, and Collection Sumps D-1, D-8, and D-10.

Leachate flow enters Sump D-1 from the section of leachate collection piping that runs parallel to the cut-off wall. During normal operations, leachate from Sump D-1 is pumped directly to the force main, which discharges to the NYCSS. During times when the volume of NYCSS exceeds its capacity during storm events, leachate is automatically re-routed, through automatic valves, and is pumped to Lift Station No. 1. Leachate from Lift Station No.2, the downgradient collector drain, and the AST containment area sump is pumped to Lift Station No. 1. Lift Station No.1 transfers all the leachate into the five (5) ASTs where the flow is allowed to equalize prior to discharging into Sump D-1. See Figure G-3 of the CCR (Appendix J) for an operational schematic of the leachate collection system. The leachate collection system is designed to temporarily shut down if a high alarm is triggered within the collection tanks to prevent accidental surface discharge. All leachate collection pumps were tested in accordance with the Contract Documents.

Leachate Control System

The collected leachate discharges into the NYCSS at Burr Avenue/Pelham Parkway South via the off-site force main. The leachate combines with wastewater and stormwater and flows into overflow chamber Combined Sewer Overflow 22 (CSO 22). During heavy precipitation events, the combined wastewater, stormwater and leachate volume can exceed the capacity of the chamber CSO 22 and overflow directly into Westchester Creek. To prevent the leachate portion of this flow from entering the creek, a control system was designed that stops pumping from Collection Sump D-1, and further down the system if necessary, prior to the onset of overflow conditions at CSO 22.

Systems OM&M

Procedures for operating and maintaining the Groundwater and Leachate Management System are briefly discussed within the Operation and Maintenance Plan

(Section 4 of this SMP); procedures for monitoring the system are included in the Monitoring Plan (Section 3 of this SMP). The Monitoring Plan also addresses severe condition inspections in the event that a severe condition, which may affect controls at the Site, has occurred.

System operation, startup, troubleshooting, maintenance, monitoring and the technical specifications for materials and equipment are covered, in the detail required to maintain the system, in Volumes I through III of the OM&M Manual (Appendix K).

2.2.1.3. Landfill Gas Management and Flare System

Conceptual Remedial Approach

Landfill gas generation from the decomposition of waste is an ongoing process and will continue to take place at the Pelham Bay Landfill. To prevent decomposition gases from migrating off-site and to minimize the potential risks of fire and/or explosion due to the accumulation of methane, active landfill gas collection is required. Gas destruction through implementing a flare will facilitate compliance with health based ambient air quality impacts established in the ARARs, provide for permanent protection of human health and the environment, meet the requirements of 6 NYCRR Part 360, Subsections 2.15, 2.16, and 2.17 for landfill closure, and meet the requirements of 6 NYCRR Part 201 for Flare Systems.

For the Site, active landfill gas collection systems include several elements that include installation of extraction wells, lateral well connections, header pipe, condensate systems, transfer systems and a treatment system. The landfill gas collection and control system are grouped into two main components for this Site: (1) the landfill gas collection system and (2) the blower/gas flare system. Combined, these systems work together to collect, monitor and control gas emissions associated with the landfill. Figure G-1 of the CCR (Appendix J) shows the layout of the landfill gas collection system and the location of the gas flare system. The purpose of these systems was to provide long term stable operation of landfill gas extraction and its controlled, thermal destruction. The integrated Landfill Gas Management and Flare System was designed with the following objectives:

- Maintain effective gas emission control.
- Provide an anaerobic atmosphere within the landfill.

- Eliminate nuisance odor emissions.

- Prevent gas migration off the landfill.

System Design and Installation

The selected remedy set forth in the ROD (1993) required active collection and treatment of landfill gas. Installation of an actively vented engineered cap with an impermeable barrier with a gas collection layer installed below the impermeable barrier was mandated. The system designed and installed includes the impermeable barrier which prevents landfill gases from escaping to the atmosphere, a collection layer consisting of a geocomposite with 9 inches of soil placed over the re-graded waste installed below the geocomposite, gas collection points around the perimeter and throughout the landfill, a conveyance system of pipes and headers, condensate management, and a flare station located at the northwest corner of the Site for treatment of the gases. To transport the landfill gases that collect in the gas collection layer, a vacuum system was designed and installed as part of the flare station construction. The current gas management system is capable of drawing and treating up to 1500 cfm of landfill gases at the Flare Station. Detailed design information is included in Appendix K of this SMP.

Gas Extraction Wells

Moretrench Inc., a subcontractor to Breco Mechanical Group, Inc., performed drilling for gas extraction well installation. Twenty-two (22) gas extraction wells, consisting of 4-inch diameter PVC perforated and solid piping extending into the refuse were installed in January 1995. Each well head includes an isolation valve, fittings for pressure gauges, and a flexible hose connection to a 3-inch diameter solid polyethylene pipe which conveys the extracted landfill gas to the gas transmission header. The wells vary in depth from 42 to 82 feet, and are placed every 4 acres, on average, across the Site.

Gas Monitoring Wells

Four (4) gas monitoring wells were installed at the Site by Moretrench, Inc. as required by the Contract Documents. The gas monitoring wells were installed using a methodology similar to that followed for gas extraction well installation (see Figure G-1a of the CCR) (Appendix J).

Gas Collection Piping

The gas extraction wells were tied into a gas collection piping system terminating with a flare station at the base of the landfill. All gas extraction wells terminate to a common underground header collection system which, in turn, conveys the landfill gas to the gas flaring system. All well connections and header pipes slope toward the flare to allow condensate to collect at the landfill base for discharge. A 4-inch diameter High-Density Polyethylene (HDPE) horizontal perforated and corrugated gas collection pipe was installed along the perimeter base of the landfill below grade and below the 60-mil geomembrane. The purpose was to capture landfill gas that might migrate off the landfill.

The collection and flare systems became operational on August 14, 1996. Installation of this system was in strict accordance with the manufacturer's standard recommended installation procedure, which is included in Appendix K of this SMP.

Passive Landfill Gas Ventilation System

In addition to the active landfill gas management system, there is a passive landfill gas ventilation system at the site. The passive ventilation system has been installed at the surface of the landfill and was used for venting landfill gas during construction and upon completion of the post-closure period. The passive ventilation system connects to the gas venting geocomposite (single-sided geocomposite and 9" sub-base soils) and includes two horizontal gas transmission trenches and six HDPE vents. While the active landfill gas management system is in operation, the passive ventilation system is to remain closed. Upon decommissioning of the active system and the flare (when the gas generation rate and composition no longer warrant thermal destruction), the passive system will be put into operation.

Condensate Management

The condensate removal system was designed for the collection of the landfill gas condensate and its final disposal. The collected condensate flows, by gravity, via a 2-inch/4-inch double containment pipe to on-site Manhole MH-D2 shown on Figure 2-10 of Volume I of the OM&M Manual (Appendix K). The condensate removal system consists of:

- A gas condensate separator.
- A gas collection rider connection.

- A solid 2-inch diameter HDPE carrier pipe encased by a solid 4-inch diameter containment pipe for condensate water removal.

The landfill gas condensate was sampled on March 5, 1997 using the sampling methods from 6 NYCRR Part 371. Chemtech, a United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) certified facility, analyzed the samples. Based on the analytical results, the samples did not exhibit hazardous characteristics as defined in 6 NYCRR Part 371.3. Therefore, the condensate is managed as non-hazardous.

Flare Station

The flare station consists of two (2) Lamson Centrifugal LFG blowers discharging into a single enclosed John Zinc Flare System. Both have separate but interfacing controls. The flare system has a series of key safety interlocks, which include:

- High flame temperature.
- Flame failure.
- Low purge air flow.
- Low temperature.

The blowers draw landfill gas from the collection header and discharge it into the flare system. Each blower is capable of supporting flare operation requirements at a rated capacity of 1300 cfm and 6 inches Hg. The flare system can accommodate 1500 cfm at 1600°F to 1800°F and 2 to 4 inches Hg.

Compliance testing of the flare was performed after the landfill gas extraction system achieved relative stability. Operational data on the flare system was collected concurrently with the monitoring of the gas extraction wells. Environmental Laboratories, Inc. (ELI), subcontractor to Breco Mechanical Group, was responsible for the following flare monitoring activities:

- Balance of the gas collection system.
- Weekly monitoring.

- Routine maintenance.
- Test flare emissions for compliance.

Breco prepared and submitted a testing protocol for NYSDEC approval, had an independent testing firm conduct performance tests in accordance with protocols approved by NYSDEC, and provided certified testing results to demonstrate the attainment of the NYSDEC approved emissions limitations based on landfill gas design flows and composition.

Beginning with the first day of operation, August 14, 1996, ELI has submitted quarterly reports on the flare system operation to Breco. The flare unit performance criteria were presented to NYCDEP in quarterly monitoring performance reports.

Manufacturer specifications are included in the Volumes I through III of the OM&M Manual (Appendix K of this SMP).

System OM&M

General procedures for operating and maintaining the Landfill Gas Management and Flare System are documented in the Operation and Maintenance Plan (Section 4 of this SMP); procedures for monitoring the system are included in the Monitoring Plan (Section 3 of this SMP). Volumes I through III of the OM&M Manual for Pelham Bay Landfill covers the detail required to operate and maintain the gas collection system. The OM&M Manual is included as Appendix K of this SMP.

2.2.1.4. Stormwater Management System

Conceptual Remedial Approach

The Stormwater Management System was designed to remove stormwater runoff from the landfill surface during storm events to prevent ponding of water on the landfill, provide sediment control prior to discharge to Eastchester Bay, control the effects of erosion on the landfill cap, and collect precipitation infiltrating through the barrier soil to the drainage system above the geo-membrane liner.

The Stormwater Management System on the landfill surface is designed to convey runoff from the 25-year, 24-hour event (approximately 6 inches of rain in a 24-hour period) within the drainage swales and stormwater collection piping. Figure G-4 of the

CCR (Appendix J) shows the layout of the stormwater management system for the Site.

System Design and Installation

The Stormwater Management System for the Site consists of the following major components: infiltration drainage trenches, sedimentation ponds, stormwater conveyance system, as well as associated piping and fill material relating to these structures. Detailed design information is included in the OM&M Manual (Appendix K of this SMP) and CCR (Appendix J of this SMP).

Infiltration Drainage Trench

For the infiltration drainage trench and curtain drains, 6-inch diameter corrugated HDPE slotted pipes were used. These met the requirements of AASHTO M294 and ASTM F405. Geotextile filter fabric was placed for riprap underlayment, stormwater drainage ditches, access roads, and infiltration drainage trenches.

During shipment and storage of the geotextile proper precautions (i.e., protection from ultraviolet light exposure, precipitation, dirt, puncture, etc.) were taken to ensure the integrity of the geotextile material. The QA Inspector examined rolls upon delivery to the Site, and any deviation from the Contract specified requirements were reported to the Resident Engineer. Any damaged rolls were rejected and replaced.

The Installer handled and placed all geotextile in a manner to prevent damage of any type and in accordance with the procedures outlined in the Contract Documents. The QA Inspector noted any non-compliance and reported such to the Resident Engineer. The geotextile(s) were overlapped a minimum of two (2) feet. Any holes or tears in the geotextile were repaired by patching using the same geotextile material. The patch was placed with a minimum overlap of 24 inches in all directions.

Sedimentation Ponds

Three sedimentation ponds (A, B, and C) were constructed along the north and southwest perimeter of the landfill to detain silt-laden stormwater and allow fine sediments to be captured prior to discharge. The sedimentation ponds consist of the following layers, from top to bottom:

- Riprap.

- Geotextile filter fabric.
- Loamy soil barrier protection layer.
- 60-mil textured HDPE geomembrane.

Stormwater runoff on the landfill surface is collected by drainage swales located alongside the sides of the access roads, which transfer the runoff to buried 24-inch diameter corrugated HDPE pipes (see Figure G-4a of the CCR [Appendix J of this SMP]). At the base of the landfill, runoff in the pipes is discharged through concrete baffled outlets, and is then conveyed, via perimeter drainage swales, to one of three sedimentation ponds located at the base of the landfill (see Figures G-4b and G-4c of the CCR [Appendix J of this SMP]). 30-inch diameter HDPE pipes are used to convey the collected stormwater runoff from Pond A to B and from Pond B to C (see Figure G-4d of the CCR [Appendix J of this SMP]). From Pond C the stormwater is slowly discharged into Eastchester Bay via a concrete spillway structure (see Figure G-4e of the CCR [Appendix J of this SMP]). Additional information was collected and is available on the as-built drawings developed during the completion of Contract HP-876. An electronic copy of the as-built drawings for is provided in Appendix L of this SMP.

Structural backfill consisted of imported or on-site natural sandy soils that passed the gradation and material classification requirements, and were free from debris, frozen material, and gravel greater than 3/4-inch measured in any direction. Structural backfill was used for Sedimentation Pond C, baffled outlets, and under the inlet and outlet structures of Sedimentation Pond C. The structural backfill was tested during construction in accordance with Contract requirements.

Riprap bedding material consisted of crushed stone or gravel which was free of soft, nondurable particles, organic materials, and thin elongated particles which passed the gradation requirements of the Contract Documents. Riprap bedding was placed in Sedimentation Pond C Spillway and Outlet.

Piping

The HDPE pipes and appurtenances and piping installation methods were in accordance with the requirements outlined in the Contract Documents. The QA Inspector observed all phases of installation to confirm that required materials and techniques were used.

The Contractor provided the QA Inspector with the Manufacturer's guaranteed properties of the HDPE pipes and appurtenances to be used on this project. Material properties and dimensions were in accordance with the Contract Documents. The QA Inspector examined all pipes and appurtenances upon delivery and prior to placement. Any non-compliance with the requirements was reported to the Resident Engineer.

Geomembrane perforation boots were constructed with the same material and in accordance with installation procedures for the geomembrane in order that infiltration of water between boot and pipe does not occur. The Resident Engineer reviewed and approved boot details prior to installation. Seaming operations used the same procedures used for the geomembrane. Field testing and inspection were performed in the same manner where possible. Destructive test specimens were not taken due to the nature of the fabrication of the boots. However, continuous non-destructive testing was performed and observed by the QA Inspector.

System OM&M

General procedures for operating and maintaining the Stormwater Management System are documented in the Operation and Maintenance Plan (Section 4 of this SMP); procedures for monitoring the system are included in the Monitoring Plan (Section 3 of this SMP). Volumes I through III of the OM&M Manual for Pelham Bay Landfill covers all necessary details for the operation and maintenance of the stormwater collection system. The OM&M Manual is included as Appendix K of this SMP.

2.2.1.5. Ancillary Systems

To help achieve the remedial goals included in this SMP, additional engineering controls were implemented at the Site to supplement the major engineering control systems described above. These components include the following: reconstruction of sewers, road construction, utilities, well and piezometer abandonment, and fencing.

Reconstruction of Sewers

Reconstruction of existing sewers was conducted by the insertion of a flexible polyester felt liner. Flow bypass was provided during the reconstruction activities. A satisfactory written guarantee of compliance with the ASTM Standards for all materials and techniques used in the liner process was submitted to the Resident Engineer. Shop drawings, including details of the proposed flow bypassing system and a Service

Connection Plan, were submitted to the Resident Engineer. Installation of the liner was in accordance with the Contract Documents.

The finished liner incorporated thermosetting materials which are able to withstand the corrosive effects of the normal existing effluent and groundwater/leachate on the outside of the sewer. The polyester felt tubing, including the polyurethane covered felt and the thermosetting resin, met the requirements of ASTM F1216. The cured lining material conformed to minimum structural standards (tensile stress, flexural stress and modulus of elasticity) as specified in the Contract Documents.

Road Construction

There are four main access roads at the Site: "A", "B", "C", and the IRM road located along the southwest boundary of the Landfill (see Figure G-9 of the CCR [Appendix J of this SMP]). The IRM access road was constructed of crushed stone material meeting requirements of NYSDOT specifications with a maximum stone size of 2 inches.

The cut-off wall was constructed roughly along the alignment of the IRM road. To protect the cut-off wall from damage and prevent excessive pumping and rutting along the IRM road due to heavy traffic crossing the cut-off wall, a reinforced concrete slab was constructed spanning the wall along its entire length. The concrete slab is approximately 15 feet wide and centered over the cut-off wall (see Figure G-2 of the CCR [Appendix J of this SMP]). In addition, a geogrid fabric was installed within the stone layer over the concrete slab.

Access roads "A," "B," and "C" consisted of a loamy soil sub-grade with a crushed aggregate base material having a maximum stone size of 2 inches. The minimum thickness of the crushed stone base was approximately 3 inches. The access roads on the landfill have reflecting roadway delineators for nighttime visibility. They are located along the exterior edge of the road and spaced approximately 25 feet apart.

The crushed aggregate base course material met the gradation requirements outlined in the QC plan. Pre-construction and during construction testing was conducted in accordance with ASTM C136 at a frequency of 1 per source and 1 per 300 yd^3 (or 1 per 3500 ft^2 of road surface), respectively. The material was placed in one lift and compacted with a 10-ton smooth-drum vibratory roller.

Utilities

Abandoned utilities encountered during excavation were cut and capped. In June 1994, the Resident Engineering staff observed the cutting and capping of seven abandoned utilities ranging from two to twelve inches in diameter. The existing utilities that remained (66-inch and 72-inch diameter reinforced concrete storm sewer pipes) were maintained and protected.

Well and Piezometer Abandonment

Forty-five (45) groundwater monitoring wells and piezometers were in place on the landfill prior to the implementation of abandonment procedures. Eighteen (18) of the thirty-seven (37) groundwater monitoring wells were abandoned. Six (6) of the eight (8) piezometers were abandoned. In addition, in June 2007, the NYSDEC approved the abandonment of Monitoring Wells MW-121 and MW-126 (see Section 3.3 of this SMP). Seventeen (17) groundwater monitoring wells and two (2) piezometers remain in place. However, three off-site monitoring wells (MW-117B, MW-124, and MW-124B) cannot be located. An additional six (6) piezometers were installed as part of the cutoff wall construction, three (3) on the landfill side and three (3) on the Park side.

Well/piezometer abandonment was completed by the drilling contractor. Well abandonment reports were submitted to the Resident Engineer which provided detailed information on each abandoned well/piezometer.

Fencing

An eight-foot high chain link security fence surrounds the perimeter of the Site. Two 24-ft wide double leaf gates and one 12-ft wide single leaf gate are located near the main entrance to the facility. A fourth gate is located on Shore Road just south of Sedimentation Pond C. Other fenced areas at the Site include:

- Gas Flare Unit.
- IRM fenced-in complex and two adjacent fenced enclosures surrounding leachate pumping wells.
- Twenty-two (22) gas extraction well enclosures.
- Motor Control Center.
- Leachate Storage Tank Area.

2.2.2 Criteria for Completion of Remediation/Termination of Remedial Systems

This subsection describes the criteria for completion of remediation/termination of remedial systems.

2.2.2.1. Landfill Cover System

The Landfill Cover System is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in perpetuity. Inspection activities are outlined in the Monitoring Plan of this SMP (Section 3).

2.2.2.2. Groundwater and Leachate Management System

The Groundwater and Leachate Management System will not be discontinued without written approval by the NYSDEC. A proposal to discontinue the Groundwater and Leachate Management System may be submitted by the NYCDEP after the Site-specific Remedial Action goals specified in the ROD (1993) have been achieved (see Section 1.4.4 of this SMP). These assessments will be based in part on contaminant levels detected in groundwater samples collected from monitoring wells located throughout the Site, leachate samples collected from Sump D-1, and leachate quantities that are being generated. Systems will remain in place and operational until permission to discontinue their use is granted in writing by the NYSDEC. The sampling/monitoring activities will adhere to stipulations outlined in the Monitoring Plan of this SMP (Section 3).

2.2.2.3. Landfill Gas Management and Flare System

The active Landfill Gas Management and Flare System will not be discontinued without written approval by NYSDEC. A proposal to discontinue the active Landfill Gas Management and Flare System will be submitted by the NYCDEP once the gas generation rate and composition no longer warrant thermal destruction. The active Landfill Gas Management and Flare System will remain in place and operational until permission to switch to the passive landfill gas management system is granted in writing by the NYSDEC.

2.2.2.4. Stormwater Management System

The Stormwater Management System will not be discontinued. The system will be inspected and maintained at defined, regular intervals in perpetuity. Monitoring activities are outlined in the Monitoring Plan of this SMP (Section 3).

2.3 Institutional Controls Components

2.3.1 Institutional Controls

ICs are actions, such as legal controls, that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use. Although it is NYSDEC's expectation that treatment or engineering controls will be used to address principle threat wastes and that groundwater will be returned to its beneficial use whenever practicable, ICs can and do play an important role in remedies.

ICs are used when contamination is first discovered, when remedies are ongoing and when residual contamination remains on site at a level that does not allow for unrestricted use and unlimited exposure after cleanup. Implementation of ICs is a required component of the ROD-selected remedy for the Site.

The ROD-selected remedy for the Site requires a series of ICs, as follows: (1) implement, maintain and monitor Engineering Control systems; (2) prevent future exposure to residual waste materials by controlling disturbances of the subsurface waste materials; and, (3) limit the use of the Site to ensure that the integrity of the in-place remedy is not compromised and restricting use of on-site groundwater so that it may not be used as a potable water supply source. Adherence to these ICs on the Site (Controlled Property) is required under the Deed Restriction and will be implemented under this Site Management Plan. These Institutional Controls are:

- Compliance with the Deed Restriction by the Grantor and the Grantor's successors and assigns with all elements of this SMP.
- All Engineering Controls on the Controlled Property must be operated, maintained, monitored, and certified at a frequency and in a manner defied in this SMP, which include the following:
  - Landfill Cover System.
  - Landfill Gas Management and Flare System.
  - Groundwater/Leachate Management System.
  - Stormwater Management System.

- o Ancillary Systems.

The Site has a series of ICs in the form of Site restrictions. Adherence to these ICs is required by the Deed Restriction. Site restrictions that apply to the Controlled Property are:

- The use of the groundwater underlying the Controlled Property is prohibited.
- All future activities on the Controlled Property that will disturb capped residual waste materials are prohibited unless they are conducted in accordance with the soil management provisions in this SMP.
- Limitation of Site usage to reduce the risk of the Remedial Action being damaged or compromised and to prevent future exposure to residual waste materials remaining at the Site.
- Fencing to limit Site access and use.
- The Controlled Property may potentially be used for passive recreation (e.g., birdwatching, nature trails) at some time in the future if the NYCDEP elected, provided that the long-term ECs and ICs included in this SMP are employed.

2.3.2 Soil/Materials Management Plan

Site use has been restricted except for operation and maintenance of the ECs. It is not expected that future non-OM&M related intrusive work will be allowed at the Site. However, in the event that future OM&M related intrusive work is required that will disturb the capped residual waste materials, the intrusive work and modifications or repairs to the existing Landfill Cover System will be performed in compliance with the SoMP provided herein. Intrusive construction work (if any) must also be conducted in accordance with the procedures defined in a Health and Safety Plan (HASP) and Community Air Monitoring Plan (CAMP) prepared for the Site. The SoMP is presented herein as Section 2.3.2 (inclusive of all its subsections) of this SMP. The HASP is the responsibility of the property owner and should be prepared in compliance with DER-10 Technical Guide and 29 CFR 1910 and 1926, and all other applicable Federal, State and local regulations. Intrusive construction work (if any) must be certified as compliant with the SoMP and included in the periodic inspection and certification reports submitted under the Site Management Reporting Plan (See Section 5).

2.3.2.1. Soil Screening Methods

Visual, olfactory and photoionization detector (PID) screening and assessment will be performed by a qualified environmental professional during intrusive work (if any) into known or potentially contaminated material (i.e., Residual Waste Materials Zone). Residual waste material screening will be performed regardless of when the invasive work is done.

Screening will be performed by qualified environmental professionals. Resumes will be provided in the Annual Site Management Report for all personnel conducting invasive work field screening (i.e., those representing the Remedial Engineer) for residual waste materials during intrusive work (if any).

2.3.2.2. Stockpile Methods

Silt removed from the sedimentation ponds, the swales, the manholes and the sumps shall be stockpiled and reused on site, if there is available stockpile space at the Site. Stockpile protection from erosion will follow the recommendations presented in the New York Standards and Specifications for Erosion and Sediment Control – August 2005. Stockpiles will be located where erosion and sediment hazards are slight. The proposed silt stockpile staging areas are shown on Figure 10. The silt stockpile staging area will be surrounded with a silt fence (or hay bales) at the toe of the slope. The side slope of the stockpile will be maintained at a ratio of 2:1 (H:V) or flatter. Stockpiles will be kept covered at all times and stockpiles will be routinely inspected as described above. In case the stockpile will not be used within a short period of time, a temporary grass cover will be provided. If the season prevents the establishment of a temporary grass cover, then mulch or straw will be used to stabilize the stockpile until a grass cover can be provided.

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by the NYSDEC.

2.3.2.3. Materials Excavation and Load Out

The Remediation Engineer or a qualified environmental professional under his/her supervision will oversee all invasive work and the excavation and load-out of all excavated material (if any).

The owner of the Controlled Property and its Contractors are solely responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the Site will be investigated by the Remedial Engineer. It will be determined whether a risk or impediment to the planned work under this SMP is posed by utilities or easements on the Site.

Loaded vehicles leaving the Site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

If determined necessary, a truck wash will be operated on-Site. The Remediation Engineer will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the Site until the intrusive work is complete.

Locations where vehicles enter or exit the Site shall be inspected daily for evidence of off-Site sediment tracking.

The Remedial Engineer will be responsible for ensuring that all egress points for truck and equipment transport from the Site will be clean of dirt and other materials derived from the Site during intrusive work. Cleaning of the adjacent streets will be performed, as needed, to maintain a clean condition with respect to Site-derived materials.

The Applicant and associated parties preparing documents submitted to the State, and parties performing this work, are completely responsible for the safe performance of all invasive work and the structural integrity of excavations.

Mechanical processing of excavated residual waste materials and contaminated soil on-Site is prohibited.

2.3.2.4. *Materials Transport Off-Site*

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Truck transport routes are as follows: trucks will access the Site via Shore Road that leads to Interstate 95. All trucks loaded with Site materials will exit the vicinity of the Site using only these approved truck routes.

This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-Site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project Site.

Egress points for truck and equipment transport from the Site will be kept clean of dirt and other materials during intrusive activities at the Site.

Queuing of trucks will be performed on-Site to minimize off-Site disturbance. Off-Site queuing will be prohibited.

Material transported by trucks exiting the Site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

If determined to be necessary, all trucks will be washed prior to leaving the Site. Truck wash waters will be collected and disposed of off-Site in an appropriate manner.

2.3.2.5. *Materials Disposal Off-Site*

The disposal locations will be identified and reported to NYSDEC in the Annual Site Management Report.

All residual waste materials excavated and removed from the Site will be treated as contaminated and regulated material and will be disposed of in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of soil/fill from this Site is proposed for unregulated disposal (i.e. clean soil removed from the area above the cap), a formal request with an associated plan will be made to NYSDEC's Project Manager. Unregulated off-Site management of materials from this Site is prohibited without formal NYSDEC approval.

Material that does not meet Track 1 unrestricted SCOs (see 6 NYCRR Part 375) is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

The following documentation will be obtained and reported by the Remedial Engineer for each disposal location used in this project to fully demonstrate and document that the disposal of material derived from the Site conforms with all applicable laws: (1) a letter from the Remedial Engineer to the receiving facility describing the material to be disposed and requesting formal written acceptance of the material. This letter will state that material to be disposed is contaminated material generated at an environmental remediation site in New York State. The letter will provide the project identity and the name and phone number of the Remedial Engineer. The letter will include as an attachment a letter from all receiving facilities stating it is in receipt of the correspondence (above) and is approved to accept the material.

Non-hazardous contaminated soils (if any) taken off-Site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2.

Contaminated soils (if any) from the Site are prohibited from being disposed at Part 360-16 Registration Facilities (also known as Soil Recycling Facilities).

Soils that are contaminated but non-hazardous (if any) and are being removed from the Site are considered by the Division of Solid & Hazardous Materials (DSHM) in NYSDEC to be Construction and Demolition (C/D) materials with contamination not typical of virgin soils. These soils may be sent to a permitted Part 360 landfill. They may be sent to a permitted C/D processing facility without permit modifications only upon prior notification of NYSDEC Region 2 DSHM. This material is prohibited from being sent or redirected to a Part 360-16 Registration Facility. In this case, as dictated by DSHM, special procedures will include, at a minimum, a letter to the C/D facility that provides a detailed explanation that the material is derived from a DER remediation Site, that the soil material is contaminated and that it must not be redirected to on-Site or off-Site Soil Recycling Facilities. The letter will provide the project identity and the name and phone number of the Remedial Engineer. The letter will include as an attachment a summary of all chemical data for the material being transported.

The Annual Site Management Report will include an accounting of the destination of all material removed from the Site during work performed under this plan, including excavated soil, contaminated soil, historic fill, solid waste, and hazardous waste, non-regulated material, and fluids. Documentation associated with disposal of all material must also include records and approvals for receipt of the material. This information will also be presented in a tabular form in the Annual Site Management Report.

Bill of Lading system or equivalent will be used for off-Site movement of non-hazardous wastes and contaminated soils. This information will be reported in the Annual Site Management Report.

Hazardous wastes derived from on-Site will be handled and disposed on-Site (i.e., beneath the Landfill Cover System), whenever possible. If it is impossible to dispose of the hazardous waste on-Site, then the waste will be stored, transported, and disposed of in full compliance with applicable local, State, and Federal regulations.

Appropriately licensed haulers will be used for material removed from this Site and will be in full compliance with all applicable local, State and Federal regulations.

Waste characterization will be performed for off-Site disposal in a manner suitable to the receiving facility and in conformance with applicable permits. Sampling and analytical methods, sampling frequency, analytical results and QA/QC will be reported in the Annual Site Management Report. All data available for soil/material to be disposed of at a given facility must be submitted to the disposal facility with suitable explanation prior to shipment and receipt.

2.3.2.6. Materials Reuse On-Site

As indicated previously, silt removed from the sedimentation ponds, the swales, the manholes and the sumps will be staged on-Site for reuse, if space availability permits. Staged materials will be sampled and analyzed prior to reuse. Based on the stockpile volume, grab soil samples will be collected and analyzed for the constituents listed in 6 NYCRR Part 375-6.8(b). Soil sampling analytical results will be compared to the Restricted-Residential Use Soil Cleanup Objectives as presented in 6 NYCRR Part 375-6.8(b). The Remedial Engineer will ensure that procedures defined for materials reuse in this SMP are followed and that unacceptable material will not remain on-Site.

The NYSDEC will consider the use of specially designed devices that are self-contained and capable of providing misting for dust control. NYSDEC approval must be obtained. If dust-free operations are not achieved with such devices, this exception will be revoked.

Organic matter derived from clearing and grubbing of the Site is allowed for reuse on-Site as mulch.

Contaminated on-Site material (capped residual waste materials) removed during maintenance activities of engineering controls or other purposes will be buried on-Site underneath the Landfill Cover System where applicable; otherwise, it will be disposed of off-site, and will not be reused within landscaping berms, or as backfill for subsurface utility lines, if any.

2.3.2.7. Fluids Management

All liquids to be removed from the Site, other than leachate or purge water from groundwater sampling events, will be handled, transported and disposed of in accordance with applicable local, State, and Federal regulations. Liquids discharged into the New York City sewer system, other than leachate or purge water from groundwater sampling events, will be addressed through approval by the NYCDEP.

Dewatered fluids will not be recharged back to the land surface or subsurface of the Site. Dewatering fluids will be managed off-Site.

Discharge of water generated during intrusive activities to surface waters (i.e., Eastchester Bay or the Hutchinson River) is prohibited without a SPDES permit.

Leachate and purge water generated from groundwater sampling will be discharged via the Groundwater and Leachate Management System.

2.3.2.8. Demarcation

An actively vented impermeable final cover has already been installed at the Site. The cover design is consistent with 6 NYCRR Part 360. The underlying layers of solid waste are clearly demarcated with the 60 mil thick impermeable HDPE liner as described in Section 2.2.1.4 of this SMP.

2.3.2.9. Backfill from Off-Site Sources

The Site has been closed; leachate, groundwater, stormwater and landfill gas management systems are in place, in addition to a final impermeable cover. There are no areas to be backfilled, except for repairs to the existing engineering controls and roads, whenever necessary.

All materials proposed for import onto the Site will be approved by the Remedial Engineer and will be in compliance with provisions in this SoMP prior to receipt at the Site.

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the Site.

All imported soils will meet the Restricted-Residential Use Soil Cleanup Objectives as presented in 6 NYCRR Part 375-6.8(b). Non-compliant soils will not be imported onto the Site without prior approval by NYSDEC. Nothing in the approved SoMP or its approval by NYSDEC should be construed as an approval for this purpose.

Soils that meet 'exempt' fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this Site, will not be imported onto the Site without prior approval by NYSDEC. Nothing in this SoMP should be construed as an approval for this purpose.

Solid waste will not be imported onto the Site.

Trucks entering the Site with imported soils will be securely covered with tight fitting covers.

2.3.2.10. Stormwater Pollution Prevention

A Stormwater Management System is already in place for the Site as discussed in Section 2.2.1.3 of this SMP.

Silt fence and hay bales installed around stockpiles will be inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the Site and available for inspection by NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments in sedimentation ponds, swales, ditches, manholes, and sumps will be removed, as required, to keep the Stormwater Management System functional.

All undercutting or erosion of the silt fence toe anchor at the toe of the stockpile shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

2.3.2.11. Contingency Plan

If previously unidentified contaminant sources are found during on-Site excavation activities (if any), sampling will be performed on product, sediment and surrounding soils, etc. Chemical analytical work will be for full scan parameters (Target Analyte List [TAL] metals; Target Compound List (TCL) volatiles and semi-volatiles, TCL pesticides and PCBs). Analyses will not be otherwise limited without NYSDEC approval.

Identification of unknown or unexpected contaminated media identified by screening during invasive Site work (if any) will be promptly communicated by phone to NYSDEC's Project Manager. These findings will be also included in daily and periodic electronic media reports.

2.3.2.12. Community Air Monitoring Plan

No investigative or remediation work is expected to be conducted at the Site, as the Site is closed (in accordance with ROD [1993] requirements) and is currently in the post-closure monitoring period. In the event that OM&M activities require the Landfill Cover System to be breached and residual waste materials exposed, a CAMP is required and will be prepared at that time. The CAMP will be prepared in accordance with the requirements that are provided in Appendix 1A of NYSDEC DER-10, Generic Community Air Monitoring Plan.

2.3.2.13. Odor, Dust and Nuisance Control Plan

2.3.2.13.1. Odor Control Plan

No non-OM&M related intrusive work is anticipated at the Site that would expose solid waste. In the case that OM&M related intrusive work is conducted at the Site and solid waste is exposed, the following steps will be implemented to control odor.

In the remote case that nuisance odors are identified, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of all other complaints about the project. Implementation of all odor controls, including the halt of work, will be the responsibility of the Controlled Property owner's Remediation Engineer, who is responsible for certifying the Annual Site Management Report.

All necessary means will be employed to prevent on- and off-Site nuisances. At a minimum, procedures will include: (a) limiting the area of open excavations; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-Site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

Where odor nuisances have developed during remedial work and cannot be corrected, or where the release of nuisance odors cannot otherwise be avoided due to on-Site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering excavation and handling areas under tented containment structures equipped with appropriate air venting/filtering systems.

2.3.2.13.2. Dust Control Plan

No non-OM&M related intrusive work is anticipated at the Site that would generate dust. In the case that OM&M related intrusive work is conducted at the Site and dust is generated, the following steps will be implemented to control dust:

- Dust suppression will be achieved though the use of a dedicated on-Site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.

- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, non-vegetated soils vulnerable to dust production.

2.3.2.13.3. Other Nuisances

A plan for rodent control will be developed and utilized by the contractor prior to and during Site clearing and Site grubbing, and during all intrusive work.

A plan will be developed and utilized by the contractor for all intrusive work and will conform, at a minimum, to NYCDEP noise control standards.

2.4 Inspections and Notifications

2.4.1 Inspections

Inspections of all systems installed on-Site will be conducted at the frequency specified in the SMP Monitoring Plan schedule. The inspections will determine and document the following:

- Whether Engineering Controls continue to perform as designed.
- If these controls continue to be protective of human health and the environment.
- Compliance with requirements of this SMP and the Deed Restriction.
- Achievement of remedial performance criteria.
- Sampling and analysis of appropriate media during monitoring events.
- If Site records are complete and up to date.
- Changes, or needed changes, to the remedial or monitoring system.

Inspections will be conducted in accordance with the procedures set forth in the Monitoring Plan of this SMP (Section 3). The reporting requirements are outlined in the Site Management Reporting Plan (Section 5).

If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs, an inspection of the Site will be conducted to verify the effectiveness of the ECs/ICs implemented at the Site by a qualified environmental professional as determined by NYSDEC.

2.4.2 Notifications

2.4.2.1. NYSDEC-acceptable Electronic Database

The following information is presented in Appendix M in an electronic database format:

- A Site summary;
- The name of the current Site owner and the party implementing the SMP for the Site;
- The location of the Site;
- The current status of the Site remedial activity;
- A copy of the Deed Restriction; and
- A contact name and phone number of a person knowledgeable about the Deed Restriction's requirements, in order for NYSDEC to obtain additional information, as necessary.

This information should be: 1) modified as conditions change; (2) revised in Appendix M of this document; and, (3) submitted to NYSDEC in the Annual Site Monitoring Report. Should the Deed Restriction be modified or terminated, the copy of the revised Deed Restriction will also be updated in this manner.

2.4.2.2. Non-routine Notifications

Non-routine notifications are to be submitted by the property owner(s) to the NYSDEC on an as-needed basis for the following reasons:

- 60-day advance notice of any proposed changes in Site use that are consistent with the terms of the Consent Order.
- 10-day advance notice of any proposed ground-intrusive activities.
- Notice within 48-hours of any damage or defect that reduces the effectiveness of ECs and likewise any action taken to mitigate the damage or defect.
- Notice within 48-hours of any emergency, such as a fire, flood, or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the Site, including a summary of action taken and the impact to the environment and the public.

- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action shall be submitted to the NYSDEC within 45 days and shall describe and document actions taken to restore the effectiveness of the ECs.

3. Monitoring Plan

This section of the SMP provides the Monitoring Plan and describes the measures for evaluating the performance and effectiveness of the implemented ECs in reducing or mitigating contamination at the Site.

3.1 Introduction

Post-closure OM&M activities have been conducted at the Site since 1999 to evaluate the performance of the Remedial Action implemented. The OM&M activities were performed in accordance with the current OM&M Manual (Appendix K of this SMP). The OM&M program described in this SMP relies, for the most part, on the methods, procedures, and schedules currently in place. The OM&M Manual is provided in Appendix K and is referenced throughout this SMP. The Monitoring Plan described herein is subject to change and may be modified, as necessary. Changes to the Monitoring Plan must be approved by the NYSDEC before becoming effective.

3.1.1 General

The Monitoring Plan describes the measures for evaluating the performance and effectiveness of the implemented ECs in reducing or mitigating contamination at the Site. ECs at the Site include (1) a Landfill Cover System; (2) a Stormwater Management System; (3) a Groundwater and Leachate Management System; (4) a Landfill Gas Management and Flare System; and, (5) ancillary systems. This Monitoring Plan is subject to revision by NYSDEC.

3.1.2 Purpose

This Monitoring Plan describes the methods to be used for:

- Sampling and analysis of appropriate media (e.g., groundwater, leachate, stormwater, and landfill gas).
- Evaluating Site information periodically to confirm that the remedy continues to be effective as per the design.
- Preparing the necessary reports for the various monitoring activities.
- Assessing compliance with NYSDEC groundwater standards.

- Assessing achievement of the remedial performance criteria.

To adequately address these issues, this Monitoring Plan provides information on:

- Sampling locations, protocol, and frequency.
- Information on all designed monitoring systems (e.g., well logs).
- Analytical sampling program requirements.
- Reporting requirements.
- Quality Assurance/Quality Control (QA/QC) requirements.
- Inspection and maintenance requirements for monitoring wells.
- Monitor well decommissioning procedures.
- Annual inspection and certification.

Post-Closure monitoring of the performance of the remedy and overall reduction in contamination on-Site has been conducted since approximately 1999. Given the approximate 9 year period over which Post-Closure OM&M has already been conducted at the Site and considering that the NYCDEP prepared a 5-Year Data Summary Report (submitted to the NYSDEC on March 18, 2008) for the Site, the monitoring/inspection schedule provided in Table 2 will be implemented for a minimum period of one year following submission of this SMP. Following this one year period, the NYCDEP may propose monitoring/inspection modifications to the NYSDEC. Modifications to the monitoring/inspection schedule will require NYSDEC approval. Trends in contaminant levels in landfill gas, leachate, and/or groundwater in the affected areas, will be evaluated to determine if the remedy continues to be effective in achieving remedial goals. Monitoring programs are summarized in Table 2 and outlined in detail in Sections 3.2 and 3.3, below.

3.2 Engineering Control System Monitoring

The Monitoring Plan for each EC is described below. Specifically, this section provides the monitoring schedule, general equipment monitoring, system monitoring devices and alarms, and discharge permit limit requirements for each EC.

3.2.1 Landfill Cover System Monitoring

The Landfill Cover System has been installed to minimize surface infiltration of precipitation and to collect gases generated by the waste material. The Landfill Cover System design is described in the EC/IC Plan (see Section 2.0 of this SMP), and available as-built drawings are provided in Appendix L. The Landfill Cover System will be monitored, inspected, and maintained, as described in this SMP, to evaluate if the remedy continues to be effective in achieving remedial goals. Currently, the Landfill Cover System is somewhat overgrown with vegetation (e.g., grass) and is supporting wildlife (e.g., birds, rabbits). The overgrown vegetation has been allowed to develop over an approximate 9 year period, primarily to support the ROD-specified end use goal for the Site, which is passive recreational (e.g., birdwatching, nature trails). The OM&M Manual allowed for the NYCDEP to determine the schedule for the mowing of the grass cover, and mowing has been periodically conducted. To facilitate Landfill Cover System (and other system) inspections, it is anticipated that the current landfill mowing frequency will be adjusted. A revised mowing schedule will be proposed to the NYSDEC subsequent to the issuance of this SMP.

For monitoring, inspection, and maintenance purposes, the Landfill Cover System has been divided into the following items:

- Grass cover/topsoil layer; and
- Cover soil and cap components.

3.2.1.1. Landfill Cover System Monitoring Schedule

The Landfill Cover System will be inspected on a monthly basis and after each major rainfall event (i.e., 2.5 inches in 24 hours or larger). As described below and in Section 2.0, Volume III of the OM&M Manual (November 1996), which is provided as Appendix K of this SMP, every effort will be made to conduct the Landfill Cover System inspections in the most comprehensive fashion possible. Where possible, inspections should be conducted by walking the Site and recording observations made, including (as applicable) observations related to items such as stressed vegetation and evidence of erosion, significant amount of sediment present in drainage ditches, surface cracks, settlement, and slope stability. However, it is anticipated that where the vegetated cover is especially overgrown and dense a more general "overview" inspection will be conducted until such time as the overgrown vegetation is mowed. To facilitate inspection and allow for a passive recreational end use of the Site, it is anticipated that a rotating mowing schedule (i.e., mow a portion of the landfill at selected periods and rotate the area mowed each time) will be developed and proposed to the NYSDEC subsequent to the issuance of this SMP. More comprehensive inspections will be conducted during periods when the grass is below a height of approximately 18 inches. As described in Section 2.0 of Volume III of the OM&M Manual (Appendix K), the grass cover/topsoil layer, and cover soil and cap components will be visually inspected using the Inspection Checklist Form FCS-1. A description of deficiencies and problems will be provided on the Inspection Checklist Form DP-1.

The inspection frequency is subject to change by NYSDEC. Unscheduled inspections and/or sampling may take place when a suspected failure of the Landfill Cover System has been reported or an emergency occurs that is deemed likely to affect the operation of the system. Monitoring deliverables for the Landfill Cover System are specified later in this Plan.

3.2.1.2. Landfill Cover System General Equipment Monitoring

Monitoring/inspection of the Landfill Cover System does not require the use of equipment; therefore, this subsection is not applicable.

3.2.1.3. Landfill Cover System Monitoring Devices and Alarms

Monitoring/inspection of the Landfill Cover System does not require monitoring devices or alarms; therefore, this subsection is not applicable.

3.2.1.4. Landfill Cover System Discharge Permit Limit Requirements

There is no discharge associated with the Landfill Cover System; therefore, this subsection is not applicable.

3.2.2 Groundwater and Leachate Management System Monitoring

The Groundwater and Leachate Management System has been installed to control groundwater that would otherwise enter on to the Site and to collect, manage, and dispose of leachate. The Groundwater and Leachate Management System design is described in the EC/IC Plan (see Section 2.0 of this SMP), and available as-built drawings are included in Appendix L. The Groundwater and Leachate Management System will be monitored, inspected, and maintained, as described in this SMP, to evaluate if the remedy continues to be effective in achieving remedial goals.

3.2.2.1. Groundwater and Leachate Management System Monitoring Schedule

The Groundwater and Leachate Management System will be inspected on a weekly, monthly, and semi-annual basis depending on the element that is being inspected. As described in Section 4.0 of Volume III of the OM&M Manual (Appendix K), elements of the Groundwater and Leachate Management System will be inspected using Inspection Checklist Forms GWL-1 (weekly), GWL-2 (monthly), and GWL-3 (semi-annually). A description of deficiencies and problems will be provided on the Inspection Checklist Form DP-1. Groundwater samples will be collected for laboratory analysis on a semi-annual basis (see Section 3.3 of this SMP for details). Leachate samples will be collected for laboratory analysis on a semi-annual basis (see Section 3.2.6 of this SMP for details). Leachate samples will also be collected for laboratory analysis on a monthly basis per the Sewer Discharge Permit requirements (see Section 3.2.3.4 of this SMP for details).

The inspection frequency is subject to change by NYSDEC. Unscheduled inspections and/or sampling may take place when a suspected failure of the Groundwater and Leachate Management System has been reported or an emergency occurs that is deemed likely to affect the operation of the system. Monitoring deliverables for the Groundwater and Leachate Management System are specified later in this Plan.

3.2.2.2. Groundwater and Leachate Management System General Equipment Monitoring

A visual inspection of the complete system will be conducted during the monitoring events. Groundwater and Leachate Management System components to be monitored include, but are not limited to, the following:

- Downgradient collector drains and manholes.
- Collection sumps (D-1, D-8, and D-10).
- Curtain drain.
- Lift stations (No. 1 and No. 2).
- Force mains heat tracing.
- Gravel decontamination pad area sump (present, but inactive).

- Leachate storage tanks.
- Leachate storage tank containment sump.
- Carbon adsorption system (storage tank off-gas).
- Force main discharge to Publicly Owned Treatment Works (POTW).
- Storage tank off-loading and tanker loading (present, but inactive).
- Remote telemetry tied in with the NYCDEP's DYNAC system.
- Motor control center.
- Cut-off wall.
- Upgradient collector drain and manholes.
- Piezometers and monitoring wells.

A complete list of components to be checked is provided in the Inspection Checklists (Forms GWL-1, GWL-2, and GWL-3), presented in Appendix N of this SMP. If equipment is observed to be malfunctioning, or if the system is not performing within specifications, maintenance and repair, as per the Operation and Maintenance Plan (see Section 4.0 of this SMP), is required.

3.2.2.3. Groundwater and Leachate Management System Monitoring Devices and Alarms

The Groundwater and Leachate Management System has warning devices to indicate alarm conditions or that the system is not operating properly. The system monitoring devices and alarms are described in Volume III of the OM&M Manual (Appendix K). In the event that the warning device is activated, applicable maintenance and repairs will be conducted, as specified in the Operation and Maintenance Plan (see Section 4.0 of this SMP). Operational problems will be noted in the Annual Site Management Report.

3.2.2.4. Groundwater and Leachate Management System Discharge Permit Limit Requirements

The groundwater/leachate collected from the downgradient collection drain ultimately discharges into a New York City sewer manhole at Burr Avenue via an off-site force main. The groundwater/leachate is then conveyed via underground pipeline to the Hunts Point Water Pollution Control Plant for treatment. The discharge permit limit requirements associated with the groundwater/leachate management system are provided in the Sewer Discharge Permit Table A, presented in Appendix O of this SMP. The Sewer Discharge Permit Table A provides limitations for effluent to sanitary or combined sewers.

The groundwater collected from the upgradient collection drain (Pelham Bay Park side of the cut-off wall) intercepts groundwater flowing from Pelham Bay Park toward the landfill and diverts the flow via a buried 8-inch diameter HDPE pipe (slotted and solid) to an existing storm sewer, which outlets directly to Eastchester Bay. There are no discharge permit limit requirements associated with this groundwater discharge to Eastchester Bay.

3.2.3 Landfill Gas Management and Flare System Monitoring

The Landfill Gas Management and Flare System has been installed to collect, monitor, and control gas emissions associated with the landfill. The Landfill Gas Management and Flare System design is described in the EC/IC Plan (see Section 2.0 of this SMP), and available as-built drawings are included in Appendix L. The Landfill Gas Management and Flare System will be monitored, inspected, and maintained, as described in this SMP, to evaluate if the remedy continues to be effective in achieving remedial goals.

3.2.3.1. Landfill Gas Management and Flare System Monitoring Schedule

The Landfill Gas Management and Flare System will be inspected on a weekly, monthly, and quarterly basis depending on the element that is being inspected. As described in Section 5.0 of Volume III of the OM&M Manual (Appendix K), the elements of the Landfill Gas Management and Flare System will be inspected using Inspection Checklist Forms LFG-1 (weekly), LFG-2 (monthly), and LFG-3 (quarterly). A description of deficiencies and problems will be provided on the Inspection Checklist Form DP-1. In addition, landfill gas testing and monitoring will be conducted on a semi-annual basis (see Section 3.2.6 of this SMP).

The inspection frequency is subject to change by NYSDEC. Unscheduled inspections and/or sampling may take place when a suspected failure of the Landfill Gas Management and Flare System has been reported or an emergency occurs that is deemed likely to affect the operation of the system. Monitoring deliverables for the Landfill Gas Management and Flare System are specified later in this Plan.

3.2.3.2. *Landfill Gas Management and Flare System General Equipment Monitoring*

A visual inspection of the complete system will be conducted during the monitoring events. Landfill Gas Management and Flare System components to be monitored include, but are not limited to, the following:

- Gas collection system and blower.
- Condensate system
- Enclosed flare system.
- Electrical system.

A complete list of components to be checked is provided in the Inspection Checklists (Forms LFG-1, LFG-2, and LFG-3), presented in Appendix N of this SMP. If equipment readings are not within their typical range, equipment is observed to be malfunctioning, or the system is not performing within specifications, maintenance and repair, as per the Operation and Maintenance Plan (see Section 4.0 of this SMP), is required.

3.2.3.3. *Landfill Gas Management and Flare System Monitoring Devices and Alarms*

The Landfill Gas Management and Flare System has warning devices to indicate that the system is not operating properly. The system monitoring devices and alarms are described in Volume III of the OM&M Manual (Appendix K). In the event that a warning device is activated, applicable maintenance and repairs will be conducted, as specified in the Operation and Maintenance Plan (see Section 4.0 of this SMP). Operational problems will be noted in the Annual Site Management Report.

The NYCDEP is currently evaluating permitting requirements with the New York City Fire Department. System modifications required will be completed by the NYCDEP and will be reported in the Annual Site Management Report and this SMP will be revised, as applicable.

3.2.3.4. Landfill Gas Management and Flare System Discharge Permit Limit Requirements

Based on emission calculations and historical operations at the Site, the Site is subject to Minor Facility Registration requirements. A completed NYSDEC Air Facility Registration Form for the Site gas collection and flare system was submitted to the NYSDEC in August 2006. The August 2006 Air Facility Registration Form and the Air Facility Registration Certificate that was issued by the NYSDEC in October 2006 are provided in Appendix P. As discussed above, the NYCDEP is currently evaluating permitting requirements with the New York City Fire Department.

3.2.4 Stormwater Management System Monitoring

The Stormwater Management System has been installed to collect and convey stormwater runoff from the Site to the final discharge point, which is Eastchester Bay. The Stormwater Management System design is described in the EC/IC Plan (see Section 2.0 of this SMP), and available as-built drawings are included in Appendix L. The Stormwater Management System will be monitored, inspected, and maintained, as described in this SMP, to evaluate if the remedy continues to be effective in achieving remedial goals.

3.2.4.1. Stormwater Management System Monitoring Schedule

The Stormwater Management System will be inspected on a monthly basis and after each major rainfall event (i.e., 2.5 inches in 24 hours or larger). As described in Section 3.0 of Volume III of the OM&M Manual (November 1996) (provided in Appendix K of this SMP), the elements of the Stormwater Management System will be visually inspected using Inspection Checklist Forms SMS-1, SMS-2, and SMS-3. A description of deficiencies and problems will be provided on the Inspection Checklist Form DP-1. In addition, stormwater samples will be collected for laboratory analysis on a semi-annual basis (see Section 3.2.6 of this SMP).

The inspection frequency is subject to change by NYSDEC. Unscheduled inspections and/or sampling may take place when a suspected failure of the Stormwater Management System has been reported or an emergency occurs that is deemed likely to affect the operation of the system. Monitoring deliverables for the Stormwater Management System are specified later in this Plan.

3.2.4.2. Stormwater Management System General Equipment Monitoring

A visual inspection of the complete system will be conducted during the monitoring events. Stormwater Management System components to be monitored include, but are not limited to, the following:

- Stormwater drainage ditches.
- Buried 6-inch diameter corrugated HDPE infiltration pipe and flap gate.
- Riprap.
- Stormwater collection manholes and buried 24-inch diameter corrugated HDPE pipe.
- Concrete baffled outlets.
- Sedimentation Ponds A, B, and C.
- Concrete inlet/outlet structures.
- Sedimentation pond connection manholes and 30-inch diameter HDPE sedimentation pond connection pipes.
- 24-inch diameter reinforced concrete pipe (RCP) and flap gate.
- 30-inch diameter drainage culverts.

The stormwater collection pipes will be inspected for blockages following the procedures described in Section 3.0 of Volume III of the OM&M Manual (Appendix K). If it is determined that there is a blockage in a pipe, a visual inspection of the pipe run will be conducted from inside the manholes or from the baffled outlet structures. In addition, video inspection equipment may be used to locate the blockage if it cannot be seen from either end of the pipe run. A complete list of components to be checked is provided in the Inspection Checklists (Forms SMS-1, SMS-2, and SMS-3), presented in Appendix N of this SMP. If equipment is observed to be malfunctioning, or if the system is not performing within specifications, maintenance and repair, as per the Operation and Maintenance Plan (see Section 4.0 of this SMP), is required.

3.2.4.3. Stormwater Management System Monitoring Devices and Alarms

The Stormwater Management System operates without automatic or manual controls/alarms; therefore, this subsection is not applicable.

3.2.4.4. Stormwater Management System Discharge Permit Limit Requirements

After conducting an evaluation of permitting requirements and meeting with the NYSDEC, the NYCDEP concluded that there are no applicable stormwater permitting requirements. The NYCDEP submitted a letter to the NYSDEC on June 15, 2006 that presented the findings of the stormwater permitting evaluation and the rationale for why the Site is not subject to the General Permitting requirements for stormwater. On January 9, 2007, the NYSDEC provided written reply (via e-mail) that it agreed with the evaluation findings. The June 15, 2006 letter and NYSDEC reply are provided in Appendix Q.

3.2.5 Ancillary Systems Monitoring

The ancillary systems have been installed to provide access to and security for the Site. Ancillary systems present at the Site include roads, fences, gates, and locks. The ancillary systems design is described in the EC/IC Plan (see Section 2.0 of this SMP), and available as-built drawings are included in Appendix L. The ancillary systems will be monitored, inspected, and maintained, as described in this SMP, to evaluate if the remedy continues to be effective in achieving remedial goals.

3.2.5.1. Ancillary Systems Monitoring Schedule

The ancillary systems will be inspected on a quarterly basis. As described in Section 7.0 of Volume III of the OM&M Manual (Appendix K), the elements of the ancillary systems will be visually inspected on quarterly basis using Inspection Checklist Form AS-1. A description of deficiencies and problems will be provided on the Inspection Checklist Form DP-1.

The inspection frequency is subject to change by NYSDEC. Unscheduled inspections and/or sampling may take place when a suspected failure of the ancillary systems has been reported or an emergency occurs that is deemed likely to affect the operation of the system. Monitoring deliverables for the ancillary systems are specified later in this Plan.

3.2.5.2. Ancillary Systems General Equipment Monitoring

A visual inspection of the complete system will be conducted during the quarterly monitoring event. Ancillary systems components to be monitored include, but are not limited to, the following:

- Roads.
- Fences.
- Gates.
- Locks.

A complete list of components to be checked is provided in the Inspection Checklist (Form AS-1), presented in Appendix N. If the systems are not performing within specifications, maintenance and repair, as per the Operation and Maintenance Plan (see Section 4.0 of this SMP), is required.

3.2.5.3. Ancillary Systems Monitoring Devices and Alarms

The ancillary systems do not have monitoring devices or alarms; therefore, this subsection is not applicable.

3.2.5.4. Ancillary Systems Discharge Permit Limit Requirements

There is no discharge associated with the ancillary systems; therefore, this subsection is not applicable.

3.2.6 Sampling Event Protocol

This subsection describes the protocols/methods, materials, and analytical methods for sample collection for the Site ECs.

The groundwater monitoring program, which involves the collection of groundwater samples on a semi-annual basis, is discussed (in detail) in Section 3.3 of this SMP. Additional details related to analytes, sample labeling, chain of custody procedures, sample preservation, sample holding times, and lab certification are discussed in Section 3.3.4 of this SMP and in the Quality Assurance Project Plan (QAPP), presented as Appendix R of this SMP.

The Leachate Management System component involves the collection of leachate samples on a semi-annual basis from Collection Sump No. D-1. Leachate samples will be collected as grab samples and submitted to a NYSDOH-approved laboratory for the analysis of TCL VOCs, TCL SVOCs, TCL pesticides, TAL inorganics, cyanide, and conventional leachate parameters (see QAPP [Appendix R of this SMP] for parameter list). The leachate samples will be collected in accordance with the procedures specified in Section 6.0 of Volume III of the OM&M Manual (see Appendix K of this SMP).

The Landfill Gas Management and Flare System involves the semi-annual testing of gas monitoring wells for methane, oxygen, and carbon dioxide, and the semi-annual monitoring of landfill surface gas for the presence of methane gas. The testing and monitoring will be performed using the instrumentation and procedures described in Section 6.0 of Volume III of the OM&M Manual (see Appendix K of this SMP). The Landfill Gas Management and Flare System also involves testing and monitoring associated with the gas collection system and the gas flaring system. The sampling and analysis of methane, oxygen, carbon dioxide, and carbon monoxide will be performed using the instrumentation and procedures described in Section 5.0 of Volume III of the OM&M Manual (see Appendix K of this SMP).

The Stormwater Management System involves the collection of stormwater samples on a semi-annual basis (spring and fall) from the effluent of Sedimentation Pond C. Stormwater samples will no longer be collected from the 6-inch infiltration stormwater pipe because of health and safety concerns (i.e., traversing riprap to access sampling location). Stormwater samples will be collected as grab samples and submitted to a NYSDOH-approved laboratory for the analysis of TCL VOCs, TCL SVOCs, TCL pesticides, TAL inorganics, cyanide, and conventional leachate parameters (see QAPP [Appendix R of this SMP] for parameter list). The stormwater samples will be collected in accordance with the procedures specified in Section 6.0 and Appendix F of Volume III of the OM&M Manual (see Appendix K of this SMP).

3.3 Groundwater Monitoring Program

Groundwater monitoring will be performed on a regular basis to assess the performance of the remedy. The groundwater monitoring program is described in the following subsections of this SMP.

3.3.1 Monitoring System Design

The network of monitoring wells is designed to monitor groundwater conditions at the Site. The network of on-Site and off-Site wells has been located based on the following criteria:

- The network of monitoring wells is designed to enable evaluation of the effectiveness of the remedial measures, in terms of both hydraulic control and groundwater quality changes, and to evaluate and assess tidal affects.

The monitoring well networks described below are subject to change in the future. Any changes will require written NYSDEC approval.

Groundwater quality samples will be collected from a network of ten (10) on-site monitoring wells (groundwater quality monitoring well network), as follows: Wells MW-104, MW-106, MW-109, MW-110, MW-113, MW-114, MW-119, MW-120, MW-120B, and MW-122. Figure 11 shows the locations of the wells that form the groundwater quality monitoring well network. Table 3 provides the construction details for the monitoring wells that will be sampled. The analytes that will be tested are discussed in Section 3.3.4 of this SMP. On-site Monitoring Well MW-121, which was previously part of the groundwater sampling monitoring well network, was abandoned in June 2007 because the well was damaged beyond repair. The abandonment of Well MW-121 was approved by the NYSDEC.

Groundwater elevations will be measured in a network of fourteen (14) on-site and off-site monitoring wells (groundwater elevation monitoring well network), as follows: Wells MW-104, MW-106, MW-109, MW-110, MW-113, MW-114, MW-115, MW-115B, MW-117, MW-118, MW-119, MW-120, MW-120B, and MW-122. In addition, groundwater elevations will be measured in six (6) piezometers to monitor the groundwater and leachate levels on either side of the cut-off wall, upgradient and downgradient, respectively. Figure 12 shows the locations of the wells that form the groundwater elevation measurement monitoring well network. Table 4 provides the construction details for the monitoring wells where groundwater elevations will be measured. Monitoring Wells MW-117B, MW-121, MW-124, MW-124B, and MW-126, which were previously part of the groundwater elevation measurement monitoring well network, either cannot be located (off-site Monitoring Wells MW-117B, MW-124, and MW-124B [located in Pelham Bay Park]) or were abandoned in June 2007 (on-site Monitoring Wells MW-121 and MW-126). It was determined during the 2007 monitoring well rehabilitation efforts, which were conducted between April and June 2007, that Well

MW-126 was partially abandoned (at some time in the past). Well MW-126 appeared to have been partially sealed with cement grout; therefore, the abandonment was completed in June 2007. The abandonment of Well MW-126 was approved by the NYSDEC.

Baseline conditions for this Site were agreed by the NYSDEC to be the pre-remedial action conditions, as presented in the RI Report (1993). A baseline condition well data summary, including well construction details and the geologic unit in which each well is screened, is provided in Table 2-1 from the RI Report (see Appendix S of this SMP). Baseline water-level measurements that were collected during the RI in 1992 are provided in Table 2-4 from the RI Report (see Appendix S of this SMP). Baseline groundwater flow maps (Figures 5, 6, and 7) were prepared based on the water-level measurement data that was collected during the RI in 1992. Baseline maps summarizing the 1992 RI groundwater analytical results are shown on Figures 4-17 through 4-20 from the RI Report (see Appendix E of this SMP).

3.3.2 Groundwater Well Construction

Monitoring Wells MW-101 through MW-112 were installed between November and December 1989 as part of an environmental assessment of the Site. RI drilling activities were conducted between May and July 1992. A total of twenty-six monitoring wells (MW-113 through MW-126) and fourteen piezometers were installed during the RI drilling program. Twenty of the monitoring wells were installed at the perimeter of the Site, five monitoring wells were installed at off-site locations, and one monitoring well (MW-126) was installed near the middle of the landfill (i.e., interior of the landfill). Drilling was performed using hollow-stem auger, direct rotary, and casing advancer drilling methods. The majority of the monitoring wells were constructed of 4-inch diameter PVC casing and well screen. Two monitoring wells (MW-115 and MW-120) were constructed of 6-inch diameter PVC casing and well screen. Well MW-115B was constructed as a 6-inch diameter open rock hole. Well MW-126 was constructed of stainless steel casing and well screen. The majority of the piezometers were constructed of 2-inch diameter PVC casing and well screen. Four of the piezometers were constructed of steel casing and stainless steel well screen. As discussed previously, off-site Monitoring Wells MW-117B, MW-124, and MW-124B cannot be located and Monitoring Wells MW-121 and MW-126 were abandoned. There are no plans for the installation of additional monitoring wells at this time. Well construction logs are provided in Appendix T of this SMP.

3.3.3 Monitoring Schedule

Groundwater quality samples will be collected from the specified monitoring well network and groundwater elevations will be measured in the specified monitoring well network on a semi-annual basis. The duration of the semi-annual groundwater monitoring event is approximately 5 days. The sampling frequency may be modified by NYSDEC. The SMP will be modified to reflect changes in sampling plans approved by NYSDEC.

Deliverables for the groundwater-monitoring program are specified below.

3.3.4 Sampling Event Protocol

All well sampling activities will be recorded in a field book and a groundwater well sampling log presented in Appendix U. Other observations (e.g., well integrity, etc.) will be noted on the well sampling log. The well sampling log will serve as the inspection form for the groundwater monitoring well network.

Except as discussed below, water-level measurements will be collected from the groundwater elevation monitoring well network (described in Section 3.3.1) using an electronic water-level indicator and following the procedure described in Appendix G of Volume III of the OM&M Manual (see Appendix K of this SMP). Modifications to the water-level measurement protocols include the following: (1) Since non-aqueous phase liquid (NAPL) is not present at the Site, the monitoring well network will not be gauged for the presence of NAPL, and (2) Since most of the wells at the Site are tidally affected (i.e., water from Eastchester Bay enters/drains from the Site during high/low tides, respectively), water-level measurements will be collected about mid-way through the ebb (i.e., outgoing) tide predicted for City Island.

In general, the monitoring wells will be purged and sampled following the procedures and methodologies described in Appendices C, D, and E of Volume III of the OM&M Manual (see Appendix K of this SMP). However, modifications to the sampling procedures and methodologies will be instituted and are described in Appendix V of this SMP. Modifications to the groundwater sample collection protocols include the following: (1) Since most of the wells at the Site are tidally affected (as discussed above), groundwater quality sampling will be conducted about mid-way through the ebb (i.e., outgoing) tide predicted for City Island, and (2) The low-flow purging and sampling and bailer purging and sampling protocol modifications outlined in Appendix V of this SMP.

Groundwater samples will be submitted to the laboratory for the analysis of TCL VOCs, TCL SVOCs, TCL pesticides, TAL inorganics, cyanide, and conventional leachate parameters. Table 5 provides a summary of the analytical methods. The QAPP (see Appendix R) provides details related to the groundwater sample laboratory analyses. All groundwater samples (including QA/QC samples) are currently being submitted to EcoTest Laboratories, Inc. (EcoTest) located in North Babylon, New York. The EcoTest facility is a NYSDOH-approved laboratory (NY Lab ID No. 10320). The groundwater samples may be submitted to other NYSDOH-approved laboratories in the future. NYSDEC Analytical Services Protocol (ASP) Category B data deliverables will be provided for the groundwater monitoring samples.

3.4 Groundwater Monitoring Well Maintenance

If biofouling or silt accumulation has occurred in the monitoring wells, the wells will be physically agitated/surged and redeveloped. Additionally, monitoring wells will be properly decommissioned and replaced (as per the Monitoring Plan), if an event renders the wells unusable.

3.5 Well Replacement/Repairs and Decommissioning

Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity and overall performance. Well decommissioning, for the purpose of replacement, will be reported to NYSDEC prior to performance and in the annual report. Well decommissioning without replacement must receive prior approval by NYSDEC. Well abandonment will be performed in accordance with NYSDEC's "Groundwater Monitoring Well Decommissioning Procedures (see Appendix W of this SMP)." Monitoring wells that are decommissioned because they have been rendered unusable will be reinstalled in the nearest available location, unless otherwise approved by the NYSDEC.

3.6 Site-Wide Inspection

EC system monitoring inspections will be performed on a defined, regular schedule as specified in Sections 3 and 4 of this SMP. During these inspections, the Inspection Checklist Forms will be completed (Appendix N of this SMP). The Inspection Checklist Forms will compile sufficient information to assess the following:

- An evaluation of the condition and continued effectiveness of ECs.
- General Site conditions at the time of the inspection.
- The Site management activities being conducted.
- Compliance with permits and schedules included in the Operation and Maintenance Plan.
- Confirm that Site records are up to date.

3.7 Monitoring Quality Assurance/Quality Control

All sampling and analyses will be performed in accordance with the requirements of the QAPP prepared for the Site (Appendix R). Main Components of the QAPP include:

- QA/QC Objectives for Data Measurement.
- Project Organizational Chart.
- Communication Pathways.
- Personnel Responsibilities.
- Reference Limits.
- Sampling Design and Rationale.
- Sampling Program:
  - Sample containers will be properly washed, decontaminated, and appropriate preservative will be added (if applicable) prior to their use by the analytical laboratory. Containers with preservative will be tagged as such.
  - Sample holding times will be in accordance with the NYSDEC Analytical Services Protocol (ASP) requirements.
  - Field QC samples (e.g., trip blanks, coded field duplicates, and matrix spike/matrix spike duplicates) will be collected as necessary.

- Sample Tracking and Custody.
- Calibration Procedures:
  - All field analytical equipment will be calibrated immediately prior to each day's use. Calibration procedures will conform to manufacturer's standard instructions.
  - The laboratory will follow all calibration procedures and schedules as specified in USEPA SW-846 and subsequent updates that apply to the instruments used for the analytical methods.
- Analytical Procedures.
- Data Reduction and Validation:
  - Data validation will be performed in accordance with the USEPA validation guidelines for organic and inorganic data review. Validation will include the following:
    - Verification of 100% of all QC sample results (both qualitative and quantitative).
    - Verification of the identification of 100% of all sample results (both positive hits and non-detects).
    - A Data Usability Summary Report (DUSR) which will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation and chain of custody procedures, and a summary assessment of precision, accuracy, representativeness, comparability, and completeness for each analytical method.
- Internal QC and Checks.
- QA Performance and System Audits.
- Preventative Maintenance Procedures and Schedules.

- Corrective Action Measures.

3.8 Monitoring Reporting Requirements

Forms and any other information generated during regular monitoring events and inspections will be kept on file. All forms, and other relevant reporting formats used during the monitoring/inspection events, will be: (1) subject to approval by NYSDEC and (2) submitted at the time of the Annual Site Management Report, as specified in the Reporting Plan of the SMP.

All monitoring results will be reported to NYSDEC on an Annual basis in the Site Management Report. Additionally, a quarterly report will be prepared that provides all logs and validated data collected during the subject quarterly report period. No data interpretation or evaluation will be included in the quarterly reports. If required by the NYSDEC for a specific sampling event, a report or letter will be prepared for submission. The report (or letter) will include, at a minimum:

- Date of event.
- Personnel conducting sampling.
- Description of the activities performed.
- Type of samples collected (e.g., groundwater, etc).
- Copies of all field forms completed (e.g., well sampling logs, chain-of-custody documentation, etc.).
- Sampling results in comparison to appropriate standards/criteria.
- A figure illustrating sample type and sampling locations.
- Copies of all laboratory data sheets and the required laboratory data deliverables required for all points sampled (also to be submitted electronically in the NYSDEC-identified format).
- A copy of the laboratory certification.
- Any observations, conclusions, or recommendations.

- A determination as to whether groundwater quality conditions have changed since the last reporting event.

Reports and data will be provided in hard copy and digital format as requested by NYSDEC (See Section 5.4 of this SMP). A summary of the monitoring program deliverables are provided in Table 6.

3.9 Certifications

Site inspections and sampling activities will take place as outlined above. Frequency of inspection is subject to change by NYSDEC. Inspection certification for all ICs and ECs will be submitted to NYSDEC on a calendar year basis and must be submitted by March 31 of the following year. A qualified environmental professional, as determined by NYSDEC, will perform inspection and certification. Further information on the certification requirements are outlined in the Reporting Plan of the SMP (see Section 5.0 of this SMP).

4. Operation and Maintenance Plan

TO BE PROVIDED

5. Site Management Reporting Plan

5.1 Introduction

An Annual Site Management Report will be submitted to NYSDEC by March 31 of the calendar year following the reporting period. The Site Management Report will be prepared in accordance with NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation requirements. This Site Management Reporting Plan and its requirements are subject to revision by NYSDEC.

This Annual Site Management Report will include the following:

- Identification of all required ECs/ICs required by the ROD for the Site.
- An evaluation of the EC/IC Plan and the Monitoring Plan for adequacy in meeting remedial goals.
- Assessment of the continued effectiveness of all ICs and ECs for the Site.
- Certification of the ECs/ICs.
- Results of the required periodic Site Inspections.
- All deliverables generated during the reporting period, as specified in Section 2 EC/IC Plan, Section 3 Monitoring Plan, and Section 4 Operation and Maintenance Plan.

The Site Management Reporting Plan is subject to NYSDEC revision.

5.2 Certification of Engineering and Institutional Controls

Information of ECs/ICs can be found in the EC/IC Plan portion of this SMP. Inspection of the ECs/ICs will occur at a frequency described in Section 3 Monitoring Plan and Section 4 Operation and Maintenance Plan. After the last inspection of the reporting period, a Professional Engineer licensed to practice in New York State will sign and certify the document. The document will certify that:

- On-Site ECs/ICs are unchanged from the previous certification.

- The on-site ECs/ICs remain in-place and effective.
- The systems are performing as designed.
- Nothing has occurred that would impair the ability of the controls to protect public health and the environment.
- Nothing has occurred that would constitute a violation or failure to comply with any operation and maintenance plan for such controls.
- Access is available to the Site by NYSDEC and NYSDOH to evaluate continued maintenance of such controls.
- Site usage is compliant with the Deed Restriction.

The signed certification will be included in the Annual Site Management Report (see Section 5.3).

5.3 Site Inspections

5.3.1 Inspection Frequency

All inspections will be conducted at the frequency specified in the schedules provided in Section 3 Monitoring Plan and Section 4 Operation and Maintenance Plan of this SMP.

5.3.2 Inspection Forms, Sampling Data, and Maintenance Reports

All inspections and monitoring events will be recorded on the appropriate forms for their respective system (refer to Appendix N of this SMP). These forms are subject to NYSDEC revision.

All applicable inspection forms and other records (including all sampling data of any media at the Site and system maintenance reports) generated for the Site during the calendar year will be included in the Annual Site Management Report.

5.3.3 Evaluation of Records and Reporting

The results of the inspection and Site monitoring data will be evaluated as part of the EC/IC certification to confirm that the:

- ECs/ICs are in place, are performing properly, and remain effective.
- The Monitoring Plan is being implemented.
- Operation and maintenance activities are being conducted properly, and, based on the above items,
- The Site remedy continues to be protective of public health and the environment and is performing as designed.

5.4 Site Management Report

The Site Management Report will be submitted annually and will be submitted by March 31 of the calendar year following the reporting period. The report will include:

- EC/IC certification.
- All applicable inspection forms and other records generated for the Site during the reporting period.
- A summary of any discharge monitoring data and/or information generated during the reporting period with comments and conclusions.
- Cumulative data summary tables and/or graphical representations of contaminants of concern by media [groundwater], which include a listing of all compounds analyzed along with the applicable standards, with all exceedances highlighted.
- Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables required for all points sampled during the calendar year (also to be submitted electronically in the NYSDEC-specified format).
- A performance summary for all systems at the Site during the calendar year, including information such as:
    - The number of days the system(s) were run for the reporting period.
    - The average, high, and low flows per day.

- A description of significant breakdowns and/or repairs along with an explanation for any significant downtime.
- A summary of the performance and/or effectiveness monitoring.
- Comments, conclusions, and recommendations based on data evaluation.
- Description of the resolution of performance problems.

- A Site evaluation, which will address the following:
  - The compliance of the remedy with the requirements of the Site-specific ROD.
  - The performance and effectiveness of the remedy.
  - The operation and the effectiveness of all treatment units, etc., including identification of any needed significant repairs or modifications.
  - Any new conclusions or observations regarding Site contamination based on inspections or data generated by the Monitoring Plan for the media being monitored.
  - Recommendations regarding any necessary changes to the remedy and/or Monitoring Plan.
- A figure showing sampling and well locations, and significant analytical values at sampling locations.
- Comments, conclusions, and recommendations, based on an evaluation of the information included in the report, regarding ECs/ICs at the Site.

The Site Management Report will be submitted, in hard-copy format, to the Region 2 NYSDEC offices, located at 47-40 21st Street, Long Island City, New York, and in electronic format to NYSDEC and NYSDOH.

6. References

New York Standards and Specifications for Erosion and Sediment Control. 2005.

New York State Department of Environmental Conservation (NYSDEC). 1990. Order on Consent, Index #2-03-001.

New York State Department of Environmental Conservation (NYSDEC). 1993. Pelham Bay Landfill, I.D. Number 203001, Bronx County, New York, Record of Decision.

New York State Department of Environmental Conservation (NYSDEC). 2002. Draft DER-10 Technical Guidance for Site Investigation and Remediation.

New York State Department of Environmental Conservation (NYSDEC). 2007. Generic Template for Site Management Plan Region 2 DER Managed Projects.

URS Corporation (URS). 2002. Pelham Bay Landfill Closure and Final Remediation Construction Certification Report.

Woodward-Clyde Consultants, Inc. (WCCI) 2005. Pelham Bay Landfill, Bronx, New York, Operation Maintenance & Monitoring Manual.

WCCI 1993a. Final Remedial Investigation Report, Pelham Bay Landfill, Bronx, New York.

WCCI 1993b. Supplemental Remedial Investigation Report, Pelham Bay Landfill, Bronx, New York.

WCCI 1993c. Final Draft Feasibility Study Report, Pelham Bay Landfill, Bronx, New York

WCCI 1993d. Baseline Risk Assessment, Volume 1 - Human Health Evaluation and Volume 2 – Ecological Evaluation

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Table 1. Summary of Average Water-Level Elevations During the Period August 13 - 17, 2007, Pelham Bay Landfill, Bronx, New York.

Well ID	Average Water-Level Elevation (ft BD)	Tidal Affect
MW-104	2.38	Tidally Affected
MW-106	0.73	Tidally Affected
MW-109	5.89	Minimal Tidal Affect
MW-110	0.44	Tidally Affected
MW-113	1.53	Tidally Affected
MW-114	4.17	Minimal Tidal Affect
MW-115	4.16	Tidally Affected
MW-117	2.64	Tidally Affected
MW-118	-0.46	Tidally Affected
MW-119	-1.00	Tidally Affected
MW-120	-1.41	Tidally Affected
MW-122	-0.77	Tidally Affected
PZ-A	5.69	Minimal Tidal Affect
PZ-B	6.42	Minimal Tidal Affect
PZ-C	5.77	Minimal Tidal Affect
PZ-D	6.02	Minimal Tidal Affect
PZ-E	3.07	Tidally Affected
PZ-F	2.84	Tidally Affected

ft BD Feet relative to Bronx Highway Datum. (1)

Notes: (1) Bronx Highway Datum is 2.608 ft above mean sea level.

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Table 2. Monitoring/Inspection Schedule, Pelham Bay Landfill, Bronx, New York.

Monitoring Program	Frequency [(a), (b)]	Matrix	Analysis
Landfill Cover System	Monthly [(c)] (Forms FCS-1 and DP-1)	Landfill Cover	Inspection
Groundwater and Leachate Management System	(1) Inspections: Weekly (Forms GWL-1 and DP-1), Monthly (Forms GWL-2 and DP-1), and Semi-Annual (Forms GWL-3 and DP-1) (2) Sampling and Groundwater Elevation Measurements: Semi-Annual	Groundwater/Leachate	(1) Inspection (2) Laboratory Analysis for TCL VOCs, TCL SVOCs, TAL inorganics, Cyanide, TCL pesticides, and Conventional leachate parameters (3) Field Parameters (DO, ORP, pH, specific conductance, temperature, and turbidity)
Landfill Gas Management and Flare System	(1) Inspections: Weekly (Forms LFG-1 and DP-1), Monthly (Forms LFG-2 and DP-1), and Quarterly (Forms LFG-3 and DP-1) (2) Monitoring: Semi-Annual	Landfill Gas	(1) Inspection (2) Field Measurement of Methane, Oxygen, and Carbon Dioxide (Gas Monitoring Wells) (3) Field Measurement of Methane (Landfill Surface Gas)
Stormwater Management System	(1) Inspections: Monthly [(c)] (Forms SMS-1, SMS-2, SMS-3, and DP-1) (2) Sampling: Semi-Annual (Spring and Fall)	Stormwater	(1) Inspection (2) Laboratory Analysis for TCL VOCs, TCL SVOCs, TAL inorganics, Cyanide, TCL pesticides, and Conventional leachate parameters
Ancillary Systems	Quarterly (Forms AS-1 and DP-1)	Ancillary Systems	Inspection

See footnotes on last page.

Footnotes:

TCL	Target Compound List
TAL	Target Analyte List
VOCs	Volatile Organic Compounds
SVOCs	Semi-Volatile Organic Compounds
DO	Dissolved Oxygen
ORP	Oxidation-Reduction Potential
SMP	Site Management Plan

(a) The frequency of events will be conducted as specified until otherwise approved by NYSDEC.
(b) Referenced Forms can be located in Appendix N of this SMP.
(c) Inspections are also required after each major rainfall event (i.e., 2.5 inches in 24 hours or larger).

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Table 3. Semi-Annual Groundwater Quality Monitoring Well Network, Pelham Bay Landfill, Bronx, New York.

Well Designation [2]	Well Depth (ft)	Measuring Point Elevation (ft BD)	Screen Elevation Top (ft BD)	Screen Elevation Bottom (ft BD)
MW-104	15.35	19.132	4.20	-5.80
MW-106	17.47	18.388	2.39	-7.61
MW-109	16.75	23.952	10.21	0.21
MW-110	16.89	20.013	4.45	-5.55
MW-113	12.08	14.442	3.99	-1.01
MW-114	11.87	14.66	6.14	-3.86
MW-119	31.21	20.421	-7.43	-17.43
MW-120	55.58	18.838	-23.97	-43.97
MW-120B	79.70	19.296	-58.86	-68.86
MW-122	38.15	17.575	-16.47	-26.47

ft Feet.
ft BD Feet relative to Bronx Highway Datum. [1]

Sources:

Well Depths and Screen Elevations
Remedial Investigation (RI) Report, Table 2-1, Well Data Summary.
RI Report Prepared by Woodward-Clyde Consultants, Inc., April 1993.

Measuring Point Elevations
Nelson & Pope Engineers & Surveyors - July 2006 Monitoring Well Survey

Notes:

(1) Bronx Highway Datum is 2.608 ft above mean sea level.
(2) Monitoring Well MW-121, which was previously part of the groundwater sampling monitoring well network, was abandoned, as approved by the NYSDEC, in June 2007.

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Table 4. Semi-Annual Groundwater Elevation Measurement Monitoring Well Network, Pelham Bay Landfill, Bronx, New York.

Well Designation	Well Depth (ft)	Measuring Point Elevation (ft BD)	Screen Elevation Top (ft BD)	Screen Elevation Bottom (ft BD)
Monitoring Wells [(2), (3), (4)]				
MW-104	15.35	19.132	4.20	-5.80
MW-106	17.47	18.388	2.39	-7.61
MW-109	16.75	23.952	10.21	0.21
MW-110	16.89	20.013	4.45	-5.55
MW-113	12.08	14.442	3.99	-1.01
MW-114	11.87	14.66	6.14	-3.86
MW-115	42.50	24.807	-2.16	-22.16
MW-115B	72.41	24.876 (a)	-33.89	-52.30
MW-117	19.66	8.077	-2.33	-12.33
MW-117B	79.13	8.319 (b)	-62.73	-72.73
MW-118	17.19	19.113	6.00	-4.00
MW-119	31.21	20.421	-7.43	-17.43
MW-120	55.58	18.838	-23.97	-43.97
MW-120B	79.70	19.296	-58.86	-68.86
MW-122	38.15	17.575	-16.47	-26.47
Piezometers				
PZ-A	NA	11.951	NA	NA
PZ-B	NA	14.254	NA	NA
PZ-C	NA	11.374	NA	NA
PZ-D	NA	12.411	NA	NA
PZ-E	NA	9.545	NA	NA
PZ-F	NA	9.645	NA	NA

ft Feet.
ft BD Feet relative to Bronx Highway Datum. [(1)]
NA Not available.
(a) Top of Steel Casing.
(b) Top of PVC Cap.

Sources: Well Depths and Screen Elevations
Remedial Investigation (RI) Report, Table 2-1, Well Data Summary.
RI Report Prepared by Woodward-Clyde Consultants, Inc., April 1993.

Measuring Point Elevations
Nelson & Pope Engineers & Surveyors - July 2006 Monitoring Well Survey

Notes:
(1) Bronx Highway Datum is 2.608 ft above mean sea level.
(2) Monitoring Wells MW-121 and MW-126, which were previously part of the groundwater elevation measurement monitoring well network, were abandoned, as approved by the NYSDEC, in June 2007.
(3) Monitoring Wells MW-124 and MW-124B, which were previously part of the groundwater elevation measurement monitoring well network, cannot be located.
(4) Monitoring Well MW-117B, which was surveyed in July 2006, cannot be located.

Table 5. Groundwater, Leachate, and Stormwater Sample Analytical Protocols, Pelham Bay Landfill, Bronx, New York.

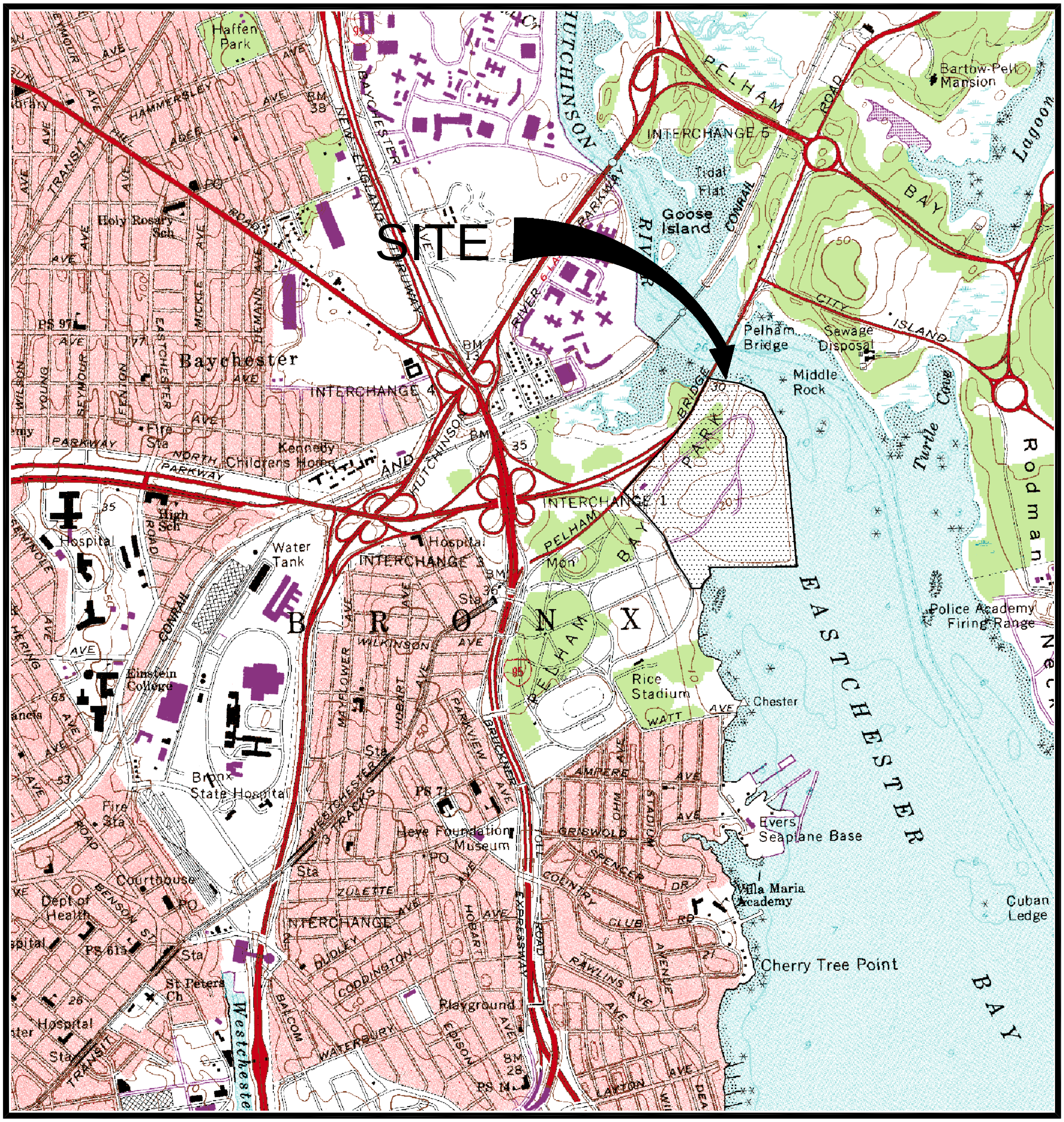
Parameter	Analytical Method
TCL VOCs	EPA Method 8260
TCL SVOCs	EPA Method 8270
TCL Pesticides	EPA Method 8081
TAL Inorganics	EPA Methods 200.7 and 245.1
Cyanide	EPA Method 335.4
Alkalinity as Bicarbonate	SM 2320 B
Alkalinity as Carbonate	SM 2320 B
Ammonia	SM 4500-NH_3 C and D
Chemical Oxygen Demand	EPA Method 410.1
Chloride	SM 4500-Cl^- B
Nitrate	EPA Method 353.2
Sulfate	ASTM D516-90, 02
Total Dissolved Solids	SM 2540 C
Total Kjeldahl Nitrogen	SM 4500 B

ASTM ASTM International (formerly American Society for Testing and Materials).
EPA Environmental Protection Agency.
SM Standard Method.
TCL Target Compound List.
TAL Target Analyte List.
VOCs Volatile Organic Compounds.
SVOCs Semi-Volatile Organic Compounds.

Table 6. Monitoring/Inspection Deliverables, Pelham Bay Landfill, Bronx, New York.

Task	Frequency [a]	Quarterly Reporting Requirement	Annual Reporting Requirement
Landfill Cover System Inspections	See Table 2	60 Days Following Subject Quarterly Report Period	By March 31 of the Calendar Year Following the Reporting Period
Groundwater and Leachate Management System Inspections and Monitoring	See Table 2	60 Days Following Subject Quarterly Report Period	By March 31 of the Calendar Year Following the Reporting Period
Landfill Gas Management and Flare System Inspections and Monitoring	See Table 2	60 Days Following Subject Quarterly Report Period	By March 31 of the Calendar Year Following the Reporting Period
Stormwater Management System Inspections and Monitoring	See Table 2	60 Days Following Subject Quarterly Report Period	By March 31 of the Calendar Year Following the Reporting Period
Ancillary Systems Inspections	See Table 2	60 Days Following Subject Quarterly Report Period	By March 31 of the Calendar Year Following the Reporting Period

(a) The frequency of events will be conducted as specified until otherwise approved by NYSDEC.



LOCATION MAP

SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

MAP SOURCE: USGS 7.5 MINUTE QUADRANGLE 1979
FLUSHING, NEW YORK

MN GN
12° 213 MILS
0°47' 14 MILS
UTM GRID AND 1979 MAGNETIC NORTH

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Acad Version : R17.0s (LMS Tech)
User Name : alsanchez

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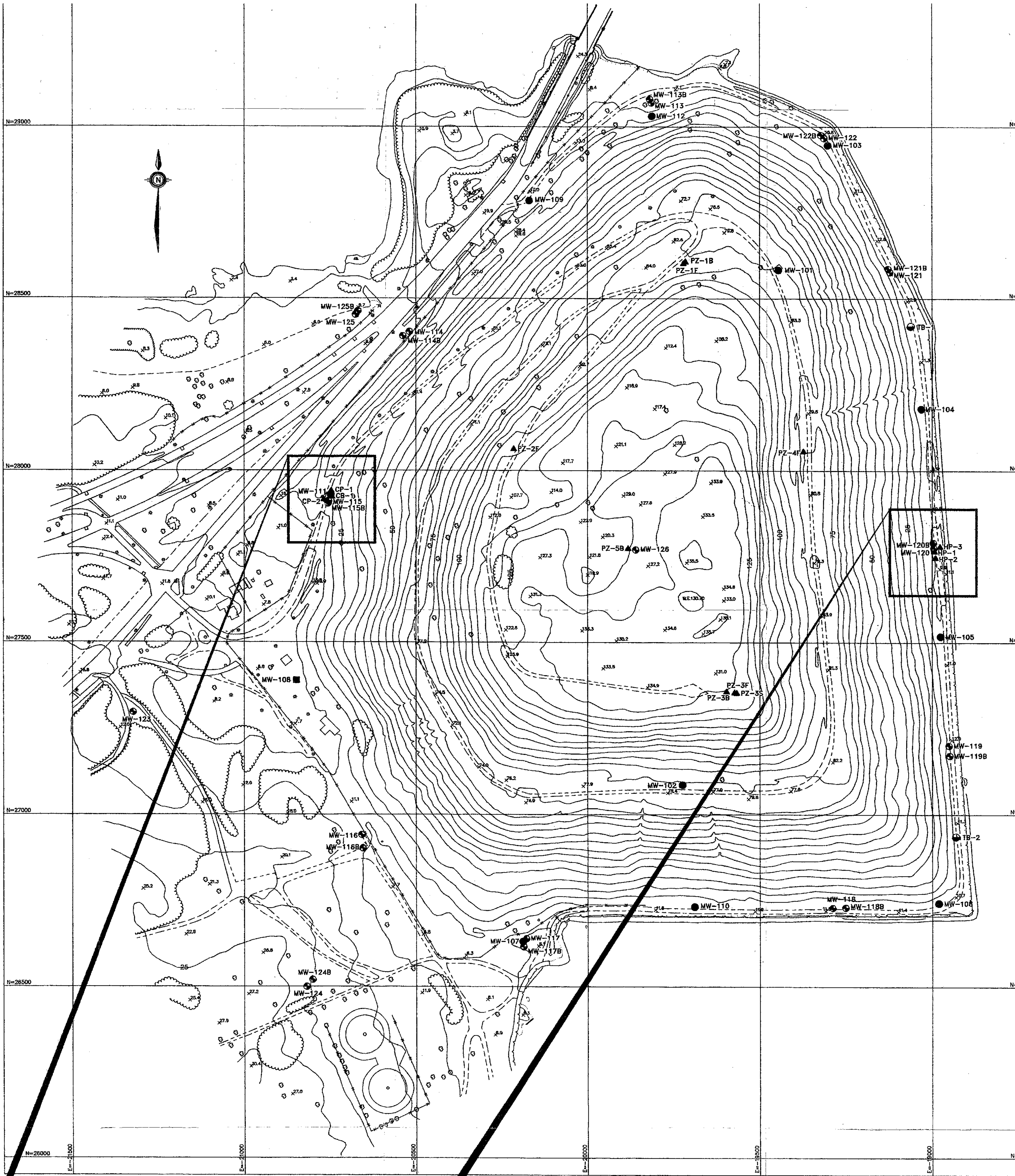
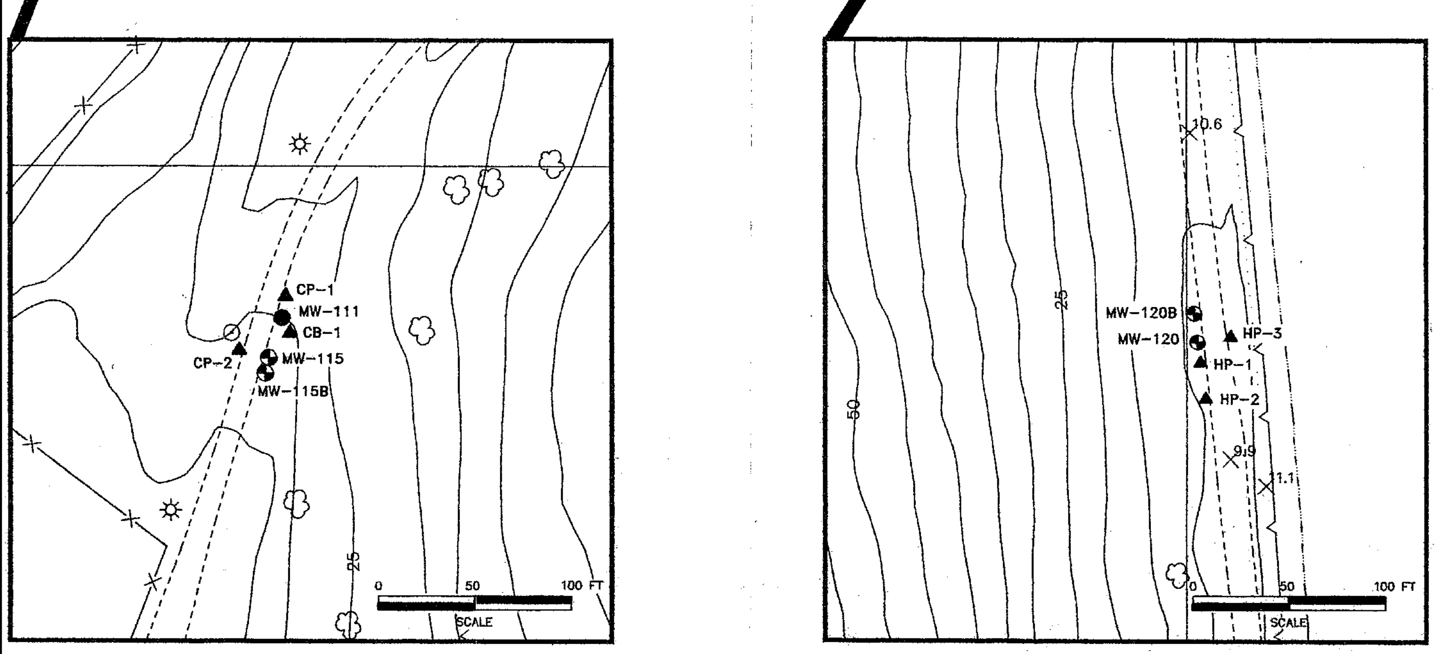
PROJECT MANAGER	DEPARTMENT MANAGER	LEAD DESIGN PROF.	CHECKED BY
C. SAN GIOVANNI	M. WOLFERT	K. PIERIDES	C. KEEN
SHEET TITLE		TASK/PHASE NUMBER	DRAWN BY
SITE LOCATION MAP PELHAM BAY LANDFILL BRONX, NEW YORK		00013	A. SANCHEZ
		PROJECT NUMBER	DRAWING NUMBER
		NY001443.0003	1

FIGURE 2
TO BE PROVIDED FOLLOWING THE PERFORMANCE OF THE METES AND BOUNDS SURVEY





LEGEND:

- MW-103 ● MONITORING WELLS INSTALLED 1989
- MW-108 ■ MONITORING WELL DESTROYED DURING IRM
- PZ-3B ▲ PIEZOMETERS INSTALLED 1992
- MW-113 MONITORING WELLS INSTALLED 1992
- MW-116B BEDROCK WELLS INSTALLED 1992
- TB-1 TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET

0 150' 300'
SCALE IN FEET

MAP SOURCE:
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

WOODWARD-CLYDE CONSULTANTS, INC.
FINAL REMEDIAL INVESTIGATION REPORT,
PELHAM BAY LANDFILL, BRONX, NEW YORK, 1993.

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

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PROJECT TITLE: PELHAM BAY LANDFILL BRONX, NEW YORK	PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT	LEAD DESIGN PROF.:
	SHEET TITLE: MONITORING WELL AND PIEZOMETER LOCATION MAP		TASK/PHASE NUMBER: 00013
			PROJECT NUMBER: NY001443.0003

CHECKED BY	DRAWN BY	DRAWING NUMBER
C. KEEN	A. SANCHEZ	3

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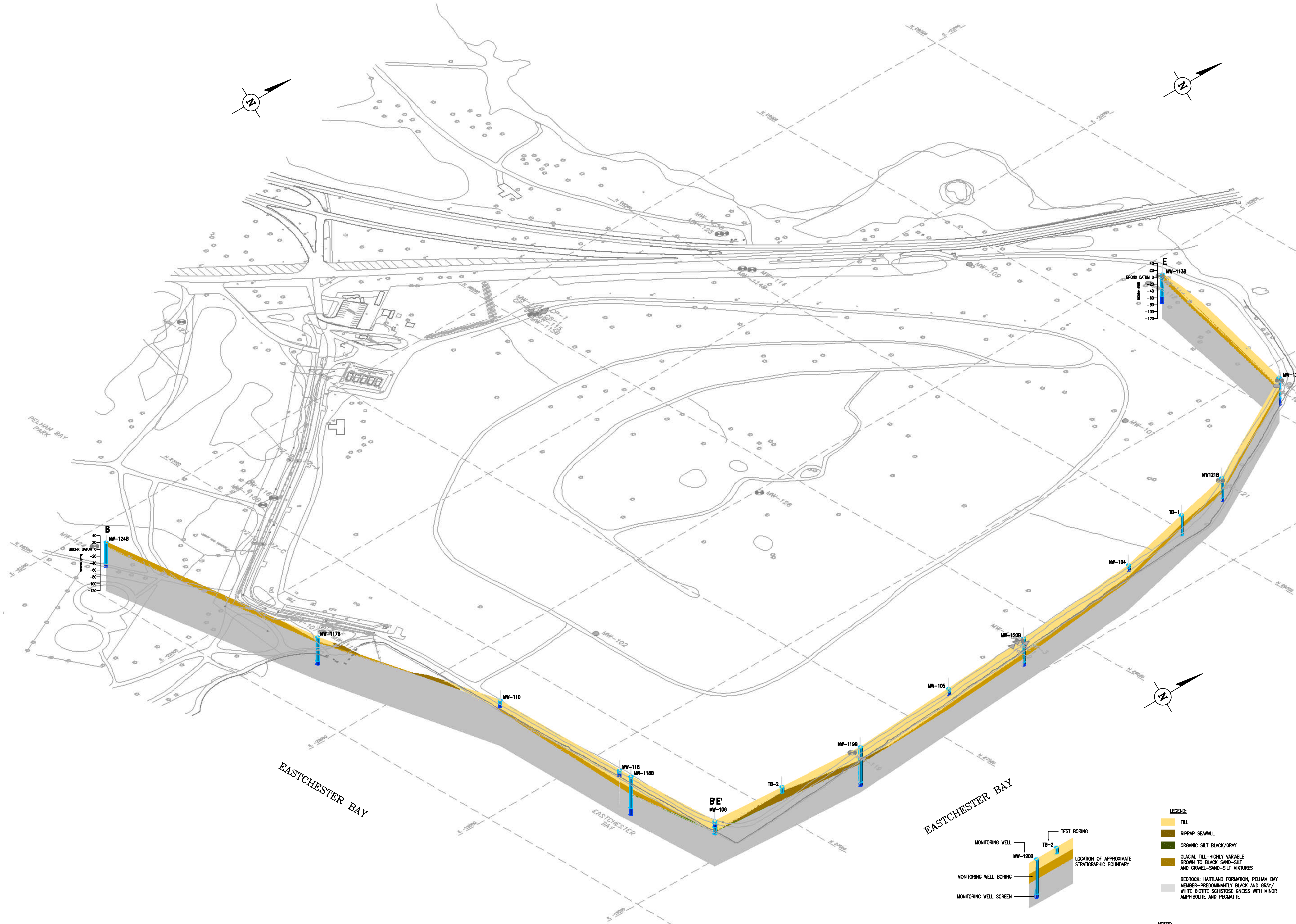
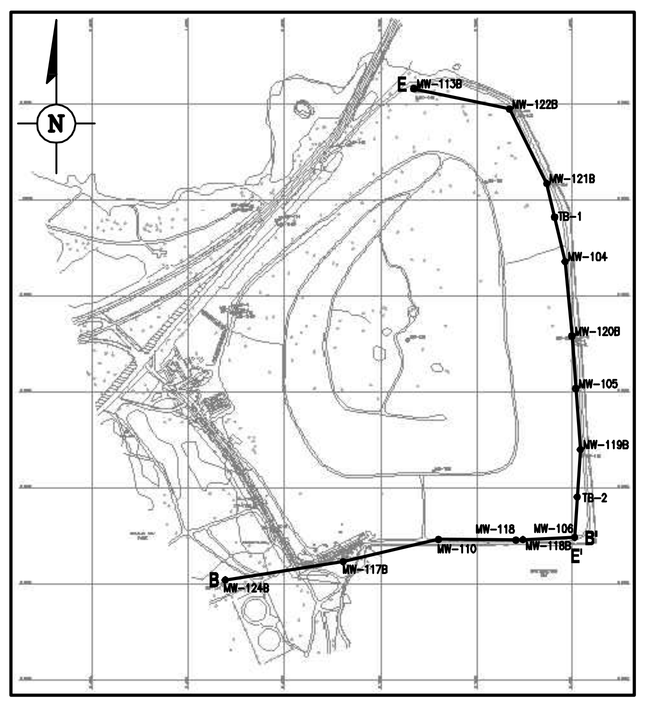


LEGEND:

- FILL
- RIPRAP SEAWALL
- ORGANIC SILT BLACK/GRAY
- GLACIAL TILL–HIGHLY VARIABLE BROWN TO BLACK SAND–SILT AND GRAVEL–SAND–SILT MIXTURES
- BEDROCK: HARTLAND FORMATION, PELHAM BAY MEMBER–PREDOMINANTLY BLACK AND GRAY/WHITE BIOTITE SCHISTOSE GNEISS WITH MINOR AMPHIBOLITE AND PEGMATITE

NOTES:

1. THE SOURCE OF THE GEOLOGIC INFORMATION SHOWN ON THIS FIGURE ARE THE GEOLOGIC CROSS–SECTIONS (CROSS–SECTIONS E–E' AND B–B') THAT ARE PROVIDED IN THE FINAL REMEDIAL INVESTIGATION REPORT (1993) THAT WAS PREPARED BY WOODWARD–CLYDE CONSULTANTS, INC.
2. BRONX DATUM = 2.608 FEET ABOVE MEAN SEA LEVEL
3. INFERRED BEDROCK ELEVATIONS BASED ON BEDROCK ELEVATION MAP.
4. THE GEOLOGIC FENCE DIAGRAM SHOWS THE STRATIGRAPHIC UNITS ALONG THE SOUTHERN AND EASTERN PERIMETERS OF THE SITE (i.e., ALONG EASTCHESTER BAY), WHICH IS THE PRIMARY GROUNDWATER DISCHARGE BOUNDARY FOR THE SITE. AS SUCH, THE INTENT OF THIS DIAGRAM IS TO PRESENT THE PRIMARY STRATIGRAPHIC UNITS ALONG EASTCHESTER BAY FOR VISUALIZATION PURPOSES. DETAILED INFORMATION IS AVAILABLE IN THE RI REPORT CROSS–SECTIONS.



PLAN VIEW

0 500' 1000'
SCALE IN FEET

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEYPLAN

SEAL

SEAL

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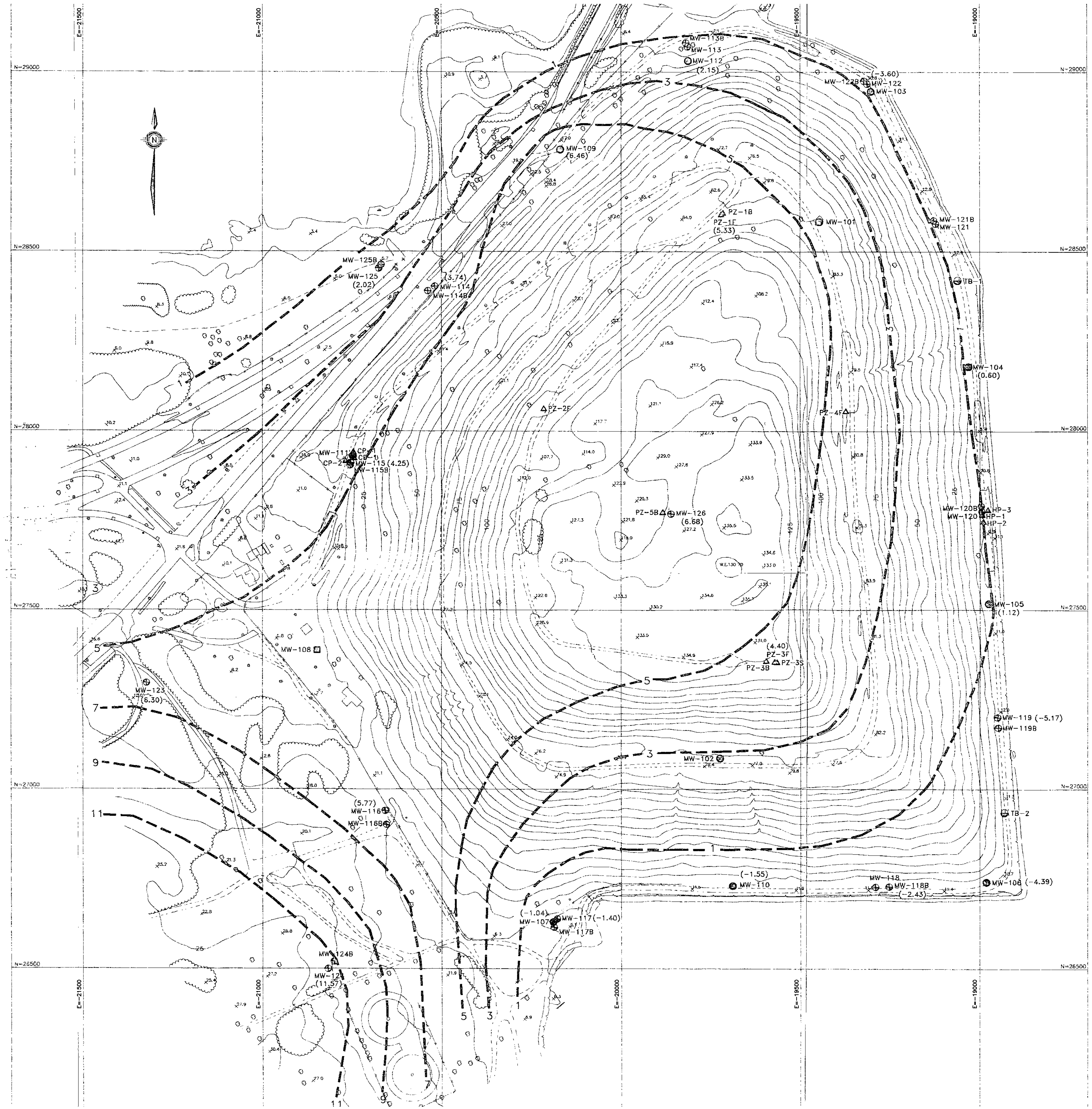
PROJECT TITLE
PELHAM BAY LANDFILL
BRONX, NEW YORK

PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT	LEAD DESIGN PROF.: K. PIERIDES	CHECKED BY: C. KEEN
SHEET TITLE: GEOLOGIC FENCE DIAGRAM VIEW FACING NORTHWEST		TASK/PHASE NUMBER: 00013	DRAWN BY: A. SANCHEZ
		PROJECT NUMBER: NY001443.0003	DRAWING NUMBER: 4



LEGEND:

- MW-103 — MONITORING WELLS INSTALLED 1989
- MW-108 — MONITORING WELL DESTROYED DURING IRM
- PZ-3B — PIEZOMETER INSTALLED 1992
- MW-113 — MONITORING WELLS INSTALLED 1992
- MW-116B — BEDROCK WELLS INSTALLED 1992
- TB-1 — TEST BORING ADVANCED 1992
- (2.68) — GROUNDWATER ELEVATIONS, AUGUST 4, 1992
- — —5— — — GROUNDWATER ELEVATION CONTOURS – LOW TIDE

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM – 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL – 5 FEET.

0 150' 300'
SCALE IN FEET

MAP SOURCE:
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.
WOODWARD-CLYDE CONSULTANTS, INC.
FINAL REMEDIAL INVESTIGATION REPORT,
PELHAM BAY LANDFILL, BRONX, NEW YORK, 1993.

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

SHEET TITLE

GROUNDWATER ELEVATIONS IN THE FILL/TILL WELLS – LOW TIDE, AUGUST 4, 1992

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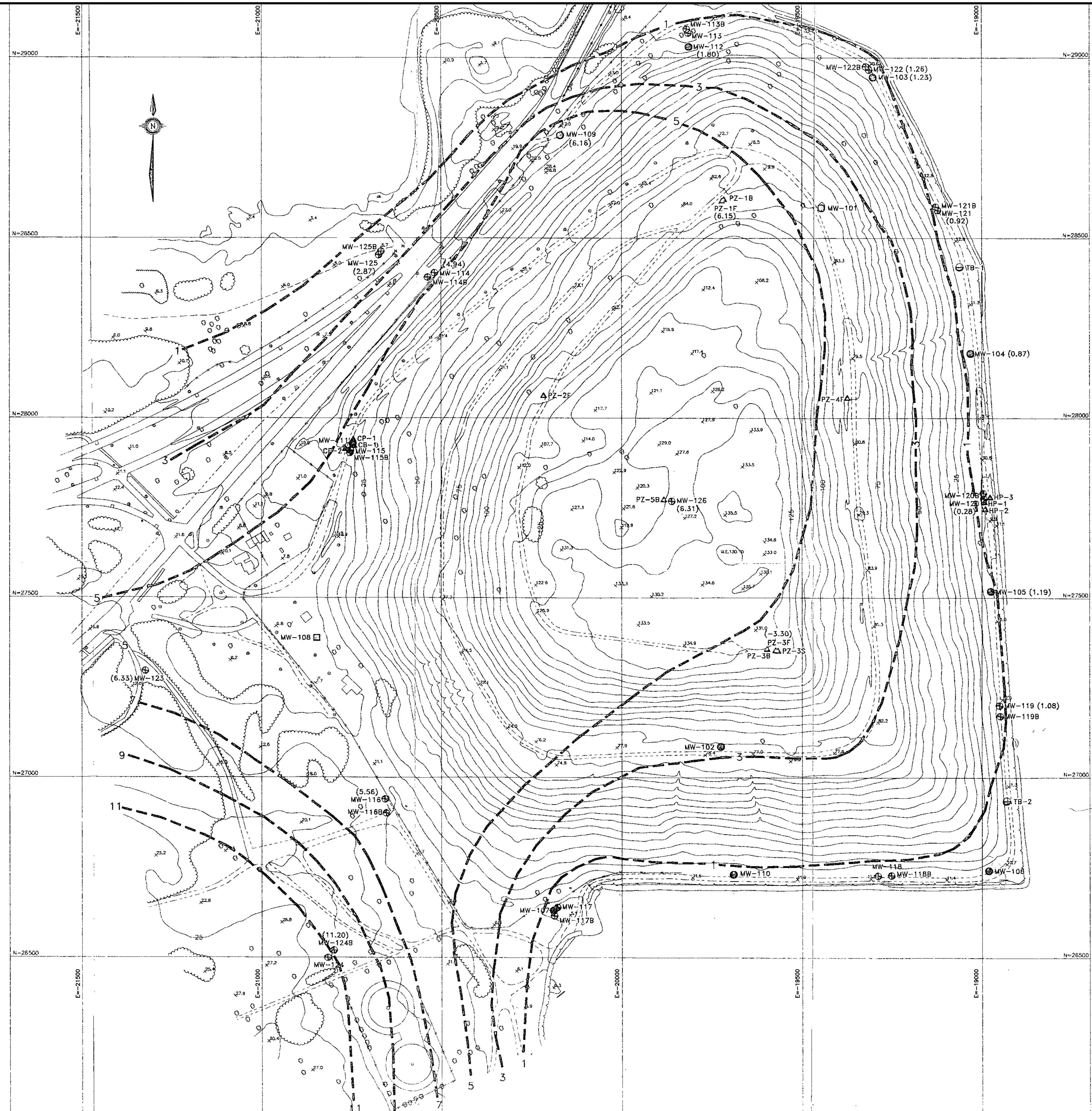
PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY: C. KEEN
TASK/PHASE NUMBER: 00013	DRAWN BY: A. SANCHEZ
PROJECT NUMBER: NY001443.0003	DRAWING NUMBER: 5



LEGEND:

MW-103	MONITORING WELLS INSTALLED 1989
MW-108	MONITORING WELL DESTROYED DURING IRM
PZ-5B	PIEZOMETER INSTALLED 1992
MW-113	MONITORING WELLS INSTALLED 1992
MW-116B	BEDROCK WELLS INSTALLED 1992
TB-1	TEST BORING ADVANCED 1992
(2.68)	GROUNDWATER ELEVATIONS, AUGUST 12, 1992
— 5 —	GROUNDWATER ELEVATION CONTOURS – HIGH TIDE

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM – 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL – 5 FEET.

0 150' 300'
SCALE IN FEET

MAP SOURCE:
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.
WOODWARD-CLYDE CONSULTANTS, INC.
FINAL REMEDIAL INVESTIGATION REPORT,
PELHAM BAY LANDFILL, BRONX, NEW YORK, 1993.

NO.	ISSUED	DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

SHEET TITLE

GROUNDWATER ELEVATIONS IN THE FILL/TILL WELLS – HIGH TIDE, AUGUST 12, 1992

ARCADIS OF NEW YORK, INC.
Two Huntington Quadrangle
Suite 1S10
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

SEAL | SEAL

PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY: C. KEEN
TASK/PHASE NUMBER: 00013	DRAWN BY: A. SANCHEZ
PROJECT NUMBER: NY001443.0003	DRAWING NUMBER: 6

LEGEND:

MW-103	MONITORING WELLS INSTALLED 1989
MW-108	MONITORING WELL DESTROYED DURING IRM
PZ-3B	PIEZOMETER INSTALLED 1992
MW-113	MONITORING WELLS INSTALLED 1992
MW-116B	BEDROCK WELLS INSTALLED 1992
TB-1	TEST BORING ADVANCED 1992
(-1.98)	GROUNDWATER ELEVATIONS, NOVEMBER 5, 1992
— 5 —	GROUNDWATER ELEVATION CONTOURS – LOW TIDE

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM – 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL – 5 FEET.

0 150' 300'
SCALE IN FEET

MAP SOURCE:
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.
WOODWARD-CLYDE CONSULTANTS, INC.
FINAL REMEDIAL INVESTIGATION REPORT,
PELHAM BAY LANDFILL, BRONX, NEW YORK, 1993.

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

SHEET TITLE

GROUNDWATER ELEVATIONS IN THE FILL/TILL WELLS – LOW TIDE, NOVEMBER 5, 1992

ARCADIS OF NEW YORK, INC.
Two Huntington Quadrangle
Suite 1S10
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

SEAL | SEAL

PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY: C. KEEN
TASK/PHASE NUMBER: 00013	DRAWN BY: A. SANCHEZ
PROJECT NUMBER: NY001443.0003	DRAWING NUMBER: 7

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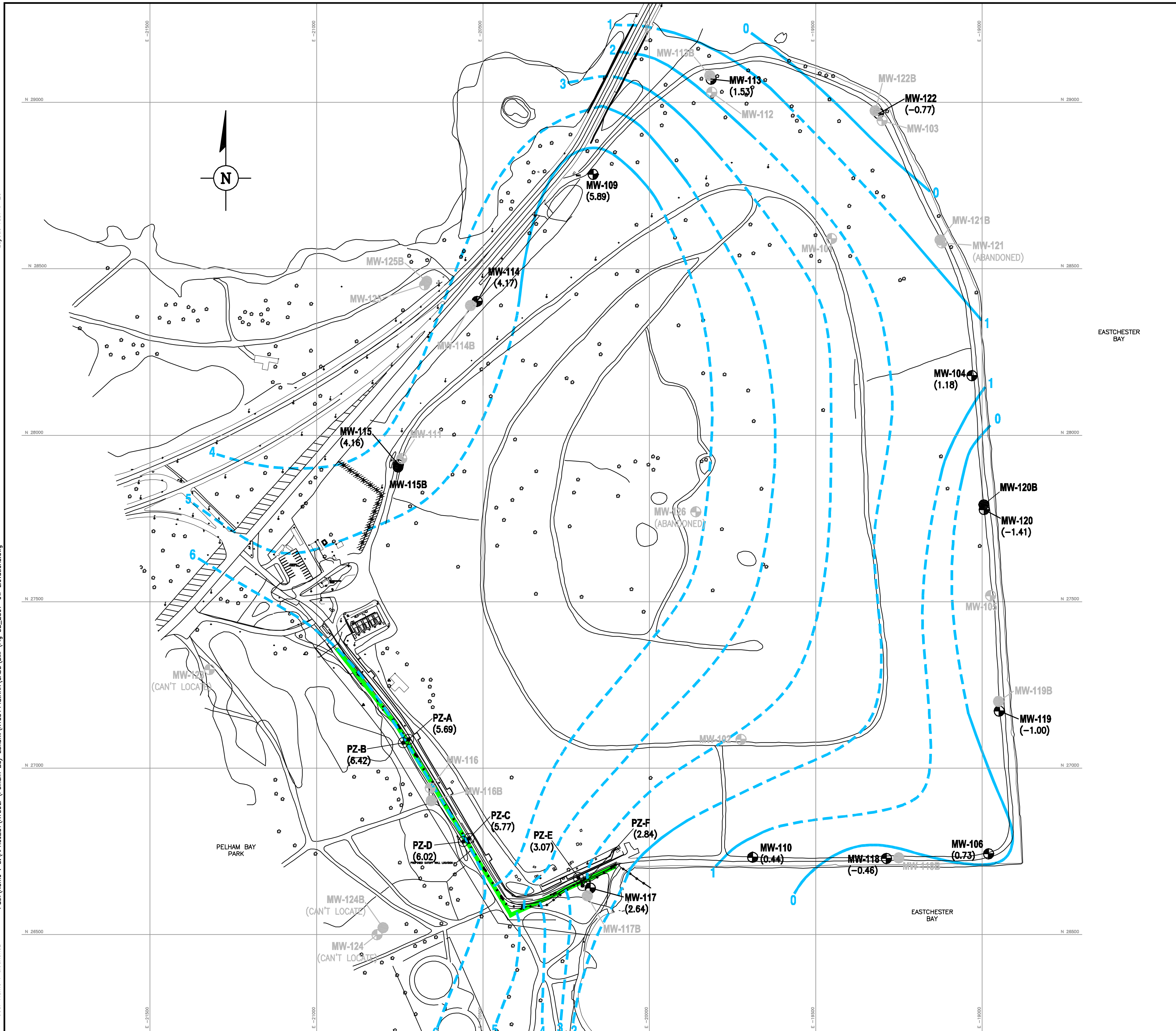

LEGEND:

MW-103	MONITORING WELL
MW-120B	BEDROCK MONITORING WELL
PZ-A	PIEZOMETER
	FORMER MONITORING WELLS
2	LINE OF EQUAL GROUNDWATER ELEVATION (DASHED WHERE INFERRED)
(-1.41)	GROUNDWATER ELEVATION
	SLURRY WALL

NOTE:

AVERAGE GROUNDWATER LEVEL ELEVATIONS BASED ON CONTINUOUS WATER-LEVEL ELEVATION MEASUREMENTS COLLECTED AUGUST 13-17, 2007.

0 150' 300'
SCALE IN FEET

NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

SHEET TITLE

AVERAGE GROUNDWATER ELEVATIONS AUGUST 13 - 17, 2007

ARCADIS OF NEW YORK, INC.
Two Huntington Quadrangle
Suite 1S10
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

SEAL | SEAL

PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY: A. NEMICKAS
TASK/PHASE NUMBER: 00013	DRAWN BY: A. SANCHEZ
PROJECT NUMBER: NY001443.0003	DRAWING NUMBER: 8

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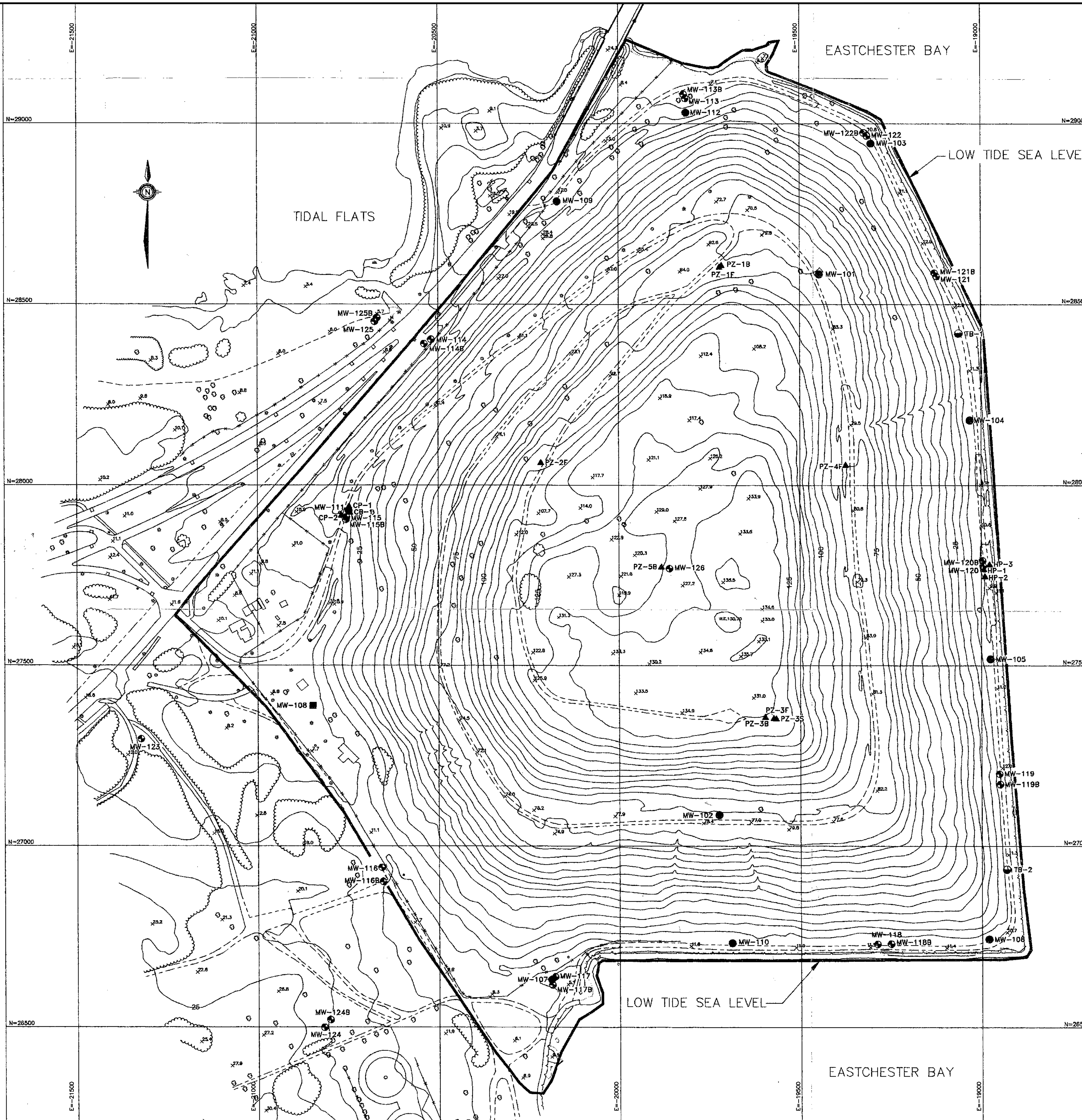

KEY

—x— FENCE

━━ SITE BOUNDARY

LEGEND:

MW-103 ● MONITORING WELLS INSTALLED 1989

MW-108 ■ MONITORING WELL DESTROYED DURING IRM

PZ-3B ▲ PIEZOMETERS INSTALLED 1992

MW-113 MONITORING WELLS INSTALLED 1992

MW-116B BEDROCK WELLS INSTALLED 1992

TB-1 TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET

0 150' 300'
SCALE IN FEET

MAP SOURCE:
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.
WOODWARD-CLYDE CONSULTANTS, INC.
FINAL REMEDIAL INVESTIGATION REPORT,
PELHAM BAY LANDFILL, BRONX, NEW YORK, 1993.

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NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

SHEET TITLE

RESIDUAL WASTE MATERIALS
ZONE MAP

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Two Huntington Quadrangle
Suite 1S10
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

SEAL | SEAL

PROJECT MANAGER C. SAN GIOVANNI	DEPARTMENT MANAGER M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY C. KEEN
TASK/PHASE NUMBER 00013	DRAWN BY A. SANCHEZ
PROJECT NUMBER NY001443.0003	DRAWING NUMBER 9

Current Plotstyle : ByColor
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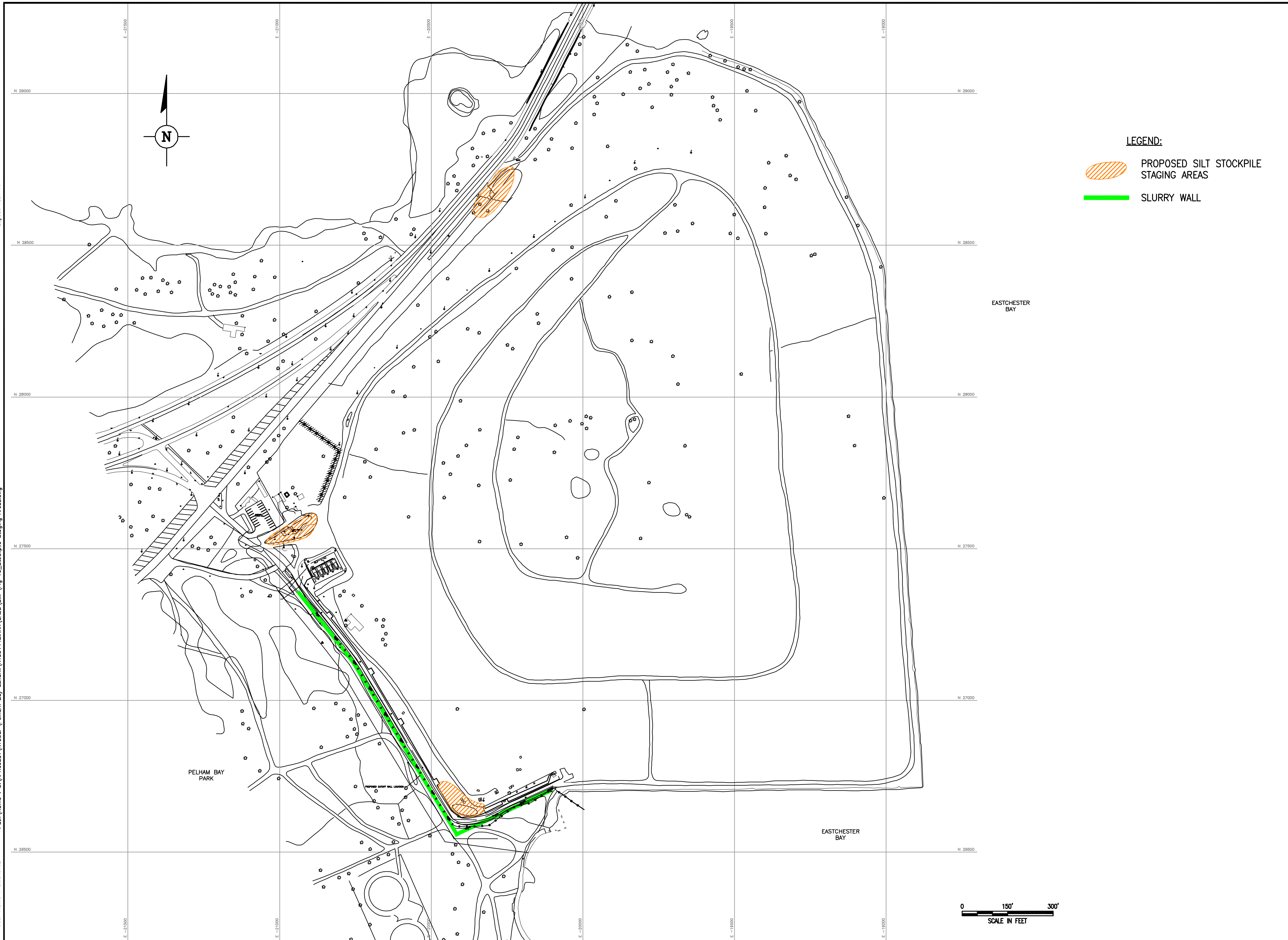


NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

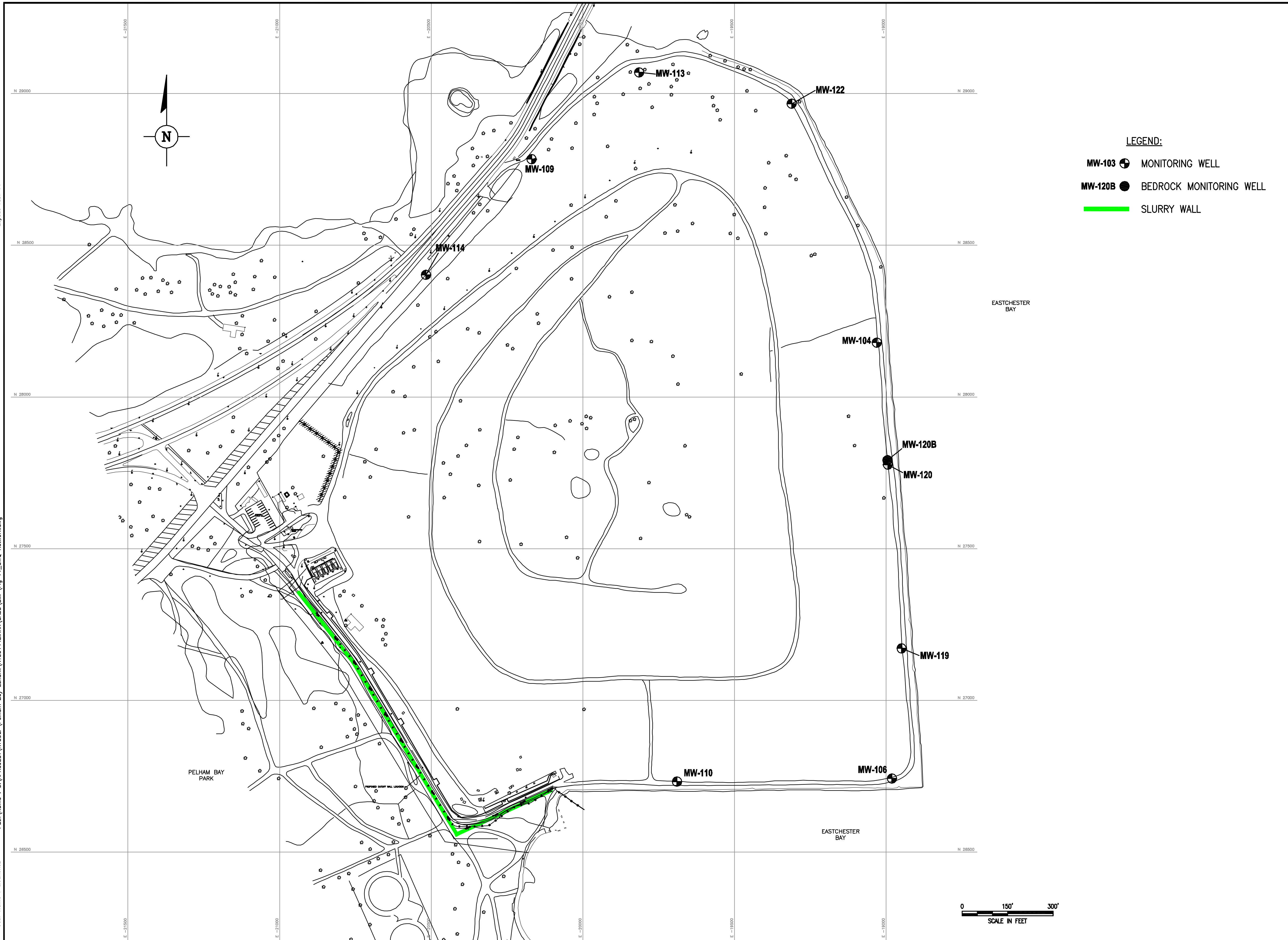
SHEET TITLE

PROPOSED SILT
STOCKPILE STAGING AREAS

ARCADIS
OF NEW YORK, INC.

Two Huntington Quadrangle
Suite 1S10
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

SEAL	SEAL
PROJECT MANAGER C. SAN GIOVANNI	DEPARTMENT MANAGER M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY C. KEEN
TASK/PHASE NUMBER 00013	DRAWN BY A. SANCHEZ
PROJECT NUMBER NY001443.0003	DRAWING NUMBER 10



NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

SHEET TITLE

GROUNDWATER QUALITY
MONITORING NETWORK

ARCADIS
OF NEW YORK, INC.

Two Huntington Quadrangle
Suite 1S10
Melville, NY 11747
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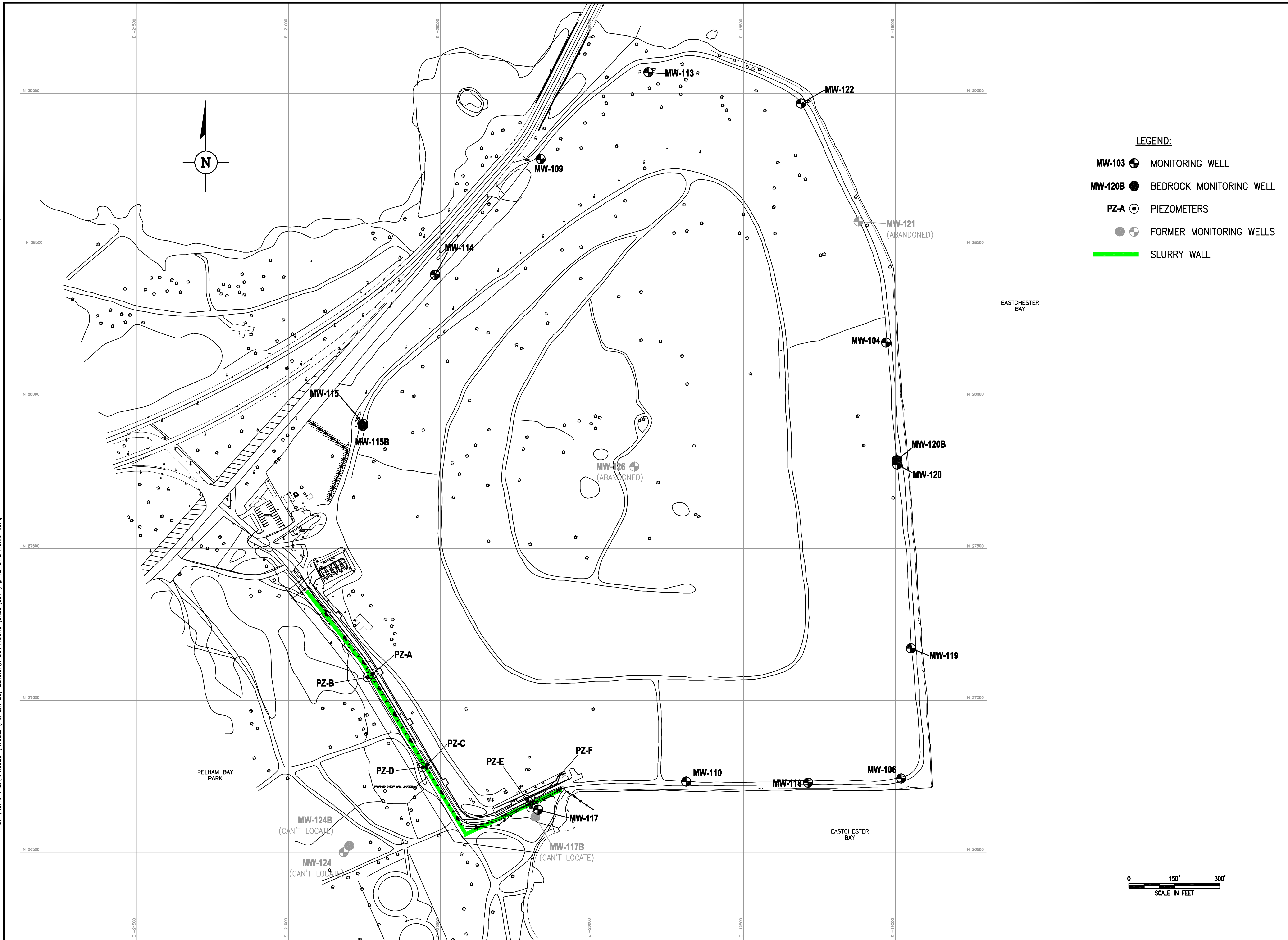
SEAL | SEAL

PROJECT MANAGER C. SAN GIOVANNI	DEPARTMENT MANAGER M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY C. KEEN
TASK/PHASE NUMBER 00013	DRAWN BY A. SANCHEZ
PROJECT NUMBER NY001443.0003	DRAWING NUMBER 11



NO.	ISSUED DATE	REVISION DESCRIPTION	BY/CKD

KEY PLAN

PROJECT TITLE

PELHAM BAY LANDFILL
BRONX, NEW YORK

SHEET TITLE

GROUNDWATER ELEVATION MONITORING NETWORK

ARCADIS
OF NEW YORK, INC.
Two Huntington Quadrangle
Suite 1S10
Melville, NY 11747
Tel: 631-249-7600 Fax: 631-249-7610
www.arcadis-us.com

SEAL | SEAL

PROJECT MANAGER: C. SAN GIOVANNI	DEPARTMENT MANAGER: M. WOLFERT
LEAD DESIGN PROF.	CHECKED BY: C. KEEN
TASK/PHASE NUMBER: 00013	DRAWN BY: A. SANCHEZ
PROJECT NUMBER: NY001443.0003	DRAWING NUMBER: 12

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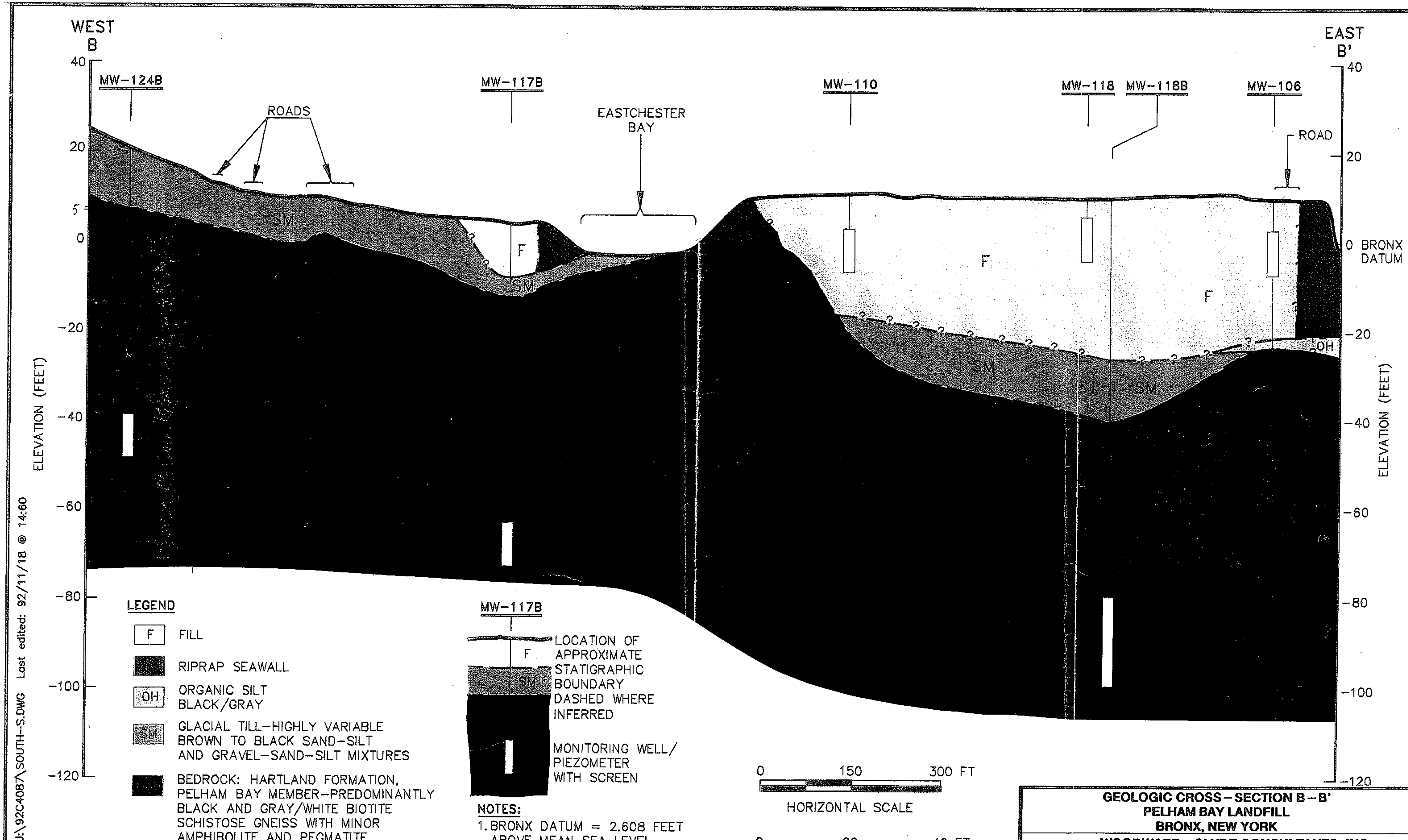
Appendix A

Metes and Bounds

TO BE PROVIDED

Appendix B

Remedial Investigation Report – Geologic Cross-Sections B-B' and E-E'



NOTES:

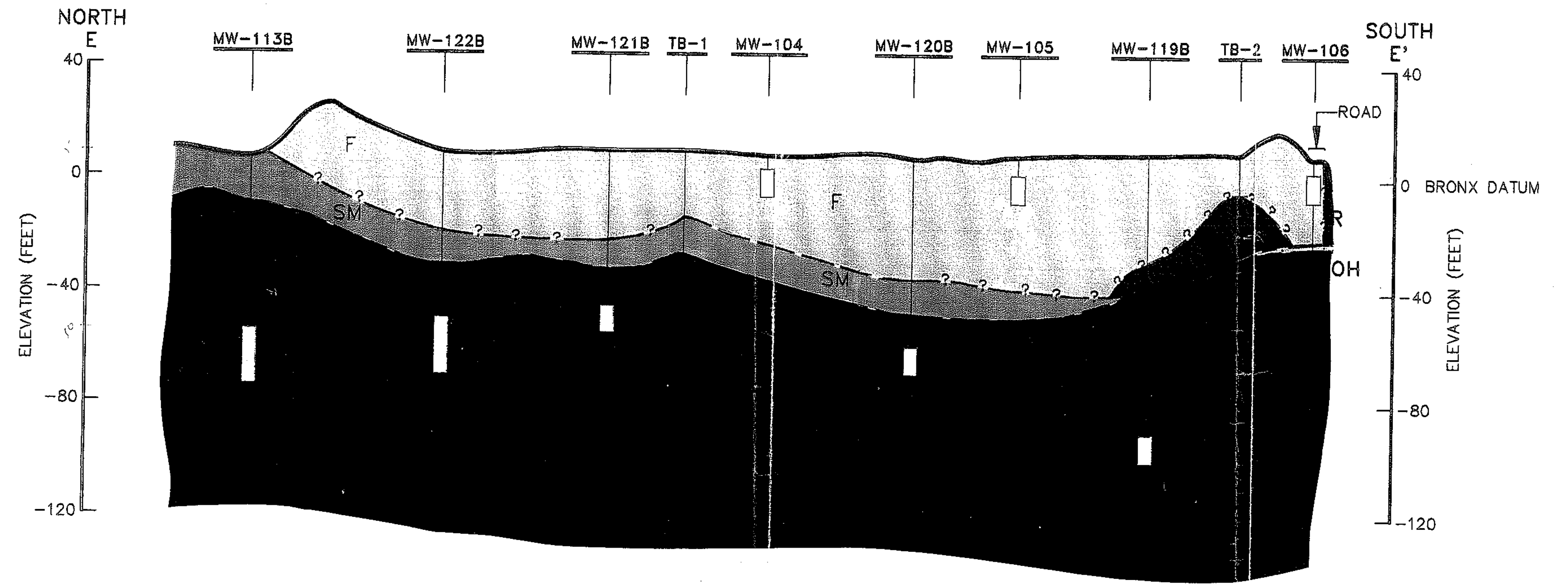
1. BRONX DATUM = 2.608 FEET ABOVE MEAN SEA LEVEL
2. INFERRED BEDROCK ELEVATIONS BASED ON BEDROCK ELEVATION MAP.

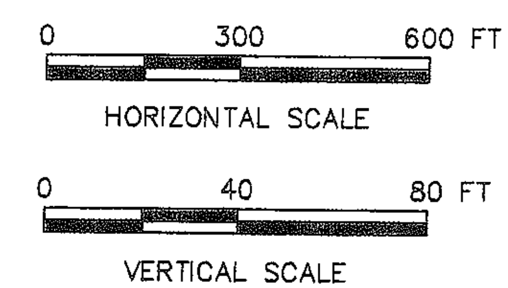
GEOLOGIC CROSS-SECTION B-B'
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	MG	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	REC	DATE:	OCT. 27, 1992	FIG. NO.:	3-4

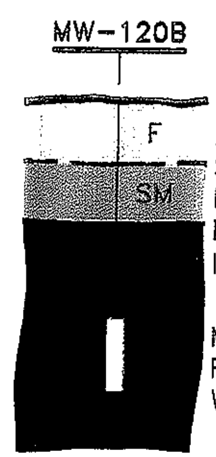
File name: J:\92C4087\SOUTH-S.DWG Last edited: 92/11/18 @ 14:60





LEGEND

F	FILL
	RIPRAP SEAWALL
OH	ORGANIC SILT BLACK/GRAY
SM	GLACIAL TILL-HIGHLY VARIABLE BROWN TO BLACK SAND-SILT AND GRAVEL-SAND-SILT MIXTURES
	BEDROCK: HARTLAND FORMATION, PELHAM BAY MEMBER-PREDOMINANTLY BLACK AND GRAY/WHITE BIOTITE SCHISTOSE GNEISS WITH MINOR AMPHIBOLITE AND PEGMATITE



LOCATION OF APPROXIMATE STATIGRAPHIC BOUNDARY DASHED WHERE INFERRED

MONITORING WELL/ PIEZOMETER WITH SCREEN

TB-1 TEST BORING

NOTES:

1. BRONX DATUM = 2.608 FEET ABOVE MEAN SEA LEVEL
2. INFERRED BEDROCK ELEVATIONS BASED ON BEDROCK ELEVATION MAP.

GEOLOGIC CROSS-SECTION E-E'
PELHAM BAY LANDFILL
BRONX, NEW YORK

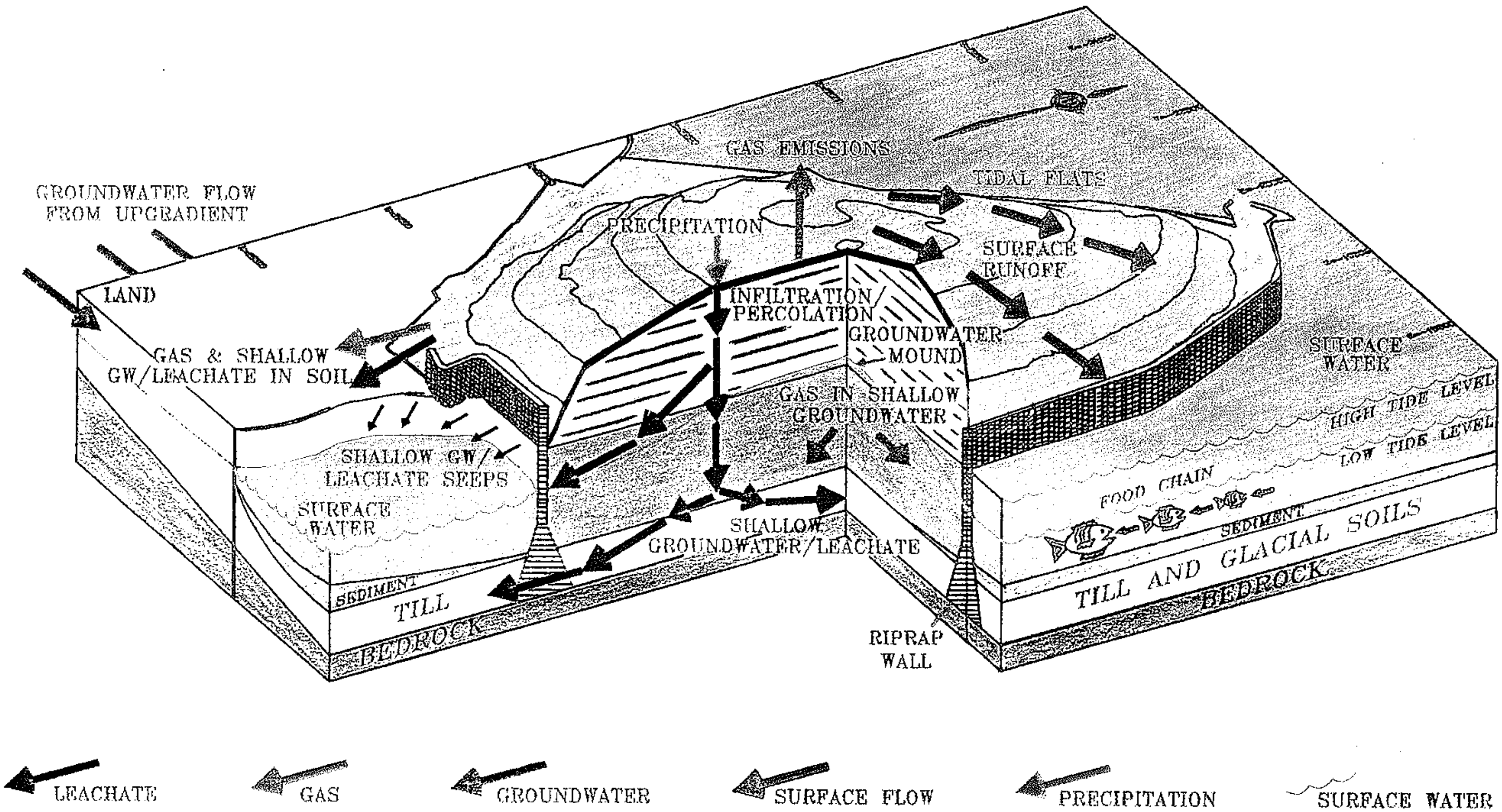
WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	MG	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	REC	DATE:	OCT. 23, 1992	FIG. NO.:	3-7

File name: J:\92C4087\E-E.DWG Last edited: 92/11/18 @ 17:31

Appendix C

Remedial Investigation Report –
Conceptual Site Model Figure



TRANSPORT PATHWAYS MODEL
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	BTM	SCALE:	NONE	PROJ. NO.:	92C4087
CK'D BY:	REC	DATE:	JAN. 25, 1992	FIG. NO.:	5–1

Appendix D

Remedial Investigation Report and Supplemental Remedial Investigation Report - Soil Tables and Figures

Table 4-1
Soil - Borings - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1 RE	SB-117S1	SB-118S1	SB-118S2	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
Halogenated Aliphatic Compounds												
Methylene chloride		2 JR#	4 BJR#	12 BJR#	11 BJR#	19 BJR#	63 BJR#	10 BJR#	72 BJR#		4 BJR#	9 BJR#
Total												
Ketones												
2-Propanone	4 BJR#	15 BR#					1400 BEJ	7 BJR#	3700 BEJ	13 BR#	1200 BJ	22 J
Total							1400		3700		1200	22
Monocyclic Aromatic Hydrocarbons												
Benzene									13 J			
Chlorobenzene							26 J					
Toluene											3 J	1 J
Total							26		13		3	1
Miscelaneous												
Carbon Disulfide											7 J	
Total											7	
Grand Total							1426		3715		1210	23

	SB-121S2	SB-122S1	SB-122S2	SB-123S1	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
Halogenated Aliphatic Compounds												
Methylene chloride	10 BR#	4 BJR#	6 BJR#	29 BJR#	11 BJR#	28 BJR#	31 BJR#	22 BJR#	2 BJR#	2 BJR#	6 BJR#	
Total												
Ketones												
2-Propanone	160 J	11 BJR#	34 BJR#	11 BJR#	13 BJR#		8 BJR#	20 BJR#		16	110 BJR#	110 J
Total	160									16		110
Monocyclic Aromatic Hydrocarbons												
Benzene								9				
Chlorobenzene												6 J
Toluene								2 J				1 J
Total								11				7
Miscellaneous												
Carbon Disulfide	2 J											
Total	2											
Grand Total	162							11		16		117

Notes:

All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant

E = Estimated value (reported concentration exceeded calibration range)
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-2
Soil - Borings - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1 RE	SB-118S2 DL	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1	SB-121S2	SB-122S1	SB-122S2	SB-123S1 RE	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
PAHs																								
2-Methylnaphthalene							1800 DJ		19 J				62 J							39 J				
Acenaphthene					99 J	37 J	5100 DJ		59 J				190 J			75 J	69 J			120 J				
Acenaphthylene				150 J									78 J	51 J		570	1200	53 J		750 J				
Anthracene				180 J	270 J	46 J	8600 DJ	130 J	100 J			100 J	590	62 J		460 J	900	41 J		950 J	40 J		53 J	40 J
Benzo(a) anthracene	91 J		210 J	760 J	1000	670 J	20000 D	410	180 J	56		240 J	1300	300 J		1500	3100	150 J		2700	160 J		140 J	110 J
Benzo(a) pyrene			230 J	790	930		23000 D	520				300 J	1500	360 J		1600	4000	160 J		2000	250 J		210 J	110 J
Benzo(b) fluoranthene	140 J		260 J	740 J	790		19000 D	410	190 J			300 J	1300	420		2400	5200	169 J		3000			200 J	110 J
Benzo(g,h,i) perylene	80 J			460 J	350 J							180 J	530	240 J		660	1100	98 J		960 J			140 J	
Benzo(k) fluoranthene	100 J		200 J	790	820		18000 D	510	200 J	45 J		190 J	1200	290 J		1400	2700	178		2500	240 J		180 J	110 J
Chrysene	130 J		250 J	960	1000	850	21000 D	580	250 J	57 J		250 J	1100	340 J		1500	3700	220 J		3000	250 J		160 J	130 J
Dibenzo(a,h) anthracene				130 J	100 J							42 J	170 J			200 J	420			460 J				
Dibenzofuran						21 J	3900 DJ	18 J	43 J				110 J				54 J			110 J				
Fluoranthene	220 J		350 J	1500	1900	530 J	30000 DJ	1100	590	200 J	56 JR#	560	2600	500		2300 J	850 J	390		4100 J	450 J	55 J	180 J	230 J
Fluorene					110 J		5900 DJ					45 J	250 J			130 J	230 J			310 J				
Indeno(1,2,3-c,d) pyrene	89 J			510 J	490 J							170 J	610	290 J		730	1300	120 J		1400 J			180 J	
Naphthalene							3000 DJ						110 J				39 J			50 J				93 J
Phenanthrene	91 J			720 J	1200	480 J	34000 D	660	520	44 J		380	2000	230 J		1200 J	3000	190 J		2000 J	240 J		140 J	170 J
Pyrene	180 J		340 J	1200	1600	720 J	31000 DJ	880	430	160 J	45 J	440	2500	480		2600	5000	290 J		4200	370 J	71 J	170 J	250 J
Total	1121		1840	8890	10659	3354	224300	5218	2581	562	45	3197	16200	3563		17325	32862	2059		28649	2000	126	1753	1353
Phenols																								
4-Methylphenol																						140 J	150 J	
4-Nitrophenol																								61 J
Total																						140	150	61
Phthalates																								
Bis(2-Ethylhexyl) Phthalate	110 J	58 J		100 J	180 J	4900 BJ		610 BJR#	360 BJR#	130 J		73 J	82 J	1600	74 J	1400	650			96 J	670 J	2800 J	3000 JR#	950 JR#
Butyl benzyl phthalate								130 J						64 J		170 J				43 J				
Di-n-butyl phthalate	44 J	57 J		85 J	83 J	670 J	1400 DJ	1300	1400				290 J	43 BJR#	79 BJR#	79 BJR#	44 J	41 BJR#		53 BJR#	1000 J	820	100 JR#	48 BJ
Di-n-octyl phthalate																							370 J	110 J
Total	154	115		185	263	5570	1400	1430	1400	130		73	372	1664	74	1570	694			139	1670	3620	370	158
Chlorinated Hydrocarbons																								
1,4-Dichlorobenzene							1600 DJ																	
Total							1600																	
Grand Total	1275	115	1840	9075	10922	8924	227300	6648	3981	692	45	3270	16572	5227	74	18895	33556	2059		28788	3670	3886	2273	1572

Notes:
All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
D = Results reported from a diluted sample or sample extract
DL = Diluted sample
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-3
Soil - Borings - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1	SB-118S2 DL	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
4,4'-DDD			12 J				410					
4,4'-DDE	44 J		7.7 J				190 J		24 J			
4,4'-DDT	100		18 J	14 J								16 J
alpha-Chlordane			5.1 J					23 J				
delta-BHC					7.4 J							
Dieldrin												
Endosulfan sulfate			8.2 JR#	27 J	17 J							
Endrin ketone												
gamma-Chlordane												3.1 J
Heptachlor epoxide												
PCB-1242												
PCB-1254						200 J		310 J				
PCB-1260			130 J									

	SB-121S2	SB-122S1	SB-122S2	SB-123S1	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	22-24	0-2	30-32	0-0.5	7-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
4,4'-DDD	9.4 J			420	18			66 J				
4,4'-DDE	7.4 J	10 J		750	307	1.1 J		40 J				
4,4'-DDT				1400	530			85 J				
alpha-Chlordane				11 J					17 J			
delta-BHC												
Dieldrin				45 J				55 J				
Endosulfan sulfate				30 J	2.2 J	0.82 JR#	0.81 JR#					
Endrin ketone					42			37 J				
gamma-Chlordane												
Heptachlor epoxide				20 J								
PCB-1242											150 J	
PCB-1254		140 J							270			130 J
PCB-1260				430 J							99 J	

Notes:
All concentrations in micrograms per kilogram (ppb)
Blank indicates compound was not detected
DL = Diluted sample
J = Estimated value
R# = Negated result

Prepared by: SMM
Checked by: REC
92C4087

Table 4-4
Soil - Borings - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-113S1	SB-113S2	SB-114S1	SB-116S1	SB-117S1	SB-118S1	SB-118S2	SB-119S1	SB-119S2	SB-120S1	SB-120S2	SB-121S1
date:	11-Jun-92	11-Jun-92	7-Jul-92	10-Aug-92	10-Aug-92	25-Jun-92	25-Jun-92	25-Jun-92	25-Jun-92	9-Jun-92	9-Jun-92	28-May-92
depth (ft):	0-0.5	5-7	0-0.75	0-0.5	0-0.5	0-0.5	8-12	0-0.5	8-12	0-0.8	45-46	0-2
Aluminum	9690	11800	7600	12700	6040	11100	8830	8380	12000	3210	7990	5590
Antimony												
Arsenic	8.8	1.6 B	5.9	3.7	4.8	3.5 N	4.3 N	2.6 N	4.2 N	1.7 B	1.1 B	2 B
Barium	57.2	120	67.9	111	120	136 N*	236 N*	94.7 N*	140 N*	31.1 B	51.6	55
Beryllium				0.45 B	0.27 B			0.2 B				
Cadmium			1.2					0.88 B	2.6			
Calcium	2190	1620	34500 E	3460	4710	6910 *	40100 *	5320 *	10400 *	3160	1490	3200
Chromium	19.8	93.7	16.9	29.3	22.1	27.5	21.4	23.6	34.7	24.4	37.2	13.8
Cobalt	5.6 B	17.5	3.9 B	8.7 B	6.4 B	8.4 B	6.2 B	6 B	8.1 B	5.3 B	9.4 B	6.2 B
Copper	30.7	27.4	53	21.1	126	45.8 *	62.5 *	33.1 *	41.9 *	10.9	23.1	37.4
Iron	15200	26900	18100	16500	21100	23100	24400	22600	28700	16700	15600	15200
Lead	91.2	6.4	90.7	72	161	119 N*R	285 N*R	86.8 N*R	87.5 N*R	26.7	10.8	35.5
Magnesium	2620	8150	10700	3800	2780	6140 *	10100 *	4500 *	5620 *	2420	5800	2380
Manganese	261 NR	295 NR	224 E	549	218	316	302	294	345	159 NR	151 NR	199
Mercury	0.19 *J	0.19 *J	0.29	0.25	0.24	0.46 *J	0.34 *J	0.36 *J	0.2 *J			
Nickel	22.6	123	17.5	37.1	15.3	22.9	22.5	22	27.5	36.7	53.4	20.2
Potassium	1390	5760	1380	901 B	1010	2600	2060	1240	3110	514 B	3210	862 B
Selenium								0.48 BW				
Sodium	69.1 B	280 B	149 B	51.8 B	262 B	157 B	417 B	322 B	2050	194 B	2040	320 B
Thallium	0.49 B				0.63 BW	0.53 BW						0.47 B
Vanadium	27.6	33.8	40	27.2	20	38.7	46.3	28.9	61.5	15.5	26.3	21.7
Zinc	67.7 E	37.4 E	107	95.4	500	164 N*	205 N*	144 N*	158 N*	29.6 E	35 E	81.1

Notes: All concentrations in milligrams per kilogram (ppm)

Blank indicates compound was not detected

B = Reported value is acceptable (reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit))

E = Estimated value due to matrix interference

J = Estimated value

N = Estimated value (spiked sample recovery not within quality control limits)

R = Rejected result

R# = Negated result

W = Estimated value (post-digestion spike sample results reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)

* = Estimated value (duplicate analysis result not within quality control limits)

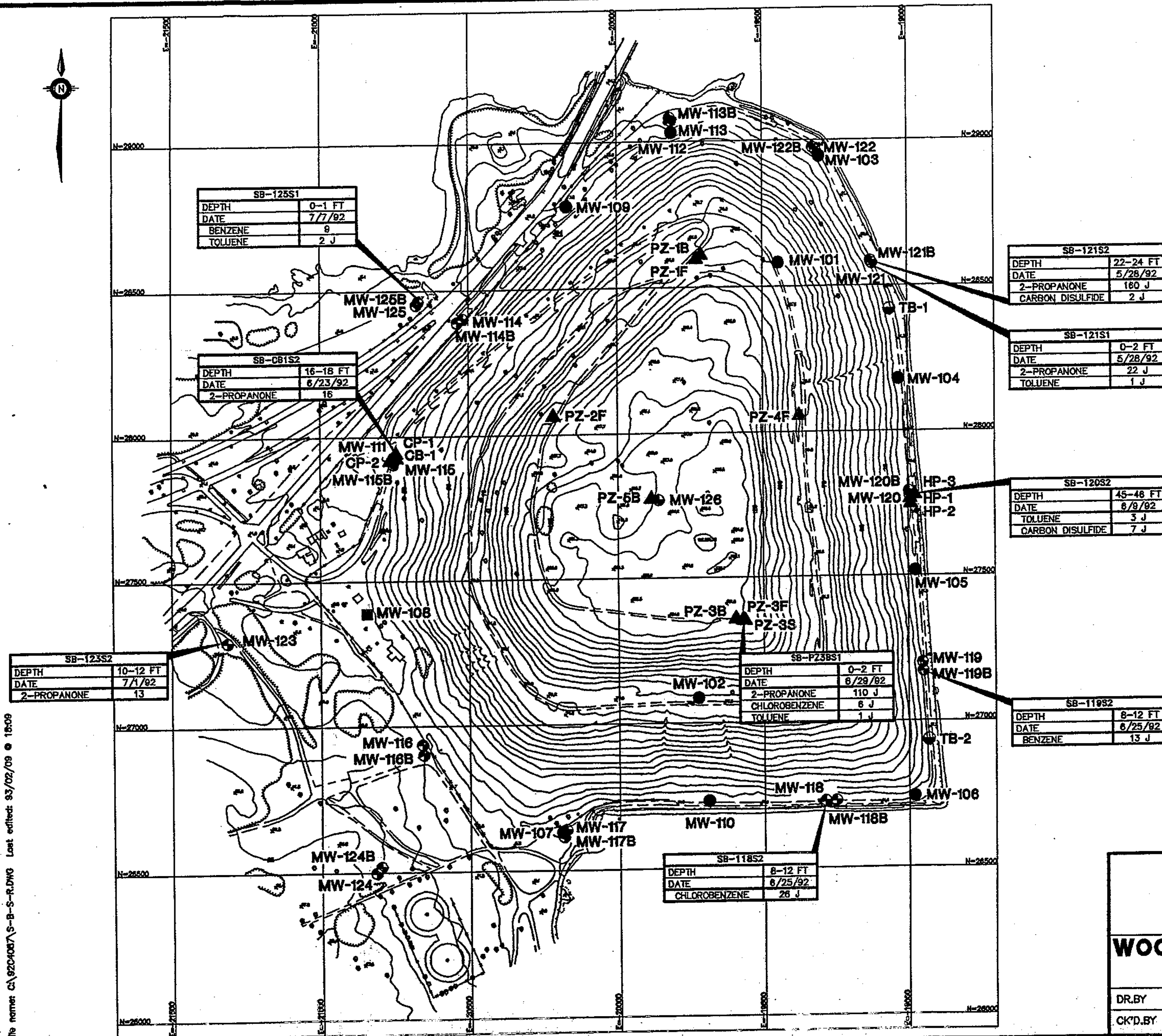
Prepared by: SMM
Checked by: REC
92C4087

Table 4-4
Soil - Borings - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	SB-121S2	SB-122S1	SB-122S2	SB-123S1	SB-123S2	SB-124S1	SB-124S2	SB-125S1	SB-CB1S1	SB-CB1S2	SB-P3BS2	SB-PZ3BS1
date:	28-May-92	2-Jun-92	2-Jun-92	7-Jul-92	1-Jul-92	7-Jul-92	7-Jul-92	7-Jul-92	23-Jun-92	23-Jun-92	4-Jun-92	29-May-92
depth (ft):	22-24	0-2	30-32	0-0.5	10-12	0-1	8-10	0-1	0-0.5	16-18	147-149	0-2
Aluminum	9590	12100	6490	12500	9360	16800	10100	13900	4880	9700	8590	7060
Antimony						9.1 BN						
Arsenic	3.1	5.6	0.42 B	11	10.9	4.4	2 B	4.9	2.9 N	1.8 BN	0.48 B	5
Barium	125	371	77.2	136	77.2	76.3	45	174	326 N*	53.7 N*	82.3	36.6 B
Beryllium		0.33 B			0.24 B	0.39 B			0.19 B	0.29 B		
Cadmium								1				
Calcium	13200	14100	1700	17000 E	2550	473 BE	1340 E	3640 E	20000 *	3530 *	2510	17100
Chromium	27.1	35.4	37	32.3	25.3	30.8	31.4	32	17.8	26.6	33.2	15.7
Cobalt	9.5 B	11.3	9.6 B	5.9 B	8.3 B	8.7 B	10.5	13	3.5 B	7.5 B	8.5 B	5 B
Copper	28.5	97.8	18	66.5	34.8 *	18.2	24.6	51.5	21 *	18.4 *	25.5	13.1
Iron	19300	30400	16100	18700	14200 E	19900	16300	30200	14200	19600	17200	14100
Lead	69.2	211	2.1	411 *	96.5	36.8 *J	24.75 *J	151 *	287 R	21.5 R	9.3	49.1
Magnesium	10300	7060	7380	10000	2930	3310	3810	6450	5810 *	4280 *	6570	8050
Manganese	230	450	149	392 E	224	479 E	272 E	374 E	199	206	158	252
Mercury	0.12 N	0.57	1.3	0.39	0.58 N*	0.22	0.39	0.51	0.96 *J			0.11 N
Nickel	23.2	30.6	84.1	24.5	39.4 *	33.3	49.5	54.9	10.3	18.7	40.4	18.1
Potassium	4540	2470	3090	1200	1490	574 B	1180	5120	786 B	2240	3560	761 B
Selenium												
Sodium	1540	281 B	617 B	134 B	163 B	27.1 B	121 B	544 B	164 B	8270	1200	162 B
Thallium			0.55 BJR#			0.5 BW				0.57 B		
Vanadium	31.8	83.2	22.2	49.1	28.9	34.4	26.4	58.2	21.1	36.3	31.2	45.5
Zinc	105	351	23.9	320	76 E	48.8	21.8	132	321 N*	40.4 N*	31.5	32.4

Notes:
All concentrations in milligrams per kilogram (ppm)
Blank indicates compound was not detected
B = Reported value is acceptable (reported value less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit))
E = Estimated value due to matrix interference
J = Estimated value
N = Estimated value (spiked sample recovery not within quality control limits)
R = Rejected result
R# = Negated result
W = Estimated value (post-digestion spike sample results reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)
* = Estimated value (duplicate analysis result not within quality control limits)

Prepared by: SMM
Checked by: REC
92C4087



LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	⊕	MONITORING WELLS INSTALLED 1992
MW-116B	⊕	BEDROCK WELLS INSTALLED 1992
TB-1	⊖	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
5. REFER TO TABLE 4-1 FOR ALL SOIL BORING SAMPLE VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

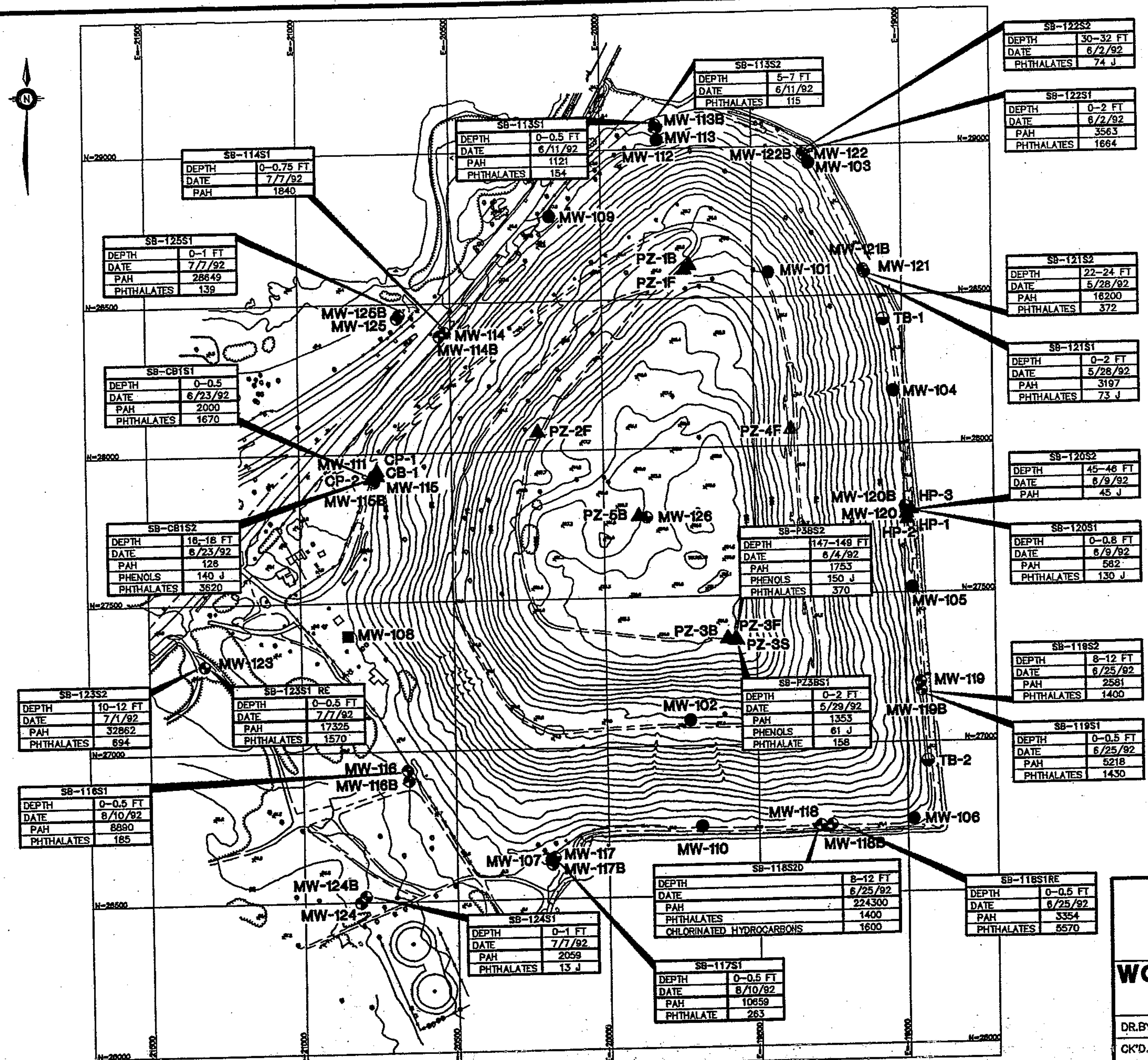
ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

SOIL BORING SAMPLE ANALYTICAL RESULTS
VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-1



LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	◐	MONITORING WELLS INSTALLED 1992
MW-116B	◐	BEDROCK WELLS INSTALLED 1992
TB-1	◒	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
5. REFER TO TABLE 4-2 FOR ALL SOIL BORING SAMPLE SEMI-VOLATILE ORGANIC COMPOUND ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

SOIL BORING SAMPLE ANALYTICAL RESULTS
SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-2

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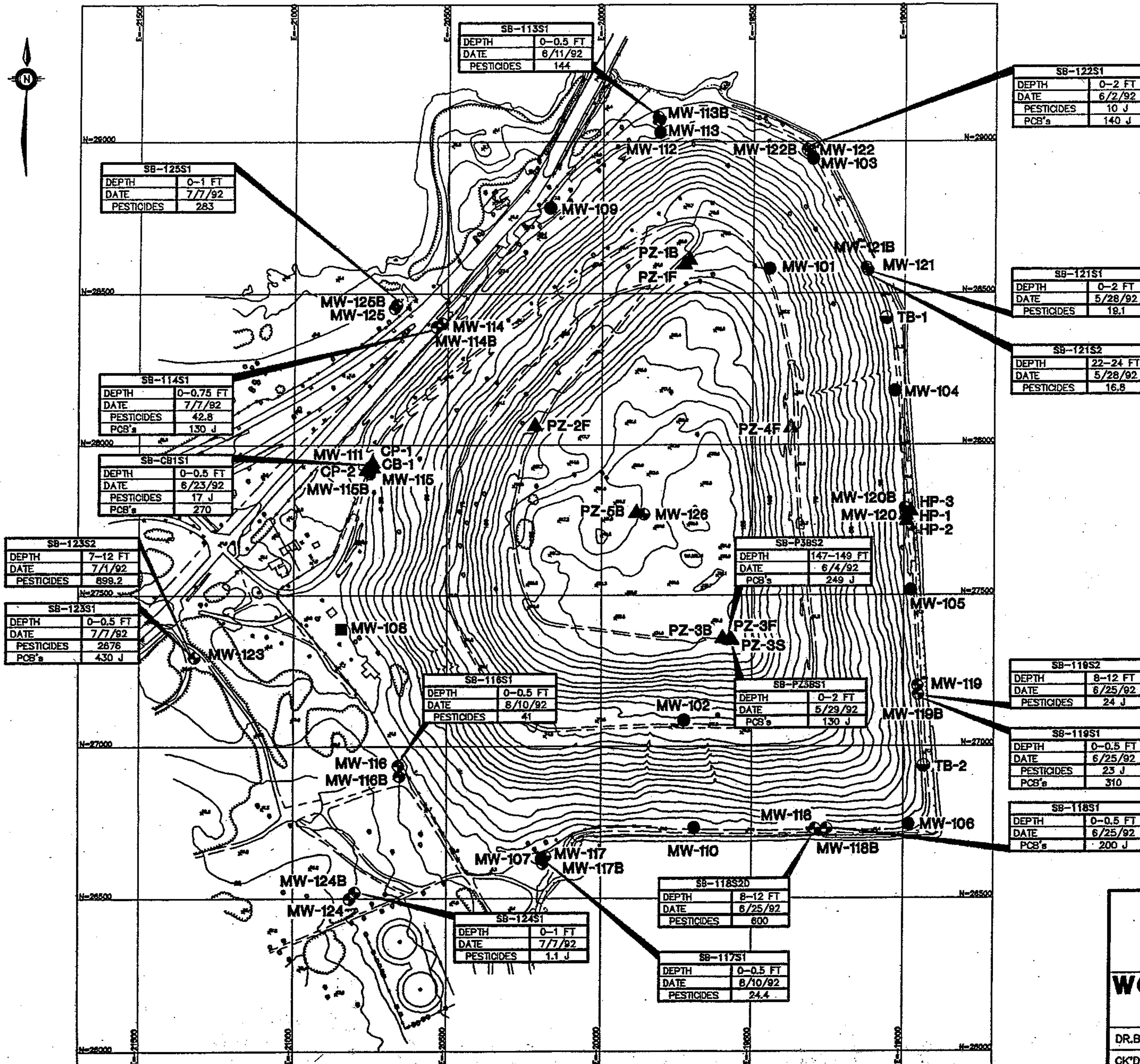


LEGEND:

MW-103 ● MONITORING WELLS INSTALLED 1989

MW-108 ■ MONITORING WELL DESTROYED DURING IRM

PZ-3B ▲ PIEZOMETERS INSTALLED 1992

MW-113 MONITORING WELLS INSTALLED 1992

MW-116B BEDROCK WELLS INSTALLED 1992

TB-1 TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS ARE IN ug/kg (ppb). J = ESTIMATED VALUE.
5. REFER TO TABLE 4-3 FOR ALL SOIL BORING SAMPLE PESTICIDE AND PCB ANALYTICAL RESULTS.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

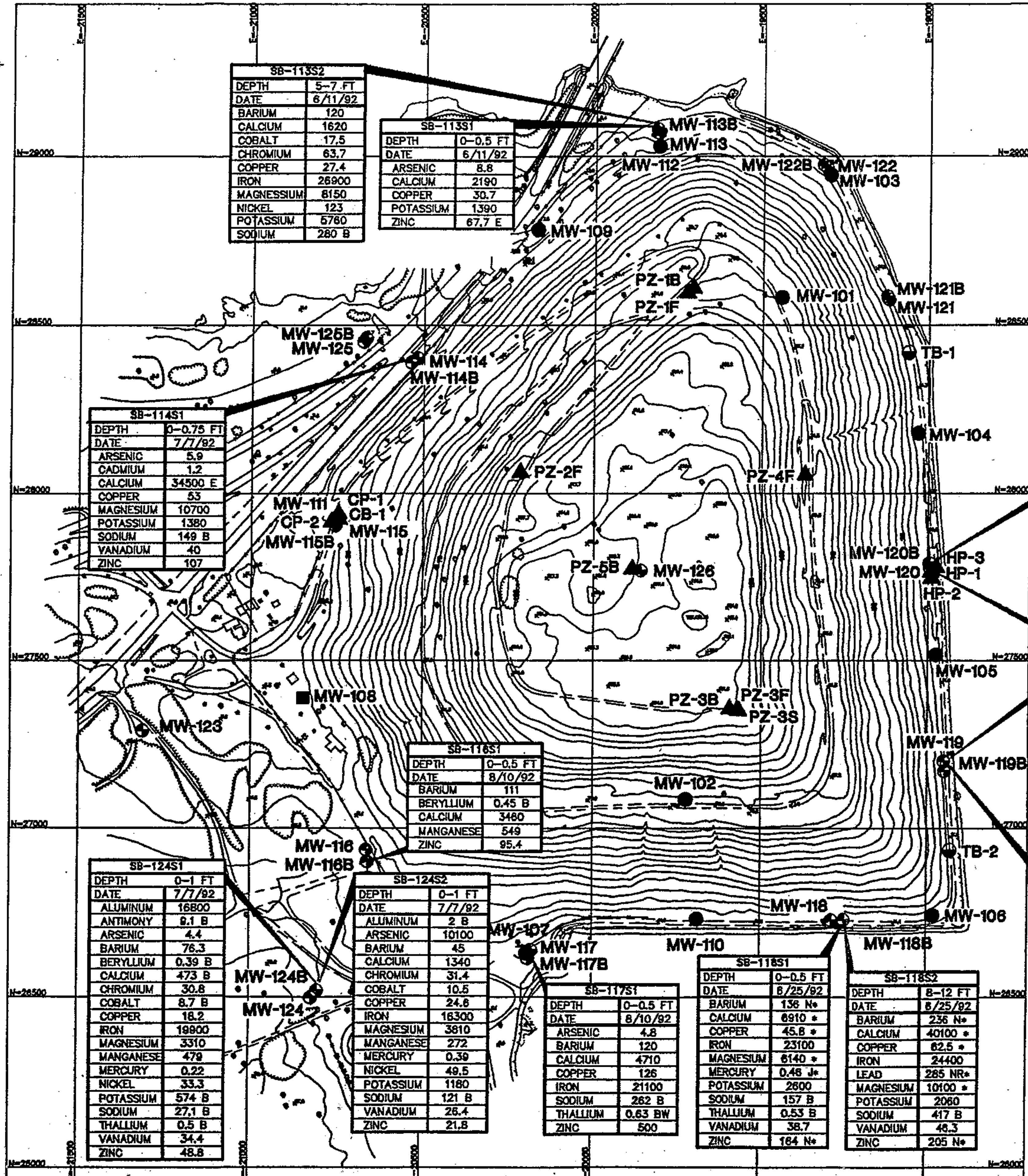
SOIL BORING SAMPLE ANALYTICAL RESULTS
PESTICIDES AND PCBs
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-3

File name: C:\92C4087\P-PCB.DWG Last edited: 93/02/09 @ 18:25



SB-113S2	
DEPTH	5-7 FT
DATE	6/11/92
BARIUM	120
CALCIUM	1620
COBALT	17.5
CHROMIUM	63.7
COPPER	27.4
IRON	26900
MAGNESSIUM	8150
NICKEL	123
POTASSIUM	5760
SODIUM	280 B

SB-113S1	
DEPTH	0-0.5 FT
DATE	6/11/92
ARSENIC	8.8
CALCIUM	2190
COPPER	30.7
POTASSIUM	1390
ZINC	67.7 E

SB-114S1	
DEPTH	0-0.75 FT
DATE	7/7/92
ARSENIC	5.9
CADMIUM	1.2
CALCIUM	34500 E
COPPER	53
MAGNESIUM	10700
POTASSIUM	1380
SODIUM	149 B
VANADIUM	40
ZINC	107

SB-116S1	
DEPTH	0-0.5 FT
DATE	8/10/92
BARIUM	111
BERYLLIUM	0.45 B
CALCIUM	3460
MANGANESE	549
ZINC	95.4

SB-124S1	
DEPTH	0-1 FT
DATE	7/7/92
ALUMINUM	16800
ANTIMONY	9.1 B
ARSENIC	4.4
BARIUM	76.3
BERYLLIUM	0.39 B
CALCIUM	473 B
CHROMIUM	30.8
COBALT	8.7 B
COPPER	18.2
IRON	19900
MAGNESIUM	3310
MANGANESE	479
MERCURY	0.22
NICKEL	33.3
POTASSIUM	574 B
SODIUM	27.1 B
THALLIUM	0.5 B
VANADIUM	34.4
ZINC	48.8

SB-124S2	
DEPTH	0-1 FT
DATE	7/7/92
ALUMINUM	2 B
ARSENIC	10100
BARIUM	45
CALCIUM	1340
CHROMIUM	31.4
COBALT	10.5
COPPER	24.6
IRON	16300
MAGNESIUM	3810
MANGANESE	272
MERCURY	0.39
NICKEL	49.5
POTASSIUM	1180
SODIUM	121 B
VANADIUM	26.4
ZINC	21.8

SB-117S1	
DEPTH	0-0.5 FT
DATE	8/10/92
ARSENIC	4.8
BARIUM	120
CALCIUM	4710
COPPER	126
IRON	21100
SODIUM	262 B
THALLIUM	0.63 BW
ZINC	500

SB-118S1	
DEPTH	0-0.5 FT
DATE	6/25/92
BARIUM	136 N*
CALCIUM	6910 *
COPPER	45.8 *
IRON	23100
MAGNESIUM	6140 *
MERCURY	0.46 J*
POTASSIUM	2600
SODIUM	157 B
THALLIUM	0.53 B
VANADIUM	38.7
ZINC	164 N*

SB-118S2	
DEPTH	8-12 FT
DATE	6/25/92
BARIUM	236 N*
CALCIUM	40100 *
COPPER	62.5 *
IRON	24400
LEAD	285 NR*
MAGNESIUM	10100 *
POTASSIUM	2060
SODIUM	417 B
VANADIUM	46.3
ZINC	205 N*

SB-120S2	
DEPTH	45-46 FT
DATE	6/9/92
CALCIUM	1490
CHROMIUM	37.2
MAGNESIUM	5800
NICKEL	53.4
POTASSIUM	3210
SODIUM	2040

SB-120S1	
DEPTH	0-0.8 FT
DATE	6/9/92
CALCIUM	3160
SODIUM	194 B

SB-119S2	
DEPTH	0-0.5 FT
DATE	6/25/92
BARIUM	140 N*
CADMIUM	2.6
CALCIUM	10400 *
CHROMIUM	34.7
COPPER	41.8 *
IRON	28700
MAGNESSIUM	5620 *
POTASSIUM	3110
SODIUM	2050
VANADIUM	61.5
ZINC	158 N*

SB-119S1	
DEPTH	0-0.5 FT
DATE	6/25/92
BARIUM	94.7 N*
CADMIUM	0.88 B
CALCIUM	5320 *
COPPER	33.1 *
IRON	22600
MAGNESIUM	4500 *
POTASSIUM	1240
SELENIUM	0.48 BW
SODIUM	322 B
ZINC	144 N*

LEGEND:

- MW-103 ● MONITORING WELLS INSTALLED 1989
- MW-108 ■ MONITORING WELL DESTROYED DURING IRM
- PZ-3B ▲ PIEZOMETERS INSTALLED 1992
- MW-113 ⊕ MONITORING WELLS INSTALLED 1992
- MW-116B ⊕ BEDROCK WELLS INSTALLED 1992
- TB-1 ⊖ TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. ALL CONCENTRATIONS IN mg/kg (ppm).
   - * = ESTIMATED VALUE (DUPLICATE ANALYSIS RESULT NOT WITHIN QUALITY CONTROL LIMITS).
   - B = REPORTED VALUE IS ACCEPTABLE (REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT)).
   - N = ESTIMATED VALUE (SPIKED SAMPLE RECOVERY NOT WITHIN QUALITY CONTROL LIMITS).
   - R = REJECTED RESULT.
   - W = ESTIMATED VALUE (POST-DIGESTION SPIKE SAMPLE RESULTS REPORTED OUTSIDE QUALITY CONTROL LIMITS, WHILE SAMPLE ABSORBANCE IS LESS THAN 50% OF SPIKE ABSORBANCE).
5. SOIL BORING SAMPLES SB-124S1 AND SB-124S2 ARE REFERENCE CONCENTRATIONS.
6. ONLY SAMPLE CONCENTRATIONS WHICH EXCEED THE MAXIMUM REFERENCE CONCENTRATIONS FROM SOIL BORINGS SB-124S1 AND SB-124S2 (TABLE 4-4) ARE INCLUDED.
7. ONLY VALUES >200 ppm WERE REPORTED FOR LEAD.
8. REFER TO TABLE 4-4 FOR ALL SOIL BORING SAMPLE INORGANIC COMPOUND ANALYTICAL RESULTS.
9. SHEET 1 OF 2.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

SOIL BORING SAMPLE ANALYTICAL RESULTS INORGANIC COMPOUNDS PELHAM BAY LANDFILL BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	REC	DATE	DEC. 14, 1992	FIG.NO.	4-4

File name: C:\92C4087\M-S-INOR.DWG Last edited: 93/02/15 @ 11:42

TABLE 2
PELHAM BAY SRI
SOIL - VOLATILE ORGANIC COMPOUND DATA SUMMARY
92C4987

Location:	AREA 1			
Sample ID:	SRI-1	SRI-2	SRI-3	SRI-4
Date:	4/1/93	4/1/93	4/1/93	4/1/93
Matrix:	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"
Acetone				
Total:				
Tentatively Identified Compounds				
Unknown				
Total:				

Location:	AREA 2													
Sample ID:	SRI-5A	SRI-5ARE	SRI-5B	SRI-6A	SRI-6B	SRI-7A	SRI-7B	SRI-8A	SRI-8ARE	SRI-8B	SRI-9A	SRI-9B	SRI-DUP	SRI-DUPRE
Date:	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	4/1/93	4/1/93
Matrix:	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"
Acetone												91 J		
Total:												91		
Tentatively Identified Compounds														
Unknown	16 J						52 J					38.20 J	8.20 J	
Total:	16						52					38.20	8.20	

Location:	BACKGROUND			
Sample ID:	SRI-10	SRI-11	SRI-12	SRI-13
Date:	3/31/93	4/1/93	4/1/93	4/1/93
Matrix:	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"
Acetone				
Total:				
Tentatively Identified Compounds				
Unknown				
Total:				

Notes: J = Detected below the reporting limit

Prepared by: DAJ
Checked by: PGN

TABLE 3
SOIL - SEMI-VOLATILE ORGANIC DATA SUMMARY
PELHAM BAY SRI
92C4087

Location:	AREA 1				AREA 2										
Sample ID:	SRI-1	SRI-2	SRI-3	SRI-4	SRI-5A	SRI-5B	SRI-6A	SRI-6B	SRI-7A	SRI-7B	SRI-8A	SRI-8B	SRI-9A	SRI-9B	SRI-DUP
Date:	4/1/93	4/1/93	4/1/93	4/1/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	4/1/93
Matrix:	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"
PAHs															
Acenaphthylene						260 J				240 J					
Acenaphthene											80 J				
Fluorene										160 J	80 J				
Phenanthrene				130 J	600	1200			220 J	2200	900	350 J	300 J	880	280 J
Anthracene						280 J				390 J	120 J		90 J	220 J	
Fluoranthene	100 J		510	200 J	840	2400	130 J		320 J	4600	1300	900	700	1100	400 J
Pyrene			610	210 J	1150	2600	150 J		360 J	4800	1300	650	630	920	270 J
Benzo(a)anthracene					370 J	1200			130 J	1800	460		320 J	390 J	130 J
Chrysene					460	1300			160 J	2200	500	370 J	360 J	390 J	130 J
Benzo(b)fluoranthene					900 J	1700 J	110 J		490 J	2500 J	1000 J	540 J	580 J	680 J	160 J
Benzo(k)fluoranthene					800 J	2000 J			420 J	3800	850	620	540	670 J	200 J
Benzo(a)pyrene					230 J	1400 J			100 J	1900	420	350 J	470	540 J	160 J
Ideno(1,2,3-cd) pyrene					230 J	480 J			110 J	660	200 J		140 J	120 J	
Dibenzo(a,h)anthracene										120 J					
Benzo(g,h,i)perylene						420 J									
Total:	100	0	1,120	540	5,580	15,240	390	0	2,310	25,370	7,210	3,780	4,130	5,910	1,730
Phthalates															
Di-n-butylphthalate		160 J		430 J	90 J	160 J	110 J			100 J	80 J		160 J		
Butylbenzylphthalate										120 J					
Bis (2-Ethylhexyl) phthalate				1000	350 J	240 J					550	120 J			
Total:	0	160	0	1,430	440	400	110	0	0	220	630	120	160	0	0
Phenols															
2-Chlorophenol															
4-Chloro-3-methylphenol															
4-Nitrophenol															
Pentachlorophenol															
Total:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other SVOs															
N-Nitrosodi-n-propylamine															
Total:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL SVOs	100	160	1,120	1,970	6,020	15,640	500	0	2,310	25,590	7,840	3,900	4,290	5,910	1,730

TABLE 3
SOIL - SEMI-VOLATILE ORGANIC DATA SUMMARY
PELHAM BAY SRI
92C4087

Location:	BACKGROUND			
Sample ID:	SRI-10	SRI-11	SRI-12	SRI-13
Date:	3/31/93	4/1/93	4/1/93	4/1/93
Matrix:	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"
PAHs				
Acenaphthylene	610		200 J	
Acenaphthene				
Fluorene				
Phenanthrene	870		600	
Anthracene	180 J		160 J	
Fluoranthene	2700	100 J	1300	
Pyrene	2100	100 J	1100	
Benzo(a)anthracene	1400		580	
Chrysene	1800		710	
Benzo(b)fluoranthene	690 J		1300 J	
Benzo(k)fluoranthene	4100		1400	
Benzo(a)pyrene	1900		1000	
Ideno(1,2,3-cd) pyrene			360 J	
Dibenzo(a,h)anthracene	160 J			
Benzo(g,h,i)perylene	120 J		360 J	
Total:	16,630	200	9,070	0
Phthalates				
Di-n-butylphthalate		140 J	130 J	
Butylbenzylphthalate	220 J			
Bis (2-Ethylhexyl) phthalate	130 J		330 J	
Total:	350	140	460	0
Phenols				
2-Chlorophenol	310 J			
4-Chloro-3-methylphenol	310 J			
4-Nitrophenol	310 J			
Pentachlorophenol	270 J			
Total:	1,200	0	0	0
Other SVOs				
N-Nitrosodi-n-propylamine			650	
Total:	0	0	650	0
TOTAL SVOs	18,180	340	9,530	0

TABLE 5
SOIL - PESTICIDE/PCB DATA ANALYSIS
PELHAM BAY SRI
92C4087

Location:	AREA 1				
Sample ID:	SRI-1	SRI-1RE	SRI-2	SRI-3	SRI-4
Date:	4/1/93	4/1/93	4/1/93	4/1/93	4/1/93
Matrix:	soil	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"	0-4"
Pesticides					
4,4'-DDT					
Total:	0	0	0	0	0

Location:	AREA 2										
Sample ID:	SRI-5A	SRI-5B	SRI-6A	SRI-6B	SRI-7A	SRI-7B	SRI-8A	SRI-8B	SRI-9A	SRI-9B	SRI-DUP
Date:	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	4/1/93
Matrix:	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"
Pesticides											
4,4'-DDT											
Total:	0	0	0	0	0	0	0	0	0	0	0

Location:	BACKGROUND			
Sample ID:	SRI-10	SRI-11	SRI-12	SRI-13
Date:	3/31/93	4/1/93	4/1/93	4/1/93
Matrix:	soil	soil	soil	soil
Units:	ug/kg	ug/kg	ug/kg	ug/kg
Depth:	0-4"	0-4"	0-4"	0-4"
Pesticides				
4,4'-DDT			180 J	
Total:	0	0	180	0

DUP taken at location SRI-9B

Prepared by: DAJ
Checked by: CAH

TABLE 6
SOIL - INORGANIC DATA SUMMARY
PELHAM BAY SRI
92C4087

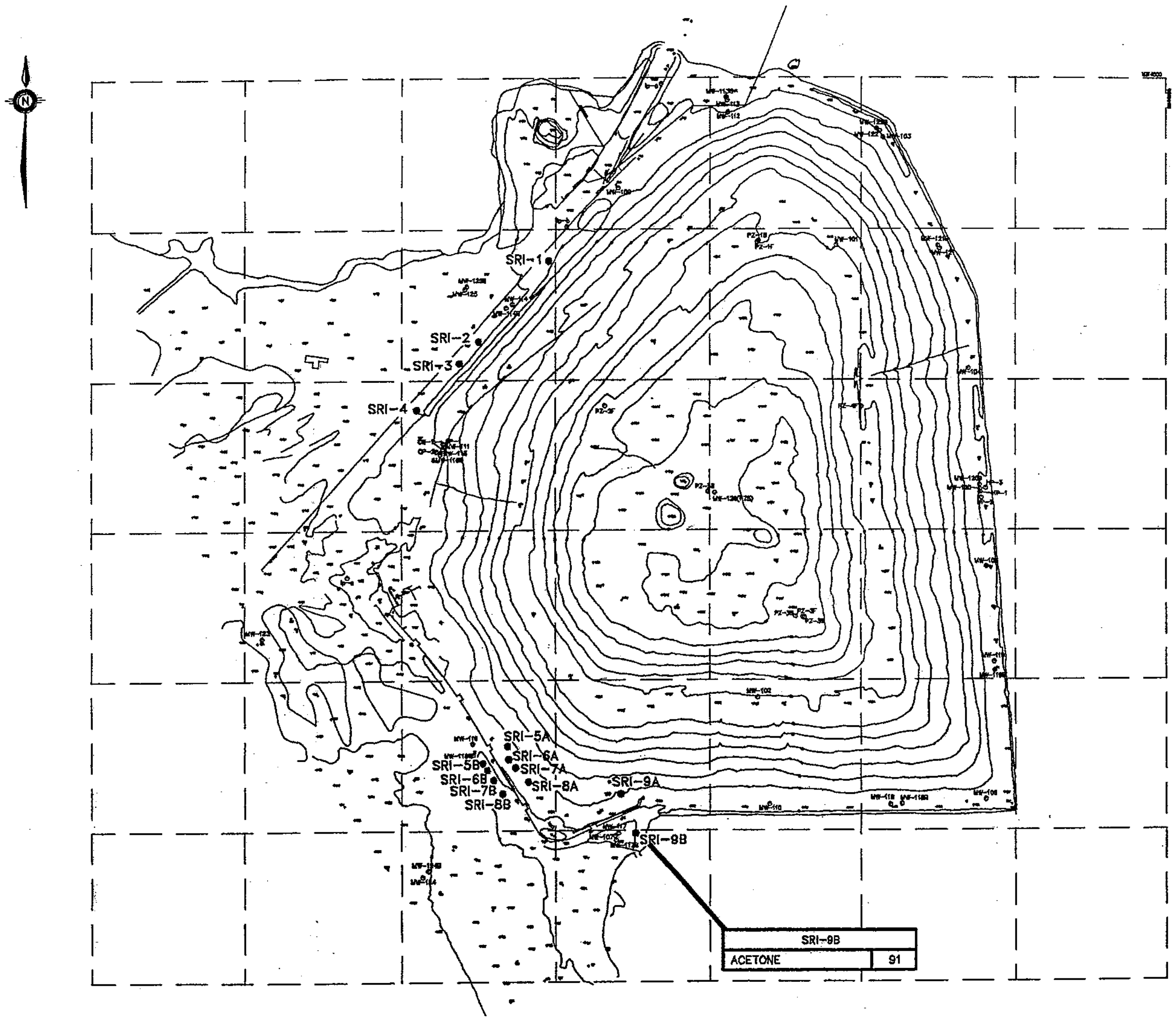
Location:	AREA 1				AREA 2										
Sample ID:	SRI-1	SRI-2	SRI-3	SRI-4	SRI-5A	SRI-5B	SRI-6A	SRI-6B	SRI-7A	SRI-7B	SRI-8A	SRI-8B	SRI-9A	SRI-9B	SRI-DUP
Date:	4/1/93	4/1/93	4/1/93	4/1/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	3/31/93	4/1/93
Matrix:	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil	soil
Units:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Depth:	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"	0-4"
Aluminum	13600	11000	5960	6980	7550	11000	7830	6340	8870	3900	6480	10000	6930	4630	4060
Antimony						12.6 B									
Arsenic	3.9		2.3 B	1.8 B	2.4 B	2.9	1.5 B			1.5 B	1.8 B	1.6 B	1.5 B		1.3 B
Barium	127	33.8 B	74.8	89.6	87	60	63.1	54.3	76.3	34.5 B	59.5	145	52.7	40.7 B	39.1 B
Beryllium	0.91 B				0.83 B						1.1 B				
Calcium	4950	13800	46700	7940	4880	3920	5300	11300	10800	5620	4300	11300	2940	9510	60400
Chromium	45	4.5	15.1	23.5	24.8	24.1	28	20.5	22.1	7.3	24	30.8	20	13.1	15.2
Cobalt	13.4 B	13.8 B	6.5 B	9.6 B	10.1 B	6.2 B	7 B	5.9 B	7.9 B	4.7 B	7.5 B	9.7 B	7.2 B	4.3 B	4.3 B
Copper	29 U	119	51.7 U	72.3 U	31.9 U	18.1 U	15.5 U	16.1 U	20.1 U	8.6 U	22.5 U	29.7 U	17.7 U	19.2 U	28.7 U
Iron	21800	23400	13000	13900	19200	15400	17100	12300	16900	7450	20100	20500	18000	12200	11600
Lead	99.2	32.6	91.7	102	101	63.8	69.3	40.2	93.9	35.8	60.4	122	61	38.7	161
Magnesium	7070	6470	19300	4550	3980	3510	4570	6660	4120	3230	3310	6660	2760	6120	35600
Manganese	309	217	258	367	268	231	262	197	251	106	252	407	182	189	207
Mercury				0.28	0.27				0.15						
Nickel	82.6	15.7	13.9	22.5	23	22.1	23.7	12.4	17.7	10.7	19.2	25	48.3	13.7	10.7 B
Potassium	2300	642 B	1050 B	1360 B	1410	899 B	1600	1120 B	1650	733 B	1110 B	2000	873 B	658 B	728 B
Sodium	420 U	2530 U	272 U	470 U	237 U	565 U	194 U	273 U	227 U	330 U	281 U	400 U	219 U	310 U	398 U
Vanadium	41.2	37.5	30.3	31.5	29.8	32.2	30	25.1	28.4	12.5	24.6	39.7	30.7	19.2	19.5
Zinc	1060	197	785	1710	168	81.7	98.5	64.6	128	36.4 U	88.2	177	87.9	81.2	85.2

TABLE 6
SOIL - INORGANIC DATA SUMMARY
PELHAM BAY SRI
92C4087

Location:	BACKGROUND							
Sample ID:	SRI-10		SRI-11		SRI-12		SRI-13	
Date:	3/31/93		4/1/93		4/1/93		4/1/93	
Matrix:	soil		soil		soil		soil	
Units:	mg/kg		mg/kg		mg/kg		mg/kg	
Depth:	0-4"		0-4"		0-4"		0-4"	
Aluminum	14100		13200		14200		14200	
Antimony								
Arsenic	5.2		4.3		13		5	
Barium	67.7		61.4		103		136	
Beryllium	1.2	B			0.93	B	1.3	B
Calcium	1530		1120		15500		6730	
Chromium	30.3		30.8		22.7		38.4	
Cobalt	9.2	B	8.3	B	8.5	B	9	B
Copper	33.9	U	37.6	U	52	U	41.3	U
Iron	18400		16600		20500		18200	
Lead	132		112		413		204	
Magnesium	3370		2940		3830		5300	
Manganese	394		367		485		355	
Mercury	0.16				0.35			
Nickel	39.4		33.7		22.6		42	
Potassium	1050	B	593	B	1160	B	1400	
Sodium	377	U	138	U	211	U	875	U
Vanadium	58.6		42.4		50.9		51.2	
Zinc	91.3		96.9		247		154	

Notes: B = detected above the Instrument Detection Limit
but below the Contract Detection Limit
U = Compound Detected in Blank

Prepared by: DAJ
Checked by: PGN



LEGEND

● SRI-1 APPROXIMATE LOCATION OF SOIL SAMPLE

NOTES:

1. UNITS ARE ug/kg.
2. ON SITE SAMPLES: SRI-5A THROUGH SRI-9A.
3. OFF SITE SAMPLES: SRI-1 THROUGH SRI-4, SRI-5B THROUGH SRI-9B.
4. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
5. ELEVATIONS ABOVE BRONX DATUM = 2.608 FEET ABOVE MEAN SEA LEVEL.
6. CONTOUR INTERVAL = 40 FEET.

MAP SOURCE:

GABRIEL E. SENIOR, P.C.
SITE SURVEY, 1992
WCCI FIELD SURVEY 3/31/93.

0 200 400 800 FT
SCALE

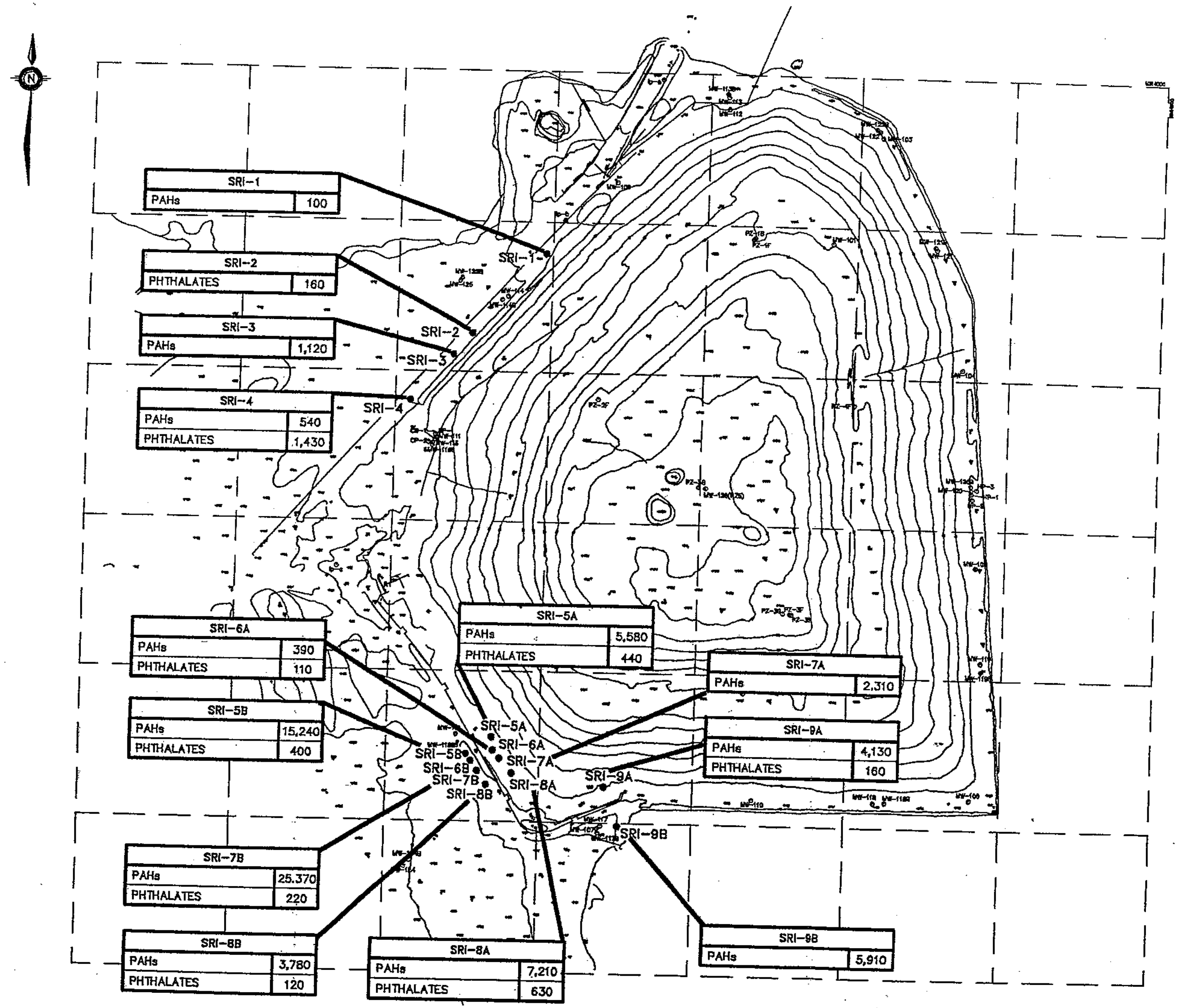
SRI SHALLOW SOIL SAMPLING LOCATIONS SHOWING CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
WAYNE, NEW JERSEY

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	PGN	DATE	MAY 24 1993	FIG.NO.	7

File name: H:\PELHAM\FIG-7.DWG Last edited: 93/05/24 @ 11:42



LEGEND

● SRI-1 APPROXIMATE LOCATION OF SOIL SAMPLE

NOTES:

1. UNITS ARE ug/kg.
2. ON SITE SAMPLES: SRI-5A THROUGH SRI-9A.
3. OFF SITE SAMPLES: SRI-1 THROUGH SRI-4, SRI-5B THROUGH SRI-9B.
4. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
5. ELEVATIONS ABOVE BRONX DATUM = 2.608 FEET ABOVE MEAN SEA LEVEL.
6. CONTOUR INTERVAL = 40 FEET.

MAP SOURCE:

GABRIEL E. SENIOR, P.C.
SITE SURVEY, 1992
WCC FIELD SURVEY 3/31/93.

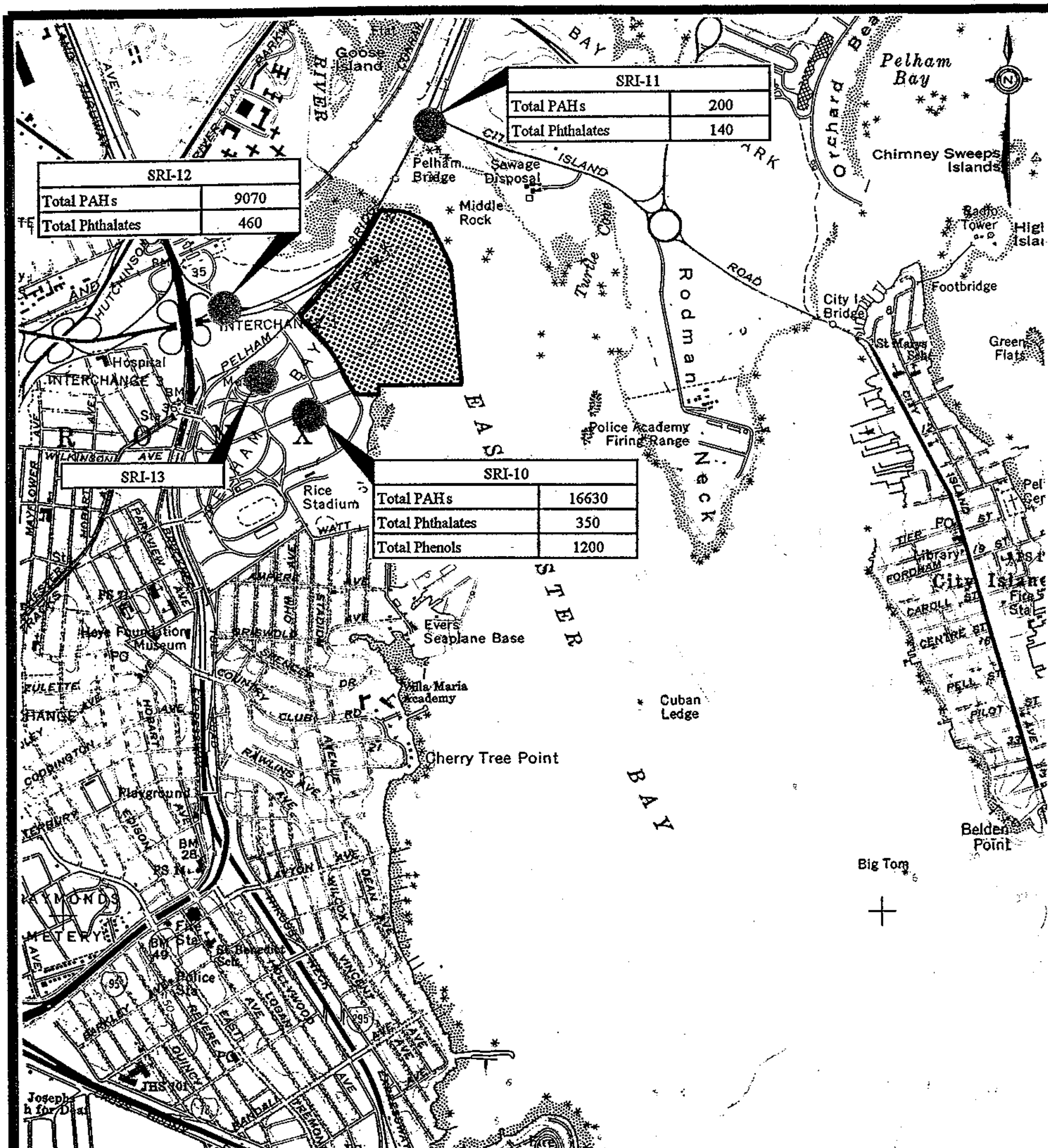
0 200 400 800 FT
SCALE

SRI SHALLOW SOIL SAMPLING LOCATIONS SHOWING CONCENTRATIONS OF SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	PGN	DATE	MAY 24 1993	FIG.NO.	8

File name: H:\PELHAM\FIG-8.DWG Last edited: 93/05/24 @ 11:33



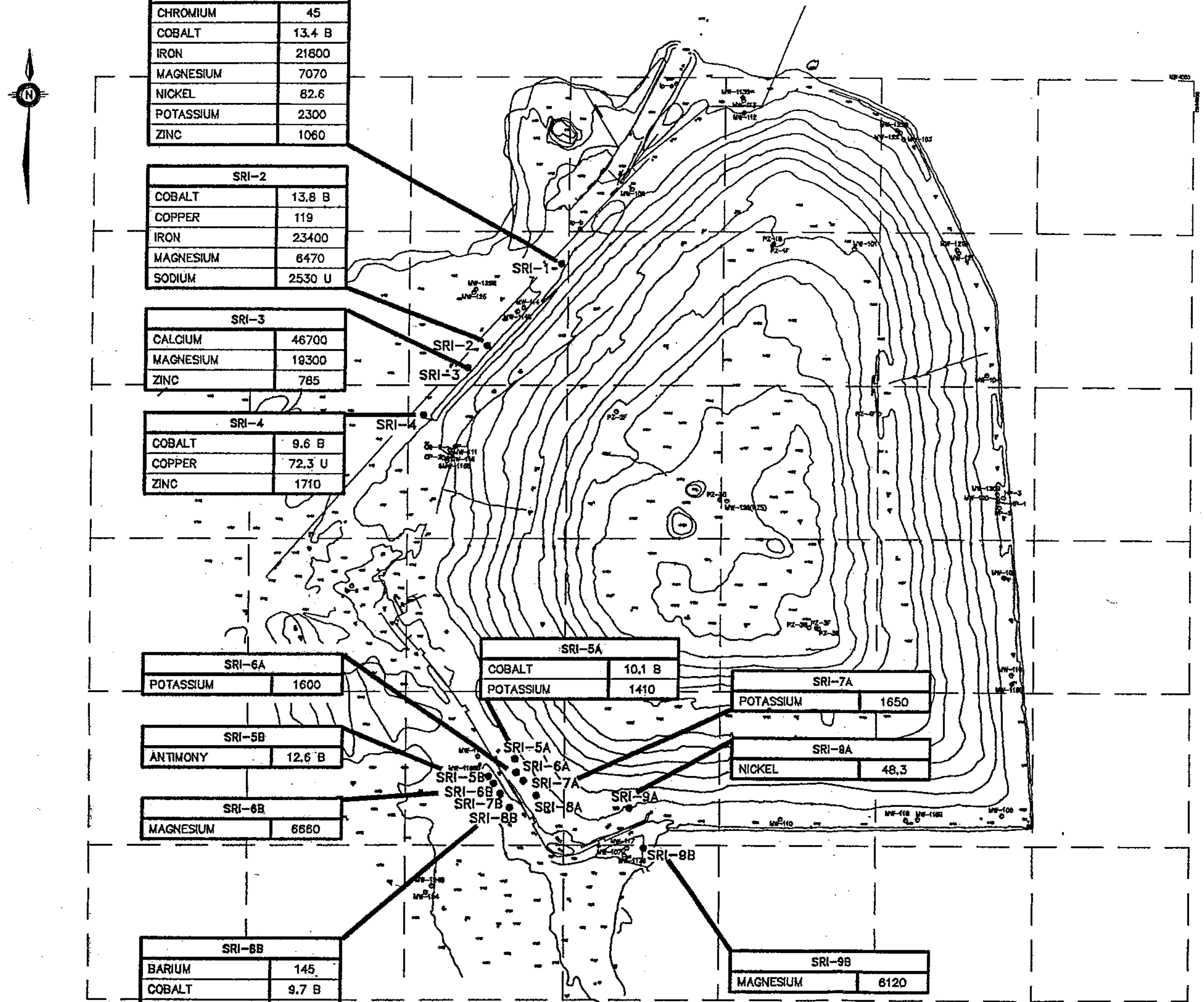
NOTE:
UNITS ARE ug/kg.

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

BACKGROUND ANALYTICAL RESULTS
SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY: KJF	SCALE: AS SHOWN	PROJ. NO.: 92C4087
CK'D BY: DAJ	DATE: MAY 19, 1993	FIG. NO: 9



SRI-1	
CHROMIUM	45
COBALT	13.4 B
IRON	21600
MAGNESIUM	7070
NICKEL	82.6
POTASSIUM	2300
ZINC	1060

SRI-2	
COBALT	13.8 B
COPPER	119
IRON	23400
MAGNESIUM	6470
SODIUM	2530 U

SRI-3	
CALCIUM	46700
MAGNESIUM	19300
ZINC	765

SRI-4	
COBALT	9.6 B
COPPER	72.3 U
ZINC	1710

SRI-5A	
COBALT	10.1 B
POTASSIUM	1410

SRI-6A	
POTASSIUM	1600

SRI-7A	
POTASSIUM	1650

SRI-8A	
NICKEL	48.3

SRI-5B	
ANTIMONY	12.6 B

SRI-6B	
MAGNESIUM	6660

SRI-8B	
BARIUM	145
COBALT	9.7 B
MAGNESIUM	6660
POTASSIUM	2000

SRI-9B	
MAGNESIUM	6120

LEGEND

● SRI-1 APPROXIMATE LOCATION OF SOIL SAMPLE

NOTES:

1. UNITS ARE mg/kg.
2. ON SITE SAMPLES: SRI-5A THROUGH SRI-9A.
3. OFF SITE SAMPLES: SRI-1 THROUGH SRI-4, SRI-5B THROUGH SRI-9B.
4. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
5. ELEVATIONS ABOVE BRONX DATUM = 2.608 FEET ABOVE MEAN SEA LEVEL.
6. CONTOUR INTERVAL = 40 FEET.
7. ONLY VALUES >200 ppm WERE REPORTED FOR LEAD.
8. B=REPORTED VALUE IS ACCEPTABLE (REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT).
9. ONLY SAMPLE CONCENTRATIONS WHICH EXCEED THE MAXIMUM BACKGROUND CONCENTRATIONS FROM THE BACKGROUND SOIL SAMPLES ARE SHOWN.
10. U= COMPOUND DETECTED IN FIELD BLANK.

MAP SOURCE:

GABRIEL E. SENIOR, P.C.
SITE SURVEY, 1992
WCCI FIELD SURVEY 3/31/93.

0 200 400 800 FT

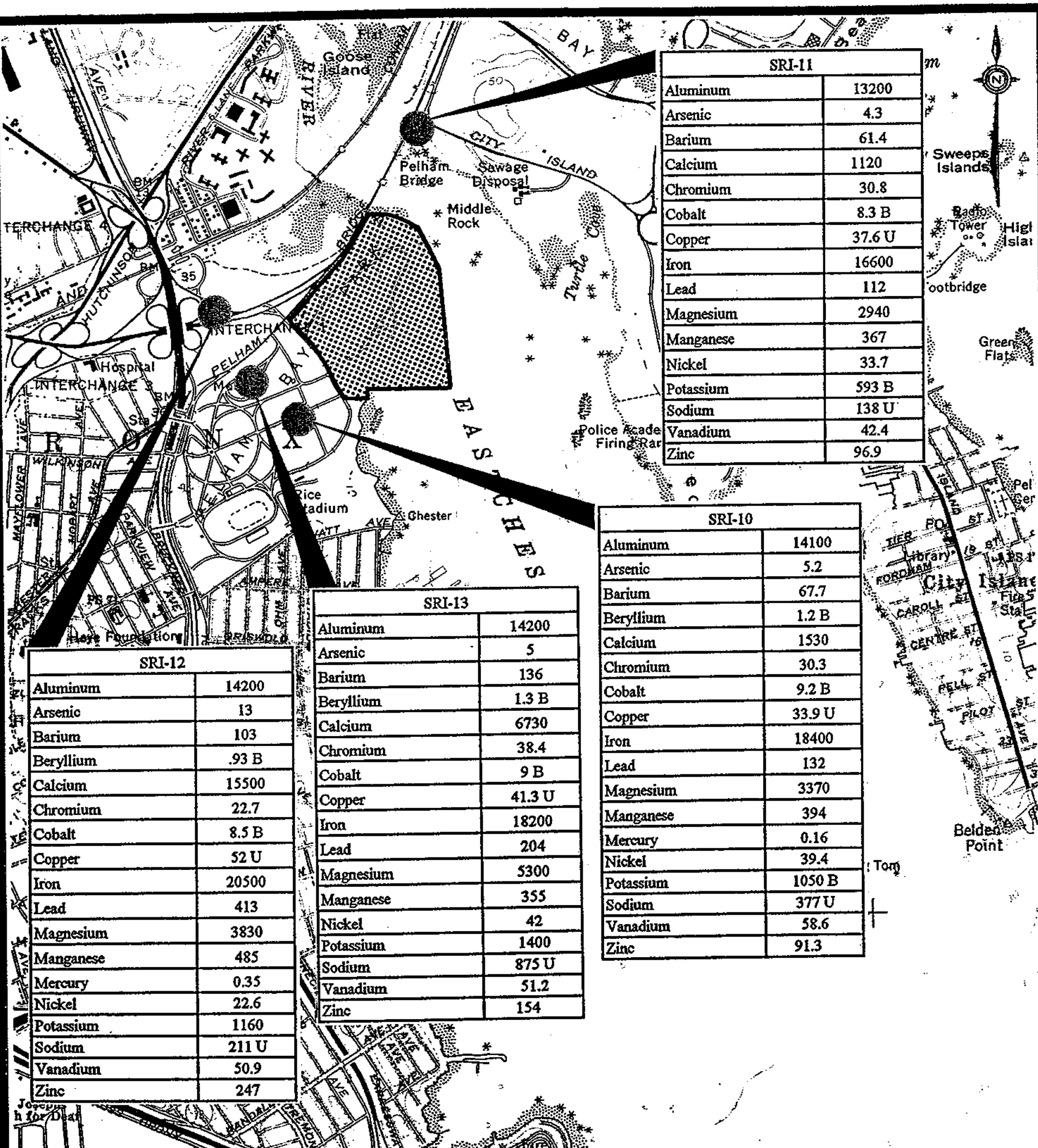
SCALE

SRI SHALLOW SOIL SAMPLING LOCATIONS SHOWING CONCENTRATIONS OF INORGANIC CONSTITUENTS PELHAM BAY LANDFILL BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	PGN	DATE	MAY 11 1993	FIG.NO.	10

File name: C:\92C4087\FIG-11.DWG Last edited: 93/05/25 @ 16:48



SRI-11	
Aluminum	13200
Arsenic	4.3
Barium	61.4
Calcium	1120
Chromium	30.8
Cobalt	8.3 B
Copper	37.6 U
Iron	16600
Lead	112
Magnesium	2940
Manganese	367
Nickel	33.7
Potassium	593 B
Sodium	138 U
Vanadium	42.4
Zinc	96.9

SRI-10	
Aluminum	14100
Arsenic	5.2
Barium	67.7
Beryllium	1.2 B
Calcium	1530
Chromium	30.3
Cobalt	9.2 B
Copper	33.9 U
Iron	18400
Lead	132
Magnesium	3370
Manganese	394
Mercury	0.16
Nickel	39.4
Potassium	1050 B
Sodium	377 U
Vanadium	58.6
Zinc	91.3

SRI-13	
Aluminum	14200
Arsenic	5
Barium	136
Beryllium	1.3 B
Calcium	6730
Chromium	38.4
Cobalt	9 B
Copper	41.3 U
Iron	18200
Lead	204
Magnesium	5300
Manganese	355
Nickel	42
Potassium	1400
Sodium	875 U
Vanadium	51.2
Zinc	154

SRI-12	
Aluminum	14200
Arsenic	13
Barium	103
Beryllium	.93 B
Calcium	15500
Chromium	22.7
Cobalt	8.5 B
Copper	52 U
Iron	20500
Lead	413
Magnesium	3830
Manganese	485
Mercury	0.35
Nickel	22.6
Potassium	1160
Sodium	211 U
Vanadium	50.9
Zinc	247

0 1000 2000 FT
SCALE

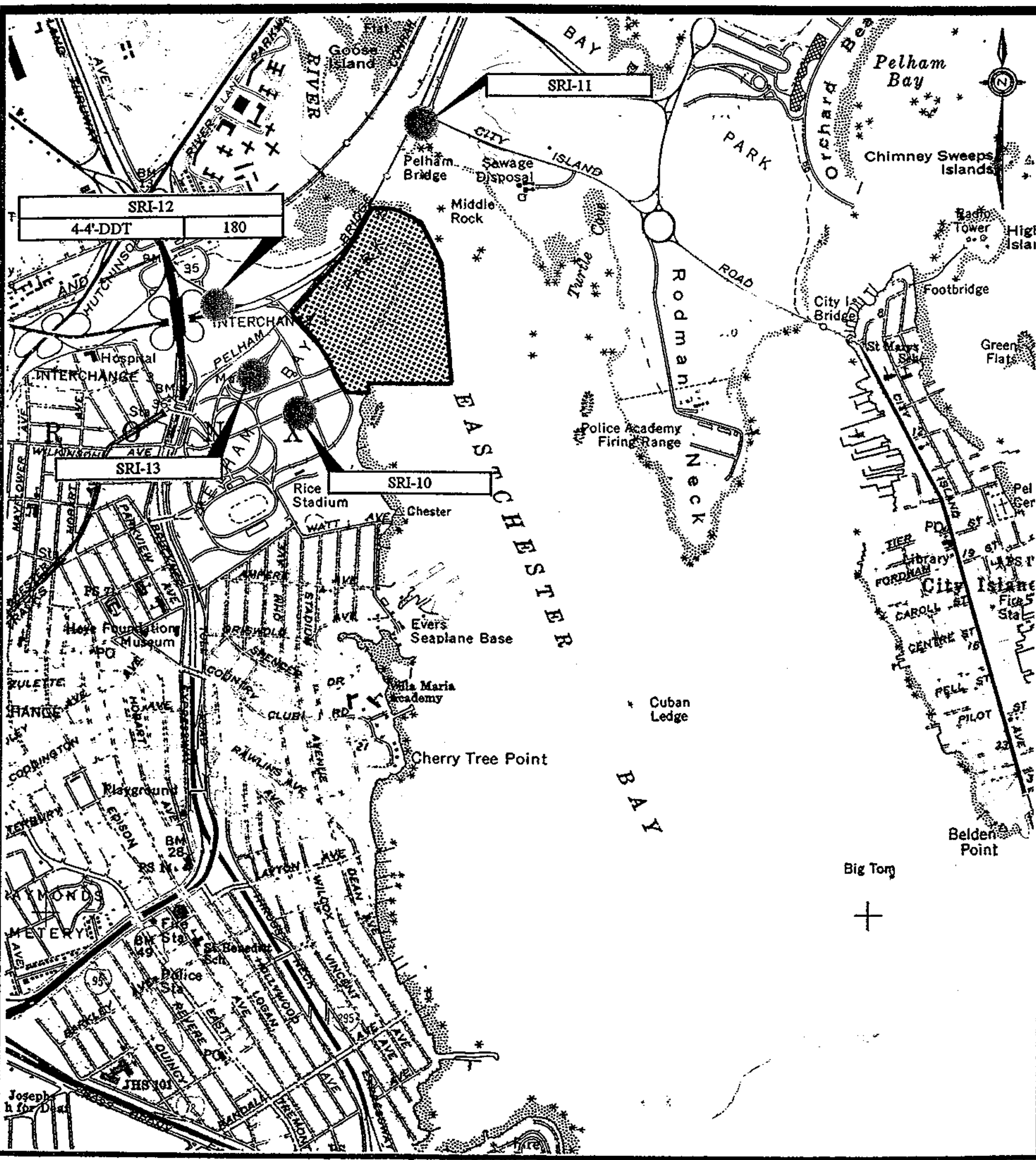
NOTE:
UNITS ARE mg/kg.
U = COMPOUND DETECTED IN FIELD BLANK.
B = REPORTED VALUE IS ACCEPTABLE [REPORTED VALUE LESS THAN THE CRDL (CONTRACT REQUIRED DETECTION LIMIT) BUT GREATER THAN THE IDL (INSTRUMENT DETECTION LIMIT)].

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

BACKGROUND ANALYTICAL RESULTS
INORGANIC CONSTITUENTS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.: 92C4087	
CK'D BY:	DAJ	DATE:	MAY 19, 1993	FIG. NO:	11



BACKGROUND ANALYTICAL RESULTS
PESTICIDE/PCB s
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.: 92C4087	
CK'D BY:	DAJ	DATE:	MAY 19, 1993	FIG. NO:	12

NOTE:
UNITS ARE ug/kg.

MAP SOURCE:
FLUSHING, N.Y. USGS QUADRANGLE MAP, 1979.

Appendix E

Remedial Investigation Report -
Groundwater Tables and Figures

Table 4-19
Monitoring Wells - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115B	MW-115BP	MW-115P	MW-116	MW-116B	MW-117	MW-117B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	8-Aug-92	28-Jul-92	29-Jul-92	30-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	30-Jul-92	30-Jul-92	31-Jul-92	31-Jul-92	14-Aug-92	12-Aug-92	3-Aug-92	7-Aug-92	31-Jul-92	7-Aug-92
Halogenated Aliphatic Compounds																					
1,1-Dichloroethylene																					
1,2-Dichloroethylene			1 J																		
Chloroform						2 J															
Methylene chloride	2 BJR#	2 BJR#	2 BJR#		12 BJR#	2 BJR#		2 BJR#	3 BJR#	2 BJR#	1 BJ	3 BJR#	3 BJR#	2 BJR#	12 BR#		4 J	15 BJR#	9 BJR#	9 BR#	2 BJR#
Tetrachloroethylene																			6 J		
Trichloroethylene																			5 J		
Total			1			2											4		11		
Ketones																					
2-Butanone																					
2-Hexanone																				5 J	
2-Propanone															8 J				47		
4-Methyl-2-pentanone																					
Total															8				47	5	
Monocyclic Aromatic Hydrocarbons																					
Benzene		2 J	4 J	3 J			3 JBR#	2 J		1 J	3 J								62		
Chlorobenzene		7	1 J	2 J			5	18	11	16	28	14		3 J							
Ethylbenzene			8					3 J											36		
Toluene																			230		
Xylenes (total)																			200		
Total		9	13	5			5	23	11	17	31	14		3					528		
Miscellaneous																					
Carbon Disulfide		1 J																			
Total		1																			
Grand Total		10	14	5		2	5	23	11	17	31	14		3	8		4		586	5	

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
D= Result reported from a diluted sample or sample extract
E = Estimated value (Reported concentration exceeded the calibration range)
J ==Estimated value
R# = Negated

Prepared by: SMM
Checked by: TRP
92C4087

Table 4-19
Monitoring Wells - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-118	MW-118B	MW-119	MW-119B	MW119BD	MW-120	MW-120B	MW-120H	MW-120L	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	29-Jul-92	6-Aug-92	5-Aug-92	7-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	20-Aug-92	20-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
Halogenated Aliphatic Compounds																			
1,1-Dichloroethylene																			
1,2-Dichloroethylene						1 J													
Chloroform		11 J									20 J								
Methylene chloride		120 BR#		2 BJR#	150 BDJR#	12 BJR#	12 BJR#	2 BJR#	1 BJR#	11 BJR#	99 BJR#	8 BJR#	3 BJR#		15 BJR#	15 BJR#	1 BJR#	3 BJR#	3 BJR#
Tetrachloroethylene				6															
Trichloroethylene				3 J															1 J
Total		11		9		1					20								1
Ketones																			
2-Butanone																			51
2-Hexanone																			
2-Propanone		1700 B		1800 EJ	1500 D	24 JR#		18	20 B	9 JR#	2100 BJ	120 J	26		62		8 J		87
4-Methyl-2-pentanone																			9 J
Total		1700		1800	1500			18	20		2100	120	26		62		8		147
Monocyclic Aromatic Hydrocarbons																			
Benzene						3 J		4 J	5	1 J		4 J	3 J						1 J
Chlorobenzene						12		14	17			25	46				3 J	2 J	
Ethylbenzene				8		5		6	7	3 J		5 J	5 J						2 J
Toluene				2		8		9	11			1	2						8
Xylenes (total)				40		9		5	14										6
Total				50		37		38	54	4		35	56				3	2	17
Miscellaneous																			
Carbon Disulfide																			
Total																			
Grand Total		1711		1859	1500	38		56	74	4	2120	155	82		62		11	2	165

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
D= Result reported from a diluted sample or sample extract
E = Estimated value (Reported concentration exceeded the calibration range)
J = Estimated value
R# = Negated

Prepared by: SMM
Checked by: TRP
92C4087

SMMOKBE0\92C4087\GRNDWATR\GWVOA.XLS

Table 4-20
Monitoring Wells - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115B RE	MW-116	MW-116B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	3-Aug-92	28-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92	31-Jul-92	31-Jul-92	3-Aug-92	7-Aug-92
PAHs																	
2-Methylnaphthalene			33 J														2 J
Acenaphthene		4 J	18	3 J										8 J			
Acenaphthylene																	
Anthracene			8 J														
Benzo(a) anthracene			2 J														
Chrysene																	
Dibenzofuran			12											3 J			
Fluoranthene		2 J	10														
Fluorene		2 J	15	3 J													
Naphthalene		6 J	140 J	8 J													8 J
Phenanthrene			35														
Pyrene		2 J	9 J														
Total		16	282	14										11			10
Phenols																	
2-Methylphenol																	
2,4-Dimethylphenol			73														
4-Methylphenol																	
Total			73														
Phthalates																	
Bis(2-Ethylhexyl) Phthalate		4 J	13								2 J						
Di-n-butyl phthalate	3 JR#		3 BJR#	3 J	3 BJR#	4 BJR#			3 BJR#					2 J			
Di-n-octyl phthalate																	
Total		4	13	3							2			2			
Ethers																	
bis(2-Chloroisopropyl) ether						4 J					3 J						
Total						4					3						
Chlorinated Hydrocarbons																	
1,4-Dichlorobenzene											6 J						
Total											6						
Amines/Nitroarenes																	
N-Nitrosodi-n-propylamine											24						
N-Nitrosodiphenylamine																	
Total											24						
Grand Total		20	368	17		4					35			13			10

Notes:
All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-20
Monitoring Wells - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-117	MW-117B	MW-118	MW-118B	MW-119	MW-119B	MW-120	MW-120B	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	31-Jul-92	7-Aug-92	29-Jul-92	29-Jul-92	5-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
PAHs																		
2-Methylnaphthalene						2 J	4 J											6 J
Acenaphthene							4 J		2 J									8 J
Acenaphthylene						2 J												
Anthracene							3 J		2 J									5 J
Benzo(a) anthracene																		3 J
Chrysene																		3 J
Dibenzofuran																		5 J
Fluoranthene							3 J											10 J
Fluorene							3 J											5 J
Naphthalene						4 J	35		2 J									45
Phenanthrene							4 J											19
Pyrene																		9 J
Total						8	56		6									118
Phenols																		
2-Methylphenol							51											49 J
2,4-Dimethylphenol							68		5 J									290
4-Methylphenol			4 J															
Total			4				119		5									339
Phthalates																		
Bis(2-Ethylhexyl) Phthalate				28 J		17 J	6 J	2 J										38
Di-n-butyl phthalate	2 J			4 J								2 J	2 J		2 BJR#			
Di-n-octyl phthalate																		10 J
Total	2			32		17	6	2				2	2					48
Ethers																		
bis(2-Chloroisopropyl) ether		5 J	3 J															
Total		5	3															
Chlorinated Hydrocarbons																		
1,4-Dichlorobenzene							4 J											
Total							4											
Amines/Nitroarenes																		
N-Nitrosodi-n-propylamine																		
N-Nitrosodiphenylamine				11 J		17 J				4 J								
Total				11		17				4								
Grand Total	2	5	7	43		42	185	2	11	4		2	2					505

Notes:
All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
RE = Reanalysis
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-21
Monitoring Wells - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-106AR	MW-107	MW-109	MW-110AR	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115B	MW-116	MW-116B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	29-Jul-92	3-Aug-92	28-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92	31-Jul-92	31-Jul-92	3-Aug-92	7-Aug-92
4,4'-DDD	0.013 JV	0.012 J		0.024 JV				0.015 J										
4,4'-DDE	0.013 JV	0.015 J	0.067 JV	0.027 JV	0.01 JV			0.011 J										0.014 J
alpha-BHC			0.1 V									0.02 JV						0.032 J
alpha-Chlordane	0.056 JV																	
delta-BHC		0.017 J	0.068 V		0.058 VR#			0.018 JVR#					0.02 J					
Dieldrin	0.18 V	0.0063 J	0.47 V	0.04 JV					0.011 J	0.042 JV	0.033 JV							0.044 J
Endosulfan II			2.1 V								0.053 JV							
Endosulfan sulfate	0.04 BJVR#						0.051 BJVR#			0.047 BJVR#	0.031 BJVR#					0.011 JR#		
Endrin										0.023 JV								
Endrin ketone																		
gamma-BHC																		
Methoxychlor			0.27 JV	0.15 JV														
PCB-1016			0.84 J															
PCB-1260			1 J															

	MW-117	MW-117B	MW-118AR	MW-118B	MW-119	MW-119B	MW-120	MW-120B	MW-121	MW-121B	MW-122	MW-122B	MW-123AR	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	31-Jul-92	7-Aug-92	29-Jul-92	29-Jul-92	5-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92	30-Jul-92	6-Aug-92
4,4'-DDD					0.011 JV				0.037 JV									
4,4'-DDE							0.013 J	0.017 JV										0.052 J
alpha-BHC								0.011 JV		0.0082 J	0.0093 JV							
alpha-Chlordane																		
delta-BHC			0.011 BJVR#									0.02 J						
Dieldrin						0.014 J	0.03 J											0.091 J
Endosulfan II																		
Endosulfan sulfate	0.059 JR#	0.036 J				0.052 J							0.011 JVR#					
Endrin																		
Endrin ketone						0.057 J												
gamma-BHC																		0.037 J
Methoxychlor							0.41 J											
PCB-1016																		
PCB-1260																		

Notes: All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
AR=Archived portion of sample reanalyzed
B=Blank contaminant
J = Estimated value
R# = Negated result
V = Reported results for this compound could not be verified during data validation

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-22
Monitoring Wells - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-112	MW-113	MW-113B	MW-114	MW-114B
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	3-Aug-92	28-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92
Aluminum	460	874			30300 N	305	1170	351	156 B	9510	3460 N	2040	1080
Antimony					51.2 B	56.3 BJR#	52.5 BJR#						
Arsenic		7.2 BJ	13.4	2.3 BW	10.1 B			6.2 B	2 B	3.7 B	6.2 B	15.8 J	1.8 BJ
Barium	57 B	983	1030	946	908 EN	167 B	539	129 B	891	393	1110 EN	164 B	210
Beryllium					0.6 B								
Cadmium			9.6	6.6									
Calcium	259000	122000	57700	147000	79900 E	100000	180000	150000	87400	99900	437000 E	53600	338000
Chromium		110	312	56	165		25.4	18.6	13.7	39.9	23.2	36.5	
Cobalt		16 BJR#	39.9 B	8.3 B	42.3 BJNR#	78.7		29.2 BJR#	24.4 B	23.2 B	59 N	19.3 BJR#	8 BJR#
Copper	590	50.6 S	471	182	173	13.3 BJR#	52.5	20.7 B	61.9	43.9	771	7.3 B	
Cyanide		10.8		24.6						22.6			
Iron	2160	6110	11200	15100	62600 E	657	9770	19200	11900	18800	10300 E	12100	1210
Lead	40.2	51.9	65.1 S	9.5 B+	36.3 J		68.3	2.8 BJR#	7.7	26.2 S	30.3	3.6 B	1.2 B
Magnesium	921000	252000	44300	296000	104000	43700	288000	201000	50800	45800	220000	54500	56500
Manganese	162	111	75.8	98.8	2030 E	5100	121	8920	630	3060	24500 E	691	147
Mercury	1.2			0.2 BJ									
Nickel		26 BJ	73.3	14.9 B	246	483	18.3 B	227	106	182	267	67.4 J	
Potassium	300000	331000	563000	309000	84300	5850	170000	97000	129000	94400	50200	243000	17100
Selenium		13.6 BN											
Silver		8.6 BNWJR#									4.8 B	4.1 BNJR#	
Sodium	8764000	3053000	3154000	3836000	566000	116000	3150000	2268000	316000	428000	790000	709000	1151000
Thallium													
Vanadium	5.7 B	244	869	102	109		46.3 B	9.6 B	5.2 B	23.7 B	14.5 BJR#	33.8 B	
Zinc	70.2	45	139	43.9	141 E	34.9	99	15.9 BJR#	24.4 JR#	39.9	88.9 E	17.3 B	28.2

Notes: All concentrations in microgram per liter (ppb)
Blank indicates compound was not detected
B = Reported value is acceptable. Reported value is less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit)
E = Estimated value due to matrix interference
J = Estimated value.
N= Estimated value (Spiked sample recovery was not within quality control limits)
R = Rejected result
R# = Negated result
S = Reported value is acceptable. Reported value was determined by the Method of Standard Additions (MSA)
W = Estimated value (Post-digestion spike sample results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)
\+ = Estimated value (The correlation coefficient reported for the MSA is less than 0.995)

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-22
Monitoring Wells - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-115	MW-115B	MW-115BP	MW-115P	MW-116	MW-116B	MW-117	MW-117B	MW-118	MW-118B	MW-119	MW-119B	MW-120
date:	31-Jul-92	31-Jul-92	14-Aug-92	12-Aug-92	3-Aug-92	7-Aug-92	31-Jul-92	7-Aug-92	29-Jul-92	6-Aug-92	5-Aug-92	7-Aug-92	4-Aug-92
Aluminum	19900	1390	48.7 B	87.3 B	3930 N	14000	6840		253	46200	7110 N	7320	3150 N
Antimony													
Arsenic	2.3 B	1.6 B				2.8 B	21.2		7.9 B	53.2		16.7	7.4 B+
Barium	551	572	575	154 B	60 BEN	367	746	272	199 B	1120	314 EN	313	731 EN
Beryllium							0.6 BJR#			0.9 B			
Cadmium												5.4	5.8 N
Calcium	197000	376000	309000	147000	7740 E	360000	124000	199000	232000	2752000	240000 E	2312000	98400 E
Chromium	92.3	8.8 B	9.9 B	11.1	13.4	59.6	60.3		39.7	217	21.6	64.1	338
Cobalt	57.4	52.2	46.8 B	46.8 B	16.2 BJNR#		39.2 B		8.1 B	48.9 B	18.3 BN		42.8 BNJR#
Copper	80.1	95.3	99.9	37.3	22.7 BJR#	70.7	74.6	15.5 B	33 JR#	1130	44 JR#	297	40.3 JR#
Cyanide									267				
Iron	40200	8400	389	689 E	6300 E	18400	22200	165	978	194000	17200	46800	13000 E
Lead	17.3 J	2.1 BJR#				39 JR#	6.1 JR#	11.9 JR#	17.2 B	252	134	41.4	23.9
Magnesium	216000	289000	244000	177000	5290	6670	75900	144000	740000	1936000	803000	894000	258000
Manganese	10100	13800	9720	6370	554 E	286	1910	173	263	29600	1230	7700	316 E
Mercury												0.62	
Nickel	328	283	248	176		25.4 BJ	164	47.4 J	29.6 B	94.9			73.1 J
Potassium	77500	18500	16200	21200	2950 B	93800	165000	21900	344000	107000	312000	136000	684000
Selenium													
Silver	7.2 BNJR#	5.6 BNJR#										5.4 B	
Sodium	1215000	1312000	1070000 EJ	986000 EJ	70000	93300	1000000	462000	7592000	3539000	7496000	6164000	5362000
Thallium	2.8 B								13.5 B				
Vanadium	51.3		8.6 B	12.2 B	15.7 B	47.7 B	37.6 B		81.2	120	33.8 B	12.8 B	989
Zinc	64.2 JR#	14.4 BJR#	65.1	49.1	15.3 BE	154	30.7 JR#	6.5 B	89.2	7110	142	3220	136 E

Notes:
All concentrations in microgram per liter (ppb)
Blank indicates compound was not detected
B = Reported value is acceptable. Reported value is less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit)
E = Estimated value due to matrix interference
J = Estimated value.
N= Estimated value (Spiked sample recovery was not within quality control limits)
R = Rejected result
R# = Negated result
S = Reported value is acceptable. Reported value was determined by the Method of Standard Additions (MSA)
W = Estimated value (Post-digestion spike sample results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)
+ = Estimated value (The correlation coefficient reported for the MSA is less than 0.995)

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-22
Monitoring Wells - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-120B	MW-120H	MW-120L	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	4-Aug-92	20-Aug-92	20-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
Aluminum		234	534 J	1430 N	2300 N	941 N		2450	11000 N	3670 N	3930	2010	3230
Antimony											55.5 BJ		
Arsenic	4.5 B			11 B	4.4 B	21.9	3.3 B	2.1 BW	4.5 B	2.1 B	7 BJ	1.8 BJ	63.4
Barium	70 BEN	782 J	973 J	437 EN	547 EN	807 EN	441	111 B	218 EN	73 BEN	112 B	163 B	3090
Beryllium		4.5 B	8.7										
Cadmium							6.8 R				5.2 WR#		7.5 R
Calcium	547000 E	94100 J	67100 J	60600 E	943000 E	158000 E	141000	35300	55400	54100	93100	1297000	19100
Chromium		297 J	409 J	42.1	23.6	33.8	21	15.4	72.7		26.6	15.7	1240
Cobalt	13.8 BNJR#	67.6	60.8	42.2 BNJR#	13.8 BNJR#	45.7 BNJR#	34.4 B	17 B	28.7 BNJR#	11.2 BNJR#	23.3 BJR#	22.3 BJR#	77.3
Copper	13.7 BJR#	32.5	45.8	34.1 JR#	50.7	47.7	20.5 B	14.6 BJR#	75.3 BJR#	12.1 BJR#	16.2 B	24.3 B	356
Cyanide													30.4
Iron	3760 E	3660 EJ	6350 EJ	8540 E	6450 E	63300 E	10800	4440	26600 E	4390 E	24200	10800	39400
Lead				2.9 B	34	14.2	11.3 JR#	7.2	23.1	3.4 B	6.1	16.1 +	423
Magnesium	901000	255000 J	142000 J	275000	98200	319000	328000	23500	63500	8940	250000	829000	13700
Manganese	2200 E	678	312 J	1640 E	117 E	6870 E	2220	2100	4310 E	93.6 E	1040	2240	265
Mercury		0.26	0.39	0.24 N									1.1
Nickel		216 J	158	328		414	322	65	168		304	126 J	213
Potassium	137000	558000 J	668000 J	246000	47500	100000	101000	5390	9790	17800	100000	93300	1431000
Selenium													
Silver				3.5 B		3.7 B				5.4 B	7.1 BNJR#	5.7 BNJR+	
Sodium	7449000	4440000 J	3567000 J	4242000	1224000	1786000	2505000	36300	404000	10700	2449000	6909000	6924000
Thallium													
Vanadium	5 B	955 J	1370 J	19.7 B	11.1 B	16.6 B	9.9 B	8.9 B	29.8 B	14.3 B	11.9 B	4.6 B	2860
Zinc	20.2 E	66.6 EJ	123 J	8.5 BE	37.5 E	30.7 E	37.9	15.1 BJR#	48.8 E	53.4 E	20.6	50	1390

Notes: All concentrations in microgram per liter (ppb)
Blank indicates compound was not detected
B = Reported value is acceptable. Reported value is less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit)
E = Estimated value due to matrix interference
J = Estimated value.
N= Estimated value (Spiked sample recovery was not within quality control limits)
R = Rejected result
R# = Negated result
S = Reported value is acceptable. Reported value was determined by the Method of Standard Additions (MSA)
W = Estimated value (Post-digestion spike sample results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)
+ = Estimated value (The correlation coefficient reported for the MSA is less than 0.995)

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-23
Monitoring Wells - Conventional Parameters (Modified BMW List) Data Summary
Pelham Bay Landfill
Bronx, New York

	MW-103	MW-104	MW-105	MW-106	MW-107	MW-109	MW-110	MW-111	MW-113	MW-113B	MW-114	MW-114B	MW-115	MW-115D DUP	MW-115B	MW-115BP	MW-115P	MW-116	MW-116B	MW-117
date:	28-Jul-92	30-Jul-92	28-Jul-92	29-Jul-92	3-Aug-92	29-Jul-92	29-Jul-92	31-Jul-92	28-Jul-92	5-Aug-92	10-Aug-92	30-Jul-92	31-Jul-92	31-Jul-92	31-Jul-92	14-Aug-92	12-Aug-92	3-Aug-92	7-Aug-92	31-Jul-92
Alkalinity as Bicarbonate	225	2760	5880	2040	780	34	1064	1640	1350	1470	2000	41	950	970	570			106	1480	1580
Alkalinity as Carbonate																			720	
Ammonia Nitrogen	4.86	320	234	159	64	3.00	113	82.9	77.8	26.7	240	0.37	59.6	60.8	2.95				0.17	221
Chemical Oxygen Demand	258 J	997	3250	724 J	177		394 J	421 J	181	517	509									428 J
Chloride	14700	3720	6040	4270 J	780	468	5120	3160	514	1130	638	2460	2110	1950	2440	2550	2170	30	105	1990
Nitrate Nitrogen	0.22		0.23	0.23	0.04		1.81	0.05		0.02		0.02	0.04	0.03	0.03			0.11	0.104	0.02
Sulfate	1490	356	277	542	224	125	435	315	102	69	55	177	120	110	158			80	42	128
Total Dissolved Solids	26000	9230	10500	9870 J	2250	1170	10540	6920	1620	4270	2680	5320	4700	4680	6370			304	1130	3710
Total Kjeldahl Nitrogen	9.37 J	451 J	1010 J	335 J	68.7	0.36 J	168 J	134	156 J	52	372 J	1.1 J	73.6 J		8.52			0.28	0.72	281 J

	MW-117B	MW-118	MW-118B	MW-119	MW-119B	MW-119D	MW-120	MW-120B	MW-120H	MW-120L	MW-121	MW-121B	MW-122	MW-122B	MW-123	MW-124	MW-124B	MW-125	MW-125B	MW-126
date:	7-Aug-92	29-Jul-92	6-Aug-92	5-Aug-92	7-Aug-92	7-Aug-92	4-Aug-92	4-Aug-92	20-Aug-92	20-Aug-92	4-Aug-92	4-Aug-92	4-Aug-92	6-Aug-92	29-Jul-92	3-Aug-92	3-Aug-92	30-Jul-92	30-Jul-92	6-Aug-92
Alkalinity as Bicarbonate	332	924	35	574	190	594	5050	724			2780	60	1780	2370	1100	70	69	1560	1030	1346
Alkalinity as Carbonate			10														6			900
Ammonia Nitrogen		96.8	1.83	40.6	3	37.9	604	3.28			91.8		16.9	0.93				0.34	0.52	1260
Chemical Oxygen Demand		480 J	1380 J	620 J	635		2360	628 J			997	170 J	805					436 J	580 J	8170
Chloride	2150	10570	10460 J	11240	11740	11360	5320	13560	5500	3740	4980	3210	1840	3050 J	179	590	11	2940	11980	5140 J
Nitrate Nitrogen	0.084	23		0.23		0.24											0.01			
Sulfate	149	594	599	1680	520	1720	713	494			336	364	86	98	30	102	60	161	408 J	759
Total Dissolved Solids	3110	24500	24250	25200	27100	25300	15200	28300			13000	7380	5730	8640	334	1410	194	7360	26300	12200
Total Kjeldahl Nitrogen	0.29	151 J	4.27	52.6	3.83		1640	4.95			132	2.4	35.1	24.9	0.32 J		0.37	10.7 J	9.79 J	1200

Notes:
All concentrations in milligrams per liter (ppm)
Blank indicates compound was not detected
D = Laboratory QA/QC duplicate
DUP = Duplicate sample
J = Estimated value

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-33
Comparison of Monitoring Well and Seep Samples to NYSDEC Groundwater Standards
Pelham Bay Landfill
Bronx, New York

Compound	NYSDEC SCG[1] (ug/l)	Range of Concentrations (ug/l)	Samples that Exceed Standards
Benzene	0.7	1 to 62	104, 105, 106, 111, 113, 113B, 116B, 120, 121, 122, 122B, 125, 125B, LS-1, LS-9, LS-10
Chlorobenzene	5	1 to 46	104, 111, 112, 113, 113B, 114, 120, 122, 122B, LS-4, LS-9
Ethylbenzene	5	3 to 36	105, 116B, 119B, 120, LS-1
Methylene Chloride	5	1 to 150	(2)
Toluene	5	1 to 230	116B, 120, 126, LS-1, LS-9
Xylenes	5	4 to 200	116B, 119B, 120, 126, LS-1, LS-9
Acenaphthene	20*	2 to 18	
Anthracene	50*	2 to 8	
Fluoranthene	50	2 to 10	
Fluorene	50*	2 to 15	
Naphthalene	10*	2 to 140	105, 120, 126, LS-9
Phenanthrene	50*	3 to 35	
Pyrene	50*	2 to 9	
1,2-Dichlorobenzene	4.7	5	LS-4
1,3-Dichlorobenzene	5	5	
1,4-Dichlorobenzene	4.7	4 to 9	113B, LS-4
N-Nitrosodiphenylamine	50*	4 to 17	
bis(2-Ethylhexyl)phthalate	50	2 to 38	
Aldrin	Non-detect	0.058	LS-2
Dieldrin	Non-detect	0.0063 to 0.64	103, 104, 105, 106, 111, 112, 113, 116B, 119B, 120, 126, LS-2, LS-5, LS-9, LS-10
4,4' DDD	Non-detect	0.011 to 0.078	103, 104, 106, 110, 119, 121, LS-1, LS-2, LS-5
4,4' DDE	Non-detect	0.01 to 0.078	103, 104, 105, 106, 110, 116B, 120, 120B, 126, LS-2, LS-5, LS-10
Antimony	3*	51.2 to 56.3	107, 125, LS-5
Arsenic	25	2.3 to 89.1	118B, 126, LS-1, LS-5
Barium	1,000	60 to 8470	105, 113B, 118B, 126, LS-1, LS-2, LS-5
Boron	1,000	1570 to 8900	LS-1, LS-2, LS-3, LS-4, LS-5, LS-7, LS-9, LS-10 (3)
Cadmium	10	5.4 to 29.1	LS-2
Chromium	50	18.6 to 1240	104, 105, 106, 107, 115, 116B, 117, 118B, 119B, 120, 124, 126, LS-1, LS-2, LS-5, LS-9, LS-10
Hexavalent Chromium	50	20 to 560	LS-1, LS-2, LS-9, LS-10 (3)
Cobalt	34	8.1 to 77.3	105, 109, 113B, 115, 115B, 117, 118B, 126, LS-1, LS-2, LS-5
Copper	200	7.3 to 1130	103, 105, 113B, 118B, 126, LS-2, LS-5
Iron	300	165 to 860,000	All monitoring well and seep samples except 117B
Lead	25	7.7 to 2,780	103, 104, 105, 107, 110, 113, 113B, 118B, 119, 121B, 126, LS-1, LS-2, LS-9, LS-10
Magnesium	35,000*	5,290 to 1,936,000	All monitoring well and seep samples except 116, 116B, 124B
Manganese	300	75.8 to 29,600	107, 109, 111, 112, 113, 113B, 114, 115, 115B, 116, 117, 118B, 119, 119B, 120, 120B, 121, 122, 122B, 123, 124, 125, 125B, LS-2, LS-4, LS-5, LS-9
Mercury	2	0.2 to 5	LS-7
Selenium	10	13.6	104
Sodium	20,000	10,700 to 8,000,000	All monitoring well and seep samples except 124B
Thallium	4*	2.8 to 16.8	118, LS-7
Zinc	300	6.5 to 7,110	118B, 119B, 126, LS-2, LS-5
TDS	500,000	304,000 to 27,100,000	All monitoring well and seep samples except 116, 123, 124B
Ammonia	2,000	170 to 1,260,000	All monitoring well and seep samples except 114B, 116, 116B, 117B, 121B, 123, 124, 124B, 125, 125B
Chloride	250,000	11,000 to 12,250,000	All monitoring well and seep samples except 116, 116B, 124B
Cyanide	100	10.8 to 267	118
Nitrate	10,000	20 to 23,000	118
Sulfate	250,000	46,000 to 1,690,000	104, 105, 106, 110, 111, 118, 118B, 119, 119B, 120, 120B, 121, 121B, 126, LS-1, LS-2, LS-3, LS-4, LS-5, LS-7, LS-9, LS-10

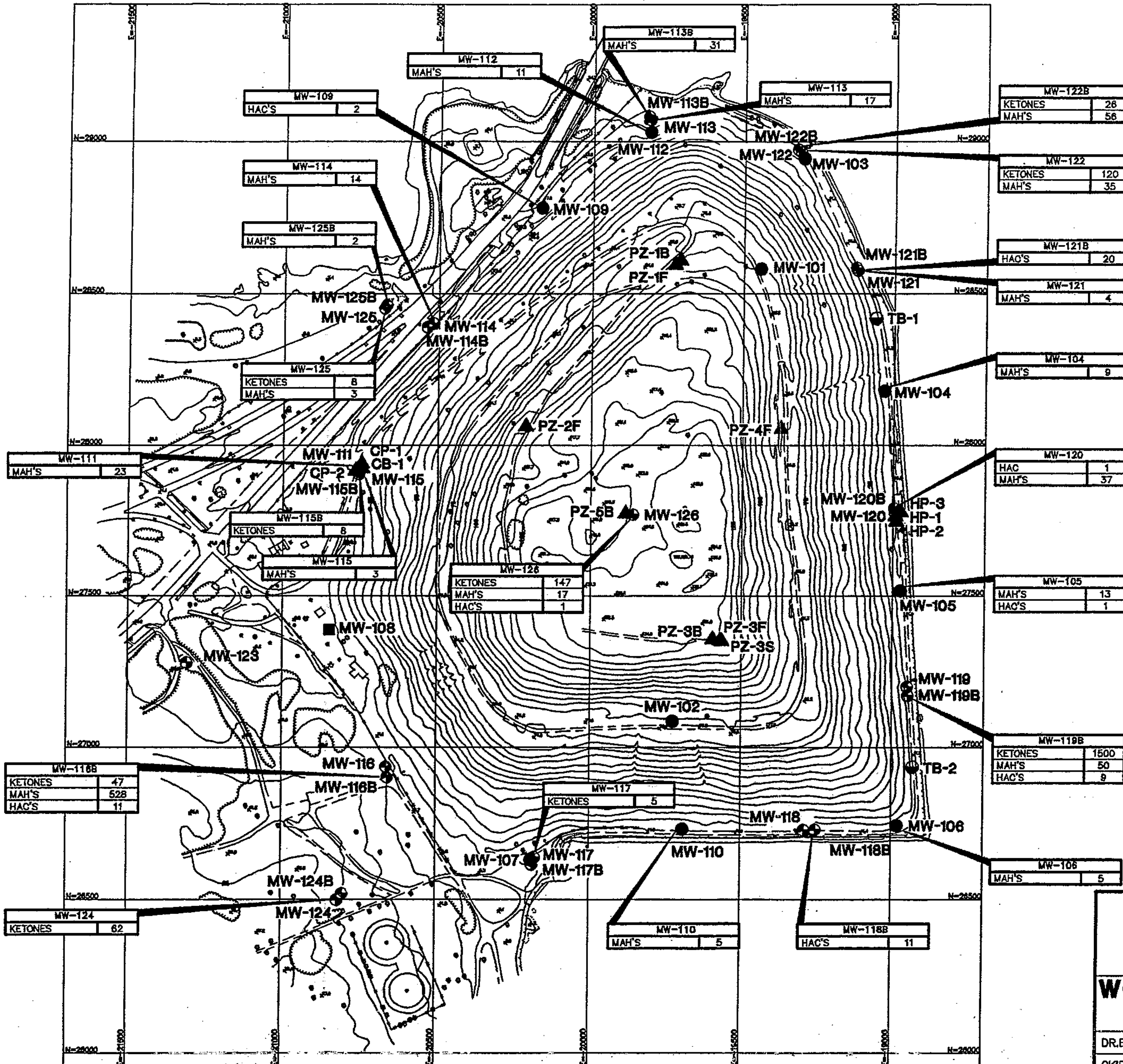
Notes:
* Guidance value, regulated standard for this chemical is not available
1. New York State Department of Environmental Conservation, Water Quality Standards and Guidance Values, September 25, 1990, 6NYCRR Part 700-705
2. Compound was also detected in blank sample
3. Indicates compound was only analyzed in the leachate seep samples

Prepared by:SMM
Checked by: TRP
92C4087

Table 4-34
Compounds that Exceed NYSDEC Groundwater Standards by Sampling Location
Pelham Bay Landfill
Bronx, New York

Samples	Compounds that Exceed NYSDEC Groundwater Standards
MW-103	4,4' DDD, 4,4' DDE, dieldrin, copper, lead, iron, magnesium, sodium, TDS, chloride, ammonia
MW-104	4,4' DDD, 4,4' DDE, benzene, chlorobenzene, dieldrin, chromium, iron, lead, magnesium, selenium, sodium, TDS, ammonia, chloride, sulfate
MW-105	4,4' DDE, benzene, ethylbenzene, naphthalene, dieldrin, barium, chromium, cobalt, copper, iron, lead, magnesium, sodium, TDS, chloride, sulfate, ammonia
MW-106	4,4' DDD, 4,4' DDE, benzene, dieldrin, chromium, iron, magnesium, sodium, TDS, chloride, sulfate, ammonia
MW-107	antimony, chromium, cobalt, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-108	iron, magnesium, sodium, TDS, chloride
MW-109	cobalt, iron, lead, magnesium, manganese, sodium, TDS, chloride, ammonia
MW-110	4,4' DDD, 4,4' DDE, iron, lead, magnesium, sodium, TDS, chloride, sulfate, ammonia
MW-111	benzene, chlorobenzene, dieldrin, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-113	benzene, chlorobenzene, dieldrin, iron, lead, magnesium, manganese, sodium, TDS, chloride, ammonia
MW-113B	benzene, chlorobenzene, 1,4-dichlorobenzene, barium cobalt, copper, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-114	chlorobenzene, iron, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-114B	iron, magnesium, manganese, sodium, TDS, chloride
MW-115	chromium, cobalt, iron, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-115B	cobalt, iron, magnesium, manganese, sodium, TDS, ammonia, chloride
MW-116	iron, manganese, sodium
MW-116B	4,4' DDE, benzene, ethylbenzene, toluene, xylenes, dieldrin, chromium, iron, sodium, TDS
MW-117	chromium, cobalt, iron, magnesium, manganese, sodium, ammonia, chloride
MW-117B	magnesium, sodium, TDS, chloride
MW-118	iron, magnesium, sodium, thallium, TDS, chloride, cyanide, nitrate, sulfate, ammonia
MW-118B	arsenic, barium, chromium, cobalt, copper, iron, lead, magnesium, manganese, sodium, TDS, chloride, sulfate
MW-119	4,4' DDD, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-119B	4,4' DDD, ethylbenzene, xylenes, dieldrin, chromium, iron, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
MW-120	4,4' DDE, benzene, chlorobenzene, ethylbenzene, toluene, xylenes, naphthalene, dieldrin, chromium, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-120B	4,4' DDE, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-121	4,4' DDD, benzene, iron, magnesium, manganese, sodium, ammonia, chloride, sulfate
MW-121B	iron, lead, magnesium, sodium, TDS, chloride, sulfate
MW-122	benzene, chlorobenzene, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
MW-122B	benzene, chlorobenzene, iron, magnesium, manganese, sodium, TDS, chloride, sulfate
MW-123	iron, magnesium, manganese, sodium, chloride
MW-124	chromium, iron, magnesium, manganese, sodium, TDS, chloride
MW-124B	iron
MW-125	benzene, antimony, iron, magnesium, manganese, sodium, TDS, chloride
MW-125B	benzene, iron, magnesium, manganese, sodium, TDS, chloride
MW-126	4,4' DDE, toluene, xylenes, naphthalene, dieldrin, arsenic, barium, chromium, cobalt, copper, iron, lead, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
LS-1	4,4' DDD, benzene, toluene, xylenes, arsenic, boron, chromium, hexavalent chromium, iron, lead, magnesium, sodium, TDS, ammonia, chloride, sulfate
LS-2/LS-2DUP	4,4' DDD, 4,4' DDE, aldrin, dieldrin, barium, cadmium, chromium, hexavalent chromium, cobalt, copper, iron, lead, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
LS-3	boron, iron, magnesium, sodium, TDS, ammonia, chloride, sulfate
LS-4	chlorobenzene, 1,4-dichlorobenzene, boron, iron, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
LS-5	4,4' DDD, 4,4' DDE, dieldrin, antimony, barium, boron, chromium, cobalt, copper, iron, magnesium, manganese, sodium, zinc, TDS, ammonia, chloride, sulfate
LS-7	boron, iron, magnesium, sodium, thallium, TDS, ammonia, chloride, sulfate
LS-9	benzene, chlorobenzene, toluene, xylene, naphthalene, dieldrin, boron, chromium, hexavalent chromium, iron, lead, magnesium, manganese, sodium, TDS, ammonia, chloride, sulfate
LS-10	4,4' DDE, benzene, dieldrin, boron, chromium, hexavalent chromium, iron, lead, magnesium, sodium, TDS, ammonia, chloride, sulfate

Prepared by: SMM
Checked by: TRP
92C4087



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LEGEND:

MW-103 ● MONITORING WELLS INSTALLED 1989

MW-108 ■ MONITORING WELL DESTROYED DURING IRM

PZ-3B ▲ PIEZOMETERS INSTALLED 1992

MW-113 MONITORING WELLS INSTALLED 1992

MW-116B BEDROCK WELLS INSTALLED 1992

TB-1 TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN ug/l

MAH'S – MONOCYCLIC AROMATIC HYDROCARBONS

HAC'S – HALOGENATED ALIPHATIC COMPOUNDS

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541

ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

MONITORING WELL SAMPLING LOCATIONS SHOWING CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-17

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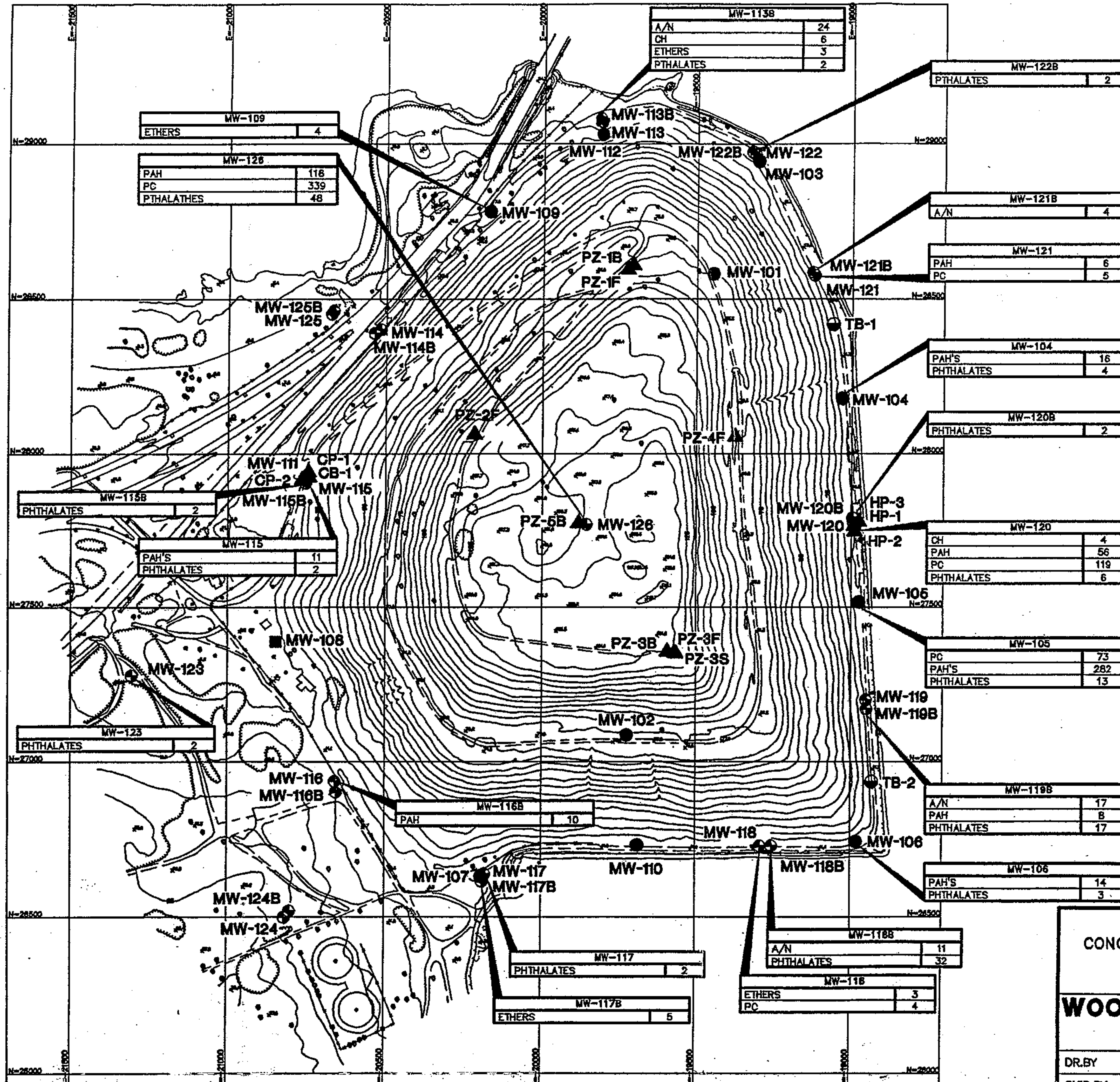

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LEGEND:

MW-103	●	MONITORING WELLS INSTALLED 1989
MW-108	■	MONITORING WELL DESTROYED DURING IRM
PZ-3B	▲	PIEZOMETERS INSTALLED 1992
MW-113	⊕	MONITORING WELLS INSTALLED 1992
MW-116B	⊕	BEDROCK WELLS INSTALLED 1992
TB-1	⊖	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN ug/l

CH – CHLORINATED HYDROCARBONS
PC – PHENOLIC COMPOUNDS
PAH'S – POLYNUCLEAR AROMATIC HYDROCARBONS
A/N – AMINES/NITROARENES

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

MONITORING WELL SAMPLING LOCATIONS SHOWING CONCENTRATIONS OF SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-18

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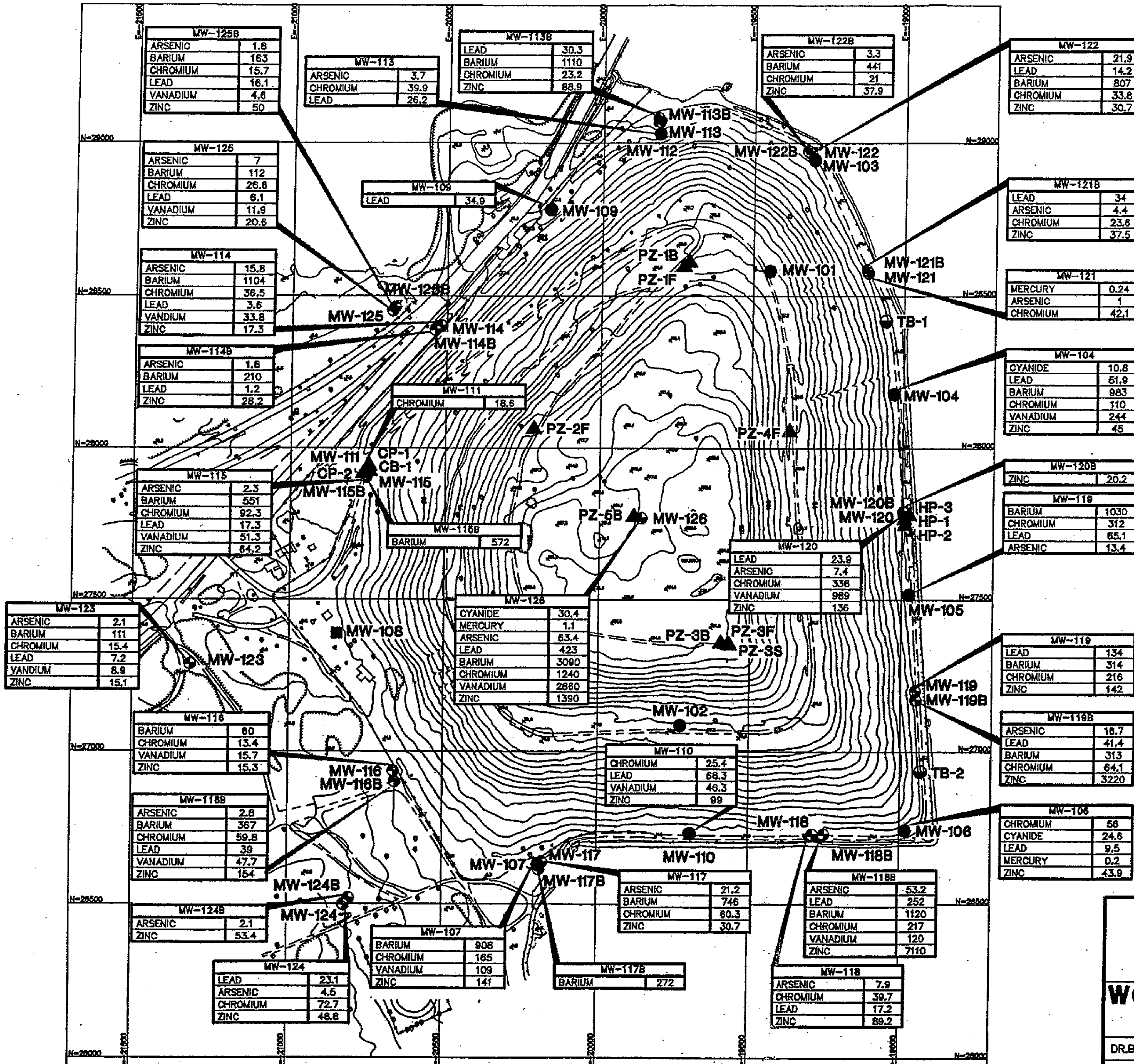


MW-125B	
ARSENIC	1.8
BARIUM	163
CHROMIUM	15.7
LEAD	16.1
VANADIUM	4.6
ZINC	50

MW-113	
ARSENIC	3.7
CHROMIUM	39.9
LEAD	26.2

MW-113B	
LEAD	30.3
BARIUM	1110
CHROMIUM	23.2
ZINC	88.9

MW-122B	
ARSENIC	3.3
BARIUM	441
CHROMIUM	21
ZINC	37.9

MW-122	
ARSENIC	21.9
LEAD	14.2
BARIUM	807
CHROMIUM	33.8
ZINC	30.7

MW-125	
ARSENIC	7
BARIUM	112
CHROMIUM	26.6
LEAD	6.1
VANADIUM	11.9
ZINC	20.6

MW-109	
LEAD	34.9

MW-121B	
LEAD	34
ARSENIC	4.4
CHROMIUM	23.6
ZINC	37.5

MW-114	
ARSENIC	15.8
BARIUM	1104
CHROMIUM	36.5
LEAD	3.6
VANDIUM	33.8
ZINC	17.3

MW-121	
MERCURY	0.24
ARSENIC	1
CHROMIUM	42.1

MW-114B	
ARSENIC	1.8
BARIUM	210
LEAD	1.2
ZINC	28.2

MW-104	
CYANIDE	10.8
LEAD	51.9
BARIUM	983
CHROMIUM	110
VANADIUM	244
ZINC	45

MW-111	
CHROMIUM	18.6

MW-115	
ARSENIC	2.3
BARIUM	551
CHROMIUM	92.3
LEAD	17.3
VANADIUM	51.3
ZINC	64.2

MW-120B	
ZINC	20.2

MW-115B	
BARIUM	572

MW-119	
BARIUM	1030
CHROMIUM	312
LEAD	65.1
ARSENIC	13.4

MW-120	
LEAD	23.9
ARSENIC	7.4
CHROMIUM	338
VANADIUM	989
ZINC	136

MW-123	
ARSENIC	2.1
BARIUM	111
CHROMIUM	15.4
LEAD	7.2
VANDIUM	8.9
ZINC	15.1

MW-126	
CYANIDE	30.4
MERCURY	1.1
ARSENIC	63.4
LEAD	423
BARIUM	3090
CHROMIUM	1240
VANADIUM	2860
ZINC	1390

MW-119	
LEAD	134
BARIUM	314
CHROMIUM	216
ZINC	142

MW-116	
BARIUM	60
CHROMIUM	13.4
VANADIUM	15.7
ZINC	15.3

MW-119B	
ARSENIC	16.7
LEAD	41.4
BARIUM	313
CHROMIUM	64.1
ZINC	3220

MW-110	
CHROMIUM	25.4
LEAD	68.3
VANADIUM	46.3
ZINC	99

MW-116B	
ARSENIC	2.8
BARIUM	367
CHROMIUM	59.8
LEAD	39
VANADIUM	47.7
ZINC	154

MW-106	
CHROMIUM	56
CYANIDE	24.6
LEAD	9.5
MERCURY	0.2
ZINC	43.9

MW-117	
ARSENIC	21.2
BARIUM	746
CHROMIUM	60.3
ZINC	30.7

MW-118B	
ARSENIC	53.2
LEAD	252
BARIUM	1120
CHROMIUM	217
VANADIUM	120
ZINC	7110

MW-124B	
ARSENIC	2.1
ZINC	53.4

MW-107	
BARIUM	908
CHROMIUM	165
VANADIUM	109
ZINC	141

MW-117B	
BARIUM	272

MW-124	
LEAD	23.1
ARSENIC	4.5
CHROMIUM	72.7
ZINC	48.8

MW-118	
ARSENIC	7.9
CHROMIUM	39.7
LEAD	17.2
ZINC	89.2

LEGEND:

MW-103 ● MONITORING WELLS INSTALLED 1989

MW-108 ■ MONITORING WELL DESTROYED DURING IRM

PZ-3B ▲ PIEZOMETERS INSTALLED 1992

MW-113 MONITORING WELLS INSTALLED 1992

MW-116B BEDROCK WELLS INSTALLED 1992

TB-1 TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN ug/l

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541

ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

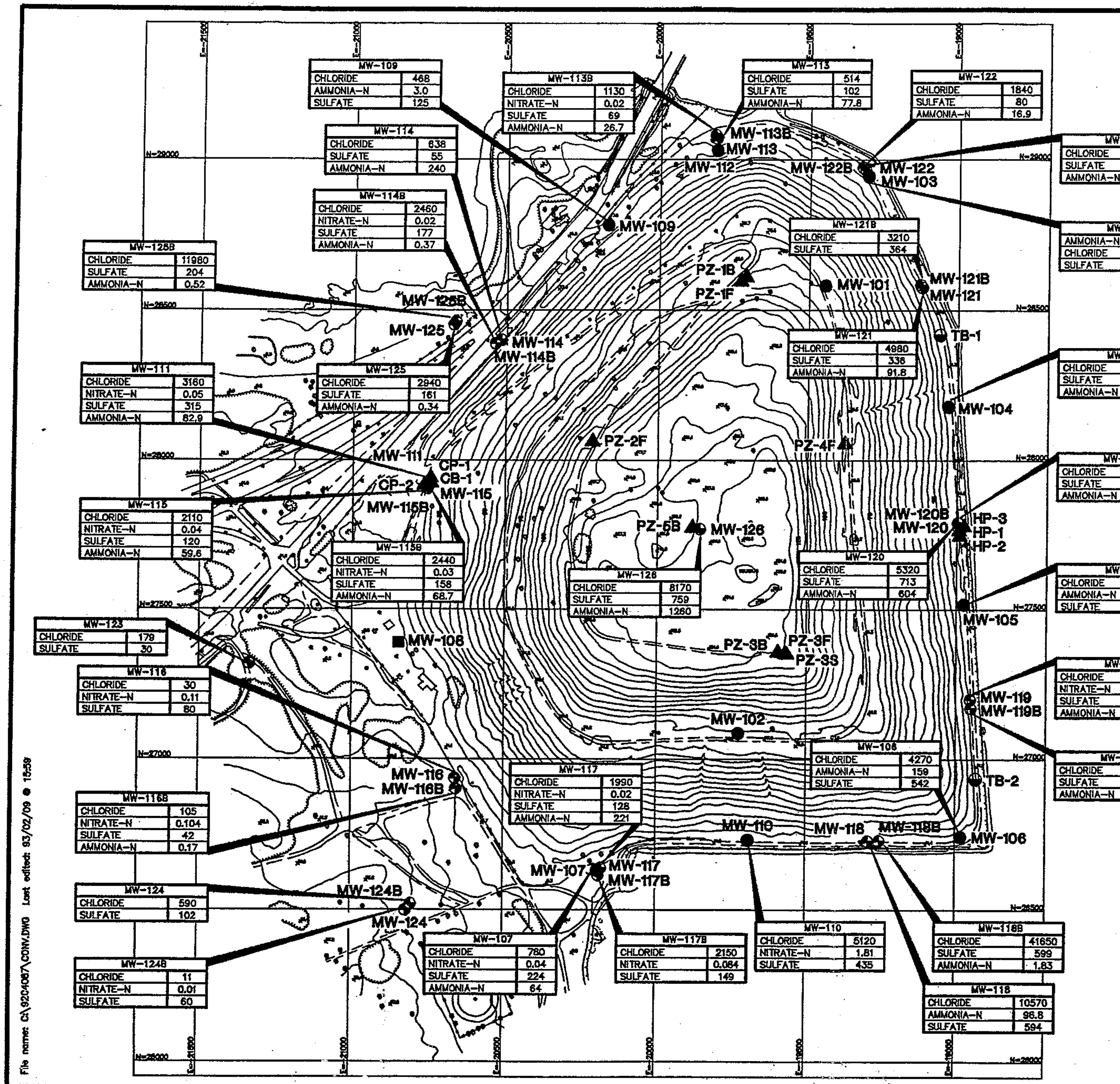
MONITORING WELL SAMPLING LOCATIONS
SHOWING CONCENTRATIONS OF INORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-19

File name: C:\92C4087\G-W-INOR.DWG Last edited 03/02/12 @ 15:37



LEGEND:

MW-103 ●	MONITORING WELLS INSTALLED 1989
MW-108 ■	MONITORING WELL DESTROYED DURING IRM
PZ-3B ▲	PIEZOMETERS INSTALLED 1992
MW-113	MONITORING WELLS INSTALLED 1992
MW-116B	BEDROCK WELLS INSTALLED 1992
TB-1	TEST BORING ADVANCED 1992

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. ALL CONCENTRATIONS ARE IN mg/l

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

MONITORING WELL SAMPLING LOCATIONS
SHOWING CONVENTIONAL PARAMETER CONCENTRATIONS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-20

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-113 Concentration
date:				28-Jul-92
Ammonia Nitrogen	ppm	2	26.4	77.8
Chloride	ppm	250		514
Total Dissolved Solids	ppm	500		1620
Benzene	ppb	0.7	10	1 J
Chlorobenzene	ppb	5		16
Cyanide	ppb	100	10	22.6
Iron	ppb	300	4000	18800
Lead	ppb	25	200	26.2 S
Magnesium	ppb	35000*		45800
Manganese	ppb	300	750	3060
Sodium	ppb	20000		428000
Dieldrin	ppb	Non-detect		0.033 JV

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-122 Concentration
date:				4-Aug-92
Ammonia Nitrogen	ppm	2	26.4	16.9
Chloride	ppm	250		1840
Total Dissolved Solids	ppm	500		5730
Benzene	ppb	0.7	10	4 J
Chlorobenzene	ppb	5		25
Ethylbenzene	ppb	5	100	5 J
Iron	ppb	300	4000	63300 E
Magnesium	ppb	35000*		319000
Manganese	ppb	300	750	6870 E
Sodium	ppb	20000		1786000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-103 Concentration
date:				28-Jul-92
Ammonia Nitrogen	ppm	2	26.4	4.86
Chloride	ppm	250		14700
Sulfate	ppm	250		1490
Total Dissolved Solids	ppm	500		26000
Copper	ppb	200	400	590
Iron	ppb	300	4000	2160
Lead	ppb	25	200	40.2
Magnesium	ppb	35000*		921000
Sodium	ppb	20000		8764000
4,4-DDD	ppb	Non-detect		0.013 JV
4,4-DDE	ppb	Non-detect		0.013 JV
Dieldrin	ppb	Non-detect		0.18 V

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-112 Concentration
date:				28-Jul-92
Ammonia Nitrogen	ppm	2	26.4	na
Chloride	ppm	250		na
Nitrate Nitrogen	ppm	10		na
Sulfate	ppm	250		na
Total Dissolved Solids	ppm	500		na
Chlorobenzene	ppb	5		11
Iron	ppb	300	4000	11900
Magnesium	ppb	35000*		50800
Manganese	ppb	300	750	630
Sodium	ppb	20000		316000
Dieldrin	ppb	Non-detect		0.042 JV

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-121 Concentration
date:				4-Aug-92
Ammonia Nitrogen	ppm	2	26.4	91.8
Chloride	ppm	250		4980
Sulfate	ppm	250		336
Total Dissolved Solids	ppm	500		13000
Benzene	ppb	0.7	10	1 J
Iron	ppb	300	4000	8540 E
Magnesium	ppb	35000*		275000
Manganese	ppb	300	750	1640 E
Sodium	ppb	20000		4242000
4,4-DDD	ppb	Non-detect		0.037 JV

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-109 Concentration
date:				28-Jul-92
Ammonia Nitrogen	ppm	2	26.4	3
Chloride	ppm	250		468
Total Dissolved Solids	ppm	500		1170
Cobalt	ppb	34	400	78.7
Iron	ppb	300	4000	657
Magnesium	ppb	35000*		43700
Manganese	ppb	300	750	5100
Sodium	ppb	2000		116000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-126 Concentration
date:				6-Aug-92
Ammonia Nitrogen	ppm	2	26.4	1260
Chloride	ppm	250		5140 J
Sulfate	ppm	250		759
Total Dissolved Solids	ppm	500		12200
Benzene	ppb	0.7	10	1 J
Toluene	ppb	5	100	8
Xylenes (total)	ppb	5	100	6
Arsenic	ppb	25	70	63.4
Barium	ppb	1000	4000	3090
Chromium	ppb	50	1000	1240
Cobalt	ppb	34	400	77.3
Copper	ppb	200	400	356
Cyanide	ppb	100	10	30.4
Iron	ppb	300	4000	39400
Lead	ppb	25	200	423
Sodium	ppb	20000		6924000
Zinc	ppb	300	400	1390
Naphthalene	ppb	10*	10	45
4,4-DDE	ppb	Non-detect		0.052 J
Dieldrin	ppb	Non-detect		0.091 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-114 Concentration
date:				10-Aug-92
Ammonia Nitrogen	ppm	2	26.4	240
Chloride	ppm	250		638
Total Dissolved Solids	ppm	500		2680
Chlorobenzene	ppb	5		14
Iron	ppb	300	4000	12100
Magnesium	ppb	35000*		54500
Manganese	ppb	300	750	691
Sodium	ppb	20000		709000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-104 Concentration
date:				30-Jul-92
Ammonia Nitrogen	ppm	2	26.4	320
Chloride	ppm	250		3720
Sulfate	ppm	250		356
Total Dissolved Solids	ppm	500		9230
Benzene	ppb	0.7	10	2 J
Chlorobenzene	ppb	5		7
Chromium	ppb	50	1000	110
Cyanide	ppb	100	10	10.8
Iron	ppb	300	4000	6110
Lead	ppb	25	200	51.9
Magnesium	ppb	35000*		252000
Selenium	ppb	10		13.6 BN
Sodium	ppb	20000		3053000
4,4-DDD	ppb	Non-detect		0.012 J
4,4-DDE	ppb	Non-detect		0.015 J
Dieldrin	ppb	Non-detect		0.0063 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-125 Concentration
date:				30-Jul-92
Chloride	ppm	250		2940
Total Dissolved Solids	ppm	500		7360
Antimony	ppb	3*		55.5 BJ
Iron	ppb	300	4000	24200
Magnesium	ppb	35000*		250000
Manganese	ppb	300	750	1040
Sodium	ppb	20000		2449000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-111 Concentration
date:				31-Jul-92
Ammonia Nitrogen	ppm	2	26.4	82.9
Chloride	ppm	250		3160
Sulfate	ppm	250		315
Total Dissolved Solids	ppm	500		6920
Benzene	ppb	0.7	10	2 J
Chlorobenzene	ppb	5		18
Iron	ppb	300	4000	19200
Magnesium	ppb	35000*		201000
Manganese	ppb	300	750	8920
Sodium	ppb	20000		2268000
Dieldrin	ppb	Non-detect		0.011 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-10 Concentration
date:				29-Jul-92
Ammonia Nitrogen	ppm	2	26.4	85.1
Chloride	ppm	250		2860 J
Total Dissolved Solids	ppm	500		8420
Benzene	ppb	0.7	10	2 J
Boron	ppb	1000		6800
Chromium	ppb	50	1000	180
Iron	ppb	300	4000	24900 E
Lead	ppb	25	200	88.7
Magnesium	ppb	35000*		175000
Sodium	ppb	20000		2781000
4,4-DDE	ppb	Non-detect		0.078 JV
Dieldrin	ppb	Non-detect		0.64 V

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-9 Concentration
date:				29-Jul-92
Ammonia Nitrogen	ppm	2	26.4	404
Chloride	ppm	250		6830
Sulfate	ppm	250		599
Total Dissolved Solids	ppm	500		17460
Benzene	ppb	0.7	10	4 J
Chlorobenzene	ppb	5		12
Ethylbenzene	ppb	5	100	5
Toluene	ppb	5	100	7
Xylenes (total)	ppb	5	100	8
Boron	ppb	1000		6910
Chromium	ppb	50	1000	293
Cobalt	ppb	34	400	34.8 B
Iron	ppb	300	4000	12500 E
Lead	ppb	25	200	58.5
Magnesium	ppb	35000*		333000
Manganese	ppb	300	750	523
Sodium	ppb	20000		5676000
Naphthalene	ppb	10*	10	33
Dieldrin	ppb	Non-detect		0.23 V

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-115 Concentration
date:				31-Jul-92
Ammonia Nitrogen	ppm	2	26.4	59.6
Chloride	ppm	250		2110
Total Dissolved Solids	ppm	500		4700
Chromium	ppb	50	1000	92.3
Cobalt	ppb	34	400	57.4
Iron	ppb	300	4000	40200
Magnesium	ppb	35000*		216000
Manganese	ppb	300	750	10100
Sodium	ppb	20000		1215000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-120 Concentration
date:				4-Aug-92
Ammonia Nitrogen	ppm	2	26.4	604
Chloride	ppm	250		5320
Sulfate	ppm	250		713
Total Dissolved Solids	ppm	500		15200
Benzene	ppb	0.7	10	3J
Chlorobenzene	ppb	5		12
Ethylbenzene	ppb	5	100	5
Toluene	ppb	5	100	8
Xylenes (total)	ppb	5	100	9
Chromium	ppb	50	1000	338
Iron	ppb	300	4000	13000 E
Magnesium	ppb	35000*		258000
Manganese	ppb	300	750	316 E
Sodium	ppb	20000		5362000
Naphthalene	ppb	10*	10	35
4,4-DDE	ppb	Non-detect		0.013 J
Dieldrin	ppb	Non-detect		0.03 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-2 Concentration
date:				28-Jul-92
Ammonia Nitrogen	ppm	2	26.4	74.8
Chloride	ppm	250		1420
Total Dissolved Solids	ppm	500		2850 J
Boron	ppb	1000		4200
Chromium	ppb	50	1000	62.3
Cyanide	ppb	100	10	20.4
Iron	ppb	300	4000	44400 E
Lead	ppb	25	200	146
Magnesium	ppb	35000*		66400
Sodium	ppb	20000		743000
4,4-DDD	ppb	Non-detect		0.042 JV
4,4-DDE	ppb	Non-detect		0.049 JV

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-105 Concentration
date:				28-Jul-92
Ammonia Nitrogen	ppm	2	26.4	234
Chloride	ppm	250		6040
Sulfate	ppm	250		277
Total Dissolved Solids	ppm	500		10500
Benzene	ppb	0.7	10	4 J
Ethylbenzene	ppb	5	100	8
Barium	ppb	1000	4000	1030
Chromium	ppb	50	1000	312
Cobalt	ppb	34	400	39.9 B
Copper	ppb	200	400	471
Iron	ppb	300	4000	11200
Lead	ppb	25	200	65.1 S
Magnesium	ppb	35000*		44300
Sodium	ppb	20000		3154000
Naphthalene	ppb	10*	10	140 J
4,4-DDE	ppb	Non-detect		0.067 JV
Dieldrin	ppb	Non-detect		0.4 V

	unit	NYSDEC (1) GW Standard	Effluent limitations (2)	MW-123 Concentration
date:				29-Jul-92
Chloride	ppm	250		179
Iron	ppb	300	4000	4440
Manganese	ppb	300	750	2100
Sodium	ppb	20000		36300

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-7 Concentration
date:				30-Jul-92
Ammonia Nitrogen	ppm	2	26.4	44.2
Chloride	ppm	250		11680
Sulfate	ppm	250		1690
Total Dissolved Solids	ppm	500		24400
Boron	ppb	1000		2820
Iron	ppb	300	4000	2970 E
Magnesium	ppb	35000*		795000
Mercury	ppb	2		5
Sodium	ppb	20000		7587000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-116 Concentration
date:				3-Aug-92
Iron	ppb	300	4000	6300 E
Manganese	ppb	300	750	554 E
Sodium	ppb	20000		70000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-124 Concentration
date:				3-Aug-92
Chloride	ppm	250		590
Total Dissolved Solids	ppm	500		1410
Chromium	ppb	50	1000	72.7
Iron	ppb	300	4000	26600 E
Magnesium	ppb	35000*		63500
Manganese	ppb	300	750	4310 E
Sodium	ppb	20000		404000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-119 Concentration
date:				5-Aug-92
Ammonia Nitrogen	ppm	2	26.4	40.6
Chloride	ppm	250		11240
Sulfate	ppm	250		1680
Total Dissolved Solids	ppm	500		25200
Iron	ppb	300	4000	17200
Lead	ppb	25	200	134
Magnesium	ppb	35000*		803000
Manganese	ppb	300	750	1230
Sodium	ppb	20000		7496000
4,4-DDD	ppb	Non-detect		0.011 JV

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-106 Concentration
date:				29-Jul-92
Ammonia Nitrogen	ppm	2	26.4	159
Chloride	ppm	250		4270 J
Sulfate	ppm	250		542
Total Dissolved Solids	ppm	500		9870 J
Benzene	ppb	0.7	10	3 J
Chromium	ppb	50	1000	56
Cyanide	ppb	100	10	24.6
Iron	ppb	300	4000	15100
Magnesium	ppb	35000*		296000
Sodium	ppb	2000		3836000
4,4-DDD	ppb	Non-detect		0.024 JV
4,4-DDE	ppb	Non-detect		0.027 JV
Dieldrin	ppb	Non-detect		0.04 JV

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-107 Concentration
date:				3-Aug-92
Ammonia Nitrogen	ppm	2	26.4	64
Chloride	ppm	250		780
Total Dissolved Solids	ppm	500		2250
Antimony	ppb	3*		51.2 B
Chromium	ppb	50	1000	165
Iron	ppb	300	4000	62600 E
Lead	ppb	25	200	36.3 J
Magnesium	ppb	35000*		104000
Manganese	ppb	300	750	2030 E
Sodium	ppb	20000		566000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-1 Concentration
date:				30-Jul-92
Ammonia Nitrogen	ppm	2	26.4	637
Chloride	ppm	250		3740
Sulfate	ppm	250		379
Total Dissolved Solids	ppm	500		12900
Benzene	ppb	0.7	10	4 J
Chlorobenzene	ppb	5		5 J
Ethylbenzene	ppb	5	100	15
Toluene	ppb	5	100	81
Xylenes (total)	ppb	5	100	65
Arsenic	ppb	25	70	40.3 +
Barium	ppb	1000	4000	1060
Boron	ppb	1000		8900
Chromium	ppb	50	1000	289
Cobalt	ppb	34	400	54.2
Iron	ppb	300	4000	9760 E
Lead	ppb	25	200	104
Magnesium	ppb	35000*		80200
Sodium	ppb	20000		4146000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-118 (3) Concentration
date:				29-Jul-92
Ammonia Nitrogen	ppm	2	26.4	96.8
Chloride	ppm	250		10570
Nitrate Nitrogen	ppm	10		23
Sulfate	ppm	250		594
Total Dissolved Solids	ppm	500		24500
Cyanide	ppb	100	10	267
Iron	ppb	300	4000	978
Magnesium	ppb	35000*		740000
Sodium	ppb	20000		7592000
Thallium	ppb	4*		13.5 B

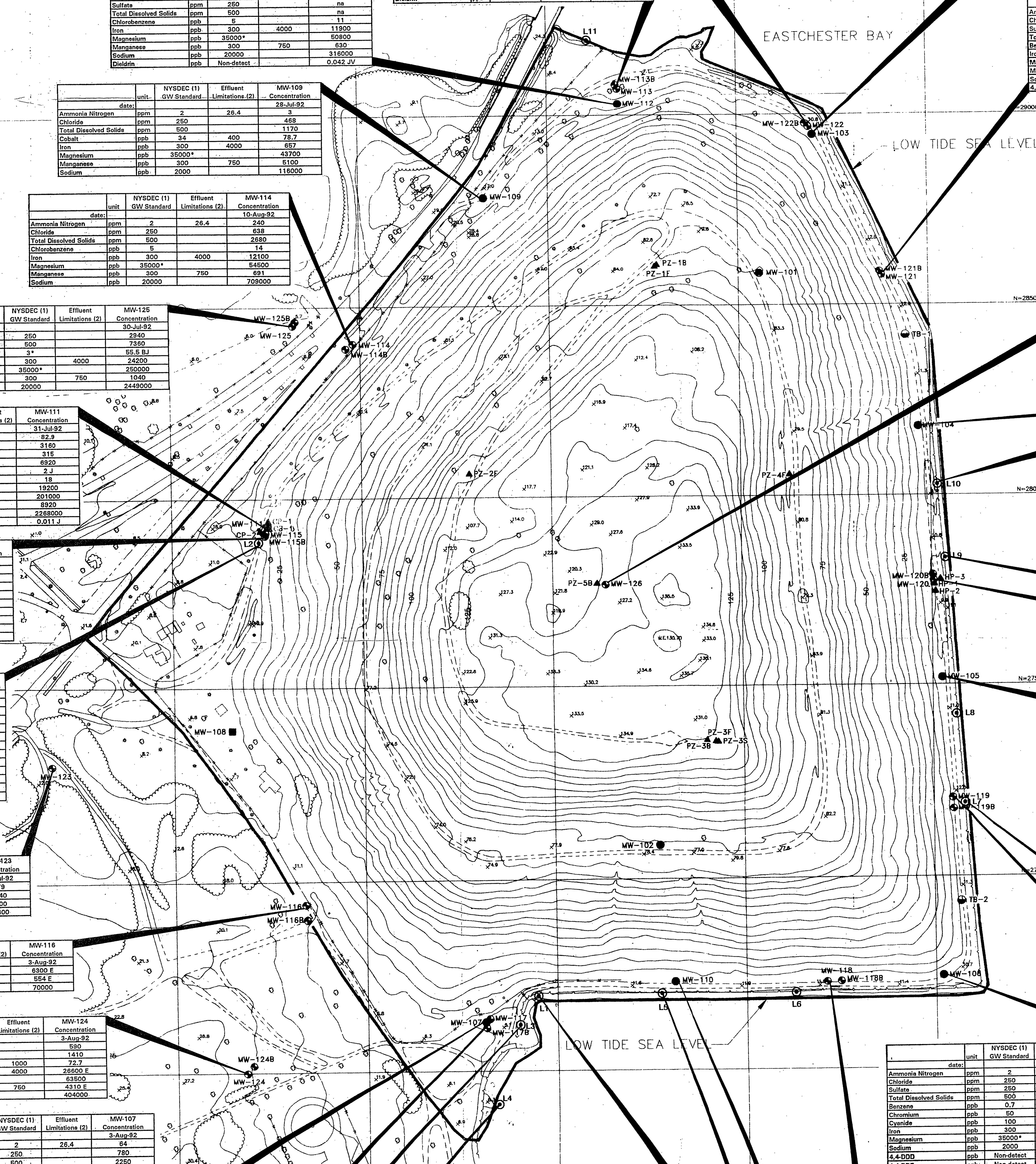
	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-117 Concentration
date:				31-Jul-92
Ammonia Nitrogen	ppm	2	26.4	221
Chloride	ppm	250		1990
Total Dissolved Solids	ppm	500		3710
Chromium	ppb	50	1000	60.3
Cobalt	ppb	34	400	39.2 B
Iron	ppb	300	4000	22200
Magnesium	ppb	35000*		75900
Manganese	ppb	300	750	1910
Sodium	ppb	20000		1000000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-110 (3) Concentration
date:				29-Jul-92
Ammonia Nitrogen	ppm	2	26.4	113
Chloride	ppm	250		5120
Sulfate	ppm	250		435
Total Dissolved Solids	ppm	500		10540
Iron	ppb	300	4000	9770
Lead	ppb	25	200	68.3
Magnesium	ppb	35000*		288000
Sodium	ppb	2000		3150000
4,4-DDD	ppb	Non-detect		0.015 J
4,4-DDE	ppb	Non-detect		0.011 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-3 Concentration
date:				30-Jul-92
Ammonia Nitrogen	ppm	2	26.4	5.54
Chloride	ppm	250		11400
Sulfate	ppm	250		1770
Total Dissolved Solids	ppm	500		26100
Boron	ppb	1000		2520
Iron	ppb	300	4000	4070 E
Magnesium	ppb	35000*		899000
Sodium	ppb	20000		7912000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-4 Concentration
date:				30-Jul-92
Ammonia Nitrogen	ppm	2	26.4	151
Chloride	ppm	250		1170
Total Dissolved Solids	ppm	500		3190
Chlorobenzene	ppb	5		10
Boron	ppb	1000		1570
Iron	ppb	300	4000	2990 E
Magnesium	ppb	35000*		46300
Manganese	ppb	300	750	546
Sodium	ppb	20000		862000
1,2 Dichlorobenzene	ppb	4.7		5 J
1,3 Dichlorobenzene	ppb	5		5 J
1,4-Dichlorobenzene	ppb	4.7		9 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	LS-5 Concentration
date:				30-Jul-92
Ammonia Nitrogen	ppm	2	26.4	373
Chloride	ppm	250		12250 J
Sulfate	ppm	250		1680
Total Dissolved Solids	ppm	500		24300
Antimony	ppb	3*		70.3
Arsenic	ppb	25	70	89.1
Barium	ppb	1000	4000	1490
Boron	ppb	1000		4680
Chromium	ppb	50	1000	390
Cobalt	ppb	34	400	61.7
Copper	ppb	200	400	977
Iron	ppb	300	4000	136000 E
Lead	ppb	25	200	707
Magnesium	ppb	35000*		481000
Manganese	ppb	300	750	2260
Mercury	ppb	2		2
Sodium	ppb	20000		5931000
Zinc	ppb	300	400	1330
4,4-DDD	ppb	Non-detect		0.015 JV
4,4-DDE	ppb	Non-detect		0.026 V
Dieldrin	ppb	Non-detect		0.24 V



NOTES:

1. NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, WATER QUALITY STANDARDS AND GUIDANCE VALUES, SEPTEMBER 25, 1990, NYCRR PART 700–705
2. NYSDEC DRAFT SURFACE WATER DISCHARGE EFFLUENT LIMITATIONS (NOVEMBER 23, 1992).
3. ARCHIVED PORTION OF SAMPLE REANALYZED FOR PESTICIDE AND PCB DATA.

LEGEND:

B– BLANK CONTAMINANT

J– ESTIMATED VALUE

V– REPORTED RESULTS FOR THIS COMPOUND COULD NOT BE VERIFIED DURING DATA VALIDATION

E– ESTIMATED VALUE DUE TO MATRIX INTERFERENCE

N– ESTIMATED VALUE (SPIKED SAMPLE RECOVERY WAS NOT WITHIN QUALITY CONTROL LIMITS)

+ – ESTIMATED VALUE (THE CORRELATION COEFFICIENT REPORTED FOR THE MSA IS LESS THAN 0.995)

na – NOT ANALYZED

* – GUIDANCE VALUE, REGULATED STANDARD FOR THIS CHEMICAL IS NOT AVAILABLE

0 150 300 FT
SCALE

KEY

FENCE

SITE BOUNDARY

LEGEND:

MW-103 MONITORING WELLS INSTALLED 1989

MW-108 MONITORING WELL DESTROYED DURING IRM

PZ-3B PIEZOMETERS INSTALLED 1992

MW-113 MONITORING WELLS INSTALLED 1992

MW-116B BEDROCK WELLS INSTALLED 1992

TB-1 TEST BORING ADVANCED 1992

L1 LEACHATE SEEP LOCATION

NOTES:

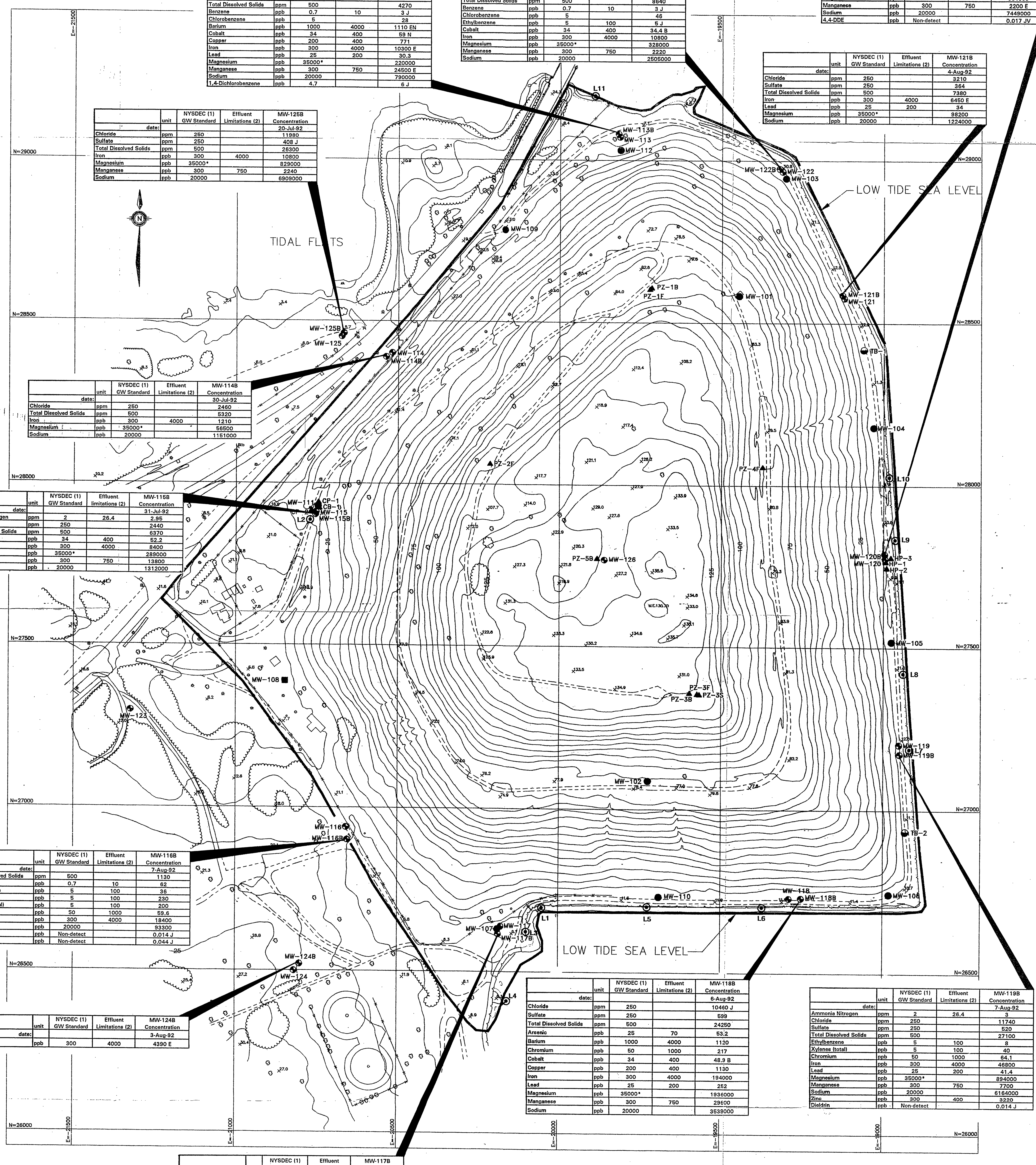
1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MSL
3. CONTOUR INTERVAL = 5 FEET

MAP SOURCE:
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

COMPARISON OF CONSTITUENT LEVELS TO NYSDEC GROUNDWATER STANDARDS AND EFFLUENT LIMITATIONS IN SHALLOW WELL AND SEEP SAMPLES
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.: 92C4087
CK'D BY:	TRP	DATE:	APR. 13, 1993	FIG. NO.: 4–25A



	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-113B Concentration
date:				5-Aug-92
Ammonia Nitrogen	ppm	2	26.4	26.7
Chloride	ppm	250		1130
Total Dissolved Solids	ppm	500		4270
Benzene	ppb	0.7	10	3 J
Chlorobenzene	ppb	5		28
Barium	ppb	1000	4000	1110 EN
Cobalt	ppb	34	400	59 N
Copper	ppb	200	400	771
Iron	ppb	300	4000	10300 E
Lead	ppb	25	200	30.3
Magnesium	ppb	35000*		220000
Manganese	ppb	300	750	24500 E
Sodium	ppb	20000		790000
1,4-Dichlorobenzene	ppb	4.7		6 J

	unit	NYSDEC (1) GW Standard	Effflueny Limitations (2)	MW-122B Concentration
date:				6-Aug-92
Chloride	ppm	250		3050 J
Total Dissolved Solids	ppm	500		8640
Benzene	ppb	0.7	10	3 J
Chlorobenzene	ppb	5		46
Ethylbenzene	ppb	5	100	5 J
Cobalt	ppb	34	400	34.4 B
Iron	ppb	300	4000	10800
Magnesium	ppb	35000*		328000
Manganese	ppb	300	750	2220
Sodium	ppb	20000		2505000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-120B Concentration
date:				4-Aug-92
Ammonia Nitrogen	ppm	2	26.4	3.28
Chloride	ppm	250		13560
Sulfate	ppm	250		494
Total Dissolved Solids	ppm	500		28300
Iron	ppb	300	4000	3760 E
Magnesium	ppb	35000*		901000
Manganese	ppb	300	750	2200 E
Sodium	ppb	20000		7449000
4,4-DDE	ppb	Non-detect		0.017 JV

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-121B Concentration
date:				4-Aug-92
Chloride	ppm	250		3210
Sulfate	ppm	250		364
Total Dissolved Solids	ppm	500		7380
Iron	ppb	300	4000	6450 E
Lead	ppb	25	200	34
Magnesium	ppb	35000*		98200
Sodium	ppb	20000		1224000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-125B Concentration
date:				20-Jul-92
Chloride	ppm	250		11980
Sulfate	ppm	250		408 J
Total Dissolved Solids	ppm	500		26300
Iron	ppb	300	4000	10800
Magnesium	ppb	35000*		829000
Manganese	ppb	300	750	2240
Sodium	ppb	20000		6909000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-114B Concentration
date:				30-Jul-92
Chloride	ppm	250		2460
Total Dissolved Solids	ppm	500		5320
Iron	ppb	300	4000	1210
Magnesium	ppb	35000*		56500
Sodium	ppb	20000		1151000

	unit	NYSDEC (1) GW Standard	Effluent limitations (2)	MW-115B Concentration
date:				31-Jul-92
Ammonia Nitrogen	ppm	2	26.4	2.95
Chloride	ppm	250		2440
Total Dissolved Solids	ppm	500		6370
Cobalt	ppb	34	400	52.2
Iron	ppb	300	4000	8400
Magnesium	ppb	35000*		289000
Manganese	ppb	300	750	13800
Sodium	ppb	20000		1312000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-116B Concentration
date:				7-Aug-92
Total Dissolved Solids	ppm	500		1130
Benzene	ppb	0.7	10	62
Ethylbenzene	ppb	5	100	36
Toluene	ppb	5	100	230
Xylenes (total)	ppb	5	100	200
Chromium	ppb	50	1000	59.6
Iron	ppb	300	4000	18400
Sodium	ppb	20000		93300
4,4-DDE	ppb	Non-detect		0.014 J
Dieldrin	ppb	Non-detect		0.044 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-124B Concentration
date:				3-Aug-92
Iron	ppb	300	4000	4390 E

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-118B Concentration
date:				6-Aug-92
Chloride	ppm	250		10460 J
Sulfate	ppm	250		599
Total Dissolved Solids	ppm	500		24250
Arsenic	ppb	25	70	53.2
Barium	ppb	1000	4000	1120
Chromium	ppb	50	1000	217
Cobalt	ppb	34	400	48.9 B
Copper	ppb	200	400	1130
Iron	ppb	300	4000	194000
Lead	ppb	25	200	252
Magnesium	ppb	35000*		1936000
Manganese	ppb	300	750	29600
Sodium	ppb	20000		3539000

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-119B Concentration
date:				7-Aug-92
Ammonia Nitrogen	ppm	2	26.4	3
Chloride	ppm	250		11740
Sulfate	ppm	250		520
Total Dissolved Solids	ppm	500		27100
Ethylbenzene	ppb	5	100	8
Xylenes (total)	ppb	5	100	40
Chromium	ppb	50	1000	64.1
Iron	ppb	300	4000	46800
Lead	ppb	25	200	41.4
Magnesium	ppb	35000*		894000
Manganese	ppb	300	750	7700
Sodium	ppb	20000		6164000
Zinc	ppb	300	400	3220
Dieldrin	ppb	Non-detect		0.014 J

	unit	NYSDEC (1) GW Standard	Effluent Limitations (2)	MW-117B Concentration
date:				7-Aug-92
Chloride	ppm	250		2150
Total Dissolved Solids	ppm	500		3110
Magnesium	ppb	35000*		144000
Sodium	ppb	20000		462000

KEY

- —x— FENCE
- ━━ SITE BOUNDARY

LEGEND:

- MW-103 ● MONITORING WELLS INSTALLED 1989
- MW-108 ■ MONITORING WELLS DESTROYED DURING IRM
- PZ-3B ▲ PIEZOMETERS INSTALLED 1992
- MW-113 MONITORING WELLS INSTALLED 1992
- MW-116B BEDROCK WELLS INSTALLED 1992
- TB-1 TEST BORING ADVANCED 1992
- L1 ⊙ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET

0 150 300 FT
SCALE

NOTES:

1. NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, WATER QUALITY STANDARDS AND GUIDANCE VALUES, SEPTEMBER 25, 1990, NYCRR PART 700–705
2. NYSDEC DRAFT SURFACE WATER DISCHARGE EFFLUENT LIMITATIONS (NOVEMBER 23, 1992).
3. ARCHIVED PORTION OF SAMPLE REANALYZED FOR PESTICIDE AND PCB DATA.

LEGEND:

B– BLANK CONTAMINANT

J– ESTIMATED VALUE

V– REPORTED RESULTS FOR THIS COMPOUND COULD NOT BE VERIFIED DURING DATA VALIDATION

E– ESTIMATED VALUE DUE TO MATRIX INTERFERENCE

N– ESTIMATED VALUE (SPIKED SAMPLE RECOVERY WAS NOT WITHIN QUALITY CONTROL LIMITS)

+ – ESTIMATED VALUE (THE CORRELATION COEFFICIENT REPORTED FOR THE MSA IS LESS THAN 0.995)

na– NOT ANALYZED

*– GUIDANCE VALUE, REGULATED STANDARD FOR THIS CHEMICAL IS NOT AVAILABLE

MAP SOURCE:
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

COMPARISON OF CONSTITUENT LEVELS TO NYSDEC GROUNDWATER STANDARDS AND EFFLUENT LIMITATIONS IN BEDROCK WELL SAMPLES
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD – CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	KJF	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	TRP	DATE:	APR. 13, 1993	FIG. NO.:	4–25B

File name: D:\92C4087\1A–BASE.DWG Last edited: 92/11/24 @ 19:34

Appendix F

Remedial Investigation Report -
Leachate Seeps Tables and Figures

Table 4-24
Seeps - Volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
Halogenated Aliphatic Compounds									
Methylene chloride	2 JBR#	2 JBR#	2 JBR#	19 JBR#	12 JBR#	11 JBR#	2 JBR#	1 JBR#	2 JBR#
Total									
Ketones									
2-Butanone	62								
2-Propanone	13 JR#						12		
Total	62						12		
Monocyclic Aromatic Hydrocarbons									
Benzene	4 J						4 J	2 J	
Chlorobenzene	5 J	2 J		10	2 J		12	4 J	2 J
Ethylbenzene	15				1 J		5	2 J	
Toluene	81						7		
Xylenes (total)	65						8	4 J	
Total	170	2		10	3		36	12	2
Miscellaneous									
Carbon Disulfide	3 J						1 J		
Total	3						1		
Grand Total	235	2		10	3		49	12	2

Notes:

All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
Totals do not include compounds with "R#" qualifier
B = Blank contaminant
J = Estimated value
R# = Negated

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-25
Seeps - Semi-volatile Organic Compounds Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
PAHs									
2-Methylnaphthalene	5 J						4 J		
Acenaphthene	12						3 J		
Anthracene	8 J								
Dibenzofuran	9 J	10							
Fluorene	12								
Naphthalene							33	3 J	
Phenanthrene	24						3 J		
Pyrene	4 J								
Total	74	10					43	3	
Phenols									
2,4-Dimethylphenol	7 J						51		
4-Methylphenol	8 J								
4-Nitrophenol		4 J							
Total	15	4					51		
Phthalates									
Bis(2-Ethylhexyl) Phthalate	13	5 J					5 J	3 J	7 J
Di-n-butyl phthalate							3 J	2 J	
Di-n-octyl phthalate	2 J								
Total	15	5					8	5	7
Chlorinated Hydrocarbons									
1,2-Dichlorobenzene				5 J					
1,3-Dichlorobenzene				5 J					
1,4-Dichlorobenzene				9 J			4 J		
Total				19			4		
Miscellaneous									
Benzoic Acid		33 J							
Total		33							
Grand Total	104	52		19			106	8	7

Notes: All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
J = Estimated value

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-26
Seeps - Pesticides and PCBs Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2AR	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
4,4'-DDD		0.042 JV			0.015 JV				0.078 JV
4,4'-DDE		0.049 JV			0.026 V			0.078 JV	
Aldrin									0.058 JV
alpha-Chlordane		0.025 JV							
beta-BHC		0.033 JV							
delta-BHC		0.047 JV		0.01 JV	0.028 JV	0.0099 J			0.03 JV
Dieldrin					0.24 V		0.23 V	0.64 V	0.024 JV
Endosulfan II							1.5 V		
Endosulfan sulfate		0.042 BJVR#			0.028 BJVR#				
Endrin	0.023 JV							0.062 JV	
Methoxychlor								0.65 V	
PCB-1016		0.88 J							

Notes:
All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
B = Blank contaminant
J = Estimated value
V = Reported results for this compound could not be verified during data validation
R# = Negated result

Prepared by: CLH
Checked by: TRP
92C4087

Table 4-27
Seeps - Inorganics Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-3	LS-4	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
Aluminum	2380	1300	839		65800	501	4480	3410	60300
Antimony					70.3				
Arsenic	40.3 +	7.5 B	2.7 BW	8.3 B	89.1		18.7 B+	14.5	1.6 B
Barium	1060	660	104 B	287	1490	123 B	590	844	8470
Beryllium					1 B				1.2 BJ
Boron	8900	4200	2520	1570	4680	2820	6910	6800	4330
Cadmium									29.1
Calcium	35600	76500	282000	65600	218000	228000	134000	116000	301000
Chromium	289	62.3		27.2	390	26	293	180	483
Cobalt	54.2	16.2 B		12.5 B	61.7		34.8 B	24.4 B	57.4
Copper	56.8	41.6	20.7 B	6.1 B	977	11.7 B	54.8	70.7	852
Cyanide		20.4							26.2
Iron	9760 E	44400 E	4070 E	2990 E	136000 E	2970 E	12500 E	24900 E	860000 E
Lead	104	146	17.4	3 B	707	7 B+	58.5	88.7	2780
Magnesium	80200	66400	899000	46300	481000	795000	333000	175000	120000
Manganese	130	259	140	546	2260	162	523	239	4290
Mercury		0.34			2	5			1.6
Nickel	127 J	25.4 BJ		46.8 J	137 J		54 J	48.7 J	161 J
Potassium	650000	269000	306000	101000	402000	282000	562000	456000	256000
Silver					12.1				
Sodium	4146000	743000	7912000	862000	5931000	7587000	5676000	2781000	672000
Thallium						16.77			
Vanadium	562	29.8 B	4.9 B	34.2 B	368	46 B	822	397	367
Zinc	226	201	48.8	48.4	1330	28.1	136	177	3710

Notes: All concentrations in micrograms per liter (ppb)
Blank indicates compound was not detected
B = Reported value is acceptable. Reported value is less than the CRDL (Contract Required Detection Limit) but greater than the IDL (Instrument Detection Limit)
J = Estimated value
E = Estimated value due to matrix interference
W = Estimated value (Post-digestion spike results were reported outside quality control limits, while sample absorbance is less than 50% of spike absorbance)
+ = Estimated value (The correlation coefficient reported for the MSA is less than 0.995)

Prepared by: CLH
Checked by: TRP
92C4087

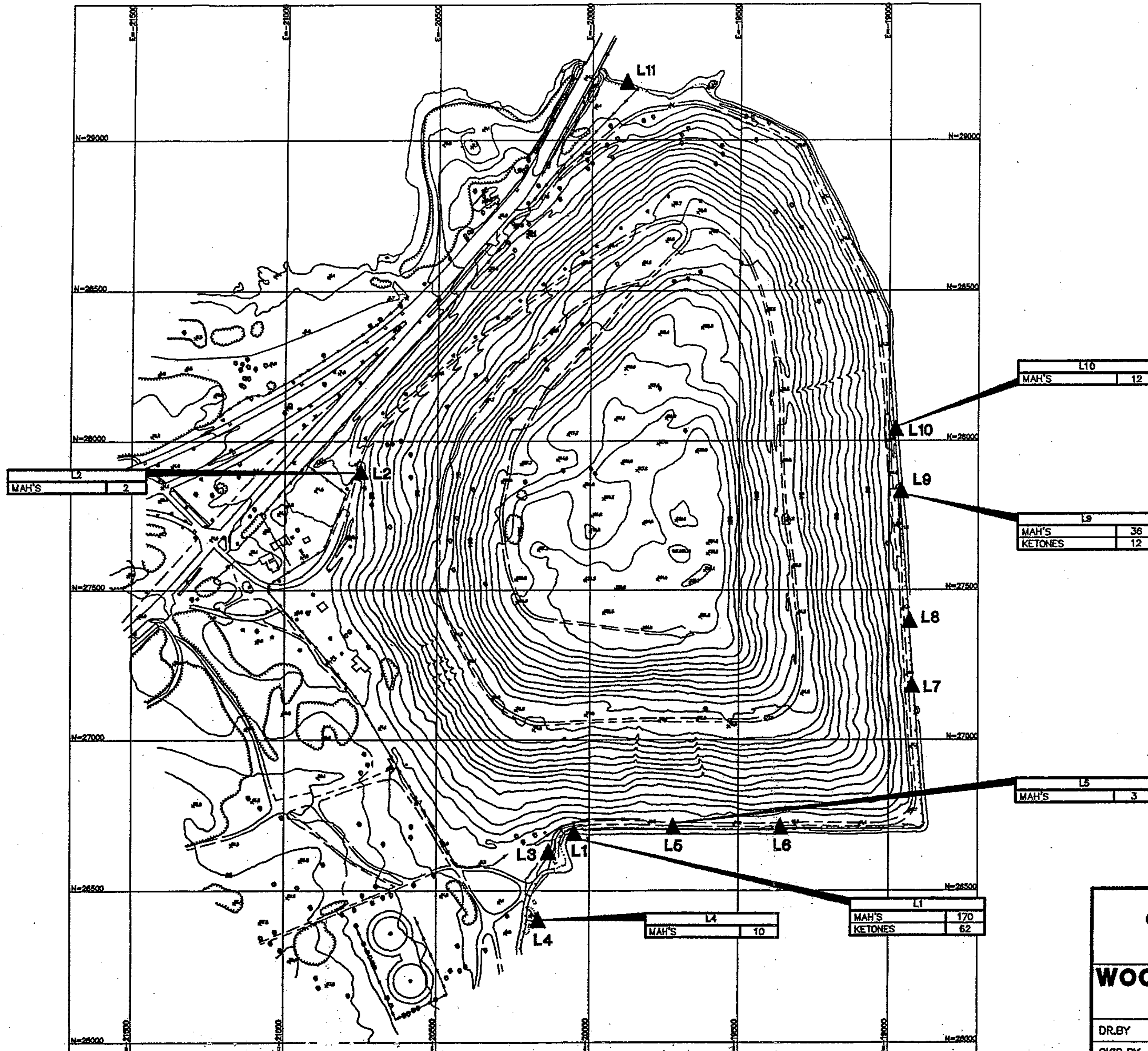
Table 4-28
Seeps - Conventional Parameters (Modified BMW List) Data Summary
Pelham Bay Landfill
Bronx, New York

	LS-1	LS-2	LS-2D	LS-3	LS-4	LS-4 D	LS-5	LS-7	LS-9	LS-10	LS-2 DUP
date:	30-Jul-92	28-Jul-92	28-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	30-Jul-92	29-Jul-92	29-Jul-92	30-Jul-92
Alkalinity as Bicarbonate	5900	2300		200	1170	1190	1030	610	801	3320	6000
Alkalinity as Carbonate		80	84							98	
Ammonia Nitrogen	637	74.8		5.54	151	161	373	44.2	404	85.1	317
BOD	190	41		< 3	24		277	7	157	107	NA
Chemical Oxygen Demand		716 J			369 J		2040 J	295 J		1230 J	2370 J
Chloride	3740	1420		11400	1170	1140	12250 J	11680	6830	2860 J	1310
Color, Pt/Co	300	200		60	200		240	200	300	200	NA
Hardness	419	465		4410	354	332	2520	3840	1710	1010	1240
Hexavalent Chromium	0.4	0.08		< 0.01	0.03		0.02	0.02	0.56	0.21	NA
Nitrate Nitrogen	0.06	0.71		0.44	1.02	1.01	6.26 J	0.24	0.35	0.35.	0.22
Odor, T.O.N	10	10		1	10		50	10	10	10	NA
Phenolics	0.12 J								0.1 J		
Sulfate	379	110		1770	157	155	1680	1690	599	335	320
Total Dissolved Solids	12900	2850 J		26100	3190	3180	24300	24400	17460	8420	3250
Total Kjeldahl Nitrogen	1110 J	366 J		6.27 J	175 J		506 J	75.6 J	718 J	542 J	408 J
Total Organic Carbon	1900	450		14	140	140	110	59		780	360
Total Volatile Solids	1480	641		3560	307	314	4500	3170	2120	1060	2510

Notes:

All concentrations in milligrams per liter (ppm) except for color and odor
Blank indicates compound was not detected
D = Laboratory QA/QC duplicate
J = Estimated value
NA = Not Analyzed

Prepared by: CLH
Checked by: TRP
92C4087



LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATION IN ug/l

MAH'S – MONOCYCLIC AROMATIC HYDROCARBONS

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

SEEP LOCATIONS SHOWING
CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-21

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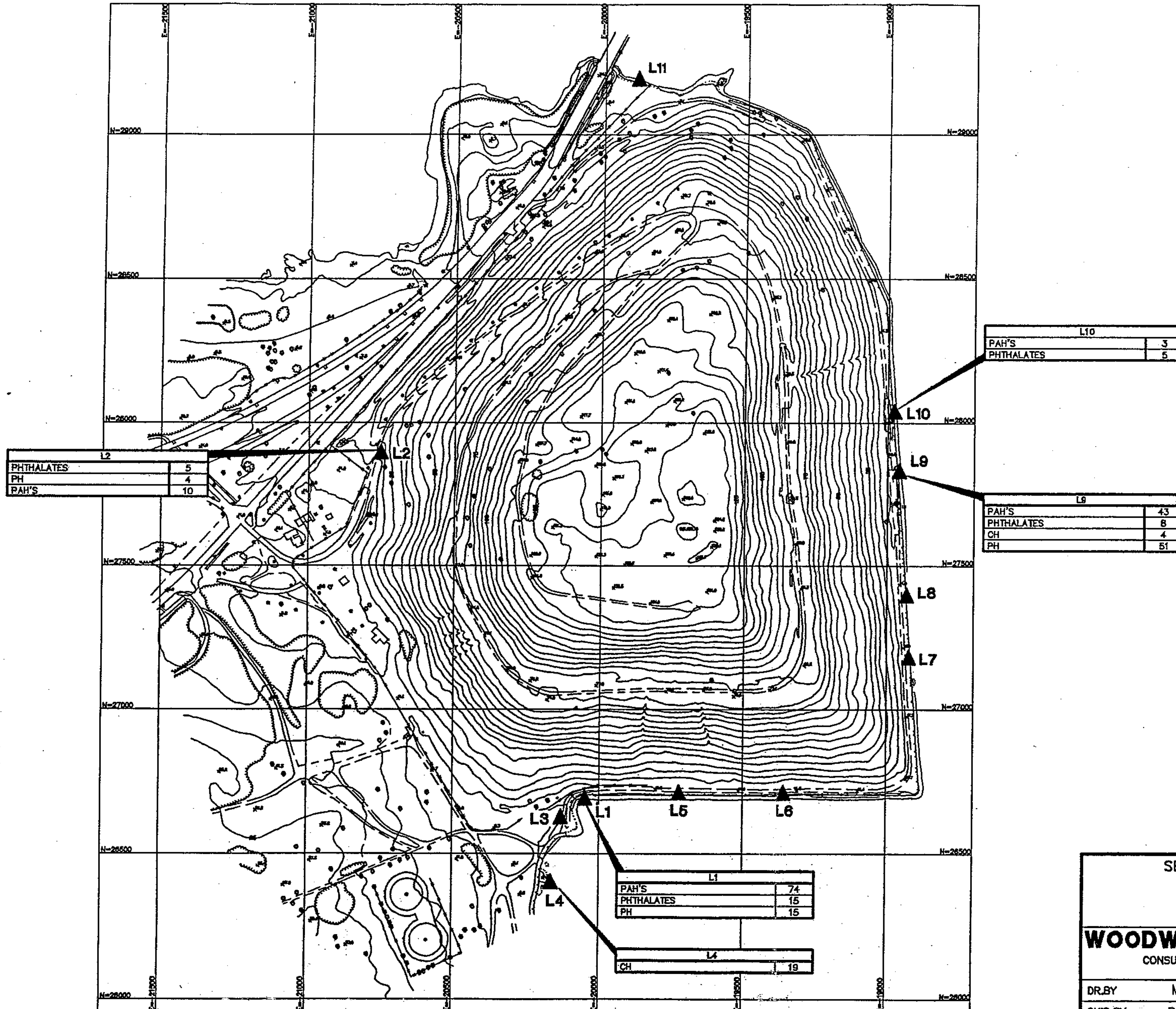

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATIONS IN ug/l

PAH'S – POLYNUCLEAR AROMATIC HYDROCARBONS
CH – CHLORINATED HYDROCARBONS
PH – PHENOLIC COMPOUNDS

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

SEEP LOCATIONS SHOWING CONCENTRATIONS OF SEMI-VOLATILE ORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-22

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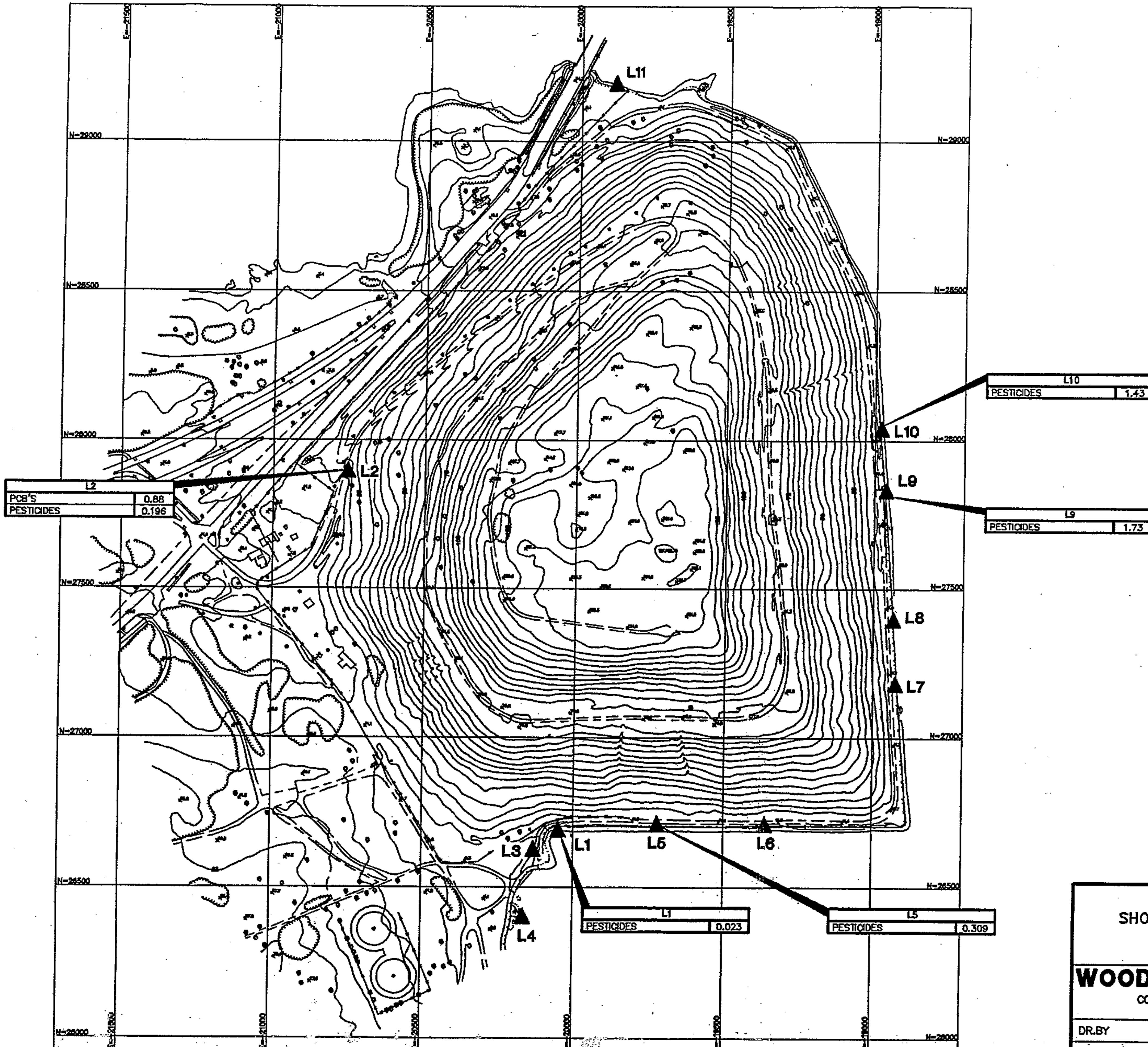

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATIONS IN ug/l

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

SEEP LOCATIONS
SHOWING CONCENTRATIONS OF PESTICIDES AND PCBs
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV 23 1992	FIG.NO.	4-23

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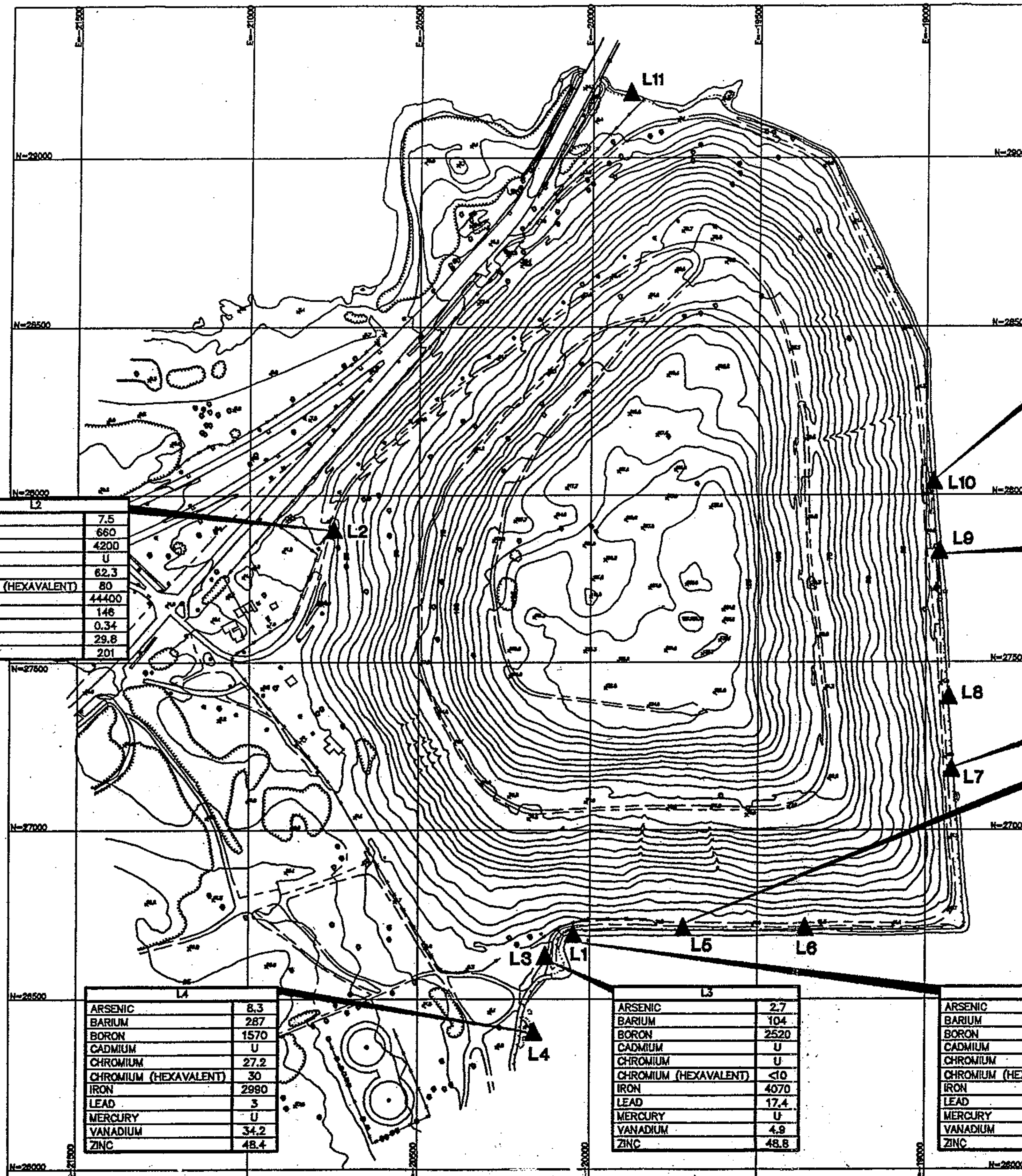


L10	
ARSENIC	14.5
BARIUM	844
BORON	6800
CADMIUM	U
CHROMIUM	180
CHROMIUM (HEXAVALENT)	210
IRON	24900
LEAD	88.7
MERCURY	U
VANADIUM	397
ZINC	177

L9	
ARSENIC	18.7
BARIUM	590
BORON	6910
CADMIUM	U
CHROMIUM	293
CHROMIUM (HEXAVALENT)	560
IRON	12500
LEAD	58.5
MERCURY	U
VANADIUM	822
ZINC	136

L7	
ARSENIC	U
BARIUM	123
BORON	2820
CADMIUM	U
CHROMIUM	26
CHROMIUM (HEXAVALENT)	20
IRON	2970
LEAD	7
MERCURY	5
VANADIUM	46
ZINC	28.1

L5	
ARSENIC	89.1
BARIUM	1490
BORON	4680
CADMIUM	U
CHROMIUM	390
CHROMIUM (HEXAVALENT)	20
IRON	136000
LEAD	707
MERCURY	2
VANADIUM	368
ZINC	1330

L2	
ARSENIC	7.5
BARIUM	660
BORON	4200
CADMIUM	U
CHROMIUM	62.3
CHROMIUM (HEXAVALENT)	80
IRON	44400
LEAD	146
MERCURY	0.34
VANADIUM	29.8
ZINC	201

L4	
ARSENIC	8.3
BARIUM	287
BORON	1570
CADMIUM	U
CHROMIUM	27.2
CHROMIUM (HEXAVALENT)	30
IRON	2980
LEAD	3
MERCURY	U
VANADIUM	34.2
ZINC	48.4

L3	
ARSENIC	2.7
BARIUM	104
BORON	2520
CADMIUM	U
CHROMIUM	U
CHROMIUM (HEXAVALENT)	<10
IRON	4070
LEAD	17.4
MERCURY	U
VANADIUM	4.9
ZINC	48.8

L1	
ARSENIC	40.3
BARIUM	1060
BORON	8900
CADMIUM	U
CHROMIUM	289
CHROMIUM (HEXAVALENT)	400
IRON	9760
LEAD	104
MERCURY	U
VANADIUM	562
ZINC	226

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET
4. CONCENTRATIONS IN ug/l
5. U=NOT DETECTED

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541

ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT

SCALE

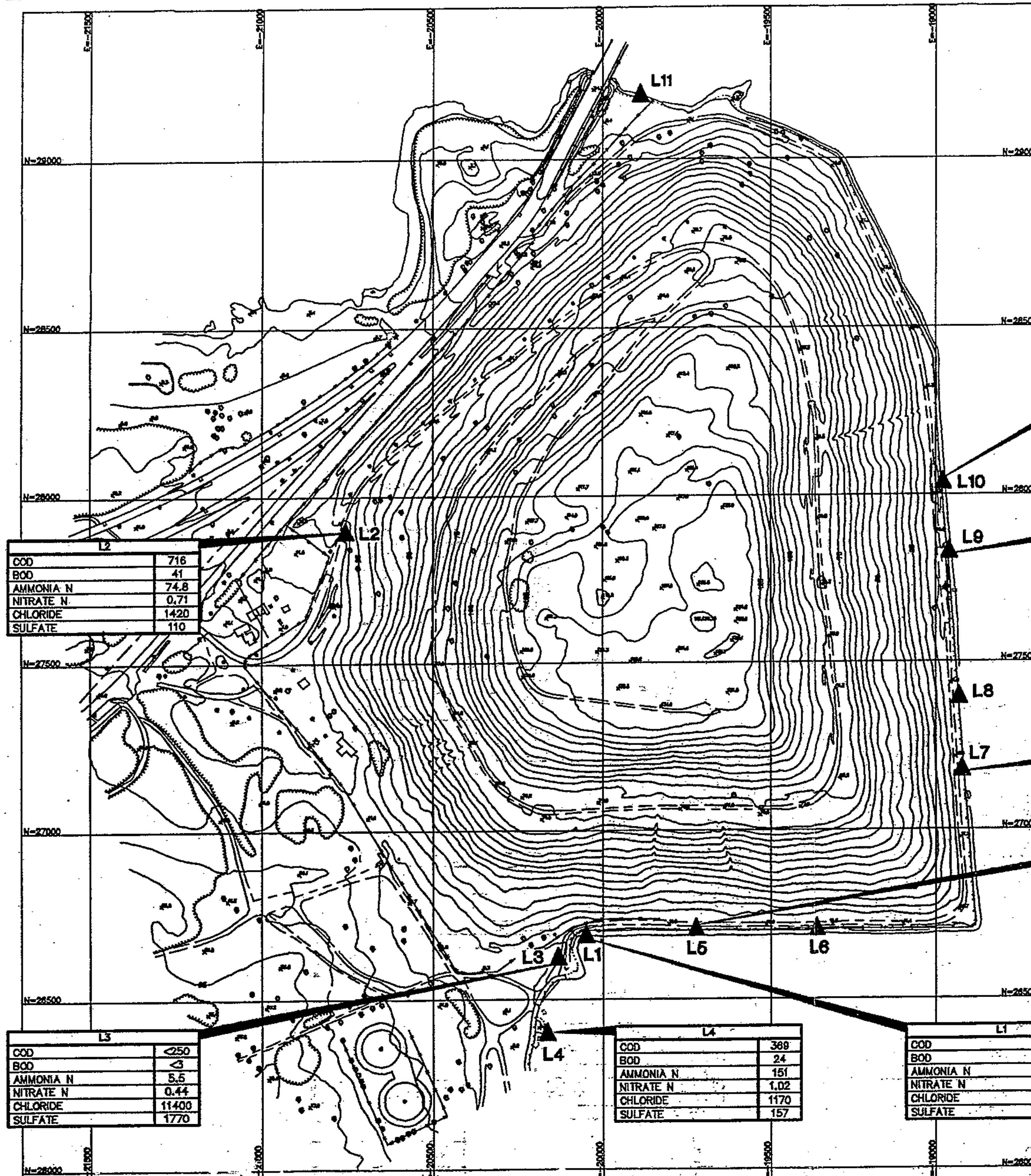
SEEP LOCATIONS
SHOWING CONCENTRATIONS OF INORGANIC COMPOUNDS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.

CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4–24

File name: C:\92C4087\INORGAN.DWG Last edited: 93/02/18 @ 09:29



L2	
COD	716
BOD	41
AMMONIA N	74.8
NITRATE N	0.71
CHLORIDE	1420
SULFATE	110

L3	
COD	<250
BOD	<3
AMMONIA N	5.5
NITRATE N	0.44
CHLORIDE	11400
SULFATE	1770

L4	
COD	369
BOD	24
AMMONIA N	151
NITRATE N	1.02
CHLORIDE	1170
SULFATE	157

L1	
COD	<500
BOD	190
AMMONIA N	637
NITRATE N	0.06
CHLORIDE	3740
SULFATE	379

L10	
COD	1230
BOD	107
AMMONIA N	85.1
NITRATE N	0.35
CHLORIDE	11340
SULFATE	355

L9	
COD	<500
BOD	157
AMMONIA N	404
NITRATE N	0.35
CHLORIDE	6830
SULFATE	599

L7	
COD	295
BOD	7
AMMONIA N	44.2
NITRATE N	0.24
CHLORIDE	11680
SULFATE	1690

L5	
COD	2040
BOD	277
AMMONIA N	373
NITRATE N	0.42
CHLORIDE	3380
SULFATE	1680

LEGEND:

L1 ▲ LEACHATE SEEP LOCATION

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET.
4. CONCENTRATIONS IN mg/l.

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541.
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

SEEP LOCATIONS SHOWING
CONVENTIONAL PARAMETER CONCENTRATIONS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR.BY	MG	SCALE	AS SHOWN	PROJ.	92C4087
CK'D.BY	DAD	DATE	NOV. 23, 1993	FIG.NO.	4-25

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Appendix G

Remedial Investigation Report - Soil Gas Tables and Figures

Table 4-79
Results of Perimeter Soil Gas Survey
Pelham Bay Landfill
Bronx, New York

Sample Number	Depth (inches)	Date	Time	%LEL (background)	%LEL (measured)	%O2 (background)	%O2 (measured)	PPM H2S (background)	PPM H2S (measured)
SG92-1	19.75	9/2/92	1100	0	0	21.0	21.0	0.0	0.5
SG92-2	26.25	9/2/92	1106	0	0	21.0	20.8	0.3	0.5
SG92-3	37.00	9/2/92	1110	0	10	20.8	20.2	0.4	0.5
SG92-4	38.50	9/2/92	1120	1	>100	21.3	16.0	0.3	0.5
SG92-5	43.00	9/2/92	1130	0	>100	21.0	16.0	0.0	0.2
SG92-6	43.00	9/2/92	1140	0	0	21.0	20.5	0.0	0.5
SG92-7	30.50	9/2/92	1200	0	0	20.3	20.3	0.2	0.2
VENT-1	0.00	9/2/92	1330	0	15	21.0	20.6	0.0	0.0
VENT-1A	0.00	9/2/92	1335	0	>100	21.0	2.2	0.0	1.2
VENT-2	0.00	9/2/92	1350	1	1	20.6	20.6	0.1	0.1

Notes: LEL = Lower Explosive Limit
ppm = Parts per million.

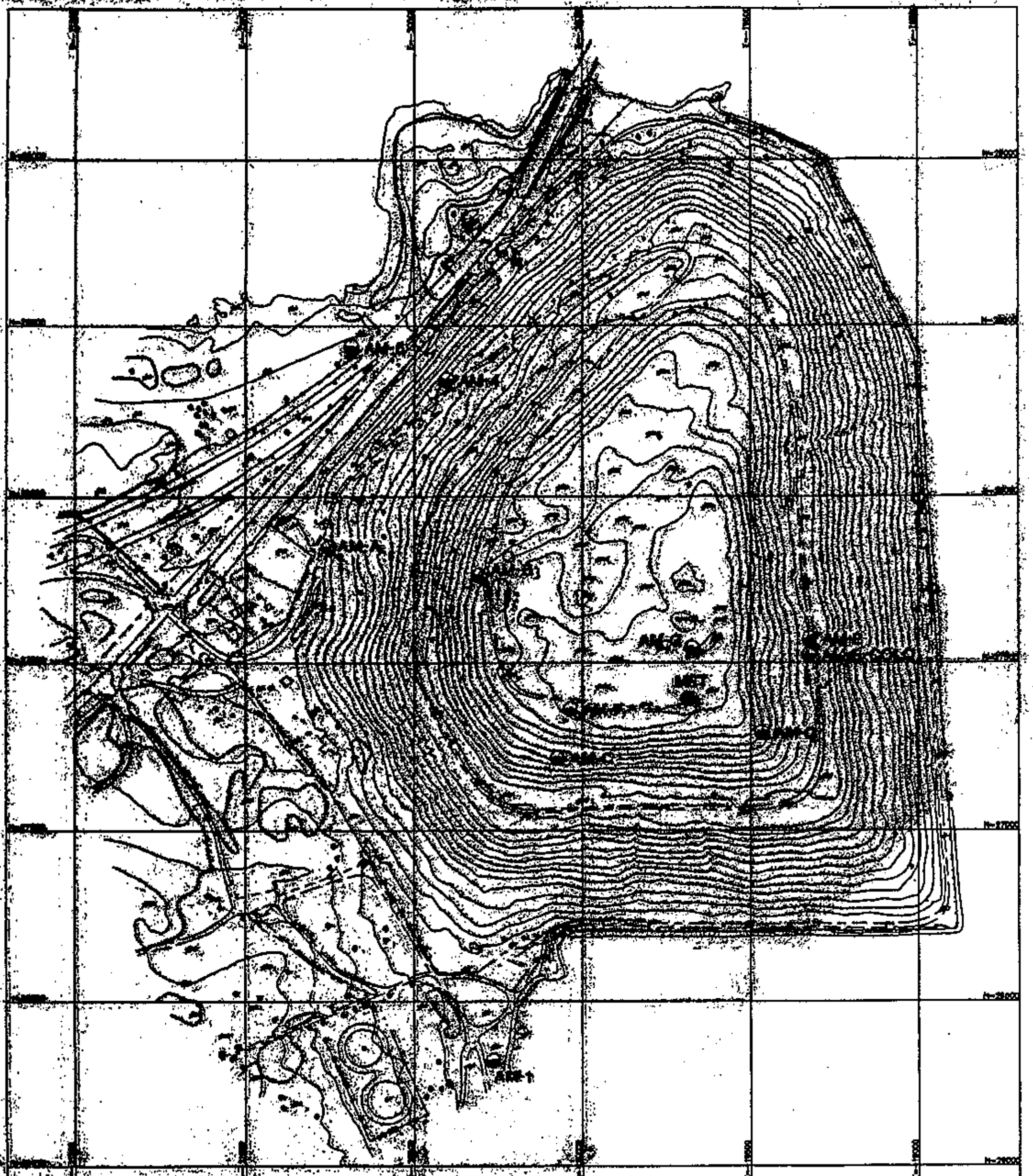
Prepared by: DA
Checked by: PGN
92C4087

Table 4-80
EIFC Compound Emission Rates
Pelham Bay Landfill
Bronx, New York

Compound	AM-A	AM-B	AM-C	AM-D	AM-E	AM-F	AM-G	AM-1
1,1,1-Trichloroethane	0.0004	0.0045	0.0014	1.5485	0.0009	<0.0005	1.4453	0.0006
1,2,4-Trichlorobenzene	<0.0011	0.0035	<0.0013	<0.0016	<0.0006	0.0007	<0.0010	<0.0004
1,2,4-Trimethylbenzene	0.0029	0.0439	0.0791	<0.0011	0.0558	0.0016	0.0035	0.0015
1,2-Dichlorobenzene	<0.0004	<0.0014	0.0426	0.0152	0.0720	<0.0005	<0.0008	<0.0003
1,2-Dichloroethylene	<0.0003	0.0042	<0.0031	<0.0009	0.0046	<0.0003	<0.0005	<0.0002
1,3,5-Trimethylbenzene	0.0009	0.0151	0.0348	0.0175	0.0260	0.0006	0.0038	0.0004
1,3-Dichlorobenzene	<0.0008	0.0069	0.0309	0.0120	0.0261	<0.0005	0.0019	<0.0003
1,4-Dichlorobenzene	0.0025	0.1458	0.1973	0.0338	0.0833	0.0005	0.0248	0.0021
2-Propanone	0.0090	0.0379	0.0520	0.0316	0.1362	0.0197	0.0224	0.0076
Ammonia Nitrogen	10.2633	<0.2349	<0.2533	<0.2454	<0.2578	<0.2648	<0.2429	<0.2836
Benzene	0.0006	0.0245	0.1007	0.0131	0.2013	0.0005	0.0086	0.0005
Bromoform	0.0007	0.0030	0.0019	<0.0027	0.0009	0.0010	0.0015	0.0006
Carbon Disulfide	0.0020	0.0022	0.0017	0.0023	0.0029	0.0014	0.0011	0.0006
Chlorobenzene	0.0019	0.0353	0.7109	0.0500	1.1312	<0.0004	0.0325	0.0007
Cumene	0.0011	0.0085	0.0981	<0.0011	0.0310	0.0006	0.0021	<0.0002
Ethylbenzene	0.0007	0.0277	0.3074	0.0029	0.0438	0.0004	0.0066	0.0006
Freon 11	0.0011	0.0024	0.0012	0.0014	0.0015	0.0013	<0.0012	0.0010
Freon 113	0.0160	<0.0018	<0.0014	<0.0017	<0.0006	<0.0006	<0.0010	0.0006
Freon 114	<0.0004	0.0085	<0.0049	<0.0015	0.0128	<0.0006	<0.0009	<0.0003
Freon 12	<0.0003	<0.0012	<0.0009	0.0221	<0.0004	<0.0004	<0.0006	0.0009
Heptane	<0.0003	0.0419	0.0040	0.0021	<0.0003	<0.0003	0.0013	<0.0002
Hexachlorobutadiene	<0.0020	<0.0025	<0.0019	<0.0023	<0.0009	0.0014	<0.0014	<0.0005
Hydrogen Sulfide	<0.0013	<0.0007	0.0213	<0.0009	<0.0009	<0.0014	<0.0009	<0.0009
Methane	<0.8284	4606.1000	6331.9000	1624.1000	9093.5000	<1.0457	965.4000	<0.6457
Methylene Chloride	0.0006	<0.0008	<0.0006	<0.0008	<0.0003	0.0007	<0.0004	<0.0002
Styrene	0.0180	0.0139	0.0060	0.0098	0.0062	0.0024	0.0075	0.0105
Tetrachloroethylene	<0.0004	0.0031	<0.0012	<0.0015	<0.0006	<0.0006	0.0022	0.0006
Toluene	0.0809	0.0722	0.0242	0.0432	0.0332	<0.0004	0.0184	0.0121
Trichloroethylene	<0.0003	0.0015	<0.0010	<0.0012	<0.0004	<0.0004	<0.0007	<0.0003
Xylenes	0.0025	0.0665	0.0503	0.0147	0.0224	0.0019	0.0064	0.0016

Notes:
All values are ug/m^2-sec
This table lists only those compounds detected at least once
The value following the "<" indicates the minimum level of detection for that compound
These numbers have not been reviewed

Prepared by: BW
Checked by: RJM
92C4087



LEGEND

AIR MONITORING STATION

METERLOGICAL STATION

NOTE:

1. OFF-SITE LOCATIONS AM-5, AM-1, AM-4 ARE ALSO INCLUDED ON THIS FIGURE.

MAP SOURCE:

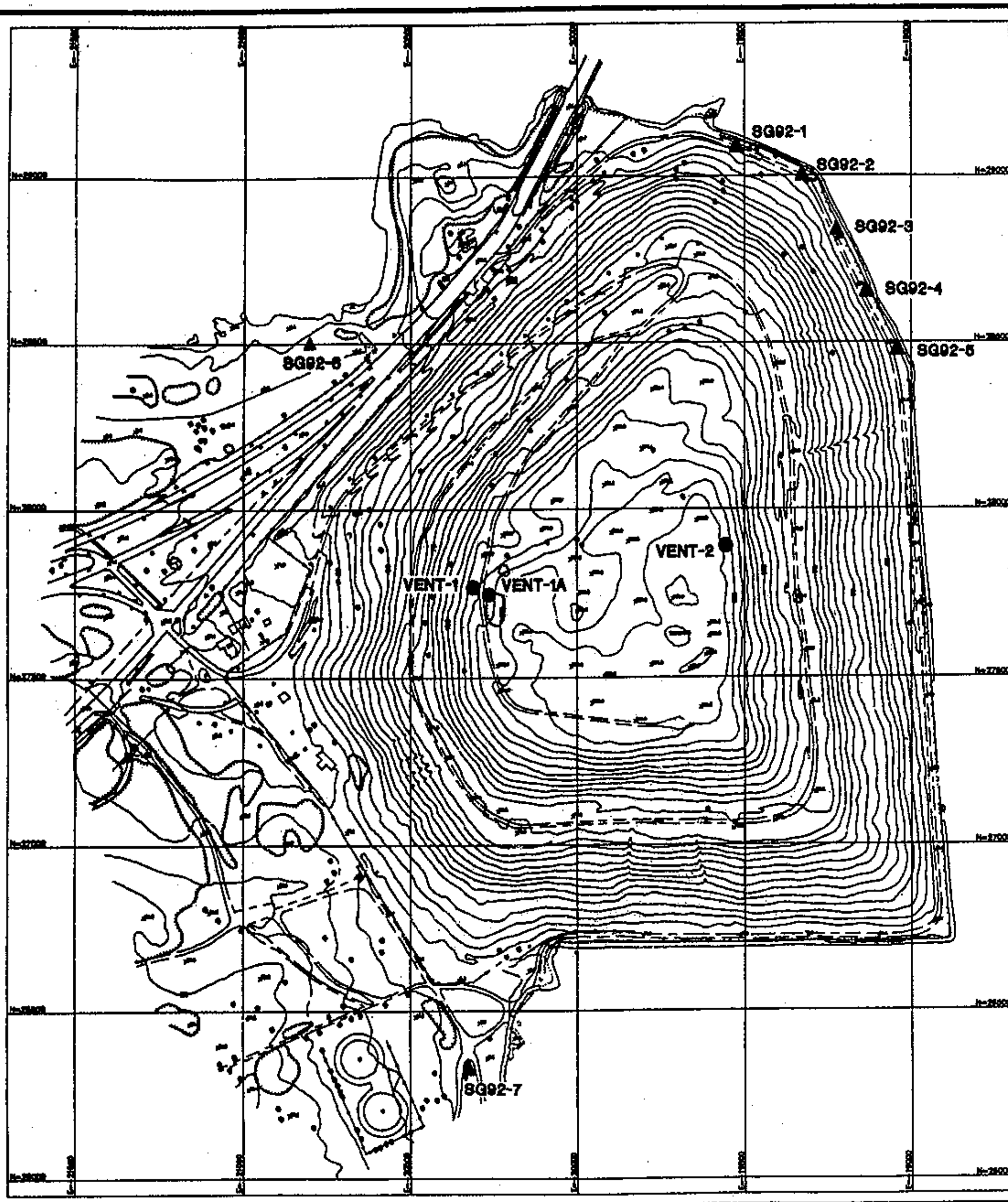
ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

ON-SITE AIR MONITORING LOCATIONS
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	BAS	SCALE:	AS SHOWN	PROJ. NO.:	92C4087
CK'D BY:	PAR	DATE:	OCT. 8, 1992	FIG. NO.:	2-2



LEGEND:

SG92-2 ▲ SOIL GAS

VENT-1 ● FISSURE VENTS

NOTES:

1. COORDINATES AND BEARINGS IN BRONX HIGHWAY DATUM.
2. ELEVATIONS ABOVE BRONX DATUM = 2.608 FT ABOVE MEAN SEA LEVEL.
3. CONTOUR INTERVAL = 5 FEET

MAP SOURCE:

ETTLINGER & ETTLINGER DRAWING NUMBER 87541
ETTLINGER & ETTLINGER SITE SURVEY 1992.

0 350 700 FT
SCALE

PERIMETER SOIL GAS LOCATION MAP
PELHAM BAY LANDFILL
BRONX, NEW YORK

WOODWARD-CLYDE CONSULTANTS, INC.
CONSULTING ENGINEERS, GEOLOGISTS AND ENVIRONMENTAL SCIENTISTS
NEW YORK, NEW YORK

DR. BY:	MG	SCALE:	AS SHOWN	PROJ. NO.:	92C4087		
CK'D BY:	REC	DATE:	SEPT. 21, 1992	FIG. NO.:	2-14		

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Appendix H

Deed Restriction

TO BE PROVIDED

Appendix I

Record of Decision

Appendix J

Pelham Bay Landfill Closure and Final Remediation Construction Certification Report

ELECTRONIC VERSION OF CCR IS AVAILABLE ON THE CD PROVIDED IN APPENDIX I

Appendix K

Operation, Maintenance and Monitoring Manual – Volumes I, II, and III

ELECTRONIC VERSION OF OM&M MANUAL IS AVAILABLE ON THE CD PROVIDED IN APPENDIX I

Appendix L

Pelham Bay Landfill As-Built Drawings

Appendix M

NYSDEC-Acceptable Electronic Database Site Information

TO BE PROVIDED FOLLOWING PREPARATION
OF DEED RESTRICTION

Appendix N

Inspection Checklist Forms

FORM FCS-1
PERIODIC* INSPECTION CHECKLIST
FINAL COVER SYSTEM
PELHAM BAY LANDFILL, BRONX, NEW YORK
(Reference Volume III, Figure 2-1)

Item No.	Item Title	Zone Number 1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Surface Cracks														
2	Vegetative Growth														
3	Vector Penetration														
4	Settlement														
5	Erosion														
6	Slope Stability														
7	Seepage														
8	Vandalism														

Notes:
* Inspection will be conducted following grass mowing per the DEP approved schedule
1. Use a check in the checkbox to indicate that the specific item number in the zone has been inspected and no problems were noted.
2. Use "NS" (Not Satisfactory) where problems are noted.
3. For boxes checked NS, on Form DP-1, a description of deficiency/problem. Attach additional sheets if necessary

Date Initials

FORM GWL-1
WEEKLY (TWICE WEEKLY) O & M INSPECTION CHECKLIST
GROUNDWATER/LEACHATE MANAGEMENT SYSTEM
PELHAM BAY LANDFILL
(REFERENCE VOLUME III SECTION 4)

Date: ______________ Initials ______________

1. Downgradient Collection Sumps	D-1		D-8		D-10	
	Pump 1	Pump 2				
A. Circuit Breakers	On / Off	On / Off	On / Off	On / Off	X On / Off	On / Off
B. Running Light On	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No	Yes / No
C. Selector Switch Position Han-Off Automatic (HOA)	H / O / A	H / O / A	H / O / A	H / O / A	H / O / A	H / O / A
D. Liquid Level in Sump pump	H / L / O		H / L / O		H / L / O	
E. Leak in Manifold Piping	Yes / No		Yes / No		Yes / No	
	Pumps	ETM	Pumps	ETM	Pumps	ETM
	P-1		P-1		P-1	
	P-2		P-2		P-2	

2. Downgradient and Curtain Drain

A. Is there settlement along alignment of downgradient curtain drain [ ] Yes [X] No

3. D-1 Forcemain Flow Totalizer x 100 =

$. D-1 Forcemain Pressure

FORM GWL-1 (continued)

3. LIFT STATION NO. 1

A. Flow from Curtain Drain	☐ Low	☐ Normal	☐ High
B. Are Sump Pumps Operating		☐ Yes	☐ No
C. Alarm indicator Lights		☐ Yes	☐ No

Pumps	ETM	High Temp	Seal Fail	Fault
P-1		☐	☐	☐
P-2		☐	☐	☐

D. Check liquid level in sump	☐ Low	☐ High	☐ Other
E. Check for leak in manifold leachate piping		☐ Yes	☐ No

4. LIFT STATION NO. 2

A. Settlement along buried section of forcemain		☐ High	☐ No
B. Are sump pumps operating		☐ High	☐ No
C. Are the alarms or indicator lights on		☐ Yes	☐ No

Pumps	ETM	High Temp	Seal Fail	Fault
P-1		☐	☐	☐
P-2		☐	☐	☐

D. Check liquid level around stop planks Is the level,	☐ Low	☐ High	☐ Other
E. Any leaks in the manifold discharge piping		☐ Yes	☐ No
F. Check surface water in the Bay and Rip-Rap Are there any signs of leachate		☐ Yes	☐ No
G. Check if a pump is out of service		☐ Pump 1	☐ Pump 2

FORM GWL-1 (continued)

5. LEACHATE STORAGE CONTAINMENT AREA AND SUMP

A. Flow through sump weep holes ☐ ☐ Normal ☐ High
B. Are sump pumps operating ☐ Yes ☐ No
C. Alarm indicator Lights ☐ Yes ☐ No

Pumps	ETM	High Temp	Seal Fail	Fault
P-1		☐	☐	☐
P-2		☐	☐	☐

D. Check liquid level in sump ☐ Low ☐ High ☐ Other

E. Is there any leak in the storage tanks and manifold discharge piping ☐ Yes ☐ No

G. Check if a pump is out of service ☐ Pump 1 ☐ Pump 2

6. CARBON ADSROPTION SYSTEM

A. Air Compressors on ☐ Yes ☐ No
B. Activated carbon canisters operating (On Line) ☐ Yes ☐ No

	ETM
Blower 1	
Blower 2	

7. CONTRACT HP-877 FORCE MAIN DISCHARGE TO POTW

A. Leakage from pipwork in valve box beside Lift Station No. 1 ☐ Yes ☐ No
B. Settlement along alignment of forcemain to Burr Avenue manhole ☐ Yes ☐ No

8. MOTOR CONTROL CENTER (MCC)

A. Are all breakers, for the following equipment, in the ON position:

Lift Station No. 1	☐ Yes	☐ No
Lift Station No. 2	☐ Yes	☐ No
Decontamination Sump	☐ Yes	☐ No
Storage Containment Sump	☐ Yes	☐ No
Site Lighting	☐ Yes	☐ No

Notes: For noted deficiencies and problems provide description on form DP-1. Attached additional sheets if necessary.

FORM GWL-2
MONTHLY INSPECTION CHECKLIST
MANHOLE AND SUMPS
GROUNDWATER/LEACHATE MANAGEMENT SYSTEM
PELHAM BAY LANDFILL
(REFERENCE VOLUME III SECTION 4)

DATE: INITIALS:

Item No.	Inspection Item	Manhole and Sump Number									
		D-1	D-2	D-3	D-4	D-5	D-6	D-7	D-8	D-9	D-10
1	Manhole Cover										
2	Silt Accumulation										
3	Settlement										
4	Pipe Connections										
5	Settlement Along Curtain Drain										
6	Flow into manhole or sump										

Item No.	Inspection Item	Manhole and Sump Number										
		LS-1	LS-2	DS-1	DS-2	TS-1	U-1	U-2	U-3	U-4	U-5	U-6
1	Manhole Cover											
2	Silt Accumulation											
3	Settlement											
4	Pipe Connections											
5	Settlement Along Curtain Drain											
6	Flow into manhole or sump											

FORM GWL-3
SEMI-ANNUAL INSPECTION CHECKLIST
MONITORING WELL
GROUNDWATER/LEACHATE MANAGEMENT SYSTEM
PELHAM BAY LANDILL
(REFERENCE VOLUME III SECTION 4)

DATE: INITIALS:

Check For	**Sampling Well Designation**									
	MW 104	**MW 106**	**MW 109**	**MW 110**	**MW 113**	**MW 114**	**MW 115**	**MW 115B**	**MW 118**	**MW 119**
1. Damage/Vandalism										
2. Settlement										
3. Accessibility										

Check For	**Sampling Well Designation**								
	MW 120	**MW 120B**	**MW 121**	**MW 122**	**MW 126**	**MW 117**	**MW 117B**	**MW 124**	**MW 124B**
1. Damage/Vandalism									
2. Settlement									
3. Accessibility									

Check For	**PZ-A**	**PZ-B**	**PZ-C**	**PZ-D**	**PZ-F**
1. Damage/Vandalism					
2. Settlement					
3. Accessibility					

Notes: Use a check in the checkbox to indicate that the specific item number in the zone has been inspected and no problems were noted.
1. Use "NS" (Not Satisfactory) where problems are noted.
2. For boxes checked NS, on Form DP-1, a description of deficiency/problem. Attach additional sheets if necessary

FORM LFG-1
WEEKLY(TWICE WEEKLY) INSPECTION CHECKLIST
LANDFILL GAS MANAGEMENT SYSTEM
PELHAMBAY LANDFILL
(REFERENCE VOLUME III, SECTION 5)

Date				
Time				
Technician				
1.OPERATING BLOWER 1 OR 2	1	2	1	2
A. Noise or Vibration	Ok	N/A	Ok	N/A
B. Measureable or Oderiferous Gas Leaks	No	Yes	No	Yes
C. Upstream Vacuum-Inches WC	0		0	
D. Downstream Pressure -Inches WC				
E. Inlet Temperature-Degree F				
F. Discharge Temperature-Degree F				
2. BLOWER CONTROL PANEL				
A. Disconnnect Blower 1 and 2 Switch				
B. Flow Meter-CFM, Min & Max				
C. Hour Meter Blower 1 (Zero=)				
Blower 2 (Zero=)				
D. Blower 1 or Blower 2 Running Light	1	2	1	2
E. The Blower Hand-Off_Auto Switch	Off	Auto	Off	Auto
F. Blower 1 or 2 Current Alarm	Off	On	Off	On
G. High Motor Current Alarm	Off		Off	
H. Reset Alarm				
3. FLARE CONTROL PANEL				
A. Panel Power Switch	Off	On	Off	On
B. Panel Power Light	Off	On	Off	On
C. Start-Up Sequence Switch	Auto			
D. Local Unit Control Switch	Start/Run	Stop	Start/Run	Stop
E. Unit Stop				
F. Security Light	Off	On	Off	On
G. Purge Start				
H. Low Purge Air Flow, Red Indicator Light	Off	On	Off	On
I. Purging, Blue Indicator Light	Off	On	Off	On
J. Purge Complete, Amber Indicating Light	Off	On	Off	On
K. Ignition Start				
L. Pilot Gas On, Green Indicator Light	Off	On	Off	On
M. Flame Proved, Green Indicator Light	Off	On	Off	On
N. Waste Inlet Valve	C O	Auto	C O	Auto
O. Waste Gas On, Green Indicator Light	Off	On	Off	On
P. Flare Reset				
Q. Waste Gas Blower Failure, Red Indicator Light	Off	On	Off	On
R. High Flare Temperature, Red Indicator Light	Off	On	Off	On
S. Flare Failure, Red Indicator Light	Off	On	Off	On
4. FLARE				
A. Flame Condition	Good	N/A	Good	N/A
B. Abnormal Burner Hotspots	Yes	No	Yes	No
C. Unusual Sounds or Odors	Yes	No	Yes	No
D. Damper Motor Running	Yes	No	Yes	No
Manual Damper Postion				
5. PIPING				
A. General Condition	OK		OK	
B. Propane Tank Pressure/Level-PSIG				
C. Inlet Valve Position		% Open		% Open
D. LFG Flowrate-CFM				
E. Gauges Operational?	Yes	No	Yes	No
F. Nitrogen Pressure-PSIG				
6. SITE CONDITION				
Vandalism, Cleanliness	Good	Bad	Good	Bad
Reviewed By				
Date				

Comments ______________________________

MONTHLY MONITORING
LANDFILLL GAS MANAGEMENT SYSTEM
PELHAM BAY LANFDFILL
REFERENCE VOLUME III SECTION 5

Inspector: **Date:**

Location	Concentration by % Volume			Temp (^0F)	Static Pressure	Pressure Differential	Remarks
	Methane	CO_2	Oxygen				
Flare Inlet							
Well Head No. 1							
Well Head No. 2							
Well Head No. 3							
Well Head No. 4							
Well Head No. 5							
Well Head No. 6							
Well Head No. 7							
Well Head No. 8							
Well Head No. 9							
Well Head No. 10							
Well Head No. 11							
Well Head No. 12							
Well Head No. 13							
Well Head No. 14							
Well Head No. 15							
Well Head No. 16							
Well Head No. 17							
Well Head No. 18							
Well Head No. 19							
Well Head No. 20							
Well Head No. 21							
Well Head No. 22							

FORM LFG-3
QUARTERLY* CHECKLIST
GAS COLLECTION SYSTEM, BELOW GROUND PIPING
LANDFILL GAS MANAGEMENT SYSTEM
PELHAM BAY LANDFILL, BRONX NEW YORK
(REFERENCE VOLUME 1 FIGURE 2-11)

<u>PERFORATED HORIZONTAL GAS COLLECTION</u>

	S	NS
• TOP OF LANFILL, HORIZONAL GAS COLLECTION		
• BOTTOM OF LANFILL, HORIZONTAL GAS COLLECTION		

<u>LATERALS SOLID PIPING</u>

	S	NS
• FROM EW-4 TO EW-10 AND MAIN HEADER		
• FROM EW-7 TO EW-10		
• FROM EW-11 TO MAIN HEADER		
• FROM EW-12 TO MAIN HEADER		
• FROM EW-13 TO MAIN HEADER		
• FROM EW-14 TO MAIN HEADER		
• FROM EW-15 TO MAIN HEADER		
• FROM EW-17 TO MAIN HEADER		
• FROM EW-20 TO MAIN HEADER		

<u>MAIN HEADER SOLID PIPING</u>

	S	NS
• FROM VB-1 TO VB-2		
• FROM VB-2 TO VB-3 AND VB-6		
• FROM VB-1 TO VB-5		
• FROM VB-5 TO VB-4 AND VB-6		
• FROM VB-6 TO FLARE STATION		

Notes:

*: Inspection will be conducted following periodic grass mowing as approved by the DEP

1. The inspection or the belowground gas collection and conveyance piping from well head to flare station the operator shall check for pipe settlement, landfill gas leak and any exposed piping.

2. Use an "S" check box to indicate that the specific item has been inspected and no problems were noted.

3. Use "NS" (not satisfactory) where problems are noted, and provide a description of the deficiency problem on Form DP-1. Attach additional sheets if necessary.

FORM SMS-1
MONTHLY INSPECTION CHECKLIST
STORMWATER DRAINAGE DITCHES
STORMWATER MANAGEMENT SYSTEM
PELHAM BAY LANDFILL, BRONX, NEW YORK

(Reference Volume I, Figures 2-2 and 2-3

Item	Item	Zone Number													
	Title	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No.	**Drainage Ditch Road A**														
1	Overgrown Vegetation														
2	Standing Water														
3	Sediments and Debris														
4	Erosion/Washouts														
5	Sinkholes														
6	Culvert Road A to Road B														
7	Flapgate at 6" pipe Outlet														
	Drainage Ditch, Road B														
1	Overgrown Vegetation														
2	Standing Water														
3	Sediments and Debris														
4	Erosion/Washouts														
5	Sinkholes														
6	Culvert Road B to Road C														
	Drainage Ditch, Road B^2														
1	Overgrown Vegetation														
2	Standing Water														
3	Sediments and Debris														
4	Erosion/Washouts														
5	Sinkholes														
6	Culvert Road B to Road C														
	Drainage Ditch, Road C														
1	Overgrown Vegetation														
2	Standing Water														
3	Sediments and Debris														
4	Erosion/Washouts														
5	Sinkholes														

Notes:

1. Use a check in the checkbox to indicate that the specific item number in the zone has been inspected and no problems were noted.
2. Use "NS" (Not Satisfactory) where problems are noted.
3. For boxes checked NS, on Form DP-1, a description of deficiency/problem. Attach additional sheets if necessary

Date: Initials:

FORM SMS-2
MONTHLY INSPECTION CHECKLIST
STORMWATER DRAINAGE DITCHES
STORMWATER MANAGEMENT SYSTEM
PELHAM BAY LANDFILL, BRONX, NEW YORK
(Reference Volume I, Figures 2-2 and 2-3

Stormwater Collection Manholes (SP Series)												
Item No.	Item Title	Manhole Number										
		SP1	SP2	SP3	SP4	SP5	SP6	SP7	SP8	SP9	SP10	SP11
1	Trashracks											
2	Silt Accumulation											
3	Pipe Connections to Manhole											
4	Flow From 8" HDPE Inlets											
5	Debris/Silt Blockage in 24" Pipe											
6	Settlement Along 24" Pipe											
7	Settlement Around Manhole											
8	Baffles Inside Manhole											

Pond Collection Manholes (CP Series)						
Item No.	Item Title	Manhole Number				
		CP1	CP2	CP3	CP4	CP5
1	Grates					
2	Silt Accumulation					
3	Flow Through Manhole					
4	Settlement Above 30" Pipe					

Baffled Outlets (BO Series)					
Item No.	Item Title	Manhole Number			
		BO1	BO2	BO3	BO4
1	Silt Accumulation				
2	Connection to 24" Pipe				
3	Erosion Around Structure				
4	Spalling, Cracking, etc.				
5	Weep Holes				
6	Guard Rails				

Notes:
1. Use a check in the checkbox to indicate that the specific item number in the zone has been inspected and no problems were noted.
2. Use "NS" (Not Satisfactory) where problems are noted.
3. For boxes checked NS, on Form DP-1, a description of deficiency/problem. Attach additional sheets if necessary

Date: Initials:

FORM SMS-3
MONTHLY INSPECTION CHECKLIST
SEDIMENTATION PONDS
STORMWATER MANAGEMENT SYSTEM
PELHAM BAY LANDFILL, BRONX, NEW YORK

(Reference Volume I, Figure 2-3)

Inspection Item		Check Box			Check Box
Sedimentation Pond A			**Sedimentation Pond C**		
Pond			**Pond**		
1	Minimum 2 ft. Freeboard		1	Minimum 2 ft. Freeboard	
2	Silt Accumulation		2	Silt Accumulation	
3	Slope Erosion/Stability		3	Slope Erosion/Stability	
4	Debris		4	Debris	
	Outlet Structure		5	Riprap	
1	Debris/Silt Blockage			**Inlet Structure**	
2	Connections to Pipe		1	Debris/Silt Blockage	
3	Erosion Around Structure		2	Connections to Pipe	
4	Spalling, Cracking, etc.		3	Erosion Around Structure	
			4	Spalling, Cracking, etc.	
	Sedimentation Pond B		5	Riprap	
	Pond			**RCP Inlet Section**	
1	Minimum 2 ft. Freeboard		1	Debris/Silt Blockage	
2	Silt Accumulation		2	Connections to Pipe	
3	Slope Erosion/Stability		3	Erosion Around Structure	
4	Debris		4	Spalling, Cracking, etc.	
	Inlet Structure		5	Weepholes	
1	Debris/Silt Blockage		6	Trashrack	
2	Connections to Pipe		7	RC Pipe	
3	Erosion Around Structure			**RCP Outlet Section**	
4	Spalling, Cracking, etc.		1	Debris/Silt Blockage	
	Outlet Structure		2	Connections to Pipe	
1	Debris/Silt Blockage		3	Erosion Around Structure	
2	Connections to Pipe		4	Spalling, Cracking, etc.	
3	Erosion Around Structure		5	Trashrack	
4	Spalling, Cracking, etc.		6	Flapgate	
			7	Spillway Riprap	

Notes:

1. Use a check in the checkbox to indicate that the specific item number in the zone has been inspected and no problems were noted.
2. Use "NS" (Not Satisfactory) where problems are noted.
3. For boxes checked NS, on Form DP-1, a description of deficiency/problem. Attach additional sheets if necessary

Date: Initials:

FORM AS-1
MONTHLY INSPECTION CHECKLIST
ANCILLARY SYSTEMS
PELHAM BAY LANDFILL, BRONX, NEW YORK

(Reference Volume I, Section 2.2 and Volume III, Section 6)

Description		Check Box	If N/S or NI, description and location
IRM Roadway			
1	Rutting		
2	Depressions/Settlement		
3	Washout		
4	Pavement Condition		
5	Reflectors		
Road A			
1	Rutting		
2	Depressions/Settlement		
3	Washout		
4	Pavement Condition		
5	Reflectors		
Road B			
1	Rutting		
2	Depressions/Settlement		
3	Washout		
4	Pavement Condition		
5	Reflectors		
Road B^2			
1	Rutting		
2	Depressions/Settlement		
3	Washout		
4	Pavement Condition		
5	Reflectors		
Road C			
1	Rutting		
2	Depressions/Settlement		
3	Washout		
4	Pavement Condition		
5	Reflectors		
Perimeter Fence, Gates, Locks			
Seawall Condition			

Notes:

1. Use a check in the checkbox to indicate that the specific item number in the zone has been inspected and no problems were noted.
2. Use "NS" (Not Satisfactory) where problems are noted.
3. For boxes checked NS, on Form DP-1, a description of deficiency/problem. Attach additional sheets if necessary

Date: Initials:

FORM NO. DP-1
DESCRIPTION OF DEFICIENCIES AND PROBLEMS
PELHAM BAY LANDFILL, BRONX, NEW YORK

Form No.	Location	Description of Deficiency/Problem	Corrective Action Taken

Date ______________________ Inspected by ____________________

Weather ______________________ Signature____________________

Appendix O

Sewer Discharge Permit Table A

TABLE A

LIMITATIONS FOR EFFLUENT TO ***SANITARY OR COMBINED*** SEWERS

Parameter [1]	Daily Limit	Units	Sample Type [9]	Monthly Limit	Average Leachate Concentrations [6]	Maximum Leachate Concentration [7]
Non-polar Material [2]	50	mg/L	Instantaneous	--	<5.0	<5.0
pH	5-11	SU's	Instantaneous	--	7.56	7.97
Temperature	<150	Degree F	Instantaneous	--	--	--
Flash Point	>140	Degree F	Instantaneous	--	>212	>212
Cadmium	2 0.69	mg/L mg/L	Instantaneous Composite	-- --	0.0010	0.0012
Chromium (VI)	5	mg/L	Instantaneous	--	<0.02	<0.02
Copper	5	mg/L	Instantaneous	--	0.0294	0.0570
Lead	2	mg/L	Instantaneous	--	0.0254	0.0402
Mercury	0.05	mg/L	Instantaneous	--	<0.01	<0.02
Nickel	3	mg/L	Instantaneous	--	0.0133	0.0253
Zinc	5	mg/L	Instantaneous	--	0.79	2.94
Benzene	134	ppb	Instantaneous	57	0.72	0.72
Carbontetrachloride	--	ppb	Composite	--	<10	<10
Chloroform	--	ppb	Composite	--	0.95	0.95
1,4 Dichlorobenzene	--	ppb	Composite	--	<10	<10
Ethylbenzene	380	ppb	Instantaneous	142	<10	<10
MTBE (Methyl-Tert-Butyl-Ether)	50	ppb	Instantaneous	--	<10	<10
Naphthalene	47	ppb	Composite	19	<10	<10
Phenol	--	ppb	Composite	--	<10	<10
Tetrachloroethylene (Perc)	20	ppb	Instantaneous	--	<10	<10
Toluene	74	ppb	Instantaneous	28	<10	<10
1,2,4 Trichlorobenzene	--	ppb	Composite	--	<10	<10
1,1,1 Trichloroethane	--	ppb	Composite	--	<10	<10
Xylenes (Total)	74	ppb	Instantaneous	28	<10	<10
PCB's (Total) [3]	1	ppb	Composite	--	<0.065	<0.065
Total Suspended Solids (TSS)	350 [4]	mg/L	Instantaneous	--	48.45	191.00
CBOD5 [5,8]	--	mg/L	Composite	--	13.30	20.20
Chloride [5]	--	mg/L	Instantaneous	--	479.83	1100.00
Total Nitrogen [5]	--	mg/L	Composite	--	45.20	123.90
Total Solids [5]	--	--	Instantaneous	--	600.00	600.00
Other					--	--

1. All handling and preservation of collected samples and laboratory analyses of samples shall be performed in accordance with 40 C.F.R. pt. 136. If 40 C.F.R pt. 136 does not cover the pollutant in question, the handling, preservation, and analysis must be performed in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater." All analyses shall be performed using a detection level less than the lowest applicable regulatory discharge limit. If a parameter does not have a limit, then the detection level is defined as the least of the Practical Quantitation Limits identified in NYSDEC's Analytical Detectability and Quantitiation Guidlines for Selected Environmental Parameters, December 1988.

2. Analysis for ***non-polar materials*** must be done by EPA method 1664 Rev. A. Non-Polar Material shall mean that portion of the oil and grease that is not eliminated from a solution containing N-Hexane, or any other extraction solvent the EPA shall prescribe, by silica gel absorption.

3. Analysis for PCB's is required if ***both*** conditions listed below are met:
   1) if proposed discharge ≥ 10,000 gpd;
   2) if duration of discharge > 10 days

   Analysis for PCBs must be done by EPA method 608 with MDL=<65 ppt. PCB's (total) is the sum of PCB-1242 (Arochlor 1242), PCB-1254 (Arochlor 1254), PCB-1221 (Arochlor 1221), PCB-1232 (Arochlor 1248), PCB-1260 (Arochlor 1260) and PCB-1016 (Arochlor 1016)

4. For discharge ≥10,000 gpd, the TSS limit is 350 mg/L. For discharge < 10,000 gpd, the limit is determined on a case by case basis.

5. Analysis for Carbonaceous Biochemical Oxygen Demand (CBOD), Chloride, Total Solids, and Total Nitrogen are required if proposed discharge is ≥ 10,000 gpd.

6. The average leachate concentrations were determined by averaging analytical laboratory sample results from May of 2004 to December of 2006. Five samples were taken over this time period. Analysis for total PCBs, non-polar materials, total solids, and flashpoint was done only for the December 5, 2006 sample.

7. The maximum leachate concentration is the highest analytical result for the specified analyte during the period from May 2004 to December 2006.

8. CBOD5 concentrations are the analytical sample results for BOD5.

9. All samples were collected as grab samples from the pumping station before discharged to the sewer. Leachate concentrations are not

Appendix P

NYSDEC Air Facility Registration and Air Facility Registration Certificate

New York State Department of Environmental Conservation
Air Facility Registration

DEC ID
- -

Owner/Firm				Taxpayer ID: 1 3 6 4 0 0 4 3 4
Name	New York City Department of Environmental Protection			
Street Address	96-05 Horace Harding Expressway, 2nd Floor			
City / Town / Village	**Corona**	State or Province **New York**	Country **USA**	Zip **11368**

Owner/Firm Contact		
Name	**Douglas S. Greeley, P.E., Deputy Commissioner**	Phone No. **(718) 595-6389**

Facility		
Name	**Pelham Bay Landfill**	
Location Address	**301 Shore Road**	
■ City / □ Town / □ Village	**Bronx, New York**	Zip **10465**

Facility Information	
Total Number of Emission Points: 1 (Flare)	□ Cap by Rule

Description

The Pelham Bay Landfill (PBL) is currently closed and, in accordance with the August 1993 Record of Decision, the following remedial program was implemented with the ongoing operation, maintenance and monitoring of the remedial program: (1) conduct a remedial design program; (2) re-grade portions of the Site to ensure proper drainage and minimize erosion; (3) install an actively vented cover, consistent with Part 360 requirements, to minimize surface infiltration of precipitation and collect gases generated by the waste; (4) install a landfill gas collection and treatment system (see details below) to recover and treat gases generated at the Site and prevent off-site migration; (5) install a groundwater management system, consisting of a slurry wall and upgradient collection trench along the southwestern Site boundary (i.e., the upgradient system), to minimize the migration of groundwater onto the Site; (6) install a leachate collection system and a force-main to transmit leachate to the Hunts Point Water Pollution Control Plant; (7) installation of fencing to limit Site access; and (8) implementation of a post-closure monitoring program to evaluate performance of the remedial program. The volume of the landfill, including waste, and cover soil is approximately 8,130,000 cubic yards (Figure 1).

The PBL gas collection, monitoring and treatment system consists of 22 gas extraction wells, 4 gas monitoring wells, and 10 surface monitoring points, a gas venting layer at the surface of the landfill, a perimeter gas collection pipe around the base of the landfill, and an enclosed flare system. Extracted gas is conveyed, via polyethylene piping, to the enclosed flare system. The gas flare system consists of two centrifugal blowers and a burner management system. Each blower is designed to operate at a flow rate of 1,500 standard cubic feet per minute (SCFM); however, the maximum gas flow rate through the system during the year 2005 was approximately 1,150 SCFM. During normal operation, one blower is on-line while the other is in standby mode. The approximately 7-feet in diameter and 40-feet in height gas flare is operated at approximately 1,600 degrees Fahrenheit (deg F).

Standard Industrial Classification Codes					
4953	(Refuse System)				

HAP CAS Numbers					
See					
Table 1					

Applicable Federal and New York State Requirements (Part Nos.)					
201-4 (3) and (5)					

Certification	
I certify that this facility will be operated in conformance with all provisions of existing regulations.	
Responsible Official **Douglas S. Greeley, P.E., Deputy Commissioner**	Title **Deputy Commissioner**
Signature	Date / /

7/29/96

Fred Sachs
11/20

New York State Department of Environmental Conservation

Registration ID: 2-6006-00127/00001 **Facility DEC ID:** 2-6006-00127

AIR FACILITY REGISTRATION CERTIFICATE
in accordance with 6NYCRR Part 201-4

xc: Spangel

Registration Issued to: NYC DEPT OF ENVIRONMENTAL PROTECTION
96-05 HORACE HARDING EXPWY
FLUSHING,NY 11368

Contact: DOUGLAS S GREELEY
NYCDEP/BWT
96-05 HORACE HARDING EXPWY
2ND FL
CORONA,NY 11368
(718) 595-5050

Facility: PELHAM BAY LANDFILL
301 SHORE RD
BRONX,NY 10465

Description:

The Pelham Bay Landfill (PBL) is currently closed and, in accordance with the August 1993 Record of Decision, the following remedial program was implemented with the ongoing operation, maintenance and monitoring of the remedial program :(1) Conduct a remedial design program; (2) re-grade portions of the site to ensure proper drainage and minimize erosion;(3) install an actively vented cover, consistent with Part 360 requirements, to minimize surface infiltration of precipitation and collect gases generated by the waste;(4) install a landfill gas collection and treatment system (see details below)to recover and treat gases generated at the site and prevent off-site migration; (5) install a ground water management system, consisting of a slurry wall and up gradient collection trench along the south western site boundary(i.e. the up gradient system), to minimize the migration of ground water onto the site;(6) install a leachate collection system and a force -main to transmit leachate to the Hunts Point Water Pollution Control Plant;(7) Installation of fencing to limit site access; and (8) implementation of a post closure monitoring program to evaluate of the remedial program. The volume of the landfill, including the waste and cover soil is approximately 8,130,000 Cubic Yards.
The PBL gas collection, monitoring and treatment system consists of 22 gas extraction wells, 4 gas monitoring wells and 10 surface monitoring points, a gas venting layer at the surface of the landfill, a perimeter gas collection pipe around the base of the land fill and an enclosed flare system. Extracted gas is conveyed, via polyethylene piping to the enclosed flare system. The gas flare system consists of two centrifugal blowers and a burner management system. Each blower is designed to operate at a flow rate of 1500 standard cubic feet per minute (SCFM): however maximum gas flow rate through the system during the year 2005 was approximately 1150SCFM. During normal operation, one blower is on-line while other is standby mode. The approximately 7 feet in diameter and 40 feet in height gas flare is operated at approximately 1,600deg F.

Total Number of Emission Points: 1 **Cap By Rule:** No

New York State Department of Environmental Conservation

Registration ID: 2-6006-00127/00001 **Facility DEC ID:** 2-6006-00127

AIR FACILITY REGISTRATION CERTIFICATE
in accordance with 6NYCRR Part 201-4

Authorized Activity By Standard Industrial Classification Code:

4953 - REFUSE SYSTEMS

Registration Effective Date: 10/24/2006 **Registration Expiration Date:** (Not Applicable)

List of Regulations in Application:

6NYCRR 200	General Provisions
6NYCRR 201	Permits and Certificates

for Richard Fram

SAM LIEBLICH
REGION 2 AIR POLLUTION CONTROL ENGINEER
NYSDEC - REGION 2
47-40 21ST STREET
LONG ISLAND CITY,NY 11101

This registrant is required to operate this facility in accordance with all air pollution control applicable Federal and State laws and regulations. Failure to comply with these laws and regulations is a violation of the ECL and the registrant is subject to fines and/or penalties as provided by the ECL. If ownership of this facility changes, the registrant is required to notify the Department at the address shown below using the appropriate forms and procedures within 30 days after the transfer takes place. The present registrant will continue to be responsible for all fees and penalties until the Department has been notified of any change in ownership.

Appendix Q

Stormwater Permitting Evaluation
Correspondence

The City of New York
DEPARTMENT OF ENVIRONMENTAL PROTECTION
59-17 Junction Boulevard
Flushing, New York 11373

Emily Lloyd
Commissioner

Douglas S. Greeley, P.E.
Deputy Commissioner

Bureau of Wastewater Treatment

Tel (718) 595-5330
Fax (718) 595-6950
DGreeley@dep.nyc.gov

June 15, 2006

Angus Eaton, P.E.
Section Chief, General Permits Section
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233-3505

Subject: Storm Water Permitting Evaluation, Pelham Bay Landfill, Bronx, New York

Dear Mr. Eaton:

The purpose of this letter is to confirm our consultant's, ARCADIS G&M, telephone conversations and e-mail correspondence with the New York State Department of Environmental Conservation (NYSDEC) regarding storm water permitting for capped and closed landfills. ARCADIS was contracted by the New York City Department of Environmental Protection (NYCDEP) to evaluate the storm water permitting requirements for the Pelham Bay Landfill, located in the Bronx, New York. After an initial evaluation of permitting requirements was completed, ARCADIS held a meeting on March 23, 2006 with NYCDEP and NYSDEC's case manager, Nigel Crawford, to review findings and discuss storm water permitting at the Pelham Bay Landfill.

Based on the summary provided below, we believe that the Pelham Bay Landfill is not subject to General Permitting requirements for storm water.

Site Background

The Pelham Bay Landfill was opened in 1963 to mainly handle the waste (municipal waste, commercial waste and demolition debris) from the Bronx. The landfill ceased operations in 1978 and has remained inactive since that date. New York City conducted a Remedial Investigation/Feasibility Study (RI/FS) in 1992, and thereafter the site was closed and capped in accordance with a Record of Decision (ROD) issued by NYSDEC in 1993 and NYSDEC regulations. Currently, the site is undergoing post-closure monitoring.

As a part of the landfill closure, the landfill was capped and a storm water management system was installed. Storm water runoff from the landfill is diverted through a series of swales, baffled outlets and drainage pipes. The storm water is directed to one of three sedimentation ponds located around the landfill and then flows by gravity to an outfall located on the northeast side of the landfill into Eastchester Bay.

NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DEP
www.nyc.gov/dep
DIAL 311 Government Information and Services for NYC

Storm Water Permitting Evaluation

The National Pollutant Discharge Elimination System (NPDES) Program under Sections 318, 402, and 405 of the Clean Water Act (CWA) provides that storm water discharges associated with industrial activity from a point source to waters of the United States are unlawful, unless authorized by a NPDES permit. In New York, which is a NPDES delegated state, this is accomplished through the administration of the State Pollutant Discharge Elimination System (SPDES) program.

Pursuant to Article 17, Titles 7, 8 and Article 70 of the Environmental Conservation Law, Permit No. GP-98-03 is required for a storm water discharge associated with industrial activity. As defined in 40 CFR 122.26(b)(14), landfills, land application sites, and open dumps that receive or have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under Subtitle D of Resource Conservation and Recovery Act (RCRA) are considered to be engaging in an "industrial activity".

Based on ARCADIS' discussions with your Department, the NYSDEC interprets the rule to not include requirements for permits for capped and closed landfills, unless the NYSDEC explicitly designates the landfill as requiring a permit.

As ARCADIS discussed with your department, 40 CFR 122.26(b)(14)(v) covers landfills, land application sites, and open dumps (non-compliant landfills) that receive or have received industrial wastes (i.e., waste that is received from any of the facilities described under categories(i)-(xi)) including those subject to the regulations under Subtitle D of RCRA. Additionally, the monitoring requirements for GP-98-03, for land disposal units/incinerators, refers to "storm water discharges from any active or inactive landfill, land application site or open dump without a stabilized final cover that has received industrial waste . . . "The Sector L benchmark monitoring requirements in Environmental Protection Agency's (EPA's) multi-sector general permit apply to all landfills, land application sites and open dumps, except for municipal solid waste landfill (MSWLF) areas closed in accordance with 40 CFR 258.60 (which is the MSWLF closure and post closure care requirements). Also, Sector L of EPA's multi-sector general permit requires compliance monitoring of storm water discharges from MSWLFs that have not been closed in accordance with 40 CFR 258.60.

Based on the above information:

- A storm water permit is not required if the landfill is properly capped in accordance with applicable regulations (Subtitle C for MSWLFs or Subtitle D for RCRA landfills) and the facility has a post closure care program to inspect and maintain the cap.

- A permit is needed for non-compliant landfills that have not been closed in accordance with applicable regulations (Subtitle C for MSWLFs or Subtitle D for RCRA landfills) closure and post closure care regulations. These facilities must also monitor their storm water and comply with Numeric Limitations for specific parameters identified in 40 CFR 445 Subparts A & B.

Therefore, as stated previously and based on the summary provided, we believe that the Pelham Bay Landfill is not subject to the General Permitting requirements for storm water based on the following rational:

- The facility is inactive and capped in accordance with NYSDEC requirements.

- There is no waste in contact with storm water, the appropriate barriers are in place to prevent any storm water to come in contact with a waste stream and a post closure care program, approved by NYSDEC, is in place to inspect and maintain the cap.

Please let me know if this is not consistent with your understanding.

If you have any questions, please contact me at (718) 595-6389 or my staff Rupak Raha, P.E. at (718) 595-6210.

Sincerely,

for D G

Douglas Greeley, P.E.
Deputy Commissioner

Copies:
Rupak Raha, BWT, NYCDEP
Walter Goyzueta, BWT, NYCDEP
Nigel Crawford, NYSDEC Region 2, Case Manager
Kyriacos Pierides, ARCADIS Project Manager
Christina Berardi Tuohy, P.E., ARCADIS Principal Engineer

From: Angus Eaton [mailto:akeaton@gw.dec.state.ny.us]
Sent: Tuesday, January 09, 2007 10:23 AM
To: Tuohy, Christina Berardi
Subject: RE: Storm Water Permitting

I am very sorry Christina. We had an answer within two days, I guess it did not get sent.

Response:
Given the fact pattern described in your letter, I concur that an industrial stormwater permit is not required for this facility.
Angus

Angus Eaton
NYS Dept of Environmental Conservation
625 Broadway
Albany, NY 12233-3505
518 402 8123

>>> "Tuohy, Christina Berardi" <CTuohy@arcadis-us.com> 01/09/07 9:32 AM >>>
Angus,

I hope you had a nice holiday. I called yesterday to follow up with you regarding the permitting status at the Pelham Bay Landfill. If you could please call or respond with an e-mail or letter we would appreciate it. Thank you in advance.

Christina Tuohy, P.E.
Principal Engineer
ARCADIS
Two Huntington Quadrangle, Suite 1S10
Melville, NY 11747
Direct: 631.391-5213
Cell: 516.779-8033
Fax: 631.249-7610
Email: CTuohy@arcadis-us.com

From: Tuohy, Christina Berardi
Sent: Monday, December 11, 2006 8:18 AM
To: 'Angus Eaton'
Cc: Pierides, Kyriacos; 'rraha@dep.nyc.gov'
Subject: Storm Water Permitting

Angus,

Consistent with our phone calls, I attached the June 15, 2006 letter from the New York City Department of Environmental Protection regarding storm water permitting at the Pelham Bay Landfill. Please review and provide comments.

Thank you,

Christina Tuohy, P.E.
Principal Engineer
ARCADIS
Two Huntington Quadrangle, Suite 1S10
Melville, NY 11747
Direct: 631.391-5213
Cell: 516.779-8033
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Email: CTuohy@arcadis-us.com

Appendix R

Quality Assurance Project Plan

TO BE PROVIDED

Appendix S

Remedial Investigation Report – Well Data Summary and Water Level Measurements Tables

Table 2-1
Well Data Summary
Pelham Bay Landfill
Bronx, New York

	Date Installed	Depth (ft)	Diameter (in)	Length of Screen (ft)	Estimated Yield (gpm)	Well Type	Screened Material	Riser Material	Ground Elevation (ft above BD)	Metal Casing Elevation (ft above BD)	Riser Elevation (ft above BD)	Riser Height (ft above GRD)	Screen Elevation Top (ft)	Screen Elevation Bottom (ft)	Northing	Easting	Bedrock Elevation (ft above BD)
1992 WELLS																	
MW-113	26-May-92	12.08	4	5	<0.5	stickup	overburden	sch 40 PVC	8.22	11.42	11.07	2.85	3.99	-1.01	29070.315	-19814.674	-9.78
MW-113B	11-Jun-92	83.98	4	20	~1.5	stickup	bedrock	sch 80 PVC	7.09	10.59	10.20	3.11	-53.78	-73.78	29081.229	-19818.601	-9.91
MW-114	27-May-92	11.87	4	10	< 0.5	flush mount	overburden	sch 80 PVC	7.96	8.26	8.01	0.05	6.14	-3.86	28402.734	-20517.931	-
MW-114B	7-Jul-92	91.48	4	10	< 0.5	flush mount	bedrock	sch 40 PVC	7.62	7.72	7.32	-0.30	-74.16	-84.16	28390.178	-20537.285	-23.38
MW-115	8-Jun-92	42.50	6	20	> 5.0	stickup	overburden	sch 40 PVC	18.44	21.64	20.34	1.90	-2.16	-22.16	27911.455	-20754.435	-22.56
MW-115B	8-Jun-92	72.41	8 & 6	18.41' open hole	> 5.0	stickup	bedrock	8" to 6" (54')	17.71	20.11	open hole	-	-33.89	-52.30	27904.201	-20755.529	-28.29
MW-116	29-May-92	12.20	4	5	<1.0	stickup	sed./fill	sch 80 PVC	10.97	14.27	13.92	2.95	6.72	1.72	26940.256	-20658.534	0.97
MW-116B	29-Jun-92	73.37	4	10	<0.5	stickup	bedrock	sch 80 PVC	11.71	14.11	13.79	2.08	-49.58	-59.58	26901.876	-20656.069	-0.29
MW-117	1-Jun-92	19.66	4	10	0.5	stickup	overburden	sch 80 PVC	5.18	7.49	7.33	2.15	-2.33	-12.33	26639.141	-20177.984	-12.82
MW-117B	29-Jun-92	79.13	4	10	0.5	stickup	bedrock	sch 80 PVC	4.62	6.52	6.40	1.78	-62.73	-72.73	26615.782	-20186.704	-11.38
MW-118	3-Jun-92	17.19	4	10	<1.0	stickup	fill	sch 80 PVC	10.83	13.73	13.19	2.36	6.00	-4.00	26728.412	-19287.747	-
MW-118B	19-Jun-92	112.20	4	20	<0.5	stickup	bedrock	sch 80 PVC	11.00	13.30	13.09	2.09	-79.11	-99.11	26729.859	-19250.687	-39.00
MW-119	10-Jun-92	31.21	4	10	>0.5	stickup	riprap	sch 80 PVC	11.52	13.92	13.78	2.26	-7.43	-17.43	27200.090	-18950.844	-40.48
MW-119B	24-Jun-92	113.51	4	10	<0.5	stickup	bedrock	sch 80 PVC	11.63	14.63	14.29	2.66	-89.22	-99.22	27171.359	-18948.976	-37.37
MW-120	10-Jun-92	55.58	6	20	>10	stickup	overburden	sch 40 PVC	9.05	12.45	11.61	2.56	-23.97	-43.97	27776.950	-18994.003	-43.95
MW-120B	22-May-92	79.70	4	10	<0.5	stickup	bedrock	sch 40 PVC	9.09	10.99	10.84	1.75	-58.86	-68.86	27791.700	-18995.120	-46.91
MW-121	29-May-92	40.71	4	10	>10	stickup	overburden	sch 80 PVC	10.85	13.45	13.10	2.25	-17.61	-27.61	28578.134	-19121.503	-
MW-121B	27-May-92	69.25	4	10	<0.5	stickup	bedrock	sch 80 PVC	11.06	14.66	13.54	2.48	-45.71	-55.71	28587.134	-19126.776	-31.94
MW-122	2-Jun-92	38.15	4	10	>5	stickup	overburden	sch 80 PVC	9.54	12.04	11.68	2.14	-16.47	-26.47	28967.060	-19311.343	-
MW-122B	29-May-92	80.25	4	20	<1.0	stickup	bedrock	sch 80 PVC	9.57	11.37	11.17	1.60	-49.08	-69.08	28975.330	-19321.196	-30.43
MW-123	2-Jul-92	14.50	4	10	<0.5	flush mount	overburden	sch 80 PVC	12.96	13.41	13.23	0.27	8.73	-1.27	27295.939	-21322.259	-
MW-124	2-Jul-92	13.27	4	10	< 0.5	flush mount	overburden	sch 40 PVC	22.14	22.24	22.12	-0.02	18.85	8.85	26498.996	-20818.821	7.64
MW-124B	7-Jul-92	69.67	4	10	<0.5	flush mount	bedrock	sch 40 PVC	20.90	21.00	20.60	-0.30	-39.07	-49.07	26520.305	-20800.748	7.90
MW-125	13-Jul-92	19.58	4	10	~3.0	flush mount	overburden	sch 80 PVC	5.58	6.03	5.92	0.34	-3.66	-13.66	28452.426	-20675.673	-
MW-125B	6-Jul-92	103.04	4	20	~8.0	flush mount	bedrock	sch 40 PVC	5.95	6.15	5.90	-0.05	-77.14	-97.14	28462.816	-20669.218	-45.05
MW-126 (PZ5)	1-Jul-92	140.00	4	20	>2.0	stickup	fill	sch 40 SS	124.12	125.23	124.68	0.56	4.68	-15.32	27770.025	-19860.461	-23.88
PZ-1F	19-May-92	78.42	2	10	-	stickup	fill	sch 40 PVC	80.40	82.60	82.33	1.93	13.91	3.91	28602.070	-19719.777	-
PZ-1B	19-May-92	106.22	2	10	-	stickup	bedrock	sch 40 PVC	79.95	82.35	82.08	2.13	-14.14	-24.14	28607.553	-19715.618	1.45
PZ-2F	13-May-92	97.73	2	10	-	stickup	fill	sch 40 PVC	92.00	95.60	95.48	3.48	7.75	-2.25	28062.389	-20214.844	-10.00
PZ-3F	5-Jun-92	136.00	2	10	-	stickup	fill	iron	127.36	129.26	129.10	1.74	3.10	-6.90	27353.441	-19573.734	-
PZ-3S	29-May-92	160.00	2	10	-	stickup	overburden	iron	126.89	129.49	129.46	2.57	-20.54	-30.54	27352.641	-19567.616	-33.11
PZ-3B	12-Jun-92	172.00	2	5	-	stickup	bedrock	iron	128.82	131.32	130.93	2.11	-36.07	-41.07	27356.313	-19597.121	-28.68
PZ-4F	21-May-92	77.83	2	10	-	stickup	fill	sch 40 PVC	79.31	81.81	81.27	1.96	13.44	3.44	28055.269	-19373.243	-2.69
PZ-5B	17-Jun-92	165.00	2	5	-	stickup	bedrock	iron	123.40	126.20	126.08	2.68	-33.92	-38.92	27773.634	-19882.983	-24.60
CP-1	21-Jun-92	44.35	2	20	-	stickup	overburden	sch 40 PVC	20.72	23.82	23.62	2.90	-0.73	-20.73	27940.300	-20746.521	-42.78
CP-2	16-Jun-92	41.07	2	20	-	flush mount	overburden	sch 40 PVC	18.32	18.42	18.18	-0.14	-2.89	-22.89	27914.767	-20768.121	-37.18
CB-1	30-Jun-92	77.72	2	10	-	stickup	bedrock	sch 40 PVC	19.79	21.89	21.77	1.98	-45.95	-55.95	27922.866	-20747.965	-41.21
HP-1	23-Jun-92	45.40	2	10	-	stickup	overburden	sch 40 PVC	8.40	11.00	10.89	2.49	-24.51	-34.51	27766.674	-18992.946	-37.60
HP-2	25-Jun-92	48.24	2	10	-	stickup	bedrock	sch 40 PVC	9.15	11.55	11.39	2.24	-26.85	-36.85	27748.104	-18989.605	-36.85
HP-3	9-Jul-92	25.19	2	10	-	flush mount	fill	sch 40 PVC	8.63	8.73	8.53	-0.10	-6.66	-16.66	27780.225	-18975.657	-
TB-1	29-Jun-92	56.00	Abandoned Test boring		-	-	-	-	~11	-	-	-	-	-	-	-	~-27.00
TB-2	14-Jul-92	20.00	Abandoned Test Boring		-	-	-	-	~11	-	-	-	-	-	-	-	-

Table 2-1
Well Data Summary
Pelham Bay Landfill
Bronx, New York

	Date Installed	Depth (ft)	Diameter (in)	Length of Screen (ft)	Estimated Yield (gpm)	Well Type	Screened Material	Riser Material	Ground Elevation (ft above BD)	Metal Casing Elevation (ft above BD)	Riser Elevation (ft above BD)	Riser Height (ft above GRD)	Screen Elevation Top (ft)	Screen Elevation Bottom (ft)	Northing	Easting	Bedrock Elevation (ft above BD)
1989 WELLS																	
MW-101	1-Dec-89	45.00	4	10	-	flush mount	fill	sch 80 PVC	80.02	-	-	-	-	-	28590.892	-19452.983	-
MW-102	5-Dec-89	56.00	4	10	-	flush mount	fill	sch 80 PVC	78.79	78.89	78.43	-0.36	32.43	22.43	27086.164	-19724.929	-
MW-103	27-Nov-89	13.62	4	10	>5	flush mount	overburden	sch 80 PVC	9.43	9.73	9.43	0.00	5.81	-4.19	28946.055	-19300.926	-
MW-104	21-Nov-89	15.35	4	10	~0.6	flush mount	overburden	sch 80 PVC	9.75	9.85	9.55	-0.20	4.20	-5.80	28179.490	-19030.697	-
MW-105	28-Nov-89	17.40	4	10	>5	flush mount	overburden	sch 80 PVC	9.99	10.30	9.99	0.00	2.59	-7.41	27518.177	-18974.661	-
MW-106	28-Nov-89	17.47	4	10	>5	flush mount	overburden	sch 80 PVC	10.05	10.25	9.86	-0.19	2.39	-7.61	26742.231	-18980.711	-23
MW-107	20-Nov-89	15.83	4	5	<0.1	flush mount	overburden	sch 80 PVC	5.03	5.43	5.19	0.16	-5.64	-10.64	26630.328	-20189.235	-
MW-108	21-Nov-89	Destroyed during IRM 5/92			-	flush mount	-	-	-	-	-	-	-	-	-	-	-
MW-109	10-Nov-89	16.75	4	10	<0.1	flush mount	overburden	sch 80 PVC	17.16	17.26	16.96	-0.20	10.21	0.21	28784.326	-20169.171	-5.84
MW-110	30-Nov-89	16.89	4	10	>5	flush mount	overburden	sch 80 PVC	11.39	11.69	11.34	-0.05	4.45	-5.55	26731.688	-19689.792	-
MW-111	1-Dec-89	34.86	4	10	~0.3	flush mount	overburden	sch 80 PVC	20.36	20.86	20.71	0.35	-4.15	-14.15	27930.200	-20744.629	-
MW-112	7-Dec-89	12.00	4	10	<0.1	flush mount	overburden	sch 80 PVC	10.64	10.84	10.54	-0.10	8.54	-1.46	29031.043	-19812.714	-

Notes:
BD = Bronx Datum = 2.608 ft. above mean sea level
SS = Stainless Steel
GRD = Ground
gpm = gallons per minute
HP-2 was damaged during the weekend of 8/8/92
Well depth measured from top of inner riser

Prepared by: DAD
Checked by: PGN
92C4087

Table 2-4
Water Level Measurements
Pelham Bay Landfill
Bronx, New York

Well Number	AUGUST 4, 1992 LOW TIDE AT 1103				AUGUST 12, 1992 HIGH TIDE AT 1208				NOVEMBER 5, 1992 LOW TIDE AT 1420			
	Time	Depth to Water (ft)	Elevation of PVC (ft)	Water Table Elevation (ft)	Time	Depth to Water (ft)	Elevation of PVC (ft)	Water Table Elevation (ft)	Time	Depth to Water (ft)	Elevation of PVC (ft)	Water Table Elevation (ft)
MW-103	omitted		9.43		1244	8.2	9.43	1.23	1433	14.55	9.43	-5.12
MW-104	1114	8.95	9.55	0.60	1212	8.68	9.55	0.87	1442	9.08	9.55	0.47
MW-105	1109	8.87	9.99	1.12	1230	8.80	9.99	1.19	1425	8.89	9.99	1.10
MW-106	1100	14.25	9.86	-4.39	1229	8.10	9.86	1.76	1435	9.04	9.86	0.82
MW-107	1103	6.59	5.19	-1.40	omitted		5.19		1420	5.54	5.19	-0.35
MW-109	1015	10.50	16.96	6.46	1138	10.80	16.96	6.16	1420	11.58	16.96	5.38
MW-110	1113	12.89	11.34	-1.55	omitted		11.34		1445	13.32	11.34	-1.98
MW-111									1508	16.67	20.71	4.04
MW-112	1109	8.39	10.54	2.15	1221	8.74	10.54	1.80	1424	8.96	10.54	1.58
MW-113	1108	9.66	11.07	1.41	Aquistar power failure		11.07		1423	9.97	11.07	1.10
MW-113B	1105	10.12	10.20	0.08	1220	7.53	10.20	2.67				
MW-114	1031	4.27	8.01	3.74	1327	3.07	8.01	4.94	1420	4.45	8.01	3.56
MW-114B	1030	3.45	7.32	3.87	omitted		7.32					
MW-115	1354	16.08	20.34	4.26	pump test		20.34		1431	15.95	20.34	4.39
MW-115B	1351	15.80	21.77	5.97	pump test		21.77					
MW-116	1408	8.15	13.92	5.77	1516	8.36	13.92	5.56	1435	7.51	13.92	6.41
MW-116B	1410	57.70	13.79	-43.91	1548	62.00	13.79	-48.21				
MW-117	1108	8.73	7.33	-1.40	1220	6.82	7.33	0.51	1421	7.7	7.33	-0.37
MW-117B	1104	8.08	6.40	-1.68	1208	6.70	6.40	-0.30				
MW-118	1116	15.62	13.19	-2.43	Aquistar power failure		13.19		1440	13.94	13.19	-0.75
MW-118B	1117	20.02	13.09	-6.93	development		13.09					
MW-119	1106	18.95	13.78	-5.17	1231	12.70	13.78	1.08	1430	18.52	13.78	-4.74
MW-119B	1104	16.20	14.29	-1.91	1238	15.63	14.29	-1.34				
MW-120	development		11.61		1209	11.33	11.61	0.28	1420	12.13	11.61	-0.52
MW-120B	1111	14.42	10.84	-3.58	1239	10.77	10.84	0.07				
MW-121	development		13.10		1215	12.18	13.10	0.92	1437	17.35	13.10	-4.25
MW-121B	development		13.54		1215	66.92	13.54	-53.38				
MW-122	1117	15.28	11.68	-3.60	1217	10.42	11.68	1.26	1427	15.07	11.68	-3.39
MW-122B	1115	15.00	11.17	-3.83	1217	9.75	11.17	1.42				
MW-123	1358	6.70	13.23	6.53	1515	6.90	13.23	6.33	1440	6.55	13.23	6.68
MW-124	1405	10.55	22.12	11.57	1526	10.92	22.12	11.20	1430	11.98	22.12	10.14
MW-124B	1404	12.80	20.60	7.80	1526	9.18	20.60	11.42				
MW-125	1024	3.90	5.92	2.02	1300	3.05	5.92	2.87	1424	3.98	5.92	1.94
MW-125B	1023	3.90	5.90	2.00	omitted		5.90					
MW-126	1304	118.00	124.68	6.68	1425	120.37	124.68	6.31	1443	115.15	124.68	9.53
PZ-1B	1244	77.90	82.08	4.18	1426	78.02	82.08	4.06				
PZ-1F	1251	77.00	82.33	5.33	1428	76.18	82.33	6.15	1510	76.25	82.33	6.08
PZ-2F	1257	94.78	95.48	0.70	1437	dry	95.48	dry	1500	97.6	95.48	-2.12
PZ-3B	1344	132.20	130.93	-1.27	1457	132.40	130.93	-1.47				
PZ-3F	1336	124.70	129.10	4.40	1457	132.40	129.10	-3.30	1454	121.66	129.10	7.44
PZ-3S	1340	131.36	129.46	-1.90	1458	131.60	129.46	-2.14				
PZ-4F	1157	dry	81.27	dry	1505	dry	81.27	dry	1500	Well Dry	81.27	
PZ-5B	1310	121.58	126.08	4.50	1347	133.28	126.08	-7.20				

Note: Elevations are referenced to the Bronx Datum which is 2.608 feet above mean sea level at Sandy Hook, NJ

Prepared by: KNS
Checked by: TRP
92C4087

S:\MOKE\E092C4087\GRNDWATR\TP1.XLS

02:09 PM 1/7/93

Appendix T

Well Construction Logs

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

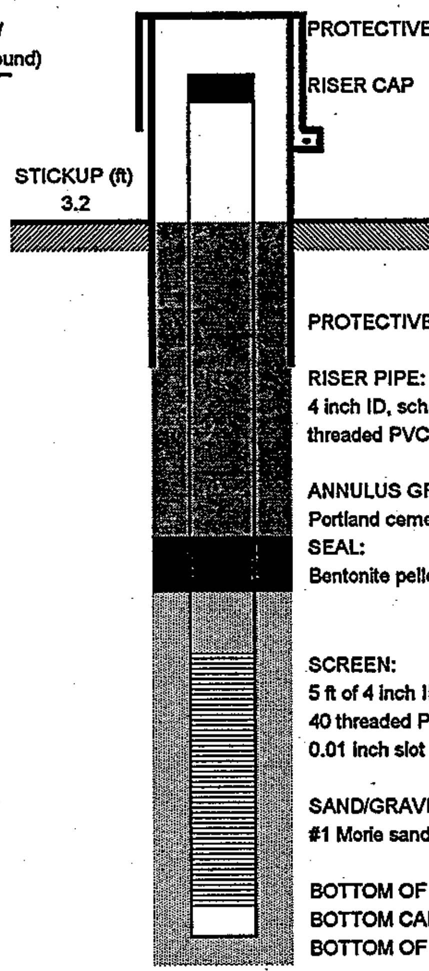
CONSTRUCTION OF WELL / PIEZOMETER **MW-113**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	***Well lock No.*** 3220	***Elevation datum*** Bronx Datum (BD) 2.068 ft. above MSL
Drilling company WARREN-GEORGE INC.	***Surveyor*** ETTLINGER & ETTLINGER	***Ground elevation*** 8.22 ft
Date and time of completion 5/26/92	***Northing*** 29070.315	***Top of protective steel casing elevation*** 11.42 ft
Inspector D. Davidson	***Easting*** -19814.674	***Top of riser pipe elevation*** 11.07 ft

A = Top of Riser
B = Ground Surface
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

ELEV. (ft above/ below BD)		DEPTHS (ft below / above ground)
11.07	A	2.85
8.22	B	0
6.72	C	1.5
5.72	D	2.5
3.72	E	4.5
-1.28	F	9.5
-1.28	G	9.5
-19.78	H	28

STICKUP (ft)
3.2



GENERALIZED SOIL DESCRIPTION

0-10 inches: Brown organic soil.
11"- 13ft.: Sand, silt, gravel, and decomposed rock.

13-14 ft.: Dk-med. grey SILT.

14-18 ft.: Decomposed ROCK.

18-22 ft.: Fine biotite GNEISS with garnet.

22-23 ft.: Coarse grained PEGMATITE DIKE.

23-28 ft.: White and black biotite-feldspar GNEISS with garnet, quartz.

REMARKS (Installation, development) :
MATERIALS: 10 FT. OF 4" SCH 40 PVC RISER, 5 FT. OF SCC 40 PVC SCREEN, 2 BOTTOM/TOP CAPS, 4 BAGS #1 SAND, 1 BUCKET OF BENTONITE PELLETS, 2 BAGS OF PORTLAND CEMENT, 1 4" STICK UP.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

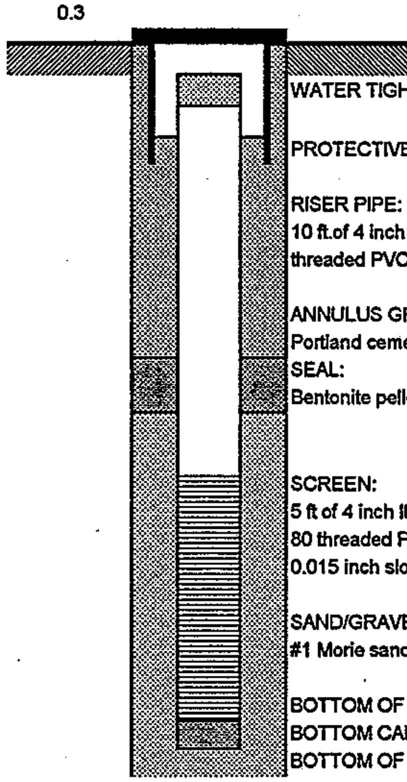
CONSTRUCTION OF WELL / PIEZOMETER **MW-114**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	*Well lock No.* 3220	*Elevation datum* Bronx Datum (BD) 2.608 ft. above MSL
Drilling company WARREN-GEORGE	*Surveyor* ETTLINGER & ETTLINGER	*Ground elevation* 7.96 ft
Date and time of completion 5/27/92	*Northing* 28402.734	*Top of protective steel casing elevation* 8.26 ft
Inspector D. Davidson	*Easting* -20517.931	*Top of riser pipe elevation* 8.01 ft

A = Ground Surface
B = Top of Riser
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

FLUSHMOUNT (ft)
0.3

GENERALIZED SOIL DESCRIPTION	ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
	7.96	A	0
	8.01	B	0.05
0-8 ft.: Dk. brown gravelly sandy organic soil.			
	8.01	C	0.05
	7.14	D	0.82
	6.14	E	1.82
8-12 ft.: Orange-brown and green-brown micaceous varved SILT.			
12-22 ft.: Brown to olive green fine-coarse silty SAND w/ gravel, decomposed micaceous rock. Very green color at 18 ft. (chlorite?) Varved mica. silt stringers at 20 ft.	-3.86	F	11.82
	-3.86	G	11.82
	-5.54	H	13.5



GROUND SURFACE
WATER TIGHT CAP WITH LOCK
PROTECTIVE STEEL CASING CEMENTED IN PLACE
RISER PIPE:
10 ft.of 4 inch ID, schedule 80 threaded PVC
ANNULUS GROUTED WITH:
Portland cement
SEAL:
Bentonite pellets
SCREEN:
5 ft of 4 inch ID, schedule 80 threaded PVC, 0.015 inch slot
SAND/GRAVEL PACK:
#1 Morie sand
BOTTOM OF SCREEN
BOTTOM CAP
BOTTOM OF BOREHOLE

DIAMETER OF BOREHOLE:
11.5"

REMARKS (Installation, development) :
MATERIALS: 5 FT. OF 4" SCH 80 PVC SCREEN,10 FT OF 4" SCH 80 PVC RISER, 1 BOTTOM CAP,
3 BAGS OF #1 SAND, 1 BUCKET OF BENTONITE PELLETS, 1 BAG OF PORTLAND CEMENT,1 FLUSH MOUNT CASING.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-115**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	***Well lock No.*** 3220	***Elevation datum*** Bronx Datum (BD) 2.608 ft above MSL
Drilling company WARREN-GEORGE INC.	***Surveyor*** ETTLINGER & ETTLINGER	***Ground elevation*** 18.44 ft
Date and time of completion 6/8/92	***Northing*** 27911.455	***Top of protective steel casing elevation*** 21.64 ft
Inspector B. Atkinson	***Easting*** -20754.435	***Top of riser pipe elevation*** 20.34 ft

A = Top of Riser
B = Ground Surface
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
20.34	A	1.9
18.44	B	0
9.44	C	9
1.44	D	17
-2.56	E	21
-22.56	F	41
-22.56	G	41
-22.56	H	41

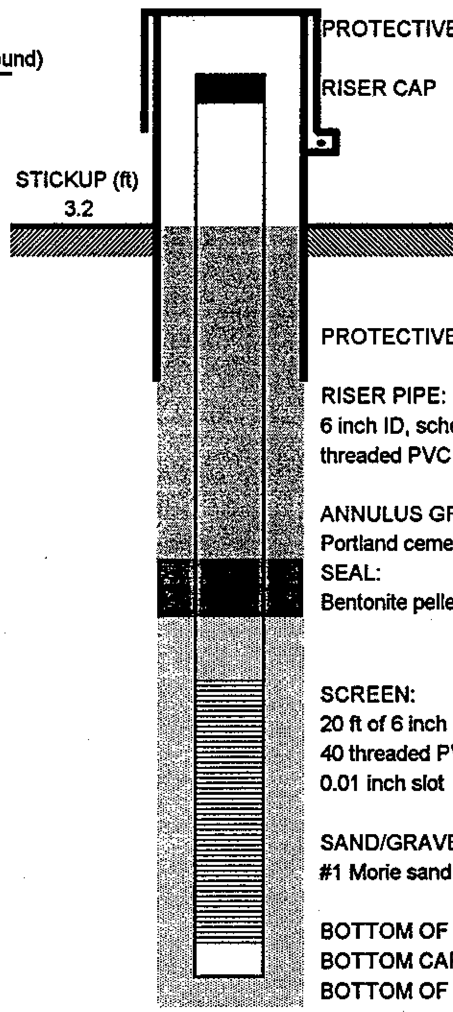
STICKUP (ft)
3.2

GENERALIZED SOIL DESCRIPTION

0-6 ft.: Lt. brown cuttings.

6-16 ft.: Black cuttings.

16-41 ft.: Lt. brown-brown fine SAND w/ mica and gravel.



PROTECTIVE STEEL CAP WITH LOCK

RISER CAP

GROUND SURFACE

PROTECTIVE STEEL CASING CEMENTED

RISER PIPE:
6 inch ID, schedule 40
threaded PVC

ANNULUS GROUTED WITH:
Portland cement

SEAL:
Bentonite pellets

SCREEN:
20 ft of 6 inch ID, schedule
40 threaded PVC,
0.01 inch slot

SAND/GRAVEL PACK:
#1 Morie sand

BOTTOM OF SCREEN
BOTTOM CAP
BOTTOM OF BOREHOLE

DIAMETER OF BOREHOLE:
6"

REMARKS (Installation, development) :

MATERIALS: 22 ft. OF 6" SCH 40 PVC RISER, 20 FT. OF 6" SCH 40 WIRE WRAPPED PVC SCREEN,
8 BAGS OF # 1 SAND, 1 1/2 BUCKETS OF BENTONITE PELLETS, 4 BAGS OF CEMENT.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-115B**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	*Well lock No.* 3220	*Elevation datum* Bronx Datum (BD) 2.608 ft. above MSL
Drilling company WARREN-GEORGE, INC.	*Surveyor* ETTLINGER & ETTLINGER	*Ground elevation* 19.79 ft
Date and time of completion 6/8/92	*Northing* 27904.201	*Top of protective steel casing elevation* 21.89 ft
Inspector B. Atkinson	*Easting* -20755.529	*Top of riser pipe elevation* 21.77 ft

A = Top of Riser
B = Ground Surface
C = Top of Bedrock
D = Bottom of 8" Casing
E = Bottom of Borehole

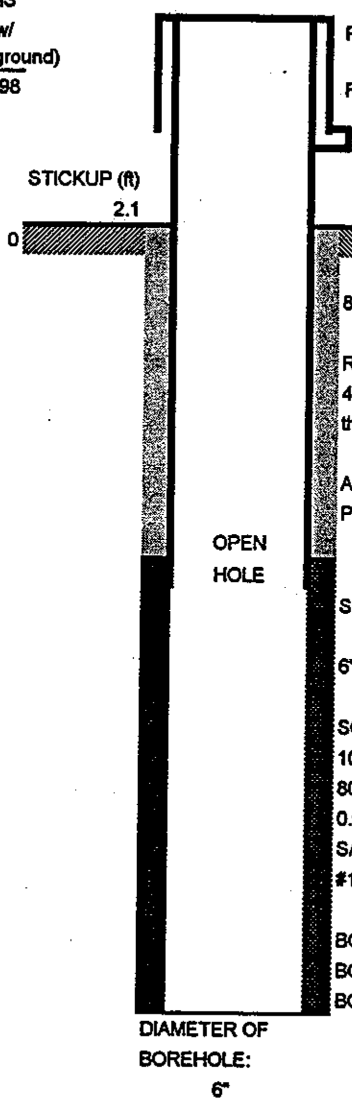
	ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
	21.77	A	1.98
	19.79	B	0
	-26.21	C	46
	-34.21	D	54
	-54.21	E	74

GENERALIZED SOIL DESCRIPTION

0-1.5 ft. Black to brown silty SAND & FILL

1.5-40 ft. Black FILL

40-74 ft.Competent Bedrock: Biotite-Garnet SCHIST.



PROTECTIVE STEEL CAP WITH LOCK

RISER CAP

GROUND SURFACE

8" STEEL CASING CEMENTED IN PLACE

RISER PIPE:
4 inch ID, schedule 80
threaded PVC

ANNULUS GROUTED WITH:
Portland cement

SEAL: Bentonite pellets

6" DIAMETER BORE HOLE

SCREEN:
10 ft of 4 inch ID, schedule
80 threaded PVC,
0.015 inch slot
SAND/GRAVEL PACK:
#1 Morie sand

BOTTOM OF SCREEN
BOTTOM CAP
BOTTOM OF BOREHOLE

REMARKS (Installation, development) :
Open bedrock hole 54 - 74 feet. MATERIALS: 10 FT OF 4" SCH 80 PVC SCREEN, 104 FT OF SCH 80 PVC RISER, 21 FT OF 8" STEEL CASING,1 BOTTOM CAP, 6 BAGS OF #1 SAND, 1 BUCKET OF BENTONITE PELLETS, 10 BAGS OF PORTLAND CEMENT, 1 6 " STICK UP CASING.

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Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-117**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	***Well lock No.*** 3220	***Elevation datum*** Bronx Datum (BD) 2.608 ft above MSL
Drilling company WARREN-GEORGE, INC.	***Surveyor*** ETTLINGER & ETTLINGER	***Ground elevation*** 5.18 ft
Date and time of completion 6/1/92	***Northing*** 26639.141	***Top of protective steel casing elevation*** 7.49 ft
Inspector D. Davidson	***Easting*** -20177.984	***Top of riser pipe elevation*** 7.33 ft

A = Top of Riser
B = Ground Surface
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
7.33	A	2.15
5.18	B	0
1.18	C	4
-0.82	D	6
-2.82	E	8
-12.82	F	18
-12.82	G	18
-12.82	H	18

STICKUP (ft) 2.31

GENERALIZED SOIL DESCRIPTION

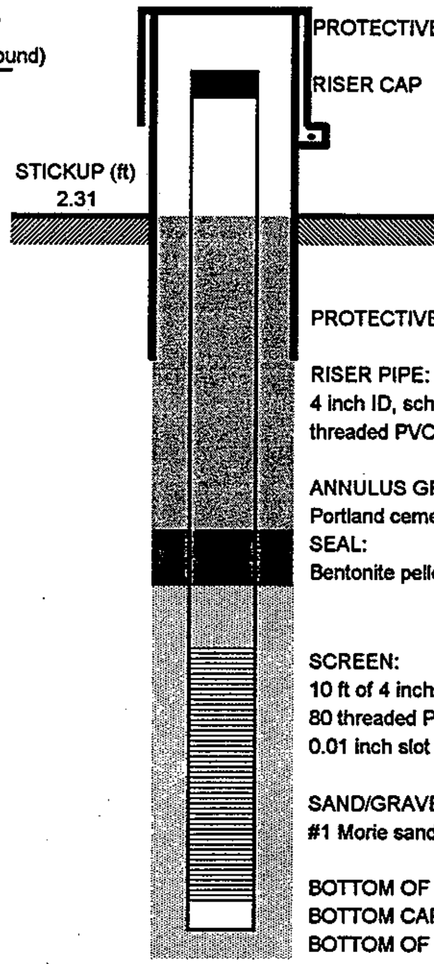
0-2 ft.: Highly organic sandy, silty soil.

2-9 ft.: Crushed SLAG

9-11 ft.: Lt. gray highly organic SILT.

11-18 ft.: Decomposed ROCK w/ silt and sand.

18-28 ft. NX core: Competent bedrock Biotite-feldspar GNEISS w/ quartz and garnet.



PROTECTIVE STEEL CAP WITH LOCK

RISER CAP

GROUND SURFACE

PROTECTIVE STEEL CASING CEMENTED

RISER PIPE: 4 inch ID, schedule 80 threaded PVC

ANNULUS GROUTED WITH: Portland cement

SEAL: Bentonite pellets

SCREEN: 10 ft of 4 inch ID, schedule 80 threaded PVC, 0.01 inch slot

SAND/GRAVEL PACK: #1 Morie sand

BOTTOM OF SCREEN

BOTTOM CAP

BOTTOM OF BOREHOLE

DIAMETER OF BOREHOLE: 11 1/2"

REMARKS (Installation, development) :

MATERIALS: 10 FT OF 4" SCH 80 PVC SCREEN, 10 FT OF 4" SCH 80 PVC RISER, 1 BOTTOM CAP, 2 BAGS OF #1 SAND, 1 BUCKET OF BENTONITE PELLETS, 2 BAGS OF PORTLAND CEMENT, 1 6" STICK UP CASING.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-117B**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	***Well lock No.*** 3220	***Elevation datum*** Bronx Datum (BD) 2.608 ft. above MSL
Drilling company WARREN-GEORGE, INC.	***Surveyor*** ETTLINGER & ETTLINGER	***Ground elevation*** 4.62 ft
Date and time of completion 6/29/92	***Northing*** 26615.782	***Top of protective steel casing elevation*** 6.52 ft
Inspector R. Costa	***Easting*** -20186.704	***Top of riser pipe elevation*** 6.40 ft

A = Top of Riser
B = Ground Surface
C = Top of Bedrock
D = Bottom of 8" Casing
E = Top of Bentonite Seal
F = Top of Sand Pack
G = Top of Screen
H = Bottom of Screen
I = Bottom of PVC/Steel
J = Bottom of Borehole

ELEV. (ft above MSL)		DEPTHS (ft below/ above ground)
6.40	A	1.78
4.62	B	0
-19.88	C	24.5
-21.38	D	26
-25.38	E	30
-27.38	F	32
-63.38	G	68
-73.38	H	78
-73.38	I	78
-73.38	J	78

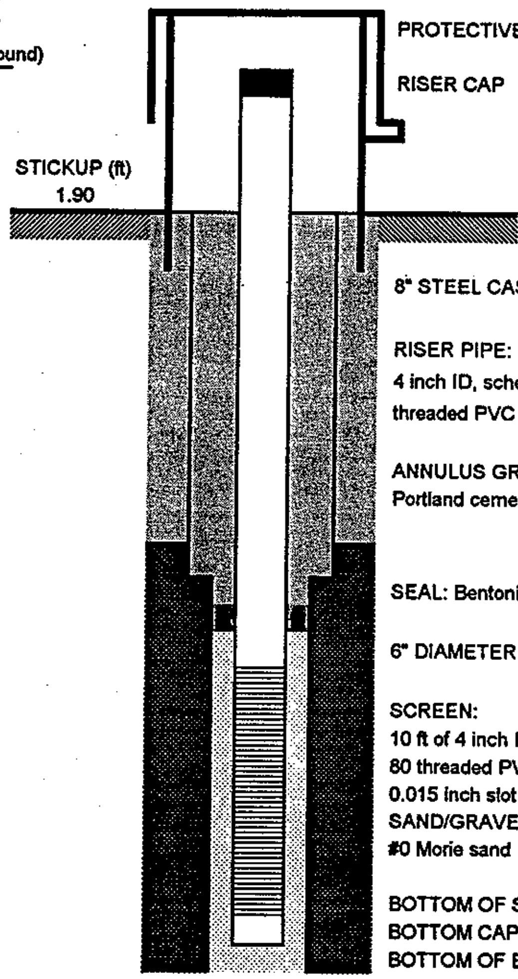
STICKUP (ft)
1.90

GENERALIZED
SOIL DESCRIPTION

0-16 ft.: Brown med. SAND and SILT.

16-24.5 ft.: Decomposed biotite SCHIST.

24.5-78 ft.: Competent Bedrock: Biotite-garnet SCHIST.



PROTECTIVE STEEL CAP WITH LOCK

RISER CAP

GROUND SURFACE

8" STEEL CASING CEMENTED IN PLACE

RISER PIPE:
4 inch ID, schedule 80
threaded PVC

ANNULUS GROUTED WITH:
Portland cement

SEAL: Bentonite pellets

6" DIAMETER BORE HOLE

SCREEN:
10 ft of 4 inch ID, schedule
80 threaded PVC,
0.015 inch slot
SAND/GRAVEL PACK:
#0 Morie sand

BOTTOM OF SCREEN
BOTTOM CAP
BOTTOM OF BOREHOLE

DIAMETER OF
BOREHOLE:
7 1/2"

REMARKS (Installation, development) :

MATERIALS: 26 FT OF 8" STEEL CASING; 1 BOTTOM PLUG; 10 FT OF SCH 80 4" PVC SCREEN 0.015 SLOT; 70 FT OF 4" SCH 80 PVC RISER; 6 BAGS #0 MORIE SAND; 1/2 BUCKET BENTONITE PELLETS, 4 BAGS PORTLAND CEMENT; 1 STANDPIPE W/ LOCK.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-118**

Project name & location	*Well lock No.*	*Elevation datum*
PELHAM BAY LANDFILL, BRONX, NEW YORK	3220	Bronx Datum (BD) 2.608 ft. above MSL
Drilling company	*Surveyor*	*Ground elevation*
WARREN-GEORGE, INC.	ETTLINGER & ETTLINGER	10.83 ft
Date and time of completion	*Northing*	*Top of protective steel casing elevation*
6/3/92	26728.412	13.73 ft
Inspector	*Easting*	*Top of riser pipe elevation*
D. Davidson	-19287.747	13.19 ft

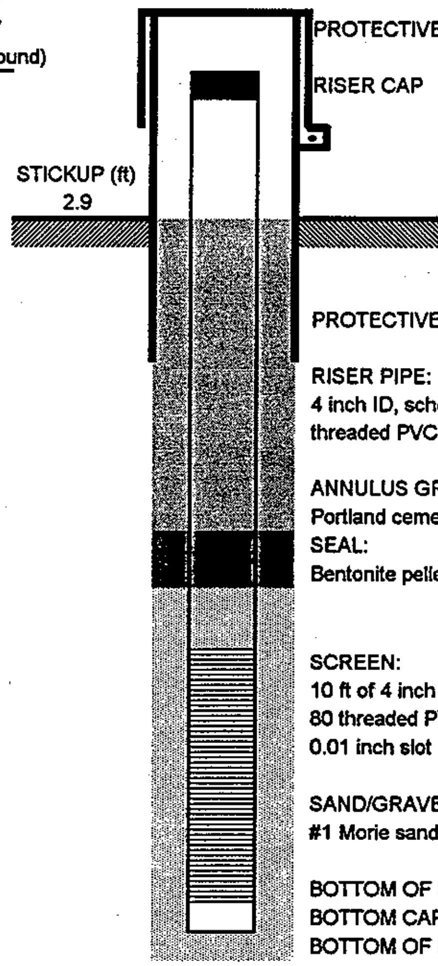
A = Top of Riser
B = Ground Surface
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
13.19	A	2.36
10.83	B	0
8.83	C	2
7.33	D	3.5
5.83	E	5
-4.17	F	15
-4.17	G	15
-4.71	H	15

GENERALIZED SOIL DESCRIPTION

0-6 ft.: Sand, silt, gravel, and decomposed rock.

6-15 ft.: FILL



REMARKS (Installation, development) :

MATERIALS: 10 FT OF 4" SCH 80 PVC SCREEN, 10 FT OF 4" SCH 80 PVC RISER,1 BOTTOM CAP, 6 BAGS OF #1 SAND, 1 BUCKET OF BENTONITE PELLETS, 3 BAGS OF PORTLAND CEMENT,1 6" STICK UP CASING.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-119**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	***Well lock No.*** 3220	***Elevation datum*** Bronx Datum (BD) 2.608 ft. above MSL.
Drilling company WARREN-GEORGE INC.	***Surveyor*** ETTLINGER & ETTLINGER	***Ground elevation*** 11.52 ft
Date and time of completion 6/10/92	***Northing*** 27200.09	***Top of protective steel casing elevation*** 13.92 ft
Inspector D. Davidson	***Easting*** -18950.844	***Top of riser pipe elevation*** 13.78 ft

A = Top of Riser
B = Ground Surface
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
13.78	A	2.26
11.52	B	0
-0.48	C	12
-2.48	D	14
-6.48	E	18
-16.48	F	28
-16.48	G	28
-40.48	H	52

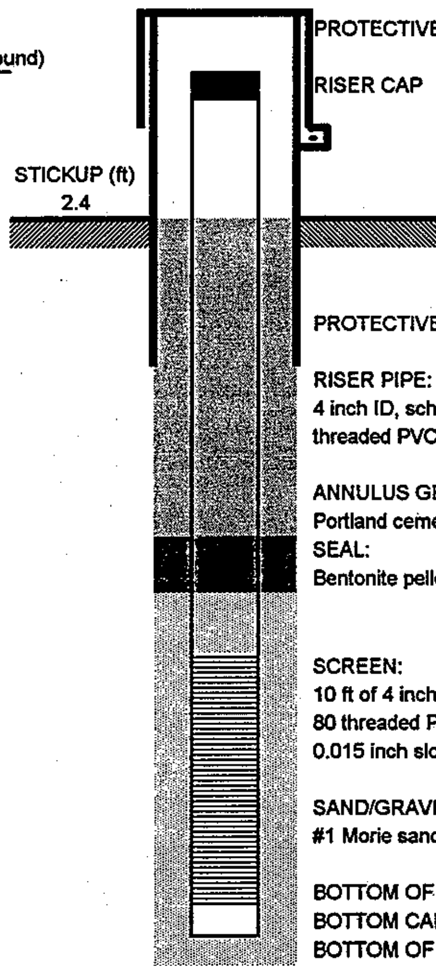
STICKUP (ft)
2.4

GENERALIZED SOIL DESCRIPTION

0-27 ft.: FILL.

27-52 ft.: RIP-RAP

52-58.5 ft.: White and black biotite feldspar GNEISS w/ muscovite, quartz, and garnet.



PROTECTIVE STEEL CAP WITH LOCK

RISER CAP

GROUND SURFACE

PROTECTIVE STEEL CASING CEMENTED

RISER PIPE:
4 inch ID, schedule 80
threaded PVC

ANNULUS GROUTED WITH:
Portland cement

SEAL:
Bentonite pellets

SCREEN:
10 ft of 4 inch ID, schedule
80 threaded PVC,
0.015 inch slot

SAND/GRAVEL PACK:
#1 Morie sand

BOTTOM OF SCREEN
BOTTOM CAP
BOTTOM OF BOREHOLE

DIAMETER OF BOREHOLE:
11"

REMARKS (Installation, development) :
MATERIALS: 10 FT OF 4" SCH 80 PVC SCREEN, 20 FT OF 4" SCH 80 PVC RISER, 1 BOTTOM CAP, 4 BAGS OF #1 SAND, 1 BUCKET OF BENTONITE PELLETS, 3 BAGS OF PORTLAND CEMENT, 1 6" STICK UP CASING.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-120**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	*Well lock No.* 3220	*Elevation datum* Bronx Datum (BD) 2.608 ft. above MSL.
Drilling company WARREN-GEORGE, INC.	*Surveyor* ETTLINGER & ETTLINGER	*Ground elevation* 9.05 ft
Date and time of completion 6/10/92	*Northing* 27776.950	*Top of protective steel casing elevation* 12.45 ft
Inspector B. Atkinson	*Easting* -18994.003	*Top of riser pipe elevation* 11.61 ft

A = Top of Riser
B = Ground Surface
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
11.16	A	2.56
9.05	B	0
-20.31	C	31
-22.31	D	33
-22.31	E	33
-42.31	F	53
-42.31	G	53
-44.89	H	55.58

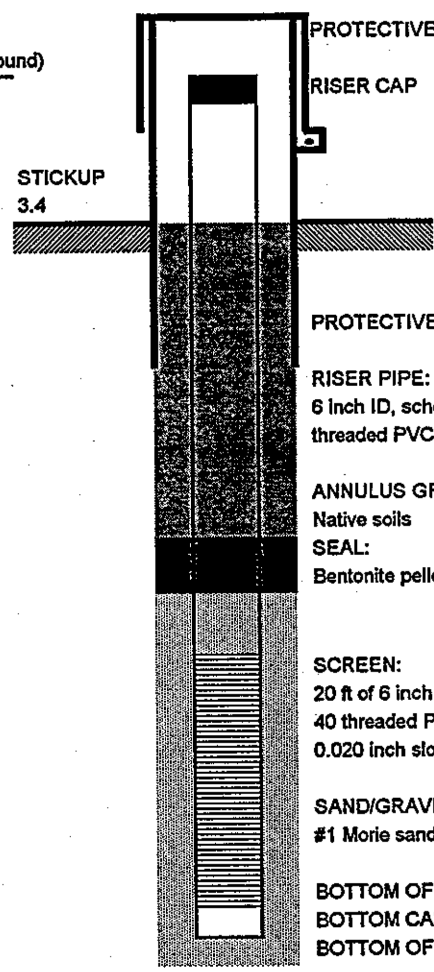
GENERALIZED SOIL DESCRIPTION

0-6 ft.: Brown cuttings.

6-30 ft.: Black cuttings, abundant gravel.

30-46 ft.: Dark grey, silty CLAY.

46-53 ft.: Lt. brown fine SAND.



PROTECTIVE STEEL CAP WITH LOCK

RISER CAP

GROUND SURFACE

PROTECTIVE STEEL CASING CEMENTED

RISER PIPE:
6 inch ID, schedule 40
threaded PVC

ANNULUS GROUTED WITH:
Native soils

SEAL:
Bentonite pellets

SCREEN:
20 ft of 6 inch ID, schedule
40 threaded PVC,
0.020 inch slot

SAND/GRAVEL PACK:
#1 Morie sand

BOTTOM OF SCREEN
BOTTOM CAP
BOTTOM OF BOREHOLE

DIAMETER OF BOREHOLE:
6"

REMARKS (Installation, development) :
MATERIALS: 20 FT OF 6" SCH 40 PVC SCREEN, 36 FT OF 6" SCH 40 PVC RISER, 1 BOTTOM CAP, 9 BAGS OF #1 SAND, 1 BUCKET OF BENTONITE PELLETS.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

CONSTRUCTION OF WELL / PIEZOMETER **MW-120B**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	***Well lock No.*** 3220	***Elevation datum*** Bronx Datum (BD) 2.608 ft. above MSL
Drilling company WARREN-GEORGE, INC.	***Surveyor*** ETTLINGER & ETTLINGER	***Ground elevation*** 9.09 ft
Date and time of completion 5/22/92	***Northing*** 27791.700	***Top of protective steel casing elevation*** 10.99 ft
Inspector J. Prunetti	***Easting*** -18995.120	***Top of riser pipe elevation*** 10.84 ft

A = Top of Riser
B = Ground Surface
C = Top of Bedrock
D = Bottom of 8" Casing
E = Top of Bentonite Seal
F = Top of Sand Pack
G = Top of Screen
H = Bottom of Screen
I = Bottom of PVC/Steel
J = Bottom of Borehole

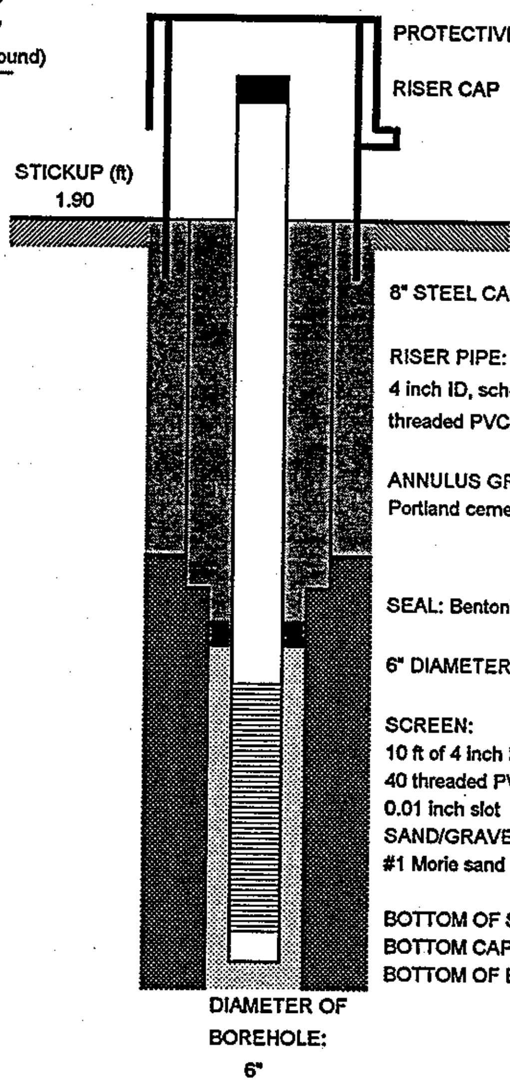
ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
10.84	A	1.75
9.09	B	0
-46.95	C	56
-54.95	D	64
-55.95	E	65
-57.95	F	67
-59.95	G	69
-69.95	H	79
-69.95	I	79
-69.95	J	79

GENERALIZED SOIL DESCRIPTION

0-45 ft.: Dark grey cuttings and fluids; unconsolidated material. (FILL?)

45-56 ft.: Tan cuttings, very soft material. (Glacial Sediment?)

56-79 ft.: Lt. grey cuttings; BEDROCK.



REMARKS (Installation, development) :
8" casing driven to 64 ft.; borehole advanced to 79 ft. to set well.

MATERIALS: 10 FT 4" SCH 40 PVC SCREEN; 70 FT 4" SCH 40 PVC RISER; 65 FT 8" STEEL CASING; 3 BAGS #1 MORIE SAND; 11 BAGS PORTLAND CEMENT; 1 BUCKET BENTONITE PELLETS; I BOTTOM CAP; 1 STANDPIPE W/ LOCK.

WOODWARD-CLYDE CONSULTANTS
Consulting Engineers, Geologists and Environmental Scientists

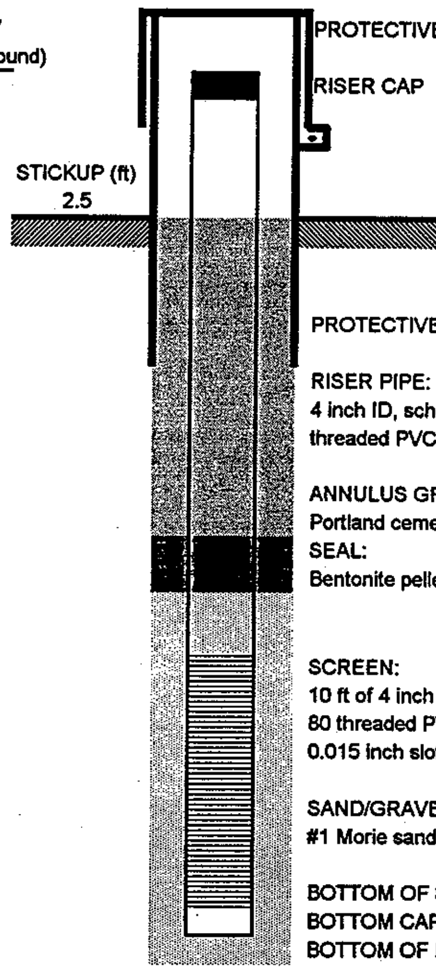
CONSTRUCTION OF WELL / PIEZOMETER **MW-122**

Project name & location PELHAM BAY LANDFILL, BRONX, NEW YORK	***Well lock No.*** 3220	***Elevation datum*** Bronx Datum (BD) 2.608 ft, above MSL.
Drilling company WARREN-GEORGE INC.	***Surveyor*** ETTLINGER & ETTLINGER	***Ground elevation*** 9.54 ft
Date and time of completion 6/2/92	***Northing*** 28967.069	***Top of protective steel casing elevation*** 12.04 ft
Inspector B. Atkinson	***Easting*** -19311.343	***Top of riser pipe elevation*** 11.68 ft

A = Top of Riser
B = Ground Surface
C = Top of Bentonite Seal
D = Top of Sand Pack
E = Top of Screen
F = Bottom of Screen
G = Bottom of PVC/Steel
H = Bottom of Borehole

ELEV. (ft above/ below BD)		DEPTHS (ft below/ above ground)
11.68	A	2.14
9.54	B	0
-11.46	C	21
-14.46	D	24
-17.46	E	27
-27.46	F	37
-27.46	G	37
-27.46	H	37

STICKUP (ft)
2.5



PROTECTIVE STEEL CAP WITH LOCK

RISER CAP

GROUND SURFACE

PROTECTIVE STEEL CASING CEMENTED

RISER PIPE:
4 inch ID, schedule 80
threaded PVC

ANNULUS GROUTED WITH:
Portland cement

SEAL:
Bentonite pellets

SCREEN:
10 ft of 4 inch ID, schedule 80 threaded PVC,
0.015 inch slot

SAND/GRAVEL PACK:
#1 Morie sand

BOTTOM OF SCREEN
BOTTOM CAP
BOTTOM OF BOREHOLE

DIAMETER OF BOREHOLE:
9"

GENERALIZED SOIL DESCRIPTION

0-26 ft.: Brownish-dk. grey gravelly cuttings.

26-28 ft.: Dk. grey-black SILT.

28-37 ft.: Lt. brown fine SAND.

REMARKS (Installation, development) :
30 FT. OF SCH 80 4" PVC RISER, 10 FT. OF SCH 80 4" PVC SCREEN, 1 BUCKET OF BENTONITE PELLETS, 5 BAGS OF #1 SAND, 4 BAGS OF PORTLAND CEMENT, 2 SCH 80 PVC BOTTOM/TOP CAPS.

Appendix U

Groundwater Well Sampling Log

GROUNDWATER ELEVATION CALCULATION SHEET
PELHAM BAY LANDFILL, BRONX, NEW YORK

Date ______________ Time ________________________

Measurer ______________

Well Number	Top of Well Elevation**	Depth to Groundwater (ft)	Water Table Elev.
MW – 104	19.132		
MW – 106	18.388		
MW – 109	23.952		
MW – 110	20.013		
MW – 113	14.442		
MW – 114	14.66		
MW – 115	24.807		
MW – 115B	24.876		
MW – 117 *	8.077		
MW – 117B *	Can't locate		
MW – 118	19.113		
MW – 119	20.421		
MW – 120	18.838		
MW – 120B	19.296		
MW – 121	15.621		
MW – 122	17.575		
MW – 124 *	Can't locate		
MW – 124B *	Can't locate		
MW – 126 (PZ-5)	Can't locate		
PZ-A	11.951		
PZ-B *	14.254		
PZ-C	11.374		
PZ-D *	12.411		
PZ-E	9.545		
PZ-F	9.645		

* MW -117, MW-117B, MW-124, MW-124B, PZ-B & PZ-D
are located outside landfill on Pelham park side

** Wells re-surveyed in July 2006

GROUNDWATER ELEVATION LOG
PELHAM BAY LANDFILL, BRONX, NEW YORK

Date ____________ **Measurer** ____________________

GROUNDWATER ELEVATION			
Well Number	**Time**	**Elevation (ft) ***	**Comments**
MW – 104		19.132	
MW – 106		18.388	
MW – 109		23.952	
MW – 110		20.013	
MW – 113		14.442	
MW – 114		14.66	
MW – 115		24.807	
MW – 115B		24.876	
MW – 117		8.077	
MW – 117B		--	
MW – 118		19.113	
MW – 119		20.421	
MW – 120		18.838	
MW – 120B		19.296	
MW – 121		15.621	
MW – 122		17.575	
MW – 124		--	
MW – 124B		--	
MW – 126 (PZ-5)		--	
PZ-A		11.951	
PZ-B		14.254	
PZ-C		11.374	
PZ-D		12.411	
PZ-E		9.545	
PZ-F		9.645	

PZ-A, PZ-C, and PZ-E are piezometer wells upstream of slurry wall
PZ-B, PZ-D, and PZ-F are piezometer wells downstream of slurry wall

*** ALL ELEVATIONS REFER TO BRONX HIGHWAY DATUM, WHICH IS 2.608 FEET ABOVE MEAN SEA LEVEL AT SANDY HOOK, NEW JERSEY AS ESTABLISHED BY U.S. COAST AND GEODETIC SURVEY.**

Appendix V

Groundwater Sample Collection
Protocol Modifications

APPENDIX V

GROUNDWATER SAMPLE COLLECTION PROTOCOL MODIFICATIONS

This document describes the modifications to the groundwater sample collection protocols provided in Volume III of the Operation, Maintenance and Monitoring (OM&M) Manual (see Appendix K of this SMP) to address the tidally-influenced nature of groundwater at the Site and deletion of the requirement to gauge for the presence of non-aqueous phase liquid (NAPL). Two groundwater sample collection protocols are provided as Appendix D (Groundwater Sample Collection Using Bailers) and Appendix E (Groundwater Sample Collection Using Low-Flow Rate Purging and Sampling Technique) in Volume III of the OM&M Manual. Additionally, Appendix C of Volume III of the OM&M Manual provides the Long-Term Monitoring Program Sampling and Analysis Plan, which provides general guidance for groundwater sample collection. The general modifications provided herein apply to both groundwater sample collection protocols and the protocol-specific modifications for each technique are described below.

General Groundwater Sample Collection Protocol Modifications

One of the primary objectives of the groundwater monitoring program is to obtain representative groundwater samples (i.e., to characterize groundwater quality during periods when the groundwater is not significantly mixed with surface water from Eastchester Bay). Since the groundwater at the Site is tidally-influenced (i.e., groundwater mixes with surface water from Eastchester Bay during flood [incoming] tide), groundwater samples collected during the incoming and high tides may result in lower concentrations of aqueous species in the groundwater due to dilution. Therefore, groundwater samples will be collected from the monitoring well network during ebb (i.e., outgoing) tide, but prior to low tide conditions (i.e., between approximately 3 to 5 hours following high tide). Collecting groundwater samples during this period should yield samples that are representative of groundwater quality and allow for a sufficient amount of water column to be present in the monitoring wells for well purging and sampling activities. Monitoring wells that generally have a smaller water column height, and therefore less groundwater available for purging and sampling, will be sampled during the earlier part of the ebb tide (i.e., between 3 to 4 hours following high tide). Monitoring wells that generally have a greater water column height will be sampled during the later part of the ebb tide (i.e., between 4 to 5 hours following high tide).

Based on historical NAPL gauging and groundwater quality data (i.e., NAPL has not been detected at the Site and concentrations of aqueous species in the groundwater are not indicative of the presence of NAPL), the monitoring well network will no longer be gauged for the presence of NAPL during the groundwater sampling events. Water-level measurements will be collected from the monitoring well network using an electronic water-level indicator. However, if NAPL is visually observed during purging activities, or if concentrations of aqueous species in the groundwater significantly increase, NAPL gauging will be conducted.

Low-Flow Rate Purging and Sampling Technique Modifications

1. The low-flow rate purging and sampling protocol indicates that dedicated gas-operated stainless steel and Teflon bladder pumps (equipped with Teflon or Teflon lined polyethylene tubing) will be used for well purging and sample collection. Bladder pumps will no longer be used during low-flow rate purging and sampling. Alternative well sampling pumps will be used including, but not limited to, submersible pumps (e.g., Grundfos Redi-Flo2, ProActive Monsoon) or peristaltic pumps. Polyethylene tubing will be used and will be dedicated to each monitoring well. The tubing will be replaced in each well as necessary. The submersible pump may be dedicated to the monitoring well or may be portable and used in different monitoring wells. A peristaltic pump will generally be used to purge and sample monitoring wells with a low yield. If a peristaltic pump is used, all sample parameters will be collected directly from the pump discharge with the exception of the volatile organic compound (VOC) sample. The VOC sample will be collected using a disposable polyethylene bailer after all other sample parameters have been collected.

2. The groundwater purging and sampling will be conducted in accordance with United States Environmental Protection Agency (EPA) low-flow (minimal drawdown) groundwater sampling procedures (see attached EPA April 1996 document).

3. Water-level measurements will be collected from the monitoring well and the total depth of the well will be measured (i.e., sounded) using a measuring tape before well purging and sampling activities begin.

4. Well purging flow rates will not exceed 500 milliliters per minute (mL/min) in order to minimize drawdown in the well. The flow rate will be adjusted (i.e., lowered) as necessary with the goal of not exceeding 0.3 feet of drawdown during purging. This goal may be difficult to achieve in some monitoring wells due to geologic heterogeneities within the screened interval (i.e., less transmissive formation). As discussed previously, peristaltic pumps may be used to sample monitoring wells with a low yield.

5. With respect to the monitoring of turbidity during well purging, the well is considered stabilized and ready for sample collection when the turbidity is 50 nephelometric turbidity units (NTUs) or less. The stabilization of turbidity is required along with the other field parameters that are to be monitored during well purging: pH, temperature, specific conductance, oxidation-reduction potential (ORP), and dissolved oxygen (DO).

6. The monitoring wells will be purged until the water quality indicator parameters have stabilized, as discussed in the low-flow rate purging and sampling protocol. However, if the stabilization criteria cannot be achieved after 1 hour of purging, then the groundwater sample will be collected following 1 hour of purging.

7. The polyethylene tubing will be disconnected from the flow-through cell prior to sample collection and the groundwater sample will be collected directly from the submersible pump discharge (i.e., prior to the flow-through cell). This will preclude the need to decontaminate

the flow-through cell between well locations. Groundwater samples will not be collected from the flow-through cell discharge.

8. If a submersible pump is dedicated to a monitoring well, then decontamination of the equipment will not be necessary. Non-dedicated equipment will be decontaminated as follows: Rinse equipment with Micro-90 low-phosphate detergent (or equivalent) and potable water solution and scrub with a brush. Rinse equipment with distilled/deionized rinse water.

Bailer Purging and Sampling Technique Modifications

1. The existing OM&M Manual procedures for bailer purging and sampling protocol indicates that a stainless steel or Teflon bailer will be used for well purging and sample collection. Additionally, a disposable polyethylene bailer will also be permitted for well purging and sample collection. A new or dedicated disposable polyethylene bailer will be used at each well where bailer purging and sampling techniques are being employed during each sampling event. Therefore, there will be no decontamination activities associated with bailer purging and sampling.

2. As discussed previously, NAPL has not been detected at the Site. Therefore, there is no need to initially lower the bailer partially into the water column and decant groundwater from the bailer into a glass container for observation of oil sheens.

3. The bailer purging and sampling protocol indicates that 5 well volumes will be purged prior to sample collection, assuming that the well has not been bailed dry. Alternatively, 3 well volumes will now be purged prior to sample collection.

4. The total depth of the well will be measured (i.e., sounded) using a measuring tape after well purging and sampling activities have been completed.

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LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

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I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

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chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

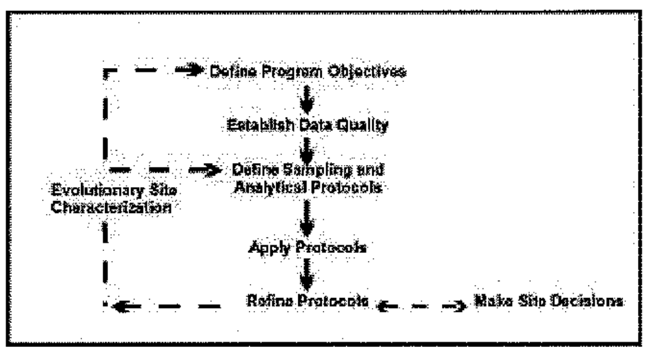

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action.*

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer's recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described herein as part of its in-house research program and under Contract No. 68-C4-0031 to Dynamac Corporation. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

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Figure 2. **Ground Water Sampling Log**

Project ______________ **Site** ______________ **Well No.** ____________ **Date** ______________________

Well Depth ___________ **Screen Length** _________ **Well Diameter** ________ **Casing Type** ___________

Sampling Device ______________ **Tubing type** ___________________ **Water Level** ________________

Measuring Point _________________ **Other Infor** ____

____

Sampling Personnel ____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project ______________ **Site** ______________ **Well No.** ____________ **Date** ______________________

Well Depth ____________ **Screen Length** __________ **Well Diameter** _________ **Casing Type** ___________

Sampling Device ______________ **Tubing type** ____________________ **Water Level** ________________

Measuring Point __________________ **Other Infor** ____

____

Sampling Personnel ____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi r^3$

Appendix W

NYSDEC Groundwater Monitoring
Well Decommissioning Procedures

GROUNDWATER MONITORING WELL DECOMMISSIONING PROCEDURES

April 2003

New York State Department
of Environmental Conservation

Division of Environmental Remediation

DECOMMISSIONING PROCEDURES

NYS SUPERFUND STANDBY CONTRACT
WORK ASSIGNMENT D002852-10

NPL SITE MONITORING WELL DECOMMISSIONING

NEW YORK STATE DEPARTMENT
OF ENVIRONMENTAL CONSERVATION

MAY 1995
Revised October 1996

0266-317-002

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NYS SUPERFUND STANDBY CONTRACT
NPL SITE MONITORING WELL DECOMMISSIONING

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LIST OF APPENDICES

DISCLAIMER

October 21, 1996

RE: New York State Department of Environmental Conservation
Division of Environmental Remediation
Monitoring Well Decommissioning Procedures

Per your request, the enclosed referenced document is being made available to you for informational purposes. These procedures may be used as a guidance when decommissioning a monitoring well. Please note that this document does not address some site specific special situations that may be encountered in the field. These procedures have not been adopted by the Department of Environmental Conservation. Compliance with the procedures set forth in this document does not relieve any party of the obligation to successfully and satisfactorily decommission a well.

If you have any questions, please contact Ben Loredo, of my staff, at (518) 457-0927.

Sincerely,

Gerald J. Rider, Jr., P.E.
Chief, Operation, Maintenance and Support Section
Bureau of Hazardous Site Control
Division of Environmental Remediation
New York State Department of Environmental Conservation

Enclosure

INTRODUCTION

Malcolm Pirnie, Inc. has developed hazardous waste site monitoring well decommissioning procedures for the New York State Department of Environmental Conservation (NYSDEC) under the New York State Superfund Standby Contract, Work Assignment No. D002852-10. These procedures have been established as a guide for successful decommissioning of wells that are no longer used for monitoring at select National Priorities List (NPL) sites in New York State. A well is successfully decommissioned when:

- Migration of existing or future contaminants into an aquifer or between aquifers cannot occur.
- Migration of existing or future contaminants in the vadose zone cannot occur.
- The potential for vertical or horizontal migration of fluids in the well or adjacent to the well is minimized
- Aquifer yield and hydrostatic ahead are conserved.

The decommissioning procedures are based on NYSDEC-approved methods originally developed by Malcolm Pirnie which entailed an extensive literature search and consultations withe industrial and NYSDEC officials. The literature search included sources from the National Ground Water Association, American Society for Testing and Materials (A.S.T.M.), State and EPA guidance documents, Malcolm Pirnie decommissioning procedures, and various other technical sources. A complete listing of sources is included at the end of these procedures. The industry officials consulted include drilling contractors, equipment suppliers and manufacturers, and A.S.T.M. members on Soil and Rock (D-18) and Water (D-19) committees.

These decommissioning procedures describe criteria for a satisfactorily decommissioning a monitoring well. Selection of a preferred decommissioning method will be dependent on site-specific and location-specified conditions such as the type of aquifer, the mature of the contamination, geological conditions and the type of well construction. Prior to initiating field work, the available site and location-specific data will be collected and reviewed, and a pre-construction inspection of the monitoring well will be conducted to assist in determining the best-suited decommissioning method.

For maximum protection of human health and the environment, any material brought to the surface during the decommissioning process will be treated as a hazardous waste unless sample data indicates otherwise. The selection of disposal methods for these materials will depend on information reported in site investigation reports and analytical characterization of the retrieved materials for hazardous characteristics (see Sections 4.1.3 through 4.1.4). An appropriate procedure will be followed for the physical and hydrologic setting of the well that best protects the environment.

The following sections describe the procedures that will be implemented to properly decommission a well, including the procedure for selecting which decommissioning method will be used. There are eleven elements to be addressed in decommissioning a monitoring well at a hazardous waste site:

1) Reviewing Site Data
2) Selecting the Well Decommissioning Method
3) Preparing a Site-Specific Health and Safety Plan
4) Preparing a Materials Handling and Disposal Plan
5) Establishing Decontamination Procedures
6) Locating and Setting-Up on the Well
7) Removing the Protective Casing
8) Decommissioning of Screen and Riser
9) Selecting, Mixing, and Placing Grout
10) Backfilling and Site Restoration
11) Quality Assurance/Quality Control (QA/QC) Procedures

The proper well decommissioning methods and selection process are presented on the flow chart presented as Plate 1. For each decommissioning method, the specific procedures are determined by (1) geology, (2) contaminants, and (3) well design. For example, decommissioning a well that penetrates a confining layer may require a different approach than decommissioning an unconfined water table well.

1.0 REVIEWING SITE DATA

The first step in selecting the well decommissioning process consists of reviewing all pertinent site information; boring and well logs, field inspection sheets, and laboratory analytical results performed on site soil and groundwater samples. This site information will form the basis for decisions throughout the decommissioning process. Field inspection of the wells prior to decommissioning is also recommended to verify the characteristics and conditions of the wells. Special conditions such as access problems, well extensions through capped and covered landfills, and cap conditions due to seasonal weather patterns should be assessed. At well locations that have been extended, the burial of a previous concrete pad may require the excavation of soil to the top of the concrete pad to remove the well. Decommissioning work requiring the use of heavy vehicular equipment on RCRA landfill caps should be scheduled during dry weather if possible so as to minimize damage to the cover. If work must be performed during the Spring, Winter or inclement weather, special measures such as placement of plywood to reduce ruts should be employed to maintain the integrity of the completed landfill cover system. A sample Monitoring Well Field Inspection Log indicating the minimum information to be collected during field verification activities is included as Figure 1.

2.0 SELECTING THE WELL DECOMMISSIONING METHOD

The primary rationale for well decommissioning is to prevent contaminant migration along the disturbed construction zone created by the original well boring. This requires selection of a decommissioning procedure that takes into account factors such as:

- The hydrogeological conditions at the well site.
- The presence or absence of contamination in the groundwater.
- The original well construction details.

This section presents a summary of the well decommissioning methods and the selection process, which is illustrated in the flow chart presented as Plate 1. The primary well decommissioning procedures consist of:

- Casing pulling.
- Overdrilling.
- Grouting the casing in-place.
- Perforating the casing followed by grouting in-place.

A general discussion of each decommissioning procedure is presented in Sections 2.1 through 2.4.

2.1 CASING PULLING

In general, casing pulling is the preferred method for decommissioning wells where: no contamination is present; contamination is present but the well does not penetrate a confining layer; and when both contamination and a confining layer are present but the contamination cannot cross the confining layer. Additionally, the well construction materials and well depth must be such that pulling can be effected without breaking the riser.

Casing pulling involves removing the well casing by lifting. The procedure for removing the casing must allow grout to be added during pulling. The grout will fill the space once occupied by the material being withdrawn. Grout mixing and placement must be performed according to the procedures in Section 9.0.

An acceptable procedure to remove casing involves puncturing the bottom of the casing, flushing with water to remove sand (if necessary to mitigate lock-up of the casing during pulling), filling the casing with grout tremied from the bottom of the well, using jacks to free casing from the hole, and lifting the casing out by using a drill rig, backhoe, crane, or other suitable equipment. Additional grout must be added to the casing as it is withdrawn. In wells or wellpoints in which the bottom cannot be punctured, the casing or screened interval will be perforated prior to being filled with grout. This procedure should be followed for wells installed in collapsible formations or for highly contaminated wells. At site locations in which the borehole does not collapse it may not be necessary to perforate the well casing prior to pulling the well (i.e., grouting the borehole can be completed after the well materials have been removed). However, measurements of the borehole depth must be taken before and after the well is pulled to ensure that no collapse of well construction or formation materials occurred.

In the event that the casing or well screen is severed during casing pulling or if borehole collapse occurs, the remaining materials can be removed by overdrilling using the conventional augering method described in Section 2.2. In situations where well materials such as PVC screens and risers are suspected to sever, and removal of all well materials is required (i.e., at wells that are contaminated or those that penetrate an aquiclude), the contractor should install rods inside the well so that the rods would serve as a steel guide pipe for advancing augers during overdrilling.

At sites in which well casings have been grouted into a rock socket the casing pulling procedure may not be feasible. An alternative procedure involving overdrilling into the bedrock, pulling the casing, and subsequently grouting the openhole interval may be employed. For uncontaminated wells or wells with low levels of contamination, overdrilling, grinding on the rock, and grouting inside and outside of the well should be acceptable if the casing cannot be pulled. When this procedure is not acceptable and the casing must be pulled from a contaminated well, a spin and flush drilling technique may be used to advance flushpoint casing equipped with a diamond cutting shoe to the bottom of the casing socket. Water used during the spin and flush casing advancement will be controlled by the use of oversized casing, a coupling and a drilling tee. Drilling water will be containerized and disposed of in accordance with the site specific Material Handling and Disposal Plan.

2.2 OVERDRILLING

Overdrilling is used where casing pulling is determined to be unfeasible, or where installation of a temporary casing is necessary to prevent cross-contamination, such as when a confining layer is present and contamination in the deeper aquifer could migrate to the upper aquifer as the well was pulled (see Section 2.5). The overdrilling method should:

- Follow the original well bore.
- Create a borehole of the same or greater diameter than the original boring.
- Remove all of the well construction materials.

Acceptable methods for overdrilling include the following:

- Using conventional augering (i.e., a hollow stem auger fitted with a plug). The plug cutter will grind the well construction materials, which will be brought to the well surface by the auger.

- Using a conventional cable tool rig to advance casing having a larger diameter than the original boring. The cable tool kit is advanced within the casing to grind the well construction materials and soils, which are periodically removed with large diameter bailer. This method is not applicable to bedrock wells.

- Using an over-reaming tool with a pilot bit nearly the same size as the inside diameter of the casing and a reaming bit slightly larger than the original borehole diameter. This method can be used for wells with steel casings.

- Using a hollow-stem auger with outward facing carbide cutting teeth having a diameter two to four inches larger than the casing. Outward-facing cutting teeth will prevent severing the casing and drifting off center.

- Using a hollow-stem auger with a steel guide pipe inside. The casing guides the cutter head and remains inside the auger. The guide pipe should be firmly attached to the inside of the casing by use of a packer or other type of expansion or friction device.

Prior to overdrilling, an expandable J-plug or other suitable well cap will be used to prevent the introduction of soil or cuttings into the well, thereby ensuring a continuous grout column for wells that are grouted in place.

In all cases above, overdrilling should advance through the original bore depth by a distance of 0.5 feet to ensure complete removal of the construction materials. When the overdrilling is complete, the casing and screen can be retrieved from the center of the auger (American Society for Testing and Materials, Standard D 5299-92, 1992), if one of the hollow stem auger methods described above is employed. Subsequent to overdrilling at flush mount well locations where it may be impractical to remove well materials from inside the augers, a 1-2 foot deep area should be excavated by hand around the flush-mount well to facilitate a conventional well removal while tremie-grouting inside the well. Alternatively, the soil within the annular space may be removed by raising the augers to allow the soil to fall out and re-advance the augers to the original target depth. Grout should then be tremied within the annular space between the augers and well casings. The grout level in the borehole should be maintained as the drilling equipment and well materials are sequentially removed. After overdrilling is completed, the borehole must be grouted according to the procedures in Section 9.0 and the upper five feet of borehole must be restored according to the procedures in Section 10.0.

2.3 GROUTING IN-PLACE

Grouting in-place is the simplest decommissioning procedure, but offers the least long-term protection of all the methods. As discussed in Section 2.5, however, this method is preferred for the bedrock portion of bedrock wells, and is used for decommissioning cased wells in certain situations. For cased wells, the procedure involves filling the casing with grout to a level of five feet below the land surface, cutting the well casing at the five-foot depth, and removing the top portion of the casing and associated well materials from the ground. The casing must be grouted according to the procedures in Section 9.0. In addition, the upper five feet of the borehole is filled to land surface and restored according to the procedures described in Section 10.0.

For wells installed in bedrock, the procedure involves filling the casing (or open hole) with grout to the top of rock according to the procedures in Section 9.0. The grout mix, however, will vary according to the hydrogeological conditions as discussed in Section 2.5.

It should be noted that for wells located on landfills regulated under 6NYCRR Part 360, the screened interval of the well must be sealed separately and hydrostatically tested to ensure its adequacy before sealing the remaining borehole. The Standard Operating Procedure (SOP) for the hydrostatic test has been included under Appendix D.

2.4 CASING PERFORATION/GROUTING IN-PLACE

At this time, casing perforation is the preferred method for wells with four-inch or larger inside diameter which are designated to be grouted in-place in accordance with the selection flow chart. The procedure involves perforating the well casing and screen then grouting the well. A wide variety of commercial equipment is available for perforating casings and screens in wells with four-inch or larger inside diameters. Due to the diversity of application, experienced contractors must recommend a specific technique based on site-specific conditions. A minimum of four rows of perforations several inches long and a minimum of five perforations per linear foot of casing or screen is recommended (American Society for Testing and Materials, Standard D 5299-92, 1992).

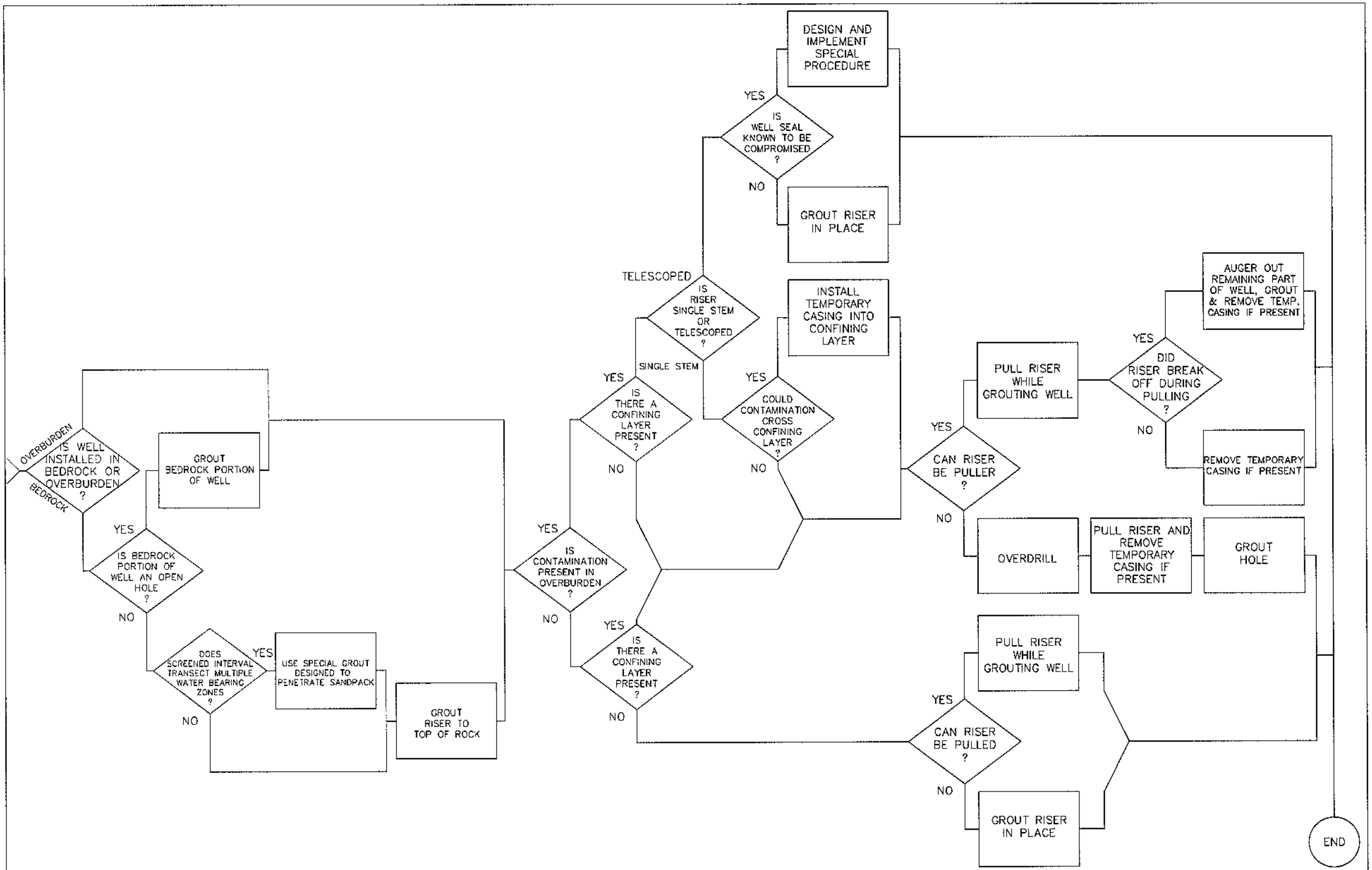
After perforating is complete, the borehole must be grouted according to the procedures in Section 9.0 and the upper five feet of borehole must be restored according to the procedures in Section 10.0.

2.5 SELECTION PROCESS AND IMPLEMENTATION

Selection of the decommissioning method is governed by the flow chart presented as Plate 1. A discussion of the selection criteria and decommissioning methodology is presented below.

2.5.1 Contaminated Monitoring Wells/Piezometers

For wells and piezometers suspected or known to be contaminated with NAPL or DNAPL product, measurement of the product volume will be determined using a weighted cotton string or by using an interface probe. Subsequent to calculation of the product volume, the NAPL/DNAPL product will be removed from inside the well. Removal of the contaminant product will be accomplished by bailing, pumping or installing an absorbent passive recovery system. Subsequent to product recovery, all contaminated materials will



Decommissioning Proceedure Selection

Source: Malcolm Pirnie for NYSDEC, March 1995, Plate 1

decom_flo2.dwg

be disposed of in accordance with the segregation and containment procedures described in Section 4.1.2.

2.5.2 Bedrock Wells

As illustrated on Plate 1,if the well is constructed within a bedrock formation, the screened or the open hole portion of the well is grouted to the top of the bedrock. Prior to initiating any grouting procedure, the depth of the well will be measured to determine if any silt or debris infilling has plugged the well. If plugging has occurred, the well will be flushed with an appropriately sized roller bit or drill rods to remove or suspend the obstruction in the water column. The borehole will then be tremie grouted from the bottom of the well to the top of bedrock to insure a continuous grout column. Note that if the bedrock well is cased, the screen should be perforated to the top of the rock if the inside diameter of the casing is 4-inches or larger. Furthermore, if the screened interval transects multiple water bearing zones the special grout mix discussed in Section 9.1.3 should be used to ensure penetration of the sand pack.

After the rock hole is grouted, the overburden portion of the well is decommissioned in accordance with the following sections. If the borehole extends to the surface, no further decommissioning procedures are required; however, the boring should only be filled to within 5-feet of the ground surface and site restoration should be completed in accordance with Section 10.0.

2.5.3 Uncontaminated Overburden Wells

For overburden wells and the overburden portion of bedrock wells, the first decision point in determining the decommissioning method considers whether the overburden portion of the well exhibits evidence of contamination, as determined through historical groundwater and/or soil sampling results. If the overburden portion of the well is uncontaminated, the next criteria considers whether the well penetrates a confining layer. In the case that the overburden portion of the well does not penetrate a confining layer, the casing should be pulled (and tremie-grouted) if possible. As a general rule, PVC wells greater than 25-feet deep should not be pulled unless site-specific conditions or other factors indicate that the well can be pulled without breaking. If the well cannot be pulled, such as in the case that a bedrock portion of the well has already been grouted in place, or if the well materials and depth prohibit pulling or will likely result in breakage, the well should be grouted in-place as accordance with Section 2.3 (if the casing is less than 4-inch in diameter) or Section 2.4 (if the casing diameter is 4-inches or larger).

If the overburden portion of the well penetrates a confining layer, the casing should be removed by pulling (if possible) in accordance with Section 2.1. If the casing cannot be removed by pulling, the well should be removed by overdrilling. The overdrilling method used will depend on the site-specific conditions and requirements. If pulling is attempted and fails (i.e., a portion of the riser breaks) the remaining portion of the well should be removed by using the conventional augering procedure identified in Section 2.2. In all cases, after the well construction materials have been removed, the borehole will be grouted in accordance with Section 9.0 and the upper five feet will be restored in accordance with Section 10.0.

2.5.4 Contaminated Overburden Wells

If an overburden well or the overburden portion of a bedrock well is contaminated as evidenced by historical sampling results, the first decision point in selecting a decommissioning procedure is whether the well penetrates a confining layer. If the well does not penetrate a confining layer, the selection process follows the same pathway as for uncontaminated wells that penetrate a confining layer (i.e., the casing is pulled, if possible; otherwise the well is overdrilled - see Section 2.5.3). Plastic sheeting should be placed around the well surface to contain contaminated materials displaced during removal of the well.

For overburden wells that are contaminated and which penetrate a confining layer, the next selection criteria is whether the well riser is a single stem or is telescoped inside one or more outer casings. The procedures to be followed in determining the decommissioning method are presented for both situations below.

2.5.4.1 Single Stem Riser

If the riser is a single stem, the potential for cross-contamination between confining layers must be addressed. In particular, if the lower confining unit is contaminated, there is a potential that the contamination may be transferred to the upper unit as the well construction materials are removed to the ground surface. In this event, it will be necessary to install a temporary casing having a diameter larger than the original borehole into the top of the confining layer. This may be accomplished using a hollow stem auger or by employing a spin and flush technique to advance the casing. If the confining layer is less than 5 feet thick, the casing should be installed to the top of the confining layer. Otherwise, it is installed to a depth of 2 feet below the top of the confining layer. After the temporary casing has been set, the well can be removed and grouted through pulling (if possible) or through overdrilling if pulling is not feasible. Plastic sheeting should be placed around the well surface to contain contaminated materials displaced during removal of the well. As an alternative to installation of a temporary casing, the hollow-stem auger could serve the same purpose in that it would prevent the contamination from migrating to the upper unit. The hollow-stem auger would be advanced into the confining layer until the joint between the uppermost sections was nearly flush with the ground surface, and the sections would be disconnected to expose the riser prior to pulling or overdrilling.

After the casing and screen are removed and the well is grouted, the temporary casing (if used) is removed and the casing and/or hollow stem auger can be decontaminated for reuse. The upper 5 feet of the well surface should then be restored in accordance with Section 10.0.

2.5.4.2 Telescoped Riser

If the riser is telescoped in one or more outer casings, the decommissioning approach is dependent on the integrity of the well seal. For the purpose of the monitoring well decommissioning procedures, the well seal is defined as the bentonite seal above the sand pack. Although it is not possible to visually inspect or otherwise test the well seal to assess its condition, an indication of the well seal integrity may be obtained through review of the boring logs and/or a comparison of groundwater elevations if the well is part of a cluster. Any problems noted on the boring logs pertaining to the well seal, such as bridging of bentonite pellets or running sands, or disparities between field notes (if available) and the well log would indicate the potential for a poor well seal. Alternatively, if the well is part of a cluster a comparison of groundwater elevations between the shallow and deep wells should also be performed. By observing trends at other clusters it may be possible to identify inconsistencies in groundwater elevations at the well slated for decommissioning, thereby indicating a poor well seal.

If there is no evidence that the well seal integrity is compromised, the riser should be grouted in-place in accordance with Section 2.3 or 2.4, depending on the diameter of the well casing, and the upper 5 feet of the well surface should be restored in accordance with Section 10.0. If indications are that the well seal is not competent, it will be necessary to design and implement a special procedure to remove the well construction materials, as the presence and configuration of the outer casing(s) will be specific in the individual wells and will be a key factor in the decommissioning approach. The special procedure should be designed to mitigate the potential for cross-contamination during removal of the well construction materials, and should be designed prior to initiating field work.

3.0 PREPARATION OF A SITE-SPECIFIC HEALTH AND SAFETY PLAN

Prior to initiating decommissioning activities at a site, it is necessary to prepare a site-specific health and safety plan (HASP) in accordance with the requirements of 29 CFR 1910.120. Accordingly, the HASP should include:

- The names of key personnel responsible for site health and safety, including an appointed site health and safety officer.
- A safety and health risk analysis for each site task and operation.
- Employee training requirements.
- Personal protective equipment (PPE) to be used by employees for each of the site tasks and operations being conducted.

- Medical surveillance requirements.
- Frequency and types of air monitoring, personnel monitoring and environmental sampling techniques and instrumentation to be used.
- Site control measures.
- Decontamination procedures.
- Site standard operating procedures.
- A contingency plan for responses to emergencies.
- Confined space entry procedures.

An example of a health and safety plan is attached as Appendix A. This document provides a general framework for preparing a HASP. Examples of site-specific information, such as names of responsible personnel, contaminant data, and other information which must be developed to meet the OSHA requirements discussed above are included in Appendix A but will need to be modified in the site-specific HASP.

4.0 PREPARATION OF A MATERIALS HANDLING AND DISPOSAL PLAN

Materials handling and disposal procedures for each of the wells slated for decommissioning should be identified in a site-specific materials handling and disposal plan. This plan will be used as a guideline to ensure safe and efficient control of contaminated materials, and will promote conformance with the applicable regulatory requirements for storage, characterization, labeling, transportation and disposal of materials prior to off-site transport.

4.1 MATERIALS HANDLING PROCEDURES

The materials anticipated to be generated during well decommissioning activities include decontamination fluids, disposable safety equipment (including personal protective equipment), drill cuttings, groundwater, well construction materials (PVC and/or stainless steel casings, well screens, sand, bentonite/grout mixtures, etc.), and any spill-contaminated materials. Proper handling of these materials is effected through a series of steps, including: identification/pre-characterization of the waste materials; segregation/containment of the wastes including storage in proper containers; characterization of the waste materials through analytical testing to determine the absence/presence or nature of the contamination; and proper labeling in accordance with 49 CFR Part 172. Each of these steps is described in the following sections.

4.1.1 Identification/Pre-characterization

Prior to initiating well decommissioning activities at a site, the site history, most importantly historical analytical data from the monitoring wells, must be reviewed as well as the monitoring well construction details: number, type (overburden, bedrock), depth, diameter, and construction materials. This knowledge will aid in estimating the nature and quantities of waste materials which potentially may be generated as a result of decommissioning activities and will also assist in pre-determining the number of roll-off boxes, 55-gallon drums, and any other containers necessary to contain the wastes generated at each respective site.

4.1.2 Segregation and Containment

During well decommissioning activities, generated waste materials must be contained and segregated according to the nature of the suspected contamination. Well materials generated from decommissioning those wells with known contamination will be segregated from materials generated from those wells with little to no contamination (based on historical results). Contaminated materials will be further segregated according to contaminant type (e.g., well materials suspected of containing volatile organic contamination will be segregated from materials suspected of containing Polychlorinated Biphenyl (PCB) contamination).

For wells exhibiting contamination, all materials brought to the surface must either be decontaminated, disposed of at an appropriate Treatment, Storage and Disposal Facility

Fluids generated during the decommissioning program will generally be contained in 55-gallon drums unless extremely large volumes are expected; in this case 5,000-gallon tankers or other suitable temporary storage may be used. All drums will be initially labeled according to the wastewater source(s) and will be assumed to contain the same contaminants as the groundwater measured by the particular monitoring well being decommissioned. All 55-gallon drums containing fluids should be sealed and temporarily stored at the decontamination pad until final off-site disposal at an approved treatment facility.

4.1.3 Characterization

Hazardous waste characterization is necessary to determine the nature of the waste materials, to verify whether the materials are hazardous, and to determine proper disposition. Characterization of waste materials will be conducted at each of the sites to determine the appropriate disposal requirements. The decision as to the number, location and types of samples to be collected will be site specific and will depend on factors such as the quantity of waste generated and type of containers used, the nature of the waste, and the distribution of contaminant types across the site with respect to the origin of the waste materials. In general, the sample collection program will be designed to ensure that analytical data representative of all the materials to be disposed will be generated from the minimal number of samples. This may be accomplished by means such as:

- collection of composite samples for contaminants such as metals and PCBs (compositing is not typically acceptable for volatile organic compound analyses).
- collection of grab samples from select drums/containers suspected of elevated contaminant concentrations based on visual observation (e.g., soil staining, liquid sheen or non-aqueous product) or PID screening

Sample analysis will be based on site history and the requirements of the disposal facility. At a minimum, the samples should be analyzed for the parameters of concern indicated by past monitoring well analytical results, as well as the hazardous waste

(TSDF), or properly containerized in a secure area for disposal by others. For all uncontaminated wells, the materials (except the casings) can be left at the surface near the former well unless the surrounding land use prohibits this disposal (e.g., if the well is located in an area where people could be exposed to the materials left on the surface; or if recovered decommissioning materials would not be consistent with the intended use of the land). In this case, the materials must be disposed of in a 6NYCRR Part 360 landfill. For contaminated wells, PVC and/or steel casing materials may be decontaminated for disposal in a Part 360 landfill, provided that the decontamination effort is thorough and cost effective. Requirements for characterization and disposal of contaminated materials are discussed in Sections 4.1.3 through 4.1.5.

Containment methods will be based on the estimated quantity of materials anticipated to be generated at each respective site. Solid waste materials (i.e., well construction materials, soils, drill cuttings, PPE), will typically be contained in roll-off boxes or 55-gallon drums. Since federal DOT regulations (49 CFR Part 177) generally limit the combined truck and cargo weight to 80,000 lbs, most hazardous waste transporters will limit the roll-off box capacity to 20 tons of hazardous waste per shipment. Thus, if the materials are to be transported off-site to a treatment, storage and disposal facility (TSDF) that accepts bulk waste, and if the anticipated quantity of waste will be large (greater than 5 tons), water-tight roll-off containers may be more practical and cost-effective for temporarily containing and transporting the waste in lieu or in combination with 55-gallon drums (e.g., 55-gallon drums may still be used for personal protective equipment or other articles not directly derived from the abandoned well). The roll-off containers should be lined with disposable HDPE liners to prevent contact with the container, and will be initially labeled according to the source(s) of the contained waste materials. Likewise, if drums are used they will be lined with a protective plastic sleeve, filled and the drum initially labeled according to the source of the contaminated materials. After the contents of the roll-offs and drums have been characterized, they should be labeled in accordance with 49 CFR Part 172. Roll-off containers will be covered with polyethylene covers and tarps with bows during temporary storage and transportation, and all drums will be sealed.

characteristic parameters: toxicity by TCLP; ignitability; reactivity; and corrosivity in accordance with 40 CFR Part 261.

4.1.4 Labeling

Depending on the nature of the materials, proper labeling of the storage containers (roll-offs and/or drums) must be completed according to 49 CFR Part 172.

4.1.5 Disposal

Disposal of waste materials will depend on whether the waste has been characterized as hazardous or non-hazardous. Non-hazardous waste will be disposed of on-site in accordance with NYSDEC TAGM #4032 with the prior consent of the owner and the Department, or may be landfilled at a permitted 6NYCRR Part 360 facility.

For wastes that exhibit contamination, the requirements for disposal or treatment will be dependent on the waste characteristics. To determine these requirements the following procedure should be followed upon receipt of the waste characterization results:

1) Determine if the waste is characteristically hazardous (by failure of any of the criteria for toxicity, corrosivity, reactivity, or ignitability) or if it is a listed hazardous waste per the classifications identified in 40 CFR Part 261.

2) Determine the EPA hazardous waste code(s) for the applicable waste classification(s) listed in 40 CFR Part 261.

3) Determine any treatment standards for the hazardous waste code(s) per 40 CFR Part 268. Depending on the waste classification, treatment standards may be based on final concentration in the waste/waste extract or may require a specific treatment technology (e.g., incineration).

4) If the hazardous waste contains other constituents that are not listed in the treatment standards, and if landfilling is a disposal option, it should be determined if the waste is a California List waste per the criteria in 40 CFR Part 268.32 (e.g., under these regulations, nonliquid wastes must not contain total halogenated organics at or in excess of 1,000 ppm).

5) If the hazardous waste meets all treatment standards including the California List Standards (if applicable), it may be disposed of at a permitted hazardous

waste land disposal facility. For each shipment the generator is required to provide the following manifest information:

- Hazardous Waste Code(s)
- Corresponding concentration-based or technology-based treatment standards.
- Manifest number.
- Waste analysis data.
- Certification Statement per 40 CFR 268.7(a)(2)(D)(ii).

In addition, the generator is required to maintain the records specified in 40 CFR Part 268.7(a)(7) for a minimum of 5 years.

6) If the waste fails to meet any of the treatment standards listed in 40 CFR Part 268, it must be sent to a treatment, storage, or recycling facility. If the waste's treatment standard is technology-based, it must be treated in accordance with the specified method. Land disposal is not allowable unless the waste is eligible for a National Capacity Variance (40 CFR Subpart C) and meets the California List standards. In all cases, the notification and recordkeeping requirements identified above must be fulfilled by the generator.

The hazardous waste will be transported in accordance with DOT regulations (49 CFR Parts 172-173) to either a secure hazardous waste landfill or TSDF, as appropriate. The contractor will be responsible for arranging for proper transportation and the disposal of the wastes. The Engineer will sign a hazardous waste manifest, as an agent of the Owner.

5.0 EQUIPMENT DECONTAMINATION REQUIREMENTS

Since the monitoring well decommissioning will involve multiple wells, there is a possibility of contamination from one well location to another. To avoid cross-contamination, procedures have been established for decontamination after operations at each well location is complete. The procedures for decontamination of personnel at the site will be specified in the site-specific Health and Safety Plan. Decontamination of equipment will follow established equipment cleaning protocols which are written in accordance with the Engineer's corporate policies and OSHA regulations.

The drilling and excavation equipment (i.e., drill rigs, cutting bits, and associated equipment) will be cleaned at a constructed decontamination facility. In general, the decontamination facility (i.e., decon pad or wash pad) will consist of plywood placed over a heavy synthetic liner. The pad will slope down to a sump that will collect all liquids. A detailed description and drawing of the decontamination facility that will be constructed is included in Appendix B as Item 1.

The drilling and excavation equipment will be prepared before it is brought to the decontamination facility and then cleaned at the facility. The preceding preparation includes removing gross soil/rock from the equipment to minimize losses during movement to the decon pad. At the decontamination facility, the equipment will be rinsed with low-volume water or steam, washed with phosphate-free detergent, and rinsed again with pressurized low-volume water or steam. The equipment will be inspected by the Engineer's field representative after cleaning. The detailed cleaning procedures are included in Appendix B as Item 2.

In the event that sampling equipment must be used, the decontamination guidelines included in Appendix B as Item 3 will be followed. In general, these guidelines describe cleaning with non-phosphate detergent, then performing rinsing cycles with water and acid. After the equipment is air-dried, it must be wrapped in aluminum foil to avoid accidental contamination after cleaning.

After all equipment is decontaminated, the solutions produced must be properly containerized and disposed of. All other disposable contaminated supplies/equipment such as disposable safety and sampling equipment will also need to be properly disposed of. Unless characterization of the decon fluids and disposable equipment is performed in accordance with Section 4.0, these materials will be handled in the same manner as the drill cuttings/fluids from the well locations. All materials must be temporarily stored in a secure area such as the fenced decon pad.

If sampling is necessary, the Engineer's personnel will be responsible for the decontamination of the sampling equipment. The decontamination of drilling and excavation equipment is the responsibility of the Contractor(s). The Engineer's field representative will make daily inspections to insure that decontamination procedures are being followed.

6.0 LOCATING AND SETTING-UP ON THE WELL

The following tasks shall be performed to locate the well to be decommissioned:

- Notify property owner and/or other interested parties including the governing regulatory agency prior to site mobilization whenever possible.
- Review information about the well contained in the site file. This information may include one or more of the following: the site map, well boring log, well construction diagram, field inspection log, well photograph, and proposed well decommissioning procedure.
- Verify the well location and identification by locating the identifying marker.
- Verify the depth of the well in the well construction log by sounding with a weighted tape.

After the well has been located, the decommissioning procedure should be selected in accordance with Section 2.0 based on the available boring and sampling data. The rig must be set up prior to initiating drilling to ensure proper alignment with the well (i.e., the drill string must be aligned with the monitoring well).

7.0 REMOVING THE PROTECTIVE CASING

7.1 GENERAL

Removal of the protective casing of a well must not interfere with or compromise the integrity of decommissioning activities performed at the well.

The procedure for removing the protective casing of a well depends upon the decommissioning method used. When a well is decommissioned by the overdrilling or casing pulling method, the protective casing may be removed either before or after the casing is removed. When the decommissioning procedure requires casing perforation or grouting in-place, the protective casing should be removed after grout is added to the well. The protective casing handling and disposal must be consistent with the methods used for the well materials, unless an alternate disposal method can be employed (e.g., steam cleaning followed by disposal as nonhazardous waste).

7.2 PRIOR TO SEALING THE WELL BORE

When overdrilling, the protective casing must be removed first, unless the drilling tools have an inside diameter larger than the protective casing. The variety of protective casings available preclude developing a specific removal procedure. In all cases, however, the specific procedure used must minimize the risk of:

- breaking the well casing off below ground and
- allowing foreign material to enter the well casing.

If the decommissioning method used is casing pulling, the decision of when to remove the protective casing is not critical.

An acceptable protective casing removal method involves breaking up the concrete seal surrounding the casing and jacking or hoisting the casing out of the ground. A check should be made during pulling to insure that the inner well casing is not being hoisted with the protective casing. If this occurs, the well casing should be cut off after the base of the protective casing is lifted above the land surface.

7.3 AFTER SEALING THE WELL

If the decommissioning method used allows well casing to remain in the ground, the protective casing should be removed after the well has been properly filled with grout. This will insure that the well is properly sealed regardless of problems with protective casing removal. During grouting in-place, the well casing must be removed to a depth of five feet below the land surface. The upper five feet of casing and the protective casing can be removed in one operation if a casing cutter is used. If the height of the protective casing makes working conditions at the well awkward, the casing can be cut off at a lower level. However, the inner well casing must remain aboveground and cannot be damaged in any way that prevents the well from being filled with grout.

8.0 DECOMMISSIONING OF SCREEN AND RISER

After setting up on the well and removing the protective casing (if necessary), the well screen and riser are decommissioned in accordance with the appropriate procedure and methodology as discussed in Section 2.0 (i.e., if the wells are overdrilled or pulled, the casing and riser are removed. Otherwise, they are perforated and/or grouted in-place). During the decommissioning activities the requirements of the site-specific health and safety plan, materials handling and disposal plan and equipment decontamination plan will be followed to ensure maximum protection of human health and the environment.

9.0 SELECTING, MIXING, AND PLACING GROUT

9.1 SELECTING GROUT MIXTURE

There are two types of grout mixes that may be used to seal wells: a standard mix and a special mix. Both mixes use Type 1 Portland cement and four percent bentonite by weight. However, the special mix uses a smaller volume of water and is used in situations where excessive loss of the standard grout mix is possible (e.g. highly-fractured bedrock or coarse gravels).

9.1.1 Standard Grout Mixture

For most boreholes, the following standard mixture will be used:

- One 94-pound bag Type I Portland cement
- 3.9 pounds powdered bentonite
- 7.8 gallons potable water

This mixture results in a grout with a bentonite content of four percent by weight, and will be used in all cases except in boreholes where excessive use of grout is anticipated. In these cases a special mixture will be used (see Section 9.1.2).

See Section 9.2 for grout mixing procedures.

9.1.2 Special Mixture

In cases where excessive use of grout is anticipated, such as high permeability formations and highly fractured or cavernous bedrock formations, the following special mixture will be used:

- One 94-pound bag type I Portland cement
- 3.9 pounds powdered bentonite
- 1 pound calcium chloride
- 6.0-7.8 gallons potable water (depending on desired thickness)

The special mixture results in a grout with a bentonite content of four percent by weight. It is thicker than the standard mixture because it contains less water. This grout is expected to set faster than the Standard Grout Mixture. The least amount of water that can be added for the mixture to be readily pumpable is six gallons per 94-pound bag of cement.

See Section 9.2 for grout mixing procedures.

9.1.3 Alternate Special Grout

In cases where the penetration of the sandpack is critical, such as bedrock wells with screens that transect multiple water-bearing zones, the following alternate mixture will be used:

- One 94 pound bag Type III Portland Cement.
- 3.9 pounds powdered bentonite.
- 7.8 gallons potable water.

Refer to Section 9.2 for grout mixing procedures. It should be noted that this grout is expected to set faster than the standard grout mixture.

9.2 GROUT MIXING PROCEDURE

To begin the grout-mixing procedure, calculate the volume of grout required to fill the borehole. If possible, the mixing basin should be large enough to hold all of the grout necessary for the borehole. Tall cylindrical and long shallow basins should not be used as it is difficult to obtain a homogeneous mixture in these types of basins.

Mix grout until a smooth, homogeneous mixture is achieved. No lumps or dry clots should be present. Grout can be mixed manually or with a mechanized mixer. One acceptable type of mixer is a vertical paddle grout mixer. Colloidal mixers should not be used as they tend to excessively decrease the thickness of the grout for the above recipes.

9.3 GROUT PLACEMENT

Grout will be placed in the borehole from the bottom to the top using a tremie pipe of not less than 1-inch diameter. Grout will then be pumped into the borehole until the grout appears at the land surface (when grouting open holes in bedrock, the grout level only needs to reach above the bedrock surface). Any groundwater displaced during grout placement will be pumped via suction lift to a 55-gallon drum for proper disposal.

At this time the rate of settling should be observed. When the grout level stabilizes, casing or augers will be removed from the hole. As each section is removed, grout will be added to keep the level between 0-feet and 5-feet below land surface. If the grout level drops below the land surface to an excessive degree, an alternate grouting method must be used. One possibility is to grout in stages; i.e., the first batch of grout is allowed to partially cure before a second batch of grout is added.

Upon completion of grouting, insure that the final grout level is approximately five feet below land surface. A ferrous metal marker will be embedded in the top of the grout to indicate the location of the former monitoring well.

10.0 BACKFILLING AND SITE RESTORATION

The uppermost five feet of the borehole at the land surface will be filled with a material appropriate to the intended use of the land. The materials will be physically similar to the natural soils. No materials will be used that limit the use of the property in any way. The surface of the borehole will be restored to the condition of the area surrounding the borehole. For example, concrete or asphalt will be patched with concrete or asphalt of the same type and thickness, grassed areas will be seeded, and topsoil will be used in other areas. All solid waste materials generated during the decommissioning process will be disposed of properly.

11.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) PROCEDURES

This section describes the quality control/quality assurance (QA/QC) procedures necessary for monitoring and ensuring the Contractor's adherence to the Monitoring Well Decommissioning Project procedures, plans and specifications, prepared by the Engineer. This section will discuss the minimum inspection and documentation requirements necessary to facilitate proper well decommissioning procedures and also will:

- Review the general requirements specified in the Contract Documents.
- Define roles and responsibilities of all parties.
- Establish the key tasks to be monitored by the on-site construction inspector and the appropriate inspector forms and logs to be used for recording the Contractor's activities.
- Establish procedures for communicating change orders, field modifications and variations from the Contract Documents to the Owner.
- Establish scheduled meetings and briefings during the construction phase.

The overall goal of the project QA/QC program is to ensure that proper well decommissioning techniques and procedures are used in accordance with the requirements of the Contract Documents. The QA/QC procedures herein should be followed by QA personnel including: Construction Contractor personnel, the Contractor's subcontracted laboratory and field personnel, and the Engineer's on-site construction inspector.

11.1 RESPONSIBILITY AND AUTHORITY

The principal organizations involved in developing, designing and conducting well decommissioning activities are the Owner, Engineer, and the Construction Contractor.

11.1.1 Owner

The Owner will be responsible for reviewing the well decommissioning procedures to determine whether the documents meet their requirements, and to obtain approval of the procedures from the appropriate regulatory agencies. The Owner will have the responsibility and authority to review and accept or reject any design or procedural revisions or requests. The Owner also has the responsibility and authority to review and approve the Construction Monitoring Report and all QA documentation collected during well decommissioning activities.

11.1.2 Engineer

The Engineer will be responsible for reviewing and approving any engineering design changes, construction monitoring and quality assurance in accordance with this QA Plan. The Engineer will inform all parties involved with construction of their responsibilities, lines of communication, lines of authority, and QA/QC procedures. The Engineer's construction inspector (QA Engineer) will monitor decommissioning activities and will be assigned specific responsibilities and tasks. Most of the waste sample collection and testing will be conducted by the contractor at a frequency and manner specified in the site specific Materials Handling and Disposal Plan.

The person filling the construction inspector (QA Engineer) position will be trained and certified to operate an HNu organic vapor photoionization detector (PID), will be OSHA 40-hour Hazardous Waste Worker trained and will have a working knowledge of documents pertaining to well decommissioning activities, including this plan. The Engineer's field personnel will be instructed to contact the construction inspector (QA Engineer) in the event well decommissioning requirements are not being met, QA procedures are not being implemented, or construction problems have been encountered.

11.1.3 Construction Contractor

In addition to performing the monitoring well decommissioning in accordance with the design documents, the Contractor will be required to obtain the services of a qualified testing laboratory to perform the analytical testing of the waste materials and will also be responsible for procuring transportation and disposal/treatment services.

11.2 PROJECT MEETINGS

The Engineer's management of the monitoring well decommissioning project will include conducting periodic project meetings as described below:

11.2.1 Pre-construction Meeting

The Engineer will schedule and attend one (1) pre-construction meeting for the purpose of discussing the project approach and answering contractor questions. The Engineer will also prepare and distribute meeting minutes. The meeting will also:

- Provide each party (organization) with relevant QA documents and supporting information.
- Familiarize each organization with the QA Plan and its role relative to the well decommissioning criteria and construction documents.
- Review the responsibilities of each organization and review the lines of authority and communication for each organization.
- Discuss the established procedures for observations and tests including waste sampling.

- Discuss the established procedures for handling construction deficiencies, repairs, and/or retesting.
- Review methods for documenting and reporting inspection data.

11.2.2 Monthly Progress Meetings

Monthly project meetings will be held during the course of the work to discuss the project schedule and work performed to date, and to address and resolve any existing or anticipated problems.

A special meeting will be held when and if a major QA problem or deficiency is present or likely to occur. At a minimum, the meeting shall be attended by the Construction Contractor and the Engineer's on-site inspector (QA Engineer). The purpose of the meeting will be to define and resolve the problem(s) or deficiencies encountered. The meeting minutes will be documented by the Engineer.

11.3 KEY TASKS

The key tasks that the Engineer will conduct during the well decommissioning project are briefly summarized below.

11.3.1 Review of Contractor Submissions

Prior to well decommissioning activities, all written submissions required by the contract documents will be evaluated and forwarded to the Owner, together with written submissions regarding their suitability. The Engineer will also obtain and review all necessary shop drawings, material tests and as-built drawings submitted throughout the construction and will make recommendations for acceptance/rejection to the Owner. The contractor's progress will be continuously monitored during the construction period, and Owner will be informed of the schedule and any corrective measures planned or implemented.

Throughout the project, payment requests by the contractor will be reviewed for accuracy and completeness prior to making recommendations relative to payment. Review will involve comparing actual notes of field personnel to items contained in the payment request. Discrepancies will be discussed with the contractor and will be amended if necessary.

11.3.2 Construction Inspection

The Engineer will provide full-time inspection of the contractor during all critical well decommissioning activities at each of the sites. This will be accomplished by providing an experienced on-site inspector(s) to document the contractor's adherence to the contract specifications and monitoring the contractor's progress. The Engineer will notify the Owner in the event that the contractor fails to perform the decommissioning work as specified in the contract and recommend to the Owner the acceptance, conditional approval/disapproval or rejection of the contractor's work. The Engineer will issue instructions, field orders, interpretations and clarification of contract language to the contractor as required. In the event that a change order is necessary, the Engineer will submit the change order with a detailed cost estimate to the Owner. The Engineer will also document, evaluate and recommend a course of action for all disputes and claims with the contractor.

In addition, the Engineer will inspect, evaluate and document the monitoring well condition after the well has been removed.

11.4 DOCUMENTATION

The Engineer's on-site construction inspector will document all monitoring well decommissioning activities. Such documentation will include, at a minimum, daily reports of construction activities, photographs, and sketches as necessary. Field investigation reports will be completed by the construction inspector when major questions arise at the site. Forms to be used for this purpose are presented in Appendix C.

The Engineer will maintain complete and detailed records associated with all construction and related activities during the duration of the project. These records will be maintained at the Engineer's office(s) and will include but not be limited to the following:

- Daily work completed and important conversations.
- Contractor's daily use of personnel, material and equipment.
- Records documenting the contractor's deviation from work as specified in the contract documents, and any instructions issued regarding deviations.
- Unusual circumstances (weather conditions, labor disputes, environmental problems, health and safety hazards encountered, etc.).
- General files including correspondence and other documentation related to the project.
- Job meeting minutes with documentation on resolution of issues raised.
- Records of contractor's submittals including shop drawings, modifications/change orders, soil tests, material tests and action taken (e.g.,Owner approval/disapproval, further information needed).
- Construction photos.
- Telephone conversation

In addition, the Engineer will submit monthly Project Summary Reports to the Owner. These reports will identify the work which has been accomplished and will document the status of each monitoring well at each site where decommissioning work has occurred.

Upon substantial completion of the decommissioning activities at each site, the Engineer will prepare a detailed list of any work remaining unfinished. The Engineer will then prepare and submit a written notice to the Owner which will include a determination as to whether the completed work meets the requirements of the contract documents. Following satisfactory completion of the work, the Engineer will perform a final inspection of the site and submit a notice to the Owner that decommissioning activities were performed in accordance with the contract documents as revised by any approved change orders or modifications to the scope of work.

Documentation on the condition of the removed wells with respect to the impacts of hazardous waste, minerals and other pertinent environmental factors, or discernable through direct observation, will be presented to Owner along with any recommendations for future well installation techniques and materials.

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EXAMPLE

APPENDIX A

HEALTH AND SAFETY PLAN

EXAMPLE

HEALTH AND SAFETY PLAN FOR MULTIPLE NPL SITES MONITORING WELL DECOMMISSIONING

NEW YORK STATE DEPT. OF ENVIRONMENTAL CONSERVATION DIVISION OF HAZARDOUS WASTE REMEDIATION

AUGUST 1994
REVISED NOVEMBER 1994
REVISED MARCH 1995

____

Site Health and Safety Officer

____

Project Manager

____

Corporate Health & Safety Manager

EXAMPLE

We, the undersigned, being employed by Consultant, have read in full and understand this Health and Safety Plan:

Signature	Print	Date
Signature	Print	Date
Signature	Print	Date
Signature	Print	Date
Signature	Print	Date
Signature	Print	Date
Signature	Print	Date
Signature	Print	Date
Signature	Print	Date
Signature	Print	Date

EXAMPLE

HEALTH AND SAFETY PLAN
FOR
MULTIPLE NPL SITES MONITORING WELL DECOMMISSIONING

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1.0 INTRODUCTION

1.1 GENERAL

In accordance with Consultant corporate policies and OSHA regulations, this Health and Safety Plan (HASP) describes specific health and safety practices and procedures to be used during Monitoring Well Decommissioning activities at the ____________ Site, located in ____________, New York. The HASP covers Consultant employees and activities, and is not intended to cover the activities of other employers on the site. This general Health and Safety Plan will be modified for each monitoring well-decommissioning assignment with site-specific data including site-specific contaminant and emergency response information, identification of hazards associated with the individual contaminants or categories of contaminants known to be present at the site, a hospital route, and identification of task-specific personal protective equipment (PPE). Consultant accepts no responsibility for the Health and Safety of subcontractor personnel. This HASP presents information on known site health and safety hazards and includes the equipment, materials and procedures that will be used to eliminate or control these hazards and is based on an assessment of potential health and safety hazards at the site using available historical information. Environmental monitoring will be performed during the course of field activities to provide real-time data for an on-going assessment of potential physical and chemical hazards. Personal detector tubes will be utilized in conjunction with an HNu photoionization detector to determine the extent of exposure to chemical hazards.

All Consultant personnel involved with site inspection, environmental sampling, and other monitoring well decommissioning activities will be required to comply with this Health and Safety Plan. Tasks on this site will be completed using methods that meet the requirements set forth in the OSHA Health and Safety regulations contained in 29 CFR 1910 and 1926. Construction subcontractor(s) conducting drilling and excavating operations are required to provide their own Health and Safety Plans.

1.2 ORGANIZATION

The Consultant Project Manager, the Health and Safety Officer and the Site Health and Safety Coordinator (or his designee) identified below will determine and enforce compliance.

- PROJECT MANAGER

  Name:
  Telephone: Office:
  Home:

- CORPORATE HEALTH AND SAFETY MANAGER:

  Name:
  Telephone: Office:
  Home:

- SITE HEALTH AND SAFETY OFFICER

  Name:
  Telephone: Office:
  Home:

- SITE HEALTH AND SAFETY COORDINATOR

  Name:
  Telephone: Office:
  Home:

The following roles have been identified for consultant project personnel:

Project Manager - The Project Manager has full responsibility for implementing and executing an effective program of employee protection and accident prevention. He may delegate authority to expedite and facilitate any application of the program.

Health and Safety Manager - The Health and Safety Manager serves as the administrator of the corporation's health and safety program. He is responsible for ensuring that consultant field personnel are properly trained, that they have obtained medical clearance to wear respiratory protection (per 29 CFR Part 1910.134(b)(10)), and that they are properly trained in the selection, use and maintenance of personal protective equipment, including qualitative respirator fit testing.

The Health and Safety Manager will also serve as scientific advisor for the duration of the project, providing guidance on data interpretation and the determination of appropriate levels of worker protection.

Site Health and Safety Officer - The Site Health and Safety Officer is knowledgeable in safety and worker protection techniques as they relate to the project. Responsibilities include the development of the specific provisions of this HASP, including the level of personnel protection to be employed, identification of emergency procedures, and personnel/equipment decontamination procedures. This individual will provide technical assistance to project management on problems relating to industrial hygiene and work site safety.

Any health and safety briefings required during the course of the project will be conducted by the Site Health and Safety Officer. Examples of briefings might include accident prevention, respirator refresher courses or current issues. The frequency of safety briefings will be based upon the potential hazards specific to the designated work tasks and any new information relative to such hazards which are discovered during the project.

Site Health and Safety Coordinator - Consultant's Site Health and Safety Coordinator or his/her designee will be responsible for enforcement of this HASP for consultant employees at the site and for monitoring the personal exposures of employees to hazardous substances contained in air, soil or water. This will consist of spot checking workplace air sampling performed by the Subcontractor such as organic vapor monitoring and the documentation of such data. Consultant's Site Health and Safety Coordinator or his/her designee will communicate directly with consultant's Site Health and Safety Officer on a regular basis to advise him/her of monitoring results and any unexpected conditions found at the site. As data are received and evaluated, the Site Health and Safety Officer will adapt this Health and Safety Plan to fit the current consultant employee protection needs at the site. All affected consultant employees and the Subcontractor's designated Site Health and Safety Officer will be informed of the air sampling results.

When unsafe work conditions are identified, the Site Health and Safety Coordinator or his/her designee is authorized to order consultant personnel to stop work. Resolution of all on-site health and safety problems will be coordinated through the Project Manager with assistance from the Health and Safety Manager and Site Health and Safety Officer as well as the Subcontractor's designated Health and Safety personnel.

2.0 HAZARD EVALUATION

2.1 SUMMARY OF PROJECTED RISKS

Due to the variety of potential contaminants at the site, the possibility exists that workers will be exposed to hazardous substances during field activities (see Table 2-1). The principal points of exposure would be through direct contact with contaminated fill/soils and groundwater, through the inhalation of contaminated particles or vapors. In addition, the use of drill rigs and backhoes on-site will present conditions for potential physical injury to workers. Further, since work will be performed during summer/winter time periods, the potential exists for heat/cold stress to impact workers especially those wearing protective equipment and clothing. The specific tasks involved in well decommissioning have been delineated in the July 1994 Work Plan for Multiple NPL Sites Monitoring Well Decommissioning, and in the February 1995 NPL Site Monitoring Well Decommissioning Procedures prepared by Consultant.

Although no work can be considered completely risk-free, logical and reasonable precautions will be implemented to provide an adequate level of protection for workers. The integration of medical evaluations, worker training relative to chemical hazards, safe work practices, proper personal protection, environmental monitoring, work zones and site control, appropriate decontamination procedures and contingency planning into the project approach will minimize the chance of unnecessary exposures and physical injuries.

2.2 PHYSICAL HAZARDS

Well decommissioning and sampling activities at the _______________ Site may present the following physical hazards:

- The potential for physical injury during heavy construction equipment use, such as drill rigs and backhoes.
- The potential for heat/cold stress to employees during the summer/winter months (see Section 8.0).
- The potential for slip-and-fall injuries due to rough, uneven terrain.

- The potential for injury due to fire/explosion if methane gas is released during drilling operations and/or excavations (see Sections 5.0 and 11.0).

2.3 BIOLOGICAL HAZARDS

- **Poison Ivy (Rhus Radicans)**

Poison ivy may be found at the site. It is highly recommended that all personnel entering into an area with poison wear a minimum of a paper Tyvek to avoid skin contact.

Contact with poisonous plants:

Characteristic Reactions:

The majority of skin reactions following contact with offending plants are allergic in nature and characterized by:

- general symptoms of headache and fever
- itching
- redness
- a rash

Some of the most common and most severe allergic reactions result from contact with plants of the poison ivy group, including poison oak and poison sumac. Such plants produce severe rash characterized by redness, blisters, swelling, and intense burning and itching. The victim may develop a high fever and feel very ill. Ordinarily, the rash begins within a few hours after exposure, but may be delayed 24 to 48 hours.

Distinguishing Features of Poison Ivy Group Plants:

The most distinctive features of poison ivy and poison oak are their leaves, which are composed of three leaflets each. Both plants have greenish-white flowers and berries that grow in clusters.

First Aid:

a. Remove contaminated clothing; wash all exposed areas thoroughly with soap and water, followed by rubbing alcohol.

b. Apply calamine or other soothing lotion if rash is mild.

c. Seek medical advice if a severe reaction occurs, or if there is a known history of previous sensitivity.

- **Ticks**

Heavily vegetated areas of a site may have ticks. it is highly recommended that all personnel walking through such areas wear a minimum of a paper Tyvek and latex boot covers. The ticks will stand out against the light colors. A tick repellent or insect repellent containing DEET is also suggested.

Ticks can transmit several diseases, including Rocky Mountain spotted fever, a disease that occurs in the eastern portion of the United States as well as the western portion, and Lyme disease. Ticks adhere tenaciously to the skin or scalp. there is some evidence that the longer an infected tick remains attached, the greater is the chance that it will transmit disease.

First Aid:

a. Cover the tick with heavy oil (mineral, salad, or machine) to close its breathing pores. The tick may disengage at once; if not, allow oil to remain in place for a half hour. Carefully (slowly and gently) remove the tick with tweezers, taking care that all parts are removed.

b. With soap and water, thoroughly, but gently, scrub the area from which the tick has been removed, because disease germs may be present on the skin; also wipe the bite area with an antiseptic. Although use of tweezers for the removal of the tick and application of heat to the tick's body often have been attempted, these methods may leave tick parts in the wound or may injure the skin.

c. If you have been bitten, place the tick in a jar labeled with the date, location of the bite, and the location acquired. If any symptom appears, such as an expanding red rash, contact a physician immediately.

- **Lyme Disease**

Lyme disease may cause a number of medical conditions, including arthritis, that can be treated if you recognize the symptoms early and see your doctor. Early signs may include a flu-like illness, an expanding skin rash, and joint pain. If left untreated, Lyme disease can cause serious nerve and heart problems as well as a disabling type of arthritis.

You are more likely to spot early signs of Lyme disease rather than see the tick or its bite. This is because the tick is so small (about the size of the head of a common pin or a period on this page and a little larger after they fill with blood), you may miss it or signs of a bite. However, it is also easy to miss the early symptoms of Lyme disease.

In its early stage, Lyme disease may be a mild illness with symptoms like the flu. It can include a stiff neck, chills, fever, sore throat, headache, fatigue, and joint pain. But this flu-like illness is usually out of season, commonly happening between May and October when ticks bite.

Most people develop a large, expanding skin rash around the area of the bite. Some people may get more than one rash. The rash may feel hot to the touch and may be painful. Rashes vary in size, shape, and color, but often look like a red ring with a clear center. The outer edges expand in size. It's easy to miss the rash and the connection between the rash and the tick bite. The rash develops from three days to as long as a month after the tick bite. Almost one-third of those with Lyme disease never get the rash.

Joint or muscle pain may be another early sign of Lyme disease. These aches and pains maya be easy to confuse with the pain that comes from other types of arthritis. However, unlike many other types of arthritis, this pain seems to move or travel from joint to joint.

In later stages, lyme disease may be confused with other medical problems. These problems can develop months to years after the first tick bite.

Early treatment of Lyme disease symptoms with antibiotics can prevent the more serious medical problems of later sages. If you suspect that you have symptoms of Lyme disease, contact your doctor.

Lyme disease can cause problems with the nervous system that look like diseases. These include symptoms of stiff neck, severe headache, and fatigue usually linked to meningitis. They may also include pain and drooping of the muscles on the face, called Bell's Palsy. Lyme disease can also mimic symptoms of multiple sclerosis or other types of paralysis.

Lyme disease can also cause serious but reversible heart problems, such as irregular heart beat. Finally, Lyme disease can result in a disabling, chronic type of arthritis that most often affects the knees. Treatment is more difficult and less successful in later stages. Researchers think these more serious problems may be linked to how the body's defense or immune system responds to the infection.

2.4 NOISE

Hearing protection is required for workers operating or working near heavy equipment where the noise level is greater than 85 dBA (TWA). The SSHO will determine the need for and appropriate testing procedures; i.e., sound level meter and/or dosimeter for noise measurement.

2.5 CHEMICAL HAZARDS

This section presents an example of a chemical Hazards Summary for a site characterized by trichloroethylene (TCE) contamination. Similar information will need to be provided on a site-by-site basis for all chemicals that may be encountered during the well decommissioning work.

Table 2-1 presents the potential chemicals that may be encountered during well decommissioning work at the ______________ Site. The information presented in Table 2-1 is based on the available analytical data for the wells to be decommissioned. A summary of the exposure hazards for these chemicals is presented below.

- **Trichloroethylene (TCE)** is a common industrial solvent used primarily in dry cleaning and metal degreasing. Trichloroethylene exposure at vapor levels of 200 ppm has been associated with mild behavioral and psychomotor effects, including vertigo, fatigue, and headache. TCE is a suspected human carcinogen. The principal routes of potential personnel exposure to TCE are through inhalation of volatilized TCE and direct skin contact.

3.0 MEDICAL SURVEILLANCE

Medical monitoring, including initial employment, annual and employment termination examinations will be provided to Consultant employees whose work may result in potential chemical exposure or present unusual physical demands. Medical evaluations will be performed by an occupational physician designated by Consultant. The medical evaluations will be conducted according to the Consultant Medical Monitoring Program and include an evaluation of the workers' ability to use respirator protective equipment (as per 29 CFR 1910). The examination will include:

- Occupational history;
- Medical history;
- Medical review;
- Medical surveillance examination with emphasis on organ systems potentially affected by toxic substances identified in the work environment;
- Medical certification of physical requirements (sight, hearing, musculoskeletal, cardiovascular) for safe job performance; and
- Laboratory testing to include a complete blood count, white cell differential count, serum multiphasic screening and urinalysis.

The purposes of the medical evaluation are to: (1) determine fitness for duty on hazardous waste sites (such an evaluation is based upon the employee's occupational and medical history, a comprehensive physical examination and an evaluation of the ability to work while wearing protective equipment); and (2) establish baseline medical data.

Supplemental examinations may be performed whenever there is an actual or suspected excessive exposure to chemical contaminants or upon experience of exposure symptoms, or following injuries or temperature stresses.

In conformance with OSHA regulations, Consultant will maintain and preserve medical records for a period of 30 years following termination of employment. Employees have access to the results of medical testing and to full medical records and analyses.

EXAMPLE

TABLE 2-1

HEALTH AND SAFETY PLAN FOR ________________ SITE
MONITORING WELL DECOMMISSIONING

POTENTIAL CONTAMINANTS AND CONCENTRATIONS

Chemical	Affected Media	Maximum Concentration	Location of Max.	TWA[1]	
				mg/m^3	ppm
Trichloroethylene (TCE)	Groundwater	1,500 ug/l	MW-1	269	50

***Note (1):** Time-weighted average per 1994 ACGIH Threshold Limit Values.*

4.0 EMPLOYEE TRAINING PROGRAM

All employees who may be exposed to hazardous substances, health hazards, or safety hazards shall be adequately trained prior to engaging in any on-site work activities. At a minimum, such training shall include an initial 40-hour Hazardous Waste Site Worker Protection Course, an 8-hour Annual Refresher Course subsequent to the initial 40-hour training, and 3 days of actual field experience under the direct supervision of a trained, experienced supervisor (i.e., the Health and Safety Coordinator or his/her designee). This training shall be conducted by a qualified instructor and shall be specifically designed to meet the requirements of OSHA Standard 29 CFR 1910.120(e)(2). At a minimum, the initial 40-hour training course will include the following:

TOPICS

- OSHA/SARA/EPA/RCRA/HCS Requirements
- Decontamination of Personnel & Equipment
- Fire, Explosion & Accident Prevention
- Respiratory Protection Selection & Use
- Preparation of Health & Safety Plans
- Emergency Preparedness & Escape
- Protective Clothing Use & Selection
- Air Monitoring & Surveillance
- Work Practices to Minimize Risk
- Waste Site Safety
- Hazard Recognition
- Medical Surveillance
- Cold & Heat Stress
- Site Entry & Set-Up
- Permissible Exposure Limits
- Site Control & Work Zones
- Chemical & Physical Hazards
- Confined Space Entry

WORKSHOPS/EXERCISES

- Self-Contained Breathing Apparatus
- Air Monitoring Equipment Workshop
- Air Purifying Respirator Workshop
- Decontamination
- Qualitative/Quantitative Fit Test
- Level A/B Field Exercise
- Level B/C Field Exercise
- Air Tank Refilling Workshop

Records and certifications received from the course instructor documenting each employee's successful completion of the training identified above will be maintained on file in Consultant's corporate headquarters offices. Subcontractor(s) will be required to provide similar documentation of training for all their personnel who will be involved in on-site work activities.

Any employee who has not received adequate training and has been so certified shall be prohibited from engaging in on-site work activities that may involve exposure to hazardous substances, health hazards or safety hazards. All individuals functioning in a supervisory capacity shall have had a minimum of 8 hours of Hazardous Waste Site Supervisor Training.

Prior to commencing work at a hazardous waste site, all Consultant employees will participate in an initial health and safety briefing conducted by the Site Health and Safety Officer to discuss site-specific hazards, PPE requirements, and emergency response procedures. In addition, periodic health and safety briefings will be conducted by Consultant's Site Health and Safety Officer for Consultant employees on an as-needed basis. Problems relative to respiratory protection, inclement weather, heat/cold stress or the interpretation of newly-available environmental monitoring data are examples of topics which might be covered during these briefings.

5.0 SAFE WORK PRACTICES

All Consultant employees shall obey the following safety rules during on-site work activities conducted within the exclusion and support zones:

General:

- Eating, drinking, chewing gum or tobacco, smoking, or any practice which increases the probability of hand-to-mouth transfer of contaminated material is strictly prohibited;
- The hands and face must be thoroughly washed upon leaving the work area and prior to engaging in any activity indicated above.
- Any required respiratory protective equipment and clothing must be worn by all personnel going on-site. Excessive facial hair (i.e., beards, long mustaches or sideburns), which interferes with the satisfactory respirator-to-face seal is prohibited;
- Contact with surfaces/materials either suspected or known to be contaminated will be avoided to minimize the potential for transfer to personnel, crosscontamination and need for decontamination;
- Medicine and alcohol can potentiate the effects of exposure to toxic chemicals. Due to possible contraindications, use of prescribed drugs should be reviewed with the consultant occupational physician. Alcoholic beverage and illegal drug intake are strictly forbidden during site work activities;
- All personnel shall be familiar with standard operating safety procedures and additional instructions contained in this Health and Safety Plan;
- On-site personnel shall use the "buddy" system. No one may work alone, i.e., out of earshot or visual contact with other workers in the exclusion zone;
- Personnel and equipment in the contaminated area shall be minimized, consistent with effective site operations;
- All employees have the obligation to correct or report unsafe work conditions;
- Use of contact lenses on-site will not be permitted. Spectacle kits for insertion into full-face respirators will be provided for Consultant employees, as required.

The recommended general safety practices for working around the drilling Contractor's and/ or backhoe operator's equipment (i.e. drill rigs and backhoes) are as follows:

Contractor's Duties:

- The drilling Contractor is responsible for the condition of his equipment and its safe operation on the site. Consultant personnel are responsible for their own safety when working around this equipment. The inspector will include a check for obvious structural damage, loose nuts and bolts, loose or missing guards, cable guides or protective covers, fluid leaks, damaged hoses, cables, pressure gauges or pressure relief valves, and damaged drilling tools and equipment. The equipment should also have a fire extinguisher. The project manager will notify all subcontractors that they are expected to conduct daily inspections of their equipment and report any potential problems to the Consultant Site Health and Safety Coordinator or his/her designee. If the condition of the equipment is considered to be unsafe based on the Contractor's inspection, and/or the Consultant Site Health and Safety Coordinator's inspection, have the Contractor make the necessary repairs prior to beginning construction. If the Contractor refuses to fix the equipment or is not operating the equipment safely, the job site will be closed down and the Project Manager contacted for additional instructions.

- Drilling/excavation will not be initiated without first clearing underground services such as; gas, water, telephone, sewer, hydrogen, steam, and cable T.V.

- Drill rigs and backhoes should not be operated within 20 feet of overhead wires. This distance may be increased if windy conditions are anticipated. The site should also be clear to ensure the project staff can move around the heavy machinery safely.

- Slippage is one of the most common causes of accidents around drill rigs and test pits. Drainage should be provided to divert mud and water away from the construction site.

- The Contractor should keep the construction site tidy. This will prevent personnel from tripping and will allow for fast emergency exit from the site.

- A drill rig must not be moved from site to site with the drill mast in the raised position.

- Proper lighting will be provided if drilling/excavating at night.

- Drilling/excavation will be discontinued during an electrical storm.

Consultant's Duties:

- Hard hats and safety boots must be worn at all times in the vicinity of the drill rig and/or backhoe. Hearing protection is also recommended. Safety glasses are necessary.

- The presence of combustible gases should be checked before igniting any open flame (e.g., during welding).

- Consultant personnel shall stand upwind of any drilling/excavating operation when not immediately involved in sampling/logging activities.

- Consultant personnel will not enter trenches unless the trenches are shored or back sloped according to OSHA 29CFR 1926.652.

- Consultant personnel will not approach the edge of an unsecured trench closer than 2 feet.

6.0 PERSONAL PROTECTIVE EQUIPMENT

This section presents an example of personal protective equipment requirements for an unspecified site. Similar information will need to be provided on a site-by-site basis for all tasks that will be undertaken as part of the well decommissioning work.

6.1 PROTECTION LEVELS

Personnel must wear protective equipment when work activities involve known or suspected atmospheric contamination; when vapors, gases, or particulates may be generated; or when direct contact with dermal-active substances may occur. Full-face respirators will be used to protect the lungs, the gastrointestinal tract, and the eyes against air toxicants. Chemical-resistant clothing will be used to protect the skin from contact with skin-destructive and skin-absorbable chemicals. All personal protective equipment shall be maintained and stored as specified by the manufacturers. Good personal hygiene and safe work practices, as identified in Section 5.0, are also necessary to limit or prevent the ingestion of potentially harmful substances.

Based upon current information regarding both the contaminants suspected to be present at the ________________ Site and the various tasks that are included in the well decommissioning program, the minimum required levels of protection shall be as identified in Table 6-1. The Site Health and Safety office will monitor the use of PPE during extreme temperature conditions.

EXAMPLE

TABLE 6-1

HEALTH AND SAFETY PLAN FOR _______ SITE
MONITORING WELL DECOMMISSIONING

REQUIRED LEVELS OF PROTECTION

Activity	Respiratory*	Clothing(2)	Gloves	Boots	Other Modifications(3)
Field Reconnaissance	D/C	T	–	L	Safety Glasses
Well Decommissioning Inspection	D/C	T	L/N	L	Hard Hat, Safety Glasses

Notes:

(1) T = Tyvek; L/N = Latex Inner Glove, Nitrile Outer Glove; L = Latex Outer Boot
(2) Tyvek uniforms will be worn when Level C conditions are present (mandatory) or when Level D conditions are present (optional).
(3) At the discretion of the Site Health and Safety Officer, respirators will be donned whenever potentially contaminated airborne particulate (i.e., dust) are generated in significant amounts in the breathing zone.
* Respiratory protection shall correspond to guidelines presented in Section 7.2. The Level C requirement is an air-purifying cartridge respirator equipped with Organic Compound/Acid Gases/Dust cartridges.

[illegible]

7.0 ENVIRONMENTAL MONITORING

7.1 GENERAL APPROACH

7.1.1 On-Site Monitoring

Modifications to the level of protection established for consultant employees for each task will be based upon measurements of the contaminants present in the work environment. Tasks and activities proposed for each site along with the estimated potential of exposure to contaminants known to be present in the groundwater and soil at each site will be used to determine the minimum required levels of personal protection and will be described in the Site-Specific Health and Safety Plans. Based upon the existing data base, a release of organic vapors is anticipated during both intrusive investigations and sampling activities. Ambient breathing zone concentrations may, at times, exceed the permissible exposure limits (PEL) established by OSHA for the individual compounds (see Table ____). Respiratory and dermal protection may be modified (upgraded or downgraded) based upon real-time field monitoring data.

Contaminated soil and groundwater are most likely to be encountered during over drilling, excavation, sampling and other monitoring well decommissioning activities. The air monitoring program to be implemented by Consultant will monitor volatile contaminants as well as the presence of respirable dust when the soil is physically disturbed by drilling equipment and backhoes. A combustible gas meter and total organic vapor analyzer (HNu) shall be utilized by Consultant personnel to verify field conditions during drilling/excavating operations. Real time monitoring will be performed by consultant personnel on a periodic basis during other on-site activities such as sample collection and reconnaissance surveys. Drager detector-type tubes will be used to measure chemical specific concentrations in air. The level of respiratory and dermal protection in use will be based upon an evaluation of general and chemical specific air monitoring data.

Monitoring instruments will be protected from surface contamination during use to allow for easy decontamination. When not in use, the monitoring instruments will be placed on plastic sheeting to avoid surface contact. Additional monitoring instruments may be required if the situations or conditions change.

During drilling/excavating and soil examination operations, the work area surrounding the borehole will be monitored at regular intervals using an HNu photoionization detector, (or similar organic vapor monitoring device) as well as an explosimeter and a particulate meter. Observed values will then be recorded and maintained as part of the permanent field record. Breathing zone monitoring with an HNu will be performed at two-hour intervals during drilling and continuously during test pit work. The actual frequency of breathing zone monitoring will be dependent primarily upon values generated by screening the cuttings and the proximity of the worker's breathing zones to the source of contamination. Contaminant values which are in excess of established action levels appropriate for the prescribed level of protection will be immediately addressed.

Any split-spoon samples which are collected will be surveyed with the HNu, or similar equipment as each sample is retrieved. These values will be recorded with the respective sample number and will assist in the determination of the adequacy of employee protective equipment. In addition, to minimize dermal contact with potentially contaminated fill/soils, long-handled spoons and knives shall be used during split-spoon sampling and examination of the soil-core sample by the hydrogeologist.

7.2 MONITORING ACTION LEVELS

7.2.1 On-Site Levels

The HNu or other appropriate instrument(s) will be used by either Consultant personnel or the Contractor to monitor organic vapor concentrations as specified in this plan and in the Contractor's Health and Safety Plan. Methane gas will be monitored with the "combustible gas" option on the explosimeter/tritector or other appropriate instrument(s) in accordance with the drilling Contractor's Health and Safety Plan. In addition, fugitive dust/particulate concentrations will be monitored using a real-time particulate monitor, as specified in this plan and in the Contractor's Health and Safety Plan. Readings obtained in the breathing zone may be interpreted (with regard to other site conditions) as follows for on-site Consultant personnel:

- Total atmospheric concentrations of unidentified vapors or gases ranging from 0 to background on the Hnu - Continue Operations Under Level D (see Attachment 1).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings above background to 5 ppm on the Hnu (vapors not suspected of containing high levels of chemicals toxic to the skin) - Continue Operations Under Level C (see Attachment 1).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings of 5 to 50 ppm above background on the Hnu - continue operations under Level B (see Attachment 1), re-evaluate and alter (if possible) Work Plan to achieve lower vapor concentrations.

- Total atmospheric concentrations of unidentified vapors or gases above 50 ppm on the Hnu - discontinue engineering operations and exit the work zone immediately.

The explosimeter will be used to monitor levels of both combustible gases and oxygen during site activities. Action levels based on the instrument readings shall be as follows:

- Less than 10% LEL - Continue engineering operations with caution;

- 10-25% LEL - Continuous monitoring with extreme caution, determine source/cause of elevated reading;

- Greater than 25% LEL - Explosion hazard, evaluate source and leave the Work Zone;

- Less than 19.5% oxygen - leave Work Zone immediately;

- 19.5-25% oxygen - Continue engineering operations with caution; and

- Greater than 25% oxygen - Fire hazard potential, leave Work Zone immediately.

The particulate monitor will be used to monitor respirable dust concentrations during all intrusive activities. Action levels based on the instrument readings shall be as follows:

- Less than 150 ug/m^3 - Continue field operations

- Greater than 150 ug/m^3- Don dust/particulate mask or equivalent. Initiate engineering controls (viz. wetting of excavated soils or tools at discretion of Site Health and Safety Officer).

Readings with the explosimeter, particulate monitor and organic vapor analyzer will be recorded and documented in the Health and Safety logbook. All instruments will be maintained according to the manufacturer's specifications and calibrated before use and the procedure will be documented in the Health and Safety logbook.

7.2.2 Community Air Monitoring

Real-time air monitoring for volatile compounds and particulate levels will be performed at the perimeter of the work area. Volatile compounds will be measured using an HNu or similar device. Drager detector-type tubes which are compound-specific will be used to monitor the perimeter of the work area. For purposes of this monitoring activity the perimeter of the work areas are determined to be 50 feet from the outside edge of the excavation or boring. Air monitoring will occur as follows:

- Volatile organic compounds will be monitored at the downwind perimeter of the work area daily at 2-hour intervals. If total organic vapor levels exceed 5 ppm above background, work activities must be halted and monitoring continued under the provisions of a Vapor Emission Response Plan. Readings will be recorded and be available for State (DEC and DOH) personnel to review.

- Particulates should be continuously monitored upwind, downwind, and within the work area at temporary particulate monitoring stations. If the downwind particulate level is 150 ug/m^3 greater than the upwind particulate level, then dust suppression techniques must be employed. Readings will be recorded and be available for State (DEC and DOH) personnel to review.

7.2.2.1 Vapor Emission Response Plan

If the ambient air concentration of organic vapors exceeds 5 ppm above background at the perimeter of the work area, activities will be halted and monitoring continued. The exclusion zone shall be extended to include the area in which the organic vapors exceed 5 ppm above the background. If the organic vapor level decreases below 5 ppm above background, work activities can resume but more frequent intervals of monitoring, as directed by the Safety Officer, must be conducted. If the organic vapor levels are greater than 5 ppm over background, but less than 25 ppm over background at the perimeter of the work area, activities can resume, provided:

- the organic vapor level 200 feet downwind of the work area or half the distance to the nearest residential or commercial structure, whichever is less, is below 5 ppm over background, and

- more frequent intervals of monitoring, as directed by the Safety Officer, are conducted.

If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shut down. When work shutdown occurs, downwind air monitoring as directed by the Safety officer will be implemented to ensure that vapor emission does not impact the nearest residential or commercial structure at levels exceeding those specified in the Major Vapor Emission section.

7.2.2.2 Major Vapor Emission

If any organic levels greater than 5 ppm over background are identified 200 feet downwind from the work area or half the distance to the nearest residential or commercial property, whichever is less, all work activities must be halted.

If, following the cessation of the work activities or as the result of an emergency, organic levels persist for more than 30 minutes above 5 ppm above background 200 feet downwind or half the distance to the nearest residential or commercial property from the work area, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20-Foot Zone).

If efforts to abate the emission source are unsuccessful and if any of the following levels persist for more than 30 minutes in the 20-Foot Zone, then the Major Vapor Emission Response Plan shall automatically be placed into effect if organic vapor levels are approaching 5 ppm above background. However, the Major Vapor Emission Response Plan shall be immediately placed into effect if organic vapor levels are greater than 10 ppm above background.

7.2.2.3 Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

1. All Emergency Response Contacts as listed in the Health and Safety Plan of the Work Plan will go into effect.

2. The local police authorities will immediately be contacted by the Safety Officer and advised of the situation.

3. Frequent air monitoring will be conducted at 30-minute intervals within the 20-Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the Safety Officer.

8.0 HEAT/COLD STRESS MONITORING

Since some of the work activities at the Monitoring Well Decommissioning Sites will be scheduled for both the summer and winter months, measures will be taken to minimize heat/cold stress to Consultant employees. Consultant's Site Health and Safety Coordinator or his/her designee will be responsible for monitoring Consultant employees for symptoms of heat/cold stress.

8.1 HEAT STRESS MONITORING

Personal protective equipment may place an employee at risk of developing heat stress, probably one of the most common (and potentially serious) illnesses encountered at hazardous waste disposal sites. The potential for heat stress is dependent on a number of factors, including environmental conditions, clothing, workload, physical conditioning and age. Personal protective equipment may severely reduce the body's normal ability to maintain equilibrium (via evaporation, convection and radiation), and by its bulk and weight increases energy expenditure.

The signs and symptoms of heat stress are as follows:

- Heat rash may result from continuous exposure to heat or humid air.

- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

  - muscle spasms
  - pain in the hands, feet and abdomen

- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

  - pale, cool, moist skin
  - heavy sweating
  - dizziness
  - nausea
  - fainting

- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:

- red, hot, usually dry skin
- lack of or reduced perspiration
- nausea
- dizziness and confusion
- strong, rapid pulse
- coma

The monitoring of personnel wearing protective clothing should commence when the ambient temperature is 70 degrees Fahrenheit or above. For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism.

- Heart rate may be measured by the radial pulse for 30 seconds as early as possible in the resting period. The rate at the beginning of the rest period should not exceed 110 beats per minute. If the rate is higher, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period stays the same. If the pulse rate is 100 beats per minute at the beginning of the next rest period, the following work cycle should be further shortened by 33%.

- Body temperature may be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period should not exceed 99.6 degrees Fahrenheit. If it does, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period stays the same. However, if the oral temperature exceeds 99.6 degrees Fahrenheit at the beginning of the next period, the following work cycle may be further shortened by 33%. Oral temperature should be measured again at the end of the rest period to make sure that it has dropped below 99.6 degrees Fahrenheit. No consultant employee will be permitted to continue wearing semipermeable or impermeable garments when his/her oral temperature exceeds 100.6° Fahrenheit.

8.1 COLD STRESS MONITORING

Exposure to cold conditions may result in frostbite or hypothermia, each of which progresses in stages as shown below.

- **Frostbite** occurs when body tissue (usually on the extremities) begins to freeze. The three states of frostbite are:

1) **Frostnip**- This is the first stage of the freezing process. It is characterized by a whitened area of skin, along with a slight burning or painful sensation.

Treatment consists of removing the victim from the cold conditions, removal of boots and gloves, soaking the injured part in warm water (102-108°F) and drinking a warm beverage.

2) **Superficial Frostbite** - This is the second stage of the freezing process. It is characterized by a whitish-grey area of tissue which will be firm to the touch but will yield little pain. Treatment is identical to that for Frostnip.

3) **Deep Frostbite** - In this final stage of the freezing process the affected tissue will be cold, numb and hard, and will yield little to no pain. Treatment is identical to that for Frostnip.

- **Hypothermia** occurs when the body loses heat faster than it can produce it. The stages of hypothermia (which may not be clearly defined or visible at first) are the following:

  1) Shivering
  2) Apathy (a change to a disagreeable mood)
  3) Unconsciousness
  4) Bodily freezing
  5) Death (if untreated)

  Treatment of hypothermia is given below:

  - Remove the victim from the cold environment and remove wet or frozen clothing. (Do this carefully as frostbite may have started.)
  - Perform active re-warming with hot liquids for drinking (Note: do not give the victim any liquid containing alcohol or caffeine in this case) and a warm water bath (102-108°F)
  - Perform passive re-warming with a blanket or jacket wrapped around the victim.

In any potential cold stress situation, it is the responsibility of the Site Health and Safety Officer to encourage the following:

- Workers should dress warmly, with more layers of thin clothing as opposed to one thick layer.
- Personnel should remain active and keep moving.
- Personnel should be allowed to take shelter in a heated area, as necessary.
- Personnel should drink warm liquids (no caffeine or alcohol if frostbite has set in).

9.0 WORK ZONES AND SITE CONTROL

Work zones around the areas designated for drilling, test pit excavation, sample collection, and monitoring well installation will be established by the Contractor on a daily basis and communicated to all employees and other site users by the Contractor's Site Health and Safety Officer. It shall be the Contractor's Site Health and Safety Officer's responsibility to ensure that all site workers are aware of the work zone boundaries and to enforce proper procedures in each area. The zones will include:

- **Exclusion Zone ("Hot Zone")** - the area where contaminated materials may be exposed, excavated or handled and all areas where contaminated equipment or personnel may travel. The zone will be delineated by flagging tape. All personnel entering the Exclusion Zone must wear the prescribed level of personal protective equipment identified in Section 7.0;

- **Contamination Reduction Zone** - the zone where decontamination of personnel and equipment takes place. Any potentially contaminated clothing, equipment and samples must remain in the Contamination Reduction Zone until decontaminated;

- **Support Zone** - the part of the site which is considered non-contaminated or "clean". Support equipment will be located in this zone, and personnel may wear normal work clothes within this zone.

During drilling operations, Consultant personnel will establish a second exclusion zone immediately upwind of the borehole. Split-spoons shall be brought into this zone to Consultant personnel by the Contractor(s). Sample collection and logging of soil-core samples will be completed in this zone.

Access of non-essential personnel to the Exclusion and Contamination Reduction Zones will be strictly controlled by the Contractor. Only personnel who are essential to the completion of the task will be allowed access to these areas and only if they are wearing the prescribed level of protection. Entrance of all personnel must be approved by the Contractor's Site Health and Safety Officer.

A log containing the names of workers and their level of protection will be maintained by the Contractor(s).

The zone boundaries may be changed by the Site Health and Safety Officer as environmental conditions warrant, and to respond to the necessary changes in work locations on-site.

10.0 DECONTAMINATION PROCEDURES

10.1 PERSONAL DECONTAMINATION FOR MPI EMPLOYEES

The degree of decontamination required is a function of both a particular task and the physical environment within which it takes place. The following decontamination procedure, although somewhat specific to the tasks described herein, will remain flexible, thereby allowing the decontamination crew to respond appropriately to the changing environmental conditions which may arise at the site. The procedure shall be followed by all Consultant personnel who are on the site.

Station 1:	Equipment Drop	1. Deposit Equipment used on-site (tools, containers, monitoring instruments, radios, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination.
Station 2:	Boots and Gloves Wash and Rinse	2. Scrub outer boots and outer gloves with decon solution or detergent water. Rinse off using copious amounts of water.
Station 3:	Tape, Outer Boot and Glove Removal	3. Remove tape, outer boots and gloves. Deposit tape and gloves in container provided by Contractor.
Station 4:	Canister or Mask Change	4. If worker leaves exclusive zone to c hange canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot covers donned, and worker returns to duty.
Station 5:	Outer Garment Removal	5. Protective suit removed and deposited in separate container provided by Contra-ctor(s).
Station 6:	Face Piece, Hard Hat, Safety Goggles Removal	6. Face piece or safety glasses removed (if used). Avoid touching face with fingers. Facepiece and/or safety glasses deposited on plastic sheet. Hard hat removed and placed on plastic sheet.

Station 7: Inner Glove Removal

7. Inner gloves are the last personal protective equipment to be removed. Avoid touching the outside of the gloves with bare fingers. Dispose of these gloves in container provided by Contractor.

10.2 DECONTAMINATION FOR MEDICAL EMERGENCIES

In the event of a minor, non-life threatening injury, personnel should follow the decontamination procedures as defined, and then administer first-aid.

In the event of a major injury or other serious medical concern (i.e., heat stroke), immediate first-aid is to be administered and the victim transported to the hospital in lieu of further decontamination efforts unless exposure to a site contaminant would be considered "Immediately Dangerous to Life or Health."

10.3 DECONTAMINATION OF FIELD EQUIPMENT

Decontamination of heavy equipment will be conducted by the Contractor(s) in accordance with his approved Health and Safety Plan in the Contamination Reduction Zone. Heavy equipment and tools utilized during drilling/excavating and monitoring well decommissioning activities will be placed on a decontamination pad and cleaned with high-pressure water followed by steam. Decontamination water will be prevented from moving outside the decontamination pad and will be transferred to a holding tank. The Contractor(s) Health and Safety Officer will make daily inspections to determine that this procedure is being followed. All hazardous chemicals (eg., decon fluids) brought to the site will be properly labeled and their Material Safety Data Sheets will be maintained on-site in accordance with the requirements of 29 CFR 1910-1200.

Decontamination of all tools used for sample collection purposes will be conducted by Consultant personnel. Decontamination fluids will remain within the confines of the deco pad area. Spend fluids will be containerized and prepared for proper off-site disposal. Decontamination of all bailers, split-spoons, spatula knives, and other tools used for multi-media environmental sampling and examination shall be as follows:

- disassemble the equipment;
- water wash to remove all visible foreign matter;
- wash with detergent;

- rinse all parts with distilled-deionized water;
- allow to air dry; and
- wrap all parts in aluminum foil or polyethylene to prevent contamination of clean equipment.

11.0 FIRE PREVENTION AND PROTECTION

11.1 GENERAL APPROACH

Recommended practices and standards of the National Fire Protection Association (NFPA) and other applicable regulations will be followed in the development and application of Project Fire Protection Programs. When required by regulatory (DEC) authorities, the Contractor will prepare and submit a Fire Protection Plan for the approval of the contracting officers, authorized representative or other designated official. Essential considerations for the Fire Protection Plan will include:

- Proper site preparation and safe storage of combustible and flammable materials;
- Availability of coordination with private and public fire authorities;
- Adequate job-site fire protection and inspections for fire prevention; and
- Adequate indoctrination and training of employees.

11.2 EQUIPMENT AND REQUIREMENTS

- Fire extinguishers will be provided by the Contractor(s);

- Fire extinguishers will be inspected, serviced, and maintained in accordance with the manufacturer's instructions. As a minimum, all extinguishers shall be checked monthly and weighed semi-annually, and recharged if necessary; and

- Immediately after each use, fire extinguishers will be either recharged or replaced.

11.3 FLAMMABLE AND COMBUSTIBLE SUBSTANCES

- All storage, handling or use of flammable and combustible substances will be under the supervision of qualified persons; and

- All tanks, containers and pumping equipment, whether portable or stationary, which are used for the storage and handling of flammable and combustible liquids, will meet the recommendations of the National Fire Protection Association.

- If the LEL exceeds 10% for any compound, fans will be used to dissipate volatile/combustible gases and to minimize the explosion hazard during drilling/excavation activities. In addition, % O_2/explosive gas monitoring will be conducted throughout the drilling/excavation operations.

ATTACHMENT 1

PROTECTION ENSEMBLES

ATTACHMENT 1

PROTECTION ENSEMBLES

Equipment designed to protect the body against contact with known or anticipated chemical hazards have been divided into four categories according to the degree of protection afforded:

- Level A: Should be selected when the highest level of respiratory, skin and eye protection is needed.
- Level B: Should be selected when the highest level of respiratory protection is needed, but a lesser level of skin protection is required; Level B protection is the minimum level recommended on initial site entries until the hazards have been further defined by on-site studies.
- Level C: Should be selected when the types of airborne substances are known, the concentrations have been measured and the criteria for using air-purifying respirators are met. In atmospheres where no airborne contaminants are present, Level C provides dermal protection only.
- Level D: Should not be worn on any site with respiratory or skin hazards. This is primarily a work uniform providing minimal protection.

The level of protection selected is based primarily on:

- Types and measured concentrations of the chemical substances in the ambient atmosphere and their associated toxicity; and
- Potential or measured exposure to substances in air, splashes of liquids or other indirect contact with material due to the task being performed.

In situations where the types of chemicals, concentrations, and possibilities of contact are not known, the appropriate level of protection must be selected based on professional experience and judgement until the hazards may be further characterized. The individual components of clothing and equipment must be assembled into a full protective ensemble to protect the worker from site-specific hazards, while at the same time minimizing hazards and drawbacks of the personal protective gear itself. Ensemble components based on the widely used USEPA Levels of Protection are detailed below for levels B, C, and D protection.

Level B Protection Ensemble

Recommended

- Pressure-demand, full-facepiece self-contained breathing apparatus (MSHA/NIOSH approved) or pressure-demand supplied-air respirator with escape SCBA;
- Saranex chemical-resistant clothing (overalls and long-sleeved jacket; hooded one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit); disposable chemical-resistant one-piece suit);
- Inner and outer chemical resistant gloves (silver shell);
- Chemical-resistant latex safety boots/shoes; and
- Hard hat.

Optional

- Coveralls.
- Disposable boot covers.
- Face shield.
- Long cotton underwear.

Meeting any one of the following criteria warrant the use of Level B protection: -

The types and atmospheric concentrations of toxic substances have been identified and require the highest level of respiratory protection, but a lower level of skin and eye protection. These would be atmospheres:

- with concentrations Immediately Dangerous to Life and Health (IDLH)
- exceeding limits of protection afforded by a full-face air-purifying mask;
- containing substances for which air-purifying canisters do not exist or have low removal efficiency;
- containing substances requiring air-supplied equipment, but substances and/or concentrations do not represent a serious skin hazard;
- containing less than 19.5% oxygen; or

- with evidence of incompletely identified vapors or gases as indicated by direct reading organic vapor detection instrument, but those vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin.

Level B equipment provides a high level of protection to the respiratory tract, but a somewhat lower level of protection to skin. The chemical-resistant clothing required in Level B is available in a wide variety of styles, materials, construction detail and permeability. These factors all affect the degree of protection afforded. Therefore, a specialist should select the most effective, chemical-resistant clothing based on the known or anticipated hazards and task. Level B skin protection is selected by:

- Comparing the concentrations of identified substances in the air with skin toxicity data;
- Assessing the effect of the substance (at its measured air concentrations or splash potential) on the small area of the head and neck unprotected by chemical-resistant clothing.

Level C Protection Ensemble

Recommended

- Full-facepiece, air-purifying respirator equipped with MSHA and NIOSH approved organic vapor/acid gas/dust/mist combination cartridges or as designated by the Health and Safety Manager;
- Chemical-resistant clothing (polycoated Tyvek overalls and long-sleeved jacket, hooded, one- or two-piece chemical splash suit or disposable chemical-resistant one-piece suit);
- Inner and outer chemical-resistant gloves (butyl/nitrile);
- Chemical-resistant latex safety boots/shoes; and
- Hardhat.

Optional

- Coveralls;
- Disposal boot covers;
- Face shield;
- Escape mask;
- Long cotton underwear.

The use of Level C protection is permissible upon satisfaction of these criteria:

- Measured air concentrations of identified substances will be reduced by the respirator to below the substance's permissible exposure limit (PEL), threshold limit value (TLV), and/or the concentration is within the service limit of the cartridge;

- Atmospheric contaminant concentrations do not exceed IDLH levels; and

- Atmospheric contaminants, liquid splashes or other direct contact will not adversely affect the small area of skin left unprotected by chemical-resistant clothing.

Level C protection is distinguished from Level B by the equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main selection criterion for Level C is that conditions permit wearing an air-purifying device. The device (when required) must be an air purifying respirator (MSHA/NIOSH approved) equipped with filter cartridges. Cartridges must be able to remove the substances encountered. Respiratory protection will be used only with proper fitting, training and the approval of a qualified individual. In addition, an air-purifying respirator can be used only if:

- Oxygen content of the atmosphere is at least 19.5% in volume;
- Substances are identified and concentrations measured;
- Substances have adequate warning properties;
- Individual passes a qualitative fit-test for the mask; and
- Appropriate cartridge/canister is used, and its service limit concentration is not exceeded.

An air monitoring program is part of all response operations when atmospheric contamination is known or suspected. It is particularly important that the air be monitored thoroughly when personnel are wearing air-purifying respirators. Continual surveillance using direct-reading instruments is needed to detect any changes in air quality necessitating a higher level of respiratory protection.

Level D Protection Ensemble

Recommended

- Tyvek coveralls;
- Safety boots/shoes;
- Safety glasses or chemical splash goggles;

- Hardhat;
- Latex gloves.

Optional

- Gloves;
- Escape mask;
- Face shield.

The use of Level D protection is permissible upon satisfaction of these criteria:

- No hazardous air pollutants have been measured; and

- Work functions preclude splashes, immersion or the potential for unexpected inhalation of any chemicals; and

- Atmospheric contains at least 19.5% oxygen.

Level D protection is primarily a work uniform. It can be worn in areas where only boots can be contaminated, or where there are no inhalable toxic substances.

ATTACHMENT 2

CONTINGENCY PLAN AND HOSPITAL ROUTE

(to be developed on a site-specific basis)

ATTACHMENT 2

This attachment presents an example of an emergency response plan for a site in the Love Canal, NY area. A similar plan will need to be developed for each site where well decommissioning activities are to be performed.

Personnel Exposure

- Skin contact: Use copious amounts of soap and water. Wash/rinse affected area for at least 15 minutes. Decontaminate and provide medical attention. Eyewash stations will be provided on site. If necessary, transport to Niagara Falls Memorial Hospital.

- Inhalation: Move to fresh air and, if necessary, transport to Niagara Falls Memorial Hospital.

- Ingestion: Decontaminate and transport to Niagara Falls Memorial Hospital.

Personal Injury

Minor first-aid will be applied on-site as deemed necessary. In the event of a life threatening injury, the individual should be transported to Niagara Falls Memorial Hospital via ambulance. The Consultant and Subcontractor Health and Safety Officers will supply available chemical-specific information to appropriate medical personnel as requested.

The consultant or subcontractor first aid kits will conform to Red Cross and other applicable good health standards, and shall consist of a weatherproof container with individually-sealed packages for each type of item. First aid kits will be fully equipped before being sent out on each job and will be checked weekly by the On-Site Health and Safety Coordinator to ensure that the expended items are replaced.

Communications

Internal emergency communication systems are used to alert workers to danger, convey safety information, and maintain site control. Any effective system can be employed. Hand signals and air-horn blasts are also commonly used. It shall be the responsibility of the Subcontractor's Site Health and Safety Officer to ensure that an adequate method of internal communication is understood by all personnel entering the site. Unless all personnel are otherwise informed, the following signals shall be used.

1) Emergency signals by portable air horn, siren, or whistle: two short blasts, personal injury; continuous blast, emergency requiring site excavation.

2) Visual signals: hand gripping throat, out of air/cannot breathe; hands on top of head, need assistance; thumbs up, affirmative/ everything is OK; thumbs down, no/negative; grip partner's wrist or waist, leave area immediately.

Evacuation

In the event that an area must be evacuated due to an emergency, such as a chemical spill or a fire, workers shall exit upwind, if possible. Since work conditions and work zones within the site may be changing on daily basis, it shall be the responsibility of the Subcontractor's Site Health and Safety Officer to review evacuation routes and procedures as necessary and to inform all site workers of any charges.

Adverse Weather Conditions

In the event of adverse weather conditions, the Consultant's Site Health and Safety Coordinator in conjunction with the Consultant's Health and Safety Officer will determine if engineering operations can continue without sacrificing the health and safety of the Consultants employees. Some of the items to be considered prior to determining if work should continue are:

- Potential for heat/cold stress;
- Inclement weather - related working conditions;
- Limited visibility; and
- Potential for electrical storms.

Emergency Telephone Numbers

PROJECT MANAGER:

CORPORATE HEALTH AND SAFETY MANAGER:

SITE HEALTH AND SAFETY OFFICER:

SITE HEALTH AND SAFETY COORDINATOR:

NIAGARA FALLS MEMORIAL HOSPITAL:	(716) 278-4000
FIRE	911 (Local) 285-1234
AMBULANCE	911 or 285-3663
POLICE	911 (Local) 286-4711
ON-SITE CELLULAR TELEPHONE	(716) 866-4367

The site location is:
Love Canal Site
Military Road
Niagara Falls, New York

Nearest Trauma Center:
Children's Hospital of Buffalo
219 Bryant Street
Buffalo, New York
Dr. James Allen (716) 878-7953

Directions to Hospital

The following directions describe the most efficient route to Niagara Falls Memorial Hospital (see Figure A-1):

(1) From the Site, turn right onto Military Rd. and proceed north to Pine Ave.

(2) Turn left (west) onto Pine Avenue and proceed to 10th Street.

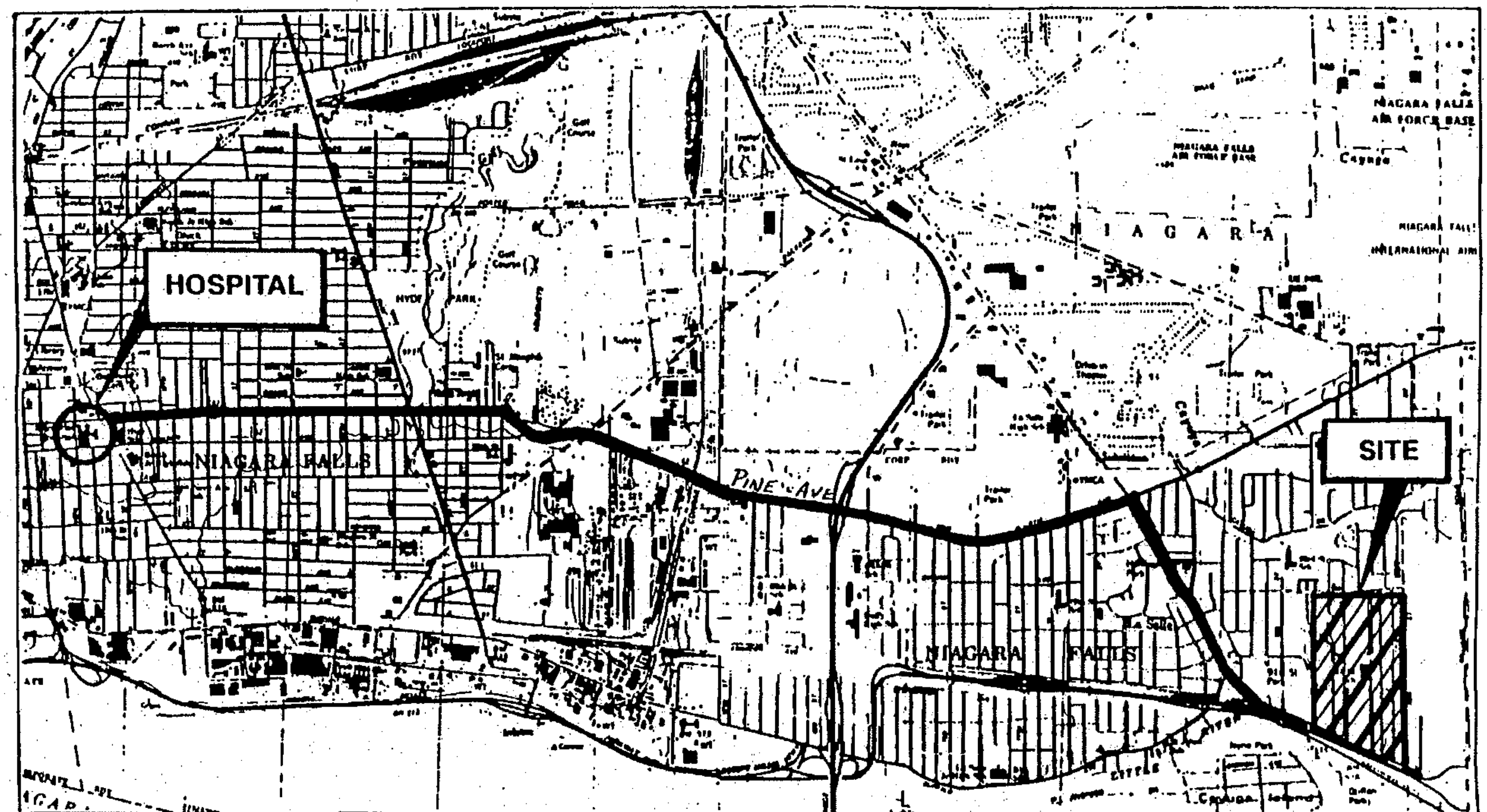
(3) Turn left (south) onto 10th St. and proceed for approximately one-tenth (1/10) mile.

(4) Hospital is on the left side of road (601 10th St.)

Records and Reporting

It shall be the responsibility of each employer to establish and assure adequate records of all:

- Occupational injuries and illnesses;
- Accident investigations;
- Reports to insurance carrier or State compensation agencies;
- Reports required by client;
- Records and reports required by local, state, federal and/or international agencies;
- Property or equipment damage;
- Third party injury or damage claims;
- Environmental testing logs;
- Explosive and hazardous substances inventories and records;



HOSPITAL ROUTE

APPENDIX B

EQUIPMENT DECONTAMINATION SOPs

Appendix B: Item 1 - DECONTAMINATION FACILITY CONSTRUCTION

Applicability: GENERAL Revision No.: ____ Date: ________

Prepared By: NWT Date: 02/02/90 Approved By: GHF Date: 02/02/90

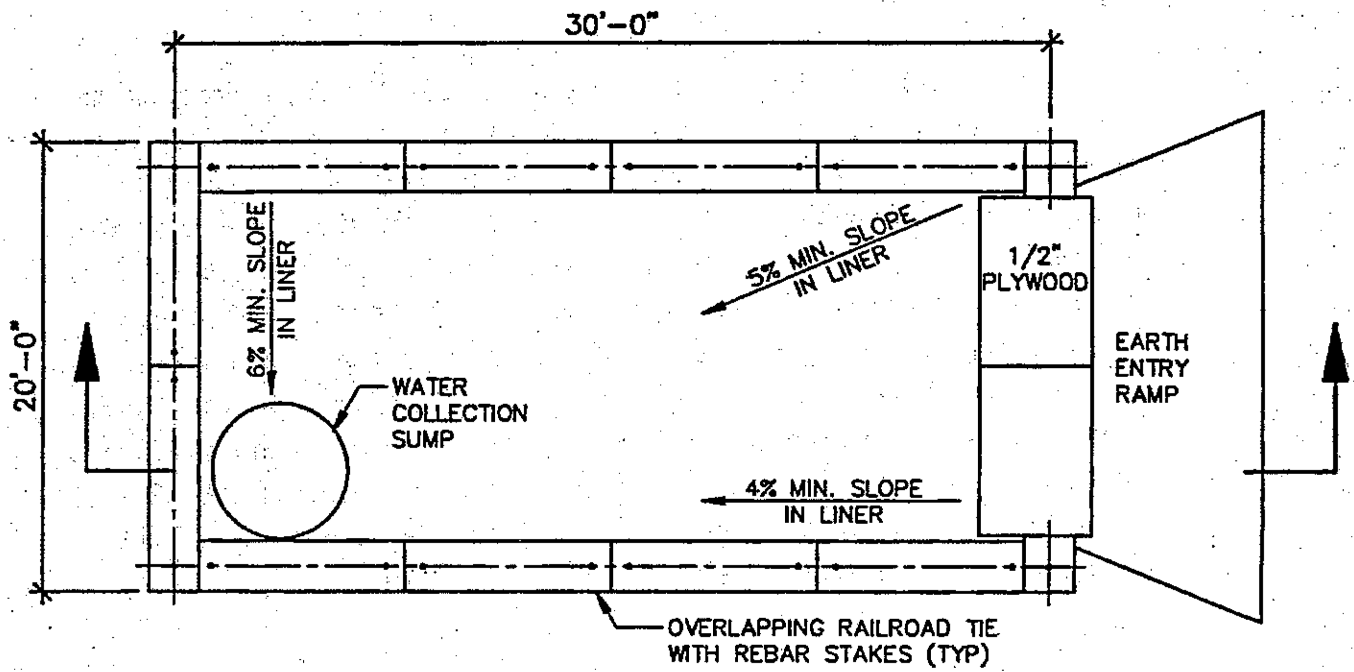
1.0 INTRODUCTION

This guideline presents the construction details for a decontamination facility (i.e., decon pad or wash pad) to be used for the decontamination of drilling and excavation equipment (i.e., drill rigs, backhoes, augers, cutting bits, drill steel, buckets, and associated equipment). A synthetic liner will be installed under the pad for leak and spill protection. In addition, the pad will be constructed with an integral sump to allow for removal of collected liquids. The surface of the liner will be sloped to direct gravity drainage towards a sump. Liquids collected in the sump will be pumped out as necessary and stored in containers until final disposition according to State and Federal regulations. In addition, the decon pad will be covered by a tarp to preclude the collection of precipitation in the sump.

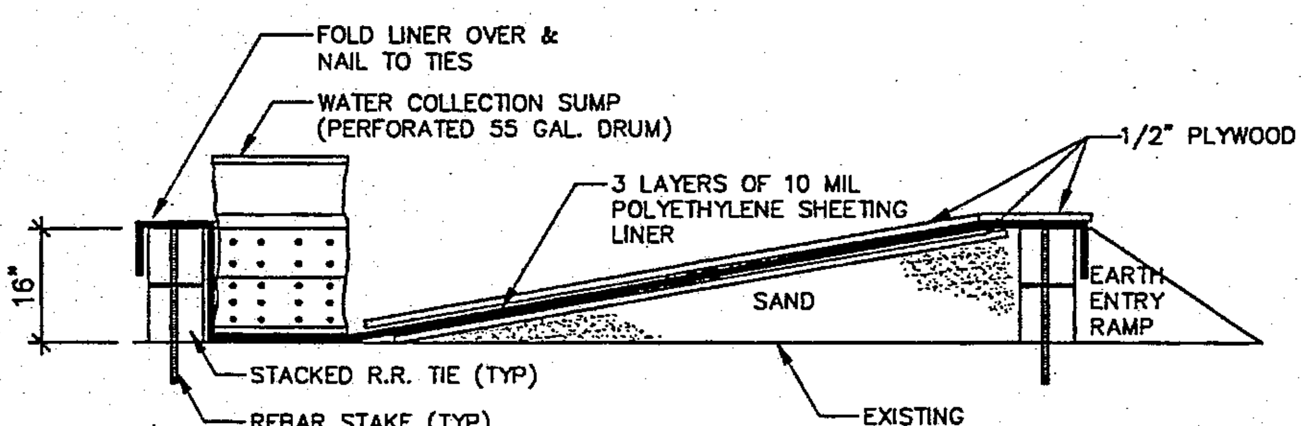
APPENDIX B : ITEM 1 – DECONTAMINATION FACILITY CONSTRUCTION

APPLICABILITY: GENERAL REVISION NO.: DATE:

PREPARED BY: DATE: APPROVED BY: DATE:



PLAN VIEW
NOT TO SCALE



SECTION
NOT TO SCALE

Appendix B: Item 2 - DRILLING/EXCAVATION EQUIPMENT DECONTAMINATION PROTOCOLS

Applicability: GENERAL Revision No.: 1 Date: 10/8/90

Prepared By: NWT Date: 12/20/89 Approved By: GHF Date: 02/02/90

1.0 INTRODUCTION

This guideline presents a method for the decontamination of drilling and excavation equipment (i.e., drill rigs, backhoes, augers, cutting bits, drill steel, buckets, and associated equipment) used during a subsurface investigation. Equipment will be decontaminated at an established and clearly demarcated decontamination facility (see appropriate guideline) prior to initiating surface penetration of each boring/excavation (drill equipment cleaning is not required between wells of the same nest). This will prevent cross-contamination from the previous drilling/excavation location.

2.0 METHODOLOGY

1. Remove all soil/rock material from the equipment at the survey site.
2. Wrap augers, tools, plywood, and other reusable items with a plastic cover prior to transport from the survey site to the decontamination facility.
3. Transport equipment to the decontamination facility.
4. Wash equipment thoroughly with pressurized low-volume water or steam (power washer or steam jenny) using a wire brush to remove visible soils/etc. adhering to the equipment.
5. Use phosphate-free detergent (e.g., Alconox) to remove any oils, grease, and/or hydraulic fluids adhering to the equipment.
6. Rinse with pressurized low-volume water or steam.

7. Allow equipment to air dry.

8. Wrap with clean plastic or aluminum foil, if appropriate, to prevent contamination if equipment is going to be stored or transported.

9. Fluids used for decontamination will not be recycled. Store all wash water, rinse water, and decontamination fluids in containers until final disposal requirements are determined.

10. Following final rinse, inspect openings to verify they are fee of soil/etc. particulates which may contribute to possible cross-contamination.

3.0 REFERENCES

(a) USEPA Region IV Engineering Support Branch. 1986. Standard Operating Procedures and Quality Assurance Manual.

Appendix B : Item 3 - SAMPLING EQUIPMENT DECONTAMINATION PROTOCOLS

Applicability: NYSDEC-SPECIFICATION Revision No.: 3 Date: 10/9/90

Prepared By: AJM Date: 10/31/89 Approved By: KLB Date: 12/12/89

1.0 INTRODUCTION

This guideline presents a method for the decontamination of sampling equipment used in the collection of environmental samples.

2.0 HEALTH AND SAFETY

Nitric acid is a strong oxidizing agent as well as being extremely corrosive to the skin and eyes. Solvents such as acetone, methanol, hexane, and isopropanol are flammable liquids. Limited contact with skin can cause irritation, while prolonged contact may result in dermatitis. Eye contact with the solvents may cause irritation or temporary corneal damage. Safety glasses with protective side shields, neoprene or nitrile gloves, and long-sleeve protective clothing must be worn whenever acids and solvents are being used.

3.0 METHODOLOGY

1. All equipment used in sampling must be clean and free from residue of any previous samples. To accomplish this, the following procedures are to be followed:

   a. wash equipment thoroughly with non-phosphate detergent and tap water(1) using a brush to remove any particulate matter or surface film;

   b. rinse with tap water(1);

   c. rinse with a 10% HNO_3 solution(2);

d. rinse with tap water[(1)];

e. rinse with deionized water (demonstrated-analyte-free)[(3)];

f. air dry; and

g. wrap in aluminum foil (shiny side out)

2. Well evacuation equipment, such as submersible pumps and bailers, which are put into the borehole must be decontaminated following the procedures listed above. All evacuation tubing must be dedicated to individual wells, (i.e., tubing cannot be reused).

3. Bailer cord must be cleaned with non-phosphate detergent and demonstrated analyte-free deionized water before use. Cord can be reused; it is not necessary to dedicate it to individual wells. If a ten (10) foot or greater length leader is being used, only the leader need be cleaned (assumes bailer cord is not allowed to contact water).

4. All unused sample bottles and sampling equipment must be maintained in such a manner that there is no possibility of casual contamination.

4.0 EQUIPMENT REQUIREMENTS

- personal protective garment and gear
- brush, buckets, and wash basins
- squirt bottles
- supply of solvents and water
- aluminum foil

5.0 REFERENCES

New York State Department of Environmental Conservation, Division of Hazardous Substances Regulation, August 1989, RCRA Quality Assurance Project Plan Guidance.

Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, April 1, 1986. USEPA Region IV.

NOTES

(1) Tap water may be used from any municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute.

(2) Omit this step if metals are not being analyzed. For carbon steel split spoon samplers, a 1% rather than 10% HNO_3 solution should be used.

(3) Deionized water must be demonstrated to be analyte-free water. The criteria for analyte-free water are the Method Detection Limits (MDLs) for the analytes. Specifically for the common laboratory contaminants listed below, the allowable limits are set at three times the respective MDLs determined by the most sensitive analytical method:

1. Methylene Chloride
2. Acetone
3. Toluene
4. 2-Butanone
5. Phthalates

APPENDIX C

CONSTRUCTION INSPECTION FORMS

Inspector's Daily Report

CONTRACTOR:
ADDRESS:

TELEPHONE:
LOCATION ______________________ FROM ____________ TO ____________
WEATHER ______________________ TEMP ______ A.M. ______ P.M. ______ DATE ____________

CONTRACTOR'S WORK FORCE AND EQUIPMENT											
DESCRIPTION	*H*	*#*	*DESCRIPTION*	*H*	*#*	*DESCRIPTION*	*H*	*#*	*DESCRIPTION*	*H*	*#*
Field Engineer						Equipment			Front Loader Ton		
Superintendent			Ironworker			Generators			Bulldozer		
						Welding Equip.					
Laborer-Foreman			Carpenter								
Laborer									Backhoe		
Operating Engineer			Concrete Finisher								
Carpenter						Paving Equip. & Roller					
						Air Compressor					

SEE REVERSE SIDE FOR SKETCH ☐ YES ☐ NO
WORK PERFORMED:

PAY ITEMS:

CONTRACT		STA		DESCRIPTION	QUANTITY	REMARKS
NO.	ITEM	FROM	TO			

TEST PERFORMED: ______________________
PICTURES TAKEN: ______________________

VISITORS: ______________________

QA PERSONNEL
SIGNATURE ____________

REPORT NO. ____________
SHEET ______ of ______

MEETINGS HELD & RESULTS:

REMARKS:

REFERENCES TO OTHER FORMS:

SKETCHES

SAMPLE LOG

SAMPLE NUMBER:

APPROXIMATE LOCATION OF STOCKPILE:

NUMBER OF STOCKPILE:

DATE OF COLLECTION:

CLIMATOLOGIC CONDITIONS:

FIELD OBSERVATION:

PROBLEM IDENTIFICATION REPORT

FORM H

DATE ____________

DAY | S | M | T | W | TH | F | S |

Project ____________ Job No. ____________

Contractor ____________

Subject ____________

WEATHER	Bright Sun	Clear	Overcast	Rain	Snow
TEMP.	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moder.	High	Report No.	
HUMIDITY	Dry	Moder.	Humid		

PROBLEM DESCRIPTION (Reference Daily Report No.): ____________

____

____

____

PROBLEM LOCATION - REFERENCE TEST RESULTS AND LOCATION (Note: Use sketches on back of form as appropriate): ____________

____

____

____

PROBABLE CAUSES: ____________

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____

____

SUGGESTED CORRECTIVE MEASURES: ____________

____

____

____

APPROVALS:

QA ENGINEER: ____________

PROJECT MANAGER: ____________

DISTRIBUTION:
1. Proj. Mgr.
2. Field Office
3. File
4. Owner

QA Personnel Signature ____________

Wiley-Fisk Form 8-3

CORRECTIVE MEASURES REPORT

FORM I

DATE ____________________

DAY

S	M	T	W	TH	F	S

Project ______________________ Job No. __________

Contractor ______________________________

Subject ______________________________

WEATHER	[illegible]	Clear	Overcast	Rain	Snow
TEMP.	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moder.	High	Report No.	
HUMIDITY	Dry	Moder.	Humid		

CORRECTIVE MEASURES UNDERTAKEN (Reference Problem Identification Report No.): __________

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RETESTING LOCATION: ______________________________

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SUGGESTED METHOD OF MINIMIZING RE-OCCURRENCE: ______________________________

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APPROVALS:

QA ENGINEER: ______________________________

PROJECT MANAGER: ______________________________

DISTRIBUTION:
1. Proj. Mgr.
2. Field Office
3. File
4. Owner

QA Personnel
Signature ____________________

Wiley-Fisk Form 8-3

APPENDIX D

HYDRAULIC PRESSURE TESTING SOP

Appendix D: Item 1 - HYDRAULIC PRESSURE TESTING OF SCREENED INTERVAL

Applicability: HAZARDOUS WASTE Revision No.: ____ Date: ____

Prepared By: BGP Date: 4/28/95 Approved By: ____ Date: ____

1.0 INTRODUCTION

This guideline presents a method for evaluating the integrity of a grout seal in the screened interval of a well being decommissioned by grouting in place.

2.0 METHODOLOGY

1. Grout the screened interval of the well using a tremie pipe, up to a level of one to two feet above the screened section.

2. Allow the grout to set for a period of not less than 24 hours and not greater than 72 hours before pressure testing of the grouted interval is begun.

3. Place a pneumatic packer at a maximum of four and one half feet above the top of the screened section of the well casing.

4. Apply an inflation pressure to the packer, not exceeding the pressure rating of the well casing material. If the interval between the top of the grout and the bottom of the packer is not saturated, use potable water to fill the interval.

5. Apply a gauge pressure of 5 psig at the well head to the interval for a period of 5 minutes to allow for temperature stabilization. After 5 minutes maintain the pressure at 5 psig for 30 minutes.

6. The grout seal shall be considered acceptable if the total loss of water to the seal does not exceed 0.5 gallons over a 30-minute period.

7. If the grout seal is determined to be unacceptable, an additional 5 feet of grout will be added to the well casing with a tremie pipe. The interval will be retested as described above.