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Off-Site Groundwater Treatment Remedial Design Report for the Hempstead Intersection Street Former Manufactured Gas Plant Site

Villages of Hempstead & Garden City
Nassau County, New York

Prepared for:

National Grid
175 East Old Country Road
Hicksville, New York 11801

Prepared by:

URS Corporation - New York
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Buffalo, New York 14203

URS

February 2010

OFF-SITE GROUNDWATER TREATMENT
REMEDIAL DESIGN REPORT

HEMPSTEAD INTERSECTION STREET
FORMER MANUFACTURED GAS PLANT SITE
VILLAGES OF HEMPSTEAD AND GARDEN CITY
NASSAU COUNTY, NEW YORK

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LIST OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and xylenes
CAMP	Community Air Monitoring Plan
CLSM	controlled low strength material
DO	dissolved oxygen
FS/RAP	Feasibility Study/Remedial Action Plan
GIS	geographic information system
HASP	Health and Safety Plan
HCN	hydrogen cyanide
HDPE	high-density polyethylene
IRM	interim remedial measure
ISS	in-situ solidification
cm/sec	centimeters per second
lbs	pounds
LILCO	Long Island Lighting Company
LIRR	Long Island Railroad
Matrix	Matrix Environmental, Inc.
mV	millivolts
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MGP	manufactured gas plant
NAPL	non-aqueous phase liquid
NCDH	Nassau County Department of Health
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance and Monitoring
ORP	oxidation-reduction potential
PAH	polycyclic aromatic hydrocarbon

PDI	Pre-Design Investigation
PSA	pressure swing adsorption
psi	pounds per square inch
RI	Remedial Investigation
ROW	right-of-way
scfh	standard cubic feet per hour
UIC	Underground Injection Control
URS	URS Corporation-New York
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µg/m^3	micrograms per cubic meter

EXECUTIVE SUMMARY

Reason for the Remedial Design Report

This report summarizes the remedial design for treatment of an off-site plume of dissolved-phase groundwater contamination associated with the Hempstead Intersection Street Former Manufactured Gas Plant (MGP) site (Site) located in the Villages of Hempstead and Garden City, Nassau County, New York (refer to Drawings 2 and 3). This report was prepared for National Grid by URS Corporation in accordance with an Order on Consent with the New York State Department of Environmental Conservation (NYSDEC).

The report documents the background, decision making process, and rationale behind the design of three treatment systems. The report also presents the Site history, present site conditions, the goal for the remedial action, an overview of the treatment systems, critical design parameters for all major system components, and their basis for design. The report discusses implementation of the remedial design, how the system components will be installed, monitoring activities that will be conducted during the installation, and operation and maintenance of the systems.

Site Description and History

MGP operations began in the early 1900’s in the southern portion of the Site and expanded north as the demand for gas increased. The Long Island Lighting Company (LILCO) acquired the Site in the early 1930's. The on-site MGP was subsequently demolished by LILCO following the start of natural gas availability on Long Island in the early 1950’s. In 1998, LILCO merged with Brooklyn Union Gas forming KeySpan Corporation. In 2007, KeySpan Corporation was purchased by National Grid.

A “cut and plug” interim remedial measure (IRM) Program was undertaken at the Site during the winter of 1999. The objective of that IRM was to locate underground piping associated with historic MGP operations so that each pipe could be cut, drained of any fluids and plugged in order to limit the potential for any off-site migration of MGP-related constituents. The IRM was completed in the summer of 2000.

A second IRM was implemented in 2008 for the excavation of shallow MGP source materials from the Site and for the recovery of non-aqueous phase liquid (NAPL) from the groundwater (refer to Drawing 2 for the IRM locations). The IRM was performed to remove MGP source materials from areas of the Site where no additional future remediation will be necessary and to support future site-wide remediation activities by providing clean areas for support facilities, vehicle parking, and the staging of equipment and materials. A total of 4,432 cubic yards of MGP source material (as contaminated soil) and construction / demolition debris was taken off-site for treatment and disposal. 9,493 gallons of liquid was also taken off-site for treatment and disposal.

A dissolved phase groundwater plume is located downgradient of the Site. The plume reaches a maximum width of approximately 600 feet (ft) and extends approximately 3,800 ft south of the Site. The plume boundaries are defined by total benzene, toluene, ethylbenzene, and xylenes (BTEX) or total polycyclic aromatic hydrocarbon (PAH) concentrations greater than 100 micrograms per liter (µg/L). Monitoring data indicates that the plume is stable and has not increased in size or strength in recent years. The highest BTEX and PAH concentrations occur in the plume immediately south of the Site. South of Atlantic Avenue, the plume dips and is overlain by clean groundwater. Groundwater contamination is found at depths greater than 100 ft below ground surface (bgs).

The most concentrated area of the plume (greater than 5,000 µg/L) is approximately 1,000 ft long and directly downgradient from the Site. The concentrations of BTEX and PAHs decrease rapidly as they migrate away from the Site.

Remedial Goal

The remedial goal for the groundwater treatment systems is to restore, to the extent practicable, groundwater impacted by MGP Site related contaminants of concern to meet ambient water quality standards and guidance values. The groundwater treatment systems have been designed with this goal in mind and will continue to operate until the groundwater has been restored to the extent practicable or until the systems have reached their limits of effectiveness.

Remedial Technology

The evaluation conducted in the Feasibility Study / Remedial Action Plan (URS, 2008b) for the Hempstead site recommended bioremediation of the dissolved phase groundwater plume as the groundwater remediation alternative. Information collected during previous investigations indicate that intrinsic bioremediation of the dissolved phase contaminant plume is an active process at the Site and supports the plan to implement enhanced aerobic bioremediation for the groundwater. Biodegradation involves microbially mediated oxidation-reduction reactions that transform BTEX and PAHs to carbon dioxide and water. Dissolved oxygen (DO) is the most thermodynamically favored electron acceptor used in the biodegradation of hydrocarbons and is typically the primary growth limiting factor for hydrocarbon degrading bacteria. Therefore, by increasing the DO concentration, the rate of bioremediation can be increased by at least one and sometimes several orders of magnitude over naturally occurring, non-stimulated rates.

The remedial technology proposed for enhanced aerobic bioremediation is a patented technology that involves the injection of high-purity oxygen into groundwater at a rate low enough to avoid migration or volatilization of the contaminants, but high enough to increase DO concentrations within the aquifer. Delivery of oxygen into groundwater can increase DO concentrations to a maximum of 40 milligrams per liter (mg/L) as compared to 9 mg/L for a typical air sparging system.

High-purity oxygen, generated from on-site systems, will be introduced into the contaminated groundwater plume via a network of wells installed across the direction of groundwater flow. The wells will produce oxygenated zones that enable aerobic bioremediation of contaminated groundwater as it flows through the treatment areas.

Design Overview and Summary

The groundwater treatment systems are designed to provide zones of elevated DO that will stimulate aerobic bioremediation of contaminated groundwater as it flows through the treatment areas. The primary basis for the system design is to ensure that the quantity of oxygen dissolved into the groundwater is sufficient to support the aerobic biodegradation of the contaminants traveling through each treatment area. Aerobic bioremediation of the plume at select locations, in conjunction with solidifying the contaminant source via in-situ solidification (ISS), will accelerate the rate at which the dissolved contaminant mass is oxidized and will eventually lead to decreased contaminant concentrations in the entire plume. The planned locations of the groundwater treatment systems and ISS remediation are shown on Drawing 2.

Based on the dimensions and location of the groundwater contaminant plume, three separate groundwater oxygen treatment systems are planned:

- In the vicinity of Smith Street, the inactive Long Island Railroad (LIRR) Right-of-Way (ROW), and in the road ROWs for Atlantic Avenue and Hilton Avenue (Treatment System 1).

- In Mirschel Park, on private property located at 158 Hilton Avenue, and in the road ROWs for Hilton Avenue and Kensington Court (System No. 2).

- On private property located at 106 Hilton Avenue and in the road ROWs for Hilton Place and Cathedral Court (System No. 3).

The installation of System 3 is dependent on the ability to obtain the necessary private property access agreements for this system.

The contaminant mass flux and corresponding oxygen requirement at each treatment system is significantly less than the capacity of each oxygen generating system. For all three systems, the minimum oxygen generation rate will be 175 standard cubic feet per hour (scfh), or 190 pounds (lbs) per day. Each system will consist of an equipment enclosure that will house the oxygen generation and control systems, a piping system for distribution of the high-purity oxygen, and oxygen wells. The three systems will generate oxygen via air compressors and pressure swing adsorption units. Oxygen will be stored in tanks until it is directed to the wells. Each well will be connected to the generation system via a separate pipe that will be connected to a manifold inside the enclosure. Oxygen will be distributed to the contaminated groundwater via a system of wells screened in or below the zone of groundwater contamination. Ninety-six (96) wells will be installed for Treatment System 1, 59 wells will be installed for Treatment System 2, and 70 wells will be installed for Treatment System 3. A control system will direct the duration and flow of oxygen to the wells, which will be grouped together in quantities of 8 to 10 per manifold for control purposes. Each manifold will be on-line for a programmed duration. At the end of the cycle, the oxygen flow to the manifold will be stopped and the next manifold in the sequence will then be started.

1.0 INTRODUCTION

This Remedial Design Report was prepared by URS Corporation-New York (URS) on behalf of National Grid, for the Hempstead Intersection Street Former manufactured gas plant (MGP) site (the Site) located in the Villages of Hempstead and Garden City, Nassau County, New York (see Drawing 1). This report describes remediation systems that will be used to treat an off-site plume of groundwater impacted by site-related MGP contaminants. Bioremediation augmented by the addition of oxygen to the contaminant plume was the technology proposed for groundwater treatment in the Feasibility Study/Remedial Action Plan (FS/RAP) (URS, 2008b). This Design Report was completed in accordance with an Order on Consent (#D1-0001-98-11) (the Order) with the New York State Department of Environmental Conservation (NYSDEC).

1.1 Site Description

The Site, shown on Drawings 1 and 2, is located in the Villages of Hempstead and Garden City, Nassau County, New York. The majority of the approximately 8-acre Site is located within the Village of Garden City. The property is bordered to the north by Second Street, east by the Long Island Railroad (LIRR) inactive railroad right-of-way (ROW), on the south by Intersection Street, and on the west by a park owned by the Village of Garden City. The park contains a public parking lot, two public water supply wells, and a recharge basin for maintaining those two wells. There are residences and commercial businesses near the Site, including a Professional Office Building to the southwest, an Active Oil Storage Terminal to the southeast, and an Inactive Petroleum Storage Facility to the southeast. An active National Grid natural gas regulator station is located within the northwestern portion of the Site.

The Site and surrounding area are generally flat with the ground surface gently sloping to the west, northwest, and southwest. The Site is predominantly covered with crushed stone and is secured with a perimeter fence. Limited grass, shrubs and trees serve as a buffer across the northern fence line. Other than gas piping in the regulator station and Site security fences, there are no permanent aboveground structures on the Site.

The dissolved phase groundwater plume is located downgradient of the Site (refer to Drawings 2 and 3), extends approximately 3,800 feet (ft) to the south, and is approximately 600 ft wide. The plume boundaries are defined by total benzene, toluene, ethylbenzene, and xylenes (BTEX) or total polycyclic aromatic hydrocarbon (PAH) concentrations greater than 100 micrograms per liter (µg/L). Monitoring data indicates that the plume is stable and has not increased in size or strength in recent years. The highest BTEX and PAH concentrations occur in the plume immediately to the south of the Site. South of Atlantic Avenue, the plume dips and is overlain by clean groundwater. Drawing 4 provides a cross section view of the plume along its length. Groundwater contamination is found at depths greater than 100 ft below ground surface (bgs).

1.2 Site History

MGP operations began in the early 1900’s in the southern portion of the Site and expanded north as the demand for gas increased. The Long Island Lighting Company (LILCO) acquired the Site in the early 1930's. The on-site MGP was subsequently demolished by LILCO following the start of natural gas availability on Long Island in the early 1950’s. In 1998, LILCO merged with Brooklyn Union Gas forming KeySpan Corporation. In 2007, KeySpan Corporation was purchased by National Grid.

A “cut and plug” interim remedial measure (IRM) Program was undertaken at the Site during the winter of 1999. The objective of that IRM was to locate underground piping associated with historic MGP operations so that each pipe could be cut, drained of any fluids and plugged in order to limit the potential for any off-site migration of MGP-related constituents. The IRM was completed in the summer of 2000.

A second IRM was implemented in 2008 to excavate shallow MGP source materials from the Site and to recover non-aqueous phase liquid (NAPL) from the groundwater (refer to Drawing 2 for the excavation locations). The IRM removed MGP source materials from areas of the Site where no additional future remediation will be necessary, which will support future site-wide remediation activities by providing clean areas for support facilities, vehicle parking, and the staging of equipment and materials. A total of 4,432 cubic yards of MGP source material (as contaminated soil) and construction / demolition debris and 9,493 gallons of liquid were taken off-site for treatment and disposal.

1.3 Previous Investigations

Several investigations have been performed at the Site and adjacent properties to identify the presence of MGP impacts, determine the presence and extent of off-site MGP impacts, establish IRM boundaries, install NAPL recovery wells, and characterize the hydrogeology of the area. Investigations that were performed prior to and during the RI are documented in the November 2006 Remedial Investigation (RI) Report (PS&S, 2006). Since completing the RI, the following reports have been completed:

- Groundwater Sampling and NAPL Monitoring/Recovery Reports (URS)
  - Report for the Second and Third Quarters of 2007
  - Annual Report for 2007
  - Report for the First Quarter of 2008
  - Report for the Second Quarter of 2008
  - Report for the Third Quarter of 2008
  - Annual Report for 2008
  - Report for the First Quarter of 2009
  - Report for the Second Quarter of 2009
  - Report for the Third Quarter of 2009
- IRM Remedial Action Work Plan (URS, 2007b).
- Feasibility Study/Remedial Action Plan (URS, 2008b).
- Technical Specifications/Contract Documents for Interim Remedial Measures (URS, 2008c).
- Pre-Design Investigation Work Plan for In-Situ Solidification and Off-Site Groundwater Treatment (URS, 2008e).
- Construction Operations Plan for Interim Remedial Measures (URS, 2008f).
- IRM Excavation Completion Report Interim Remedial Measures (URS, 2009c).

- Pre-Design Investigation Report for In-Situ Solidification and Off-Site Groundwater Treatment (URS, 2010).

Activities performed during these investigations have included test pit excavations, soil borings, installation of monitoring wells, air monitoring, sampling and analysis of soil, groundwater, soil gas, MGP waste, and other impacted materials, private well surveys, surveying and mapping, excavation of shallow MGP source material, and dense non-aqueous phase liquid (DNAPL) recovery. For the purpose of this Remedial Design, the RI and the pre-design investigation (PDI) provide the most relevant data.

1.3.1 Remedial Investigation

The RI report was prepared by PS&S in 2006 to provide an understanding of the nature and extent of chemical constituents in the environment and identify potential human exposure pathways and environmental risks in sufficient detail to allow for the selection and design of a remedial action for the Site.

The results of the RI and previous investigations that were incorporated into the RI report indicated the following:

- The majority of MGP-related residuals or NAPL were observed in two intervals: shallow soils in the upper 8 ft of the Site at locations in proximity to the former MGP operations and in a zone at or near the water table interface approximately 24 to 34 ft beneath the Site.

- The on-site impacts have migrated downgradient of the site resulting in a dissolved phase contaminant plume in the groundwater approximately 600 ft wide and approximately 3,800 ft long in a southerly direction from the Site.

- Downgradient migration of the dissolved phase BTEX/PAH plume is being retarded and attenuated by naturally occurring organic carbon present in the soil matrix and by naturally occurring biodegradation.

- Some of the chemical constituents in the plume path are attributable to past and present petroleum sources including commercial and industrial operations and chemicals generated by vehicle traffic and other internal combustion engines.

- Chemical constituents from the Site have not adversely impacted drinking water supplies in the community. Groundwater flow modeling indicates that the former MGP site is outside the groundwater capture zones for the adjacent Village of Garden City and Village of Hempstead Clinton Street water supply wells assuming normal pumping rates and based on historical data.

- The on-site shallow source area soils present the greatest potential for risk via direct contact with the soils via the release of volatile organic vapors and the potential for the continuing release of NAPL and dissolved phase constituents to the environment. The greatest risk of potential exposure is associated with on-site subsurface construction activities undertaken without appropriate precautions.

1.3.2 Pre-Design Investigation

The PDI was performed in 2008 and 2009 to collect data and further delineate the extent of the plume in the vicinity of the treatment system locations and to provide information to be used in the design of the remedial action. The following activities were conducted:

- Sampling and field screening of soils collected from borings drilled in the vicinity of each groundwater oxygenation system.

- Sampling and analysis of groundwater from temporary points installed in the borings to establish extent of the plume in the vicinity of each groundwater oxygenation system.

- Installation of monitoring wells to monitor groundwater conditions prior to and during system operations.

- Sampling and analysis of groundwater from new and existing monitoring wells to establish dissolved phase contaminant concentrations and geochemical conditions relative to intrinsic bioremediation processes.

1.4 Conceptual Site Model

The conceptual Site model describes the relationship between former MGP operations and the observations of physical impacts (i.e., NAPL, staining, sheen and odors), detected chemical constituents, migration pathways, and potential exposure pathways as identified through past Site investigations.

- NAPL associated with the former MGP Site is primarily a DNAPL that ranges from a thick tar-like substance to a more mobile, lower viscosity fluid.

- Following a release from a former structure, the NAPL accumulated in the shallow soils around source areas until the sorptive capacity of the soil was exceeded. The heavier tar-like NAPL remained in the shallow soils while the lower viscosity NAPL tended to migrate downward into the deeper soils.

- A significant portion of the NAPL has preferentially migrated horizontally along the slope of the water table and has extended approximately 450 ft beyond the southern boundary of the Site. This NAPL saturation extending south of the Site occurs as thin (0 to 6-inch thick) layers. Interim product recovery wells were installed in this zone in 2008 and are used together with other NAPL-producing wells to recover NAPL on a twice-a-month basis.

- A dissolved plume is present in the groundwater and extends approximately 3,800 ft. south of the Site. Monitoring data during the period 2000 to 2009 has indicated that the plume is stable and has not increased in size or strength during this period.

A comprehensive conceptual Site model, especially as it relates to the location and migration of the NAPL, is presented in the RI (PS&S, 2006). Further information on the dissolved phase groundwater contaminant plume is presented in Section 3.2.

1.5 Report Organization

This report was prepared to document the background, the decision making process, and the rationale behind the design of the groundwater treatment systems for the Site. Five sections are included. Sections 1 through 3 provide the introduction, remedial goals, and the Site conditions. Section 4 presents an overview of the treatment systems, including critical design parameters for all major system components, the basis for their design, and other information required to present a complete overview of the proposed system design and operation. Section 5 discusses the implementation of groundwater remediation, outlines how each of the system components will be installed, and identifies monitoring activities that will be conducted in conjunction with the installations.

2.0 REMEDIAL GOALS

As identified in the FS/RAP (URS, 2008b), the following remedial action goals have been established for groundwater at the Hempstead Site:

- Reduce or mitigate NAPL, to the extent practicable to decrease the source of chemicals that contribute to soil, air, soil vapor and groundwater contamination.
- Prevent or mitigate, to the extent practicable, off-site migration of groundwater contamination resulting from Site-related contaminants.
- To restore, to the extent practicable, groundwater impacted by Site related MGP contaminants of concern to meet ambient water quality standards and guidance values.

The first two goals, reduce NAPL and prevent off-site migration, will be addressed via ISS of MGP source materials and other removal activities that have been or will be implemented for the source area. The groundwater treatment systems, as outlined in this design report, will aid in the bioremediation of the groundwater contaminants. The groundwater treatment systems will operate until the groundwater has been restored to the extent practicable or until the systems have reached their limits of effectiveness.

3.0 SITE CONDITIONS

The following sections summarize the general conditions of the Site and off-site areas as they relate to the dissolved phase groundwater contaminant plume and the design of the groundwater treatment systems. Additional Site information can be found in the RI, PDI and other investigation reports for the Site. Specific information used in the design of the treatment systems is identified in Sections 4 and 5, as well as in Appendix A, which presents calculations associated with the remedial design.

3.1 Hydrogeology

Major hydrogeologic units within the area of the dissolved phase groundwater plume are illustrated on Drawing 4. The water table occurs within the glacial outwash sediments (Upper Glacial aquifer) at depths ranging from approximately 25 to 30 ft bgs. Groundwater flow within the glacial outwash is in a south-southwesterly direction at a gradient of approximately 0.001 ft/ft.

Hydraulic conductivities of the Upper Glacial aquifer and the upper subunit of the Magothy Formation were estimated to be approximately 1×10^{-1} centimeter per second (cm/sec) and 1×10^{-2} to 5×10^{-2} cm/sec, respectively (McClymonds and Franke, 1972). Site-specific hydraulic conductivity testing, discussed in the PDI, confirmed these values.

The corresponding horizontal-to-vertical anisotropies of the Upper Glacial and Upper Magothy Formation are approximately 1:10 and 1:100, respectively (McClymonds and Franke, 1972). The lower subunit of the Magothy Formation is characterized by very low hydraulic conductivity of approximately 1×10^{-7} cm/sec (PS&S, 2006). The groundwater treatment system will only slightly extend into the Lower Magothy Formation.

3.2 Dissolved-Phase Groundwater Plume

As discussed in the PDI and previous investigations, dissolved BTEX and PAHs emanate from the Site in a groundwater plume that reaches a maximum width of approximately 600 ft wide by approximately 3,800 ft long (based on a plume boundary defined by 100 µg/L BTEX or total PAHs). The most concentrated area of the plume (greater than 5,000 µg/L) is directly downgradient from the Site and is approximately 1,000 ft long. A plan view of the plume of contaminants dissolved in groundwater is shown on Drawings 2 and 3. Analytical data from groundwater sample locations within and around the contaminant plume also are presented on Drawing 3. The concentrations of BTEX and PAHs decrease rapidly as they migrate away from the Site.

Groundwater analytical results from the PDI investigation are similar to results presented in the RI report in terms of strength (i.e., concentration) and extent of the plume, which indicate that the plume is stable and is not expanding or increasing in concentration. Drawing 4 shows the plume in section view along its principle axis and incorporates analytical data from the PDI and RI. The figure shows that the highest concentrations occur at the Site and south to Atlantic Avenue. The bottom of the plume was observed at approximately 75 ft bgs along Smith Street. Further south, at Atlantic Avenue, the plume dips and is overlain by uncontaminated groundwater. The bottom of the plume is approximately 85 ft bgs at Atlantic Avenue and 75 ft bgs in Mirschel Park.

Perpendicular cross sections through the contaminant plume are shown on Drawings 5 through 7. The cross section locations shown on these drawings correspond to the locations of the proposed treatment systems that are discussed in Section 4.0.

The dissolved phase contaminant plume presented on Drawings 3 through 7 shows the estimated contaminant concentration isopleths that represent 5,000 µg/L, 1,000 µg/L and 100 µg/L of BTEX or total PAHs. The plume and cross sections were constructed using data from the RI, the PDI, and from the quarterly groundwater sampling events. This data was entered into a geographic information system (GIS) database which was used to prepare a three dimensional interpolation of the data. Once this “model” of the plume was complete, it was used to develop the cross sections for Drawings 5 through 7.

In addition to the concentration isopleths, cross section Drawings 5 through 7 show actual BTEX and PAH groundwater analytical results from sample locations in close proximity to the proposed locations of the treatment systems. As shown on Drawing 5, at the eastern end of Smith Street, only low BTEX and PAH contaminant concentrations were observed at HISB-103, with no detections in the samples collected from HISB-104 located slightly further to the east. These borings were located at the southwestern and southeastern corners of Smith Street and Sealey

Avenue, respectively. The eastern edge of the plume in this area was established by these points. The western edge of the groundwater plume was established by HISB-114, where both BTEX and PAHs were non-detectable. Both BTEX and PAHs were found at HISB-116 and the western boundary of the plume lies between these two points.

At the eastern boundary of the plume in Mirschel Park location HIGP-68 contained concentrations of both BTEX and PAHs above 100 µg/L. Modeling of the plume however (based on data to the north and south of HIGP-68) indicates that the plume may not extend quite as far east as shown at HIGP-68. For the purpose of this design, the plume boundary was interpreted to be located in close vicinity to HIGP-68. At the western boundary of the plume no samples have been collected in the nearby vicinity. The extent of the 100 µg/L isoconcentration line in this area was based on three dimensional modeling using groundwater analytical from surrounding points.

Additional sampling and analysis may be conducted to refine the plume boundaries at the western ends of the groundwater treatment systems. These additional samples may be taken during implementation of the remedial action in conjunction with drilling for the oxygen wells.

3.3 Aquifer Geochemistry

The geochemistry of the aquifer was evaluated during the PDI to verify that bioremediation is a viable alternative for treatment of the groundwater and to determine parameters specific to the design of the treatment system.

The PDI report provides a summary of analytical data for parameters used to assess intrinsic remediation processes in groundwater. The following discussion presents a summary of the data from the PDI and previous investigations and provides interpretations related to the design of the groundwater treatment systems.

Electron Acceptors

Dissolved oxygen (DO) concentrations inside the plume range from 0.0 milligrams per liter (mg/L) to 0.7 mg/L. Outside the plume, at HISB-108 and -109, the concentrations range from 0.0 mg/L to 7.1 mg/L. The data indicate that oxygen is deficient and that aerobic biodegradation of BTEX and MGP-related PAHs is an active process within the plume. Aerobic conditions (i.e. DO > 2.0 parts per million [ppm]) were observed at HISB-101 (> 80'), HISB-104 (entire boring), HISB -103 (60' – 74'), HISB -108 (30'-34'), and HISB -109 (30'-34').

Nitrate concentrations are depleted within the plume (0.2 mg/L – geometric mean) relative to areas outside of the plume (2.6 mg/L – geometric mean). These results demonstrate that anaerobic degradation of the contaminants is occurring via denitrification.

Metabolic Byproduct

Ferrous iron concentrations within the plume range between 1.9 mg/L to greater than 29.7 mg/L. Areas that contain elevated levels of ferrous iron appear to be experiencing metabolic processes that result in the reduction of ferric iron to ferrous iron. Dissolved iron concentrations greater than approximately 20 mg/L may create the following conditions:

- The dissolved iron will exert an oxygen demand on the system that must be accounted for; and
- The injection points could be fouled by bacterial residues and iron oxide precipitates.

These conditions and remedies to address them are discussed in Section 4.0.

Alkalinity

Total alkalinity (as $CaCO_3$) inside of the plume (67.5 mg/L – geometric mean) is greater than the alkalinity measured outside of the plume (28.5 mg/L – geometric mean). This data provides evidence that the respiration of DO, nitrate, ferrous iron, and possibly sulfate are active processes.

Oxidation Reduction Potential

Oxidation reduction potential (ORP) was observed to range from -252 millivolts (mV) to 149 mV. Nitrate reduction, iron reduction, and sulfate reduction processes can occur at these oxidation/reduction states.

Ortho Phosphate

Phosphate was not detected in the samples (detection limit 0.05 mg/L), which suggests that the nutrient concentrations are low. The need for nutrient addition is evaluated in Section 4.0.

3.4 Soil Properties

Soil properties are an important component for the design of the groundwater treatment system. Calculations of the total volume and mass of dissolved phase contamination and the velocity of the groundwater depend on soil porosity. Effective design of the screen size and sand pack for the oxygen wells is based on the grain size distribution of the soil.

For all proposed treatment systems (described in Section 4.0) oxygen wells will be installed to depths up to 100 ft bgs. Groundwater typically is encountered at 25 ft bgs and soil properties from 25 to 100 ft bgs have been evaluated.

Boring logs from HISB-08 and -12 (drilled during the RI) and HISB-102, -104, -106, and -108 (drilled during the PDI) indicate the following conditions (all sample locations are shown on Drawing 2):

- 25 to 70 ft bgs – Fine to coarse sand with some gravel is identified in the HISB borings. The log for HIMW-12 generally corresponds with these conditions except that fine sand is not typically noted for HIMW-12. HIMW-08, which is located near the corner of Smith Street and Wendell Street, differs in that silt/clay is present intermittently from 25 to 32 ft bgs, at 50 ft bgs, and at 60 to 70 ft bgs.

- 70 to 85 ft bgs – The HISB borings and HIMW-12 indicate that the soil is generally fine sand with traces of silt or interbedded clay/silt layers or seams. HIMW-08 indicates more clay than sand at this depth. (Additional sampling to determine the extent of the clay in this area may be conducted prior to system installation as outlined in Section 5.5.).

- 85 to 100 ft bgs – For the most part, the only borings completed in this range are the HIMW locations that correspond to monitoring well installations. These boring logs indicate that the soil is generally fine to medium sand at this interval. HIMW-08 indicates a few thin layers of sandy clay at approximately 86 and 92 ft bgs.

Based on the above findings for the soil at the site, typical values of porosity for the soil types above can be found in literature, and are as follows:

- 25 to 70 ft bgs – Porosity is equal to about 35 percent for Site soil with no fines and about 35 to 40 percent for soils with some silt.
- 70 to 90 ft bgs – Porosity is equal to about 40 percent for uniform sand including small fines content such as found at this Site.

As part of the PDI, 8 soil samples collected from borings HISB-102, -106, and -108 were analyzed for grain size distribution to provide data that was used to design the openings of the oxygen well screens. The grain size curves (located in Appendix C of the PDI) demonstrate general agreement of grain size distribution with boring log descriptions and indicate that the zones targeted for treatment contain less than 8 percent fines by weight. The laboratory data shows the tested soil in the 25 to 70 ft bgs interval to be poorly graded sand that is primarily distributed over the fine and medium sand range. The laboratory data also shows the tested soil in the 70 to 90 ft bgs interval to be poorly graded sand and silty sand that is primarily uniformly sized over the fine sand range. The HIMW boring logs provided descriptions of the soil density and indicated, on average, a medium dense type of soil. Calculations to determine the filter pack gradation and well slot size are included in Appendix A.

3.5 Utilities

Utility information (approximate locations and elevations only) has been obtained for all streets within the area affected by the plume of dissolved phase contamination. Although some utilities have been surveyed during previous Site investigations, most utility information is based on drawings and sketches provided by the Village of Hempstead.

For simplicity, this Design Report presents utility information only in the areas where intrusive work is proposed. The location of below ground utilities identified within and around the proposed work areas are shown on Drawings 8 through 12.

3.6 Property Ownership

Property ownership information has been obtained for all of the streets within the area of the dissolved phase groundwater plume. Parcel boundaries were obtained from the Nassau County Department of Assessment Internet Map Server and owner information (as of 2007) was acquired from the New York State Office of Real Property Services as downloaded from the New York State GIS Clearinghouse.

Property ownership information is not included in this report. However, as the design progresses, properties owners that may be affected by the proposed construction are being contacted and, where possible, access agreements are being developed. A survey will be conducted on those properties that will be affected by installation of the systems unless existing survey information is available.

Survey(s) may also be required prior to construction to mark out specific property lines and to ensure that all construction and construction activities remain within the boundaries of the specific properties.

4.0 DESIGN OVERVIEW

4.1 Description of the Remedial Technology

The evaluation conducted in the FS/RAP for the Hempstead site recommended bioremediation of the dissolved phase groundwater plume as the groundwater remediation alternative. Information collected during the PDI and previous investigations indicated that intrinsic bioremediation of the dissolved phase contaminant plume is an active process at the Site and supports the plan to implement enhanced aerobic bioremediation for contaminated groundwater. Biodegradation involves microbially mediated oxidation-reduction reactions that transform BTEX and PAHs to carbon dioxide and water. DO is the most thermodynamically favored electron acceptor used in the biodegradation of hydrocarbons and it is typically the primary growth limiting factor for hydrocarbon degrading bacteria. Therefore, by increasing the DO concentration, the rate of bioremediation can be increased by at least one and sometimes several orders of magnitude over naturally occurring, non-stimulated rates.

The remedial technology proposed for enhanced aerobic bioremediation is a patented technology that involves the injection of high-purity oxygen into groundwater at a rate low enough to avoid migration or volatilization of the contaminants but high enough to increase DO concentrations within the aquifer. Injection of oxygen into groundwater can increase DO concentrations to a maximum of 40 mg/L as compared to 9 mg/L for a typical air sparging system.

High-purity oxygen, generated from on-site systems, will be introduced into the contaminated groundwater plume via a network of wells installed across the direction of groundwater flow. The wells will produce oxygenated zones that enable aerobic bioremediation of contaminated groundwater as it flows through the treatment areas. The technology will not stop or impede the natural flow of the groundwater.

Oxygen will be delivered at a relatively low rate to maximize the contact time between the oxygen and contaminated groundwater before the oxygen rises through the contaminated zone to the water table surface. Trapping of injected oxygen in the soil matrix (e.g., in the soil pores or by semi-confining layers) beneficially prolongs contact between the oxygen and the groundwater, leading to more efficient oxygen utilization. Ideally, most of the oxygen is dissolved in the groundwater instead of moving to the surface of the water table.

4.2 Design Criteria

Design criteria for the groundwater treatment system is summarized in Table 4-1 and discussed in the following sections.

4.2.1 Treatment Concept

The groundwater treatment systems are designed to provide zones of elevated DO that will stimulate aerobic bioremediation of contaminated groundwater as it flows through the treatment areas. The primary basis for the system design is to ensure that the quantity of oxygen dissolved into the groundwater is sufficient to support the aerobic biodegradation of the mass of contamination traveling through the treatment areas. Aerobic bioremediation of the plume at select locations, in conjunction with solidifying the contaminant source via ISS, will accelerate the rate at which the dissolved contaminant mass is oxidized and will eventually lead to decreased contaminant concentrations in the entire plume. Furthermore, as the contaminant mass passing through each treatment area decreases, the oxygen utilization demand will decrease and the corresponding zone of elevated DO (i.e. the treatment area) will increase.

Based on the dimensions and location of the groundwater contaminant plume, three separate groundwater oxygen treatment systems are proposed:

- In the vicinity of Smith Street, the inactive Long Island Railroad (LIRR) Right-of-Way (ROW), and in the road ROWs for Atlantic Avenue and Hilton Avenue (Treatment System 1).
- In Mirschel Park, on private property located at 158 Hilton Avenue, and in the road ROWs for Hilton Avenue and Kensington Court (System No. 2).
- On private property located at 106 Hilton Avenue and in the road ROWs for Hilton Place and Cathedral Court (System No. 3).

4.2.2 Lateral Extent of Treatment

Throughout the PDI and subsequent documents, the groundwater contaminant plume has been defined as the area where the concentrations of either BTEX or PAHs exceed 100 µg/L. The design is based on enhancing aerobic bioremediation of the plume within the area of total BTEX or total PAHs greater than or equal to 100 µg/L. Beyond these limits, natural bioremediation processes will degrade the plume, which will accelerate with time as the oxygenated areas increase due to diminishing oxygen utilization rates and decreased source strength following the ISS remediation.

4.2.3 Contaminant Mass Flux and Oxygen Requirements

The contaminant mass flux across each of the three proposed treatment systems was evaluated for the design. The contaminant mass flux (defined as the contaminant mass flow rate across a cross-sectional area of the plume) is based on the contaminant concentrations in the groundwater, the cross-sectional area of the plume, and the groundwater flow velocity. The contaminant mass flux was determined to be approximately 4.6 pounds (lbs) per day at Treatment System 1, 3.3 lbs per day at Treatment System 2, and 2.0 lbs per day at Treatment System 3 for system configurations that were presented in the draft remedial design report (refer to Appendix A).

The required oxygen delivery rates are a function of the contaminant mass flux across each treatment area and oxygen transfer efficiency in the aquifer. The amount of oxygen required to support the microbially-mediated oxidation-reduction reactions (i.e. the stoichiometric ratio of oxygen per contaminant [hydrocarbon]), is approximately 3 lbs oxygen to 1 lb of hydrocarbons. The oxygen transfer efficiency in the aquifer typically varies from 75 to 90 percent and was conservatively estimated at 75 percent for the design. Based on these values, the total amount of oxygen required was determined to be 30 lbs per day at System 1, 14 lbs per day at System 2, and 9 lbs per day at System 3 for preliminary system configurations.

The calculations provided in Appendix A are based on conservative assumptions and the oxygen delivery rates will be higher than required. Excess DO not utilized within the treatment zones will migrate in the aquifer by advection and diffusion, thereby extending the zone of treatment.

4.2.4 Nutrient Addition

As described in Section 3.3, phosphate was not detected in the groundwater samples (detection limit 0.05 mg/L), which suggests that the nutrient concentrations may be low for sustaining biological processes in the soil. However, based on experience at similar sites where supplemental nutrient addition was not performed, it was determined that the need for nutrient addition and other ancillary treatments would be implemented in the future, if necessary. Data collected during the monitoring and operation of the system will be evaluated to determine whether aerobic bioremediation is successfully reducing contaminant concentrations in the groundwater. If the data indicates that the nutrient addition is necessary, it may be implemented at that time. Nutrient addition would not require any additional construction as nutrients or other additives would periodically be added to the groundwater via the oxygen wells. The wells would be temporarily isolated from the treatment system during the additions.

4.3 Groundwater Treatment System Locations

Three treatment systems are proposed, referred to as Systems 1, 2, and 3. The locations of the system enclosures and oxygen wells in relation to the contaminant plume are shown on Drawings 11 and 12.

Several criteria and factors were considered for selecting the oxygen well locations:

1. Distance from the ISS Activities in the Source Area - The oxygen wells were located sufficiently downgradient from the MGP source area to avoid the potential changes in the groundwater chemistry due to the addition of alkaline reagents (i.e. Portland cement) associated with the ISS that may impact the effectiveness of the bioremediation.

2. Presence of NAPL - Bioremediation in general is not an effective remedial strategy at sites or areas where a significant quantity of NAPL is present. NAPL requires a long time to dissolve into the groundwater and thus limits the rate at which bioremediation will progress. Other methods of NAPL collection or removal should be applied first and then bioremediation can be used as a subsequent remedial strategy. NAPL is most likely to be found near the source area and the system should be located far enough downgradient from the source area to avoid potential areas of NAPL.

3. Property Access Agreements - Where public streets, ROWs, and parks were not available, discussions were held with property owners to obtain agreements for locating the system on private property. The locations shown on the attached drawings represent areas where access agreements are being pursued by National Grid.

Based on the above factors, the treatment system locations were chosen based on design requirements, clearance from existing utilities and buildings, and the potential for property access agreements. The currently proposed layouts for the systems are described below.

4.3.1 Treatment System 1

System 1 is the furthest upgradient (closest to the source) of the three systems and is shown on Drawing 3. Additional details are provided on Drawing 11. From east to west, this system will be installed along Smith Street between Sealey Avenue and Wendell Street, through a short (dead-end) section of Wendell Street, along a section of the LIRR ROW, along a short portion of Atlantic Avenue, and along the east side of Hilton Avenue. The actual extent of the system to the west along Hilton Avenue may be refined during installation based on further exploratory borings / groundwater analyses that will be conducted, if necessary, prior to system installation. The entire length of the system will be installed in the public ROW except for the portion on the LIRR ROW. The portion of the system to be installed on the LIRR ROW is located near apartment buildings in this area.

The system will also include additional spare connections for expansion into other areas, should that be required at some time in the future.

4.3.2 Treatment System 2

The location and layout of System 2 is shown on Drawing 3 and additional details are provided on Drawing 12. The system is located approximately 1,300 ft downgradient from the Site.

System 2 will be installed in Mirschel Park, through private property located at 158 Hilton Avenue, in the ROW along the east side of Hilton Avenue, across Hilton Avenue, and within the ROW on the south side of Kensington Court. Oxygen wells will not be placed in Hilton Avenue.

As with System 1, the actual extent of System 2 at the west end may be refined during installation based on further exploratory borings / groundwater analyses in this area. The treatment system will also include additional spare connections for expansion into other areas, should that be required at some time in the future.

4.3.3 Treatment System 3

The layout for System 3 is shown on Drawing 3 and additional details are provided on Drawing 12. The proposed location of System 3 is approximately 2,000 ft downgradient from the Site. The installation of System 3 is dependent on the ability to obtain private property access agreements for the system.

The proposed location of System will be on private property at 106 Hilton Avenue, across Hilton Avenue, in the ROW on the west side of Hilton Avenue, in the ROW along the north side of Hilton Place, across private property at 22 Cathedral Court, and in the ROW along the north side of Cathedral Court. Oxygen wells will not be placed in Hilton Avenue and in the Hilton Ave ROW. Access agreements for this proposed alignment have not been obtained yet and changes to the layout may be necessary depending on the results of the property access negotiations.

The actual extent of Treatment System 3 at the west end may be refined during installation based on further exploratory borings / groundwater analyses in this area. The treatment system will also include additional spare connections for expansion into other areas, should that be required at some time in the future.

4.4 Description of Oxygen Generation and Distribution System

The general arrangement and layout of the three treatment systems are shown on Drawings 11 and 12. Each system consists of an equipment enclosure that houses the oxygen generation and control systems, a piping system for distribution of the high-purity oxygen, and the oxygen delivery wells. Drawing 14 shows the primary equipment that will be located inside the enclosure and schematically shows the distribution system to the oxygen wells.

4.4.1 Equipment Enclosure

Each groundwater treatment system has a dedicated equipment enclosure to house the oxygen generation equipment, a piping manifold, and controls. The enclosure for Treatment System 1 will be located on the LIRR ROW as shown on Drawing 11. This location is approximately in the middle of the wells and will distribute oxygen to wells located east and west of the enclosure. The enclosure for Treatment System 2 will be located at the east end of a private residence located at 185 Hilton Avenue as shown on Drawing 12. Treatment System 3 will be located at the east end of the church property at 106 Hilton Avenue, also shown on Drawing 12.

The system enclosures will be skid-mounted and consist of a small, utility type structure as would typically be used for a large garden shed. All equipment and controls will be housed within the enclosure. All equipment, controls, and the enclosure will be supplied by Matrix Environmental Technologies, Inc. as one complete system.

Each shed will include ventilation louvers for air that will be pulled in by an air compressor, as well as piping to exhaust nitrogen that is produced by the system. The enclosures will include insulation to muffle sounds from the air compressor, which itself will be designed for low sound levels. No windows will be included in the structure and there will be one set of access doors. A dedicated line will separately connect each oxygen well to a manifold located inside the enclosure.

The enclosures will include fencing, lighting, and other security measures to protect against vandalism. The use of fencing, lighting, and security measures for Systems 2 and 3 will be based in part on negotiations with the property owners. The 185 Hilton Avenue property is enclosed with a fence. Additionally, the enclosure will be located behind an existing garage and thus will only be visible to persons in the immediate vicinity.

4.4.2 Oxygen Generation System

All oxygen will be generated on site as needed to eliminate the need for transporting and storing large quantities of oxygen on site. The oxygen generation systems will be located entirely inside of the equipment enclosures. The major components of the system are identified on Drawing 14.

A rotary screw air compressor will produce clean, dry compressed air. The compressed (pressurized) air will be fed to a pressure swing adsorption (PSA) oxygen generating system. The PSA system contains a material that adsorbs nitrogen under pressure. As the nitrogen is removed from the air stream, the oxygen and other components are left remaining in a concentrated stream. Once the adsorbent material is full of nitrogen, the pressure is released and the nitrogen desorbs and is exhausted to the atmosphere. The oxygen stream, which should be 90-95% pure, is stored in an oxygen storage tank. From the storage tank, the control system will distribute the oxygen to the wells.

All three of the treatment systems will be designed to provide a minimum of 175 scfh (190 lbs per day) of oxygen. The systems will also include capacity for additional wells. Further details and information used in the determination of the required oxygen generation rates are included in Appendix A.

4.4.3 Controls

The primary purpose of the control system is to direct the duration and flow (and thus quantity) of oxygen to the wells. The control system allows all control functions to be completed from inside the enclosure, without the need to visit the individual well locations except as required for occasional monitoring or maintenance.

The oxygen wells will be grouped together in quantities of 8 to 10 per manifold. Each manifold will have an associated solenoid valve that provides on/off control of the flow of oxygen. The control system will open the valve for a programmed duration, allowing the oxygen to flow into the manifold, tubing and connected oxygen wells. At the end of the cycle, the valve will be closed and the system proceeds to open the valve to the next manifold. The typical length of operation for each manifold will be approximately 20 minutes. The duration, frequency, and sequence for operation of the manifolds are programmable and can be modified base on the observed results and performance of the system. Wells in more contaminated or deeper areas that require additional oxygen can be programmed to operate for a longer duration or on a more frequent basis.

In addition to the control of groups of wells via the solenoid valves and manifolds, there also are individual controls for each well. These include a dedicated valve, flowmeter and pressure indicator that allow the operator to manually adjust and equalize the flow among the specific wells on each manifold, as well as to shut off specific wells that are not required to operate. These manual controls are all located on the manifolds inside the enclosure and allow each well to be individually controlled and monitored without the need to separately open the wellheads to make adjustments.

In addition to routine control of the flow of oxygen, the control system also will be used to monitor for alarm conditions (e.g., high or low pressures) that indicate a problem or situation that requires operator input. The control system will include wireless callout service to alert the designated operator of the system problem requiring attention. The operator will also be able to call into the system remotely in order to view the status of the system, acknowledge alarms, and restart the system if necessary.

4.4.4 Piping

Each oxygen well has a separate, dedicated pipe to connect it into the control system. The pipe will be consist of ¾-inch, black, high-density polyethylene (HDPE) rated for a minimum pressure of 100 pounds per square inch (psi). The pipe will be installed in bundles in a common trench along the line of oxygen wells, with one pipe leading to each well. (Note that "piping" and "tubing" are used interchangeably through this document.)

4.4.5 Oxygen Wells

Details for the construction of a typical oxygen well are show on Drawing 13. Depths and screened intervals for the wells are shown on cross-sections of the contaminant plume on Drawing 8 for System 1, Drawing 9 for System 2, and Drawing 10 for System 3. Drawings 11 and 12 show the proposed locations of the wells in plan view and include tables that summarize construction requirements for each well. At locations along the system where the contamination is thicker, or more highly concentrated, the wells will be installed as shallow and deep pairs, separated by vertical distances of 10 to 30 ft.

The screened depth for the deeper wells was determined based on the estimated depth of contamination in each particular location as shown on the cross-sections. The top of the screened section of well will be located just below the bottom of the 100 µg/L isoconcentration line. At a few locations on System 1, the individual sample results do not exactly match the isoconcentration lines that were derived by computer modeling (e.g., at location HISB-116). Oxygen wells in those locations will be installed somewhat deeper than indicated by the lines to account for these results.

The deep wells will deliver oxygen into the formation that will travel upward towards the water table surface. Shallow oxygen wells will also be used in areas where there is a greater vertical extent of contamination and where higher contaminant concentrations are present. These shallow wells place additional oxygen immediately into the areas of higher contamination and provide additional operational flexibility, which will ensure that the oxygen is reaching the areas where the demand is higher. The shallow and deep intervals will also allow for more variable and directed operation in the future after the plume has begun to degrade.

The radial extent of oxygen flow for a typical oxygen well is dependent upon many factors and is difficult to determine without a pilot study. Even with pilot study data, subsurface conditions and the performance of the wells may vary across the site. Based on data presented in the RI Report (PS&S, 2006) and the PDI Report (URS, 2009d) a conservative lateral separation of 15 ft perpendicular to the direction of groundwater flow was chosen for the well spacing. This spacing is consistent with current engineering practice for air sparge systems (Battelle, 2002) and is less than or equal to well spacing for similar systems that were installed in the Glacial sediments and Upper Magothy sediments elsewhere on Long Island. The 15 ft lateral spacing requires each well to oxygenate a radius of approximately 7½ ft to provide a continuous zone of elevated DO across the contaminant plume. Where the line of oxygen wells is oriented perpendicular to the plume flow, such as on Smith Street between Sealey Avenue and Wendell Street, the wells are placed 15 ft apart. For sections where the wells are situated at angles less than 90 degrees to the plume (e.g., the LIRR ROW), the wells will be installed further apart to provide a perpendicular spacing of 15 ft relative to the plume flow direction.

The oxygen wells will be constructed with a two-ft screened section at the bottom of the well (typical construction is shown on Drawing 13). Given the low rates at which oxygen flows into the groundwater, only a very short length of screen is required. The 2 ft length will provide additional area in the event that the screens become fouled via mineralization and/or biogrowth.

Each well will be installed in a flush mounted road box (rated for traffic) large enough to allow access for cleaning, adjustment, or monitoring at the well head, yet small enough to be relatively unobtrusive. The wells will be constructed with removable caps to provide access in the event that maintenance or rehabilitation activities are required due to biofouling or iron precipitation. These caps will be lockable and gas-tight to prevent leakage or tampering. Each wellhead will also include a ¾-inch check valve in-line with the oxygen piping to prevent the loss of stored oxygen within the well casing during the off cycles.

4.5 Operating Conditions

The oxygen delivery systems will cycle or pulse the operation of the oxygen wells over time. The intent is to operate the wells long enough to maximize the amount of DO in the groundwater while minimizing any bubbling of oxygen or movement of contaminants to the surface. Experience and monitoring during startup of the system will provide information and data that will be used to optimize the system operations.

To aid in monitoring the performance of the systems, monitoring points will be installed within and downgradient of the oxygen wells. These points have been designed to serve multiple functions including monitoring the vadose zone for elevated oxygen or contaminant concentrations, monitoring groundwater for DO concentrations, and allowing for the periodic collection of groundwater samples for analysis. During operation, the primary purpose of the monitoring points will be to monitor DO concentrations.

The locations of the proposed monitoring points are shown on Drawings 11 and 12. Twelve points are proposed for System 1, six points at Systems 2, and seven points at System 3. Some of the points are located directly in the line of the oxygen wells for monitoring DO concentrations directly in the area of oxygenation. Other locations are situated approximately 15 to 50 ft downgradient to monitor in situ conditions as groundwater passes through the oxygenated zones. Monitoring points located within the line of wells will be constructed as shallow/deep pairs to differentiate between the deep and shallow treatment zones.

4.6 Permits

It is anticipated that several permits will be required prior to the installation of the groundwater treatment systems. For operation of the system, although not technically required, an Underground Injection Control (UIC) permit application will be submitted to the NYSDEC (who administer the permit for the United States Environmental Protection Agency [USEPA]). UIC permits are required for the protection of groundwater whenever underground injections are proposed.

Several permits will be required for construction of the systems. Permits from the Village of Hempstead will be required for the street work, sidewalk work / replacements, and possibly for the buildings that will house the oxygen generating equipment. The contractor hired to install the systems will be responsible for obtaining the permits and complying with all conditions of the permits from the Village.

The only vapor discharge from the system is nitrogen gas (which accounts for 78% of the natural air) and no air permits will be required. Likewise, the only liquid discharge will be a small amount of condensate (i.e., clean water) from the compressor and air dryer. The quantity of condensate will be small enough that it will be discharged to the ground surface in the vicinity of the system enclosure.

4.7 System Monitoring and Maintenance

The groundwater treatment systems can be optimized during operation by controlling the oxygen flow rate, pressure, and timing of injection. Optimization will enable the systems to meet the remedial goal as quickly and efficiently as possible. System operating data, field monitoring data (e.g., DO concentrations) and analytical data will be collected and evaluated to focus system operations in the most beneficial manner. These details will be included in an Operation, Maintenance, and Monitoring (OM&M) plan that will be developed in conjunction with installation of the systems.

4.7.1 Typical Monitoring Data

The following information will be collected in order to monitor system performance and remedial progress at the site:

- Operating time for each well
- Oxygen flow rate to each well
- Pressure at each well
- DO concentrations at all monitoring points
- PID readings from all monitoring points
- Water elevations at all monitoring points
- System runtimes

Other monitoring will include measurement of field parameters and geochemical changes that may result from the cement-based ISS remediation of the source area and from iron precipitation that may occur as the oxidation state of the groundwater is changed. These monitoring requirements will be incorporated into an overall plan for the site that encompasses all monitoring to be conducted.

4.7.2 System Maintenance

During the first week of operation, system checks and monitoring will be conducted on a daily basis. Following the first week, the system will be checked on a minimum weekly basis during the startup period (minimally one month). These checks will be performed to ensure that the system is operating as intended.

Following startup, routine system checks will be conducted at least twice per month and include the following tasks:

- Adjust flow rates
- Make operational changes
- Perform equipment checklists (belts, etc.)
- Inspect for vandalism
- Perform routine outside maintenance (e.g., weed removal)
- Visually check all well locations for damage, tampering, settling, or evidence of leaks

Actual equipment maintenance will be conducted at least on a quarterly basis. These activities will include servicing the air compressor, servicing the PSA oxygen generator, checking/changing all filters, and other similar tasks. Sufficient spare parts and maintenance kits will be stored inside the enclosures to ensure that there are no long term shut down problems with the systems.

In addition to routine site visits, there may be times when a special visit to the site may be required. The systems will include a pressure sensor on the oxygen tank to detect leaks and shut the system down in the case of an emergency. The autodialer on the control system will notify the system operator of the problem at the site, who will dial into the system and resolve the problem.

4.7.3 Well Maintenance

Dissolved iron concentrations greater than approximately 20 mg/L may lead to fouling of the oxygen wells by bacterial residues and iron oxide precipitates. However, because the iron concentrations vary across the site, and because they may change as the bioremediation process accelerates, it is difficult to predict with certainty whether or not fouling of the wells will occur.

The potential for biofouling was taken in consideration in the design of the treatment system. These measures include:

- Installing longer screen lengths on the oxygen wells.
- Installing the oxygen wells somewhat closer than may be required, including the installation of a shallower set of wells.
- Constructing the wellheads to provide for cleaning or other procedures as outlined below.

Biofouling, if it occurs, will be evident via increased resistance to the oxygen flow at the wells and lower rates of oxygen input. Monitoring of these parameters over time will help to indicate whether any biofouling is occurring in the subsurface. If the wells become fouled to the point where they are no longer effective, remedial measures such as physical cleaning (brushing), pressurized jet cleaning, or chemical agent addition will be evaluated to determine the best method to clean the wells. The small diameter and depths of the wells would most likely limit the viability of the physical options; there are however several different chemical options that would be possible with the proposed well construction. Well cleaning also would be added to the routine activities for the site.

5.0 IMPLEMENTATION

The following sections outline how the specific tasks associated with the installation of the groundwater treatment systems will be accomplished. While sufficient information has been provided to outline how the work will be conducted, the contractor selected to install the systems will be required to prepare their own work plans that meet the requirements identified herein. The three treatment systems may be installed concurrently or separately.

5.1 Mobilization and Site Access

Prior to mobilization or work at the site, all access agreements, work plans, permits, and other approvals required for the work must be approved and in place. Because the work involved includes several different property owners, municipalities, and agencies, a delay or change by any of these could have a significant impact not only to the schedule, but also to the actual layout and placement of the systems.

Major work activities at the site for which equipment must be mobilized will include:

- Well drilling and installation
- Trenching and excavation
- Leveling the ground and installing the enclosures
- Installing electric power to the enclosures and digging around utilities
- Installing the treatment systems
- Restoring work areas

Separate subcontractors may be used by the general contractor to perform one or more of these work activities. The general contractor will be responsible for coordinating all of these activities.

The contractor will be required to use the National Grid property (i.e. the former MGP site) to stage materials, store equipment when not in use, and for employee parking. The contractor may also establish meeting spaces, offices, and other support facilities on the National Grid property.

5.2 Site Preparation

Site preparation work will consist of the following:

- Ensure that all site access agreements and permits are in place before beginning any work at the Site.

- Communicate with all residents, property owners, and businesses in the areas to be affected by the construction to notify them of the schedule for the pending work, make arrangements to coordinate their access requirements, and generally resolve any questions in relation to the work (to be performed by National Grid with assistance from their engineer and the contractor).

- Conduct a pre-construction survey and document the condition of all fences, structures, roads, yards, buildings, and other areas that may potentially be impacted by the construction activities.

- Field-locate all underground utilities and other critical structures to be avoided during the construction activities.

- Coordinate the schedule of work with the Village of Hempstead, the NYSDEC, and other agencies that may be involved in some capacity in oversight of the work.

- Conduct clearing and grubbing of the bushes and undergrowth along the LIRR ROW as required for installation of the oxygen system, wells, monitoring point, and associated piping.

- Remove existing fences (e.g., at 185 Hilton Street) and other structures that will interfere with construction.

- Decontaminate drilling tools and equipment that are used to install the oxygen wells, monitoring points, and delineation borings prior to leaving the site.

5.3 Erosion and Sediment Control

The Contractor will be responsible for implementing best management practices for erosion and sediment control. The contractor will be responsible for developing a work plan that identifies the activities that will be undertaken to prevent erosion from disturbed areas and the release of sediment to stormwater collection facilities. The contractor will also be responsible for actively monitoring erosion and sediment controls during the course of the construction activity until restoration is complete and vegetated areas have been re-established.

5.4 Traffic Control

All traffic control requirements and plans will be coordinated with the Village of Hempstead prior to conducting any work. The contractor selected for the work will be responsible for preparing the plans and obtaining permits that are required from the Village.

5.4.1 Traffic Control for Treatment System 1

Traffic controls associated with installation of System 1 are expected to minimally include:

- Temporary closure of the sidewalk on the north side of Smith Street between Sealey Avenue and Wendell Street for installation of the oxygen wells and associated piping.

- Temporary closure of approximately 100 ft of sidewalk on the north side of Atlantic Avenue between the LIRR ROW and Hilton Avenue for installation of the oxygen wells and associated piping.

- Temporary closure of approximately 220 ft of sidewalk along the eastern side of Hilton Avenue, north of Atlantic Avenue for installation of the oxygen wells and associated piping.

- Temporary closure of one traffic lane along the north side of Smith Street for installation of the piping and laterals that connect the pipes to the oxygen wells. Access to the apartment building on the south side of Smith Street and to the businesses on the north side of Smith Street will be maintained throughout the construction. Lane closures will be accomplished through signage, barriers, and most likely will include a flag person(s) for traffic control during working hours.

- The short dead-end section of Wendell Street north of the Smith Street will be closed, although this area is primarily used for parking by employees of nearby businesses. No traffic controls other than signage and temporary barriers should be required. However, communications to maintain good relations with the local property owners is important. National Grid will handle this with support from the Engineer and the Contractor.

- No lane closures are expected for the work along Atlantic and Hilton Avenues, although it may be necessary to temporarily restrict traffic during the mobilization of equipment to the site.

The contractor will be required to provide marked detour routes for any anticipated sidewalk closures.

5.4.2 Traffic Control for Treatment Systems 2 and 3

Traffic control requirements for systems 2 and 3 will be similar to the requirements outlined for Treatment System 1. Installation of these systems also will require temporary closure of sidewalks. Each system will be installed across Hilton Avenue and a detailed traffic plan will be prepared by the Contractor to outline the traffic control measures that will be implemented for each crossing. It is anticipated that the work can be completed without the need for complete closure of the street. Traffic controls will include signs, flag persons, and temporary road plates.

5.5 Plume Delineation Sampling and Analysis

Immediately prior to installation of the oxygen wells, new borings may be drilled and groundwater samples collected to further refine the extent of the western plume boundary at each of the three treatment systems. The eastern ends of these systems are generally close enough to existing borings to adequately establish the eastern boundary; no additional sampling will be performed at these areas.

The delineation borings will be located at the endpoint of the treatment systems (i.e., where the 100 µg/L contaminant concentration line is drawn) and additional locations may be sampled based on the analytical results. Discrete groundwater samples will be collected at intervals of ten ft and analyzed for BTEX and PAHs. Samples will not be collected from the upper 20 ft of the groundwater, since the existing data indicates that the contamination should be deeper in these areas. The analytical results will be provided in an expedited turnaround time so that they can be evaluated while the installation of the oxygen wells is on-going.

For each location, if the analytical results indicate contaminant concentrations greater than 100 µg/L, then additional step-out borings may be drilled and sampled to verify the 100 µg/L boundary. If the delineation samples indicate that the contaminant concentrations are less than 100 µg/L, then the 100 µg/L concentration line will be redrawn and the treatment systems may be shortened to account for the revised boundary.

In addition to the plume delineation borings, a few borings may be drilled in the vicinity of previous sample location HIMW-08D. As described in Section 3.4, this particular location indicated more clay than other areas of the site. The presence and extent of the clay layer(s) may be investigated to ensure that the oxygen wells in that area are appropriately designed in regard to the screen length and elevation.

5.6 Oxygen Well Installation

Installation of the oxygen wells will begin after or concurrently with the first set of plume delineation borings, depending on whether one or two drill rigs are utilized. The intent is to ensure that the plume is adequately defined in time to ensure that all well installation activities are completed in one mobilization of the drilling equipment.

Oxygen wells will be installed at the locations shown on Drawings 11 and 12, although it may be necessary to adjust some of the locations based on the markout of utilities and other structures in the area. Along Smith Street and other streets with overhead power lines, the wells will be situated a minimum of 3 ft away from existing poles and utilities, and preferably 4 to 5 ft away if possible, if this can be accomplished without impacting the effectiveness of the system. If work is required closer than 3 ft to a utility pole, a pole holding truck and other precautionary measures would be enacted to ensure that the work is conducted safely and with minimal impact to the surrounding area.

For the work along Smith Street, Atlantic Avenue, Hilton Avenue, Kensington Court, Hilton Place, and Cathedral Court, select areas of the sidewalk may be cut and removed as required for installation of the wells or piping.

All of the oxygen wells will be completed with flush mounted well boxes for protection and access. The well boxes will be a heavy duty; traffic rated construction to ensure that they are suitable for long-term duty and are strong enough to handle any unexpected traffic or issues that may impact the wells in the future.

These boxes will be carefully installed, especially in the sidewalk areas, to ensure that they do not settle, heave, or otherwise present any type of trip hazard. Likewise, the well box locations, to the extent possible, will be placed near the edge of the sidewalk, as opposed to the middle, to further minimize the possibility of creating a trip hazard. A sufficient apron of new concrete will be placed around the well box to prevent potential settlement and heaving issues. Replacement of entire sidewalk squares also will be considered if it simplifies installation of the wells and well boxes. Wells in unpaved areas will be installed at or slightly below ground level to make them less obtrusive and to prevent them from being damaged by equipment such as lawn mowers, etc. Well boxes in Mirschel Park will be covered with a minimum of six inches of topsoil and seeded to minimize the potential for injury to persons using the park as well as to minimize the potential for tampering with the wells.

Because the oxygen wells will be used for groundwater treatment and not for investigation, all wells will be installed using continuous advance methods (either direct push, sonic, or auger) without sampling or logging of the borehole. Well construction information, including installed depth, screened interval, and other pertinent details will be recorded. Drill cuttings and other waste materials will be handled in accordance with Section 5.9. The quantity of drill cuttings and other materials for disposal could vary greatly depending on the actual method of well installation chosen by the contractor.

5.7 Monitoring Point Installation

Monitoring points shown on Drawings 11 and 12 will be installed in conjunction with the oxygen wells. Well construction, including installed depth, screened interval, and other pertinent information will be recorded. Soil or groundwater samples will not be collected while the borings are drilled. Because these points may be used for monitoring of water levels, the installed locations will be surveyed to establish position (US State Plane 1983, Long Island zone) and elevation (North American Vertical Datum, 1983). The monitoring points will be developed as they may be for groundwater sampling.

5.8 Piping

Tubing (i.e., piping) for connecting the oxygen wells to the system will consist of nominal ¾ inch ID, HDPE rated for 100 psi. Given the layout of the oxygen delivery wells in relation to the oxygen generation system, it will be necessary to install large bundles of tubing adjacent to the proposed wells. Tubing will be installed in a common trench, with a large number of tubes in close proximity to the oxygen generating system, and a small quantity at the outer limits of the system.

5.8.1 Installation

The trench and tubing bundles will be installed at the locations shown on Drawings 11 and 12. Proposed installation details are shown on Drawing 13. Wherever possible, the tubing bundles will be installed in the public right-of-way adjacent to the sidewalks.

For System 1, installation of the tubing bundles in the ROW north of Smith Street may not be possible because the sidewalks are narrow and abut several buildings. Therefore, the tubing may be installed beneath the bituminous pavement of the street, parallel to the line of wells. Piping laterals will be run from the trench to the wells in the sidewalk. A combination curb and gutter is located along Smith Street adjacent to the sidewalk. To maintain the integrity of the existing curb and gutter, a small diameter steel sleeve will be installed from the excavation in the street, under the curbing, to each well location. The oxygen tubing will then be routed through the sleeve for connection to the wellhead. Similar construction methods will be used for System 3 along Hilton Place.

In all areas, the systems will be installed as neatly and cleanly as possible, and the surrounding area restored consistent with the existing conditions.

5.8.2 Testing

The piping will be difficult to access after installation and pressure testing will be conducted prior to the placement of backfill to ensure that there are no leaks in the system. Low pressure pneumatic tests will be conducted after installation, but prior to backfill. This will involve connecting pipe to the oxygen wells followed by pressurizing the system from the opposite end. The pipe will not pressurized to the point where it would overcome the hydrostatic head in the well. The pressure in the pipe will be monitored via a gauge to determine if there is any decrease over time that would indicate leaks in the system. A soapy water solution will also be used at joints and connections to inspect for leaks. Backfill will be placed around all pipes after they have passed inspection.

5.8.3 Backfill

The proposed pipe locations include streets and sidewalks and backfill will be carefully installed to eliminate voids and prevent the occurrence of settlement. If granular backfill cannot be placed and compacted in accordance with Village and County standards, an alternate material, such as controlled low strength material (CLSM or “flowable fill”) will be used. This material will flow into the void spaces much easier than sand or other dry material. The CLSM will achieve a specified compressive strength of 90 to 150 psi and will serve to protect the tubes from potential crushing in pavement areas. It may be necessary to anchor the tubing bundles until the CLSM has hardened to prevent the tubing from floating upwards. Above the CLSM layer, standard backfill will be placed within unpaved areas and pavement materials will be placed in paved areas.

The oxygen lines will be HDPE and not detectable via standard metal detectors and other equipment typically used in utility markouts. A metallic warning tape with printed graphics will be placed over the underground utility lines approximately 4 to 6 inches below the surface. Neutral wires will also be placed above the pipes to facilitate detection during subsequent utility markouts.

Upon completion, all areas affected by construction will be restored to pre-existing conditions. This may include cleaning, landscape repair, and reseeding, as well as the re-construction of fences and other structures removed and/or relocated during construction. Roads, sidewalks, curbs and gutters will be restored in accordance with Village of Hempstead and Nassau County requirements.

5.9 Equipment Enclosures

A total of three equipment enclosures are proposed at the locations shown on Drawings 11 and 12. Minimum system requirements are described below. The enclosures will be designed and placed to comply with applicable codes of the Village of Hempstead as well as with the desires of property owners where systems will be located (e.g., colors, fencing, lighting, etc.).

5.9.1 Fabrication

The enclosures will be supplied by Matrix, the supplier of the oxygen generating systems. All fabrication will be conducted off-site and each complete enclosure and equipment will be mobilized to the site as one complete package. Final finishing details of the enclosures may be refined depending on the installed locations and the desires of the property owners.

The enclosure that will be located on the LIRR ROW will include security provisions since it will not be visible to the general public and may be susceptible to vandalism. The enclosures for systems 2 and 3 will be more visible and located on private properties.

5.9.2 Installation

Installation of the equipment enclosures will include the following tasks:

- Preparation of the ground surface, including leveling, sod removal and placement of weed barriers and stone.
- Off-loading of the enclosure from the delivery vehicle.
- Installation of a power supply for operation of the system.
- Installation of fencing, outdoor lighting, signage, etc.

5.10 Waste Materials Handling

Selected contractor will prepare a plan for the handling of all waste materials generated in conjunction with the work at the site.

5.10.1 Soils

Waste soil materials to be considered in the handling plan will primarily consist of drill cuttings as soil generated from excavation of the trenches for the piping should not be MGP impacted. The contractor will be responsible for characterizing all excess materials requiring disposal. Most of the soil generated from on-site construction activities will not be MGP-contaminated. Soil from the trench excavations will be above the groundwater table and above any potential impacts from the MGP Site. Likewise unsaturated zone soils generated from the borings are not expected to contain MGP contaminants. Soil from below the water table may contain MGP contaminants and will be properly handled and disposed after appropriate testing. The contractor will segregate the soil from the trench excavations from this soil for separate analysis and/or disposal.

5.10.2 Water

Contaminated water will be generated from drilling and monitoring point development activities. This water will be containerized and transported for off-site disposal.

5.11 Air Monitoring and Vapor/Odor Management

Air monitoring will be performed during significant intrusive activities into potentially contaminated soil and groundwater. The monitoring programs will include worker health and safety monitoring in the exclusion zone and community air monitoring upwind and downwind of the work area. Intrusive activities that will potentially penetrate contaminated soil or groundwater include drilling, groundwater sampling, installation of the oxygen wells, and installation of the monitoring points.

Worker health and safety monitoring will be performed in accordance with a Health and Safety Plan (HASP) prepared by the contractor. The plan will be issued prior to the start of Site activities and will meet the requirements presented in the most recent versions of the following publications:

- 29CFR Part 1910.120 – Occupational Health and Safety Standards
- 29CFR Part 1926 – Safety and Health Regulations for Construction
- 29CFR Part 1910, Subpart I – Personal Protective Equipment
- NIOSH Publication No. 85-115
- ANSI Z358.1, Emergency Eyewash and Shower Equipment
- ANSI Z88.2 Practices for Respirator Protection
- ANSI Z87.1 Practice for Occupational and Educational Eye and Face Protection

Community air monitoring will be performed to measure, document, and respond to potential airborne contaminants during significant ground intrusive activities into potentially contaminated soil and groundwater. The community air monitoring will be performed upwind and downwind of the work area and will compliment the work zone monitoring conducted pursuant to the contractor's HASP. A Community Air Monitoring Plan (CAMP) will be prepared prior to the start of Site activities that is based upon guidelines established by the New York State Department of Health (NYSDOH) in the NYSDEC DER-10 Draft Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC, 2009). The CAMP will include monitoring procedures, Alert Limits, Action Limits, and contingency measures if Action Limits are approached. An Alert Limit is a contaminant concentration or odor intensity that will serve as a screening tool to trigger contingent measures, if necessary, to assist in minimizing offsite transport of contaminants and odors during remedial activities. An Action Limit is a contaminant concentration or odor intensity that will trigger a work stoppage. Community air monitoring will be performed for volatile organic compounds (VOCs) and respirable particulate. Upwind and downwind air monitoring will also be performed for hydrogen cyanide (HCN) if purifier waste is encountered or if a confirmed measurement above the Action Level is recorded by the exclusion zone monitoring. HCN monitoring will be performed using a direct-reading instrument that incorporates an electrochemical cell sensor. HCN detector tubes will also be used for verification if any elevated measurements are recorded with the direct-reading instrument.

Any MGP-odors from contaminated soils or groundwater will be controlled by conducting waste handling activities in a manner that minimizes the time that the contaminated materials are exposed to the air. Potentially contaminated soils and water will be placed in 55-gallon drums or roll-off boxes and covered. The drums and roll-off boxes will be moved from the work area and placed at a secure location on the former MGP Site (National Grid property). Any offensive odors at the work zone will be mitigated, if necessary, by placing a layer of non-odorous soil or polyethylene sheeting over the exposed area.

5.12 System Start-up

System startup refers to the testing and activities conducted between the installation of the system and the actual start of system operation. The following tasks will be conducted during the startup:

- Baseline conditions (DO, pH, ORP, specific conductance, and water level) will be measured in the monitoring points and at other monitoring well locations.
- All individual system components will be checked and verified for proper installation and correct operation.
- All alarm conditions and other control functions will be tested and verified.
- The remote callout and monitoring system will be test both for alarm notification and for remote dial-in for system monitoring.
- Flows to all wells will be verified and balanced.
- All well locations will be observed for visual or other indications of leakage.
- Final housekeeping type issues will be resolved.
- Training of operations staff (if necessary) will be conducted.

5.13 Operation, Maintenance, and Monitoring Plan

Details and requirements for startup and operation of the groundwater treatment systems will be outlined in an OM&M Plan that will incorporate manufacturer information. Matrix will submit an O&M manual specific to the operation and maintenance of the oxygen systems. An in-situ monitoring plan will be developed to provide data that documents baseline conditions and identifies measurements that will be taken during system operation to enable optimization and document remedial progress.

5.14 Schedule

The actual schedule for construction and installation of the groundwater treatment systems will be developed in conjunction with the contractor selected for the work, although the contract documents will have some requirements and expectations of the contractor in regard to the timeframe for completion of work at the Site.

The next major milestones in the schedule for the work will include:

- Obtain property access agreements that are currently pending.
- Approval of this document by the NYSDEC, NYSDOH, and Nassau County Department of Health (NCDH).
- Preparation of Contract Documents (Drawings and Specifications) for the work as outlined in this document.
- Solicit bids from prospective contractors.
- Selection of a contractor, negotiation of the contract terms, and issuing a Notice to Proceed.
- Participation in a public availability session to inform local residents and official about the remedial construction activities and system operation.
- Order systems from Matrix.

- Contractor preparation and National Grid/Engineer review of all submittals and documents as required by the contract documents.

- Contractor mobilization to the Site and start of construction.

- Construction complete, start of operation and monitoring.

6.0 SUMMARY

6.1 Reason for the Remedial Design Report

This report summarizes the remedial design for treatment of an off-site plume of dissolved-phase groundwater contamination associated with the Hempstead Intersection Street Former MGP site located in the Villages of Hempstead and Garden City, Nassau County, New York. This report was prepared for National Grid by URS Corporation in accordance with an Order on Consent with the NYSDEC.

The report documents the background, decision making process, and the rationale behind the design of treatment systems to address the off-site plume of dissolved-phase groundwater contamination. The report also presents site conditions, the goal for the remedial action, an overview of the treatment systems, critical design parameters for all major system components, and their basis for design. The report discusses implementation of the remedial design, how the system components will be installed, monitoring activities that will be conducted during the installation, and operation and maintenance of the systems.

6.2 Site Description and History

MGP operations began in the early 1900’s in the southern portion of the Site and expanded north as the demand for gas increased. LILCO acquired the Site in the early 1930's. The on-site MGP was subsequently demolished by LILCO following the start of natural gas availability on Long Island in the early 1950’s. In 1998, LILCO merged with Brooklyn Union Gas forming KeySpan Corporation. In 2007, KeySpan Corporation was purchased by National Grid.

A “cut and plug” IRM Program was undertaken at the Site during the winter of 1999. The objective of that IRM was to locate underground piping associated with historic MGP operations so that each pipe could be cut, drained of any fluids and plugged in order to limit the potential for any off-site migration of MGP-related constituents. The IRM was completed in the summer of 2000.

A second IRM was implemented in 2008 for the excavation of shallow MGP source materials from the Site and for the recovery of NAPL from the groundwater. The IRM was performed to remove MGP source materials from areas of the Site where no additional future remediation will be necessary and to support future site-wide remediation activities by providing clean areas for support facilities, vehicle parking, and the staging of equipment and materials. A total of 4,432 cubic yards of MGP source material (as contaminated soil) and construction / demolition debris was taken off-site for treatment and disposal. 9,493 gallons of liquid was also taken off-site for treatment and disposal.

The dissolved phase groundwater plume is located downgradient of the Site. The plume reaches a maximum width of approximately 600 ft and extends approximately 3,800 ft south of the Site. The plume boundaries are defined by total BTEX or total PAH concentrations greater than 100 µg/L. Monitoring data indicates that the plume is stable and has not increased in size or strength in recent years. The highest BTEX and PAH concentrations occur in the plume immediately to the south of the Site. South of Atlantic Avenue, the plume dips and is overlain by clean groundwater. Groundwater contamination is found at depths greater than 100 ft bgs.

The most concentrated area of the plume (greater than 5,000 µg/L) is approximately 1,000 ft long, directly downgradient from the Site. The concentrations of BTEX and PAHs decrease rapidly as they migrate away from the Site.

6.3 Remedial Goal

The remedial goal for the groundwater treatment systems is to restore, to the extent practicable, groundwater impacted by MGP Site related contaminants of concern to meet ambient water quality standards and guidance values. The groundwater treatment systems have been designed with this goal in mind and will continue to operate until the groundwater has been restored to the extent practicable or until the systems have reached their limits of effectiveness.

6.4 Remedial Technology

The evaluation conducted in the Feasibility Study / Remedial Action Plan for the Hempstead site recommended bioremediation of the dissolved phase groundwater plume as the groundwater remediation alternative. Information collected during previous investigations indicate that intrinsic bioremediation of the dissolved phase contaminant plume is an active process at the Site and supports the plan to implement enhanced aerobic bioremediation for the groundwater. Biodegradation involves microbially mediated oxidation-reduction reactions that transform BTEX and PAHs to carbon dioxide and water. DO is the most thermodynamically favored electron acceptor used in the biodegradation of hydrocarbons and is typically the primary growth limiting factor for hydrocarbon degrading bacteria. Therefore, by increasing the DO concentration, the rate of bioremediation can be increased by at least one and sometimes several orders of magnitude over naturally occurring, non-stimulated rates.

The remedial technology proposed for enhanced aerobic bioremediation is a patented technology that involves the injection of high-purity oxygen into groundwater at a rate low enough to avoid migration or volatilization of the contaminants, but high enough to increase DO concentrations within the aquifer. Delivery of oxygen into groundwater can increase DO concentrations to a maximum of 40 mg/L as compared to 9 mg/L for a typical air sparging system.

High-purity oxygen, generated from on-site systems, will be introduced into the contaminated groundwater plume via a network of wells installed across the direction of groundwater flow. The wells will produce oxygenated zones that enable aerobic bioremediation of contaminated groundwater as it flows through the treatment areas.

6.5 Design Overview and Summary

The groundwater treatment systems are designed to provide zones of elevated DO that will stimulate aerobic bioremediation of contaminated groundwater as it flows through the treatment areas. The primary basis for the system design is to ensure that the quantity of oxygen dissolved into the groundwater is sufficient to support the aerobic biodegradation of the contaminants traveling through each treatment area. Aerobic bioremediation of the plume at select locations, in conjunction with solidifying the contaminant source via ISS, will accelerate the rate at which the dissolved contaminant mass is oxidized and will eventually lead to decreased contaminant concentrations in the entire plume. The planned locations of the groundwater treatment systems and ISS remediation are shown on Drawing 2.

Based on the dimensions and location of the groundwater contaminant plume, three separate groundwater oxygen treatment systems are planned:

- In the vicinity of Smith Street, the inactive Long Island Railroad (LIRR) Right-of-Way (ROW), and in the road ROWs for Atlantic Avenue and Hilton Avenue (Treatment System 1).

- In Mirschel Park, on private property located at 158 Hilton Avenue, and in the road ROWs for Hilton Avenue and Kensington Court (System No. 2).

- On private property located at 106 Hilton Avenue and in the road ROWs for Hilton Place and Cathedral Court (System No. 3).

The installation of System 3 is dependent on the ability to obtain the necessary private property access agreements for this system.

The contaminant mass flux and corresponding oxygen requirement at each treatment system is significantly less than the capacity of each oxygen generating system. For all three systems, the minimum oxygen generation rate will be 175 standard cubic scfh, or 190 lbs per day. Each system consists of an equipment enclosure that houses the oxygen generation and control systems, a piping system for distribution of the high-purity oxygen, and the oxygen wells. The three systems generate oxygen via air compressors and pressure swing adsorption units. Oxygen is stored in tanks until it is directed to the wells. Each well will be connected to the generation system via a separate pipe that will be connected to a manifold inside the enclosure. Oxygen will be distributed to the contaminated groundwater via a system of wells screened in or below the zone of groundwater contamination. Ninety-six (96) wells will be installed for Treatment System 1, 59 wells will be installed for Treatment System 2, and 70 wells will be installed for Treatment System 3. A control system will direct the duration and flow of oxygen to the wells, which will be grouped together in quantities of 8 to 10 per manifold for control purposes. Each manifold will be on-line for a programmed duration. At the end of the cycle, the oxygen flow to the manifold will be stopped and the next manifold in the sequence will then be started.

7.0 REFERENCES

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TABLES

Table 4-1

Summary of Design Criteria

All Systems

- Treatment of BTEX or PAHs greater than 100 µg/L
- Provide a minimum 3 lbs oxygen per 1 lb of hydrocarbons
- 75% oxygen transfer/utilization efficiency
- 1-inch diameter, PVC wells, with 2 foot screened length
- All delivery wells include dedicated:
  - Piping from the oxygen generation system
  - Pressure Gauge
  - Flow meter and flow control valve
- Cycled/Pulsed operation of the delivery wells
- 230 Volt, 3-phase power supply
- Skid-mounted enclosure including double locking doors, lighting, wall-mounted heater, ventilation fan, noise insulation, and two standard wall outlets
- Oxygen Generating Equipment to include:
  - Rotary screw air compressor with noise insulation, filter and dryer
  - Pressure Swing Adsorption Oxygen Generator
  - Oxygen Storage Tank(s)
  - Programmable Logic Controller
  - Wireless-based Remote Monitoring and Control System

Treatment System 1

- Contaminant Flux of 4.6 lbs per day
- Total Oxygen Requirement of 30 lbs per day
- Oxygen Delivery Manifold of 96 wells, 40 shallow and 56 deep.
- Spare capacity for 10 additional points.

Treatment System 2

- Contaminant Flux of 3.3 lbs per day
- Total Oxygen Requirement of 14 lbs per day
- Oxygen Delivery Manifold of 59 wells, 12 shallow and 47 deep.
- Spare capacity for 10 additional points.

Treatment System 3

- Contaminant Flux of 2.0 lbs per day
- Total Oxygen Requirement of 9 lbs per day
- Oxygen Delivery Manifold of 70 wells, 20 shallow and 50 deep.
- Spare capacity for 10 additional points.

DRAWINGS

GROUNDWATER REMEDIATION DESIGN

FOR

THE HEMPSTEAD INTERSECTION STREET
FORMER MANUFACTURED GAS PLANT SITE

VILLAGES OF HEMPSTEAD AND GARDEN CITY, NASSAU COUNTY, NEW YORK

PREPARED BY:

URS Corporation

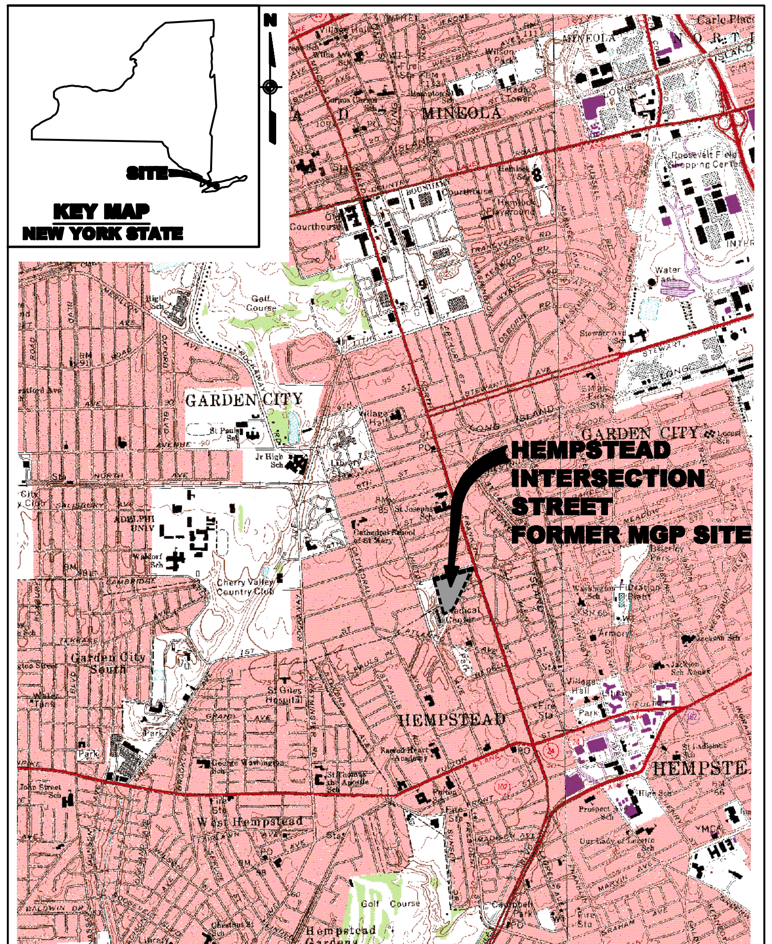
77 Goodell Street, Buffalo, New York 14203
(716)856-5636 phone - (716)856-2545 fax

PREPARED FOR:

NATIONAL GRID

175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

JANUARY 2010



SOURCE:
USGS 7.5 MINUTE SERIES
TOPOGRAPHICAL QUANDRANGLES:
FREEPORT, NY (1969)
LYNBROOK, NY (1969)

LOCATION MAP

2000' 0 2000'
SCALE IN FEET

LEGEND - EXISTING

	CATCH BASIN/DI
	SANITARY MANHOLE
	STORM MANHOLE
	UNKNOWN MANHOLE
	WATER MANHOLE
	WELL OR PIEZOMETER
	GAS VALVE
	GUY
	FENCE
	LIGHT POLE
	METAL POLE
	SIGN
	UTILITY POLE
	WATER VALVE
PZ-02	PIEZOMETER
HITW-02	TEMPORARY GROUNDWATER MONITORING WELL (TAKEN FROM RI REPORT, 2006)
HIGP-53	TEMPORARY GROUNDWATER SAMPLE LOCATION (TAKEN FROM RI REPORT, 2006)
HIMW-13	MONITORING WELL
HISB-114	TEMPORARY GROUNDWATER SAMPLE LOCATION (URS, 2008-2009)
GAS	GAS LINE
OHW	OVERHEAD WIRES
PL	PROPERTY LINE (APPROX.)
SAN	SANITARY LINE
W	WATER LINE

GENERAL NOTES

1. SOURCE BASE MAP IS URS CORPORATION TOPOGRAPHIC SURVEY PERFORMED NOVEMBER 2007 AND NYS GIS CLEARINGHOUSE, 2007 NASSAU COUNTY ORTHOIMAGERY.
2. HORIZONTAL DATUM IS REFERENCED TO US STATE PLANE 1983 ZONE: NEW YORK LONG ISLAND.
3. VERTICAL DATUM IS REFERENCED TO NORTH AMERICAN VERTICAL DATUM 1983 (NAVD 83).
4. HORIZONTAL AND VERTICAL CONTROLS REFERENCED TO PREVIOUSLY ESTABLISHED CONTROL PREPARED BY NATIONAL GRID.
5. LOCATIONS OF ALL UNDERGROUND UTILITIES THAT ARE SHOWN SHALL BE CONSIDERED APPROXIMATE.

ABBREVIATIONS

BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENE
CONC	CONCRETE
FT	FEET
INV	INVERT
L.I.R.R.	LONG ISLAND RAILROAD
MGP	MANUFACTURED GAS PLANT
MH	MANHOLE
NEUT	NEUTRAL
ND	NOT DETECTED
OHW	OVERHEAD WIRE
PAH	POLYCYCLIC AROMATIC HYDROCARBONS
ROW	RIGHT-OF-WAY
SAN	SANITARY
TEL	TELEPHONE
ug/L	MICROGRAMS PER LITER
UK	UNKNOWN
UP	UTILITY POLE

INDEX OF DRAWINGS

DRAWING NO.	DESCRIPTION
	COVER
1	INDEX OF DRAWINGS, LOCATION MAP, LEGEND AND NOTES
2	SOIL REMEDIATION AND GROUNDWATER TREATMENT LOCATIONS
3	SITE PLAN, SAMPLE LOCATIONS, AND EXTENT OF DISSOLVED PHASE GROUNDWATER PLUME
4	DISSOLVED PHASE GROUNDWATER PLUME SECTION A-A'
5	DISSOLVED PHASE GROUNDWATER PLUME SECTION B-B'
6	DISSOLVED PHASE GROUNDWATER PLUME SECTION C-C'
7	DISSOLVED PHASE GROUNDWATER PLUME SECTION D-D'
8	OXYGEN DELIVERY WELLS AND UTILITIES, SECTION B-B', TREATMENT SYSTEM 1
9	OXYGEN DELIVERY WELLS AND UTILITIES, SECTION C-C', TREATMENT SYSTEM 2
10	OXYGEN DELIVERY WELLS AND UTILITIES, SECTION D-D', TREATMENT SYSTEM 3
11	TREATMENT SYSTEM 1 LAYOUT
12	TREATMENT SYSTEMS 2 AND 3 LAYOUT
13	MISCELLANEOUS DETAILS
14	PROCESS FLOW DIAGRAM FOR OXYGEN GENERATION AND DELIVERY

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

INDEX OF DRAWINGS, LOCATION MAP, LEGEND AND NOTES

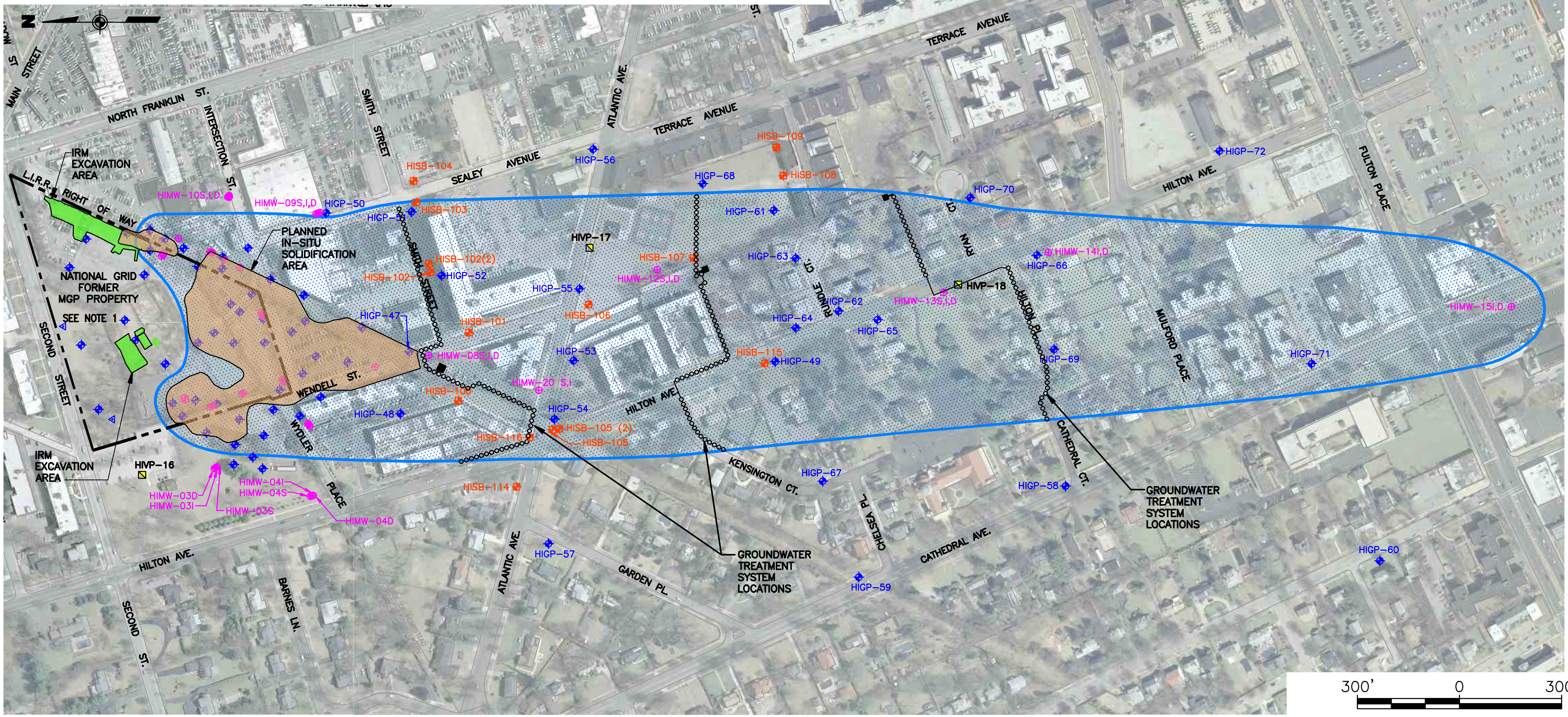
Scale: AS SHOWN | Date: JAN. 2010 | DWG-1

LEGEND:

- MGP TAR IMPACTS (PLANNED IN-SITU SOLIDIFICATION AREA)
- IRM EXCAVATION AREAS
- GROUNDWATER PLUME
- PLANNED OXYGEN DELIVERY WELLS (SEE DWGS. 11 AND 12 FOR ACTUAL WELL LOCATIONS)
- ■ PLANNED TREATMENT SYSTEM ENCLOSURE
- HIVP-16 VAPOR MONITORING LOCATION
- HIGP-53 TEMPORARY GROUNDWATER SAMPLE LOCATION (TAKEN FROM RI REPORT, 2006)
- HIMW-03I MONITORING WELL
- HISB-114 TEMPORARY GROUNDWATER SAMPLE LOCATION (URS, 2008-2009)

NOTE:

1. SAMPLE ID's NOT SHOWN IN THIS AREA FOR CLARITY



J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\JAN 10\DWG-2.dwg, DWG 2 1/18/10 - 2 RAL

WARNING
IT IS A VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON OTHER THAN WHOSE SEAL APPEARS ON THIS DRAWING, TO ALTER IN ANY WAY AN ITEM ON THIS DRAWING. IF AN ITEM IS ALTERED, THE ALTERING ENGINEER SHALL AFFIX TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

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DRAWN BY: RAL
CHECKED BY: JRS
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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

SOIL REMEDIATION AND GROUNDWATER TREATMENT LOCATIONS

Scale: AS SHOWN | Date: JAN. 2010 | DWG-2

DGP-209 (11/11/08)		
DEPTH	TOT. BTEX	TOT. PAHs
34-38	1,709	1,066
40-44	4,980	645
50-54	3,859	1,297
70-74	2	3

HIGP-40 (8/7/00)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	4,166	9,815
56-60	4	112

HIGP-49 (10/16/00)		
DEPTH	TOT. BTEX	TOT. PAHs
36-40	ND	ND
60-64	7	63
90-94	ND	16

HIGP-55 (9/7/00)		
DEPTH	TOT. BTEX	TOT. PAHs
23-27	31	244
60-64	69	532
80-84	2	ND

HIGP-61 (11/8/00)		
DEPTH	TOT. BTEX	TOT. PAHs
26-30	ND	ND
60-64	30	39
90-94	2	2

HIGP-66 (12/14/00)		
DEPTH	TOT. BTEX	TOT. PAHs
40-44	ND	1
56-60	8	60
72-76	398	787
90-94	12,970	259

HIGP-71 (11/6/01)		
DEPTH	TOT. BTEX	TOT. PAHs
46-50	ND	ND
54-58	ND	ND
62-66	1	7
72-76	29	84
81-85	126	95

HIMW-09S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
28-38	ND-19	ND-16
70-80	ND-2	ND
113-123	ND-16	ND-10

HIMW-15 I,D		
DEPTH	TOT. BTEX	TOT. PAHs
80-90	4-111	ND-273
141.5-151.5	ND-94	ND-1

HISB-102(2) (1/8/09)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	423	859
40-44	464	274
50-54	349	652
60-64	68	453
70-74	5	5
80-84	ND	1

HISB-106 (12/4/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	418	602
40-44	1,162	383
50-54	1,800	2,513
60-64	815	572
70-74	68	51
80-84	38	30
90-94	124	98

HISB-114 (12/23/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	ND
50-54	ND	ND
60-64	ND	ND
70-74	ND	ND
80-84	ND	ND
90-94	ND	ND

HIGP-01 (8/7/00)		
DEPTH	TOT. BTEX	TOT. PAHs
25-29	ND	ND
56-60	1	1

HIGP-41 (8/11/00)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	2,241	3,258
58-62	1	17

HIGP-50 (9/8/00)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	8
60-64	ND	ND

HIGP-56 (10/9/00)		
DEPTH	TOT. BTEX	TOT. PAHs
24-28	ND	2
60-64	ND	ND

HIGP-62 (11/8/00)		
DEPTH	TOT. BTEX	TOT. PAHs
37-41	8	4
54-58	771	152
84-89	45	89

HIGP-67 (12/20/00)		
DEPTH	TOT. BTEX	TOT. PAHs
37-41	ND	ND
54-58	ND	ND
72-76	ND	27
90-94	ND	ND

HIGP-72 (11/6/01)		
DEPTH	TOT. BTEX	TOT. PAHs
52-56	ND	ND
62-66	ND	ND
72-76	ND	ND
82-86	ND	ND
92-96	ND	ND

HIMW-10S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
28-38	ND-33	1-150
80.5-90.5	ND-13	ND
112.5-132.5	ND-16	ND

HIMW-20S,I (2/09)		
DEPTH	TOT. BTEX	TOT. PAHs
25-35	ND	ND
63-73	215.6-224	96-179

HISB-103 (12/1/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	4	6
50-54	84	171
60-64	ND	ND
70-74	ND	ND
80-84	5	9

HISB-107 (12/8/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	217	47
50-54	551	258
60-64	29	68
70-74	ND	ND
80-84	ND	ND
90-94	24	8

HISB-115 (1/14/09)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	15
40-44	9	14
50-54	288	265
60-64	125	133
70-74	1,411	1,153
80-84	123	99
90-94	56	67

HIGP-02 (8/8/00)		
DEPTH	TOT. BTEX	TOT. PAHs
31-35	ND	ND
56-60	ND	ND

HIGP-44 (8/10/00)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	469	244
57-61	3	47

HIGP-51 (8/31/00)		
DEPTH	TOT. BTEX	TOT. PAHs
28-32	ND	ND
58-60	ND	ND

HIGP-57 (9/21/00)		
DEPTH	TOT. BTEX	TOT. PAHs
36-40	ND	ND
64-68	ND	ND

HIGP-63 (12/15/00)		
DEPTH	TOT. BTEX	TOT. PAHs
37-41	2	3
54-58	18	22
72-76	3,979	2,769
90-94	773	63

HIGP-68 (12/20/00)		
DEPTH	TOT. BTEX	TOT. PAHs
37-41	3	5
54-58	163	300
72-76	ND	ND
90-94	ND	ND

HIMW-03S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
23-33	ND-36	ND
80.5-90.5	ND-13	ND
133-143	ND-8.2	ND-30

HIMW-12S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
22-32	ND-11	ND-4
63-73	29.2-256	65-527
117-127	ND-6	ND-2

HISB-100 (11/19/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	12,000	1,576
50-54	441	332
60-64	1,470	599
70-74	747	1,809
80-84	22	21

HISB-104 (9/24/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
45-49	ND	ND
55-59	ND	ND

HISB-108 (12/9/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	ND
50-54	ND	ND
60-64	ND	ND
70-74	12	1
80-84	20	1
90-94	26	2

HISB-116 (6/23/09)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	ND
50-54	1.3	ND
60-64	100	192
70-74	6	37
80-84	91	330
90-94	100	451
100-104	292	604

HIGP-03 (7/28/00)		
DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	ND
56-60	ND	ND

HIGP-45 (10/17/00)		
DEPTH	TOT. BTEX	TOT. PAHs
32-38	1,229	1,254
60-64	ND	ND

HIGP-52 (9/11/00)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	1,031	2,629
58-60	ND	ND

HIGP-58 (10/18/00)		
DEPTH	TOT. BTEX	TOT. PAHs
36-40	ND	ND
60-64	ND	ND
90-94	ND	ND

HIGP-64 (12/18/00)		
DEPTH	TOT. BTEX	TOT. PAHs
37-41	27	17
54-58	4,031	1,574
72-76	401	239
90-94	14	48

HIGP-69 (9/24/01)		
DEPTH	TOT. BTEX	TOT. PAHs
54-58	ND	ND
70-74	28	28
82-86	126	76
90-94	12	19
104-108	5	ND

HIMW-04S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
30-40	ND-33	ND-6
80-90	ND-13	ND
167-177	ND-4	ND-1

HIMW-13S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
38-48	ND-143	ND
70-80	ND-164	58-156
110-120	ND-30	ND-21

HISB-101 (11/19/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	122	190
40-44	14,100	4,356
50-54	4,040	3,244
60-64	1,995	2,074
70-74	4	4
80-84	1	2

HISB-105 (12/4/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	518
50-54	469	ND
60-64	1,043	3,058
70-74	60	59
80-84	279	576
90-94	48	99

HISB-109 (12/10/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	ND
50-54	8	ND
60-64	19	ND
70-74	28	ND
80-84	31	2
90-94	ND	ND

HITW-01 (9/21/01)		
DEPTH	TOT. BTEX	TOT. PAHs
40-44	2	ND
54-58	3	6
70-74	95	278
82-86	293	274
90-94	45	44
109-113	210	1

HIGP-04 (7/24/00)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
56-60	ND	2

HIGP-47 (8/22/00)		
DEPTH	TOT. BTEX	TOT. PAHs
31-35	6,670	18,715
60-64	500	369

HIGP-53 (9/1/00)		
DEPTH	TOT. BTEX	TOT. PAHs
27-31	76	317
60-64	15	35
90-94	1	ND

HIGP-59 (10/17/00)		
DEPTH	TOT. BTEX	TOT. PAHs
34-38	1	ND
60-64	ND	2
90-94	27	4

HIGP-65 (12/19/00)		
DEPTH	TOT. BTEX	TOT. PAHs
37-41	2	ND
54-58	376	125
72-76	775	190
90-94	36	59

HIGP-70 (9/20/01)		
DEPTH	TOT. BTEX	TOT. PAHs
54-58	ND	0
70-74	21	20
82-86	29	38
92-96	15	18
110-114	3	6
140-144	3	ND

HIMW-05S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
27-37	ND-232	ND-765
80-90	158-439	1,654-5,337
130-140	ND-185.1	ND-503

HIMW-14 I,D		
DEPTH	TOT. BTEX	TOT. PAHs
85-95	56.5-273	33-288
140-150	ND-15	ND

HISB-102 (12/1/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	1,800	2,706
40-44	835	1,119
50-54	225	2,735
60-64	ND	10
70-74	1	4
80-84	76	130

HISB-105(2) (12/18/08)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	15	19
40-44	14	35
50-54	247	912
60-64	560	2,941
70-74	59	34
80-84	14	69
90-94	24	221
100-104	1	ND

HITW-02 (10/31/01)		
DEPTH	TOT. BTEX	TOT. PAHs
55-60	2	ND
65-70	5	9
75-80	9	40
85-90	29	52
115-120	42	ND
148-153	9	0

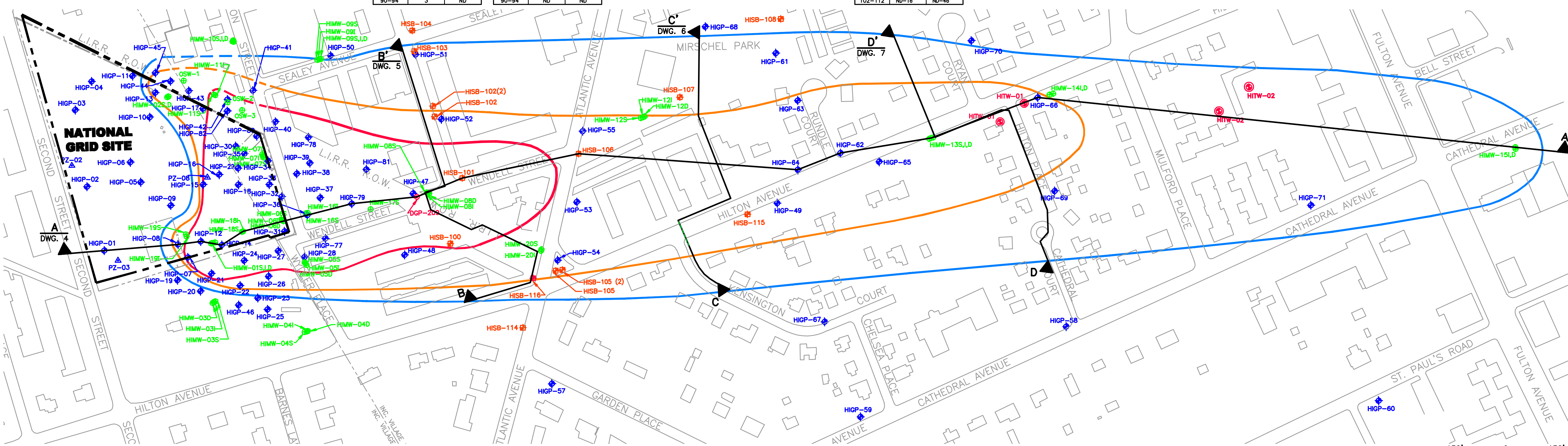
HIGP-28 (8/4/00)		
DEPTH	TOT. BTEX	TOT. PAHs
29-33	17	22
58-62	2,640	5,933

HIGP-48 (8/25/00)		
DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	2
60-64	766	926

HIGP-54 (9/5/00)		
DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	1
60-64	373	338
90-94	3	ND

HIGP-60 (10/19/00)		
DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	ND
60-64	ND	ND
90-94	ND	ND

HIMW-08S,I,D		
DEPTH	TOT. BTEX	TOT. PAHs
25-35	ND-8,240	ND-3,069
63-73	ND-8.6	ND-251
102-112	ND-16	ND-46



LEGEND:

HITW-02 TEMPORARY GROUNDWATER MONITORING WELL (TAKEN FROM RI REPORT, 2006)

HIGP-53 TEMPORARY GROUNDWATER SAMPLE LOCATION (TAKEN FROM RI REPORT, 2006)

HIMW-13 MONITORING WELL

PZ-02 PIEZOMETER

HISB-114 TEMPORARY GROUNDWATER SAMPLE LOCATION (URS, 2008-2009)

ND NOT DETECTED

HIGP-60 (10/19/00)		
DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	ND
60-64	ND	ND
90-94	ND	ND

LOCATION ID — SAMPLE DATE; DEPTH (ft bgs) — CONCENTRATION UNITS ARE ug/L

* SOME LOCATIONS ON SITE AND ADJACENT TO SITE ARE NOT SHOWN FOR FIGURE CLARITY.

EXISTING HOUSE OR BUILDING

NATIONAL GRID PROPERTY BOUNDARY

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS. DASHED LINES REPRESENT CONTAMINATION CONCENTRATIONS THAT ARE LIKELY INFLUENCED BY THIRD PARTY SOURCES.

150' 0 150'
SCALE IN FEET

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REVISIONS

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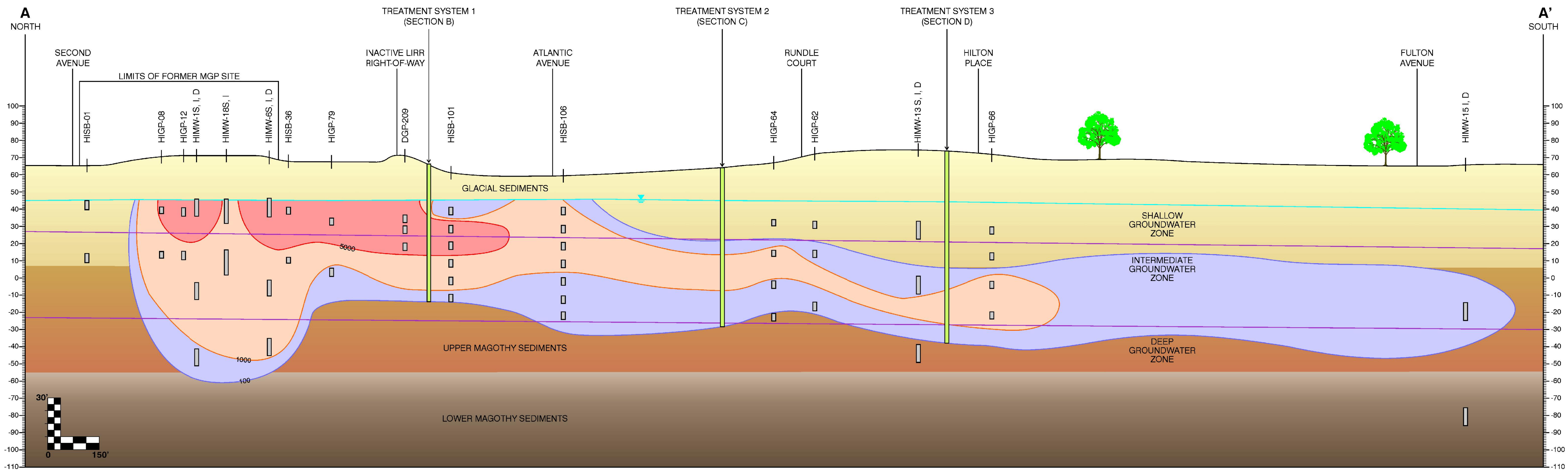
THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

SITE PLAN, SAMPLE LOCATIONS, AND EXTENT OF DISSOLVED PHASE GROUNDWATER PLUME

Scale: AS SHOWN
Date: JAN. 2010
DWG-3

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\JAN 10\DWG-3.dwg 1/12/10 - 2 RAL



GROUNDWATER SURFACE (APPROXIMATE DEPTH)

>5000 μgl/L TOTAL BTEX OR PAHs

>1000 μgl/L TOTAL BTEX OR PAHs

>100 μgl/L TOTAL BTEX OR PAHs

WELL SCREEN

OXYGEN DIFFUSION SYSTEM

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\JAN 10\DWG-4.dwg 1/25/10 - 1 EJH

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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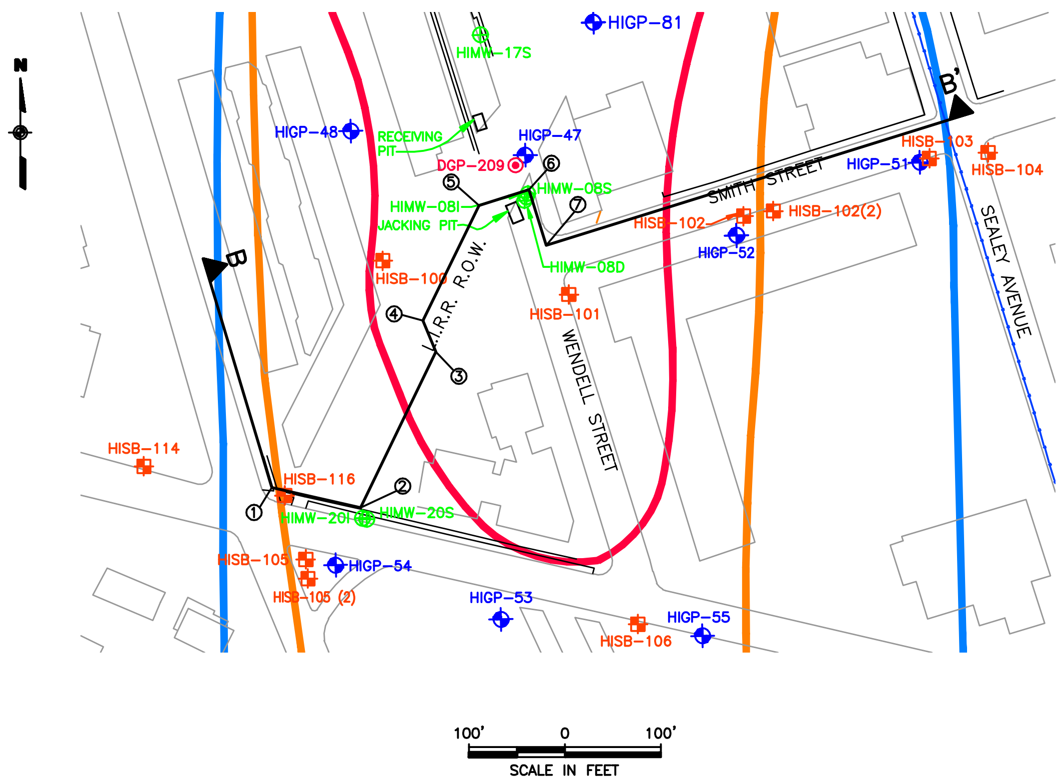
THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME SECTION A–A'

Scale: AS SHOWN | Date: JAN. 2010 | DWG–4

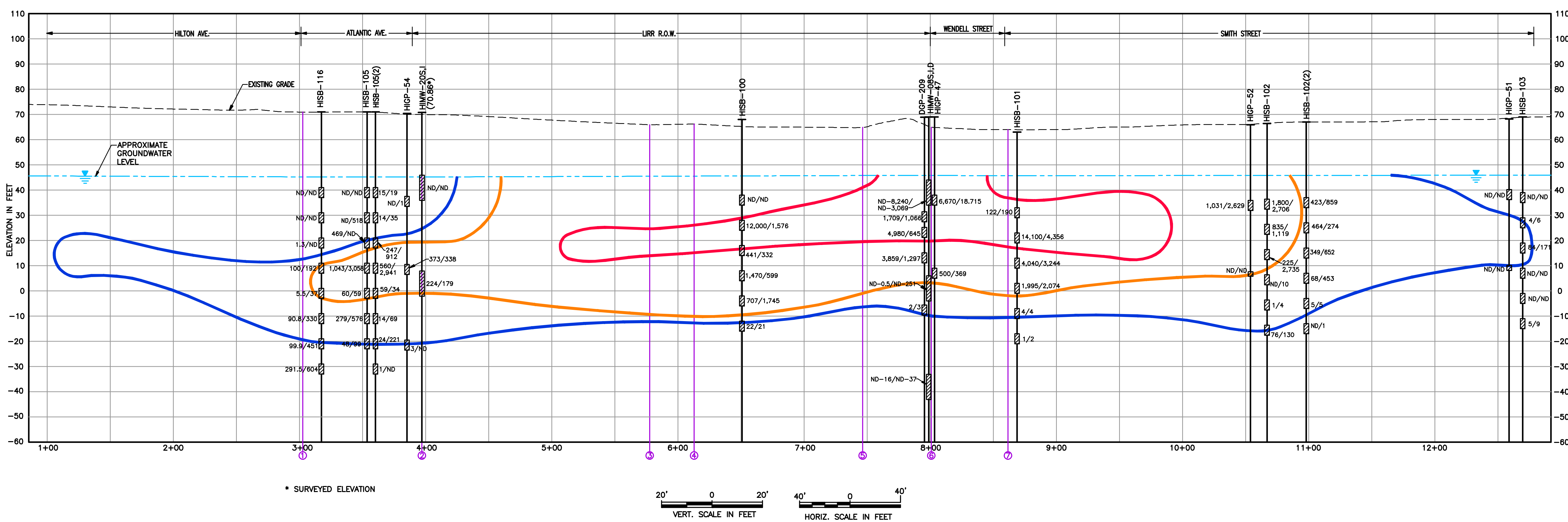


NOTE:

1. THE CROSS-SECTION B-B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 11 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWING 8 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY BE PRESENT OUTSIDE THE BOUNDARIES SHOWN.

LEGEND:

- HISB-100 — BORING ID
- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- GROUNDWATER SAMPLE INTERVAL
- 22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L
- (red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- (orange line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- (blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME SECTION B-B'

Scale: AS SHOWN | Date: JAN. 2010 | DWG-5

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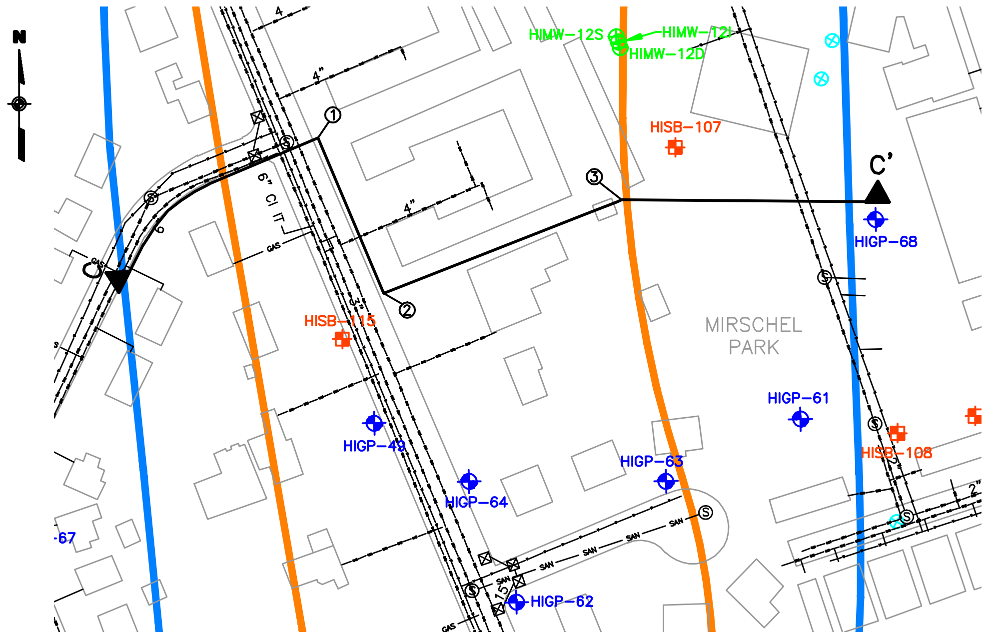
NOTE:

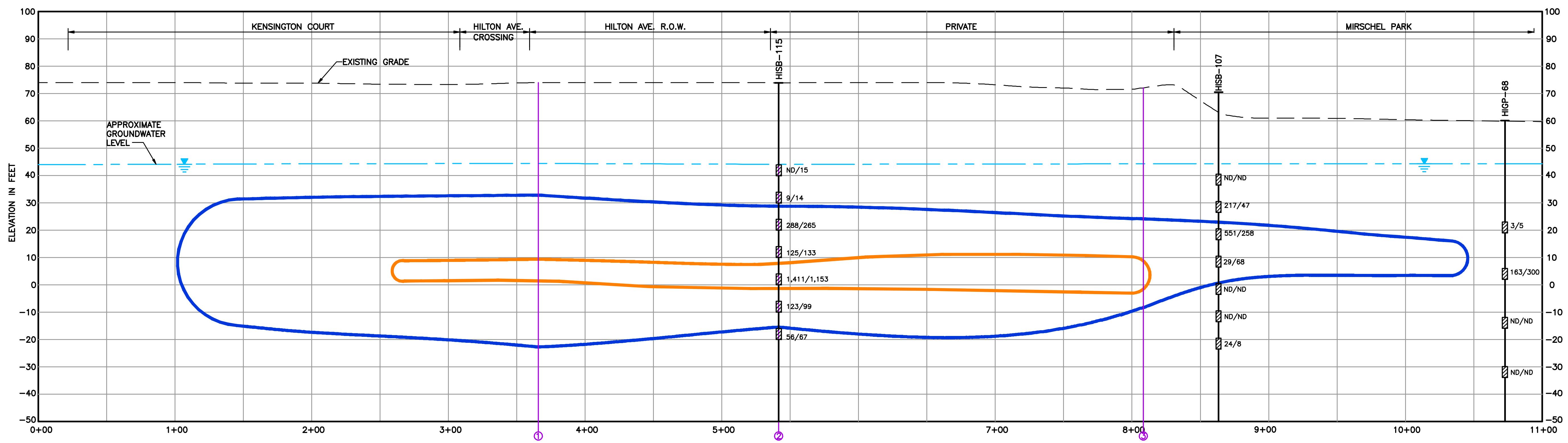
1. THE CROSS–SECTION C–C' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 12 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS–SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWING 9 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY BE PRESENT OUTSIDE THE BOUNDARIES SHOWN.

LEGEND:

- HISB–100 — BORING ID
- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- GROUNDWATER SAMPLE INTERVAL
- 22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L
- (red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- (orange line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- (blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



100' 0 100'
SCALE IN FEET



20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

WARNING
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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

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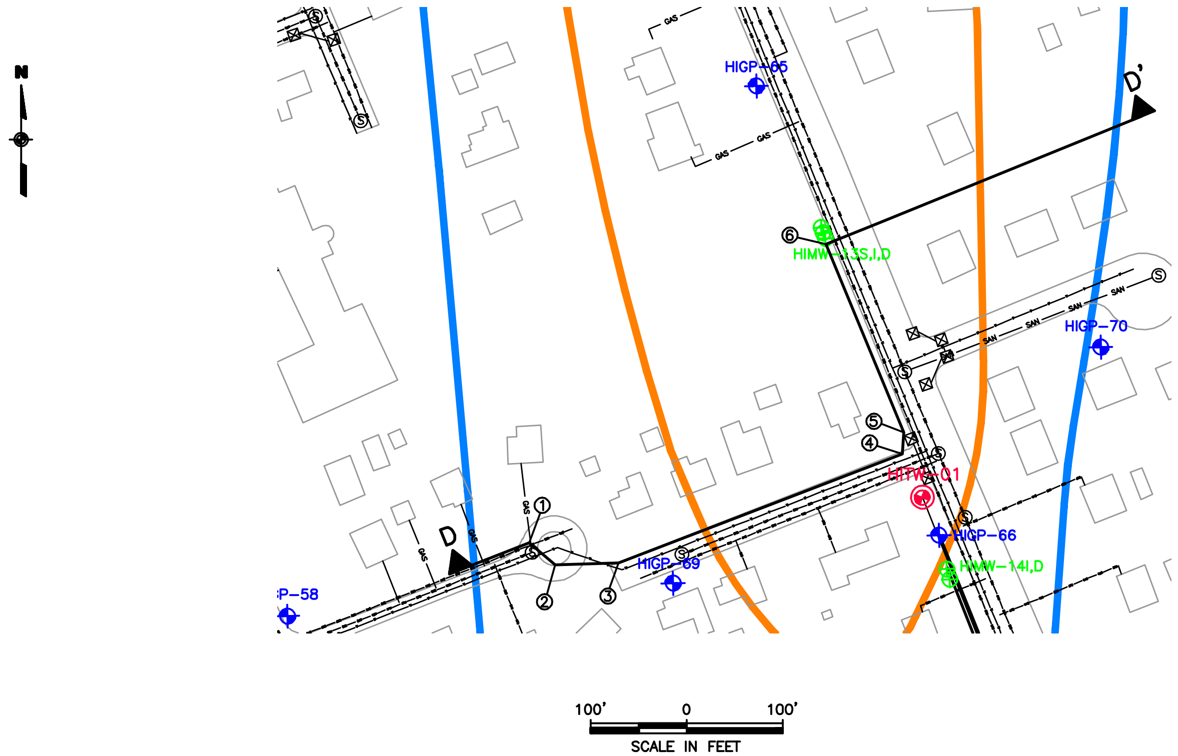
nationalgrid
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME SECTION C–C'

Scale: AS SHOWN Date: JAN. 2010 DWG–6

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE–WIDE REMEDY\GROUNDWATER TREATMENT\JAN 10\DWG 5–7.dwg 1/25/10 – 3 RAL



NOTE:

1. THE CROSS-SECTION D-D' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 12 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS-SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWING 10 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY BE PRESENT OUTSIDE THE BOUNDARIES SHOWN.

LEGEND:

HISB-100 — BORING ID

APPROXIMATE GROUND SURFACE

APPROXIMATE GROUNDWATER SURFACE

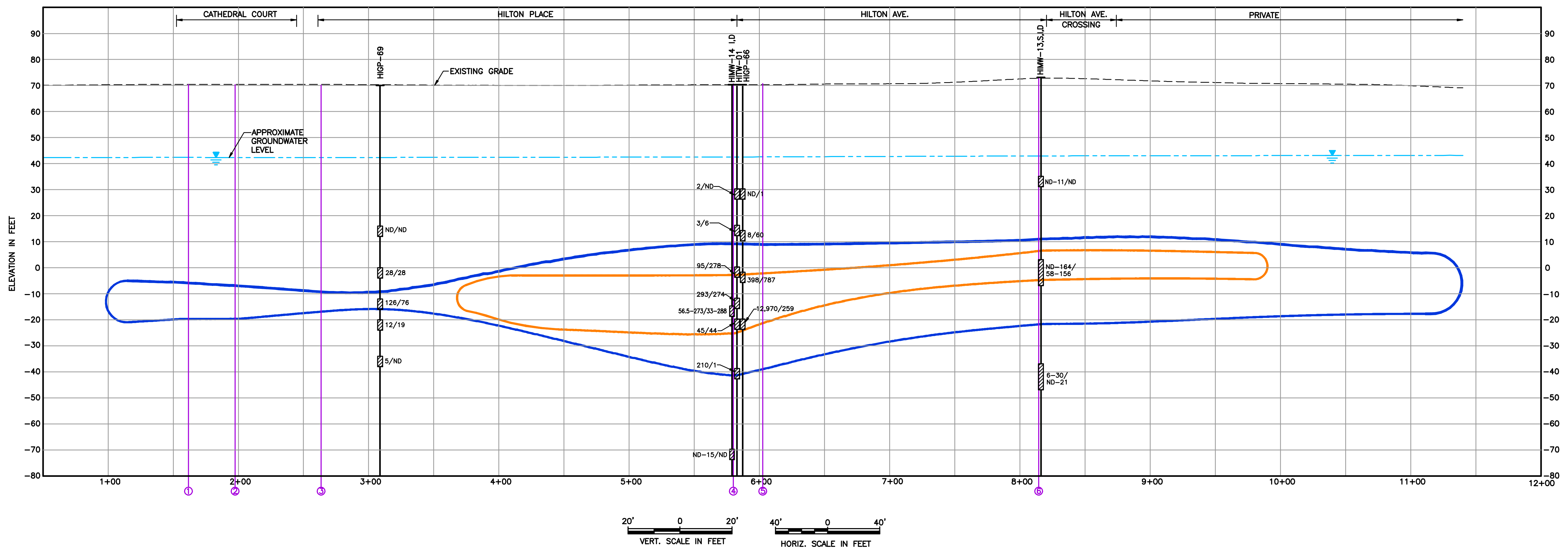
GROUNDWATER SAMPLE INTERVAL

22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L

(red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L

(orange line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L

(blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



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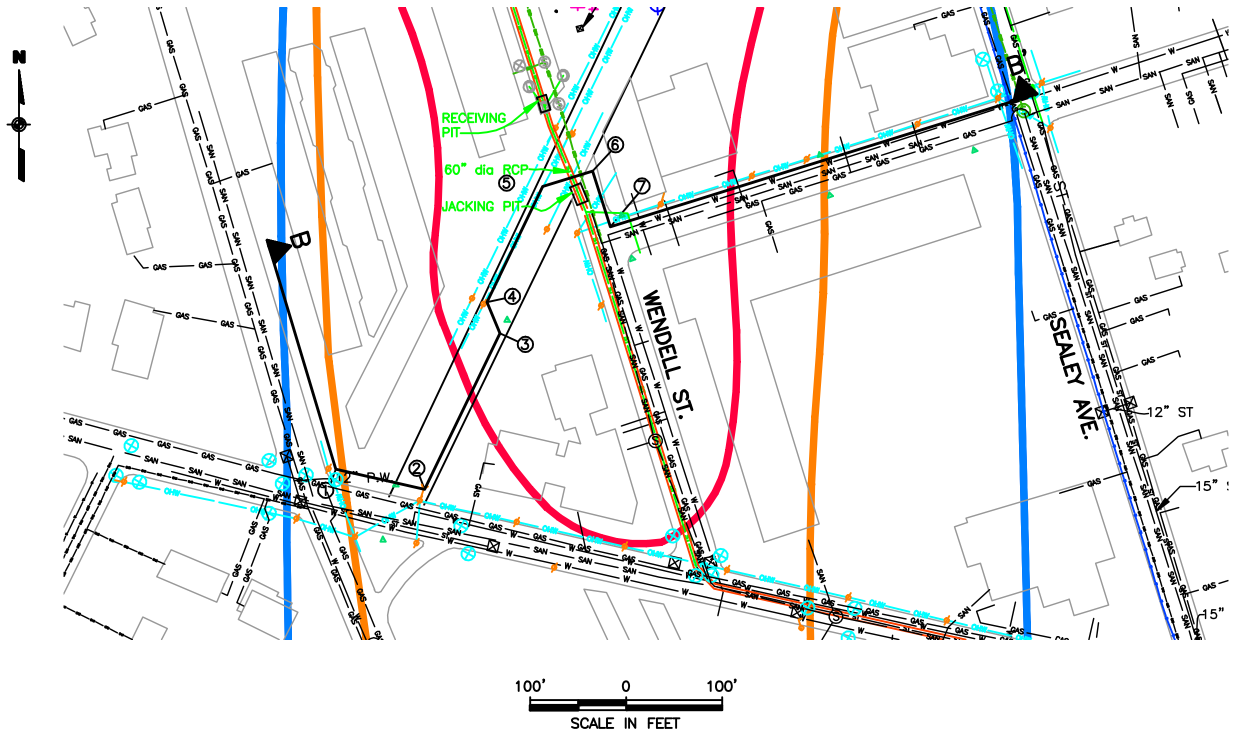
THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME SECTION D-D'

Scale: AS SHOWN | Date: JAN. 2010 | DWG-7

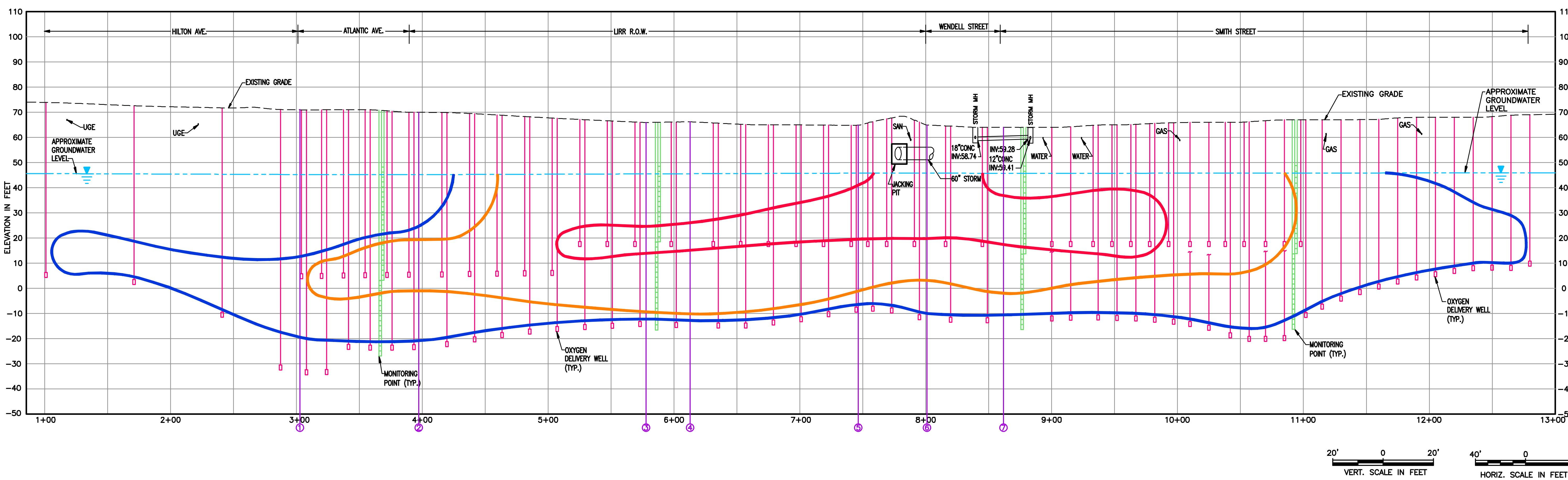


NOTE:

1. THE CROSS-SECTION B-B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 11 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY BE PRESENT OUTSIDE THE BOUNDARIES SHOWN.
3. THE HORIZONTAL SPACING OF SOME OXYGEN DELIVERY WELLS HAVE BEEN MODIFIED TO AVOID UTILITIES AND STRUCTURES IN THE AREA.
4. TUBING NOT SHOWN FOR CLARITY.
5. SEE SHEET 11 FOR WELL CONSTRUCTION INFORMATION.

LEGEND:

- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- PROPOSED OXYGEN DELIVERY WELLS
- SCREENED INTERVAL
- PROPOSED MONITORING POINT(S)
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

OXYGEN DELIVERY WELLS AND UTILITIES SECTION B-B' TREATMENT SYSTEM 1

Scale: AS SHOWN
Date: JAN. 2010
DWG-8

NOTES:

1. THE CROSS-SECTION C–C' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 12 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY BE PRESENT OUTSIDE THE BOUNDARIES SHOWN.
3. THE HORIZONTAL SPACING OF SOME OXYGEN DELIVERY WELLS HAVE BEEN MODIFIED TO AVOID UTILITIES AND STRUCTURES IN THE AREA.
4. FRENCH DRAIN SYSTEM LOCATED ALONG WESTERN END OF MIRSCHEL PARK. EXACT LOCATION, DEPTH, AND CONSTRUCTION DETAILS ARE UNKNOWN.
5. TUBING NOT SHOWN FOR CLARITY.
6. SEE SHEET 12 FOR WELL CONSTRUCTION INFORMATION.

LEGEND:

- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- PROPOSED OXYGEN DELIVERY WELLS
- SCREENED INTERVAL
- PROPOSED MONITORING POINT(S)
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
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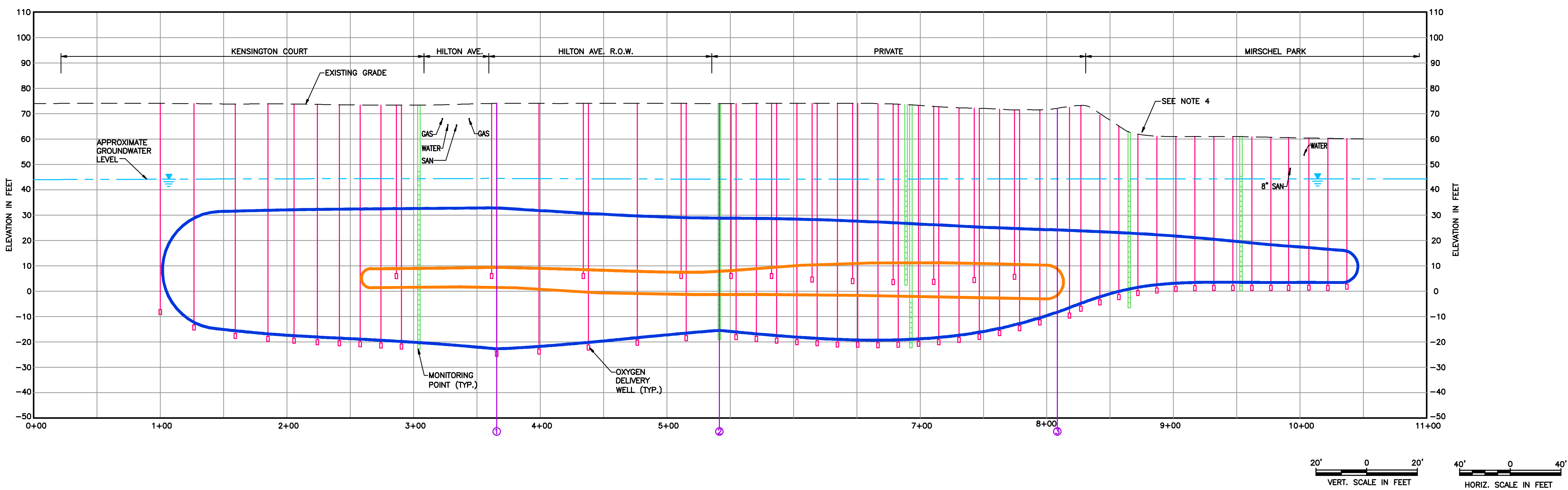

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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

OXYGEN DELIVERY WELLS AND UTILITIES SECTION C–C' TREATMENT SYSTEM 2

Scale: AS SHOWN | Date: JAN. 2010 | DWG–9

NOTES:

1. THE CROSS-SECTION D-D' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 12 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY BE PRESENT OUTSIDE THE BOUNDARIES SHOWN.
3. THE HORIZONTAL SPACING OF SOME OXYGEN DELIVERY WELLS HAVE BEEN MODIFIED TO AVOID UTILITIES AND STRUCTURES IN THE AREA.
4. TUBING NOT SHOWN FOR CLARITY.
5. SEE SHEET 12 FOR WELL CONSTRUCTION INFORMATION.

LEGEND:

- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- PROPOSED OXYGEN DELIVERY WELLS
- SCREENED INTERVAL
- PROPOSED MONITORING POINT(S)
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
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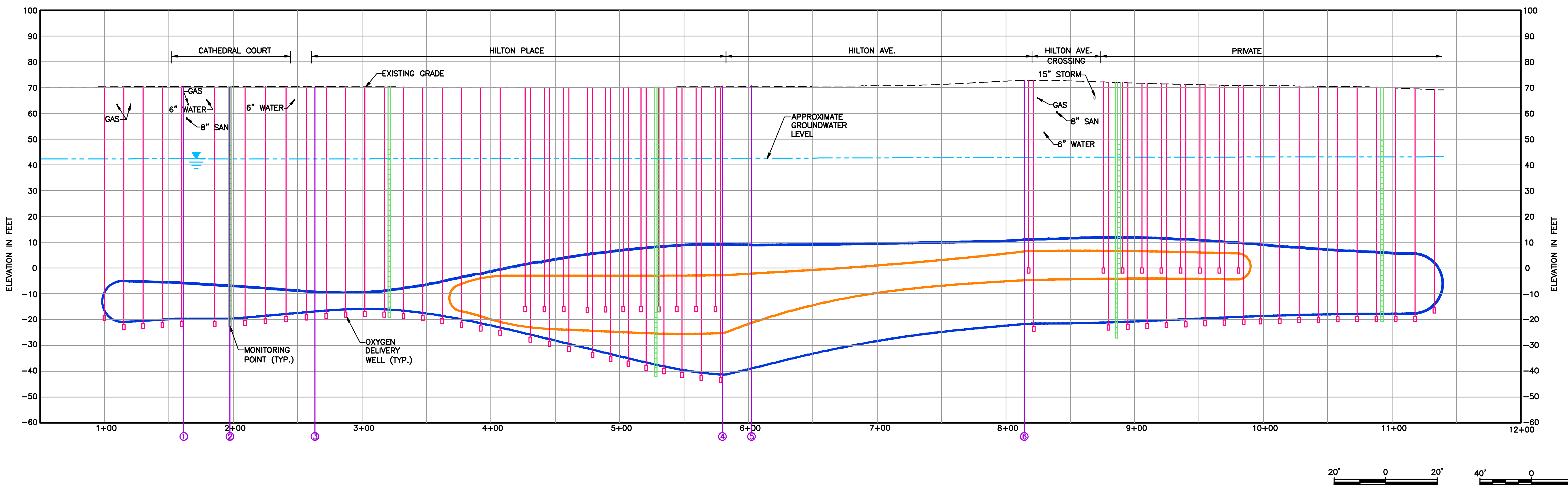
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

OXYGEN DELIVERY WELLS AND UTILITIES SECTION D-D' TREATMENT SYSTEM 3

Scale: AS SHOWN | Date: JAN. 2010 | DWG-10

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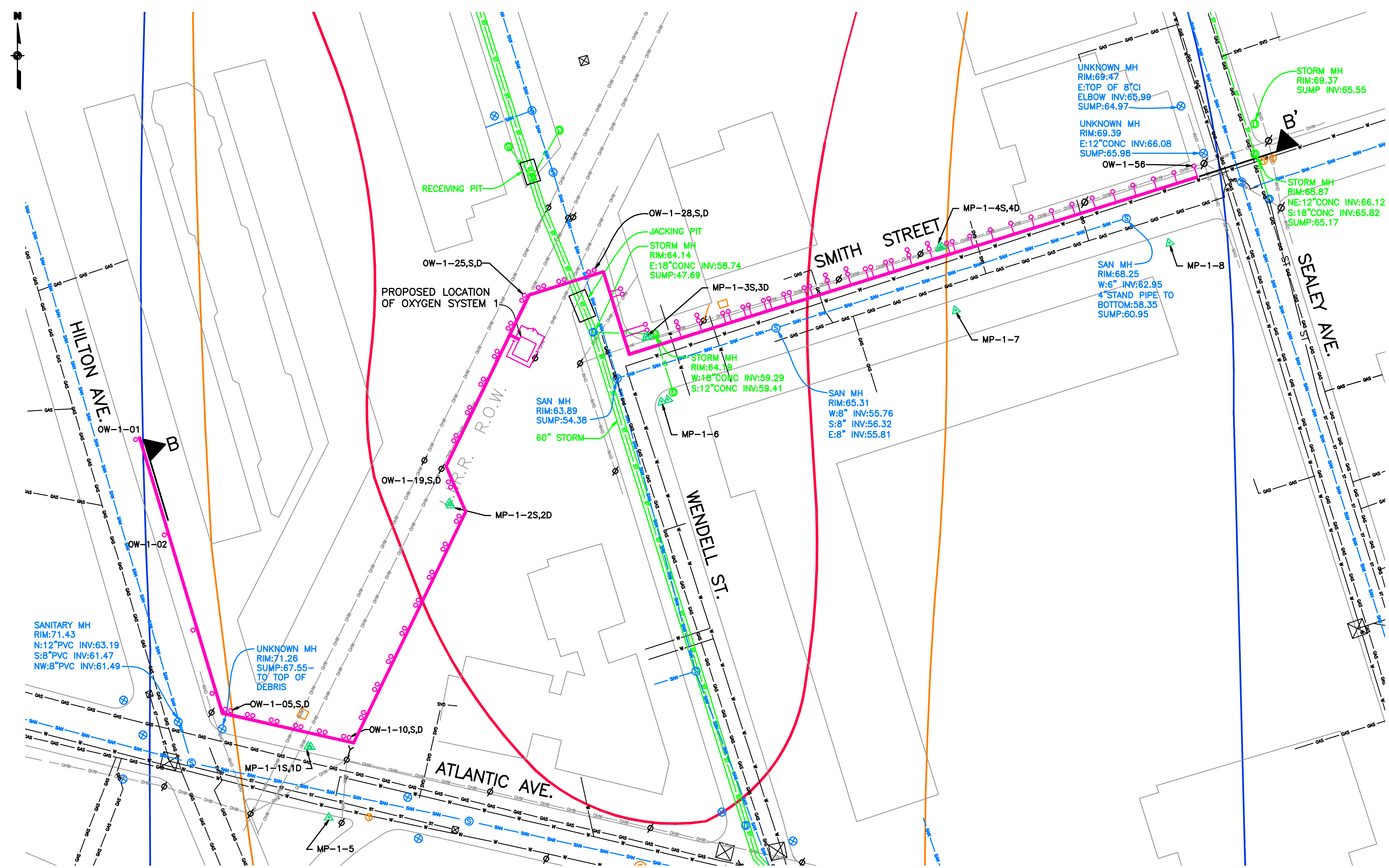

LEGEND:

- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- PROPOSED OXYGEN DELIVERY WELL
- PROPOSED ROUTING OF TUBING BUNDLE FOR OXYGEN DELIVERY.
- PROPOSED MONITORING POINTS

NOTES:

1. UTILITY AND OTHER INFORMATION SHOWN HAS NOT BEEN SURVEYED OR VERIFIED BY URS OR NATIONAL GRID.
2. ALL WELL, TRENCH, AND OTHER SYSTEM LOCATIONS SHOWN ARE ESTIMATED BASED ON THE AVAILABLE INFORMATION. ALL LOCATIONS WILL BE FIELD VERIFIED PRIOR TO CONSTRUCTION BASED ON UTILITY MARKOUTS, ACCESS AGREEMENTS, RESIDENT CONCERNS, AND OTHER FACTORS.
3. SEE DRAWING 13 FOR TYPICAL WELL AND TRENCH CONSTRUCTION DETAILS.
4. FOR OXYGEN DELIVERY WELLS INSTALLED IN SIDEWALKS, THE WELLS SHOULD BE LOCATED TO THE SIDE AND NOT IN THE CENTER OR THE MAIN PATH OF TRAVEL.
5. WELL PAIRS SHOULD BE INSTALLED PARALLEL TO THE STREET WHEREVER POSSIBLE. WELL PAIRS SHOWN PERPENDICULAR ON THESE DRAWINGS ARE TO AVOID UTILITIES. THESE SHOULD BE RE-EVALUATED IN THE FIELD PRIOR TO INSTALLATION, AND SHOULD BE INSTALLED PARALLEL IF POSSIBLE BASED ON THE ACTUAL LOCATION OF THE UTILITIES.

40' 0 40'
SCALE IN FEET

Oxygen Delivery Well Schedule
Treatment System 1

Oxygen Well	Station	Offset (ft)		Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Total Depth of Well (ft)
OW-1-01	1+61.0	3.0	RT	73.0	64.6	66.6	67.6	69.6	70.6
OW-1-02	1+71.0	3.0	RT	72.6	66.0	68.0	69.0	71.0	72.0
OW-1-03	2+41.0	3.0	RT	71.7	78.2	80.2	81.2	83.2	84.2
OW-1-04	2+67.4	3.0	RT	71.1	96.5	98.5	99.5	101.5	102.5
OW-1-05S	3+04.0	3.0	LT	70.0	62.1	64.1	65.1	67.1	68.1
OW-1-05D	3+08.0	3.0	LT	70.0	98.3	100.3	101.3	103.3	104.3
OW-1-06S	3+19.0	3.0	LT	71.0	62.0	64.0	65.0	67.0	68.0
OW-1-06D	3+23.0	3.0	LT	71.0	98.2	100.2	101.2	103.2	104.2
OW-1-07S	3+37.3	3.0	LT	71.0	61.0	63.0	64.0	66.0	67.0
OW-1-07D	3+41.3	3.0	LT	71.0	90.3	92.3	93.3	95.3	96.3
OW-1-08S	3+54.6	3.0	LT	71.0	61.8	63.8	64.8	66.8	67.8
OW-1-08D	3+58.6	3.0	LT	71.0	90.5	92.5	93.5	95.5	96.5
OW-1-09S	3+72.0	3.0	LT	70.6	61.3	63.3	64.3	66.3	67.3
OW-1-09D	3+76.0	3.0	LT	70.4	90.0	92.0	93.0	95.0	96.0
OW-1-10S	3+88.3	3.0	LT	70.0	60.6	62.6	63.6	65.6	66.6
OW-1-10D	3+93.3	3.0	LT	70.0	89.4	91.4	92.4	94.4	95.4
OW-1-11S	4+15.6	3.0	LT	69.0	60.3	62.3	63.3	65.3	66.3
OW-1-11D	4+19.6	3.0	LT	69.6	88.0	90.0	91.0	93.0	94.0
OW-1-12S	4+37.5	3.0	LT	69.5	59.8	61.8	62.8	64.8	65.8

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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

TREATMENT SYSTEM 1 LAYOUT

Scale: AS SHOWN | Date: JAN. 2010 | DWG-11

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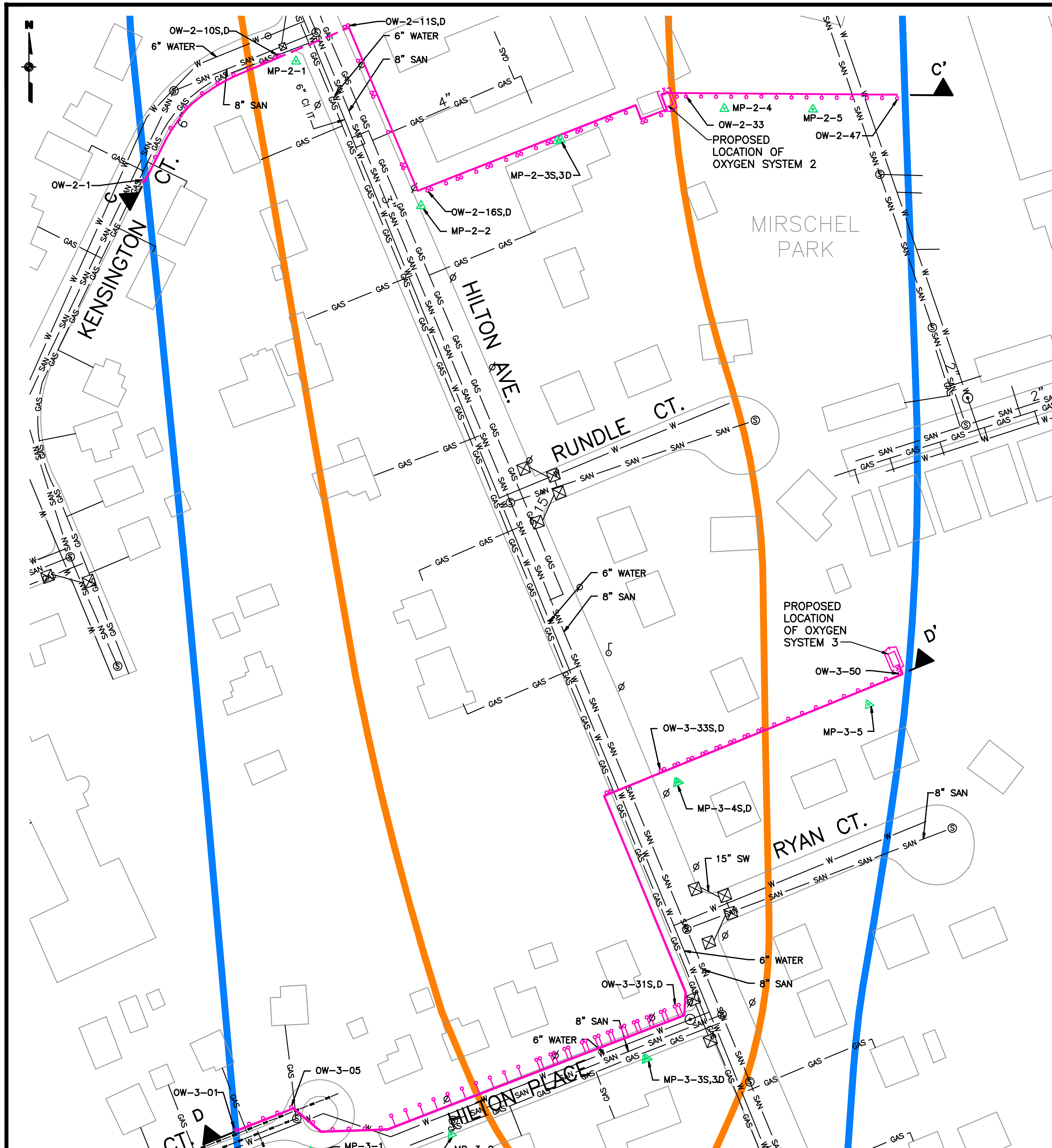

Oxygen Delivery Well Schedule Treatment System 2									
Oxygen Well	Station	Offset (ft)		Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Total Depth of Well (ft)
OW-2-1	1+00	1.5	LT	74.0	78.2	80.2	81.2	83.2	84.2
OW-2-2	1+26.7	1.5	LT	73.9	84.2	86.2	87.2	89.2	90.2
OW-2-3	1+59.28	1.5	LT	73.8	87.4	89.4	90.4	92.4	93.4
OW-2-4	1+85.05	1.5	LT	73.8	88.7	90.7	91.7	93.7	94.7
OW-2-5	2+05.68	1.5	LT	73.8	89.3	91.3	92.3	94.3	95.3
OW-2-6	2+24.08	1.5	LT	73.7	89.7	91.7	92.7	94.7	95.7
OW-2-7	2+41.58	1.5	LT	73.5	90.0	92.0	93.0	95.0	96.0
OW-2-8	2+57.88	1.5	LT	73.4	90.3	92.3	93.3	95.3	96.3
OW-2-9	2+74.18	1.5	LT	73.4	90.7	92.7	93.7	95.7	96.7
OW-2-10S	2+86.49	1.5	LT	73.4	63.4	65.4	66.4	68.4	69.4
OW-2-10D	2+90.49	1.5	LT	73.3	91.2	93.2	94.2	96.2	97.2
OW-2-11S	3+61.71	2.0	LT	74.0	64.0	66.0	67.0	69.0	70.0
OW-2-11D	3+65.71	2.0	LT	74.0	94.8	96.8	97.8	99.8	100.8
OW-2-12	3+99.23	4.0	RT	74.0	93.8	95.8	96.8	98.8	99.8
OW-2-13S	4+33.92	4.0	RT	74.0	64.0	66.0	67.0	69.0	70.0
OW-2-13D	4+37.92	4.0	RT	74.0	92.2	94.2	95.2	97.2	98.2
OW-2-14	4+76.61	4.0	RT	74.1	90.4	92.4	93.4	95.4	96.4
OW-2-15S	5+11.3	4.0	RT	74.0	64.0	66.0	67.0	69.0	70.0
OW-2-15D	5+15.3	4.0	RT	74.0	88.6	90.6	91.6	93.6	94.6
OW-2-16S	5+50.7	2.5	RT	74.0	64.0	66.0	67.0	69.0	70.0
OW-2-16D	5+54.74	2.5	RT	74.0	88.1	90.1	91.1	93.1	94.1
OW-2-17	5+70.74	2.5	RT	74.0	88.9	90.9	91.9	93.9	94.9
OW-2-18S	5+82.7	2.5	RT	74.0	64.7	66.7	67.7	69.7	70.7
OW-2-18D	5+86.74	2.5	RT	74.0	89.5	91.5	92.5	94.5	95.5
OW-2-19	6+02.74	2.5	RT	74.0	90.1	92.1	93.1	95.1	96.1
OW-2-20S	6+14.7	2.5	RT	74.0	65.4	67.4	68.4	70.4	71.4
OW-2-20D	6+18.74	2.5	RT	74.0	90.6	92.6	93.6	95.6	96.6
OW-2-21	6+34.74	2.5	RT	74.0	91.0	93.0	94.0	96.0	97.0
OW-2-22S	6+46.7	2.5	RT	74.0	66.0	68.0	69.0	71.0	72.0
OW-2-22D	6+50.74	2.5	RT	74.0	91.2	93.2	94.2	96.2	97.2
OW-2-23	6+66.74	2.5	RT	74.0	91.3	93.3	94.3	96.3	97.3
OW-2-24S	6+78.7	2.5	RT	73.8	66.2	68.2	69.2	71.2	72.2
OW-2-24D	6+82.74	2.5	RT	73.7	90.8	92.8	93.8	95.8	96.8
OW-2-25	6+98.74	2.5	RT	73.3	90.0	92.0	93.0	95.0	96.0
OW-2-26S	7+10.7	2.5	RT	72.8	65.1	67.1	68.1	70.1	71.1
OW-2-26D	7+14.74	2.5	RT	72.7	88.8	90.8	91.8	93.8	94.8
OW-2-27	7+30.74	2.5	RT	72.3	87.5	89.5	90.5	92.5	93.5
OW-2-28S	7+42.7	2.5	RT	72.2	63.9	65.9	66.9	68.9	69.9
OW-2-28D	7+46.74	2.5	RT	72	86.1	88.1	89.1	91.1	92.1
OW-2-29	7+62.74	2.5	RT	71.7	84.2	86.2	87.2	89.2	90.2
OW-2-30S	7+74.59	10.0	RT	71.5	61.8	63.8	64.8	66.8	67.8
OW-2-30D	7+78.59	10.0	RT	71.5	82.1	84.1	85.1	87.1	88.1
OW-2-31	7+94.59	10.0	RT	71.5	79.8	81.8	82.8	84.8	85.8
OW-2-32	8+17.82	2.5	RT	72.4	78.0	80.0	81.0	83.0	84.0
OW-2-33	8+26.89	2.5	RT	73.2	76.1	78.1	79.1	81.1	82.1
OW-2-34	8+41.89	2.5	RT	69.8	70.2	72.2	73.2	75.2	76.2
OW-2-35	8+56.89	2.5	RT	64.9	63.2	65.2	66.2	68.2	69.2
OW-2-36	8+71.89	2.5	RT	62	58.8	60.8	61.8	63.8	64.8
OW-2-37	8+86.89	2.5	RT	61.1	56.8	58.8	59.8	61.8	62.8
OW-2-38	9+01.89	2.5	RT	61	56.1	58.1	59.1	61.1	62.1
OW-2-39	9+16.89	2.5	RT	61	55.8	57.8	58.8	60.8	61.8
OW-2-40	9+31.89	2.5	RT	61	55.7	57.7	58.7	60.7	61.7
OW-2-41	9+46.89	2.5	RT	61	55.7	57.7	58.7	60.7	61.7
OW-2-42	9+61.89	2.5	RT	60.9	55.6	57.6	58.6	60.6	61.6
OW-2-43	9+76.89	2.5	RT	60.7	55.4	57.4	58.4	60.4	61.4
OW-2-44	9+91.89	2.5	RT	60.6	55.3	57.3	58.3	60.3	61.3
OW-2-45	10+06.89	2.5	RT	60.4	55.1	57.1	58.1	60.1	61.1
OW-2-46	10+21.89	2.5	RT	60.3	55.0	57.0	58.0	60.0	61.0
OW-2-47	10+36.89	2.5	RT	60.2	54.4	56.4	57.4	59.4	60.4
Monitoring Points									
MP-2-1	3+04.2	15.0	RT	73.3	23.2	25.2	26.2	96.2	97.2
MP-2-2	5+41.57	15.0	RT	74.0	20.1	22.1	23.1	93.1	94.1
MP-2-3S	6+88.82	4.3	RT	73.6	23.2	25.2	26.2	71.2	72.2
MP-2-3D	6+92.65	4.3	RT	73.5	72.8	74.8	75.8	95.8	96.8
MP-2-4	8+65.15	15.0	RT	62.7	16.2	18.2	19.2	69.2	70.2
MP-2-5	9+53.25	15.0	RT	60.9	12.7	14.7	15.7	60.7	61.7

Oxygen Well Schedule Treatment System 3									
Oxygen Well	Station	Offset (ft)		Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Total Depth of Well (ft)
OW-3-01	1+00	2.0	LT	70.3	85.7	87.7	88.7	90.7	91.7
OW-3-02	1+15	2.0	LT	70.4	89.3	91.3	92.3	94.3	95.3
OW-3-03	1+30	2.0	LT	70.4	88.9	90.9	91.9	93.9	94.9
OW-3-04	1+45	2.0	LT	70.4	88.5	90.5	91.5	93.5	94.5
OW-3-05	1+60	2.0	LT	70.4	88.1	90.1	91.1	93.1	94.1
OW-3-06	1+65.7	2.0	LT	70.4	88.1	90.1	91.1	93.1	94.1
OW-3-07	2+09.3	2.0	LT	70.4	87.6	89.6	90.6	92.6	93.6
OW-3-08	2+26.2	2.0	LT	70.4	86.9	88.9	89.9	91.9	92.9
OW-3-09	2+41.0	2.0	LT	70.4	86.2	88.2	89.2	91.2	92.2
OW-3-10	2+56.0	2.0	LT	70.4	85.6	87.6	88.6	90.6	91.6
OW-3-11	2+72.3	11.5	LT	70.4	84.9	86.9	87.9	89.9	90.9
OW-3-12	2+87.3	11.5	LT	70.4	84.4	86.4	87.4	89.4	90.4
OW-3-13	3+02.3	11.5	LT	70.3	84.2	86.2	87.2	89.2	90.2
OW-3-14	3+17.3	11.5	LT	70.3	84.3	86.3	87.3	89.3	90.3
OW-3-15	3+32.3	11.5	LT	70.3	84.8	86.8	87.8	89.8	90.8
OW-3-16	3+47.3	11.5	LT	70.2	85.6	87.6	88.6	90.6	91.6
OW-3-17	3+62.3	11.5	LT	70.1	86.7	88.7	89.7	91.7	92.7
OW-3-18	3+77.3	11.5	LT	70.1	88.0	90.0	91.0	93.0	94.0
OW-3-19	3+92.3	11.5	LT	70.1	89.5	91.5	92.5	94.5	95.5
OW-3-20	4+07.3	11.5	LT	70.1	91.2	93.2	94.2	96.2	97.2
OW-3-21S	4+26.7	11.5	LT	70.1	82.1	84.1	85.1	87.1	88.1
OW-3-21D	4+30.7	11.5	LT	70.1	93.8	95.8	96.8	98.8	99.8
OW-3-22S	4+41.7	11.5	LT	70.0	82.0	84.0	85.0	87.0	88.0
OW-3-22D	4+45.7	11.5	LT	70.0	95.6	97.6	98.6	100.6	101.6
OW-3-23S	4+56.7	11.5	LT	70.0	82.0	84.0	85.0	87.0	88.0
OW-3-23D	4+60.7	11.5	LT	70.0	97.4	99.4	100.4	102.4	103.4
OW-3-24S	4+75.1	11.5	LT	70.1	82.4	84.4	85.4	87.4	88.4
OW-3-24D	4+79.1	11.5	LT	70.1	99.8	101.8	102.8	104.8	105.8
OW-3-25S	4+90.0	11.5	LT	70.1	82.2	84.2	85.2	87.2	88.2
OW-3-25D	4+93.9	11.5	LT	70.1	101.5	103.5	104.5	106.5	107.5
OW-3-26S	5+02.9	11.5	LT	70.2	82.2	84.2	85.2	87.2	88.2
OW-3-26D	5+06.9	11.5	LT	70.2	103.2	105.2	106.2	108.2	109.2
OW-3-27S	5+16.7	11.5	LT	70.2	82.2	84.2	85.2	87.2	88.2
OW-3-27D	5+20.7	11.5	LT	70.2	104.8	106.8	107.8	109.8	110.8
OW-3-28S	5+30.6	11.5	LT	70.3	82.3	84.3	85.3	87.3	88.3
OW-3-28D	5+34.6	11.5	LT	70.3	106.4	108.4	109.4	111.4	112.4
OW-3-29S	5+44.4	11.5	LT	70.3	82.3	84.3	85.3	87.3	88.3
OW-3-29D	5+48.4	11.5	LT	70.3	107.7	109.7	110.7	112.7	113.7
OW-3-30S	5+59.4	11.5	LT	70.3	82.3	84.3	85.3	87.3	88.3
OW-3-30D	5+63.4	11.5	LT	70.3	108.9	110.9	111.9	113.9	114.9
OW-3-31S	5+74.4	11.5	LT	70.3	82.3	84.3	85.3	87.3	88.3
OW-3-31D	5+78.4	11.5	LT	70.3	109.6	111.6	112.6	114.6	115.6
OW-3-32S	8+17.7	2.0	LT	72.9	69.9	71.9	72.9	74.9	75.9
OW-3-32D	8+21.7	2.0	LT	72.9	92.4	94.4	95.4	97.4	98.4
OW-3-33S	8+75.7	2.0	LT	72.2	69.2	71.2	72.2	74.2	75.2
OW-3-33D	8+79.7	2.0	LT	72.1	91.2	93.2	94.2	96.2	97.2
OW-3-34S	8+90.7	2.0	LT	72.0	69.0	71.0	72.0	74.0	75.0
OW-3-34D	8+94.7	2.0	LT	71.9	90.7	92.7	93.7	95.7	96.7
OW-3-35S	9+05.7	2.0	LT	71.1	68.7	70.7	71.7	73.7	74.7
OW-3-35D	9+09.7	2.0	LT	71.6	90.1	92.1	93.1	95.1	96.1
OW-3-36S	9+20.7	2.0	LT	71.5	68.7	70.7	71.7	73.7	74.7
OW-3-36D	9+24.7	2.0	LT	71.4	89.6	91.6	92.6	94.6	95.6
OW-3-37S	9+35.7	2.0	LT	71.3	68.3	70.3	71.3	73.3	74.3
OW-3-37D	9+39.7	2.0	LT	71.3	89.1	91.1	92.1	94.1	95.1
OW-3-38S	9+50.7	2.0	LT	71.2	68.2	70.2	71.2	73.2	74.2
OW-3-38D	9+54.7	2.0	LT	71.1	88.6	90.6	91.6	93.6	94.6
OW-3-39S	9+65.7	2.0	LT	71.0	68.0	70.0	71.0	73.0	74.0
OW-3-39D	9+69.7	2.0	LT	70.9	88.1	90.1	91.1	93.1	94.1
OW-3-40S	9+80.7	2.0	LT	70.8	67.8	69.8	70.8	72.8	73.8
OW-3-40D	9+84.7	2.0	LT	70.8	87.7	89.7	90.7	92.7	93.7
OW-3-41	9+97.7	2.0	LT	70.8	87.4	89.4	90.4	92.4	93.4
OW-3-42	10+12.7	2.0	LT	70.7	87.1	89.1	90.1	92.1	93.1
OW-3-43	10+27.7	2.0	LT	70.7	86.9	88.9	89.9	91.9	92.9
OW-3-44	10+42.7	2.0	LT	70.6	86.6	88.6	89.6	91.6	92.6
OW-3-45	10+57.7	2.0	LT	70.5	86.4	88.4	89.4	91.4	92.4
OW-3-46	10+72.7	2.0	LT	70.4	86.2	88.2	89.2	91.2	92.2
OW-3-47	10+87.7	2.0	LT	70.2	85.9	87.9	88.9	90.9	91.9
OW-3-48	11+02.7	2.0	LT	69.9	85.5	87.5	88.5	90.5	91.5
OW-3-49	11+17.7	2.0	LT	69.6	85.2	87.2	88.2	90.2	91.2
OW-3-50	11+32.7	2.0	LT	69.2	81.7	83.7	84.7	86.7	87.7
Monitoring Points									
MP-3-1	1+87.5	21.3	RT	70.4	20.0	22.0	23.0	93.0	94.0
MP-3-2	3+21.2	27.2	RT	70.3	21.4	23.4	24.4	89.4	90.4
MP-3-3D	5+26.0	26.7	RT	70.2	84.4	86.4	87.4	112.4	113.4
MP-3-3S	5+28.0	26.7	RT	70.3	19.3	21.3	22.3	87.3	88.3
MP-3-4D	8+65.9	15.0	RT	72.0	71.2	73.2	74.2	99.2	100.2
MP-3-4S	8+67.9	15.0	RT	72.0	21.1	23.1	24.1	74.1	75.1
MP-3-5	10+02.1	15.0	RT	70.1	17.8	19.8	20.8	90.8	91.8

NOTES:

1. UTILITY AND OTHER INFORMATION SHOWN HAS NOT BEEN SURVEYED OR VERIFIED BY URS OR NATIONAL GRID.
2. ALL WELL, TRENCH, AND OTHER SYSTEM LOCATIONS SHOWN ARE ESTIMATED BASED ON THE AVAILABLE INFORMATION. ALL LOCATIONS WILL BE FIELD VERIFIED PRIOR TO CONSTRUCTION BASED ON UTILITY MARKOUTS, ACCESS AGREEMENTS, RESIDENT CONCERNS, AND OTHER FACTORS.
3. SEE DRAWING 13 FOR TYPICAL WELL AND TRENCH CONSTRUCTION DETAILS.
4. FOR OXYGEN DELIVERY WELLS INSTALLED IN SIDEWALKS, THE WELLS SHOULD BE LOCATED TO THE SIDE AND NOT IN THE CENTER OR THE MAIN PATH OF TRAVEL.
5. WELL PAIRS SHOULD BE INSTALLED PARALLEL TO THE STREET WHEREVER POSSIBLE. WELL PAIRS SHOWN PERPENDICULAR ON THESE DRAWINGS ARE TO AVOID UTILITIES. THESE SHOULD BE RE-EVALUATED IN THE FIELD PRIOR TO INSTALLATION, AND SHOULD BE INSTALLED PARALLEL IF POSSIBLE BASED ON THE ACTUAL LOCATION OF THE UTILITIES.

LEGEND:

- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- PROPOSED OXYGEN DELIVERY WELL
- PROPOSED ROUTING OF TUBING BUNDLE FOR OXYGEN DELIVERY.
- PROPOSED MONITORING POINTS

60' 0 60'
SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

URS Corporation
New York
77 Goodell Street, Buffalo, New York 14203
(716)856-5636 - (716)856-2545 fax

JOB NO. 11175065

nationalgrid
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

TREATMENT SYSTEMS 2 AND 3 LAYOUT

Scale: AS SHOWN | Date: JAN. 2010 | DWG-12

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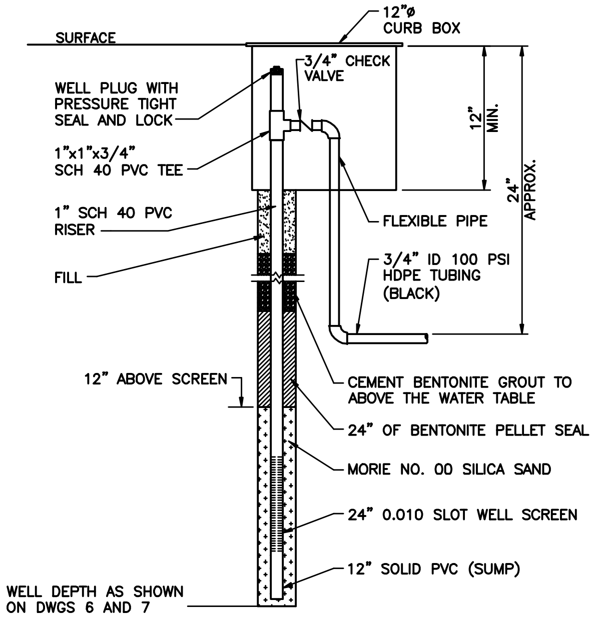
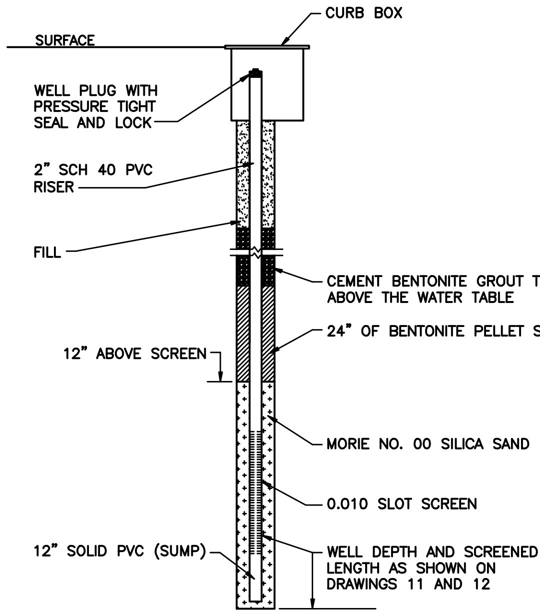


TYPICAL OXYGEN DELIVERY WELL CONSTRUCTION DIAGRAM

NOT TO SCALE

TYPICAL OF 96 LOCATIONS FOR TREATMENT SYSTEM 1, 59 LOCATIONS FOR TREATMENT SYSTEM 2 AND 70 LOCATIONS FOR TREATMENT SYSTEM 3

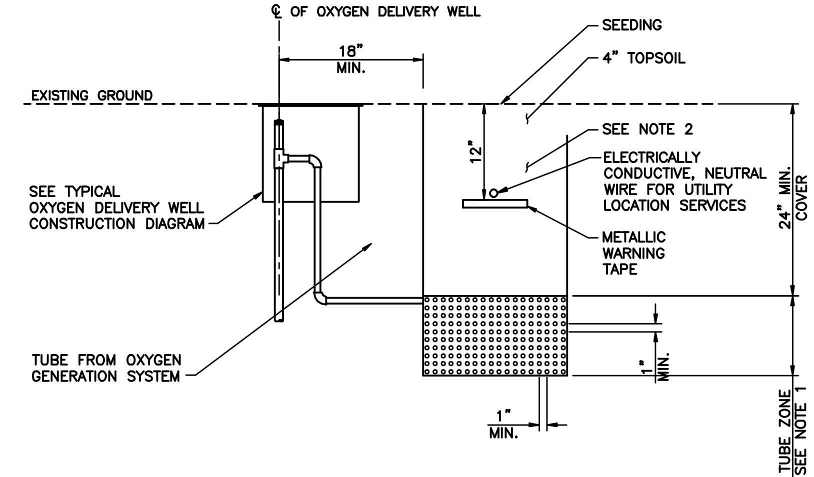


TYPICAL MONITORING POINT CONSTRUCTION

NOT TO SCALE

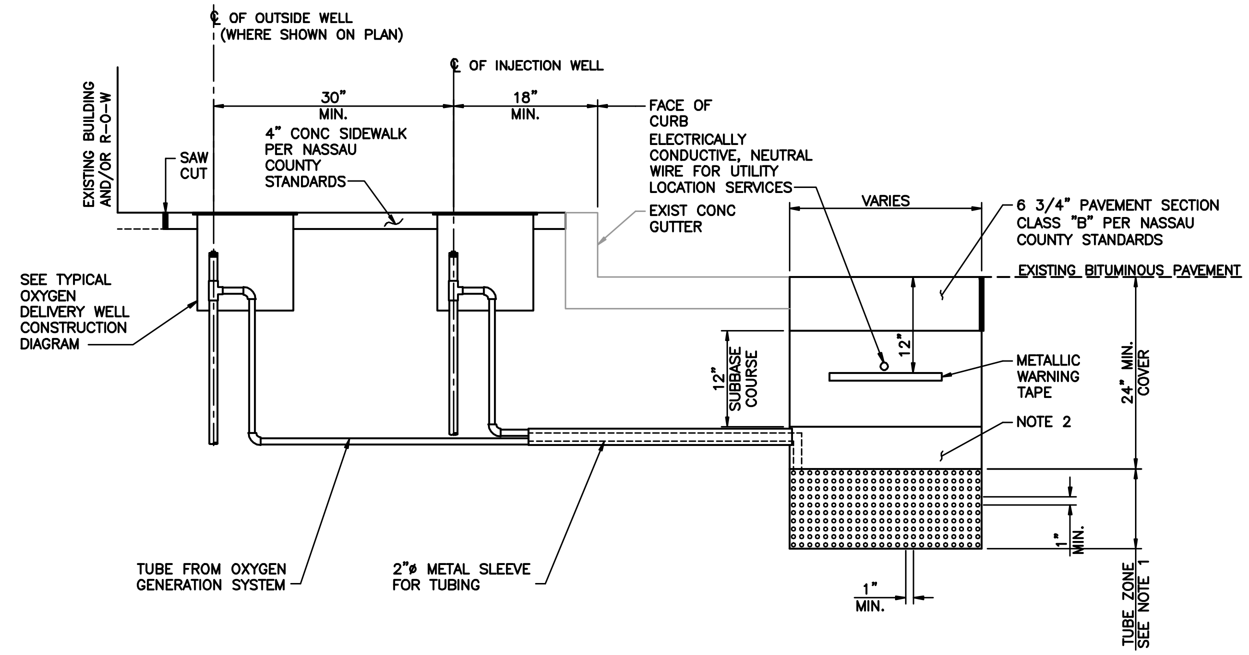
NOTES:

1. ALL WELLHEADS SHALL BE SET EVEN WITH OR SLIGHTLY BELOW THE SURROUNDING GROUND SURFACE TO PREVENT TRIP HAZARDS AND ALSO TO PREVENT ACCUMULATION OF PRECIPITATION.
2. NEW CONCRETE APRONS (APPROXIMATELY 2 FOOT SQUARE) SHALL BE PLACE AROUND ALL WELLHEADS TO STABILIZE THE WELLHEADS AND PREVENT THE WELLS FROM SHIFTING OR HEAVING. OTHER WELLHEAD CONSTRUCTIONS MAY BE REQUIRED TO MEET THE SPECIFIC REQUIREMENTS OF THE PROPERTY OWNERS WHERE THE WELLS ARE INSTALLED.



TRENCH DETAIL – UNPAVED AREAS

1/2" = 1'-0"



TRENCH DETAIL – SMITH STREET AND WENDELL STREET

1/2" = 1'-0"

NOTES:

1. BACKFILL MATERIAL FOR TUBING SHALL BE EITHER SAND OR CONTROLLED LOW STRENGTH MATERIAL
2. BACKFILL BETWEEN TUBE ZONE AND SUBBASE COURSE SHALL BE NATIVE SOIL WITH NO ROCKS GREATER THAN 4"ø.
3. WELL PAIR SHOWN PREPENDICULAR TO THE STREET FOR ILLUSTRATION ONLY. PARALLEL (SIDE-BY-SIDE) INSTALLATION IS PREFERRED.

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
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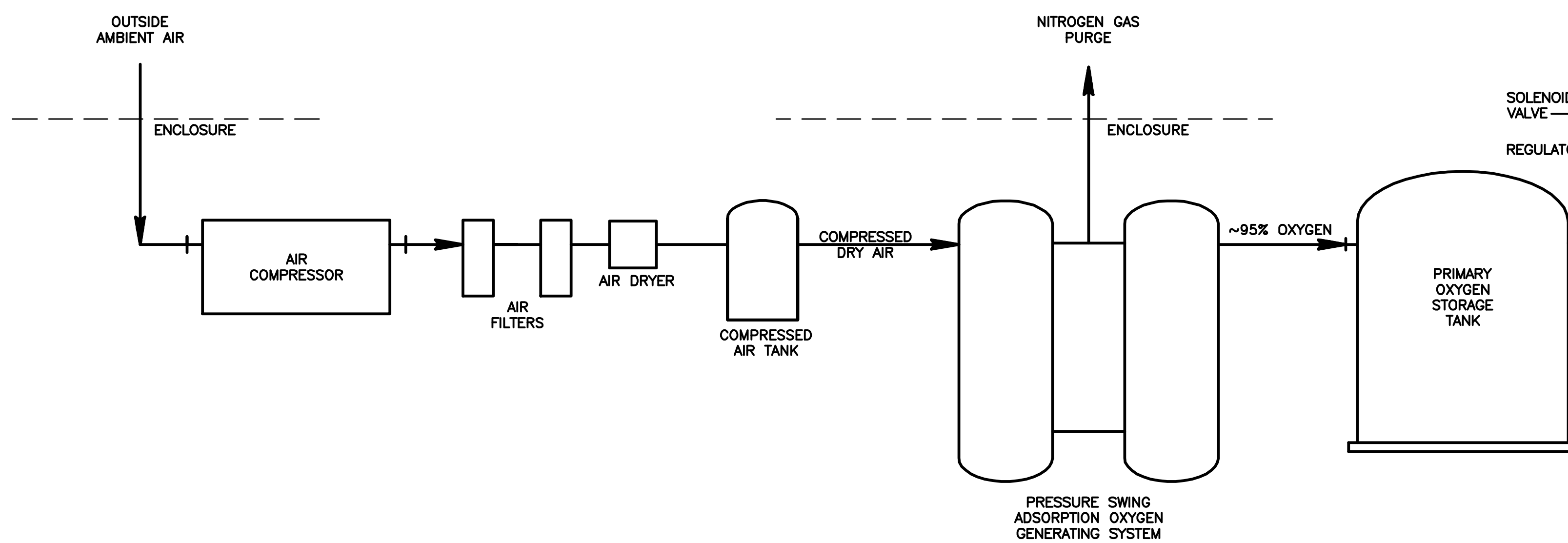
THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

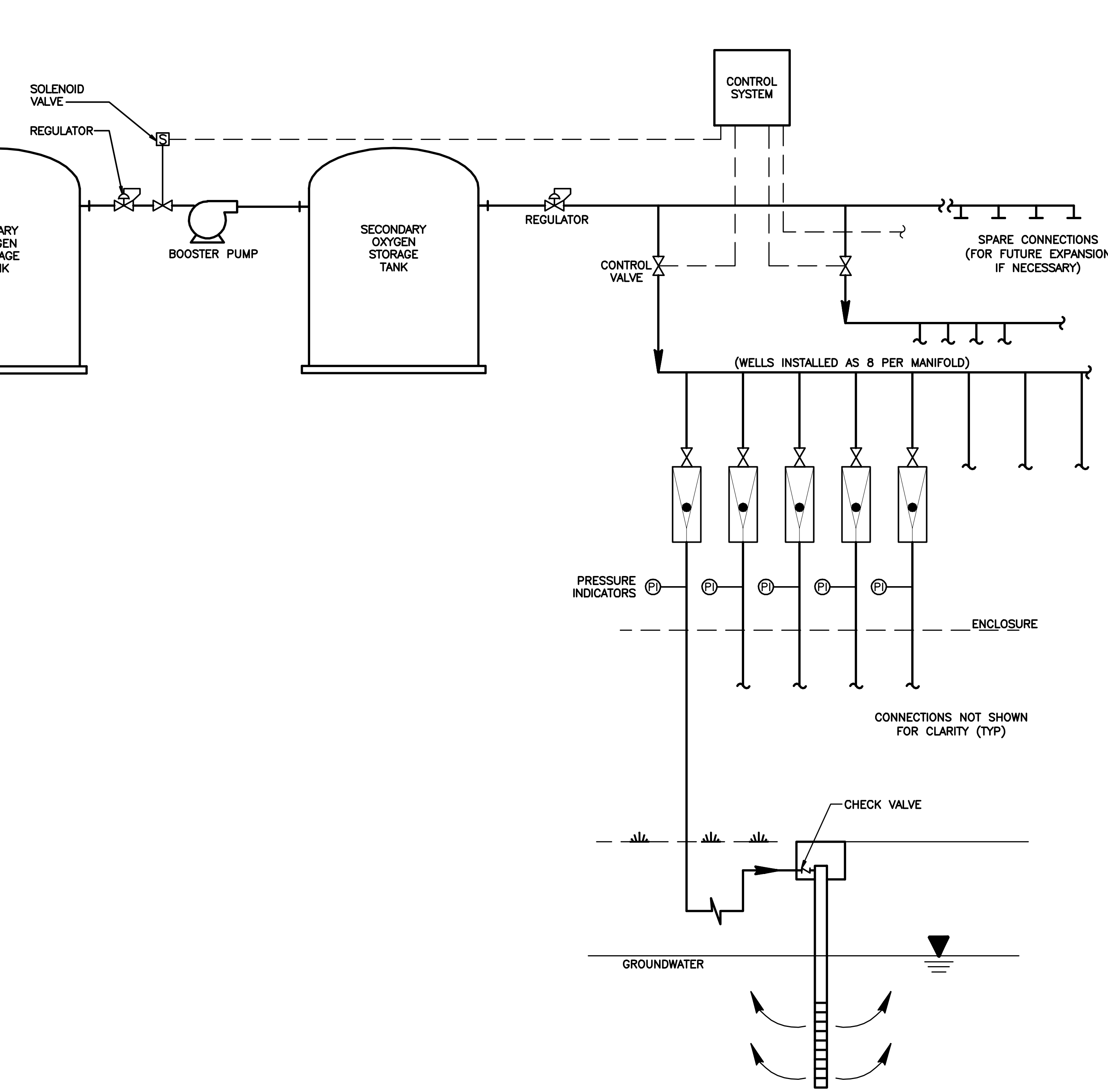
MISCELLANEOUS DETAILS

Scale: AS SHOWN | Date: JAN. 2010 | DWG–13

OXYGEN DISTRIBUTION SYSTEM



OXYGEN GENERATION SYSTEM (TYP)



OXYGEN DIFFUSION WELL

TYPICAL OF 96 LOCATIONS FOR TREATMENT SYSTEM 1,
59 LOCATIONS FOR TREATMENT SYSTEM 2 AND
70 LOCATIONS FOR TREATMENT SYSTEM 3

NOTE:

OXYGEN SYSTEMS (INSIDE ENCLOSURE) BY MATRIX ENVIRONMENTAL TECHNOLOGIES INC.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

PROCESS FLOW DIAGRAM FOR OXYGEN GENERATION AND DELIVERY

Scale: AS SHOWN | Date: JAN. 2010 | DWG-14

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APPENDICES

APPENDIX A

DESIGN CALCULATIONS

OXYGEN REQUIREMENT FOR AEROBIC BIODEGRADATION

NOTE: The calculation included in this Appendix is based on the layouts of the treatment systems that were envisioned at the time the draft document was prepared (September 2009). The layouts of Systems 2 and 3 have since been revised based on property access agreements and NYSDEC review comments. The layout of System 1 is mostly unchanged.

The text and drawings of this report have been updated to reflect the revised layout of the systems; however this appendix has not been changed from the draft report. Calculations of the contaminant mass flux and other related design criteria for System 1 are still valid. The contaminant mass flux calculations for Systems 2 and 3 do not reflect the current configurations. These calculations were not revised because the original calculations demonstrate that oxygen demand is significantly less than the amount of oxygen that will be supplied by the systems.

The system manufacturer suggests that the systems should provide enough oxygen to achieve an in situ DO concentration of 40 mg/L. Therefore, the oxygen generation rates provided by the manufacturer are higher than the stiochiometric rates that are based on contaminant flux. The injection of oxygen at the higher rates may result in a shortened operating timeframe for the systems.

The actual construction documents associated with this project should be referenced for the most up-to-date design information for the systems.

1.0 Purpose

1. Evaluate the amount of oxygen required to facilitate intrinsic aerobic biodegradation of dissolved phase contaminants in a groundwater plume associated with the Hempstead Intersection Street former MGP Site, Hempstead and Garden City, NY. The evaluation is performed at three (3) locations that correspond to groundwater treatment systems that are described in the Remedial Design Report for Off-Site Groundwater Treatment (URS, 2009).

2. Evaluate the maximum amount of oxygen that can be injected into the groundwater plume at the treatment system locations using oxygen injection systems manufactured by Matrix Environmental Technologies, Inc. The amount of oxygen injected at each location should meet the stoichiometric demand associated with microbially-mediated aerobic oxidation-reduction reactions that transform benzene, toluene, ethylbenzene, xylenes (BTEX) and polycyclic aromatic hydrocarbons (PAHs) into carbon dioxide and water.

2.0 Description of the Treatment Systems

The groundwater treatment systems will inject oxygen into a dissolved phase groundwater contaminant plume at three locations, summarized below and shown on page 21 and 23 of 74:

1. **System No. 1**– The system is located (east to west) along the Smith Street right-of-way (ROW) between Sealey Ave. and Wendell St., the Long Island Rail Road (LIRR) ROW between Wendell St. and Atlantic Ave., the Atlantic Ave. ROW, and the Hilton Ave. ROW. Ninety six oxygen injection wells will be installed to depths of between 45 feet below ground surface (ft bgs) and 101 ft bgs. Plan and section views of the injection wells are shown on pages 21-22 of 74.
2. **System No. 2**– The system is located (east to west) in Mirschel Park and on private property at 158 Hilton Ave. (parcel ID 34-285-227). Forty oxygen injection wells will be installed to depths of between 58 ft bgs and 93 ft bgs. Plan and section views of the injection wells are shown on pages 23-24 of 74.
3. **System No. 3**– The system is located on private property owned by St. Paul's Greek Orthodox Church (parcel ID 34-284-14). Thirty six wells will be installed to depths of between 77 ft bgs and 98 ft bgs. Plan and section views of the injection wells are shown on pages 23-24 of 74.

High-purity oxygen (90% - 95%) will be injected as a gas into the saturated zone via injection points that will be located in Glacial Sediments and Upper Magothy Sediments. The wells will be oriented perpendicular to the plume in barrier configurations.

The injection system is designed with an oxygen production capacity of 160 standard cubic feet per hour (SCFH). The oxygen is delivered to injection wells via individual ¾-inch diameter high-density polyethylene (HDPE) pipe and a manifold that is arranged into banks of 10 wells (maximum). The typical operating condition will be 75% of capacity (120 SCFH).

3.0 Site Characteristics

The groundwater contaminant plume is shown on page 25 of 74, which is based on groundwater monitoring conducted during 2000 to 2009. The plume contains dissolved phase BTEX and PAHs.

Unconsolidated geologic deposits within the plume consist of, in descending order:

- Glacial Sediments – fine to coarse sand with varying amounts of gravel and occasional lenses of silty-sand and silt. These sediments comprise the Upper Glacial Aquifer and are approximately 60 to 95 feet thick within the plume area. Hydrogeologic characteristics of the Upper Glacial sediments are listed below:

Hydraulic conductivity [k] – 158.5 feet/day (ft/day) [measured]

Porosity [n] – 0.35 [estimated from literature]

Unit Weight [γ] – 111 lbs/ft^3 [estimated from literature]

Hydraulic Gradient [i] – 0.0018 [measured]

Fraction of Organic Carbon [F_{oc}] – 0.005 [measured]

Upper Magothy Sediments – predominately composed of fine to very fine sand with varying amounts of silt. These sediments also contain numerous lenses of fine to coarse sand along with thin clay layers or laminae, which create a high degree of anisotropy. The vertical hydraulic conductivity is reported to be several orders of magnitude less than the horizontal hydraulic conductivity (PS&S, 2006). The thickness of the Upper Magothy sediments within the plume area varies from approximately 49 feet to 110 feet. Hydrogeologic characteristics of the Upper Magothy sediments are listed below:

Hydraulic conductivity [k] – 110 ft/day [measured]

Porosity [n] – 0.4 [estimated from literature]

Unit Weight [γ] – 111 lbs/ft^3 [estimated from literature]

Hydraulic Gradient [i] – 0.0017 [measured]

Fraction of Organic Carbon [F_{oc}] – 0.035 [measured]

Chemical analytical data & geochemical data from the plume are provided on pages 26-50 of 74 and pages 71-72 of 74. Hydrogeologic information and well construction summaries are provided on pages 54-70 of 74. Pages 73 and 74 provide typical values used to estimate porosity and unit weight.

4.0 Methodology

The contaminant mass flux across each treatment boundary was determined based on cross-sectional area, average contaminant concentrations, and groundwater flow velocity. Separate calculations were performed for the Glacial sediments and Upper Magothy sediments. The approximate transition between the Glacial sediments and Upper Magothy sediments occurs at an elevation of 7 feet above mean sea level (ft AMSL) in the vicinity of the treatment system sections.

4.1 Cross-Sectional Area

The groundwater plume surfaces (5,000 µg/L, 1,000 µg/L, and 100 µg/L) were modeled using ESRI® ArcGIS® software (ModelBuilder and Cross-View tools). Plume surfaces created by ArcGIS® were evaluated by a Hydrogeologist and revised to reflect boundary conditions, plume bottom depths, and water table surface depths. Cross-sections were established at the injection well system locations and exported into AutoCAD®. Cross-sectional areas bounded by the 5,000 µg/L, 1,000 µg/L, and 100 µg/L and isoconcentration lines were determined using features available in the software. An output showing measured areas is provided on page 51 of 74.

4.2 Contaminant Concentrations

Average contaminant concentrations for areas bounded by the 5,000 µg/L, 1,000 µg/L, and 100 µg/L isoconcentration lines associated with the System No. 1 were determined using groundwater analytical results obtained during the period October 2000 to January 2009 (see pages 52-53 of 74).

Groundwater analytical data in the vicinity of the System No. 2 and System No. 3 was available from widely-spaced locations and were not averaged. Contaminant concentrations for areas bounded by the 5,000 µg/L, 1,000 µg/L, and 100 µg/L isoconcentration lines were conservatively estimated as the upper value bounded by the lines (i.e. 5,000 µg/L and 1,000 µg/L). Contaminant concentrations did not exceed 5,000 µg/L in these areas.

4.3 Contaminant & Oxygen Flux at the Treatment System Barriers

Contaminant and oxygen flux at treatment system barriers was estimated using the following relationship:

Contaminant Flux

$$J_c = C_w * Q * 1x10^{-9} \text{ kg/µg}$$

where:

J_c = Contaminant flux (kg/day)
C_w = Contaminant concentration (µg/L)
Q = Groundwater flow rate (L/day)

Oxygen Flux

$$J_{DO} = C_{DO} * Q * 1x10^{-6} \text{ kg/mg}$$

where:

J_{DO} = Oxygen flux (kg/day)
C_{DO} = Dissolved oxygen concentration (mg/L)

Groundwater flow rate was estimated using the following relationship:

$$Q = k * i * A * (7.48_{gal/ft3} * 3.78_{L/gal})$$

where:

k = hydraulic conductivity (ft/day)
i = Hydraulic gradient (ft/ft)
A = Cross-sectional area perpendicular to flow (ft^2)

4.4 Stoichiometric Ratios (Oxygen/Contaminant)

System No. 1

The amount of oxygen required to meet the biological demand for aerobic oxidation-reduction of the contaminants was determined for each BTEX and PAH compound that was analyzed during the PDI and RI investigations. Example coupled oxidation-reduction reactions for benzene and naphthalene are provided below.

Benzene (C_6H_6)

$$7.5\ O_2 + C_6H_6 \rightarrow 6\ CO_2 + 3H_2O$$

7.5 moles of oxygen (32 g/g-mole) are required for each mole of benzene (78 g/g-mole). The stoichiometric ratio of oxygen to benzene (mass basis) is (7.5 * 32)/(1*78) = 3.08

Naphthalene

$12\ O_2 + C_{10}H_8 \rightarrow 10\ CO_2 + 4\ H_2O$

7.5 moles of oxygen (32 g/g-mole) are required for each mole of naphthalene (128 g/g-mole). The stoichiometric ratio of oxygen to naphthalene (mass basis) is (12 * 32)/(1*128) = 3.00

System Nos. 2 and 3

Approximate stoichiometric ratios of oxygen to BTEX compounds (3.2) and oxygen to PAHs (3.0) were used for the Mirschel Park system calculations because groundwater data at these areas was sparse.

4.5 Oxygen Demand

Oxygen demand is the product of the contaminant reduction, stoichiometric amount of oxygen required per mass of contaminant reduction, and the change in dissolved oxygen (DO) concentration in groundwater flowing through the treatment area (assuming an initial DO concentration of 0 mg/L and final concentration of 2 mg/L [considered adequate to support aerobic bioremediation]).

Oxygen Demand Attributed to Contaminant Reduction

$$O_2 = -(J_{c\text{-}out} - J_{c\text{-}in}) * (O_2/\text{Cont.})$$

where:

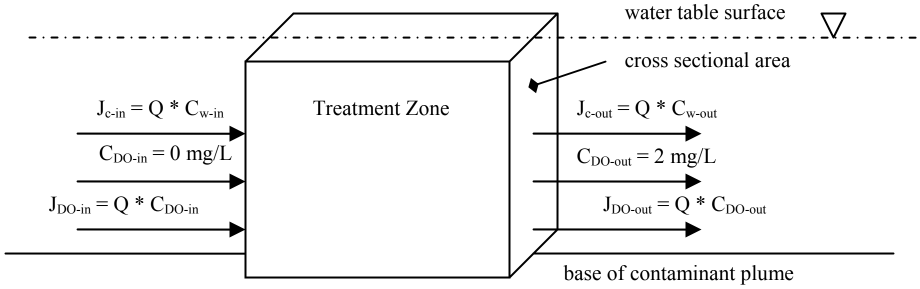
O_2	=	Oxygen demand (kg/day)
$J_{c\text{-}in}$	=	Contaminant flux entering the treatment zone (kg/day)
$J_{c\text{-}out}$	=	Contaminant flux leaving the treatment zone (kg/day), assuming zero
$(O_2/\text{cont.})$	=	Stoichiometric ratio of oxygen: contaminant (mass basis)

Oxygen Demand Attributed to Change in DO Concentration

$$O_2 = J_{DO\text{-}out} - J_{DO\text{-}in}$$

where:

O_2	=	Oxygen demand (kg/day)
$J_{DO\text{-}in}$	=	Dissolved oxygen flux entering the treatment zone (kg/day)
$J_{DO\text{-}out}$	=	Dissolved oxygen flux leaving the treatment zone (kg/day)



A factor of safety of 4 was applied to the calculated amount of oxygen required to account for other organic compounds and oxygen sinks in the system that were not measured by the analytical testing.

5.0 Calculations and Results

5.1 Calculations

Calculations are provided on the following pages.

- System No. 1 (pages 7-11 of 74)
- System Nos. 2 & 3 (page 12-19 of 74)

5.2 Results

Location	Contaminant Flux (lbs/day)	Oxygen Required (lbs/day)	Oxygen Delivered (lbs/day)
System No. 1	4.6	30.4	173.4
System No. 2	3.3	13.9	173.4
System No. 3	2.0	9.3	173.4

The amount of oxygen delivered is sufficient to meet stoichiometric requirements based on contaminant flux across the treatment areas and to change the DO concentration from 0 mg/L to 2 mg/L.

6.0 References

Das, B.M., *Principles of Foundation Engineering, 2nd Ed.,* © 1990 PWS-Kent Publishing Co., Boston, MA.

McClymonds, N.E. and Franke, O.L., *Water Transmitting Properties of Aquifers on Long Island, New York, U.S. Geological Survey Professional Paper 627*.E. 1972.

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1. Hydrogeologic Characteristics

1A. Glacial Sediments

Hydraulic Conductivity [k]	158.5 ft/day	page 54-56 of 74
Hydraulic Gradient [i]	0.0018	page 54 of 74

2A. Upper Magothy Sediments

Hydraulic Conductivity [k]	110.0 ft/day	page 54-56 of 74
Hydraulic Gradient [i]	0.0017	page 54 of 74

2. Plume Cross-Sectional Areas (A)

2A. Glacial Sediments (page 51 of 74)

	Areas Shown on Cross-Section B-B' (ft^2)			Correction Factor	Areas Normal to Flow Vector (ft^2)		
	Concentration Interval				Concentration Interval		
Section (refer to page 21 of 74)	100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L		100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L
B - 1	1,774	-	-	0.06	107	-	-
1 - 2	369	791	-	0.85	313	672	-
2 - 3	810	8,480	3,542	0.70	564	5,912	2,469
3 - 4	98	788	1,521	0.42	41	333	642
4 - B'	6,072	5,107	2,573	1.00	6,072	5,107	2,573
Totals	9,122	15,166	7,635		7,099	12,024	5,684

2B. Upper Magothy Sediments (page 51 of 74)

	Areas Shown on Cross-Section B-B' (ft^2)			Correction Factor	Areas Normal to Flow Vector (ft^2)		
	Concentration Interval				Concentration Interval		
Section (refer to page 21 of 74)	100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L		100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L
B - 1	2,165	-	-	0.06	131	-	-
1 - 2	1,826	738	-	0.85	1,552	627	-
2 - 3	2,640	4,560	-	0.70	1,840	3,179	-
3 - 4	688	418	-	0.42	290	176	-
4 - B'	4,114	541	-	1.00	4,114	541	-
Totals	11,432	6,256	-		7,928	4,523	-

3. Stoichiometric Ratios (O_2/cont.) & Dissolved-Phase Concentrations (C_w)

Compound	(O_2/cont.)	Average Concentration, C_w (interval) ≥ 5,000 ug/L	1,000 - 5,000 ug/L	100 - 1,000 ug/L
Benzene	3.1	3,421 ug/L	381 ug/L	32 ug/L
Ethylbenzene	3.2	596 ug/L	180 ug/L	43 ug/L
Toluene	3.1	2,780 ug/L	81 ug/L	9 ug/L
Xylene (total)	3.2	1,891 ug/L	458 ug/L	86 ug/L
2-Methylnaphthalene	3.0	1,234 ug/L	202 ug/L	23 ug/L
Acenaphthene [5]	3.0	65 ug/L	23 ug/L	9 ug/L
Acenaphthylene	2.9	461 ug/L	103 ug/L	32 ug/L
Anthracene	3.0	144 ug/L	3 ug/L	1 ug/L
Benzo(a)anthracene	2.9	70 ug/L	- ug/L	- ug/L
Benzo(a)pyrene	2.9	33 ug/L	- ug/L	- ug/L
Benzo(b)fluoranthene	2.9	24 ug/L	- ug/L	- ug/L
Benzo(g,h,i)perylene	2.9	7 ug/L	- ug/L	- ug/L
Benzo(k)fluoranthene	2.9	9 ug/L	- ug/L	- ug/L
Chrysene	2.9	60 ug/L	- ug/L	- ug/L
Dibenz(a,h)anthracene	2.9	3 ug/L	- ug/L	- ug/L
Fluoranthene	2.9	105 ug/L	0.2 ug/L	0.1 ug/L
Fluorene	3.0	256 ug/L	23 ug/L	6 ug/L
Indeno(1,2,3-cd)pyrene	2.9	7 ug/L	- ug/L	- ug/L
Naphthalene	3.0	3,157 ug/L	1,429 ug/L	222 ug/L
Phenanthrene	3.0	463 ug/L	14 ug/L	5 ug/L
Pyrene	2.9	145 ug/L	0.38 ug/L	0.2 ug/L

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Other Electron Acceptors	(O_2/cont.)	> 5,000 ug/L	1,000 - 5,000 ug/L	100 - 1,000 ug/L
Ferrous Iron	0.1	29.7 mg/L	23 mg/L	19 mg/L
Required Dissolved Oxygen Concentration	1.0	2 mg/L	2 mg/L	2 mg/L

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4. Contaminant Flux Through Barrier & Oxygen Requirements

Groundwater Flow Rate

$Q=k*i*A*(28.319)$ Eqn. 1

where: Q = volumetric flow rate

28.319 = a conversion factor (L/ft^3)

Contaminant Flux

$J_c = C_w*Q*1x10^{-9}$ Eqn. 2

where: J_c = contaminant flux

$1x10^{-9}$ = a conversion factor (kg/ug)

Dissolved Oxygen (DO) Flux

$J_{DO} = C_{DO}*Q*1x10^{-6}$ Eqn. 3

where: J_{DO} = dissolved oxygen flux

C_{DO} =concentration of dissolved oxygen

$1x10^{-6}$ = a conversion factor (kg/mg)

Oxygen Required

O_2 required = $J*(O_2$/cont.) Eqn. 4

4A. Glacial Sediments

	> 5,000 ug/L Area			1,000 - 5,000 ug/L Area			100 - 1,000 ug/L Area		
Groundwater Flow Rate	45,177 L/day	(Eqn. 1)		95,565 L/day	(Eqn. 1)		56,420 L/day	(Eqn. 1)	
Contaminant Flux & O_2 Requirement	Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)	
Benzene	1.55E-01 kg/day	4.75E-01 kg/day	1.05E+00 lb/day	3.64E-02 kg/day	1.12E-01 kg/day	2.47E-01 lb/day	1.78E-03 kg/day	5.49E-03 kg/day	1.21E-02 lb/day
Ethylbenzene	2.69E-02 kg/day	8.53E-02 kg/day	1.88E-01 lb/day	1.72E-02 kg/day	5.46E-02 kg/day	1.20E-01 lb/day	2.42E-03 kg/day	7.66E-03 kg/day	1.69E-02 lb/day
Toluene	1.26E-01 kg/day	3.93E-01 kg/day	8.67E-01 lb/day	7.77E-03 kg/day	2.43E-02 kg/day	5.36E-02 lb/day	5.30E-04 kg/day	1.66E-03 kg/day	3.66E-03 lb/day
Xylene (total)	8.54E-02 kg/day	2.71E-01 kg/day	5.97E-01 lb/day	4.38E-02 kg/day	1.39E-01 kg/day	3.06E-01 lb/day	4.86E-03 kg/day	1.54E-02 kg/day	3.40E-02 lb/day
2-Methylnaphthalene	5.58E-02 kg/day	1.69E-01 kg/day	3.73E-01 lb/day	1.93E-02 kg/day	5.86E-02 kg/day	1.29E-01 lb/day	1.32E-03 kg/day	4.01E-03 kg/day	8.83E-03 lb/day
Acenaphthene [2]	2.94E-03 kg/day	8.84E-03 kg/day	1.95E-02 lb/day	2.20E-03 kg/day	6.61E-03 kg/day	1.46E-02 lb/day	5.03E-04 kg/day	1.51E-03 kg/day	3.34E-03 lb/day
Acenaphthylene	2.08E-02 kg/day	6.14E-02 kg/day	1.35E-01 lb/day	9.83E-03 kg/day	2.89E-02 kg/day	6.38E-02 lb/day	1.81E-03 kg/day	5.33E-03 kg/day	1.17E-02 lb/day
Anthracene	6.50E-03 kg/day	1.92E-02 kg/day	4.24E-02 lb/day	2.43E-04 kg/day	7.19E-04 kg/day	1.58E-03 lb/day	3.39E-05 kg/day	1.00E-04 kg/day	2.21E-04 lb/day
Benzo(a)anthracene	3.16E-03 kg/day	9.31E-03 kg/day	2.05E-02 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Benzo(a)pyrene	1.47E-03 kg/day	4.29E-03 kg/day	9.45E-03 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Benzo(b)fluoranthene	1.08E-03 kg/day	3.16E-03 kg/day	6.97E-03 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Benzo(g,h,i)perylene	3.07E-04 kg/day	8.89E-04 kg/day	1.96E-03 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Benzo(k)fluoranthene	3.84E-04 kg/day	1.11E-03 kg/day	2.45E-03 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Chrysene	2.71E-03 kg/day	7.99E-03 kg/day	1.76E-02 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Dibenz(a,h)anthracene	1.36E-04 kg/day	3.97E-04 kg/day	8.76E-04 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Fluoranthene	4.74E-03 kg/day	1.39E-02 kg/day	3.06E-02 lb/day	2.21E-05 kg/day	6.46E-05 kg/day	1.42E-04 lb/day	6.77E-06 kg/day	1.98E-05 kg/day	4.37E-05 lb/day
Fluorene	1.16E-02 kg/day	3.45E-02 kg/day	7.60E-02 lb/day	2.21E-03 kg/day	6.60E-03 kg/day	1.46E-02 lb/day	3.32E-04 kg/day	9.92E-04 kg/day	2.19E-03 lb/day
Indeno(1,2,3-cd)pyrene	3.19E-04 kg/day	9.26E-04 kg/day	2.04E-03 lb/day	- kg/day	- kg/day	- lb/day	- kg/day	- kg/day	- lb/day
Naphthalene	1.43E-01 kg/day	4.28E-01 kg/day	9.43E-01 lb/day	1.37E-01 kg/day	4.10E-01 kg/day	9.03E-01 lb/day	1.25E-02 kg/day	3.76E-02 kg/day	8.28E-02 lb/day
Phenanthrene	2.09E-02 kg/day	6.20E-02 kg/day	1.37E-01 lb/day	1.38E-03 kg/day	4.09E-03 kg/day	9.03E-03 lb/day	2.58E-04 kg/day	7.63E-04 kg/day	1.68E-03 lb/day
Pyrene	6.55E-03 kg/day	1.92E-02 kg/day	4.23E-02 lb/day	3.68E-05 kg/day	1.08E-04 kg/day	2.37E-04 lb/day	9.03E-06 kg/day	2.65E-05 kg/day	5.83E-05 lb/day
Ferrous Iron	1.34E+00 kg/day	1.34E-01 kg/day	2.96E-01 lb/day	2.18E+00 kg/day	2.18E-01 kg/day	4.80E-01 lb/day	1.91E-06 kg/day	1.91E-07 kg/day	4.21E-07 lb/day
Subtotals	6.74E-01 kg/day	2.07E+00 kg/day	4.56 lb/day	2.45E+00 kg/day	1.06E+00 kg/day	2.342 lb/day	2.64E-02 kg/day	8.05E-02 kg/day	0.178 lb/day

Total Glacial Sediments	Contaminant Flux		Oxygen Requirement	
			SF	
	3.15 kg/day	7.08 lb/day	4	28.33 lb/day

Oxygen Required to Change DO Concentration Within the Treatment Barrier

Treatment Barrier Dimensions	Length (Normal to Flow Vector)	782 ft.		
	Height	36 ft.		
	Area	28,152 ft^2		
Groundwater Flow Through the Treatment Barrier		223,754 L/day	(Eqn. 1)	
DO Concentration Change		2 mg/L		
Oxygen Required for DO Change				0.99 lb/day (Eqn. 3)

Total Oxygen Requirement for Glacial Sediments 29.31 lb/day

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4B. Upper Magothy Sediments

	> 5,000 ug/L Area			1,000 - 5,000 ug/L Area			100 - 1,000 ug/L Area		
Groundwater Flow Rate	- L/day	(Eqn. 1)		- L/day	(Eqn. 1)		24,654 L/day	(Eqn. 1)	
Contaminant Flux & O_2 Requirement	Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)	
Benzene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	7.79E-04 kg/day	2.40E-03 kg/day	5.29E-03 lb/day
Ethylbenzene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	1.06E-03 kg/day	3.35E-03 kg/day	7.38E-03 lb/day
Toluene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	2.32E-04 kg/day	7.25E-04 kg/day	1.60E-03 lb/day
Xylene (total)	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	2.12E-03 kg/day	6.74E-03 kg/day	1.48E-02 lb/day
2-Methylnaphthalene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	5.76E-04 kg/day	1.75E-03 kg/day	3.86E-03 lb/day
Acenaphthene (2)	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	2.20E-04 kg/day	6.62E-04 kg/day	1.46E-03 lb/day
Acenaphthylene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	7.91E-04 kg/day	2.33E-03 kg/day	5.13E-03 lb/day
Anthracene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	1.48E-05 kg/day	4.38E-05 kg/day	9.66E-05 lb/day
Benzo(a)anthracene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Benzo(a)pyrene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Benzo(b)fluoranthene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Benzo(g,h,i)perylene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Benzo(k)fluoranthene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Chrysene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Dibenz(a,h)anthracene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Fluoranthene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	2.96E-06 kg/day	8.67E-06 kg/day	1.91E-05 lb/day
Fluorene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	1.45E-04 kg/day	4.33E-04 kg/day	9.55E-04 lb/day
Indeno(1,2,3-cd)pyrene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	- kg/day	- lb/day	- kg/day	0.00E+00 kg/day	0.00E+00 lb/day
Naphthalene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	5.47E-03 kg/day	1.64E-02 kg/day	3.62E-02 lb/day
Phenanthrene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	1.13E-04 kg/day	3.34E-04 kg/day	7.35E-04 lb/day
Pyrene	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	3.94E-06 kg/day	1.16E-05 kg/day	2.55E-05 lb/day
Ferrous Iron	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	0.47 kg/day	0.05 kg/day	1.04E-01 lb/day
Subtotals	- kg/day	- kg/day	- lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00 lb/day	4.83E-01 kg/day	8.23E-02 kg/day	0.18 lb/day

Total Upper Magothy Sediments	Contaminant Flux		Oxygen Requirement	
			SF	
	0.48 kg/day	0.18 lb/day	4	0.73 lb/day

Oxygen Required to Change DO Concentration Within the Treatment Barrier

Treatment Barrier Dimensions	Length (Normal to Flow Vector)	782 ft.	
	Height	17 ft.	
	Area	13,294 ft^2	
Groundwater Flow Through the Treatment Barrier		72,463 L/day	(Eqn. 1)
DO Concentration Change		2 mg/L	
Oxygen Required for DO Change		0.32 lb/day	(Equ. 3)

page 22 of 74

page 21 of 74

Total Oxygen Requirement for Upper Magothy Sediments: 1.05 lb/day

Total System No. 1 Treatment Line

Contaminant Flux	Oxygen Requirement	
3.64 kg/day	30.36 lb/day	← Design Basis

5. Oxygen Injection System Flow Rates

Typical Flow Rate (Entire System)	120 ft^3/hr		
Volume Gas Injected/Day	2,880 ft^3		
Oxygen Concentration	90%		
Oxygen Transfer Efficiency	75%		
Volume Oxygen Injected/Day	1,944 ft^3		
Mass Oxygen (M_{O2}) Transferred/Day			
n = PV/RT	Eqn. 5		
where:			
n = No. moles O_2			
P = pressure (atm)	1 atm		
V = volume (L)	1,944 ft^3	55,054 L	
R = Universal Gas constant (atm*L/mol*K)	0.08206 atm*L/mol*K		
T = temperature (K)	0 deg C	273 K	
M_{O2} = n* mol wt. O_2	Eqn. 6		
where:			
mol wt. O_2	32 g/g-mol.		

n (Eqn. 5)	M_{O2}/Day (Eqn. 6)		
2,458 moles	78,640 g	173.4 lbs	← Greater than amount required to meet daily demand & to change the oxygen concentration within the treatment volume

System No. 2

1. **Hydrogeologic Characteristics**

1A. **Glacial Sediments**

Hydraulic Conductivity [k]	158.5 ft/day	page 54-56 of 74
Hydraulic Gradient [i]	0.0018	page 54 of 74

2A. **Upper Magothy Sediments**

Hydraulic Conductivity [k]	110.0 ft/day	page 54-56 of 74
Hydraulic Gradient [i]	0.0017	page 54 of 74

2. **Plume Cross-Sectional Areas (A)**

2A. **Glacial Sediments** (page 51 of 74)

	Areas Shown on Cross-Section C2-C2' (ft^2) Concentration Interval			Correction Factor	Areas Normal to Flow Vector (ft^2) Concentration Interval		
Section (refer to page 23 of 74)	100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L		100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L
C2 - 3	4,537	1,024	-	0.927	4,207	949	-
3 - C2'	3,004	1	-	1.000	3,004	1	-
Totals	7,541	1,025	-		7,210	950	-

2B. **Upper Magothy Sediments** (page 51 of 74)

	Areas Shown on Cross-Section C2-C2' (ft^2) Concentration Interval			Correction Factor	Areas Normal to Flow Vector (ft^2) Concentration Interval		
Section (refer to page 23 of 74)	100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L		100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L
C2 - 3	4,130	2,618	-	0.927	3,829	2,427	-
3 - C2'	1,262	22	-	1.000	1,262	22	-
Totals	5,392	2,640	-		5,091	2,449	-

3. **Stoichiometric Ratios (O_2/cont.), & Dissolved-Phase Concentrations (C_w)**

		Average Concentration, C_w (Interval)[1]		
Compound	(O_2/cont.)	≥ 5,000 ug/L	1,000 - 5,000 ug/L	100 - 1,000 ug/L
BTEX[2]	3.2	- ug/L	5,000 ug/L	1,000 ug/L
PAHs[2]	3.0	- ug/L	5,000 ug/L	1,000 ug/L
Other Electron Acceptors	(O_2/cont.)	> 5,000 ug/L	1,000 - 5,000 ug/L	100 - 1,000 ug/L
Ferrous Iron[3]	0.1	29.7 mg/L	29.7 mg/L	29.7 mg/L
Required Minimum Dissolved Oxygen Concentration	1.0	2 mg/L	2 mg/L	2 mg/L

System No. 2

4. Contaminant Flux Through Barrier & Oxygen Requirements

Groundwater Flow Rate

$Q=k*i*A*(28.319)$ Eqn. 1

where: Q = volumetric flow rate

28.319 = a conversion factor (L/ft^3)

Contaminant Flux

$J_c = C_w*Q*1x10^{-9}$ Eqn. 2

where: J_c = contaminant flux

$1x10^{-9}$ = a conversion factor (kg/ug)

Dissolved Oxygen (DO) Flux

$J_{DO} = C_{DO}*Q*1x10^{-6}$ Eqn. 3

where: J_{DO} = dissolved oxygen flux

C_{DO} =concentration of dissolved oxygen

$1x10^{-6}$ = a conversion factor (kg/mg)

Oxygen Required

O_2 required = $J*(O_2/cont.)$ Eqn. 4

4A. Glacial Sediments

	> 5,000 ug/L Area			1,000 - 5,000 ug/L Area			100 - 1,000 ug/L Area		
Groundwater Flow Rate	- L/day	(Eqn. 1)		7,553 L/day	(Eqn. 1)		57,306 L/day	(Eqn. 1)	
Contaminant Flux & O_2 Requirement	Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)	
BTEX	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	3.78E-02 kg/day	1.21E-01 kg/day	2.66E-01 lb/day	5.73E-02 kg/day	1.83E-01 kg/day	4.04E-01 lb/day
PAHs	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	3.78E-02 kg/day	1.13E-01 kg/day	2.50E-01 lb/day	5.73E-02 kg/day	1.72E-01 kg/day	3.79E-01 lb/day
Ferrous Iron	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	2.24E-01 kg/day	2.24E-02 kg/day	4.95E-02 lb/day	1.70E+00 kg/day	1.70E-01 kg/day	3.75E-01 lb/day
Subtotals	0.00E+00 kg/day	0.00E+00 kg/day	0.00 lb/day	3.00E-01 kg/day	2.57E-01 kg/day	0.566 lb/day	1.82E+00 kg/day	5.25E-01 kg/day	1.159 lb/day

Total Glacial Sediments	Contaminant Flux	Oxygen Requirement	SF	
	2.12E+00 kg/day	1.72 lb/day	4	**6.90** lb/day

Oxygen Required to Change DO Concentration Within the Treatment Barrier

Treatment Barrier Dimensions	Length (Normal to Flow Vector)	462 ft		page 24 of 74
	Height	36 ft		page 23 of 74
	Area	16,641 ft^2		
Groundwater Flow Through the Treatment Barrier		132,256 L/day	(Eqn. 1)	
DO Concentration Change		2 mg/L		
Oxygen Requirement for DO Change		**0.58** lb/day	(Eqn. 3)	
Total Oxygen Requirement for Glacial Sediments		**7.48** lb/day		

System No. 2

4B. Upper Magothy Sediments

	> 5,000 ug/L Area						1,000 - 5,000 ug/L Area				100 - 1,000 ug/L Area			
Groundwater Flow Rate	- L/day	(Eqn. 1)					13,349 L/day	(Eqn. 1)			27,748 L/day	(Eqn. 1)		
Contaminant Flux & O_2 Requirement	Flux (Eqn. 2)		Oxygen Requirement (Eqn. 4)				Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)			Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		
BTEX	- kg/day		- kg/day	- lb/day			6.67E-02 kg/day	2.14E-01 kg/day	4.71E-01 lb/day		2.77E-02 kg/day	8.88E-02 kg/day	1.96E-01 lb/day	
PAHs	- kg/day		- kg/day	- lb/day			6.67E-02 kg/day	2.00E-01 kg/day	4.41E-01 lb/day		2.77E-02 kg/day	8.32E-02 kg/day	1.84E-01 lb/day	
Ferrous Iron	- kg/day		- kg/day	- lb/day			3.96E-01 kg/day	3.96E-02 kg/day	8.74E-02 lb/day		0.82 kg/day	0.08 kg/day	1.82E-01 lb/day	
Subtotals	- kg/day		- kg/day	- lb/day			5.30E-01 kg/day	4.53E-01 kg/day	1.00 lb/day		8.80E-01 kg/day	2.54E-01 kg/day	0.56 lb/day	

Total Upper Magothy Sediments	Contaminant Flux		Oxygen Requirement	
			SF	
	1.41E+00 kg/day	1.56 lb/day	4	**6.24** lb/day

Oxygen Required to Change DO Concentration Within the Treatment Barrier

Treatment Barrier Dimensions	Length (Normal to Flow Vector)	462 ft		page 24 of 74
	Height	17 ft		page 23 of 74
	Area	7,858 ft^2		
Groundwater Flow Through the Treatment Barrier		42,831 L/day	(Eqn. 1)	
DO Concentration Change		2 mg/L		
Oxygen Requirement for DO Change			**0.19** lb/day	(Eqn. 3)

Total Oxygen Requirement for Upper Magothy Sediments **6.43** lb/day

Total System No. 2	Contaminant Flux	Oxygen Requirement	
	3.53 kg/day	**13.91** lb/day	← Design Basis

System No. 2

5. Oxygen Injection System Flow Rates

Typical Flow Rate (Entire System)	120 ft^3/hr	
Volume/day	2880 ft^3/d	
Oxygen Concentration	90%	
Oxygen Transfer Efficiency	75%	
Volume Oxygen Transferred/Day	1944 ft^3/d	
Mass Oxygen (M_{O2}) Transferred/Day		
n = PV/RT	Eqn. 5	
where:		
n = No. moles O_2		
P = pressure (atm)	1 atm	
V = volume (L)	1944 ft^3/d	55054.1 L/d
R = Universal Gas constant (atm*L/mol*K)	0.08206 atm*L/mol*K	
T = temperature (K)	0 deg C	273 K
M_{O2} = n* mol wt. O_2	Eqn. 6	
where:		
mol wt. O_2	32 g/g-mol.	

n (Eqn. 5)		M_{O2} (Eqn 6)
2457.51 moles/d	78,640 g/d	**173.4** lbs/d

Notes:

(1) Because of insufficient groundwater analytical data along the proposed oxygen injection line, the average BTEX or PAHs concentration within a concentration interval is assumed to equal the upper limit of the concentration interval.
(2) The stoichiometric ratio of oxygen to concentration for BTEX is assumed to be 0.32 based on the fact that the stoichiometric ratio of oxygen to concentration for individual BTEX ranges from 0.31 to 0.32.
The stoichiometric ratio of oxygen to concentration for PAHs is assumed to be 0.3 based on the fact that the stoichiometric ratio of oxygen to concentration for individual PAH ranges from 0.29 to 0.30.
(3) The value of the highest ferrous iron concentration detected at the site is used to calculate the oxygen demand from ferrous iron at Mirschel Park.

System No. 3

1. Hydrogeologic Characteristics

1A. Glacial Sediments

Hydraulic Conductivity [k]	158.5 ft/day	page 54-56 of 74
Hydraulic Gradient [i]	0.0018	page 54 of 74

2A. Upper Magothy Sediments

Hydraulic Conductivity [k]	110.0 ft/day	page 54-56 of 74
Hydraulic Gradient [i]	0.0017	page 54 of 74

2. Plume Cross-Sectional Areas (A)

2A. Glacial Sediments (page 51 of 74)

	Areas Shown on Cross-Section C1-C1' (ft²) Concentration Interval			Correction Factor	Areas Normal to Flow Vector (ft²) Concentration Interval		
Section (refer to page 23 of 74)	100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L		100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L
C1 - 1	-	-	-		-	-	-
1 - 2	-	-	-		-	-	-
2 - C1'	455	-	-	0.927	422	-	-
Totals	455	-	-		422	-	-

2B. Upper Magothy Sediments (page 51 of 74)

	Areas Shown on Cross-Section C1-C1' (ft²) Concentration Interval			Correction Factor	Areas Normal to Flow Vector (ft²) Concentration Interval		
Section (refer to page 23 of 74)	100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L		100-1,000 ug/L	1,000 - 5,000 ug/L	>5,000 ug/L
C1 - 1	2,001	-	-	0.927	1,856	-	-
1 - 2	2,594	-	-	0.375	972	-	-
2 - C1'	6,772	2,763	-	0.927	6,279	2,561	-
Totals	11,367	2,763	-		9,106	2,561	-

3. Stoichiometric Ratios (O_2/cont.) & Dissolved-Phase Concentrations (C_w)

		Average Concentration, C_w (Interval)[1]		
Compound	(O_2/cont.)	≥ 5,000 ug/L	1,000 - 5,000 ug/L	100 - 1,000 ug/L
BTEX[2]	3.2	- ug/L	5,000 ug/L	1,000 ug/L
PAHs[2]	3.0	- ug/L	5,000 ug/L	1,000 ug/L

Other Electron Acceptors	(O_2/cont.)	> 5,000 ug/L	1,000 - 5,000 ug/L	100 - 1,000 ug/L
Ferrous Iron[3]	0.1	29.7 mg/L	29.7 mg/L	29.7 mg/L
Required Minimum Dissolved Oxygen Concentration	1.0	2 mg/L	2 mg/L	2 mg/L

System No. 3

4. Contaminant Flux Through Barrier & Oxygen Requirements

Groundwater Flow Rate

$Q=k*i*A*(28.319)$ Eqn. 1

where: Q = volumetric flow rate

28.319 = a conversion factor (L/ft^3)

Contaminant Flux

$J_c = C_w*Q*1x10^{-9}$ Eqn. 2

where: J_c = contaminant flux

$1x10^{-9}$ = a conversion factor (kg/ug)

Dissolved Oxygen (DO) Flux

$J_{DO} = C_{DO}*Q*1x10^{-6}$ Eqn. 3

where: J_{DO} = dissolved oxygen flux

C_{DO} =concentration of dissolved oxygen

$1x10^{-6}$ = a conversion factor (kg/mg)

Oxygen Required

O_2 required = $J*(O_2/cont.)$ Eqn. 4

4A. Glacial Sediments

	> 5,000 ug/L Area			1,000 - 5,000 ug/L Area			100 - 1,000 ug/L Area		
Groundwater Flow Rate	- L/day	(Eqn. 1)		- L/day	(Eqn. 1)		3,355 L/day	(Eqn. 1)	
Contaminant Flux & O_2 Requirement	Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)		Flux (Eqn. 2)	Oxygen Requirement (Eqn. 4)	
BTEX	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	3.36E-03 kg/day	1.07E-02 kg/day	2.37E-02 lb/day
PAHs	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	3.36E-03 kg/day	1.01E-02 kg/day	2.22E-02 lb/day
Ferrous Iron	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.00E+00 lb/day	9.96E-02 kg/day	9.96E-03 kg/day	2.20E-02 lb/day
Subtotals	0.00E+00 kg/day	0.00E+00 kg/day	0.00 lb/day	0.00E+00 kg/day	0.00E+00 kg/day	0.000 lb/day	1.06E-01 kg/day	3.08E-02 kg/day	0.068 lb/day

Total Glacial Sediments	Contaminant Flux	Oxygen Requirement	SF	
	1.06E-01 kg/day	0.07 lb/day	4	0.27 lb/day

Oxygen Required to Change DO Concentration Within the Treatment Barrier

Treatment Barrier Dimensions	Length (Normal to Flow Vector)	409 ft		page 24 of 74
	Height	36 ft		page 23 of 74
	Area	14,734 ft^2		
Groundwater Flow Through the Treatment Barrier		117,106 L/day	(Eqn. 1)	
DO Concentration Change		2 mg/L		
Oxygen Requirement for DO Change			0.52 lb/day	(Eqn. 3)
Total Oxygen Requirement for Glacial Sediments			0.79 lb/day	

System No. 3

4B. Upper Magothy Sediments

	> 5,000 ug/L Area						1,000 - 5,000 ug/L Area						100 - 1,000 ug/L Area					
Groundwater Flow Rate	-	L/day	(Eqn. 1)				13,961	L/day	(Eqn. 1)				49,635	L/day	(Eqn. 1)			
Contaminant Flux & O_2 Requirement	Flux (Eqn. 2)		Oxygen Requirement (Eqn. 4)				Flux (Eqn. 2)		Oxygen Requirement (Eqn. 4)				Flux (Eqn. 2)		Oxygen Requirement (Eqn. 4)			
BTEX	-	kg/day	-	kg/day	-	lb/day	6.98E-02	kg/day	2.23E-01	kg/day	4.92E-01	lb/day	4.96E-02	kg/day	1.59E-01	kg/day	3.50E-01	lb/day
PAHs	-	kg/day	-	kg/day	-	lb/day	6.98E-02	kg/day	2.09E-01	kg/day	4.62E-01	lb/day	4.96E-02	kg/day	1.49E-01	kg/day	3.28E-01	lb/day
Ferrous Iron	-	kg/day	-	kg/day	-	lb/day	4.15E-01	kg/day	4.15E-02	kg/day	9.14E-02	lb/day	1.47	kg/day	0.15	kg/day	3.25E-01	lb/day
Subtotals	-	kg/day	-	kg/day	-	lb/day	5.54E-01	kg/day	4.74E-01	kg/day	1.05	lb/day	1.57E+00	kg/day	4.55E-01	kg/day	1.00	lb/day

Total Upper Magothy Sediments	Contaminant Flux	Oxygen Requirement	SF	
	2.13E+00 kg/day	2.05 lb/day	4	**8.20** lb/day

Oxygen Required to Change DO Concentration Within the Treatment Barrier

Treatment Barrier Dimensions	Length (Normal to Flow Vector)	409 ft		page 24 of 74
	Height	32 ft		page 23 of 74
	Area	13,097 ft^2		
Groundwater Flow Through the Treatment Barrier		71,388 L/day	(Eqn. 1)	
DO Concentration Change		2 mg/L		
Oxygen Requirement for DO Change			**0.31** lb/day	(Eqn. 3)

Total Oxygen Requirement for Upper Magothy Sediments **8.51** lb/day

Total System No. 3	Contaminant Flux	Oxygen Requirement	
	2.23 kg/day	**9.30** lb/day	← Design Basis

System No. 3

5. Oxygen Injection System Flow Rates

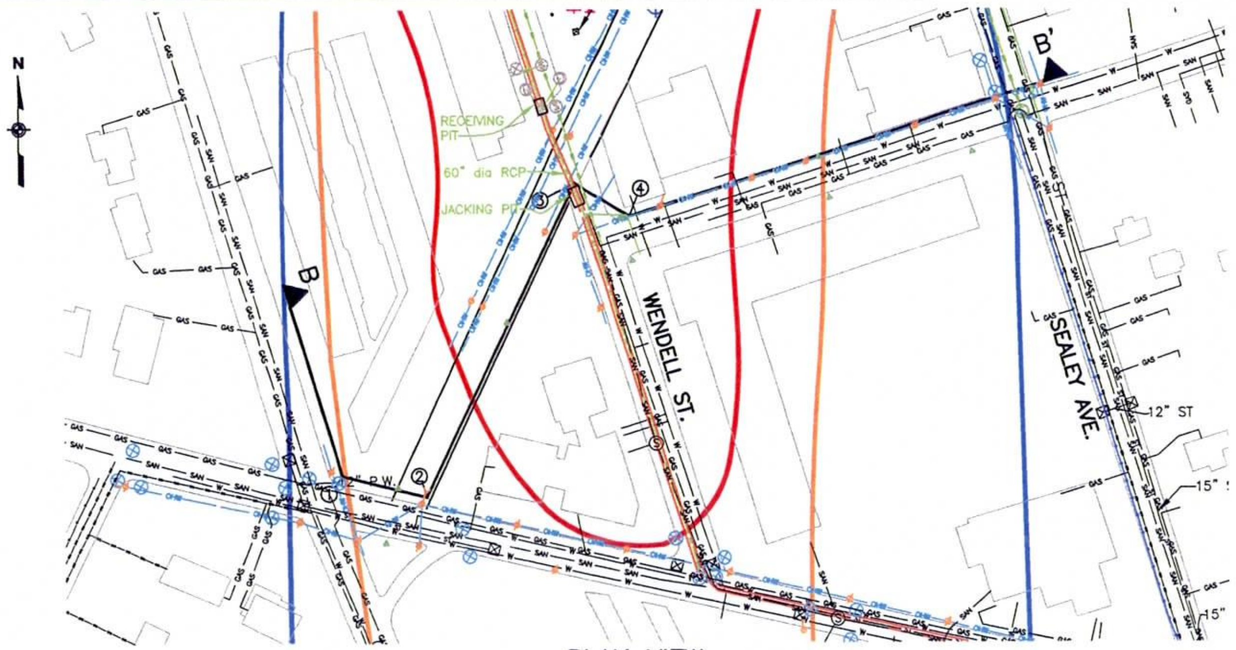
Typical Flow Rate (Entire System)	120 ft^3/hr	
Volume/day	2880 ft^3/d	
Oxygen Concentration	90%	
Oxygen Transfer Efficiency	75%	
Volume Oxygen Transferred/Day	1944 ft^3/d	
Mass Oxygen (M_{O2}) Transferred/Day		
n = PV/RT	Eqn. 5	
where:		
n = No. moles O_2		
P = pressure (atm)	1 atm	
V = volume (L)	1944 ft^3/d	55054.1 L/d
R = Universal Gas constant (atm*L/mol*K)	0.08206 atm*L/mol*K	
T = temperature (K)	0 deg C	273 K
M_{O2} = n* mol wt. O_2	Eqn. 6	
where:		
mol wt. O_2	32 g/g-mol.	

n (Eqn. 5)		M_{O2} (Eqn 6)
2457.51 moles/d	78,640 g/d	**173.4** lbs/d

Notes:

(1) Because of insufficient groundwater analytical data along the proposed oxygen injection line, the average BTEX or PAHs concentration within a concentration interval is assumed to equal the upper limit of the concentration interval.
(2) The stoichiometric ratio of oxygen to concentration for BTEX is assumed to be 0.32 based on the fact that the stoichiometric ratio of oxygen to concentration for individual BTEX ranges from 0.31 to 0.32.
The stoichiometric ratio of oxygen to concentration for PAHs is assumed to be 0.3 based on the fact that the stoichiometric ratio of oxygen to concentration for individual PAH ranges from 0.29 to 0.30.
(3) The value of the highest ferrous iron concentration detected at the site is used to calculate the oxygen demand from ferrous iron at Mirschel Park.

REFERENCES



PLAN VIEW

100' 0 100'
SCALE IN FEET

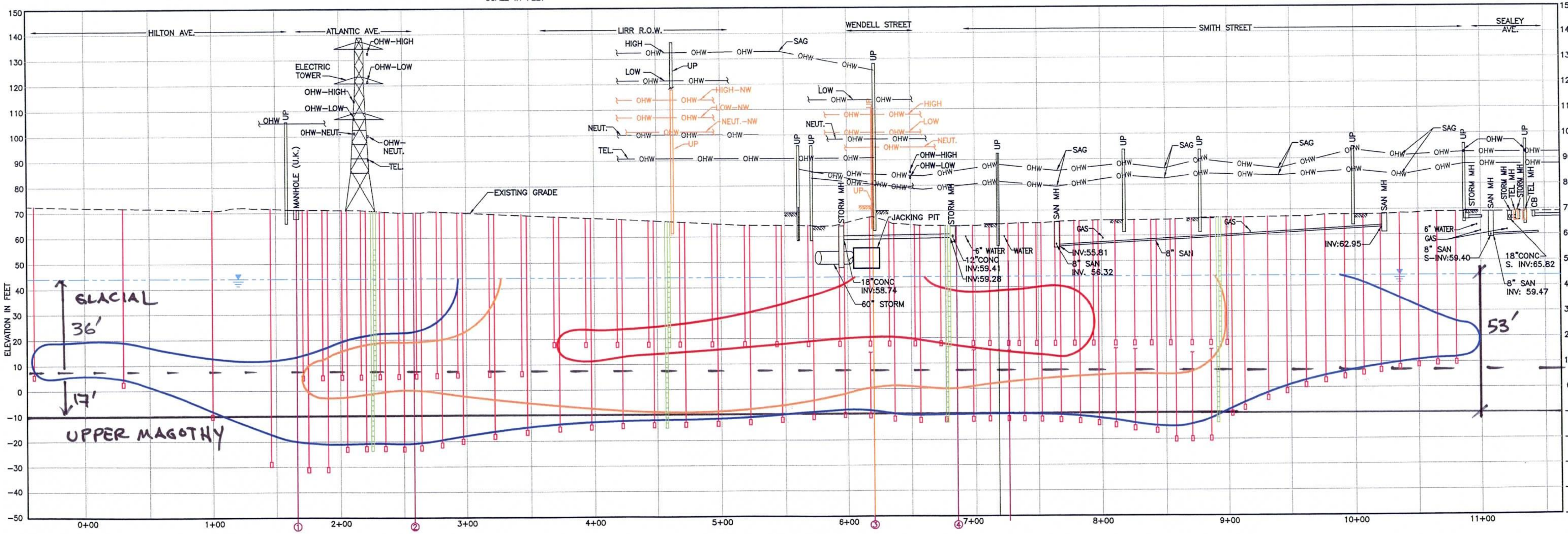
NOTE:

1. THE CROSS-SECTION B–B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 8 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.
3. THE HORIZONTAL SPACING OF SOME OXYGEN DELIVERY WELLS HAVE BEEN MODIFIED TO AVOID UTILITIES AND STRUCTURES IN THE AREA.

LEGEND:

- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- PROPOSED OXYGEN DELIVERY WELLS
- SCREENED INTERVAL
- PROPOSED MONITORING POINT(S)
- UTILITY POLE (NEAR SIDE)
- UTILITY POLE (FAR SIDE)
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- OHW — OVERHEAD ELECTRIC WIRE (FAR SIDE)
- OHW — OVERHEAD ELECTRIC WIRE (NEAR SIDE)

APPROXIMATE TREATMENT AREA HEIGHT (ft.)



SECTION B–B'
(TREATMENT SYSTEM 1)

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

URS Corporation
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77 Goodell Street, Buffalo, New York 14203
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JOB NO. 11175065

NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

OXYGEN DELIVERY WELLS AND UTILITIES, SECTION B–B', TREATMENT SYSTEM 1

Scale: AS SHOWN | Date: SEPT. 2009 | [redacted]

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 7-8.dwg 9/29/09 - 3 RAL

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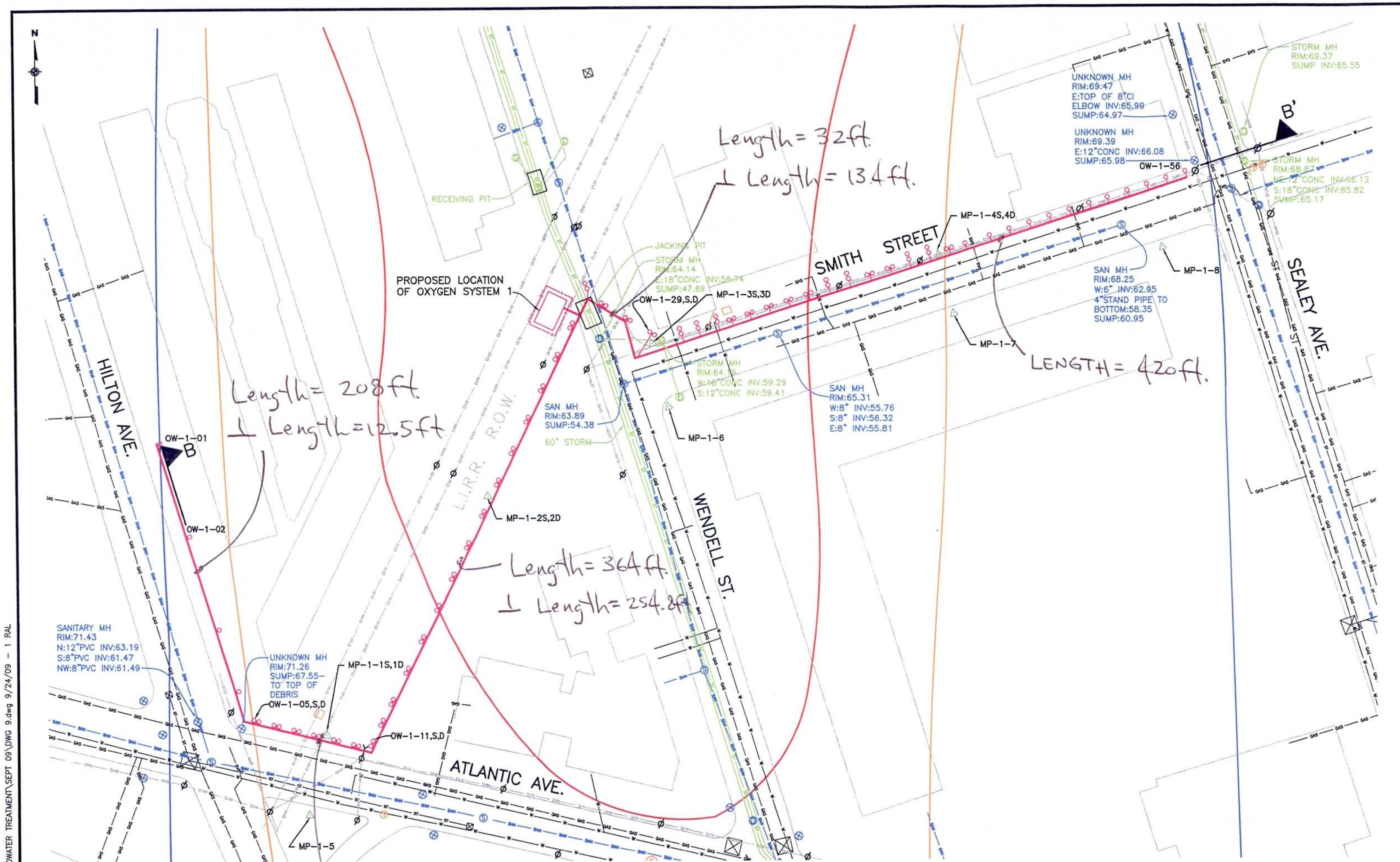


Oxygen Well Schedule Treatment System 1					
Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-1-01	72.5	63.2	65.2	66.2	68.2
OW-1-02	71.8	65.5	67.5	68.5	70.5
OW-1-03	70.9	77.3	79.3	80.3	82.3
OW-1-04	71.5	96.5	98.5	99.5	101.5
OW-1-05S	71.1	62.2	64.2	65.2	67.2
OW-1-05D	71.1	98.3	100.3	101.3	103.3
OW-1-06S	71.1	62.1	64.1	65.1	67.1
OW-1-06D	71.0	98.2	100.2	101.2	103.2
OW-1-07S	71.0	61.9	63.9	64.9	66.9
OW-1-07D	71.0	90.1	92.1	93.1	95.1
OW-1-08S	70.9	61.7	63.7	64.7	66.7
OW-1-08D	70.8	89.7	91.7	92.7	94.7
OW-1-09S	70.5	61.2	63.2	64.2	66.2
OW-1-09D	70.4	89.2	91.2	92.2	94.2
OW-1-10S	70.0	60.6	62.6	63.6	65.6
OW-1-10D	70.0	89.0	91.0	92.0	94.0
OW-1-11S	70.0	60.5	62.5	63.5	65.5
OW-1-11D	70.0	88.6	90.6	91.6	93.6
OW-1-12S	70.3	60.6	62.6	63.6	65.6
OW-1-12D	70.2	87.7	89.7	90.7	92.7
OW-1-13S	69.9	60.0	62.0	63.0	65.0
OW-1-13D	69.8	85.9	87.9	88.9	90.9
OW-1-14S	69.3	59.2	61.2	62.2	64.2
OW-1-14D	69.2	83.5	85.5	86.5	88.5
OW-1-15S	69.0	58.7	60.7	61.7	63.7
OW-1-15D	68.6	81.3	83.3	84.3	86.3
OW-1-16S	68.2	42.5	44.5	45.5	47.5
OW-1-16D	68.1	79.6	81.6	82.6	84.6
OW-1-17S	67.6	45.9	47.9	48.9	50.9
OW-1-17D	67.5	78.3	80.3	81.3	83.3
OW-1-18S	67.1	45.4	47.4	48.4	50.4
OW-1-18D	67.0	77.3	79.3	80.3	82.3
OW-1-19S	66.4	44.7	46.7	47.7	49.7
OW-1-19D	66.3	76.3	78.3	79.3	81.3
OW-1-20S	65.8	44.1	46.1	47.1	49.1
OW-1-20D	65.6	75.4	77.4	78.4	80.4
OW-1-21S	65.1	43.4	45.4	46.4	48.4
OW-1-21D	65.0	74.5	76.5	77.5	79.5
OW-1-22S	64.4	42.7	44.7	45.7	47.7
OW-1-22D	64.4	73.4	75.4	76.4	78.4
OW-1-23S	64.4	42.7	44.7	45.7	47.7
OW-1-23D	64.4	72.5	74.5	75.5	77.5
OW-1-24S	64.2	42.5	44.5	45.5	47.5
OW-1-24D	64.2	71.3	73.3	74.3	76.3
OW-1-25S	64.7	43.0	45.0	46.0	48.0
OW-1-25D	65.2	71.5	73.5	74.5	76.5
OW-1-26S	67.6	45.9	47.9	48.9	50.9
OW-1-26D	67.6	74.1	76.1	77.1	79.1
OW-1-27S	65.7	44.0	46.0	47.0	49.0
OW-1-27D	65.0	72.8	74.8	75.8	77.8
OW-1-28S	64.4	42.7	44.7	45.7	47.7
OW-1-28D	64.2	72.6	74.6	75.6	77.6
OW-1-29S	64.1	42.4	44.4	45.4	47.4
OW-1-29D	64.1	72.3	74.3	75.3	77.3

Continued

Oxygen Well Schedule Treatment System 1					
Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-1-30S	64.0	42.3	44.3	45.3	47.3
OW-1-30D	64.0	72.0	74.0	75.0	77.0
OW-1-31S	64.3	42.6	44.6	45.6	47.6
OW-1-31D	64.3	72.3	74.3	75.3	77.3
OW-1-32S	64.7	43.0	45.0	46.0	48.0
OW-1-32D	64.7	72.6	74.6	75.6	77.6
OW-1-33S	64.9	43.2	45.2	46.2	48.2
OW-1-33D	65.0	72.9	74.9	75.9	77.9
OW-1-34S	65.0	43.3	45.3	46.3	48.3
OW-1-34D	65.0	73.0	75.0	76.0	78.0
OW-1-35S	65.4	43.7	45.7	46.7	48.7
OW-1-35D	65.5	73.8	75.8	76.8	78.8
OW-1-36S	65.9	44.2	46.2	47.2	49.2
OW-1-36D	65.8	74.6	76.6	77.6	79.6
OW-1-37S	66.0	44.3	46.3	47.3	49.3
OW-1-37D	66.0	75.6	77.6	78.6	80.6
OW-1-38S	66.0	44.3	46.3	47.3	49.3
OW-1-38D	66.0	76.4	78.4	79.4	81.4
OW-1-39S	66.2	44.5	46.5	47.5	49.5
OW-1-39D	66.2	77.8	79.8	80.8	82.8
OW-1-40S	66.1	44.4	46.4	47.4	49.4
OW-1-40D	66.1	78.8	80.8	81.8	83.8
OW-1-41S	66.2	44.5	46.5	47.5	49.5
OW-1-41D	66.3	82.4	84.4	85.4	87.4
OW-1-42S	66.6	44.9	46.9	47.9	49.9
OW-1-42D	66.6	82.7	84.7	85.7	87.7
OW-1-43S	67.0	45.3	47.3	48.3	50.3
OW-1-43D	67.0	82.8	84.8	85.8	87.8
OW-1-44S	67.2	45.5	47.5	48.5	50.5
OW-1-44D	67.0	73.1	75.1	76.1	78.1
OW-1-45	67.0	70.9	72.9	73.9	75.9
OW-1-46	67.1	67.2	69.2	70.2	72.2
OW-1-47	67.3	64.7	66.7	67.7	69.7
OW-1-48	67.3	62.5	64.5	65.5	67.5
OW-1-49	67.9	61.2	63.2	64.2	66.2
OW-1-50	68.0	59.7	61.7	62.7	64.7
OW-1-51	68.0	58.4	60.4	61.4	63.4
OW-1-52	68.1	57.3	59.3	60.3	62.3
OW-1-53	68.4	56.6	58.6	59.6	61.6
OW-1-54	68.6	55.8	57.8	58.8	60.8
OW-1-55	69.0	56.2	58.2	59.2	61.2
OW-1-56	68.9	55.1	57.1	58.1	60.1
Monitoring Points					
MP-1-1S	70.6	15.0	17.0	18.0	66.6
MP-1-1D	70.7	15.0	17.0	18.0	94.4
MP-1-2S	66.0	15.0	17.0	18.0	49.4
MP-1-2D	66.1	15.0	17.0	18.0	81.2
MP-1-3S	64.0	15.0	17.0	18.0	47.7
MP-1-3D	64.1	15.0	17.0	18.0	77.5
MP-1-4S	67.0	15.0	17.0	18.0	51.1
MP-1-4D	67.0	15.0	17.0	18.0	80.8
MP-1-5	70.6	15.0	17.0	18.0	93.6
MP-1-6	64.0	15.0	17.0	18.0	77.4
MP-1-7	67.0	15.0	17.0	18.0	80.8
MP-1-8	68.9	15.0	17.0	18.0	61.1

LEGEND:

- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- PROPOSED OXYGEN DELIVERY WELL
- PROPOSED ROUTING OF TUBING BUNDLE FOR OXYGEN DELIVERY.
- PROPOSED MONITORING POINTS

Length= 96ft.
⊥ Length= 81.6ft.

NOTES:

1. UTILITY AND OTHER INFORMATION SHOWN HAS NOT BEEN SURVEYED OR VERIFIED BY URS OR NATIONAL GRID.
2. ALL WELL, TRENCH, AND OTHER SYSTEM LOCATIONS SHOWN ARE ESTIMATED BASED ON THE AVAILABLE INFORMATION. ALL LOCATIONS WILL BE FIELD VERIFIED PRIOR TO CONSTRUCTION BASED ON UTILITY MARKOUTS, ACCESS AGREEMENTS, RESIDENT CONCERNS, AND OTHER FACTORS.
3. SEE DRAWING 10 FOR TYPICAL WELL AND TRENCH CONSTRUCTION DETAILS.
4. FOR OXYGEN DELIVERY WELLS INSTALLED IN SIDEWALKS, THE WELLS SHOULD BE LOCATED TO THE SIDE AND NOT IN THE CENTER OR THE MAIN PATH OF TRAVEL.
5. WELL PAIRS SHOULD BE INSTALLED PARALLEL TO THE STREET WHEREVER POSSIBLE. WELL PAIRS SHOWN PERPENDICULAR ON THESE DRAWINGS ARE TO AVOID UTILITIES. THESE SHOULD BE RE-EVALUATED IN THE FIELD PRIOR TO INSTALLATION, AND SHOULD BE INSTALLED PARALLEL IF POSSIBLE BASED ON THE ACTUAL LOCATION OF THE UTILITIES.

40' 0 40'
SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

URS Corporation
New York
77 Goodell Street, Buffalo, New York 14203
(716)856-5636 - (716)856-2545 fax

JOB NO. 11175065

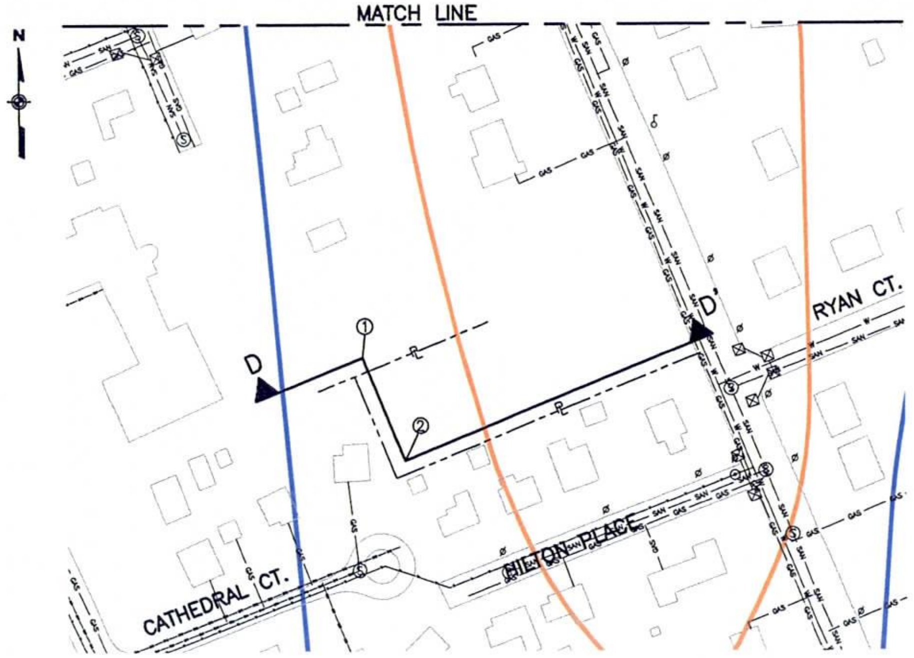
NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

TREATMENT SYSTEM 1 LAYOUT

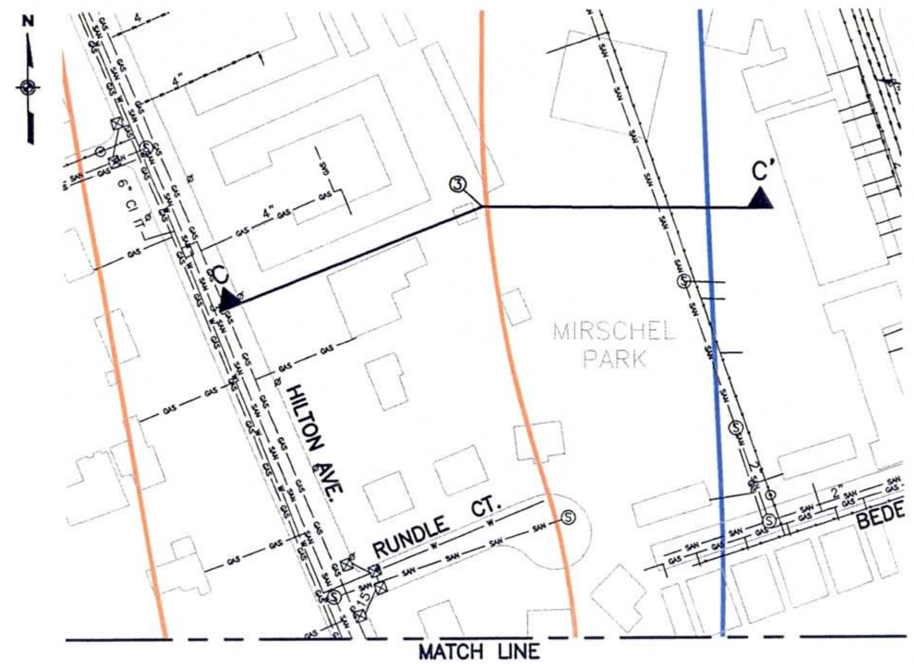
Scale: AS SHOWN | Date: SEPT. 2009 | ~~DWG 9~~

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 9.dwg 9/24/09 - 1 RAL



PLAN VIEW D–D'

100' 0 100'
SCALE IN FEET



PLAN VIEW C–C'

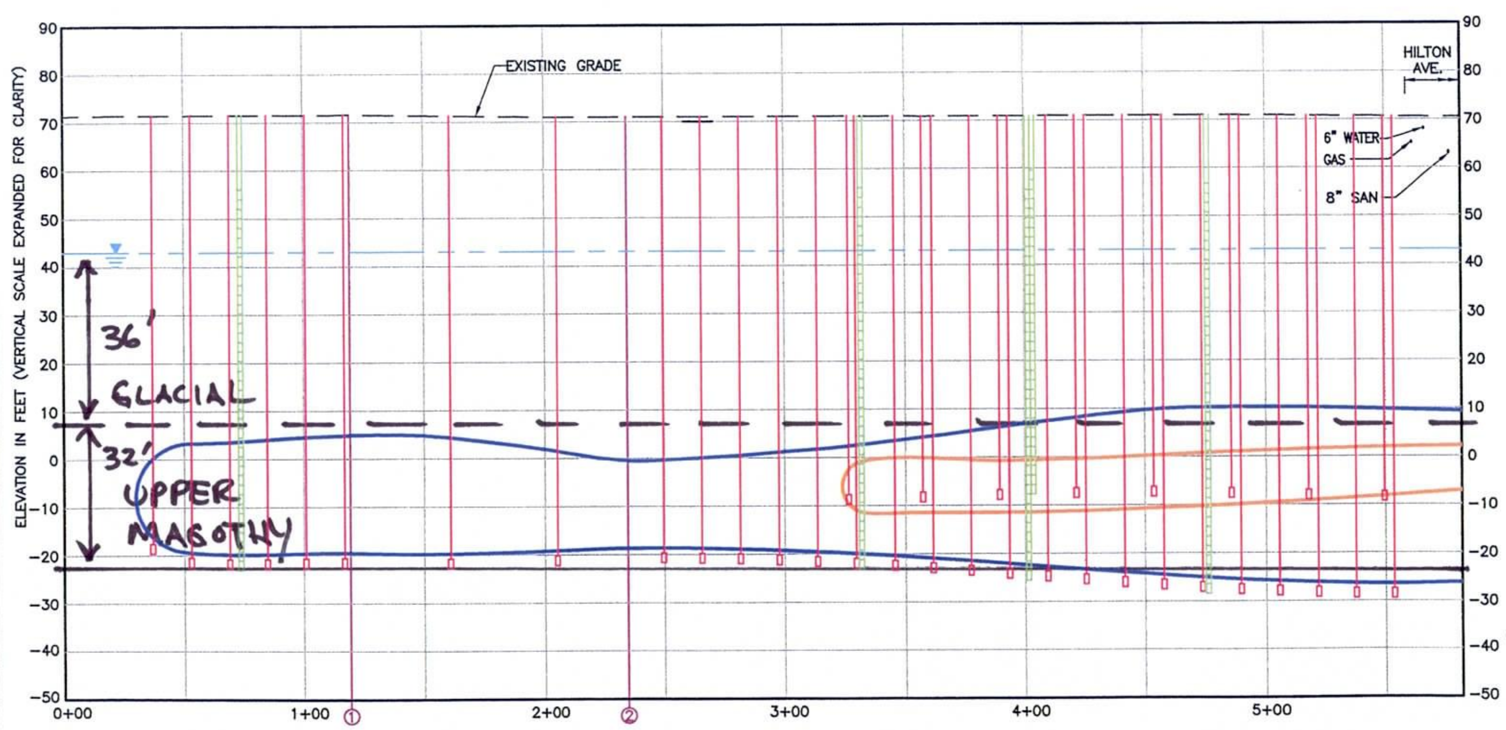
100' 0 100'
SCALE IN FEET

LEGEND:

- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- PROPOSED OXYGEN DELIVERY WELLS
- SCREENED INTERVAL
- PROPOSED MONITORING POINT(S)
- UTILITY POLE
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- — OHW — OVERHEAD ELECTRIC WIRE

NOTE:

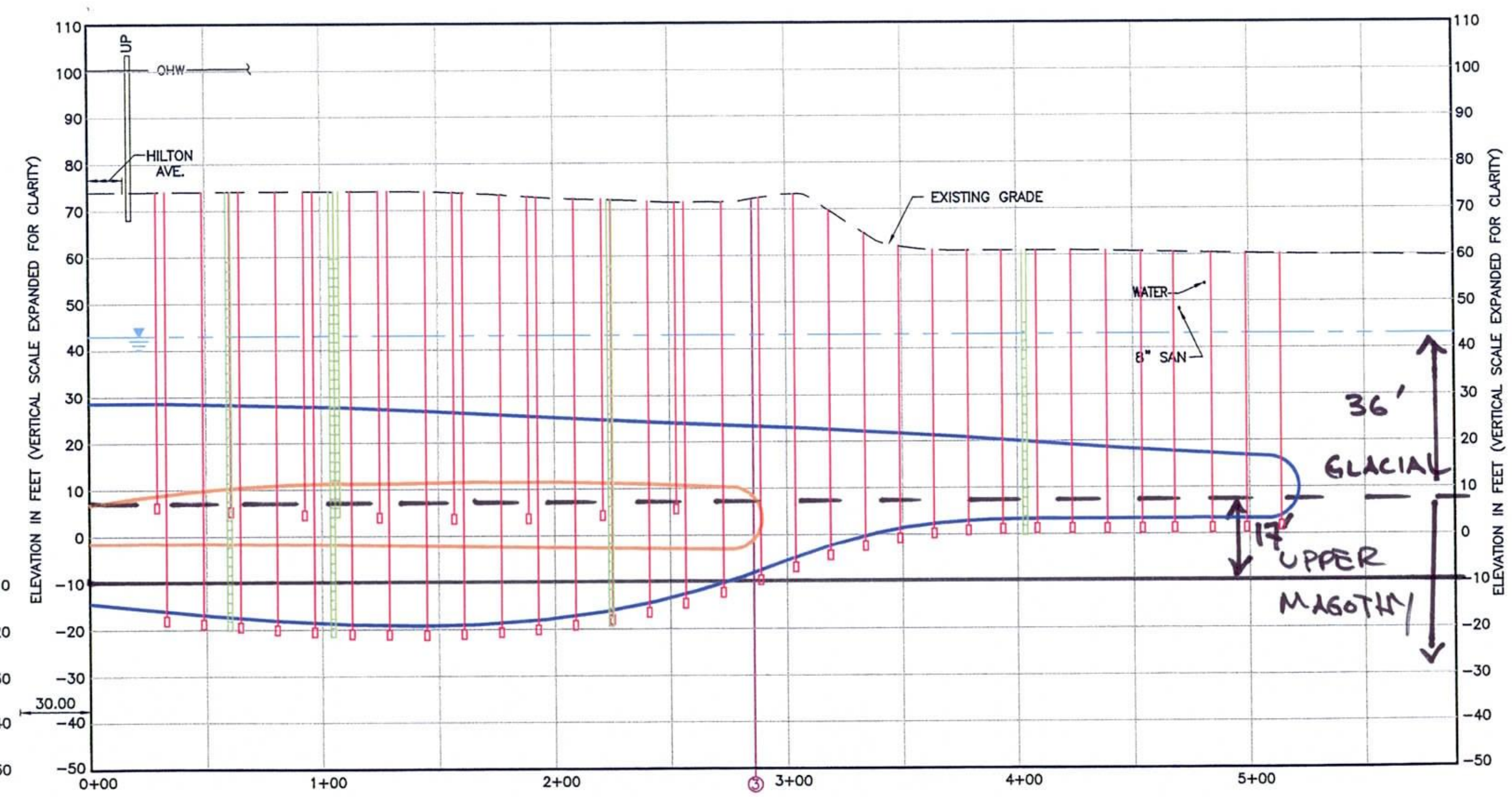
1. THE CROSS–SECTIONS C–C' AND D–D' REPRESENT THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 9 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.
3. THE HORIZONTAL SPACING OF SOME OXYGEN DELIVERY WELLS HAVE BEEN MODIFIED TO AVOID UTILITIES AND STRUCTURES IN THE AREA.



SECTION D–D'
(TREATMENT SYSTEM 3)

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET



SECTION C–C'
(TREATMENT SYSTEM 2)

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

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New York
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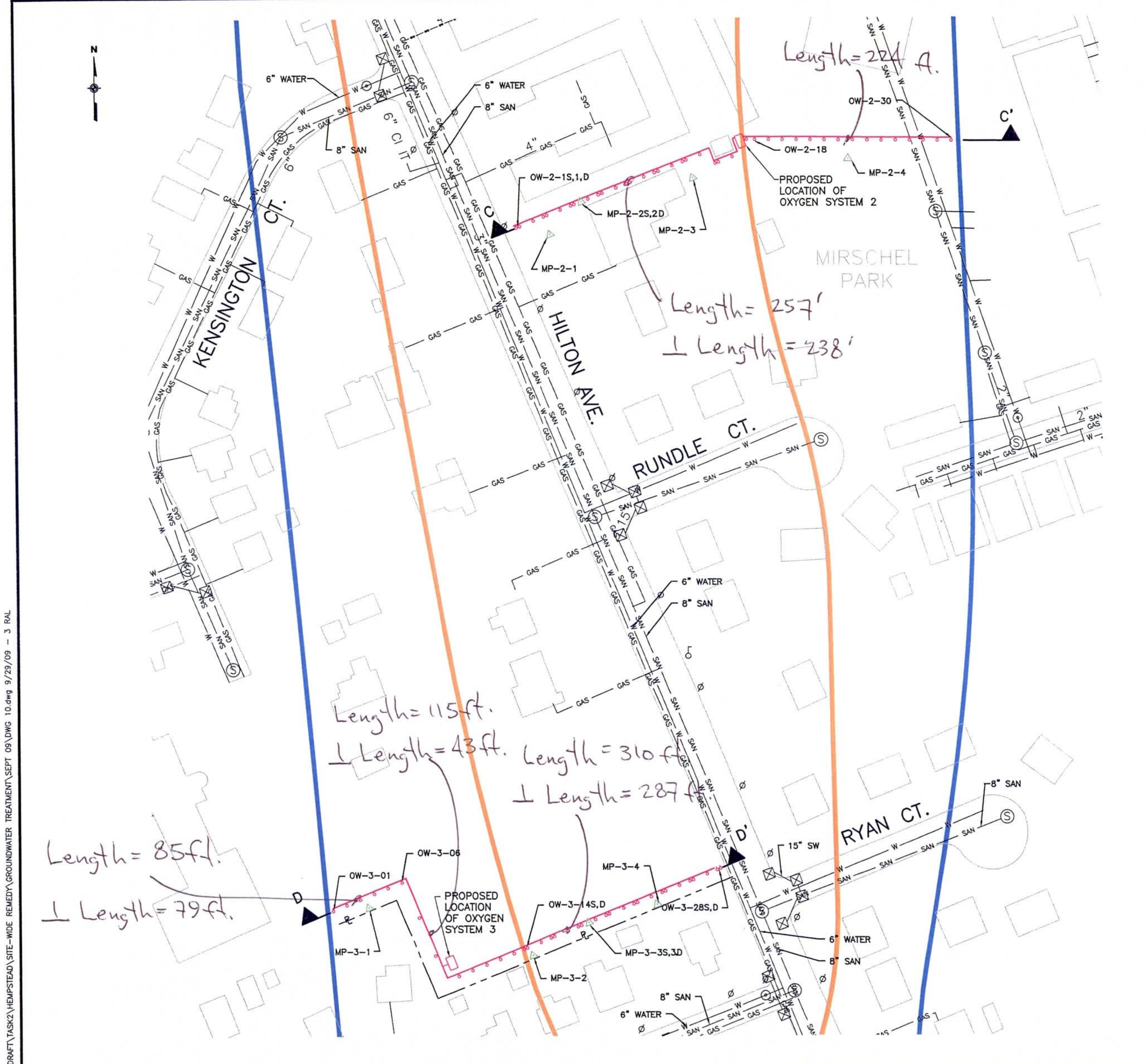
THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

OXYGEN DELIVERY WELLS AND UTILITIES, SECTION C–C' AND D–D', TREATMENT SYSTEMS 2 AND 3

Scale: AS SHOWN | Date: SEPT. 2009 | ~~DWG 8~~



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Oxygen Well Schedule Treatment System 2					
Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-2-1S	74.0	63.8	65.8	66.8	68.8
OW-2-1D	74.0	88.0	90.0	91.0	93.0
OW-2-2	74.0	88.9	90.9	91.9	93.9
OW-2-3S	74.0	64.7	66.7	67.7	69.7
OW-2-3D	74.0	89.5	91.5	92.5	94.5
OW-2-4	74.0	90.1	92.1	93.1	95.1
OW-2-5S	74.0	65.4	67.4	68.4	70.4
OW-2-5D	74.0	90.6	92.6	93.6	95.6
OW-2-6	74.0	91.0	93.0	94.0	96.0
OW-2-7S	74.0	66.0	68.0	69.0	71.0
OW-2-7D	74.1	91.2	93.2	94.2	96.2
OW-2-8	74.0	91.3	93.3	94.3	96.3
OW-2-9S	73.8	66.2	68.2	69.2	71.2
OW-2-9D	73.7	90.8	92.8	93.8	95.8
OW-2-10	73.3	90.0	92.0	93.0	95.0
OW-2-11S	72.8	65.1	67.1	68.1	70.1
OW-2-11D	72.7	88.8	90.8	91.8	93.8
OW-2-12	72.3	87.5	89.5	90.5	92.5
OW-2-13S	72.2	63.9	65.9	66.9	68.9
OW-2-13D	72.0	86.0	88.0	89.0	91.0
OW-2-14	71.7	84.2	86.2	87.2	89.2
OW-2-15S	71.5	61.8	63.8	64.8	66.8
OW-2-15D	71.5	82.1	84.1	85.1	87.1
OW-2-16	71.5	79.8	81.8	82.8	84.8
OW-2-17	72.4	80.7	82.7	83.7	85.7
OW-2-18	73.2	76.1	78.1	79.1	81.1
OW-2-19	69.8	70.2	72.2	73.2	75.2
OW-2-20	64.9	63.2	65.2	66.2	68.2
OW-2-21	62.0	58.8	60.8	61.8	63.8
OW-2-22	61.1	56.8	58.8	59.8	61.8
OW-2-23	61.0	56.1	58.1	59.1	61.1
OW-2-24	61.0	55.8	57.8	58.8	60.8
OW-2-25	61.0	55.7	57.7	58.7	60.7
OW-2-26	61.0	55.7	57.7	58.7	60.7
OW-2-27	60.9	55.6	57.6	58.6	60.6
OW-2-28	60.7	55.5	57.5	58.5	60.5
OW-2-29	60.6	55.3	57.3	58.3	60.3
OW-2-30	60.4	55.1	57.1	58.1	60.1
OW-2-31	60.3	55.0	57.0	58.0	60.0
OW-2-32	60.2	54.4	56.4	57.4	59.4
Monitoring Points					
MP-2-1	74.0	15.0	17.0	18.0	94.2
MP-2-2S	74.0	15.0	17.0	18.0	69.9
MP-2-2D	74.0	15.0	17.0	18.0	95.6
MP-2-3	72.1	15.0	17.0	18.0	91.6
MP-2-4	61.0	15.0	17.0	18.0	61.2

Oxygen Well Schedule Treatment System 3					
Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-3-01	71.5	86.1	88.1	89.1	91.1
OW-3-02	71.5	88.9	90.9	91.9	93.9
OW-3-03	71.5	89.4	91.4	92.4	94.4
OW-3-04	71.5	89.4	91.4	92.4	94.4
OW-3-05	71.5	89.2	91.2	92.2	94.2
OW-3-06	71.6	89.3	91.3	92.3	94.3
OW-3-07	71.3	89.1	91.1	92.1	94.1
OW-3-08	71.0	88.2	90.2	91.2	93.2
OW-3-09	71.0	87.7	89.7	90.7	92.7
OW-3-10	71.0	87.8	89.8	90.8	92.8
OW-3-11	71.0	88.0	90.0	91.0	93.0
OW-3-12	71.0	88.0	90.0	91.0	93.0
OW-3-13	71.0	88.6	90.6	91.6	93.6
OW-3-14S	71.0	75.7	77.7	78.7	80.7
OW-3-14D	71.0	89.0	91.0	92.0	94.0
OW-3-15	70.9	89.3	91.3	92.3	94.3
OW-3-16S	70.9	75.2	77.2	78.2	80.2
OW-3-16D	70.9	89.9	91.9	92.9	94.9
OW-3-17	70.9	90.4	92.4	93.4	95.4
OW-3-18S	70.9	74.7	76.7	77.7	79.7
OW-3-18D	70.9	91.0	93.0	94.0	96.0
OW-3-19	71.0	91.8	93.8	94.8	96.8
OW-3-20S	71.0	74.5	76.5	77.5	79.5
OW-3-20D	71.0	92.4	94.4	95.4	97.4
OW-3-21	71.0	93.0	95.0	96.0	98.0
OW-3-22S	71.0	74.3	76.3	77.3	79.3
OW-3-22D	71.0	93.6	95.6	96.6	98.6
OW-3-23	71.0	94.1	96.1	97.1	99.1
OW-3-24S	71.0	74.6	76.6	77.6	79.6
OW-3-24D	71.0	94.6	96.6	97.6	99.6
OW-3-25	70.9	94.5	96.5	97.5	99.5
OW-3-26S	70.8	74.8	76.8	77.8	79.8
OW-3-26D	70.8	95.0	97.0	98.0	100.0
OW-3-27	70.7	95.1	97.1	98.1	100.1
OW-3-28S	70.6	75.0	77.0	78.0	80.0
OW-3-28D	70.6	95.1	97.1	98.1	100.1
Monitoring Points					
MP-3-1	71.5	15.0	17.0	18.0	94.6
MP-3-2	70.9	15.0	17.0	18.0	94.1
MP-3-3S	71.0	15.0	17.0	18.0	78.8
MP-3-3D	70.9	15.0	17.0	18.0	96.5
MP-3-4	71.0	15.0	17.0	18.0	99.5

LEGEND:

- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- ○ PROPOSED OXYGEN DELIVERY WELL
- PROPOSED ROUTING OF TUBING BUNDLE FOR OXYGEN DELIVERY.
- △ PROPOSED MONITORING POINTS

NOTES:

1. UTILITY AND OTHER INFORMATION SHOWN HAS NOT BEEN SURVEYED OR VERIFIED BY URS OR NATIONAL GRID.
2. ALL WELL, TRENCH, AND OTHER SYSTEM LOCATIONS SHOWN ARE ESTIMATED BASED ON THE AVAILABLE INFORMATION. ALL LOCATIONS WILL BE FIELD VERIFIED PRIOR TO CONSTRUCTION BASED ON UTILITY MARKOUTS, ACCESS AGREEMENTS, RESIDENT CONCERNS, AND OTHER FACTORS.
3. SEE DRAWING 10 FOR TYPICAL WELL AND TRENCH CONSTRUCTION DETAILS.
4. FOR OXYGEN DELIVERY WELLS INSTALLED IN SIDEWALKS, THE WELLS SHOULD BE LOCATED TO THE SIDE AND NOT IN THE CENTER OR THE MAIN PATH OF TRAVEL.
5. WELL PAIRS SHOULD BE INSTALLED PARALLEL TO THE STREET WHEREVER POSSIBLE. WELL PAIRS SHOWN PERPENDICULAR ON THESE DRAWINGS ARE TO AVOID UTILITIES. THESE SHOULD BE RE-EVALUATED IN THE FIELD PRIOR TO INSTALLATION, AND SHOULD BE INSTALLED PARALLEL IF POSSIBLE BASED ON THE ACTUAL LOCATION OF THE UTILITIES.

60' 0 60'
SCALE IN FEET

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 10.dwg 9/29/09 - 3 RAL

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
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JOB NO. 11175065

NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

TREATMENT SYSTEMS 2 AND 3 LAYOUT

Scale: AS SHOWN | Date: SEPT. 2009 | ~~DWG 10~~

25/74

DGP-209 (11/11/08)

DEPTH	TOT. BTEX	TOT. PAHs
34-38	1,709	1,066
40-44	4,980	645
50-54	3,859	1,297
70-74	2	3

HIGP-40 (8/7/00)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	4,166	9,815
56-60	4	112

HIGP-49 (10/16/00)

DEPTH	TOT. BTEX	TOT. PAHs
36-40	ND	ND
60-64	7	63
90-94	ND	16

HIGP-55 (9/7/00)

DEPTH	TOT. BTEX	TOT. PAHs
23-27	31	244
60-64	69	532
80-84	2	ND

HIGP-61 (11/8/00)

DEPTH	TOT. BTEX	TOT. PAHs
26-30	ND	ND
60-64	30	39
90-94	2	2

HIGP-66 (12/14/00)

DEPTH	TOT. BTEX	TOT. PAHs
40-44	ND	1
56-60	8	60
72-76	398	787
90-94	12,970	259

HIGP-71 (11/6/01)

DEPTH	TOT. BTEX	TOT. PAHs
46-50	ND	ND
54-58	ND	ND
62-66	1	7
72-76	29	84
81-85	126	95

HIMW-09S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
28-38	ND-16	ND-8
70-80	ND-2	ND
113-123	ND-16	ND-10

HIMW-15 I,D

DEPTH	TOT. BTEX	TOT. PAHs
80-90	5-111	ND-273
141.5-151.5	ND-94	ND-1

HISB-102(2) (1/8/09)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	423	859
40-44	464	274
50-54	349	652
60-64	68	453
70-74	5	5
80-84	ND	1

HISB-106 (12/4/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	418	602
40-44	1,162	383
50-54	1,800	2,513
60-64	815	572
70-74	68	51
80-84	38	30
90-94	124	98

HISB-114 (12/23/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	ND
50-54	ND	ND
60-64	ND	ND
70-74	ND	ND
80-84	ND	ND
90-94	ND	ND

HIGP-01 (8/7/00)

DEPTH	TOT. BTEX	TOT. PAHs
25-29	ND	ND
56-60	1	1

HIGP-41 (8/11/00)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	2,241	3,258
58-62	1	17

HIGP-50 (9/8/00)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	8
60-64	ND	ND

HIGP-56 (10/9/00)

DEPTH	TOT. BTEX	TOT. PAHs
24-28	ND	2
60-64	ND	ND

HIGP-62 (11/8/00)

DEPTH	TOT. BTEX	TOT. PAHs
37-41	8	4
54-58	771	152
84-89	45	89

HIGP-67 (12/20/00)

DEPTH	TOT. BTEX	TOT. PAHs
37-41	ND	ND
54-58	ND	ND
72-76	ND	27
90-94	ND	ND

HIGP-72 (11/6/01)

DEPTH	TOT. BTEX	TOT. PAHs
52-56	ND	ND
62-66	ND	ND
72-76	ND	ND
82-86	ND	ND
92-96	ND	ND

HIMW-10S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
28-38	ND-33	1-150
80.5-90.5	ND-13	ND
112.5-132.5	ND-16	ND

HIMW-20S,I (2/09)

DEPTH	TOT. BTEX	TOT. PAHs
25-35	ND	ND
63-73	224	179

HISB-103 (12/1/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	4	6
50-54	84	171
60-64	ND	ND
70-74	ND	ND
80-84	5	9

HISB-107 (12/8/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	217	47
50-54	551	258
60-64	29	68
70-74	ND	ND
80-84	ND	ND
90-94	24	8

HISB-115 (1/14/09)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	15
40-44	9	14
50-54	288	265
60-64	125	133
70-74	1,411	1,153
80-84	123	99
90-94	56	67

HIGP-02 (8/8/00)

DEPTH	TOT. BTEX	TOT. PAHs
31-35	ND	ND
56-60	ND	ND

HIGP-44 (8/10/00)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	469	244
57-61	3	47

HIGP-51 (8/31/00)

DEPTH	TOT. BTEX	TOT. PAHs
28-32	ND	ND
58-60	ND	ND

HIGP-57 (9/21/00)

DEPTH	TOT. BTEX	TOT. PAHs
36-40	ND	ND
64-68	ND	ND

HIGP-63 (12/15/00)

DEPTH	TOT. BTEX	TOT. PAHs
37-41	2	3
54-58	18	22
72-76	3,979	2,769
90-94	773	63

HIGP-68 (12/20/00)

DEPTH	TOT. BTEX	TOT. PAHs
37-41	3	5
54-58	163	300
72-76	ND	ND
90-94	ND	ND

HIMW-03S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
23-33	ND-36	ND
80.5-90.5	ND-13	ND
133-143	ND-8.2	ND-30

HIMW-12S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
22-32	ND-11	ND-4
63-73	29.2-256	65-527
117-127	ND-6	ND-2

HISB-100 (11/19/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	12,000	1,576
50-54	441	332
60-64	1,470	599
70-74	747	1,809
80-84	22	21

HISB-104 (9/24/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
45-49	ND	ND
55-59	ND	ND

HISB-108 (12/9/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	ND
50-54	ND	ND
60-64	ND	ND
70-74	12	1
80-84	20	1
90-94	26	2

HITW-01 (9/21/01)

DEPTH	TOT. BTEX	TOT. PAHs
40-44	2	ND
54-58	3	6
70-74	95	278
82-86	293	274
90-94	45	44
109-113	210	1

HIGP-03 (7/28/00)

DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	ND
56-60	ND	ND

HIGP-45 (10/17/00)

DEPTH	TOT. BTEX	TOT. PAHs
32-38	1,229	1,254
60-64	ND	ND

HIGP-52 (9/11/00)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	1,031	2,629
58-60	ND	ND

HIGP-58 (10/18/00)

DEPTH	TOT. BTEX	TOT. PAHs
36-40	ND	ND
60-64	ND	ND
90-94	ND	ND

HIGP-64 (12/18/00)

DEPTH	TOT. BTEX	TOT. PAHs
37-41	27	17
54-58	4,031	1,574
72-76	401	239
90-94	14	48

HIGP-69 (9/24/01)

DEPTH	TOT. BTEX	TOT. PAHs
54-58	ND	ND
70-74	28	28
82-86	126	76
90-94	12	19
104-108	5	ND

HIMW-04S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
30-40	ND-4	ND-1
80-90	ND-13	ND
167-177	ND-4	ND-1

HIMW-13S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
38-48	ND-11	ND
70-80	ND-164	58-156
110-120	2.8-30	ND-21

HISB-101 (11/19/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	122	190
40-44	14,100	4,356
50-54	4,040	3,244
60-64	1,995	2,074
70-74	4	4
80-84	1	2

HISB-105 (12/4/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	518
50-54	469	ND
60-64	1,043	3,058
70-74	60	59
80-84	279	576
90-94	48	99

HISB-109 (12/10/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
40-44	ND	ND
50-54	8	ND
60-64	19	ND
70-74	28	ND
80-84	31	2
90-94	ND	ND

HITW-02 (10/31/01)

DEPTH	TOT. BTEX	TOT. PAHs
55-60	2	ND
65-70	5	9
75-80	9	40
85-90	29	52
115-120	42	ND
148-153	9	0

HIGP-04 (7/24/00)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	ND
56-60	ND	2

HIGP-47 (8/22/00)

DEPTH	TOT. BTEX	TOT. PAHs
31-35	6,670	18,715
60-64	500	369

HIGP-53 (9/1/00)

DEPTH	TOT. BTEX	TOT. PAHs
27-31	76	317
60-64	15	35
90-94	1	ND

HIGP-59 (10/17/00)

DEPTH	TOT. BTEX	TOT. PAHs
34-38	1	ND
60-64	ND	2
90-94	27	4

HIGP-65 (12/19/00)

DEPTH	TOT. BTEX	TOT. PAHs
37-41	2	ND
54-58	376	125
72-76	775	190
90-94	36	59

HIGP-70 (9/20/01)

DEPTH	TOT. BTEX	TOT. PAHs
54-58	ND	0
70-74	21	20
82-86	29	38
92-96	15	18
110-114	3	6
140-144	3	ND

HIMW-05S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
27-37	ND-232	ND-765
80-90	158-439	1,454-5,337
130-140	ND-62	ND-301

HIMW-14 I,D

DEPTH	TOT. BTEX	TOT. PAHs
85-95	72.6-273	41-288
140-150	ND-15	ND

HISB-102 (12/1/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	1,800	2,706
40-44	835	1,119
50-54	225	2,735
60-64	ND	10
70-74	1	4
80-84	76	130

HISB-105(2) (12/18/08)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	15	19
40-44	14	35
50-54	247	912
60-64	560	2,941
70-74	59	34
80-84	14	69
90-94	24	221
100-104	1	ND

HIGP-28 (8/4/00)

DEPTH	TOT. BTEX	TOT. PAHs
29-33	17	22
58-62	2,640	5,933

HIGP-48 (8/25/00)

DEPTH	TOT. BTEX	TOT. PAHs
30-34	ND	2
60-64	766	926

HIGP-54 (9/5/00)

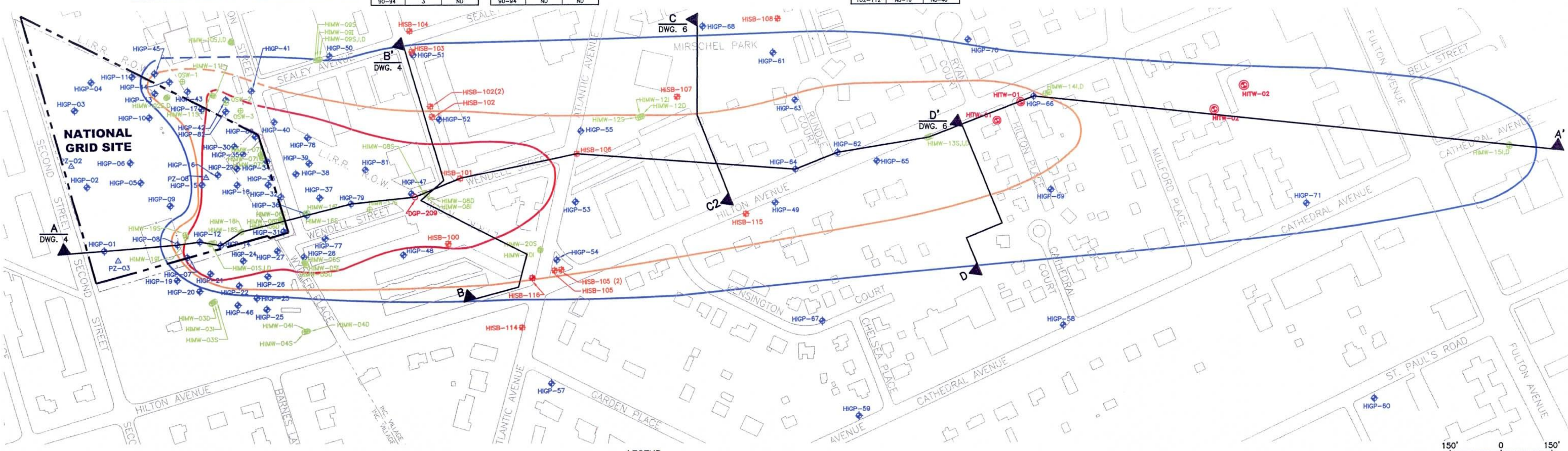
DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	1
60-64	373	338
90-94	3	ND

HIGP-60 (10/19/00)

DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	ND
60-64	ND	ND
90-94	ND	ND

HIMW-08S,I,D

DEPTH	TOT. BTEX	TOT. PAHs
25-35	ND-8,240	ND-3,069
63-73	ND-8.6	ND-251
102-112	ND-16	ND-46



LEGEND:

HITW-02 — TEMPORARY GROUNDWATER MONITORING WELL (TAKEN FROM RI REPORT, 2006)

HIGP-53 — TEMPORARY GROUNDWATER SAMPLE LOCATION (TAKEN FROM RI REPORT, 2006)

HIMW-13 — MONITORING WELL

PZ-02 — PIEZOMETER

HISB-114 — TEMPORARY GROUNDWATER SAMPLE LOCATION (URS, 2008-2009)

ND — NOT DETECTED

LOCATION ID → **HIGP-60** (10/19/00) ← SAMPLE DATE

DEPTH (ft bgs) →

DEPTH	TOT. BTEX	TOT. PAHs
33-37	ND	ND
60-64	ND	ND
90-94	ND	ND

← CONCENTRATION UNITS ARE ug/L

* SOME LOCATIONS ON SITE AND ADJACENT TO SITE ARE NOT SHOWN FOR FIGURE CLARITY.

EXISTING HOUSE OR BUILDING

NATIONAL GRID PROPERTY BOUNDARY

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS. DASHED LINES REPRESENT CONTAMINATION CONCENTRATIONS THAT ARE LIKELY INFLUENCED BY THIRD PARTY SOURCES.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

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DRAWN BY: RAL
CHECKED BY: JRS
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175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

SITE PLAN, SAMPLE LOCATIONS, AND EXTENT OF DISSOLVED PHASE GROUNDWATER PLUME

Scale: AS SHOWN | Date: SEPT. 2009 | DWG-3

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG-3.dwg 9/30/09 - 2 RAL

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-01D	HIMW-01D	HIMW-01D	HIMW-01I	HIMW-01S	HIMW-02D	HIMW-02D	HIMW-02D	HIMW-02I	HIMW-02I	HIMW-02I	HIMW-02S	HIMW-02S	HIMW-02S	HIMW-03D
		12/17/01	04/13/07	07/24/07	12/17/01	12/17/01	12/13/01	04/16/07	08/03/07	12/13/01	04/16/07	08/02/07	12/13/01	04/17/07	08/06/07	10/10/00
Volatile Organic Compounds																
Benzene	UG/L	1	0.260 U	10 U	2	1,500	1 U	0.260 U	10 U	1 U	0.260 U	10 U	1 U	0.260 U	10 U	1 U
Ethylbenzene	UG/L	2	0.400 U	10 U	2	1,700	1 U	0.400 U	10 U	1 U	0.400 U	10 U	1 U	0.400 U	10 U	1 U
Toluene	UG/L	120 D	0.260 U	10 U	96	3,500	2	0.260 U	10 U	18	0.260 U	10 U	2	0.260 U	10 U	1 U
Xylene (total)	UG/L	9	1.21 U	10 U	39	7,100	1 U	1.21 U	10 U	1 U	1.21 U	10 U	3	1.21 U	10 U	1 U
Total BTEX		**132**	**1.21 U**	**10 U**	**139**	**13,800**	**2**	**1.21 U**	**10 U**	**18**	**1.21 U**	**10 U**	**5**	**1.21 U**	**10 U**	**1 U**
Semivolatile Organic Compounds																
2-Methylnaphthalene	UG/L	10 U	---	10 U	360 D	47,000 D	10 U	---	10 U	10 U	---	10 U	10 U	---	10 U	10 U
Acenaphthene	UG/L	10 U	0.085 U	10 U	6 J	1,800	10 U	0.085 U	10 U	10 U	0.085 U	10 U	10 U	0.085 U	10 U	10 U
Acenaphthylene	UG/L	10 U	0.079 U	10 U	99	16,000	10 U	0.079 U	10 U	10 U	0.079 U	10 U	10 U	0.079 U	10 U	10 U
Anthracene	UG/L	10 U	0.214 U	10 U	2 J	7,600	10 U	0.214 U	10 U	10 U	0.214 U	10 U	10 U	0.214 U	10 U	10 U
Benzo(a)anthracene	UG/L	10 U	0.130 U	10 U	10 U	2,900	10 U	0.130 U	10 U	10 U	0.130 U	10 U	10 U	0.130 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	0.190 U	10 U	10 U	2,400	10 U	0.190 U	10 U	10 U	0.190 U	10 U	10 U	0.190 U	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	0.270 U	10 U	10 U	1,600	10 U	0.270 U	10 U	10 U	0.270 U	10 U	10 U	0.270 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	0.293 U	10 UJ	10 U	970 J	10 U	0.293 U	10 U	10 U	0.293 U	10 U	10 U	0.293 U	10 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	0.250 U	10 UJ	10 U	520 J	10 U	0.250 U	10 U	10 U	0.250 U	10 U	10 U	0.250 U	10 U	10 U
Chrysene	UG/L	10 U	0.142 U	10 U	10 U	1,200 U	10 U	0.142 U	10 U	10 U	0.142 U	10 U	10 U	0.142 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	0.360 U	10 U	10 U	5,900	10 U	0.360 U	10 U	10 U	0.360 U	10 U	10 U	0.360 U	10 U	10 U
Fluoranthene	UG/L	10 U	0.288 U	10 U	10 U	9,100	10 U	0.288 U	10 U	10 U	0.288 U	10 U	10 U	0.288 U	10 U	10 U
Fluorene	UG/L	10 U	0.128 U	10 U	18	690 J	10 U	0.128 U	10 U	10 U	0.128 U	10 U	10 U	0.128 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	0.260 U	10 U	10 U	69,000 D	10 U	0.260 U	10 U	10 U	0.260 U	10 U	10 U	0.260 U	10 U	10 U
Naphthalene	UG/L	10 U	1.41	10 U	1,200 D	30,000 D	10 U	0.079 U	10 U	10 U	0.203	10 U	10 U	0.079 U	10 U	10 U
Phenanthrene	UG/L	10 U	0.220 U	10 U	17	2,600	10 U	0.220 U	10 U	10 U	0.220 U	10 U	10 U	0.220 U	10 U	10 U
Pyrene	UG/L	10 U	0.144 U	1 J	10 U	10,000	10 U	0.144 U	10 U	10 U	0.144 U	10 U	10 U	0.144 U	10 U	10 U
Total PAHs		**10 U**	**1.4**	**1**	**1,702**	**208,080**	**10 U**	**0.36 U**	**10 U**	**10 U**	**0.2**	**10 U**	**10 U**	**0.36 U**	**10 U**	**10 U**
Total Metals																
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																
Carbon Dioxide	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-03D	HIMW-03D	HIMW-03D	HIMW-03D	HIMW-03D	HIMW-03D	HIMW-03D	HIMW-03D	HIMW-03I	HIMW-03I	HIMW-03I	HIMW-03I	HIMW-03I	HIMW-03I dup	HIMW-03I	HIMW-03I
		12/07/01	04/04/07	07/27/07	01/25/08	04/08/08	07/07/08	10/21/08	01/09/09	10/10/00	12/07/01	04/05/07	07/26/07	10/16/07	10/16/07	01/29/08	04/14/08
Volatile Organic Compounds																	
Benzene	UG/L	1 U	0.250 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.250 U	10 U	10 U	10 U	4.3	1 U
Ethylbenzene	UG/L	1 U	0.300 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.300 U	10 U	10 U	10 U	1 U	1 U
Toluene	UG/L	1 U	0.310 U	10 U	1 U	1 U	1 U	1 U	1 U	1	1 U	0.310 U	10 U	10 U	10 U	1.3	1 U
Xylene (total)	UG/L	1 U	0.800 U	10 U	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U	0.800 U	10 U	10 U	10 U	4.3	1 U
Total BTEX		**1 U**	**0.8 U**	**10 U**	**1 U**	**1 U**	**1 U**	**1 U**	**1 U**	**1**	**1 U**	**0.8 U**	**10 U**	**10 U**	**10 U**	**9.9**	**1 U**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	---	10 U	4 J	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Acenaphthene	UG/L	10 U	0.170 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	UG/L	10 U	0.158 U	10 U	2 J	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Anthracene	UG/L	10 U	0.428 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	UG/L	10 U	0.260 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	0.380 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 UJ	10 UJ	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	0.540 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	0.586 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	---	10 U	10 UJ	10 UJ	10 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	0.500 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 UJ
Chrysene	UG/L	10 U	0.284 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	0.720 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	---	10 U	10 UJ	10 UJ	10 U	10 U
Fluoranthene	UG/L	10 U	0.576 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	10 U	0.256 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	0.520 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	---	10 U	10 UJ	10 UJ	10 U	10 U
Naphthalene	UG/L	1 J	0.158 U	10 U	24	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Phenanthrene	UG/L	10 U	0.440 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U
Pyrene	UG/L	10 U	0.288 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 UJ
Total PAHs		**1**	**.586 U**	**10 U**	**30**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**---**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**
Total Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-03I	HIMW-03I	HIMW-03I	HIMW-03S	HIMW-03S	HIMW-03S	HIMW-03S	HIMW-03S	HIMW-03S	HIMW-03S	HIMW-03S	HIMW-03S	HIMW-04D	HIMW-04D	HIMW-04D	HIMW-04D
		07/03/08	10/22/08	01/15/09	12/07/01	04/03/07	07/25/07	10/15/07	01/31/08	04/15/08	07/01/08	10/23/08	01/15/09	10/12/00	12/06/01	04/04/07	08/06/07
Volatile Organic Compounds																	
Benzene	UG/L	1 U	1 U	1 U	1 U	0.250 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.250 U	10 U
Ethylbenzene	UG/L	1 U	1 U	1 U	4	0.300 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.300 U	10 U
Toluene	UG/L	1 U	1 U	9	8	0.310 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	4	0.310 U	10 U
Xylene (total)	UG/L	1 U	1 UJ	4	24	0.800 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.800 U	10 U
Total BTEX		**1 U**	**1 U**	**13**	**36**	**0.8 U**	**10 U**	**10 U**	**1 U**	**1 U**	**1 U**	**1 U**	**1 U**	**1 U**	**4**	**0.8 U**	**10 U**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U
Acenaphthene	UG/L	10 U	10 U	10 U	10 U	0.170 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.170 U	10 U
Acenaphthylene	UG/L	10 U	10 U	10 U	10 U	0.158 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.158 U	10 U
Anthracene	UG/L	10 U	10 U	10 U	10 U	0.428 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.428 U	10 U
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.260 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	10 U	0.380 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.380 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	0.540 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.540 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 UJ	10 U	10 U	0.586 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.586 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	0.500 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	0.500 U	10 U
Chrysene	UG/L	10 U	10 U	10 U	10 U	0.284 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.284 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 UJ	10 U	10 U	0.720 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.720 U	10 U
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	0.576 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.576 U	10 U
Fluorene	UG/L	10 U	10 U	10 U	10 U	0.256 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.256 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 UJ	10 U	10 U	0.520 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.520 U	10 U
Naphthalene	UG/L	10 U	10 U	10 U	10 U	0.158 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.158 U	10 U
Phenanthrene	UG/L	10 U	10 U	10 U	10 U	0.440 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	0.440 U	10 U
Pyrene	UG/L	10 U	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	0.288 U	10 U
Total PAHs		**10 U**	**10 U**	**10 U**	**10 U**	**0.720 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**1**	**0.720 U**	**10 U**
Total Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	330	213 J
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	100 U	111
Manganese		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	13,000	13,000
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	5,020	4,360
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50.0 U	100 U
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	23,100	27,800
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	---	---	---	---	---	---	---	56	210 J
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	34,400	60,900
Methane	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	60.0 U	1 U

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GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-04I	HIMW-04I	HIMW-04I	HIMW-04I	HIMW-04I	HIMW-04S	HIMW-04S	HIMW-04S	HIMW-04S	HIMW-05D	HIMW-05D	HIMW-05D	HIMW-05D	HIMW-05D	HIMW-05D	HIMW-05D
		10/12/00	12/06/01	11/14/03	04/05/07	08/02/07	12/07/01	11/17/03	04/04/07	07/31/07	10/13/00	12/11/01	04/12/07	07/31/07	10/18/07	01/28/08	04/08/08
Volatile Organic Compounds																	
Benzene	UG/L	1 U	1	10 U	0.250 U	10 U	1 U	10 U	0.250 U	10 U	1 U	1	0.250 U	10 U	10 U	1 U	1 U
Ethylbenzene	UG/L	1 U	1 U	10 U	0.300 U	10 U	3	10 U	0.300 U	10 U	1 U	3	0.300 U	10 U	10 U	1 U	1 U
Toluene	UG/L	1 U	10	10 U	0.438	10 U	8	10 U	0.310 U	10 U	4	14	1.66	4 J	2 J	1.2	1 U
Xylene (total)	UG/L	1 U	2	10 U	0.800 U	10 U	22	10 U	0.800 U	10 U	5	27	47	58	15	1 U	11
Total BTEX		**1 U**	**13**	**10 U**	**0.8 U**	**10 U**	**33**	**10 U**	**0.8 U**	**10 U**	**9**	**45**	**48.7**	**62**	**17**	**1.2**	**11**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	---	10 U	2 J	10 U	---	10 U	8 J	19	---	11	10 U	10 U	10 U
Acenaphthene	UG/L	10 U	10 U	10 U	0.170 U	10 U	10 U	10 U	0.170 U	10 U	10 U	10 U	0.425 U	10 U	10 U	10 U	10 U
Acenaphthylene	UG/L	10 U	10 U	10 U	0.158 U	10 U	10 U	10 U	0.158 U	10 U	4 J	7 J	8.77	5 J	10 U	10 U	10 U
Anthracene	UG/L	10 U	10 U	10 U	0.428 U	10 U	10 U	10 U	0.428 U	10 U	10 U	10 U	1.07 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	0.650 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	0.380 U	10 U	10 U	10 U	0.380 U	10 U	10 U	10 U	0.950 U	10 U	10 UJ	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	0.540 U	10 U	10 U	10 U	0.540 U	10 U	10 U	10 U	1.35 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 U	10 U	0.586 U	10 U	10 U	10 U	0.586 U	10 U	10 U	10 U	1.47 U	10 U	10 UJ	10 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	0.500 U	10 U	10 U	10 U	0.500 U	10 U	10 U	10 U	1.25 U	10 U	10 U	10 U	10 U
Chrysene	UG/L	10 U	10 U	10 U	0.284 U	10 U	10 U	10 U	0.284 U	10 U	10 U	10 U	0.710 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 U	10 U	0.720 U	10 U	10 U	10 U	0.720 U	10 U	10 U	10 U	1.80 U	10 U	10 UJ	10 U	10 U
Fluoranthene	UG/L	10 U	10 U	10 U	0.576 U	10 U	10 U	10 U	0.576 U	10 U	10 U	10 U	1.44 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	10 U	10 U	10 U	0.256 U	10 U	10 U	10 U	0.256 U	10 U	10 U	1 J	0.640 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 U	10 U	0.520 U	10 U	10 U	10 U	0.520 U	10 UJ	10 U	10 U	1.30 U	10 UJ	10 UJ	10 U	10 U
Naphthalene	UG/L	10 U	10 U	10 U	0.158 U	10 U	4 J	10 U	0.158 U	6 J	34	87	293	76 D	10 U	10 U	10 U
Phenanthrene	UG/L	10 U	10 U	10 U	0.440 U	10 U	10 U	10 U	0.440 U	10 U	10 U	1 J	1.10 U	10 U	10 U	10 U	10 U
Pyrene	UG/L	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	0.720 U	10 U	10 U	10 U	10 U
Total PAHs		**10 U**	**10 U**	**10 U**	**0.720 U**	**10 U**	**6**	**10 U**	**0.720 U**	**6**	**46**	**115**	**301.8**	**92**	**10 U**	**10 U**	**10 U**
Total Metals																	
Iron	UG/L	---	---	---	688	567	---	---	120	45.3 J	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	100 U	21.0 J	---	---	100 U	48.4 J	---	---	---	---	---	---	---
Manganese		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	32,500	34,800	---	---	13,500	12,600	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	3,920	2,360	---	---	2,000	3,390	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	50.0 U	100 U	---	---	50.0 U	100 U	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	29,700	23,700	---	---	22,700	18,500	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	980 J	320 J	---	---	26	210 J	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	20,500	63,500	---	---	22,000	39,600	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	60.0 U	1 U	---	---	60.0 U	1 U	---	---	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-05D	HIMW-05D	HIMW-05D	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05I	HIMW-05S	HIMW-05S	HIMW-05S
		07/03/08	10/20/08	01/20/09	10/13/00	12/11/01	04/13/07	07/30/07	10/16/07	01/29/08	04/09/08	07/09/08	10/23/08	01/16/09	12/11/01	04/12/07	07/30/07
Volatile Organic Compounds																	
Benzene	UG/L	1 U	1 U	1 U	10	7	8.42	7 J	9 J	5.2	4	3	2	4	2 U	0.250 U	10 U
Ethylbenzene	UG/L	3	1 U	1 U	9	8	3.9	3 J	4 J	2.8	3	2	1 U	2	14	0.300 U	10 U
Toluene	UG/L	1 U	1 U	4	100	14	3.18	3 J	3 J	2.3	2	3 J	2	13	8	0.310 U	10 U
Xylene (total)	UG/L	9	1 UJ	44	320	200	142 D	170	280	200	200	250	170 J	170	210	0.800 U	10 U
Total BTEX		**12**	**1 U**	**48**	**439**	**229**	**157.5**	**183**	**296**	**210.3**	**209**	**258**	**174**	**189**	**232**	**0.8 U**	**10 U**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	8 J	10 U	15	170	480 D	---	540 D	900 DJ	1,000 D	640 D	510 DJ	220 D	370 DJ	91	---	10 U
Acenaphthene	UG/L	10 U	10 U	10 U	100 U	14	8.86	16	14	18	17	17	8 J	10	10 U	0.085 U	10 U
Acenaphthylene	UG/L	10 U	10 U	6 J	84 J	220 D	113	170 DJ	300 DJ	350 DJ	210 DJ	230 DJ	130 DJ	160 DJ	32	0.079 U	10 U
Anthracene	UG/L	10 U	10 U	10 U	100 U	10 U	5.35 U	2 J	3 J	3 J	3 J	3 J	1 J	2 J	10 U	0.214 U	10 U
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	100 U	10 U	3.25 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.130 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	100 U	10 U	4.75 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	0.190 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	100 U	10 U	6.75 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.270 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 UJ	10 U	100 U	10 U	7.33 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	0.293 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	100 U	10 U	6.25 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.250 U	10 U
Chrysene	UG/L	10 U	10 U	10 U	100 U	10 U	3.55 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.142 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 UJ	10 U	100 U	10 U	9.00 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	0.360 U	10 U
Fluoranthene	UG/L	10 U	10 U	10 U	100 U	10 U	7.20 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.288 U	10 U
Fluorene	UG/L	10 U	10 U	10 U	100 U	32	25.7	35	35	42	43	39	12	18	1 J	0.128 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 UJ	10 U	100 U	10 U	6.50 U	10 UJ	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	0.260 U	10 UJ
Naphthalene	UG/L	26	10 U	32	1,200	2,200 D	1680	2,600 D	3,600 D	3,900 D	2,400 D	2,400 D	1,100 D	1,800 D	640 D	0.079 U	10 U
Phenanthrene	UG/L	10 U	10 U	10 U	100 U	6 J	12.5	20	20	24	23	18	8 J	14 J	1 J	0.220 U	10 U
Pyrene	UG/L	10 U	10 U	10 U	100 U	10 U	3.60 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	0.144 U	10 U
Total PAHs		**34**	**10 U**	**53**	**1,454**	**2,952**	**1,840**	**3,383**	**4,872**	**5,337**	**3,336**	**3,217**	**1,479**	**2,374**	**765**	**0.360 U**	**10 U**
Total Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-05S	HIMW-05S	HIMW-05S	HIMW-05S	HIMW-05S	HIMW-05S	HIMW-06D	HIMW-06D	HIMW-06D	HIMW-06D	HIMW-06I	HIMW-06I	HIMW-06I	HIMW-06I	HIMW-06I	HIMW-06S
		10/16/07	01/30/08	04/10/08	07/01/08	10/24/08	01/16/09	10/09/00	12/18/01	04/11/07	08/02/07	10/09/00	12/18/01	11/18/03	04/11/07	08/01/07	12/18/01
Volatile Organic Compounds																	
Benzene	UG/L	10 U	1 U	1 U	1 U	1 U	1 U	46	1 U	0.260 U	10 U	7	1	2 J	13.6	17	56,000 D
Ethylbenzene	UG/L	10 U	1 U	1 U	1 U	1 U	1 U	39	1 U	0.400 U	10 U	2	1 U	10 U	0.400 U	10 U	1,000
Toluene	UG/L	10 U	1 U	1 U	1 U	1 U	1 U	150	1 U	0.262	10 U	23	14	7 J	5.72	10	34,000 D
Xylene (total)	UG/L	10 U	1 U	1 U	1 U	1 U	1 U	150	1 U	1.21 U	3 J	14	2	89	7.34	13	12,000
Total BTEX		**10 U**	**1 U**	**1 U**	**1 U**	**1 U**	**1 U**	**385**	**1 U**	**0.262**	**3**	**46**	**17**	**98**	**26.7**	**40**	**103,000**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	220 D	10 U	---	10 U	39	10 U	57	---	24	1,300,000
Acenaphthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	9 J	10 U	0.522	10 U	2 J	10 U	10 U	0.511	10 U	130,000
Acenaphthylene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	88	2 J	2.41	2 J	15	1 J	11	7.82	14	920,000
Anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	9 J	2 J	2.18	10 U	2 J	10 U	10 U	0.214 U	10 U	490,000
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	0.478	10 U	10 U	10 U	10 U	0.130 U	10 U	350,000
Benzo(a)pyrene	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	2 J	0.190 U	10 U	10 U	10 U	10 U	0.190 U	10 U	250,000
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	0.270 U	10 U	10 U	10 U	10 U	0.270 U	10 U	190,000
Benzo(g,h,i)perylene	UG/L	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.293 U	10 U	10 U	10 U	10 U	0.293 U	10 U	81,000 J
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.250 U	10 U	10 U	10 U	10 U	0.250 U	10 U	80,000 J
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J	0.816	10 U	10 U	10 U	10 U	0.142 U	10 U	340,000
Dibenz(a,h)anthracene	UG/L	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.360 U	10 U	10 U	10 U	10 U	0.360 U	10 U	24,000 J
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	3 J	1 J	1.47	10 U	2 J	10 U	10 U	0.288 U	10 U	580,000
Fluorene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	30	10 U	2.19	10 U	6 J	10 U	2 J	1.54	3 J	650,000
Indeno(1,2,3-cd)pyrene	UG/L	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	10 U	0.260 U	10 U	71,000
Naphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	640 D	10 U	8.82	1 J	84	10 U	490 D	53.1	110 D	2,800,000 D
Phenanthrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	44	10 U	7.04	3 J	11	10 U	10 U	0.295	10 U	1,400,000
Pyrene	UG/L	10 U	10 U	10 UJ	10 U	10 U	10 U	5 J	2 J	2.33	10 U	2 J	10 U	10 U	0.144 U	10 U	800,000
Total PAHs		**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**1,048**	**13**	**28.3**	**6**	**163**	**1**	**560**	**63.3**	**151**	**10,456,000**
Total Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	117	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	34.2	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	11.8	---	---	---
Manganese		---	---	---	---	---	---	---	---	---	---	---	---	42.8	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	30,100	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	400 U	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	3,030	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	100 U	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	58,000	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	---	---	---	---	---		---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	2,000	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	10,000 U	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	1,000 U	---	---	---
Orthophosphate		---	---	---	---	---	---	---	---	---	---	---	---	50 U	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	52,800	---	---	---
Methane	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	1 U	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-06S	HIMW-07D	HIMW-07D	HIMW-07D	HIMW-07D	HIMW-07I	HIMW-07I	HIMW-07I	HIMW-07I	HIMW-07S	HIMW-07S	HIMW-08D	HIMW-08D	HIMW-08D	HIMW-08D	HIMW-08D
		11/18/03	10/06/00	12/17/01	04/11/07	08/01/07	10/06/00	12/17/01	04/11/07	08/02/07	12/18/01	11/19/03	01/08/01	12/12/01	04/09/07	07/31/07	10/19/07
Volatile Organic Compounds																	
Benzene	UG/L	---	1	1 U	0.260 U	10 U	2	1	0.260 U		2,700	10 U	1 U	1 U	0.260 U	10 UJ	10 U
Ethylbenzene	UG/L	---	3	1 U	0.400 U	10 U	2	1 U	0.400 U	10 U	1,400	10 U	1 U	1 U	0.400 U	10 UJ	10 U
Toluene	UG/L	---	3	34	0.260 U	10 U	2	4	0.260 U	10 U	2,900	10 U	1 U	16	0.260 U	1	10 U
Xylene (total)	UG/L	---	6	6	1.21 U	10 U	2	4	1.21 U	10 U	3,300	10 U	1 U	1 U	1.21 U	10 U	10 U
Total BTEX		---	**13**	**40**	**1.21 U**	**10 U**	**8**	**9**	**1.21 U**	**10 U**	**10,300**	**10 U**	**1 U**	**16**	**1.21 U**	**1**	**10 U**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	---	11	10 U	---	10 U	4 J	10 U	---	10 U	1,400	10 U	10 U	10 U	---	10 U	10 U
Acenaphthene	UG/L	---	10 U	10 U	0.085 U	10 U	10 U	10 U	0.085 U	10 U	72 J	10 U	10 U	10 U	0.085 U	10 U	10 U
Acenaphthylene	UG/L	---	3 J	10 U	0.079 U	10 U	1 J	2 J	0.079 U	10 U	700	10 U	10 U	10 U	0.079 U	10 U	10 U
Anthracene	UG/L	---	10 U	10 U	0.214 U	10 U	10 U	10 U	0.214 U	10 U	180 J	10 U	10 U	10 U	0.214 U	10 U	10 U
Benzo(a)anthracene	UG/L	---	10 U	10 U	0.130 U	10 U	10 U	10 U	0.130 U	10 U	91 J	10 U	10 U	10 U	0.130 U	10 U	10 U
Benzo(a)pyrene	UG/L	---	10 U	10 U	0.190 U	10 U	10 U	10 U	0.190 U	10 U	53 J	10 U	10 U	10 U	0.190 U	10 U	10 UJ
Benzo(b)fluoranthene	UG/L	---	10 U	10 U	0.270 U	10 U	10 U	10 U	0.270 U	10 U	35 J	10 U	10 U	10 U	0.270 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	---	10 U	10 U	0.293 U	10 U	10 U	10 U	0.293 U	10 U	250 U	10 U	10 U	10 U	0.293 U	10 U	10 U
Benzo(k)fluoranthene	UG/L	---	10 U	10 U	0.250 U	10 U	10 U	10 U	0.250 U	10 U	250 U	10 U	10 U	10 U	0.250 U	10 U	10 U
Chrysene	UG/L	---	10 U	10 U	0.142 U	10 U	10 U	10 U	0.142 U	10 U	91 J	10 U	10 U	10 U	0.142 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	---	10 U	10 U	0.360 U	10 U	10 U	10 U	0.360 U	10 U	250 U	10 U	10 U	10 U	0.360 U	10 U	10 U
Fluoranthene	UG/L	---	10 U	10 U	0.288 U	10 U	10 U	1 J	0.288 U	10 U	160 J	10 U	10 U	10 U	0.288 U	10 U	10 U
Fluorene	UG/L	---	2 J	10 U	0.128 U	10 U	10 U	10 U	0.128 U	10 U	350	10 U	10 U	10 U	0.128 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	---	10 U	10 U	0.260 U	10 U	10 U	10 U	0.260 U	10 U	250 U	10 U	10 U	10 U	0.260 U	10 UJ	10 U
Naphthalene	UG/L	---	20	2 J	0.239	10 U	7 J	2 J	0.945	10 U	3,900	10 U	10 U	10 U	0.079 U	10 U	10 U
Phenanthrene	UG/L	---	3 J	10 U	0.328	10 U	2 J	1 J	0.220 U	10 U	730	10 U	10 U	10 U	0.220 U	10 U	10 U
Pyrene	UG/L	---	10 U	10 U	0.144 U	10 U	10 U	2 J	0.144 U	10 U	250	10 U	10 U	10 U	0.144 U	10 U	10 U
Total PAHs		---	**39**	**2**	**0.6**	**10 U**	**14**	**8**	**0.9**	**10 U**	**8,012**	**10 U**	**10 U**	**10 U**	**0.360 U**	**10 U**	**10 U**
Total Metals																	
Iron	UG/L	7,690	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	346	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	5,160	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Manganese		324	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	1,000 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	400 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	1,510	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	350	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	169,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
BOD	UG/L	67,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	342,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	17,700	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate		50 U	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	269,000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Methane	UG/L	3.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-08D	HIMW-08D	HIMW-08D	HIMW-08D	HIMW-08D	HIMW-08D	HIMW-08I	HIMW-08I	HIMW-08I	HIMW-08I	HIMW-08I	HIMW-08I	HIMW-08I	HIMW-08I	HIMW-08I	HIMW-08I
		01/25/08	04/09/08	07/02/08	10/16/08	01/19/09	Avg.	01/08/01	12/12/01	11/18/03	04/06/07	08/01/07	10/23/07	01/30/08	04/11/08	07/09/08	10/23/08
Volatile Organic Compounds																	
Benzene	UG/L	1 U	1 U	1 U	1 U	1 U	0	1 U	1 U	10 U	0.525	10 UJ	10 U	1 U	1 U	1 U	1 U
Ethylbenzene	UG/L	1 U	1 U	1 U	1 U	1 U	0	1 U	1 U	10 U	0.300 U	10 UJ	10 U	1 U	1 U	1 U	1 U
Toluene	UG/L	1 U	1 U	1 U	1 U	1 U	1.7	1 U	1 U	10 U	0.310 U	10 U	10 U	1 U	1 U	1 UJ	1 U
Xylene (total)	UG/L	1 U	1 U	1 U	1 U	1 U	0	1 U	1 U	10 U	0.800 U	10 U	10 U	1 U	1 U	1 U	1 U
Total BTEX		**1 U**	**1 U**	**1 U**	**1 U**	1 U	1.7	**1 U**	**1 U**	**10 U**	**0.525**	**10 U**	**10 U**	**1 U**	**1 U**	**1 U**	**1 U**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	8	10 U	10 U	10 U	0.8	10 U	10 U	10 U	---	10 U	10 U	42	10 U	10 U	10 U
Acenaphthene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.085 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	UG/L	10 U	3	10 U	10 U	10 U	0.3	10 U	10 U	10 U	0.079 U	10 U	10 U	14	10 U	10 U	10 U
Anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.214 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.130 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.190 U	10 U	10 UJ	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.270 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 U	10 U	10 UJ	10 U	0	10 U	10 U	10 U	0.293 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.250 U	10 U	10 U	10 U	10 U	10 UJ	10 U
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.142 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 U	10 U	10 UJ	10 U	0	10 U	10 U	10 U	0.360 U	10 U	10 U	10 U	10 U	10 U	10 UJ
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.128 U	10 U	10 U	3	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 U	10 U	10 UJ	10 U	0	10 U	10 U	10 U	0.260 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ
Naphthalene	UG/L	10 U	26	10 U	10 U	10 U	2.6	10 U	10 U	10 U	0.079 U	10 U	10 U	190	10 U	10 U	10 U
Phenanthrene	UG/L	10 U	10 U	10 U	10 U	10 U	0	10 U	10 U	10 U	0.220 U	10 U	10 U	2	10 U	10 U	10 U
Pyrene	UG/L	10 U	10 UJ	10 U	10 U	10 U	0	10 U	10 U	10 U	0.144 U	10 U	10 U	10 U	10 UJ	10 U	10 U
Total PAHs		**10 U**	**37**	**10 U**	**10 U**	**10 U**	3.7	**10 U**	**10 U**	**10 U**	**0.360 U**	**10 U**	**10 U**	**251**	**10 U**	**10 U**	**10 U**
Total Metals																	
Iron	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Manganese		---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Orthophosphate		---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	---	---		---	---	---	---	---	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-08I	HIMW-08I	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S	HIMW-08S
		01/19/09	Avg.	01/08/01	12/12/01	11/18/03	04/06/07	04/17/07	08/01/07	10/16/07	01/31/08	04/15/08	07/03/08	10/24/08	01/19/09
Volatile Organic Compounds															
Benzene	UG/L	1 U	0.048	830	600	580	0.250 U	---	10 UJ	10 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	UG/L	1 U	0	510	370	360	0.300 U	---	10 UJ	10 U	1 U	1 U	1 U	1 U	1 U
Toluene	UG/L	1 U	0	4,200	3,700	3,300	0.416	---	10 U	10 U	1 U	1 U	1 U	1 U	5
Xylene (total)	UG/L	1 U	0	2,700	2,400	2,200	0.800 U	---	10 U	10 U	1 U	3	1 U	1 U	2
Total BTEX		**1 U**	0.048	**8,240**	**7,070**	**6,440**	**0.416**	**---**	**10 U**	**10 U**	**1 U**	**3**	**1 U**	**1 U**	**7**
Semivolatile Organic Compounds															
2-Methylnaphthalene	UG/L	10 U	4.2	460	1	160	---	---	10 U	4	10 U	10 U	10 U	10 U	10 U
Acenaphthene	UG/L	10 U	0	200 U	10 U	3	---	0.085 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	UG/L	10 U	1.3	160	10 U	47	---	0.079 U	10 U	2	3	4	2	1	10 U
Anthracene	UG/L	10 U	0	200 U	10 U	10 U	---	0.214 U	10 U	10 U	1	1	10 U	10 U	10 U
Benzo(a)anthracene	UG/L	10 U	0	200 U	10 U	10 U	---	0.130 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	0	200 U	10 U	10 U	---	0.190 U	10 U	10 UJ	10 U	1	10 U	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	0	200 U	10 U	10 U	---	0.270 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	0	200 U	10 U	10 U	---	0.293 U	10 U	10 UJ	10 U	2	10 U	10 UJ	10 U
Benzo(k)fluoranthene	UG/L	10 U	0	200 U	10 U	10 U	---	0.250 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Chrysene	UG/L	10 U	0	200 U	10 U	10 U	---	0.142 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	0	200 U	10 U	10 U	---	0.360 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U
Fluoranthene	UG/L	10 U	0	200 U	10 U	10 U	---	0.288 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	10 U	0.3	29	3	4	---	0.128 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	0	200 U	10 U	10 U	---	0.260 U	10 UJ	10 UJ	1	2	10 U	10 UJ	10 U
Naphthalene	UG/L	10 U	17.3	2,400	10	1200	---	0.079 U	10 U	14	10 U	10 U	3	10 U	10 U
Phenanthrene	UG/L	10 U	0.2	20	2	1	---	0.220 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	UG/L	10 U	0	200 U	10 U	10 U	---	0.144 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Total PAHs		**10 U**	22.8	**3,069**	**16**	**1,415**	---	**0.360 U**	**10 U**	**20**	**5**	**10**	**5**	**1**	**10 U**
Total Metals															
Iron	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals															
Iron	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Manganese		---		---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters															
Alkalinity, Total (as CaCO3)	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---		---	---	---	---	---	---	---	---	---	---	---	---
BOD	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate		---		---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases															
Carbon Dioxide	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---
Methane	UG/L	---		---	---	---	---	---	---	---	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-09D	HIMW-09D	HIMW-09D	HIMW-09I	HIMW-09I	HIMW-09I	HIMW-09S	HIMW-09S	HIMW-09S	HIMW-10D	HIMW-10D	HIMW-10D	HIMW-10D	HIMW-10I	HIMW-10I	HIMW-10I
		12/10/01	04/06/07	08/01/07	12/10/01	04/05/07	08/01/07	12/10/01	04/05/07	07/31/07	10/11/00	12/10/01	04/05/07	08/03/07	10/11/00	12/11/01	04/06/07
Volatile Organic Compounds																	
Benzene	UG/L	1 U	0.250 U	10 UJ	1 U	0.250 U	10 UJ	4	0.250 U	10 U	1 U	1 U	0.250 U	10 U	1 U	1	0.250 U
Ethylbenzene	UG/L	1 U	0.300 U	10 UJ	1 U	0.300 U	10 UJ	1	0.300 U	10 U	1 U	1 U	0.300 U	10 U	1 U	1 U	0.300 U
Toluene	UG/L	11	0.310 U	1 J	2	0.310 U	10 U	5	0.310 U	10 U	1	14	0.310 U	10 U	1 U	11	0.310 U
Xylene (total)	UG/L	5	0.800 U	10 U	1 U	0.800 U	10 U	9	0.800 U	10 U	1 U	2	0.800 U	10 U	1 U	1	0.800 U
Total BTEX		**16**	**0.8 U**	**1**	**2**	**0.8 U**	**10 U**	**19**	**0.8 U**	**10 U**	**1**	**16**	**0.8 U**	**10 U**	**1 U**	**13**	**0.8 U**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	3 J	---	10 U	10 U	---	10 U	1 J	---	10 U	10 U	10 U	---	10 U	10 U	10 U	---
Acenaphthene	UG/L	10 U	0.085 U	10 U	10 U	0.170 U	10 U	10 U	0.170 U	10 U	10 U	10 U	0.170 U	10 U	10 U	10 U	0.085 U
Acenaphthylene	UG/L	1 J	0.079 U	10 U	10 U	0.158 U	10 U	10 U	0.158 U	10 U	10 U	10 U	0.158 U	10 U	10 U	10 U	0.079 U
Anthracene	UG/L	10 U	0.214 U	10 U	10 U	0.428 U	10 U	10 U	0.428 U	10 U	10 U	10 U	0.428 U	10 U	10 U	10 U	0.214 U
Benzo(a)anthracene	UG/L	10 U	0.130 U	10 U	10 U	0.260 U	10 U	10 U	0.260 U	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	0.130 U
Benzo(a)pyrene	UG/L	10 U	0.190 U	10 U	10 U	0.380 U	10 U	10 U	0.380 U	10 U	10 U	10 U	0.380 U	10 U	10 U	10 U	0.190 U
Benzo(b)fluoranthene	UG/L	10 U	0.270 U	10 U	10 U	0.540 U	10 U	10 U	0.540 U	10 U	10 U	10 U	0.540 U	10 U	10 U	10 U	0.270 U
Benzo(g,h,i)perylene	UG/L	10 U	0.293 U	10 U	10 U	0.586 U	10 U	10 U	0.586 U	10 U	10 U	10 U	0.586 U	10 U	10 U	10 U	0.293 U
Benzo(k)fluoranthene	UG/L	10 U	0.250 U	10 U	10 U	0.500 U	10 U	10 U	0.500 U	10 U	10 U	10 U	0.500 U	10 U	10 U	10 U	0.250 U
Chrysene	UG/L	10 U	0.142 U	10 U	10 U	0.284 U	10 U	10 U	0.284 U	10 U	10 U	10 U	0.284 U	10 U	10 U	10 U	0.142 U
Dibenz(a,h)anthracene	UG/L	10 U	0.360 U	10 U	10 U	0.720 U	10 U	10 U	0.720 U	10 U	10 U	10 U	0.720 U	10 U	10 U	10 U	0.360 U
Fluoranthene	UG/L	10 U	0.288 U	10 U	10 U	0.576 U	10 U	10 U	0.576 U	10 U	10 U	10 U	0.576 U	10 U	10 U	10 U	0.288 U
Fluorene	UG/L	10 U	0.128 U	10 U	10 U	0.256 U	10 U	3 J	0.256 U	10 U	10 U	10 U	0.256 U	10 U	10 U	10 U	0.128 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	0.260 U	10 UJ	10 UJ	0.520 U	10 UJ	10 U	0.520 U	10 UJ	10 UJ	10 UJ	0.520 U	10 U	10 UJ	10 UJ	0.260 U
Naphthalene	UG/L	4 J	0.079 U	10 U	10 U	0.158 U	10 U	10	0.158 U	10 U	10 U	10 U	0.158 U	10 U	10 U	10 U	0.079 U
Phenanthrene	UG/L	2 J	0.220 U	10 U	10 U	0.440 U	10 U	2 J	0.440 U	10 U	10 U	10 U	0.440 U	10 U	10 U	10 U	0.220 U
Pyrene	UG/L	10 U	0.144 U	10 U	10 U	0.288 U	10 U	10 U	0.288 U	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	0.144 U
Total PAHs		**10**	**0.360 U**	**10 U**	**10 U**	**0.720 U**	**10 U**	**16**	**0.720 U**	**10 U**	**10 U**	**10 U**	**0.720 U**	**10 U**	**10 U**	**10 U**	**0.360 U**
Total Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	198	929 J	---	---	199
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	100 U	48.9 J	---	---	100 U
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	---	---	---	---	---	9,000	4,800	---	---	3,000
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	1,980	2,140	---	---	2,420
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	---	50.0 U	100 U	---	---	50.0 U
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	---	---	---	---	---	15,200	22,000	---	---	28,700
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	---	---	---	---	46 J	120 J	---	---	50
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	---	---	---	---	---	---	9,900	42,900	---	---	400 U
Methane	UG/L	---	---	---	---	---	---	---	---	---	---	---	60.0 U	1 U	---	---	60.0 U

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-10I	HIMW-10S	HIMW-10S	HIMW-10S	HIMW-11D	HIMW-11D	HIMW-11D	HIMW-11I	HIMW-11I	HIMW-11I	HIMW-11I	HIMW-11S	HIMW-11S	HIMW-12D	HIMW-12D	HIMW-12D
		08/02/07	12/11/01	04/09/07	08/06/07	12/13/01	04/16/07	08/03/07	12/13/01	11/19/03	04/16/07	08/02/07	12/14/01	04/06/07	01/10/01	12/06/01	04/13/07
Volatile Organic Compounds																	
Benzene	UG/L	10 U	1 U	0.260 U	10 U	1 U	0.260 U	10 U	1 U	10 U	0.260 U	10 U	100 U	---	2	1 U	0.503
Ethylbenzene	UG/L	10 U	2	0.400 U	10 U	1	0.400 U	10 U	2	10 U	0.400 U	10 U	4,000	---	1 U	1 U	0.400 U
Toluene	UG/L	10 U	7	0.260 U	10 U	29	0.260 U	10 U	37	10 U	0.260 U	10 U	220	---	1 U	6	0.260 U
Xylene (total)	UG/L	10 U	24	1.21 U	10 U	9	1.21 U	10 U	10	10 U	1.21 U	10 U	9,700	---	1 U	1 U	1.21 U
Total BTEX		**10 U**	**33**	**1.21 U**	**10 U**	**39**	**1.21 U**	**10 U**	**49**	**10 U**	**1.21 U**	**10 U**	**13,920**	**---**	**2**	**6**	**0.5**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	92	---	10 U	4 J	---	10 U	10 U	10 U	---	10 U	4,000 D	---	10 U	10 U	---
Acenaphthene	UG/L	10 U	6 J	0.669	10 U	10 U	0.085 U	10 U	10 U	10 U	0.085 U	10 U	790	---	10 U	10 U	0.085 U
Acenaphthylene	UG/L	10 U	10 U	0.25	10 U	2 J	0.079 U	10 U	2 J	10 U	0.079 U	10 U	50 U	---	10 U	10 U	0.079 U
Anthracene	UG/L	10 U	1 J	0.214 U	10 U	10 U	0.214 U	10 U	10 U	10 U	0.214 U	10 U	440	---	10 U	10 U	0.214 U
Benzo(a)anthracene	UG/L	10 U	10 U	0.130 U	10 U	10 U	0.130 U	10 U	10 U	10 U	0.130 U	10 U	220	---	10 U	10 U	0.130 U
Benzo(a)pyrene	UG/L	10 U	10 U	0.190 U	10 U	10 U	0.190 U	10 U	1 J	10 U	0.190 U	10 U	160	---	10 U	10 U	0.190 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	0.270 U	10 U	10 U	0.270 U	10 U	10 U	10 U	0.270 U	10 U	110	---	10 U	10 U	0.270 U
Benzo(g,h,i)perylene	UG/L	10 U	10 U	0.293 U	10 U	10 U	0.293 U	10 U	10 U	10 U	0.293 U	10 U	54	---	10 U	10 U	0.293 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	0.250 U	10 U	10 U	0.250 U	10 U	10 U	10 U	0.250 U	10 U	46 J	---	10 U	10 U	0.250 U
Chrysene	UG/L	10 U	10 U	0.142 U	10 U	10 U	0.142 U	10 U	10 U	10 U	0.142 U	10 U	220	---	10 U	10 U	0.142 U
Dibenz(a,h)anthracene	UG/L	10 U	10 U	0.360 U	10 U	10 U	0.360 U	10 U	10 U	10 U	0.360 U	10 U	18 J	---	10 U	10 U	0.360 U
Fluoranthene	UG/L	10 U	10 U	0.288 U	10 U	10 U	0.288 U	10 U	10 U	10 U	0.288 U	10 U	380	---	10 U	10 U	0.288 U
Fluorene	UG/L	10 U	8 J	0.809	10 U	1 J	0.128 U	10 U	10 U	10 U	0.128 U	10 U	570	---	10 U	10 U	0.128 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 U	0.260 U	10 U	10 U	0.260 U	10 U	10 U	10 U	0.260 U	10 U	48 J	---	10 U	10 U	0.260 U
Naphthalene	UG/L	10 U	27	1.28	10 U	8 J	0.079 U	10 U	10 U	10 U	0.079 U	10 U	3,600 D	---	10 U	2 J	0.454
Phenanthrene	UG/L	10 U	14	1.53	1 J	3 J	0.220 U	10 U	10 U	10 U	0.220 U	10 U	1,700 D	---	10 U	10 U	0.220 U
Pyrene	UG/L	10 U	2 J	0.362	10 U	1 J	0.144 U	10 U	10 U	10 U	0.144 U	10 U	600	---	10 U	10 U	0.144 U
Total PAHs		**10 U**	**150**	**4.9**	**1**	**19**	**0.360 U**	**10 U**	**3**	**10 U**	**0.360 U**	**10 U**	**12,956**	**---**	**10 U**	**2**	**0.454**
Total Metals																	
Iron	UG/L	129 J	---	9,250	3,910	---	---	---	---	---	---	---	---	---	---	---	727
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals														---			
Iron	UG/L	75.3 J	---	8,660	2,510	---	---	---	---	---	---	---	---	---	---	---	124
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	1,000 U	---	28,000	1,700	---	---	---	---	---	---	---	---	35,000	---	---	13,000
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	2,400	---	3,040	5,510	---	---	---	---	---	---	---	---	2,480	---	---	955
Nitrite-Nitrogen	UG/L	100 U	---	90	220	---	---	---	---	---	---	---	---	50 U	---	---	50.0 U
Sulfate (as SO4)	UG/L	30,200	---	59,400	96,500	---	---	---	---	---	---	---	---	21,400	---	---	54,700
Heterotrophic Plate Count	CFU/ML	340 J	---	44	1,000 J	---	---	---	---	---	---	---	---	---	---	---	26
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases														---			
Carbon Dioxide	UG/L	1,000 U	---	45,200	9,400	---	---	---	---	---	---	---	---	---	---	---	10,900
Methane	UG/L	1 U	---	60.0 U	1 U	---	---	---	---	---	---	---	---	---	---	---	60.0 U

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-12D	HIMW-12D	HIMW-12D	HIMW-012D	HIMW-12D	HIMW-12D	HIMW-12D	HIMW-12I	HIMW-12I	HIMW-12I	HIMW-12I	HIMW-12I	HIMW-12I	HIMW-12I	HIMW-012I	HIMW-12I
		07/31/07	10/18/07	01/23/08	04/07/08	07/01/08	10/21/08	01/13/09	01/10/01	12/06/01	11/19/03	04/09/07	07/30/07	10/17/07	01/30/08	04/10/08	07/08/08
Volatile Organic Compounds																	
Benzene	UG/L	10 U	1 J	1 U	1 U	1 U	1 U	1	24	19	51	20.8	26	7 J	34	29	42
Ethylbenzene	UG/L	10 U	10 U	1 U	1 U	1 U	1 U	1 U	7	2	6 J	11.8	15	3 J	7	6	5
Toluene	UG/L	10 U	1 J	1 U	1 U	1 U	1 U	1 U	5	10	5 J	0.260 U	10 U	3 J	1.1	1 U	1
Xylene (total)	UG/L	10 U	10 U	1 U	1 U	1 U	1 U	1 U	220	78	15	5.75	22	240	7.8	12	19
Total BTEX		**10 U**	**2**	**1 U**	**1 U**	**1 U**	**1 U**	**1**	**256**	**109**	**77**	**38.4**	**63**	**253**	**49.9**	**47**	**67**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	30 J	7 J	3 J	---	10 U	10 U	10 U	10 U	10 U
Acenaphthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	13 J	6 J	27	30.5	51	41	48	53	47
Acenaphthylene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	29 J	16	50	37.4	66	50	54	56	52
Anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.377	10 U	10 U	10 U	10 U	1 J
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.130 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.190 U	10 U	10 UJ	10 U	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.270 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	40 U	10 U	10 U	0.293 U	10 U	10 UJ	10 U	10 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.250 U	10 U	10 U	10 U	10 U	10 U
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.142 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	40 U	10 U	10 U	0.360 U	10 U	10 UJ	10 U	10 U	10 U
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.288 U	10 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 J	4 J	18	23.8	37	31	34	36	31
Indeno(1,2,3-cd)pyrene	UG/L	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	40 U	10 U	10 U	0.260 U	10 UJ	10 UJ	10 U	10 U	10 U
Naphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	450	93	34	2.21	8 J	10	6 J	9 J	20
Phenanthrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	4 J	3.65	6 J	6 J	7 J	7 J	7 J
Pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	40 U	10 U	10 U	0.144 U	10 U	10 U	10 U	10 UJ	10 U
Total PAHs		**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**527**	**126**	**136**	**97.9**	**168**	**138**	**149**	**161**	**158**
Total Metals																	
Iron	UG/L	255 J	---	---	---	---	---	---	---	---	---	22,900	20,500 J	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	98.2 J	---	---	---	---	---	---	---	---	---	20,800	16,900	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	6,100	---	---	---	---	---	---	---	---	---	65,000	69,400	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	1,390	---	---	---	---	---	---	---	---	---	500 U	100 U	---	---	---	---
Nitrite-Nitrogen	UG/L	100 U	---	---	---	---	---	---	---	---	---	50.0 U	100 U	---	---	---	---
Sulfate (as SO4)	UG/L	61,800	---	---	---	---	---	---	---	---	---	38,400	43,200	---	---	---	---
Heterotrophic Plate Count	CFU/ML	100 J	---	---	---	---	---	---	---	---	---	9	77 J	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	70,200	---	---	---	---	---	---	---	---	---	59,100	230,000	---	---	---	---
Methane	UG/L	19	---	---	---	---	---	---	---	---	---	65	330 D	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-12I	HIMW-12I	HIMW-12S	HIMW-12S	HIMW-12S	HIMW-12S	HIMW-12S	HIMW-12S	HIMW-12S	HIMW-012S	HIMW-12S	HIMW-12S	HIMW-12S	HIMW-13D	HIMW-13D	HIMW-13D
		10/28/08	01/12/09	01/10/01	12/06/01	11/19/03	04/06/07	07/26/07	10/17/07	01/25/08	04/11/08	07/02/08	10/24/08	01/12/09	01/08/01	12/04/01	04/10/07
Volatile Organic Compounds																	
Benzene	UG/L	42	41	1 U	1 U	10 U	0.250 U	10 U	10 U	1 U	1 U	1 U	1 U	1	4	1 U	4.13
Ethylbenzene	UG/L	3	3	1 U	1 U	10 U	0.300 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	0.300 U
Toluene	UG/L	1 U	1 U	1 U	2	10 U	0.403	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	12	0.532
Xylene (total)	UG/L	12	9	1	3	10 U	0.800 U	10 U	10 U	1 U	1 U	1 U	1 U	10	2	18	3.59
Total BTEX		57	53	1	5	**10 U**	0.4	**10 U**	**10 U**	**1 U**	**1 U**	**1 U**	**1 U**	**11**	6	30	8.3
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	---
Acenaphthene	UG/L	36	30	10 U	10 U	10 U	0.085 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	3 J	10 U	4
Acenaphthylene	UG/L	42	37	10 U	10 U	10 U	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	6 J	10 U	5.77
Anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	0.214 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.214 U
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	0.130 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.130 U
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	0.190 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.190 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0.270 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.270 UJ
Benzo(g,h,i)perylene	UG/L	10 U	10 U	10 U	10 U	10 U	0.293 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.293 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0.250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.250 U
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	0.142 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.142 U
Dibenz(a,h)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	0.360 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.360 U
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.288 U
Fluorene	UG/L	26	22	10 U	10 U	10 U	0.128 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J	10 U	0.4
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	0.260 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.260 U
Naphthalene	UG/L	7 J	3 J	4 J	10 U	10 U	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	4 J	0.312
Phenanthrene	UG/L	7 J	8 J	10 U	10 U	10 U	0.220 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.220 U
Pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	0.144 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	0.144 U
Total PAHs		118	100	4	**10 U**	**10 U**	**0.360 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	11	5	10.5
Total Metals																	
Iron	UG/L	---	---	---	---	---	1,660	390 J	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	100 U	34.7 J	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	35,000	30,200	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	2,480	5,290	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---	50.0 U	100 U	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---	21,400	21,600	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	40	460	---	---	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	6,500	64,700	---	---	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	---	---	60.0 U	1 U	---	---	---	---	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-13D	HIMW-13D	HIMW-13D	HIMW-13D	HIMW-013D	HIMW-13D	HIMW-13D	HIMW-13D	HIMW-13I	HIMW-13I	HIMW-13I	HIMW-13I	HIMW-13I	HIMW-13I	HIMW-13I	HIMW-013I
		07/26/07	10/22/07	01/28/08	01/28/08	04/10/08	07/07/08	10/21/08	01/13/09	01/10/01	12/04/01	11/17/03	04/09/07	07/27/07	10/18/07	01/29/08	04/14/08
Volatile Organic Compounds																	
Benzene	UG/L	4 J	6 J	3.5	1 U	4	4	3	4	45	47		154 D	140	10 U	33	20
Ethylbenzene	UG/L	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	55	1 U		6.09	3 J	10 U	1.4	2
Toluene	UG/L	10 U	10 U	1	1 U	1 U	1 U	1 U	1 U	2 U	15		0.421	10 U	10 U	1 U	1 U
Xylene (total)	UG/L	5 J	8 J	4	1 U	4	5	2 J	3	7	13		3.9	9 J	10 U	7	6
Total BTEX		9	14	8.5	1 U	8	9	5	7	107	75		164.4	152	10 U	41.4	28
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U
Acenaphthene	UG/L	7 J	8 J	5 J	6 J	8 J	7 J	10 U	3 J	8 J	4 J	11	5.2	9 J	8 J	11	6 J
Acenaphthylene	UG/L	10	13	8 J	9 J	13	14	10 U	6 J	32	35	100 D	46.1	75	63	66	43
Anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	10 U	2 J	0.753	1 J	1 J	2 J	1 J
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.130 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.190 U	10 U	10 UJ	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.270 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	0.293 U	10 U	10 UJ	10 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.250 U	10 UJ	10 U	10 U	10 UJ
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.142 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	0.360 U	10 U	10 UJ	10 U	10 U
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.393	10 U	10 U	10 U	10 U
Fluorene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	11	4 J	23	11.8	16	15	18	12
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	0.260 U	10 U	10 UJ	10 U	10 U
Naphthalene	UG/L	10 U	10 U	10 U	2 J	10 U	10 U	10 U	10 U	4 J	8 J	6 J	0.949	1 J	1 J	2 J	10 U
Phenanthrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	7 J	5 J	13	11.1	17	16	21	15
Pyrene	UG/L	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	1 J	0.599	10 U	10 U	10 U	10 UJ
Total PAHs		17	21	13	17	21	21	10 U	9	63	56	156	76.9	119	104	120	77
Total Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	82,400	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	1,700	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	---	---	---	---	---	28,200	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	1,620	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	---	---	---	---	86,800	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	49,000	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	100 U	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	---	---	---	---	490	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	---	---	---	---	17,900	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	---	---	---	---	6	---	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	4,000	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	31,400	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	6,700	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	50 U	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	---	---	---	---	---	163,000	---	---	---	---	---
Methane	UG/L	---	---	---	---	---	---	---	---	---	---	66 D	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-13I	HIMW-13I	HIMW-13I	HIMW-13S	HIMW-13S	HIMW-13S	HIMW-13S	HIMW-13S	HIMW-13S	HIMW-13S	HIMW-013S	HIMW-13S	HIMW-13S	HIMW-13S	HIMW-14D	HIMW-14D
		07/08/08	10/28/08	01/12/09	01/10/01	12/05/01	11/17/03	04/12/07	07/27/07	10/17/07	01/31/08	04/14/08	07/02/08	10/24/08	01/12/09	12/27/01	11/14/03
Volatile Organic Compounds																	
Benzene	UG/L	19	34	38	1 U	1 U	89	0.250 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1	10 U
Ethylbenzene	UG/L	1 U	1 U	1 U	1 U	1 U	35	0.300 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1	10 U
Toluene	UG/L	1	1 U	1 U	1 U	5	10 U	0.310 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	7	10 U
Xylene (total)	UG/L	6	4	7	1 U	6	18	0.800 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	6	10 U
Total BTEX		**26**	**38**	**45**	**1 U**	**11**	**143**	**0.8 U**	**10 U**	**10 U**	**1 U**	**1 U**	**1 U**	**1 U**	**1 U**	**15**	**10 U**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthene	UG/L	6 J	7 J	6 J	10 U	10 U	10 U	0.085 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	UG/L	40	44	46	10 U	10 U	10 U	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	UG/L	2 J	1 J	2 J	10 U	10 U	10 U	0.214 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.130 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.190 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.270 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.293 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.250 U	10 UJ	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.142 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.360 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	14	13	13	10 U	10 U	10 U	0.128 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.260 U	10 U	10 UJ	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Naphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenanthrene	UG/L	16	8 J	13 J	10 U	10 U	10 U	0.220 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.144 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U
Total PAHs		**78**	**73**	**80**	**10 U**	**10 U**	**10 U**	**0.360 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**
Total Metals																	
Iron	UG/L	---	---	---	---	---	468	---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	15.6	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	25.1	---	---	---	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	---	3.6	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	20,300	---	---	---	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	400 U	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	---	2,670	---	---	---	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	---	100 U	---	---	---	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	---	17,100	---	---	---	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	230	---	---	---	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	---	2,000 U	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	58,100	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	1,000 U	---	---	---	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	50 U	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	44,000	---	---	---	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	---	---	1 U	---	---	---	---	---	---	---	---	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-14D	HIMW-14D	HIMW-14D	HIMW-14D	HIMW-014D	HIMW-14D	HIMW-14D	HIMW-14D	HIMW-14I	HIMW-14I	HIMW-14I	HIMW-14I	HIMW-14I	HIMW-14I	HIMW-14I	HIMW-14I
		04/13/07	07/25/07	10/19/07	01/25/08	04/09/08	07/01/08	10/16/08	01/09/09	12/27/01	11/13/03	04/10/07	07/26/07	10/22/07	01/28/08	04/11/08	07/08/08
Volatile Organic Compounds																	
Benzene	UG/L	0.39	10 U	10 U	1 U	1 U	1 U	1 U	1 U	12	46	69	80	88	53	56	86
Ethylbenzene	UG/L	0.400 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	32	130	29.3	86	74	26	33	66
Toluene	UG/L	0.260 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	19	3 J	0.507	10 U	10 U	1 U	1 U	1 U
Xylene (total)	UG/L	1.21 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	37	94	14.5	8 J	13	11	13	9
Total BTEX		**0.39**	**10 U**	**10 U**	**1 U**	**1 U**	**1 U**	**1 U**	**1 U**	**100**	**273**	**619.8**	**174**	**175**	**90**	**102**	**161**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J	---	10 U	10 U	10 U	10 U	10 U
Acenaphthene	UG/L	0.085 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	12	20	14.8	19	24	25	24	23
Acenaphthylene	UG/L	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	30	40	24.6	30	35	33	34	29
Anthracene	UG/L	0.214 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J	0.765	10 U	1 J	1 J	10 U	2 J
Benzo(a)anthracene	UG/L	0.130 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.130 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	0.190 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.190 U	10 U	10 UJ	10 U	10 U	10 U
Benzo(b)fluoranthene	UG/L	0.270 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.270 UJ	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	0.293 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.293 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	UG/L	0.250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.250 U	10 U	10 U	10 U	10 U	10 U
Chrysene	UG/L	0.142 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.142 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	0.360 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.360 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	UG/L	0.288 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	0.216 J	10 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	0.128 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	7 J	14	7.31	8 J	11	10	10	10
Indeno(1,2,3-cd)pyrene	UG/L	0.260 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	UG/L	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	8 J	200 D	1.11	3 J	1 J	2 J	10 U	1 J
Phenanthrene	UG/L	0.220 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	3 J	10	4.72	7 J	6 J	5 J	6 J	10
Pyrene	UG/L	0.144 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	0.274	10 U	10 U	10 U	10 UJ	10 U
Total PAHs		**0.360 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**60**	**288**	**53.8**	**67**	**78**	**76**	**74**	**75**
Total Metals																	
Iron	UG/L	2,430	5,620 J	---	---	---	---	---	---	---	---	45,700	44,900 J	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	1,020	898	---	---	---	---	---	---	---	---	32,500	16,700	---	---	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	28,000	24,100	---	---	---	---	---	---	---	---	116,000	62,500	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	500 U	100 U	---	---	---	---	---	---	---	---	500 U	100 U	---	---	---	---
Nitrite-Nitrogen	UG/L	50.0 U	100 U	---	---	---	---	---	---	---	---	50.0 U	100 U	---	---	---	---
Sulfate (as SO4)	UG/L	60,200	79,500	---	---	---	---	---	---	---	---	20,000	23,100	---	---	---	---
Heterotrophic Plate Count	CFU/ML	16	190 J	---	---	---	---	---	---	---	---	3	160 J	---	---	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	42,200	171,000	---	---	---	---	---	---	---	---	75,600	244,000	---	---	---	---
Methane	UG/L	60.0 U	180 D	---	---	---	---	---	---	---	---	60.0 U	290 D	---	---	---	---

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GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-14I	HIMW-14I	HIMW-14I	HIMW-14I	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15D	HIMW-15I	HIMW-15I
		07/08/08	10/21/08	10/21/08	01/13/09	12/28/01	11/13/03	04/18/07	07/25/07	10/22/07	01/23/08	04/07/08	07/02/08	10/22/08	01/14/09	12/28/01	11/18/03
Volatile Organic Compounds																	
Benzene	UG/L	86	65	66	74	42	10 U	0.180 U	10 U	10 U	1 U	1 U	1 U	1 U	7	1	110
Ethylbenzene	UG/L	67	5	5	19	9	10 U	0.220 U	10 U	10 U	1 U	1 U	1 U	1 U	3	4	10 U
Toluene	UG/L	1 U	1 U	1 U	1 U	13	10 U	0.160 U	10 U	10 U	1 U	1 U	1 U	1 U	48	13	1 J
Xylene (total)	UG/L	9	3 J	3 J	8	30	10 U	0.630 U	10 U	10 U	1 U	1 U	1 U	1 UJ	12	23	10 U
Total BTEX		**162**	**73**	**74**	**101**	**94**	**10 U**	**.63 U**	**10 U**	**10 U**	**1 U**	**1 U**	**1 U**	**1 U**	**70**	**41**	**111**
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	---	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthene	UG/L	10 U	12	11	13	10 U	10 U	0.085 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	5 J
Acenaphthylene	UG/L	10 U	19	17	19	10 U	10 U	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	8 J	12
Anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.214 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.130 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.190 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.270 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	UG/L	10 U	10 UJ	10 UJ	10 U	10 U	10 U	0.293 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Benzo(k)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.250 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.142 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	UG/L	10 U	10 UJ	10 UJ	10 U	10 U	10 U	0.360 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	UG/L	10 U	6 J	6 J	6 J	10 U	10 U	0.128 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	2 J	7 J
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 UJ	10 UJ	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U
Naphthalene	UG/L	10 U	10 U	10 U	10 U	1 J	10 U	0.079 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	4 J	10 U
Phenanthrene	UG/L	10 U	5 J	5 J	5 J	10 U	10 U	0.220 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 J
Pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	10 U	0.144 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Total PAHs		**10 U**	**42**	**40**	**43**	**1**	**10 U**	**0.360 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**10 U**	**15**	**29**
Total Metals																	
Iron	UG/L	---	---	---	---	---	---	16,500	17,200 J	---	---	---	---	---	---	---	138
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9,040
Dissolved Metals																	
Iron	UG/L	---	---	---	---	---	---	17,100	16,200	---	---	---	---	---	---	---	10.9
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	7,570
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	---	---	2,000 U	1,000 U	---	---	---	---	---	---	---	81,800
Ferrous Iron	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6,000
Nitrate-Nitrogen	UG/L	---	---	---	---	---	---	500 U	100 U	---	---	---	---	---	---	---	100 U
Nitrite-Nitrogen	UG/L	---	---	---	---	---	---	50.0 U	100 U	---	---	---	---	---	---	---	100 U
Sulfate (as SO4)	UG/L	---	---	---	---	---	---	47,600	57,500	---	---	---	---	---	---	---	32,000
Heterotrophic Plate Count	CFU/ML	---	---	---	---	---	---	35 J	930	---	---	---	---	---	---	---	32
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2,000 U
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	16,800
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2,100
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	50 U
Dissolved Gases																	
Carbon Dioxide	UG/L	---	---	---	---	---	---	400 U	1,000 U	---	---	---	---	---	---	---	88,000
Methane	UG/L	---	---	---	---	---	---	---	210 D	---	---	---	---	---	---	---	88 D

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-15I	HIMW-15I	HIMW-15I	HIMW-15I	HIMW-0150	HIMW-015I	HIMW-15I	HIMW-15I	HIMW-15I	HIMW-15I	HIMW-16I	HIMW-18I	HIMW-18I	HIMW-18I	HIMW-19I	HIMW-19I
		04/18/07	07/24/07	10/23/07	01/24/08	04/07/08	04/07/08	07/08/08	10/23/08	10/23/08	01/14/09	11/19/09	11/20/03	05/02/07	08/03/07	11/20/03	04/12/07
Volatile Organic Compounds																	
Benzene	UG/L	19.5	21	11	5.9	5	4	8	8	7	13	7 J	320 D	2.68	1 J	10 U	0.250 U
Ethylbenzene	UG/L	0.220 U	10 U	10 U	1 U	1 U	1 U	1 U	1 U	1 U	1	10 U	68	0.400 U	10 U	10 U	0.300 U
Toluene	UG/L	0.261	10 U	10 U	1 U	1 U	1 U	1 UJ	1 U	1 U	8	10 U	360 D	3.32	2 J	10 U	0.310 U
Xylene (total)	UG/L	0.630 U	10 U	10 U	1 U	1 U	1 U	1 U	1 UJ	1 U	5	2 J	570	63.6	18	10 U	0.800 U
Total BTEX		19.8	21	11	5.9	5	4	8	8	7	27	9	1,338	69.6	21	10 U	0.8 U
Semivolatile Organic Compounds																	
2-Methylnaphthalene	UG/L	---	10 U	10 U	48	10 U	10 U	10 U	10 U	10 U	10 U	10 U	740 D	---	35	10 U	---
Acenaphthene	UG/L	2.53	5 J	5 J	36	2 J	2 J	10 U	2 J	2 J	3 J	10 U	18	1.62	2 J	1 J	0.085 U
Acenaphthylene	UG/L	13.3	22	17	10 U	6 J	5 J	10 U	4 J	5 J	12	10 U	200 DJ	18.4	11	1 J	0.079 U
Anthracene	UG/L	0.255	10 U	10 U	7 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	13	1.28 U	2 J	10 U	0.214 U
Benzo(a)anthracene	UG/L	0.130 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	0.780 U	10 U	10 U	0.130 U
Benzo(a)pyrene	UG/L	0.190 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1.14 U	10 U	10 U	0.190 U
Benzo(b)fluoranthene	UG/L	0.270 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1.62 U	10 U	10 U	0.270 U
Benzo(g,h,i)perylene	UG/L	0.293 U	10 UJ	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	1.76 U	10 U	10 U	0.293 U
Benzo(k)fluoranthene	UG/L	0.250 U	10 UJ	10 U	10 U	10 U	10 U	10 UJ	10 U	10 U	10 U	10 U	10 U	1.50 U	10 U	10 U	0.250 U
Chrysene	UG/L	0.142 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1 J	0.852 U	10 U	10 U	0.142 U
Dibenz(a,h)anthracene	UG/L	0.360 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	2.16 U	10 U	10 U	0.360 U
Fluoranthene	UG/L	0.288 U	10 U	10 U	3 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1.73 U	1 J	2 J	0.288 U
Fluorene	UG/L	0.778	10 U	10 U	19	10 U	10 U	10 U	10 U	10 U	10 U	10 U	5 J	4.53	5 J	5 J	0.128 U
Indeno(1,2,3-cd)pyrene	UG/L	0.260 U	10 U	10 U	10 U	10 U	10 U	10 U	10 UJ	10 UJ	10 U	10 U	10 U	1.56 U	10 U	10 U	0.260 U
Naphthalene	UG/L	0.261	10 U	10 U	130 D	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1,900 D	230	120 D	10 U	0.079 U
Phenanthrene	UG/L	2.29	3 J	10 U	27	10 U	10 U	10 U	10 U	10 U	2 J	10 U	75	3.71	12	3 J	0.220 U
Pyrene	UG/L	0.144 U	10 U	10 U	3 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	8 J	0.864 U	3 J	3 J	0.144 U
Total PAHs		19.4	30	22	273	8	7	10 U	6	7	17	10 U	3,008	258.3	191	19	0.360 U
Total Metals																	
Iron	UG/L	375	480 J	---	---	---	---	---	---	---	---	---	---	342	3,560 J	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Metals																	
Iron	UG/L	114	97.4 J	---	---	---	---	---	---	---	---	---	---	267	159	---	---
Manganese	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous Parameters																	
Alkalinity, Total (as CaCO3)	UG/L	65,000	63,000	---	---	---	---	---	---	---	---	---	---	4,000	1,000 U	---	---
Ferrous Iron	UG/L			---	---	---	---	---	---	---	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	500 U	200	---	---	---	---	---	---	---	---	---	---	3,760	4,100	---	---
Nitrite-Nitrogen	UG/L	50.0 U	100 U	---	---	---	---	---	---	---	---	---	---	52	100 U	---	---
Sulfate (as SO4)	UG/L	28,800	29,600	---	---	---	---	---	---	---	---	---	---	41,400	57,200	---	---
Heterotrophic Plate Count	CFU/ML	104 J	640	---	---	---	---	---	---	---	---	---	---	99	3,800 J	---	---
BOD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Dissolved Gases																	
Carbon Dioxide	UG/L	18,700	135,000	---	---	---	---	---	---	---	---	---	---	400 U	1,000 U	---	---
Methane	UG/L	60.0 U	32 D	---	---	---	---	---	---	---	---	---	---	60.0 U	1 U	---	---

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009
MONITORING WELLS AND PIEZOMETERS
NATIONAL GRID - HEMPSTEAD INTERSECTION STREET FORMER MGP SITE

PARAMETER	UNITS	HIMW-19I	HIMW-20I	HIMW-20S	PZ-02	PZ-02	PZ-02	PZ-02	PZ-03	PZ-03	PZ-03	PZ-03	PZ-08
		07/24/07	02/04/09	02/04/09	12/19/01	11/19/03	04/03/07	07/24/07	12/19/01	11/20/03	04/04/07	07/25/07	12/19/01
Volatile Organic Compounds													
Benzene	UG/L	10 U	140	10 U	1 U	10 U	0.250 U	10 U	1 U	10 U	0.250 U	10 U	1,200
Ethylbenzene	UG/L	10 U	46	10 U	1 U	10 U	0.300 U	10 U	1 U	10 U	0.300 U	10 U	510
Toluene	UG/L	10 U	10 U	10 U	1 U	10 U	0.310 U	10 U	1 U	10 U	0.310 U	10 U	3,900
Xylene (total)	UG/L	10 U	38	10 U	1 U	10 U	0.800 U	10 U	1	10 U	0.800 U	10 U	2,400
Total BTEX		**10 U**	**224**	**10 U**	**1 U**	**10 U**	**0.8 U**	**10 U**	**1**	**10 U**	**0.8 U**	**10 U**	**8,010**
Semivolatile Organic Compounds													
2-Methylnaphthalene	UG/L	10 U	2 J	10 U	10 U	10 U	---	10 U	10 U	10 U	---	10 U	---
Acenaphthene	UG/L	10 U	9 J	10 U	10 U	10 U	0.170 U	10 U	10 U	10 U	0.170 U	10 U	---
Acenaphthylene	UG/L	10 U	120 D	10 U	10 U	10 U	0.158 U	10 U	10 U	10 U	0.158 U	10 U	---
Anthracene	UG/L	10 U	1 J	10 U	10 U	10 U	0.428 U	10 U	10 U	10 U	0.428 U	10 U	---
Benzo(a)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	0.260 U	10 U	10 U	10 U	0.260 U	10 U	---
Benzo(a)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	0.380 U	10 U	10 U	10 U	0.380 U	10 U	---
Benzo(b)fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0.540 U	10 U	10 U	10 U	0.540 U	10 U	---
Benzo(g,h,i)perylene	UG/L	10 UJ	10 U	10 UJ	10 U	10 U	0.586 U	10 UJ	10 U	10 U	0.586 U	10 U	---
Benzo(k)fluoranthene	UG/L	10 UJ	10 U	10 UJ	10 U	10 U	0.500 U	10 UJ	10 U	10 U	0.500 U	10 U	---
Chrysene	UG/L	10 U	10 U	10 U	10 U	10 U	0.284 U	10 U	10 U	10 U	0.284 U	10 U	---
Dibenz(a,h)anthracene	UG/L	10 U	10 U	10 U	10 U	10 U	0.720 U	10 U	10 U	10 U	0.720 U	10 U	---
Fluoranthene	UG/L	10 U	10 U	10 U	10 U	10 U	0.576 U	10 U	10 U	10 U	0.576 U	10 U	---
Fluorene	UG/L	10 U	20	10 U	10 U	10 U	0.256 U	10 U	10 U	10 U	0.256 U	10 U	---
Indeno(1,2,3-cd)pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	0.520 U	10 U	10 U	10 U	0.520 U	10 U	---
Naphthalene	UG/L	10 U	11	10 U	10 U	10 U	0.158 U	10 U	10 U	10 U	0.158 U	10 U	---
Phenanthrene	UG/L	10 U	16	10 U	10 U	10 U	0.440 U	10 U	10 U	10 U	0.440 U	10 U	---
Pyrene	UG/L	10 U	10 U	10 U	10 U	10 U	0.288 U	10 U	10 U	10 U	0.288 U	10 U	---
Total PAHs		**10 U**	**179**	**10 U**	**10 U**	**10 U**	**0.720 U**	**10 U**	**10 U**	**10 U**	**0.720 U**	**10 U**	**---**
Total Metals													
Iron	UG/L	---	---	---	---	48.8	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	7.1	---	---	---	---	---	---	---
Dissolved Metals													
Iron	UG/L	---	---	---	---	35.3	---	---	---	---	---	---	---
Manganese	UG/L	---	---	---	---	16.7	---	---	---	---	---	---	---
Miscellaneous Parameters													
Alkalinity, Total (as CaCO3)	UG/L	---	---	---	---	8,800	---	---	---	---	---	---	---
Ferrous Iron	UG/L	---	---	---	---	400 U	---	---	---	---	---	---	---
Nitrate-Nitrogen	UG/L	---	---	---	---	2,850	---	---	---	---	---	---	---
Nitrite-Nitrogen	UG/L	---	---	---	---	100 U	---	---	---	---	---	---	---
Sulfate (as SO4)	UG/L	---	---	---	---	5,200	---	---	---	---	---	---	---
Heterotrophic Plate Count	CFU/ML	---	---	---	---	15	---	---	---	---	---	---	---
BOD	UG/L	---	---	---	---	14,000	---	---	---	---	---	---	---
COD	UG/L	---	---	---	---	10,000 U	---	---	---	---	---	---	---
Dissolved Organic Carbon	UG/L	---	---	---	---	1,000 U	---	---	---	---	---	---	---
Orthophosphate	UG/L	---	---	---	---	50 U	---	---	---	---	---	---	---
Dissolved Gases													
Carbon Dioxide	UG/L	---	---	---	---	26,400	---	---	---	---	---	---	---
Methane	UG/L	---	---	---	---	1 U	---	---	---	---	---	---	---

TABLE E-39
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
GEOCHEMICAL PARAMETERS IN GROUNDWATER
NOVEMBER 2003

Sample Number:	HIMW-13I	HIMW-13S	FB111703	HIMW-06I	HIMW-06S	HIMW-15I	PZ-02
Lab Sample ID No:	0311469-001A	0311469-002A	0311469-003A	0311516-001A	0311516-002A	0311516-003A	0311569-001A
Depth(ft):	NA	NA	NA	NA	NA	NA	NA
Sample Type:	Groundwater	Groundwater	`Water	Groundwater	Groundwater	Groundwater	Groundwater
Sample Date:	11/17/03	11/17/03	11/17/03	11/18/03	11/18/03	11/18/03	11/19/03
Units:	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Methane	66 D	ND @ 1	ND @ 1	ND @ 1	3.5	88 D	ND @ 1
Dissolved Organic Carbon	6700	< 1000	< 1000	< 1000	17700	2100	< 1000
Nitrogen, Ammonia	490	< 100	< 100	< 100	350	< 100	< 100
Nitrate as N	< 100	2670	< 100	3030	1510	< 100	2850
Ortho Phosphate	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Sulfate	17900	17100	< 5000	58000	169000	32000	5200
TDS	156000	261000	< 10000	198000	293000	364000	254000
Calcium	25800	17400	172 B	20400	25600	32500	14200
Iron	62400	468	7.6 B	117	7690	138	48.8 B
Dissolved Iron	28200	25.1 B	9.5 B	11.8 B	5160	10.9 B	35.3 B
Magnesium	5270	4000 B	8.3 B	4260 B	3250 B	5790	5740
Manganese	1700	15.6	ND @ 0.5	34.2	346	9040	7.1 B
Dissolved Manganese	1620	3.6 B	ND @ 0.5	42.8	324	7570	16.7
Potassium	2930 B	2400 B	39.8 B	3230 B	2480 B	3830 B	2920 B
Sodium	25600	52700	315 B	32800	4020 B	35900	34100
Ferrous Iron	49000	ND @ 400	ND @ 400	ND @ 400	ND @ 400	6000	ND @ 400
Total Alkalinity	86800	20300	< 1000	30100	< 1000	81800	8800
BOD	4000	< 2000	< 2000	2000	67000	< 2000	14000
Chloride	50100	95800	< 2000	51300	< 2000	58100	78100
Carbon Dioxide	163000	44000	1800	52800	269000	88000	26400
COD	31400	58100	< 10000	< 10000	342000	16800	< 10000
Standard Plate Count	6	230	< 1	150	410	32	15

NOTES:
NA - Indicates Sample Was Not Analyzed For That Parameter.
ND - Indicates Sample Was Not Detected At The Method Detection Limit.
D - Indicates Sample Was Diluted.
J - Indicates Sample Was Detected At A Concentration Below The Method Detection Limit.
B - Indicates Compound Was Also Reported In Quality Assurance/Quality Control Blanks.
NYSDEC GWCGs Taken From The Most Current Edition Of TAGM # 4046.

Table 3-7
Groundwater Geochemical Data
Pre-Design Investigation Report
Hempstead Former MGP Site

Parameter	Depth	Ferrous Iron	Alkalinity [(2)]	Nitrate-N	Nitrite-N	Sulfate [(3)]	Phosphate (ortho)	Dissolved Oxygen	Dissolved Oxygen	Oxidation-Reduction Potential	pH	Notes
Unit	(ft bgs)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(ppm)	(mV)	(SU)	
Method		HACH 8146 [(1)]	EPA 310.1	EPA 352.1	EPA 354.1	EPA 375.4	EPA 365	(flow-thru cell)	(down hole)	(flow-thru cell)	(flow-thru cell)	
HIMW-10S (12/11/01)	28-38	---	---	---	---	---	---	---	---	---	---	See Note 4
(4/9/07)		---	28.0	3.04	0.09	59.4	---	---	---	---	---	See Note 5
(8/6/07)		---	1.7	5.51	0.22	96.5	---	---	---	---	---	See Note 5
HIMW-10I (12/11/01)	80.5-90.5	---	---	---	---	---	---	---	---	---	---	See Note 4
(4/6/07)		---	3.0	2.42	ND	28.7	---	---	---	---	---	See Note 5
(8/2/07)		---	ND	2.40	ND	30.2	---	---	---	---	---	See Note 5
HIMW-10D (4/5/07)	112.5-132.5	---	9.0	1.98	ND	15.2	---	---	---	---	---	See Note 5
(8/3/07)		---	4.8	2.14	ND	22.0	---	---	---	---	---	See Note 5
DGP-209	34-38	19.0	---	---	---	---	---	2.83	---	-132	8.14	See Note 6
	40-44	>29.7	---	---	---	---	---	3.70	---	-92	8.25	
(11/11/08 -	50-54	23.0	---	---	---	---	---	2.19	---	17	7.13	
11/14/08)	70-74	11.9	---	---	---	---	---	2.10	---	30	6.84	
HISB-100	30-34	8.4	112	3.92	ND	---	ND	0.00	---	-77	7.35	See Note 6
	40-44	>29.7	---	---	---	---	---	0.00	---	-77	7.05	
(11/19/08 -	50-54	>29.7	17	0.11	ND	---	ND	0.00	---	-35	6.83	
11/21/08)	60-64	---	---	---	---	---	---	0.00	---	-99	7.23	
	70-74	---	---	---	---	---	---	0.00	0.48	74	5.56	
	80-84	---	---	---	---	---	---	0.00	---	-16	5.73	
HISB-101	30-34	1.9	24.2	0.22	ND	---	ND	2.22	0.20	-88	8.12	See Note 6
	40-44	>29.7	---	---	---	---	---	2.14	0.21	-75	7.34	
(11/20/08 -	50-54	>29.7	143	0.29	ND	---	ND	2.19	0.24	-24	7.30	
11/20/08)	60-64	---	---	---	---	---	---	---	---	-74	7.45	
	70-74	---	---	---	---	---	---	0.50	2.21	52	5.95	
	80-84	---	---	---	---	---	---	2.90	2.04	44	6.26	
HISB-102	30-34	>29.7	97.5	0.12	ND		ND	0.00	---	-15	6.08	See Note 6
	40-44	---	---	---	---		---	0.00	---	-75	6.43	
(12/1/08 -	50-54	8.9	49.8	0.54	ND		ND	0.00	0.72	2	6.25	
12/2/08)	60-64	---	---	---	---		---	2.65	---	18	6.30	
	70-74	---	---	---	---		---	3.33	0.75	62	5.90	
	80-84	---	---	---	---		---	0.00	---	-127	6.80	
HISB-102-2	30-34	---	---	---	---		---	0.00	---	-173	5.97	See Note 7
	40-44	---	---	---	---		---	0.00	---	-192	5.74	
(1/7/09 -	50-54	---	---	---	---		---	0.00	---	-118	5.81	
1/8/09)	60-64	---	---	---	---		---	0.00	---	-116	6.08	
	70-74	---	---	---	---		---	0.00	---	-60	6.15	
	80-84	---	---	---	---		---	0.00	---	-76	6.75	

Table 3-7
Groundwater Geochemical Data
Pre-Design Investigation Report
Hempstead Former MGP Site

Parameter	Depth	Ferrous Iron	Alkalinity [(2)]	Nitrate-N	Nitrite-N	Sulfate [(3)]	Phosphate (ortho)	Dissolved Oxygen		Oxidation-Reduction Potential	pH	Notes
Unit	(ft bgs)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(ppm)	(mV)	(SU)	
Method		HACH 8146 [(1)]	EPA 310.1	EPA 352.1	EPA 354.1	EPA 375.4	EPA 365	(flow-thru cell)	(down hole)	(flow-thru cell)	(flow-thru cell)	
HISB-103	30-34	14.8	34.6	23.6	0.66		ND	0.00	---	-52	5.46	See Note 6
	40-44	---	---	---	---		---	0.00	---	-11	5.64	
(12/1/08 -	50-54	>29.7	58.2	0.19	ND		ND	0.00	---	-33	5.77	
12/2/08)	60-64	---	---	---	---		---	5.38	3.50	110	5.28	
	70-74	---	---	---	---		---	4.46	---	129	5.36	
	80-84	---	---	---	---		---	0.00	---	-89	5.98	
HISB-104	30-34	>3.3	63.7	4.84	ND		ND	7.08	---	14.5	6.31	See Note 6
(9/24/08 -	45-49	>3.3	---	---	---		---	6.30	---	-114.2	6.81	
9/25/08)	55-59	>3.3	15.9	3.66	ND		ND	5.71	---	-96.2	7.06	
HISB-105	30-34	---	---	---	---		---	0.00	0.75	-30	6.27	See Note 6
	40-44	---	---	---	---		---	0.00	0.36	-28	6.45	
(12/4/08 -	50-54	23.6	61.0	0.10	ND		ND	0.00	0.36	-54	6.46	
12/5/08)	60-64	---	---	---	---		---	0.00	0.43	-52	6.30	
	70-74	27.9	90.2	0.13	ND		ND	0.00	0.48	-56	6.65	
	80-84	---	---	---	---		---	0.00	0.42	-32	6.06	
	90-94	---	---	---	---		---	0.00	---	-70	6.25	
HISB-105-2	30-34	---	---	---	---		---	0.00	---	-163	6.29	See Note 7
	40-44	---	---	---	---		---	0.00	---	-146	6.38	
(12/18/08)	50-54	---	---	---	---		---	0.00	---	-198	6.01	
	60-64	---	---	---	---		---	0.00	---	-135	5.88	
	70-74	---	---	---	---		---	0.00	---	-138	6.14	
	80-84	---	---	---	---		---	0.00	---	-141	6.43	
	90-94	---	---	---	---		---	0.00	---	-188	6.37	
	100-104	---	---	---	---		---	0.00	---	-59	5.79	
HISB-106	30-34	---	---	---	---		---	0.00	0.52	52	5.48	See Note 6
	40-44	---	---	---	---		---	0.51	0.48	-87	5.74	
(12/4/08)	50-54	>29.7	50.6	ND	ND		ND	0.00	---	36	5.38	
	60-64	---	---	---	---		---	0.00	0.52	3	5.63	
	70-74	>29.7	23.6	0.13	ND		ND	0.00	0.37	-101	5.72	
	80-84	---	---	---	---		---	0.00	0.43	-134	5.95	
	90-94	---	---	---	---		---	0.00	---	-252	6.53	
HISB-107	30-34	---	---	---	---		---	0.00	0.82	57	5.75	See Note 6
	40-44	---	---	---	---		---	0.00	---	-24	6.04	
(12/8/08 -	50-54	>29.7	76.2/73.8	0.11/0.11	ND/ND		ND/ND	0.00	0.83	-30	6.26	
12/9/08)	60-64	---	---	---	---		---	0.00	---	-12	6.13	
	70-74	26.0	24.3	0.17	ND		ND	0.62	0.50	-1	5.48	
	80-84	---	---	---	---		---	0.00	---	71	5.39	
	90-94	---	---	---	---		---	0.00	---	-170	6.14	
HISB-108	30-34	---	---	---	---		---	7.73	3.37	32	6.10	See Note 6
	40-44	---	---	---	---		---	0.00	0.63	37	5.62	
(12/9/08 -	50-54	9.5	11.8	3.28	ND		ND	0.00	0.50	49	5.26	

Table 3-7
Groundwater Geochemical Data
Pre-Design Investigation Report
Hempstead Former MGP Site

Parameter	Depth	Ferrous Iron	Alkalinity [2]	Nitrate-N	Nitrite-N	Sulfate [3]	Phosphate (ortho)	Dissolved Oxygen		Oxidation-Reduction Potential	pH	Notes
Unit	(ft bgs)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(ppm)	(ppm)	(mV)	(SU)	
Method		HACH 8146 [1]	EPA 310.1	EPA 352.1	EPA 354.1	EPA 375.4	EPA 365	(flow-thru cell)	(down hole)	(flow-thru cell)	(flow-thru cell)	
HISB-108	60-64	---	---	---	---		---	0.00	0.51	54	5.33	See Note 6
	70-74	10.3	24.4	2.82	ND		ND	0.00	0.52	91	5.08	
12/10/08)	80-84	---	---	---	---		---	0.00	0.33	2	5.79	
	90-94	---	---	---	---		---	0.00	---	-121	5.76	
HISB-109	30-34	---	---	---	---		---	4.62	4.76	149	6.63	See Note 6
	40-44	---	---	---	---		---	1.41	---	-29	10.35	
(12/10/08 -	50-54	19.7	28.1	2.46	ND		ND	4.33	1.42	-90	8.68	
12/11/08)	60-64	---	---	---	---		---	0.00	---	-32	7.64	
	70-74	>29.7	31	2.21	ND		ND	0.00	0.78	40	4.70	
	80-84	---	---	---	---		---	0.00	0.39	-6	5.06	
	90-94	---	---	---	---		---	0.00	---	-8	5.35	
HISB-114	30-34	---	---	---	---		---	0.00	---	-134	6.42	See Note 6
	40-44	---	---	---	---		---	0.00	---	-136	6.47	
(12/22/08 -	50-54	18.9	75.0/70.0	3.11/3.66	ND/ND		ND/ND	0.00	---	-180	6.23	
12/23/08)	60-64	---	---	---	---		---	0.00	---	-129	6.37	
	70-74	>29.7	34.1	0.70	ND		ND	0.00	---	-135	6.42	
	80-84	---	---	---	---		---	0.00	---	-96	6.54	
	90-94	---	---	---	---		---	0.00	---	-130	6.67	
HISB-115	30-34	---	---	---	---		---	0.00	---	-76	5.73	See Note 6
	40-44	---	---	---	---		---	0.00	---	-119	5.83	
(1/14/09 -	50-54	>29.7	138	0.46	ND		ND	0.00	---	-101	6.23	
1/5/09)	60-64	---	---	---	---		---	0.00	---	-133	5.85	
	70-74	>29.7	112	0.28	ND		ND	0.00	---	-135	6.08	
	80-84	---	---	---	---		---	0.00	---	-152	5.67	
	90-94	---	---	---	---		---	0.00	---	-130	5.69	

Notes:

1 Field Analysis - Hach Kit
2 as $CaCO_3$
3 as SO_4
4 Data from Remedial Investigation Report (PS&S, November 2006)
5 Data from Groundwater Sampling and NAPL Monitoring/Recovery Report for the Second and Third Quarters of 2007 (URS, November 2007)
6 Samples collected with Geoprobe SP22 sampler & tubing check valve assembly, top-bottom sampling sequence used
7 Samples collected with Geoprobe SP22 sampler & tubing check valve assembly, bottom-top sampling sequence used

—	Not measured or not reported
ND	Not Detected
ft bgs	feet below ground surface
ug/L	micrograms per liter
mg/L	milligrams per liter
ppm	parts per million
mV	millivolts
SU	standard units
mS/cm	millisiemens per centimeter

49/74

TABLE 3-1
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR GLACIAL SEDIMENTS

Sample Identification		HIMW-01	HIMW-02		HIMW-06		HIMW-11	AVERAGE CHARACTERISTICS FOR GLACIAL SEDIMENTS
Depth Below Grade (feet)		36-38	26-28	32-34	24-26	28-30	26-28	
Date Collected		10/27/2000	10/13/2000	10/13/2000	9/27/2000	10/4/2000	11/14/2000	
CHARACTERISTIC	UNIT							
w	%	9.8	2.9	14.8	4.0	1.6	5.0	6.4
Sieve (200)	%	1	5	23	3	22	6	10
Hyd (2 μ)	%	N/A	N/A	N/A	N/A	<1	N/A	<1
TOC	%	0.8	0.3	0.1	0.6	0.6	0.6	0.5
G_s	none	2.64	2.64	2.71	2.66	2.65	2.72	2.67
d_{10}	mm	0.38	0.20	0.25	0.23	0.052	0.17	0.21

*

NOTES:

w - Water content
Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd- % sample particles finer than 2 μ as determined through hydrometer analysis
TOC - Total Organic Carbon
Gs - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ – Micron
N/A Not analyzed
* - d_{10} finer than endpoint of grain size analysis

TABLE 3-2
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

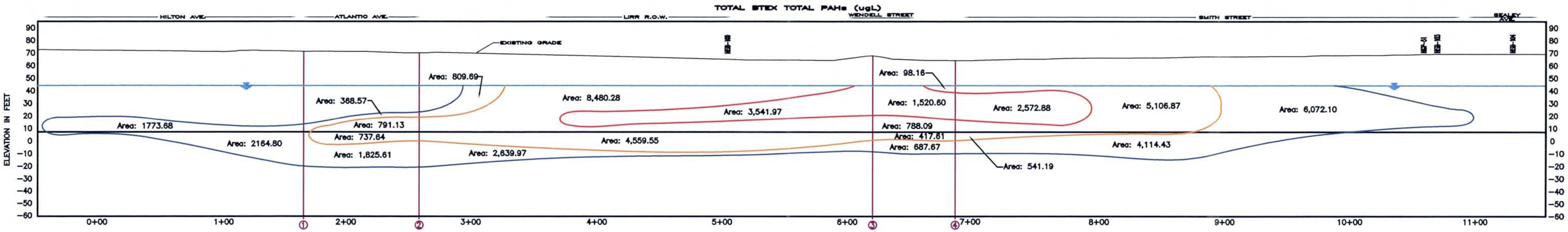
GEOTECHNICAL ANALYSIS RESULTS FOR ~~GLACIAL~~ SEDIMENTS
UPPER MAGOTHY

Sample Identification		HIMW-01		HIMW-02		HIMW-06	HIMW-11	AVERAGE CHARACTERISTICS FOR UPPER MAGOTHY FORMATION DEPOSITS
Depth (feet)		84-86	116-118	80-82	108-110	75-77	80-82	
Date Collected		10/30/2000	10/31/2000	10/12/2000	10/10/2000	10/5/2000	11/14/2000	
CHARACTERISTIC	UNIT							
w	%	21.7	22.2	22.1	17.8	19.6	1.1	17.4
Sieve (200)	%	13	12	5	7	10	35	14
Hyd (2 μ)	%	2	2	N/A	N/A	2	8	4
TOC	%	1.0	0.2	0.5	4.8	12.4	1.8	3.5
G_s	none	2.69	2.65	2.67	2.70	2.74	2.76	2.70
d_{10}	mm	0.04	0.055	0.15	0.17	0.07	0.0024	0.080

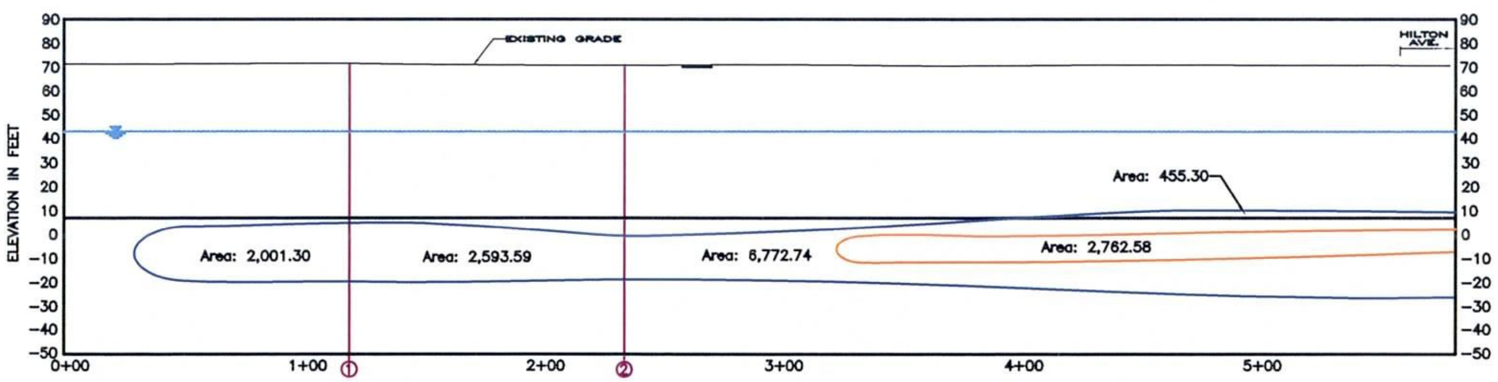
*

NOTES:

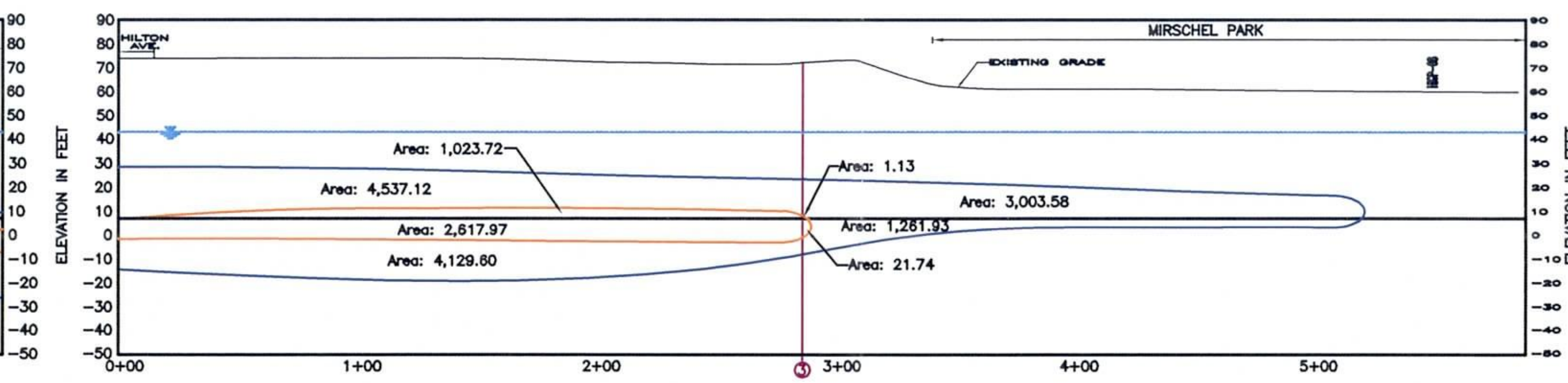
w - Water content
Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd- % sample particles finer than 2 μ as determined through hydrometer analysis
TOC - Total Organic Carbon
Gs - Specific Gravity
d_{10} - Effective grain size : diameter at which 10% of sample particles are finer and 90% are coarser
% - Percent
mm - Millimeters
μ – Micron
N/A Not analyzed
* - d_{10} finer than endpoint of grain size analysis



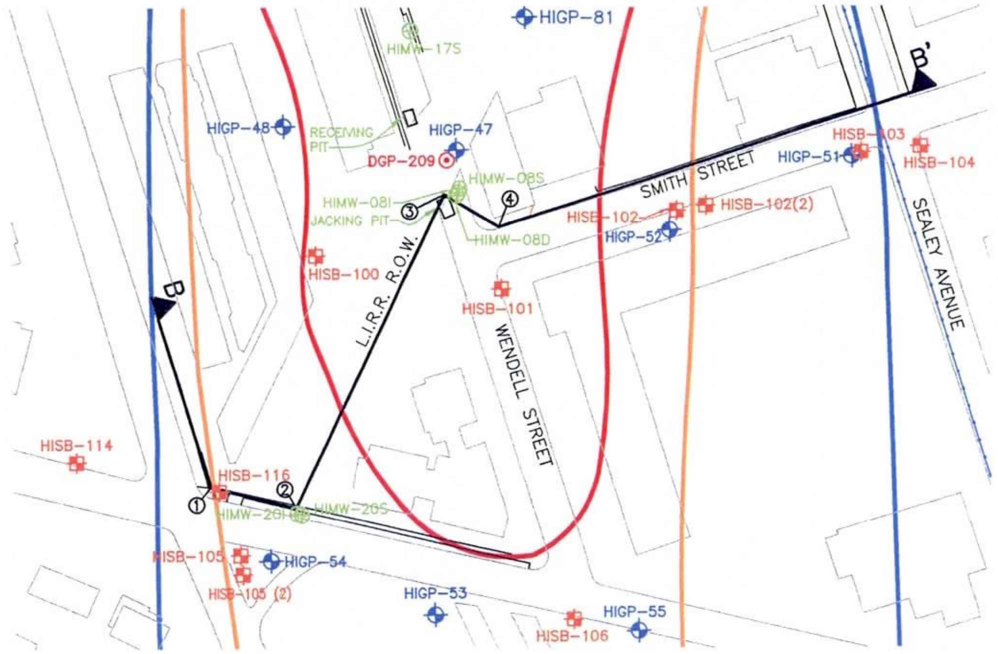
SECTION B–B'



SECTION C1–C1'



SECTION C2–C2'



PLAN VIEW

100' 0 100'
SCALE IN FEET

NOTE:

1. THE CROSS-SECTION B-B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 8 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS-SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWINGS 6 AND 7 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.

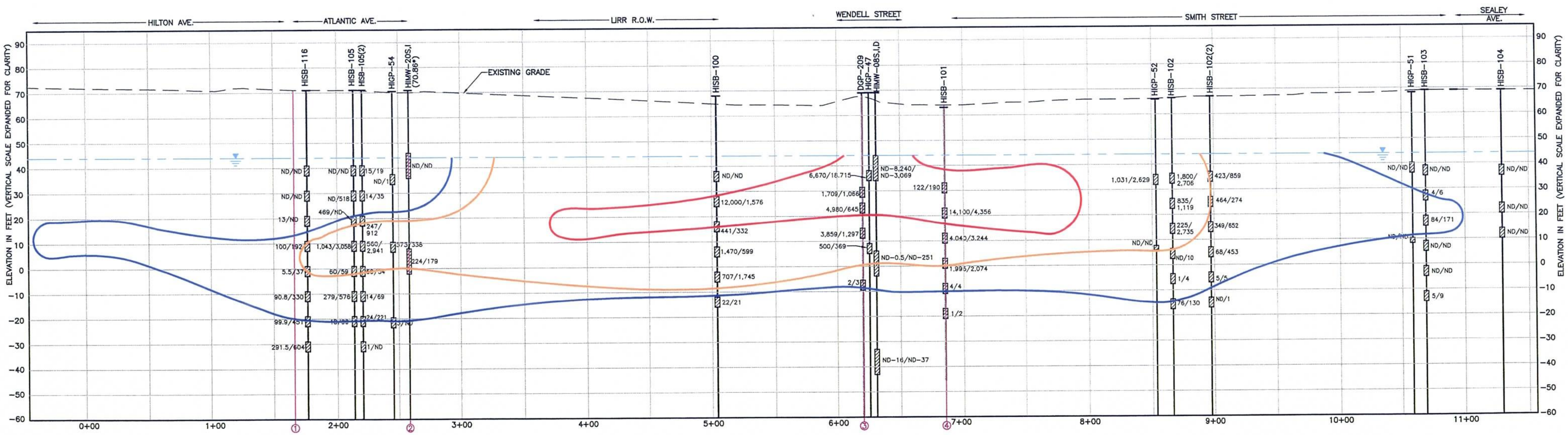
LEGEND:

HISB-100 — BORING ID
APPROXIMATE GROUND SURFACE
APPROXIMATE GROUNDWATER SURFACE
GROUNDWATER SAMPLE INTERVAL
22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L

ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



SECTION B-B'

* SURVEYED ELEVATION

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

WARNING
IT IS A VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON OTHER THAN WHOSE SEAL APPEARS ON THIS DRAWING, TO ALTER IN ANY WAY AN ITEM ON THIS DRAWING. IF AN ITEM IS ALTERED, THE ALTERING ENGINEER SHALL AFFIX TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

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JOB NO. 11175065

NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME SECTION B-B'

Scale: AS SHOWN | Date: SEPT. 2009 | DWG 5

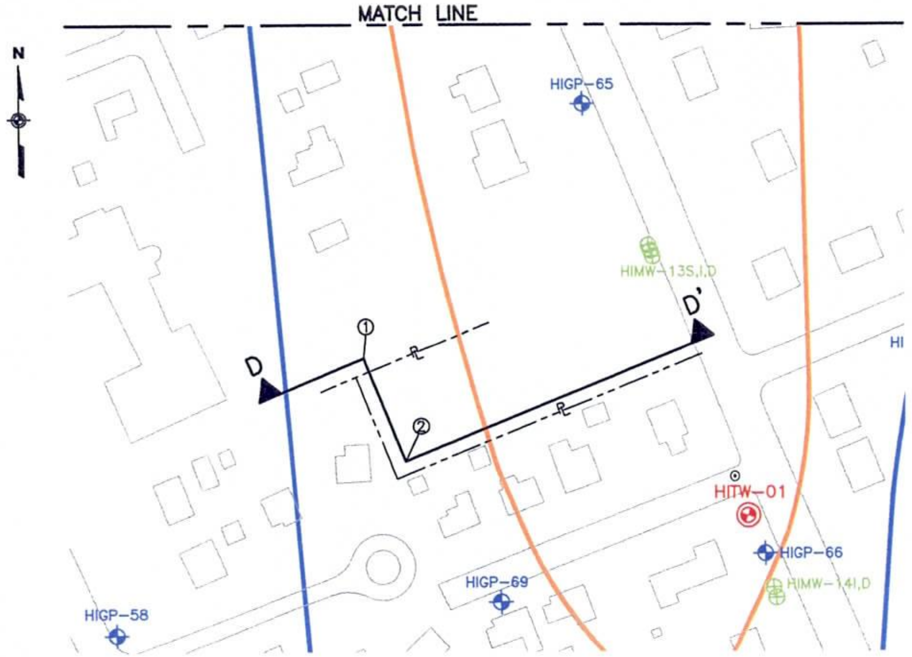
J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 5-6.dwg 9/29/09 - 3 RAL

NOTE:

1. THE CROSS-SECTIONS C-C' AND D-D' REPRESENT THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 9 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS-SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWINGS 6 AND 7 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.

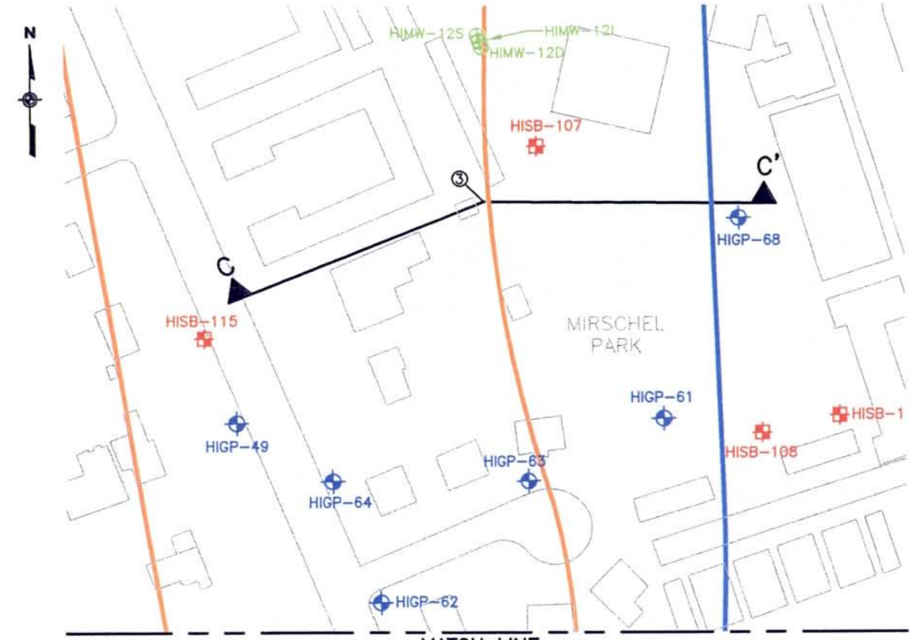
LEGEND:

- HISB-100 — BORING ID
- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- GROUNDWATER SAMPLE INTERVAL
- 22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



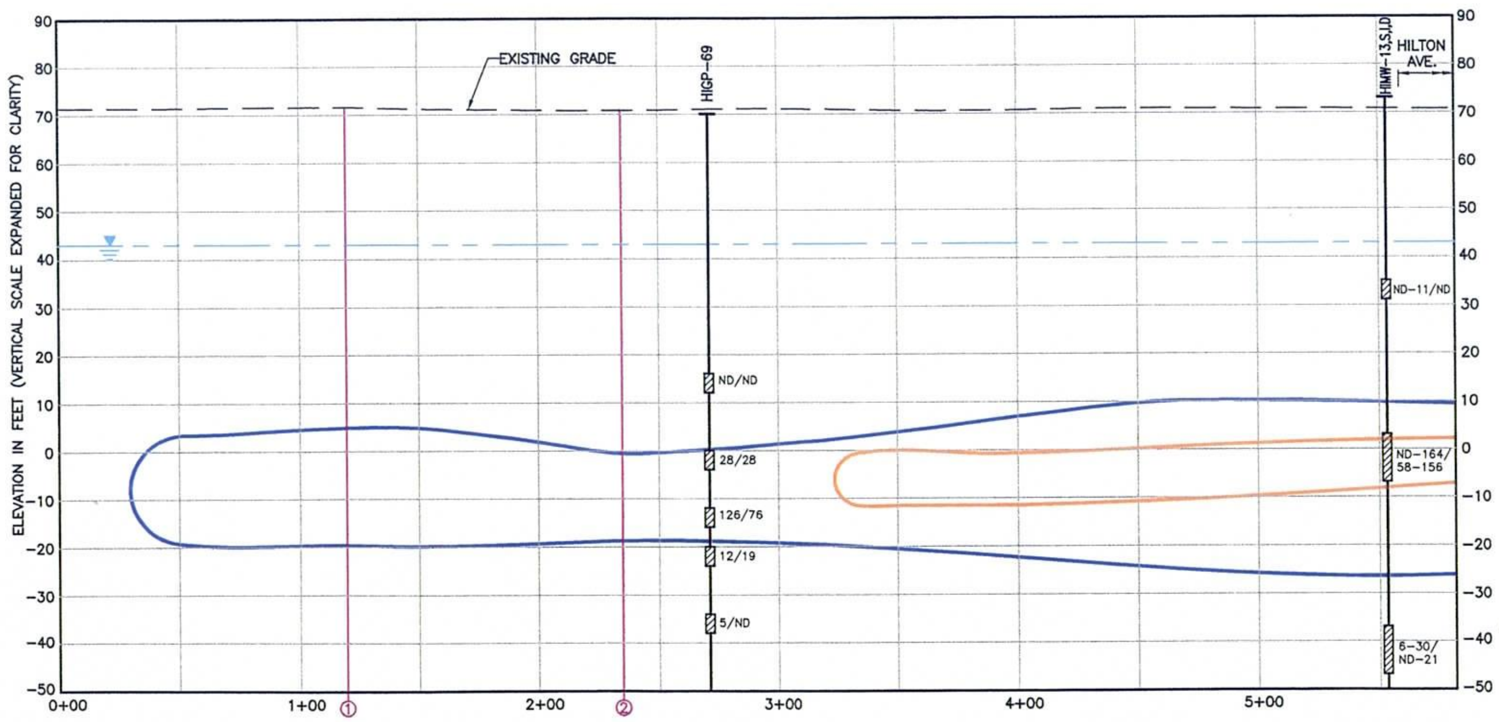
PLAN VIEW D-D'

100' 0 100'
SCALE IN FEET

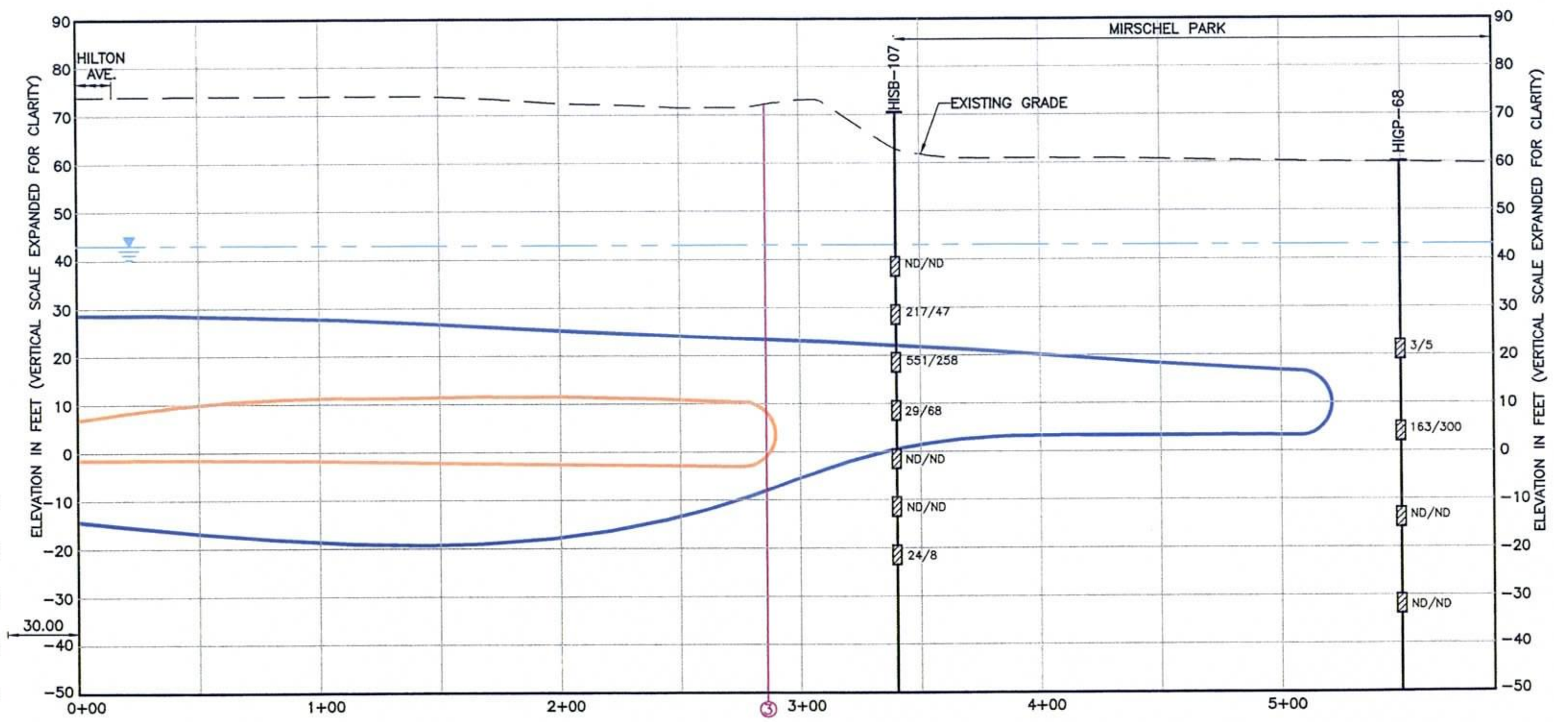


PLAN VIEW C-C'

100' 0 100'
SCALE IN FEET



SECTION D-D'



SECTION C-C'

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 5-6.dwg 9/29/09 - 3 RAL

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
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NATIONAL GRID
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HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME CROSS-SECTION C-C' AND D-D'

Scale: AS SHOWN | Date: SEPT. 2009 | DWG 6

Hydraulic Conductivity

Location	Screened Interval	Well Screen [1] Depth (ft bgs) Top	Bottom	Hydraulic Conductivity [2] (ft/day)	(cm/sec)
HIMW-02I	Upper Magothy	78	88	94.0	3.3E-02
HIMW-02D	Upper Magothy	104	114	121.9	4.3E-02
HIMW-03S	Glacial Sediments	23	33	150.5	5.3E-02
HIMW-03I	Upper Magothy	80.5	90.5	66.0	2.3E-02
HIMW-03D	Upper Magothy	133	143	88.0	3.1E-02
HIMW-08S	Glacial Sediments	25	35	133.4	4.7E-02
HIMW-08D	Upper Magothy	102	112	103.3	3.6E-02
HIMW-12S	Glacial Sediments	22	32	204.1	7.2E-02
HIMW-13S	Glacial Sediments	38	48	172.4	6.1E-02
HIMW-15I	Upper Magothy	80	90	172.6	6.1E-02
HIMW-15D	Upper Magothy	141.5	151.5	135.1	4.8E-02
HIMW-20S	Glacial Sediments	25	35	141.8	5.0E-02
HIMW-20I	Upper Magothy	63	73	134.0	4.7E-02
Geometric Mean (all wells)				126.6	4.5E-02
Geometric Mean (wells screened in glacial sediments)				158.5	5.6E-02
Geometric Mean (wells screened in Upper Magothy sediments)				110.0	3.9E-02

Reference

1 PS&S, 2006. *Final Remedial Investigation Report, Hempstead Intersection Street Former Manufactured Gas Plant Site*. November.

2 URS. 2008. *Pre-Design Investigation Report for In-Situ Solidification and Off-Site Groundwater Treatment, Hempstead Intersection Street Former Manufactured Gas Plant Site*. May

Hydraulic Gradient

Zone	Approx. Screened Interval Formation	Depth (ft bgs)	Period	Gradient
Shallow	Glacial Sediments	22 - 48	1st Quarter 2008 [3]	0.0019
			2nd Quarter 2008 [4]	0.0019
			3rd Quarter 2008 [5]	0.0016
			4th Quarter 2008 [6]	0.0017
Geometric Mean				0.0018
Intermediate	Upper Magothy	55 - 95	1st Quarter 2008	0.0018
			2nd Quarter 2008	0.0018
			3rd Quarter 2008	0.0017
			4th Quarter 2008	0.0017
Geometric Mean				0.0017

Reference

3 URS. 2008. *Groundwater Sampling and NAPL Monitoring/Recovery Report for the First Quarter of 2008.* June.

4 URS. 2008. *Groundwater Sampling and NAPL Monitoring/Recovery Report for the Second Quarter of 2008.* October.

5 URS. 2009. *Groundwater Sampling and NAPL Monitoring/Recovery Report for the Third Quarter of 2008.* January.

6 URS. 2009. 2008 Annual *Groundwater Sampling and NAPL Monitoring/Recovery Report.* March.

Table 3-5
Hydraulic Conductivity Test Results
Pre-Design Investigation Report
Hempstead Former MGP Site

Location	Hydraulic Conductivity (ft/day)	Hydraulic Conductivity (cm/sec)
HIMW-02I	94	$3.3x10^{-2}$
HIMW-02D	122	$4.3x10^{-2}$
HIMW-03S	151	$5.3x10^{-2}$
HIMW-03I	66	$2.3x10^{-2}$
HISB-03D	88	$3.1x10^{-2}$
HIMW-08S	133	$4.7x10^{-2}$
HIMW-08D	103	$3.7x10^{-2}$
HIMW-12S	204	$7.2x10^{-2}$
HIMW-13S	172	$6.1x10^{-2}$
HIMW-15I	173	$6.1x10^{-2}$
HIMW-15D	135	$4.8x10^{-2}$
HIMW-20S	142	$5.0x10^{-2}$
HIMW-20I	134	$4.7x10^{-2}$

TABLE 2-2

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MEASURING POINT ELEVATION(1) (feet)	CASING DIAMETER (inches)	SCREENED DEPTHS (feet bgs) Interval	SCREENED DEPTHS Description	ANNULAR FILLS (feet bgs) Interval	ANNULAR FILLS Type	ANNULAR FILLS Material
HIMW-01S	38.00	38.00	69.41	71.61	2.00	26-36	Slotted PVC	0-1.5	Seal	Cement
								1.5-18	Backfill	Cement/Bentonite Grout
								18-20	Seal	Bentonite
								20-38	Filter	#2 Gravel Pack
HIMW-01I	86.00	86.00	69.27	71.68	2.00	74-84	Slotted PVC	0-1.5	Seal	Cement
								1.5-62	Backfill	Cement/Bentonite Grout
								62-64	Seal	Bentonite
								64-86	Filter	#1 Gravel Pack
HIMW-01D	124.00	152.00	69.39	71.95	2.00	112-122	Slotted PVC	0-1.5	Seal	Cement
								1.5-100	Backfill	Cement/Bentonite Grout
								100-102	Seal	Bentonite
								102-124	Filter	#1 Gravel Pack
HIMW-02S	40.00	40.00	71.79	73.82	2.00	28-38	Slotted PVC	0-1.5	Seal	Cement
								1.5-23.3	Backfill	Cement/Bentonite Grout
								23.3-25.3	Seal	Bentonite
								25.3-40	Filter	#2 Gravel Pack
HIMW-02I	90.00	90.00	76.82*	78.87*	2.00	78-88	Slotted PVC	0-1.5	Seal	Cement
								1.5-76	Backfill	Cement/Bentonite Grout
								76-78	Seal	Bentonite
								78-90	Filter	#2 Gravel Pack
HIMW-02D	116.00	130.50	71.73	74.13	2.00	104-114	Slotted PVC	0-1.5	Seal	Cement
								1.5-95	Backfill	Cement/Bentonite Grout
								95-97	Seal	Bentonite
								97-120	Filter	#2 Gravel Pack
HIMW-03S	35.00	35.00	65.34	65.00	2.00	23-33	Slotted PVC	0-1	Seal	Cement
								1-17	Backfill	Cement/Bentonite Grout
								17-19	Seal	Bentonite Pellets
								19-35	Filter	#2 Gravel Pack
HIMW-03I	92.50	93.00	65.54	64.94	2.00	80.5-90.5	Slotted PVC	0-1	Seal	Cement
								1-68	Backfill	Cement/Bentonite Grout
								68-70	Seal	Bentonite Slurry
								70-93	Filter	#2 Gravel Pack
HIMW-03D	145.00	151.00	65.88	65.26	2.00	133-143	Slotted PVC	0-1	Seal	Cement
								1-123	Backfill	Cement/Bentonite Grout
								123-125	Seal	Bentonite Slurry
								125-146	Filter	#1 Gravel Pack
HIMW-04S	42.00	42.00	73.18	72.74	2.00	30-40	Slotted PVC	0-1	Seal	Cement
								1-22.5	Backfill	Cement/Bentonite Grout
								22.5-24.5	Seal	Bentonite Pellets
								24.5-42	Filter	#2 Gravel Pack
HIMW-04I	92.00	92.00	73.22	72.78	2.00	80-90	Slotted PVC	0-1	Seal	Cement
								1-70	Backfill	Cement/Bentonite Grout
								70-72	Seal	Bentonite Slurry
								72-92	Filter	#2 Gravel Pack
HIMW-04D	179.00	182.00	73.37	72.65	2.00	167-177	Slotted PVC	0-1	Seal	Cement
								1-152	Backfill	Cement/Bentonite Grout
								152-154	Seal	Bentonite Slurry
								154-179	Filter	#1 Gravel Pack
HIMW-05S	39.00	40.00	67.33	67.19	2.00	27-37	Slotted PVC	0-1	Seal	Cement
								1-21	Backfill	Cement
								21-24	Seal	Bentonite Pellets
								24-40	Filter	#1 Gravel Pack

TABLE 2-2 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH	TOTAL DEPTH	GROUND SURFACE ELEVATION	MEASURING POINT ELEVATION[1]	CASING DIAMETER	SCREENED DEPTHS (feet bgs)		ANNULAR FILLS (feet bgs)		
	(feet bgs)	(feet bgs)	(feet)	(feet)	(inches)	Interval	Description	Interval	Type	Material
HIMW-05I	92.00	93.00	67.32	67.22	2.00	80-90	Slotted PVC	0-1	Seal	Cement
								1-73	Backfill	Cement
								73-75	Seal	Bentonite Slurry
								75-93	Filter	#2 Gravel Pack
HIMW-05D	142.00	172.00	67.38	67.22	2.00	130-140	Slotted PVC	0-1	Seal	Cement
								1-123	Backfill	Cement
								123-125	Seal	Bentonite Slurry
								125-143	Filter	#2 Gravel Pack
HIMW-06S	37.50	38.00	68.30	68.25	2.00	25.5-35.5	Slotted PVC	0-1	Seal	Cement
								1-19.2	Backfill	Cement
								19.2-22.5	Seal	Bentonite Pellets
								22.5-38	Filter	#2 Gravel Pack
HIMW-06I	84.00	85.00	68.09	67.88	2.00	72-82	Slotted PVC	0-1	Seal	Cement
								1-67	Backfill	Cement
								67-69	Seal	Bentonite
								69-71	Filter	#00 Sand Pack
								71-85	Filter	#2 Gravel Pack
HIMW-06D	118.00	132.50	67.89	67.77	2.00	106-116	Slotted PVC	0-1	Seal	Cement
								1-98	Backfill	Cement
								98-101	Seal	Bentonite Slurry
								101-103	Filter	#00 Sand Pack
								103-118.5	Filter	#2 Gravel Pack
HIMW-07S	41.00	41.00	70.80	70.47	2.00	29-39	Slotted PVC	0-1	Seal	Cement
								1-22	Backfill	Cement/Bentonite Grout
								22-24	Seal	Bentonite Pellets
								24-41	Filter	#2 Gravel Pack
HIMW-07I	90.00	90.00	70.31	70.10	2.00	78-88	Slotted PVC	0-1	Seal	Cement
								1-62	Backfill	Cement/Bentonite Grout
								62-64	Seal	Bentonite Slurry
								64-90	Filter	#1 Gravel Pack
HIMW-07D	117.00	132.00	70.75	70.40	2.00	105-115	Slotted PVC	0-1	Seal	Cement
								1-92	Backfill	Cement/Bentonite Grout
								92-94	Seal	Bentonite Slurry
								94-117	Filter	#1 Gravel Pack
HIMW-08S	37.00	38.00	65.32	65.04	2.00	25-35	Slotted PVC	0-1	Seal	Cement
								1-19	Backfill	Cement
								19-21	Seal	Bentonite Pellets (Hydrated)
								21-38	Filter	#2 Gravel Pack
HIMW-08I	75.00	76.00	65.34	65.14	2.00	63-73	Slotted PVC	0-1	Seal	Cement
								1-50	Backfill	Cement
								50-52	Seal	Bentonite Slurry
								52-76	Filter	#2 Gravel Pack
HIMW-08D	114.00	152.00	65.34	64.93	2.00	102-112	Slotted PVC	0-1	Seal	Cement
								1-95	Backfill	Cement
								95-97	Seal	Bentonite Slurry
								97-115	Filter	#2 Gravel Pack
HIMW-09S	40.00	41.00	70.44	70.03	2.00	28-38	Slotted PVC	0-1	Seal	Cement
								1-22.8	Backfill	Cement
								22.8-25.5	Seal	Bentonite Pellets
								25.5-41	Filter	#2 Gravel Pack
HIMW-09I	82.00	83.00	70.44	69.93	2.00	70-80	Slotted PVC	0-1	Seal	Cement
								1-61	Backfill	Cement
								61-63	Seal	Bentonite Slurry
								63-83	Filter	#2 Gravel Pack
HIMW-09D	125.00	152.00	70.39	69.96	2.00	113-123	Slotted PVC	0-1	Seal	Cement
								1-106	Backfill	Cement
								106-108	Seal	Bentonite Slurry
								108-126	Filter	#2 Gravel Pack

TABLE 2-2 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH	TOTAL DEPTH	GROUND SURFACE ELEVATION	MEASURING POINT ELEVATION[1]	CASING DIAMETER	SCREENED DEPTHS (feet bgs)		ANNULAR FILLS (feet bgs)		
	(feet bgs)	(feet bgs)	(feet)	(feet)	(inches)	Interval	Description	Interval	Type	Material
HIMW-10S	40.00	40.00	71.97	71.60	2.00	28-38	Slotted PVC	0-1	Seal	Cement
								1-22	Backfill	Cement
								22-26	Seal	Bentonite Pellets
								26-40	Filter	#2 Gravel Pack
HIMW-10I	92.50	93.00	71.90	71.47	2.00	80.5-90.5	Slotted PVC	0-1	Seal	Cement
								1-70	Backfill	Cement
								70-72	Seal	Bentonite Slurry
								72-76	Filter	#00 Sand Pack
								76-93	Filter	#2 Gravel Pack
HIMW-10D	134.50	139.00	71.74	71.44	2.00	122.5-132.5	Slotted PVC	0-1	Seal	Cement
								1-114	Backfill	Cement
								114-116	Seal	Bentonite
								116-118	Filter	#00 Sand Pack
								118-135.5	Filter	#2 Gravel Pack
HIMW-11S	40.00	40.00	71.69	71.62	2.00	28-38	Slotted PVC	0-1	Seal	Cement
								1-21	Backfill	Cement/Bentonite Grout
								21-23	Seal	Bentonite Pellets
								23-40	Filter	#2 Gravel Pack
HIMW-11I	92.00	92.00	71.60	71.43	2.00	80-90	Slotted PVC	0-1	Seal	Cement
								1-69	Backfill	Cement/Bentonite Grout
								69-71	Seal	Bentonite Slurry
								71-75.5	Filter	#00 Sand Pack
								75.5-92	Filter	#2 Gravel Pack
HIMW-11D	121.00	126.00	71.61	71.39	2.00	109-119	Slotted PVC	0-1	Seal	Cement
								1-97	Backfill	Cement/Bentonite Grout
								97-99	Seal	Bentonite Slurry
								99-104	Filter	#00 Sand Pack
								104-121	Filter	#1 Gravel Pack
HIMW-12S	34.00	35.00	61.85	61.58	2.00	22-32	Slotted PVC	0-1	Seal	Cement
								1-15.7	Backfill	Cement
								15.7-18.6	Seal	Bentonite Pellets
								18.6-35	Filter	#2 Gravel Pack
HIMW-12I	75.00	76.00	61.90	61.59	2.00	63-73	Slotted PVC	0-1	Seal	Cement
								1-55.8	Backfill	Cement
								55.8-57.8	Seal	Bentonite Slurry
								57.8-76	Filter	#2 Gravel Pack
HIMW-12D	129.00	182.00	62.09	61.82	2.00	117-127	Slotted PVC	0-1	Seal	Cement
								1-113	Backfill	Cement
								113-115	Seal	Bentonite Slurry
								115-130	Filter	#2 Gravel Pack
HIMW-13S	49.00	50.00	73.14	72.83	2.00	38-48	Slotted PVC	0-1	Seal	Cement
								1-33	Backfill	Cement
								33-35	Seal	Bentonite Slurry
								35-50	Filter	#2 Gravel Pack
HIMW-13I	82.00	83.00	73.01	72.60	2.00	70-80	Slotted PVC	0-1	Seal	Cement
								1-63	Backfill	Cement
								63-65	Seal	Bentonite Slurry
								65-83	Filter	#2 Gravel Pack
HIMW-13D	122.00	175.00	72.95	72.53	2.00	110-120	Slotted PVC	0-1	Seal	Cement
								1-102	Backfill	Cement
								102-104	Seal	Bentonite Slurry
								104-123	Filter	#2 Gravel Pack
HIMW-14I	97.00	97.00	72.01	71.71	2.00	85-95	Slotted PVC	0-1	Seal	Cement
								1-75	Backfill	Cement/Bentonite Grout
								75-77	Seal	Bentonite Slurry
								77-80	Filter	#00 Sand Pack
								80-97	Filter	#1 Gravel Pack

TABLE 2-2 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

MONITORING WELL CONSTRUCTION SUMMARY

MONITORING WELL	WELL DEPTH (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MEASURING POINT ELEVATION(1) (feet)	CASING DIAMETER (inches)	SCREENED DEPTHS (feet bgs) Interval	Description	ANNULAR FILLS (feet bgs) Interval	Type	Material
HIMW-14D	152.00	152.00	71.99	71.59	2.00	140-150	Slotted PVC	0-1	Seal	Cement
								1-129	Backfill	Cement/Bentonite Grout
								129-131	Seal	Bentonite Slurry
								131-134	Filter	#00 Sand Pack
								134-152	Filter	#1 Gravel Pack
HIMW-15I	92.00	93.00	64.59	64.18	2.00	80-90	Slotted PVC	0-1	Seal	Cement
								1-68	Backfill	Cement/Bentonite Grout
								68-70.5	Seal	Bentonite Slurry
								70.5-76.5	Filter	#00 Sand Pack
								76.5-93	Filter	#1 Gravel Pack
HIMW-15D	153.50	153.50	64.36	63.96	2.00	141.5-151.5	Slotted PVC	0-1	Seal	Cement
								1-123	Backfill	Cement/Bentonite Grout
								123-125	Seal	Bentonite Slurry
								125-128	Filter	#00 Sand Pack
								128-153.5	Filter	#1 Gravel Pack
HIMW-16S	36.00	36.00	67.81	67.45	2.00	24-34	Slotted PVC	0-1	Seal	Cement
								1-22	Backfill	Cement/Bentonite Grout
								22-24	Seal	Bentonite
								24-36	Filter	#1 Sand Pack
HIMW-16I	82.00	82.00	67.92	67.50	2.00	70-80	Slotted PVC	0-1	Seal	Cement
								1-66	Backfill	Cement/Bentonite Grout
								66-68	Seal	Bentonite
								68-82	Filter	#1 Sand Pack
HIMW-17S	37.00	37.00	66.42	65.96	2.00	25-35	Slotted PVC	0-1	Seal	Cement
								1-20	Backfill	Cement/Bentonite Grout
								20-22	Seal	Bentonite
								22-37	Filter	#1 Sand Pack
HIMW-18S	42.00	42.00	69.94	69.76	2.00	25-40	Slotted PVC	0-1	Seal	Cement
								1-21	Backfill	Cement/Bentonite Grout
								21-23	Seal	Bentonite
								23-42	Filter	#1 Sand Pack
HIMW-18I	72.00	72.00	70.07	69.70	2.00	55-70	Slotted PVC	0-1	Seal	Cement
								1-51	Backfill	Cement/Bentonite Grout
								51-53	Seal	Bentonite
								53-72	Filter	#1 Sand Pack
HIMW-19S	37.00	37.00	69.42	70.95	2.00	25-35	Slotted PVC	0-1	Seal	Cement
								1-20	Backfill	Cement/Bentonite Grout
								20-23	Seal	Bentonite
								23-37	Filter	#1 Sand Pack
HIMW-19I	67.00	67.00	69.66	71.27	2.00	55-65	Slotted PVC	0-1	Seal	Cement
								1-50	Backfill	Cement/Bentonite Grout
								50-53	Seal	Bentonite
								53-67	Filter	#1 Sand Pack
PZ-02	36.00	37.00	72.88	72.96	2.00	26-36	Slotted PVC	0-22	Seal	Cement Grout
								22-24	Seal	Bentonite
								24-37	Filter	Sand
PZ-03	30.00	31.00	64.87	64.58	2.00	20-30	Slotted PVC	0-16	Seal	Cement Grout
								16-18	Seal	Bentonite
								18-31	Filter	Sand
PZ-08	36.00	37.00	70.89	70.51	2.00	26-36	Slotted PVC	0-21	Seal	Cement Grout
								21-23	Seal	Bentonite
								23-37	Filter	Sand

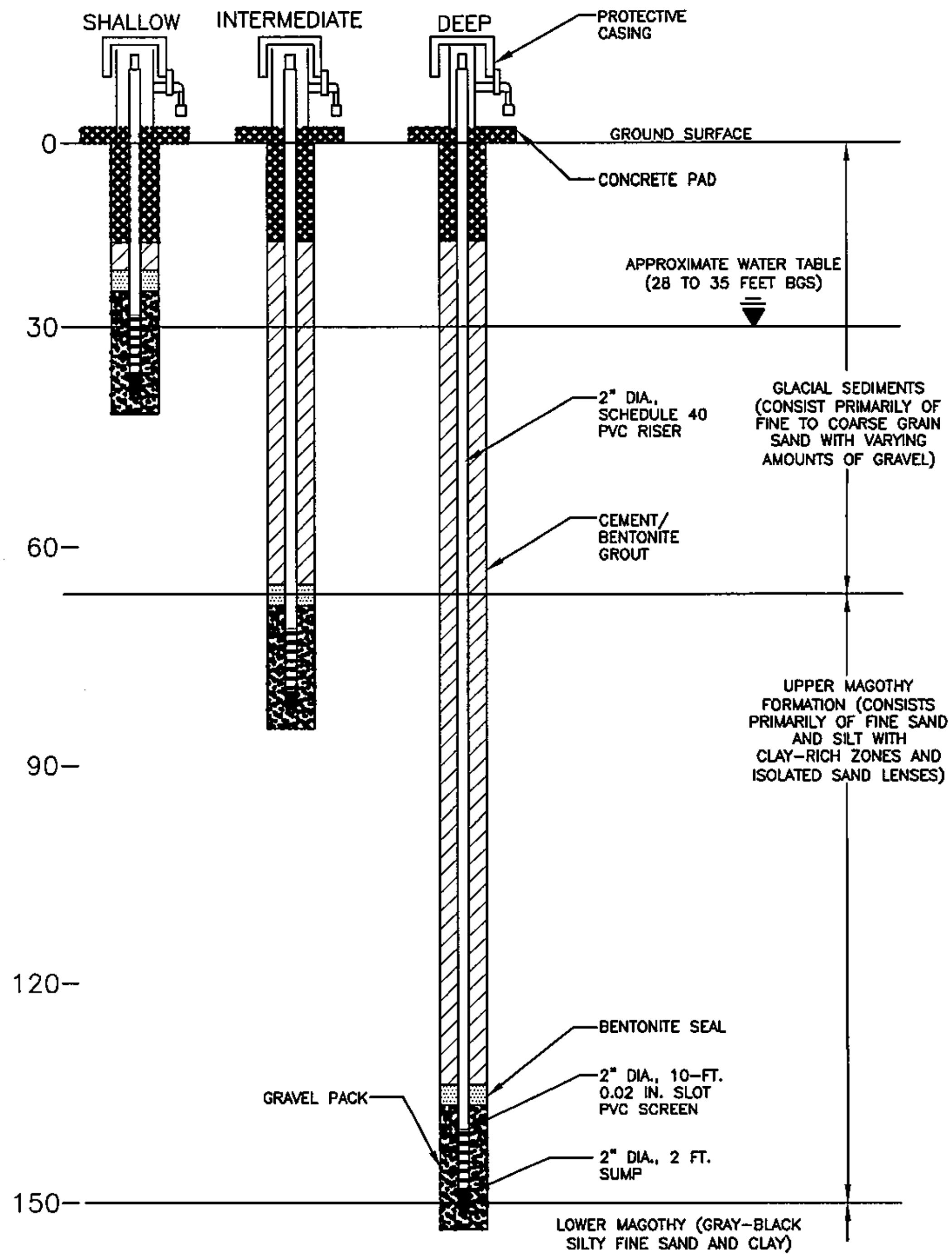
Notes:
(1) Top of casing elevation
* Elevation is suspect and will require re-survey
bgs: Below ground surface

Table 2-7
Monitoring Well Construction Summary
Pre-Design Investigation Report
Hempstead Intersection Street Former MGP Site

Monitoring Well	Well Depth (ft bgs)	Ground Surface Elevation [1] (ft. amsl)	Measuring Point Elevation[1] (ft. amsl)	Casing Diameter (in)	Screen Interval (ft bgs)	Screen Type	Sump Interval (ft bgs)	Annular Fill Interval (ft bgs)	Annular Fill Material
HIMW-20S	37	70.79	70.43	2	25-35	sch 40 PVC #10 slot	35-37	0-1	Cement
								1-20	Cement/bentonite
								20-22	Bentonite
								22-37	Type 2 Sand
HIMW-20I	75	70.94	70.30	2	63-73	sch 40 PVC #10 slot	73-75	0-1	Cement
								1-57	Cement/bentonite
								57-59	Bentonite
								59-75	Type 2 Sand

Notes:

1 North American Vertical Datum 1983 (NAVD 1983)
ft bgs feet below ground surface
ft amsl feet above mean sea level
in inches



PAULUS
SOKOLOWSKI and
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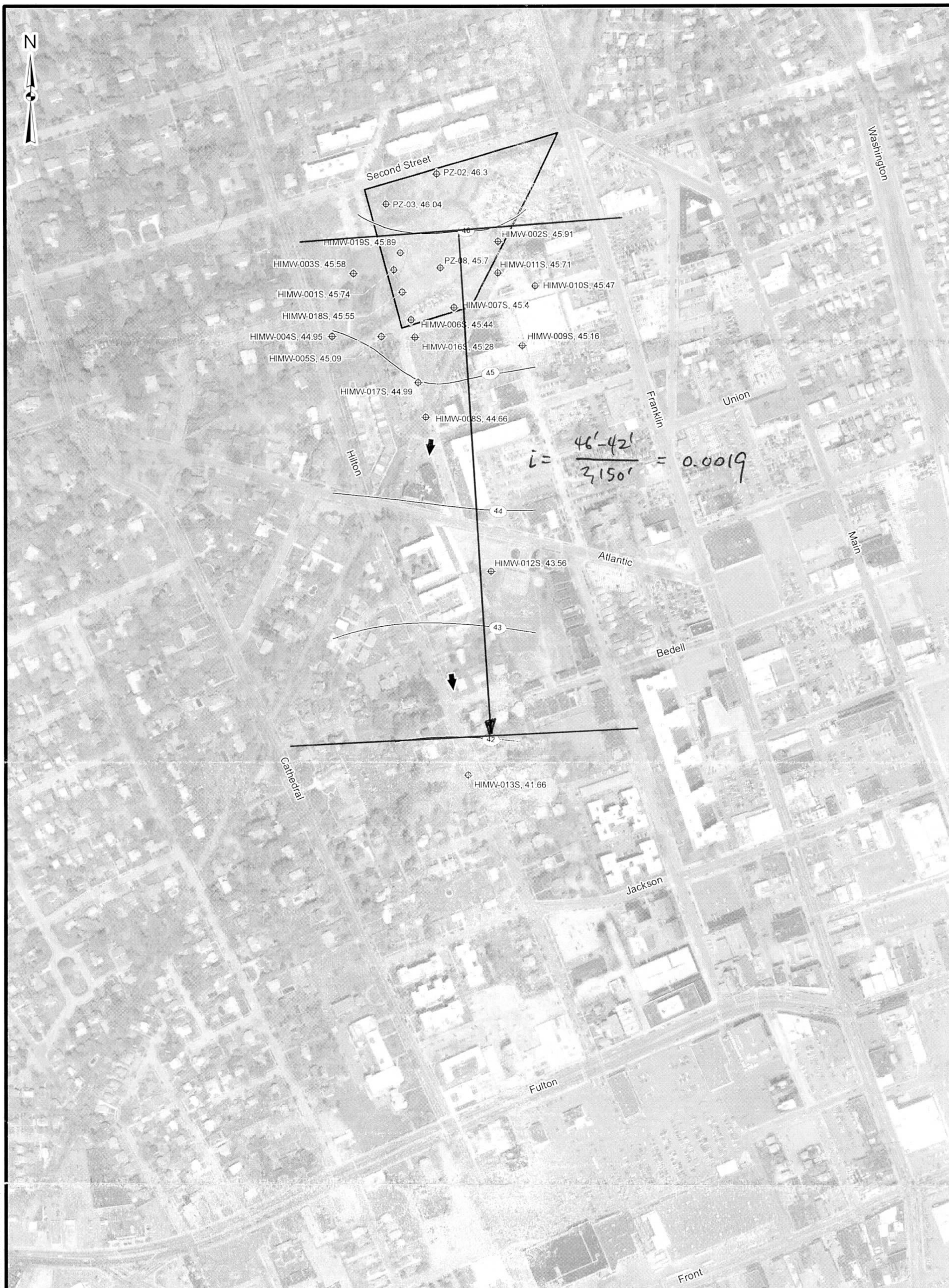
KEYSPAN CORPORATION
HEMPSTEAD INTERSECTION STREET
FORMER MGP SITE REMEDIAL INVESTIGATION
GARDEN CITY/HEMPSTEAD, NEW YORK
TYPICAL CONSTRUCTION OF
MONITORING WELL CLUSTER

Source: DVIRKA AND BARTILUCCI CONSULTING ENGINEERS A DIVISION OF WILLIAM F. COSULICH ASSOCIATES, P.C.

The base drawing and RI information presented on this drawing for work performed in accordance with the Site Investigation Workplan, dated June 2000 and the Phase II Investigation Workplan, dated June 2001 was prepared by Dvirka & Bartilucci Consulting Engineers. RI information presented in this drawing for work performed in accordance with the Supplemental Remedial Investigation Work plan, dated March 2003 was prepared by Paulus, Sokolowski and Sartor Engineering, P.C.

Drn. By: JJ	Scale: NOT TO SCALE	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 2-1



Legend

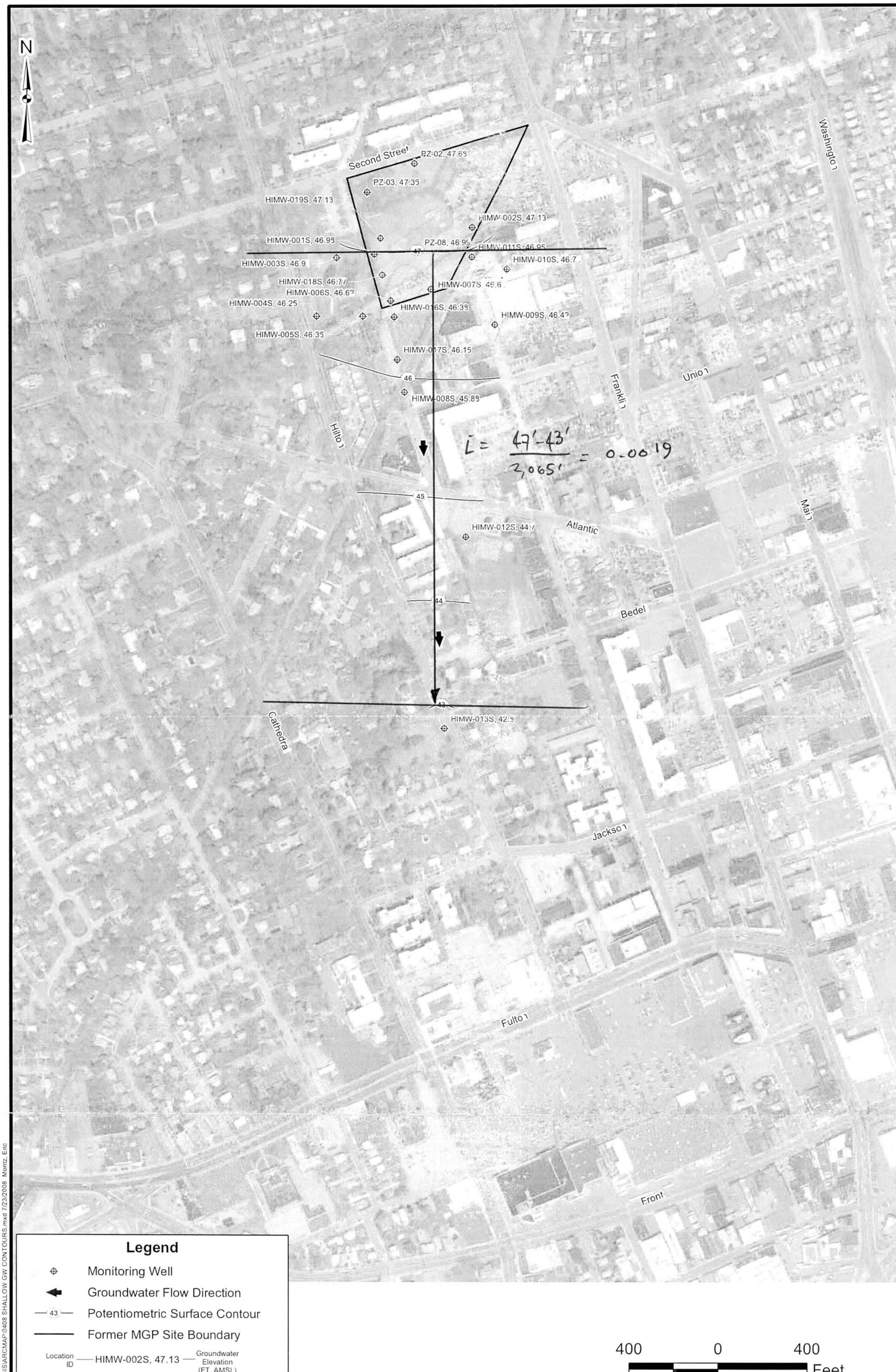
- ⌖ Monitoring Well
- Groundwater Flow Direction
- —43— Potentiometric Surface Contour
- —— Former MGP Site Boundary
- Location ID —HIMW-002S, 44.30— Groundwater Elevation (FT. AMSL)

FT. AMSL = FEET ABOVE MEAN SEA LEVEL

400 0 400 Feet

URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR SHALLOW GROUNDWATER JANUARY 22-23, 2008	FIGURE 3

J:\11175065.00000\DB\GIS\ARCMAP\0108 SHALLOW GW CONTOURS.mxd 3/26/2008 9:12:09 AM Lumb, M



URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR SHALLOW GROUNDWATER APRIL 16-17, 2008	FIGURE 3

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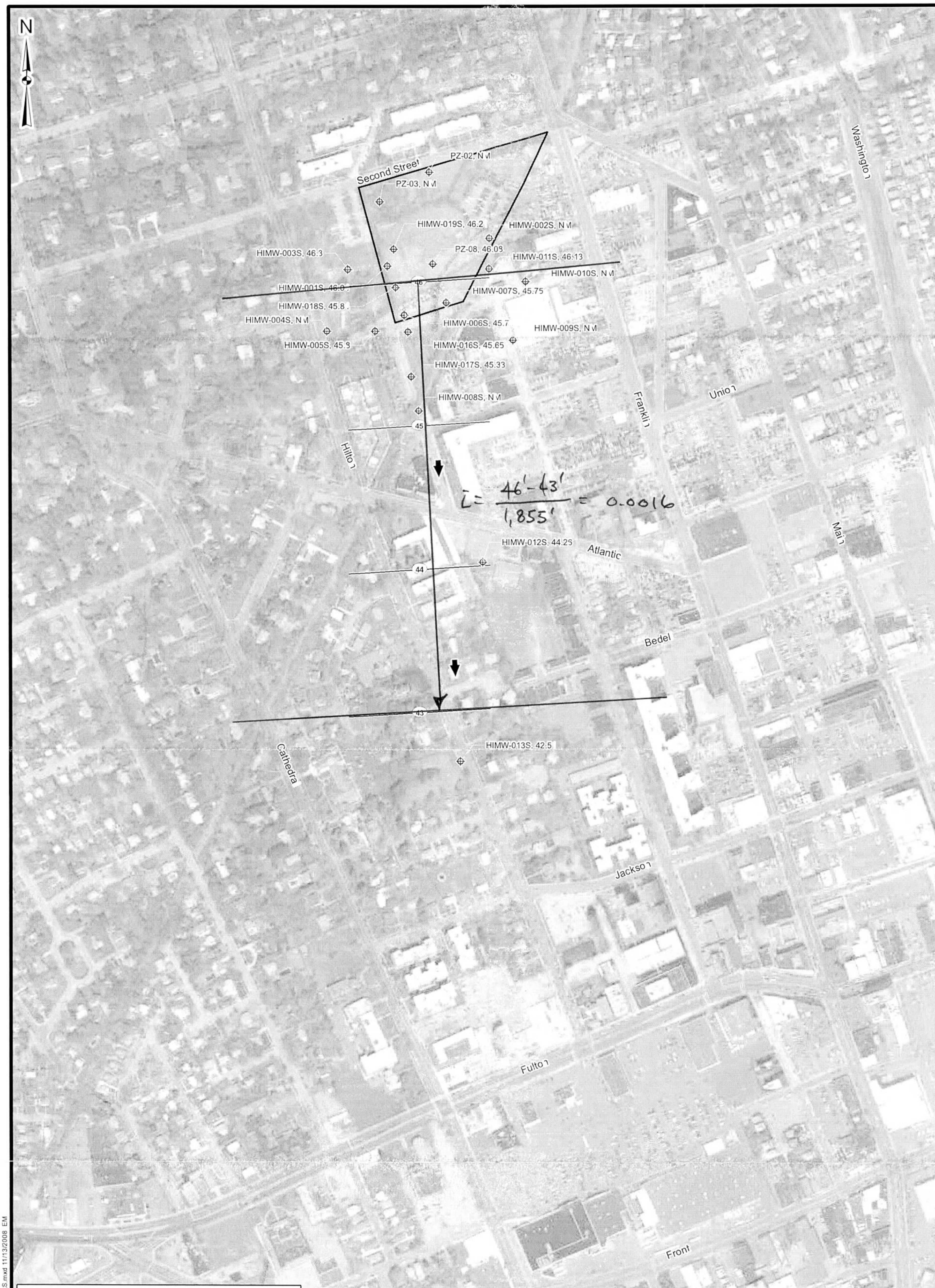

Legend

- Monitoring Well
- Groundwater Flow Direction
- (43) Potentiometric Surface Contour
- Former MGP Site Boundary

Location ID — HIMW-002S, 47.13 — Groundwater Elevation (FT. AMSL)

NM = NOT MEASURED DURING THIS SAMPLING EVENT

FT. AMSL = FEET ABOVE MEAN SEA LEVEL

400 0 400 Feet

URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR SHALLOW GROUNDWATER JULY 1-18, 2008	FIGURE 3

J:\11175065.00000\DB\GIS\ARCMAP\0708 SHALLOW GW CONTOURS.mxd 11/13/2008 EM

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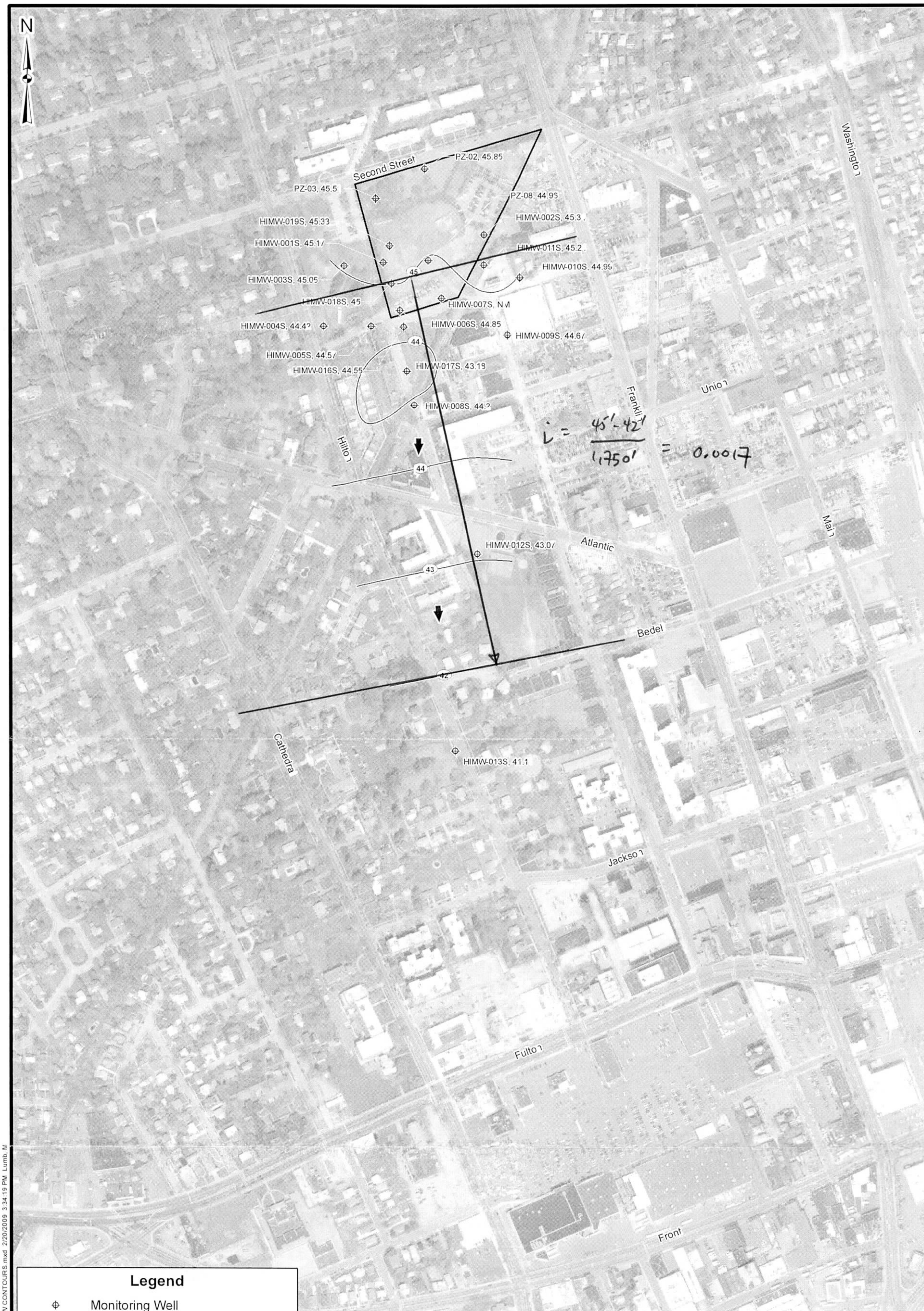

Legend

- Monitoring Well
- Groundwater Flow Direction
- 43 Potentiometric Surface Contour
- Former MGP Site Boundary

Location ID — HIMW-002S, 47.13 — Groundwater Elevation (FT. AMSL)

NM = NOT MEASURED DURING THIS SAMPLING EVENT

FT. AMSL = FEET ABOVE MEAN SEA LEVEL

400 0 400 Feet

URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR SHALLOW GROUNDWATER OCTOBER 15-24, 2008	FIGURE 3

J:\11175065.00000\DB\GIS\ARCMAP\1008 SHALLOW GW CONTOURS.mxd 2/20/2009 3:34:19 PM Lumb, N

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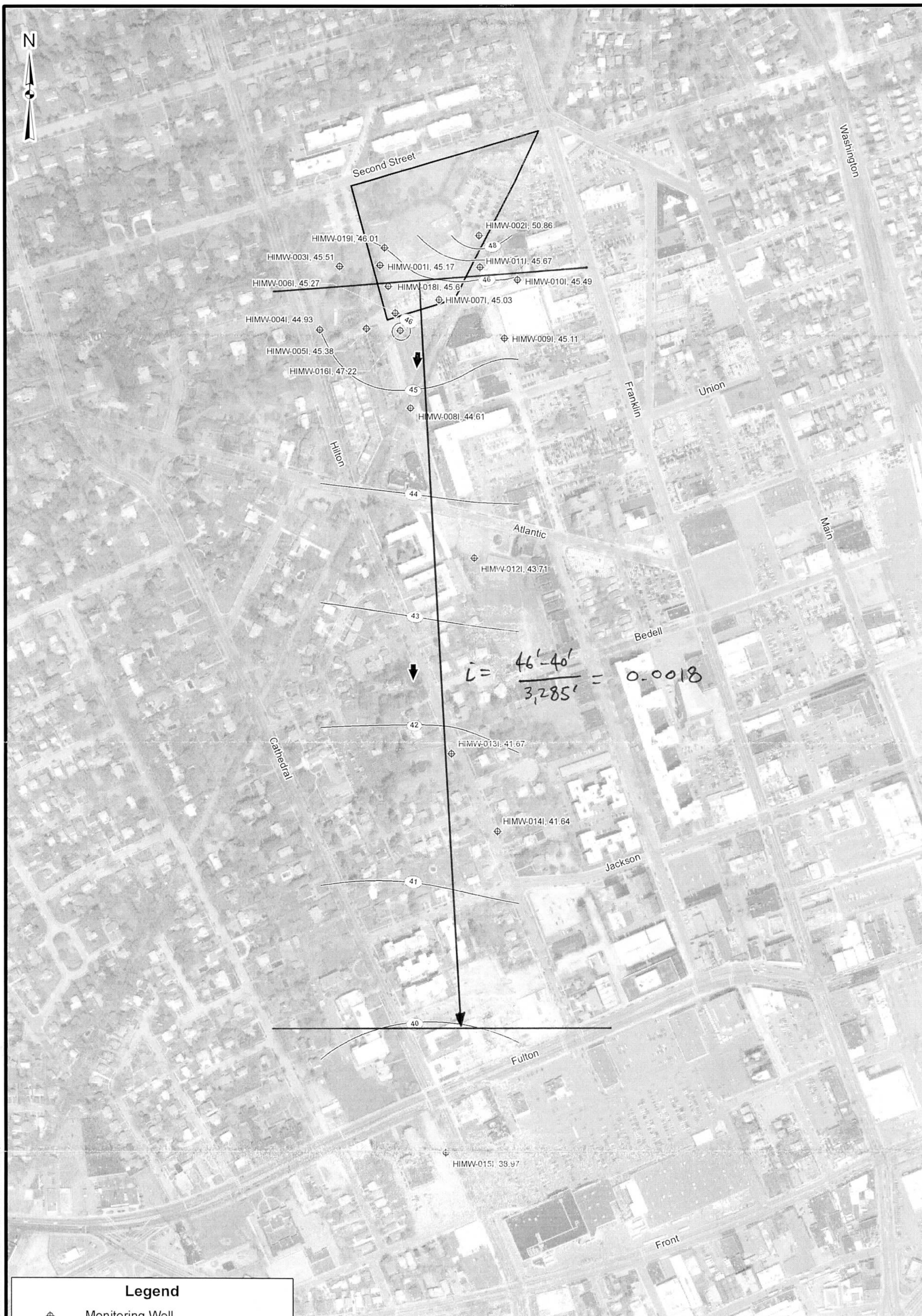
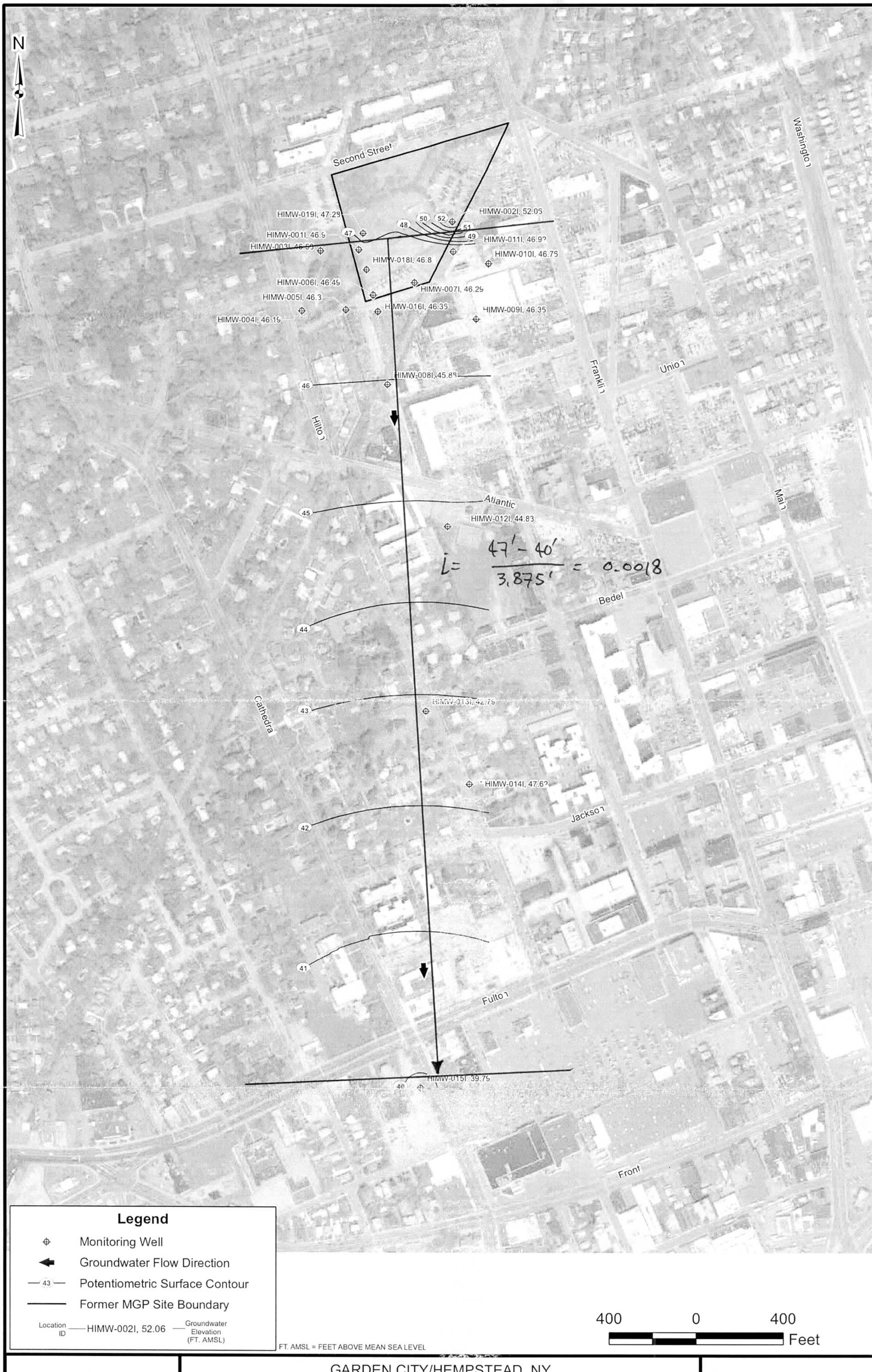


URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR INTERMEDIATE GROUNDWATER JANUARY 22-23, 2008	FIGURE 4

J:\11175065.00000\DB\GIS\ARCMAP\0108 INTERMEDIATE GW CONTOURS.mxd 3/26/2008 9:12:30 AM Lumb, M



URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR INTERMEDIATE GROUNDWATER APRIL 16-17, 2008	FIGURE 4

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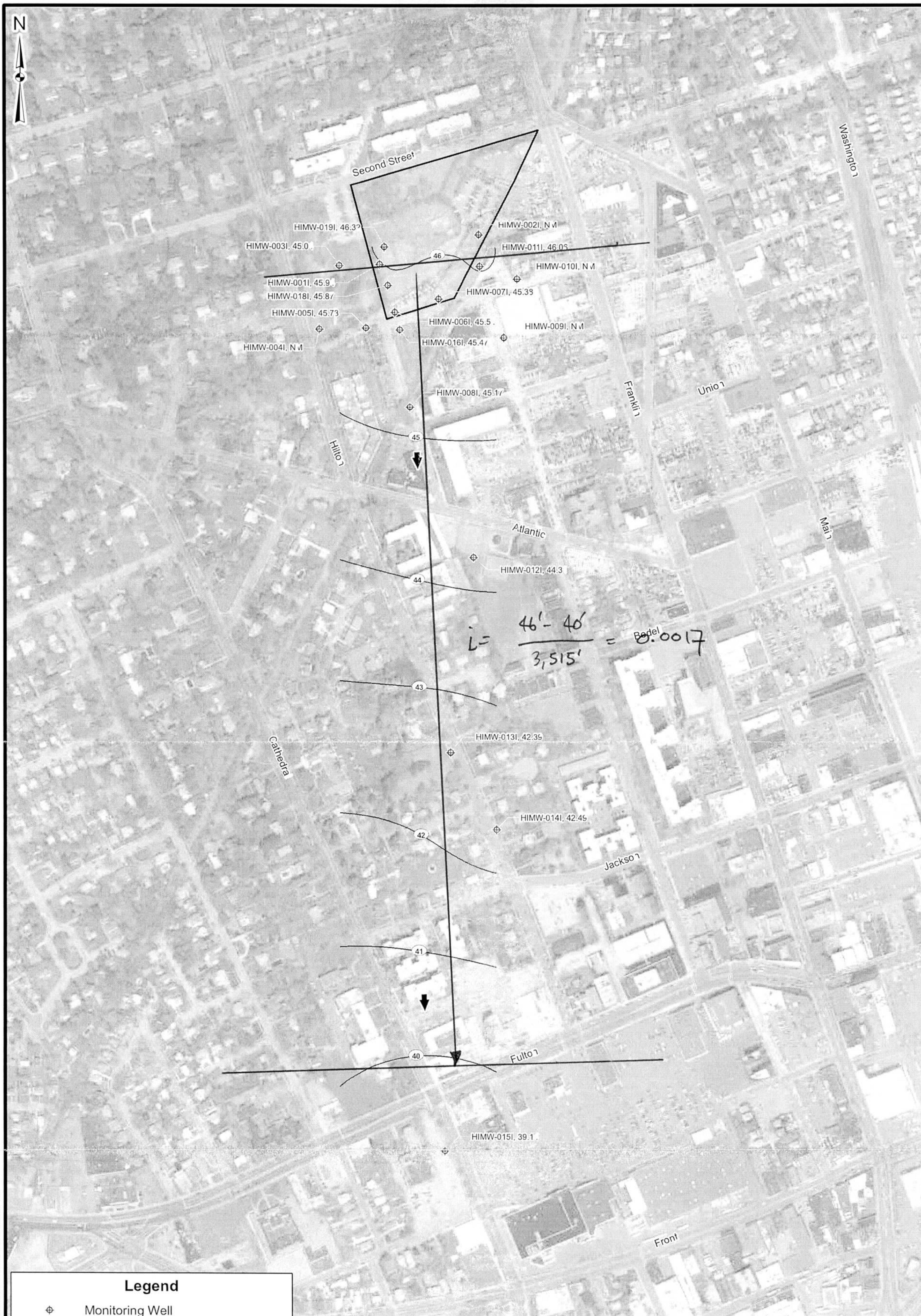


Legend

- Monitoring Well
- Groundwater Flow Direction
- 43 — Potentiometric Surface Contour
- Former MGP Site Boundary

Location ID — HIMW-002I, 52.06 — Groundwater Elevation (FT. AMSL)

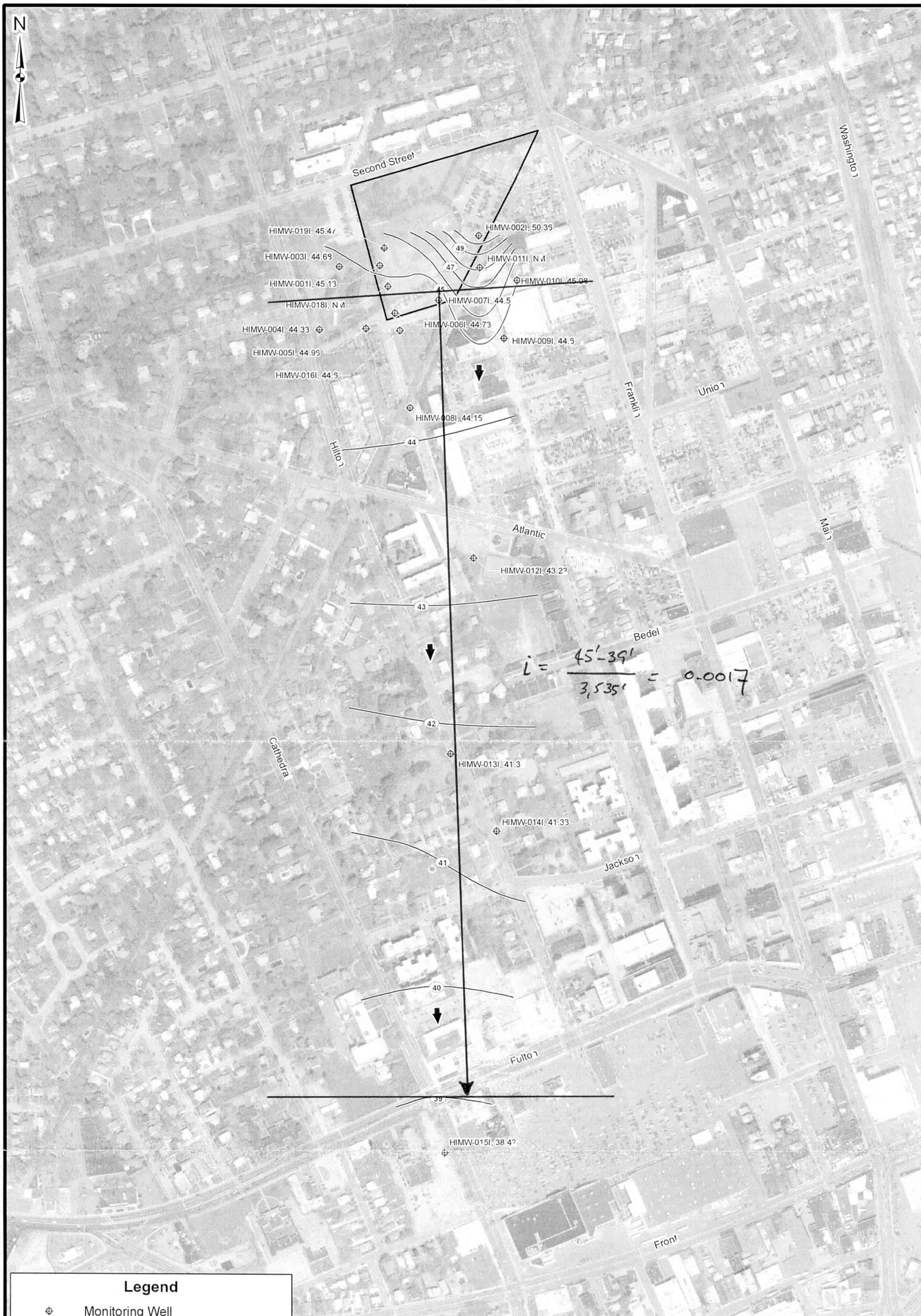
NM = NOT MEASURED DURING THIS SAMPLING EVENT

FT. AMSL = FEET ABOVE MEAN SEA LEVEL

400 0 400 Feet

URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR INTERMEDIATE GROUNDWATER JULY 3-18, 2008	FIGURE 4

J:\11175065.00000\DB\GIS\ARCMAP\0708 INTERMEDIATE GW CONTOURS.mxd 11/13/2008 EM



Legend

- Monitoring Well
- Groundwater Flow Direction
- 43 — Potentiometric Surface Contour
- Former MGP Site Boundary

Location ID — HIMW-002I, 52.06 — Groundwater Elevation (FT. AMSL)

NM = NOT MEASURED DURING THIS SAMPLING EVENT

FT. AMSL = FEET ABOVE MEAN SEA LEVEL

400 0 400 Feet

URS	GARDEN CITY/HEMPSTEAD, NY POTENTIOMETRIC SURFACE MAP FOR INTERMEDIATE GROUNDWATER OCTOBER 15, 2008	FIGURE 4

J:\11175065.00000\DB\GIS\ARCMAP\1008 INTERMEDIATE GW CONTOURS.mxd 3/2/2009 1:49:34 PM Lumb M

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GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009

PARAMETER	UNITS	Area Within 5,000 ug/L Isoconcentration Line						Area Between 1,000 and 5,000 ug/L Isoconcentration Lines														
		HISB-100	HISB-101	HIGP-47	HMW-08	Count	Avg.	HIGP-52		HIGP-54	HMW-20	HISB-100		HISB-101		HISB-102			HISB-105	HISB-105(2)	Count	Avg.
		40-44	40-44	31-35	25-35			30-34	60-64	60-64	63-73	60-64	70-74	50-54	60-64	30-34	40-44	50-54	60-64	60-64		
Volatile Organic Compounds																						
Benzene	UG/L	6,100	7,400	50U	183	4	3,421	23	5U	140	140	630	445	2,300	1,200	27	38	1U	3	2	13	381
Ethylbenzene	UG/L	700	1,000	570	113	4	596	350	5U	61	46	260	3	300	71	500	440	3	190	130	13	180
Toluene	UG/L	4,100	3,400	2,500	1,019	4	2,780	28	5U	2	10 U	170	14	340	94	73	16	2	230	88	13	81
Xylene (total)	UG/L	1,100	2,300	3,600	664	4	1,891	630	5U	180	38	410	245	1,100	630	1,200	340	220	620	340	13	458
Total BTEX		12,000	14,100	6,670	1,978	4	8,687	1,031	5U	373	224	1,470	707	4,040	1,995	1,800	835	225	1,043	660	13	1,100
Semivolatile Organic Compounds																						
2-Methylnaphthalene	UG/L	160	620	4,100	57	4	1,234	290	10U	13	2	36	315	140	18	380	140	470	430	390	13	202
Acenaphthene	UG/L	8	12	240	0	4	65	46	10U	10	9	2	7	15	9	26	110	17	13	33	13	23
Acenaphthylene	UG/L	76	250	1,500	20	4	461	67	10U	100	120	23	68	210	120	46	33	190	180	180	13	103
Anthracene	UG/L	10U	5	570	0	4	144	150U	10U	2	1	10U	10U	6	10U	5	13	2	2	2	13	3
Benzo(a)anthracene	UG/L	10U	10U	280	0	4	70	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Benzo(a)pyrene	UG/L	10U	10U	130	0	4	33	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Benzo(b)fluoranthene	UG/L	10U	10U	96	0	4	24	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Benzo(g,h,i)perylene	UG/L	10U	10U	27	0	4	7	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Benzo(k)fluoranthene	UG/L	10U	10U	34	0	4	9	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Chrysene	UG/L	10U	10U	240	0	4	60	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Dibenz(a,h)anthracene	UG/L	10U	10U	12	0	4	3	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Fluoranthene	UG/L	10U	10U	420	0	4	105	150U	10U	10U	10 U	10U	10U	10U	10U	10U	3	10U	10U	10U	13	0
Fluorene	UG/L	18	32	970	3	4	256	26	10U	15	20	4	6	39	18	24	53	41	25	30	13	23
Indeno(1,2,3-cd)pyrene	UG/L	10U	10U	28	0	4	7	150U	10U	10U	10 U	10U	10U	10U	10U	10U	10U	10U	10U	10U	13	0
Naphthalene	UG/L	1,300	3,400	7,600	330	4	3,157	2,200	10U	180	11	530	1,350	2,800	1,900	2,200	700	2,000	2,400	2,300	13	1,429
Phenanthrene	UG/L	14	37	1,800	2	4	463	150U	10U	11	16	4	10U	34	9	23	64	13	6	6	13	14
Pyrene	UG/L	10U	10U	580	0	4	145	150U	10U	10U	10 U	10U	10U	10U	10U	10U	3	2	10U	10U	13	0
Total PAHs		1,676	4,356	18,627	413	4	6,243	2,629	10U	331	178	598	1,746	3,244	2,074	2,706	1,119	2,735	3,068	2,841	13	1,797
Total Metals																						
Iron	UG/L																					
Manganese	UG/L																					
Dissolved Metals																						
Iron	UG/L																					
Manganese	UG/L																					
Miscellaneous Parameters																						
Alkalinity, Total (as CaCO3)	MG/L													143		97.5		49.8			3	97
Ferrous Iron	MG/L	29.7	29.7			2	29.7							29.7		29.7		8.9			3	23
Nitrate-Nitrogen	MG/L													0.29		0.12		0.54			3	0.3
Nitrite-Nitrogen	MG/L													0.1U		0.1U		0.1U			3	0
Sulfate (as SO4)	MG/L																					
Heterotrophic Plate Count	CFU/ML																					
BOD	UG/L																					
COD	UG/L																					
Dissolved Organic Carbon	UG/L																					
Orthophosphate	MG/L													0.05U		0.08		0.05U			3	0
Dissolved Gases																						
Carbon Dioxide	UG/L																					
Methane	UG/L																					
DO	MG/L	0	0.21			2	0.11					0	0.2	0.24		0	0	0.36	0.22	0	6	0

GROUNDWATER SAMPLE ANALYTICAL RESULTS FOR 2000-2009

Area Between 100 and 1,000 ug/L Isoconcentration Lines

PARAMETER	UNITS	HIGP-47	HMW-08	HISB-100	HISB-101	HISB-102	HISB-102(2)				HISB-103	HISB-105					HISB-105(2)					HISB-116					Count	Avg.
		60-64	63-73	50-54	30-34	60-64	30-34	40-44	50-54	60-64	50-54	40-44	50-54	70-74	80-84	90-94	40-44	50-54	70-74	80-84	90-94	60-64	70-74	80-84	90-94	100-104		
Volatile Organic Compounds																												
Benzene	UG/L	430	0.048	150	46	1U	12	23	5	15	3	1U	6	4	7	5.7	R	9	3	3	11	1U	1U	6.8	9.5	29	25	32
Ethylbenzene	UG/L	1U	0	82	5	1U	190	250	110	4	1	1U	160	12	99	8.8	4	70	15	2	R	21	1.6	28	1.9	5.5	25	43
Toluene	UG/L	5	0	49	6	1U	21	11	4	R	8	1U	33	4	2.6	9.9	2	18	3	2	2	1U	1U	1U	6.5	47	25	9
Xylene (total)	UG/L	84	0	150	66	1U	200	180	230	49	72	1U	270	40	170	24	8	150	38	7	11	80	3.7	55	82.0	210	25	86
Total BTEX		600	0.048	441	118	1U	423	464	349	68	84	1U	469	60	279	48	14	247	59	14	24	101	6.6	91	99.9	291.5	25	170
Semivolatile Organic Compounds																												
2-Methylnaphthalene	UG/L	25	4.2	55	28	3	120	11	30	75	7	2	10U	3	77	6	3	55	2	8	29	10U	10U	26	10U	13	25	23
Acenaphthene	UG/L	40U	0	3	5	10U	25	20	23	9	2	15	10U	1	9	10U	10U	11	3	2	10U	5	10U	15	31	41	25	9
Acenaphthylene	UG/L	11	1.273	21	31	2	20	57	170	25	9	44	10U	12	91	3	2	39	8	6	2	100	25	120	10U	10U	25	32
Anthracene	UG/L	40U	0	10U	2	10U	2	2	4	2	10U	2	10U	10U	10U	10U	10U	1	R	10U	10U	10U	10U	10U	10U	10U	25	1
Benzo(a)anthracene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Benzo(a)pyrene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Benzo(b)fluoranthene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Benzo(g,h,i)perylene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Benzo(k)fluoranthene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Chrysene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Dibenz(a,h)anthracene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Fluoranthene	UG/L	40U	0	10U	10U	10U	10U	10U	2	10U	10U	1	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Fluorene	UG/L	40U	0.273	8	7	10U	11	17	35	9	10U	17	10U	10U	13	10U	10U	4	1	1	10U	5	10U	19	10U	10U	25	6
Indeno(1,2,3-cd)pyrene	UG/L	40U	0	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Naphthalene	UG/L	330	17.273	240	79	5	870	150	350	320	150	410	10U	43	380	91	30	600	18	52	190	82	12	150	420	550	25	222
Phenanthrene	UG/L	40U	0.182	5	10	10U	11	17	26	10	3	22	10U	10U	6	10U	10U	2	2	10U	10U	10U	10U	10U	10U	10U	25	5
Pyrene	UG/L	40U	0	10U	10U	10U	10U	10U	2	10U	10U	2	10U	10U	10U	10U	10U	10U	R	10U	10U	10U	10U	10U	10U	10U	25	0
Total PAHs		369	23	332	162	10	869	274	552	453	171	518	10U	69	576	99	35	812	34	69	221	192	37	330	451	604	25	298
Total Metals																												
Iron	UG/L																											
Manganese	UG/L																											
Dissolved Metals																												
Iron	UG/L																											
Manganese	UG/L																											
Miscellaneous Parameters																												
Alkalinity, Total (as CaCO3)	MG/L			17	24.2	24.2					58.2		61.0	90.2													6	46
Ferrous Iron	MG/L			29.7	1.9	1.9					29.7		23.6	27.9													6	19
Nitrate-Nitrogen	MG/L			0.11	0.22	0.22					0.19		0.10	0.13													6	0.2
Nitrite-Nitrogen	MG/L										0.1U		0.1U	0.1U													3	0
Sulfate (as SO4)	MG/L																											
Heterotrophic Plate Count	CFU/ML																											
BOD	UG/L																											
COD	UG/L																											
Dissolved Organic Carbon	UG/L																											
Orthophosphate	MG/L										0.05U		0.05U	0.05U													3	0
Dissolved Gases																												
Carbon Dioxide	UG/L																											
Methane	UG/L																											
DO	MG/L			0	0.20	0.20	0	0	0	0	0	0.16	0.16	0.24	0.21	0											13	0

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PRINCIPLES OF FOUNDATION ENGINEERING

Second Edition

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PWS-KENT Publishing Company
BOSTON

Table 1.3 Typical Void Ratio, Moisture Content, and Dry Unit Weight for Some Soils

Type of soil	Void ratio e	Natural moisture content in saturated condition (%)	Dry unit weight, γ_d (kN/m³)	Dry unit weight, γ_d (lb/ft³)
Loose uniform sand	0.8	30	14.5	92
Dense uniform sand	0.45	16	18	115
Loose angular-grained silty sand	0.65	25	16	102
Dense angular-grained silty sand	0.4	15	19	120
Stiff clay	0.6	21	17	108
Soft clay	0.9–1.4	30–50	11.5–14.5	73–92
Loess	0.9	25	13.5	86
Soft organic clay	2.5–3.2	90–120	6–8	38–51
Glacial till	0.3	10	21	134

1.7 Atterberg's Limits

When a clayey soil is mixed with an excessive amount of water, it may flow like a *semiliquid*. If the soil is gradually dried, it will lose moisture. Depending on its moisture content, it will behave like a *plastic*, *semisolid*, or *solid* material. The moisture content, in percent, at which the soil changes from a liquid to a plastic stage is defined as the *liquid limit* (*LL*). Similarly, the moisture contents, in percent, at which the soil changes from a plastic to a semisolid state and from a semisolid to a solid state are defined as the *plastic limit* (*PL*) and the *shrinkage limit* (*SL*), respectively. These limits are referred to as *Atterberg's limits* (Figure 1.4).

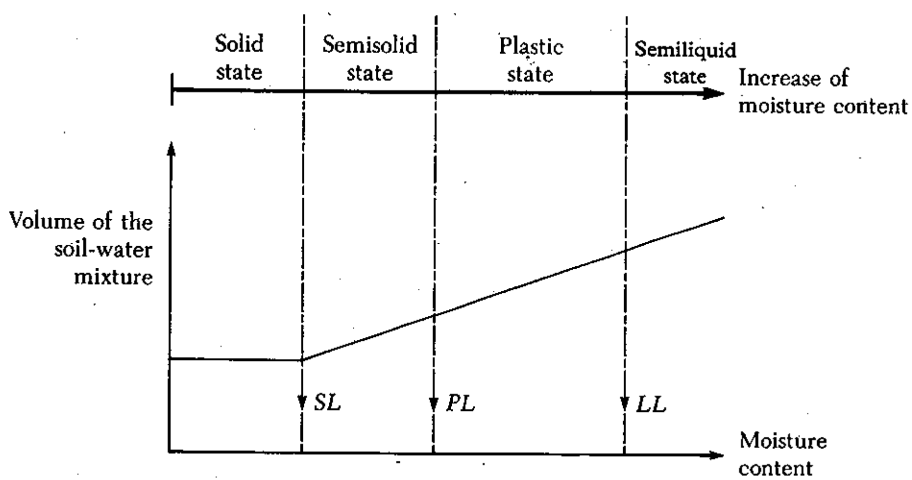


Figure 1.4 Definition of Atterberg's limits

PRESSURE LOSS AND MINIMUM SYSTEM PRESSURE

System Pressure Loss and Minimum System Pressure Calculations

1.0 PURPOSE

The purposes of these calculations are to determine the pressure losses in the oxygen diffusion system when delivering the oxygen through the piping into the saturated zones and the minimum compressor pressure required for the system. The results of the calculations will be used in the selection of the pipe size and compressor capacity. Small piping size will be selected to reduce the trench size, but without causing significant pressure losses.

2.0 SYSTEM PRESSURE LOSS CALCULATIONS

2.1 Methodology

The pressure losses between the manifold inside the system enclosure and an oxygen diffusion well of the oxygen diffusion system include the losses from the straight pipe runs and the various fittings and elbows. The pressure loss from the straight pipe runs is estimated using the American Conference of Governmental Industrial Hygienists (ACGIH) (Reference 1) guidelines as follows:

$$\frac{\Delta P}{100(ft)} = \frac{2.74 \times \left(\frac{V}{1{,}000}\right)^{1.9}}{D^{1.22}} \qquad \text{Eqn (1)}$$

where, ΔP = pressure loss in pipe (in of water)
V = air velocity in the pipe (ft/min)
D = diameter of the pipe (in)

A safety factor equivalent to 50% of the sum of the pressure losses from the straight pipes is used in the calculation for the total pressure loss from the pipes. This safety factor also accounts for losses from fittings, elbows, etc.

The greatest total pressure loss will occurred at the well farthest away from the manifold. Therefore, the total pressure loss between the manifold and the farthest well will be calculated and used for sizing the piping and compressor.

2.2 Calculations

2.2.1 System No. 1

The proposed system, which is shown on page 6 of 14, consists of 96 oxygen delivery wells and has a design flow rate of 0.25 cubic feet per minute (cfm) per well. Individual polyethylene piping will connect each well to a manifold inside the system enclosure. The farthest well, S-01, is approximately 670 ft away from the manifold. The total pressure loss between the manifold and well S-01 is calculated using Equation (1) as follows:

D = 0.824 in

V= (0.25 cfm)/(3.14 x $(0.824/12)^2/4$ ft^2) = 67.54 ft/min

$$\frac{\Delta P}{100(ft)} = \frac{2.74 \times \left(\frac{67.54}{1,000}\right)^{1.9}}{0.824^{1.22}} = 0.0207 \text{ in-water/100 ft}$$

Pressure loss for 670 ft of pipe = 670 ft x 0.207 in-water/100 ft = 0.14 in-water

Safety Factor = 50% x 0.14 in-water = 0.07 in-water

Total Pressure Loss = 0.14 in-water + 0.07 in-water = 0.21 in-water

Based on the calculations, the total head loss from the piping between the manifold and an oxygen delivery well will be less than 0.21 in of water when using 0.75-in (nominal size) piping with an inside diameter of 0.824 in. This pressure loss is negligible and verifies that 0.75-in pipe will be adequate for the system.

2.2.2 System No. 2

System No. 2, which is shown on page 7 of 14, consists of 40 oxygen delivery wells and has a design flow rate of 0.25 cfm per well. Each well will be connected to a manifold inside the system enclosure with individual polyethylene piping. The farthest well (M-29S) is approximately 290 ft from the manifold. The total pressure loss between the manifold and well M-29S is calculated as follows:

D = 0.824 in

V= (0.25 cfm)/(3.14 x $(0.824/12)^2/4$ ft^2) = 67.54 ft/min

$$\frac{\Delta P}{100(ft)} = \frac{2.74 \times \left(\frac{67.54}{1,000}\right)^{1.9}}{0.824^{1.22}} = 0.0207 \text{ in-water/100 ft}$$

Pressure loss for 290 ft of pipe = 290 ft x 0.0207 in-water/100 ft = 0.06 in-water

Safety Factor = 50% x 0.06 in-water = 0.03 in-water

Total Pressure Loss = 0.06 in-water + 0.03 in-water = 0.09 in-water

Based on the calculations, the total pressure loss from the piping between the manifold and a delivery well will be less than 0.09 in of water when using the 0.75-in size piping with an inside diameter of 0.824 in. This pressure loss is negligible and verifies that 0.75-in pipe will be adequate for the system.

2.2.3 System No. 3

System No. 3, which is shown on page 7 of 14, consists of 35 oxygen delivery wells and has a design flow rate of 0.25 cfm per well. Each well will be connected to a manifold with individual polyethylene piping. The farthest well (M-28S) is approximately 330 ft from the manifold. The total pressure loss between the manifold and well M-28S is calculated as follows:

D = 0.824 in
V= (0.25 cfm)/(3.14 x $(0.824/12)^2/4$ ft^2) = 67.54 ft/min

$$\frac{\Delta P}{100(ft)} = \frac{2.74 \times \left(\frac{67.54}{1,000}\right)^{1.9}}{0.824^{1.22}} = 0.0207 \text{ in-water/100 ft}$$

Pressure loss for 330 ft of pipe = 330 ft x 0.0207 in-water/100 ft = 0.07 in-water

Safety Factor = 50% x 0.07 in-water = 0.04 in-water

Total Pressure Loss = 0.07 in-water + 0.04 in-water = 0.11 in-water

Based on the calculation, the total pressure loss from the piping between the manifold and a delivery well will be less than 0.11 in of water when using the 0.75-in (nominal size) piping with an inside diameter of 0.824 in. This pressure loss is negligible and verifies that 0.75-in pipe will be adequate for the system.

3.0 MINIMUM SYSTEM PRESSURE CALCULATION

3.1 Methodology

For the oxygen to flow from a well to the saturated zone, a minimum injection pressure is required to induce the flow. This minimum injection pressure at the wellhead is determined by the depth of the well screen below the water table and the permeability of the aquifer and can be estimated using the following equation (Reference 2):

$$P_{min\ well}\ (psig) = 0.43\ H_h + P_{packing} + P_{formation} \qquad \text{Eqn (2)}$$

Where, $P_{min\ well}$ = the minimum pressure required at a well (psig)
H_h = the depth below the water table to the top of a well screen (hydrostatic head) (ft)
$P_{packing}$ = air entry pressure for the well annulus packing material (psig)
$P_{formation}$ = air entry pressure for the formation (psig)

Typically, $P_{packing}$ and $P_{formation}$ are small compared to the hydrostatic head. Air entry pressures are generally less than 0.2 psig for sand (Reference 2).

By including the head losses from the piping in the oxygen diffusion system, the minimum pressure at the manifold is calculated as follows:

$$P_{min\ manifold}\ (psig) = 0.43\ H_h + P_{packing} + P_{formation} + 0.43H_{pipe\ loss} \qquad \text{Eqn (3)}$$

Where, $P_{min\ manifold}$ = the minimum pressure required at the manifold (psig)
$H_{pipe\ loss}$ = the total head loss in ft from the piping between the manifold and a diffusion well including losses from pipe runs and the various fittings and elbows (ft).

3.2 Calculations

The minimum system pressure at the manifold is calculated using Equation (3) with the following assumptions:

- Groundwater table elevation
  - System No. 1: 45 ft
  - System No. 2: 43 ft
  - System No. 3: 43 ft
- Top of the screen elevation of the deepest well
  - System No. 1: -30 ft

System No. 2: -20 ft
System No. 3: -23 ft

- Screen packing material: sand
- Deep aquifer formation: Upper Magothy
- $P_{packing} + P_{formation}$: 0.2 psig (Reference 2)

The example calculations for the minimum system pressure at the manifold for System No. 1 are shown as follows:

$H_h = 45 \text{ ft} – (-30 \text{ ft}) = 75 \text{ ft}$
$H_{pipe\ loss} = 0.21 \text{ in} = 0.0175 \text{ ft}$
$P_{packing} + P_{formation} = 0.2 \text{ psig}$
$P_{min\ manifold} \text{ (psig)} = 0.43 \times 75 + 0.2 + 0.43 \times 0.0175 = 33 \text{ psig}$

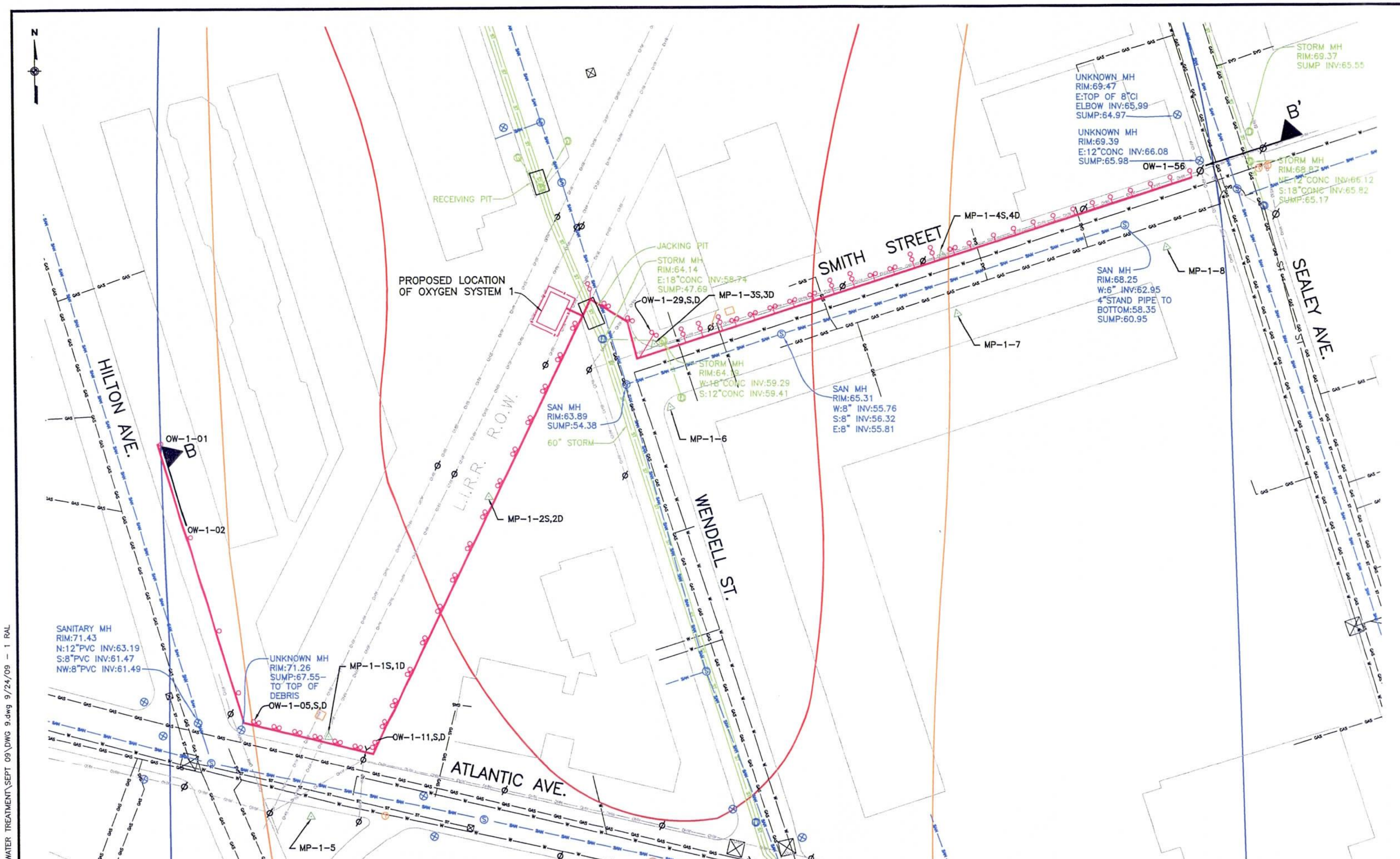
A summary of the calculation results for the minimum system pressure at the manifold for the three systems is presented below:

	System No. 1	System No. 2	System No. 3
$0.43H_h$ (psig)	32.3	27.1	28.4
$P_{packing} + P_{formation}$ (psig)	0.2	0.2	0.2
$0.43H_{pipe\ loss}$ (psig)	0.008	0.003	0.004
$P_{min\ manifold}$ (psig)	33	28	29

4.0 REFERENCES

1. Industrial Ventilation. A Manual of Recommended Practice
American Conference of Governmental Industrial Hygienists (ACGIH)
1980

2. Air Sparging Design Paradigm
Battelle
2002



40' 0 40'
SCALE IN FEET

LEGEND:

- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- PROPOSED OXYGEN DELIVERY WELL
- PROPOSED ROUTING OF TUBING BUNDLE FOR OXYGEN DELIVERY.
- PROPOSED MONITORING POINTS

NOTES:

1. UTILITY AND OTHER INFORMATION SHOWN HAS NOT BEEN SURVEYED OR VERIFIED BY URS OR NATIONAL GRID.
2. ALL WELL, TRENCH, AND OTHER SYSTEM LOCATIONS SHOWN ARE ESTIMATED BASED ON THE AVAILABLE INFORMATION. ALL LOCATIONS WILL BE FIELD VERIFIED PRIOR TO CONSTRUCTION BASED ON UTILITY MARKOUTS, ACCESS AGREEMENTS, RESIDENT CONCERNS, AND OTHER FACTORS.
3. SEE DRAWING 10 FOR TYPICAL WELL AND TRENCH CONSTRUCTION DETAILS.
4. FOR OXYGEN DELIVERY WELLS INSTALLED IN SIDEWALKS, THE WELLS SHOULD BE LOCATED TO THE SIDE AND NOT IN THE CENTER OR THE MAIN PATH OF TRAVEL.
5. WELL PAIRS SHOULD BE INSTALLED PARALLEL TO THE STREET WHEREVER POSSIBLE. WELL PAIRS SHOWN PERPENDICULAR ON THESE DRAWINGS ARE TO AVOID UTILITIES. THESE SHOULD BE RE-EVALUATED IN THE FIELD PRIOR TO INSTALLATION, AND SHOULD BE INSTALLED PARALLEL IF POSSIBLE BASED ON THE ACTUAL LOCATION OF THE UTILITIES.

Oxygen Well Schedule Treatment System 1

Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-1-01	72.5	63.2	65.2	66.2	68.2
OW-1-02	71.8	65.5	67.5	68.5	70.5
OW-1-03	70.9	77.3	79.3	80.3	82.3
OW-1-04	71.5	96.5	98.5	99.5	101.5
OW-1-05S	71.1	62.2	64.2	65.2	67.2
OW-1-05D	71.1	98.3	100.3	101.3	103.3
OW-1-06S	71.1	62.1	64.1	65.1	67.1
OW-1-06D	71.0	98.2	100.2	101.2	103.2
OW-1-07S	71.0	61.9	63.9	64.9	66.9
OW-1-07D	71.0	90.1	92.1	93.1	95.1
OW-1-08S	70.9	61.7	63.7	64.7	66.7
OW-1-08D	70.8	89.7	91.7	92.7	94.7
OW-1-09S	70.5	61.2	63.2	64.2	66.2
OW-1-09D	70.4	89.2	91.2	92.2	94.2
OW-1-10S	70.0	60.6	62.6	63.6	65.6
OW-1-10D	70.0	89.0	91.0	92.0	94.0
OW-1-11S	70.0	60.5	62.5	63.5	65.5
OW-1-11D	70.0	88.6	90.6	91.6	93.6
OW-1-12S	70.3	60.6	62.6	63.6	65.6
OW-1-12D	70.2	87.7	89.7	90.7	92.7
OW-1-13S	69.9	60.0	62.0	63.0	65.0
OW-1-13D	69.8	85.9	87.9	88.9	90.9
OW-1-14S	69.3	59.2	61.2	62.2	64.2
OW-1-14D	69.2	83.5	85.5	86.5	88.5
OW-1-15S	69.0	58.7	60.7	61.7	63.7
OW-1-15D	68.6	81.3	83.3	84.3	86.3
OW-1-16S	68.2	42.5	44.5	45.5	47.5
OW-1-16D	68.1	79.6	81.6	82.6	84.6
OW-1-17S	67.6	45.9	47.9	48.9	50.9
OW-1-17D	67.5	78.3	80.3	81.3	83.3
OW-1-18S	67.1	45.4	47.4	48.4	50.4
OW-1-18D	67.0	77.3	79.3	80.3	82.3
OW-1-19S	66.4	44.7	46.7	47.7	49.7
OW-1-19D	66.3	76.3	78.3	79.3	81.3
OW-1-20S	65.8	44.1	46.1	47.1	49.1
OW-1-20D	65.6	75.4	77.4	78.4	80.4
OW-1-21S	65.1	43.4	45.4	46.4	48.4
OW-1-21D	65.0	74.5	76.5	77.5	79.5
OW-1-22S	64.4	42.7	44.7	45.7	47.7
OW-1-22D	64.4	73.4	75.4	76.4	78.4
OW-1-23S	64.4	42.7	44.7	45.7	47.7
OW-1-23D	64.4	72.5	74.5	75.5	77.5
OW-1-24S	64.2	42.5	44.5	45.5	47.5
OW-1-24D	64.2	71.3	73.3	74.3	76.3
OW-1-25S	64.7	43.0	45.0	46.0	48.0
OW-1-25D	65.2	71.5	73.5	74.5	76.5
OW-1-26S	67.6	45.9	47.9	48.9	50.9
OW-1-26D	67.6	74.1	76.1	77.1	79.1
OW-1-27S	65.7	44.0	46.0	47.0	49.0
OW-1-27D	65.0	72.8	74.8	75.8	77.8
OW-1-28S	64.4	42.7	44.7	45.7	47.7
OW-1-28D	64.2	72.6	74.6	75.6	77.6
OW-1-29S	64.1	42.4	44.4	45.4	47.4
OW-1-29D	64.1	72.3	74.3	75.3	77.3

Continued

Oxygen Well Schedule Treatment System 1

Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-1-30S	64.0	42.3	44.3	45.3	47.3
OW-1-30D	64.0	72.0	74.0	75.0	77.0
OW-1-31S	64.3	42.6	44.6	45.6	47.6
OW-1-31D	64.3	72.3	74.3	75.3	77.3
OW-1-32S	64.7	43.0	45.0	46.0	48.0
OW-1-32D	64.7	72.6	74.6	75.6	77.6
OW-1-33S	64.9	43.2	45.2	46.2	48.2
OW-1-33D	65.0	72.9	74.9	75.9	77.9
OW-1-34S	65.0	43.3	45.3	46.3	48.3
OW-1-34D	65.0	73.0	75.0	76.0	78.0
OW-1-35S	65.4	43.7	45.7	46.7	48.7
OW-1-35D	65.5	73.8	75.8	76.8	78.8
OW-1-36S	65.9	44.2	46.2	47.2	49.2
OW-1-36D	65.8	74.6	76.6	77.6	79.6
OW-1-37S	66.0	44.3	46.3	47.3	49.3
OW-1-37D	66.0	75.6	77.6	78.6	80.6
OW-1-38S	66.0	44.3	46.3	47.3	49.3
OW-1-38D	66.0	76.4	78.4	79.4	81.4
OW-1-39S	66.2	44.5	46.5	47.5	49.5
OW-1-39D	66.2	77.8	79.8	80.8	82.8
OW-1-40S	66.1	44.4	46.4	47.4	49.4
OW-1-40D	66.1	78.8	80.8	81.8	83.8
OW-1-41S	66.2	44.5	46.5	47.5	49.5
OW-1-41D	66.3	82.4	84.4	85.4	87.4
OW-1-42S	66.6	44.9	46.9	47.9	49.9
OW-1-42D	66.6	82.7	84.7	85.7	87.7
OW-1-43S	67.0	45.3	47.3	48.3	50.3
OW-1-43D	67.0	82.8	84.8	85.8	87.8
OW-1-44S	67.2	45.5	47.5	48.5	50.5
OW-1-44D	67.0	73.1	75.1	76.1	78.1
OW-1-45	67.0	70.9	72.9	73.9	75.9
OW-1-46	67.1	67.2	69.2	70.2	72.2
OW-1-47	67.3	64.7	66.7	67.7	69.7
OW-1-48	67.3	62.5	64.5	65.5	67.5
OW-1-49	67.9	61.2	63.2	64.2	66.2
OW-1-50	68.0	59.7	61.7	62.7	64.7
OW-1-51	68.0	58.4	60.4	61.4	63.4
OW-1-52	68.1	57.3	59.3	60.3	62.3
OW-1-53	68.4	56.6	58.6	59.6	61.6
OW-1-54	68.6	55.8	57.8	58.8	60.8
OW-1-55	69.0	56.2	58.2	59.2	61.2
OW-1-56	68.9	55.1	57.1	58.1	60.1
Monitoring Points					
MP-1-1S	70.6	15.0	17.0	18.0	66.6
MP-1-1D	70.7	15.0	17.0	18.0	94.4
MP-1-2S	66.0	15.0	17.0	18.0	49.4
MP-1-2D	66.1	15.0	17.0	18.0	81.2
MP-1-3S	64.0	15.0	17.0	18.0	47.7
MP-1-3D	64.1	15.0	17.0	18.0	77.5
MP-1-4S	67.0	15.0	17.0	18.0	51.1
MP-1-4D	67.0	15.0	17.0	18.0	80.8
MP-1-5	70.6	15.0	17.0	18.0	93.6
MP-1-6	64.0	15.0	17.0	18.0	77.4
MP-1-7	67.0	15.0	17.0	18.0	80.8
MP-1-8	68.9	15.0	17.0	18.0	61.1

6/14

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

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(716)856-5636 - (716)856-2545 fax

JOB NO. 11175065

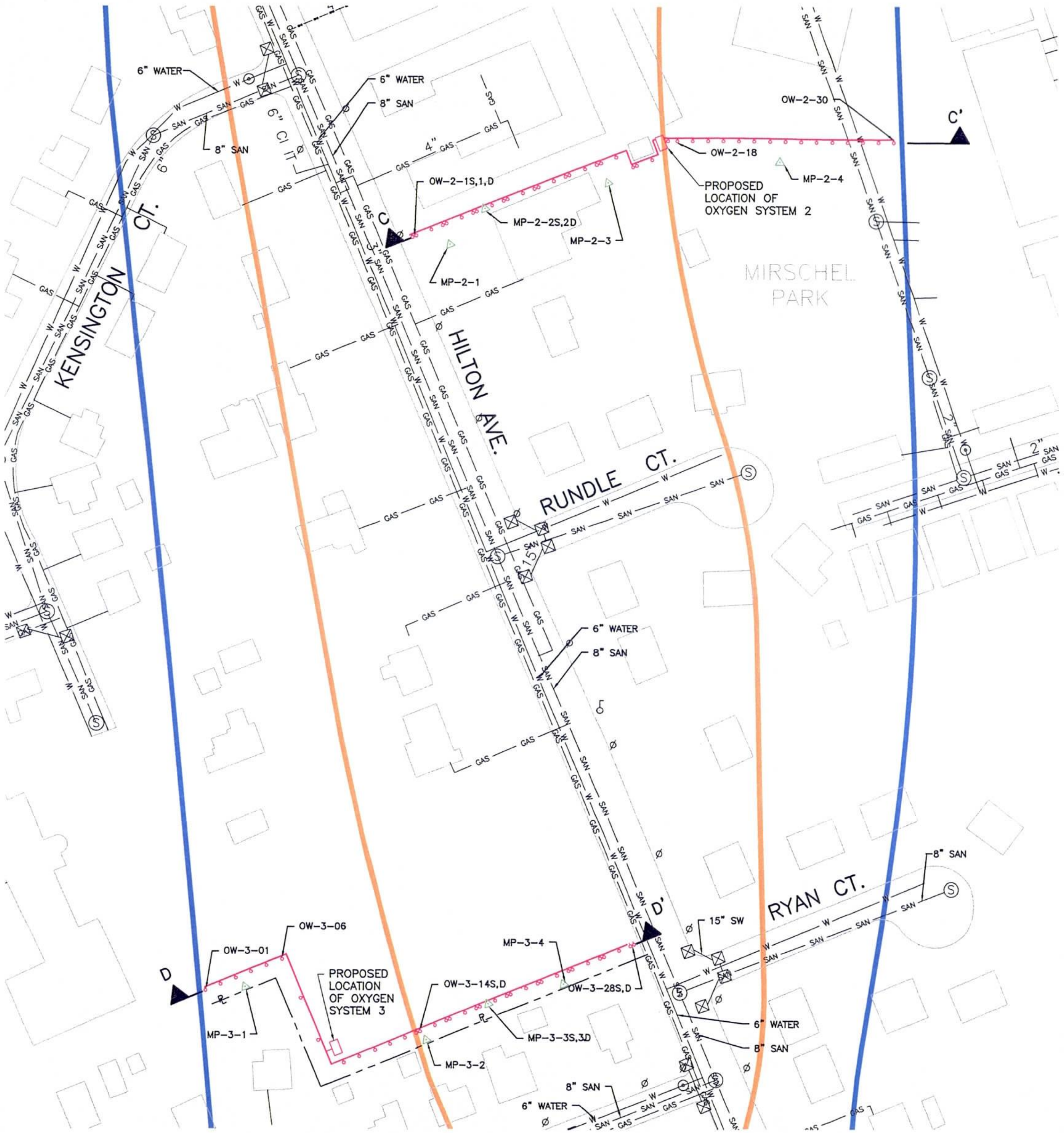
NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

TREATMENT SYSTEM 1 LAYOUT

Scale: AS SHOWN | Date: SEPT. 2009 | DWG-10

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 9.dwg 9/24/09 - 1 RAL



Oxygen Well Schedule Treatment System 2					
Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-2-1S	74.0	63.8	65.8	66.8	68.8
OW-2-1D	74.0	88.0	90.0	91.0	93.0
OW-2-2	74.0	88.9	90.9	91.9	93.9
OW-2-3S	74.0	64.7	66.7	67.7	69.7
OW-2-3D	74.0	89.5	91.5	92.5	94.5
OW-2-4	74.0	90.1	92.1	93.1	95.1
OW-2-5S	74.0	65.4	67.4	68.4	70.4
OW-2-5D	74.0	90.6	92.6	93.6	95.6
OW-2-6	74.0	91.0	93.0	94.0	96.0
OW-2-7S	74.0	66.0	68.0	69.0	71.0
OW-2-7D	74.1	91.2	93.2	94.2	96.2
OW-2-8	74.0	91.3	93.3	94.3	96.3
OW-2-9S	73.8	66.2	68.2	69.2	71.2
OW-2-9D	73.7	90.8	92.8	93.8	95.8
OW-2-10	73.3	90.0	92.0	93.0	95.0
OW-2-11S	72.8	65.1	67.1	68.1	70.1
OW-2-11D	72.7	88.8	90.8	91.8	93.8
OW-2-12	72.3	87.5	89.5	90.5	92.5
OW-2-13S	72.2	63.9	65.9	66.9	68.9
OW-2-13D	72.0	86.0	88.0	89.0	91.0
OW-2-14	71.7	84.2	86.2	87.2	89.2
OW-2-15S	71.5	61.8	63.8	64.8	66.8
OW-2-15D	71.5	82.1	84.1	85.1	87.1
OW-2-16	71.5	79.8	81.8	82.8	84.8
OW-2-17	72.4	80.7	82.7	83.7	85.7
OW-2-18	73.2	76.1	78.1	79.1	81.1
OW-2-19	69.8	70.2	72.2	73.2	75.2
OW-2-20	64.9	63.2	65.2	66.2	68.2
OW-2-21	62.0	58.8	60.8	61.8	63.8
OW-2-22	61.1	56.8	58.8	59.8	61.8
OW-2-23	61.0	56.1	58.1	59.1	61.1
OW-2-24	61.0	55.8	57.8	58.8	60.8
OW-2-25	61.0	55.7	57.7	58.7	60.7
OW-2-26	61.0	55.7	57.7	58.7	60.7
OW-2-27	60.9	55.6	57.6	58.6	60.6
OW-2-28	60.7	55.5	57.5	58.5	60.5
OW-2-29	60.6	55.3	57.3	58.3	60.3
OW-2-30	60.4	55.1	57.1	58.1	60.1
OW-2-31	60.3	55.0	57.0	58.0	60.0
OW-2-32	60.2	54.4	56.4	57.4	59.4
Monitoring Points					
MP-2-1	74.0	15.0	17.0	18.0	94.2
MP-2-2S	74.0	15.0	17.0	18.0	69.9
MP-2-2D	74.0	15.0	17.0	18.0	95.6
MP-2-3	72.1	15.0	17.0	18.0	91.6
MP-2-4	61.0	15.0	17.0	18.0	61.2

Oxygen Well Schedule Treatment System 3					
Oxygen Well	Ground Elevation (ft amsl, approx)	Top of Seal (ft bgs)	Top of Sand Pack (ft bgs)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
OW-3-01	71.5	86.1	88.1	89.1	91.1
OW-3-02	71.5	88.9	90.9	91.9	93.9
OW-3-03	71.5	89.4	91.4	92.4	94.4
OW-3-04	71.5	89.4	91.4	92.4	94.4
OW-3-05	71.5	89.2	91.2	92.2	94.2
OW-3-06	71.6	89.3	91.3	92.3	94.3
OW-3-07	71.3	89.1	91.1	92.1	94.1
OW-3-08	71.0	88.2	90.2	91.2	93.2
OW-3-09	71.0	87.7	89.7	90.7	92.7
OW-3-10	71.0	87.8	89.8	90.8	92.8
OW-3-11	71.0	88.0	90.0	91.0	93.0
OW-3-12	71.0	88.0	90.0	91.0	93.0
OW-3-13	71.0	88.6	90.6	91.6	93.6
OW-3-14S	71.0	75.7	77.7	78.7	80.7
OW-3-14D	71.0	89.0	91.0	92.0	94.0
OW-3-15	70.9	89.3	91.3	92.3	94.3
OW-3-16S	70.9	75.2	77.2	78.2	80.2
OW-3-16D	70.9	89.9	91.9	92.9	94.9
OW-3-17	70.9	90.4	92.4	93.4	95.4
OW-3-18S	70.9	74.7	76.7	77.7	79.7
OW-3-18D	70.9	91.0	93.0	94.0	96.0
OW-3-19	71.0	91.8	93.8	94.8	96.8
OW-3-20S	71.0	74.5	76.5	77.5	79.5
OW-3-20D	71.0	92.4	94.4	95.4	97.4
OW-3-21	71.0	93.0	95.0	96.0	98.0
OW-3-22S	71.0	74.3	76.3	77.3	79.3
OW-3-22D	71.0	93.6	95.6	96.6	98.6
OW-3-23	71.0	94.1	96.1	97.1	99.1
OW-3-24S	71.0	74.6	76.6	77.6	79.6
OW-3-24D	71.0	94.6	96.6	97.6	99.6
OW-3-25	70.9	94.5	96.5	97.5	99.5
OW-3-26S	70.8	74.8	76.8	77.8	79.8
OW-3-26D	70.8	95.0	97.0	98.0	100.0
OW-3-27	70.7	95.1	97.1	98.1	100.1
OW-3-28S	70.6	75.0	77.0	78.0	80.0
OW-3-28D	70.6	95.1	97.1	98.1	100.1
Monitoring Points					
MP-3-1	71.5	15.0	17.0	18.0	94.6
MP-3-2	70.9	15.0	17.0	18.0	94.1
MP-3-3S	71.0	15.0	17.0	18.0	78.8
MP-3-3D	70.9	15.0	17.0	18.0	96.5
MP-3-4	71.0	15.0	17.0	18.0	99.5

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LEGEND:

- (red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- (orange line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- (blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- ○ PROPOSED OXYGEN DELIVERY WELL
- (pink line) PROPOSED ROUTING OF TUBING BUNDLE FOR OXYGEN DELIVERY.
- △ PROPOSED MONITORING POINTS

NOTES:

1. UTILITY AND OTHER INFORMATION SHOWN HAS NOT BEEN SURVEYED OR VERIFIED BY URS OR NATIONAL GRID.
2. ALL WELL, TRENCH, AND OTHER SYSTEM LOCATIONS SHOWN ARE ESTIMATED BASED ON THE AVAILABLE INFORMATION. ALL LOCATIONS WILL BE FIELD VERIFIED PRIOR TO CONSTRUCTION BASED ON UTILITY MARKOUTS, ACCESS AGREEMENTS, RESIDENT CONCERNS, AND OTHER FACTORS.
3. SEE DRAWING 10 FOR TYPICAL WELL AND TRENCH CONSTRUCTION DETAILS.
4. FOR OXYGEN DELIVERY WELLS INSTALLED IN SIDEWALKS, THE WELLS SHOULD BE LOCATED TO THE SIDE AND NOT IN THE CENTER OR THE MAIN PATH OF TRAVEL.
5. WELL PAIRS SHOULD BE INSTALLED PARALLEL TO THE STREET WHEREVER POSSIBLE. WELL PAIRS SHOWN PERPENDICULAR ON THESE DRAWINGS ARE TO AVOID UTILITIES. THESE SHOULD BE RE-EVALUATED IN THE FIELD PRIOR TO INSTALLATION, AND SHOULD BE INSTALLED PARALLEL IF POSSIBLE BASED ON THE ACTUAL LOCATION OF THE UTILITIES.

60' 0 60'
SCALE IN FEET

WARNING
IT IS A VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON OTHER THAN WHOSE SEAL APPEARS ON THIS DRAWING, TO ALTER IN ANY WAY AN ITEM ON THIS DRAWING. IF AN ITEM IS ALTERED, THE ALTERING ENGINEER SHALL AFFIX TO TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION
REVISIONS				

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

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NATIONAL GRID
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HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

TREATMENT SYSTEMS 2 AND 3 LAYOUT

Scale: AS SHOWN | Date: SEPT. 2009 | ~~DWG 10~~

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 10.dwg 9/29/09 - 3 RAL

REFERENCES

9/14

Ref. 1

INDUSTRIAL VENTILATION

A Manual of Recommended Practice

1980

COMMITTEE ON INDUSTRIAL VENTILATION
P.O. BOX 16153
LANSING, MICHIGAN, 48901, U.S.A.

American Conference of Governmental Industrial Hygienists

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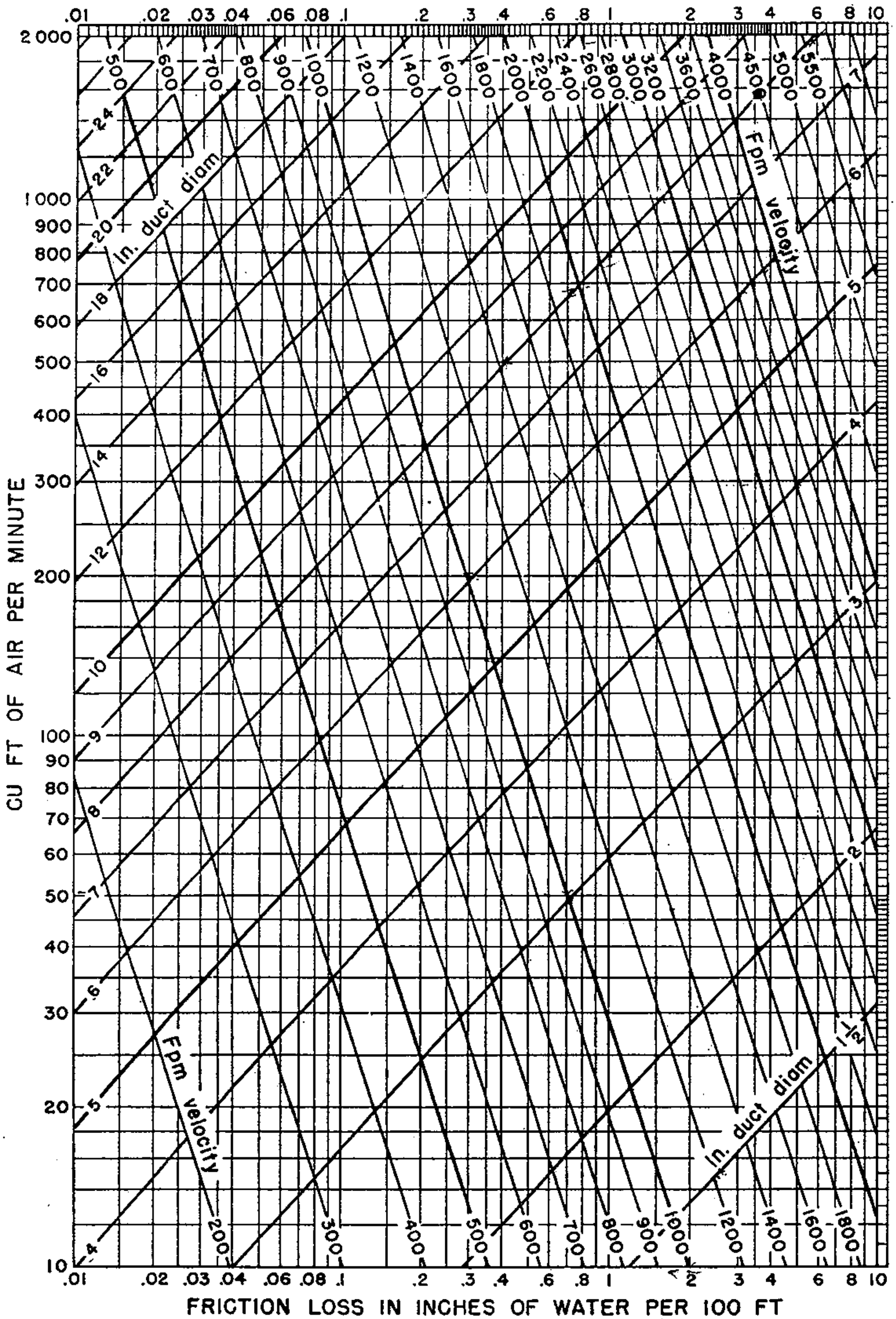


(Based on Standard Air of 0.075 lb per cu ft density flowing through average, clean, round, galvanized metal ducts having approximately 40 joints per 100 ft.)
Caution: Do not extrapolate below chart.

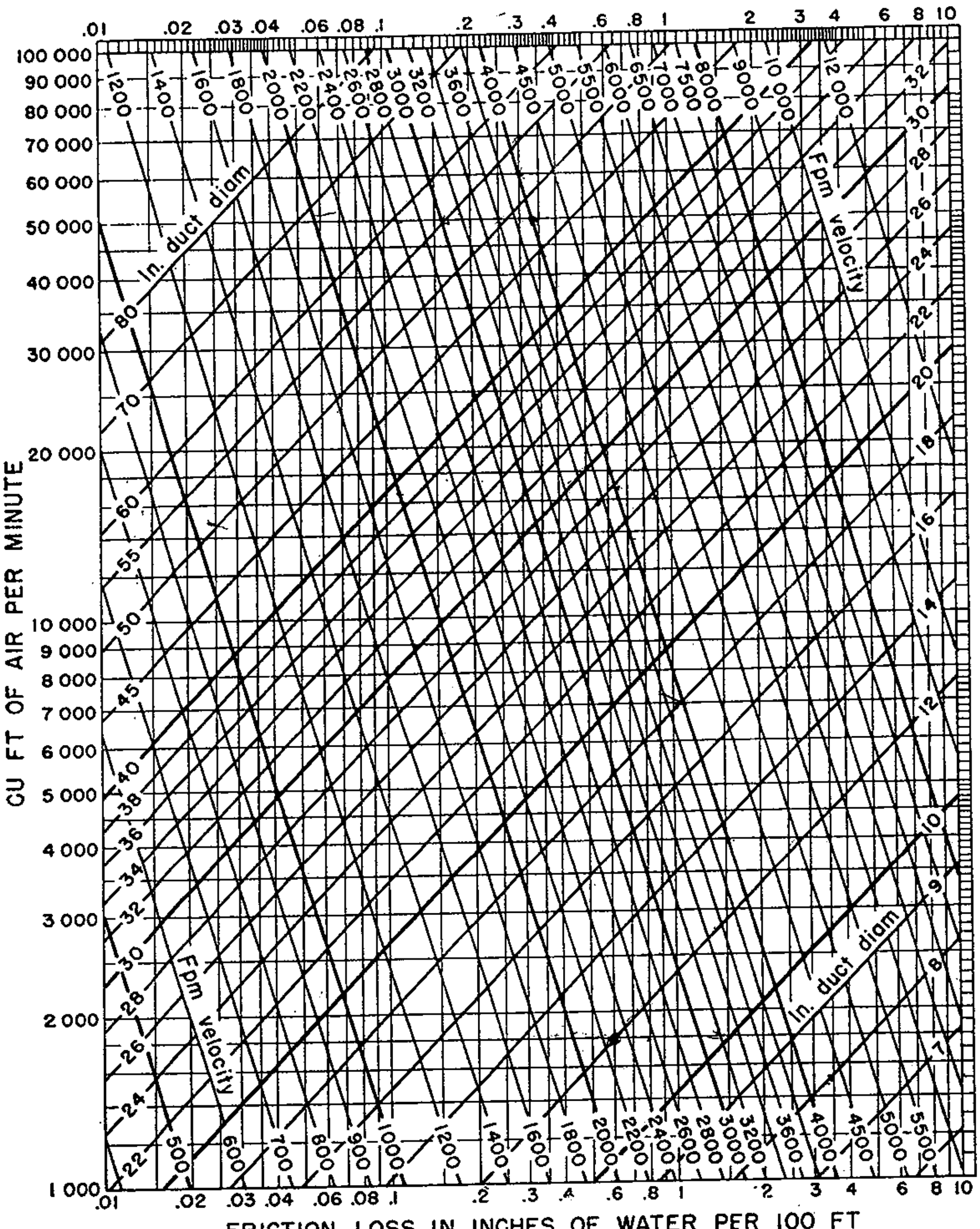
For proprietary duct, obtain data from manufacturer. Friction of Air in Straight Ducts for Volumes of 10 to 2000 Cfm

$$\text{Friction Loss}/100' = \frac{2.74\left[\frac{V_{fpm}}{1000}\right]^{1.9}}{[D_{inches}]^{1.22}}$$

(Ref. 130)

Note: Both "1.9" and "1.22" are exponents.

Fig. 6-15A



(Based on Standard Air of 0.075 lb per cu ft density flowing through average, clean, round, galvanized metal ducts having approximately 40 joints per 100 ft.)

For proprietary duct, obtain data from manufacturer. Friction of Air in Straight Ducts for Volumes of 1000 to 100,000 Cfm

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$$\text{Friction Loss}/100' = \frac{2.74\left[\dfrac{V_{fpm}}{1000}\right]^{1.9}}{[D_{inches}]^{1.22}}$$

(Ref. 130)

Note: Both "1.9" and "1.22" are exponents.

Fig. 6-15B

12/14

Ref. 2

AIR SPARGING DESIGN PARADIGM

by

Andrea Leeson, Paul C. Johnson, Richard L. Johnson, Catherine M. Vogel, Robert E. Hinchee, Michael Marley, Tom Peargin, Cristin L. Bruce, Illa L. Amerson, Christopher T. Coonfare, and Rick D. Gillespie, and David B. McWhorter

Battelle
505 King Avenue
Columbus, Ohio 43201

12 August 2002

followed by a case history in which the various pieces of the pilot test are combined to interpret what is occurring at the site and assess if air sparging is appropriate at the site.

5.2.1 Baseline Sampling (PT1)

Baseline sampling represents a critical step in the pilot test process. For several of the parameters, it is important to collect data prior to any air sparging activity to ensure that initial conditions are understood. In particular, those parameters include dissolved oxygen (DO) concentrations and any geophysical measurements (if geophysical tests are to be conducted as part of the pilot test). It is also important to collect baseline pressure transducer data with a data-logger. The pressure data should be collected for a sufficiently long period to assess diurnal changes in water level (e.g., tidal fluctuations) if they are believed to be a significant.

If an SVE system is to be used in conjunction with the air sparging system, then the SVE system should be operated for a period of time prior to air sparging startup primarily to ensure that the SVE system is operating properly to capture the initial high mass loading from air sparging. During this period, it may also be of interest to monitor SVE off-gas for the contaminants of interest in order to establish mass loading from volatilization from the vadose zone compared to volatilization from groundwater. Ideally, prior to initiating air sparging, the off-gas concentrations should have stabilized to the extent that changes in off-gas concentrations due to air sparging operation can be easily determined. In many cases it may be sufficient to monitor those off-gas concentrations with a hand-held field instrument, rather than requiring more sophisticated chromatographic analysis. If off-gas is regulated, regulatory requirements often will dictate which analytical method must be used.

If an SVE system is not part of the air sparging system, then soil gas concentrations (including both contaminant and oxygen concentrations) should be measured prior to air sparging startup. The initial contaminant concentration in the vadose zone can be used to calculate roughly contaminant mass removal from groundwater via volatilization (see Section 5.2.5). Initial oxygen concentrations are useful for measuring bioactivity in the vadose zone. Hand-held instruments should be appropriate for this since soil gas concentrations of contaminants are rarely regulated.

5.2.2 Air Injection Flowrate and Injection Pressure (PT2)

Prior to pilot test activities, it is important to evaluate the expected operating pressure for the air sparging system. This is important both for the selection of the correct air injection system and for the prevention of pneumatic fracturing of the aquifer. Outlined below is the general procedure for estimating the minimum pressure required to initiate sparging and the maximum pressures that should be exerted on the aquifer.

The operating pressure for an air sparging system will be determined by the depth of the air sparging well below the water table and the permeability of the aquifer. The minimum injection pressure necessary to induce flow (P_{min} [psig]) is given by:

$$P_{min}\,(\text{psig}) = 0.43\,H_h + P_{packing} + P_{formation} \tag{4}$$

The pressure at which fracturing of the aquifer can occur is given by:

$$P_{fracture}\,(\text{psig}) = 0.73\,D \tag{5}$$

Where H_h = depth below the water table to the top of the injection well screened section (e.g., the hydrostatic head) (ft); $P_{packing}$ and $P_{formation}$ = air entry pressures for the well annulus packing material and the formation (psig); and D = depth below ground surface to the top of the air injection well screened interval (ft).

For typical air sparging wells and applications, $P_{packing}$ and $P_{formation}$ are small compared to the contribution from the hydrostatic head (air entry pressures are generally <0.2 psig for sands, <0.4 psig for silts, but may be >1.5 psig in some clayey settings). At start-up, it is not unusual for users to exceed P_{min} by as much as 5 to 10 psig to initiate flow quickly. The injection pressure then generally declines to about P_{min} as steady flow conditions are approached. Pressures in excess of $P_{fracture}$ can cause fracturing of the formation; however, as the pressure drops off rapidly away from an injection point, the extent of fracturing in most cases is expected to be limited to the area immediately surrounding the well.

In general, it is recommended that oil-less compressors be used for the pilot test (even if it is not chosen for operation of the full air sparging system), because it eliminates uncertainties relating to air flowrate and potential overheating. Other pumps may be used for air injection, but the practitioner may experience more operational difficulties, depending on site conditions.

As part of the initial shakedown of the air sparging system, the air injection system must be tested. During this process, it is important to measure both the air flowrate and the injection pressure to ensure that neither P_{min} nor $P_{fracture}$ are exceeded at the required air flowrate. There are two general approaches for the initial introduction of air into the subsurface. The first is to include a "vent valve" in the injection air line. This valve should be fully open to begin the test and then be closed slowly while monitoring the increase in pressure and flowrate up to the desired flowrate. During this process, care should be taken not to exceed the upper pressure limit for the system (as determined by the calculations described above). In addition, if the air injection system requires some minimum airflow to provide cooling for the motor/pump, total air flow and system temperature should also be monitored.

A second approach for air sparging startup is to determine the maximum pressure for air injection and to include an in-line pressure regulator in the air injection line. (This approach is best suited to oil-less compressors that do not require airflow for cooling.) In this case, the pressure can be set at the air sparging well head and flow allowed to increase as air pathways in the aquifer become developed. In general, when using this approach it will be necessary to make adjustments in the system to achieve the desired flowrate.

It is desirable to begin the test with an air injection flowrate of 20 ft^3/min if possible. The air injection pressure at the on-set of flow should be recorded, as well as pressures every 5 to 10 min until the pressure and flow stabilize.

5.2.3 Groundwater Pressure Measurements During Air Sparging Startup and Shutdown (PT3)

Once the flow and pressure conditions for sparging have been established (PT2), groundwater pressures during air sparging startup and shutdown can be determined. The primary objective of this test is to assess the time required for airflow distribution to come to steady state. As discussed by Johnson et al. (2000a) (Appendix E), pressure measurements provide an easy and sensitive means of assessing if air sparging air is stratigraphically trapped below the water table. The pressure measurements can also provide a measure of site permeability, based on the magnitude of the response. In general terms, during air sparging startup groundwater pressures will increase because air is being pushed into the formation faster than the water can move away from the air sparging well. Typically, as long as the volume of air below the water table is increasing, the groundwater pressure will remain above pre-air sparging levels. As a result, the time required for groundwater pressure to return to pre-air sparging values is a good

WELL SCREEN OPENING SIZE AND FILTER PACK GRADATION

REF. 1

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LABORATORY TESTING DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS: WATER CONTENT (%)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	HYDRO. % MINUS 2 μm (%)	ORGANIC CONTENT (burnoff) (%)	SPECIFIC GRAVITY (-)	REMARKS
HISB-102		30-34	16.8	SP	2.1				
HISB-102		50-54	18.9	SP	1.3				
HISB-106		35-45	17.7	SP	2.9	1	0.3	2.663	
HISB-106		49-53	18.0	SP	4.7				
HISB-106		65-85	31.0	SP-SM	7.2	2	0.4	2.680	
HISB-106		70-74	36.3	SP-SM	5.4				
HISB-108		50-55	22.0	SP	1.5				
HISB-108		70-75	19.0	SP-SM	6.2				

Note: (1) USCS symbol based on visual observation and Sieve reported.

Prepared by: JR
Reviewed by: CMJ
Date: 1/23/2009

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45 J Commerce Way
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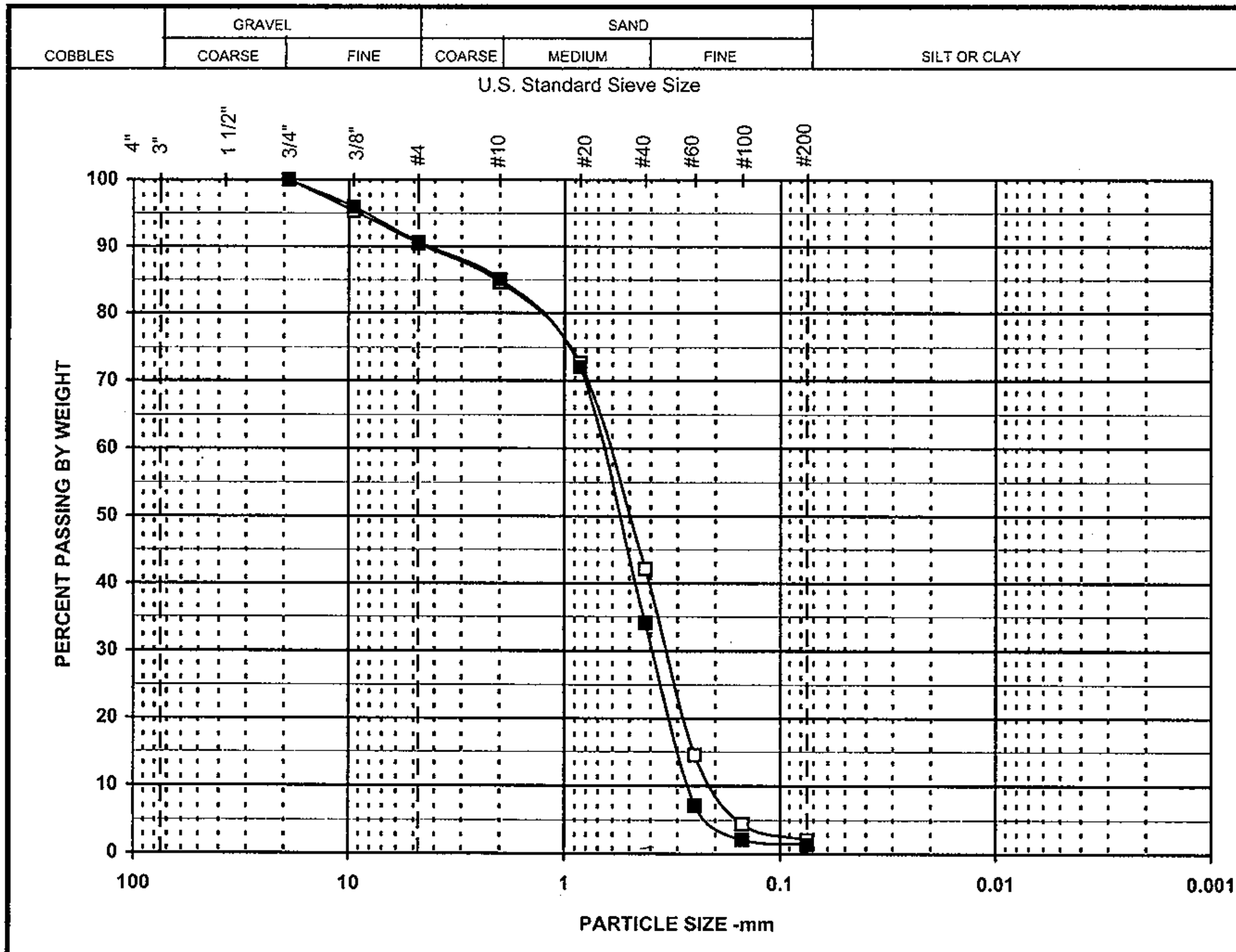

Symbol	□	■	○
Boring	HISB-102	HISB-102	
Sample			
Spec			
Depth	30-34	50-54	
% +3"			
% Gravel	9.5	9.4	
% SAND	88.4	89.3	
% FINES	2.1	1.3	
% -2μ			
Cc	0.9	0.8	
Cu	3.3	2.7	
LL			
PL			
PI			
USCS	SP	SP	
w (%)	16.8	18.9	

Particle Size (Sieve #)	PERCENT FINER □	PERCENT FINER ■	PERCENT FINER ○
4"			
3"			
1 1/2"			
3/4"	100.0	100.0	
3/8"	95.3	95.9	
4	90.5	90.6	
10	84.6	85.1	
20	72.7	72.0	
40	42.2	34.1	
60	14.5	7.2	
100	4.5	2.1	
200	2.1	1.3	

SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown c-f SAND, trace f. gravel, silt.
■	yellowish brown c-f SAND, trace f. gravel, silt.
○	

PARTICLE SIZE DISTRIBUTION

National Grid Hempstead MGP PDI

Project No. 11175065	January 2009	Figure

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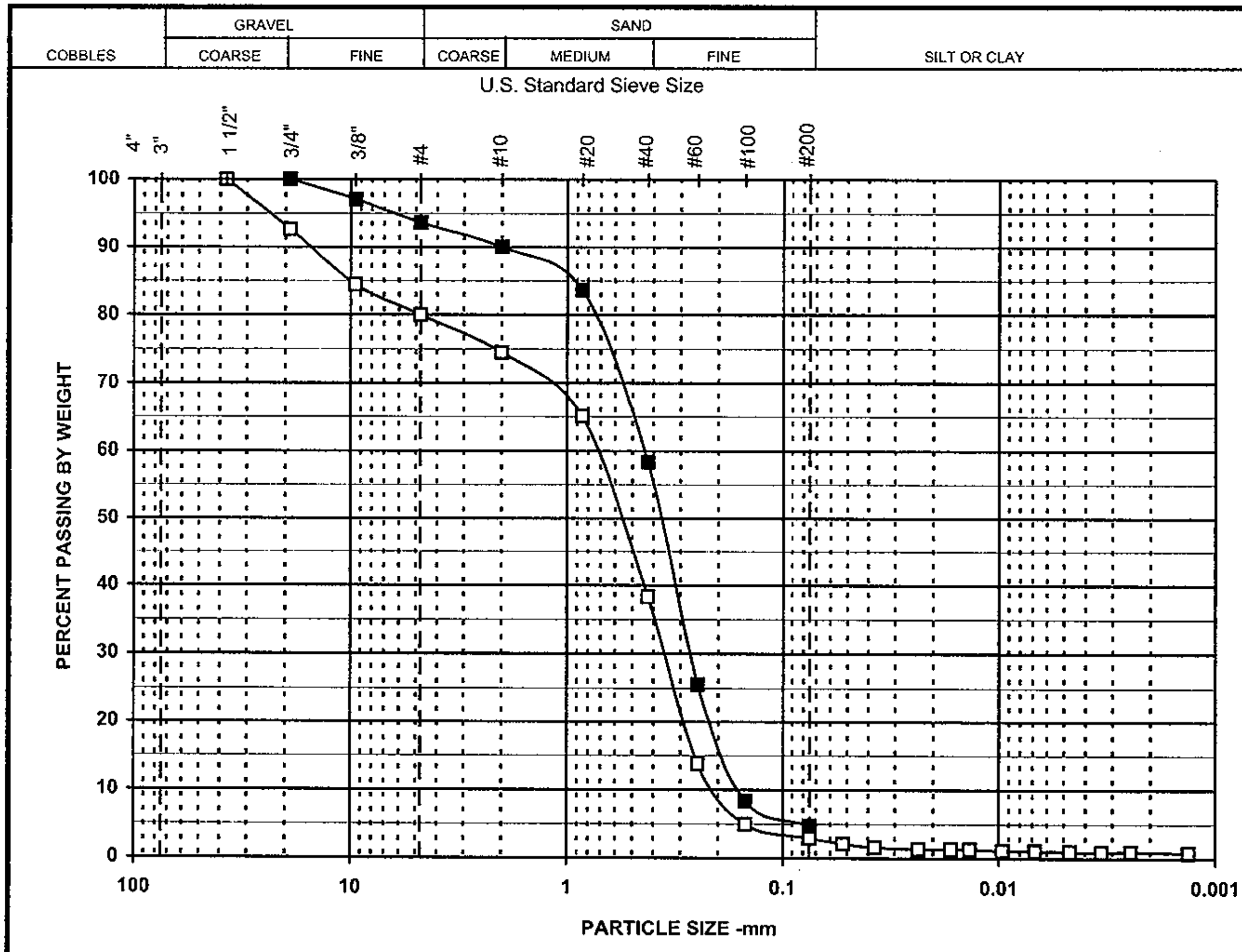

SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown c-f SAND, some gravel, trace silt.
■	yellowish brown c-f SAND, trace f. gravel, silt.
○	

Symbol	□	■	○
Boring	HISB-106	HISB-106	
Sample			
Spec			
Depth	35-45	49-53	
% +3"			
% Gravel	20.0	6.4	
% SAND	77.1	88.9	
% FINES	2.9	4.7	
% -2μ	1		
Cc	0.8	1.0	
Cu	3.7	2.8	
LL			
PL			
PI			
USCS	SP	SP	
w (%)	17.7	18.0	

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"	100.0		
3/4"	92.7	100.0	
3/8"	84.4	97.1	
4	80.0	93.6	
10	74.5	90.0	
20	65.1	83.6	
40	38.3	58.4	
60	13.8	25.6	
100	4.9	8.4	
200	2.9	4.7	

PARTICLE SIZE DISTRIBUTION
National Grid Hempstead MGP PDI

Project No. 11175065 | January 2009 | Figure

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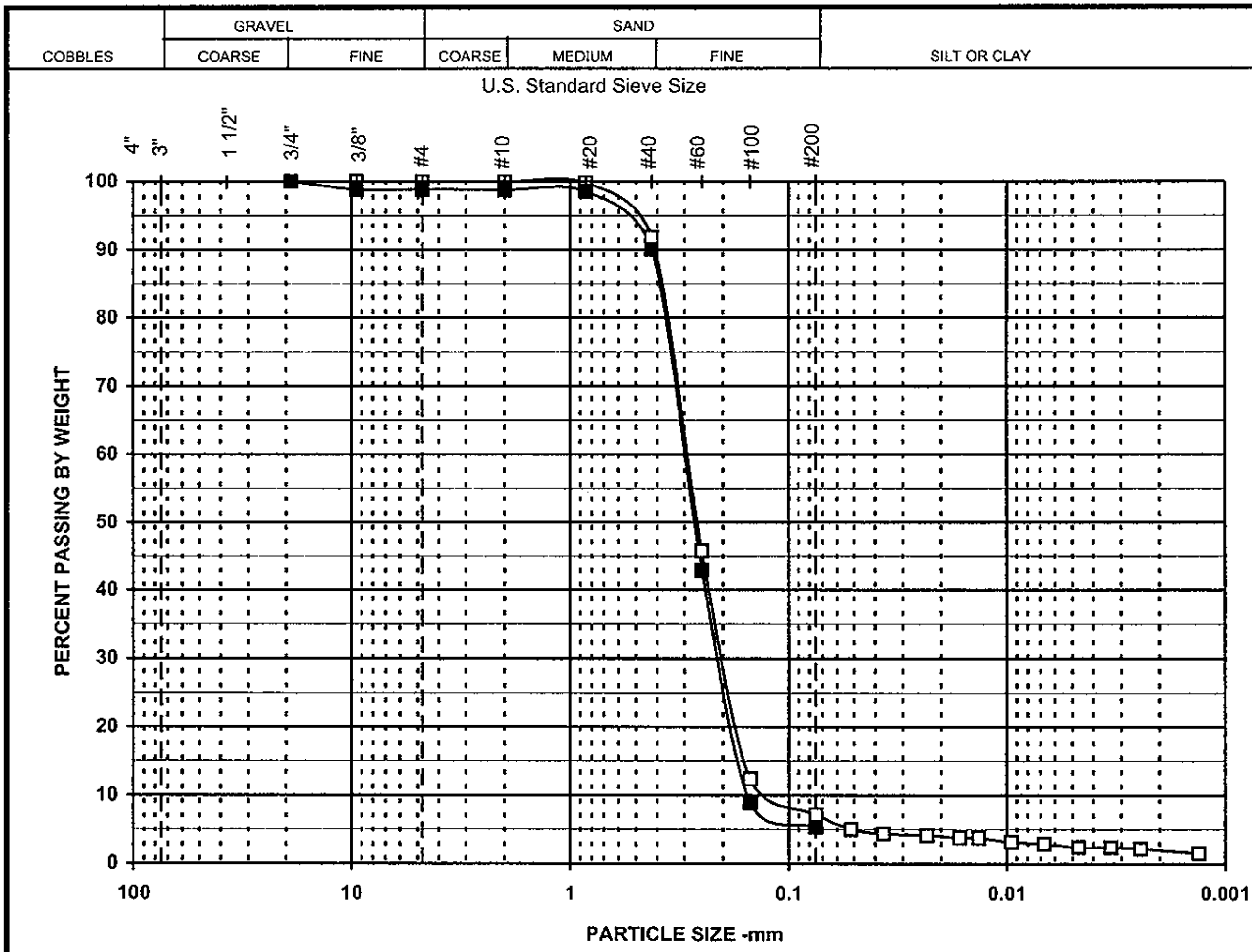

SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown f. SAND, trace m. sand, silt.
■	yellowish brown f. SAND, trace f. gravel, m. sand, silt.
○	

Symbol	□	■	○
Boring	HISB-106	HISB-106	
Sample			
Spec			
Depth	65-85	70-74	
% +3"			
% Gravel	0.1	1.2	
% SAND	92.7	93.4	
% FINES	7.2	5.4	
% -2μ	2		
Cc	1.2	0.9	
Cu	2.6	2.0	
LL			
PL			
PI			
USCS	SP-SM	SP-SM	
w (%)	31.0	36.3	

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"		100.0	
3/8"	100.0	98.8	
4	99.9	98.8	
10	99.9	98.7	
20	99.8	98.5	
40	91.8	90.0	
60	45.7	42.9	
100	12.4	8.9	
200	7.2	5.4	

PARTICLE SIZE DISTRIBUTION
National Grid Hempstead MGP PDI

Project No. 11175065	January 2009	Figure

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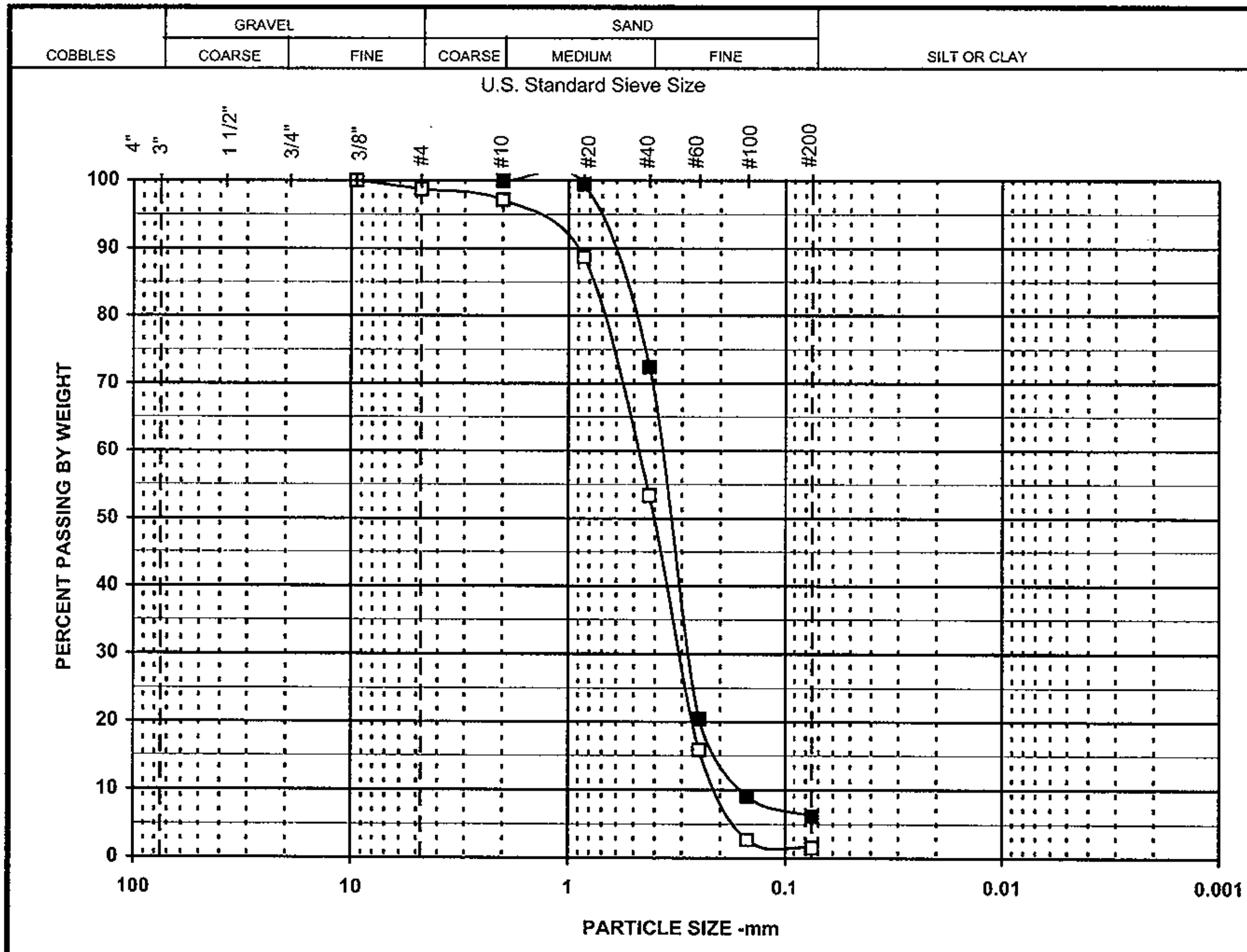

Symbol	□	■	○
Boring	HISB-108	HISB-108	
Sample			
Spec			
Depth	50-55	70-75	
% +3"			
% Gravel	1.3		
% SAND	97.2	93.8	
% FINES	1.5	6.2	
% -2μ			
Cc	1.0	1.3	
Cu	2.5	2.4	
LL			
PL			
PI			
USCS	SP	SP-SM	
w (%)	22.0	19.0	

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"	100.0		
4	98.7		
10	97.1	100.0	
20	88.7	99.4	
40	53.3	72.4	
60	15.9	20.4	
100	2.7	9.1	
200	1.5	6.2	

SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown c-f SAND, trace f. gravel, silt.
■	yellowish brown m-f SAND, trace silt.
○	

PARTICLE SIZE DISTRIBUTION

National Grid Hempstead MGP PDI

Project No. 11175065	January 2009	Figure

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REF. 2

1 of 4

Groundwater and Wells

Second Edition

Fletcher G. Driscoll, Ph.D.
Principal Author and Editor

U.S. FILTER JOHNSON SCREENS Published by U.S. Filter/Johnson Screens, St Paul, MN 55112

The grading of the filter pack should be based on the grain size of the finest layer to be screened. A filter pack selected in this manner ordinarily does not restrict the flow from the layers of coarsest material. The hydraulic conductivity of the pack is generally several times greater than that of the coarsest layers because the pack is cleaner and more uniform.

Filter pack material should consist of clean, well-rounded grains of a uniform size. These characteristics increase the permeability and porosity of the pack material. Pit-run or crushed materials are usually not satisfactory for filter packs. The chemical nature of the filter pack is as important as its physical characteristics. Filter pack material consisting mostly of siliceous, rather than calcareous, particles is preferred. Up to 5 percent calcareous material is a common allowable limit. This is important because acid treatment of the well might be required later, and most of the acid could be spent in dissolving calcareous particles of the filter pack rather than in removing incrusting deposits of calcium or iron. Similarily, if the groundwater is slightly acidic, partial dissolution of the pack may occur over time. Particles of shale, anhydrite, and gypsum in the filter pack material also are undesirable. Table 13.12 lists the desirable physical and chemical characteristics for a filter pack and the advantages of using these materials.

The steps outlined below are followed in designing a filter pack:

1. Choose the layers to be screened and construct sieve-analysis curves for these formations. Select the grading of the filter pack on the basis of the sieve analysis for the layer of finest material. Figure 13.10 shows the grading of two samples of typical water-bearing material from an aquifer 30 ft (9.1 m) thick. The finest material lies between 75 and 90 ft (22.9 and 27.4 m). The design of the filter pack in this example will be based on this layer. In some instances, it is good practice to ignore unfavorable portions of an aquifer and to use blank pipe between sections of screen positioned in the more permeable sections of the aquifer.

2. Multiply the 70-percent size of the sediment by a factor between 4 and 10. Use 4 to 6 as the multiplier if the formation is uniform and the 40-percent-retained size

Table 13.12. Desirable Filter Pack Characteristics and Derived Advantages

Characteristic	Advantage
Clean	Little loss of material during development Less development time
Well-rounded grains	Higher hydraulic conductivity and porosity Reduced drawdown Higher yield More effective development
90 to 95% quartz grains	No loss of volume caused by dissolution of minerals
Uniformity coefficient of 2.5 or less	Less separation during installation Lower head loss through filter pack

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is 0.010 (0.25 mm) or less. Use a multiplier between 6 and 10 for semiconsolidated or unconsolidated aquifers when formation sediment has highly nonuniform gradation and includes silt or thin clay stringers, as commonly found in arid or semiarid areas. Using multipliers greater than 10 may result in a sand-pumping well. Place the result of this multiplication on the graph as the 70-percent size of the filter material. In Figure 13.10, 0.005 in (0.13 mm) is the 70-percent size of the sand between 75 and 90 ft. Using 5 as the multiplier, the 70-percent size of the filter material is 5 × 0.005 = 0.025 in (5 × 0.13 = 0.65 mm). This is the first point on a curve that represents the grading for the filter pack material.

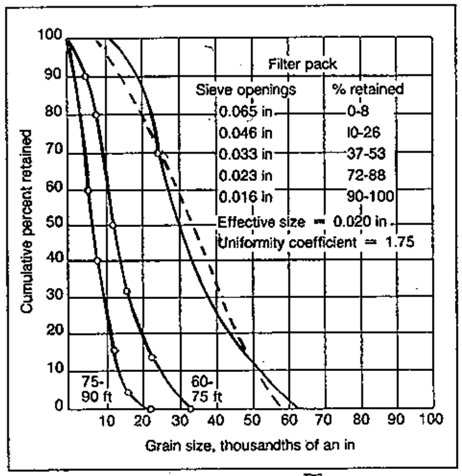

Figure 13.10 Grain-size curves for aquifer sand and corresponding curve for properly selected filter pack material.

3. Through the initial point on the filter pack curve, draw a smooth curve representing material with a uniformity coefficient of approximately 2.5 or less. In Figure 13.10, the curve drawn as a solid line has a uniformity coefficient of about 1.8. It could have been drawn somewhat differently, as shown by the dashed line which has a uniformity coefficient of 2.5. It is good practice to draw the filter pack curve so that the pack is as uniform as practicable. Thus, the material indicated by the solid-line curve is more desirable than the material indicated by the dashed-line curve.

4. Select a commercial filter pack that fulfills the dimensional and chemical requirements listed in Table 13.12. If a proper commercial pack cannot be purchased, but a local source of sand and gravel is available, the following procedure can be used to construct a suitable filter pack.

Prepare specifications for the filter pack material by first selecting four or five sieve sizes that cover the range of values for the curve, and then set down a permissible range for the percentage retained on each of the selected sieves. This range may be eight percentage points below and above the percentage retained at any point on the curve. In the example, the largest sieve would have an opening of 0.065 in (1.7 mm). The curve shows zero percent retained on this sieve, so up to 8 percent of the filter pack may contain 0.065-in material. The next smaller opening in the most commonly used series of sieves is 0.046 in (1.2 mm). The curve, as drawn, shows 18 percent retained on this sieve; 8 percent is added and subtracted to obtain the permissible range. Thus, on the 0.046-in sieve, the range is from 10 to 26 percent. This procedure is repeated until each of the sieves previously selected has been assigned a permissible range. In Figure 13.10, five sizes of sieve openings are shown to cover the desired gradation of the pack material. Giving the filter pack supplier an acceptable range at each of these points makes it possible to produce the desired material at reasonable cost. When designing filter pack material, the designer should keep in mind local sources of filter sand used for rapid sand filters*. Firms that produce these materials

*Rapid sand filters consist of sand beds used to filter drinking water supplies in water treatment plants.

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have large stocks of clean, uniformly graded sands and gravels that readily fit the requirements for filter packing of water wells. Some firms supply sand materials to oil and gas companies for use as propping materials in hydraulic fracturing of formations. These materials are also suitable for filter packing of water wells. Drilling contractors should obtain grain-size-distribution curves for all local sources of potential filter pack materials. For economic reasons, these packs should be specified if possible.

5. As a final step, select a screen slot size that will retain 90 percent or more of the filter pack material. In our example, the correct slot size is 0.018 in (0.46 mm).

6. Calculate the volume of filter pack required from Table 13.13. The pack should extend well above the screen to compensate for settlement of the pack during development. Use of a caliper log may reveal the presence of washouts in the borehole, necessitating additional filter pack. It is good practice to have extra filter pack on the site, especially if the stability of the borehole is in doubt.

If the well designer and contractor carefully follow the foregoing steps, sand-pumping wells can be avoided. The pack will provide mechanical retention of the formation material and prevent sediment from moving through the filter pack into the well. Occasionally it may be necessary to install more than one size of filter pack in a borehole. For example, thick boulder beds may overlie sand deposits and the yield requirements may dictate that both layers be screened. If the use of more than one filter pack is contemplated, the screen manufacturer should be consulted for specific design recommendations.

Thickness of Filter Pack

The design theory of filter pack gradation is based on the mechanical retention of formation particles; therefore, a pack thickness of only two or three grain diameters is actually needed to retain and control a formation. Laboratory tests made by Johnson Division show that a properly sized pack with a thickness of less than 0.5 in (12.7 mm) successfully retains the formation particles regardless of the velocity of water passing through the filter pack. It is impossible, however, to place a filter pack that is only 0.5 in thick and expect the material to completely surround the well screen. To insure that a continuous layer of filter material will surround the entire screen, the design should specify that the annulus around the screen be at least 3 in (76 mm).

Filter-pack thickness does little to reduce the possibility of sand pumping, because the controlling factor is the ratio of the grain size for the pack material in relation to the formation material. Also, a filter pack that is too thick can make final development of the well more difficult, as explained in Chapter 15. Under most conditions, filter packs should not be more than 8 in (203 mm) thick because the energy created by the development procedure must be able to penetrate the pack to repair the damage done by drilling, break down any residual drilling fluid on the borehole wall, and remove fine particles near the borehole.

It has been suggested that the presence of a filter pack will augment the well yield because water from an overlying aquifer can percolate downward through the filter pack and into the well screen. In practice, however, calculations show this contribution to be insignificant in relation to total yield. For example, assume the conditions shown in Figure 13.11, where 90 percent of a confined aquifer has been screened. The overlying sediments are water bearing and are connected hydraulically to the screened

REF. 3

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Soil Mechanics

T. William Lambe • Robert V. Whitman

Massachusetts Institute of Technology

1969

John Wiley & Sons, Inc.

New York London Sydney Toronto

(REF. 3) 2 of 2 29/37

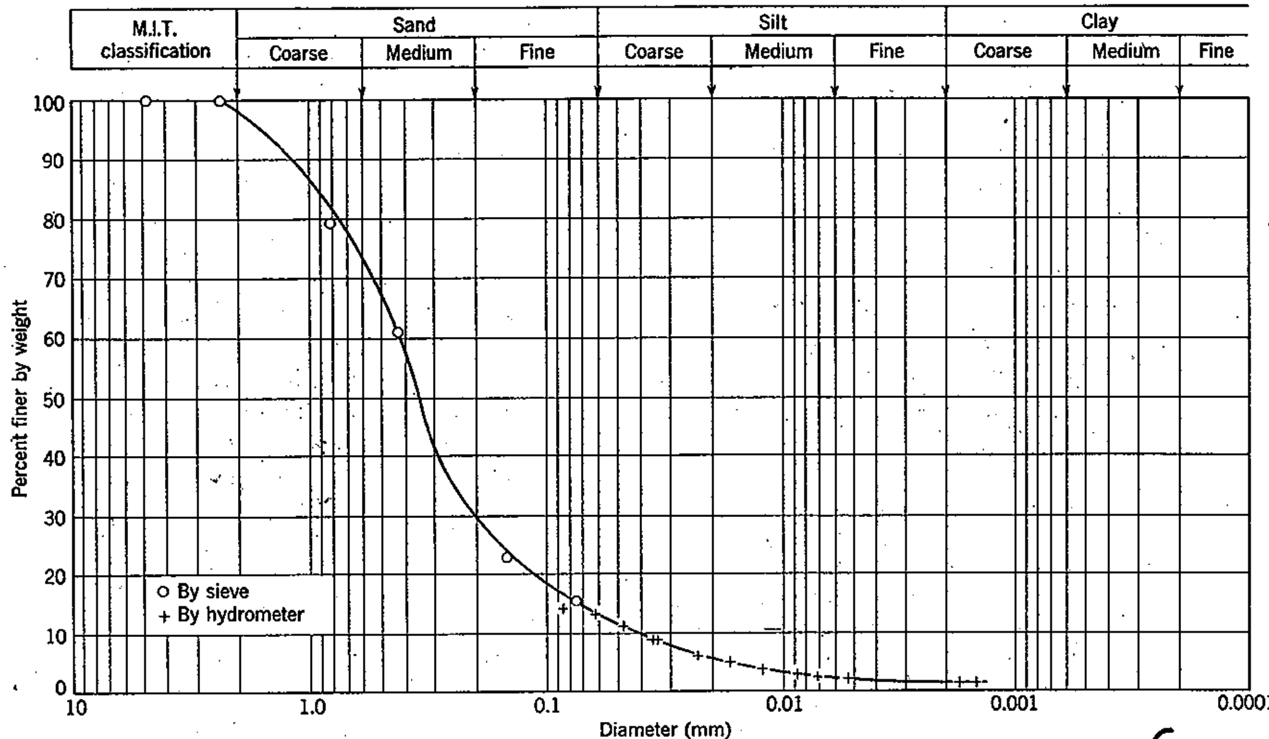

Fig. 3.3 Particle size distribution curve (From Lambe, 1951).

Cu

compressed under the high stresses (e.g., 10,000 psi) that exist at great depths in the ground can have void ratios less than 0.2.

Using the expression $Gw = Se$ (Fig. 3.1), we can compute the water contents corresponding to these quoted values of void ratio:

Sodium montmorillonite	900%
Clay under high pressure	7%

If a sample of oven-dry Mexico City clay sits in the laboratory (temperature = 70°F, relative humidity = 50%), it will absorb enough moisture from the atmosphere for its water content to rise to $2\frac{1}{2}$% or more. Under similar conditions, montmorillonite can get to a water content of 20%.

3.2 PARTICLE SIZE CHARACTERISTICS

The particle size distribution of an assemblage of soil particles is expressed by a plot of percent finer by weight versus diameter in millimeters, as shown in Fig. 3.3. Using the definition for sand, silt, and clay noted at the top of this figure[4] we can estimate the make-up of the soil sample as:

Gravel	2%
Sand	85%
Silt	12%
Clay	1%

[4] This set of particle size definitions is convenient and widely used. A slightly different set is given in Tables 3.5 and 3.6.

The uniformity of a soil can be expressed by the *uniformity coefficient*, which is the ratio of D_{60} to D_{10}, where D_{60} is the soil diameter at which 60% of the soil weight is finer and D_{10} is the corresponding value at 10% finer. A soil having a uniformity coefficient smaller than about 2 is considered "uniform." The uniformity of the soil whose distribution curve is shown in Fig. 3.3 is 10. This soil would be termed a "well-graded silty sand."

There are many reasons, both practical and theoretical, why the particle size distribution curve of a soil is only approximate. As discussed in Chapter 4, the definition of particle size is different for the coarse particles and the fine particles.

The accuracy of the distribution curves for fine-grained soils is more questionable than the accuracy of the curves for coarse soils. The chemical and mechanical treatments given natural soils prior to the performance of a particle size analysis—especially for a hydrometer analysis—usually result in effective particle sizes that are quite different from those existing in the natural soil. Even if an exact particle size curve were obtained, it would be of only limited value. Although the behavior of a cohesionless soil can often be related to particle size distribution, the behavior of a cohesive soil usually depends much more on geological history and structure than on particle size.

In spite of their serious limitations, particle size curves, particularly those of sands and silts, do have practical value. Both theory and laboratory experiments show

REF. 4
1 of 1

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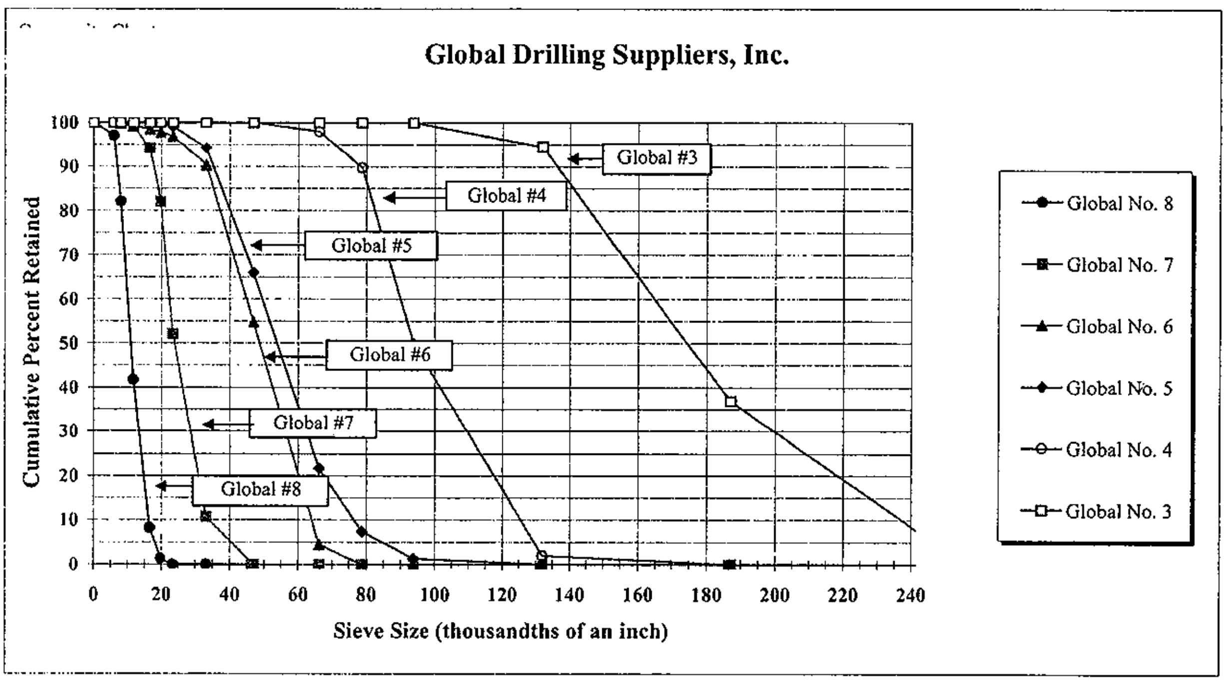
GLOBAL FILTER PACK SIEVE ANALYSES (2007)

Effective: 1-Oct-2007
Supercedes 8-MAY-2007 version

Features:
*NSF -approved (Standard 61) *Washed & Dried - will not freeze up
*E-Z carry, UV-treated 50 lb. plastic bags, 56 bags per pallet *99% Quartz Silica
Technical data (average, subject to change):
*Moh hardness - 7 *Sp. Gravity - 2.64 *Porosity - 40% *Roundness & Sphericity - 0.8
*Acid Solubility - <1% *Uniformity Coefficent < 1.7 *Bulk Density - 100#/ft³

Applicability: No recommendation or inference is made to correlate any filter pack to any particular application or well screen slot size. No. 8 is **NOT** to be used as a primary filter pack.

Sieve Size	Mesh Size	Global No. 8		Global No. 7		Global No. 6		Global No. 5		Global No. 4		Global No. 3	
		Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %
0.2500	3											3.2	**3.2**
0.1870	4							0.0	**0.0**	0.0	**0.0**	36.8	**36.8**
0.1320	6							0.1	**0.1**	2.0	**2.0**	94.5	**94.5**
0.0937	8					0.0	**0.0**	1.3	**1.3**	49.8	**49.8**	100.0	**100.0**
0.0787	10					0.0	**0.0**	7.4	**7.4**	89.7	**89.7**	100.0	**100.0**
0.0661	12			0.0	**0.0**	4.4	**4.4**	21.6	**21.6**	98.0	**98.0**	100.0	**100.0**
0.0469	16			0.0	**0.0**	54.8	**54.8**	66.0	**66.0**	100.0	**100.0**	100.0	**100.0**
0.0331	20			10.7	**10.7**	90.3	**90.3**	94.2	**94.2**	100.0	**100.0**	100.0	**100.0**
0.0234	30	0.0	**0.0**	52.0	**52.0**	96.9	**96.9**	99.1	**99.1**	100.0	**100.0**	100.0	**100.0**
0.0197	35	1.4	**1.4**	82.0	**82.0**	97.8	**97.8**	99.6	**99.6**	100.0	**100.0**	100.0	**100.0**
0.0165	40	8.2	**8.2**	94.2	**94.2**	98.4	**98.4**	99.8	**99.8**	100.0	**100.0**	100.0	**100.0**
0.0117	50	41.7	**41.7**	99.0	**99.0**	99.4	**99.4**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**
0.0080	70	82.1	**82.1**	99.7	**99.7**	99.9	**99.9**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**
0.0059	100	97.0	**97.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**
PAN	PAN	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**



REF. 5

1 of 2

31/37

ASTM STANDARDS ON GROUND WATER AND VADOSE ZONE INVESTIGATIONS

Sponsored by ASTM Committee D-18
on Soil and Rock

Second Edition
1994

ASTM Publication Code Number (PCN): 03-418094-38

ASTM
1916 Race St., Philadelphia, PA 19103

TABLE 1 Recommended (Achievable) Filter Pack Characteristics for Common Screen Slot Sizes

Size of Screen Opening, mm (in.)	Slot No.	Sand Pack Mesh Size Name(s)	1 % Passing Size (D-1), mm	Effective Size, (D-10), mm	30 % Passing Size (D-30), mm	Range of Uniformity Coefficient	Roundness (Powers Scale)
0.125 (0.005)	5[A]	100	0.09 to 0.12	0.14 to 0.17	0.17 to 0.21	1.3 to 2.0	2 to 5
0.25 (0.010)	10	20 to 40	0.25 to 0.35	0.4 to 0.5	0.5 to 0.6	1.1 to 1.6	3 to 5
0.50 (0.020)	20	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
0.75 (0.030)	30	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
1.0 (0.040)	40	8 to 12	1.2 to 1.4	1.6 to 1.8	1.7 to 2.0	1.1 to 1.6	4 to 6
1.5 (0.060)	60	6 to 9	1.5 to 1.8	2.3 to 2.8	2.5 to 3.0	1.1 to 1.7	4 to 6
2.0 (0.080)	80	4 to 8	2.0 to 2.4	2.4 to 3.0	2.6 to 3.1	1.1 to 1.7	4 to 6

[A] A 5-slot (0.152-mm) opening is not currently available in slotted PVC but is available in Vee wire PVC and Stainless; 6-slot opening may be substituted in these cases.

materials that would not impact the water sample for the constituents of concern may be selected for use on flush joint threads.

6.6 *Casing*—Where conditions warrant, the use of permanent casing installed to prevent communication between water-bearing zones is encouraged. The following subsections address both temporary and permanent casings.

6.6.1 *Materials*—The material type and minimum wall thickness of the casing should be adequate to withstand the forces of installation. All casing that is to remain as a permanent part of the installation (that is, multi-cased wells) should be new and cleaned to be free of interior and exterior protective coatings.

NOTE 9—The exterior casing (temporary or permanent multi-cased) is generally composed of steel, although other appropriate materials may be used.

6.6.2 *Diameter*—Several different casing sizes may be required depending on the subsurface geologic conditions penetrated. The diameter of the casing for filter packed wells should be selected so that a minimum annular space of 2 in. (50 mm) is maintained between the inside diameter of the casing and outside diameter of the riser. In addition, the diameter of the casings in multi-cased wells should be selected so that a minimum annular space of 2 in. is maintained between the casing and the borehole (that is, a 2-in. diameter screen will require first setting a 6-in. (152-mm) diameter casing in a 10-in. (254-mm) diameter boring).

NOTE 10—Under difficult drilling conditions (collapsing soils, rock, or cobbles), it may be necessary to advance temporary casing, under these conditions a smaller annular space may be maintained.

6.6.3 *Joints (Couplings)*—The ends of each casing section should be either flush-threaded or bevelled for welding.

6.7 *Protective Casing:*

6.7.1 *Materials*—Protective casings may be made of aluminum, steel, stainless steel, cast iron, or a structural plastic. The protective casing should have a lid capable of being locked shut by a locking device.

6.7.2 *Diameter*—The inside dimensions of the protective casing should be a minimum of 2 in. (50 mm) and preferably 4 in. (101 mm) larger than the nominal diameter of the riser to facilitate the installation and operation of sampling equipment.

6.8 *Annular Sealants*—The materials used to seal the annulus may be prepared as a slurry or used un-mixed in a dry pellet, granular, or chip form. Sealants should be selected to be compatible with ambient geologic, hydrogeologic, and climatic conditions and any man-induced conditions anticipated to occur during the life of the well.

6.8.1 *Bentonite*—Bentonite should be powdered, granular, pelletized, or chipped sodium montmorillonite furnished in sacks or buckets from a commercial source and free of impurities which adversely impact the water quality in the well. Pellets consist of roughly spherical or disk shaped units of compressed bentonite powder. Chips are large, irregularly shaped, and coarse granular units of bentonite free of additives. The diameter of pellets or chips selected for monitoring well construction should be less than one fifth the width of the annular space into which they are placed to reduce the potential for bridging. Granules consist of coarse particles of unaltered bentonite, typically smaller than 0.2 in. (50 mm).

6.8.2 *Cement*—Each type of cement has slightly different characteristics that may be appropriate under various physical and chemical conditions. Cement should be one of the five Portland cement types that are specified in Specification C 150. The use of quick-setting cements containing additives is not recommended for use in monitoring well installation. Additives may leach from the cement and influence the chemistry of the water samples.

6.8.3 *Grout*—The grout backfill that is placed above the bentonite annular seal and secondary filters (see Fig. 2) is ordinarily a liquid slurry consisting of either a bentonite (powder or granules, or both) base and water, or a Portland cement base and water. Often, bentonite-based grouts are used when it is desired that the grout remain flexible (that is, to accommodate freeze-thaw) during the life of the installation. Cement or bentonite-based grouts are often used when the filling in of cracks in the surrounding geologic material, adherence to rock units, or a rigid setting is desired.

6.8.3.1 *Mixing*—The mixing (and placing) of a grout backfill should be performed with precisely recorded weights and volumes of materials, and according to procedures stipulated by the manufacturer that often include the order of component mixing. The grout should be thoroughly mixed with a paddle type mechanical mixer or by recirculating the mix through a pump until all lumps are disintegrated. Lumpy grout should not be used in the construction of a monitoring well to prevent bridging within the tremie.

NOTE 11—Lumps do not include lost circulation materials that may be added to the grout if excessive grout losses occur.

6.8.3.2 *Typical Bentonite Base Grout*—When a bentonite base grout is used, bentonite, usually unaltered, *must* be the first additive placed in the water through a venturi device. A typical unbeneficiated bentonite base grout consists of about 1 to 1.25 lb (0.57 kg) of unaltered bentonite to each 1 gal (3.8 L) of water. After the bentonite is mixed and allowed to "yield or hydrate," up to 2 lb (0.9 kg) of Type I Portland cement (per gallon of water) is often added to stiffen the mix.

{REF. 6} 1 OF 2

33/37

Guidance for Design, Installation and Operation of In Situ Air Sparging Systems

PUB-RR-186 November, 2003

Purpose:
This is a guide to using in situ air sparging as a remediation technology. In situ air sparging is a process in which a gaseous medium (commonly air) is injected into groundwater through a system of wells. As the injected air rises to the water table, it can strip volatile organic compounds (VOCs) from groundwater and the capillary fringe. The process also oxygenates groundwater, enhancing the potential for biodegradation at sites with contaminants that degrade aerobically.

The DNR developed this guidance for environmental professionals who investigate contaminated sites and design remedial systems. Designing an in situ air sparging system is a multi-disciplinary process; the designer should have a working knowledge of geology, hydrogeology and basic engineering to design an effective system. The majority of this guidance is intended for smaller VOC contaminated sites; however, some of the guidance is appropriate for larger sites. Designers may need to deviate from the guidance in some circumstances because each site has unique contaminants, access constraints, size, hydrogeology, and other characteristics. If site-specific criteria or conditions require a cost-effective system design that differs from this guidance, it is the responsibility of the remediation system designer to propose an effective system to the DNR.

Author/Contact:
This document was originally prepared by George Mickelson (608-267-7652), who now works for the Drinking and Groundwater Program. It was reviewed for accuracy by Gary A. Edelstein (608-267-7563) in November, 2003

Errata:
This document includes errata and additional information prepared in August, 1995.
The DNR rule cites and references to other DNR guidance in the document were also reviewed and found to be current, with the exception of the references to NR 112, which has been renumbered NR 812 and references to SW-157, "Guidance for Conducting Environmental Response Actions", which is no longer current guidance.

WISCONSIN DEPT. OF NATURAL RESOURCES

Wisconsin Department of Natural Resources
P.O. Box 7921, Madison, WI 53707

the geologic conditions because the geological conditions must allow the air to rise to the water table. It is highly recommended that a hydrogeologist collect samples from above the seasonal, high water table to the base of the screened interval from a sufficient number of wells to verify the geologic characterization. A hydrogeologist as defined in NR 500.03 (64) or NR 600.03 (98) should describe the soil in detail. See Subsection 2.2.2 for soil description information.

4.2.2 Filter Pack.

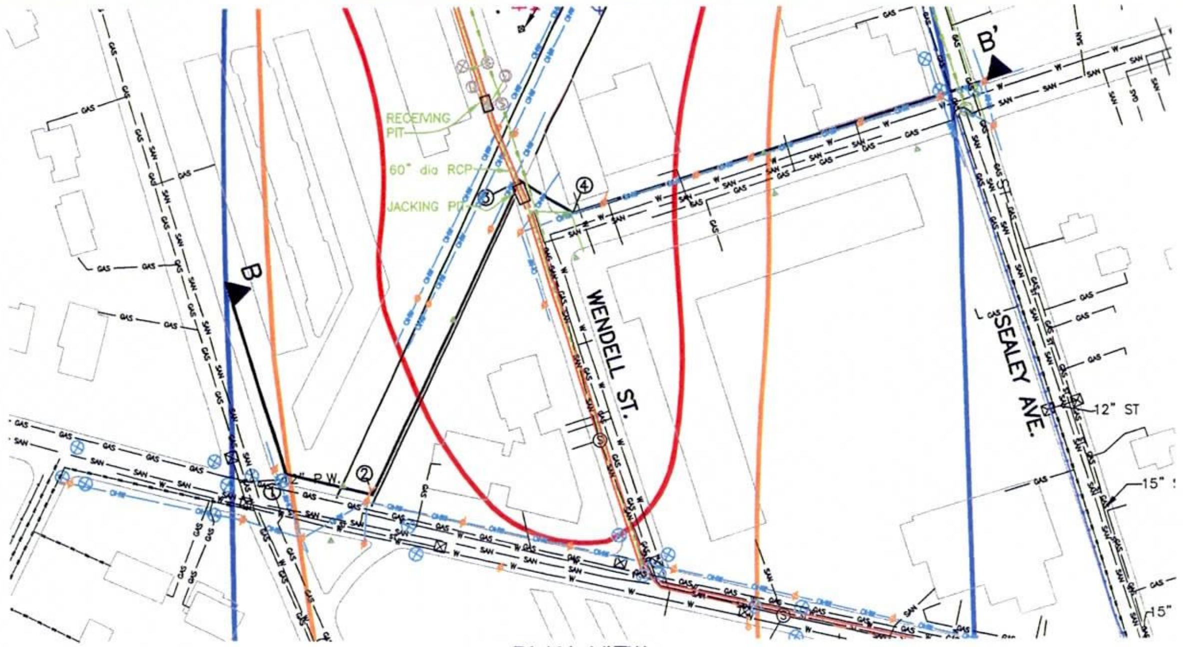
Designers should select the filter pack for the well based on the average grain size of the geologic materials below the water table. Samples for grain size analysis should be tested prior to designing an air sparging system. A sieve analysis is usually sufficient for filter pack design (a hydrometer test is usually not needed).

The average grain size of the filter pack should be as close to the native soils as practical. Coarser materials should not be used for the filter pack, however, slightly finer-grained material may be used. If the filter pack's average grain size is larger than the native geologic materials, the filter pack may be more permeable than the native soil. While a highly permeable filter pack is an advantage in constructing wells for other uses (monitoring or extraction), a filter pack that has a significantly higher permeability than the surrounding formation will be a conduit for upward short circuiting of air in the depth interval between the bentonite seal and the top of the well screen. This reduces the lateral movement of air into the aquifer. If the filter pack is significantly smaller than the native soils, too much restriction to air flow results. Natural filter packs may be used in caving formations provided that the native materials do not have significant levels of fines that may accumulate within the well screens.

The filter pack should extend from the base of the well screen to a minimum of 1 to 2 feet above the screen.

4.2.3 Seals.

A bentonite seal that is 0.5 to 2 feet thick should be placed above the filter pack. The annular space seal (above the bentonite seal) should be constructed with either bentonite cement grout or bentonite. A tremie should be used to place grout when installing a seal below the water table. The surface seal should be constructed in a manner that complies with NR 141.



PLAN VIEW

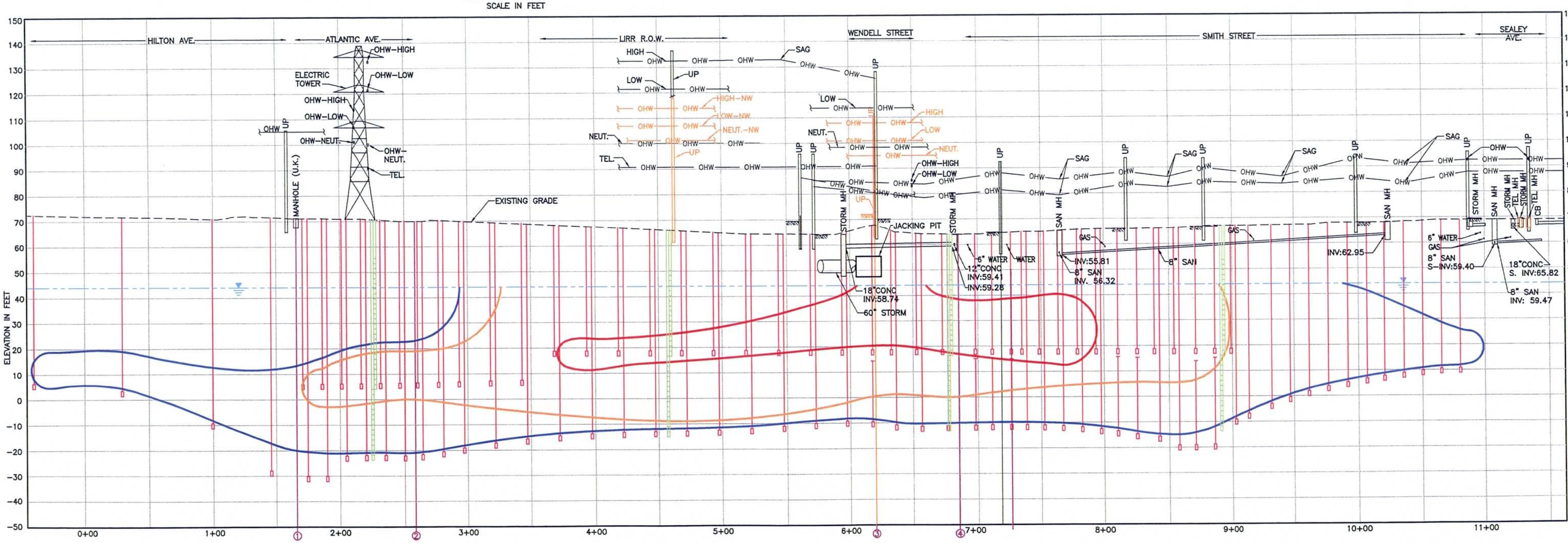
100' 0 100'
SCALE IN FEET

NOTE:

1. THE CROSS-SECTION B-B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 8 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.
3. THE HORIZONTAL SPACING OF SOME OXYGEN DELIVERY WELLS HAVE BEEN MODIFIED TO AVOID UTILITIES AND STRUCTURES IN THE AREA.

LEGEND:

- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- PROPOSED OXYGEN DELIVERY WELLS
- SCREENED INTERVAL
- PROPOSED MONITORING POINT(S)
- UTILITY POLE (NEAR SIDE)
- UTILITY POLE (FAR SIDE)
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- OHW — OVERHEAD ELECTRIC WIRE (FAR SIDE)
- OHW — OVERHEAD ELECTRIC WIRE (NEAR SIDE)



SECTION B-B'
(TREATMENT SYSTEM 1)

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

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DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

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JOB NO. 11175065

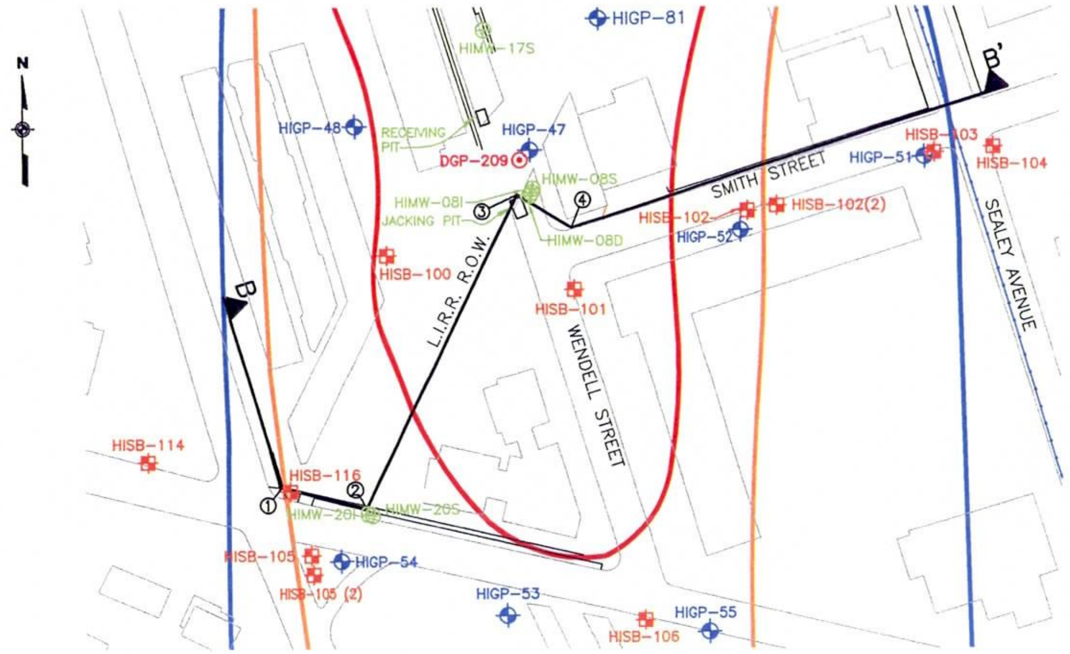
NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

OXYGEN DELIVERY WELLS AND UTILITIES, SECTION B-B', TREATMENT SYSTEM 1

Scale: AS SHOWN | Date: SEPT. 2009 | DWG-7

36/37



PLAN VIEW

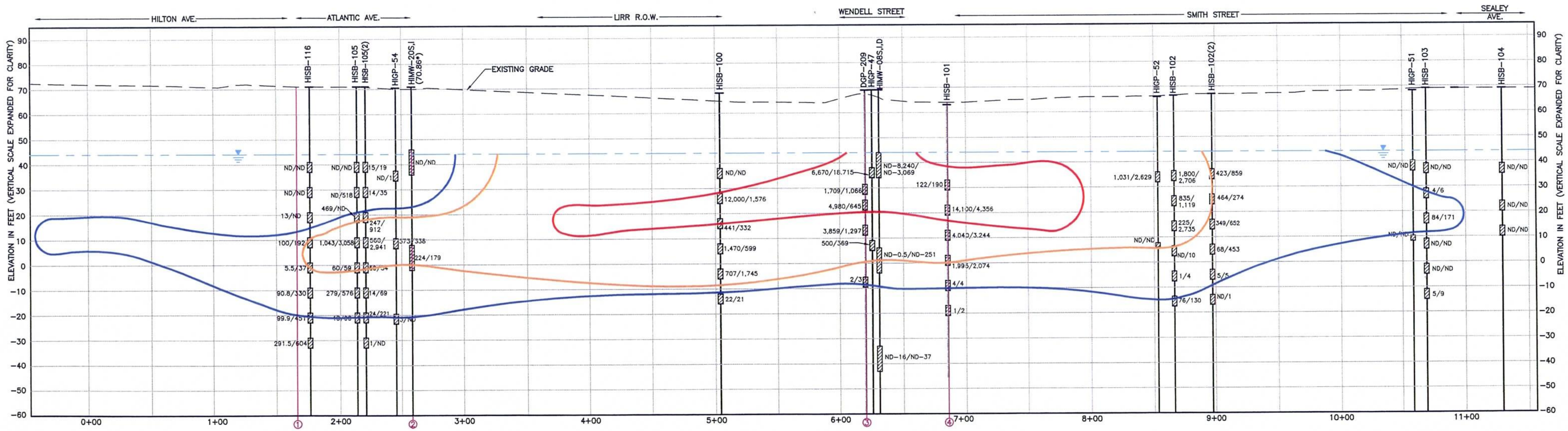
100' 0 100'
SCALE IN FEET

NOTE:

1. THE CROSS-SECTION B-B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 8 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS-SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWINGS 6 AND 7 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.

LEGEND:

- HISB-100 — BORING ID
- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- GROUNDWATER SAMPLE INTERVAL
- 22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L
- (red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- (orange line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- (blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



SECTION B-B'

* SURVEYED ELEVATION

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 5-6.dwg 9/29/09 - 3 RAL

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

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DRAWN BY: RAL
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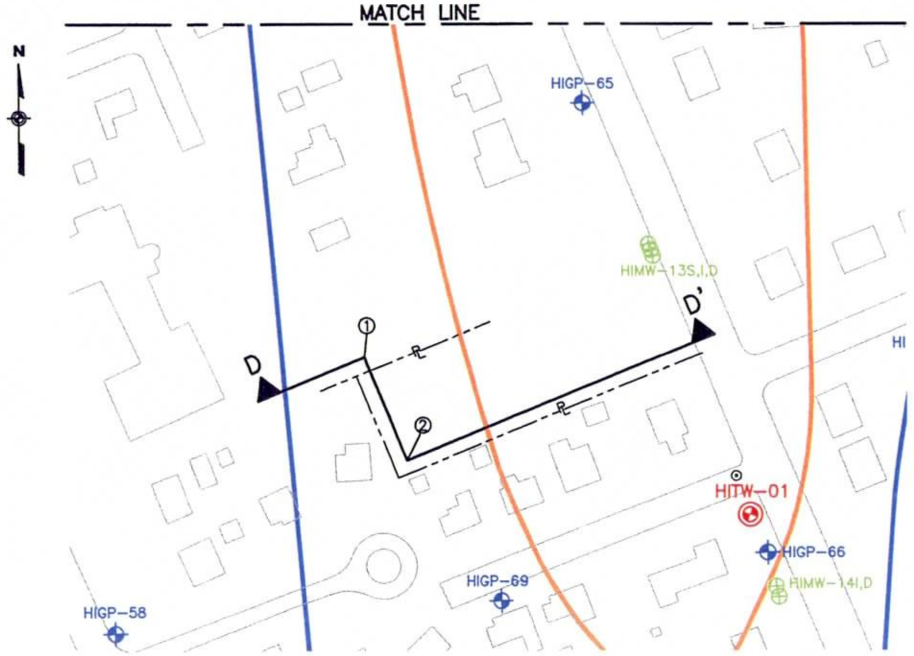
THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME SECTION B-B'

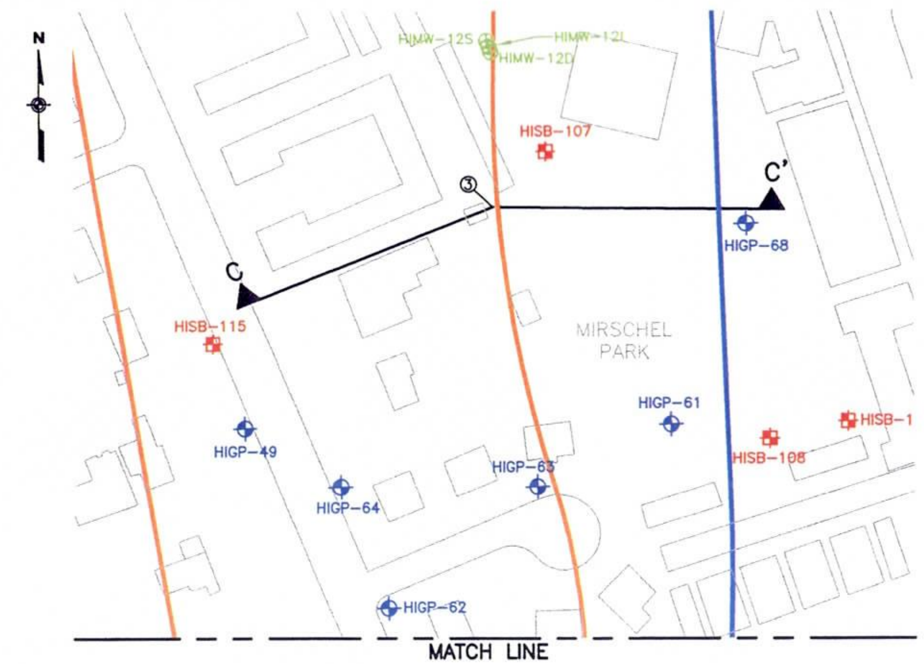
Scale: AS SHOWN | Date: SEPT. 2009 | DWG-5

37/37



PLAN VIEW D-D'

100' 0 100' SCALE IN FEET



PLAN VIEW C-C'

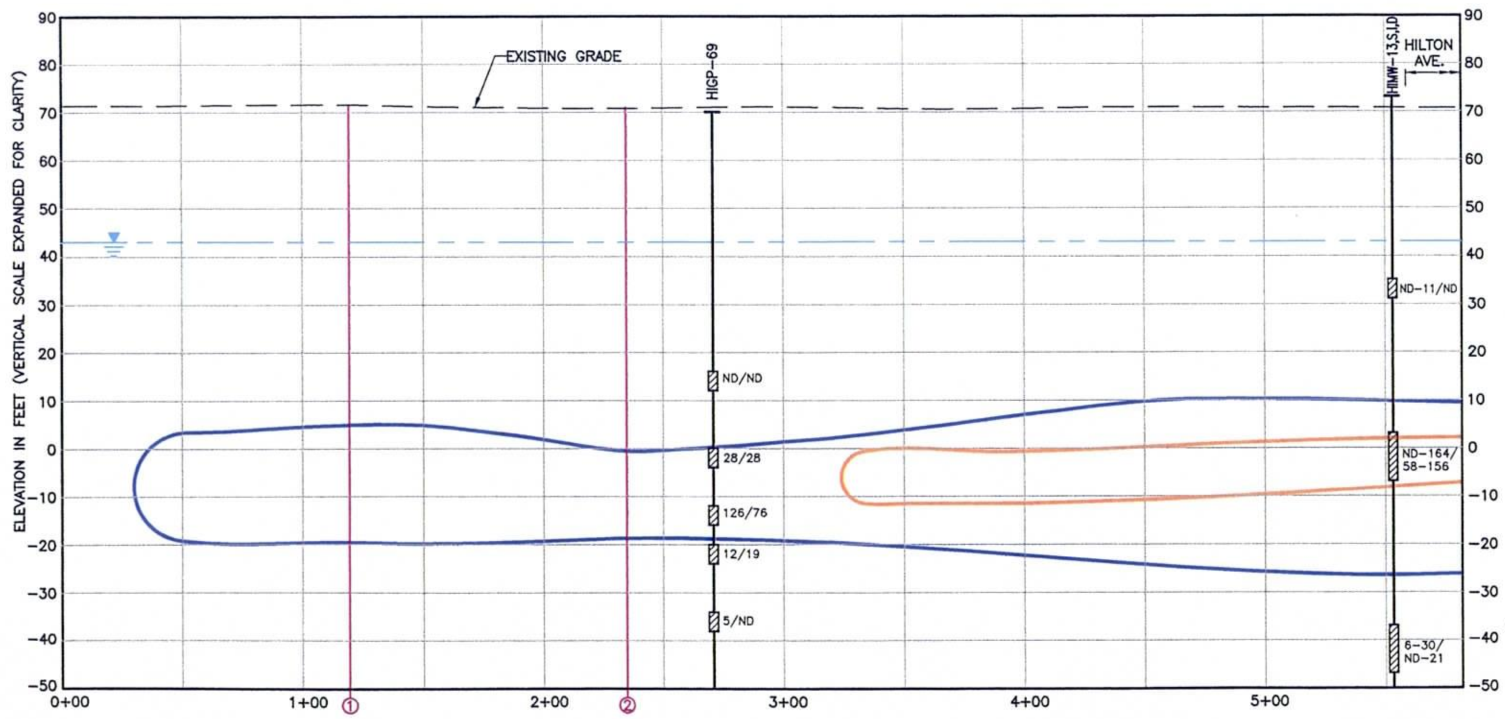
100' 0 100' SCALE IN FEET

NOTE:

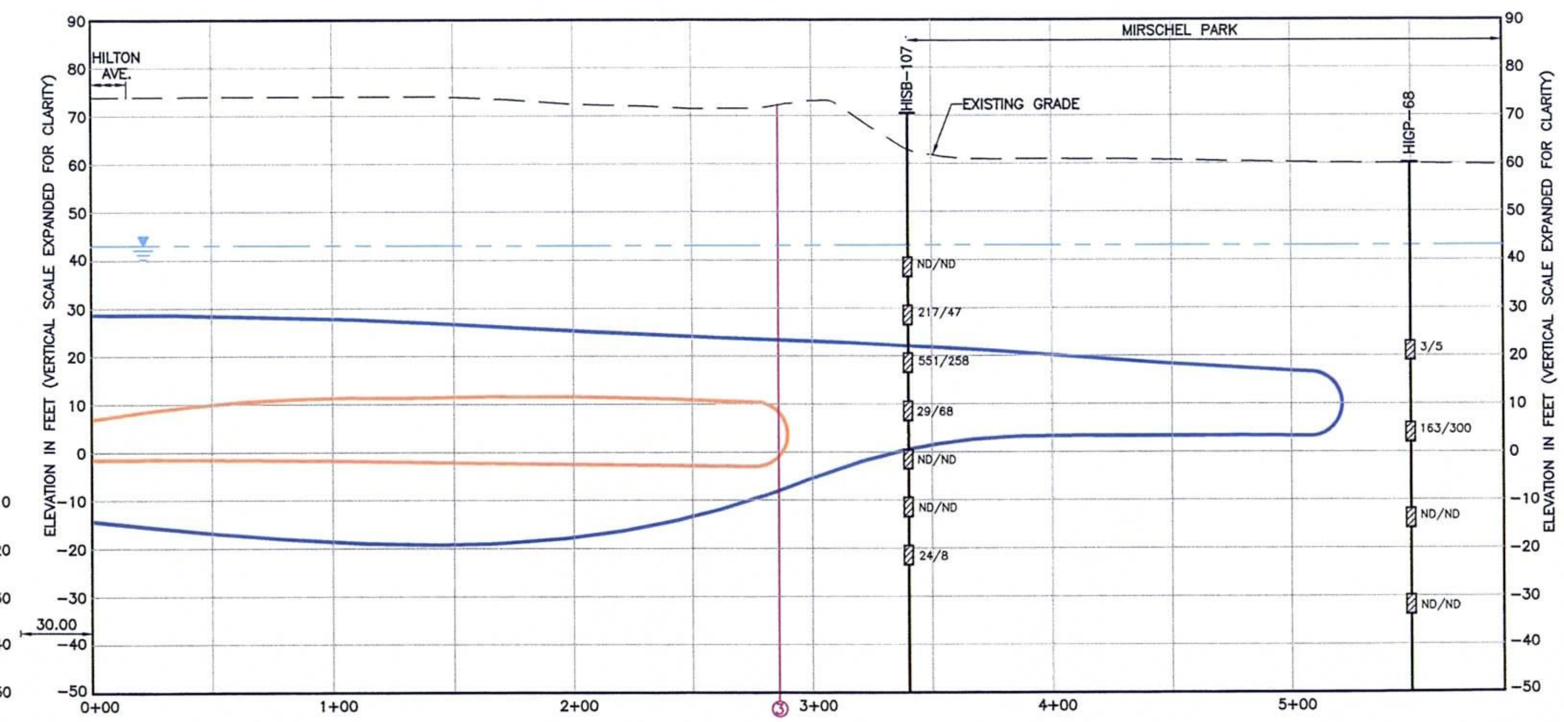
1. THE CROSS-SECTIONS C-C' AND D-D' REPRESENT THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 9 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS-SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWINGS 6 AND 7 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.

LEGEND:

- HISB-100 — BORING ID
- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- GROUNDWATER SAMPLE INTERVAL
- 22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L
- (red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- (orange line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- (blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



SECTION D-D'



SECTION C-C'

20' 0 20' VERT. SCALE IN FEET

40' 0 40' HORIZ. SCALE IN FEET

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NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

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DRAWN BY: RAL
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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME CROSS-SECTION C-C' AND D-D'

Scale: AS SHOWN | Date: SEPT. 2009 | DWG-6

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REFERENCES

(Provided in Electronic Format)

(REF. 1) 11 of 15

19/37

National Grid Hempstead MGP PDI

LABORATORY TESTING DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS						REMARKS
			WATER CONTENT (%)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	HYDRO. % MINUS 2 μm (%)	ORGANIC CONTENT (burnoff) (%)	SPECIFIC GRAVITY (-)	
HISB-102		30-34	16.8	SP	2.1				
HISB-102		50-54	18.9	SP	1.3				
HISB-106		35-45	17.7	SP	2.9	1	0.3	2.663	
HISB-106		49-53	18.0	SP	4.7				
HISB-106		65-85	31.0	SP-SM	7.2	2	0.4	2.680	
HISB-106		70-74	36.3	SP-SM	5.4				
HISB-108		50-55	22.0	SP	1.5				
HISB-108		70-75	19.0	SP-SM	6.2				

Note: (1) USCS symbol based on visual observation and Sieve reported.

Prepared by: JR
Reviewed by: CMJ
Date: 1/23/2009

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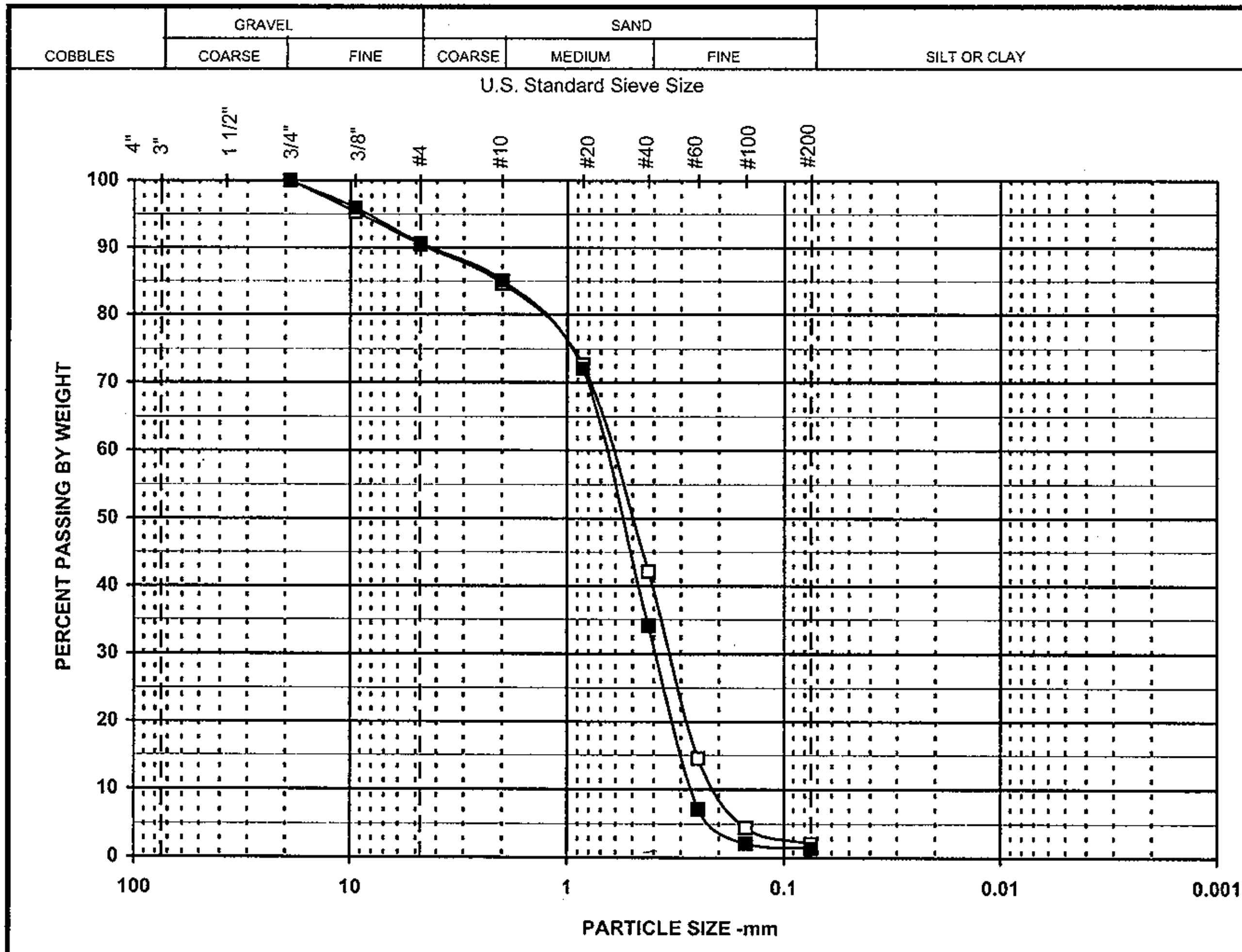
Totowa, NJ 07512



SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown c-f SAND, trace f. gravel, silt.
■	yellowish brown c-f SAND, trace f. gravel, silt.
○	

Symbol	□	■	○
Boring	HISB-102	HISB-102	
Sample			
Spec			
Depth	30-34	50-54	
% +3"			
% Gravel	9.5	9.4	
% SAND	88.4	89.3	
% FINES	2.1	1.3	
% -2μ			
Cc	0.9	0.8	
Cu	3.3	2.7	
LL			
PL			
PI			
USCS	SP	SP	
w (%)	16.8	18.9	

Particle Size	PERCENT FINER		
(Sieve #)	□	■	○
4"			
3"			
1 1/2"			
3/4"	100.0	100.0	
3/8"	95.3	95.9	
4	90.5	90.6	
10	84.6	85.1	
20	72.7	72.0	
40	42.2	34.1	
60	14.5	7.2	
100	4.5	2.1	
200	2.1	1.3	

PARTICLE SIZE DISTRIBUTION

National Grid Hempstead MGP PDI

Project No. 11175065	January 2009	Figure

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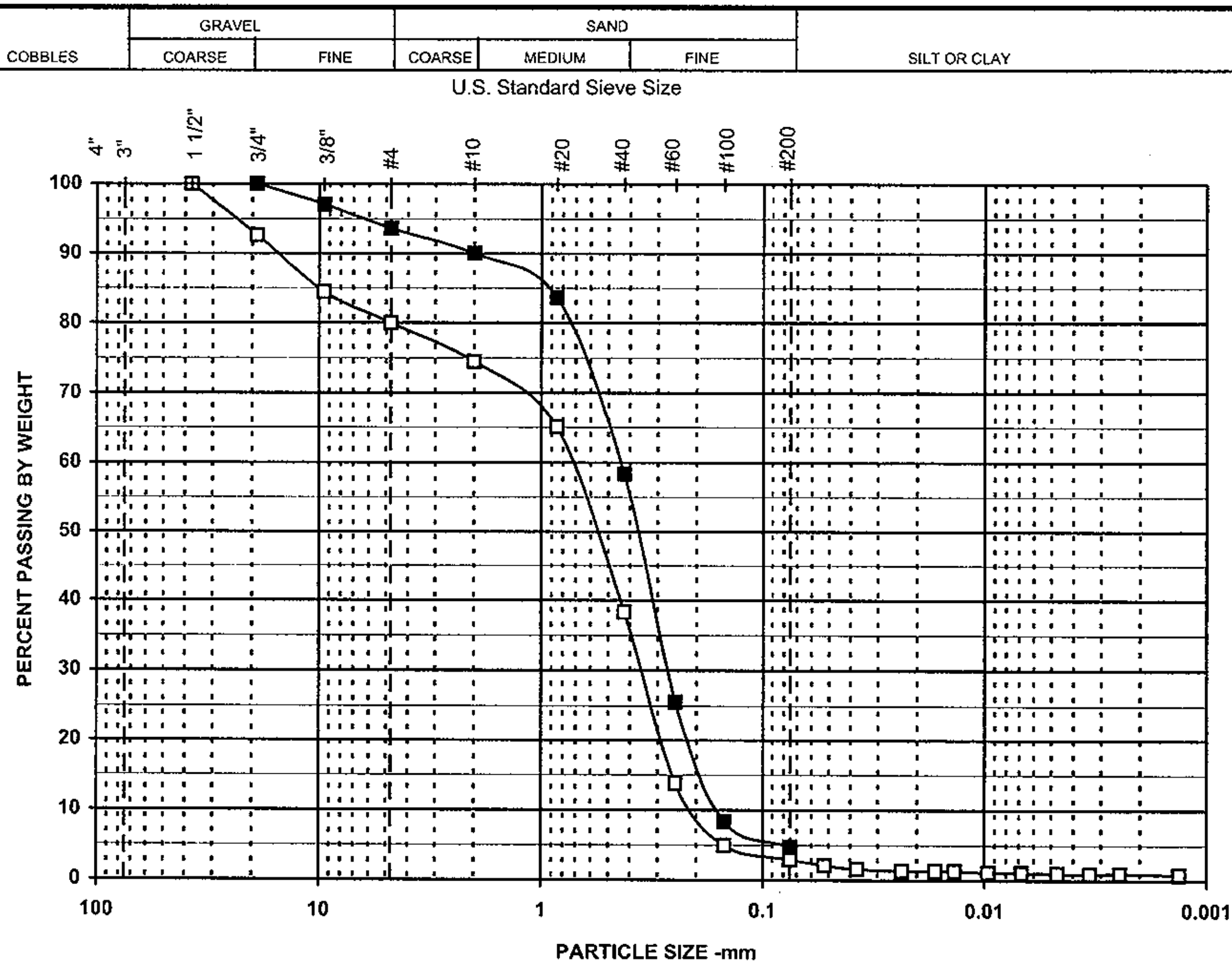

SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown c-f SAND, some gravel, trace silt.
■	yellowish brown c-f SAND, trace f. gravel, silt.
○	

Symbol	□	■	○
Boring	HISB-106	HISB-106	
Sample			
Spec			
Depth	35-45	49-53	
% +3"			
% Gravel	20.0	6.4	
% SAND	77.1	88.9	
% FINES	2.9	4.7	
% -2μ	1		
Cc	0.8	1.0	
Cu	3.7	2.8	
LL			
PL			
PI			
USCS	SP	SP	
w (%)	17.7	18.0	

Particle Size (Sieve #)	PERCENT FINER □	PERCENT FINER ■	PERCENT FINER ○
4"			
3"			
1 1/2"	100.0		
3/4"	92.7	100.0	
3/8"	84.4	97.1	
4	80.0	93.6	
10	74.5	90.0	
20	65.1	83.6	
40	38.3	58.4	
60	13.8	25.6	
100	4.9	8.4	
200	2.9	4.7	

PARTICLE SIZE DISTRIBUTION

National Grid Hempstead MGP PDI

Project No. 11175065	January 2009	Figure

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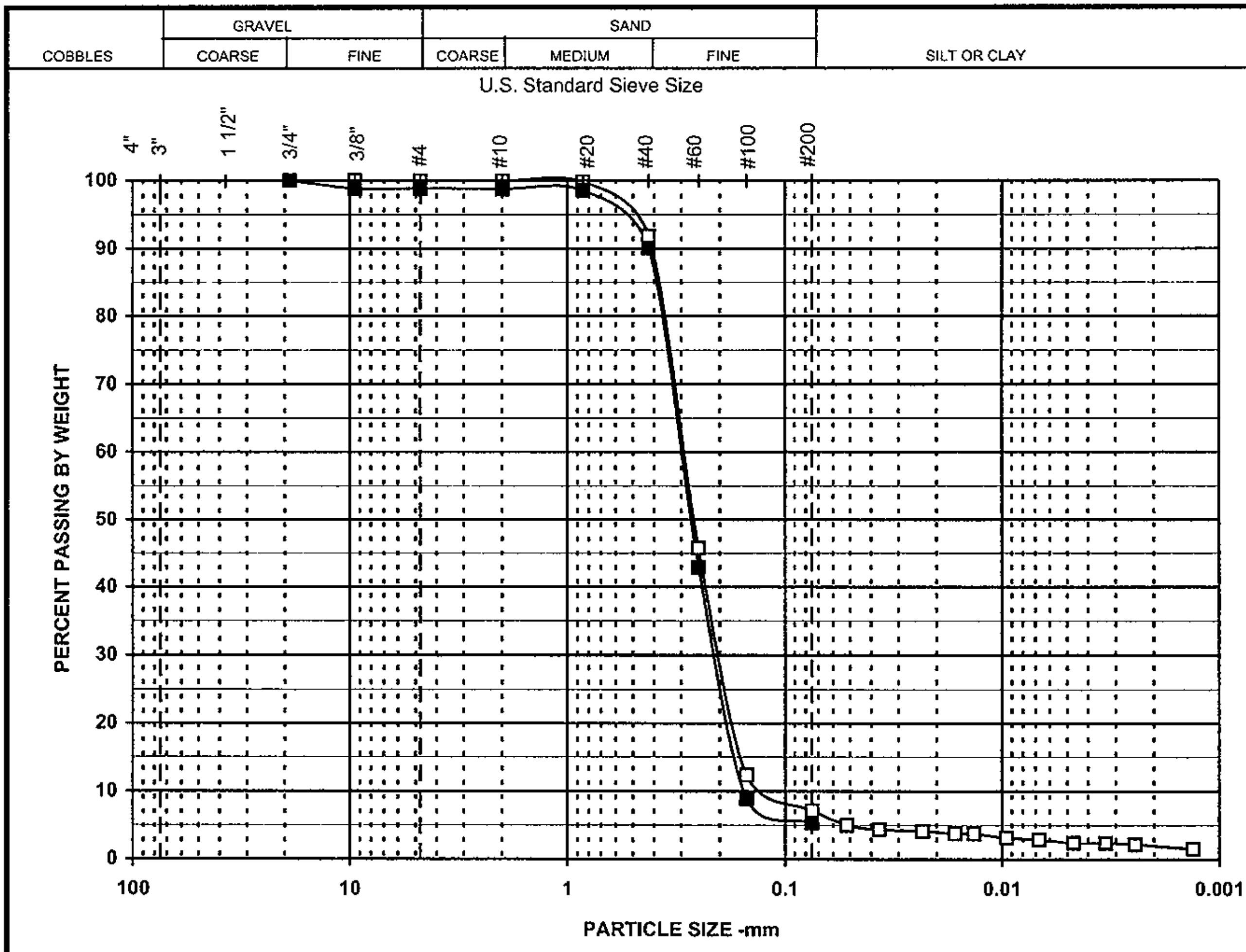

SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown f. SAND, trace m. sand, silt.
■	yellowish brown f. SAND, trace f. gravel, m. sand, silt.
○	

Symbol	□	■	○
Boring	HISB-106	HISB-106	
Sample			
Spec			
Depth	65-85	70-74	
% +3"			
% Gravel	0.1	1.2	
% SAND	92.7	93.4	
% FINES	7.2	5.4	
% -2μ	2		
Cc	1.2	0.9	
Cu	2.6	2.0	
LL			
PL			
PI			
USCS	SP-SM	SP-SM	
w (%)	31.0	36.3	

Particle Size (Sieve #)	PERCENT FINER □	PERCENT FINER ■	PERCENT FINER ○
4"			
3"			
1 1/2"			
3/4"		100.0	
3/8"	100.0	98.8	
4	99.9	98.8	
10	99.9	98.7	
20	99.8	98.5	
40	91.8	90.0	
60	45.7	42.9	
100	12.4	8.9	
200	7.2	5.4	

PARTICLE SIZE DISTRIBUTION
National Grid Hempstead MGP PDI

Project No. 11175065 | January 2009 | Figure

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REF. 1 15 of 15

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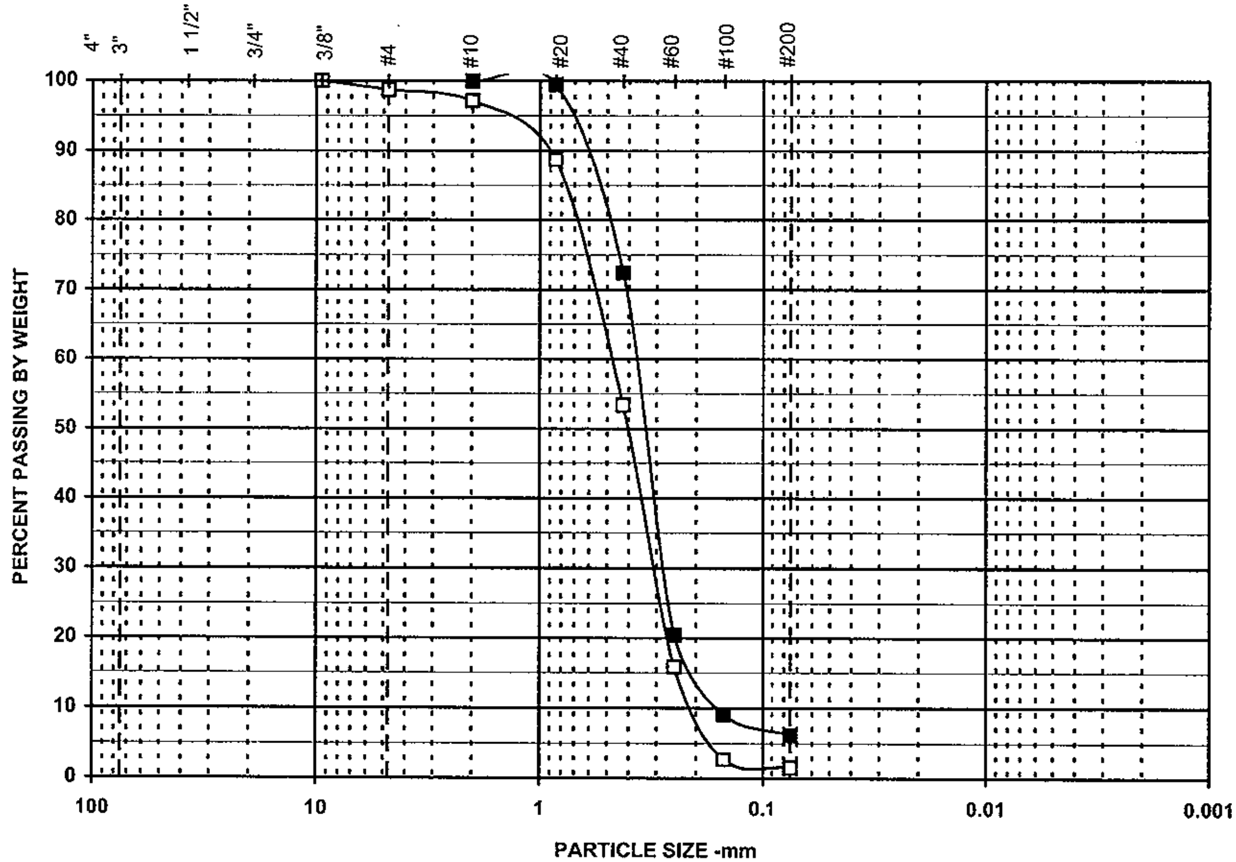

SYMBOL	DESCRIPTION AND REMARKS
□	yellowish brown c-f SAND, trace f. gravel, silt.
■	yellowish brown m-f SAND, trace silt.
○	

Symbol	□	■	○
Boring	HISB-108	HISB-108	
Sample			
Spec			
Depth	50-55	70-75	
% +3"			
% Gravel	1.3		
% SAND	97.2	93.8	
% FINES	1.5	6.2	
% -2μ			
Cc	1.0	1.3	
Cu	2.5	2.4	
LL			
PL			
PI			
USCS	SP	SP-SM	
w (%)	22.0	19.0	

Particle Size (Sieve #)	PERCENT FINER □	■	○
4"			
3"			
1 1/2"			
3/4"			
3/8"	100.0		
4	98.7		
10	97.1	100.0	
20	88.7	99.4	
40	53.3	72.4	
60	15.9	20.4	
100	2.7	9.1	
200	1.5	6.2	

PARTICLE SIZE DISTRIBUTION

National Grid Hempstead MGP PDI

Project No. 11175065 | January 2009 | Figure

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REF. 2

1 of 4

Groundwater and Wells

Second Edition

Fletcher G. Driscoll, Ph.D.
Principal Author and Editor

U.S. FILTER JOHNSON SCREENS Published by U.S. Filter/Johnson Screens, St Paul, MN 55112

The grading of the filter pack should be based on the grain size of the finest layer to be screened. A filter pack selected in this manner ordinarily does not restrict the flow from the layers of coarsest material. The hydraulic conductivity of the pack is generally several times greater than that of the coarsest layers because the pack is cleaner and more uniform.

Filter pack material should consist of clean, well-rounded grains of a uniform size. These characteristics increase the permeability and porosity of the pack material. Pit-run or crushed materials are usually not satisfactory for filter packs. The chemical nature of the filter pack is as important as its physical characteristics. Filter pack material consisting mostly of siliceous, rather than calcareous, particles is preferred. Up to 5 percent calcareous material is a common allowable limit. This is important because acid treatment of the well might be required later, and most of the acid could be spent in dissolving calcareous particles of the filter pack rather than in removing incrusting deposits of calcium or iron. Similarily, if the groundwater is slightly acidic, partial dissolution of the pack may occur over time. Particles of shale, anhydrite, and gypsum in the filter pack material also are undesirable. Table 13.12 lists the desirable physical and chemical characteristics for a filter pack and the advantages of using these materials.

The steps outlined below are followed in designing a filter pack:

1. Choose the layers to be screened and construct sieve-analysis curves for these formations. Select the grading of the filter pack on the basis of the sieve analysis for the layer of finest material. Figure 13.10 shows the grading of two samples of typical water-bearing material from an aquifer 30 ft (9.1 m) thick. The finest material lies between 75 and 90 ft (22.9 and 27.4 m). The design of the filter pack in this example will be based on this layer. In some instances, it is good practice to ignore unfavorable portions of an aquifer and to use blank pipe between sections of screen positioned in the more permeable sections of the aquifer.

2. Multiply the 70-percent size of the sediment by a factor between 4 and 10. Use 4 to 6 as the multiplier if the formation is uniform and the 40-percent-retained size

Table 13.12. Desirable Filter Pack Characteristics and Derived Advantages

Characteristic	Advantage
Clean	Little loss of material during development Less development time
Well-rounded grains	Higher hydraulic conductivity and porosity Reduced drawdown Higher yield More effective development
90 to 95% quartz grains	No loss of volume caused by dissolution of minerals
Uniformity coefficient of 2.5 or less	Less separation during installation Lower head loss through filter pack

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is 0.010 (0.25 mm) or less. Use a multiplier between 6 and 10 for semiconsolidated or unconsolidated aquifers when formation sediment has highly nonuniform gradation and includes silt or thin clay stringers, as commonly found in arid or semiarid areas. Using multipliers greater than 10 may result in a sand-pumping well. Place the result of this multiplication on the graph as the 70-percent size of the filter material. In Figure 13.10, 0.005 in (0.13 mm) is the 70-percent size of the sand between 75 and 90 ft. Using 5 as the multiplier, the 70-percent size of the filter material is 5 × 0.005 = 0.025 in (5 × 0.13 = 0.65 mm). This is the first point on a curve that represents the grading for the filter pack material.

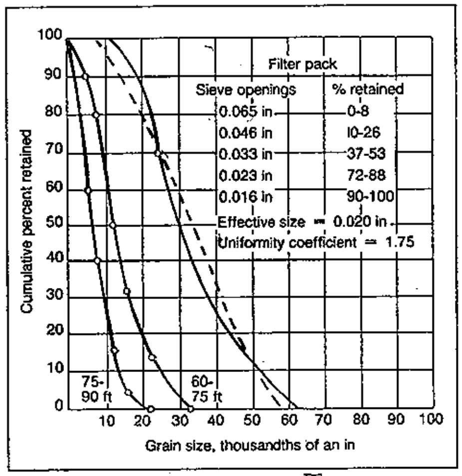

Figure 13.10 Grain-size curves for aquifer sand and corresponding curve for properly selected filter pack material.

3. Through the initial point on the filter pack curve, draw a smooth curve representing material with a uniformity coefficient of approximately 2.5 or less. In Figure 13.10, the curve drawn as a solid line has a uniformity coefficient of about 1.8. It could have been drawn somewhat differently, as shown by the dashed line which has a uniformity coefficient of 2.5. It is good practice to draw the filter pack curve so that the pack is as uniform as practicable. Thus, the material indicated by the solid-line curve is more desirable than the material indicated by the dashed-line curve.

4. Select a commercial filter pack that fulfills the dimensional and chemical requirements listed in Table 13.12. If a proper commercial pack cannot be purchased, but a local source of sand and gravel is available, the following procedure can be used to construct a suitable filter pack.

Prepare specifications for the filter pack material by first selecting four or five sieve sizes that cover the range of values for the curve, and then set down a permissible range for the percentage retained on each of the selected sieves. This range may be eight percentage points below and above the percentage retained at any point on the curve. In the example, the largest sieve would have an opening of 0.065 in (1.7 mm). The curve shows zero percent retained on this sieve, so up to 8 percent of the filter pack may contain 0.065-in material. The next smaller opening in the most commonly used series of sieves is 0.046 in (1.2 mm). The curve, as drawn, shows 18 percent retained on this sieve; 8 percent is added and subtracted to obtain the permissible range. Thus, on the 0.046-in sieve, the range is from 10 to 26 percent. This procedure is repeated until each of the sieves previously selected has been assigned a permissible range. In Figure 13.10, five sizes of sieve openings are shown to cover the desired gradation of the pack material. Giving the filter pack supplier an acceptable range at each of these points makes it possible to produce the desired material at reasonable cost. When designing filter pack material, the designer should keep in mind local sources of filter sand used for rapid sand filters*. Firms that produce these materials

*Rapid sand filters consist of sand beds used to filter drinking water supplies in water treatment plants.

have large stocks of clean, uniformly graded sands and gravels that readily fit the requirements for filter packing of water wells. Some firms supply sand materials to oil and gas companies for use as propping materials in hydraulic fracturing of formations. These materials are also suitable for filter packing of water wells. Drilling contractors should obtain grain-size-distribution curves for all local sources of potential filter pack materials. For economic reasons, these packs should be specified if possible.

5. As a final step, select a screen slot size that will retain 90 percent or more of the filter pack material. In our example, the correct slot size is 0.018 in (0.46 mm).

6. Calculate the volume of filter pack required from Table 13.13. The pack should extend well above the screen to compensate for settlement of the pack during development. Use of a caliper log may reveal the presence of washouts in the borehole, necessitating additional filter pack. It is good practice to have extra filter pack on the site, especially if the stability of the borehole is in doubt.

If the well designer and contractor carefully follow the foregoing steps, sand-pumping wells can be avoided. The pack will provide mechanical retention of the formation material and prevent sediment from moving through the filter pack into the well. Occasionally it may be necessary to install more than one size of filter pack in a borehole. For example, thick boulder beds may overlie sand deposits and the yield requirements may dictate that both layers be screened. If the use of more than one filter pack is contemplated, the screen manufacturer should be consulted for specific design recommendations.

Thickness of Filter Pack

The design theory of filter pack gradation is based on the mechanical retention of formation particles; therefore, a pack thickness of only two or three grain diameters is actually needed to retain and control a formation. Laboratory tests made by Johnson Division show that a properly sized pack with a thickness of less than 0.5 in (12.7 mm) successfully retains the formation particles regardless of the velocity of water passing through the filter pack. It is impossible, however, to place a filter pack that is only 0.5 in thick and expect the material to completely surround the well screen. To insure that a continuous layer of filter material will surround the entire screen, the design should specify that the annulus around the screen be at least 3 in (76 mm).

Filter-pack thickness does little to reduce the possibility of sand pumping, because the controlling factor is the ratio of the grain size for the pack material in relation to the formation material. Also, a filter pack that is too thick can make final development of the well more difficult, as explained in Chapter 15. Under most conditions, filter packs should not be more than 8 in (203 mm) thick because the energy created by the development procedure must be able to penetrate the pack to repair the damage done by drilling, break down any residual drilling fluid on the borehole wall, and remove fine particles near the borehole.

It has been suggested that the presence of a filter pack will augment the well yield because water from an overlying aquifer can percolate downward through the filter pack and into the well screen. In practice, however, calculations show this contribution to be insignificant in relation to total yield. For example, assume the conditions shown in Figure 13.11, where 90 percent of a confined aquifer has been screened. The overlying sediments are water bearing and are connected hydraulically to the screened

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Soil Mechanics

T. William Lambe • Robert V. Whitman

Massachusetts Institute of Technology

1969

John Wiley & Sons, Inc.

New York London Sydney Toronto

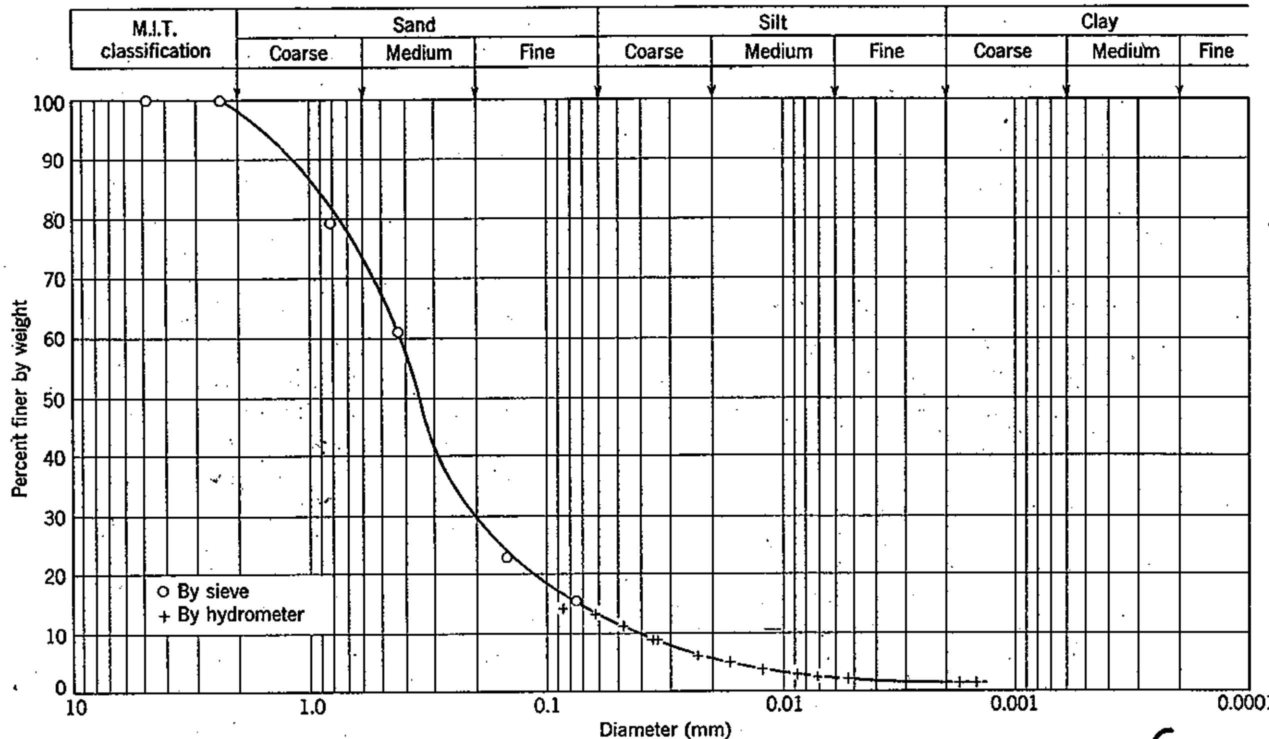

Fig. 3.3 Particle size distribution curve (From Lambe, 1951).

compressed under the high stresses (e.g., 10,000 psi) that exist at great depths in the ground can have void ratios less than 0.2.

Using the expression $Gw = Se$ (Fig. 3.1), we can compute the water contents corresponding to these quoted values of void ratio:

Sodium montmorillonite	900%
Clay under high pressure	7%

If a sample of oven-dry Mexico City clay sits in the laboratory (temperature = 70°F, relative humidity = 50%), it will absorb enough moisture from the atmosphere for its water content to rise to 2½% or more. Under similar conditions, montmorillonite can get to a water content of 20%.

3.2 PARTICLE SIZE CHARACTERISTICS

The particle size distribution of an assemblage of soil particles is expressed by a plot of percent finer by weight versus diameter in millimeters, as shown in Fig. 3.3. Using the definition for sand, silt, and clay noted at the top of this figure[4] we can estimate the make-up of the soil sample as:

Gravel	2%
Sand	85%
Silt	12%
Clay	1%

[4] This set of particle size definitions is convenient and widely used. A slightly different set is given in Tables 3.5 and 3.6.

Cu

The uniformity of a soil can be expressed by the *uniformity coefficient*, which is the ratio of D_{60} to D_{10}, where D_{60} is the soil diameter at which 60% of the soil weight is finer and D_{10} is the corresponding value at 10% finer. A soil having a uniformity coefficient smaller than about 2 is considered "uniform." The uniformity of the soil whose distribution curve is shown in Fig. 3.3 is 10. This soil would be termed a "well-graded silty sand."

There are many reasons, both practical and theoretical, why the particle size distribution curve of a soil is only approximate. As discussed in Chapter 4, the definition of particle size is different for the coarse particles and the fine particles.

The accuracy of the distribution curves for fine-grained soils is more questionable than the accuracy of the curves for coarse soils. The chemical and mechanical treatments given natural soils prior to the performance of a particle size analysis—especially for a hydrometer analysis—usually result in effective particle sizes that are quite different from those existing in the natural soil. Even if an exact particle size curve were obtained, it would be of only limited value. Although the behavior of a cohesionless soil can often be related to particle size distribution, the behavior of a cohesive soil usually depends much more on geological history and structure than on particle size.

In spite of their serious limitations, particle size curves, particularly those of sands and silts, do have practical value. Both theory and laboratory experiments show

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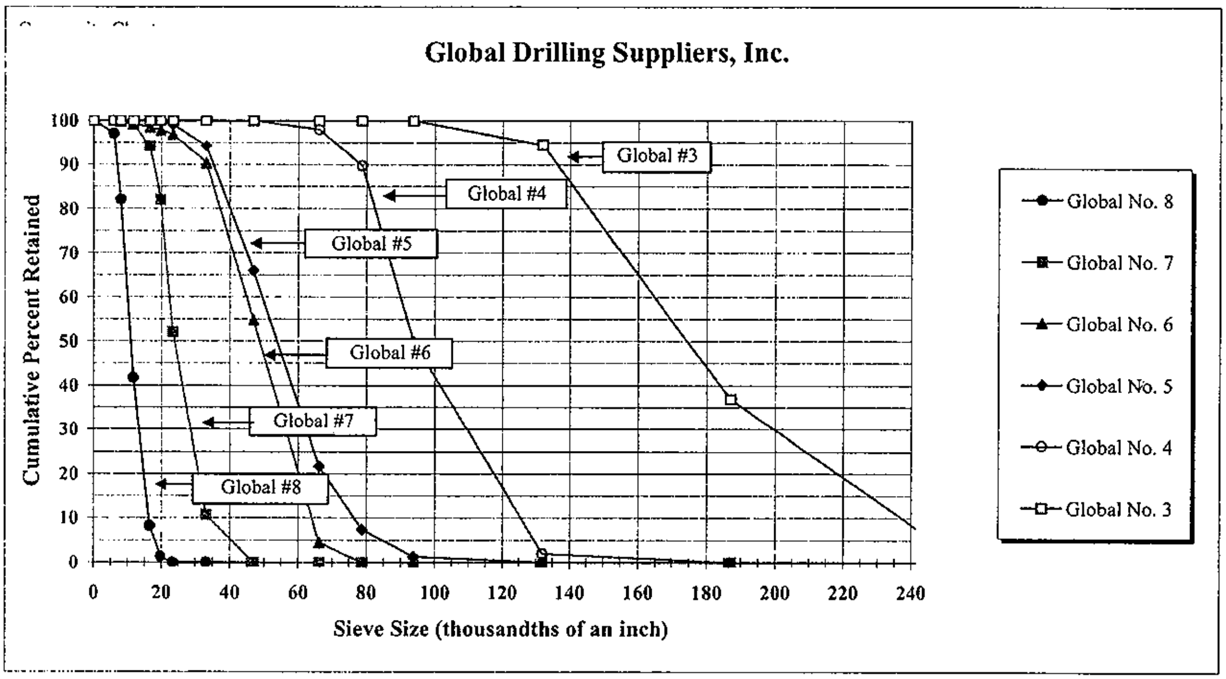
GLOBAL FILTER PACK SIEVE ANALYSES (2007)

Effective: 1-Oct-2007
Supercedes 8-MAY-2007 version

Features:
*NSF -approved (Standard 61) *Washed & Dried - will not freeze up
*E-Z carry, UV-treated 50 lb. plastic bags, 56 bags per pallet *99% Quartz Silica
Technical data (average, subject to change):
*Moh hardness - 7 *Sp. Gravity - 2.64 *Porosity - 40% *Roundness & Sphericity - 0.8
*Acid Solubility - <1% *Uniformity Coefficent < 1.7 *Bulk Density - 100#/ft^3

Applicability: No recommendation or inference is made to correlate any filter pack to any particular application or well screen slot size. No. 8 is **NOT** to be used as a primary filter pack.

Sieve Size	Mesh Size	Global No. 8		Global No. 7		Global No. 6		Global No. 5		Global No. 4		Global No. 3	
		Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %	Cum. Wt.	Cum. %
0.2500	3											3.2	**3.2**
0.1870	4							0.0	**0.0**	0.0	**0.0**	36.8	**36.8**
0.1320	6							0.1	**0.1**	2.0	**2.0**	94.5	**94.5**
0.0937	8					0.0	**0.0**	1.3	**1.3**	49.8	**49.8**	100.0	**100.0**
0.0787	10					0.0	**0.0**	7.4	**7.4**	89.7	**89.7**	100.0	**100.0**
0.0661	12			0.0	**0.0**	4.4	**4.4**	21.6	**21.6**	98.0	**98.0**	100.0	**100.0**
0.0469	16			0.0	**0.0**	54.8	**54.8**	66.0	**66.0**	100.0	**100.0**	100.0	**100.0**
0.0331	20			10.7	**10.7**	90.3	**90.3**	94.2	**94.2**	100.0	**100.0**	100.0	**100.0**
0.0234	30	0.0	**0.0**	52.0	**52.0**	96.9	**96.9**	99.1	**99.1**	100.0	**100.0**	100.0	**100.0**
0.0197	35	1.4	**1.4**	82.0	**82.0**	97.8	**97.8**	99.6	**99.6**	100.0	**100.0**	100.0	**100.0**
0.0165	40	8.2	**8.2**	94.2	**94.2**	98.4	**98.4**	99.8	**99.8**	100.0	**100.0**	100.0	**100.0**
0.0117	50	41.7	**41.7**	99.0	**99.0**	99.4	**99.4**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**
0.0080	70	82.1	**82.1**	99.7	**99.7**	99.9	**99.9**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**
0.0059	100	97.0	**97.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**
PAN	PAN	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**	100.0	**100.0**



REF. 5

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ASTM STANDARDS ON GROUND WATER AND VADOSE ZONE INVESTIGATIONS

Sponsored by ASTM Committee D-18
on Soil and Rock

Second Edition
1994

ASTM Publication Code Number (PCN): 03-418094-38

ASTM
1916 Race St., Philadelphia, PA 19103

REF. 5
2 of 2
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TABLE 1 Recommended (Achievable) Filter Pack Characteristics for Common Screen Slot Sizes

Size of Screen Opening, mm (in.)	Slot No.	Sand Pack Mesh Size Name(s)	1 % Passing Size (D-1), mm	Effective Size, (D-10), mm	30 % Passing Size (D-30), mm	Range of Uniformity Coefficient	Roundness (Powers Scale)
0.125 (0.005)	5[A]	100	0.09 to 0.12	0.14 to 0.17	0.17 to 0.21	1.3 to 2.0	2 to 5
0.25 (0.010)	10	20 to 40	0.25 to 0.35	0.4 to 0.5	0.5 to 0.6	1.1 to 1.6	3 to 5
0.50 (0.020)	20	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
0.75 (0.030)	30	10 to 20	0.7 to 0.9	1.0 to 1.2	1.2 to 1.5	1.1 to 1.6	3 to 6
1.0 (0.040)	40	8 to 12	1.2 to 1.4	1.6 to 1.8	1.7 to 2.0	1.1 to 1.6	4 to 6
1.5 (0.060)	60	6 to 9	1.5 to 1.8	2.3 to 2.8	2.5 to 3.0	1.1 to 1.7	4 to 6
2.0 (0.080)	80	4 to 8	2.0 to 2.4	2.4 to 3.0	2.6 to 3.1	1.1 to 1.7	4 to 6

[A] A 5-slot (0.152-mm) opening is not currently available in slotted PVC but is available in Vee wire PVC and Stainless; 6-slot opening may be substituted in these cases.

materials that would not impact the water sample for the constituents of concern may be selected for use on flush joint threads.

6.6 *Casing*—Where conditions warrant, the use of permanent casing installed to prevent communication between water-bearing zones is encouraged. The following subsections address both temporary and permanent casings.

6.6.1 *Materials*—The material type and minimum wall thickness of the casing should be adequate to withstand the forces of installation. All casing that is to remain as a permanent part of the installation (that is, multi-cased wells) should be new and cleaned to be free of interior and exterior protective coatings.

NOTE 9—The exterior casing (temporary or permanent multi-cased) is generally composed of steel, although other appropriate materials may be used.

6.6.2 *Diameter*—Several different casing sizes may be required depending on the subsurface geologic conditions penetrated. The diameter of the casing for filter packed wells should be selected so that a minimum annular space of 2 in. (50 mm) is maintained between the inside diameter of the casing and outside diameter of the riser. In addition, the diameter of the casings in multi-cased wells should be selected so that a minimum annular space of 2 in. is maintained between the casing and the borehole (that is, a 2-in. diameter screen will require first setting a 6-in. (152-mm) diameter casing in a 10-in. (254-mm) diameter boring).

NOTE 10—Under difficult drilling conditions (collapsing soils, rock, or cobbles), it may be necessary to advance temporary casing, under these conditions a smaller annular space may be maintained.

6.6.3 *Joints (Couplings)*—The ends of each casing section should be either flush-threaded or bevelled for welding.

6.7 *Protective Casing:*

6.7.1 *Materials*—Protective casings may be made of aluminum, steel, stainless steel, cast iron, or a structural plastic. The protective casing should have a lid capable of being locked shut by a locking device.

6.7.2 *Diameter*—The inside dimensions of the protective casing should be a minimum of 2 in. (50 mm) and preferably 4 in. (101 mm) larger than the nominal diameter of the riser to facilitate the installation and operation of sampling equipment.

6.8 *Annular Sealants*—The materials used to seal the annulus may be prepared as a slurry or used un-mixed in a dry pellet, granular, or chip form. Sealants should be selected to be compatible with ambient geologic, hydrogeologic, and climatic conditions and any man-induced conditions anticipated to occur during the life of the well.

6.8.1 *Bentonite*—Bentonite should be powdered, granular, pelletized, or chipped sodium montmorillonite furnished in sacks or buckets from a commercial source and free of impurities which adversely impact the water quality in the well. Pellets consist of roughly spherical or disk shaped units of compressed bentonite powder. Chips are large, irregularly shaped, and coarse granular units of bentonite free of additives. The diameter of pellets or chips selected for monitoring well construction should be less than one fifth the width of the annular space into which they are placed to reduce the potential for bridging. Granules consist of coarse particles of unaltered bentonite, typically smaller than 0.2 in. (50 mm).

6.8.2 *Cement*—Each type of cement has slightly different characteristics that may be appropriate under various physical and chemical conditions. Cement should be one of the five Portland cement types that are specified in Specification C 150. The use of quick-setting cements containing additives is not recommended for use in monitoring well installation. Additives may leach from the cement and influence the chemistry of the water samples.

6.8.3 *Grout*—The grout backfill that is placed above the bentonite annular seal and secondary filters (see Fig. 2) is ordinarily a liquid slurry consisting of either a bentonite (powder or granules, or both) base and water, or a Portland cement base and water. Often, bentonite-based grouts are used when it is desired that the grout remain flexible (that is, to accommodate freeze-thaw) during the life of the installation. Cement or bentonite-based grouts are often used when the filling in of cracks in the surrounding geologic material, adherence to rock units, or a rigid setting is desired.

6.8.3.1 *Mixing*—The mixing (and placing) of a grout backfill should be performed with precisely recorded weights and volumes of materials, and according to procedures stipulated by the manufacturer that often include the order of component mixing. The grout should be thoroughly mixed with a paddle type mechanical mixer or by recirculating the mix through a pump until all lumps are disintegrated. Lumpy grout should not be used in the construction of a monitoring well to prevent bridging within the tremie.

NOTE 11—Lumps do not include lost circulation materials that may be added to the grout if excessive grout losses occur.

6.8.3.2 *Typical Bentonite Base Grout*—When a bentonite base grout is used, bentonite, usually unaltered, *must* be the first additive placed in the water through a venturi device. A typical unbeneficiated bentonite base grout consists of about 1 to 1.25 lb (0.57 kg) of unaltered bentonite to each 1 gal (3.8 L) of water. After the bentonite is mixed and allowed to "yield or hydrate," up to 2 lb (0.9 kg) of Type I Portland cement (per gallon of water) is often added to stiffen the mix

REF. 6 1 OF 2

23/37

Guidance for Design, Installation and Operation of In Situ Air Sparging Systems

PUB-RR-186 November, 2003

Purpose:
This is a guide to using in situ air sparging as a remediation technology. In situ air sparging is a process in which a gaseous medium (commonly air) is injected into groundwater through a system of wells. As the injected air rises to the water table, it can strip volatile organic compounds (VOCs) from groundwater and the capillary fringe. The process also oxygenates groundwater, enhancing the potential for biodegradation at sites with contaminants that degrade aerobically.

The DNR developed this guidance for environmental professionals who investigate contaminated sites and design remedial systems. Designing an in situ air sparging system is a multi-disciplinary process; the designer should have a working knowledge of geology, hydrogeology and basic engineering to design an effective system. The majority of this guidance is intended for smaller VOC contaminated sites; however, some of the guidance is appropriate for larger sites. Designers may need to deviate from the guidance in some circumstances because each site has unique contaminants, access constraints, size, hydrogeology, and other characteristics. If site-specific criteria or conditions require a cost-effective system design that differs from this guidance, it is the responsibility of the remediation system designer to propose an effective system to the DNR.

Author/Contact:
This document was originally prepared by George Mickelson (608-267-7652), who now works for the Drinking and Groundwater Program. It was reviewed for accuracy by Gary A. Edelstein (608-267-7563) in November, 2003

Errata:
This document includes errata and additional information prepared in August, 1995.
The DNR rule cites and references to other DNR guidance in the document were also reviewed and found to be current, with the exception of the references to NR 112, which has been renumbered NR 812 and references to SW-157, "Guidance for Conducting Environmental Response Actions", which is no longer current guidance.

WISCONSIN DEPT. OF NATURAL RESOURCES

Wisconsin Department of Natural Resources
P.O. Box 7921, Madison, WI 53707

Remediation and Redevelopment Program

the geologic conditions because the geological conditions must allow the air to rise to the water table. It is highly recommended that a hydrogeologist collect samples from above the seasonal, high water table to the base of the screened interval from a sufficient number of wells to verify the geologic characterization. A hydrogeologist as defined in NR 500.03 (64) or NR 600.03 (98) should describe the soil in detail. See Subsection 2.2.2 for soil description information.

4.2.2 Filter Pack.

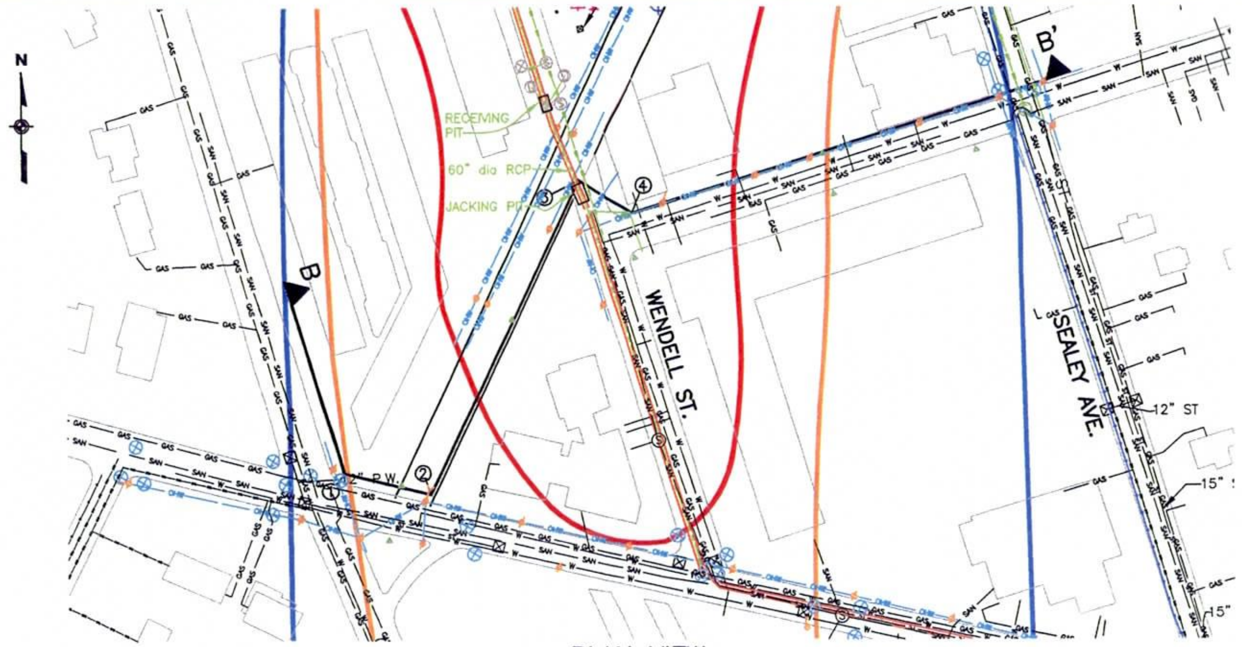
Designers should select the filter pack for the well based on the average grain size of the geologic materials below the water table. Samples for grain size analysis should be tested prior to designing an air sparging system. A sieve analysis is usually sufficient for filter pack design (a hydrometer test is usually not needed).

The average grain size of the filter pack should be as close to the native soils as practical. Coarser materials should not be used for the filter pack, however, slightly finer-grained material may be used. If the filter pack's average grain size is larger than the native geologic materials, the filter pack may be more permeable than the native soil. While a highly permeable filter pack is an advantage in constructing wells for other uses (monitoring or extraction), a filter pack that has a significantly higher permeability than the surrounding formation will be a conduit for upward short circuiting of air in the depth interval between the bentonite seal and the top of the well screen. This reduces the lateral movement of air into the aquifer. If the filter pack is significantly smaller than the native soils, too much restriction to air flow results. Natural filter packs may be used in caving formations provided that the native materials do not have significant levels of fines that may accumulate within the well screens.

The filter pack should extend from the base of the well screen to a minimum of 1 to 2 feet above the screen.

4.2.3 Seals.

A bentonite seal that is 0.5 to 2 feet thick should be placed above the filter pack. The annular space seal (above the bentonite seal) should be constructed with either bentonite cement grout or bentonite. A tremie should be used to place grout when installing a seal below the water table. The surface seal should be constructed in a manner that complies with NR 141.



PLAN VIEW

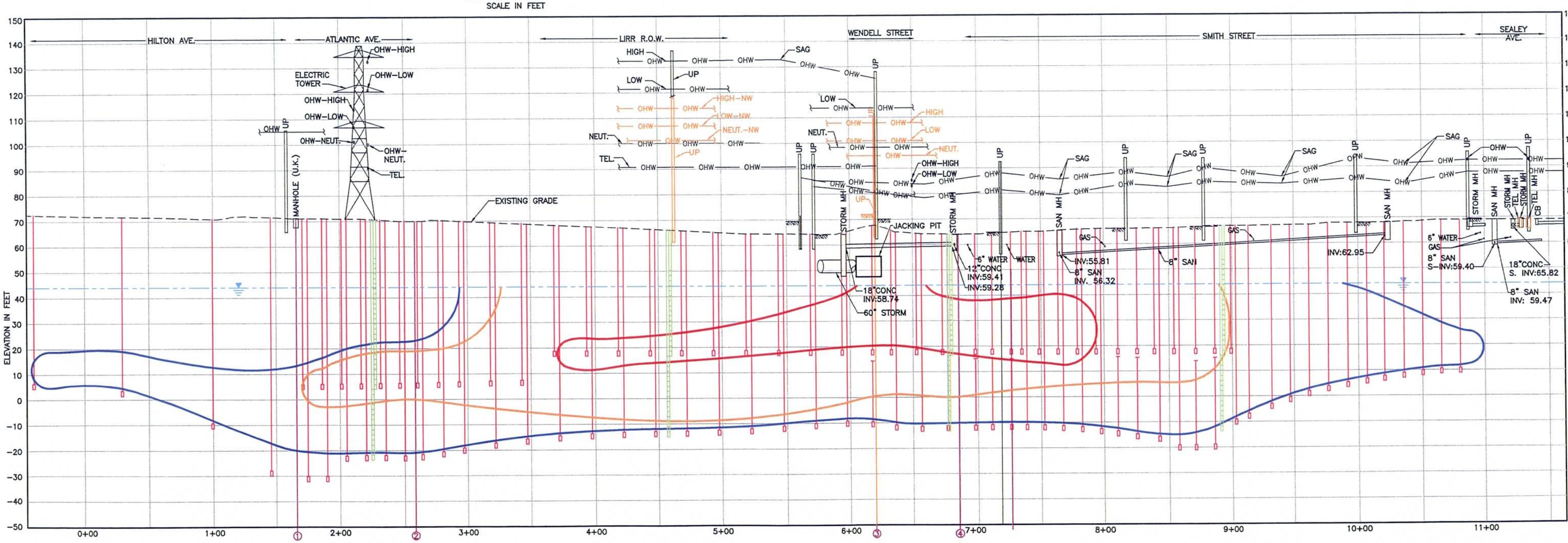
100' 0 100'
SCALE IN FEET

NOTE:

1. THE CROSS-SECTION B-B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 8 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.
3. THE HORIZONTAL SPACING OF SOME OXYGEN DELIVERY WELLS HAVE BEEN MODIFIED TO AVOID UTILITIES AND STRUCTURES IN THE AREA.

LEGEND:

- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- PROPOSED OXYGEN DELIVERY WELLS
- SCREENED INTERVAL
- PROPOSED MONITORING POINT(S)
- UTILITY POLE (NEAR SIDE)
- UTILITY POLE (FAR SIDE)
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L
- OHW — OVERHEAD ELECTRIC WIRE (FAR SIDE)
- OHW — OVERHEAD ELECTRIC WIRE (NEAR SIDE)



SECTION B-B'
(TREATMENT SYSTEM 1)

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

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New York
77 Goodell Street, Buffalo, New York 14203
(716)856-5636 - (716)856-2545 fax

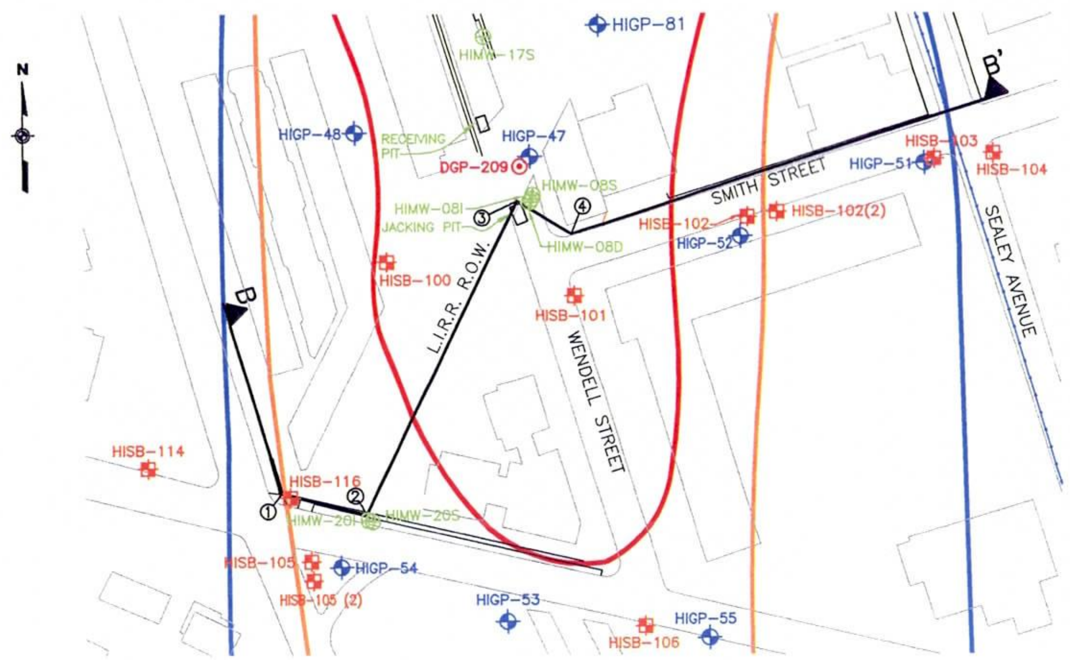
JOB NO. 11175065

NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

OXYGEN DELIVERY WELLS AND UTILITIES, SECTION B-B', TREATMENT SYSTEM 1

Scale: AS SHOWN | Date: SEPT. 2009 | DWG-7



PLAN VIEW

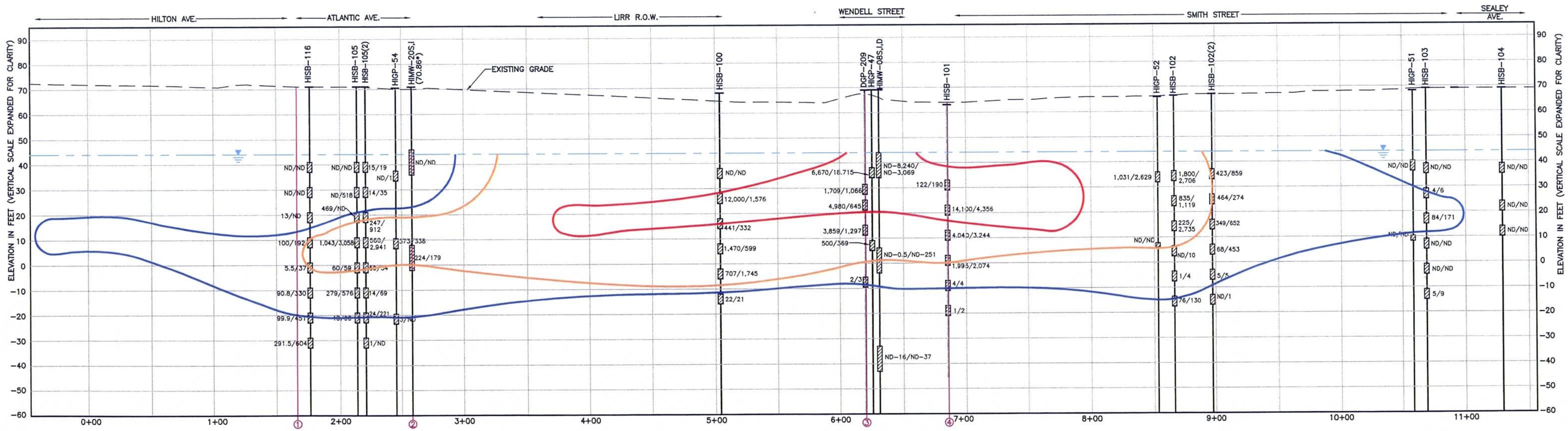
100' 0 100'
SCALE IN FEET

NOTE:

1. THE CROSS-SECTION B-B' REPRESENTS THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 8 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS-SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWINGS 6 AND 7 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.

LEGEND:

- HISB-100 — BORING ID
- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- GROUNDWATER SAMPLE INTERVAL
- 22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L
- (red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
- (orange line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 1,000 ug/L
- (blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



SECTION B-B'

* SURVEYED ELEVATION

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY:	DMc
DRAWN BY:	RAL
CHECKED BY:	JRS
PROJ. ENGR.	MA

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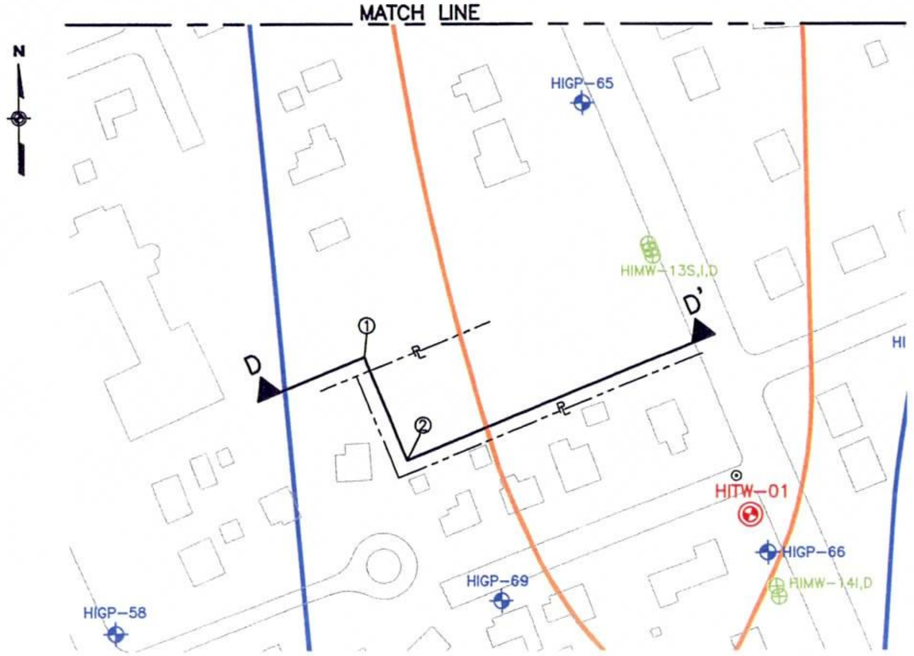
NATIONAL GRID
175 EAST OLD COUNTRY ROAD
HICKSVILLE, NEW YORK 11801

THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME SECTION B-B'

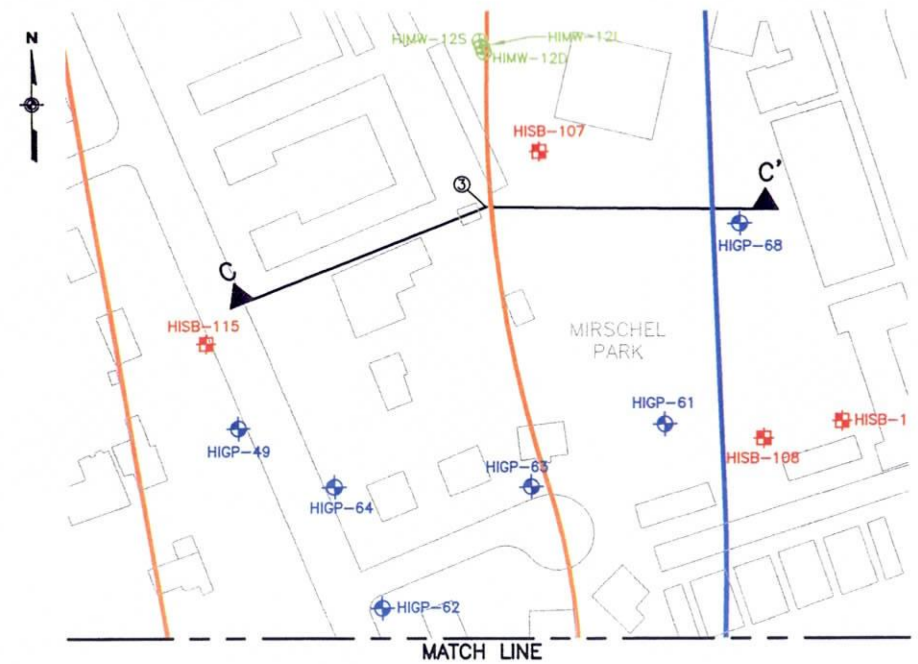
Scale: AS SHOWN | Date: SEPT. 2009 | DWG-5

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 5-6.dwg 9/29/09 - 3 RAL



PLAN VIEW D–D'

100' 0 100'
SCALE IN FEET



PLAN VIEW C–C'

100' 0 100'
SCALE IN FEET

NOTE:

1. THE CROSS–SECTIONS C–C' AND D–D' REPRESENT THE APPROXIMATE ALIGNMENT OF THE PROPOSED OXYGEN DELIVERY WELLS. DRAWING 9 PRESENTS MORE DETAILED INFORMATION ON THE WELL PLACEMENT.
2. GROUNDWATER PLUME LINES WERE DETERMINED BASED ON COMPUTER MODELING. AS SUCH, THERE ARE SOME LOCATIONS WHERE THE PLUME BOUNDARIES SHOWN DO NOT AGREE WITH THE VALUES OBTAINED FROM INDIVIDUAL SAMPLES. ADDITIONALLY, SOME SAMPLE LOCATIONS ARE OFFSET FROM THE CROSS–SECTION AND THUS DO NOT EXACTLY ALIGN TO THE PLUME CONTOUR LINES SHOWN. THE SCREENED INTERVALS FOR SOME OXYGEN DELIVERY WELLS SHOWN ON DRAWINGS 6 AND 7 HAVE BEEN ADJUSTED TO ACCOUNT FOR THE FACT THAT THE CONTAMINATION MAY LAY OUTSIDE THE BOUNDARIES SHOWN.

LEGEND:

- HISB–100 — BORING ID
- APPROXIMATE GROUND SURFACE
- APPROXIMATE GROUNDWATER SURFACE
- GROUNDWATER SAMPLE INTERVAL
- 22/21 — TOTAL BTEX/TOTAL PAH CONCENTRATIONS ug/L
- (red line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 5,000 ug/L
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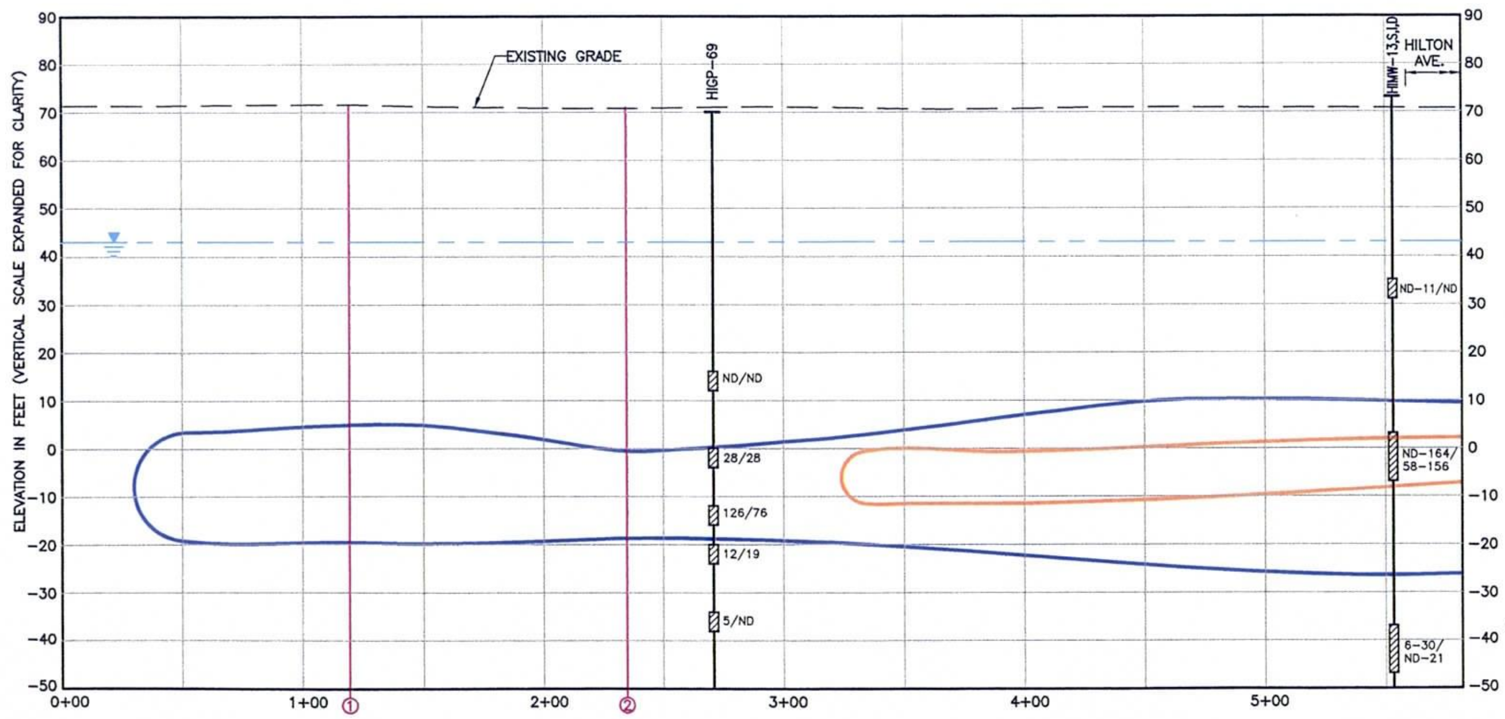
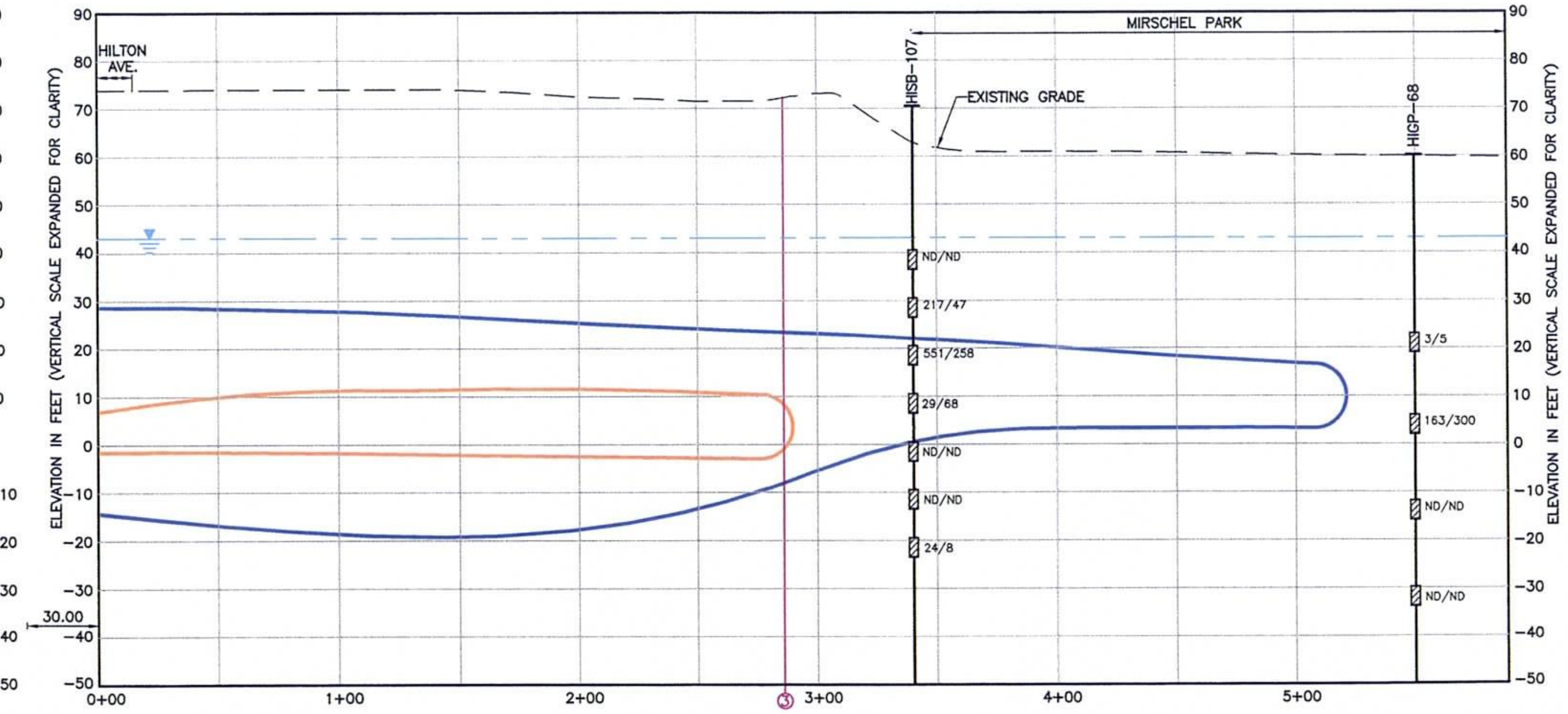
- (blue line) ESTIMATED EXTENT OF GROUNDWATER PLUME AS DEFINED BY TOTAL BTEX OR TOTAL PAH CONCENTRATIONS EQUAL TO OR GREATER THAN 100 ug/L



SECTION D–D'



SECTION C–C'

20' 0 20'
VERT. SCALE IN FEET

40' 0 40'
HORIZ. SCALE IN FEET

WARNING
IT IS A VIOLATION OF SECTION 7209, SUBDIVISION 2, OF THE NEW YORK STATE EDUCATION LAW FOR ANY PERSON OTHER THAN WHOSE SEAL APPEARS ON THIS DRAWING, TO ALTER IN ANY WAY AN ITEM ON THIS DRAWING. IF AN ITEM IS ALTERED, THE ALTERING ENGINEER SHALL AFFIX TO THE ITEM HIS SEAL AND THE NOTATION "ALTERED BY" FOLLOWED BY HIS SIGNATURE AND THE DATE OF SUCH ALTERATION, AND A SPECIFIC DESCRIPTION OF THE ALTERATION.

NO.	MADE BY	APPROVED BY	DATE	DESCRIPTION

REVISIONS

DESIGNED BY: DMc
DRAWN BY: RAL
CHECKED BY: JRS
PROJ. ENGR. MA

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THE HEMPSTEAD INTERSECTION STREET FORMER MANUFACTURED GAS PLANT SITE

DISSOLVED PHASE GROUNDWATER PLUME CROSS–SECTION C–C' AND D–D'

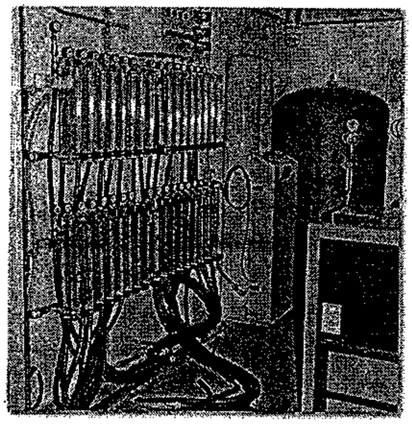
Scale: AS SHOWN | Date: SEPT. 2009 | DWG–6

J:\11175065.00000\CAD\DRAFT\TASK2\HEMPSTEAD\SITE-WIDE REMEDY\GROUNDWATER TREATMENT\SEPT 09\DWG 5-6.dwg 9/29/09 - 3 RAL

APPENDIX B

MATRIX ENVIRONMENTAL, INC.
SYSTEM SPECIFICATIONS

MATRIX



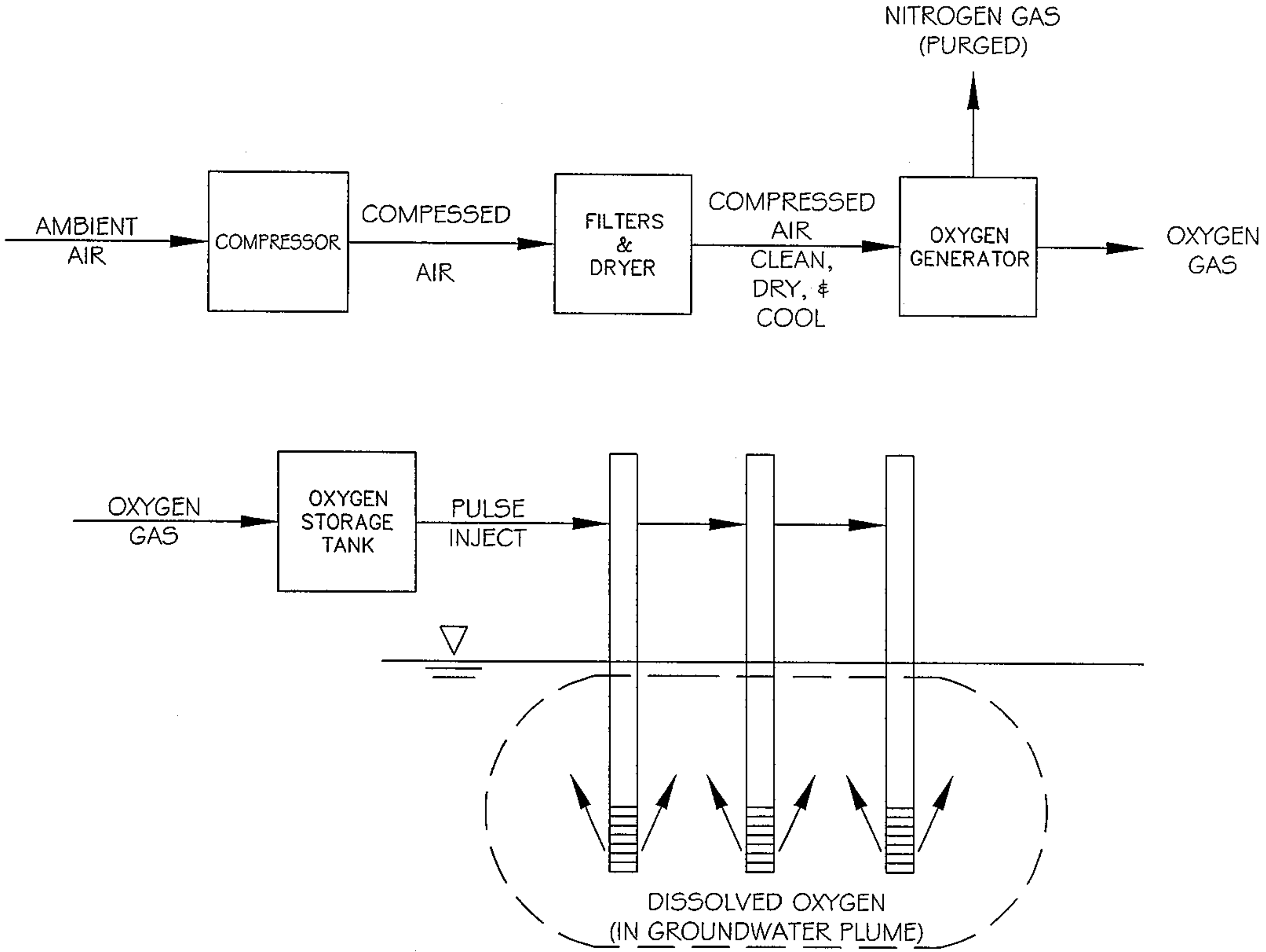
SPECIFICATIONS

175 SCFH 48 to 64 Point Oxygen Injection System

Turnkey oxygen injection system with an oxygen production capacity of 175 standard cubic feet per hour (SCFH) and oxygen delivery system for up to 64 injection points. Purchase, rental, or lease includes license to operate under U.S. Patent No. 5,874,001. The power requirement is 100-amp 230/460-volt three-phase electric supply.

The major components of the oxygen injection system are described below.

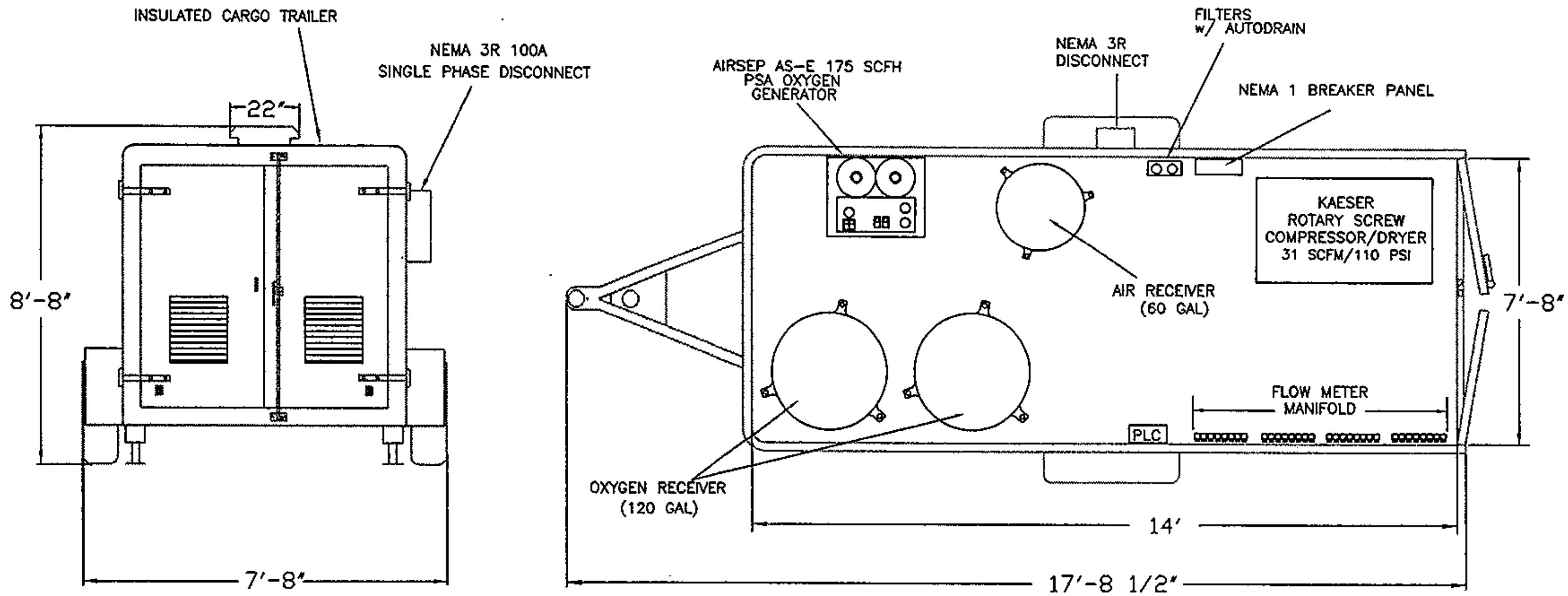
- MET Laboratories certified system built to NEC General Purpose standards.
- Seven foot by 14-foot insulated cargo trailer with rear locking double doors, trailer jacks, lighting and HVAC.
- NEMA 3R fused disconnect on exterior of the trailer and 24 slot breaker distribution panel on interior wall.
- Kaeser SM-7.5 rotary screw air compressor in a low sound enclosure. Rated for 31 SCFM @ 110 PSI. 7.5 HP TEFC motor, three phase/60 Hz/230 volts. Operated by a Sigma PLC.
- Kaeser refrigerated air dryer integrated in compressor package.
- AirSep Model AS-E oxygen generator and oxygen purity analyzer. The generator produces 175 SCFH of oxygen at 90-95% purity. Single phase/60 Hz/110 volts.
- ASME National Board Certified 120 gallon oxygen receiver (2) and 60 gallon air receiver.
- Manifold for 48, 56 or 64 injection points to include individual pressure gauges (0-30 PSI) and Dwyer variable area flow meters (10-100 SCFH).
- Six to eight oxygen clean solenoid valves with each providing oxygen flow to a bank of eight injection points.
- U.L. certified Direct Logic PLC control system in NEMA 1 panel with surge and lightning protection. User interface display screen and alarm inputs from system.
- Optional direct remote access system or wireless remote access system using a cellular modem.
- Standard one-year warranty.
- Operations manual and system schematics.



Revised: 10/19/07

MATRIX
ENVIRONMENTAL TECHNOLOGIES INC.

OXYGEN INJECTION SYSTEM
PROCESS FLOW DIAGRAM
U.S. Patent No. 5,874,001



Revised: 2/28/08

MATRIX
ENVIRONMENTAL TECHNOLOGIES INC.

OXYGEN INJECTION SYSTEM SCHEMATIC
175 SCFH 64 POINT SYSTEM
U.S. Patent No. 5,874,001

MAPLE LEAF ENVIRONMENTAL EQUIPMENT

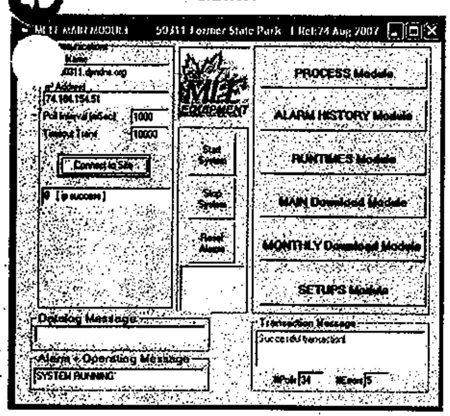
MLE-SITE LINK Telemetry System

MLE-SITE LINK is a customized software program and hardware configuration which provides a real-time link to a remediation system or any other process control system via telephone line or the internet. There are two standard Site Link configurations "**Site Link-PLC Phone**" (SL-PP) , and "**Site Link-PLC Web**" (SL-PW).

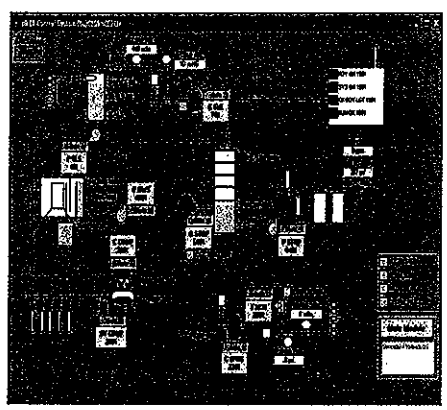
MLE-SITE LINK software for both the SL-PP and SL-PW are visually the same and have similar functionality. The only significant difference is that SL-PP uses a phone number to connect to the site and SL-PW uses a web address. The software can easily be installed on a remote laptop or desktop computer using the *Site Link Auto Install Disk.* Simply insert the disk in your PC, and follow a few simple commands. The *Auto Install Disk* automatically installs the offsite software and all related drivers. Site Link software comes with the following basic features accessible through our standard screens as shown below:

- ***Customized software program***
- ***Start/Stop/Alarm Reset***
- ***Customized process screen with P&ID display***
- ***Alarm history screen with last 20 alarms c/w time and date***
- ***Runtime screen with hour tracking for specified motors***
- ***Custom Set point adjustments & Date/time setting for PLC***

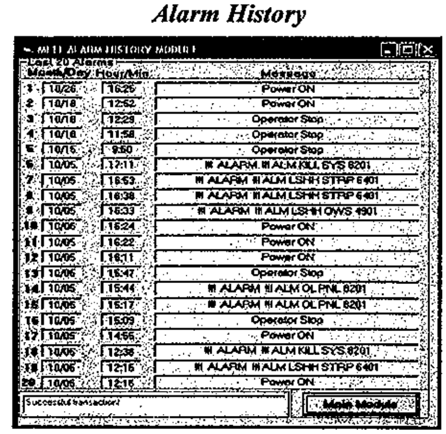
Main



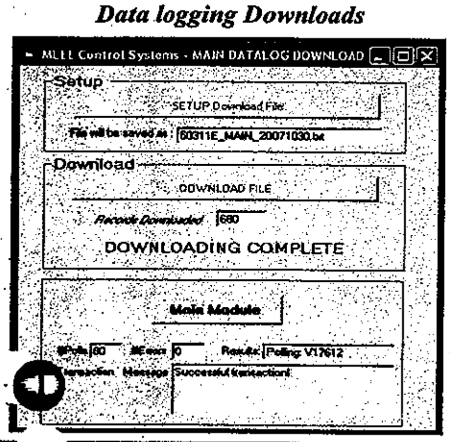
P&ID



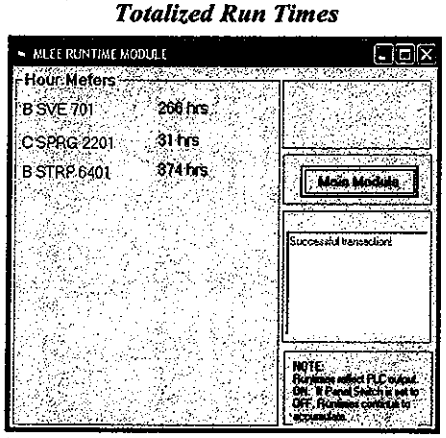
Alarm History



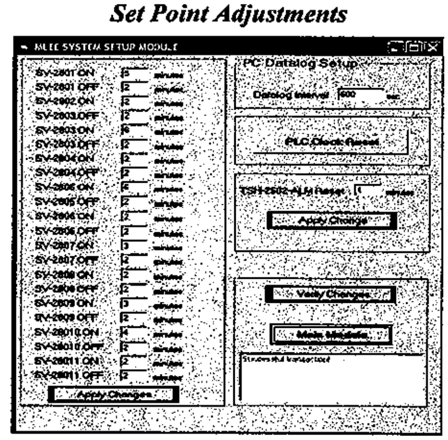
Data logging Downloads



Totalized Run Times



Set Point Adjustments



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Brockville, Ontario K6V 5Y6
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MAPLE LEAF ENVIRONMENTAL EQUIPMENT

MLE-SITE LINK Telemetry System

HARDWARE OVERVIEW

SL-PW has a hardware configuration that uses a cellular data modem, Ethernet card, and a PLC. This setup **does not** require a phone line, and comes preconfigured with a web address. As shown in Figure #2 the control panel has a cellular data modem with an Ethernet connection to a programmable logic controller (PLC). The remote user would have their custom Site Link software installed on their PC or laptop, with Internet access. The user can then connect to the system through the internet and have full monitoring and control access to the system remotely.

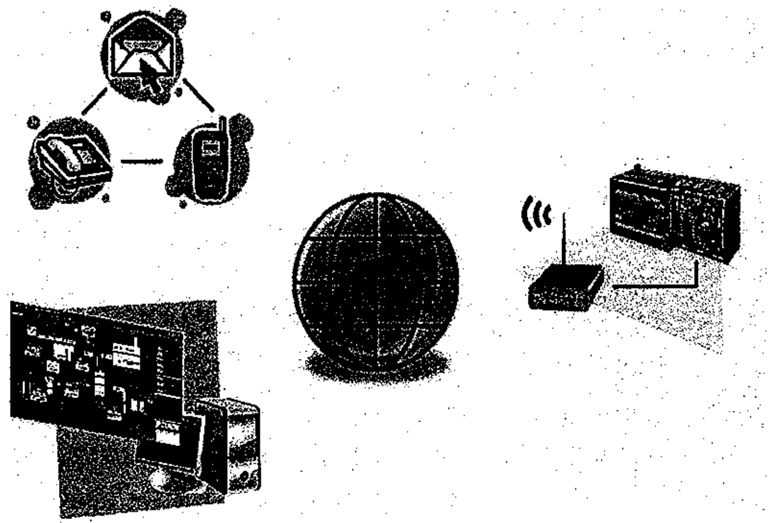

Figure #2 SL-PW

ADDITIONAL OPTIONS:

1) SL-EMONITOR:

- Provides a daily email with system status (alarms, analog values, hour meter readings and totalized readings).

2) SL-EALARM:

- Immediate Email or text message on alarm, eliminates the need of an auto dialer.

3) SL-SERVER:

- System can be accessed through any computer anywhere with internet access and Microsoft Internet Explorer.
- Log on to customer system through MLE Website in place of loading software onto customer PC.
- Access and storage data of multiple sites all in one location.
- Access to the following information from same location:
    - System manuals
    - Customized O & M procedure
    - Spare parts list

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info@mleequipment.com
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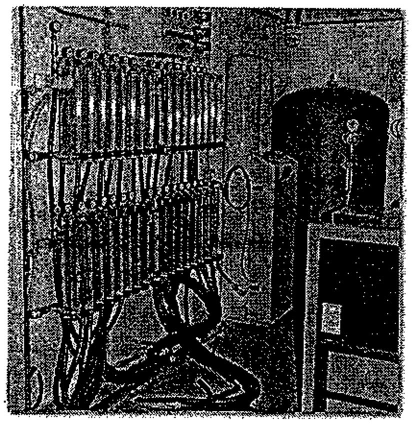
APPENDIX B

MATRIX ENVIRONMENTAL, INC.
SYSTEM SPECIFICATIONS

MATRIX



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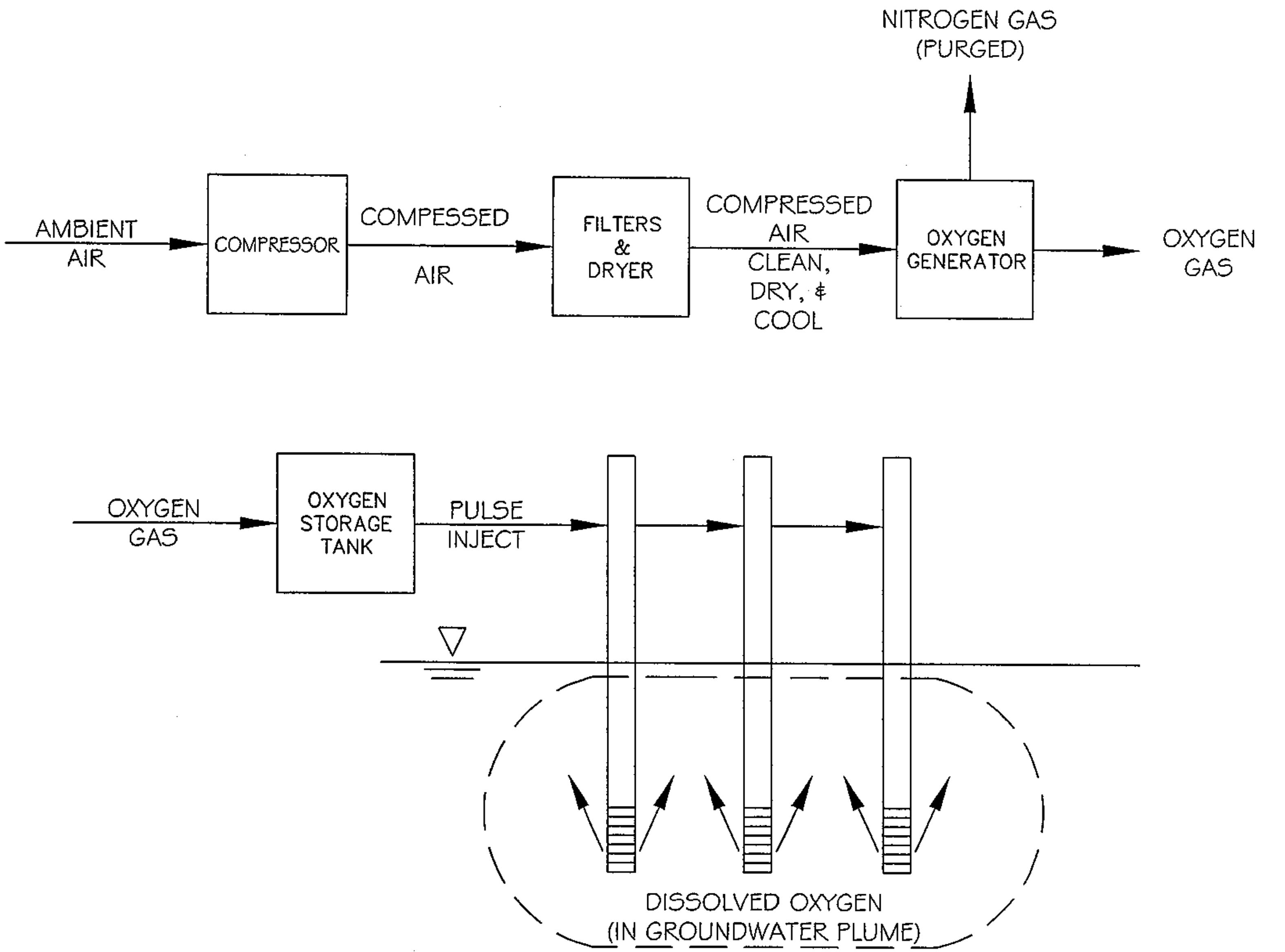
- Operations manual and system schematics.



Revised: 10/19/07

MATRIX
ENVIRONMENTAL TECHNOLOGIES INC.

OXYGEN INJECTION SYSTEM
PROCESS FLOW DIAGRAM
U.S. Patent No. 5,874,001

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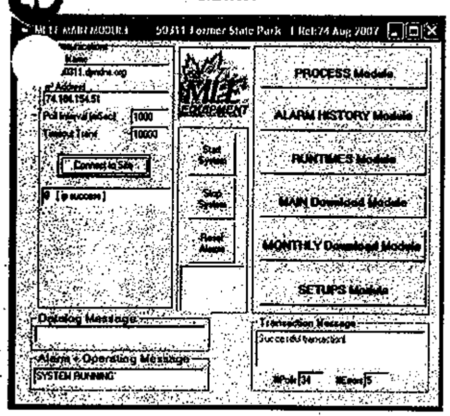
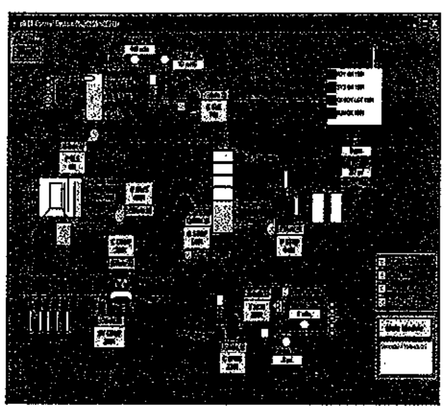
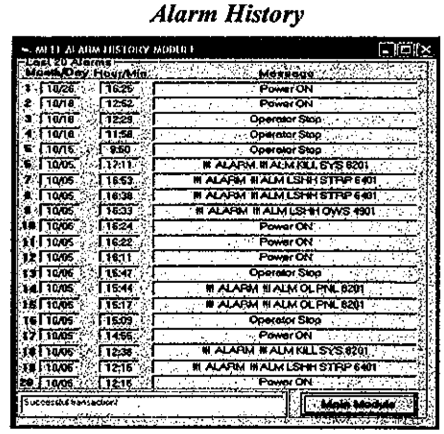
Main



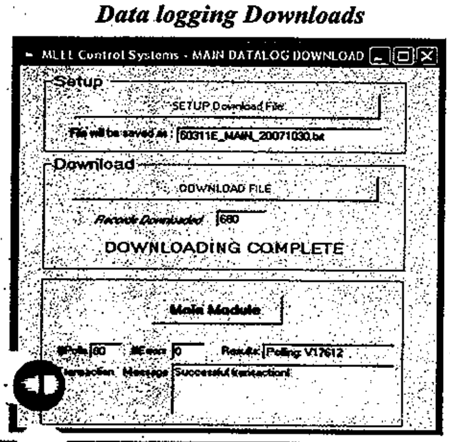
P&ID



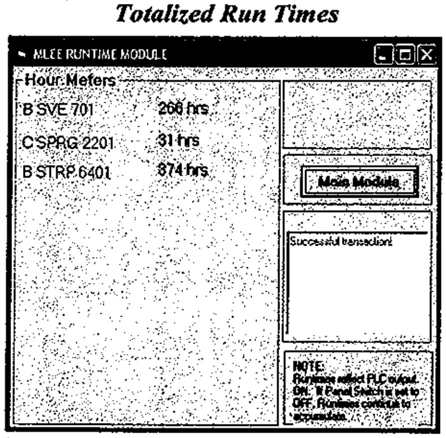
Alarm History



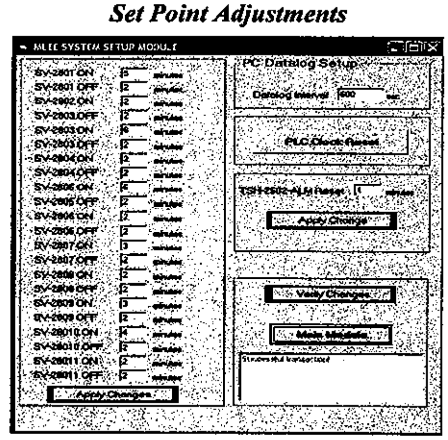
Data logging Downloads



Totalized Run Times



Set Point Adjustments



PTS-SLT-PW-V3

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MAPLE LEAF ENVIRONMENTAL EQUIPMENT

MLE-SITE LINK Telemetry System

HARDWARE OVERVIEW

SL-PW has a hardware configuration that uses a cellular data modem, Ethernet card, and a PLC. This setup **does not** require a phone line, and comes preconfigured with a web address. As shown in Figure #2 the control panel has a cellular data modem with an Ethernet connection to a programmable logic controller (PLC). The remote user would have their custom Site Link software installed on their PC or laptop, with Internet access. The user can then connect to the system through the internet and have full monitoring and control access to the system remotely.

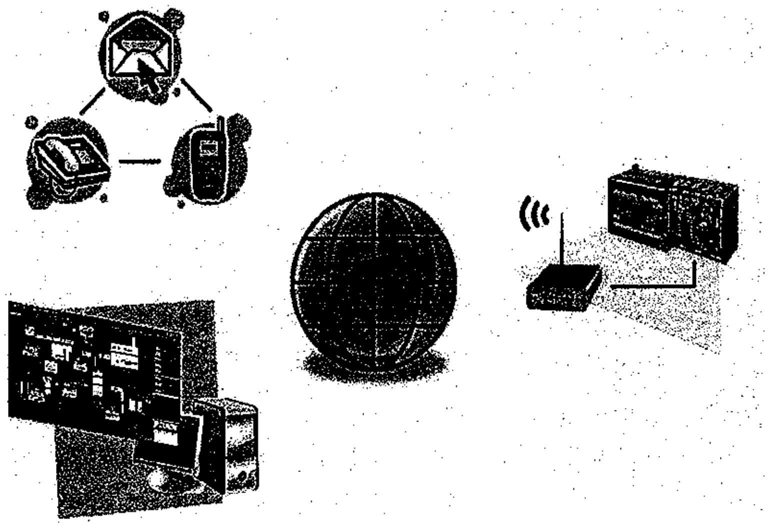


Figure #2 SL-PW

ADDITIONAL OPTIONS:

1) SL-EMONITOR:

- Provides a daily email with system status (alarms, analog values, hour meter readings and totalized readings).

2) SL-EALARM:

- Immediate Email or text message on alarm, eliminates the need of an auto dialer.

3) SL-SERVER:

- System can be accessed through any computer anywhere with internet access and Microsoft Internet Explorer.
- Log on to customer system through MLE Website in place of loading software onto customer PC.
- Access and storage data of multiple sites all in one location.
- Access to the following information from same location:
  - System manuals
  - Customized O & M procedure
  - Spare parts list

www.mleequipment.com
info@mleequipment.com
1325 California Avenue
Brockville, Ontario K6V 5Y6
800-420-4056

System No. 1 Specifications: 320 SCFH 96 Point System

Matrix will provide a building mounted oxygen injection system with an oxygen production capacity of 320 standard cubic feet per hour (SCFH). Included with the system purchase is a non-transferable multiple use license to operate under U.S. Patent No. 5,874,001.

DESIGN PARAMETERS

References:
- U.S. Patent No. 5,874,001, Groundwater Remediation Method
- Groundwater Remediation System for the Hempstead Intersection Street Former Manufactured Gas Plant Site, URS Corporation, December 2009

Operating Parameters:
- 96 oxygen injection points
- Oxygen booster pump to increase storage pressure to 100 PSIG
- Oxygen flow range 10 to 100 SCFH per point
- Mass injection rates up to 4 lbs O2 per point per day

Location Requirements:
- 230V three-phase power available, 200 amp service
- Non-hazardous location for equipment
- Secure compound for system
- Altitude less than 100 feet

Certifications:
- Control panel to be UL certified
- MET US Laboratories approval of system
- 2 year warranty on system components
- 1 year warranty on Powerex rotary scroll oxygen compressor (booster pump)

Oxygen Injection System:
- Air compressor capacity – 78 SCFM @ 110 PSI
- Oxygen generator capacity - 320 SCFH
- Oxygen booster capacity – 5 SCFM
- All equipment oxygen scavenged for oxygen service
- 96 point injection header with capacity for future expansion to 106

Remediation Enclosure:
- Equipment located in an 8 ft by 18 ft enclosure on steel skid
- Piped, wired and tested; all wiring suitable for non-hazardous locations

Control Panel:
- PLC based control system with user interface and alarm inputs
- Remote cellular telemetry with web based access

DESCRIPTION OF 320 SCFH 96 POINT OXYGEN INJECTION SYSTEM

Rotary Screw Compressor Module:

Kaeser SK 20 110 PSI Classic 230/3/60 US

- Motor: 20 HP, 230/3P, TEFC
- Sigma control panel
- Performance: 78 SCFM at 110 PSI

Compressor assembly to contain:

- Integral exhaust ducted to building exterior

Discharge piping from compressor to contain:

- Pressure gauge
- Ball valve
- Filtered Separator
- Coalescing Filter
- Steel piping/high pressure hose as applicable

Separate 240 G vertical receiver tank

- Automatic tank drain
  - NEMA 4 timed solenoid valve
- Ball valve
- Pressure switch

Air Dryer Module:

Kaeser refrigerated dryer model TB 26

- Motor: TEFC
- Air flow: 95 SCFM
- Air pressure drop: 4 PSI
- Ambient air temperature: 100 °F
- Inlet temperature: 150 °F
- Discharge dewpoint: 40 °F
- Ball valve

Oxygen Generator:

AirSep model AS-G 320 SCFH pressure swing adsorption oxygen generator

- Ball valve
- 240 Gallon Oxygen storage tank - low pressure (60 PSI)
  - Pressure switch
  - Pressure relief valve
  - Powerex rotary scroll oxygen compressor (booster), 2.5 SCFM at 100 PSI
  - Check valve and solenoid valve on compressor inlet
- 120 Gallon Oxygen storage tank – high pressure (100 PSI)
  - Pressure relief valve
- 240 Gallon Oxygen storage tank – high pressure (100 PSI)
  - Pressure switch
  - Pressure relief valve
- Ball valve
- Regulator and Piping

Oxygen Delivery Manifold:
One 3/4" oxygen discharge manifold with eight 3/4" branches, each branch to contain:
- Flow control (on/off) - discrete output
  - ASCO NEMA 4 solenoid valve

Twelve 3/4" copper branches with eight 3/4" legs
Each leg to contain:
- Air flow indicator.
  - Dwyer RMB-53 10-100 SCFH flow meters with control valves and viton seals suitable for oxygen service
- Pressure gauge (0-60 PSI)
- 3/4" hoses for termination outside of enclosure

Note: Space left in system for two future branches]

Enclosure:
Built to NEC General Purpose standards, all wiring complete and all equipment pre-piped factory tested and mounted in enclosure

8' x 18' wood frame building with the following standard features:
- Wood Chalet siding (Painted Clay color)
- White Corner posts and fascia
- Peaked shingled roof (Brown)
- Forklift pockets
- Wood floor
- Insulated walls and ceiling
- Interior plywood walls
- Double man doors (White)
- Tan sound attenuating insulation on walls and ceiling
- Maximum 10' roof height

Interior to contain the following:
- Compressor
- Air dryer
- Oxygen generator
- Oxygen compressor
- Injection manifold
- Lighting - powered device
- 2000W Heater
- Wall mounted air conditioner
- Passive vent louvers with sound attenuating hood
- All influent, effluent, and drain lines plumbed to outside of building

Control System Module:
PLC Series Direct Logic PLC based control panel with the following standard features:
- UL certification
- AIC rating of 5000
- NEMA 1 panel enclosure

- Surge and lightning protection for control system
- Direct Logic PLC control system
- UPS System with power alarm relay
- Wired and installed
- Factory tested prior to shipping

Outside cover of panel to contain the following:

- User interface display screen

Telemetry Module:
MLE model SL-PW1 Wireless remote access system using cellular modem for a PLC based control panel:

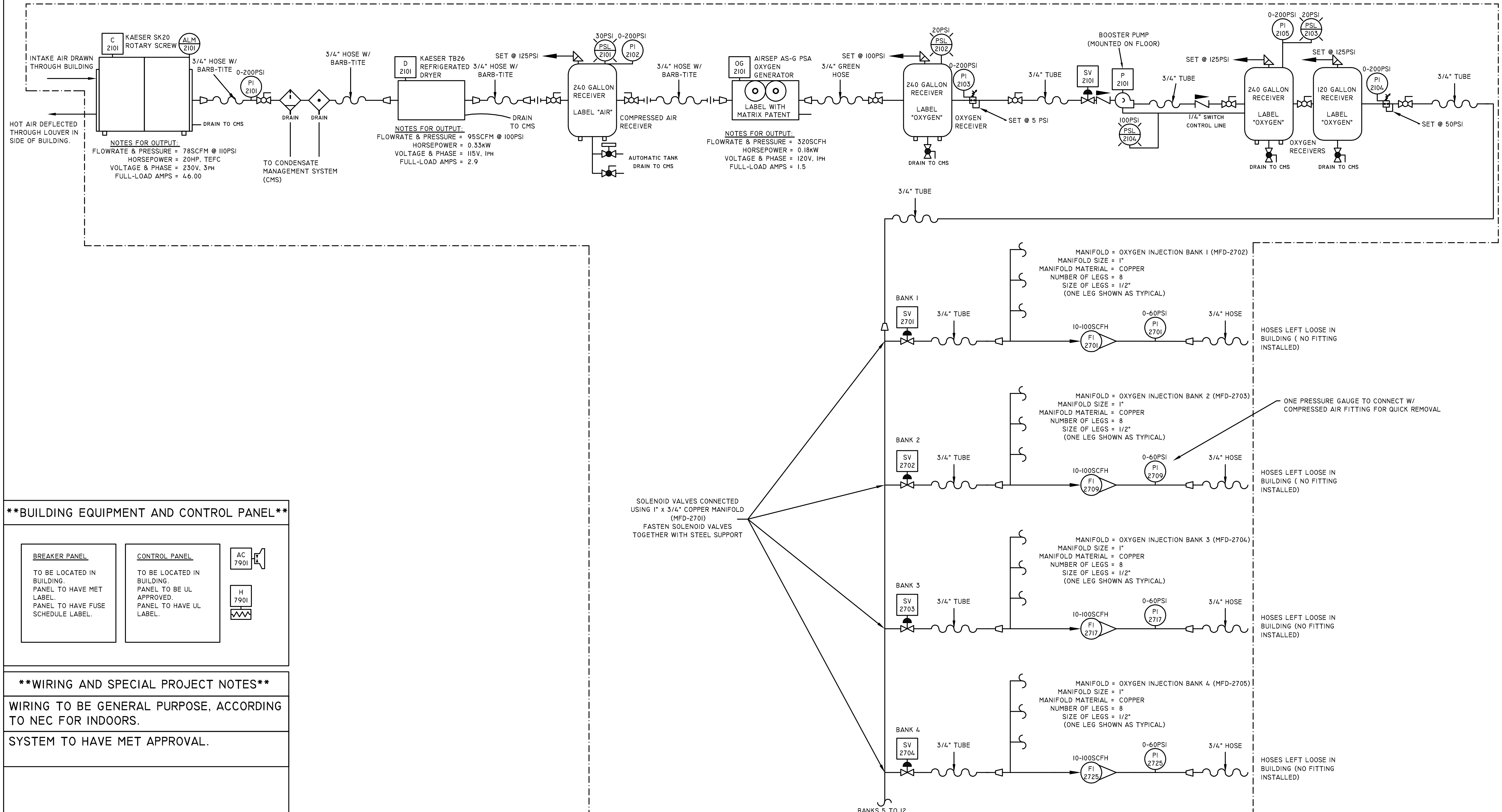
- User interface modeled after onsite HMI screen will allow control of solenoid valves and allow remote programming of valve sequencing
- Input alarms from control panels on compressor and air tank
- Remote shutdown and restart
- Cellular data account
- Email out alarm capability included

Operation and Maintenance Manual:

- Operating instructions for all system components
- Copy of operating manual for each OEM component
- Summary of system components
- Summary of system operation
- Summary of operation controls and fail safes
- Summary of maintenance requirements for each component
- Engineering schematics

Two Year Service Kit:

- AirSep Prefilter Element - 4
- AirSep Coalescing Element - 2
- AirSep Feed Valve - 2
- AirSep Waste Valve - 2
- AirSep Equalization Valve - 1
- AirSep Drain Valve – 1
- Powerex Belt – 2
- Powerex Tip Seal/Dust Seal – 4
- Powerex Grease Gun Kit – 1
- Kaeser Air Filter – 2
- Kaeser Oil Filter – 2
- Kaeser Belt – 2
- Kaeser Diaphragm – 2
- Kaeser Synthetic Lubricant - 16
- Hankinson Inline Filter – 4
- Hankinson Coalescing Filter – 4
- Replacement Pressure Gauges – 3
- Door Filters - 4



BUILDING EQUIPMENT AND CONTROL PANEL

BREAKER PANEL

TO BE LOCATED IN BUILDING.
PANEL TO HAVE MET LABEL.
PANEL TO HAVE FUSE SCHEDULE LABEL.

CONTROL PANEL

TO BE LOCATED IN BUILDING.
PANEL TO BE UL APPROVED.
PANEL TO HAVE UL LABEL.

WIRING AND SPECIAL PROJECT NOTES

WIRING TO BE GENERAL PURPOSE, ACCORDING TO NEC FOR INDOORS.

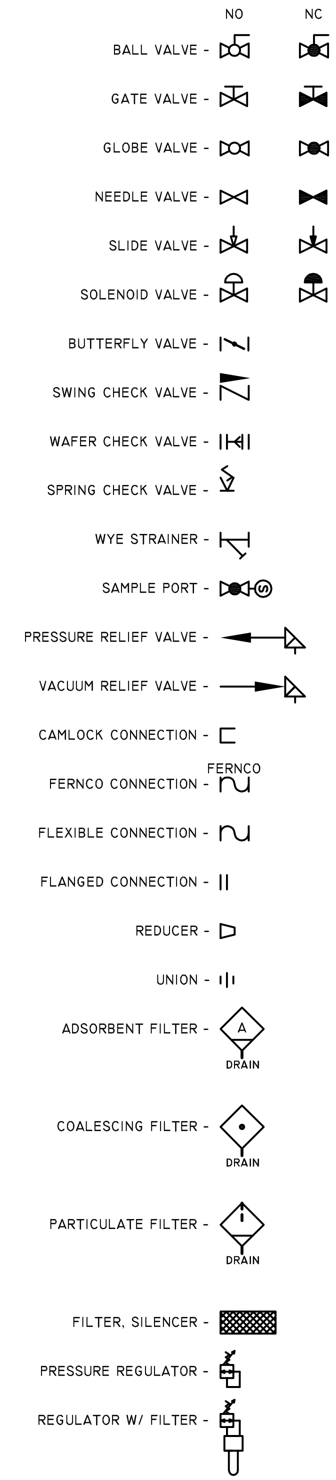
SYSTEM TO HAVE MET APPROVAL.

PIPING DETAILS:
- WATER FLOW METERS: PROVIDE 10 DIA. OF STRAIGHT PIPE BEFORE AND 5 DIA. OF STRAIGHT PIPE AFTER METERS. ENSURE THAT THROTTLING VALVES ARE NOT DIRECTLY IN LINE WITH METERS.
- AIR FLOW METERS: PROVIDE 8 DIA. OF STRAIGHT PIPE BEFORE AND 3 DIA. OF STRAIGHT PIPE AFTER METERS, IF POSSIBLE. AVOID TEES AND ELBOWS BEFORE AND AFTER METERS.
- MATERIALS OF VALVES AND FITTINGS TO BE THE SAME AS THE DESCRIPTION AT THE LINE. IF THERE IS A TRANSITION FROM PVC TO STEEL, THE VALVE SHOULD BE BRASS.
- THERE ARE NO SPECIAL PIPING REQUIREMENTS OTHER THAN WHAT IS EXPLAINED ON THE DIAGRAM.
- WHEN PVC HOSE IS SPECIFIED, ALWAYS USE VACUUM HOSE; USE GREEN HOSE FOR PRESSURES LESS THAN 60PSI; USE TANK TRUCK HOSE FOR PRESSURES BETWEEN 60PSI AND 150PSI.
- PVC PIPE MAY BE SUBSTITUTED WITH EQUAL-SIZED PVC HOSE WHERE A FLEXIBLE CONNECTION IS PREFERRED.

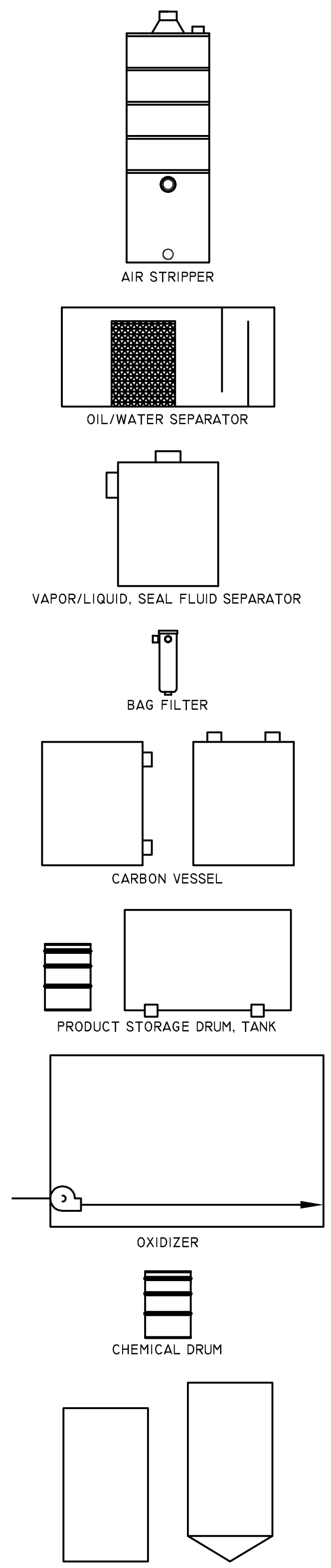
LEVEL	DATE	BY	REVISION
A	DEC 30, 09	JH	FOR APPROVAL

DWG. NO:	901460R1-01 (PAGE 1 OF 2)
TITLE:	PROCESS & INSTRUMENTATION DRAWING
CUSTOMER:	320SCFH SYSTEM HEMPSTEAD
	MLE EQUIPMENT INC.

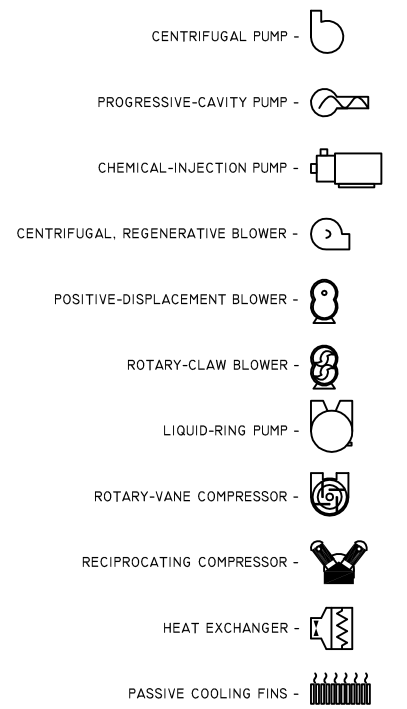
VALVES AND PIPING



EQUIPMENT



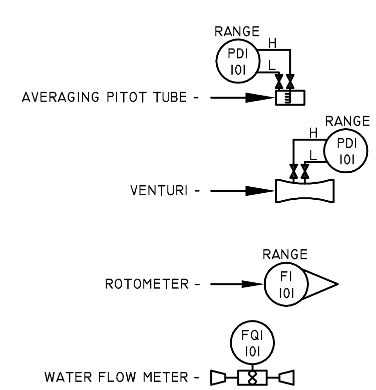
EQUIPMENT



EQUIPMENT

AS - AIR STRIPPER
BLD - BUILDING, TRAILER OR SKID
FLT - FILTER VESSEL
LPC - LIQUID-PHASE CARBON VESSEL
MFD - MANIFOLD
OWS - OIL/WATER SEPARATOR
OX - OXIDIZER
PST - PRODUCT STORAGE TANK
SOS - SEAL OIL SEPARATOR
SWS - SEAL WATER SEPARATOR
TNK - TANK
VLS - VAPOR/LIQUID SEPARATOR
VPC - VAPOR-PHASE CARBON VESSEL

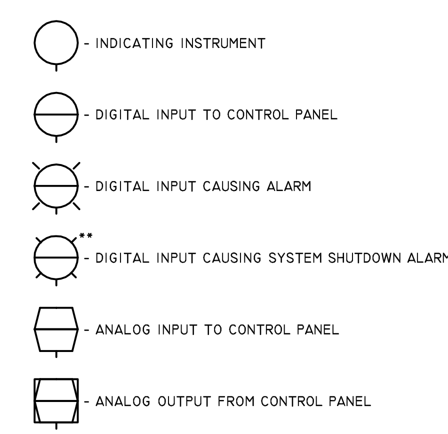
FLOW MEASUREMENT



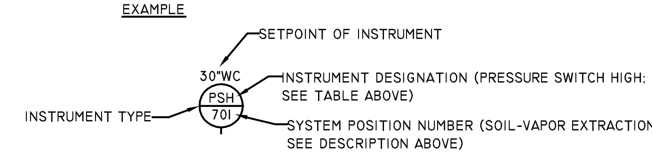
INSTRUMENT DESIGNATION

	INPUT	1st MODIFIER	2nd MODIFIER	3rd MODIFIER	OUTPUT	1st MODIFIER	
A							A
B						BLOWER	B
C	CYCLE					COMPRESSOR	C
D		DIFFERENTIAL				AIR DRYER	D
E							E
F	FLOW					FAN	F
G	GAS (LEL)		GAUGE			GENERATOR	G
H				HIGH	HAND	HEATER	H
I	CURRENT		INDICATOR				I
J							J
K							K
L	LEVEL			LOW			L
M					MOTORIZED		M
N							N
O					OXYGEN		O
P	PRESSURE				PNEUMATIC	PUMP	P
Q		QUANTITY					Q
R							R
S	SPEED		SWITCH		SOLENOID		S
T	TEMPERATURE		TRANSMITTER				T
U							U
V						VALVE	V
W							W
X							X
Y							Y
Z	POSITION						Z

INSTRUMENT IDENTIFICATION



EXAMPLE



SYSTEM POSITION DESIGNATION

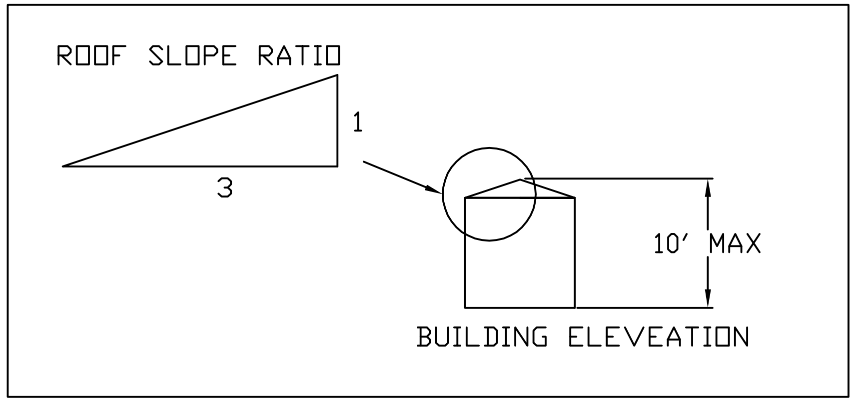
100 - VACUUM INLET MANIFOLD
400 - VAPOR/LIQUID SEPARATOR
700 - SOIL-VAPOR EXTRACTION
1000 - LIQUID-RING PUMP
1300 - SVE HEAT EXCHANGER
1600 - VAPOR-PHASE CARBON
1900 - OXIDIZER
2200 - AIR SPARGE
2500 - SPARGE HEAT EXCHANGER
2800 - SPARGE OUTLET MANIFOLD
3100 - AIR COMPRESSOR
3400 - COMPRESSED-AIR OUTLET MANIFOLD
3700 - PNEUMATIC WELL PUMPS
4000 - SUBMERSIBLE WELL PUMPS
4300 - SURFACE-MOUNT WELL PUMPS
4600 - GROUNDWATER INLET MANIFOLD
4900 - OIL/WATER SEPARATOR
5200 - PRODUCT STORAGE TANK
5500 - INLET TANK
5800 - UPSTREAM BAG FILTER
6100 - CHEMICAL INJECTION
6400 - AIR STRIPPER
6700 - PRE-CARBON BAG FILTER
7000 - LIQUID-PHASE CARBON
7300 - DISCHARGE TANK
7600 - REINJECTION
7900 - BUILDING,TRAILER OR SKID
8200 - CONTROL PANEL
8500 - ELECTRICAL PARTS
9900 - EXTRAS

LEVEL	DATE	BY	REVISION
C	JUN 22, 09	JH	AS BUILT
B	MAY 19, 09	JH	FOR PRODUCTION
A	MAY 15, 09	JH	FOR APPROVAL

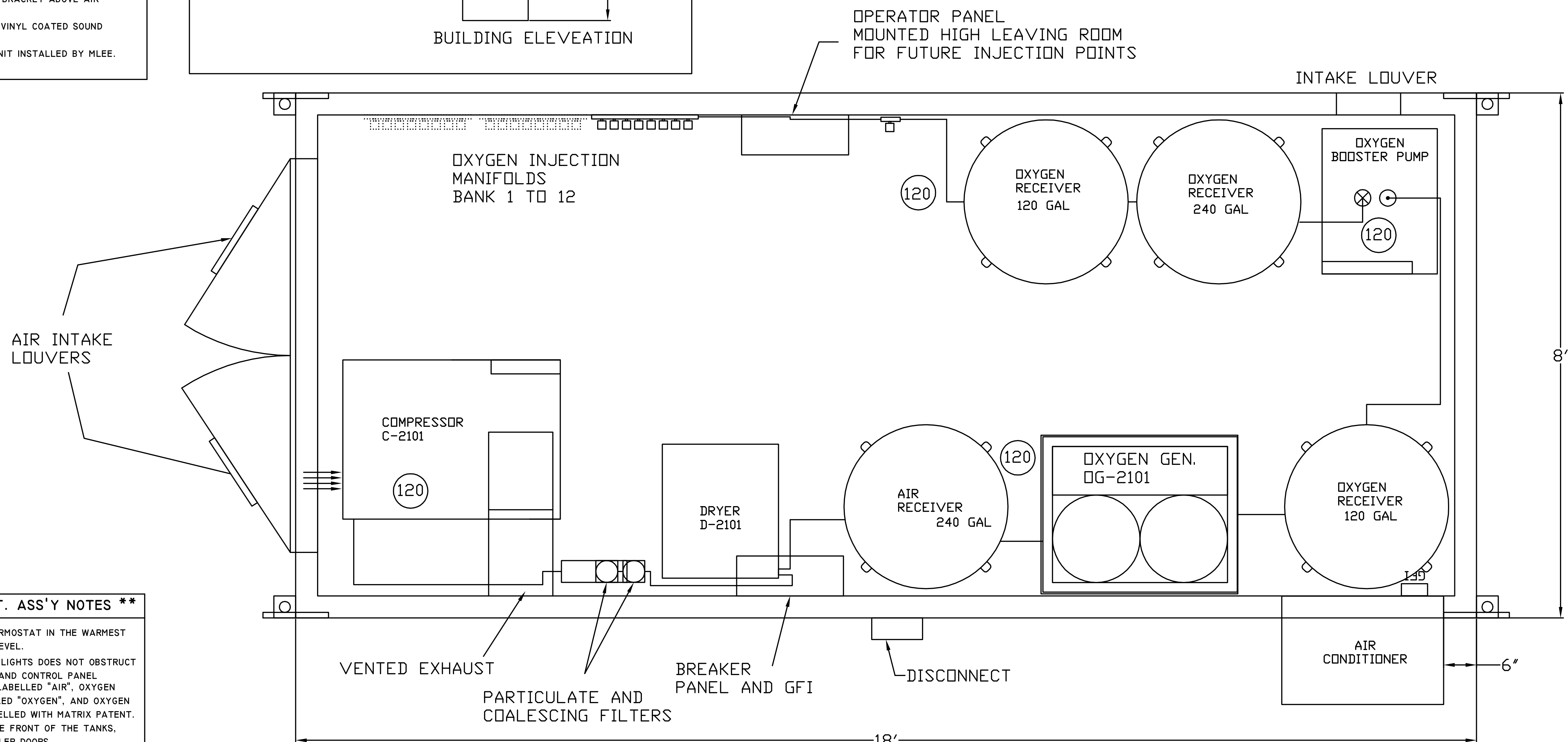
DWG. NO: 10647-01 (PAGE 2 OF 2)
TITLE: P&ID LEGEND
CUSTOMER: 312 SCFH SYSTEM MATRIX ET, INC.
MLE EQUIPMENT INC.

** CIVIL CONSTRUCTION NOTES **

- BUILDING TO HAVE THERMAL INSULATION ON WALLS AND CEILING.
- BUILDING TO HAVE WOOD PANELING, AND BE PAINTED CLAY WITH WHITE CORNER POSTS.
- BUILDING TO HAVE PLYWOOD FLOOR.
- BUILDING TO HAVE SLOPED BROWN SHINGLED ROOF AND WHITE PRIMED DOORS.
- EXHAUST DUCT TO BE INSTALLED WITH SLIDE TO BLOCK VENT DURING WINTER
- AIRSEP OXYGEN GENERATOR TO BE SUPPORTED NEAR THE TOP OF THE CYLINDER.
- INSTALL KEY HOLDER BRACKET ABOVE AIR COMPRESSOR.
- BUILDING TO HAVE 1" VINYL COATED SOUND INSULATION.
- WALL MOUNTED AC UNIT INSTALLED BY MLEE.



SCALE BAR, EACH BLOCK IS 12" LONG



**MECH./ELECT. ASS'Y NOTES **

- LOCATE COOLING THERMOSTAT IN THE WARMEST LOCATION AT CEILING LEVEL.
- ENSURE LOCATION OF LIGHTS DOES NOT OBSTRUCT OPERATION OF SYSTEM AND CONTROL PANEL
- AIR RECEIVER TO BE LABELLED "AIR", OXYGEN RECEIVER TO BE LABELLED "OXYGEN", AND OXYGEN GENERATOR TO BE LABELLED WITH MATRIX PATENT. LABELS MUST BE ON THE FRONT OF THE TANKS, VISIBLE FROM THE TRAILER DOORS.
- CONTROL PANEL TO HAVE UL LABEL.
- BREAKER PANEL TO HAVE FUSE SCHEDULE LABEL.
- BREAKER PANEL TO HAVE MET APPROVAL LABEL.
- SYSTEM TO HAVE "OXYGEN IN USE, NO SMOKING" SIGN LOCATED IN BUILDING. SIGN TO BE MOUNTED TO OUTSIDE OF DOOR ON SITE.
- ENSURE THERE ARE NO LOOSE ITEMS ON THE BUILDING FLOOR.
- ASSEMBLE OXYGEN SENSOR TUBING.
- INSTALL WASHER ON INLET AND OUTLET OF DRYER.

*** PACKING LIST ***

DESCRIPTION	DIM (L X W X H)	WEIGHT
BUILDING	18'x8'x10'	12000LB

FLOW DIRECTION

ELECTRICAL CONNECTION

FLOW INTO THE PAGE

FLOW OUT OF THE PAGE

THIS AREA REPRESENTS SERVICE SPACE REQUIRED

LEVEL	DATE:	BY	REVISION:
A	DEC 30.09	JH	FOR APPROVAL

DWG. NO:	901460RI - 02
TITLE:	SYSTEM LAYOUT
CUSTOMER:	320 SCFH SYSTEM HEMPSTEAD
	MLE EQUIPMENT INC.

System No. 2 Specifications: 175 SCFH 59 Point System

Matrix will provide a building mounted oxygen injection system with an oxygen production capacity of 175 standard cubic feet per hour (SCFH). Included with the system purchase is a non-transferable multiple use license to operate under U.S. Patent No. 5,874,001.

DESIGN PARAMETERS

References:
- U.S. Patent No. 5,874,001, Groundwater Remediation Method
- Groundwater Remediation System for the Hempstead Intersection Street Former Manufactured Gas Plant Site, URS Corporation, December 2009

Operating Parameters:
- 59 oxygen injection points
- Oxygen booster pump to increase storage pressure to 100 PSIG
- Oxygen flow range 10 to 100 SCFH per point
- Mass injection rates up to 4 lbs O2 per point per day

Location Requirements:
- 230V three-phase power available, 100 amp service
- Non-hazardous location for equipment
- Secure compound for system
- Altitude less than 100 feet

Certifications:
- Control panel to be UL certified
- MET US Laboratories approval of system
- 2 year warranty on system components
- 1 year warranty on Powerex rotary scroll oxygen compressor (booster pump)

Oxygen Injection System:
- Air compressor capacity – 30 SCFM @ 110 PSI
- Oxygen generator capacity - 175 SCFH
- Oxygen booster capacity – 2.5 SCFM
- All equipment oxygen scavenged for oxygen service
- 59 point injection header with capacity for future expansion to 69

Remediation Enclosure:
- Equipment located in an 8 ft by 14 ft enclosure on steel skid
- Piped, wired and tested; all wiring suitable for non-hazardous locations

Control Panel:
- PLC based control system with user interface and alarm inputs
- Remote cellular telemetry with web based access

DESCRIPTION OF 175 SCFH 59 POINT OXYGEN INJECTION SYSTEM

Rotary Screw Compressor Module:
Kaeser SM 7.5 110 PSI Classic 230/3/60 US

- Motor: 7.5 HP, 230/3P, TEFC
- Sigma control panel
- Performance: 30 SCFM at 110 PSI

Compressor assembly to contain:

- Integral exhaust ducted to building exterior

Discharge piping from compressor to contain:

- Pressure gauge
- Ball valve
- Filtered Separator
- Coalescing Filter
- Steel piping/high pressure hose as applicable

Separate 60 G vertical receiver tank

- Automatic tank drain
  - NEMA 4 timed solenoid valve
- Ball valve
- Pressure switch

Air Dryer Module:
Kaeser refrigerated dryer model TA 8

- Motor: TEFC
- Air flow: 30 SCFM
- Air pressure drop: 4 PSI
- Ambient air temperature: 100 °F
- Inlet temperature: 150 °F
- Discharge dewpoint: 40 °F
- Ball valve

Oxygen Generator:
AirSep model AS-E 175 SCFH pressure swing adsorption oxygen generator

- Ball valve
- 120 Gallon Oxygen storage tank - low pressure (60 PSI)
  - Pressure switch
  - Pressure relief valve
  - Powerex rotary scroll oxygen compressor (booster), 2.5 SCFM at 100 PSI
  - Check valve and solenoid valve on compressor inlet
- 240 Gallon Oxygen storage tank – high pressure (100 PSI)
  - Pressure switch
  - Pressure relief valve
- Ball valve
- Regulator and Piping

Oxygen Delivery Manifold:

One 3/4" oxygen discharge manifold with eight 3/4" branches, each branch to contain:

- Flow control (on/off) - discrete output
  - ASCO NEMA 4 solenoid valve

Eight 3/4" copper branches with eight 3/4" legs

Each leg to contain:

- Air flow indicator.
  - Dwyer RMB-53 10-100 SCFH flow meters with control valves and viton seals suitable for oxygen service
- Pressure gauge (0-60 PSI)
- 3/4" hoses for termination outside of enclosure

NOTE: Last branch to contain five (5) blank points

Enclosure:

Built to NEC General Purpose standards, all wiring complete and all equipment pre-piped factory tested and mounted in enclosure

8' x 14' wood frame building with the following standard features:

- Wood Chalet siding (Painted Clay color)
- White Corner posts and fascia
- Peaked shingled roof (Brown)
- Forklift pockets
- Wood floor
- Insulated walls and ceiling
- Interior plywood walls
- Double man doors (White)
- Tan sound attenuating insulation on walls and ceiling
- Maximum 10' roof height

Interior to contain the following:

- Compressor
- Air dryer
- Oxygen generator
- Oxygen compressor
- Injection manifold
- Lighting - powered device
- 1000W Heater
- Wall mounted air conditioner
- Passive vent louvers with sound attenuating hood
- All influent, effluent, and drain lines plumbed to outside of building

Control System Module:

PLC Series Direct Logic PLC based control panel with the following standard features:

- UL certification
- AIC rating of 5000
- NEMA 1 panel enclosure

- Surge and lightning protection for control system
- Direct Logic PLC control system
- UPS System with power alarm relay
- Wired and installed
- Factory tested prior to shipping

Outside cover of panel to contain the following:

- User interface display screen

Telemetry Module:
MLE model SL-PW1 Wireless remote access system using cellular modem for a PLC based control panel:

- User interface modeled after onsite HMI screen will allow control of solenoid valves and allow remote programming of valve sequencing
- Input alarms from control panels on compressor and air tank
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- Copy of operating manual for each OEM component
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- Summary of maintenance requirements for each component
- Engineering schematics

Two Year Service Kit:

- AirSep Prefilter Element - 4
- AirSep Coalescing Element - 2
- AirSep Feed Valve - 2
- AirSep Waste Valve - 2
- AirSep Equalization Valve - 1
- AirSep Drain Valve – 1
- Powerex Belt – 2
- Powerex Tip Seal/Dust Seal – 4
- Powerex Grease Gun Kit – 1
- Kaeser Air Filter – 2
- Kaeser Oil Filter – 2
- Kaeser Belt – 2
- Kaeser Diaphragm – 2
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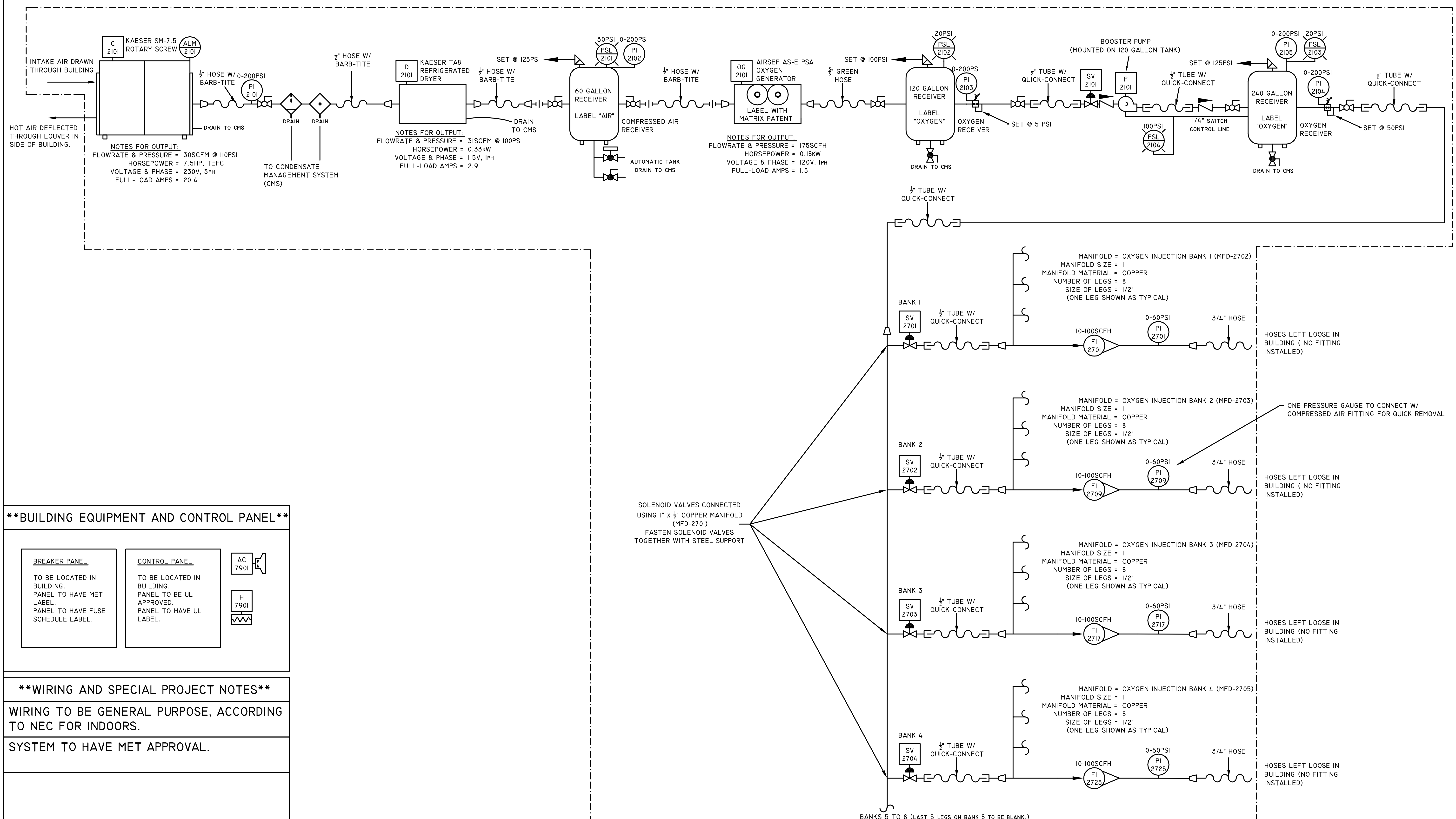
- Hankinson Coalescing Filter – 4
- Replacement Pressure Gauges – 3
- Door Filters - 4



BUILDING EQUIPMENT AND CONTROL PANEL

BREAKER PANEL

TO BE LOCATED IN BUILDING.
PANEL TO HAVE MET LABEL.
PANEL TO HAVE FUSE SCHEDULE LABEL.

CONTROL PANEL

TO BE LOCATED IN BUILDING.
PANEL TO BE UL APPROVED.
PANEL TO HAVE UL LABEL.

AC 7901

H 7901

WIRING AND SPECIAL PROJECT NOTES

WIRING TO BE GENERAL PURPOSE, ACCORDING TO NEC FOR INDOORS.

SYSTEM TO HAVE MET APPROVAL.

PIPING DETAILS:
- WATER FLOW METERS: PROVIDE 10 DIA. OF STRAIGHT PIPE BEFORE AND 5 DIA. OF STRAIGHT PIPE AFTER METERS. ENSURE THAT THROTTLING VALVES ARE NOT DIRECTLY IN LINE WITH METERS.
- AIR FLOW METERS: PROVIDE 8 DIA. OF STRAIGHT PIPE BEFORE AND 3 DIA. OF STRAIGHT PIPE AFTER METERS, IF POSSIBLE. AVOID TEES AND ELBOWS BEFORE AND AFTER METERS.
- MATERIALS OF VALVES AND FITTINGS TO BE THE SAME AS THE DESCRIPTION AT THE LINE. IF THERE IS A TRANSITION FROM PVC TO STEEL, THE VALVE SHOULD BE BRASS.
- THERE ARE NO SPECIAL PIPING REQUIREMENTS OTHER THAN WHAT IS EXPLAINED ON THE DIAGRAM.
- WHEN PVC HOSE IS SPECIFIED, ALWAYS USE VACUUM HOSE; USE GREEN HOSE FOR PRESSURES LESS THAN 60PSI; USE TANK TRUCK HOSE FOR PRESSURES BETWEEN 60PSI AND 150PSI.
- PVC PIPE MAY BE SUBSTITUTED WITH EQUAL-SIZED PVC HOSE WHERE A FLEXIBLE CONNECTION IS PREFERRED.

LEVEL	DATE	BY	REVISION
A	DEC 30, 09	JH	FOR APPROVAL

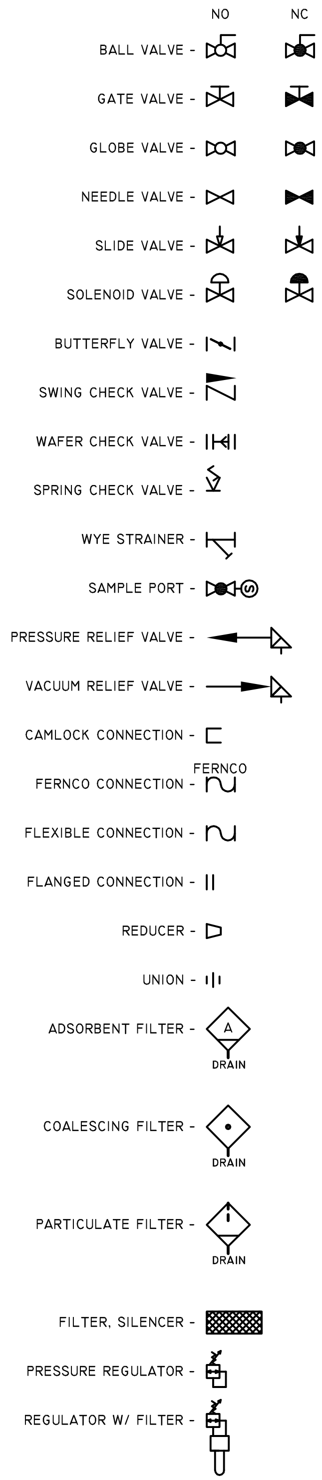
DWG. NO: 901458R1-01 (PAGE 1 OF 2)

TITLE: PROCESS & INSTRUMENTATION DRAWING

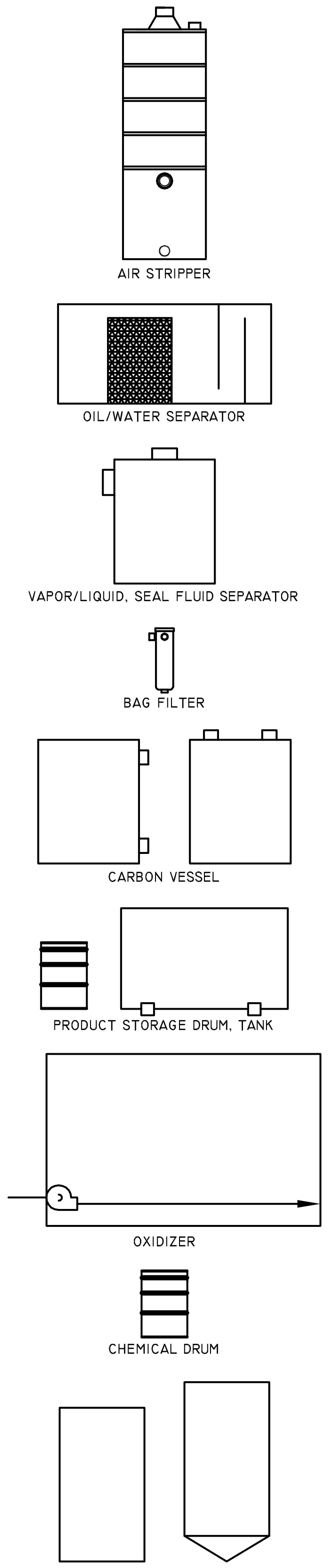
CUSTOMER: 175SCFH SYSTEM HEMPSTEAD

MLE EQUIPMENT INC.

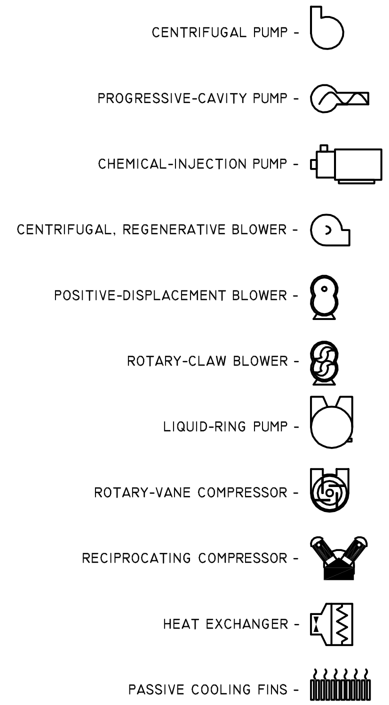
VALVES AND PIPING



EQUIPMENT



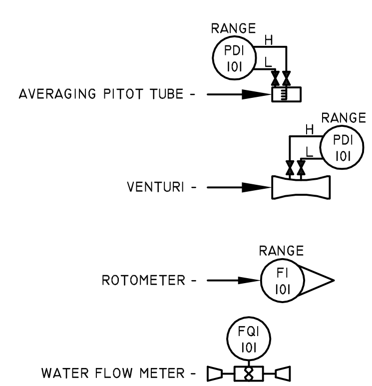
EQUIPMENT



EQUIPMENT

AS - AIR STRIPPER
BLD - BUILDING, TRAILER OR SKID
FLT - FILTER VESSEL
LPC - LIQUID-PHASE CARBON VESSEL
MFD - MANIFOLD
OWS - OIL/WATER SEPARATOR
OX - OXIDIZER
PST - PRODUCT STORAGE TANK
SOS - SEAL OIL SEPARATOR
SWS - SEAL WATER SEPARATOR
TNK - TANK
VLS - VAPOR/LIQUID SEPARATOR
VPC - VAPOR-PHASE CARBON VESSEL

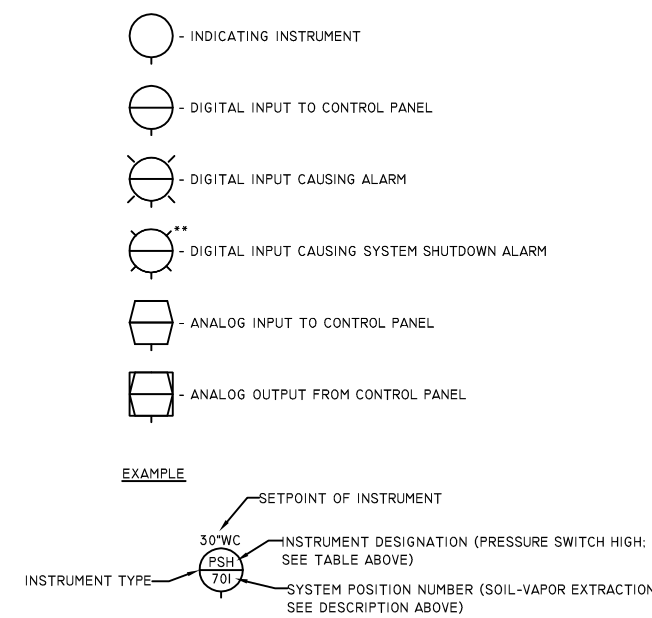
FLOW MEASUREMENT



INSTRUMENT DESIGNATION

	INPUT	1ST MODIFIER	2ND MODIFIER	3RD MODIFIER	OUTPUT	1ST MODIFIER	
A							A
B						BLOWER	B
C	CYCLE					COMPRESSOR	C
D		DIFFERENTIAL				AIR DRYER	D
E							E
F	FLOW					FAN	F
G	GAS (LEL)		GAUGE			GENERATOR	G
H				HIGH	HAND	HEATER	H
I	CURRENT		INDICATOR				I
J							J
K							K
L	LEVEL			LOW			L
M					MOTORIZED		M
N							N
O					OXYGEN		O
P	PRESSURE				PNEUMATIC	PUMP	P
Q		QUANTITY					Q
R							R
S	SPEED		SWITCH		SOLENOID		S
T	TEMPERATURE		TRANSMITTER				T
U							U
V						VALVE	V
W							W
X							X
Y							Y
Z	POSITION						Z

INSTRUMENT IDENTIFICATION

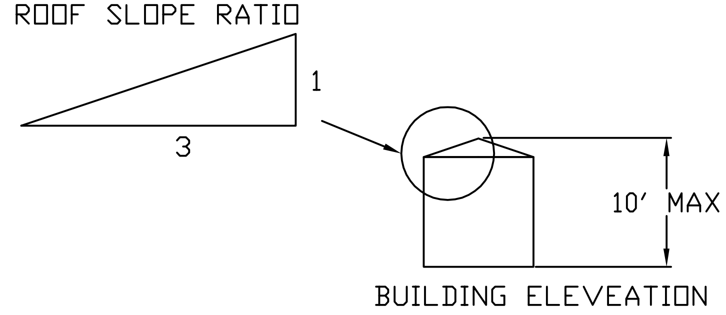


SYSTEM POSITION DESIGNATION

100 - VACUUM INLET MANIFOLD
400 - VAPOR/LIQUID SEPARATOR
700 - SOIL-VAPOR EXTRACTION
1000 - LIQUID-RING PUMP
1300 - SVE HEAT EXCHANGER
1600 - VAPOR-PHASE CARBON
1900 - OXIDIZER
2200 - AIR SPARGE
2500 - SPARGE HEAT EXCHANGER
2800 - SPARGE OUTLET MANIFOLD
3100 - AIR COMPRESSOR
3400 - COMPRESSED-AIR OUTLET MANIFOLD
3700 - PNEUMATIC WELL PUMPS
4000 - SUBMERSIBLE WELL PUMPS
4300 - SURFACE-MOUNT WELL PUMPS
4600 - GROUNDWATER INLET MANIFOLD
4900 - OIL/WATER SEPARATOR
5200 - PRODUCT STORAGE TANK
5500 - INLET TANK
5800 - UPSTREAM BAG FILTER
6100 - CHEMICAL INJECTION
6400 - AIR STRIPPER
6700 - PRE-CARBON BAG FILTER
7000 - LIQUID-PHASE CARBON
7300 - DISCHARGE TANK
7600 - REINJECTION
7900 - BUILDING,TRAILER OR SKID
8200 - CONTROL PANEL
8500 - ELECTRICAL PARTS
9900 - EXTRAS

LEVEL	DATE	BY	REVISION
C	JUN 22, 09	JH	AS BUILT
B	MAY 19, 09	JH	FOR PRODUCTION
A	MAY 15, 09	JH	FOR APPROVAL

DWG. NO: 10647-01 (PAGE 2 OF 2)
TITLE: P&ID LEGEND
CUSTOMER: 312 SCFH SYSTEM MATRIX ET, INC.
MLE EQUIPMENT INC.



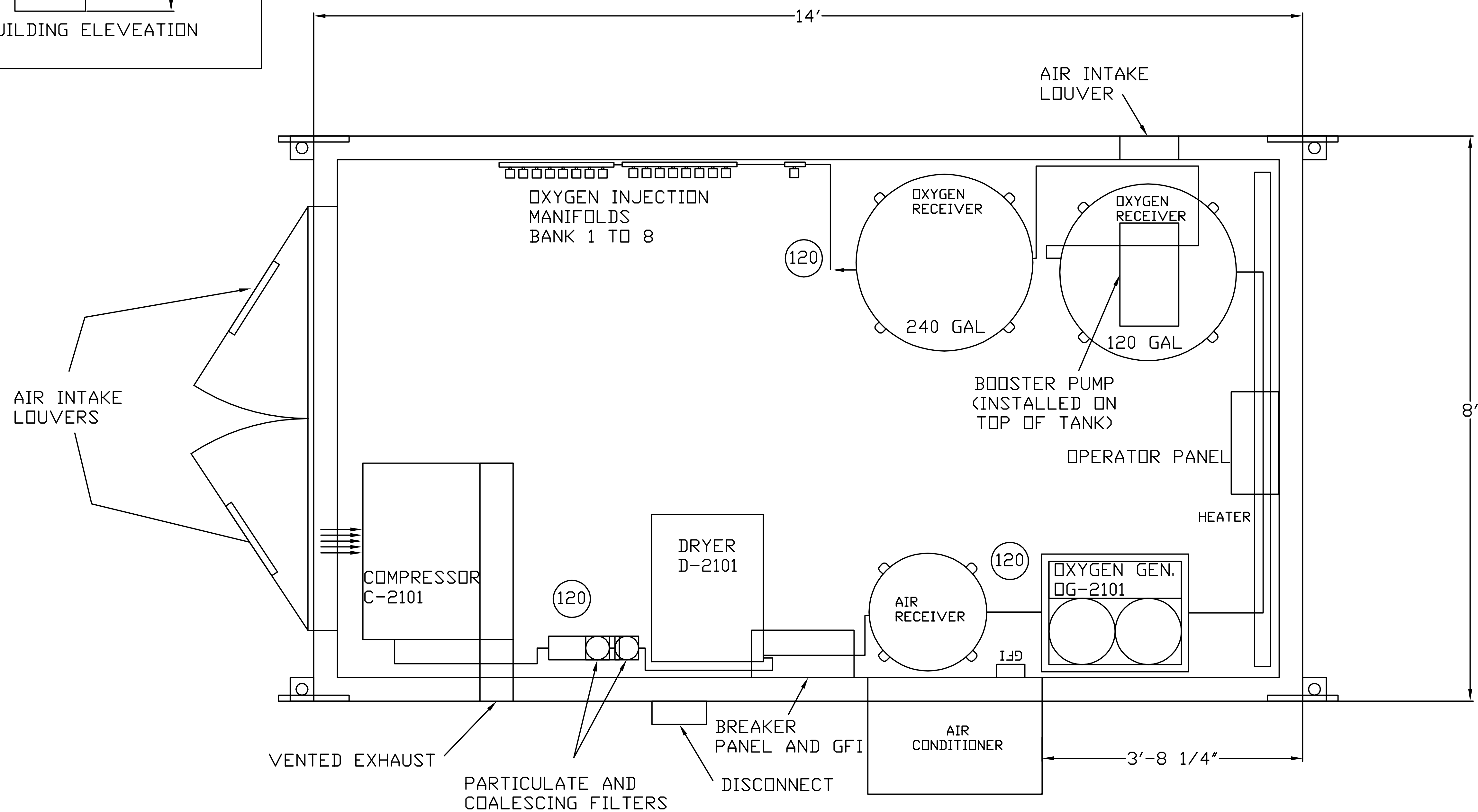
** CIVIL CONSTRUCTION NOTES **

- BUILDING TO HAVE THERMAL INSULATION ON WALLS AND CEILING.
- BUILDING TO HAVE WOOD PANELING AND BE PAINTED CLAY WITH WHITE CORNER POSTS.
- BUILDING TO HAVE PLYWOOD FLOOR.
- BUILDING TO HAVE SLOPED BROWN SHINGLED ROOF AND WHITE PRIMED DOORS.
- AIRSEP OXYGEN GENERATOR TO BE SUPPORTED NEAR THE TOP OF THE CYLINDER.
- INSTALL KEY HOLDER BRACKET ON CONTROL PANEL.
- BUILDING TO HAVE 1" VINYL COATED SOUND ATTENUATING INSULATION.
- WALL MOUNTED AC UNIT INSTALLED BY MLE

**MECH./ELECT. ASS'Y NOTES **

- LOCATE COOLING THERMOSTAT IN THE WARMEST LOCATION AT CEILING LEVEL.
- ENSURE LOCATION OF LIGHTS DOES NOT OBSTRUCT OPERATION OF SYSTEM AND CONTROL PANEL
- AIR RECEIVER TO BE LABELLED "AIR", OXYGEN RECEIVER TO BE LABELLED "OXYGEN", AND OXYGEN GENERATOR TO BE LABELLED WITH MATRIX PATENT. LABELS MUST BE ON THE FRONT OF THE TANKS, VISIBLE FROM THE TRAILER DOORS.
- CONTROL PANEL TO HAVE UL LABEL.
- BREAKER PANEL TO HAVE FUSE SCHEDULE LABEL.
- BREAKER PANEL TO HAVE MET APPROVAL LABEL.
- ENSURE THERE ARE NO LOOSE ITEMS ON THE BUILDING FLOOR.
- ASSEMBLE OXYGEN SENSOR TUBING.

*** COMMISSIONING NOTES ***



*** PACKING LIST ***

DESCRIPTION	DIM (L X W X H)	WEIGHT
BUILDING	14'x8'x10'	10000LBS

FLOW DIRECTION

ELECTRICAL CONNECTION

FLOW INTO THE PAGE

FLOW OUT OF THE PAGE

THIS AREA REPRESENTS SERVICE SPACE REQUIRED

LEVEL	DATE:	BY	REVISION:
A	DEC 29, 09	JH	FOR APPROVAL

DWG. NO:	901458R1- 02
TITLE:	SYSTEM LAYOUT
CUSTOMER:	175SCFH SYSTEM HEMPSTEAD
	MLE EQUIPMENT INC.

January 8, 2010

System No. 3 Specifications: 195 SCFH 70 Point System

Matrix will provide a building mounted oxygen injection system with an oxygen production capacity of 195 standard cubic feet per hour (SCFH). Included with the system purchase is a non-transferable multiple use license to operate under U.S. Patent No. 5,874,001.

DESIGN PARAMETERS

References:
- U.S. Patent No. 5,874,001, Groundwater Remediation Method
- Groundwater Remediation System for the Hempstead Intersection Street Former Manufactured Gas Plant Site, URS Corporation, December 2009

Operating Parameters:
- 70 oxygen injection points
- Oxygen booster pump to increase storage pressure to 100 PSIG
- Oxygen flow range 10 to 100 SCFH per point
- Mass injection rates up to 4 lbs O2 per point per day

Location Requirements:
- 230V three-phase power available, 100 amp service
- Non-hazardous location for equipment
- Secure compound for system
- Altitude less than 100 feet

Certifications:
- Control panel to be UL certified
- MET US Laboratories approval of system
- 2 year warranty on system components
- 1 year warranty on Powerex rotary scroll oxygen compressor (booster pump)

Oxygen Injection System:
- Air compressor capacity – 42 SCFM @ 110 PSI
- Oxygen generator capacity - 195 SCFH
- Oxygen booster capacity – 2.5 SCFM
- All equipment oxygen scavenged for oxygen service
- 70 point injection header with capacity for future expansion to 80

Remediation Enclosure:
- Equipment located in an 8 ft by 14 ft enclosure on steel skid
- Piped, wired and tested; all wiring suitable for non-hazardous locations

Control Panel:
- PLC based control system with user interface and alarm inputs
- Remote cellular telemetry with web based access

DESCRIPTION OF 195 SCFH 70 POINT OXYGEN INJECTION SYSTEM

Rotary Screw Compressor Module:
Kaeser SM 10 110 PSI Classic 230/3/60 US
- Motor: 10 HP, 230/3P, TEFC
- Sigma control panel
- Performance: 42 SCFM at 110 PSI

Compressor assembly to contain:
- Integral exhaust ducted to building exterior

Discharge piping from compressor to contain:
- Pressure gauge
- Ball valve
- Filtered Separator
- Coalescing Filter
- Steel piping/high pressure hose as applicable

Separate 60 G vertical receiver tank
- Automatic tank drain
  - NEMA 4 timed solenoid valve
- Ball valve
- Pressure switch

Air Dryer Module:
Kaeser refrigerated dryer model TA 11
- Motor: TEFC
- Air flow: 45 SCFM
- Air pressure drop: 4 PSI
- Ambient air temperature: 100 °F
- Inlet temperature: 150 °F
- Discharge dewpoint: 40 °F
- Ball valve

Oxygen Generator:
AirSep model AS-E 195 SCFH pressure swing adsorption oxygen generator
- Ball valve
- 120 Gallon Oxygen storage tank - low pressure (60 PSI)
  - Pressure switch
  - Pressure relief valve
  - Powerex rotary scroll oxygen compressor (booster), 2.5 SCFM at 100 PSI
  - Check valve and solenoid valve on compressor inlet
- 240 Gallon Oxygen storage tank – high pressure (100 PSI)
  - Pressure switch
  - Pressure relief valve
- Ball valve
- Regulator and Piping

Oxygen Delivery Manifold:
One 3/4" oxygen discharge manifold with eight 3/4" branches, each branch to contain:
- Flow control (on/off) - discrete output
  - ASCO NEMA 4 solenoid valve

Nine 3/4" copper branches with eight 3/4" legs
Each leg to contain:
- Air flow indicator.
  - Dwyer RMB-53 10-100 SCFH flow meters with control valves and viton seals suitable for oxygen service
- Pressure gauge (0-60 PSI)
- 3/4" hoses for termination outside of enclosure

NOTE: Last branch to contain two (2) blank points

Enclosure:
Built to NEC General Purpose standards, all wiring complete and all equipment pre-piped factory tested and mounted in enclosure

8' x 14' wood frame building with the following standard features:
- Wood Chalet siding (Painted Clay color)
- White Corner posts and fascia
- Peaked shingled roof (Brown)
- Forklift pockets
- Wood floor
- Insulated walls and ceiling
- Interior plywood walls
- Double man doors (White)
- Tan sound attenuating insulation on walls and ceiling
- Maximum 10' roof height

Interior to contain the following:
- Compressor
- Air dryer
- Oxygen generator
- Oxygen compressor
- Injection manifold
- Lighting - powered device
- 1000W Heater
- Wall mounted air conditioner
- Passive vent louvers with sound attenuating hood
- All influent, effluent, and drain lines plumbed to outside of building

Control System Module:
PLC Series Direct Logic PLC based control panel with the following standard features:
- UL certification
- AIC rating of 5000
- NEMA 1 panel enclosure

- Surge and lightning protection for control system
- Direct Logic PLC control system
- UPS System with power alarm relay
- Wired and installed
- Factory tested prior to shipping

Outside cover of panel to contain the following:

- User interface display screen

Telemetry Module:
MLE model SL-PW1 Wireless remote access system using cellular modem for a PLC based control panel:

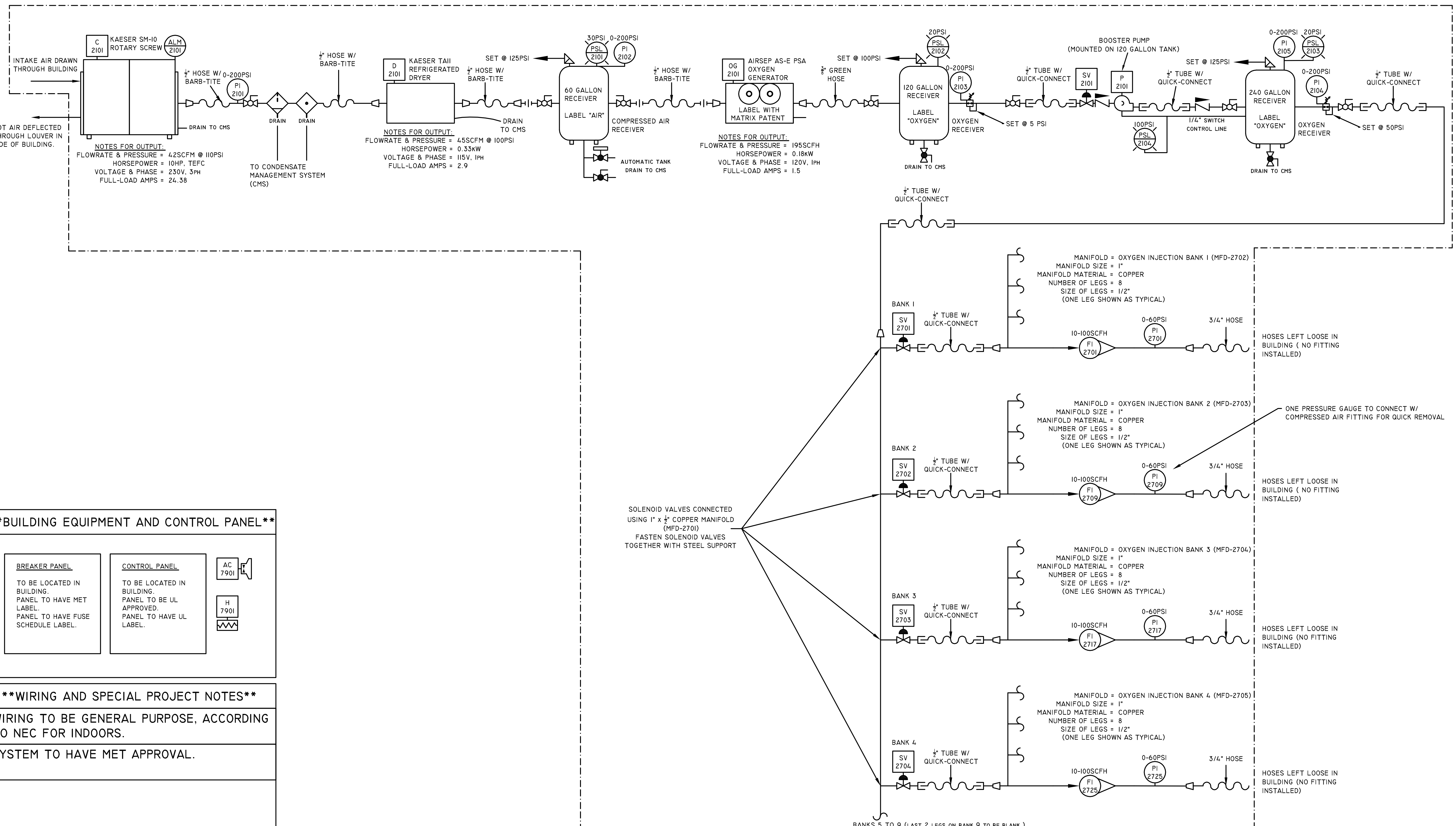
- User interface modeled after onsite HMI screen will allow control of solenoid valves and allow remote programming of valve sequencing
- Input alarms from control panels on compressor and air tank
- Remote shutdown and restart
- Cellular data account
- Email out alarm capability included

Operation and Maintenance Manual:

- Operating instructions for all system components
- Copy of operating manual for each OEM component
- Summary of system components
- Summary of system operation
- Summary of operation controls and fail safes
- Summary of maintenance requirements for each component
- Engineering schematics

Two Year Service Kit:

- AirSep Prefilter Element - 4
- AirSep Coalescing Element - 2
- AirSep Feed Valve - 2
- AirSep Waste Valve - 2
- AirSep Equalization Valve - 1
- AirSep Drain Valve – 1
- Powerex Belt – 2
- Powerex Tip Seal/Dust Seal – 4
- Powerex Grease Gun Kit – 1
- Kaeser Air Filter – 2
- Kaeser Oil Filter – 2
- Kaeser Belt – 2
- Kaeser Diaphragm – 2
- Kaeser Synthetic Lubricant - 16
- Hankinson Inline Filter – 4
- Hankinson Coalescing Filter – 4
- Replacement Pressure Gauges – 3
- Door Filters - 4



BUILDING EQUIPMENT AND CONTROL PANEL

BREAKER PANEL

TO BE LOCATED IN BUILDING.
PANEL TO HAVE MET LABEL.
PANEL TO HAVE FUSE SCHEDULE LABEL.

CONTROL PANEL

TO BE LOCATED IN BUILDING.
PANEL TO BE UL APPROVED.
PANEL TO HAVE UL LABEL.

AC 7901

H 7901

WIRING AND SPECIAL PROJECT NOTES

WIRING TO BE GENERAL PURPOSE, ACCORDING TO NEC FOR INDOORS.

SYSTEM TO HAVE MET APPROVAL.

PIPING DETAILS:
- WATER FLOW METERS: PROVIDE 10 DIA. OF STRAIGHT PIPE BEFORE AND 5 DIA. OF STRAIGHT PIPE AFTER METERS. ENSURE THAT THROTTLING VALVES ARE NOT DIRECTLY IN LINE WITH METERS.
- AIR FLOW METERS: PROVIDE 8 DIA. OF STRAIGHT PIPE BEFORE AND 3 DIA. OF STRAIGHT PIPE AFTER METERS, IF POSSIBLE. AVOID TEES AND ELBOWS BEFORE AND AFTER METERS.
- MATERIALS OF VALVES AND FITTINGS TO BE THE SAME AS THE DESCRIPTION AT THE LINE. IF THERE IS A TRANSITION FROM PVC TO STEEL, THE VALVE SHOULD BE BRASS.
- THERE ARE NO SPECIAL PIPING REQUIREMENTS OTHER THAN WHAT IS EXPLAINED ON THE DIAGRAM.
- WHEN PVC HOSE IS SPECIFIED, ALWAYS USE VACUUM HOSE; USE GREEN HOSE FOR PRESSURES LESS THAN 60PSI; USE TANK TRUCK HOSE FOR PRESSURES BETWEEN 60PSI AND 150PSI.
- PVC PIPE MAY BE SUBSTITUTED WITH EQUAL-SIZED PVC HOSE WHERE A FLEXIBLE CONNECTION IS PREFERRED.

LEVEL	DATE	BY	REVISION
A	DEC 30, 09	JH	FOR APPROVAL

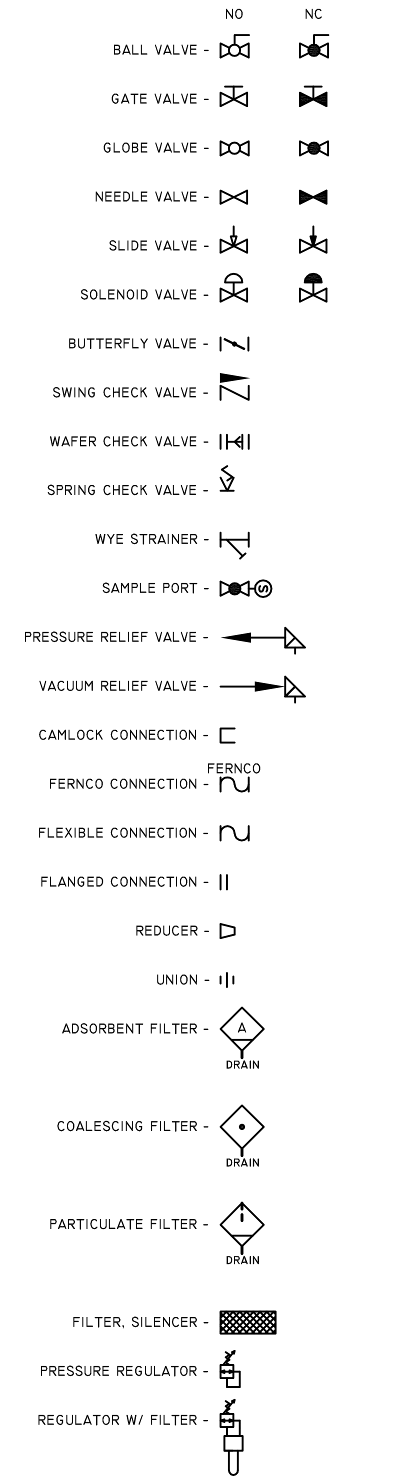
DWG. NO: 901457R1-01 (PAGE 1 OF 2)

TITLE: PROCESS & INSTRUMENTATION DRAWING

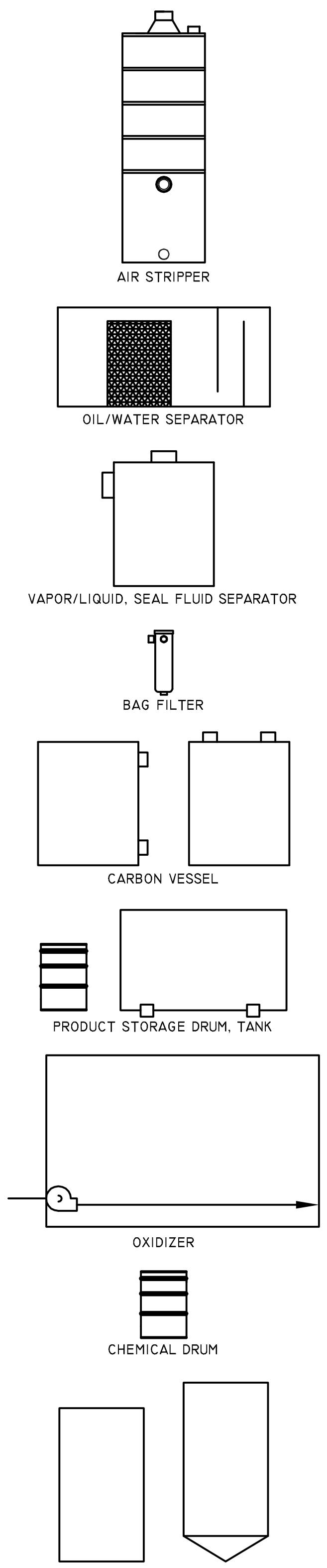
CUSTOMER: 195SCFH SYSTEM HEMPSTEAD

MLE EQUIPMENT INC.

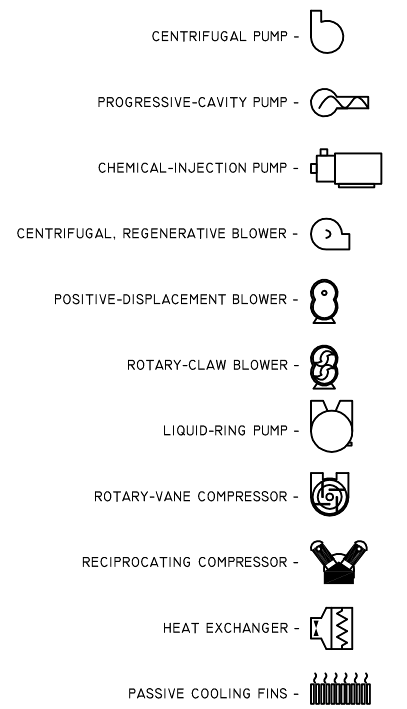
VALVES AND PIPING



EQUIPMENT



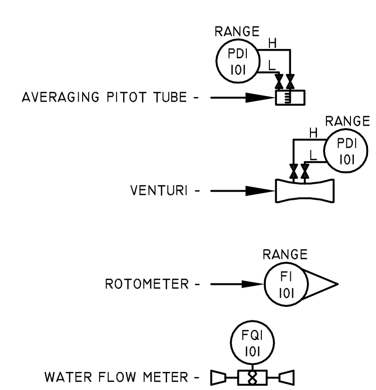
EQUIPMENT



EQUIPMENT

AS - AIR STRIPPER
BLD - BUILDING, TRAILER OR SKID
FLT - FILTER VESSEL
LPC - LIQUID-PHASE CARBON VESSEL
MFD - MANIFOLD
OWS - OIL/WATER SEPARATOR
OX - OXIDIZER
PST - PRODUCT STORAGE TANK
SOS - SEAL OIL SEPARATOR
SWS - SEAL WATER SEPARATOR
TNK - TANK
VLS - VAPOR/LIQUID SEPARATOR
VPC - VAPOR-PHASE CARBON VESSEL

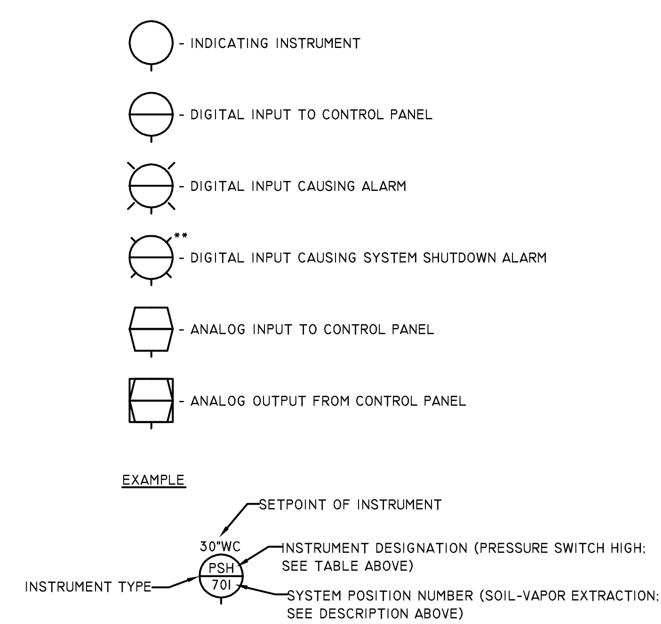
FLOW MEASUREMENT



INSTRUMENT DESIGNATION

	INPUT	1ST MODIFIER	2ND MODIFIER	3RD MODIFIER	OUTPUT	1ST MODIFIER	
A							A
B						BLOWER	B
C	CYCLE					COMPRESSOR	C
D		DIFFERENTIAL				AIR DRYER	D
E							E
F	FLOW					FAN	F
G	GAS (LEL)		GAUGE			GENERATOR	G
H				HIGH	HAND	HEATER	H
I	CURRENT		INDICATOR				I
J							J
K							K
L	LEVEL			LOW			L
M					MOTORIZED		M
N							N
O					OXYGEN		O
P	PRESSURE				PNEUMATIC	PUMP	P
Q		QUANTITY					Q
R							R
S	SPEED		SWITCH		SOLENOID		S
T	TEMPERATURE		TRANSMITTER				T
U							U
V						VALVE	V
W							W
X							X
Y							Y
Z	POSITION						Z

INSTRUMENT IDENTIFICATION



SYSTEM POSITION DESIGNATION

100 - VACUUM INLET MANIFOLD
400 - VAPOR/LIQUID SEPARATOR
700 - SOIL-VAPOR EXTRACTION
1000 - LIQUID-RING PUMP
1300 - SVE HEAT EXCHANGER
1600 - VAPOR-PHASE CARBON
1900 - OXIDIZER
2200 - AIR SPARGE
2500 - SPARGE HEAT EXCHANGER
2800 - SPARGE OUTLET MANIFOLD
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4000 - SUBMERSIBLE WELL PUMPS
4300 - SURFACE-MOUNT WELL PUMPS
4600 - GROUNDWATER INLET MANIFOLD
4900 - OIL/WATER SEPARATOR
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6700 - PRE-CARBON BAG FILTER
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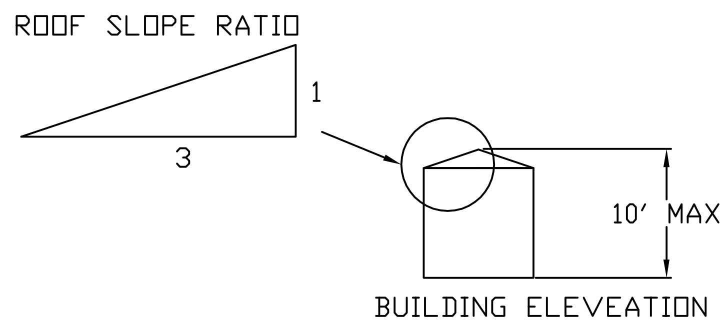
7300 - DISCHARGE TANK
7600 - REINJECTION
7900 - BUILDING,TRAILER OR SKID
8200 - CONTROL PANEL
8500 - ELECTRICAL PARTS
9900 - EXTRAS

LEVEL	DATE	BY	REVISION
C	JUN 22, 09	JH	AS BUILT
B	MAY 19, 09	JH	FOR PRODUCTION
A	MAY 15, 09	JH	FOR APPROVAL

DWG. NO:	10647-01 (PAGE 2 OF 2)
TITLE:	P&ID LEGEND
CUSTOMER:	312 SCFH SYSTEM MATRIX ET, INC.
	MLE EQUIPMENT INC.



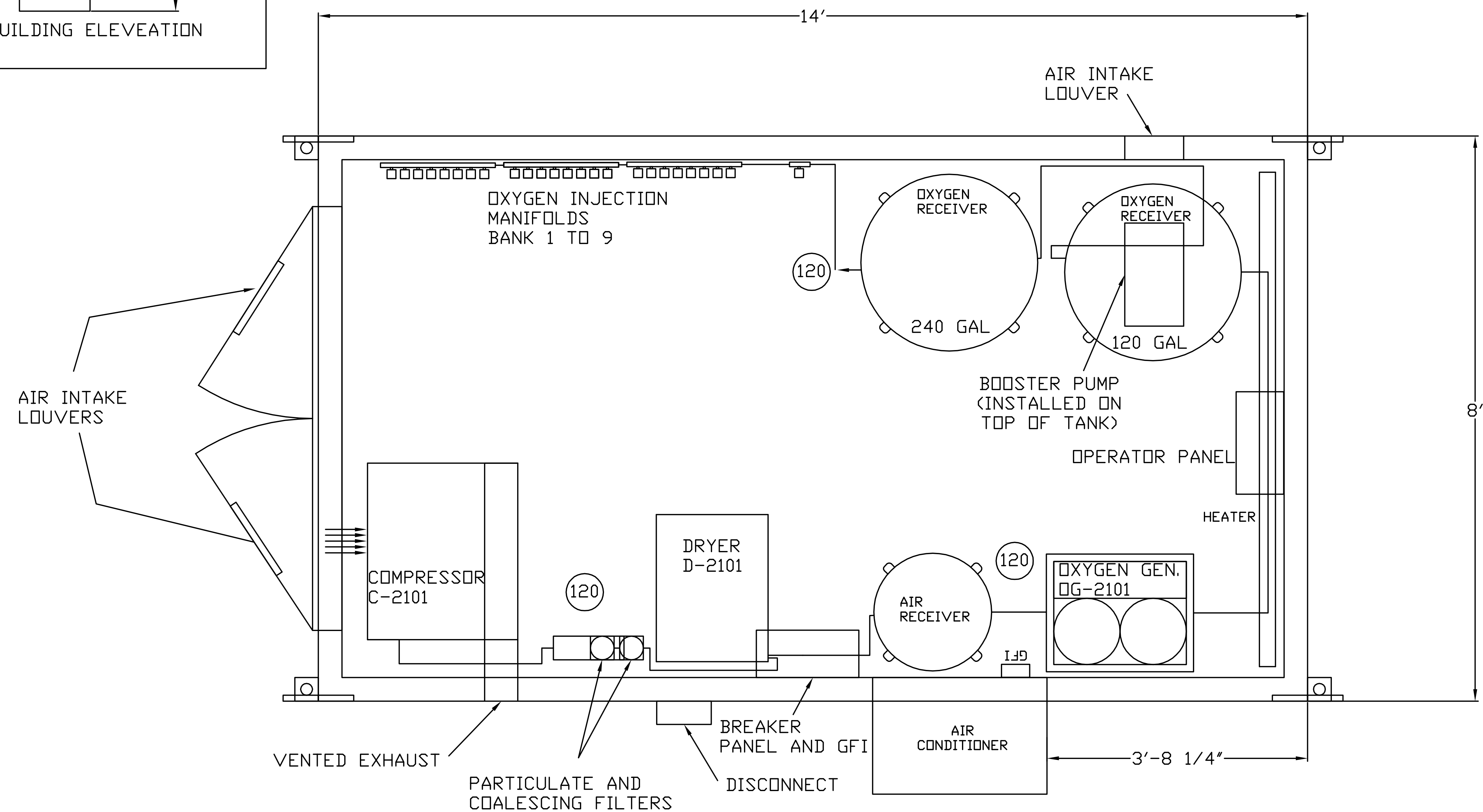
** CIVIL CONSTRUCTION NOTES **

- BUILDING TO HAVE THERMAL INSULATION ON WALLS AND CEILING.
- BUILDING TO HAVE WOOD PANELING AND BE PAINTED CLAY WITH WHITE CORNER POSTS.
- BUILDING TO HAVE PLYWOOD FLOOR.
- BUILDING TO HAVE SLOPED BROWN SHINGLED ROOF AND WHITE PRIMED DOORS.
- AIRSEP OXYGEN GENERATOR TO BE SUPPORTED NEAR THE TOP OF THE CYLINDER.
- INSTALL KEY HOLDER BRACKET ON CONTROL PANEL.
- BUILDING TO HAVE 1" VINYL COATED SOUND ATTENUATING INSULATION.
- WALL MOUNTED AC UNIT INSTALLED BY MLE

**MECH./ELECT. ASS'Y NOTES **

- LOCATE COOLING THERMOSTAT IN THE WARMEST LOCATION AT CEILING LEVEL.
- ENSURE LOCATION OF LIGHTS DOES NOT OBSTRUCT OPERATION OF SYSTEM AND CONTROL PANEL
- AIR RECEIVER TO BE LABELLED "AIR", OXYGEN RECEIVER TO BE LABELLED "OXYGEN", AND OXYGEN GENERATOR TO BE LABELLED WITH MATRIX PATENT. LABELS MUST BE ON THE FRONT OF THE TANKS, VISIBLE FROM THE TRAILER DOORS.
- CONTROL PANEL TO HAVE UL LABEL.
- BREAKER PANEL TO HAVE FUSE SCHEDULE LABEL.
- BREAKER PANEL TO HAVE MET APPROVAL LABEL.
- ENSURE THERE ARE NO LOOSE ITEMS ON THE BUILDING FLOOR.
- ASSEMBLE OXYGEN SENSOR TUBING.

*** COMMISSIONING NOTES ***



*** PACKING LIST ***

DESCRIPTION	DIM (L X W X H)	WEIGHT
BUILDING	14'x8'x10'	10500LBS

FLOW DIRECTION
ELECTRICAL CONNECTION
FLOW INTO THE PAGE
FLOW OUT OF THE PAGE
THIS AREA REPRESENTS SERVICE SPACE REQUIRED

LEVEL	DATE:	BY	REVISION:
A	DEC 29, 09	JH	FOR APPROVAL

DWG. NO: 901457R1- 02
TITLE: SYSTEM LAYOUT
CUSTOMER: 195SCFH SYSTEM HEMPSTEAD
MLE EQUIPMENT INC.