KEYSPAN

175 East Old Country Road
Hicksville, New York 11801-4280

November 17, 2006

Mr. Amen M. Omorogbe, P.E.
Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Western Remedial Action, 11th Floor
625 Broadway
Albany, New York 12233-7010

Re: Hempstead Intersection Street Former MGP Site- Site # 1-30-085
Replacement Pages for the Amended Final Remedial Investigation Report

Dear Mr. Omorogbe:

In accordance with the April 2006 comment letter from the New York State Department of Health (NYSDOH) to the NYSDEC, the March 2006 Final Remedial Investigation (RI) Report has been amended and the RI phase of the work is now complete. The overall report findings, conclusions and recommendations from the March 2006 engineer certified Final RI Report did not change from the referenced amendments. Therefore, since the nature of the changes is limited, the original P.E. stamped March 2006 Final RI Report will remain as the document of record with a new cover notation indicating that the report was amended in November 2006. The attached letter from the PS&S, PC Engineer of Record reaffirms the original P.E. certification for the Final RI Report.

Attached are the amended Final RI Report pages, tables, figures, and appendices. The current holders (NYSDEC, NYSDOH, NCDH) of the March 2006 Final RI Report have agreed to make the necessary updates to the report as detailed below:

1. Cover Page (March 2006- Amended November 2006);
2. November 2006 cover letters;
3. Text Pages 1-12, 1-13, 2-11, 4-35, 5-14, 5-16, 5-17, and 9-3;
4. Table 4-4;
5. Drawing 4N;
6. Drawing 6C;
7. Drawing 6D;

8. Appendix C – Human Health Exposure Assessment/Fish and Wildlife Resources Impact Analysis;
9. Appendix H – Village of Garden City and Village of Hempstead Capture Zone Analysis Reports.

The Final RI Report amendments are also being provided to Ms. Bridget Callaghan of the NYSDOH as requested by Ms. Sharon McClelland. If you have any questions, or require any additional information, please contact me at (516) 545-2578.

Sincerely,

Patrick J. Van Rossem

Patrick J. Van Rossem
Environmental Asset Management

Attachments

cc: B. Callaghan, NYSDOH (1 copy)
T. Leissing, (1 copy, 1 CD)
L. Liebs, (1 CD)
S. McClelland, NYSDOH (letter only)
F. Murphy, (1 CD)
R. Weitzman, NCDH (1 copy)

P S engineering

Paulus, Sokolowski & Sartor Engineering, PC
67A Mountain Boulevard Extension
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Warren, New Jersey 07059
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November 17, 2006
2522-013-024

Mr. Patrick J. Van Rossem
Senior Environmental Engineer
Environmental Asset Management
KeySpan Corporation
175 E. Old Country Road
Hicksville, NY 11801

Re: Hempstead Intersection Street Former MGP Site- Site # 1-30-085
Final Remedial Investigation Report
Replacement Pages

Dear Mr. Van Rossem:

This letter serves to summarize the amendments to the March 2006 Final Remedial Investigation (RI) Report in accordance with the comments issued by the New York State Department of Health (NYSDOH) in April 2006. As a result of the NYSDOH comments, the report amendments were completed while the overall content, conclusions and recommendations of the March 2006 New York Sate Professional Engineer signed and sealed Final RI Report have not changed. Therefore, since the nature of the amendments are limited, the original March 2006 Final RI Report will remain as the document of record with the following pages being replaced in that document:

1. Cover Page (March 2006- Amended November 2006);
2. Text Pages 1-12, 1-13, 2-11, 4-35, 5-14, 5-16, 5-17, and 9-3;
3. Table 4-4;
4. Drawing 4N;
5. Drawing 6C;
6. Drawing 6D;
7. Appendix C – Human Health Exposure Assessment/Fish and Wildlife Resources Impact Analysis;
8. Appendix H – Village of Garden City and Village of Hempstead Capture Zone Analysis Reports.

Thank you for your time and consideration. If you have any questions, or require any additional information, feel free to contact me at 732-560-9700.

Very truly yours,

PAULUS, SOKOLOWSKI AND SARTOR ENGINEERING, PC

Joseph J. Lifrieri, P.E., C.P.G, P.P
Vice President

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KEYSPAN

175 East Old Country Road
Hicksville, New York 11801-4280

March 24, 2006

Mr. Amen M. Omorogbe, P.E.
Project Manager
New York State Department of Environmental Conservation
Division of Environmental Remediation
Bureau of Western Remedial Action, 11th Floor
625 Broadway
Albany, New York 12233-7010

Re: Hempstead Intersection Street Former MGP Site
Final Remedial Investigation Report

Dear Mr. Omorogbe:

Attached are two (2) hard copies (P.E. stamped) and one CD copy of the following report from Paulus, Sokolowski, and Sartor, PC:

*"Hempstead Intersection Street
Former Manufactured Gas Plant Site
Final Remedial Investigation Report
March 2006"*

This report was revised to incorporate the NYSDEC and NYSDOH comments on the Draft Final RI Report. The public water supply well assessment reports from H2M are included in Appendix H. The Final RI Report has also been provided to Mr. Trevor Wescott of the NYSDOH. If you have any questions, or require any additional information, please contact me at (516) 545-2578.

Sincerely,

Patrick J. Van Rossem

Patrick J. Van Rossem
Environmental Asset Management

Attachment

cc: M. Lennon (1 CD)
L. Liebs, (1 CD)
F. Murphy, (1 CD)
T. Wescott, NYSDOH (1 copy)
R. Weitzman, NCDH (1 copy)

HEMPSTEAD INTERSECTION STREET
FORMER MANUFACTURED GAS PLANT SITE

FINAL REMEDIAL INVESTIGATION REPORT

Prepared for:

KEYSPAN CORPORATION
One MetroTech Center
Brooklyn, New York

MARCH 2006

Amended November 2006

Prepared by:

PS&S engineering

Paulus, Sokolowski and Sartor Engineering, PC
67A Mountain Boulevard Extension
P.O. Box 4039
Warren (Somerset County), New Jersey 07059

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EXECUTIVE SUMMARY

This Final Remedial Investigation (RI) Report addresses the former Manufactured Gas Plant (MGP) site located on Intersection Street in the Villages of Hempstead and Garden City in the Town of Hempstead, Long Island, New York. The investigation was undertaken to identify the environmental conditions at the site and to evaluate the presence and extent of any offsite impacts. In addition, the investigation was undertaken to determine whether human health and the environment are currently affected or may be affected by MGP-related impacts, and to guide the development of any required measures to remediate those impacts. This Report presents the findings, conclusions and recommendations of the investigative activities.

In July 2004, a Draft Final RI Report was submitted to and reviewed by the New York State Department of Environmental Conservation (NYSDEC). NYSDEC subsequently provided comments in letters dated November 19, 2004 and December 17, 2004 and provided a conditional approval of the Final RI Report in a May 23, 2005 letter to KeySpan. This Final RI Report has been revised to incorporate all of the NYSDEC comments, and to include the groundwater flow modeling reports in **Appendix H**.

Reason for Investigation:

A Manufactured Gas Plant (MGP) operated on the site from the early 1900s until the mid 1950s. The plant was decommissioned in the 1950's and the above ground structures related to its operations were demolished. A portion of the property was sold to a third party and is now used as an automobile dealer's storage area for cars; however, this area is considered part of the site for purposes of this investigation.

MGP operations produced wastes, which are known to present potential hazards to human health and the environment. The investigation was undertaken to delineate previously identified site related environmental conditions and a groundwater plume migrating off the site, to determine whether human health or the environment are being affected by MGP-related impacts, and to guide any required measures to remediate those impacts. This RI report incorporates the results of several periods of investigation at the site from 1990 through the Supplemental Remedial Investigation Field Program performed by Paulus, Sokolowski and Sartor Engineering, PC (PS&SPC) in 2003. Based on the investigation results, the information will guide the development of a Remedial Technology Evaluation, which will address the identified impacts for protection of human health and the environment. KeySpan is responsible for the investigation because it or a predecessor company owned the site at the time the wastes associated with the former MGP operations were produced on the site.

The objectives of the RI (including its associated Exposure Assessment and Fish and Wildlife Resources Impact Analysis) were to:

- Sufficiently characterize the site, for remediation purposes, to achieve an understanding of the nature and extent of nonaqueous phase liquid (NAPL) and associated chemical constituents in the vicinity of the former MGP structures and their migration in the environment, within and beyond the site boundaries;

- Identify the potential human exposure pathways and environmental risks associated with chemical constituents found in the environment in order to determine the need for any remedial action;

- Determine if petroleum spills reported to the NYSDEC for sites located adjacent to and downgradient of the former MGP site, including the Oswego Oil Corporation site and the Mollineaux Brothers Fuel Company site, are contributing to the identified chemical constituents and NAPL impacts;

- Determine the current status of and potential for impact to four NYSDEC-registered private water supply wells located downgradient of the site, and concurrently determine whether unregistered private water supply wells exist downgradient of the former MGP site and, if wells are identified, determine whether they are impacted by the site groundwater plume; and

- Provide sufficient environmental information to support the determination of the need for remedial action, support the evaluation of remedial technologies, and guide the design and subsequent implementation of any selected remedy.

Based on the results of the environmental sampling, the direct field observations, an evaluation of all the information assembled for the RI and the RI findings as presented in this report, the RI objectives have been achieved and the RI process is considered complete.

Key Findings:

1. The RI provides an understanding of the nature and extent of chemical constituents in the environment and identifies potential human exposure pathways and environmental risks in sufficient detail to support a Remedial Technology Evaluation, which will propose potential remedial alternatives for the site.

2. The investigation determined the presence of materials associated with coal tar and its related constituents, which are wastes expected to be found at a former MGP site. The chemical constituents are principally Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and Polycyclic Aromatic Hydrocarbon (PAH) compounds, and NAPL detected in soil and groundwater. For details about these materials, see Sections 4 and 5 of this Report. The investigation results indicate that the majority of MGP-related residuals or NAPL were observed in two intervals: shallow soils in the upper 8 feet 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 feet beneath the site.

3. The on-site impacts have migrated downgradient of the site in a southerly direction. The dissolved phase chemical constituent (BTEX/PAH) plume in the groundwater is approximately 600 feet wide and extends approximately 3,800 feet in a southerly direction. The observed NAPL zone near the water table extends approximately 450 feet south of the site. The concentrations in the dissolved BTEX/PAH plume decrease rapidly as they migrate away 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

storage facilities located directly adjacent to the site; other non-MGP related off-site sources including past and present commercial and industrial operations; and chemicals generated by vehicle traffic and other internal combustion engines.

4. The results of the investigation indicate that chemical constituents from the site have not adversely impacted drinking water supplies in the community. Groundwater flow modeling performed by H2M Group (H2M) (see **Appendix H**) also 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 modeled by H2M, assuming normal pumping rates based on historical data.

5. The RI and Qualitative Human Exposure Assessment indicate that there are potential pathways through which individuals on and near the site could be exposed to potentially hazardous materials related to former MGP activities. The shallow source area soils present the greatest potential for risk via direct contact with the soils, release of volatile organic vapors and the potential for the continuing release of NAPL and dissolve phase constituents to the environment. The greatest risk of potential exposure is associated with subsurface construction activities undertaken without appropriate precautions. There are very limited possibilities of wildlife exposure, given the location and highly transient nature of the wildlife. However, there are no significant or imminent threats to human health that warrant an interim remedial action.

Site Location and Description:

The 7.5-acre Hempstead Intersection Street Former MGP site is located primarily within the Village of Garden City in central Nassau County, New York. The border between Garden City and the Village of Hempstead is located just within the former MGP site's southern property boundary, and therefore, a small portion of the site is also located within the Village of Hempstead. A 0.8-acre parcel in the southernmost portion of the site is currently used as a parking lot for vehicle storage. This parcel was sold by the Long Island Lighting Company (LILCO, a KeySpan predecessor company) in the early 1980s.

The site is generally flat and secured by a perimeter fence. An active gas regulator station is situated on the western portion of the site. A small triangular area of the east end of the property is leased to a business for vehicle storage. As discussed above, the southernmost portion of the former MGP site was previously sold and is used as a parking lot for vehicle storage. The remaining site is currently vacant and not being actively used by KeySpan. A natural buffer, consisting of grass, shrubs and trees, extends across the northern portion of the site along Second Street.

An automobile dealership and commercial businesses are located east of the site along Franklin Avenue and residential properties are located north along Second Street. Property owned by the Village of Garden City is to the west of the site. Intersection Street and a parking lot for a medical office building are located immediately south. An inactive Long Island Rail Road (LIRR) right-of-way borders the eastern portion of the site. Commercial/manufacturing businesses are located immediately to the south of the LIRR right-of-way, including an automobile dealership, a fuel oil loading facility (Oswego Fuel oil Company) and an inactive fuel oil storage and loading facility (Mollineaux Brothers Fuel Oil Company).

Site History:

The Hempstead MGP began operations in the early 1900s. The facility originally produced coal gas but was converted to a carburetted water gas (CWG) process some time after 1910. Following the arrival of natural gas, the Hempstead site served as a peak/emergency facility to ensure gas supply until all operations ceased in the mid-1950s. The plant was subsequently demolished shortly thereafter. Propane vaporization was also used at this site to supplement the gas supplies starting in the early 1950s.

The majority of the former MGP structures and operations were located in the southernmost portion of the site, including the previously sold property which is currently used for vehicle storage. Located in this area were the 340,000-cubic foot main storage holder, the 250,000-cubic foot relief holder and a 140,000-gallon gas oil tank. Located on the southeastern corner of the site was the former gas generator house. Other structures located on the southernmost portion of the site included an effluent treatment facility, tar separators, skimming basins and various tar and tar emulsion storage and settling tanks. A series of gas purifying structures including oxide purifier boxes, tar extractors and an electric precipitator house straddled what is now the southern property line.

A coal storage area was located in the northeastern portion of the site. Tar and oil storage tanks were located in the eastern portion of the site adjacent to the LIRR right-of-way. A large tar separator and an associated cesspool were located in the south-central portion of the site. A series of cooling spray ponds was located in the north-central portion of the site. Immediately east of the former spray ponds were four 30,000-gallon liquid propane tanks. The concrete foundations for the propane tanks currently exist at the site. Three drip Oil Tanks (12,000, 7,300 and 9,500 gallons capacity), along with a paint house were located near the western property line.

LILCO acquired the former MGP site in the early 1930s. In 1998, LILCO merged with Brooklyn Union Gas forming KeySpan Corporation. Following this merger, all but the previously sold automobile dealer property became KeySpan property.

Previous Investigation Activities:

Starting in 1990 and continuing through the Supplemental Remedial Investigation Field Program performed in 2003, several investigation activities have been conducted at the site. The investigations performed are listed here and a brief summary of each investigation and associated findings is presented in Section 1.0.

1. December 1990 Preliminary Investigation;
2. October 1992 Field Investigation;
3. July 1992 Baseline Risk Assessment;
4. November 1993 Remedial Alternatives and Feasibility Analysis;
5. May 1995 Contaminant Fate Report;
6. 1999 Cut and Plug Interim Remedial Measure; and
7. March 2003 Remedial Investigation Report (March 2003 RIR).

The results of these investigations have been used to establish existing site conditions, the relationship between the historical site operations and the observed impacts to soil and groundwater, and to prepare this Final RI Report. This Final RI Report includes a Conceptual Site Model that interprets the investigation results describing 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.

Site Conditions:

The results of the investigation indicates that NAPL is present at or near saturated levels in the 0 to 8 foot shallow soil zone primarily beneath and within the vicinity of former MGP structures, including the drainage sump area located in the northwestern corner of the site, drip oil tanks area located along the western property boundary, the tar separator located in the south-central portion of the site, the oxide purifier boxes and tar extracting facilities located along the boundary of the KeySpan property and the sold property in the southernmost portion of the site, the northernmost cooling spray pond, the main gas holder and the relief holder. These areas also generally exhibited the highest BTEX and PAH concentrations observed in shallow subsurface soil. The shallow nature of these source areas also makes them key contributors to the identified potential exposure pathways, including the potential for direct contact, and inhalation.

Shallow soils saturated with NAPL (including BTEX and PAHs) are also present off-site within the adjacent LIRR right of way and near the Oswego Oil Service Corporation to the east of the site. Some of these off-site NAPL impacts are associated with several documented petroleum releases at the Oswego Oil Service Corporation, and they represent an additional non-MGP source of chemical constituents to soil and groundwater. A Freedom of Information Law (FOIL) request was conducted for the Oswego Oil Company, located at 45 Intersection Street, Hempstead, New York. Six spill numbers were reported for the Oswego Oil site. A review of the documents relating to these six spill numbers identified a history of spills associated with overfilling and equipment failure which impacted soils and groundwater at the Oswego site. Most notably was a site investigation that resulted in the discovery, monitoring and bailing of petroleum-related Light Non-Aqueous Phase Liquid (LNAPL) at four well locations on the Oswego site adjacent to the LIRR Right of Way.

Conceptual Site Model:

The observed MGP-related NAPL and site hydrogeologic conditions support a conceptual site model as summarized below:

1. NAPL associated with the former MGP site accumulated in the shallow site soils around the identified source areas until their sorption capacity was exceeded and the NAPL migrated vertically downward. NAPL and NAPL-residuals remain at or near saturated conditions in the shallow soil beneath the former source areas.

2. The vertical migration of NAPL from the near-surface source area soils appear to have occurred via isolated and relatively thin pathways. These can be envisioned as vertical columns extending down from the mass of material accumulated in the near-surface source area soils.

3. The vertical migration of NAPL was impeded when it encountered the soils at and just above the water table and NAPL has accumulated to saturated and near saturated levels. The majority of the NAPL saturated soils occurs just below 24 feet below ground surface (bgs) and extends down to and just below the water table encountered at an average of 30 ft-bgs. Although beneath the former source areas, some NAPL penetration further into the saturated zone has occurred, and the NAPL preferentially migrated horizontally along the slope of the water table extending approximately 450 feet beyond the southern site boundary as a thin (0 to 6-inch thick) layer at the water table interface.

4. The saturated and near saturated NAPL soils in the shallow source areas and at depth in proximity to the water table are sources of dissolved phase chemical constituents (BTEX and PAH). This has resulted in the plume of dissolved phase constituent; in the shallow groundwater zone that extends approximately 3800 feet from the site in a southwestern direction.

<u>Conclusions</u>:

1. This Final RIR considering together the results of the March 2003 Remedial Investigation and Supplemental Investigation, provides an understanding of the nature and extent of the chemical constituents in the environment and identify the potential human exposure pathways and environmental risks in sufficient detail to support development and evaluation of potential remedial alternatives for the site.

2. The impacts from MGP and petroleum related materials and chemical constituents present potential direct contact and inhalation exposures for current and possible future site use scenarios and adjacent area populations.

3. There are no significant or imminent threats to human health that warrant an interim remedial action. The on-site risks are associated with potential contact with near surface soils. This risk is presently limited through access restrictions, surface cover in work areas and employee training.

4. The results of the investigation indicate that drinking water supplies in the community have not been impacted by chemical constituents from the site.

5. The potential exposure pathways can be mitigated or eliminated by known remediation technologies that will be evaluated in the next phase of the project. Reducing or eliminating the observed impacts in the near surface source area soils has the greatest potential to significantly reduce the identified exposure pathways associated with the current and possible future site uses.

Recommendations:

1. A Remedial Technology Evaluation is recommended to determine the remedial measures needed to reduce or eliminate the identified potential exposure pathways associated with the shallow on-site source area soil; reduce the mobility of NAPL accumulated at or just above the water table; mitigate the dissolution of BTEX and PAHs into the groundwater from the NAPL sources; and to enhance the biodegradation and attenuation of the plume. The Remedial Technology Evaluation will need to consider the contributions of the adjacent off-site sources of NAPL and chemical constituents associated with the nearby fuel terminals east of the site. These off-site sources should be addressed by the responsible party so that the site remediation plan can be more effective.

2. In conjunction with the Remedial Technology Evaluation, additional soil gas sampling is recommended near on-site locations where shallow impacts have been identified, as well as at the adjacent Village of Garden City property and the areas east and west of the medical office building.

3. Quarterly monitoring of selected wells is recommended, including groundwater measurements, NAPL measurements and NAPL recovery. Additionally, quarterly groundwater sampling should be conducted for the centerline area of the groundwater plume to monitor the concentration and extent of previously identified chemical constituents and to monitor the rate of natural attenuation. The monitoring and sampling program should be conducted over a two-year period to provide a database to be utilized as part of the Remedial Technology Evaluation. After the two years of data is collected, the program should be scaled to be consistent with the site data needs at that time.

1.0 INTRODUCTION

KeySpan Corporation (KeySpan) entered into an Order on Consent (Index No. D1-0002-98-11) with the New York State Department of Environmental Conservation (NYSDEC) to conduct a Remedial Investigation of a former manufactured gas plant (MGP) site located in Garden City/Hempstead, Nassau County, New York (herein referred to as "the site"). As required by the Consent Order, the Remedial Investigation was completed in accordance with the scope of work presented in the Hempstead Intersection Street Former MGP Site Investigation Work Plan, dated June 2000; and the Phase II Investigation Work Plan, dated June 2001. A Remedial Investigation (RI) Report, prepared by Dvirka and Bartilucci (D&B), was accepted by the NYSDEC in June 2003.

In July 2004, a Draft Final RI Report was submitted to and reviewed by NYSDEC. NYSDEC subsequently provided comments in letters dated November 19, 2004 and December 17, 2004 and provided conditional approval of the Final RI Report in a May 23, 2005 letter to KeySpan. The Final RI Report has been revised to incorporate all of the NYSDEC comments.

This Final RIR includes data and analysis from the Remedial Investigation and also includes information gathered from implementation of the Supplemental Investigation Work Plan, dated March 17, 2003. Information presented in this report has been prepared by Paulus, Sokolowski and Sartor Engineering, P.C. for work performed in accordance with the March 2003 Supplemental Investigation Work Plan. The Report has been structured to present the data generated from the previous investigation and this investigation, providing for an overall and complete assessment of the existing site conditions.

This Final RIR presents:

- Introductory and background information related to the site;
- An overview of historic and current operations at the site;
- A discussion of the investigation program;
- A discussion of the geology and hydrogeology of the investigation area;
- A discussion of the nature and extent of chemical constituents in the environment;
- A discussion of the fate and transport of chemical constituents in the environment;
- A Conceptual Site Model;
- Conclusions; and
- Recommendations.

In addition, this report includes a Qualitative Human Exposure Assessment/Fish and Wildlife Resources Impact Analysis (QHEA/FWRIA), which has been prepared to identify potential human exposure pathways and environmental risks associated with the site. The Final RI Report includes Capture Zone Analysis Reports from H2M which is contained in **Appendix H**. The H2M reports summarize groundwater flow modeling that was conducted to assess public water supply wells relative to site related impacts.

1.1 Overview of Report Organization

This report is organized into the following sections:

- **Executive Summary:** Summarizes and provides an overview of the previous investigation activities and the findings of the Final RIR.

- **Section 1.0 - Introduction:** Presents project objectives, background and available historical information and a description of the physical setting of the site and its surroundings.

- **Section 2.0 - Investigation Program:** Provides a summarized overview of the field activities associated with the Supplemental Remedial Investigation Field Program. Additionally, it discusses data management and chemical data validation/usability and review of a Freedom of Information Law (FOIL) request.

- **Section 3.0 - Site Geology and Hydrogeology:** Summarizes from the March 2003 Remedial Investigation Report (March 2003 RIR) the geology and hydrogeology of the site and immediately surrounding study area.

- **Section 4.0 - Nature and Extent of Chemical Constituents:** Summarizes from the March 2003 RIR the direct observation of residual MGP-related materials and concentrations of chemical constituents detected in various environmental media sampled on-site and off-site on an area-by-area basis. This section also includes data and analysis from the Supplemental Remedial Investigation Field Program.

- **Section 5.0 - Fate and Transport of Chemical Constituents:** Discusses the fate and transport of chemical constituents, Non-Aqueous Phase Liquid (NAPL) and residual MGP-related materials in the on-site and off-site environment.

- **Section 6.0 – Conceptual Site Model**: Describes the relationship between the former MGP operations, the findings of the Remedial Investigations and potential migration and exposure pathways for the identified impacts.

- **Section 7.0 – Conclusions**: Provides a technical evaluation of the identified findings of all of the investigations conducted at the subject site.

- **Section 8.0 – Recommendations**: Based upon the findings of all of the investigations conducted at the site, this section contains recommendations for future work to be completed at the subject site.

- **Section 9.0 - References:** Lists all documents and other sources of information utilized in the preparation of this report.

- **Appendix A -** Database Search Report

- **Appendix B -** FOIL File Request Documentation

- **Appendix C -** Qualitative Human Exposure Assessment/Fish and Wildlife Resources Impact Analysis

- **Appendix D -** Cut and Plug IRM Analytical Results
- **Appendix E -** Boring Logs
- **Appendix F -** Analytical Methods and Detection Limits
- **Appendix G -** Analytical Results – Data Summary Tables
- **Appendix H –** Water Supply Wells – Capture Zone Analysis Reports

1.2 Project Objectives

The objectives of the Remedial Investigation, Supplemental Remedial Investigation Field Program, QHEA and FWRIA were to:

- Sufficiently characterize the site, for remediation purposes, to achieve an understanding of the nature and extent of non-aqueous phase liquid (NAPL) and associated chemical constituents in the vicinity of the former MGP structures and their migration in the environment;

- Define the off-site extent of NAPL and associated chemical constituents Benzene, Toluene, Ethylbenzene and Xylene (BTEX) and Polycylic Aromatic Hydrocarbons (PAH) immediately downgradient of the site;

- Obtain information on active NYSDEC petroleum spill sites located adjacent to and downgradient of the former MGP site, including the Oswego Oil Corporation site and the Mollineaux Brothers fuel Company site, to determine if these adjacent fuel oil facilities are contributing to the off-site groundwater plume;

- Determine the current status of four NYSDEC-registered private water supply wells located downgradient of the site, and determine whether they are impacted by the site groundwater plume; and determine whether unregistered private water supply wells exist downgradient of the former MGP site and, if wells are identified, determine whether they are impacted by the site groundwater plume;

- Identify the potential human exposure pathways and environmental risks associated with chemical constituents found in the environment in order to determine the need for any remedial action(s); and

- Provide sufficient environmental information to support the determination of the need for any remedial action(s), support the evaluation of remedial technologies, and guide the design and subsequent implementation of any selected remedy.

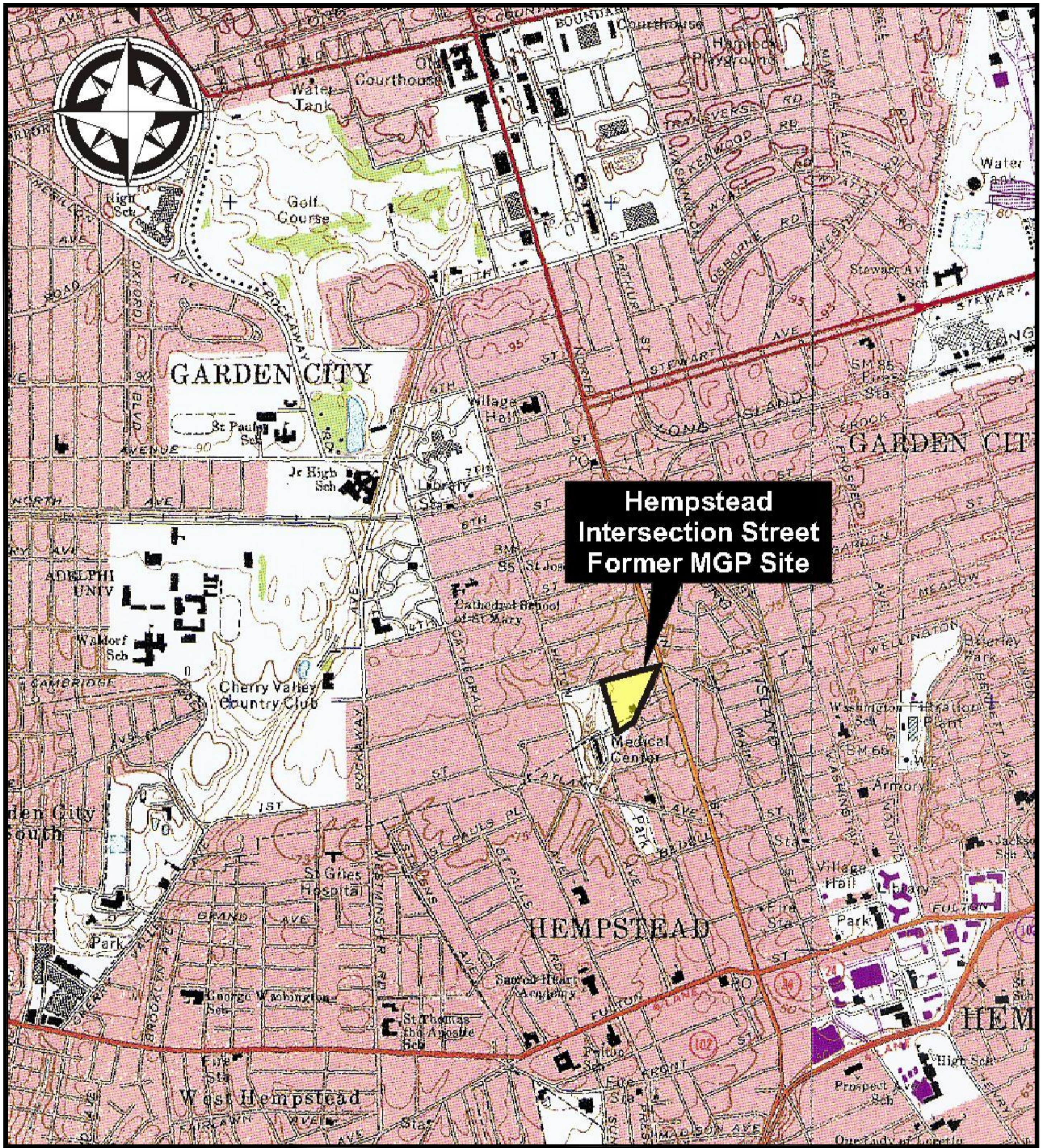
1.3 Site Location and Description

The Hempstead Intersection Street Former MGP site is located primarily within the limits of the Village of Garden City in central Nassau County, New York. The border between Garden City and the Village of Hempstead is located just within the former MGP site's southern property boundary, and a small portion of the site is located within the Village of Hempstead (see **Figure 1-1**).

The former MGP site is approximately 7.5 acres in size. Access to the site is along its southern boundary via an access road located along Intersection Street (see **Figure 1-2**). A secondary access is located along Second Street. A 0.8-acre parcel in the southernmost portion of the former MGP site is currently used to store vehicles owned by an automobile dealer. This portion of the site was leased and subsequently sold by the Long Island Lighting Company (LILCO - a KeySpan predecessor company) in the early 1980s. Note that the site investigation work plan, dated June 2000, considered the sold property as part of the Off-site Field Investigation Program. However, based on subsequent NYSDEC comments on the RI report, the investigation results from the sold property are now included as part of the On-site Field Investigation Program because the sold property was previously part of the former MGP site.

An automobile dealership and commercial businesses are located to the east of the site along Franklin Avenue and residential properties are located north of the site along Second Street. Property owned by the Village of Garden City is located to the west of the site. A public parking lot, a recreational park and a drainage basin are located on this property. In addition, the Village of Garden City water district facilities and public water supply wells are also located on this property. Intersection Street and a parking lot for a medical office building are located immediately south of the site. An inactive non-operational Long Island Rail Road (LIRR) right-of-way borders the eastern portion of the site. Commercial/manufacturing businesses are located adjacent to the LIRR right-of-way, including an automobile dealership and parking lot utilized for car dealers automobile storage and an active fuel oil storage and loading facility (Oswego Oil Service Corporation) and an inactive fuel oil storage and loading facility (Mollineaux Brothers Fuel Oil Company).

The site is generally flat and is secured by a perimeter fence. The majority of the utilized areas within the site perimeter are either paved with asphalt or covered by gravel. An active gas regulator station is situated on the western portion of the site. A small triangular area at the east end is leased to a car dealer for automobile storage. The southernmost portion of the former MGP site was previously sold and is also used as a parking lot for car dealer’s automobile storage. The remaining site is currently vacant and not being actively used by KeySpan. A natural buffer, consisting of grass, shrubs and trees, extends across the northern portion of the site along Second Street.



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KEYSPAN CORPORATION
HEMPSTEAD INTERSECTION STREET
FORMER MGP SITE REMEDIAL INVESTIGATION
GARDEN CITY/HEMPSTEAD, NEW YORK

SITE LOCATION MAP

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

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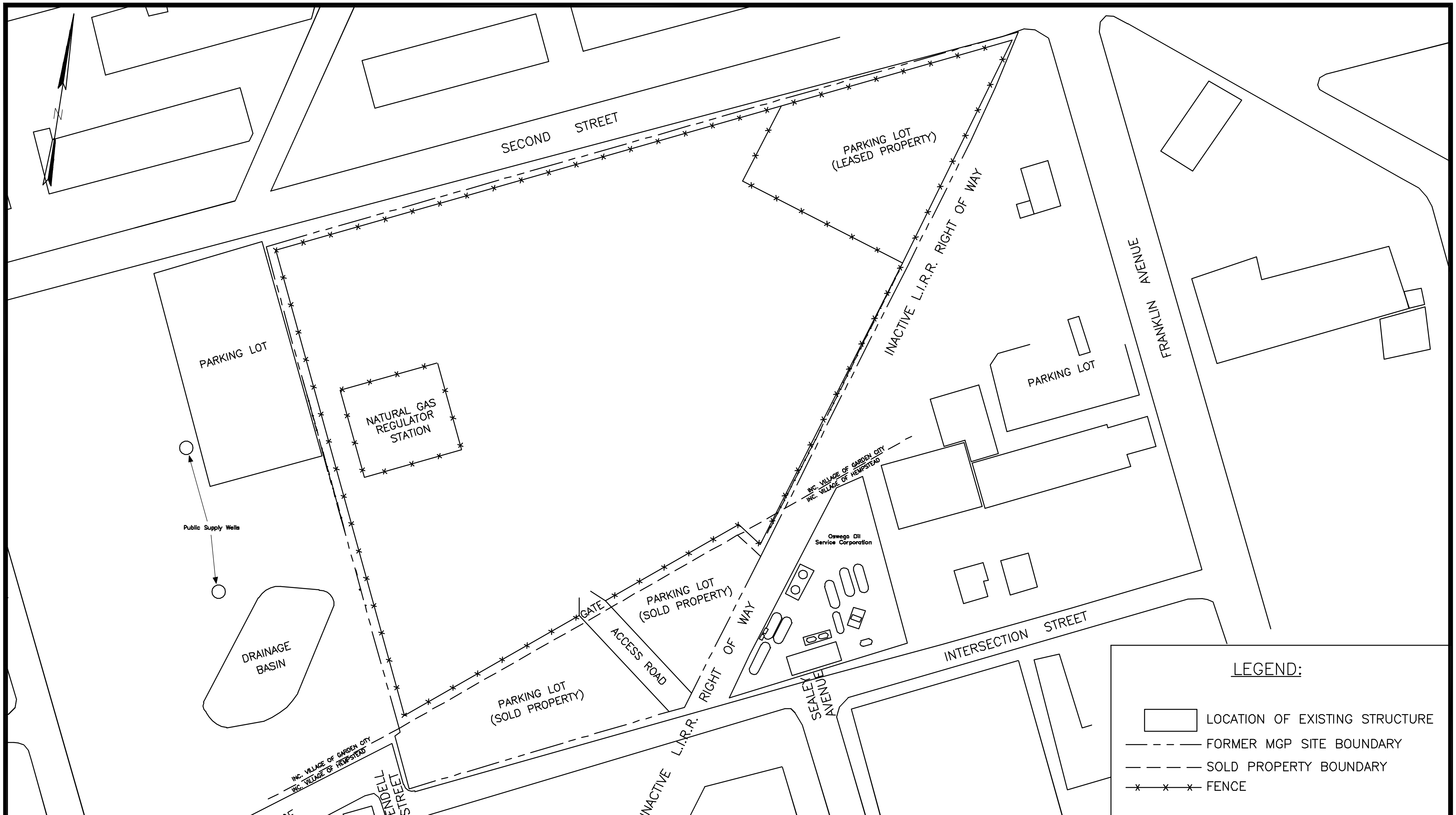
Drn. By: JJ	Scale: 1" = 2000'	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 1–1



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SITE MAP

Drn. By: JJ	Scale: 1" = 150'	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 1-2

1.4 Site History

Refer to the March 2003 RIR for a detailed history of operations on the site. Manufactured gas produced by the Hempstead MGP supplied areas of central Nassau County from Garden City to Freeport to East Rockaway. MGP operations began in the early 1900's in the southern portion of the site and expanded north as the demand for gas increased. Following the arrival of natural gas in the northeast in the early 1950's, the Hempstead former MGP served as a peak/emergency facility to ensure gas supply until operations ceased in the mid-1950s and the plant was subsequently demolished by LILCO. In 1998, LILCO merged with Brooklyn Union Gas forming KeySpan Corporation. Following this merger, the majority of the former MGP site became the property of KeySpan. The southernmost portion of the site was previously sold and is used for storing vehicles owned by an automobile dealer.

The following table summarizes information regarding the historical ownership of the former MGP site and is based on information presented in the document entitled, "Historic Review of MGP Plants on Long Island," prepared by Atlantic Environmental Services, Inc., dated June 26, 1996.

Record of Ownership [a]
Hempstead Manufactured Gas Plant (Intersection Road) [b]

Years	**Ownership**
1887 to 1903	No records available
1904	Nassau County Gas Company
1905	In hands of receiver
1906 to 1924	Nassau and Suffolk Lighting Company, Freeport, New York
1925	No records available
1926 to 1928	Nassau and Suffolk Lighting Company, New York, New York
1929 to 1933	Nassau and Suffolk Lighting Company, New York, New York
1934 to 1948	Nassau and Suffolk Lighting Company, a Subsidiary of Queensborough Gas & Electric Company (LILCO "acquired" all of the common stock of Queensborough Gas & Electric between 1923 and 1926)
1949 to 1961	Long Island Lighting Company, Mineola, New York
1962 and subsequent years	No records available

[a] Source: "Browns Directory of American Gas Companies" (Brown's Directory)
[b] Currently referred to as the Hempstead (Intersection Street) MGP

1.4.1 Former MGP Site

In summary, and as shown on **Figure 1-3**, the majority of the former MGP structures and operations were located on the southernmost portion of the site, including the sold property currently used for storing a car dealer's vehicles. For details on the structures on the former MGP site, please refer to the March 2003 RIR.

1.5 Project Background

1.5.1 Land Use and Demographics

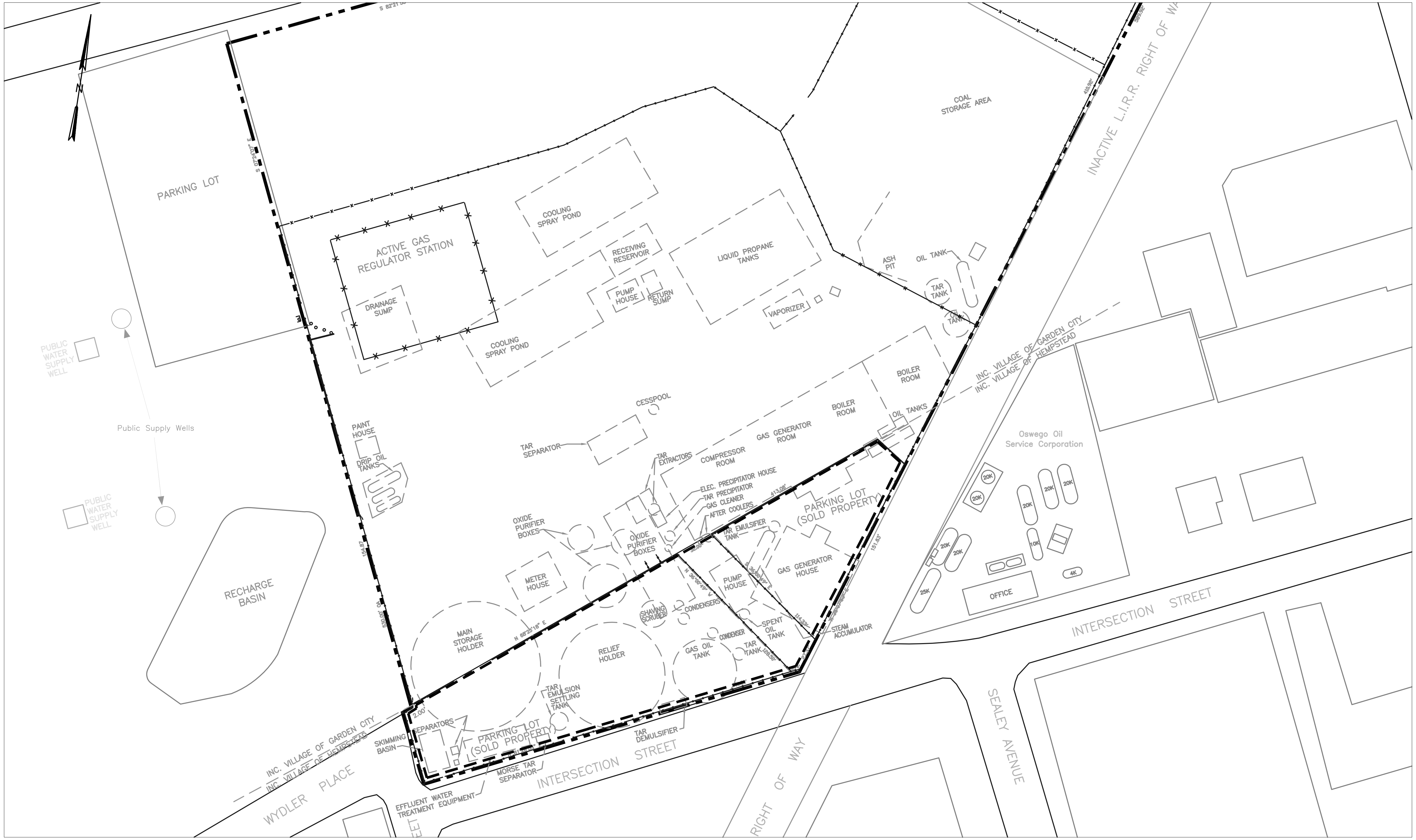
In summary, the area surrounding the site includes commercial, industrial, residential and recreational land uses. The former MGP site is zoned industrial with the exception of the sold property, which is zoned business "C." The Villages of Hempstead and Garden City are located within the Town of Hempstead. Recent population estimates prepared by the Long Island Power Authority for the Villages of Hempstead and Garden City reports 47,597 residents as of January 1, 2001. Properties immediately to the north of the site across from Second Street are zoned for multi-family residential apartment housing. Properties immediately to the east are zoned as general commercial. The property to the west is designated parkland. Property to the south of the site is zoned business "C", which includes warehouse storage, light manufacturing, car dealer's vehicle storage and repair. For additional details on Land Use and Demographics, refer to the March 2003 RIR.

1.5.2 Climate

The climate of Long Island is typically identified as humid continental with a significant maritime influence. The average annual temperature for Mineola, New York is 52.5 degrees Fahrenheit (^{o}F), with average monthly temperatures ranging from a low of 33.1 ^{o}F in January to a high of 73.6 ^{o}F in July. For additional details on climate, refer to the March 2003 RIR.

1.5.3 Topography

Topography of the Hempstead Former MGP site is relatively flat and slopes gently to the west and southwest with an on-site elevation ranging from 68 to 75 feet above mean sea level (see **Figure 1-4**). A slight depression exists in the northwest corner of the site adjacent to Second Street and the Village of Garden City parking lot to the west. As shown on **Figure 1-4**, the Village of Garden City recharge basin is located immediately west of the site, the bottom of which is approximately 53.5 feet above mean sea level.



LEGEND

APPROXIMATE LOCATION OF FORMER MGP STRUCTURE

FORMER MGP SITE BOUNDARY

SOLD PROPERTY BOUNDARY

FENCE

80 0 80

SCALE IN FEET

SOURCE:

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REVISIONS/ISSUES		
NO.	DATE	DESCRIPTION

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PROJECT

KEYSPAN CORPORATION
HEMPSTEAD INTERSECTION STREET
FORMER MGP SITE REMEDIAL INVESTIGATION
GARDEN CITY/HEMPSTEAD, NEW YORK

TITLE

FORMER MANUFACTURED GAS PLANT STRUCTURES

DATE FEBRUARY 2005	JOB NO. 2522.013.024
SCALE 1" = 80'	
DRAWN JJ	FIGURE NO. 1-3
CHKD. JMP	

1.5.4 Storm Water

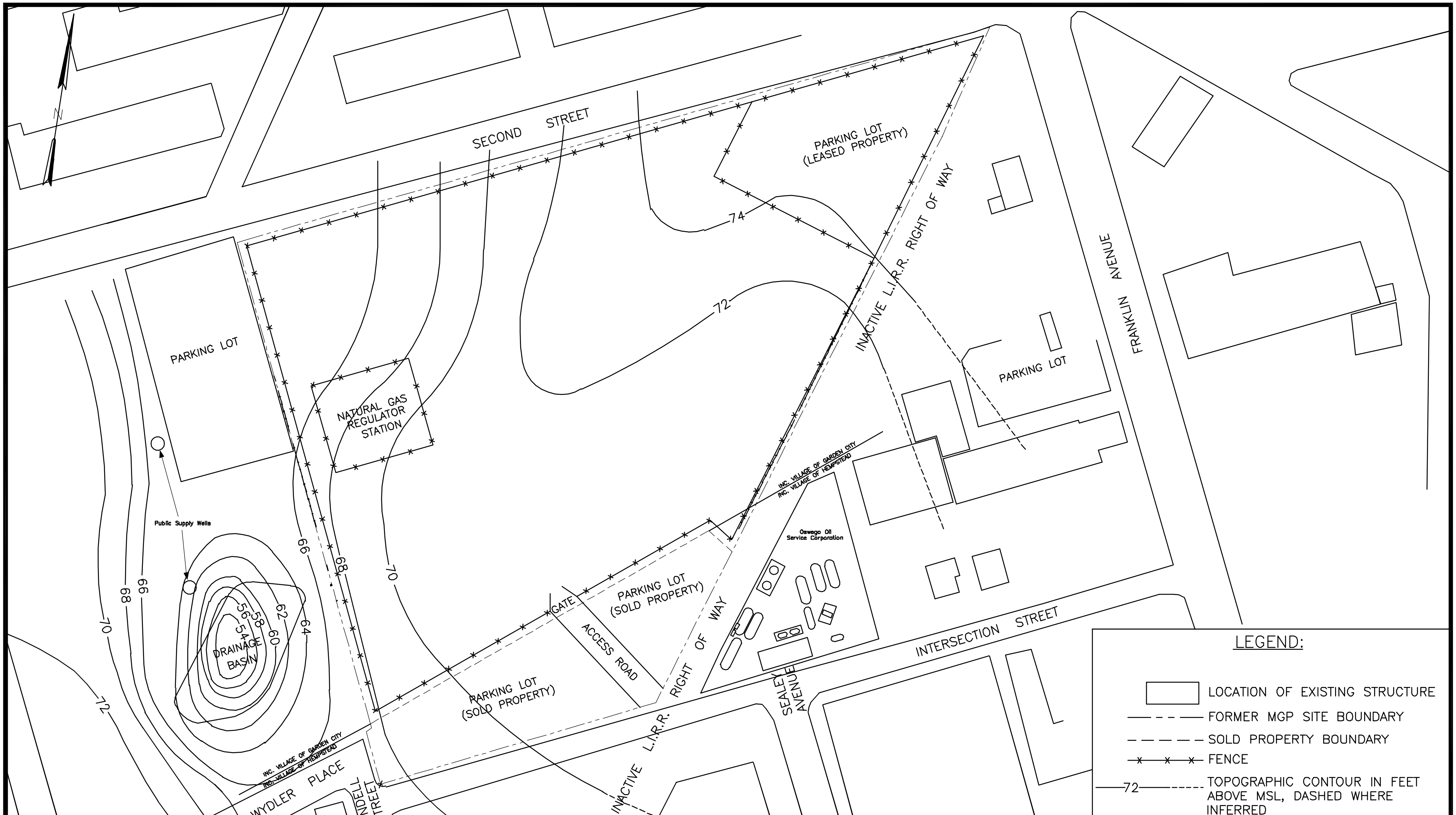
As discussed above, the site is relatively flat and slopes gently to the west and southwest. The northern two-thirds of the site, as well as the eastern portion of the site, is either unpaved ground covered with vegetation or crushed stone. Therefore, ground infiltration in these areas is generally good and storm water runoff would not be expected to occur under most storm events. The southern third of the site is covered with asphalt pavement. Storm water runoff from this paved area is diverted to a dry well located in the southern portion of the site.

1.5.5 Surface Water

There are no naturally occurring or manmade surface water bodies within the Hempstead former MGP site. The closest surface water body is a small creek located approximately 1.2 miles south of the site near the intersection of Peninsula Boulevard and President Street. This creek flows south eventually discharging to Hempstead Lake, located approximately 1.4 miles south of the site.

1.5.6 Regional Soil Classifications

Details on Regional Soil Classifications are provided in the March 2003 RIR. Area soils are classified as predominantly Urban Land-Hempstead. Urban Land-Hempstead is described as dominantly urban land and nearly level, well-drained, medium textured soils on plains. Site soils are Urban land-Hempstead complex, Urban land-Mineola complex, and Urban land-Riverhead complex. Urban land-Hempstead complex consists of very deep, well-drained soils. Urban land-Mineola complex consists of very deep, moderately well drained soils. It is in low, nearly level areas along intermittent or shallow drainage ways. Urban land-Riverhead complex consists of very deep well, drained soils.



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TOPOGRAPHIC MAP

Drn. By: JJ	Scale: 1" = 150'	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 1-4

1.5.7 <u>Regional Geology</u>

The regional geology consists of a relatively thick sequence of unconsolidated Pleistocene and Cretaceous-age sediments underlain by Precambrian-age bedrock. Pleistocene-age sediments consisting of highly permeable sands and gravels deposited as a glacial outwash plain, are approximately 60 to 80 feet thick and comprise the unconfined Upper Glacial aquifer, directly underlying the Garden City/Hempstead area. Underlying the Upper Glacial aquifer are Cretaceous-age sediments consisting of alternating layers of sand, silt and clays comprising the Magothy Formation. The Magothy Formation and its aquifer, which is under semiconfined conditions, is approximately 600 feet thick within the area and is utilized as a public source of drinking water within Nassau County. Underlying the Magothy aquifer are additional Cretaceous-age units including, in descending order, the Raritan Clay confining unit and the Lloyd aquifer. Consolidated bedrock is approximately 1,000 feet below grade. Regional groundwater flow within the Upper Glacial and the Magothy aquifers is generally to the south. **Figure 1-5** presents a geologic cross section through Central Nassau County

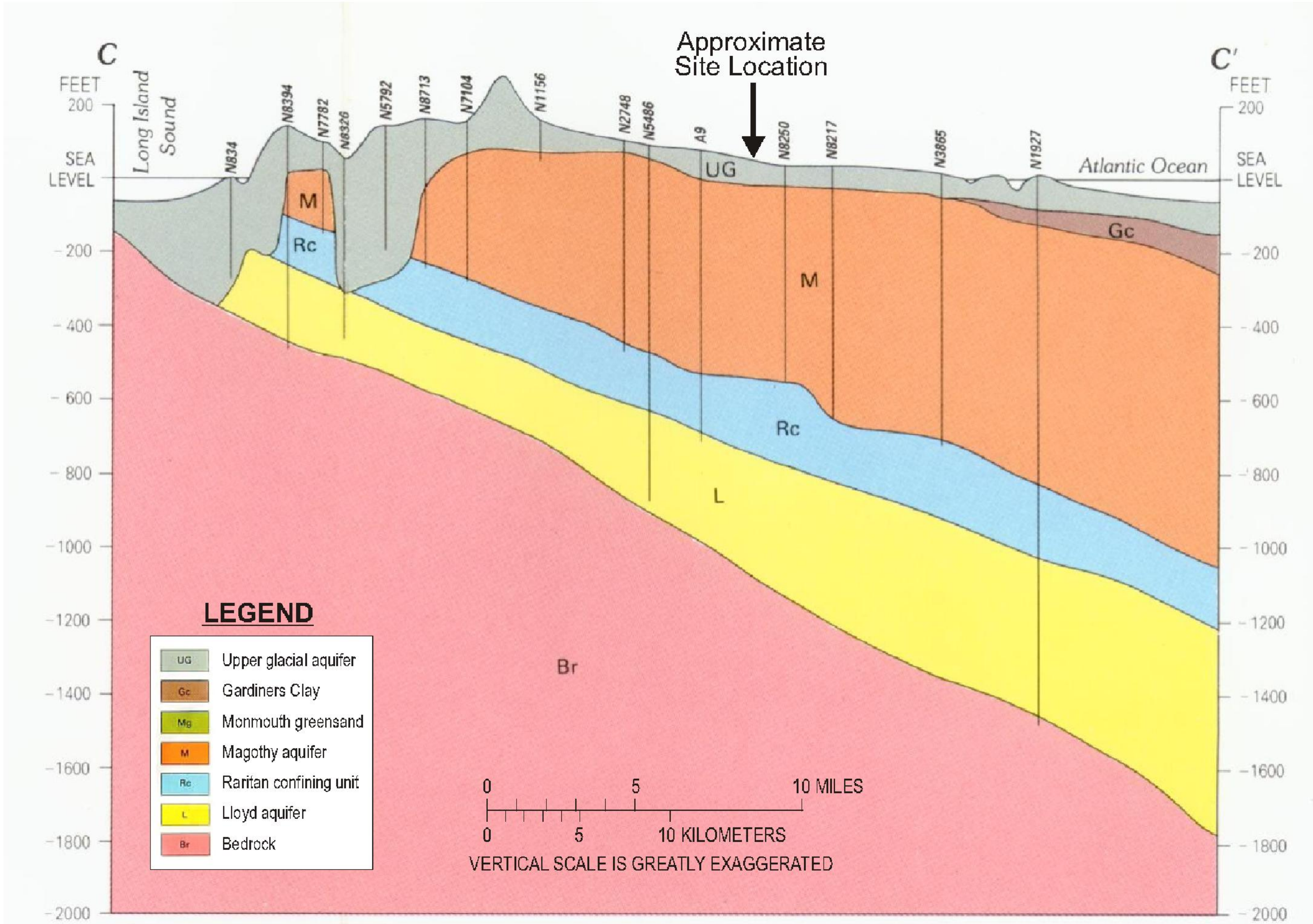
Geologic information generated as part of the Supplemental Investigation, as well as a discussion of the geologic and hydrogeologic conditions of the site and surrounding area are presented in **Section 3.0**.

1.5.8 <u>Regional Hydrogeology</u>

The saturated sands and gravels of the Lloyd, Magothy and the Upper Glacial deposits form Long Island's three major aquifers. Together, these constitute Long Island's Sole Source Aquifer System, as designated by the Environmental Protection Agency (EPA) pursuant to Section 1424(e) of the Safe Drinking Water Act. Precipitation serves as the system's only source of fresh water recharge.

Figure 1-6 is a groundwater contour map for Central Nassau County of Long Island. Based on **Figure 1-6**, in the Hempstead area, regional groundwater flow within the Upper Glacial aquifer is toward the south and southwest with groundwater discharging to Hempstead Lake and creeks that ultimately discharge to the various bays along Nassau County's south shore.

Hydraulic conductivities in the Magothy aquifer are approximately 50 to 60 ft/day (McClymonds and Franke, 1972). However, due to the presence of numerous clay-rich zones within the Magothy formation, the Magothy aquifer is highly anisotropic with vertical hydraulic conductivities being approximately 0.01 of horizontal values (McClymonds and Franke, 1972).



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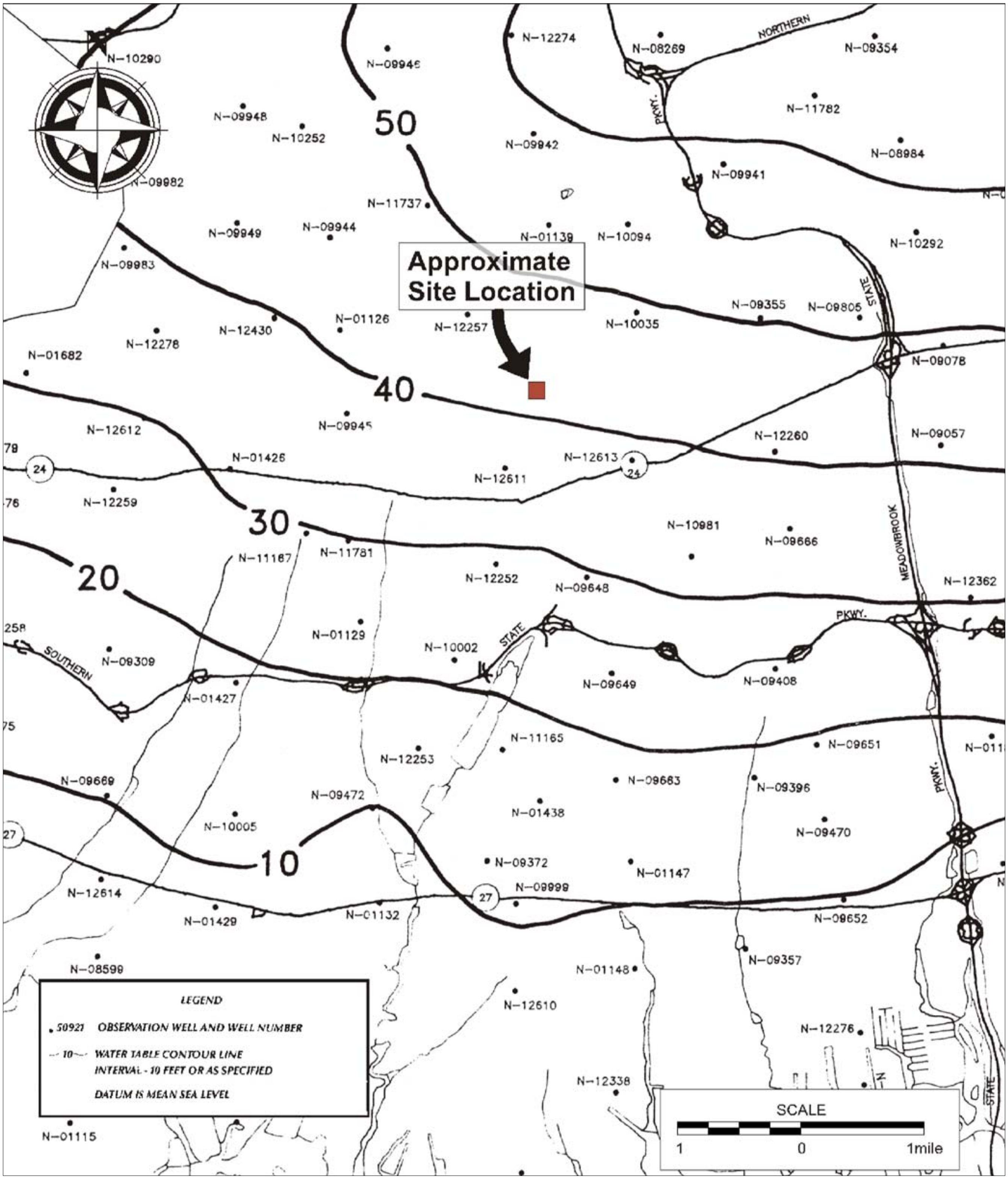
REGIONAL GEOLOGICAL CROSS SECTION
OF CENTRAL NASSAU COUNTY

Drn. By: JJ	Scale: AS SHOWN	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 1-5



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WATER TABLE CONTOUR MAP
FOR CENTRAL NASSAU COUNTY

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

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Hydrogeologic information generated as part of this Remedial Investigation, along with a discussion of local hydrogeologic conditions at the site and study area, is presented in **Section 3.0**.

1.5.9 Potable Water Supply

Details on the Potable Water Supply are presented in the March 2003 RIR. Existing public supply wells located within the vicinity of the site were identified through the review of NYSDEC and Nassau County Department of Health (NCDH) Records. **Table 1-1** presents data on public supply wells adjacent to and potentially downgradient of the site. **Table 1-2** presents data on private supply wells downgradient of the site. **Figure 1-7** provides the approximate location of public supply wells. **Figure 1-8** provides the approximate location of private supply wells.

There are two public supply wells located approximately 200 feet west (side-gradient) of the site. Both wells, N-10033 and N-10034, are operated by the Village of Garden City and are screened from 439 to 541 feet and 489 to 570 feet below grade, respectively, within the Magothy aquifer. Due to the low permeable nature of the sediments that comprise the upper portion of the Magothy aquifer, there is no projected likelihood that site-related constituents would be able to reach the screen zones of these supply wells. Analysis of samples collected from these wells on a routine basis by the Nassau County Department of Health (NCDH) confirms that site-related constituents have not affected the water quality of these wells. Additional details regarding the Village of Garden City supply wells are included in **Sections 1.7.5** and **1.7.6** of this report. **Appendix H** contains a copy of these Capture Zone Analysis Reports. A discussion of the private well sampling activities is discussed in **Sections 2.2.9**, **2.2.10** and **4.3.3** of this report.

There are two public supply well fields that may be considered potentially downgradient of the site. The first well field consists of two active production wells that are screened in the Magothy aquifer and are located approximately 1.3 miles southeast of the site. The second well field is located approximately 1.6 miles southwest of the site and consists of four active production wells all pumping from the Magothy aquifer. All active public supply wells are screened between 450 and 625 feet below grade. Based on currently available information concerning groundwater flow in the Upper Glacial and Magothy aquifers and the fact that all downgradient public supply wells are screened in the basal zone of the Magothy aquifer, it is unlikely that BTEX/PAHs associated with the site could impact the water quality of these wells.

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

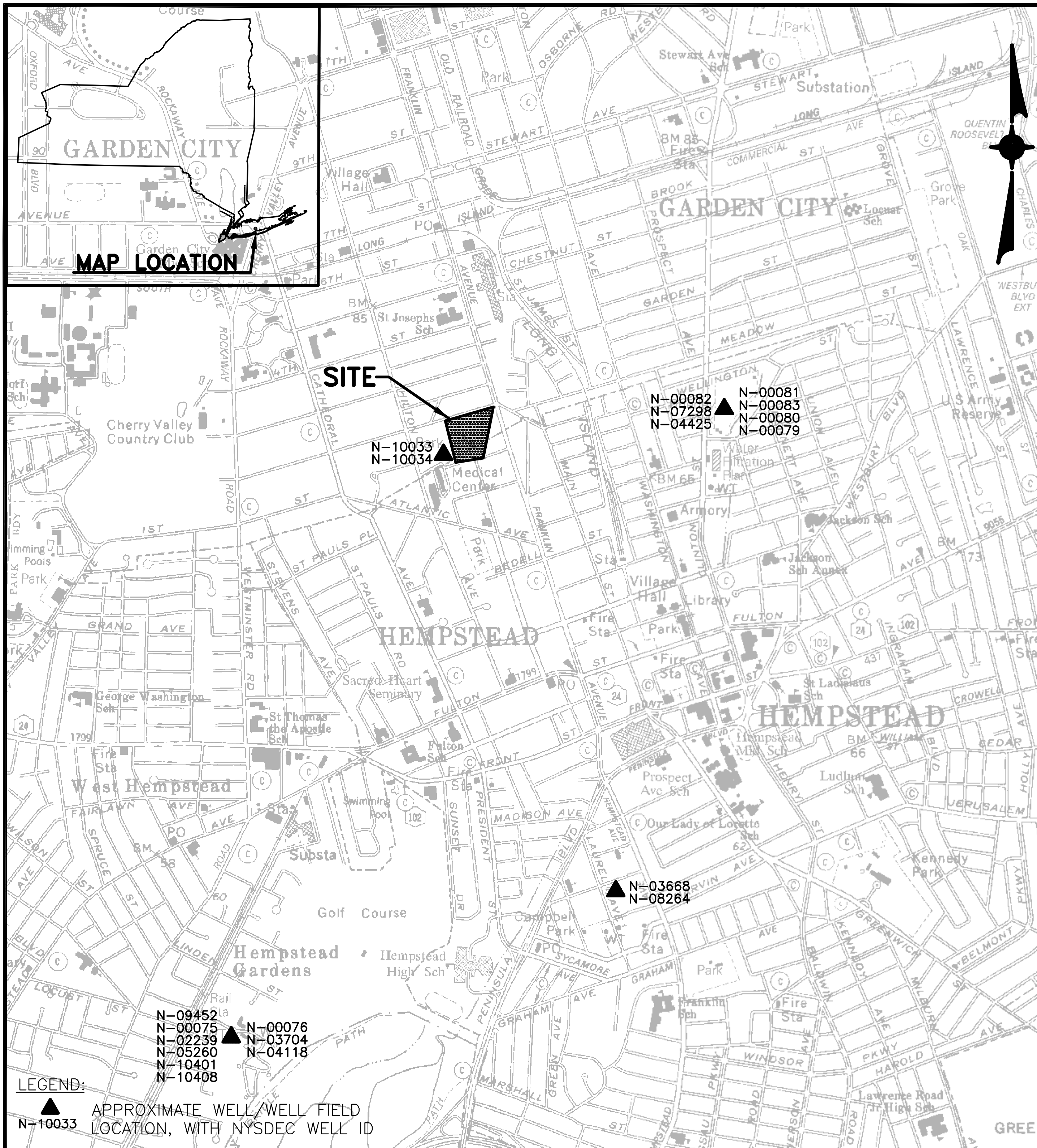
DATA ON PUBLIC SUPPLY WELLS
ADJACENT TO AND POTENTIALLY DOWNGRADIENT OF THE SITE

NYSDEC Well Number	Owner/Water District	Approximate Location Relative to Site	Screen Zone		Aquifer	Capacity (gpm)	Status
			Top (ft.)	Bottom (ft.)			
N-10034	Village of Garden City	200 ft. W	489	570	Magothy	1380	Year-round use
N-10033		200 ft. W	439	541	Magothy	1380	Year-round use
N-10408	West Hempstead-Hempstead Gardens	1.6 mi SW	600	615	Magothy	1515	Year-round use
N-10401		1.6 mi SW	600	625	Magothy	1438	Year-round use
N-09452		1.6 mi SW	521	595	Magothy	1400	Year-round use
N-05260		1.6 mi SW	452	514	Magothy	1200	Year-round use
N-04118		1.6 mi SW	146	204	Magothy	1200	Out of service - Organic contamination
N-03704		1.6 mi SW	106	159	Magothy	1200	Out of service - inorganic contamination
N-02239		1.6 mi SW	138	178	Magothy	1200	Out of service - Organic contamination
N-00076		1.6 mi SW	145	193	Magothy	1000	Out of service - Organic contamination
N-00075		1.6 mi SW	133	181	Magothy	1200	Out of service - Organic contamination
N-08264	Village of Hempstead	1.3 mi SE	460	510	Magothy	1500	Year-round use
N-03668		1.3 mi SE	450	500	Magothy	1200	Year-round use

TABLE 1-2
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

DATA ON PRIVATE WATER SUPPLY WELLS
DOWNGRADIENT OF THE SITE

NYSDEC Well Number	Use of Well	Owner of Record	Location of Well	Approximate Location Relative to Site	Screen Zone		Aquifer	Capacity (gpm)	Status
					Top (ft.)	Bottom (ft.)			
N-2185	Cooling	L.I. Frozen Foods	55 Sealy Ave. Hempstead	0.2 mi S	253.5	264	Magothy	39	Installed 9/24/47
N-3636	Laundry	State Laundry	Newman Ct. Hempstead	0.9 mi SE	329.4	355.8	Magothy	500	Installed 4/6/51
N-3646	Auto washing	Mid Island Center, Inc.	45 Hempstead Tpke. Hempstead	1.0 mi SW	39.5	44.5	Upper Glacial	50	Installed 12/29/50
N-3685	Cooling	New York Telephone	197 Fulton Ave. Hempstead	0.6 mi S	36.5	52.5	Upper Glacial	288	Installed 4/2/51
N-4080	Cooling	Castro Convertibles	Fulton Ave. & St. Paul's Pl. Hempstead	0.7 mi SW	50.5	61.5	Upper Glacial	150	Installed 2/12/53
N-4153	Cooling	First Federal Savings & Loan Association	196 Fulton Ave. Hempstead	0.6 mi S	33	43	Upper Glacial	150	Installed 5/22/53
N-4387	Cooling	Professional Building	131 Fulton Ave. Hempstead	0.6 mi S	36.3	41.3	Upper Glacial	25	Installed 4/13/54
N-4406	Cooling	Hempstead Medical Arts Corporation	218 Hilton Ave. Hempstead	0.1 mi SW	37	47	Upper Glacial	200	Installed 5/5/54
N-5182	Cooling	Farmingdale Realty	182 Fulton Ave. Hempstead	0.6 mi S	29.5	35.1	Upper Glacial	45	Installed 5/17/55
N-5920	Cooling	Sharac Restaurant Inc.	NE corner of Fulton and Cathedral Aves. Hempstead	0.6 mi S	47	57	Upper Glacial	150	Installed 7/10/56
N-7219	Auxiliary Booster	S B Construction Co. (Imperial Square)	175 Fulton Ave. Hempstead	0.6 mi S	N/A	N/A	Upper Glacial	150	Installed 4/4/63
N-7528	Irrigation	Hempstead Golf Club	Front St. Hempstead	1.1 mi S	29.5	50.1	Upper Glacial	N/A	Installed 8/2/62
N-7529	Irrigation	Hempstead Golf Club	Front St. Hempstead	1.0 mi S	43.7	62.4	Upper Glacial	600	Installed 4/1/64
N-7734	Irrigation	Stanley Small	12 Garden Pl. Hempstead	0.2 mi SW	N/A	N/A	Upper Glacial	30	Installed 10/26/64
N-8012	Cooling	Norish Manufacturing Co., Inc.	56 Newmar Ct. Hempstead	0.9 mi S	63	68	Upper Glacial	45	Installed 2/6/67
N-8099	Cooling	Thomas Mack, Inc.	125 Fulton Ave. Hempstead	0.6 mi S	N/A	N/A	Upper Glacial	40	Installed 9/66
N-8830	Cooling	Hempstead H.S. Well #2, Board of Education Dist. 1	185 Peninsula Blvd. Hempstead	1.3 mi S	44	64	Upper Glacial	850	Installed 1/3/72
N-8889	Cooling	Hunseline Plating, Co.	48 Sewell St. Hempstead	1.0 mi S	N/A	N/A	Upper Glacial	20	Installed 11/15/73



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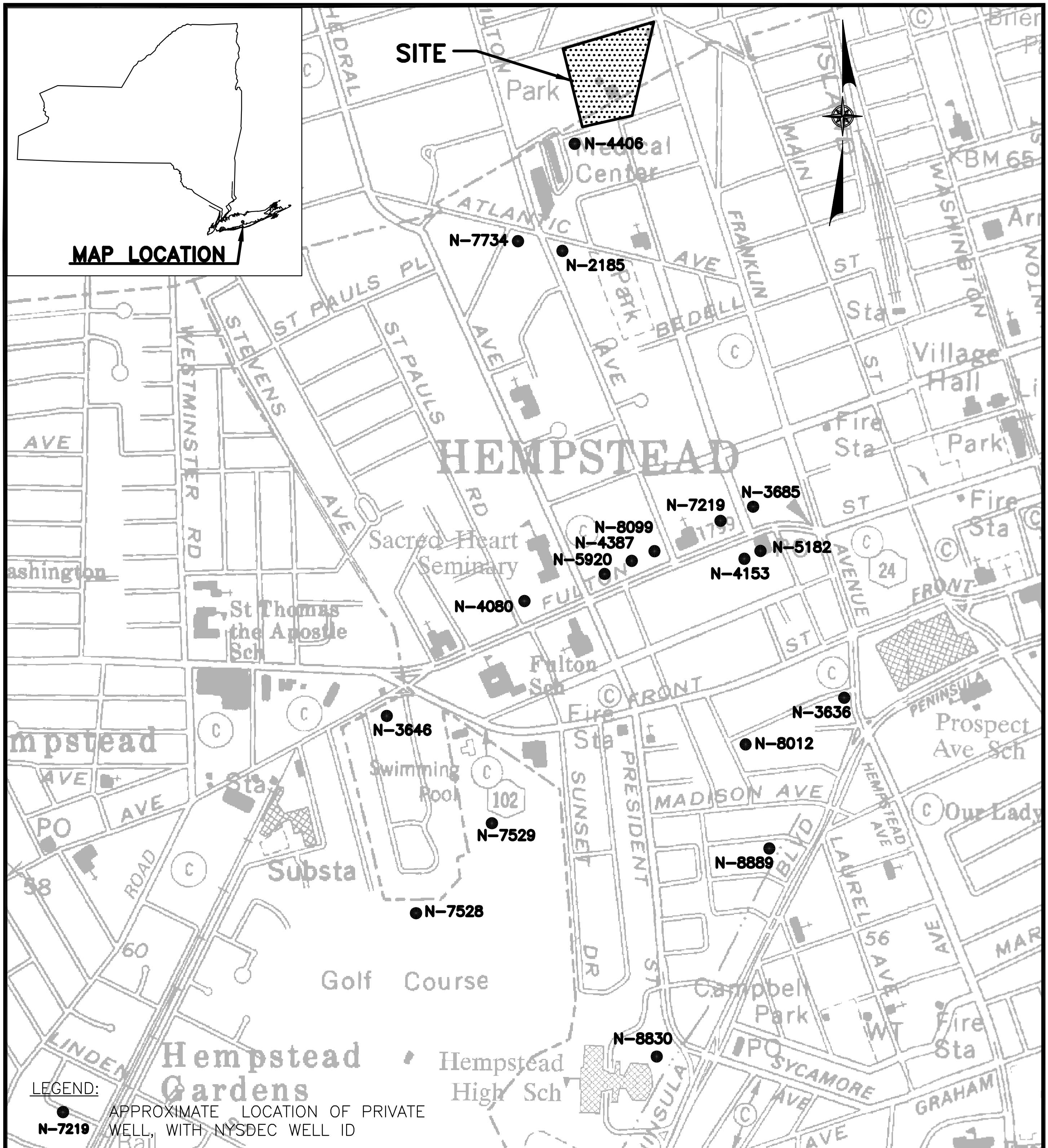
KEYSPAN CORPORATION
HEMPSTEAD INTERSECTION STREET
FORMER MGP SITE REMEDIAL INVESTIGATION
GARDEN CITY/HEMPSTEAD, NEW YORK
APPROXIMATE LOCATION OF
PUBLIC SITE WELLS

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: 1" = 2000'	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 1-7



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APPROXIMATE LOCATION OF
PRIVATE SUPPLY WELLS

Source: 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: 1" = 2000'	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 1-8

1.6 Environmental Database Searches

Details on the Environmental Database Search are presented in the March 2003 RIR. In summary, the database search included historic incidents located within 1/4 mile of the property boundaries. Additionally, the search included sites located more than 1 mile south of the site to assess the possible impact of these sites on groundwater downgradient of the site. **Tables 1-3** and **1-4** summarize identified areas of potential concern and include documented petroleum and/or chemical spills and documented petroleum and/or chemical storage facilities, respectively. **Figure 1-9** provides the approximate location of each spill and storage facility listed on the tables. **Appendix A** contains the Database Search Report.

1.7 Previous Site Investigations

The prior site investigations are fully summarized in the March 2003 RIR. The drawings (identified as Drawings 1A and 1B) depicting the sampling locations associated with these previous investigations are contained in the March 2003 RIR. The following is an overview of the principal findings and recommendations of those investigations.

1.7.1 December 1990 Preliminary Investigation

Performed By: Atlantic Environmental Services, Inc.

In September 1990, LILCO retained Atlantic Environmental Services, Inc. (Atlantic) to conduct a Preliminary Investigation at the former MGP site.

The Atlantic report concluded that residuals from former MGP operations and fuel oils were present on the property, primarily in the southern portion of the site. Atlantic recommended that additional investigation be conducted, primarily to evaluate shallow subsurface soil, groundwater and the vertical extent of BTEX and PAHs in subsurface soil.

1.7.2 October 1992 Field Investigation

Performed By: Roy F. Weston, Inc.

In November 1991 and May 1992, an additional investigation was conducted by Roy F. Weston of New York (Weston) on behalf of LILCO. The findings of this investigation are documented in a report entitled, “Final Field Investigation Report Hempstead Gas Plant,” dated October 1992. Based upon evaluation of data generated through implementation of the Weston field investigation plan, the following conclusions were made:

- The total volume of petroleum stained soil on-site was estimated at 50,000 cubic yards. This soil had generally exhibited petroleum odors, as well as typical petroleum sheen, and was generally noted at depths greater than MGP-related constituents.

TABLE 1-3

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

IDENTIFIED AREAS OF ENVIRONMENTAL CONCERN IN VICINITY OF SITE (OPEN AND CLOSED PETROLEUM SPILLS)

SPILLS LOCATED UPGRADIENT OF SITE

Map ID	Area of Concern/Address	Approximate Distance From Site/Direction	NYSDEC SPILL NO. FOR LUST/SPILLS	SPILL STATUS	MATERIAL SPILLED	QUANTITY SPILLED	SPILL DATE	Summary Report Findings/Key Issues
34	UNK 22 Hamilton Pl Garden City	275 feet N	9009641	closed (5/3/1996)	#4 Fuel Oil	0.00	11/30/1990	Pressure test of return line of 6,000 gal tank failed
39	Tuder Gardens Condominium 12 Hamilton Pl Garden City	350 feet NW	8802172	closed (10/12/1989)	#2 Fuel Oil	0.00	6/8/1988	5,000 gal tank system test failure. Tank removed on 10/11/89. No contamination found
90	Tudor Gardens Condo 12 Hamilton Pl Garden City	350 feet NW	9210188	closed (12/4/1992)	#2 Fuel Oil	0.00	12/2/1992	Return line leak
31	NCDPW District Court Main St. & Franklin Ave. Hempstead	50 feet N	9112168	closed (3/13/1995)	#2 Fuel Oil	0.00	2/27/1992	Tank failed and was repiped - system passed retest
64	UNK 130 Franklin Ave Hempstead	50 feet NE	9000497	closed (6/15/1990)	#2 Fuel Oil	30.00 gal	4/15/1990	Water entered into u/g heating oil tank forcing oil to come
69	St. Vincents DePaul Truck Franklin Ave 2nd St. & 4th Hempstead	525 feet N	8907466	closed (2/6/1990)	Motor Oil Motor Oil	0.00 6.00 gal	10/27/1989	Engine blew on truck, oil on road
78	UNK 130 Franklin Ave Garden City	50 feet NE	9500333	closed (4/10/1995)	Hydraulic Oil Waste Oil	0.00 10.00 gal	4/9/1995	Hydraulic line on commercial vehicle failed on street
79	Resident 114 Third St. Hempstead	500 feet N	9415605	closed (3/3/1995)	#2 Fuel Oil	2.00 gal	3/1/1995	Leaked from top of burner. Cleaned up and repaired
101	Hamilton Gardens Owens Co 123 Second St Garden City	50 feet N	8808219	closed (1/16/1989)	#4 Fuel Oil	20.00 gal	1/14/1989	Fitting at pump in basement loosened and leaked. Spill contained on concrete floor. Rice tank to clean up
103	Budget Rent-a-Car 130 Franklin Ave Garden City	50 feet E	8806497	closed (11/15/1988)	Gasoline	17.00 gal	11/2/1988	Gas pumped out of car and washed into drain. Spiller hired Tyree to cleanup one drain.

SPILLS LOCATED DOWNGRADIENT OF SITE

Map ID	Area of Concern/Address	Approximate Distance From Site/Direction	NYSDEC SPILL NO. FOR LUST/SPILLS	SPILL STATUS	MATERIAL SPILLED	QUANTITY SPILLED	SPILL DATE	Summary Report Findings/Key Issues
10	Mollineaux Bros F O 77 Sealy Ave Hempstead	300 feet S	9205266	open	Unk. Petroleum	0.00	8/7/1992	1-20k, 1-23k, 1-18k, 1-2k tanks to be abandoned in place, no tank testing history
12	Oswego Oil 45 Intersection St. Hempstead	Directly S	0025127	open	#2 Fuel Oil	Unknown	7/14/2000	Floating product discovered in several monitoring wells located on the property.
			9925536	open	#2 Fuel Oil Lube Oil	Unknown Unknown	3/28/2000	Numerous spills and housekeeping problems found upon inspection
			9704538	closed (9/9/1997)	#2 Fuel Oil	unknown	7/16/1997	Tank failure on two above ground tanks. Site impacted by adjacent gas facility
			9311634	closed (2/24/1994)	#2 Fuel Oil	30.00 gal	12/29/1993	Spill in berm area during tank truck fill. Clean up complete
			9003084	closed (1/9/1995)	#2 Fuel Oil	30.00 gal	6/14/1990	Various faulty equipment on site. DEC recomends wells. High BTEX readings throughout. See report for more details
15	Resident 11 Hilton Pl Hempstead	2150 feet S	9310757	open	#2 Fuel Oil	0.00	12/6/1993	Gifford Oil line failure

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

POTENTIAL AREAS OF ENVIRONMENTAL CONCERN IN VICINITY OF SITE
(OPEN AND CLOSED PETROLEUM SPILLS)

SPILLS LOCATED DOWNGRADIENT OF SITE (cont.)

Map ID	Area of Concern/Address	Approximate Distance From Site/Direction	NYSDEC SPILL NO. FOR LUST/SPILLS	SPILL STATUS	MATERIAL SPILLED	QUANTITY SPILLED	SPILL DATE	Summary Report Findings/Key Issues
18	Cathedral Gardens Co Op Cathedral Ave Hempstead	3150 feet S	9100472	open	#4 Fuel Oil	0.00	4/11/1991	F & N drilled 1-4" PVC well for bain because of tank abandonment. Driller said soil contamination was encountered all the way to groundwater & floating product was found immediately.
20	Sisters of St. Joseph 95 Fulton Ave Hempstead	3450 feet S	0007598	open	#2 Fuel Oil	1.00 gal	9/28/2000	Petro Oil fill line runs into fill pipe
21	Resident 39 Covert St. Hempstead	4550 feet S	0003844	open	#2 Fuel Oil	10.00 gal	6/28/2000	Spill on cellar floor. Contained and recovered
22	Resident 35 Covert St. Hempstead	4550 feet S	9914618	closed (3/31/2000)	#2 Fuel Oil	Unknown	3/27/2000	Two pails contaminated soil removed
23	Resident 117 Hilton Ave Hempstead	2150 feet S	9912946	closed (6/8/2000)	#2 Fuel Oil	30.00 gal	2/14/2000	20'x20' x2' area excavated. Repairs made to supply line
24	Resident Front St. & President St. Hempstead	4250 feet S	9406289	closed (8/10/1994)	Gasoline	5.00 gal	8/8/1994	Tank fell out of truck, spill contained and picked up by NCFM
25	Anchor Brass 71 Taft Ave Hempstead	4850 feet S	9209384	closed (4/27/1994)	#2 Fuel Oil	0.00	11/7/1992	Tank removal of 1k gallon tank gone bad
26	Resident 114 Parsons Dr. Hempstead	5450 feet S	9900861	closed (6/9/1999)	#2 Fuel Oil	0.00	4/22/1999	Tank test failure, no call back requested
30	Korean Church/World Crusa 94 Fulton Ave Hempstead	3450 feet S	9310322	closed (2/16/1994)	#2 Fuel Oil	0.00	11/14/1993	2500 gal tank failed, gross leak - tank removed
37	Berkey Photo 130 Front St Hempstead	4350 feet S	8806009	closed (12/1/1988)	#2 Fuel Oil	0.00	10/14/1988	3,000 gal tank failed. Tank removed, no contamination found
38	Wendell Terrace Apts 20 Wendell Terrace Hempstead	750 feet S	8802391	closed (9/3/1993)	#2 Fuel Oil	0.00	6/15/1988	F & N tester - 10,000 gal tank failed at -.411. Tank removed, no contamination found
42	Luthern Church/Epiphany 35 Fulton Ave Hempstead	4000 feet S	8704955	closed (10/14/1987)	#2 Fuel Oil	0.00	9/14/1987	Leak found in vent line of 2,000 gal steel tank Final system passed retest after repair
45	Hussline Parts Ince 48 Sewell St Hempstead	5350 feet S	9925264	closed (9/27/1995)	Unk. Petroleum	0.00	9/15/1995	Multiple chemicals leaked in plant fire
48	Hempstead Golf & Country Club 60 Front St Hempstead	4450 feet S	9404146	closed (11/20/1994)	Gasoline	0.00	6/23/1994	Old spill found during tank removal
49	Independence Financial Service Inc 111 Madison St Hempstead	5100 feet S	9403019	closed (1/7/1995)	#2 Fuel Oil	0.00	5/26/1994	Tank removal and stockpile contaminated soil
50	Independence Financial Tr 11 Madison Ave Hempstead	5100 feet S	9401715	closed (1/7/1995)	Waste Oil	0.00	5/2/1994	Found contamination during routine tank removal
53	Fulton St. School Fulton St. Hempstead	4000 feet S	9205213	closed (1/5/1998)	#2 Fuel Oil	0.00	8/6/1992	Tank removal and stockpile of contaminated soil
60	James Medical Bldg 131 Fulton Ave Hempstead	3400 feet S	9012949	closed (3/20/1991)	Unk. Petroleum	0.00	3/18/1991	Parking lot floods with oil and water during heavy rain - oil is result of runoff

TABLE 1-3 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

POTENTIAL AREAS OF ENVIRONMENTAL CONCERN IN VICINITY OF SITE (OPEN AND CLOSED PETROLEUM SPILLS)

SPILLS LOCATED DOWNGRADIENT OF SITE (cont.)

Map ID	Area of Concern/Address	Approximate Distance From Site/Direction	NYSDEC SPILL NO. FOR LUST/SPILLS	SPILL STATUS	MATERIAL SPILLED	QUANTITY SPILLED	SPILL DATE	Summary Report Findings/Key Issues
70	Whitson Street Hempstead	5550 feet S	9906861	closed (9/17/1999)	Acetic Acid	Unknown	9/8/1999	20 - 55 gallon drums were washed out at location and residue washed onto ground and into storm drain. Acid on road neutralized and washed into storm drain
71	125 Terrace Ave Hempstead	1550 feet S	9812771	closed (8/18/2000)	#2 Fuel Oil	0.00	1/17/1999	Leaking line caused spill in basement of apartment building
72	Apt Building 133-141 Terrace Ave Hempstead	1550 feet S	9801657	closed (5/21/1998)	#2 Fuel Oil	5.00 gal	5/7/1998	Driver thought tank was bigger
75	Resident 122 Terrace Ave Hempstead	1550 feet S	9511178	closed (12/6/1995)	#2 Fuel Oil	1.00 gal	12/4/1995	Small leak in fuel line. Spill cleaned up and line replaced
77	Resident 130 Parsons Dr. Hempstead	5450 feet S	9505588	closed (8/7/1995)	#2 Fuel Oil	1.00 gal	8/5/1995	Filter failure. No further action
83	Slay Transportation 75 Sealey St Hempstead	300 feet S	9406873	closed (11/29/1995)	PERC	5.00 gal	8/10/1994	Leak from truck valve. Spilled on soil. Soil removed
84	Diversified Bldg. Corp. 10 Cathedral Ave Hempstead	3450 feet S	9404164	closed (6/24/1994)	#2 Fuel Oil	1.00 gal	6/24/1994	Flare fitting leak. Contained on concrete floor and cleaned up
88	MGI 131 Fulton Ave Hempstead	3400 feet S	9211687	closed (5/12/1999)	#2 Fuel Oil	0.00	1/12/1993	Fuel leaked around fuel lines in basement of building
93	Ultra Lean Petro. Pro. President St/Front St. Hempstead	4250 feet S	9104878	closed (8/12/1991)	Unknown	Unknown	8/6/1991	3 - 55 gallon drums fell off truck. Street and drain cleaned
94	UNK 180 Hilton Ave Hempstead	1250 feet S	9011331	closed (2/7/1991)	#4 Fuel Oil	40.00 gal	1/26/1991	Spill cleaned up by spiller's contractor
98	Kapco 44 Madison Ave Hempstead	5125 feet S	9002639	closed (6/8/1990)	#2 Fuel Oil	0.00	5/25/1990	Contaminated soil removed
99	Apple Carting 4549 Whitson Ave Hempstead	5550 feet S	8910177	closed (2/27/1990)	Diesel	0.00	1/24/1990	Sloppy housekeeping on 2 - 275 gallon above ground storage tanks. Drums and buckets removed
108	UNK Intersection St./Sealey Ave Hempstead	125 feet S	8707262	closed (2/28/1995)	#2 Fuel Oil	50.00 gal	11/23/1987	Strainer on non-operating truck froze, cracked gasket. 850 gal oil and water vacced out of drain. 3 yds soil dug out.
Unlocated	Brooklyn Tabernacle 192 Atlantic Ave Hempstead		9702510	closed (7/10/1997)	#2 Fuel Oil	4.00 gal	5/28/1997	Tank overfill

TABLE 1-4
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

IDENTIFIED AREAS OF ENVIRONMENTAL CONCERN IN VICINITY OF SITE
(BULK STORAGE OF PETROLEUM AND CHEMICAL MATERIALS/WASTES)

TANKS LOCATED UPGRADIENT OF SITE

Map ID	Area of Concern/Address	Approximate Distance From Site/Direction	FACILITY ID NUMBER	TANK STATUS	TANK CONTENT	TANK CAPACITY	TANK LOCATION
113	Garden City Apartments	500 feet N	031070	In service	#2 Fuel Oil	6000 gal	belowground
	22C Hamilton Place			In service	#2 Fuel Oil	6000 gal	belowground
	Garden City						
115	Budget Rent-a-Car	525 feet N	GS1400014	Active	Gasoline	2000 gal	outdoor, underground, horizontal
	130 Franklin Ave			Active	Gasoline	2000 gal	outdoor, underground, horizontal
	Garden City			Active	Gasoline	2000 gal	outdoor, underground, horizontal

TANKS LOCATED DOWNGRADIENT OF SITE

Map ID	Area of Concern/Address	Approximate Distance From Site/Direction	FACILITY ID NUMBER	TANK STATUS	TANK CONTENT	TANK CAPACITY	TANK LOCATION
119	Oswego Oil Service Corp.	125 feet S	OL200003	Active	#2 Fuel Oil	20,000 gal	outdoor, aboveground, vertical
	45 Intersection St.			Active	Diesel	20,000 gal	outdoor, aboveground, vertical
	Hempstead						
121	Mollineux Fuel Co.	225 feet S	GS7200087	Abandoned	Gasoline-empty tank	20,000 gal	outdoor, underground, horizontal
	77 Sealey Ave			Abandoned	Gasoline-empty tank	18,000 gal	outdoor, underground, horizontal
	Hempstead			Abandoned	Gasoline-empty tank	23,000 gal	outdoor, underground, horizontal
				Removed	Gasoline-empty tank	2,000 gal	outdoor, underground, horizontal
122	Buy-Rite Chemical	225 feet S	001425	In service	Tetrachloroethylene	6,000 gal	indoor, aboveground
	73-75 Sealey Ave						
	Hempstead						
125	Hempstead Toyota Inc	450 feet S	040087	In service	Waste Oil	250 gal	belowground
	57 Sealey Ave			In service	Waste Oil	250 gal	indoor, aboveground
	Hempstead			In service	Waste Oil	250 gal	indoor, aboveground
				In service	Motor Oil	250 gal	outdoor, aboveground
				In service	Motor Oil	250 gal	outdoor, aboveground
126	Cedar Valley Apts	750 feet S	031040	In service	#2 Fuel Oil	3,000 gal	belowground
	20 Wendell Terrace						
	Hempstead						
128	Stratford Arms	1700 feet S	031069	In service	#2 Fuel Oil	5,000 gal	indoor, aboveground
	160 Hilton Ave						
	Hempstead						
129	Jackson Terrace Apts	1800 feet S	031006	In service	#4 Fuel Oil	10,000 gal	belowground
	100 Terrace Ave						
	Hempstead						
134	Apartment Building	3000 feet S	056718	In service	#2 Fuel Oil	3,000 gal	belowground
	30 Hilton Ave						
	Hempstead						
141	Cathedral Gardens	3150 feet S	031015	In service	#4 Fuel Oil	3,200 gal	indoor, aboveground
	30-36 Cathedral Ave.						
	Hempstead						
144	Mitcheltown Apts	3750 feet S	056249	In service	#2 Fuel Oil	3,000 gal	belowground
	51 Bell St						
	Hempstead						
153	Island Wide Repair Corp.	4300 feet S	055295	In service	Motor Oil	275 gal	indoor, aboveground
	154 Front St						
	Hempstead						
152	PCW Transmission Co.	4250 feet S	055026	In service	Transmission fluid	275 gal	indoor, aboveground
	160 Front St.			In service	Transmission fluid	275 gal	indoor, aboveground
	Hempstead			In service	Transmission fluid	275 gal	indoor, aboveground
				In service	Transmission fluid	275 gal	indoor, aboveground
154	JBT Auto Service Center	4300 feet S	057503	In service	Waste Oil	240 gal	indoor, aboveground
	154 Front St						
	Hempstead						

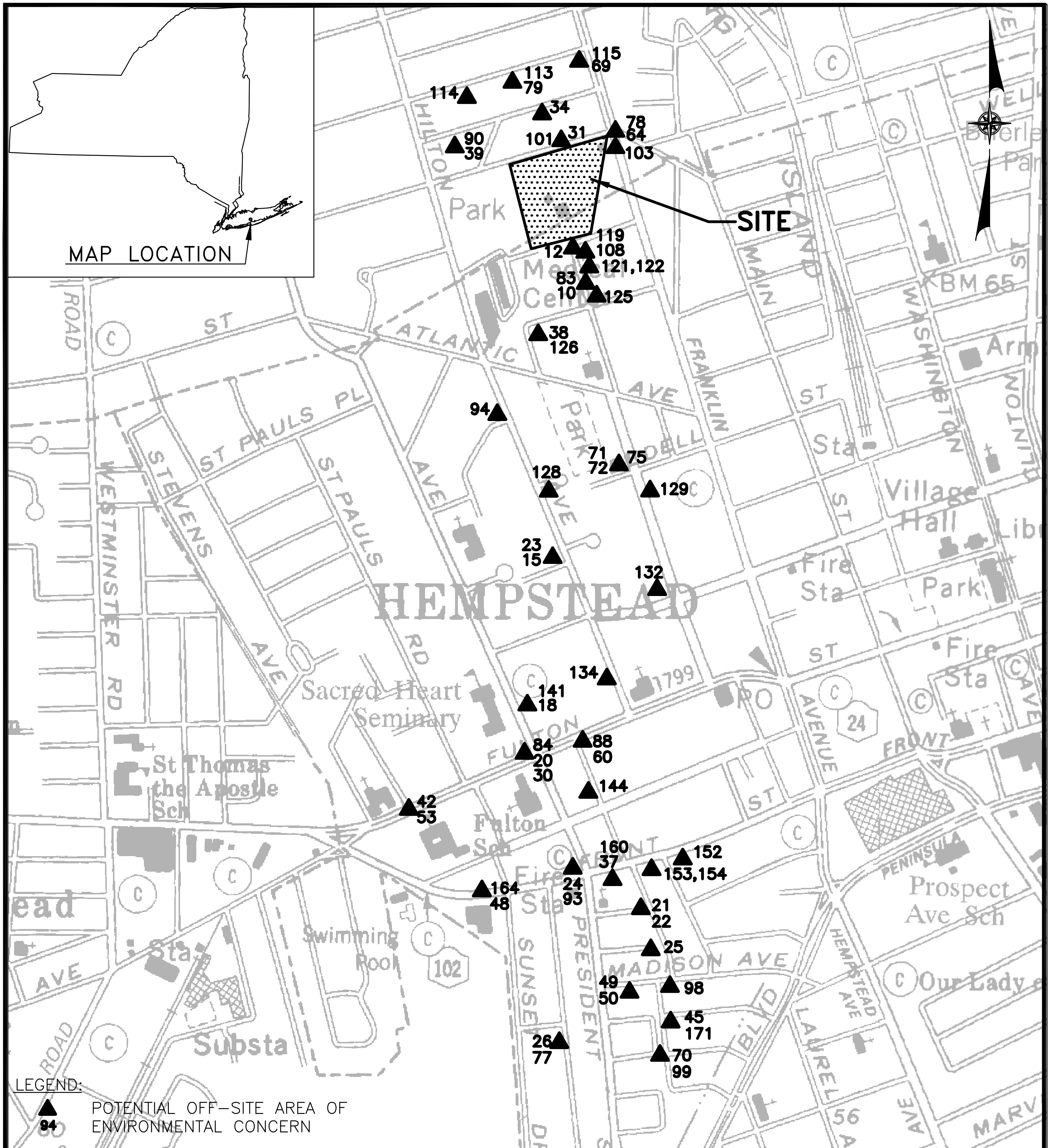
TABLE 1-4 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

IDENTIFIED AREAS OF ENVIRONMENTAL CONCERN IN VICINITY OF SITE
(BULK STORAGE OF PETROLEUM AND CHEMICAL MATERIALS/WASTES)

TANKS LOCATED DOWNGRADIENT OF SITE (cont.)

Map ID	Area of Concern/Address	Approximate Distance From Site/Direction	FACILITY ID NUMBER	TANK STATUS	TANK CONTENT	TANK CAPACITY	TANK LOCATION
160	Berkey Professional Proc.	4350 feet S	001174	In service	Kodak C-41 Bleach	100 gal	indoor aboveground
	130 Front St.			In service	Ammonium Nitrate	100 gal	indoor aboveground
	Hempstead			In service	Kodak C-41 Stabilizer	100 gal	indoor aboveground
				In service	Trecon EP2 Developer	100 gal	indoor aboveground
				In service	Trecon EP2 Bleach Fl	100 gal	indoor aboveground
				In service	Trecon EP2 Bleach Fl	100 gal	indoor aboveground
				In service	Trecon EP2 Bleach	100 gal	indoor aboveground
				In service	Trecon EP2 Bleach	150 gal	indoor aboveground
				In service	Trecon EP2 Developer	5 gal	indoor aboveground
				In service	Trecon EP2 Developer	50 gal	indoor aboveground
				In service	Trecon EP2 Developer	50 gal	indoor aboveground
				In service	Trecon EP2 Bleach	150 gal	indoor aboveground
				In service	Trecon EP2 Bleach	150 gal	indoor aboveground
				In service	Trecon EP2 Bleach	150 gal	indoor aboveground
				In service	Kodak C-41 Fixer & R	55 gal	indoor aboveground
				In service	Kodak C-41 Silver CE	25 gal	indoor aboveground
				In service	Kodak C-41 Developer	60 gal	indoor aboveground
				In service	Kodak C-41 Developer	25 gal	indoor aboveground
				In service	Photo Chemicals, NOS	5 gal	indoor aboveground
				In service	Photo Chemicals, NOS	100 gal	indoor aboveground
				In service	Ammonium Thiosulfate	25 gal	indoor aboveground
				In service	Potassium Carbonate	100 gal	indoor aboveground
164	Hempstead Golf & Countr	4450 feet S	GS7200052	Active	Diesel	500 gal	outdoor aboveground horizontal
	60 Front St			Removed	Gasoline-Empty Tank	1,000 gal	outdoor aboveground horizontal
	Hempstead			Active	Gasoline Low Gr Unl	1,000 gal	outdoor aboveground horizontal
171	Husslein Plating Corp.	5350 feet S	000224	In service	Trade Name, Organic	7,000 gal	indoor aboveground
	48 Sewell St			In service	Trade Name, Organic	850 gal	indoor aboveground
	Hempstead			In service	Sulphuric Acid	700 gal	indoor aboveground
				In service	Nickel Plating Solut	1,600 gal	indoor aboveground
				In service	Nickel Plating Solut	1,600 gal	indoor aboveground
				In service	Nickel Plating Solut	700 gal	indoor aboveground
				In service	Chrome Plating Solut	1,000 gal	indoor aboveground
				In service	Chrome Plating Solut	900 gal	indoor aboveground
171	Husslein Plating Co. (continued)	5350 feet S	000224	In service	Water Tank	700 gal	indoor aboveground
				In service	Trade Name, Inorganic	700 gal	indoor aboveground
				In service	Water Tank	200 gal	indoor aboveground
				In service	Water Tank	800 gal	indoor aboveground
				In service	Hydrochloric Acid	800 gal	indoor aboveground
				In service	Nickel Plating Solut	50 gal	indoor aboveground
				In service	Nickel Plating Solut	50 gal	indoor aboveground
114	Tudor Gardens Condominium	500 feet NW	031115	In service	#2 Fuel Oil	4,000 gal	belowground
	12 Hamilton Place						
	Garden City						
132	67 Terrace & 45 Jackson	2450 feet S	31124	In service	#6 Fuel Oil	5,000 gal	indoor aboveground
	45 Jackson			In service	#6 Fuel Oil	5,000 gal	indoor aboveground
	Hempstead						



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KEYSPAN CORPORATION
HEMPSTEAD INTERSECTION STREET
FORMER MGP SITE REMEDIAL INVESTIGATION
GARDEN CITY/HEMPSTEAD, NEW YORK
IDENTIFIED AREAS OF CONCERN IN
THE VICINITY OF THE SITE

Source: 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: 1" = 2000'	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 1-9

- Elevated soil gas concentrations were located north of the southern property boundary along the western portion of the site.

- Upon review of groundwater analytical data and comparison to NYSDEC Cleanup Guidance Values, in addition to the New York State Department of Health (NYSDOH) applicable standards and guidelines, specific concentrations of BTEX, various PAHs and cyanide were noted within the shallow Upper Glacial Aquifer above regulatory standards and guidelines. A petroleum sheen was also observed in several samples.

1.7.3 <u>July 1992 Baseline Risk Assessment</u>

Performed By: Roy F. Weston, Inc.

Subsequent to the completion of the above-referenced field investigation, Weston completed a baseline risk assessment in order to determine the potential hazards presented by the former MGP site. In a report entitled, “Final Baseline Risk Assessment Report LILCO Hempstead Gas Plant” dated July 16, 1992, and prepared for LILCO, Weston’s study examined the potential risks posed by the site under present conditions. According to the report, the presence of chemicals in site soil was primarily associated with the MGP process. Certain chemical constituents also occurred in groundwater; however, a complete exposure pathway did not exist for this medium since these chemicals did not affect drinking water in the area due to the geological configuration of the underlying strata. Weston reported that “the aquifer from which drinking water is drawn occurs in a deeper strata and these two aquifers are separated by clay layers which retard vertical mixing” (Weston, Baseline Risk Assessment Report, July 1992). According to the Report, there was a potential carcinogenic risk from dermal absorption and ingestion of soil, to both the resident youth and the adult workers. The report concluded by stating that PAHs are the chemical compounds responsible for accelerating the risk.

Based on these findings several actions were undertaken by LILCO including the upgrade of site security and fencing, and the installation of an asphalt cover and crushed stone cover in active areas of the site. In addition, on-site activities were reduced by changing the site from an active gas operations facility to an unmanned gas regulator station and storage yard.

1.7.4 <u>November 1993 Remedial Alternatives and Feasibility Analysis</u>

Performed By: Roy F. Weston, Inc.

In a report entitled, “Remedial Alternatives and Feasibility Analysis,” dated November 1993, Weston identified a variety of remedial technologies which were screened in order to develop potential remedial alternatives with respect to the site. None were implemented.

1.7.5 May 1995 Contaminant Fate Investigation

Performed By: P.W. Grosser Consulting Engineer & Hydrogeologist, P.C.

Under contract with LILCO, P.W. Grosser Consulting Engineer & Hydrogeologist, P.C., completed a contaminant fate study, and prepared a report entitled, "Contaminant Fate Report Hempstead Gas Plant." Grosser's Contaminant Fate study was designed to evaluate the chemical characteristics of the compounds, the hydraulic properties of the aquifers underlying the site and the supply well construction details to determine if the detected contaminants could impact the two public water supply wells located approximately 200 feet west of the former MGP site. As part of the study, analytical modeling was undertaken to predict solute front velocities and travel times of each of the identified chemicals of concern at the site. According to P.W. Grosser's conclusions, "results of the modeling indicate that the two public supply wells should not be impacted by the chemicals of concern identified at the LILCO site" (P.W. Grosser, Contaminant Fate Report, May 1995). The relatively high adsorption rates of the PAHs, together with the impermeable clay layer between the screened interval of the wells and the contaminants detected at the water table, appeared to effectively impede any movement of the compounds to the wells. According to the P.W. Grosser report, when the travel times representing worst case scenarios were applied, it was concluded that it will take benzene approximately 325 to 1,368 years to reach the screened interval of the public supply wells. The P.W. Grosser study stated that the findings were supported by routine sampling of the public water supply wells for BTEX, which was not detected in these wells.

1.7.6 October 2006 Village of Garden City and Village of Hempstead: CaptureZone Analysis Reports

Performed By: H2M Group

On behalf of KeySpan, H2M Group further analyzed groundwater flow in the vicinity of the former MGP site (see **Appendix H**) relative to the Village of Garden City's public water supply wells located approximately 200 feet west of the former MGP site, and the Village of Hempstead Clinton Street public water supply wells located approximately 4000 feet east of the site. Computer modeling was used to simulate groundwater flow in the aquifer system, which is the source for the public supply water wells. The modeling results indicate that the area of the former MGP site related impacts is outside of the groundwater capture zone of these water supply wells, assuming normal pumping rates based on historical data. Under the theoretical maximum pumping conditions that were modeled, the supply well capture zones move closer to the area of the former MGP site. For the adjacent Village of Garden City wells, H2M's modeling indicated that the capture zone for those supply wells could extend into the area of the former MGP site (at depths between 100 and 200 feet below ground surface), if the worst-case maximum pumping scenario persisted for about 16 years. If the maximum pumping scenario was conducted for a time period less than 16 years the modeling indicates that the Village of Garden City wells would not have the potential to receive groundwater from the area of the former MGP site. In addition, H2M's report indicates that the worst case scenario evaluated is very conservative in nature and the maximum pumping scenario is unlikely to occur for an extended time period (e.g. 16 years) because: The communities served by these wells are at or near maximum growth potential such that local water supply demand is not expected to increase significantly over time; Good engineering practice and applicable water supply industry guidance documents call for redundancy in water supply systems which would reduce the likelihood of any one system operating at full capacity for more than a few years time; There is little known precedent for water purveyors in the local region to operate pumping systems at maximum output for the timeline required to create the worst-case scenario; In addition, the modeling conservatively focuses on groundwater flow instead of contaminant migration and does not account for natural contaminant attenuation factors such as dispersion, advection, and adsorption, which can significantly limit contaminant mobility through the subsurface environment.

1.8 Cut and Plug Interim Remedial Measures

A "cut and plug" IRM Program was undertaken at the Hempstead former MGP site during the winter of 1999. The object of the Cut and Plug Interim Remedial Measure (IRM) Program 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 Summer 2000**.**

1.9 Remedial Investigation Findings

Performed by: Dvirka & Bartilucci Consulting Engineers

Between 1998 and 2002, a Remedial Investigation was conducted by Dvirka & Bartilucci Consulting Engineers of New York (D&B) on behalf of KeySpan. The findings of this investigation are documented in a report entitled, "Remedial Investigation Report" March 2003. As part of this investigation, D&B collected, visually inspected and analyzed a total of 228 surface and subsurface soil samples, 277 groundwater samples, 15 soil vapor samples and 3 ambient air samples in order to better characterize MGP-related constituents at locations on-site and off-site. Note that the original work plan, dated June 2000, included the previously sold property as part of the Off-site Field Investigation Program. However, based on subsequent NYSDEC comments on the D&B RI report, the investigation results from the sold property are now included as part of the On-site Field Investigation Program because the sold property was previously part of the former MGP site. The sample locations are shown on **Drawings 2A and 2B**. Based upon the data generated through the D&B investigation, general nature and extent of impacts at the site can be summarized as follows:

On-site Field Investigation

- Surface soil samples collected from the site exhibited detectable concentrations of total BTEX and PAHs. In general, Resource Conservation and Recovery Act (RCRA) metals were detected at concentrations within a range typical of background concentrations. One sample located in the former Coal Storage Area exhibited lead at a level exceeding NYSDEC soil guidance levels. Total cyanide analytical results were detected in 10 out of the 11 surface soil samples.

- Areas of subsurface soil exhibiting naphthalene/hydrocarbon-like odors, non-aqueous phase liquid (NAPL) saturation, staining and/or sheens, as well as blebs, and elevated Total BTEX and PAH concentrations were encountered primarily in close proximity to the former MGP structures and wastewater disposal areas located in the western and southern portions of the site. Soil staining was observed to a maximum depth of 106 feet below grade near the western property boundary.

- NAPL saturated or near saturated soils are present primarily in the upper 8 feet of the subsurface. Below the 8 feet depth NAPL is observed to extend vertically down through the unsaturated zone along isolated migration paths, which appear as thin stringers or "ganglia" of NAPL. This vertical migration was identified solely at the identified primary source areas. At and just above the water table (approximately 30 feet below grade surface (bgs) the NAPL is observed to have accumulated and migrated more horizontally. The highest BTEX and PAH concentrations identified in shallow on-site subsurface soil (less than 8 ft-bgs) during the Remedial Investigation were observed primarily within or immediately downgradient of former MGP structures.

- BTEX and PAH concentrations appear to decrease significantly below a depth of 8 feet through the unsaturated zone at the majority of on-site locations. This changes at the water table where some of the highest on-site BTEX and PAH concentrations identified in subsurface soil as part of this Remedial Investigation were detected in samples collected from borings located in the southernmost portion of the site at or near the groundwater interface.

- Groundwater samples exhibiting the highest BTEX/PAH concentrations were collected from areas where NAPL at saturated levels was observed at or near the water table. NAPL at saturated levels was identified in several locations at and below the groundwater interface.

- Surface soil samples contained detectable levels of PAHs with samples collected from the Village of Garden City Park and Wellfield property, west of the former MGP site. Metals were found to be generally within or below typical regional background concentrations. Total cyanide analysis indicates that cyanide was not detected above the Contract Required Detection Limit (CRDL) of 1 mg/kg with the exception of one sample.

these wells are at or near maximum growth potential such that local water supply demand is not expected to increase significantly over time; Good engineering practice and applicable water supply industry guidance documents call for redundancy in water supply systems which would reduce the likelihood of any one system operating at full capacity for more than a few years time; There is little known precedent for water purveyors in the local region to operate pumping systems at maximum output for the timeline required to create the worst-case scenario; In addition, the modeling conservatively focuses on groundwater flow instead of contaminant migration and does not account for natural contaminant attenuation factors such as dispersion, advection, and adsorption, which can significantly limit contaminant mobility through the subsurface environment.

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A "cut and plug" IRM Program was undertaken at the Hempstead former MGP site during the winter of 1999. The object of the Cut and Plug Interim Remedial Measure (IRM) Program 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 Summer 2000.

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Between 1998 and 2002, a Remedial Investigation was conducted by Dvirka & Bartilucci Consulting Engineers of New York (D&B) on behalf of KeySpan. The findings of this investigation are documented in a report entitled, "Remedial Investigation Report" March 2003. As part of this investigation, D&B collected, visually inspected and analyzed a total of 228 surface and subsurface soil samples, 277 groundwater samples, 15 soil vapor samples and 3 ambient air samples in order to better characterize MGP-related constituents at locations on-site and off-site. Note that the original work plan, dated June 2000, included the previously sold property as part of the Off-site Field Investigation Program. However, based on subsequent NYSDEC comments on the D&B RI report, the investigation results from the sold property are now included as part of the On-site Field Investigation Program because the sold property was previously part of the former MGP site. The sample locations are shown on **Drawings 2A and 2B**. Based upon the data generated through the D&B investigation, general nature and extent of impacts at the site can be summarized as follows:

On-site Field Investigation

- Surface soil samples collected from the site exhibited detectable concentrations of total BTEX and PAHs. In general, Resource Conservation and Recovery Act (RCRA) metals were detected at concentrations within a range typical of background concentrations. One sample located in the former Coal Storage Area exhibited lead at a level

- Shallow off-site subsurface soil does not appear to contain elevated levels of BTEX or PAHs with the exception of one sample in the storm water recharge basin located immediately west of the site on the Village of Garden City property.

- The highest BTEX and PAH concentrations identified in off-site subsurface soil and groundwater as part of this Remedial Investigation were collected from borings, groundwater probes and monitoring wells located immediately downgradient of the site within the medical office building parking lot and along the eastern side of the site near neighboring Fuel Oil Storage facilities at or near the groundwater interface.

- Groundwater samples exhibiting the highest BTEX/PAH concentrations were collected from areas where NAPL at saturated levels was observed at or near the water table. NAPL at saturated levels encountered at or near the water table appears to extend as far downgradient as sample location HISB-47/HIGP-47 located at the intersection of Wendell Street and the LIRR right-of-way, approximately 450 feet south of the site.

- Based on extensive groundwater sampling off-site, the maximum width of the plume is estimated to be approximately 800 feet immediately downgradient of the site. The western boundary of the plume adjacent to the site appears to extend at least 200 feet west or side-gradient of the property boundary. South of Atlantic Avenue, the plume appears to narrow to approximately 600 feet. The overall length of the plume is estimated to be approximately 3,800 feet with the plume terminating south of well cluster HIMW-15 but north of West Orchard Street.

- Fingerprint analysis of NAPL samples collected from off-site monitoring wells located immediately adjacent to Oswego Oil Service Corp. has indicated this material to be consistent with middle distillate range petroleums such as Diesel or No. 2 fuel oil. Oswego Oil Service Corp, located immediately downgradient of the former MGP site, is an active petroleum storage/distribution facility. Furthermore, the oil storage facility is listed by the NYSDEC as an active petroleum spill site due to the occurrence of petroleum spills and the presence of petroleum in site monitoring wells. Based on this information, it is likely that releases from this petroleum storage facility are contributing to the BTEX/PAH groundwater plume observed downgradient of the former MGP site.

- Attenuation of the dissolved BTEX/PAH plume was assessed to determine the current status of the plume (i.e., stable, contracting or expanding). Evaluation of the effect of naturally-occurring organic carbon in the aquifer matrix on the migration rate of benzene, the most mobile of the BTEX compounds, shows that the downgradient migration of benzene, as well as the other BTEX compounds and low molecular weight PAHs, from the site has been and is currently being retarded. Additionally, based on the depletion of dissolved oxygen within the delineated plume, the mass of dissolved BTEX/PAHs in the plume is being decreased naturally through aerobic biodegradation. The limited downgradient extent of the plume, the occurrence of attenuation through adsorption to organic carbon, and the biodegradation that has been observed, suggests that the plume is stable and may even be contracting at this time.

- Based on the review of NYSDEC-registered well records, there are no private wells used for potable water supplies within the defined limits of the plume. NYSDEC records do identify the presence of four private supply wells located within the defined limits of the plume that are reportedly used as a source of cooling water. There are no public supply wells located within the defined limits of the plume. The closest public supply wells are located approximately 200 feet west (side-gradient) of the site. There is no evidence to indicate that these supply wells have been impacted by site related chemicals.

- Based on BTEX/PAH subsurface soil data, field observations of recovered soil samples and groundwater data, the following former structure locations and/or surrounding subsurface soils are considered primary on-site source areas of BTEX and PAH compounds:

    1. Main storage holder, relief holder and tar separating facilities located on the southernmost portion of the site;
    2. Drainage sump located in the northwestern corner of the site;
    3. Drip oil tanks located along the western property boundary;
    4. Tar separator located in the south-central portion of the site;
    5. Oxide purifier boxes and tar extracting facilities located along the boundary between the KeySpan property and the sold property on the southernmost portion of the site; and
    6. The southeastern portion of the coal storage area and the oil tanks south of the Boiler Room.

Based on the findings of the D&B investigation, it was recommended that additional on-site and off-site field investigation activities be conducted as part of a supplemental field program.

2.0 INVESTIGATION PROGRAM

The investigation program for the March 2003 RI is presented in detail in that report. This section discusses only the work conducted for this Supplemental Remedial Investigation Field Program.

2.1 Overview of the Supplemental Remedial Investigation Field Program Objectives and Activities

The March 2003 Remedial Investigation results identified specific area data needs required to complete delineation of the extent of the identified impacts. The Supplemental Investigation Work Plan, dated March 17, 2003 was prepared by Dvirka and Bartilucci Consulting Engineers (D&B) for KeySpan and approved by the NYSDEC to address the identified data needs. The Supplemental Remedial Investigation Field Program was completed between August and December 2003 by PS&SPC, in accordance with the NYSDEC approved Work Plan. The program was targeted towards filling data needs to complete delineation of the vertical and horizontal extent of physical impacts and chemical constituents identified in previous investigations at locations On-Site and at adjacent Off-site locations.

The objectives of the Supplemental Remedial Investigation Field Program were to:

1. Further define the on-site nature and extent of non-aqueous phase liquid (NAPL) and associated chemical constituents (BTEX and PAHs) in the vicinity of Former MGP structures including tar separators, precipitators and condensers, drainage sump, drip oil tanks and unloading pits;
2. Further define the off-site migration of NAPL and associated BTEX and PAHs donwgradient of the site;
3. Provide additional information about the potential mobility and recoverability of identified on-site and off-site NAPL;
4. Obtain additional information on active NYSDEC petroleum spill sites located downgradient of the Former MGP site including the Oswego Oil Corp. site and the Mollineaux Brothers Fuel Company site;
5. Determine the current status of four NYSDEC-registered private water supply wells located downgradient of the site and, if these wells exist, determine whether they are impacted by the site groundwater plume;
6. Determine whether unregistered private water supply wells exist downgradient of the Former MGP site and, if wells are identified, determine whether they are impacted by the site groundwater plume; and
7. Obtain additional data needed to evaluate the potential effectiveness of potential remedial technologies under a Remedial Action Plan (RAP).

To achieve the Supplemental Remedial Investigation Field Program objectives, the following investigation activities were undertaken:

- Test pit excavation and sampling;
- Surface soil sampling;
- Subsurface soil sampling;
- Groundwater probe installation and sampling;
- Groundwater monitoring well installation and sampling;
- Perimeter air monitoring;
- Private Well Survey;
- Laboratory Analysis of Soil and Groundwater Samples;
- Surveying and mapping; and
- Freedom of Information Law review.

During the initial RI and the Supplemental Remedial Investigation Field Program, environmental samples collected from locations within the Hempstead Intersection Street Former MGP site were grouped and identified as the On-site Supplemental Remedial Investigation Field Program and samples from off-site locations have been grouped and identified as the Off-Site Supplemental Remedial Investigation Field Program. The On-Site Program includes the previously sold property currently used to store vehicles owned by an automobile dealer, which is located adjacent to and south of the KeySpan property. The majority of the former MGP structures and operations were located in the southernmost portion of the site, which includes the previously sold property. Samples collected from all off-site locations have been grouped into what is referred to as the Off-site Remedial Investigation Field Program.

NYSDEC's May 23, 2005 conditional approval letter identified a discrepancy in the samples collected from soil boring HISB-61 at the 10 to 12-foot and 30 to 32-foot depth intervals. Resampling in the area of soil boring HISB-61, at these depth intervals, was conducted on July 6, 2005 and are identified as soil samples HISB-61A (10'-12') and HISB-61A (30.5'-32'). Soil samples collected from boring HISB-61A were analyzed for BTEX, PAH, RCRA Metals and Total Cyanide. The data obtained from the HISB-61A resampling event replaces the original data for samples collected at these depth intervals. The original sampling results, at those depth intervals, are not included as part of the final report.

2.2 Field Investigation Program

This section provides a brief description of the field investigation activities performed during the Supplemental Remedial Investigation Field Program. The activity descriptions identify the portion of the activity performed at on- and off-site locations. Drilling and sampling methodologies and procedures are generally described in this section. Additional detailed descriptions of methodologies and procedures are provided in the Generic Work Plan for the project entitled, "Hempstead Intersection Street Former MGP Site, Investigation Work Plan," Volume II: Generic Work Plan, dated June 2000. The media sampled, chemical constituents analyzed and the laboratory methods associated with these analyses and those performed during the initial RI are summarized in **Table 2-1**. **Table 2-2** presents a summary of the monitoring well construction details for those wells installed on-site and off-site during all of the investigation activities. The investigation activities completed as part of the On-site Field Investigation Program during both the initial RI and the Supplemental Remedial Investigation Field Program are summarized in **Table 2-3**. The on-site (and immediately adjacent off-site) sample locations, performed during both the initial RI and the Supplemental Remedial Investigation Field Program, are shown on **Drawing 2A** provided in a map pocket at the end of this section of the report.

The Off-Site Field Investigation Program was undertaken to identify, delineate and assess the presence of chemical constituents that may have migrated from the site. The investigation activities that were completed as part of the Off-site Field Investigation Program during both the initial RI and the Supplemental are summarized in **Table 2-4**. Off-site sample locations performed during the initial RI and Supplemental Remedial Investigation Field Program are shown on **Drawing 2B** and is provided in a map pocket at the end of this section of the report.

2.2.1 Surface Soil Sampling

On-Site

Surface soil samples were collected from a depth of 0 to 2 inches below ground surface (bgs) utilizing a dedicated polyethylene scoop and placed into laboratory-supplied glass bottles. All samples were screened utilizing a photoionization detector (PID) for the presence of volatile organic compounds (VOCs). A total of 5 surface soil samples were collected at the site (**Drawing 2A**). These samples were collected to delineate an elevated lead concentration identified during the initial RI in the southeastern portion of the former coal storage area. The analytical results of surface soil samples collected on-site are presented and discussed in **Section 4.2.1.1**.

2.2.2 Subsurface Soil Sampling

Subsurface soil samples were collected using either a direct push (GeoProbe) sampling technique with a decontaminated probe sampler or through the use of a decontaminated split spoon sampler in conjunction with a conventional hollow stem auger drill rig. The samples were screened for VOCs utilizing a photoionization detector (PID); inspected for the presence of staining, discoloration, NAPL, ash, tar and other MGP-residuals; checked for odors; and logged by a geologist using the Unified Soil Classification system. Boring logs are included in **Appendix E**.

TABLE 2-1

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SAMPLE MEDIA, CHEMICAL CONSTITUENTS AND ANALYTICAL METHODS

CHEMICAL CONSTITUENTS	SAMPLE MEDIA AND ANALYTICAL METHOD			
	Soil	Groundwater	Soil Vapor	Air
BTEX	USEPA Method 8021	USEPA Method 8021	--	--
BTEX and Naphthalene	--	--	USEPA Modified Method TO-14	USEPA Modified Method TO-14
VOCs and Naphthalene	--	--	--	USEPA Modified Method TO-14
PAHs	USEPA Method 8270	USEPA Method 8270	--	--
Total Phenols	USEPA Method 9065	--	--	--
TCL VOCs	--	USEPA Method 8260	--	--
TCL SVOCs	--	USEPA Method 8270	--	--
RCRA Metals	USEPA Methods 6010/7471	USEPA Methods 6010/7471	--	--
Iron and Manganese	--	USEPA Methods 6010/7471	--	--
Total Cyanide	USEPA Method 9012	USEPA Method 9012	--	--
Free Cyanide	--	Method SM4500-CN1	--	--
Petroleum Fingerprint and Total Petroleum Hydrocarbons (TPHCs)	Method 310.13	Method 310.13	--	--
Full NYSDEC TCL Organics	USEPA Methods 8260, 8270 and 8080	--	--	--
Full NYSDEC TAL Metals	USEPA Methods 6010/7471	--	--	--
Grain Size	ASTM Method D422-63	--	--	--
Bulk Density	ASTM Method D2937-94	--	--	--
Specific Gravity	ASTM Method D854-92	--	--	--
Moisture Content	ASTM Method D2216-92	--	--	--
Chloride	--	USEPA Method 325.3	--	--
Ferrous Iron	--	Method D3500-Fe	--	--
Total Dissolved Solids(TDS)	--	Method E160.1	--	--
Alkalinity	--	Method E310.1	--	--
Chloride	--	Method E325.2	--	--
Ammonia	--	Method E350.1	--	--
Nitrate	--	Method E353.2	--	--
Orthophosphate	--	Methof E365.2	--	--
Sulfate	--	Method E375.4	--	--
Biological Oxygen Demand (BOD)	--	Method E405.1	--	--
Chemical Oxygen Demand (COD)	--	Method E410.4	--	--
Dissolved Organic Carbon	--	Method E415.1	--	--
Carbon Dioxide	--	Method M4500-C02C	--	--
Heterotrophic Plate Count	--	Method M9215B	--	--
Methane	--	Method RSKSOP-175	--	--
Dissolved ICP Metals	--	Method SW6010A	--	--
ICP Metals	--	Method SW6010A	--	--

Notes:

--: Not Applicable.

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	Description	ANNULAR FILLS (feet bgs) Interval	Type	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 (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-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 (feet bgs)	TOTAL DEPTH (feet bgs)	GROUND SURFACE ELEVATION (feet)	MEASURING POINT ELEVATION(1) (feet)	CASING DIAMETER (inches)	SCREENED DEPTHS (feet bgs)		ANNULAR FILLS (feet bgs)		
						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	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-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 2-3
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS													
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Surface Soil Sampling	Soil	18	15	HISS-01	6"	HISS-01		■	■	■		■								
				HISS-02	6"	HISS-02		■	■	■		■								
				HISS-03	6"	HISS-03		■	■	■		■								
				HISS-04	8"	HISS-04		■	■	■		■								
				HISS-05	8"	HISS-05		■	■	■		■								
				HISS-06	6"	HISS-06		■	■	■		■								
				HISS-07	6"	HISS-07		■	■	■		■								
				HISS-08	6"	HISS-08		■	■	■		■								
				HISS-09	6"	HISS-09		■	■	■		■								
				HISS-15	2"	HISS-15		■	■	■		■								
				HISS-16	2"	HISS-16		■	■	■		■								
				HISS-17	2"	HISS-17			■											
				HISS-18	2"	HIS-18			■											
				HISS-19	2"	HISS-19			■											
				HISS-20	2"	HISS-20			■											
Subsurface Soil Borings	--	38	45	HISB-01	60'	HISB-01 (8-10)	■	■	■	■		■								
Subsurface Soil Boring Samples	Soil	139	185			HISB-01 (17-19)	■	■	■	■		■								
						HISB-01 (26-28)	■	■	■	■		■								
						HISB-01 (58-60)	■	■	■	■		■								
				HISB-02	60'	HISB-02 (8-10)	■	■	■	■		■								
						HISB-02 (17-19)	■	■	■	■		■								
						HISB-02 (28-30)	■	■	■	■		■								
						HISB-02 (58-60)	■	■	■	■		■								
				HISB-03	60'	HISB-03 (6-8)	■	■	■	■		■								
						HISB-03 (58-60)	■	■	■	■		■								
				HISB-04	60'	HISB-04 (8-10)	■	■	■	■		■								
						HISB-04 (18-20)	■	■	■	■		■								
						HISB-04 (24-26)	■	■	■	■		■								
						HISB-04 (58-60)	■	■	■	■		■								

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS													
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-05	62'	HISB-05 (4-6)	■	■	■	■		■								
						HISB-05 (18-20)	■	■	■	■		■								
						HISB-05 (28-30)	■	■	■	■		■								
						HISB-05 (60-62)	■	■	■	■		■								
				HISB-06	62'	HISB-06 (0-2)	■	■	■	■		■								
						HISB-06 (16-18)	■	■	■	■		■								
						HISB-06 (24-26)	■	■	■	■		■								
						HISB-06 (60-62)	■	■	■	■		■								
				HISB-07	82'	HISB-07 (8.5-10)	■	■	■	■		■								
						HISB-07 (18-20)	■	■	■	■		■					■[1]			
						HISB-07 (24-26)	■	■	■	■		■								
						HISB-07 (58-60)	■	■	■	■		■								
						HISB-07 (80-82)	■	■	■	■		■								
				HISB-08	60'	HISB-08 (10-12)	■	■	■	■		■								
						HISB-08 (18-20)	■	■	■	■		■								
						HISB-08 (28-29)	■	■	■	■		■								
						HISB-08 (58-60)	■	■	■	■		■								
				HISB-09	63'	HISB-09 (2-4)	■	■	■	■		■								
						HISB-09 (12-14)	■	■	■	■		■								
						HISB-09 (26-28)	■	■	■	■		■								
						HISB-09 (61-63)	■	■	■	■		■								
				HISB-10	60'	HISB-10 (8-10)	■	■	■	■		■								
						HISB-10 (18-20)	■	■	■	■		■								
						HISB-10 (24-26)	■	■	■	■		■								
						HISB-10 (58-60)	■	■	■	■		■								
				HISB-11	60'	HISB-11 (4-6)	■	■	■	■		■								
						HISB-11 (16-17)	■	■	■	■		■								
						HISB-11 (24-26)	■	■	■	■		■								
						HISB-11 (58-60)	■	■	■	■		■								

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS													
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-12	86'	HISB-12 (9.5-11)	■	■	■	■		■								
						HISB-12 (18-20)	■	■	■	■		■								
						HISB-12 (26-28)	■	■	■	■		■								
						HISB-12 (84-86)	■	■	■	■		■								
				HISB-13	60'	HISB-13 (8-10)	■	■	■	■		■								
						HISB-13 (16-18)	■	■	■	■		■								
						HISB-13 (24-26)	■	■	■	■		■								
						HISB-13 (58-60)	■	■	■	■		■								
				HISB-14	124'	HISB-14 (6-7)	■	■	■	■		■								
						HISB-14 (16-18)	■	■	■	■		■					■			
						HISB-14 (28-30)	■	■	■	■		■					■			
						HISB-14 (56-58)	■	■	■	■		■								
						HISB-14 (98-100)	■	■	■	■		■								
						HISB-14 (122-124)	■	■	■	■		■								
				HISB-15	60'	HISB-15 (4-6)	■	■	■	■		■								
						HISB-15 (16-18)	■	■	■	■		■								
						HISB-15 (28.5-30)	■	■	■	■		■								
						HISB-15 (58-60)	■	■	■	■		■								
				HISB-16	70'	HISB-16 (4.5-6)	■	■	■	■		■								
						HISB-16 (18-20)	■	■	■	■		■								
						HISB-16 (24-26)	■	■	■	■		■					■[1]			
						HISB-16 (58-60)	■	■	■	■		■								
						HISB-16 (68-70)	■	■	■	■		■								
				HISB-17	76'	HISB-17 (8-10)	■	■	■	■		■								
						HISB-17 (16-18)	■	■	■	■		■								
						HISB-17 (24-26)	■	■	■	■		■								
						HISB-17 (58-60)	■	■	■	■		■								
						HISB-17 (74-76)	■	■	■	■		■								

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS													
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-18	60'	HISB-18 (8.5-10)	■	■	■	■		■								
						HISB-18 (18-20)	■	■	■	■		■								
						HISB-18 (28-30)	■	■	■	■		■								
						HISB-18 (58-60)	■	■	■	■		■								
				HISB-29	60'	HISB-29 (8-10)	■	■	■	■		■								
						HISB-29 (16-18)	■	■	■	■		■					■			
						HISB-29 (28-30)	■	■	■	■		■								
						HISB-29 (58-60)	■	■	■	■		■								
				HISB-30	60'	HISB-30 (8-10)	■	■	■	■		■								
						HISB-30 (16-18)										■				
						HISB-30 (18-20)			■	■										
						HISB-30 (28-30)	■	■	■	■		■								
						HISB-30 (58-60)	■	■	■	■		■								
				HISB-31	64'	HISB-31 (4-6)	■	■	■	■		■								
						HISB-31 (16-18)	■	■	■	■		■								
						HISB-31 (28-30)	■	■	■	■		■					■			
						HISB-31 (52-54)	■	■	■	■		■								
				HISB-32	60'	HISB-32 (8-10)	■	■	■	■		■								
						HISB-32 (18-20)	■	■	■	■		■					■			
						HISB-32 (28-30)	■	■	■	■		■								
						HISB-32 (58-60)	■	■	■	■		■								
				HISB-33	60'	HISB-33 (8-10)	■	■	■	■		■								
						HISB-33 (16-18)	■	■	■	■		■					■			
						HISB-33 (28-30)	■	■	■	■		■								
						HISB-33 (58-60)	■	■	■	■		■								
				HISB-34	132'	HISB-34 (6-8)	■	■	■	■		■								
						HISB-34 (18-20)	■	■	■	■		■								
						HISB-34 (28-30)	■	■	■	■		■								
						HISB-34 (66-68)	■	■	■	■		■								

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS													
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-35	60'	HISB-35 (6-8)	■	■	■	■		■								
						HISB-35 (14-16)	■	■	■	■		■								
						HISB-35 (28-30)	■	■	■	■		■								
						HISB-35 (58-60)	■	■	■	■		■								
				HISB-54	50'	HISB-54 (18-20)	■	■	■	■		■								
						HISB-54 (26-28)	■	■	■	■		■								
						HISB-54 (48-50)	■	■	■	■		■								
				HISB-55	56'	HISB-55 (16-18)	■	■	■	■		■								
						HISB-55 (28-30)	■	■	■	■		■								
						HISB-55 (36-37)	■	■	■	■		■								
						HISB-55 (50-51)	■	■	■	■		■								
				HISB-56	70'	HISB-56 (9-11)	■	■												
						HISB-56 (25-27)	■	■												
						HISB-56 (29-30)	■	■												
						HISB-56 (66-68)	■	■												
				HISB-57	70'	HISB-57 (9-11)	■	■												
						HISB-57 (29-31)	■	■												
						HISB-57 (33-35)	■	■												
						HISB-57 (68-70)	■	■												
				HISB-58	80'	HISB-58 (14-16)	■	■												
						HISB-58 (21-24)	■	■							■					
						HISB-58 (30-32)	■	■							■					
						HISB-58 (34-36)	■	■												
						HISB-58 (76-78)	■	■												
				HISB-58A	68'	HISB-58A (4-6)	■	■												
						HISB-58A (10-12)	■	■												
						HISB-58A (30-32)	■	■												
						HISB-58A (33-35)	■	■												
						HISB-58A (66-68)	■	■												

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS													
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-59	80'	HISB-59 (9-11)	■	■												
						HISB-59 (30-32)	■	■												
						HISB-59 (32-34)	■	■												
						HISB-59 (78-80)	■	■												
				HISB-60	80'	HISB-60 (4-6)	■	■												
						HISB-60 (9-11)	■	■												
						HISB-60 (17-19)	■	■							■					
						HISB-60 (29-31)	■	■												
						HISB-60 (34-36)	■	■												
						HISB-60 (78-80)	■	■												
				HISB-61	80'	HISB-61 (10-12)	■	■												
						HISB-61 (30-32)	■	■												
						HISB-61 (33-35)	■	■												
						HISB-61 (58-60)	■	■												
						HISB-61 (78-80)	■	■												
				HISB-61A	36'	HISB-61A (10'-12')	■	■	■											
						HISB-61A (30.5'-32')	■	■	■											
				HISB-62	54'	HISB-62 (9-11)	■	■												
						HISB-62 (24-26)	■	■												
						HISB-62 (30-32)	■	■												
				HISB-62A	72'	HISB-62A (25-27)	■	■												
						HISB-62A (70-72)	■	■												
				HISB-63	36'	HISB-63 (7-11)	■	■												
						HISB-63 (29-31)	■	■												
						HISB-63 (34-36)	■	■												
				HISB-64	58'	HISB-64 (10-12)	■	■												
						HISB-64 (23-25)	■	■												
						HISB-64 (30-32)	■	■												
						HISB-64 (44-46)	■	■												
						HISB-64 (56-58)	■	■												

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS													
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-65	48'	HISB-65 (10-12)	■	■												
						HISB-65 (29-31)	■	■												
						HISB-65 (32.5-34.5)	■	■												
						HISB-65 (46-48)	■	■												
				HISB-66	60'	HISB-66 (14-16)	■	■												
						HISB-66 (22-24)	■	■												
						HISB-66 (33-35)	■	■												
						HISB-66 (58-60)	■	■												
				HISB-67	52'	HISB-67 (14-16)	■	■												
						HISB-67 (26-28)	■	■												
						HISB-67 (30-32)	■	■												
						HISB-67 (50-52)	■	■												
				HISB-68	52'	HISB-68 (9-11)	■	■												
						HISB-68 (26-28)	■	■												
						HISB-68 (30-32)	■	■												
						HISB-68 (51-52)	■	■												
				HISB-74	40'	HISB-74 (9-11)	■	■												
						HISB-74 (30-32)	■	■												
						HISB-74 (37-39)	■	■												
				HISB-75	64'	HISB-75 (10-12)	■	■												
						HISB-75 (26-28)	■	■												
						HISB-75 (30-32)	■	■												
						HISB-75 (34-36)	■	■												
						HISB-75 (62-64)	■	■												
				HISB-77	48'	HISB-77 (10-12)	■	■												
						HISB-77 (30-32)	■	■												
						HISB-77 (34-36)	■	■												
						HISB-77 (46-48)	■	■												
Groundwater Probe Samples	Groundwater	50	49	HIGP-01	60'	HIGP-01 (56-60)	■	■												
				HIGP-02	60'	HIGP-02 (31-35)	■	■												
						HIGP-02 (56-60)	■	■												
				HIGP-03	60'	HIGP-03 (33-37)	■	■												
						HIGP-03 (56-60)	■	■												
				HIGP-04	60'	HIGP-04 (30-34)	■	■												
						HIGP-04 (56-60)	■	■												
				HIGP-05	60'	HIGP-05 (33-37)	■	■												
						HIGP-05 (56-60)	■	■												

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS													
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Groundwater Probe Samples (cont.)				HIGP-06	60'	HIGP-06 (33-37)	■	■												
						HIGP-06 (56-60)	■	■												
				HIGP-07	60'	HIGP-07 (30-34)	■	■												
						HIGP-07 (56-60)	■	■												
				HIGP-08	60'	HIGP-08 (30-34)	■	■												
						HIGP-08 (56-60)	■	■												
				HIGP-09	60'	HIGP-09 (32-36)	■	■												
						HIGP-09 (56-60)	■	■												
				HIGP-10	60'	HIGP-10 (30-34)	■	■												
						HIGP-10 (56-60)	■	■												
				HIGP-11	60'	HIGP-11 (30-34)	■	■												
						HIGP-11 (56-60)	■	■												
				HIGP-12	60'	HIGP-12 (30-34)	■	■												
						HIGP-12 (56-60)	■	■												
				HIGP-13	60'	HIGP-13 (33-37)	■	■												
						HIGP-13 (56-60)	■	■												
				HIGP-14	60'	HIGP-14 (30-34)	■	■												
						HIGP-14 (56-60)	■	■												
				HIGP-15	60'	HIGP-15 (30-34)	■	■												
						HIGP-15 (56-60)	■	■												
				HIGP-16	60'	HIGP-16 (30-34)	■	■												
						HIGP-16 (56-60)	■	■												
				HIGP-17	60'	HIGP-17 (30-34)	■	■												
						HIGP-17 (56-60)	■	■												
				HIGP-18	60'	HIGP-18 (30-34)	■	■												
						HIGP-18 (56-60)	■	■												
				HIGP-29	64'	HIGP-29 (30-34)	■	■												
						HIGP-29 (60-64)	■	■												
				HIGP-30	64'	HIGP-30 (32-36)	■	■												
						HIGP-30 (60-64)	■	■												
				HIGP-31	64'	HIGP-31 (29-33)	■	■												
						HIGP-31 (60-64)	■	■												
				HIGP-32	64'	HIGP-32 (30-34)	■	■												
						HIGP-32 (60-64)	■	■												
				HIGP-33	64'	HIGP-33 (30-34)	■	■												
						HIGP-33 (60-64)	■	■												

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS													
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Groundwater Probe Samples (cont.)				HIGP-34	64'	HIGP-34 (30-34)	■	■												
						HIGP-34 (60-64)	■	■												
				HIGP-35	62'	HIGP-35 (30-34)	■	■												
						HIGP-35 (56-60)	■	■												
New Groundwater Monitoring Wells	Groundwater	10	12	HIMW-01	124'	HIMW-01 (36-38)												■		■[2]
						HIMW-01 (84-86)												■		■[2]
						HIMW-01 (116-118)												■		■[2]
				HIMW-02	130.5'	HIMW-02 (26-28)												■		■[2]
						HIMW-02 (32-34)												■		■[2]
						HIMW-02 (80-82)												■		■[2]
						HIMW-02 (108-110)												■		■[2]
						HIMW-02 (128-130.5)														■[3]
				HIMW-06	132.5'	HIMW-06 (24-26)												■		■[2]
						HIMW-06 (28-30)												■		■[2]
						HIMW-06 (75-77)												■		■[2]
						HIMW-06 (130-132.5)														■[3]
Groundwater Monitoring Well Sampling	Groundwater	10	21	HIMW-01S	36'	MW01S	■	■	■	■	■			■	■					
				HIMW-01I	84'	MW01I	■	■	■	■	■			■						
				HIMW-01D	122'	MW01D	■	■	■	■	■			■						
				HIMW-02S	38'	MW02S	■	■	■	■	■									
				HIMW-02I	88'	MW02I	■	■	■	■	■									
				HIMW-02D	114'	MW02D	■	■	■	■	■									
				HIMW-06S	36'	MW06S	■	■	■	■	■			■	■					
						HIMW-06S								■						
				HIMW-06I	82'	HIMW-06I	■	■												
						MW06I	■	■	■	■	■			■						
						HIMW-06I	■	■						■						
				HIMW-06D	116'	HIMW-06D	■	■												
						MW06D	■	■	■	■	■									

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

SUMMARY OF ON-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS													
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	PCBs	Iron & Manganese	Petroleum Fingerprint	TAL Metals	Full TCL/TAL	TOC	BTEX and Naphthalene	Geotechnical Analysis
Groundwater Monitoring Well Sampling (cont.)				HIMW-07S	39'	MW07S	■	■	■	■	■				■					
				HIMW-07I	88'	HIMW-07S	■	■												
						HIMW-07I	■	■												
						MW07I	■	■	■	■	■			■						
				HIMW-07D	115'	HIMW-07D	■	■												
						MW07D	■	■	■	■	■			■						
				HIMW-18I	72'	HIMW-18I	■	■												
				HIMW-19S	37'	HIMW-19S														
				HIMW-19I	67'	HIMW-19I	■	■												
Piezometer Sampling	Groundwater	0	5	PZ-02	36'	PZ-02	■	■	■	■	■									
				PZ-03	30'	PZ-03	■	■						■						
						PZ-03	■	■	■	■	■									
						PZ-03	■	■												
				PZ-08	36'	PZ-08	■													
Test Pits	Soil	7	10	HITP-01	3'-3.5'	HITP-01 (2.5-3)	■	■	■	■										
				HITP-02	8'	HITP-02 (3-4)	■	■	■	■										
				HITP-03	8'	HITP-03 (3-4)	■	■	■	■		■					■			
				HITP-04	4'	HITP-04 (2-3)	■	■	■	■										
				HITP-05	5'	HITP-05 (4-5)	■	■	■	■		■								
				HITP-06	7'	HITP-06 (5-6)	■	■	■	■		■								
				HITP-07	11'	HITP-07 (2-3)	■	■	■	■		■								
				HITP-08	9'															
				HITP-09	7'	HITP-09 (7')	■	■												
				HITP-10	7'															
				HITP-11	8'															
				HITP-12	6'	HITP-12 (6')	■	■												
				HITP-13	7'															
				HITP-14	5'	HITP-14 (4')	■	■												
Soil Vapor Samples	Soil Vapor	2	2	HIVP-14	3.5'	HIVP-14													■	
				HIVP-15	3.5'	HIVP-15													■	
Ambient Air Monitoring	Air	1	1	HIAA-01	--	HIAA-01													■	

Notes:
(1) Excludes analysis for Pesticides and PCBs.
(2) Includes grain size, bulk density, specific gravity and moisture content only.
(3) Includes grain size and vertical permeability only.
-- : Not applicable.
TOC : Total organic carbon.

TABLE 2-4
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS																	
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene	Geotechnical Analysis	GeoChemical Analysis
Surface Soil Sampling	Soil	9	5	HISS-10	2"	HISS-10		■	■	■		■												
				HISS-11	2"	HISS-11		■	■	■		■												
				HISS-12	2"	HISS-12		■	■	■		■												
				HISS-13	2"	HISS-13		■	■	■		■												
				HISS-14	2"	HISS-14		■	■	■		■												
Subsurface Soil Borings	--	24	31	HISB-19	56'	HISB-19 (2-4)	■	■	■	■		■												
Subsurface Soil Boring Samples	Soil	92	123			HISB-19 (12-14)	■	■	■	■		■												
						HISB-19 (20-22)	■	■	■	■		■												
						HISB-19 (48-50)	■	■	■	■		■												
				HISB-20	56'	HISB-20 (0-2)	■	■	■	■		■												
						HISB-20 (12-14)	■	■	■	■		■												
						HISB-20 (20-22)	■	■	■	■		■												
						HISB-20 (50-52)	■	■	■	■		■												
				HISB-21	56'	HISB-21 (2-4)	■	■	■	■		■												
						HISB-21 (10-12)	■	■	■	■		■												
						HISB-21 (22-24)	■	■	■	■		■												
						HISB-21 (42-44)	■	■	■	■		■												
						HISB-21 (54-56)	■	■	■	■		■												
				HISB-22	49'	HISB-22 (0-2)	■	■	■	■		■												
						HISB-22 (12-14)	■	■	■	■		■												
						HISB-22 (47-49)	■	■	■	■		■												
				HISB-23	46'	HISB-23 (0-2)	■	■	■	■		■												
						HISB-23 (14-16)	■	■	■	■		■												
						HISB-23 (44-46)	■	■	■	■		■												
				HISB-24	49'	HISB-24 (2-4)	■	■	■	■		■												
						HISB-24 (14-16)	■	■	■	■		■												
						HISB-24 (22-24)	■	■	■	■		■												
						HISB-24 (47-49)	■	■	■	■		■												
				HISB-25	66'	HISB-25 (6-8)	■	■	■	■		■												
						HISB-25 (14-16)	■	■	■	■		■												
						HISB-25 (24-26)	■	■	■	■		■												
						HISB-25 (56-58)	■	■	■	■		■												

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS																	
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-26	56'	HISB-26 (2-4)	■	■	■	■		■												
						HISB-26 (14-16)	■	■	■	■		■												
						HISB-26 (21-23)	■	■	■	■		■												
						HISB-26 (54-56)	■	■	■	■		■												
				HISB-27	57'	HISB-27 (0-2)	■	■	■	■		■												
						HISB-27 (12-14)	■	■	■	■		■												
						HISB-27 (26-28)	■	■	■	■		■												
						HISB-27 (55-57)	■	■	■	■		■												
				HISB-28	66'	HISB-28 (8-10)	■	■	■	■		■												
						HISB-28 (18-20)	■	■	■	■		■												
						HISB-28 (28-30)	■	■	■	■		■												
						HISB-28 (58-60)	■	■	■	■		■												
				HISB-36	60'	HISB-36 (4-6)	■	■	■	■		■												
						HISB-36 (18-20)	■	■	■	■		■												
						HISB-36 (28-30)	■	■	■	■		■												
						HISB-36 (58-60)	■	■	■	■		■												
				HISB-37	60'	HISB-37 (8-10)	■	■	■	■		■												
						HISB-37 (18-20)	■	■	■	■		■												
						HISB-37 (28-30)	■	■	■	■		■												
						HISB-37 (58-60)	■	■	■	■		■												
				HISB-38	63'	HISB-38 (6-8)	■	■	■	■		■												
						HISB-38 (16-18)	■	■	■	■		■												
						HISB-38 (24-26)	■	■	■	■		■												
						HISB-38 (61-63)	■	■	■	■		■												
				HISB-39	60'	HISB-39 (6-8)	■	■	■	■		■												
						HISB-39 (18-20)	■	■	■	■		■												
						HISB-39 (28-30)	■	■	■	■		■												
						HISB-39 (58-60)	■	■	■	■		■												
				HISB-40	60'	HISB-40 (6-8)	■	■	■	■		■												
						HISB-40 (16-18)	■	■	■	■		■												
						HISB-40 (26-28)	■	■	■	■		■												
						HISB-40 (32-34)	■	■	■	■		■												
						HISB-40 (58-60)	■	■	■	■		■												

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS																	
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-41	60'	HISB-41 (6-8)	■	■	■	■		■												
						HISB-41 (18-20)	■	■	■	■		■												
						HISB-41 (26-28)	■	■	■	■		■		■										
						HISB-41 (34-36)	■	■	■	■		■												
						HISB-41 (58-60)	■	■	■	■		■												
				HISB-42	60'	HISB-42 (8-10)	■	■	■	■		■												
						HISB-42 (16-18)	■	■	■	■		■												
						HISB-42 (24-26)	■	■	■	■		■												
						HISB-42 (58-60)	■	■	■	■		■												
				HISB-43	63'	HISB-43 (0-2)	■	■	■	■		■												
						HISB-43 (16-18)	■	■	■	■		■												
						HISB-43 (26-28)	■	■	■	■		■												
						HISB-43 (61-63)	■	■	■	■		■												
				HISB-44	61'	HISB-44 (6-8)	■	■	■	■		■												
						HISB-44 (14-16)	■	■	■	■		■												
						HISB-44 (24-26)	■	■	■	■		■												
						HISB-44 (59-61)	■	■	■	■		■												
				HISB-45	42'	HISB-45 (6-8)	■	■	■	■		■												
						HISB-45 (16-18)	■	■	■	■		■												
						HISB-45 (28-30)	■	■	■	■		■												
				HISB-46	59'	HISB-46 (1-3)	■	■	■	■		■												
						HISB-46 (14-16)	■	■	■	■		■												
						HISB-46 (28-30)	■	■	■	■		■												
						HISB-46 (48-50)	■	■	■	■		■												
				HISB-47	60'	HISB-47 (4-6)	■	■	■	■		■												
						HISB-47 (14-16)	■	■	■	■		■												
						HISB-47 (28-30)	■	■	■	■		■												
						HISB-47 (58-60)	■	■	■	■		■												
				HISB-48	62'	HISB-48 (6-8)	■	■	■	■		■												
						HISB-48 (12-14)	■	■	■	■		■												
						HISB-48 (28-30)	■	■	■	■		■												
						HISB-48 (60-62)	■	■	■	■		■												
				HISB-69	70	HISB-69 (8-10)	■	■																
						HISB-69 (26-28)	■	■																
						HISB-69 (30-32)	■	■																
						HISB-69 (68-70)	■	■																

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS																	
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
Subsurface Soil Boring Samples (cont.)				HISB-70	70'	HISB-70 (6-8)	■	■																
						HISB-70 (25-27)	■	■						■										
						HISB-70 (31-33)	■	■						■										
						HISB-70 (68-70)	■	■																
				HISB-71	70'	HISB-71 (6-8)	■	■																
						HISB-71 (19-20)	■	■																
						HISB-71 (31-32)	■	■																
						HISB-71 (67-68)	■	■																
				HISB-72	62'	HISB-72 (9-11)	■	■																
						HISB-72 (26-28)	■	■																
						HISB-72 (28-30)									■	■								
						HISB-72 (60-62)	■	■																
				HISB-73	68'	HISB-73 (6-8)	■	■																
						HISB-73 (27-29)	■	■																
						HISB-73 (66-67)	■	■																
				HISB-76	70'	HISB-76 (14-16)	■	■																
						HISB-76 (28-30)	■	■																
						HISB-76 (30-32)	■	■																
Subsurface Soil Boring Samples (cont.)				HISB-78	52'	HISB-78 (18-20)	■	■																
						HISB-78 (26-28)	■	■																
						HISB-78 (30-32)	■	■																
						HISB-78 (39-40)	■	■																
						HISB-78 (48-52)	■	■																
				HISB-79	52'	HISB-79 (16-20)	■	■																
						HISB-79 (28-32)	■	■																
						HISB-79 (32-36)	■	■																
						HISB-79 (48-52)	■	■																
Groundwater Probes	--	25	25	HIGP-01	60'	HIGP-01 (25-29)	■	■																
Groundwater Probe Samples	Groundwater	52	157	HIGP-19	58'	HIGP-19 (26-30)	■	■																
						HIGP-19 (54-58)	■	■																
				HIGP-20	58'	HIGP-20 (26-30)	■	■																
						HIGP-20 (54-58)	■	■																
				HIGP-21	58'	HIGP-21 (26-30)	■	■																
						HIGP-21 (54-58)	■	■																
				HIGP-22	48'	HIGP-22 (16-20)	■	■																
						HIGP-22 (44-48)	■	■																
				HIGP-23	48'	HIGP-23 (16-20)	■	■																

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS																	
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
Groundwater Probe Samples (cont.)				HIGP-23	48'	HIGP-23 (44-48)	■	■																
				HIGP-24	58'	HIGP-24 (26-30)	■	■																
						HIGP-24 (54-58)	■	■																
				HIGP-25	58'	HIGP-25 (24-28)	■	■																
						HIGP-25 (54-58)	■	■																
				HIGP-26	56'	HIGP-26 (22-26)	■	■																
						HIGP-26 (52-56)	■	■																
				HIGP-27	60'	HIGP-27 (26-30)	■	■																
						HIGP-27 (56-60)	■	■																
				HIGP-28	62'	HIGP-28 (29-33)	■	■																
						HIGP-28 (56-62)	■	■																
				HIGP-36	62'	HIGP-36 (29-33)	■	■																
						HIGP-36 (58-62)	■	■																
				HIGP-37	62'	HIGP-37 (29-33)	■	■																
						HIGP-37 (58-62)	■	■																
				HIGP-38	62'	HIGP-38 (29-33)	■	■																
						HIGP-38 (58-62)	■	■																
				HIGP-39	64'	HIGP-39 (29-33)	■	■																
						HIGP-39 (60-64)	■	■																
				HIGP-40	60'	HIGP-40 (30-34)	■	■																
						HIGP-40 (56-60)	■	■																
				HIGP-41	62'	HIGP-41 (30-34)	■	■																
						HIGP-41 (58-62)	■	■																
				HIGP-42	60'	HIGP-42 (32-36)	■	■																
						HIGP-42 (56-60)	■	■																
				HIGP-43	65'	HIGP-43 (33-37)	■	■																
						HIGP-43 (61-65)	■	■																
				HIGP-44	61'	HIGP-44 (30-34)	■	■																
						HIGP-44 (57-61)	■	■																
				HIGP-45	64'	HIGP-45 (32-36)	■	■																
						HIGP-45 (60-64)	■	■																
				HIGP-46	60'	HIGP-46 (26-30)	■	■																
						HIGP-46 (56-60)	■	■																
				HIGP-47	64'	HIGP-47 (31-35)	■	■																
						HIGP-47 (60-64)	■	■																

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY PROPOSED	QUANTITY ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
Groundwater Probe Samples (cont.)				HIGP-48	64'	HIGP-48 (30-34)	■	■																
						HIGP-48 (60-64)	■	■																
				HIGP-49	94'	HIGP-49 (30-34)	■	■																
						HIGP-49 (60-64)	■	■																
						HIGP-49 (90-94)	■	■																
				HIGP-50	64'	HIGP-50 (30-34)	■	■							■	■								
						HIGP-50 (60-64)	■	■							■	■								
				HIGP-51	60'	HIGP-51 (28-32)	■	■							■	■								
						HIGP-51 (56-60)	■	■							■	■								
				HIGP-52	64'	HIGP-52 (30-34)	■	■							■	■								
						HIGP-52 (60-64)	■	■							■	■								
				HIGP-53	94'	HIGP-53 (27-31)	■	■							■	■								
						HIGP-53 (60-64)	■	■							■	■								
						HIGP-53 (90-94)	■	■							■	■								
				HIGP-54	94'	HIGP-54 (33-37)	■	■							■	■								
						HIGP-54 (60-64)	■	■							■	■								
						HIGP-54 (90-94)	■	■							■	■								
				HIGP-55	84'	HIGP-55 (23-27)	■	■							■	■								
						HIGP-55 (60-64)	■	■							■	■								
						HIGP-55 (80-84)	■	■							■	■								
				HIGP-56	64'	HIGP-56 (24-28)	■	■																
						HIGP-56 (60-64)	■	■																
				HIGP-57	68'	HIGP-57 (36-40)	■	■																
						HIGP-57 (64-68)	■	■																
				HIGP-58	94'	HIGP-58 (36-40)	■	■																
						HIGP-58 (60-64)	■	■																
						HIGP-58 (90-94)	■	■																
				HIGP-59	94'	HIGP-59 (34-38)	■	■																
						HIGP-59 (60-64)	■	■																
						HIGP-59 (90-94)	■	■																
				HIGP-60	94'	HIGP-60 (33-37)	■	■																
						HIGP-60 (60-64)	■	■																
						HIGP-60 (90-94)	■	■																
				HIGP-61	94'	HIGP-61 (26-30)	■	■																
						HIGP-61 (60-64)	■	■																
						HIGP-61 (90-94)	■	■																
Groundwater Probe Samples (cont.)				HIGP-62	88'	HIGP-62 (37-41)	■	■																
						HIGP-62 (54-58)	■	■																
						HIGP-62 (84-88)	■	■																

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS																	
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
				HIGP-63	94'	HIGP-63 (37-41)	■	■																
						HIGP-63 (54-58)	■	■																
						HIGP-63 (72-76)	■	■																
						HIGP-63 (90-94)	■	■																
				HIGP-64	94'	HIGP-64 (37-41)	■	■																
						HIGP-64 (54-58)	■	■																
						HIGP-64 (72-76)	■	■																
						HIGP-64 (90-94)	■	■																
				HIGP-65	94'	HIGP-65 (37-41)	■	■																
						HIGP-65 (54-58)	■	■																
						HIGP-65 (72-76)	■	■																
						HIGP-65 (90-94)	■	■																
				HIGP-66	94'	HIGP-66 (40-44)	■	■																
						HIGP-66 (56-60)	■	■																
						HIGP-66 (72-76)	■	■																
						HIGP-66 (90-94)	■	■																
				HIGP-67	94'	HIGP-67 (37-41)	■	■																
						HIGP-67 (54-58)	■	■																
						HIGP-67 (72-76)	■	■																
						HIGP-67 (90-94)	■	■																
				HIGP-68	92'	HIGP-68 (37-41)	■	■																
						HIGP-68 (54-58)	■	■																
						HIGP-68 (72-76)	■	■																
						HIGP-68 (90-92)	■	■																
				HIGP-69	108'	HIGP-69 (54-58)	■	■																
						HIGP-69 (70-74)	■	■																
						HIGP-69 (82-86)	■	■																
						HIGP-69 (90-94)	■	■																
						HIGP-69 (104-108)	■	■																
				HIGP-70	144'	HIGP-70 (54-58)	■	■																
						HIGP-70 (70-74)	■	■																
						HIGP-70 (82-86)	■	■																
						HIGP-70 (92-96)	■	■																
Groundwater Probe Samples (cont.)				HIGP-70	144'	HIGP-70 (110-114)	■	■																
						HIGP-70 (140-144)	■	■																
				HIGP-71	85'	HIGP-71 (46-50)	■	■																
						HIGP-71 (54-58)	■	■																
						HIGP-71 (62-66)	■	■																

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

		QUANTITY					ANALYTICAL PARAMETERS																	
ACTIVITY	SAMPLE MEDIA	PROPOSED	ACTUAL	SITE ID	DEPTH	SAMPLE ID	BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
						HIGP-71 (72-76)	■	■																
						HIGP-71 (81-85)	■	■																
				HIGP-72	96'	HIGP-72 (52-56)	■	■																
						HIGP-72 (62-66)	■	■																
						HIGP-72 (72-76)	■	■																
						HIGP-72 (82-86)	■	■																
						HIGP-72 (92-96)	■	■																
				HIGP-73	97'	HIGP-73 (53-57)	■	■																
						HIGP-73 (63-67)	■	■																
						HIGP-73 (73-77)	■	■																
						HIGP-73 (83-87)	■	■																
						HIGP-73 (93-97)	■	■																
				HIGP-74	91'	HIGP-74 (47-51)	■	■																
						HIGP-74 (57-61)	■	■																
						HIGP-74 (67-71)	■	■																
						HIGP-74 (77-81)	■	■																
						HIGP-74 (87-91)	■	■																
				HIGP-75	90'	HIGP-75 (46-50)	■	■																
						HIGP-75 (56-60)	■	■																
						HIGP-75 (66-70)	■	■																
						HIGP-75 (76-80)	■	■																
						HIGP-75 (86-90)	■	■																
				HIGP-77	88	HIGP-77 (29-33)	■	■																
						HIGP-77 (66-70)	■	■																
						HIGP-77 (84-88)	■	■																
				HIGP-78	70	HIGP-78 (31-35)	■	■																
						HIGP-78 (66-70)	■	■																
				HIGP-79	68	HIGP-79 (36-40)	■	■																
						HIGP-79 (64-68)	■	■																

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS																	
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
Groundwater Probe Samples (cont.)				HIGP-80	52	HIGP-80 (36-40)	■	■																
						HIGP-80 (48-52)	■	■																
				HIGP-81	70	HIGP-81 (30-34)	■	■																
						HIGP-81 (40-44)	■	■																
						HIGP-81 (66-70)	■	■																
				HIGP-82	52	HIGP-82 (32-36)	■	■																
						HIGP-82 (36-40))	■	■																
						HIGP-82 (48-52)	■	■																
New Groundwater Monitoring Wells		5	5	HIMW-03	151'	HIMW-03 (149-151)																	■[2]	
				HIMW-08	152'	HIMW-08 (114-115)														■			■[1]	
Groundwater Monitoring Well Sampling	Groundwater	21	62	HIMW-11	126'	HIMW-11 (26-28)														■			■[1]	
						HIMW-11 (80-82)														■			■[1]	
						HIMW-11 (112-114)														■			■[1]	
				HIMW-03S	33'	MW03S	■	■	■	■	■													
				HIMW-03I	91'	HIMW-03I	■	■																
						MW03I	■	■	■	■	■													
				HIMW-03D	141'	HIMW-03D	■	■																
						MW03D	■	■	■	■	■													
				HIMW-04S	40'	MW04S	■	■	■	■	■													
						HIMW-04S	■	■																
				HIMW-04I	90'	HIMW-04I	■	■																
						HIMW-04(I)	■	■	■	■	■													
						HIMW-04I	■	■																
				HIMW-04D	177'	HIMW-04D	■	■																
						HIMW-04(D)	■	■	■	■	■													
				HIMW-05S	37'	MW05S	■	■	■	■	■													
				HIMW-05I	90'	HIMW-05I	■	■																
						MW05I	■	■	■	■	■													
				HIMW-05D	140'	HIMW-05D	■	■																
						MW05D	■	■	■	■	■													
				HIMW-08S	35'	HIMW-08S	■	■																
						MW08S	■	■	■	■	■													
						HIMW-08S	■	■																
				HIMW-08I	73'	HIMW-08I	■	■																
						MW08I	■	■	■	■	■													
						HIMW-08I	■	■																
Groundwater Monitoring Well Sampling (cont.)				HIMW-08D	112'	HIMW-08D	■	■																
						MW08D	■	■	■	■	■													
				HIMW-09S	38'	HIMW-09S	■	■	■	■	■													

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS																	
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
				HIMW-09I	80'	HIMW-09I	■	■	■	■	■													
				HIMW-09D	123'	HIMW-09D	■	■	■	■	■													
				HIMW-10S	38'	MW10S	■	■	■	■	■			■					■					
				HIMW-10I	91'	HIMW-10I	■	■																
						MW10I	■	■	■	■	■													
				HIMW-10D	133'	HIMW-10D	■	■																
						HIMW-10D	■	■	■	■	■													
				HIMW-11S	38'	MW11S	■	■	■	■	■			■										
				HIMW-11I	90'	MW11I	■	■	■	■	■													
						HIMW-11I	■	■																
				HIMW-11D	119'	MW11D	■	■	■	■	■													
				HIMW-12S	32'	HIMW-12S	■	■																
						HIMW-12(S)	■	■	■	■	■													
						HIMW-12S	■	■																
				HIMW-12I	73'	HIMW-12I	■	■																
						HIMW-12(I)	■	■	■	■	■													
						HIMW-12I	■	■																
				HIMW-12D	127'	HIMW-12D	■	■																
						HIMW-12(D)	■	■	■	■	■													
				HIMW-13S	48'	HIMW-13S	■	■	■	■	■													
						HIMW-13S	■	■																
						HIMW-13S	■	■					■											■
				HIMW-13I	80'	HIMW-13I	■	■	■	■	■													
						HIMW-13I	■	■																
						HIMW-13I	■	■					■											■
				HIMW-13D	120'	HIMW-13D	■	■	■	■	■													
						HIMW-13D	■	■																
				HIMW-14I	95'	HIMW-14I	■	■	■	■	■													
						HIMW-14I	■	■																
				HIMW-14D	150'	HIMW-14D	■	■	■	■	■													
						HIMW-14D	■	■																
				HIMW-15I	90'	HIMW-15I	■	■	■	■	■													
						HIMW-15I	■	■					■											■

TABLE 2-4 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY OF OFF-SITE FIELD INVESTIGATION PROGRAM ACTIVITIES

ACTIVITY	SAMPLE MEDIA	QUANTITY		SITE ID	DEPTH	SAMPLE ID	ANALYTICAL PARAMETERS																	
		PROPOSED	ACTUAL				BTEX	PAHs	RCRA Metals	Total Cyanide	Free Cyanide	Total Phenols	Iron & Manganese	Petroleum Fingerprint	VOCs	SVOCs	TAL Metals	Full TCL/TAL	TPHCs	TOC	Naphthalene	BTEX and Naphthalene		Geotechnical Analysis
Groundwater Monitoring Well Sampling (cont.)				HIMW-15D	152'	HIMW-15D	■	■	■	■	■													
						HIMW-15D	■	■																
				HIMW-16I	82	HIMW-16I	■	■																
				HITW-01	180'	HITW-01 (40-44)	■	■																
						HITW-01 (54-58)	■	■																
						HITW-01 (70-74)	■	■																
						HITW-01 (82-86)	■	■																
						HITW-01 (90-94)	■	■																
						HITW-01 (109-113)	■	■																
				HITW-02	182'	HITW-02 (148-153)	■	■																
						HITW-02 (65-70)	■	■																
						HITW-02 (75-80)	■	■																
						HITW-02 (85-90)	■	■																
						HITW-02 (115-120)	■	■																
						HITW-02 (148-153)	■	■																
				HITW-03	182'	HITW-03 (50-55)	■	■																
						HITW-03 (65-70)	■	■																
						HITW-03 (80-85)	■	■																
						HITW-03 (91-96)	■	■																
						HITW-03 (130-135)	■	■																
						HITW-03 (145-150)	■	■																
Soil Vapor Samples	Soil Vapor	13	13	HIVP-01	3.5'	HIVP-01																■		
				HIVP-02	3.5'	HIVP-02																■		
				HIVP-03	3.5'	HIVP-03																■		
				HIVP-04	3.5'	HIVP-04																■		
				HIVP-05	3.5'	HIVP-05																■		
				HIVP-06	3.5'	HIVP-06																■		
				HIVP-07	3.5'	HIVP-07																■		
				HIVP-08	3.5'	HIVP-08																■		
				HIVP-09	3.5'	HIVP-09																■		
				HIVP-10	3.5'	HIVP-10																■		
				HIVP-11	3.5'	HIVP-11																■		
				HIVP-12	3.5'	HIVP-12																■		
				HIVP-13	3.5'	HIVP-13																■		
Ambient Air Monitoring	Air	0	2	HIAA-02	--	HIAA-02									■						■			
				HIAA-03	--	HIAA-03									■						■			

Notes:
(1) Includes grain size, bulk density, specific gravity and moisture content only.
(2) Includes grain size and vertical permeability only.
-- : Not applicable.
TOC : Total organic carbon.

In accordance with the Work Plan, before commencement of soil probing and drilling activities and between boring locations, all “down-hole” probing equipment, including augers, split spoon samplers and probe rods, were decontaminated using a steam cleaner/pressure washer and/or alconox and water at the decontamination pad. Split spoon and soil probe samplers were also decontaminated between each use by thoroughly washing with alconox and water, using a brush to remove particulate matter or surface film, followed by a thorough rinsing with tap water. All liquids generated from the decontamination process were pumped into 55-gallon drums for subsequent off-site disposal by KeySpan.

Soil probes were advanced to at least 20 feet below the water table (approximately 60 ft-bgs). Samples were collected continuously throughout each borehole. All of the soil probes were advanced until at least 10 feet of visibly “non-impacted” soil had been sampled. During the Supplemental Remedial Investigation Field Program, soil samples were collected at intervals that corresponded with previous investigation sampling and at depths which established the vertical and horizontal delineation of impacted zones. Generally, the samples were collected as follows: one within the impacted soil within the first 20 ft-bgs; one above groundwater; and one at the completion depth of the borehole. Additional soil samples were collected based on visual observations of the soils encountered in the borehole.

During soil probe/boring installation, a PID was used to monitor VOCs in the breathing zone and at the probe holes and boreholes. The PID was calibrated on at least a daily basis using isobutylene gas at a concentration of 100 parts per million (mg/kg) in air. Equipment calibration was documented in the project field activity form and instrument calibration log. During on-site hollow stem auger boring activities, upwind and downwind air monitoring was performed in accordance with the procedures outlined in **Section 2.2.7**.

Upon completion of soil probes and boring installations, soil cuttings and recovered sample material that was not retained for laboratory analysis was placed in a lined and covered on-site roll-off for subsequent off-site disposal by KeySpan. Each probe hole was backfilled via pressure grouting. All probe holes were restored at grade to the original condition. For example, asphalt areas were replaced with asphalt, concrete areas were replaced with concrete and grass and soil areas were restored with grass and soil.

On-Site

A total of 16 soil probes were advanced on site (**Drawing 2A**). These subsurface samples were collected in the area of the former drainage sump, the former drip oil tanks, the former tar precipitators, condensers, separators and oxide purifier boxes. The analytical results of the subsurface soil samples collected from on-site soil probes are presented and discussed in **Section 4.2.1.2**.

Off-Site

Ten soil probes were advanced at off-site locations (**Drawing 2A**) to the south, east and west of the site to define the horizontal and vertical extent of MGP-related constituents or off-site impacts. These subsurface samples were collected in the Village of Garden City property medical office building parking lot, the LIRR right-of-way near the Oswego Oil Corp and the Mollineaux Brothers Fuel Oil Company. The analytical results of the subsurface soil samples collected from off-site soil probes are presented and discussed in **Section 4.2.2.3**.

2.2.3 Test Pits

Each test pit was completed using a tire-mounted backhoe starting with the removal of topsoil or cover material. Each test pit proceeded with the excavated material being temporarily stockpiled adjacent to the excavation on top of plastic sheeting. The visibly clean material was segregated from any visibly impacted soil. Excavated soil was characterized by a field geologist using the Unified Soil Classification System (USCS) and screened for VOCs utilizing a photoionization detector (PID); inspected for the presence of staining, discoloration, NAPL, ash, tar and other MGP-residuals; and checked for odors. Photographs were also taken of the excavations. All observations and PID measurements were recorded by the field geologist in a field log. Test pit logs are included in **Appendix E**. After completing each test pit, all excavated material was placed back into the excavation, with the segregated visibly "clean" surficial material being placed last into the excavation. After compacting the excavation backfill, 6 to 12 inches of crushed stone was placed over the excavation area. During test trenching activities, a PID was used to monitor VOCs in the breathing zone and at the probe holes and boreholes. The PID was calibrated on at least a daily basis using isobutylene gas at a concentration of 100 parts per million (mg/kg) in air. Equipment calibration was documented in the project field activity form and instrument calibration log. During on-site test trenching activities, upwind and downwind air monitoring was performed in accordance with the procedures outlined in **Section 2.2.7**.

On-Site

Four test pits were excavated at on-site locations (**Drawing 2A**) to determine the presence of MGP-related impacts adjacent to former MGP structures. HITP-08 was excavated in the area of the former oxide purifier boxes to a depth of 8 ft-bgs. HITP-09 was excavated in the area of the former pump house to a depth of 7 ft-bgs. HITP-13 was excavated in the area of the former tar tank located at the southern end of the property to a depth of 7 ft-bgs. HITP-14 was excavated in the area of HISB-60, to a depth of 5 ft-bgs, to confirm the presence of observed purifier waste. One soil sample was collected from HITP-09, HITP-13 and HITP-

14 for laboratory analysis based on visual observations and PID readings. The analytical results of the on-site test pit soil samples are presented and discussed in **Section 4.2.1.2**.

Off-Site

Three test pits were excavated at off-site locations (**Drawing 2A**) to determine the presence of MGP-related impacts adjacent to former unloading pits. HITP-10 was excavated to a depth of 7 ft-bgs where the former structure was identified. HITP-11 was excavated to a depth of 8 ft-bgs and the former unloading pit was not located. HITP-12 were excavated to a depth of 6 ft-bgs and the former unloading pit was not located. One soil sample was collected from HITP-09, HITP-12 and HITP-14 for laboratory analysis, based on visual observations and PID readings. The analytical results of the off-site test pit soil samples are presented and discussed in **Section 4.2.2.3**.

2.2.4 Groundwater Probes

Groundwater probe samples were collected by driving probe rods to the designated sample depth and retracting 4 feet to expose a decontaminated stainless steel screen. Dedicated polyethylene tubing and a decontaminated stainless steel check valve were inserted into the rod assembly to obtain a water sample. The screen, check valve and rods were decontaminated and new tubing was used between each sampling interval. Water quality parameters including pH, conductivity, turbidity, dissolved oxygen, temperature and redox potential were monitored utilizing a calibrated Horiba U-22 multiple parameter instrument. Additionally, any evidence of odors, sheens or the presence of free product was noted. All observations and results were logged in project field forms. Groundwater samples were then collected from the tubing/check valve assembly into laboratory-supplied glass bottles.

Upon completion, each probe hole was allowed to naturally collapse into itself. Probe holes in potential source areas were pressure grouted to grade. All probe holes were restored at grade with the same material that was originally in place.

Off-Site

In an effort to further define the extent of the BTEX/PAH groundwater plume and to aid in the installation of permanent groundwater monitoring wells, 6 groundwater probes were installed and are identified as HIGP-77 through HIGP-82 (**Drawing 2A**).

The original Work Plan called for the collection of one additional groundwater probe (HIGP-76). A permanent shallow and intermediate groundwater monitoring well pairing HIMW-16S and HIMW-16I replaced groundwater probe HIGP-76 as agreed to by NYSDEC. Three to four groundwater samples were collected per probe location, one at the water table (approximately 30 ft-bgs); one at the completion depth of the borehole and the additional two being collected at intervals where impacted soils were encountered. The analytical results of off-site groundwater probe samples are presented and discussed in **Section 4.3.2.2**.

2.2.5 Groundwater Monitoring Well Installation

In general, well construction consisted of 2-inch diameter Schedule 40 polyvinyl chloride (PVC) well screens and casings. The wells were fitted with a 10-foot long well screen with 0.020 slot openings. Below the monitoring well screen, a 2-foot sump was installed in each of the wells. A solid 2-inch diameter PVC well casing or riser extended from the screen to grade. Monitoring wells were installed within the water table/shallow groundwater and/or in the intermediate groundwater as described in the March 2003 RI Report.

Before commencement of drilling activities and between well locations, all "down-hole" drilling equipment (i.e., augers, split spoon samplers, rods, etc.) was decontaminated using a steam cleaner/pressure washer at the decontamination pad. Split spoon samplers were also decontaminated between each use by thoroughly washing with alconox and water, using a brush to remove particulate matter or surface film, followed by a thorough rinsing with tap water.

The wells were fitted with either above grade ("stick-up") or flush-mount locking steel casings. **Figure 2-1** shows the typical construction of a monitoring well cluster installed as part of this field investigation program. **Table 2-2** summarizes the completed well construction details. In addition, the boring logs for these monitoring wells are included in **Appendix E**.

Number 2 graded gravel was set from about 1 foot below the bottom of the monitoring well sump to a point approximately 3 feet above the top of the well screen. A slurry composed of bentonite clay and water was pumped into the annulus via tremie pipe above the gravel pack. Typically this seal was at least 2 feet thick. A cement and bentonite mix was pumped into the annulus via tremie pipe, from the top of the bentonite seal to the surface. The gravel pack, bentonite seal and cement grout were placed into the annulus in a manner that ensured complete placement, free of any voids or drill cuttings that might jeopardize the integrity of the groundwater monitoring well. Soil generated during the installation of each well was placed into covered roll-off containers for subsequent proper off-site transportation and disposal by KeySpan.

The groundwater monitoring wells installed as part of the Supplemental Remedial Investigation Program were developed after installation. The well development protocol included pumping the wells with a submersible pump while monitoring the flow rate, pH, conductivity, turbidity, dissolved oxygen, temperature and depth to water. During the development process, the submersible pump was rapidly moved up and down in the groundwater column. This surging action loosens and dislodges fine material adjacent to the gravel pack in the screen zone and permits more water to enter the well. The development process continued until the turbidity readings were 50 Nephelometric Turbidity Units (NTUs) or less or a 2 hour period, whichever occurred first. All development water was temporarily containerized on-site in 55-gallon drums. After waste characterization, all containerized liquids were removed from the site for proper off-site transportation and disposal by KeySpan.

The submersible pump used for well development was decontaminated with an alconox wash followed by a rinse with potable water upon completion of the development of each monitoring well.

On-Site

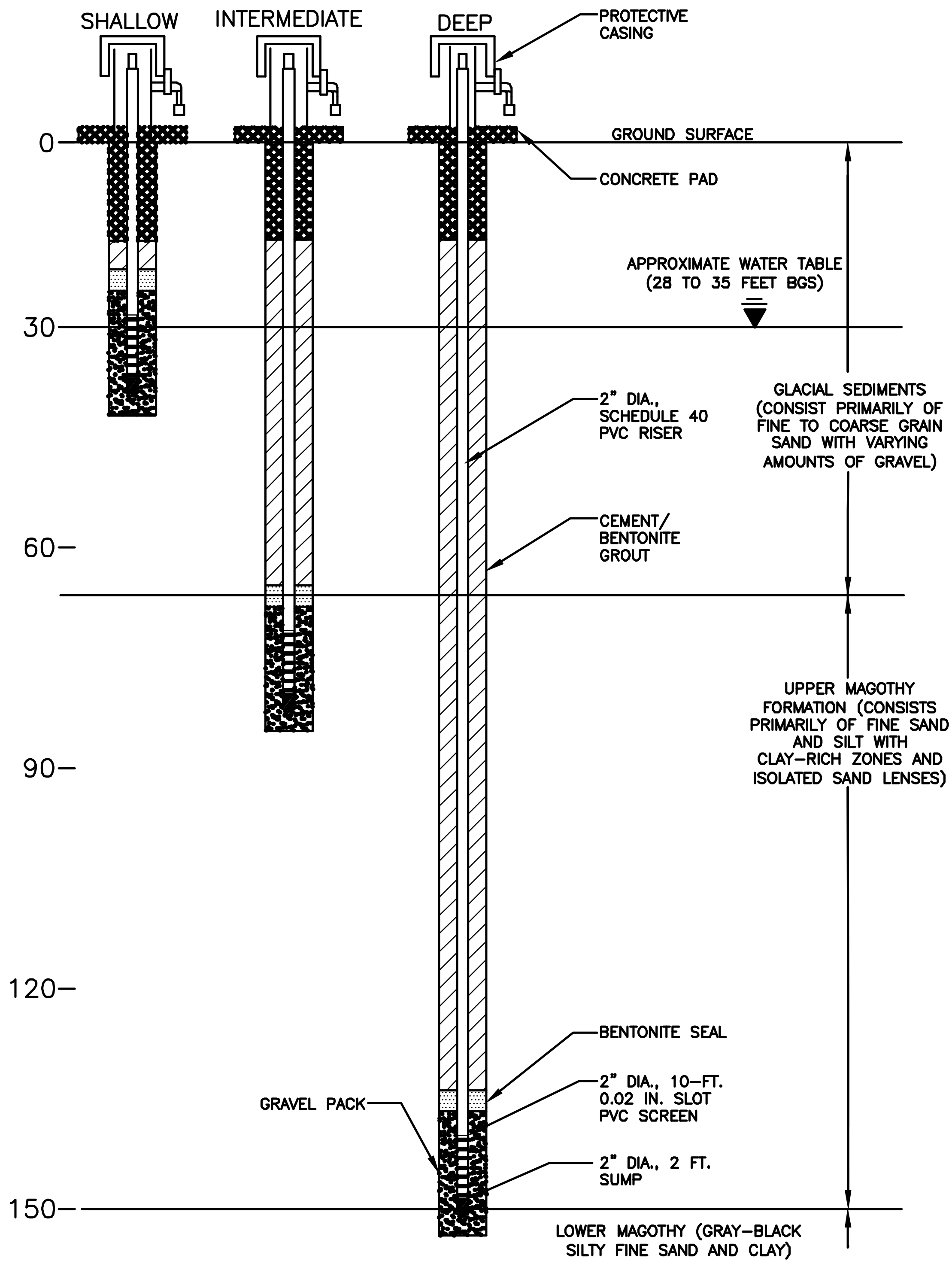
A total of 4 monitoring wells were installed as either shallow or intermediate wells based upon their location on-site (**Drawing 2A**). Monitoring wells HIMW-18SI were installed south of the former drainage sump area. Monitoring wells HIMW-19SI were installed south of the former drip oil tanks. These wells were installed in these areas to aid in delineating the extent of NAPL previously identified on-site. The analytical results of groundwater samples collected from on-site monitoring wells are presented and discussed in **Section 4.3.2.1**.

Off-Site

A total of 3 new monitoring wells were installed in off-site locations as shown on **Drawing 2A** and **Drawing 2B**. HIMW-16SI and HIMW-17S were installed in the adjacent medical office-building parking lot located immediately south of the site. These wells were installed to delineate the extent of chemical constituents and NAPL immediately south of the site. The analytical results of the groundwater samples collected from off-site groundwater monitoring wells are presented and discussed in **Section 4.3.2.2**.

2.2.6 Monitoring Well Groundwater Sampling

Approximately two weeks after the installation and development of the newly installed wells, sampling of the newly installed wells and selected on-site and off-site wells was completed in late fall of 2003. Prior to sampling, the total depth and depth to water at each well was measured and recorded. An oil/water interface probe, cotton string and disposable bailers were used to determine if NAPL was present within each well.



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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: 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

The selected monitoring wells were sampled in accordance with the “Low-Flow” sampling protocol utilizing a submersible pump equipped with dedicated tubing. Each well was purged using a Grundfos Rediflo® submersible pump. During purging, groundwater was pumped through a 0.75-inch diameter tube connected to a flow-through cell. The groundwater entered through the bottom of the flow cell and exited through a tube near the top. The probes from the Horiba-U22 were placed into the flow cell so that the parameters for pH, specific conductance, temperature, turbidity, dissolved oxygen and redox potential could be monitored and recorded using field instrumentation. Following stabilization of the field parameters, groundwater was carefully poured from the discharge tubing into laboratory-supplied glass bottles.

2.2.7 Perimeter Air Monitoring

During field activities that utilized the hollow stem auger drilling method or during test pit excavation activities, calibrated air monitoring instruments were also employed to monitor for potential releases of VOCs and/or dust. Upwind and downwind air monitoring stations were established at each drilling and test pit location. Each monitoring station contained a data logging PID and a data logging dust meter. In addition, a PID was used to monitor the air quality within the breathing zone and to quantify VOCs emanating from the borehole or drill cuttings. All air monitoring instruments were calibrated on a daily basis prior to the start of field work. The calibration records are maintained in the project files. All data from the stationary air monitoring stations were electronically downloaded to the on-site computer at the conclusion of each workday. This information is also available in the project files. The results of the perimeter air monitoring showed no exceedances of VOC levels or levels of particulate matter with a diameter less than 10 microns (PM-10).

2.2.8 Water Level and NAPL Measurements

During the November 2003 sampling episode, a complete round of groundwater levels and NAPL measurements was collected from all of the wells installed as part of the Supplemental Remedial Field Investigation Program. Measurements were taken from either a notch on the inner casing or from a point on the northernmost side of the inner casing of each monitoring well. Groundwater level measurements were recorded utilizing a Solinst water level indicator to an accuracy of 0.01-foot. In addition, a Solinst interface meter, cotton string and disposable bailers were utilized to determine whether free-product was present in any of the wells and, if present, measure its thickness. Groundwater level data is summarized in **Table 2-5**.

TABLE 2-5

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (1) (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
PZ-02	12/3/2001	72.96	33.40	39.56
	1/2/2002		33.86	39.10
	11/19/2003		31.60	41.36
PZ-03	12/3/2001	64.58	25.38	39.20
	1/2/2002		25.80	38.78
	11/20/2003		23.34	41.24
PZ-08	12/3/2001	70.51	31.33	39.18
	11/12/2003		29.55	40.96
HIMW-01S	1/16/2001	71.61	32.41	39.20
	12/3/2001		32.76	38.85
	1/2/2002		33.13	38.48
	11/12/2003		30.56	41.05
HIMW-01I	1/16/2001	71.68	32.23	39.45
	12/3/2001		32.90	38.78
	1/2/2002		33.30	38.38
	11/12/2003		30.80	40.88
HIMW-01D	1/16/2001	71.95	32.60	39.35
	12/3/2001		33.25	38.70
	1/2/2002		33.63	38.32
	11/12/2003		31.20	40.75
HIMW-02S	1/16/2001	73.82	34.09	39.73
	12/3/2001		34.70	39.12
	1/2/2002		35.18	38.64
	11/12/2003		32.70	41.12
HIMW-02I*	1/16/2001	78.87	34.15	44.72
	12/3/2001		34.77	44.10
	1/2/2002		35.23	43.64
	11/12/2003		32.80	46.07
HIMW-02D	1/16/2001	74.13	34.37	39.76
	12/3/2001		34.91	39.22
	1/2/2002		35.45	38.68
	11/12/2003		No Measurement	No Measurement
HIMW-03S	1/16/2001	65.00	25.57	39.43
	12/3/2001		26.25	38.75
	1/2/2002		36.63	28.37
	11/12/2003		24.08	40.92
HIMW-03I	1/16/2001	64.94	25.74	39.20
	12/3/2001		26.05	38.89
	1/2/2002		26.78	38.16
	11/12/2003		25.14	39.80
HIMW-03D	1/16/2001	65.26	26.62	38.64
	12/3/2001		27.18	38.08
	1/2/2002		27.41	37.85
	11/12/2003		25.20	40.06
HIMW-04S	1/16/2001	72.74	33.94	38.80
	12/3/2001		34.63	38.11
	1/2/2002		34.99	37.75
	11/12/2003		32.50	40.24

TABLE 2-5 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION [(1)] (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
HIMW-04I	1/16/2001	72.78	34.06	38.72
	12/3/2001		34.74	38.04
	1/2/2002		35.07	37.71
	11/12/2003		32.67	40.11
HIMW-04D	1/16/2001	72.65	34.73	37.92
	12/3/2001		35.35	37.30
	1/2/2002		35.52	37.13
	11/12/2003		33.40	39.25
HIMW-05S	1/16/2001	67.19	28.24	38.95
	12/3/2001		28.94	38.25
	1/2/2002		29.31	37.88
	11/12/2003		26.80	40.39
HIMW-05I	1/16/2001	67.22	28.22	39.00
	12/3/2001		28.57	38.65
	1/2/2002		29.39	37.83
	11/12/2003		26.65	40.57
HIMW-05D	1/16/2001	67.22	29.03	38.19
	12/3/2001		29.87	37.35
	1/2/2002		29.98	37.24
	11/12/2003		27.71	39.51
HIMW-06S	1/16/2001	68.25	29.01	39.24
	12/3/2001		29.68	38.57
	1/2/2002		30.07	38.18
	11/12/2003		27.40	40.85
HIMW-06I	1/16/2001	67.88	28.78	39.10
	12/3/2001		29.44	38.44
	1/2/2002		29.83	38.05
	11/12/2003		27.45	40.43
HIMW-06D	1/16/2001	67.77	28.68	39.09
	12/3/2001		29.33	38.44
	1/2/2002		29.72	38.05
	11/12/2003		27.25	38.00
HIMW-07S	1/16/2001	70.47	31.21	39.26
	12/3/2001		31.87	38.60
	1/2/2002		32.28	38.19
	11/12/2003		29.77	40.70
HIMW-07I	1/16/2001	70.10	31.21	38.89
	12/3/2001		31.85	38.25
	1/2/2002		32.27	37.83
	11/12/2003		29.77	40.33
HIMW-07D	1/16/2001	70.40	31.14	39.26
	12/3/2001		31.76	38.64
	1/2/2002		32.18	38.22
	11/12/2003		29.80	40.60
HIMW-08S	1/16/2001	65.04	26.43	38.61
	12/3/2001		27.11	37.93
	1/2/2002		27.52	37.52
	11/12/2003		25.15	39.89

TABLE 2-5 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (1) (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
HIMW-08I	1/16/2001	65.14	26.57	38.57
	12/3/2001		27.23	37.91
	1/2/2002		27.63	37.51
	11/12/2003		25.25	39.89
HIMW-08D	1/16/2001	64.93	26.37	38.56
	12/3/2001		27.04	37.89
	1/2/2002		27.44	37.49
	11/12/2003		25.08	39.85
HIMW-09S	1/16/2001	70.03	30.91	39.12
	12/3/2001		31.58	38.45
	1/2/2002		32.02	38.01
	11/12/2003		29.38	40.65
HIMW-09I	1/16/2001	69.93	30.89	39.04
	12/3/2001		31.51	38.42
	1/2/2002		31.95	37.98
	11/12/2003		29.30	40.63
HIMW-09D	1/16/2001	69.96	30.99	38.97
	12/3/2001		31.60	38.36
	1/2/2002		32.04	37.92
	11/12/2003		29.40	40.56
HIMW-10S	1/16/2001	71.60	32.16	39.44
	12/3/2001		32.93	38.67
	1/2/2002		33.23	38.37
	11/12/2003		30.56	41.04
HIMW-10I	1/16/2001	71.47	32.03	39.44
	12/3/2001		32.64	38.83
	1/2/2002		33.11	38.36
	11/12/2003		30.5	40.97
HIMW-10D	1/16/2001	71.44	32.02	39.42
	12/3/2001		32.53	38.91
	1/2/2002		33.05	38.39
	11/12/2003		30.5	40.94
HIMW-11S	1/16/2001	71.62	32.08	39.54
	12/3/2001		33.38	38.24
	1/2/2002		33.34	38.28
	11/12/2003		30.78	40.84
HIMW-11I	1/16/2001	71.43	31.87	39.56
	12/3/2001		32.50	38.93
	1/2/2002		32.96	38.47
	11/12/2003		30.60	40.83
HIMW-11D	1/16/2001	71.39	31.88	39.51
	12/3/2001		32.49	38.90
	1/2/2002		32.96	38.43
	11/12/2003		30.60	40.79
HIMW-12S	1/16/2001	61.58	23.92	37.66
	12/3/2001		24.63	36.95
	1/2/2002		25	36.58
	11/12/2003		22.60	38.98

TABLE 2-5 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

GROUNDWATER MEASUREMENTS AND CALCULATED ELEVATIONS

MONITORING WELL	DATE OF MEASUREMENT	MEASURING POINT ELEVATION (1) (feet above MSL)	DEPTH TO WATER (feet)	WATER ELEVATION (feet above MSL)
HIMW-12I	1/16/2001	61.59	23.81	37.78
	12/3/2001		24.50	37.09
	1/2/2002		24.87	36.72
	11/12/2003		22.60	38.99
HIMW-12D	1/16/2001	61.82	26.14	35.68
	12/3/2001		26.73	35.09
	1/2/2002		26.81	35.01
	11/12/2003		24.78	37.04
HIMW-13S	1/16/2001	72.83	36.89	35.94
	12/3/2001		37.60	35.23
	1/2/2002		37.96	34.87
	11/12/2003		35.47	37.36
HIMW-13I	1/16/2001	72.60	36.65	35.95
	12/3/2001		37.38	35.22
	1/2/2002		37.73	34.87
	11/12/2003		35.23	37.37
HIMW-13D	1/16/2001	72.53	36.67	35.86
	12/3/2001		37.37	35.16
	1/2/2002		37.72	34.81
	11/12/2003		35.10	37.43
HIMW-14I	1/2/2002	71.71	36.80	34.91
	11/12/2003		34.15	37.56
HIMW-14D	1/2/2002	71.59	38.85	32.74
	11/12/2003		36.65	34.94
HIMW-15I	1/2/2002	64.18	31.60	32.58
	11/12/2003		28.90	35.28
HIMW-15D	1/2/2002	63.96	33.07	30.89
	11/12/2003		30.85	33.11
HIMW-16S	11/12/2003	67.45	26.93	40.52
HIMW-16I	11/12/2003	67.50	27.17	40.33
HIMW-17S	11/12/2003	65.96	26.30	39.66
HIMW-18S	11/12/2003	69.76	28.75	41.01
HIMW-18I	11/12/2003	69.70	29.10	40.60
HIMW-19S	11/12/2003	70.95	29.74	41.21
HIMW-19I	11/12/2003	71.27	29.88	41.39

Notes:
(1) Top of casing elevation.
* Measuring point elevation and water elevations are suspect and will require re-survey
MSL: mean sea level
-- : Information not available.

2.2.9 <u>Private Well Survey</u>

As part of the Supplemental Remedial Investigation Field Program, a private well survey was conducted. The purpose of the survey was to identify any residences and/or businesses in the study area that might be utilizing private wells, and request other pertinent information necessary to meet the objectives of the survey. As part of initiating the program, a total of 398 questionnaires were mailed out to property owners/occupants within the survey area. The survey area included the properties located within the downgradient groundwater plume associated with the Hempstead site.

2.2.10 <u>Private Groundwater Well Sampling</u>

The completed private well survey (**Section 2.2.9**) identified six (6) private wells located downgradient of the Former MGP site. In addition, based on NYSDEC records, private well permit applications were identified for eleven (11) other wells associated with commercial/industrial properties (total of 17 wells). Most of these properties are located along Fulton Street near the downgradient end of the groundwater plume. It is noted that none of the 17 wells are used for drinking water purposes based on NYSDEC records, property inspections, and property owner information.

Two wells were identified as being actively used for irrigation purposes (1-private residence and 1-private commercial property). Sample results were obtained from the owner from the private well. Samples were collected from the sprinkler head of the other well by KeySpan (GEI Consultants) after letting it run for approximately 10 minutes. These samples were collected and analyzed in compliance with Section 2.0 of the DER-10 guidance (NYSDEC 2002).

A third well was identified as being active and used for air conditioning, but the owner would not allow access for sampling. This property is located near the downgradient limit of the plume (approximately 3800 feet south of the site). The property is also located approximately 450 feet side gradient of the predicted groundwater plume path. None of the remaining wells that were identified were found to be active, and they were either abandoned, or unable to be located upon inspection.

Well water samples collected by KeySpan were analyzed for volatile organic compounds, semivolatile organic compounds, total cyanide and free cyanide. The analytical results of the sample collected by KeySpan were reported as less than the laboratory detection limits for the sample parameters, and are presented in **Section 4.3.3**.

2.2.11 Public Water Supply Wells – Capture Zone Analysis Reports

H2M Group analyzed groundwater flow in the vicinity of the former MGP site (see **Appendix H**) relative to the Village of Garden City's public water supply wells located approximately 200 feet west of the former MGP site, and the Village of Hempstead Clinton Street public water supply wells located approximately 4000 feet east of the site. Computer modeling was used to simulate groundwater flow in the aquifer system, which is the source for the public supply water wells. The modeling results indicate that the area of the former MGP site related impacts is outside of the groundwater capture zone of the water supply wells, assuming normal pumping rates based on historical data. Under the theoretical maximum pumping conditions that were modeled, the supply well capture zones move closer to the area of the former MGP site. For the adjacent Village of Garden City wells, H2M's modeling indicated that the capture zone for those supply wells could extend into the area of the former MGP site (at depths between 100 and 200 feet below ground surface), if the worst-case maximum pumping scenario persisted for about 16 years. If the maximum pumping scenario was conducted for a time period less than 16 years the modeling indicated that the Village of Garden City wells would not have the potential to receive groundwater from the area of the former MGP site. In addition, the worst case scenario evaluated is very conservative in nature and the maximum pumping scenario is unlikely to occur for an extended time period (e.g. 16 years) because of the following reasons:

- The possibility of the Village of Garden City and/or Hempstead requiring the maximum pumping rates necessary to create the worst-case scenario is very remote since the residential and commercial community served by these wells is at or near maximum growth potential and local water supply demand is therefore not expected to increase significantly over time.
- Good engineering practice and applicable guidance documents for the water supply industry call for redundancy in water supply systems which would reduce the likelihood of any one system operating at full capacity for more than a few years time.
- There is little known precedent for water purveyors in the local region to operate a given pumping system at maximum output for the timeline required to create the worst-case scenario.

In addition, the model conservatively focuses on groundwater flow instead of contaminant migration and does not account for natural contaminant attenuation factors such as dispersion, advection, and adsorption, which can significantly limit contaminant mobility through the subsurface environment.

2.2.12 Surveying and Mapping

All existing and new monitoring well locations, casing elevations, soil probes/borings, groundwater probes, surface soil sampling locations and test pit locations were surveyed by a licensed surveyor and located on a base map. Top of casing measurements for monitoring wells were utilized in determining groundwater elevations. Surveyed locations for completed sample points are shown on **Drawing 2A** and **Drawing 2B** provided in the map pocket at the end of this section of the report.

2.3 Laboratory Analysis and Data Management

The analytical data was transmitted by the laboratory (H2M Labs) in both hard copy and electronic disk deliverable (EDD) format. The EDD was submitted in a database file (dbf) format for direct import into GIS/Key and Excel format. Once the data was tabulated it was checked against the hard copy data packages to ensure data integrity and completeness.

2.4 Data Validation/Data Usability

All analytical data packages submitted by H2M Labs were validated in accordance with NYSDEC 10/95 Analytical Services Protocol (ASP) Quality Assurance/Quality Control (QA/QC) requirements. Data validation of the initial and supplemental RI was performed by a QA/QC officer, meeting the qualifications required by NYSDEC to perform data validation. The data packages were reviewed for transcription errors, as well as compliance with analytical methods and QA/QC requirements.

2.4.1 Sample Collection and Analysis

The field program consisted of collecting samples from various environmental media including samples of surface soil, subsurface soil, groundwater from GeoProbes, groundwater from monitoring wells and air. Sample collection was performed in accordance with the procedures set forth in the Work Plan for the Hempstead Intersection Street Former MGP site, dated June 2000. The water and soil samples were analyzed by H2M Labs in accordance with the USEPA SW-846 methods stipulated in the Work Plan, as well as NYSDEC ASP QA/QC requirements. H2M Labs participates in the NYSDOH Environmental Laboratory Approval Program (ELAP) for all analyses performed as part of this project and also complies with the NYSDOH Contract Laboratory Program (CLP).

A summary of the analytical sampling program was previously presented in **Tables 2-3** and **2-4**. The environmental samples were primarily analyzed for the following parameters:

Sample Type	Analytical Parameters
Groundwater from Probes	BTEX and PAHs
Groundwater from Monitoring Wells	BTEX, PAHs, RCRA metals, total and free cyanide, natural attenuation parameters
Soil Probe/Borings (Subsurface Soil)	BTEX, PAHs and total and amenable Cyanide
Surface Soil	Lead
Test Pits	BTEX, PAHs and total cyanide

In addition to the above analyses, two of the subsurface soil samples were also analyzed for the full target compound list (TCL). Analytical methods and detection limits are presented in **Appendix F**.

2.4.2 Data Quality Objectives

The primary objective of this investigation was to obtain data to be used to determine the nature, extent and sources of chemical constituents at the site, as well as the preparation of a human exposure assessment and to identify, evaluate and recommend a cost effective, environmentally sound long-term remedial action plan. The data was also utilized during the Remedial Investigation to monitor for the health and safety of workers at the site and potential receptors off-site. This objective was achieved by designing a sampling program that encompasses the entire site and surrounding areas.

To ensure data quality, several types of quality control (QC) measures were implemented. QC samples were collected (field blanks, matrix spikes and matrix spike duplicates) at a rate of 1 per 20 environmental samples. Trip blanks accompanied all shipments of water samples that required volatile organic or BTEX analyses. All samples for organic analyses were spiked with surrogate and/or internal standard compounds in order to determine the integrity/reliability of the sample results.

To determine the comparability of the sample results, matrix spikes and matrix spike duplicates were analyzed for the organic parameters. In addition, the analytical methods also require that specific laboratory QA/QC measures be taken during analysis (i.e., calibrations, blanks, control samples, spiked blanks, etc.).

2.4.3 Data Quality and Usability

In order to determine the quality and usability of the sample results, the data packages, submitted by the laboratory, were validated. Data validation was performed in accordance with NYSDEC 10/95 ASP QA/QC requirements. A validation report/summary sheet was prepared for each sample delivery group (SDG) or data package. Copies of the reports are maintained in the project files.

Twenty percent of the environmental samples results, as well as all QA/QC results, were reviewed to yield a "20% validation" as required by the Work Plan.

Overall, the quality of the data was good and the results were determined to be usable for environmental assessment purposes. The findings of the validation process are summarized below.

General Findings

All laboratory packages were complete and the established analytical protocols were utilized. All holding times were met with one exception as noted below. All Quality Assurance data were acceptable, except as noted below. Correct qualifiers were utilized by the laboratory and additional qualifiers were added by the reviewer based on review of the Quality Control data. All calibrations were run in accordance with the specified methods.

Several samples had surrogate recoveries outside QC limits. The samples were reanalyzed as required by the NYSDEC ASP. The data summary tables contain the "best set" of data that were deemed to be most contractually compliant and are flagged with the appropriate qualifiers.

BTEX and PAH compound concentrations were calculated using the response factors from the initial calibrations which are acceptable with USEPA SW-846 methodologies.

Additionally, there were several soil and groundwater samples which required dilution following the initial run of the samples for both the BTEX and PAH analysis. Therefore, for those compounds which required dilution, the diluted result was reported. If it was determined that a compound was diluted out the initial undiluted result was reported.

The BTEX fraction of the samples HISB-58A (30-32) and HISB-62 (24-26) re-analysis was analyzed outside of holding times. All results have been qualified as estimated possibly biased low.

No other problems were identified. All results have been deemed valid and usable for environmental assessment, as qualified above.

2.5 Investigation of Off-Site Third Party Spills

A Freedom of Information Law (FOIL) request was submitted to NYSDEC by PS&SPC for the neighboring Oswego Oil Company, located at 45 Intersection Street, Hempstead, New York and for the Mollineaux Brothers Fuel Oil Company located on Sealy Avenue, Hempstead, New York. The purpose of the FOIL request was to obtain and review existing NYSDEC files relating to spills which may have occurred on the Oswego Oil site. A file review was conducted at the NYSDEC Regional Administration Building located at State University of New York (SUNY) in Stony Brook, New York. A copy of the reviewed documents is contained in **Appendix B**. The results of the FOIL request identified six spill numbers for the Oswego Oil site. For the Mollineaux Brothers site, although there are existing spill numbers on record (spill numbers 8707262 and 9205266), no documentation was provided by NYSDEC. Regarding the Mollineaux Brothers site, KeySpan is still in the process of obtaining information for this site. The six spill numbers for the Oswego Oil site area as follows:

- **Spill No. 90-03084** June 18, 1990: Surface Spill of 25 – 30 gallons from Truck Overfilling;
- **Spill No. 93-11634** December 29, 1993: Removal of Stockpiled Soil;
- **Spill No. 97-04538** July 22, 1997: Cracked Elbow in Pipe Resulted in 2 Drums of Contaminated Soil;
-
- **Spill No. 99-25536** March 28, 2000: Several Violations at facility Regarding Spills from Faulty Equipment and Housekeeping Practices;
- **Spill No. 00-25127** July 14, 2000: During Implementation of Site investigation Discovered Floating Product In Several on-site monitoring wells; and
- **Spill No. 03-25298** September 25, 2003: consultant encountered contaminated soil at 8 to 10 inches on-site while installing monitoring wells.

The file review indicated that there have been several inspections at the property by NYSDEC and Nassau County Fire Department. Review of the file for Spill Numbers 90-03084 and 00-25127 indicated the presence of NAPL on the groundwater adjacent to the LIRR ROW. The following provides a summary of the information present in the spill files reviewed.

Spill Number 90-03084

This spill, reported on June 14, 1990 was caused by overfilling of a truck and leaky equipment which resulted in 25 to 30 gallons of #2 petroleum being spilled and affecting the land. File information on the case extended through May 1994 and there is no documentation indicating that the case has been closed. There are several reports of product being present in the wells and sampling identified the presence of BTEX compounds and semi-volatile compounds.

Spill Number 93-11634

This spill, reported on December 29, 1993 was caused by the overfilling of a tank truck in a bermed area resulting in the release of #2 fuel oil to the ground which was cleaned up with speedy-dry. The file contained minimal correspondence which related to the submission of soil disposal manifests and a NYSDEC field form which identified a drain line leading to a distribution box which separates oil to a holding tank and water to a well. A NYSDEC spill report indicates that the case was closed on February 24, 1994.

Spill Number 97-04538

This spill, reported on July 16, 1997 was caused by a cracked elbow in a pipe containing #2 fuel oil that resulted in the generation of two drums of contaminated soil. Correspondence contained in the file indicates that the line problem was corrected and passed a tightness test. Although there is correspondence from NYSDEC requesting information to close the spill case, there is nothing stating that the case was closed.

Spill Number 99-25536

This spill was reported on March 28, 2000 as part of a routine inspection by the NYSDEC water unit which revealed various possible violations, numerous spills and the presence of #2 oil and lube oil on the ground. NYSDEC field notes indicate that the Oswego site maintained a storage capacity of 165,000 gallons and there was significant spillage at transfer pumps and rail area. The file correspondence indicates that there were several spill issues on the Oswego property and that there had been bailing of product from the on-site wells from 2000 to 2003. There was no indication in the file review that the case had been closed.

Spill Number 00-25127

This spill, reported on July 14, 2000 relates to an unknown amount of #2 oil spilled and observed as floating product in several of the on-site monitoring wells during a Site Investigation. Review of the file indicates that two diesel and two kerosene tanks were removed and they were reported to be corroded and holes were present in the diesel tanks. Further review of the file related to the presence of product in monitoring wells MW-2, MW-3, MW-4 and MW-5 ranging in thickness from one to nine inches. There was no correspondence beyond May 31, 2002 and no correspondence which indicated whether this case had been closed.

Spill Number 03-25298

This spill, reported on September 25, 2003, was disclosed when workers encountering contaminated soil at 8 to 10 inches below grade while installing wells. A series of correspondence requested clarification of compounds discovered during analysis of soil samples. The findings of the research into those contaminants indicated that they were surrogate recovery compounds and not related to any soil contamination.

3.0 SITE GEOLOGY AND HYDROGEOLOGY

3.1 Introduction

This section presents a discussion and interpretation of geologic and hydrogeologic data collected during the field investigation. Data generated as part of this field investigation and utilized in this evaluation included the following:

- Logs from completed borings and groundwater monitoring wells;
- Geotechnical analysis of selected soil samples;
- Boring logs from available private and public water supply wells located within or near the study area; and
- Hydraulic head measurements from existing and newly installed groundwater monitoring wells.

This data was evaluated and interpreted in conjunction with the regional geology/hydrogeology characterization of the study area, as presented in **Sections 1.5.6**, **1.5.7** and **1.5.8**.

Six geologic cross sections of the site and downgradient areas were prepared by D&B and are designated as **Drawings 3A**, **3B**, **3C**, **3D**, **3E** and **3F**. **Drawing 3A** is a west-east trending geologic cross section along the entire southern and eastern boundaries of the site. **Drawing 3B** is a north-south trending cross section that begins on-site at monitoring well HIMW-01D and runs south through the extent of the groundwater plume ending at temporary well HITW-03, a distance of approximately 9/10 of a mile. **Drawing 3C** is a west-east trending cross section through the approximate center of the site from outside the western boundary to the northeast corner. **Drawing 3D** is a north-south trending cross-section which lies just outside the western boundary of the site in the vicinity of two public supply wells. **Drawing 3E** is a north-south trending cross-section along the western boundary of the site, which ends at off-site monitoring well HIMW-08D. **Drawing 3F** is a north-south trending cross-section through the approximate center of the site which extends from the northern boundary to off-site soil boring HISB-39 located across Intersection Street. The information contained in some of these cross-sections is also included in the drawings contained in **Section 4.0** of this report.

The logs for the borings and groundwater monitoring wells referenced in this section are included in **Appendix E**.

3.2 Recent Deposits (Fill/Topsoil)

The fill/topsoil unit is located within and adjacent to the site and is considered a recent/post glacial or a Holocene aged geologic unit. The fill portion of this unit is characterized by the presence of anthropogenic (manmade) materials. The fill/topsoil unit encountered throughout and adjacent to the site is highly variable in character and thickness. It consists of brown to black sands, silts and gravels with varying amounts of concrete, brick, coal, bluestone, clinker, vesicular slag and wood. The unit is not continuous throughout the site and varies in thickness from approximately 1/2-foot up to 16 feet. However, as indicated by **Drawing 3A**, the unit is fairly continuous along the southern and eastern boundaries of the site where it extends up to 4 feet in thickness at soil boring HISB-35. The unit appears to be thickest in the central-western portion of the site as illustrated on **Drawing 3C**. The unit is up to 16 feet thick at soil boring HISB-14, which is located within the area of the former drip oil tanks, and up to 8 feet thick at soil boring HISB-15, which is located at the former tar separator. It is possible that, after removal of these former MGP structures, the excavations were backfilled with fill material. The north-south cross-sections, illustrated on **Drawings 3E** and **3F**, demonstrate that the fill unit decreases in thickness toward the north end of the site. As mentioned above, the existence and thickness of this unit appears to correlate well with the location and number of former MGP structures, and therefore, could possibly be related to demolition methods that occurred at a particular boring location. With the exception of a thin layer of topsoil, the fill unit does not appear to extend a significant distance south of the site as indicated by **Drawing 3B**. A thin layer of fill does appear to be present at several soil borings located west of the site within the Village of Garden City property, including BBSB-19, 20, 21, 22, 26 and 46.

3.3 Glacial Sediments

Consistent with regional geology, relatively porous glacial outwash deposits consisting of yellow to light brown fine to coarse sand with varying amounts of gravel underlie the site as well as surrounding areas. However, zones or lenses of silty sand and silt were identified within the glacial unit at a number of boring locations. The majority of the silt-sand lenses were encountered from ground surface to a depth of approximately 20 feet. As shown on **Drawing 3B**, one exception to this general observation was at monitoring well HIMW-08D where up to 32 feet of silt and silty sand was observed. The silty sand lenses may limit the vertical movement of groundwater where present at or near the water table, such as in the southern portion of the site (refer to **Drawing 3F**). Additionally, a number of gravel-rich sand lenses were identified in the glacial unit. The majority of these gravel-rich lenses were found from approximately 30 to 50 feet below ground surface. Although encountered throughout the area of investigation, the gravel-rich lenses appear to be more prevalent and continuous in the western half of the site (refer to **Drawings 3A, 3C** and **3E**) and off-site to the west and south (refer to **Drawing 3B**). Where present below the water table, these gravelly zones may act as preferred flow paths for groundwater.

The glacial outwash sediments comprise the entire unconfined Upper Glacial aquifer in the site area. Within the site, the glacial sediments are approximately 60 to 70 feet thick. South of the site, the total thickness of the glacial sediments increases to at least 95 feet as observed at monitoring well HIMW-13D (refer to **Drawing 3B**). The glacial sediments are underlain by the Magothy formation within the site as well as at downgradient areas, at least as far south as Hempstead Lake State Park, approximately 1.3 miles from the site. The interface between the glacial and Magothy formation is characterized by a transition from the glacial sand to a brown to gray layer of silty fine sand, silt and/or silty clay. A review of United States Geologic Service (USGS) reports confirms that this transition has also been recognized as the contact between the two major stratigraphic units in this area of Nassau County.

As discussed in **Section 1.5.8**, the glacial sediments within this area of Long Island exhibit excellent water transmitting properties with horizontal and vertical hydraulic conductivities averaging approximately 250 feet per day (McClymonds and Franke, 1972). Six samples of the glacial sediments were selected for geotechnical analysis (which included grain size analysis by sieving and hydrometer testing, specific gravity and water content) and total organic carbon (TOC). The results of these analyses are summarized on **Table 3-1**. Five of the six samples consist of fine to very coarse sand, typical of the majority of glacial sediments encountered at the site. The effective grain size (d_{10}), which is the grain size at which 90 percent of the sample is larger and 10 percent is finer, for these five samples ranged from 0.17 to 0.38 mm and the amount of the samples finer than 0.073 mm (i.e., grains that may be considered silt or clay) averaged 8 percent. This data indicates that the majority of the glacial sediments consists of fine to coarse sand and has good to excellent water transmitting properties. The remaining glacial sediment sample (HIMW-06 [28 to 30 ft]) consisted of a silty fine sand characteristic of the silty-sand lenses described above. The geotechnical data for this sample indicates a d_{10} of only 0.052 mm with 22 percent of the sample comprised of silt and clay. This would indicate that the silt-sand lenses present in the glacial sediment have poor water transmitting properties. As a result, where present, the silt-sand lenses may act as partial confining units, limiting the vertical migration of water and/or NAPL. Based on the TOC data presented in **Table 3-1**, the outwash deposits are relatively poor in organic matter having an average TOC content of approximately 0.5 percent. The fraction of organic content in soil is the dominant characteristic affecting the adsorption capacity of non-ionic organic compounds such as BTEX and PAHs onto the soil matrix (S.S. Suthersan, 1997). Soil with a very low fraction of organic content will have a limited ability to adsorb and therefore immobilize such organic compounds.

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

3.4 Magothy Formation Sediments

Prior to the deposition of glacial sediments described above, the underlying Magothy formation was subjected to erosional processes. As a result, the upper surface of this formation is not a flat plain but includes erosional valleys generally trending in a southerly direction towards the Atlantic Ocean. Based on the review of USGS reports, there are no mapped erosional valleys within the site or within two miles downgradient of the site. However, due to the erosional processes and variation in ground surface elevation, the depth at which the upper surface of the Magothy formation may be encountered varies throughout the site area. This variation in the topography of the Magothy formation's upper surface is clearly illustrated by the geologic cross-sections provided in **Drawings 3A** through **3F**. These drawings show that the depth to the Magothy formation generally increases with increasing distance downgradient of the site.

For the purpose of this investigation, the Magothy formation has been further divided into two subunits, with the upper subunit being characterized by a relatively complex sequence of sand, silt and clay, and the lower subunit being characterized by a low permeable gray to black silty fine sand to a gray to black stiff clay. More detailed descriptions of each of these subunits are presented below.

Upper Magothy Subunit

The Upper Magothy formation directly underlies the glacial sediments. The total thickness of the subunit is estimated to range between 49 feet, as determined at monitoring well HIMW-06D, and 110 feet, as determined at monitoring well HIMW-05D. As discussed above, this subunit consists of a relatively complex sequence of sand, silt and clay, and with widely variable sediment color ranging from brown, orange, red, yellow, gray to black. The sediment was also found to be moderately to highly micaceous (i.e., containing mica particles). In addition, lignite, which is a mineralized form of plant matter and considered an intermediary mineral in the formation of coal, was sporadically encountered along with pyrite nodules in soil samples recovered from this unit. While predominantly composed of fine to very fine sand with varying amounts of silt, a number of more permeable lenses of fine to coarse sand were encountered throughout the Upper Magothy subunit. In addition, it is common to encounter lenses of fine to coarse sand interbedded with thin clay layers or laminae of less than 1/8-inch in thickness. The majority of the sand-rich lenses do not appear to be continuous through the site, but rather more lenticular in nature. The majority of the intermediate and deep groundwater monitoring wells installed as part of the RI were screened in the more sand-rich lenses encountered in the Upper Magothy subunit. Because of its diverse stratigraphy and heterogeneous distribution of sediment types and zones, the Upper Magothy sediments are highly anisotropic with the vertical hydraulic conductivity several orders of magnitude less than the horizontal hydraulic conductivity (Franke and Cohen, 1972). As a result, groundwater has a much greater propensity to flow horizontally than vertically within this unit.

Table 3-2 summarizes the geotechnical and Total Organic Carbon (TOC) data obtained from the six samples collected from the Upper Magothy subunit. Note that the majority of these samples were collected from the screen zones of the deep and intermediate wells, and therefore, generally represent the more sand-rich lenses of the subunit described above. As shown in **Table 3-2**, the d_{10} for these samples ranged from 0.0024 mm (clay sized particles) to 0.17 mm (fine sand) and the amount of clay/silt particles in each sample ranged from five to 35 percent. Based on this data, it is concluded that the sand-rich lenses present in the Upper Magothy formation exhibit fairly poor water transmitting properties. However, it should be noted that the grain size analyses are based on composited samples, and therefore, do not reflect the actual in-situ stratigraphy and anisotropic nature of the sediment as described above. The average TOC of the Upper Magothy formation was found to be 3.5 percent. This relatively high TOC may be attributable in part to the presence of lignite in selected samples. As discussed above, lignite was sporadically encountered in samples recovered from this subunit.

Lower Magothy Subunit

As discussed above, the Lower Magothy subunit is comprised of a black silty fine sand to a gray to black stiff clay. Due to its high clay content, the subunit acts as an effective confining layer limiting the vertical migration of groundwater. The majority of the deep groundwater monitoring wells installed as part of this investigation were screened immediately above this subunit. Based on the completed borings, the Lower Magothy subunit is found from 118 ft-bgs, as identified at monitoring well HIMW-06D, to 270 ft-bgs, as identified at temporary well location HITW-02. The actual thickness of this subunit was not determined as part of this investigation; however, based on the review of well logs for the water supply wells located in the vicinity of the site, it is assumed that this subunit is a minimum of 200 feet thick. **Table 3-3** summarizes the geotechnical data obtained through the analysis of the five samples selected from this subunit. As indicated in this table, the average d_{10} for these samples is 0.012 mm and an average of 67 percent of each sample is comprised of silt and/or clay sized particles. Vertical permeability analysis of three undisturbed soil samples collected using a Shelby Tube sampler from the subunit, summarized in **Table 3-4**, confirmed the low permeability of the Lower Magothy subunit with an average vertical hydraulic conductivity of only 2.0×10^{-7} cm/second or 5.8×10^{-4} feet/day.

TABLE 3-2
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 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

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

GEOTECHNICAL ANALYSIS RESULTS FOR GLACIAL SEDIMENTS

Sample Identification		HIMW-02	HIMW-03	HIMW-06	HIMW-08	HIMW-11	AVERAGE CHARACTERISTICS FOR LOWER MAGOTHY FORMATION DEPOSITS
Depth (feet)		128-130.5	149-151	130-132.5	114-115	112-114	
Date Collected		10/11/2000	9/15/2000	9/29/2000	11/7/2000	11/14/2000	
CHARACTERISTIC	UNIT						
w	%	29.8	21.8	30.3	26.2	18.0	25.2
Sieve (200)	%	83	93	91	56	10	67
Hyd (2 μ)	%	27	27	18	9	2	17
TOC	%	N/A	N/A	N/A	0.6	0.7	0.65
G_s	none	N/A	N/A	N/A	2.64	2.71	2.68
d_{10}	mm	<0.002*	<0.0015*	<0.002*	0.0023	0.052	0.012

NOTES:

w - Water content
Sieve - % sample particles passing 200 sieve (0.074 mm)
Hyd- % sample particles finer than 2 m 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 3-4

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

GEOTECHNICAL ANALYSIS RESULTS FOR SHELBY TUBE SAMPLES FROM THE LOWER MAGOTHY FORMATION

Sample Identification		HIMW-02	HIMW-03	HIMW-06	AVERAGE CHARACTERISTICS FOR LOWER MAGOTHY FORMATION DEPOSITS
Depth (feet)		128-130.5	149-151	130-132.5	
Date Collected		10/11/2000	9/15/2000	9/29/2000	
CHARACTERISTIC	UNIT				
w	%	29.8	21.8	30.3	27.3
Sieve (200)	%	83	93	91	89
Hyd (2 μ)	%	27	27	18	24
k	cm/sec	2.3E-07	1.1E-07	2.7E-07	2.0E-07
K	ft/day	6.5E-04	3.1E-04	7.7E-04	5.8E-04
σ_c	Psf	720	720	720	720
γ	Pcf	115.7	126.6	115.2	119.1
γ_d	Pcf	89.1	103.9	88.4	93.8

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
k - Permeability (cm/sec)
K - Permeability (ft/day)
σ_c - Consolidated stress
γ - Average total unit weight
γ_d - Dry unit weight
% - Percent
cm/sec - Centimeters per second
ft/day - Feet per day
Psf - Pounds per square foot
Pcf - Pounds per cubic foot

3.5 Groundwater Flow and Hydraulic Gradients

Depths to water measured on January 2, 2002 (refer to **Table 2-5**), shows that groundwater at the Hempstead Intersection Street former MGP site is approximately 28 to 32 feet below grade. Based on the water level measurements recorded at the on-site and off-site groundwater monitoring wells on January 2, 2002, two water table/potentiometric surface maps were developed for the Upper Glacial and Magothy aquifers. **Drawing 3G** presents a water table contour map and **Drawing 3H** presents a potentiometric surface map of the Magothy aquifer using water levels measured at all deep wells based on information collected during the initial RI. Both drawings are presented in map pockets at the end of this section. The water level data collected during the Supplemental Remedial Investigation Field Program depict flow directions consistent with those in the initial RI Investigation. **Drawings 3I**, **3J** and **3K** present groundwater contour maps for the shallow, intermediate and deep groundwater zones based on information collected during the Supplemental Remedial Investigation Field Program.

As shown on **Drawing 3G**, groundwater within the Upper Glacial aquifer generally flows in a southerly to south-southwesterly direction, which is consistent with groundwater flow for the Hempstead area based on a review of regional groundwater contour maps produced by the USGS and the Nassau County Department of Public Works (NCDPW). Groundwater in the Upper Glacial aquifer south of Fulton Street likely flows in a more southerly direction in response to the influence from Hempstead Lake and its headwaters, which serve as an area of groundwater discharge. NYSDEC well records indicate that a number of water supply wells have been installed in the Upper Glacial aquifer downgradient of the site. Based on information regarding screen settings and pumping capacities, a number of these wells, if still in service, have the potential of influencing groundwater flow within the Upper Glacial aquifer.

Drawing 3H is a potentiometric surface map of the Lower Magothy formation developed using water level measurements obtained at all deep wells on January 2, 2002. Based on measured water levels, groundwater flow within this unit is in a southwesterly direction. This is generally consistent with regional flow directions, based on previously developed potentiometric surface maps produced for the Magothy aquifer. Note that the Magothy aquifer is between 500 and 650 feet thick within the site area and all nearby public supply wells are screened in the coarser basal sediments of this aquifer, between 450 and 625 feet below ground surface. As a result, groundwater flow direction in the deeper portion of the Magothy aquifer may be different from the direction determined by the deep monitoring wells screened between 120 and 170 feet below ground surface.

Using calculated hydraulic gradients based on the water table contour map, an average horizontal hydraulic conductivity for the glacial sediments of 250 feet/day (refer to **Section 1.5.8**) and a modified form of Darcy's Law for groundwater flow velocity, an estimated value for horizontal groundwater velocity or vector within the Upper Glacial aquifer can be calculated for the study area where:

$$Va = \frac{KI}{N}$$

where:

Va	=	Groundwater velocity or Darcian velocity (ft/day)
I	=	Hydraulic Gradient (ft/ft)
K	=	Hydraulic Conductivity (ft/day)
N	=	Porosity of aquifer sediments (percent)

A calculated hydraulic gradient between monitoring wells HIMW-07S and HIMW-12S is approximately 0.00144 foot per foot, which is generally consistent with published hydraulic gradients for the Upper Glacial aquifer within south-central Nassau County. An average porosity of 30 percent for sand and gravels (USGS Prof. Paper 800-C, 1972) was used in the calculation. Using this method, horizontal groundwater velocity within the Upper Glacial aquifer at and downgradient of the site has been calculated as approximately 1.2 feet per day. This is in the range of published groundwater velocities established for the Upper Glacial aquifer in south-central Nassau County (USGS Water Resources Investigation Report 86-4333).

The differences in hydraulic head elevations (water level elevations) in the vertical direction as monitored by well clusters having both a deep and shallow monitoring well (see **Table 2-5**), indicates no significant vertical head difference to a subtle downward vertical head gradient at most well clusters. Based on the January 2, 2002 water level measurements, the shallow wells at well clusters HIMW-01, HIMW-03, HIMW-04, HIMW-05, HIMW-06, HIMW-08, HIMW-09 and HIMW-13 appear to exhibit a greater static head when compared to each corresponding deep well with a difference ranging from 0.03 to 0.64 foot. Exceptions include HIMW-11 which indicates an upward vertical head distribution with a difference of 0.15 foot between the shallow and deep well. However, downgradient wells HIMW-12, HIMW-14 and HIMW-15, show relatively strong downward vertical gradients with head differences of 1.57, 2.17 and 1.69 feet, respectively. Previous rounds of water level measurements (see **Table 2-5)** are in general agreement with these results. Based on a review of the available head data, groundwater flow appears to be predominantly horizontal with little to no vertical gradient within and immediately downgradient of the site. However, farther downgradient, there appears to be a greater downward vertical gradient between the Upper Glacial and Magothy aquifers.

4.0 NATURE AND EXTENT OF CHEMICAL CONSTITUENTS

4.1 Introduction

This section presents a discussion of the nature and extent of MGP and Non-MGP related chemical constituents in the environment and identifies the potential source(s) of those chemical constituents. The section discusses data and findings from the March 2003 RI Report and Supplemental Remedial Investigation Field Program. The March 2003 RI Report included discussion of the general nature and extent of MGP and Non-MGP impacts and the areas recommended for supplemental investigation. The Supplemental Remedial Investigation Field Program focused on delineating areas identified in the March 2003 RI Report. Field observations and analytical results are presented jointly to provide a comprehensive overview of the on- and off-site soil and groundwater impacts.

The on-site areas encompass all portions of the property known as the former MGP site. This includes the existing KeySpan property and the previously sold property to the south, which is currently used for vehicle storage. As discussed in **Section 1.4.1**, the majority of the former MGP structures and operations were located in the southernmost portion of the site, including the previously sold property. Off-site areas include the Oswego Oil Service Company to the east and Medical Office Building to the south.

Soil quality results are grouped by sample depth interval and as a series with regard to field observations and type of chemical constituent. **Drawings 4A (1,2,3)** and **4B (1,2,3)** depict field observations, total BTEX and total PAH for the 0 to 8-ft-bgs and 8 to 16 ft-bgs intervals, respectively. **Drawings 4C (1,2,3)** and **4D (1,2,3)** depict field observations, total BTEX and total PAH for the 16 to 24-ft-bgs and 24 to 34 ft-bgs intervals, respectively. **Drawing 4E (1, 2, 3)** shows field observations, total BTEX and total PAH for the greater than 34 ft-bgs depth interval. **Drawings 4A1, 4B1….4E1** graphically depict the soil boring and test pit locations, and horizontal extent of field observations documented as part of this Remedial Investigation and prior studies where the following visual/olfactory field observations were noted in subsurface soil: NAPL-saturated conditions, blebs and lenses of NAPL; observations of soil grains coated by NAPL; soil staining; soil with naphthalene/hydrocarbon-like odors; and solid tar. **Drawings 4A2, 4B2….4E2** provide total BTEX concentrations at soil boring and test pit locations. **Drawings 4A3, 4B3….4E3** provide total PAH concentrations at soil boring and test pit locations. The drawings are based on soil data generated from the Remedial Investigation, the prior investigations conducted in 1990 and 1992, and the Cut and Plug IRM conducted in February/March 1999. **Drawings 4F** through **4I** provide a vertical profile of geologic media and containment impacts in soil. The Cut and Plug IRM analytical data is included in **Appendix D**. Total Petroleum Hydrocarbon (TPHC) and Fingerprint results are included in **Table E-12** included in **Appendix G**. **Tables E-4** through **E-11**, **E-13** through **E-20** and **E-33** through **E-36**, contained in **Appendix G**, present the analytical data summary tables for the subsurface soil samples collected on-site and off-site.

Groundwater quality results are grouped by shallow (water table to 48 ft-bgs), intermediate (49 to 95 ft-bgs) and deep (greater than 95 ft-bgs) zone and by the type of chemical constituent. **Drawings 4K (1, 2)** and **4L (1, 2)** depict total BTEX and total PAH for the shallow and intermediate zones, respectively. **Drawing 4M (1, 2)** shows total BTEX and total PAH for the deep zone.

A Qualitative Human Health Exposure Assessment (EA) and a Fish and Wildlife Resources Impact Analysis (FWRIA) were performed for the site. The EA utilized the findings of both the March 2003 RI Report and the Supplemental Remedial Investigation Field Program to identify human exposures associated with chemical constituents detected in soil, groundwater, indoor air, soil vapor and ambient air at or near the site. The FWRIA identifies actual or potential risks of chemical constituent impacts in soil and groundwater to wildlife residing on or near the site. **Drawings 2A** and **2B** previously presented in **Section 2** provide the surveyed locations of all on-site and adjacent off-site sample locations along with the approximate locations of former MGP structures on the site. The analytical methods and detection limits used for the Remedial Investigation are presented in **Appendix F**. **Appendix G** presents data tables summarizing the analytical results of all samples collected during the Remedial Investigation. These data summary tables also present the sum total of all detected BTEX compounds, as well as the sum total of all detected PAHs and carcinogenic PAHs (CPAHs) compounds.

The analytical results of the investigation were compared to NYSDEC regulatory standards, criteria and guidelines (SCGs) for screening purposes. The analytical data tables provided in **Appendix G** reference the applicable SCGs and include the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) 4046 for soil, and both the Class GA groundwater standards and guidance values provided in the NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 for groundwater. Concentrations of chemical constituents that exceed the SCGs are bracketed and/or highlighted on the data tables.

4.2 Summary of Field Observations and Chemical Constituents In Soil

The following section presents field observations and analytical results from the March 2003 RI Report and the Supplemental RI Field Program, as well as the investigations conducted prior to the implementation of the Remedial Investigations. The purpose of this section is to provide characterization and delineation of the soil impacts. **Table 4-1** provides a summary of following data: Media (with different class of contaminants), Contaminants of Concern, Concentration Range Detected (ppm), SCG (ppm) and Frequency of SCG Exceedances.

4.2.1 On-Site Soil Quality Conditions

4.2.1.1 On-Site Surface Soil

A total of 15 surficial soil samples (HISS-01 through 09 and HISS-15 through 20) were collected at surface depth intervals of 0-2 or 0-6 inches and analyzed for the chemical constituents; PAHs, RCRA metals and total cyanide, and phenols. Surface soil sample locations HISS-01 through 09, HISS-15 and 16 were distributed site-wide, in the northern, southern, eastern and western areas of the site. Surface samples HISS-17 through HISS-20 were positioned around previous soil sample HISS-06 to delineate an elevated lead concentration reported in the March 2003 RI Report. Each sample was screened utilizing a photoionization detector (PID) for the presence of VOCs. No samples exhibited detectable levels of VOCs, therefore were not analyzed for BTEX compounds.

Visual Observations

Visual observations and field screening of the surface soil samples indicated no evidence of impacts.

PAHs

Eleven surface soil samples were analyzed for PAHs. Total PAH concentrations in surface soils ranged from 3.11 mg/kg in sample HISS-02 to 286.50 mg/kg in sample HISS-07. Total CPAHs ranged from 1.5 mg/kg in sample HISS-02 to 95.10 mg/kg in sample HISS-07. Surface soil samples analyzed for PAHs are summarized in **Table E-1** included in **Appendix G**.

RCRA Metals and Total Cyanide

RCRA metals were generally within or below the background concentration ranges typical for soils in the eastern United States. However, surface sample HISS-06, located in the former Coal Storage Area, contained lead at a concentration of 725 mg/kg. Delineation samples HISS-17 through –20 ranged from 128 to 721 mg/kg. Total cyanide ranged from not detected in HISS-08 to 4.2 mg/kg in sample HISS-06. RCRA metals and total cyanide results are summarized in **Table E-2** included in **Appendix G.**

Phenols

Phenols were reported as not detected in all of the on-site surface soil samples as summarized in **Table E-3** included in **Appendix G**.

4.2.1.2 On-Site Subsurface Soil

A total of 210 soil samples were collected from a total of 49 soil borings (designated as HISB) and 9 test pits (designated as HITP). Soil samples were analyzed consistently for BTEX and PAHs. Additional analytical parameters

(RCRA metals, total cyanide and total phenols) were included during the March 2003 RI. The soil borings were advanced to the proposed total depth or until ten-feet of visually "non-impacted" soils were encountered below the last zone of observed impacts. The total depth of soil borings ranged typically between 60 and 80 ft-bgs.

Based on field screening of soil samples from soil borings and test pits, the heaviest NAPL impacts in subsurface soils were encountered in the vicinity of the former MGP structures. NAPL saturated or near saturated soils, tar/oil droplets or blebs, staining and/or sheens, and naphthalene/hydrocarbon-like odors were observed in soils at depth intervals ranging from 4 to 34 ft-bgs at the following MGP structures: former drainage sump; former drip oil tanks; former tar precipitators, condensers, separators and oxide purifier boxes; and former unloading pits.

Several on- and off-site soil boring locations beyond the vicinity of former MGP structures exhibited NAPL impacts in the form of stained and coated soils with naphthalene-like odors in the unsaturated zone above the water table and in the saturated zone immediately below the water table. When encountered, NAPL saturated soils beyond the former MGP structures were observed at the depth interval (24 to 34 ft-bgs) coincident with the water table. Field observations are detailed by sample depth interval below.

The distribution of BTEX concentrations in soils was consistent with the observed NAPL impacts. The highest total BTEX concentrations were detected in soil samples collected in the general vicinity of the former MGP structures where visual evidence of NAPL impacts was predominant and PID measurements were in excess of 100 ppm. **Table 4-2** summarizes data related to subsurface soil samples collected from on-site locations which exhibited the highest total BTEX and total PAH concentrations, along with the approximate location of each sample with respect to former MGP structures/features. The table also includes PID measurements and lists any significant field observations noted for the samples.

Ethylbenzene, toluene and total xylenes were the most common BTEX compounds detected and, in many cases, benzene was not detected. A detailed discussion of BTEX and PAH concentrations is presented below based on sample depth interval.

0 to 8 Foot Interval

Visual Observations

As shown on **Drawing 4A1**, NAPL saturated soils and/or tar was observed in soils at the 0-8 ft-bgs depth interval primarily in the vicinity of former MGP structures, including:

- Drainage Sump located in the northwestern corner of the site.
- Drip Oil Tanks located along the western property boundary.

- Tar Separator located in the south-central portion of the site.
- Oxide Purifier Boxes and Tar Extracting facilities located along the boundary of the KeySpan property and the sold property in the southernmost portion of the site.
- Northernmost Cooling Spray Pond.
- Main Gas Holder in the southwest corner of the site.
- Relief Holder located along the southern property boundary.
- Southeastern portion of the Coal Storage Area.

Drawing 4A1 also indicates the absence of NAPL impacts in the northernmost third of the site.

BTEX

Soil samples from the northernmost portion of the site do not contain elevated BTEX concentrations in subsurface soil, with total BTEX concentrations ranging from not detected (ND) to 0.008 mg/kg **(Drawing 4A2)**. Elevated BTEX concentrations were detected in the vicinity of the former MGP structures. The highest BTEX concentration of 1,344 mg/kg was detected in the tar-saturated soil sample HITP-06 (5-6 ft-bgs) **(Table 4-2)**.

PAHs

Subsurface soils at the 0-8 ft-bgs depth interval exhibit the highest levels of total PAHs in the southernmost portion of the site adjacent and beneath the former MGP structures **(Drawing 4A3)**. Elevated total PAH concentrations range on the order of 10,000 mg/kg as detected in soil samples HITP-07 (2-3 ft-bgs) and HITP-05 (4-5 ft-bgs) at the former relief holder and former Gas Oil Tank, respectively **(Table 4-2)**. Total PAH concentrations of 3,793 mg/kg and 3,959 mg/kg were detected at HCP-10 (2 ft-bgs) and HCP-11 (5 ft-bgs), respectively, both located in the vicinity of the former Boiler Room and Oil Storage Tanks. **Drawing 4A3** presents data at a number of other on-site areas with total PAH concentrations in excess of 2,000 mg/kg in shallow subsurface soil, including the northernmost former Cooling Spray Pond within and immediately downgradient of the former Drainage Sump, the former Tar Separator and along the eastern property boundary located in the vicinity of the former Coal Storage Area. On a site-wide basis, total CPAHs ranged from not detected in several samples to 759 mg/kg in soil sample HITP-14 (4 ft-bgs).

Total Cyanide

Total cyanide ranged from not detected in multiple samples to 41.3 mg/kg in sample HITP-03 (3-4 ft-bgs).

8 to 16 Foot Interval

Visual Observations

Visual observations indicate isolated zones of tar saturation, coatings and staining in soil at the 8-16 ft-bgs depth interval **(Drawing 4B1)**. These localized impacts suggest that vertical NAPL migration through the unsaturated soils has occurred at multiple potential sources.

BTEX

Total BTEX concentrations in the 8 to 16 ft-bgs sample interval ranged from ND in several samples to 418.80 mg/kg in soil sample HISB-8 (10 to 12 ft-bgs). The distribution of BTEX concentrations was localized to the former MGP structures, similar to the 0-8 ft-bgs depth interval **(Drawing 4B2)**. In the former Drainage Sump area, stained soil sample HISB-57 and NAPL-saturated soil sample HISB-08 exhibited elevated total BTEX concentrations of 65.29 to 418.40 mg/kg, respectively **(Table 4-2)**. Total BTEX concentrations on the order of 100s mg/kg were detected and in the vicinity of the Storage Holder (HISB-77), Relief Holder (HISB-33), and Gas Oil Tank (HISB-67).

PAH

Total PAHs concentrations ranged from not detected in several samples to 5,742 mg/kg in sample HISB-77 (10-12 ft-bgs). Total CPAHs ranged from not detected in several samples to 499 mg/kg in soil sample HISB-77 (10-12 ft-bgs). The highest total PAH concentration exists at the western portion of the site between the former Drip Oil Tanks and the former Storage Holder. This subsurface sample HISB-77 (10-12 ft-bgs) was reported at 5,742 mg/kg **(Drawing 4B3 and Table 4-2)**. Based on analytical data, the impacted areas within the area of former MGP structures including the Drainage Sump, the Cesspool, the Relief Holder and the Condensers indicate a decreasing concentration with depth.

In the area of the Drainage Sump, HISB-08 was reported to contain a total PAH concentration of 2,229 mg/kg at 10-12 ft-bgs. HISB-63 installed in the area of the Cesspool was reported to contain a total PAH concentration of 1,581 mg/kg at 7-11 ft-bgs. In the area of the Relief Holder and Condensers, HISB-33 (8-10 ft-bgs) was reported at a concentration of 2,266.70 mg/kg and HISB-67 (14-16 ft-bgs) was reported at a concentration of 1,048.9 mg/kg.

Total Cyanide

Total cyanide ranged from not detected in multiple samples to 2.3 mg/kg in sample HISB-12 (9.5-11 ft-bgs).

16 to 24 Foot Interval

Visual Observations

The majority of NAPL-saturated and stained soil conditions are isolated at the former MGP structures; former drainage sump, drip oil tanks, storage holder, tar separator, boiler room and oxide purifier boxes **(Drawing 4C1)**. This observation is also illustrated by the east-west cross sections provided on **Drawings 4F** and **4G**.

BTEX

Total BTEX concentrations at the 16-24 foot depth interval ranged from non-detect to 780.247 mg/kg in soil sample HISB-66 (22-24 ft-bgs). The highest BTEX concentrations in subsurface soil at the 16-24 ft-bgs depth interval were collected from borings located at the following former MGP structures; the Drainage Sump (HISB-08), the Tar Separator (HISB-15), the Oxide Purifier Boxes (HISB-29 and HSIB-66) and the Relief Holder (HISB-33) **(Drawing 4C2 and Table 4-2)**. HISB-08 had a total detected BTEX concentration of 415 mg/kg and was collected from soils exhibiting a sheen from 18-20 ft-bgs. In the tar separator area, the stained soil sample collected from soil boring HISB-15 (16-18 ft-bgs) had a total BTEX concentration of 149.2 mg/kg. In the oxide purifier box area, stained soil sample collected from soil boring HISB-29 (16-18 ft-bgs) had a total BTEX concentration of 108.18 mg/kg. A heavily stained soil sample collected from soil boring HISB-33 (16-18 ft-bgs), beneath the former relief holder, had a total BTEX concentration of 56.74 mg/kg.

PAH

Total PAHs concentrations ranged from not detected in several samples to 2,768 mg/kg in sample HISB-08 (18-20 ft-bgs) **(Drawing 4C3)**. Total CPAHs ranged from not detected in several samples to 205.7 mg/kg in soil sample HISB-17 (16-18 ft-bgs). Total PAH concentrations were detected in the area of the former MGP structures. The highest total PAH concentration exists in the area of the Drainage Sump in subsurface soil sample HISB-08 (18-20 ft-bgs) at 2,768 mg/kg **(Table 4-2)**. In the area of the former Tar Separator, subsurface soil samples HISB-15 (16-18 ft-bgs) and HISB-64 (23-25 ft-bgs) were reported to contain total PAH concentrations of 2,205 mg/kg and 1,081.9 mg/kg, respectively. In the area of the Oxide Purifier Boxes, HISB-29 (16-18 ft-bgs) was reported to contain a total PAH concentration of 1,010.2 mg/kg. A total PAH concentration of 2,300.7 mg/kg at the HISB-17 (16-18 ft-bgs) was detected along the eastern edge of the site in the vicinity of the Boiler Room.

Total Cyanide

Total cyanide ranged from not detected in multiple samples to 3.9 mg/kg in sample HISB-12 (18 to 20 ft-bgs).

24 to 34 Foot Interval

Visual Observations

Drawing 4D1 and **4F** illustrate that the majority of soil borings exhibiting NAPL-saturated conditions were completed in the southern portion of the site (HIMW-06D, HISB-32, HIMW-07D/HISB-34 and HISB-35), where the majority of former MGP structures and operations were located. In addition, NAPL-saturated conditions were observed in the vicinity of the former drainage sump (HISB-08) and drip oil tanks (HISB-14) located in the western portion of the site (**Drawings 4D1 and 4H**). Note that the 24-34 ft-bgs depth interval includes the water table which ranges from 28 to 32 feet below grade at most on-site and near-site locations. Fluid level gauging conducted at HIMW-01S and HIMW-19S located in the vicinity of the former drainage sump and drip oil tanks identified a separate-phase DNAPL layer in this shallow well.

At the former tar separator in the south-central portion of the site, NAPL-saturated soil was encountered in close proximity to the water table at soil boring HISB-15. **Drawing 4I** illustrates staining and NAPL-saturated soil throughout the unsaturated soil column downgradient of the former tar separator (HISB-16 and HISB-29).

BTEX

Total BTEX concentrations in this interval ranged from not detected to 1,634 mg/kg in soil sample HISB-31 (28-30 ft-bgs). The highest total BTEX concentrations were detected in areas in the southern and western portion of the site around former MGP structures. These subsurface soil samples include HISB-31 (28-30 ft-bgs), HISB-32 (28-30 ft-bgs), HISB-33 (28-30 ft-bgs), HISB-37 (28-30 ft-bgs), HISB-71 (31-32 ft-bgs) and HISB-72 (28-30 ft-bgs) which exhibited total BTEX concentrations of 1,634 mg/kg, 930 mg/kg, 795 mg/kg, 3,080 mg/kg, 1,470 mg/kg and 1283 mg/kg, respectively **(Drawing 4D2 and Table 4-2)**.

PAHs

Total PAH concentrations in this interval ranged from not detected in several samples to 5,275 mg/kg in sample HISB-59 (30-32 ft-bgs). Total CPAHs ranged from not detected in several samples to 275.7 mg/kg in soil sample HISB-15 (28.5-30.5 ft-bgs). Total PAH concentrations exist near former MGP structures **(Drawing 4D3)**. The highest total PAH concentrations were detected in the vicinity of the Drip Oil tanks in subsurface soil samples HISB-59 (30-32 ft-bgs) at 5,275 mg/kg and in subsurface soil sample HISB-14 (28-30 ft-bgs) **(Table 4-2)**. Total PAH concentrations in excess of 2,500 mg/kg were detected in subsurface soil samples HISB-15 (28.5-30 ft-bgs) in the area of the Tar Separator; HISB-56 (29-30 ft-bgs) in the area of the Drainage Sump; HISB-66 (33-35 ft-bgs) in the area of the Oxide Purifier Boxes; HISB-68 (26-28 ft-bgs) in the area of the Pump House and HISB-75 (30-32 ft-bgs) in the area of the Storage Holder **(Drawing 4D3)**.

In addition, total PAH concentrations were detected in excess of 1,000 mg/kg at or near the water table within and immediately downgradient of the former Oxide Purifier Boxes, Drip oil Tanks, Drainage Sump, Meter House, Tar Extractors, Pump House, Relief Holder, Condensers and Storage Holder **(Drawing 4D3)**.

Total Cyanide

Total cyanide ranged from not detected in multiple samples to 1.9 mg/kg in sample HISB-12 (26 to 28 ft-bgs).

Greater Than 34 Foot Interval

Total BTEX and PAH concentrations decrease rapidly at depths greater than 34 ft-bgs.

Visual Observations

NAPL-saturated soils encountered below the depth of 34 feet are limited to sample location HISB-14 in the vicinity of the former drip oil tanks and at the water table in the southernmost portion of the site as indicated by soil borings HIMW-06D, HISB-32, HIMW-07D/HISB-34 and HISB-35. **(Drawing 4E1)**. Also, NAPL blebs, globs, lenses, sheens and/or grain coatings were observed in soil in the vicinity of the former drainage sump below a depth of 34 feet. These NAPL impacts were observed at or immediately below the water table (at 34 ft-bgs) as interval thicknesses of less than 6 inches. Soil staining and/or naphthalene/hydrocarbon odors were observed at HISB-28/HIMW-05D up to a depth of 106 ft-bgs as shown on the east-west cross section provided on **Drawing 4F**.

BTEX

Total BTEX concentrations decrease rapidly in subsurface soil below the water table at approximately 34 ft-bgs. At this depth, the on-site maximum total BTEX concentration is 6.90 mg/kg as detected in subsurface soil sample HISB-55 (36-37 ft-bgs) **(Drawing 4E2 and Table 4-2)**.

PAHs

Total PAH concentrations at and immediately below the water table ranged from not detected in several samples to 4,235 mg/kg in sample HISB-66 (33-35 ft-bgs). Total CPAHs ranged from not detected in several samples to 89.70 mg/kg in soil sample HISB-55 (36-37 ft-bgs). A rapid decreasing trend in PAH concentrations is apparent in on-site subsurface soils below the water table encountered at 34 ft-bgs (**Drawing 4E3)**. However, total PAHs were detected at depth at HISB-07 (58-60 ft-bgs) in the vicinity of the former Drainage Sump with a total PAH concentration of 295.95 mg/kg. Additionally, PAHs were detected at HISB-17 (58-60 ft-bgs) and HISB-55 (36-37 ft-bgs), in the area of the Boiler Room, with total PAH concentrations of 347.90 and 1,248.10, respectively. **(Table 4-2)**.

Total Cyanide

Total cyanide ranged from not detected in multiple samples to 0.41 mg/kg in sample HISB-12 (84 to 86 ft-bgs).

TABLE 4-1A
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH AND METAL CONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

ON-SITE SURFACE AND SUBSURFACE SOIL

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Surface Soil	**PAHs**	Benzo(a)pyrene *	0.061	0.24 to 17	11 of 11	HISS-07 (0-6")
		Dibenzo(a,h)anthracene *	0.014	ND to 4.2	7 of 11	HISS-07 (0-6")
		Benzo(a)anthracene *	0.224	0.22 to 18	11 of 11	HISS-04 (0-8")
		Indeno(1,2,3-cd)pyrene *	3.2	0.099 to 14	3 of 11	HISS-04 (0-8")
		Benzo(b)fluoranthene *	1.1	0.37 to 21	10 of 11	HISS-07 (0-6")
		Benzo(k)fluoranthene *	1.1	0.16 to 6.3	4 of 11	HISS-04 (0-8")
		Chrysene *	0.4	0.41 to 22	11 of 11	HISS-04 (0-8")
		Naphthalene	13	ND to 31	1 of 11	HISS-07 (0-6")
		2-Methylnaphthalene	36.4	ND to 24	0 of 11	HISS-07 (0-6")
		Acenapthylene	41	0.1 to 24	0 of 11	HISS-07 (0-6")
		Acenapthene	50	ND to 1	0 of 11	HISS-07 (0-6")
		Dibenzofuran	6.2	ND to 1.5	0 of 11	HISS-07 (0-6")
		Fluorene	50	ND to 3.9	0 of 11	HISS-07 (0-6")
		Phenanthrene	50	0.22 to 18	0 of 11	HISS-07 (0-6")
		Anthracene	50	0.064 to 17	0 of 11	HISS-07 (0-6")
		Fluoranthene	50	0.46 to 16	0 of 11	HISS-04 (0-8")
		Pyrene	50	0.57 to 69	1 of 11	HISS-04 (0-8")
		Benzo(ghi)perylene	50	0.11 to 20	0 of 11	HISS-04 (0-8")
		Total CaPAHs	10	1.5 to 95.1	6 of 11	HISS-07 (0-6")
		Total PAHs	500 [1]	3.11 to 286.5	0 of 11	HISS-07 (0-6")
	Metals	Arsenic	7.5	2.6 to 55.1	6 of 11	HISS-06 (0-6")
		Barium	300	24.4 to 68.2	0 of 11	HISS-07 (0-6")
		Cadmium	10 [2]	0.58 to 4.8	0 of 11	HISS-07 (0-6")
		Chromium	50 [2]	5.9 to 21.8	0 of 11	HISS-03 (0-6")

TABLE 4-1A (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH, AND METAL CONSTITUENTS
IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

ON-SITE SURFACE AND SUBSURFACE SOIL						
MEDIA	**CLASS**	**CHEMICAL CONSTITUENT**	**SCGs (PPM)**	**CONCENTRATION RANGE (PPM)**	**FREQUENCY OF EXCEEDING SCG**	**SAMPLE EXHIBITING MAXIMUM CONCENTRATION**
Surface Soil (cont.)	**Metals (cont.)**	Lead	500	61.3 to 725	2 of 16	HISS-06 (0-6")
		Mercury	0.1	0.026 to 2.2	10 of 11	HISS-03 (0-6")
		Selenium	2	ND to 2.1	3 of 11	HISS-07 (0-6")
		Silver	SB	ND to 3.5	NA	HISS-07 (0-6")
		Total Cyanide	NA	ND to 4.2	NA	HISS-06 (0-6")
Subsurface Soil	**VOCs**	Benzene	0.06	ND to 94	28 of 197	HITP-06 (5-6')
		Toluene	1.5	ND to 1,000	35 of 197	HISB-31 (28-30')
		Ethylbenzene	5.5	ND to 400	68 of 197	HITP-06 (5-6')
		Total Xylenes	1.2	ND to 680	66 of 197	HISB-32 (28-30')
	PAHs	Benzo(a)pyrene *	0.061	ND to 180	120 of 197	HITP-07 (2-3')
		Dibenzo(a,h)anthracene *	0.014	ND to 4.7	44 of 197	HISB-15 (28.5-30')
		Benzo(a)anthracene *	0.224	ND to 230	107 of 197	HITP-07 (2-3')
		Indeno(1,2,3-cd)pyrene *	3.2	ND to 49	34 of 197	HITP-05 (4-5') HITP-07 (2-3')
		Benzo(b)fluoranthene *	1.1	ND to 120	51 of 197	HITP-05 (4-5') HITP-07 (2-3')
		Benzo(k)fluoranthene *	1.1	ND to 56	52 of 197	HITP-07 (2-3')
		Chrysene *	0.4	ND to 230	103 of 197	HISB-15 (4-6')
		Naphthalene	13	ND to 2,600	75 of 197	HITP-07 (2-3')
		2-Methylnaphthalene	36.4	ND to 2,000	66 of 197	HITP-07 (2-3')
		Acenapthylene	41	ND to 440	42 of 197	HISB-14 (28-30')
		Acenapthene	50	ND to 640	14 of 197	HITP-07 (2-3')
		Dibenzofuran	6.2	ND to 72	24 of 127	HITP-07 (2-3')
		Fluorene	50	ND to 480	45 of 197	HITP-07 (2-3')
		Phenanthrene	50	ND to 1,500	62 of 197	HITP-07 (2-3')
		Anthracene	50	ND to 360	41 of 197	HITP-07 (2-3')
		Fluoranthene	50	ND to 390	37 of 197	HITP-07 (2-3')

TABLE 4-1A (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH AND METAL CONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

ON-SITE SURFACE AND SUBSURFACE SOIL						
MEDIA	**CLASS**	**CHEMICAL CONSTITUENT**	**SCGs (PPM)**	**CONCENTRATION RANGE (PPM)**	**FREQUENCY OF EXCEEDING SCG**	**SAMPLE EXHIBITING MAXIMUM CONCENTRATION**
Subsurface Soil (cont.)	**PAHs (cont.)**	Pyrene	50	ND to 940	43 of 197	HITP-07 (2-3')
		Benzo(ghi)perylene	50	ND to 67	3 of 197	HITP-07 (2-3')
		Total CaPAHs	10	ND to 855	82 of 197	HITP-07 (2-3')
		Total PAHs	500 [1]	ND to 10,054	59 of 197	HITP-07 (2-3')
	Metals	Arsenic	7.5	ND to 74.3	4 of 117	HITP-01 (2.5-3')
		Barium	300	1.5 to 204	0 of 117	HISB-14 (6-7')
		Cadmium	10 [2]	ND to 1.6	0 of 117	HISB-14 (122-124')
		Chromium	50 [2]	0.65 to 27.1	0 of 117	HISB-14 (122-124')
		Lead	500	ND to 737	2 of 117	HITP-06 (5-6')
		Mercury	0.1	ND to 2	11 of 117	HISB-14 (6-7')
		Selenium	2	ND to 12.1	30 of 117	HISB-14 (122-124')
		Silver	SB	ND to 4	NA	HISB-14 (122-124')
		Total Cyanide	NA	ND to 41.3	NA	HITP-03 (3-4')

Notes:
SCGs: NYSDEC TAGM 4046 dated January 1994
NA: Not applicable
ND: Non-detect
SB: Site Background
* Carcinogenic PAH (CaPAH)
[1] SCG is for Total SVOCs
[2] Proposed NYSDEC TAGM criteria

TABLE 4-1B
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH AND METAL CONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SGCs

ON-SITE GROUNDWATER

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater	**VOCs**	Benzene	1	ND to 56,000	45 of 98	HIMW-06S
		Toluene	5	ND to 47,000	42 of 98	HIGP-31(29-33')
		Ethylbenzene	5	ND to 2,000	35 of 98	HIGP-34(30-34')
		Total Xylenes	5	ND to 13,000	50 of 98	HIGP-32(30-34')
	PAHs	Benzo(a)pyrene *	ND	ND to 250,000	23 of 98	HIMW-06S
		Dibenzo(a,h)anthracene *	NA	ND to 24,000	NA	HIMW-06S
		Benzo(a)anthracene *	0.002	ND to 350,000	26 of 98	HIMW-06S
		Indeno(1,2,3-cd)pyrene *	0.002	ND to 71,000	12 of 98	HIMW-06S
		Benzo(b)fluoranthene *	0.002	ND to 190,000	21 of 98	HIMW-06S
		Benzo(k)fluoranthene *	0.002	ND to 80,000	13 of 98	HIMW-06S
		Chrysene *	0.002	ND to 340,000	27 of 98	HIMW-06S
		Naphthalene	10	ND to 2,800,000	49 of 98	HIMW-06S
		2-Methylnaphthalene	NA	ND to 1,300,000	NA	HIMW-06S
		Acenapthylene	NA	ND to 920,000	NA	HIMW-06S
		Acenapthene	20	ND to 130,000	23 of 98	HIMW-06S
		Dibenzofuran	NA	ND to 62,000	NA	HIMW-06S
		Fluorene	50	ND to 650,000	20 of 98	HIMW-06S
		Phenanthrene	50	ND to 1,400,000	22 of 98	HIMW-06S
		Anthracene	50	ND to 490,000	16 of 98	HIMW-06S
		Fluoranthene	50	ND to 580,000	15 of 98	HIMW-06S
		Pyrene	50	ND to 800,000	16 of 98	HIMW-06S
		Benzo(ghi)perylene	NA	ND to 81,000	NA	HIMW-06S
		Total CaPAHs	NA	ND to 1,305,000	NA	HIMW-06S
		Total PAHs	NA	ND to 10,518,000	NA	HIMW-06S

TABLE 4-1B (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH AND METAL CONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

ON-SITE GROUNDWATER

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater (cont.)	**Metals**	Arsenic	25	ND to 4.9	0 of 14	HIMW-07S
		Barium	1,000	ND to 452	0 of 14	HIMW-07S
		Cadmium	5	ND to 3.2	0 of 14	HIMW-01D
		Chromium	50	ND to 19.1	0 of 14	HIMW-01I
		Lead	25	ND to 3.8	0 of 14	HIMW-02D
		Mercury	0.7	ND	0 of 14	NA
		Selenium	10	ND to 8.6	0 of 14	HIMW-01S
		Silver	50	ND to 1.3	0 of 14	HIMW-01I HIMW-07S
		Total Cyanide	200	ND to 3,030	1 of 14	HIMW-01S

Notes:
SCGs: NYSDEC Class GA Groundwater Standards/Guidelines
NA: Not applicable
ND: Non-detect
*: Carcinogenic PAH (CaPAH)

TABLE 4-1C
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH, AND METALCONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

OFF-SITE SURFACE AND SUBSURFACE SOIL

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Surface Soil	**PAHs**	Benzo(a)pyrene *	0.061	0.12 to 1.4	5 of 5	HISS-13 (0-2")
		Dibenzo(a,h)anthracene *	0.014	ND to 0.18	3 of 5	HISS-13 (0-2")
		Benzo(a)anthracene *	0.224	0.12 to 1.1	4 of 5	HISS-13 (0-2")
		Indeno(1,2,3-cd)pyrene *	3.2	0.11 to 0.71	0 of 5	HISS-13 (0-2")
		Benzo(b)fluoranthene *	1.1	0.18 to 1.8	1 of 5	HISS-13 (0-2")
		Benzo(k)fluoranthene *	1.1	0.074 to 0.67	0 of 5	HISS-13 (0-2")
		Chrysene *	0.4	0.2 to 1.4	4 of 5	HISS-13 (0-2")
		Naphthalene	13	ND to 0.12	0 of 5	HISS-13 (0-2")
		2-Methylnaphthalene	36.4	ND to 0.059	0 of 5	HISS-12 (0-2")
		Acenapthylene	41	0.083 to 0.4	0 of 5	HISS-13 (0-2")
		Acenapthene	50	ND	0 of 5	NA
		Dibenzofuran	6.2	ND	0 of 5	NA
		Fluorene	50	ND to 0.12	0 of 5	HISS-13 (0-2")
		Phenanthrene	50	0.11 to 1.6	0 of 5	HISS-13 (0-2")
		Anthracene	50	ND to 0.3	0 of 5	HISS-13 (0-2")
		Fluoranthene	50	0.2 to 2.3	0 of 5	HISS-13 (0-2")
		Pyrene	50	0.27 to 2.8	0 of 5	HISS-13 (0-2")
		Benzo(ghi)perylene	50	0.13 to 0.82	0 of 5	HISS-13 (0-2")
		Total CaPAHs	10	0.8 to 7.26	0 of 5	HISS-13 (0-2")
		Total PAHs	500 [1]	1.67 to 15.72	0 of 5	HISS-13 (0-2")
	Metals	Arsenic	7.5	1.5 to 4.5	0 of 5	HISS-13 (0-2")
		Barium	300	30.2 to 65.5	0 of 5	HISS-12 (0-2")
		Cadmium	10 [2]	0.71 to 1.3	0 of 5	HISS-13 (0-2")

TABLE 4-1C (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH, AND METAL CONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

OFF-SITE SURFACE AND SUBSURFACE SOIL

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Surface Soil (cont.)	Metals (cont.)	Chromium	50 [2]	7.7 to 19.9	0 of 5	HISS-10 (0-2")
		Lead	500	44.1 to 268	0 of 5	HISS-13 (0-2")
		Mercury	0.1	0.19 to 1	5 of 5	HISS-14 (0-2")
		Selenium	2	ND to 3.3	2 of 5	HISS-12 (0-2")
		Silver	SB	0.54 to 2.2	NA	HISS-12 (0-2")
		Total Cyanide	NA	ND to 1.8	NA	HISS-13 (0-2")
Subsurface Soil	VOCs	Benzene	0.06	ND to 310	6 of 129	HISB-71 (31-32')
		Toluene	1.5	ND to 1,100	9 of 120	HISB-37 (28-30')
		Ethylbenzene	5.5	ND to 160	17 of 129	HISB-71 (31-32')
		Total Xylenes	1.2	ND to 1,700	27 of 129	HISB-37 (28-30')
	PAHs	Benzo(a)pyrene *	0.061	ND to 200	51 of 129	HISB-37 (28-30')
		Dibenzo(a,h)anthracene *	0.014	ND to 20	28 of 129	HISB-37 (28-30')
		Benzo(a)anthracene *	0.224	ND to 360	46 of 129	HISB-37 (28-30')
		Indeno(1,2,3-cd)pyrene *	3.2	ND to 52	10 of 129	HISB-37 (28-30')
		Benzo(b)fluoranthene *	1.1	ND to 150	29 of 129	HISB-37 (28-30')
		Benzo(k)fluoranthene *	1.1	ND to 53	22 of 129	HISB-37 (28-30')
		Chrysene *	0.4	ND to 350	45 of 129	HISB-37 (28-30')
		Naphthalene	13	ND to 5,500	28 of 129	HISB-37 (28-30')
		2-Methylnaphthalene	36.4	ND to 2,700	24 of 129	HISB-37 (28-30')
		Acenapthylene	41	ND to 1,200	14 of 129	HISB-37 (28-30')
		Acenapthene	50	ND to 230	4 of 129	HISB-40 (32-34')
		Dibenzofuran	6.2	ND to 58	7 of 97	HISB-37 (28-30')
		Fluorene	50	ND to 770	14 of 97	HISB-37 (28-30')
		Phenanthrene	50	ND to 2,100	18 of 97	HISB-37 (28-30')
		Anthracene	50	ND to 560	9 of 120	HISB-37 (28-30')

TABLE 4-1C (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH AND METAL CONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

OFF-SITE SURFACE AND SUBSURFACE SOIL

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPM)	CONCENTRATION RANGE (PPM)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Subsurface Soil (cont.)	PAHs (cont.)	Fluoranthene	50	ND to 540	8 of 97	HISB-37 (28-30')
		Pyrene	50	ND to 840	16 of 97	HISB-37 (28-30')
		Benzo(ghi)perylene	50	ND to 55	1 of 97	HISB-37 (28-30')
		Total CaPAHs	10	ND to 1,185	33 of 97	HISB-37 (28-30')
		Total PAHs	500 [1]	ND to 15,688	18 of 97	HISB-37 (28-30')
	Metals	Arsenic	7.5	ND to 11.6	3 of 92	HISB-27 (0-2')
		Barium	300	2 to 57.3	0 of 92	HISB-26 (2-4')
		Cadmium	10 [2]	ND to 1.5	0 of 92	HISB-27 (0-2')
		Chromium	50 [2]	0.89 to 25.4	0 of 92	HISB-26 (21-33')
		Lead	500	ND to 297	0 of 92	HISB-26 (2-4')
		Mercury	0.1	ND to 0.41	2 of 92	HISB-43 (0-2')
		Selenium	2	ND to 5.6	15 of 92	HISB-27 (0-2')
		Silver	SB	ND to 3.3	NA	HISB-27 (0-2')
		Total Cyanide	NA	ND to 3.9	NA	HISB-45 (28-30')

Notes:
SCGs: NYSDEC TAGM 4046 dated January 1994
NA: Not applicable
ND: Non-detect
SB: Site Background
* Carcinogenic PAH (CaPAH)
[1] SCG is for Total SVOCs
[2] Proposed NYSDEC TAGM criteria

TABLE 4-1D
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH AND METAL CONSTITUENTS IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

OFF SITE GROUNDWATER

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater	VOCs	Benzene	1	ND to 38,000	93 OF 238	HIGP-37(29-33')
		Toluene	5	ND to 26,000	68 OF 238	HIGP-38 (29-33')
		Ethylbenzene	5	ND to 9,100	53 OF 238	HIGP-66 (90-94')
		Total Xylenes	5	ND to 15,000	95 OF 238	HIGP-37 (29-33')
	PAHs	Benzo(a)pyrene *	ND	ND to 38,000	10 OF 238	HIGP-36 (29-33')
		Dibenzo(a,h)anthracene *	NA	ND to 3,700	NA	HIGP-36 (29-33')
		Benzo(a)anthracene *	0.002	ND to 53,000	2 OF 238	HIGP-36 (29-33')
		Indeno(1,2,3-cd)pyrene *	0.002	ND to 11,000	7 OF 238	HIGP-36 (29-33')
		Benzo(b)fluoranthene *	0.002	ND to 31,000	6 of 238	HIGP-36 (29-33')
		Benzo(k)fluoranthene *	0.002	ND to 7,500	5 of 238	HIGP-36 (29-33')
		Chrysene *	0.002	ND to 56,000	13 OF 238	HIGP-36 (29-33')
		Naphthalene	10	ND to 820,000	74 OF 238	HIGP-36 (29-33')
		2-Methylnaphthalene	NA	ND to 350,000	NA	HIGP-36 (29-33')
		Acenapthylene	NA	ND to 200,000	NA	HIGP-36 (29-33')
		Acenapthene	20	ND to 20,000	22 OF 238	HIGP-36 (29-33')
		Dibenzofuran	NA	ND to 7,500	NA	HIGP-36 (29-33')
		Fluorene	50	ND to 140,000	15 OF 238	HIGP-36 (29-33')
		Phenanthrene	50	ND to 370,000	17 OF 238	HIGP-36 (29-33')
		Anthracene	50	ND to 98,000	7 OF 238	HIGP-36 (29-33')
		Fluoranthene	50	ND to 120,000	8 OF 238	HIGP-36 (29-33')
		Pyrene	50	ND to 160,000	8 OF 238	HIGP-36 (29-33')
		Benzo(ghi)perylene	NA	ND to 12,000	NA	HIGP-36 (29-33')
		Total CaPAHs	NA	ND to 200,200	NA	HIGP-36 (29-33')
		Total PAHs	NA	ND to 2,497,700	NA	HIGP-36 (29-33')

TABLE 4-1D (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

SUMMARY AND COMPARISON OF BTEX, PAH AND METAL CONSTITUENTS
IN ON AND OFF SITE SOILS AND GROUND WATER TO NYSDEC SCGs

OFF SITE GROUNDWATER

MEDIA	CLASS	CHEMICAL CONSTITUENT	SCGs (PPB)	CONCENTRATION RANGE (PPB)	FREQUENCY OF EXCEEDING SCG	SAMPLE EXHIBITING MAXIMUM CONCENTRATION
Groundwater (cont.)	**Metals**	Arsenic	25	ND to 13.1	0 of 31	HIMW-14I
		Barium	1,000	14.8 to 491	0 of 31	HIMW-09S
		Cadmium	5	ND to 5.3	1 of 31	HIMW-04D
		Chromium	50	ND to 71.5	1 of 31	HIMW-13S
		Lead	25	ND to 8.8	0 of 31	HIMW-15I
		Mercury	0.7	ND	0 of 31	NA
		Selenium	10	ND to 9.4	0 of 31	HIMW-05S
		Silver	50	ND to 10.6	0 of 31	HIMW-14I
		Total Cyanide	200	ND to 81.9	0 of 31	HIMW-05S

Notes:
SCGs: NYSDEC Class GA Groundwater Standards/Guidelines
NA: Not applicable
ND: Non-detect
*: Carcinogenic PAH (CaPAH)

TABLE 4-2

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-07 (24-26')	8	1,230	Directly outside southwest corner of Drainage Sump in western portion of site.	264	Sheen, odor
HISB-08 (10-12')	419	2,229	Within central portion of Drainage Sump in western portion of site.	740	Saturated w/NAPL, naphthalene-like odor
HISB-08 (18-20')	415	2,768	Within central portion of Drainage Sump in western portion of site.	1,056	Saturated w/NAPL, sheen, heavy staining, naphthalene-like odor
HISB-08 (28-29')	30	1,341	Within central portion of Drainage Sump in western portion of site.	301	Sheen, staining, slight naphthalene-like odor
HISB-11 (4-6')	325	2,490	Adjacent to fence directly southeast of Coal Storage Area in eastern portion of site.	1,845	Odor
HISB-14 (28-30')	11	5,162	Within Drip Oil Tanks in western portion of site.	451	Saturated w/NAPL, staining, hydrocarbon-like odor
HISB-15 (4-6')	405	2,227	Within Tar Separator in central/southern portion of site.	840	Staining
HISB-15 (16-18')	149	2,205	Within Tar Separator in central/southern portion of site.	650	Staining, strong hydrocarbon-like odor
HISB-15 (28.5-30')	66	4,579	Within Tar Separator in central/southern portion of site.	290	NAPL staining, naphthalene-like odor
HISB-16 (24-26')	38	1,622	Within northeast corner of Tar Extractors. Southeast of Tar Separator in southern/central portion of site.	704	NAPL staining, odor
HISB-17 (8-10')	0	779	Within Oil Tanks directly outside southwest corner of Boiler Room in eastern portion of site.	146	NAPL staining, odor

TABLE 4-2 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-17 (16-18')	6	2,301	Within Oil Tanks directly outside southwest corner of Boiler Room in eastern portion of site.	563	Staining, sheen, odor
HISB-17 (24-26')	0	932	Within Oil Tanks directly outside southwest corner of Boiler Room in eastern portion of site.	391	Staining, sheen, naphthalene-like odor
HISB-18 (28-30')	101	2,128	Between Meter House and Oxide Purifier Boxes in southern portion of site.	2000+	NAPL staining, odor
HISB-29 (16-18')	108	1,010	In southernmost portion of site. Within Oxide Purifier Boxes.	579	Black staining, naphthalene-like odor
HISB-29 (28-30')	162	1,067	In southernmost portion of site. Within Oxide Purifier Boxes.	1,896	Saturated w/NAPL and heavy staining from 29-31', naphthalene-like odor
HISB-30 (28-30')	42	682	In southernmost portion of site. Within Steam Accumulator between the Pump House and Gas Generator House.	332.0	Heavy black staining from 28-28.4' and at 30', naphthalene-like odor
HISB-31 (28-30')	1,634	602	In southernmost portion of site. Between main Storage Holder and Skimming Basin.	2000+	Saturated w/NAPL, black staining, sheen, very strong naphthalene-like odor
HISB-32 (28-30')	930	2,307	In southernmost portion of site. Within Tar Emulsion Settling Tank between Relief Holder and Morse Tar Separator.	2000+	Saturated w/NAPL and black staining from 29.5-30', black banding from 29-29.5', naphthalene-like odor
HISB-33 (8-10')	278	2,267	In southernmost portion of site. Within central portion of Relief Holder.	157	Black banding, staining, strong naphthalene-like odor
HISB-33 (16-18')	57	673	In southernmost portion of site. Within central portion of Relief Holder.	87	Heavy black staining from 16-16.5', moderate naphthalene-like odor
HISB-33 (28-30')	795	1,946	In southernmost portion of site. Within central portion of Relief Holder.	2000+	Saturated w/NAPL and staining from 29-30', heavy black banding, strong naphthalene-like odor

TABLE 4-2 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-34 (28-30')	164	1,185	In southernmost portion of site. Within southern portion of Gas Oil Tank.	364	Saturated w/NAPL, staining, hydrocarbon-like odor
HISB-35 (6-8')	9	2,873	Site Access Road. Within Pump House and downgradient of Compressor Room.	919	Staining, odor
HISB-35 (28-30')	29	1,425	Site Access Road. Within Pump House and downgradient of Compressor Room.	1,681	Black banding at 29' and 30', strong naphthalene-like odor
HISB-55 (36-37')	7	1,248	Within Boiler Room adjacent to Gas Generator Room in eastern portion of site.	154	Heavy NAPL staining in upper 0.25', sheen, strong naphthalene-like odor
HISB-56 (25-27')	16	796	Northwest Corner of Drainage Sump Area	75	Heavily Coated with NAPL and a Sheen with a Moderate Fuel-Like Odor
HISB-56 (29-30')	104	3,598	Northwest Corner of Drainage Sump Area	121	Heavily Coated to Saturated with NAPL Moderate to Strong Naphthalene-Like Odor
HISB-57 (9-11')	65	19	Northeast Corner of Drainage Sump Area	158	NAPL Staining and a Strong MGP-Like and Fuel-Like Odor
HISB-57 (29-31')	88	109	Northeast Corner of Drainage Sump Area	84	Heavily Coated to Saturated with NAPL Moderate Naphthalene-Like Odor
HISB-58 (14-16')	10	111	Southern Side of Drainage Sump Area	169	Sheen with an Unknown Odor
HISB-58 (21-24')	14	511	Southern Side of Drainage Sump Area	529	Heavily Coated with a Moderate Fuel-Like Odor
HISB-58 (30-32')	613	1,532	Southern Side of Drainage Sump Area	1,116	NAPL Saturated with a Strong Naphthalene/MGP-Like Odor

TABLE 4-2 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-58A (30-32')	104	1,658	Southeast Corner of Drainage Sump Area Southeast of HISB-58	394	Heavily Coated to Saturated with NAPL Moderate to Strong Naphthalene-Like Odor
HISB-59 (30-32')	969	5,275	North Side of Drip Oil Tanks	937	Heavily Coated to Saturated with NAPL with a Strong Naphthalene-Like Odor
HISB-59 (32-34')	391	885	North Side of Drip Oil Tanks	721	Separate Phase NAPL
HISB-60 (9-11')	0	668	East Side of Drip Oil Tanks	0	Slight MGP-Like Odor
HISB-60 (34-36')	170	2,072	East Side of Drip Oil Tanks	65	Slight Naphthalene-Like Odor
HISB-61A (30.5'-32')	144	1,990	South Side of Drip Oil Tanks	0	Saturated with NAPL with a Moderate Naphthalene-Like Odor
HISB-62 (24-26')	62	2,361	West Side of Drip Oil Tanks	269	Heavily Coated to Saturated with NAPL Srong Naphthalene-Like Odor
HISB-62A (25-27')	34	2,430	West Side of Drip Oil Tanks West of HISB-62	41	Bands of NAPL Saturation with a Strong Naphthalene-Like Odor
HISB-63 (7-11')	155	1,581	North of Tar Separator in Central Portion of Site	19	Heavily Stained with NAPL Saturation and Tar-Like Substance with a Strong Naphthalene-Like Odor
HISB-64 (23-25')	29	1,082	West of Tar Separator in Central Portion of Site	92	Heavily Coated with a Tar-Like Substance with a Moderate Naphthalene-Like Odor
HISB-64 (30-32')	50	926	West of Tar Separator in Central Portion of Site	124	Heavily Coated with a Naphthalene Like Odor

TABLE 4-2 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-65 (32.5-34.5')	20	1,031	Northeast Corner of Meter House West of Oxide Purifier Boxes	29	Heavily Coated and Blebs with a Strong MGP-Like Odor
HISB-66 (14-16')	39	868	East of Oxide Purifier Boxes	526	Heavily Coated and Blebs with a Strong MGP-Like Odor
HISB-66 (22-24')	780	409	East of Oxide Purifier Boxes	592	Heavily Coated and Blebs with a Strong MGP-Like Odor
HISB-66 (33-35')	670	4,235	East of Oxide Purifier Boxes	200	Heavily Coated with Bands of NAPL Saturation and Blebs with a Strong MGP-Like Odor
HISB-67 (14-16')	126	1,049	South of Oxide Purifier Boxes	415	Heavily Coated with a Tar-Like Substance with a Sheen and a Moderate to Strong Naphthalene/Tar-Like Odor
HISB-67 (26-28')	29	53	South of Oxide Purifier Boxes	407	Heavily Coated with a Tar-Like Substance and a Moderate to Strong Naphthalene/Tar-Like Odor
HISB-67 (30-32')	117	1,581	South of Oxide Purifier Boxes	355	Heavily Coated with a Tar-Like Substance and Blebs and a Moderate to Strong Naphthalene/Tar-Like Odor
HISB-68 (26-28')	38	2,509	Southeast of Oxide Purifier Boxes	200	Heavily Coated with Bands of Naphthalene and tar-Like Substance and a Moderate Naphthalene/Tar-Like Odor
HISB-68 (30-32')	105	177	Southeast of Oxide Purifier Boxes	122	Heavily Coated with Bands of NAPL Saturation and a Moderate Naphthalene/Tar-Like Odor
HISB-75 (26-28')	178	284	Southeast of Drip Oil Tanks	1,364	Dark Grey Staining and a Fuel-Like Odor
HISB-75 (30-32')	658	3,184	Southeast of Drip Oil Tanks	1,095	Staining and Coating with Sheen and Blebs and a Srong MGP-Like Odor

TABLE 4-2 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-77 (10-12')	301	5,742	Southwest of Drip Oil Tanks at Garden City Property Boundary	575	Tar-Like Substance Saturation and Blebs with a Strong Naphthalene-Like Odor
HISB-77 (30-32')	507	2,456	Southwest of Drip Oil Tanks at Garden City Property Boundary	942	Tar-Like Substance Saturation and Blebs with a Strong Naphthalene/MGP-Like Odor
HISB-78 (26-28)	12	163	Eastern Property Boundary at Gas Generator House	61	Heavily Coated with Sheen and Strong Petroelum-Like Odor
HISB-79 (28-32)	210	855	Eastern Property Boundary in L.I.R.R. Right-of-Way	483	Heavily Coated with a Sheen and Strong Naphthalene-Like Odor
HISB-79 (32-36)	200	619	Eastern Property Boundary in L.I.R.R. Right-of-Way	208	Heavily Coated to Saturated Soils with a Petroleum-Like Odor and a Naphthalene-Like Odor
HITP-01 (2.5-3')	680	3,003	Within north Cooling Spray Pond in central portion of site.	10*	Oil/tar saturated at base of foundation, black staining
HITP-02 (3-5')	85	688	East of Coal Storage Area in eastern portion of site.	10*	Viscous oil/water discharge, hydrocarbon-like odor
HITP-04 (2-3')	82	4,064	Partially within Electric Precipitator House and Oxide Purifier Boxes in southern portion of site.	50	Tar staining, naphthlene-like odor
HITP-05 (4-5')	185	9,455	In southernmost portion of site. Within eastern portion of Relief Holder and western portion of Gas Oil Tank downgradient of Oxide Purifier Boxes.	702	Partially saturated, naphthalene-like odor
HITP-06 (5-6')	1,344	1,470	In southernmost portion of site. Within Storage Holder downgradient of Meter House.	465	Tar/oil saturated
HITP-07 (2-3')	93	10,054	In southernmost portion of site. Within Relief Holder downgradient of Oxide Purifier Boxes.	780	Coal tar, naphthalene-like odor

TABLE 4-2 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HITP-14 (4')	12	3,956	East of Drip Oil Tanks	2	Material Resembling Purifier Waste

Note:

* PID was not functioning properly due to heavy precipitation.

4.2.1.3 Supplemental Field Program - Surface and Subsurface Soil Quality Conditions Specific to Areas in the Vicinity of the Former MGP Structures

The March 2003 RI Report identified subsurface soils requiring further delineation in areas around the former drainage sump, the former drip oil tanks, the former tar precipitators, condensers, separators, and oxide purifier boxes and the former unloading pits. Subsurface soils in these areas exhibited NAPL saturated or near saturated soils, staining and/or sheens, naphthalene/hydrocarbon-like odors as well as tar/oil droplets or blebs.

Based on these findings, supplemental subsurface soil borings were completed to delineate subsurface soil conditions in the impacted areas. Additionally, test pits were installed in the area of the former tar precipitators, condensers, separators and oxide purifier boxes, former tar tank and unloading pits.

The purpose of this section is to discuss soil quality conditions identified in the Supplemental Remedial Investigation Field Program with respect to each former MGP structure. The soil quality data discussed below is not additional data, rather the same soil quality data presented in Section 4.2.1.2.

Former Drainage Sump

The former drainage sump was located in the northwestern quadrant of the MGP property, an area used presently as a Natural Gas Regulator Station as indicated in **Drawings 4A1 through 4E3 and 4K1 through 4M2**. In accordance with the SIWP, three soil probes, HISB-56 through HISB-58, were advanced at the former drainage sump area utilizing a GeoProbe. During the installation of these soil probes, one additional probe was advanced (HISB-58A) to further aid in the delineation of this area.

A total of 18 soil samples were collected from the four soil probes and were analyzed for BTEX and PAH compounds. Total BTEX concentrations ranged from not detected to 613 parts per million (mg/kg). The highest concentrations detected were in soil samples collected in the 30-32 ft-bgs interval in boring HISB-58. Total PAH concentrations ranged from not detected to 3,598 mg/kg in sample HISB-56 at the 29-30 ft-bgs interval.

Former Drip Oil Tanks

The former drip oil tanks were located along the western (central) boundary of the MGP property as indicated in **Drawings 4A1 through 4E3 and 4K1 through 4M2**. In accordance with the Remedial Investigation Work Plan (RIWP), four soil probes, HISB-59 through HISB-62, were advanced in this area utilizing a GeoProbe. During the installation of these soil probes, one additional probe was advanced (HISB-62A) to further aid in the delineation of this area.

A total of 20 soil samples were collected from the five soil probes and were analyzed for BTEX and PAH compounds. Total BTEX concentrations ranged from not detected to 969.25 mg/kg. The highest concentrations were in the soil samples collected from the 30 to 32 foot bgs interval in boring HISB-59. Total PAH concentrations ranged from not detected to 5,275 mg/kg in sample HISB-59 at the 30 to 32 foot bgs interval.

During the investigation, it was determined that two additional soil probes were required to complete data needs south of the drip oil tanks. Therefore, two additional soil probes, HISB-75 and HISB-77, were advanced. These borings were advanced to a depth of 64 ft-bgs (HISB-75) and 48 ft-bgs (HISB-77). A total of nine soil samples were collected from these boreholes and were analyzed for the presence of BTEX and PAH compounds. Total BTEX concentrations ranged from not detected to 658.034 mg/kg in sample HISB-75 at the 30-32 foot bgs interval. Total PAH concentrations ranged from not detected to 5,742 mg/kg in sample HISB-77 at the 10-12 foot bgs interval.

One test pit (HITP-14) was excavated in the area of soil boring HISB-60 due to the presence of wood chips identified in the surface soil (0 to 8 ft-bgs). This test pit was excavated to a depth of four feet and a two-foot thick layer of wood chips was encountered between 2 to 4 ft-bgs. One sample was collected of this material and was analyzed for total and amenable cyanide. The laboratory reported a total cyanide result of 10 mg/kg and an amenable cyanide result of 8.66 mg/kg.

Former Tar Precipitators, Condensors, Separators and Oxide Purifier Boxes

The former tar precipitators, condensers, separators and oxide purifier boxes were located in the central and southern portion of the MGP property as indicated in **Drawings 4A1 through 4E3 and 4K1 through 4M2**. In accordance with the Supplemental Investigation Work Plan, six soil probes, HISB-63 through HISB-68, were advanced in this area utilizing a GeoProbe. Two test pits, HITP-08 and HITP-09, were excavated in this area.

A total of 24 soil samples were collected from the six soil probes and were analyzed for BTEX and PAH compounds. One sample was collected from test pit HITP-09 and was analyzed for the presence of BTEX and PAH compounds. Total BTEX concentrations ranged from not detected to 780.247 mg/kg. The highest concentrations were in soil samples collected from the 22 to 24 foot interval in boring HISB-66. The sample collected from HITP-09 registered a BTEX level of 0.046 mg/kg. Total PAH concentrations ranged from not detected to 4,235 mg/kg in sample HISB-66 at the 33 to 35 foot interval.

Former Unloading Pits

The former unloading pits were located in the central portion of the MGP property as indicated in **Drawings 4A1 through 4E3 and 4K1 through 4M2**. In accordance with the Supplemental Investigation Work Plan, test pits HITP-10 through HITP-12 were excavated adjacent to the former locations of the unloading pits to determine if the structures were still present and to identify any MGP-related impacts in the area of the pits. The only test pit which identified a former structure was HITP-10. No MGP-related impacts were observed in this test pit with the exception of some coal fragments in the upper one-foot of the excavation.

During the excavation of HITP-12, coal fragments were also encountered and a single soil sample was collected from the six-foot interval and analyzed for BTEX and PAH compounds. Total BTEX concentrations were reported as not detected and total PAH compounds were reported at 4.606 mg/kg.

Possible Refuse Fill Area

The possible refuse fill area was located in the central portion of the MGP property as indicated in **Drawings 4A1 through 4E3 and 4K1 through 4M2**. One soil boring, HISB-74, was installed in an area of reported fill material. This boring was advanced to a depth of 39 ft-bgs. A total of three analytical soil samples were collected and analyzed for total BTEX and PAH compounds. The analytical laboratory reported a concentration of not detected for BTEX and PAH fractions in all three samples.

Gas Oil Tank and Tar Tank

The former unloading pits were located in the central portion of the MGP property as indicated in **Drawings 4A1 through 4E3 and 4K1 through 4M2**. As per NYSDEC comments on the Supplemental Investigation Work Plan, one test pit (HITP-13) was excavated in the area of the former tar tank. This test pit was excavated to a depth of 7 ft-bgs, to determine the presence of the former structure. The former structure was encountered and the soils surrounding the structure were stained and coated with a tar-like material from 3 to 7 ft-bgs. No soil sampling was performed in this test pit.

4.2.2 MGP and Non-MGP Off-Site Soil Quality Conditions

4.2.2.2 MGP and Non-MGP Off-Site Surface Soils

A total of seven surface soil samples were collected at off-site soil boring locations HISS-10 through HISS-16. The surface soil samples were collected from the 0-0.5 ft-bgs depth interval and analyzed for PAHs, RCRA metals, total cyanide and total phenols.

Visual Observations

No visual information is available.

PAHs

Concentrations of total PAHs in surface soils ranged from 1.67 mg/kg in sample HISS-11 to 26.05 mg/kg in sample HISS-16. Total CPAHs ranged from 0.8 mg/kg in sample HISS-11 to 12.14 in sample HISS-16. The results of surface soil samples analyzed for PAHs are summarized in **Table E-1** included in **Appendix G**.

RCRA Metals

RCRA metals were generally within or below the concentration ranges typical for background soil in the eastern United States. RCRA metals results are summarized in **Table E-2** included in **Appendix G.**

Total Cyanide

Total cyanide ranged from not detected in HISS-11 and HISS-12 to 1.8 mg/kg in sample HISS-13. Total cyanide results are summarized in **Table E-2** included in **Appendix G.**

Total Phenols

Phenols were reported as not detected in all of the on-site surface soil samples. Total phenols are summarized in **Table E-3** included in **Appendix G**.

4.2.2.3 MGP and Non-MGP Off-Site Subsurface Soils

A total of 31 soil borings were installed in the Village of Garden City property, medical office building parking lot and within the LIRR Right of Way that border the Hempstead site to the west, south and east, respectively. The Oswego Oil Service Corp. and Mollineaux Brothers Fuel Oil Company are located east of the Hempstead site and LIRR Right of Way. These borings are designated as HISB-21 through 47, HISB-69 through 73 and HISB-76 through 79. In addition, three test pits HITP-10 through 12 were excavated in the LIRR Right of Way and former unloading pits. A total of 123 soil samples were collected at various depth intervals to delineate MGP and non-MGP off-site contaminant impacts. Soil samples were analyzed typically for BTEX, PAHs, RCRA metals and total cyanide. One soil sample HISB-72(28-30 ft-bgs) was analyzed for Target Compound List (TCL) VOCs and SVOCs. In addition, four soil samples HISB-41(26 -28 ft-bgs), HIMW-11 (16-18 ft-bgs), HISB-70 (25-27 ft-bgs) and HISB-70 (31-33 ft-bgs) were selected for petroleum fingerprint and TPH analysis.

In general, the highest off-site BTEX concentrations were observed in borings located immediately downgradient of the site (medical office parking lot) and in subsurface soils containing NAPL and/or staining at the groundwater interface. The presence of NAPL in subsurface soil at or near the groundwater interface appears to extend downgradient as far as HISB-47, located approximately 450 feet south of the site. However, BTEX concentrations at this location appear to be relatively low, with a total BTEX concentration of 1.46 mg/kg in HISB-47 (28 - 30 ft-bgs).

Metals identified in off-site subsurface soils were found to be generally within typical background concentrations, therefore are not discussed. Total cyanide analysis indicated that in 88 out of the 92 subsurface soil samples collected from off-site locations, cyanide was either not detected or found at concentrations at or below the contract required detection limit (CRDL) of 1 mg/kg.

Table 4-3 summarizes data related to subsurface soil samples collected from off-site locations which exhibited the highest total BTEX and total PAH concentrations, along with the approximate location of each sample in relation to former MGP structures/features. The table also includes PID measurements and significant field observations noted for the samples. The following is a brief summary of soil quality conditions at predetermined depth intervals.

0 to 8 Foot Interval

Visual Observations

NAPL-saturated soils in shallow off-site areas were generally not observed. However, HISB-42, located within the LIRR Right of Way and adjacent to Oswego Oil Service Corporation, indicated a thin layer of NAPL approximately 1-foot below grade **(Drawing 4A1)**.

Soil borings completed within the Village of Garden City property located to the west of the site indicated no visual impacts in soils except for one soil boring, HISB-22. Soil boring HISB-22 was located at the bottom of the Village of Garden City recharge basin and exhibited soil staining and naphthalene-like odor.

BTEX

Total BTEX concentrations ranged from not detected in multiple samples to 5.53 mg/kg in soil sample HISB-41 (6-8 ft-bgs) **(Drawing 4A2)**.

PAH

Total PAH concentrations ranged from not detected in several samples to 335.50 mg/kg in sample HISB-44 (4-6 ft-bgs) **(Drawing 4A3 and Table 4-3)**. Total CPAHs ranged from not detected in several samples to 79.60 mg/kg in soil sample HISB-43 (0-2 ft-bgs).

Total Cyanide

Total cyanide ranged from not detected to 3.1 mg/kg in sample HISB-39 (6-8 ft-bgs).

8 to 16 Foot Interval

Visual Observations

With the exception of soil boring HISB-42, visual impacts were limited to stained soils to the east at soil borings HISB-44 and well HIMW-11, to the south at soil boring HISB-37 and to the west at soil boring HISB-22. NAPL saturated soils were observed at HISB-42 **(Drawing 4B1)**

BTEX

Total BTEX concentrations ranged from not detected to 2.79 mg/kg in soil sample HISB-44 (14-16 ft-bgs) **(Drawing 4B2)**.

PAH

Total PAH concentrations ranged from not detected in several samples to 158.16 mg/kg in sample HISB-44 (14-16 ft-bgs). Total CPAHs ranged from not detected in several samples to 44.96 mg/kg in soil sample HISB-44 (14-16 ft-bgs). Off-site shallow subsurface soils to the west and south does not appear to contain PAHs at levels above 50 mg/kg, with the exception of HISB-22 (12 to 14 ft-bgs), which exhibited a total PAH concentration of 124.11 mg/kg **(Drawing 4B3 and Table 4-3)**. Soil boring HISB-22 was completed in the storm water recharge basin located immediately to the west of the site on the Village of Garden City property. HISB-44 located adjacent to the Long Island Railroad (LIRR) Right-of-Way was reported to contain a total PAH concentration of 158.16 mg/kg at 14-16 ft-bgs.

Total Cyanide

Total cyanide ranged from not detected to 1 mg/kg in sample HISB-44 (14-16 ft-bgs).

16 to 24 Foot Interval

Visual Observations

NAPL saturated soils were observed at soil boring HISB-44 and the HIMW-11 well cluster in the 16 to 24 ft-bgs depth interval **(Drawing 4C1)**. Blebs, globs, lenses, coatings and sheen was detected to the east and south at soil borings HISB-42, -70, -71 and –79. Stained soils were observed to the south and west at several soil boring locations adjacent to the site property line.

BTEX

Total BTEX concentrations ranged from non-detect in multiple samples to 177.6 mg/kg in soil sample HISB-37 (18-20 ft-bgs) **(Drawing 4C2)** . Soil boring HISB-37 located in the medical office building parking lot was reported to contain a total BTEX concentration of 177.6 mg/kg. This sample was collected from stained soils at 18-20 ft-bgs.

PAH

Total PAH concentrations ranged from not detected in several samples to 1,155.2 mg/kg in sample HISB-21 (22-24 ft-bgs). Total CPAHs ranged from not detected in several samples to 85 mg/kg in soil sample HISB-21 (22-24 ft-bgs). Off-site subsurface soil to the west of the site was reported to contain a total PAH of 1,155 mg/kg in subsurface soil sample HISB-21 (22-24 ft-bgs) **(Drawing 4C3)**. Soil borings HISB-42 (16-18 ft-bgs) and HISB-41 (18-20 ft-bgs) located to the east of the site adjacent to the Oswego Oil Service Corporation site were reported to contain total PAH concentrations of 232 mg/kg and 296.66 mg/kg, respectively. Soil samples HISB-37 and –71 contained total PAH concentrations of 497.31 and 347.2 mg/kg, respectively.

Total Cyanide

Total cyanide ranged from not detected in multiple samples to 0.29 mg/kg in sample HISB-21 (22-24 ft-bgs).

24 to 34 Foot Interval

Total BTEX and PAH concentrations in off-site subsurface soil are elevated in the 24-34 ft-bgs depth interval.

Visual Observations

Soil samples recovered from soil borings HISB-40, -41, -42, -44, -79 and HIMW-10D and -11D are located in close proximity to Oswego Oil Service Corp., and exhibited NAPL at saturated levels at or near the water table. However, this material exhibited a distinct petroleum-like odor, suggesting that the NAPL detected at these locations may be attributed to releases of petroleum products, such as diesel fuel or fuel oil **(Drawing 4D1)**. NAPL-saturated soils were also observed south (downgradient) of the site beneath the medical office building parking lot. These NAPL-saturated soils exhibited hydrocarbon and naphthalene-like odors.

Drawing 4H indicates that off-site NAPL migration within the intermediate soil zone extends downgradient of the site, where NAPL was observed at saturated levels in HISB-47, located approximately 450 feet downgradient of the site boundary.

In other off-site areas, NAPL-saturated soil was not encountered within the intermediate soil zone in off-site borings completed to the west and southwest of the site, soil staining and/or odors were observed at or near the water table, at soil borings HISB-21, HISB-22, HISB-24 and HISB-27 **(Drawing 4D1)**.

BTEX

Total BTEX concentrations ranged from not detected at multiple samples to 3,080 mg/kg in soil sample HISB-37 (28-30 ft-bgs). Total BTEX concentrations were detected in locations to the south in the medical office building parking lot and east along the LLIR Right of Way **(Drawing 4D2)**. The soil boring locations to the south include HISB-36 (28-30 ft-bgs), HISB-37 (28-30 ft-bgs), HISB-39 (28-29 ft-bgs), HISB-40 (32-34 ft-bgs), HISB-71 (31-32 ft-bgs), HISB-72 (28-30 ft-bgs) and HISB-73 (27-29 ft-bgs), which exhibited total BTEX concentrations of 53 mg/kg, 3,080 mg/kg, 168 mg/kg, 73 mg/kg, 1,470 mg/kg, 1,283 mg/kg and 771 mg/kg, respectively. Soil samples HISB-42 (24-26 ft-bgs) and HISB-79 (28-32 ft-bgs) exhibited total BTEX levels of 97 and 210 mg/kg, respectively.

PAH

Total PAHs concentrations ranged from not detected in several samples to 15,688 mg/kg in sample HISB-37 (28-30 ft-bgs). Total CPAHs ranged from not detected in several samples to 1,185 mg/kg in soil sample HISB-37 (28 to 30 ft-bgs). Total PAH concentrations were detected to the east, west and most notably to the south (downgradient) of the site. Total PAH concentrations to the east were on the order of 100s at HISB-41, -42, -44 and –79 **(Drawing 4D3)**. To the west, total PAH concentrations at soil borings HISB-62 and HISB-62A were 2,361 and 2,430 mg/kg, respectively.

Total PAHs were detected at 10 of the 13 soil borings located south of the site with concentrations ranging from the 100s to 10,000s mg/kg. The potential source of these total PAH concentrations is the NAPL former MGP structures located near the southern property line.

Total Cyanide

Total cyanide ranged from not detected in multiple samples to 3.9 mg/kg in sample HISB-45 (28-30 ft-bgs).

Greater Than 34 Foot Interval

Total BTEX and PAH concentrations generally decrease rapidly below the depth of 34 ft-bgs.

Visual Observations

Soils exhibiting staining and/or naphthalene/hydrocarbon-like odors were observed west of the former drainage sump and drip oil tanks at soil borings HISB-21, HISB-24, HISB-26, HISB-27 and HISB-28 **(Drawing 4E1)**. More staining was observed to the south (downgradient) at HISB-36 through HISB-39. To the east in close proximity to Oswego Oil Service Corporation, NAPL-saturated soils were detected at HISB-40, -41, -78 and –79; and blebs, globs, coatings and/or sheens at soil boring HISB-42 and well HIMW-11D.

BTEX

Off-site subsurface soil samples exhibit relatively low BTEX concentrations below a depth of 34 ft-bgs, with total BTEX concentrations not exceeding 0.66 mg/kg. **(Drawing 4E2)**.

PAHs

Total PAH concentrations ranged from not detected in multiple samples to 848.5 mg/kg in sample HISB-21 (42-44 ft-bgs) **(Drawing 4E3)**. Soil sample HISB-41(34-36 ft-bgs) exhibited the only other total PAH concentration (222.65 mg/kg) above 50 mg/kg. Total CPAHs ranged from not detected in multiple samples to 155 mg/kg in soil sample HISB-21.

TABLE 4-3

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

OFF-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-21 (22-24')	13	1,155	Directly north of Recharge Basin west of site boundary.	146	Staining, naphthalene-like odor
HISB-21 (42-44')	0	849	Directly north of Recharge Basin west of site boundary.	44	Staining, naphthalene-like odor
HISB-36 (28-30')	53	4,685	On the corner of Intersection Street and Wendell Street downgradient of Storage Holder.	2000+	Intermittant black NAPL saturation, strong hydrocarbon-like odor
HISB-37 (18-20')	178	497	Within central portion of parking lot between Intersection Street, Wendell Street, and Inactive L.I.R.R. Right Of Way. Downgradient of Relief Holder.	2000+	Brown staining, strong hydrocarbon-like odor
HISB-37 (28-30')	3,080	15,688	Within central portion of parking lot between Intersection Street, Wendell Street, and Inactive L.I.R.R. Right Of Way. Downgradient of Relief Holder.	2000+	Saturated w/NAPL, sheen, strong hydrocarbon-like odor
HISB-39 (28-29')	168	679	Within parking lot between Intersection Street, Wendell Street, and Inactive L.I.R.R. Right Of Way. Nearer to Inactive L.I.R.R. Right Of Way. Downgradient of Gas Oil Tank.	2000+	Strong naphthalene-like odor
HISB-40 (32-34')	73	2,767	Within the intersection of Intersection Street and Inactive L.I.R.R. Right Of Way downgradient of Gas Generator House.	615	Saturated w/NAPL, coal tar staining, strong naphthalene/hydrocarbon-like odor
HISB-42 (24-26')	97	873	Within Inactive L.I.R.R. Right Of Way northeast of Gas Generator House and downgradient of Boiler Room.	1,610	Intermittant zones of heavy staining and sheen, petroleum-like odor
HISB-44 (24-26')	0	962	Within Inactive L.I.R.R. Right Of Way east of Boiler Room and just outside eastern site boundary. Downgradient of Coal Storage Area.	685	Saturated w/NAPL and staining from 25-26', strong naphthalene-like odor
HISB-47 (28-30')	1	932	Within Inactive L.I.R.R. Right Of Way downgradient of the intersection of Wendell Street and Inactive L.I.R.R. Right Of Way.	247	Black banding, staining, naphthalene like odor

TABLE 4-3 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

OFF-SITE SUBSURFACE SOIL SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Boring and Sample Depth in ft. bgs)	Total BTEX Concentration (mg/kg)	Total PAH Concentration (mg/kg)	Location (in Relation to Former MGP Structure and/or Site)	PID (PPM)	Field Description of Recovered Sample
HISB-70 (25-27')	18	67	Within Inactive L.I.R.R. Right of Way between Medical Office Building Parking Lot and Mollineaux Brothers Fuel Oil Company	199	Moderate Naphthalene/Fuel-Like Odor
HISB-70 (31-33')	19	43	Within Inactive L.I.R.R. Right of Way between Medical Office Building Parking Lot and Mollineaux Brothers Fuel Oil Company	199	Heavily Coated with Reddish Orange Staining and a Moderate Fuel-Like Odor
HISB-71 (19-20')	10	347	South Side of Medical Office Building Parking Lot	275	NAPL Staining with a Moderate Naphthalene-Like Odor
HISB-71 (31-32')	1,470	3,720	South Side of Medical Office Building Parking Lot	1,647	Staining and NAPL Saturation with Blebs and a Strong Naphthalene-Like Odor
HISB-72 (26-28')	726	617	East Side of Medical Office Building Parking Lot	1,071	Sheen and a Strong Naphthalene-Like Odor
HISB-72 (28-30')	1,283	1,037	East Side of Medical Office Building Parking Lot	1,247	Staining and Tar-Like Substance Bands of Saturation
HISB-73 (27-29')	771	1,468	South of HISB-71 within the Grass Median of the Medical Office Building Parking Lot	64	Heavily Coated and Dark Brown Banding with MGP/Fuel-Like Odor

Total Cyanide

Total cyanide ranged from not detected to 0.28 mg/kg in sample HISB-24 (47 to 49 feet).

4.2.3 Petroleum Fingerprint and TPHs

Off-site subsurface soil samples HISB-41 (26-28 ft-bgs) and HIMW-11 (16-18 ft-bgs) were selected for petroleum fingerprint/total petroleum hydrocarbon (TPH) analysis due to the fact that soil at these locations exhibited a distinct petroleum-like (non-MGP) odor from approximately 4 to 32 ft-bgs. Monitoring well cluster HIMW-11 was installed immediately adjacent to the western property line of the Oswego Oil Service Corp., and soil probe HISB-41 was located immediately downgradient of this facility. As discussed in **Section 2.5**, Oswego Oil Service Corp. is a fuel oil storage facility and is currently listed as an active NYSDEC petroleum spill site. TPH results ranged from 7,200 mg/kg in HISB-41 (26-28 ft-bgs) to 8,500 mg/kg in HIMW-11 (16-18 ft-bgs). The petroleum fingerprint analysis indicated both samples were most characteristic of diesel fuel.

Off-site subsurface soil samples HISB-70 (25-27 ft-bgs) and HISB-70 (31-33 ft-bgs) were selected for petroleum fingerprint analysis due to the fact that soil at these locations exhibited a distinct petroleum-like odor. Soil Boring HISB-70 was installed in the LIRR Right-of-Way immediately adjacent to the former Mollineaux Brothers Fuel Company. As discussed in **Section 2.5**, Mollineaux Brothers Fuel Company is a former fuel oil storage facility. The petroleum fingerprint analysis indicated both samples were most characteristic of a mixture of gasoline and blended products. The concentration and ratio of PAHs in both samples also indicate that they contain tar from relatively low temperature processes and the variations in the PAH ratios indicate that the fuels and MGP tars are from separate sources.

4.3 Summary of Groundwater Quality Conditions

The following section presents NAPL and groundwater data collected as part of the March 2003 RI Report and the Supplemental RI Field Program, as well as the investigations conducted prior to the implementation of the Remedial Investigations. The purpose of this section is to provide the results of on- and off-site NAPL monitoring, and delineation of the on- and off-site groundwater impacts. In addition, the results of private potable well sampling are provided.

4.3.1 On-Site and Off-Site NAPL Monitoring

DNAPL and LNAPL were encountered in several of the on-site and off-site monitoring wells (**Table 4-4**). Light Non-Aqueous Phase Liquid (LNAPL) thicknesses were measured during groundwater sampling events beginning December 3, 2001 at the following wells; HIMW-01S, HIMW-06S, HIMW-07S, HIMW-10S, HIMW-11S, HIMW-16S, HIMW-16I, HIMW-17S and HIMW-19S.

The LNAPL encountered in these wells has been discontinuous since the initial reading in December 2001, with the exception of HIMW-11S. HIMW-11S has shown a continual presence of LNAPL on the water table. This well is located in the LIRR Right-of-Way adjacent to the Oswego Oil Service Corporation and has a strong petroleum-like odor and yellowish color.

Dense Non-Aqueous Phase Liquid (DNAPL) has been detected in the following wells: HIMW-01S, HIMW-06S, HIMW-07S, HIMW-16S, HIMW-16I, HIMW-17S, HIMW-18S and HIMW-19S. These wells are located in the areas of the former drainage sump (HIMW –19S), drip oil tanks (HIMW-01S), between the former drip oil tanks and main holder (HIMW-18S), former main storage holder (HIMW-06S), the gas oil tank (HIMW-07S), and medical office building parking lot (HIMW-16S, HIMW-16I and HIMW-17S). DNAPL has been measured periodically since the initial measurements in December 2001 as a viscous distinct layer or an emulsion of water and DNAPL ranging in thickness from 1 inch to 8 feet. The presence of DNAPL is intermittent at monitoring wells HIMW-16S, HIMW-16I, HIMW-17S, HIMW-18S and HIMW-19S. A continual presence of DNAPL is found in wells HIMW-01S, HIMW-06S and HIMW-07S.

Based on the field observations, it appears the DNAPL has migrated from the former MGP structures vertically downward through the sands and gravels in the upper glacial sediments (0 to 30 ft-bgs) to the water table. At the water table, it generally appears that the DNAPL migration has become more horizontal following the slope of the water table in a southerly direction. Soils encountered at the water table consist of glacial sediments containing a greater percentage of gravel, which may facilitate the horizontal migration and distribution of the DNAPL. Also, the soils below the water table are in many cases, noted to be denser than those above the water table, which may also inhibit further vertical migration.

The well locations exhibiting the presence of DNAPL corresponds with the presence of NAPL saturated soils and elevated dissolved phase BTEX and PAH concentrations. **Drawing 4J** graphically depicts well locations, former MGP structures and the distribution of the DNAPL measured in December 2003.

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-01S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
12/3/2001	0	2.3'	N/A	N/A	
7/16/2002	0	8'	N/A	N/A	
8/27/2002	0	5.4'	1	0	
9/6/2002	0	0	N/A	N/A	
10/25/2002	0	0	N/A	N/A	
1/7/2003	0	1.5' (tape) 1.5' (bailer)	0.5	1.12' @ (1/8/03)	
4/10/2003	0	5.75'	1.5	0.75'	
5/22/2003	0	4.1'	0.75	4.83' @ (5/23/03)	
11/12/2003	0.3'	7.97'	Not Performed	Not Performed	
12/10/2003	0.28'	3.77'	Not Performed	Not Performed	
12/18/2003	0.16'	1.5'	3.5	Not Performed	
12/19/2003	0.16'	2.49'	Not Performed	Not Performed	
1/2/2004	4.3'	6'	Not Performed	Not Performed	
03/17/04	0.16'	7.5'	Not Performed	Not Performed	LNAPL located at the top of water ~ 2" thick, Light reddish brown in color, free flowing 7.5' of staining on string, possibly due to passing through LNAPL

Notes:
1. Measurements of NAPL collected utilizing string and interface probe.
2. Measurements for HIMW-01S are approximate as the presence on the LNAPL caused interference with both the string and Interface Probe.
3. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-06S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
12/18/2001	0	4'	N/A	N/A	
7/16/2002	0.5'	3.3'	N/A	N/A	
8/27/2002	0	2.3'	1.5	0	
9/6/2002	0	3'	0.5	0	
10/25/2002	0	1.5'	1	1'	
1/7/2003	0	2.6' (tape) 3.0' (bailer)	3	2.6' @ (1/8/03)	
4/10/2003	0	1.25'	0.5	1.45' (~6 hrs. later)	
5/22/2003	0	2.1'	0.5	3.52' @ (5/23/03)	
11/12/2003	0	1.8'	Not Performed	Not Performed	
12/18/2003	0	1.5'/1.91'	2.5	Not Performed	
12/19/2003	0	1.25'/1.08'	Not Performed	Not Performed	
1/2/2004	0	1.67'	Not Performed	Not Performed	
03/17/04	0	48 (6"/27" zones)	Not Performed	Not Performed	48" total length, two zones a 6" light coating reddish brown colored zone at top, 15" clean zone, and a 27" reddish brown coating at bottom, low viscosity

Notes:
1. Measurements of NAPL collected utilizing string and interface probe.
2. Measurements for HIMW-06S are approximate as the presence on the LNAPL caused interference with both the string and Interface Probe.
3. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-07S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
7/17/2002	0	1.3'	0	N/A	
8/27/2002	0	2.8' (tape)	0.5	0	
9/6/2002	0	0	0	N/A	
10/25/2002	0	0	0	N/A	
1/8/2003	0	1/2" (tape) 1/2" (bailer)	0.1	1/4"	
4/10/2003	0	1/8"	0	N/A	
5/22/2003	0	1"	0	1" @ (5/23/03)	
11/12/2003	0	2.8'	Not Performed	Not Performed	
12/18/2003	0	3'	2.75	N/A	
12/19/2003	0	0.91'	Not Performed	N/A	
1/2/2004	0	2.71'	Not Performed	N/A	
03/17/04	33"	N/A	N/S	N/A	Reddish brown colored material, low viscosity

Notes:
1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-10S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
12/3/2001	0.19'	0	0	N/A	
7/16/2002	0.01'	0	0	N/A	
8/27/2002	0.43'	0	0	N/A	
9/6/2002	0.23'	0	0	N/A	
10/25/2002	0	0	0.5	0.02'	
1/7/2003	0	0	0	0 @ (1/8/03)	
4/10/2003	0	0	0	0 @ (~2 hrs later)	
5/22/2003	0	0	0	0 @ (5/23/03)	
11/21/2003	0	0	0	0	
12/18/2003	0	0	0	*	
12/19/2003	0	0	0	*	
1/2/2004	0	0	0	*	Reddish brown colored material, low viscosity
03/17/04	0	0	0	0	No Product

Notes:
1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available
3. * = No measurements were taken at this time.

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-11S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
12/2/2001	0.8'	0	N/A	N/A	
7/16/2002	0.15'	0	N/A	N/A	
8/27/2002	1.9'	0	1.5	0.1'	
9/6/2002	1.08'	0	0.5	0.1'	
10/25/2002	0.96'	0	1.5	0.02'	
1/7/2003	0.69'	0	0.25	0.3' @ (1/8/03)	
4/10/2003	0.23'	0	0.05	0.18' @ ~4.5 hrs later)	
5/22/2003	0.22'	0	0.025	0.18' @ (5/23/03)	
11/17/2003	0	0	0	0	
03/17/04	15"	0	0	0	Material yellowish in color, strong diesel like odor

Notes:
1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-16I

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
12/3/2001	N/A	N/A	N/A	N/A	
7/16/2002	N/A	N/A	N/A	N/A	
8/27/2002	N/A	N/A	N/A	N/A	
9/6/2002	N/A	N/A	N/A	N/A	
10/25/2002	N/A	N/A	N/A	N/A	
1/7/2003	N/A	N/A	N/A	N/A	
4/10/2003	N/A	N/A	N/A	N/A	
5/22/2003	N/A	N/A	N/A	N/A	
11/19/2003	0	3.3'	Not Performed	Not Performed	
12/10/2003	0	5.3'	Not Performed	Not Performed	
03/17/04	0	0	Not Performed	Not Performed	No Product

Notes:
1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-16S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
12/3/2001	N/A	N/A	N/A	N/A	
7/16/2002	N/A	N/A	N/A	N/A	
8/27/2002	N/A	N/A	N/A	N/A	
9/6/2002	N/A	N/A	N/A	N/A	
10/25/2002	N/A	N/A	N/A	N/A	
1/7/2003	N/A	N/A	N/A	N/A	
4/10/2003	N/A	N/A	N/A	N/A	
5/22/2003	N/A	N/A	N/A	N/A	
11/19/2003	0	4.25'	Not Performed	Not Performed	
12/10/2003	0	4.25'	Not Performed	N/A	
03/17/04	2.54" top 47" bottom	0	Not Performed	Not Performed	Low visciousity, dark black in color

Notes:
1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-17S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
11/19/2003	0	0	Not Performed	Not Performed	
12/10/2003	0	5.75'	Not Performed	Not Performed	
03/17/04	29"	0	Not Performed	Not Performed	Low visciousity, dark black in color

Notes:

1. Measurements of NAPL collected utilizing string and interface probe.

2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-18S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
11/20/2003	0	7.2'	Not Performed	Not Performed	
12/10/2003	0	1.15'	Not Performed	Not Performed	
03/17/04	0	0	Not Performed	Not Performed	Bottom emulsion of reddish brown blebs and water, low visciousity, MGP like odor

Notes:

1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-18I

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
11/20/2003	0	0	0	0	
12/10/2003	0	0	Not Performed	Not Performed	
03/17/04	0	0	Not Performed	Not Performed	No Product

Notes:

1. Measurements of NAPL collected utilizing string and interface probe.

2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-19S

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
11/20/2003	0	3.9'	Not Performed	Not Performed	
12/10/2003	0	0.41'	Not Performed	Not Performed	
03/17/04	0	13"	Not Performed	Not Performed	Reddish brown color, low visciousity

Notes:

1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available

TABLE 4-4
NAPL MEASUREMENT SUMMARY
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE
HIMW-19I

DATE	LNAPL MEASURED	DNAPL MEASURED (Pre-Bailing)	AMOUNT OF DNAPL REMOVED (gal.)	DNAPL MEASURED (Post-Bailing)	COMMENTS
11/20/2003	0	12.85'	Not Performed	Not Performed	
12/10/2003	0	6.44'	Not Performed	Not Performed	
03/17/04	0	0	Not Performed	Not Performed	No Product

Notes:

1. Measurements of NAPL collected utilizing string and interface probe.
2. N/A : Not Available

4.3.2 <u>Summary of Dissolved Phase Constituents in Groundwater</u>

Groundwater quality was characterized through the collection and analysis of groundwater samples from monitoring wells and groundwater probes. The majority of monitoring wells were located and constructed based on the results of the groundwater probe sampling. All monitoring wells were sampled in late Fall 2001. An additional round of groundwater sampling from select wells, was conducted in November 2003 during the Supplemental Remedial Investigation Field Program.

BTEX and PAH results for groundwater samples collected from monitoring wells are summarized in **Table E-21, Table E-22**, **Table E-37** and **Table E-38** included in **Appendix G**. RCRA metals, iron, manganese and total cyanide results are presented in **Table E-23** included in **Appendix G**, and free cyanide results are summarized in **Table E-24** included in **Appendix G**. Petroleum fingerprint and total petroleum hydrocarbons (TPHs) analytical results are presented in **Table E-25** included in **Appendix G**. The groundwater probe samples analyzed for BTEX and PAHs are presented in **Table E-26**, **Table E-27, Table E-40** and **Table E-41** included in **Appendix G**. BTEX and PAH analytical results along with specific geochemical parameter analytical results from the Supplemental Remedial Investigation Field Program are summarized in **Tables E-37** through **E-41** included in **Appendix G**.

The RCRA metals detected in on-site groundwater were generally within concentration ranges of upgradient or background water quality for the Upper Glacial aquifer and therefore are not discussed in the proceeding discussion. Total cyanide concentrations in the majority of groundwater samples collected on-site were either not detected or found at or below the CRDL of 20 ug/l and therefore are not discussed in the proceeding discussion.

Based on the hydrogeologic setting of the site, the groundwater chemical data has been grouped into three hydrogeologic zones including:

<u>Shallow Groundwater</u>

For the purpose of this investigation, the shallow groundwater zone is considered to be groundwater encountered from the water table to a depth of 48 ft-bgs. Monitoring wells screened at this depth interval are designated with the letter “S”.

<u>Intermediate Groundwater</u>

The intermediate groundwater zone is considered to be groundwater encountered at a depth of 48 to 95 ft-bgs. Monitoring wells screened at this depth interval are designated with the letter “I”.

Deep Groundwater

The deep groundwater zone is considered to be groundwater encountered below a depth of 95 ft-bgs, but above the top of the Lower Magothy subunit found between 118 and 270 ft-bgs as described in **Section 3.4**. Monitoring wells screened at this depth interval are designated with the letter "D".

4.3.2.1 On-Site Groundwater Quality Results

On-site groundwater quality was characterized through the collection and analysis of groundwater samples from 21 existing monitoring wells and piezometers and 25 groundwater probes **(Table 2-1)**.

Table 4-3 summarizes the results of on-site groundwater samples and approximate locations of these samples in relation to former MGP structures. In general, on-site groundwater data collected in the northern and central portions of the site indicated non-detectable concentrations of total BTEX and total PAHs. As indicated in **Table 4-5**, the highest on-site total BTEX concentrations were observed in shallow groundwater samples collected within and downgradient (south) of former MGP structures, consistent with intervals of observed NAPL-saturated/stained soils and elevated levels of BTEX detected in subsurface soils. **Drawings 4K1** through **4M2** depict total BTEX and total PAH concentrations in groundwater collected from on-site and immediately adjacent off-site sample locations.

Shallow Groundwater

The highest total BTEX, total PAH and total CPAH concentrations in shallow groundwater were detected in the general vicinity of the former MGP structures in the southwestern corner and southern property line of the site.

BTEX

Total BTEX concentrations ranged from not detected in several samples to 105,620 ug/l in groundwater sample HIGP-31 (29-33 ft-bgs). The highest total BTEX concentrations (10,000 to 100,000 ug/l) were encountered in probes HIGP-31SI through HIGP-34SI and wells HIMW-06S and 07S **(Drawing 4K1 and Table 4-5)**. Total BTEX concentrations decrease gradually from 100,000 ug/l in the southwestern corner of the site, to 1,000s ug/l at a distance of 200 feet upgradient (to the northeast). Total BTEX concentrations in the northern and central portions of the site are not detected or less than 50 ug/l.

PAHs

Total PAH concentrations of in the shallow groundwater interval ranged from not detected in several samples to 10,518,000 ug/l in sample HIMW-06S (25.5-35.5 ft-bgs). The highest total PAH concentration detected in HIMW-06S is not representative of dissolved phase concentrations in groundwater, rather representative of an emulsion of DNAPL and water contained in the well. Total CPAHs ranged from not detected in several samples to 1,305,000 ug/l in groundwater sample HIMW-06S (25.5-35.5 ft-bgs). The higher total PAH concentrations (greater than 10,000 ug/l) were detected in the vicinity of the former MGP structures as indicated at probes HIGP-7SI, -14SI, -16SI, -18SI, -29SI through –34SI and wells HIMW-1S, -6I, -18SI and –19SI **(Drawing 4K2 and Table 4-5)**. Groundwater probes located up- and side-gradient of the former MGP structures (HIGP-7SI, -8SI, -17SI, -30SI and –80 exhibit total PAH level greater than 1,000 and less than 10,000 ug/l. Total PAH concentrations in the northern and central portion of the site were not detected or below 50 ug/l.

Total Cyanide

Total cyanide ranged from not detected in several samples to 3,030 ug/l in sample HIMW-01S (26-36 ft-bgs).

Intermediate Groundwater

The analytical results indicate that the elevated concentrations of total BTEX, total PAHs and total CPAHs obtained from the on-site intermediate groundwater zone were from probes and monitoring wells positioned at former MGP structures at the western edge of the site.

BTEX

Total BTEX concentrations ranged from not detected in several samples to 1,338 ug/l in groundwater sample HIMW-18I (55-70 ft-bgs). Total BTEX concentrations were confined to the western portion of the site. Total BTEX concentrations ranged from 100s ug/l at probes HIGP-14SI and –31SI, and wells HIMW-6 and –11 **(Drawing 4L1)**. Well HIMW-18I exhibited the highest total BTEX concentration of 1,338 ug/l. Total BTEX concentrations in the remaining portions of the site were not detected or below 50 ug/l.

PAHs

Total PAH concentrations in the intermediate groundwater interval ranged from not detected in several samples to 3,008 ug/l in sample HIMW-18I (55-70 ft-bgs). Total CPAHs ranged from not detected in several samples to 105 ug/l in groundwater sample HIGP-07 (56 to 60 ft-bgs). Elevated total PAH concentrations (ranging from 100s to 1,000s ug/l) were detected along the western edge of the site at groundwater probes HIGP-7SI, -14SI and –31SI; and wells HIMW-6I and –1I **(Drawing 4L2)**. Total PAH concentrations were detected also in the south-central portion of the site exhibiting concentrations of 10s to 100s ug/l at probes HIGP-15SI, -29SI and -34SI. The remaining area of the site exhibited not detections or levels below 50 ug/l.

Total Cyanide

Total cyanide was reported as not detected in all of the groundwater samples collected from this interval.

Deep Groundwater

On-site chemical constituent concentrations decrease significantly from those chemical constituent concentrations encountered in the shallow and intermediate groundwater zone. The analytical results indicate that the highest concentrations of total BTEX, total PAHs and total CPAHs obtained from the on-site deep groundwater zone were from probes and monitoring wells in the general vicinity of the former MGP structures, specifically the Main Storage Holder.

BTEX

Total BTEX concentrations ranged from not detected in several samples to 385 ug/l in groundwater sample HIMW-06D (106 to 116 ft-bgs). Total BTEX concentrations of 132 and 385 ug/l were detected in wells HIMW-01D and –06D **(Drawing 4M1)**.

PAHs

Total PAH concentrations in the deep groundwater interval ranged from not detected in all samples except sample HIMW-06D (106 to 116 ft-bgs) at a concentration of 1,053 ug/l **(Drawing 4M2)**. Total CPAHs ranged from not detected in several samples to 6 ug/l in groundwater sample HIMW-06D (106 to 116 ft-bgs).

Total Cyanide

Total cyanide ranged from not detected in several samples to 10.8 ug/l in sample HIMW-06D (106 to 116 ft-bgs).

TABLE 4-5

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth in ft. bgs)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
HIGP-07 (30-34')	23,940	695,100	Downgradient of Drainage Sump in northwest portion of site.	Saturated w/NAPL, sheen, naphthalene-like odor
HIGP-07 (56-60')	0	1,101	Downgradient of Drainage Sump in northwest portion of site.	Slight sheen, slight naphthalene-like odor
HIGP-08 (30-34')	183	3,792	Within the Drainage Sump in northwest portion of site.	Slight naphthalene-like odor
HIGP-12 (30-34')	15,620	7,933	Downgradient of Drainage Sump.	Slight sheen, naphthalene-like odor
HIGP-14 (30-34')	14,980	17,178	Within Drip Oil Tanks in western portion of site. Downgradient of Drainage Sump.	Sheen, oil blebs, odor
HIGP-14 (56-60')	255	1,640	Within Drip Oil Tanks in western portion of site. Downgradient of Drainage Sump.	Slight sheen, odor
HIGP-15 (30-34')	1,750	14,838	Within Tar Separator in southern/central portion of site.	Sheen, odor
HIGP-16 (30-34')	13,020	292,620	In vicininty of Tar Extractors and Oxide Purifier Boxes in southern portion of site. Downgradient of Tar Separator and Cesspool.	Saturated w/NAPL, sheen, odor
HIGP-17 (30-34')	1,522	1,300	In vicinity of Oil Tanks.	Sheen, naphthalene-like odor
HIGP-18 (30-34')	12,600	87,435	In vicinity of Oxide Purifier Boxes in southern portion of site.	Sheen, odor

TABLE 4-5 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth in ft. bgs)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
HIGP-29 (30-34')	17,390	46,260	In vicinity of Oxide Purifier Boxes in southernmost portion of the site.	NAPL blebs, sheen, naphthalene-like odor
HIGP-30 (32-36')	2,610	689,500	In southernmost portion of site. Downgradient of Gas Generator Room.	NAPL blebs, sheen, strong naphthalene-like odor
HIGP-31 (29-33')	105,620	36,279	In vicinity of Skimming Basin in southernmost portion of the site. Downgradient of main Storage Holder.	Floating NAPL, sheen, strong naphthalene-like odor
HIGP-32 (30-34')	63,800	199,200	In vicinity of main Storage Holder in southernmost portion of the site. Downgradient of Relief Holder.	Oil blebs, sheen, naphthalene-like odor
HIGP-33 (30-34')	29,750	43,680	In southernmost portion of the site, through Relief Holder. Downgradient of Oxide Purifier Boxes.	Oil blebs, heavy sheen, strong naphthalene-like odor
HIGP-34 (30-34')	20,900	65,994	In southernmost portion of the site, through Gas Oil Tank. Downgradient of Compressor Room.	Floating NAPL, sheen, strong naphthalene-like odor
HIGP-35 (30-34')	6,590	8,320	In site Access Road, in vicinity of Pump house. Downgradient of Compressor Room.	Sheen, naphthalene-like odor
HIGP-80 (36-40)	1,045	570	Eastern Property Boundary at Gas Generator House	Sheen, Petroleum-Like Odor
HIGP-82 (32-36)	3,355	15,280	Eastern Property Boundary in L.I.R.R. Right-of-Way	Sheen, Petroleum-Like Odor
HIGP-82 (36-40)	2,675	2,700	Eastern Property Boundary in L.I.R.R. Right-of-Way	NAPL, Petroleum-Like Odor

TABLE 4-5 (continued)
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

ON-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth in ft. bgs)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
HIMW-01S (26-36')	13,800	209,980	Within Drip Oil Tanks in western portion of site. Downgradient of Natural Gas Regulator System and Drainage Sump.	Tar blebs, strong hydrocarbon-like odor
HIMW-01I (74-84')	139	1,706	Within Drip Oil Tanks in western portion of site. Downgradient of Drainage Sump.	None
HIMW-06S (25.5-35.5')	103,000	10,518,000	In vicinity of Storage Holder and Effluent Water Treatment Equipment in southernmost portion of the site. Downgradient of Storage Holder.	4' of DNAPL
HIMW-06I (72-82')	98	560	In vicinity of Storage Holder and Effluent Water Treatment Equipment in southernmost portion of the site. Downgradient of Storage Holder.	None
HIMW-06D (106-116')	385	1,053	In vicinity of Storage Holder and Effluent Water Treatment Equipment in southernmost portion of the site. Downgradient of Storage Holder.	None
HIMW-07S (29-39')	10,300	8,053	In southernmost portion of the site, within Gas Oil Tank. Downgradient of Compressor Room.	Measurable DNAPL layer identified
HIMW-18I (55-70')	1,338	3,008	South of Drip Oil Tanks	Fuel-Like Odor
PZ-08	8,010	NA	In vicinity of Tar Separator and Oxide Purifier Boxes in southern portion of site. Downgradient of Tar Separator and Cesspool.	Saturated w/NAPL, tar blebs, hydrocarbon-like odor

Note:
NA: Not Analyzed.

Petroleum Fingerprint and TPHs

DNAPL samples were collected from monitoring wells HIMW-01S, HIMW-06S and HIMW-07S for petroleum fingerprint/TPH analysis. The results of the analyses are presented on **Table E-25** included in **Appendix G**. TPH was detected at concentrations of 330,000 mg/l, 540,000 mg/l and 770,000 mg/l in HIMW-01S, HIMW-06S and HIMW-07S, respectively. Note that based on further inspection of DNAPL recovered from these wells, the material actually consists of a DNAPL/water mixture or emulsion and is not pure DNAPL. All DNAPL samples collected from the wells were found to be characteristic of MGP tar.

4.3.2.2 Off-Site Groundwater Quality Results

As discussed in **Section 2.2.4** and **2.2.6**, off-site groundwater quality was characterized through the collection and analysis of groundwater samples obtained from 58 groundwater probes, 3 temporary monitoring wells, and 35 groundwater monitoring wells.

Table 4-6 summarizes off-site groundwater samples that exhibited the highest total BTEX and total PAH concentrations along with the approximate locations of these samples in relation to former MGP structures/features. As indicated in **Table 4-6**, the highest total BTEX concentrations were observed in shallow groundwater samples collected downgradient (south) of the site in the medical office building parking lot. **Drawings 4K1** through **4M2** depict total BTEX and total PAH concentrations in groundwater collected from on-site and immediately adjacent off-site sample locations.

Shallow Groundwater

The highest total BTEX, total PAH and total CPAH concentrations in groundwater are centered around probe locations HIGP-36SI and 37SI and shallow well HIMW-16S, all located south of the southern property line in the medical office building parking lot. Two off-site locations within the LLIR Right of Way to the east exhibit both elevated total BTEX and total PAH concentrations. To the west, total BTEX and total PAH concentrations on the order of 1,000s ug/l extend slightly beyond the western property line.

BTEX

Total BTEX concentrations ranged from not detected in several samples to 76,000 ug/l in groundwater sample HIGP-37 (29-33 ft-bgs). This sample was collected from NAPL saturated conditions at the water table. The highest total BTEX concentrations (greater than 10,000 ug/l were exhibited by groundwater probes HIGP-36SI through –38SI and –81 south (downgradient) of the site **(Drawing 4K1)**. Groundwater probes and wells located down- and side-gradient of the highest off-site total BTEX exhibit concentrations in the 1,000s ug/l range.

Two locations east of the site exhibited elevated total BTEX concentrations, the first location involves groundwater probes HIGP-41SID, -42SI, -82 and HIMW-11S and total BTEX concentrations ranging from 100s to 10,000 ug/l; and the second location involving probes HIGP-44SI and –45SI with concentrations ranging from 100s to 10,000 ug/l/ Off-site impacts to the west involve probes HIGP-21SI and –27SI at total BTEX concentrations ranging in the 1,000s ug/l.

PAHs

Total PAH concentrations in the shallow groundwater interval ranged from not detected in several samples to 2,497,700 ug/l in sample HIGP-36 (29-33 ft-bgs). The highest total PAH concentration detected in HIGP-36 is not representative of dissolved phase concentration in groundwater, rather representative of a DNAPL/water emulsion contained in the well. Total CPAHs ranged from not detected in several samples to 200,200 ug/l in groundwater sample HIGP-36 (29 to 33 ft-bgs). Similar to the total BTEX distribution, off-site total PAH concentrations were elevated to the east, west and most notably to the south. The highest PAH concentrations (greater than 100,000 ug/l) were detected south of the site (beneath the medical office building parking lot) at groundwater probes HIGP-36SI and –37SI **(Drawing 4K2)**. Groundwater wells HIMW-16S and –17S positioned in the vicinity of HIGP-36SI and –37SI indicate the presence of NAPL. Groundwater probes and wells located downgradient of the highest PAHs exhibit concentrations in the 1,000s ug/l.

East of the site, one location involving probes HIGP-41SID, HIGP–42SI and HIGP-82; and well HIMW-11S exhibit total PAH concentrations ranging from 1,000 to 10,000 ug/l. Isolated occurrences of total PAH concentrations ranging from 100s to 1,000 ug/l were detected at probes HIGP-43SI through –45SI.

Off-site groundwater probes to the west indicate a narrow area of elevated total PAH concentrations adjacent to the western property line. Probes HIGP-21SI, -22SI and –27SI exhibit total PAH concentrations ranging in the 1,000s ug/l.

Total Cyanide

Total cyanide ranged from not detected in several samples to 7.9 ug/l in sample HIMW-03S (23 to 33 ft-bgs).

Intermediate Groundwater

The analytical results indicate that the highest concentrations of total BTEX, total PAHs and total CPAHs obtained from the off-site intermediate groundwater zone were from probes and monitoring wells adjacent to the western edge and southwestern property lines of the site.

BTEX

Total BTEX concentrations ranged from not detected in several samples to 2,640 ug/l in groundwater sample HIGP-28SI (49 to 95 ft-bgs). Elevated total BTEX concentrations (ranging from 10s to 1,000s ug/l) were detected in probes HIGP-24SI, -26SI and –28SI; and well HIMW-5I **(Drawing 4L1)**. To the southwest of the site, total BTEX concentrations ranged in the 100s ug/l were encountered at probes HIGP-47, -48 and –77. An isolated total BTEX concentration was detected at probe HIGP-79 at 110 ug/l.

PAHs

Total PAH concentrations in the intermediate groundwater interval ranged from not detected in several samples to 8,855 ug/l in sample HIGP-24 (54 to 58 ft-bgs). Total CPAHs ranged from not detected in several samples to 4 ug/l in groundwater sample HIGP-40 (56 to 60 ft-bgs). The total PAH concentrations west of the site ranged from 10s to 1,000s at probes HIGP-21SI, -24SI, -26SI through –28SI and well HIMW-5I **(Drawing 4L2)**. Probes HIGP-47, -48 and-77 exhibited total PAH concentrations in the 100s ug/l southwest of the site.

Groundwater probes HIGP-40SI, -78 and –80 exhibited total PAH concentrations ranging in the 100s ug/l to the east of the site.

Total Cyanide

Total cyanide ranged from not detected in several samples to 13 ug/l in sample HIMW-14I (85 to 95 ft-bgs).

Deep Groundwater

Chemical constituent concentrations decrease significantly off-site compared to those chemical constituent concentrations in the shallow and intermediate groundwater zone.

BTEX

Total BTEX concentrations were not detected or below 50 ug/l at off-site locations **(Drawing 4M1)**.

PAHs

Total PAH concentrations in the deep groundwater interval ranged from not detected in several samples to 115 ug/l in one sample HIMW-05D (130 to 140 ft-bgs). Total CPAHs were reported as not detected in all of the deep groundwater samples (**Drawing 4M1**).

Total Cyanide

Total cyanide ranged from not detected in several samples to 10.5 ug/l in sample HIMW-14D (140 to 150 ft-bgs).

Petroleum Fingerprint and TPHs

A LNAPL sample collected from HIMW-10S that exhibited a distinct fuel oil odor was collected for petroleum fingerprint/TPH analysis. HIMW-10S is located southeast of Oswego Oil Service Corp. As discussed in **Section 2.5**, the Oswego Oil Service Corp. facility is a fuel oil storage facility and is currently listed as an active NYSDEC petroleum spill site. **Table E-25** included in **Appendix G** summarizes the results of the analysis. The LNAPL sample collected from HIMW-10S exhibited a TPH concentration of 890,000 mg/l and was found to be characteristic of No. 2 fuel oil. The sample also appeared to be relatively unweathered.

TABLE 4-6
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION
OFF-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth in ft. bgs)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
HIGP-21 (26-30')	2,930	7,933	In Village of Garden City property. 50 ft. west of western site boundary.	Slight sheen, naphthalene-like odor
HIGP-22 (16-20')	3	2,776	In Village of Garden City property. Within Recharge Basin west of western site boundary.	Heavy sheen, strong odor
HIGP-24 (54-58')	359	8,855	East of the Village of Garden City near Recharge Basin. Downgradient of former Drip Oil Tanks and Drainage Sump.	Slight naphthalene-like odor
HIGP-26 (52-56')	84	1,708	Southeast of the Village of Garden City near Recharge Basin. Downgradient of former Drip Oil Tanks and Drainage Sump.	Naphthalene-like odor
HIGP-27 (26-30')	3,232	3,139	Southeast of the Village of Garden City near Recharge Basin. Downgradient of former Drip Oil Tanks and Drainage Sump.	None
HIGP-27 (56-60')	24	1,861	Southeast of the Village of Garden City near Recharge Basin. Downgradient of former Drip Oil Tanks and Drainage Sump.	Naphthalene-like odor
HIGP-28 (58-62')	2,640	5,933	Immediately north of Medical Office building. Downgradient of former Drip Oil Tanks and Drainage Sump.	Slight naphthalene-like odor
HIGP-36 (29-33')	63,000	2,497,700	On the corner of Wendell Street and Intersection Street. Downgradient of main Storage Holder.	Floating NAPL, sheen, strong naphthalene-like odor
HIGP-37 (29-33')	76,000	278,730	Within Medical Office building Parking Lot. Downgradient of Relief Holder.	Floating NAPL, sheen, strong naphthalene-like odor
HIGP-38 (29-33')	35,600	8,428	Within Medical Office building Parking Lot. Downgradient of Oxide Purifier Boxes.	None

Table 4-6 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

OFF-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth in ft. bgs)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
HIGP-39 (29-33')	94	8,415	Within Medical Office building Parking Lot. Downgradient of Gas Oil Tank.	Sheen, naphthalene-like odor
HIGP-40 (30-34')	4,166	9,815	Within the intersection of Intersection Street and Inactive L.I.R.R Right Of Way. Downgradient of Generator House.	Heavy sheen, hydrocarbon-like odor
HIGP-41 (30-34')	2,241	3,258	North of the intersection of Intersection Street and Sealey Avenue. Downgradient of Sage Oil and Oil Tanks.	Sheen, slight hydrocarbon-like odor
HIGP-42 (32-36')	10,480	7,877	Within Inactive L.I.R.R. Right Of Way. Downgradient of Boiler Room and Tar Tank, and in close proximity to Sage Oil.	Floating NAPL, sheen, hydrocarbon like odor
HIGP-43 (33-37')	6	590	Within Inactive L.I.R.R. Right Of Way. Downgradient of Tar Tanks.	None
HIGP-44 (30-34')	469	244	Within Inactive L.I.R.R. Right Of Way. Downgradient of Oil Tanks and Coal Storage Area.	None
HIGP-45 (32-36')	1,229	1,254	Within Inactive L.I.R.R. Right Of Way. Downgradient of Coal Storage Area.	Naphthalene-like odor
HIGP-47 (31-35')	6,670	18,715	Within Inactive L.I.R.R. Right Of Way. Approximately 400 ft. south-southeast of site.	Free NAPL, sheen, naphthalene-like odor
HIGP-48 (60-64')	766	926	Within Office Parking Lot between Hilton Avenue, Wydler Place, and Inactive L.I.R.R. Right Of Way. Approximately 400 ft. south of site.	Slight naphthalene-like odor
HIGP-52 (30-34')	1,031	2,629	Within Smith Street, approximately 600 ft. south-southeast of site.	Strong naphthalene-like odor
HIGP-63 (72-76')	3,979	2,769	Within Rundle Court, south of Atlantic Avenue. Approximately 1,600 ft. south-southeast of site.	Moderate naphthalene-like odor

Table 4-6 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

OFF-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth in ft. bgs)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
HIGP-64 (54-58')	4,031	1,574	Within Hilton Avenue, south of Atlantic Avenue. Approximately 1,550 ft. south of site.	Moderate naphthalene-like odor
HIGP-66 (90-94')	12,970*	259	On the corner of Hilton Avenue and Hilton Place, south of Atlantic Avenue. Approximately 2,250 ft. south of site.	Moderate naphthalene-like odor
HIGP-77 (29-33')	477	1,001	East Side of Wendell Street between the Street and the Medical offie Building	Naphthalene-Like Odor
HIGP-77 (66-70')	289	633	East Side of Wendell Street between the Street and the Medical offie Building	None
HIGP-77 (84-88')	45	639	East Side of Wendell Street between the Street and the Medical offie Building	None
HIGP-78 (31-35')	5,644	2,088	East of Medical Office Building parking Lot in the L.I.R.R. Right of Way	Petroleum-Like Odor
HIGP-79 (36-40')	15,470	900	South Central portion of Medical Office Buidling Parking Lot	Naphthalene-Like Odor
HIGP-79 (64-68')	110	361	South Central portion of Medical Office Buidling Parking Lot	None
HIGP-81 (30-34')	6,170	65	Southeast of Medical Office Parking Lot in L.I.R.R. Right of Way	None
HIGP-81 (40-44')	56,900	3,147	Southeast of Medical Office Parking Lot in L.I.R.R. Right of Way	MGP-Like Odor
HIMW-05I (80-90')	439 (10/13/00) 229 (12/11/01)	1,454 (10/13/00) 2,960 (12/11/01)	Immediately north of Medical Office building, downgradient of Drip Oil Tanks and Drainage Sump.	Strong naphthalene-like odor

Table 4-6 (continued)

HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

OFF-SITE GROUNDWATER SAMPLES EXHIBITING THE HIGHEST TOTAL BTEX AND TOTAL PAH CONCENTRATIONS

Sample ID (Probe/Well No. and Sample Depth in ft. bgs)	Total BTEX Concentration (ug/l)	Total PAH Concentration (ug/l)	Location (in Relation to Former MGP Structure and/or Site)	Field Description of Recovered Sample
HIMW-08S (25-35')	8,240 (01/08/01) 7,070 (12/12/01) 6440 (11/13/03)	3,069 (01/08/01) 1,995 (12/12/01)	Near the corner of Wendell Street and Inactive L.I.R.R. Right Of Way north of Atlantic Avenue. Approximately 550 ft. south of site.	Naphthalene-like odor (01/08/01) Hydrocarbon-like odor (12/12/01)
HIMW-11S (28-38')	13,920	13,076	Within Inactive L.I.R.R. Right Of Way. Downgradient of Coal Storage Area. Immediately upgradient of Sage Oil.	Measurable LNAPL layer identified
HIMW-12I (63-73')	77	136	Vicinity of the Johnny Harrison Memorial Playground	Fuel-Like Odor
HIMW-13I (70-80')	143	156	Eastern Side of Hilton Avenue	Slight Unknown Odor
HIMW-14I (85-95')	273	288	Eastern Side of Hilton Avenue	None
HIMW-15I (80-90')	111	29	Eastern Side of Cathedral Avenue	None
HIMW-16I (70-80')	9	ND	Eastern side of Cathedral Avenue	None

* : Note that follow-up sampling conducted in the immediate vicinity of groundwater sample HIGP-66 (90-94') using temporary monitoring wells indicated that total BTEX concentrations within this portion of the aquifer did not exceed 300 ug/l. Therefore the BTEX data for HIGP-66 (90-94') is considered anomalous.

4.3.3 Private Well Groundwater Sampling

As discussed in **Sections 2.2.10**, two private water supply wells were identified. One private well (irrigation) downgradient of the Hempstead former MGP site was sampled and the second well (irrigation) was not sampled, although the well owner provided sample results for this well. Groundwater samples collected by KeySpan (GEI Consultants) were analyzed for VOCs, Semi-Volatile Organic Compounds (SVOCs), total cyanide and free cyanide. The sample that was collected by KeySpan was collected from the irrigation sprinkler head. This well is located approximately 700 feet south of the site and approximately 300 feet to the west (outside) of the identified groundwater plume. The analytical results of the sample collected by KeySpan were reported as less than the laboratory detection limits for the sample parameters.

Review of the analytical data provided by the private commercial property well owner indicated VOCs (including naphthalene) at less than the laboratory detection limits. SVOCs, total cyanide and free cyanide were not included in the analytical data provided by the private commercial property well owner. This property is located beyond the downgradient limit of the identified plume and approximately 450 feet side gradient of the predicted groundwater plume path.

4.3.4 Dissolved BTEX/PAH Plume

Due to the presence of the BTEX and PAH source areas located within the site, a dissolved phase BTEX/PAH plume exists downgradient of the site primarily within the shallow and intermediate groundwater zones. **Drawing 4N** summarizes the off-site groundwater BTEX/PAH data collected from groundwater probes, temporary monitoring wells and permanent monitoring wells, and includes an estimated limit of the BTEX/PAH plume. As discussed above, the highest BTEX and PAH concentrations were observed in shallow groundwater in the southernmost portion of the site and within the medical office building parking lot to the south of the site. In addition, evidence of NAPL at saturated levels has been identified at and immediately below the water table in this area. The presence of NAPL at the water table does not appear to extend further than groundwater probe/soil probe HIGP-47/HISB-47, located approximately 450 feet south-southeast of the site. Beyond this location, the plume appears to exist only in a dissolved phase. The concentrations of total BTEX and total PAHs contained within the dissolved plume decrease significantly beyond HIMW-08, located approximately 500 feet south of the site.

As shown in **Drawing 4N**, the dissolved BTEX/PAH plume extends in a southerly direction which is consistent with the natural flow of groundwater in the Upper Glacial aquifer. South of Atlantic Avenue, the highest BTEX and PAH concentrations appear to be primarily within the intermediate groundwater zone and in the Glacial sediments at or near the Glacial/Magothy interface. In this portion of the plume, shallow groundwater at or near the water table exhibits little to no BTEX and/or PAHs. As shown on **Drawing 4N**, preliminary groundwater sampling conducted at HIGP-66, located at the corner of Hilton Avenue and Hilton Place, identified elevated BTEX concentrations at the Glacial/Magothy interface in this portion of the plume. However, additional sampling conducted at this location through the use of permanent and temporary monitoring wells did not confirm the HIGP-66 sample data as total BTEX concentrations did not exceed 300 ug/l in this portion of the plume. Therefore, the BTEX data for HIGP-66 (90 to 94 ft-bgs) is considered to be anomalous.

South of monitoring well cluster HIMW-14, located approximately 2,500 feet from the site, BTEX and PAH concentrations drop to below 130 ug/l in all groundwater zones with the highest concentrations generally remaining within the intermediate groundwater zone at or near the Glacial/Magothy interface. However, the highest total BTEX concentration (94 ug/l) observed at the downgradient limits of the plume was detected in the deep well of monitoring well cluster HIMW-15. Further downgradient of HIMW-15, all groundwater samples exhibited non-detectable levels of BTEX and PAHs.

Based on the extensive groundwater sampling conducted off-site, the maximum width of the plume is estimated to be approximately 800 feet immediately downgradient of the site. The western boundary of the plume adjacent to the site appears to extend at least 200 feet west or sidegradient of the property boundary. This “bulge” in the plume is possibly due to the historic use of the former drainage basin located on the northwest corner of the site for the disposal of wastewater and the presence of the Village of Garden City’s recharge basin to the south. Both basins likely created some localized mounding of the water table which in turn created a localized radial flow of groundwater. This radial flow of groundwater dispersed a portion of the BTEX/PAH plume to the west before the plume continued in a southerly direction along with the natural flow of groundwater. South of Atlantic Avenue, the plume appears to narrow to approximately 600 feet wide. The overall length of the plume is estimated to be approximately 3,800 feet long with the plume terminating south of well cluster HIMW-15 but north of West Orchard Street.

Total cyanide was not detected in 21 out of the 31 groundwater samples collected from off-site monitoring wells that were analyzed for cyanide. The highest total cyanide concentrations were detected in groundwater samples HIMW-05S (81.9 ug/l) and HIMW-08S (67.9 ug/l). Free cyanide was detected in six off-site wells including HIMW-05S (37.8 ug/l), HIMW-04S (169 ug/l), HIMW-09I (8.2 ug/l), HIMW-09S (84.1 ug/l), HIMW-13S (7.2 ug/l) and HIMW-13D (16.1 ug/l).

4.4 Soil Vapor

4.4.1 On-Site

Two soil vapor probe samples (HIVP-14 and HIVP-15) were collected from on-site locations to assess the likelihood of dissolved BTEX and naphthalene volatilizing from groundwater into soil gas (**Drawing 2A**). Both samples were collected from the southernmost portion of the site, and were analyzed for BTEX compounds and naphthalene. **Table E-30** included in **Appendix G** summarizes the analytical results of the soil vapor samples.

As shown on **Table E-30** included in **Appendix G**, results indicate the presence of toluene, benzene, ethylbenzene, m/p-xylene and o-xylene in both samples. HIVP-14 and HIVP-15 exhibited total BTEX concentrations of 142.2 parts per billion on a volume basis (ppbv) and 32,720 ppbv, respectively. Naphthalene was not detected in either sample.

4.4.2 Off-Site

A total of 13 soil vapor probe samples were collected from off-site locations in order to assess the likelihood of dissolved BTEX and naphthalene volatilizing from groundwater and migrating into soil gas. All samples were analyzed for BTEX compounds and naphthalene. **Table E-30** included in **Appendix G** summarizes the analytical results of the soil vapor samples (**Drawing 2A**).

As shown on **Table E-30** included in **Appendix G**, analysis of the off-site soil vapor samples identified toluene, ethylbenzene, m/p-xylene and o-xylene at concentrations above the detection limits in all samples. The highest BTEX concentrations were observed within the medical office building parking lot with HIVP-06 exhibiting a total BTEX concentration of 779 ppbv. HIVP-05, collected immediately adjacent to the north side of the medical building, exhibited a relatively low total BTEX concentration of 72.8 ppbv. Naphthalene was not detected in any of the 13 samples collected.

4.5 Ambient Air

4.5.1 On-Site

One ambient outdoor air sample (HIAA-01) was collected at the approximate center of the site and analyzed for BTEX compounds and naphthalene. **Table E-31** included in **Appendix G** summarizes the analytical results of the air samples (**Drawing 2A**)

Based on the analysis of HIAA-01, naphthalene was not found at detectable concentrations. However, trace levels of BTEX compounds were detected in the sample.

4.5.2 Off-Site

One indoor air sample (HIAA-02) and one outdoor air sample (HIAA-03) were collected at off-site locations as shown on **Drawing 2A** for VOC analysis. Indoor air sample HIAA-02 was collected within the medical office building located immediately to the southwest of the site. Outdoor air sample HIAA-03 was collected across Wydler Place north of the medical office building. The analytical results of the air samples are presented in **Table E-32** included in **Appendix G**.

Of the 61 VOCs analyzed, 43 were reported as "not detected." Eighteen chemicals were reported at concentrations above the limit of detection, which for all chemicals ranged from 0.50 ppbv to 10 ppbv.

The chemicals 1,1,1-trichloroethane, 2-propanol, cyclohexane and Freon-12 were detected only in HIAA-03. 1,2,4-trimethylbenzene, 1,4-dioxane, ethylbenzene and tetrachloroethene were detected only in HIAA-02, while 2-butanone, acetone, benzene, chloromethane, ethanol, *m,p*-xylenes, methyl tert-butyl ether, methylene chloride, *o*-xylene and toluene were detected in both samples. Naphthalene, the compound most generally associated with MGP sites, was not detected. Note that according to the information provided by building management personnel, the room adjacent to indoor sampling point HIAA-02 was painted approximately one week prior to the sampling event; while varnishing occurred on the first floor approximately one week prior to sampling.

4.6 Qualitative Human Health Exposure Assessment

The following Qualitative Human Health Exposure Assessment (EA) and Fish and Wildlife Resources Impact Analysis (FWRIA) was revised by GEI Consultants, Inc. in November 2005. The EA and FWRIA utilize all of the data reported in the March 2003 RI Report and this Final RI Report. A copy of the EA and FWRIA are included in this report as **Appendix C**.

4.6.1 On-Site Current Scenarios

Current human populations considered in this exposure assessment include on-site trespassers, adult on-site KeySpan workers, adult commercial workers, and adult and child visitors to the leased property located to the east of the active utility property and for the property to the south previously owned by KeySpan. The population of the leased and previously owned properties consists of salespeople and customers of an automobile dealership as this property is used for storage of vehicles. While trespassing at these properties is unlikely given security measures, the potential for trespasser exposure was considered because the properties could be accessed, with difficulty, over the fence. Additionally, gates to these properties may occasionally be left unlocked, thereby allowing potential trespasser access. Potential on-site exposure for trespassers is limited to chemicals in surface soil and ambient air. Current on-site KeySpan workers are those individuals currently engaged in activities associated with utility operations. Potential exposure to surface soil, subsurface soil, and ambient air is possible for these individuals. Potential exposure media for adult commercial workers and adult children visitors to the leased and previously owned parcels include surface soil and ambient air. A copy of the Exposure Assessment is contained in **Appendix C**.

4.6.2 Off-Site Current Scenarios

Current off-site human populations considered in the exposure assessment include adult commercial workers, adult and child visitors to commercial establishments, adult and child residents, and adults and children using the park adjacent to the site. Potential indoor air exposure to chemicals volatilizing from subsurface soil underneath commercial structures may be possible for the off-site commercial workers and visitors. Additionally, potential exposure to surface soil, and particulates and vapors in ambient air exists for the individuals visiting the car lots adjacent to the site. There are areas of these lots that are devoid of gravel and vegetation; these conditions potentially permit direct contact with surface soil. For adult and child residents, potential exposure media include surface and subsurface soil and indoor and ambient air. For the adults and children using the park, potential exposure media include surface soil and ambient air. Potential exposure to surface soil is expected to be limited given the vast majority of the park is vegetated.

4.6.3 Future Scenarios

Future uses of the site and immediate off-site areas are not expected to change substantially from the current commercial/residential uses. As a consequence, the current exposure scenarios also hold for future use of the site and surrounding areas.

Future human populations considered in this exposure assessment include on-site and off-site construction workers, on-site commercial workers, and on-site adult and child visitors to commercial establishments; on-site adult and child residents, and nearby off-site adult utility workers. The construction worker is considered because any site or off-site redevelopment likely would involve construction activity. Potential exposure media for the construction worker include surface and subsurface soil, and ambient air.

The possibility exists that the site may be used in the future for commercial purposes. Thus, exposures for adult on-site commercial workers and adult and child visitors to future on-site commercial establishments may occur. These individuals have the potential for exposure to chemicals in indoor air that have volatilized from the subsurface soil underneath a future commercial structure.

There is a potential for chemical exposure for nearby off-site utility workers because of the presence of subsurface utility lines in areas adjacent to the site. Potential exposure media for nearby off-site utility workers includes surface and subsurface soil, and soil vapor.

Potential exposure media for future on-site adult and child residents includes surface and subsurface soil and indoor and ambient air.

Because groundwater is present at approximately 30 feet below ground surface, complete exposure pathways do not exist for potential human receptors. In addition, the results from private well survey and associated groundwater sampling and analysis further support that there is no significant potential for groundwater exposure to residents and workers in the area.

Two public water supply wells are located just west of the site and serve the residents of the Village of Garden City. Although considered side-gradient of site-related contamination, H2M Group was consulted by KeySpan to provide an in-depth capture zone analysis to help provide a better understanding of the groundwater flow in this area. This report, dated October 2006, used current and historic well pumping data and aquifer properties to simulate groundwater flow in the area of interest. The groundwater model was used as a predictive tool after achieving reasonable agreement between observed and simulated data. The objective of the predictive model was to estimate groundwater capture zones and the potential for inducing groundwater flow from the MGP site using current and worst-case well pumping scenarios. Based on the predictive model results, H2M concluded that under normal pumping rates, the site is outside of the capture zone of the two water supply wells. H2M also noted that the capture zones have the potential to extend into the area of the former MGP site (at 100 and 200 feet below ground surface) under theoretical maximum pumping conditions, if those maximum pumping conditions persisted for 16 years. However, there isn’t a precedent for this type of well operation for these wells or other local wells. In addition, standard engineering practice and applicable industry guidance standards generally prevent such maximum pumping conditions for a length of time that would be significant enough to draw site related groundwater into the wells (e.g. 16 years). Based on these findings, the two Village of Garden City public water supply wells are very unlikely to draw from the groundwater impacted by the site.

A similar analysis was conducted by H2M for the Village of Hempstead water supply wells which are located on Clinton Street approximately 4000 feet east of the former MGP site. Similar findings were reached by H2M. Based on H2M's report, these Village of Hempstead public water supply wells are also unlikely to draw water from the groundwater impacted by the site. Because drinking water is obtained from either the Village of Hempstead or Village of Garden City public water supply system, and the site is not considered to be within the capture zone of the two nearest public water supply well fields, the drinking water exposure pathway is not considered complete for current or future off-site residents.

The Remedial Investigation and qualitative human exposure assessment have indicated that there are pathways through which people on-site and in the vicinity of the site could be exposed to potentially hazardous material related to former MGP activities. However, there are no significant or imminent threats to human health that warrant an interim remedial action.

4.7 Fish and Wildlife Resources Impact Analysis

Although several chemicals of potential ecological concern (COPECs) were detected at concentrations greater than the toxicological benchmark values, which may pose a risk of impact to wildlife, the potential for an impact from COPECs is minimal for several reasons. These reasons are exposure frequency, chemical concentration (especially within the upper 6 inches of the ground surface), mechanism of exposure, and duration of exposure. The industrial/commercial areas provide minimal habitat areas (i.e., weedy patches) that would support a wildlife population. These areas experience constant physical disturbance that prevents populations of wildlife from developing. Because only transient species and a few individual animals would use this area, the frequency and duration of exposure is limited. Thus, the observed chemicals detected on-site do not pose a risk, nor is any expected in the future.

Wildlife resources in the industrial/commercial/residential area surrounding the site are limited due to the general lack of quality food and appropriate cover. In addition, constant human disturbance limits the population to wildlife species more tolerant of human activity. No federally or state-listed species were identified as occurring on the site. Several wetlands were identified in the 2-mile radius study area. Some of the wetlands are located downgradient of the site. However, there are no known direct migration pathways from the site into the wetlands. Also, due to the distance and the fate and transport mechanisms involved, no significant effects on wetlands are expected. A copy of the Fish and Wildlife Resources Impact Analysis is contained in **Appendix C**.

5.0 FATE AND TRANSPORT OF CHEMICAL CONSTITUENTS

5.1 Introduction

This section describes the physical, chemical and biological processes that have affected the fate and transport of chemical constituents within and downgradient of the Hempstead Intersection Former MGP site. The primary influences affecting the fate and transport of chemicals in the environment at the site include:

- The physical properties of the chemicals, including state (i.e., solid, liquid, gas), density/specific gravity, solubility in water, and propensity for volatilization and adsorption to soil;

- The environmental media in which the chemicals are released (i.e., air, soil, water) and the spatial and temporal changes of the character of the media encountered by a chemical as it moves through the environment;

- The physical, chemical and biologic processes that affect the mobility of the chemicals and/or transform the chemicals into innocuous forms; and

- Hydrogeologic characteristics of the aquifer.

Based on the results of the Remedial Investigation presented in **Section 4.0** and the results from previous site investigations presented in **Section 1.0**, soil and groundwater are the environmental media primarily affected at and downgradient from the site. The primary chemical constituents affecting on-site and off-site environmental media are BTEX and PAH compounds.

The key processes and chemical properties affecting the fate and transport of BTEX and PAH compounds within the environment are described below. **Table 5-1** summarizes the relative degree to which each process affects BTEX compounds, low molecular weight PAHs, mid or transitional weight PAHs and high molecular weight PAHs.

- *Sorption* - Sorption is the process by which chemicals in either a liquid or gas phase become physically and/or chemically associated with the surface of a solid phase. The sorption of organic chemicals is primarily governed by the amount of naturally occurring organic carbon present in the matrix of the soil or aquifer and the chemical's susceptibility to sorption to organic carbon. Organic carbon is typically present as coatings on the surfaces of the solid matrix (e.g., sediment grains, fractured bedrock surfaces, etc.) of the aquifer or as particulate organic matter. The organic carbon partition coefficient (K_{oc}) is used as an indicator for the propensity of an organic chemical to adsorb to naturally occurring organic carbon. The affinity of a chemical to adsorb to organic carbon, as reflected by its K_{oc}, influences the mobility and/or attenuation of the chemical. Organic chemicals with higher K_{oc}s will adsorb to organic carbon more readily than chemicals with lower K_{oc}s.

TABLE 5-1
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

RELATIVE INFLUENCE OF CHEMICAL PROPERTIES AND PROCESSES RELATED TO THE FATE AND TRANSPORT OF BTEX AND PAH COMPOUNDS

COMPOUND GROUP/SPECIES	MOLECULAR WEIGHT (g/mol)(1)	SORPTION	Log K_{oc} (1)(2)	SOLUBILITY	SOLUBILITY IN WATER (mg/L)(1)	VOLATILIZATION	BIOLOGICAL DEGRADATION	NET EFFECT
BTEX								
Benzene	78.11	**Low**	1.89	**High**	1,780	**High**	**High**	Mobile within most environments. Degrades quickly under favorable conditions.
Toluene	92.14		2.12		515			
Ethylbenzene	106.17		2.2		152			
Xylenes	106.17		2.54		174.3(3)			
LOW MOLECULAR WEIGHT PAHs								
Naphthalene	128.18	**Moderate**	3.14	**Moderate**	30	**Low**	**Moderate**	Moderate mobility within most environments. Degrades at moderate rates under favorable conditions.
Acenaphthylene	152.2		3.68		3.93			
Acenaphthene	154.21		1.25		3.47			
2-Methylnaphthalene	142.2		3.4		24.6			
MID OR TRANSITIONAL MOLECULAR WEIGHT PAHs								
Phenanthrene	178.24	**High**	4.22	**Low**	1.6	**Very Low**	**Low**	Immobile within most enviroments. Recalcitrant to biodegradation.
Dibenzofuran	168.2		3.91 - 4.10		10			
Fluorene	166.22		3.7		1.69			
Anthracene	178.24		4.3		0.075			
HIGH MOLECULAR WEIGHT PAHs								
Fluoranthene	202.26	**High to Very High**	4.62	**Low to Very Low**	0.265	**Very Low**	**Very Low**	Immobile within most enviroments. Recalcitrant to biodegradation.
Pyrene	202.26		4.84		0.16			
Chrysene	228.3		5.39		0.0015			
Benzo (b) fluoranthene	252.32		5.74		0.0012			
Benzo (k) fluoranthene	252.32		6.64		0.00055			
Benzo (a) anthracene	228.3		6.14		0.014			
Indeno (1,2,3-cd) pyrene	276.34		7.49		0.062			
Dibenzo (a,h) anthracene	278.36		6.22		0.0005			
Benzo (g,h,i) perylene	276.34		6.89		0.00026			
Benzo(a)pyrene	252.32		5.60 - 6.29		0.0038			

Notes

(1) From: Montgomery, John H., and Linda M. Welkom. *Groundwater Chemicals Desk Reference* (Chelsea, MI: Lewis Publishers, Inc., 1990), 640 p.

(2) Sorption Coefficient - The ratio of adsorbed chemical per unit weight of organic carbon to the aqueous solute concentration.

(3) Taken from average solubility of all three xylenes at or around 20° C.

The migration rates of organic chemicals in groundwater that adsorb onto organic matter in the aquifer (i.e., that have higher K_{oc}s) are attenuated or retarded relative to the natural groundwater flow rate. Consistent with this principle, the migration rate of an organic chemical with a relatively high K_{oc}, is more strongly retarded as a result of sorption to organic carbon in the aquifer as compared to the migration rate for a chemical with a low $K_{oc.}$ In general, BTEX and low molecular weight PAH compounds, such as naphthalene have low to moderate K_{oc} values as compared to the higher molecular weight PAH compounds, such as benzo(a)pyrene. Accordingly, in soil and aquifers containing measurable TOC, the higher molecular weight PAHs will migrate at a slower rate than the BTEX and low molecular weight PAHs. Therefore, higher molecular weight PAHs would not be expected to migrate far from a source area in most soil environments and aquifers. An exception to this general rule occurs when the PAH compounds are migrating as a component of a NAPL, such as tar and oil. In this case the bulk of the NAPL containing PAHs may migrate through the soil at a higher rate irrespective of sorption considerations.

- *Aqueous Solubility* - Aqueous solubility is a measure of the maximum mass of a chemical that can exist in an aqueous phase at equilibrium with the pure chemical. This chemical property is used indirectly to assign relative potentials for a chemical to leach into an aqueous phase from a source material, such as a NAPL. Chemicals with high solubilities will tend to leach easily and to remain in aqueous solution. The opposite conditions apply to chemicals with low aqueous solubilities. In general, high solubility chemicals, such as the BTEX compounds, are more mobile in the environment than chemicals with moderate solubilities, such as the low molecular weight PAH compounds such as naphthalene, acenaphthylene, acenaphthene and 2-methylnaphthalene. The higher molecular weight PAH compounds, such as fluoranthene, pyrene and chrysene, have low to very low solubilities, are not very mobile and are not expected to migrate far from a source.

- *Volatilization* - Volatilization is the process by which a fraction of a chemical in a solid or liquid phase partitions into a gas phase. The extent to which this process proceeds is measured by the vapor pressure for a particular chemical. In general, chemicals with higher vapor pressures, such as BTEX, volatilize more readily than chemicals with low vapor pressures, such as PAHs. For these reasons, BTEX dissolved in groundwater is more likely to migrate to soil vapor and migrate through unsaturated soil, eventually releasing to the atmosphere. Low molecular weight PAHs have low vapor pressures relative to BTEX, therefore, while volatilization of these compounds does occur, the extent of volatilization of PAHs is negligible compared to BTEX. High molecular weight PAHs have very low vapor pressures indicating virtually no volatilization will occur under most conditions.

- *Biodegradation* - Biodegradation is the transformation of organic chemicals to innocuous secondary compounds and ultimately to carbon dioxide and water as the result of the metabolic activity of microbes, including bacteria and fungi, that are typically present in most natural environments (S.S. Suthersan, 1997). The processes that facilitate biodegradation have been extensively investigated and well documented and have been demonstrated to be effective in reducing concentrations of a wide range of organic compounds within soil, groundwater and surface water. Biological processes which take place in the natural environment can modify and destroy organic compounds at the point of introduction or during their transport within soil, groundwater or surface water. While rates of degradation are highly variable and are directly influenced by physical and chemical conditions in the environmental media, BTEX compounds are readily degraded under aerobic (oxygen-rich) conditions in soil, groundwater and surface water. However, benzene and ethylbenzene appear to be relatively resistant to degradation under anaerobic (oxygen deprived) conditions (R.C. Borden, et al., 1995). Low molecular weight PAHs have been shown to naturally degrade at moderate rates under aerobic conditions.

The processes described above, along with the results of the Remedial Investigation, historical site investigations, and the known on-site and off-site hydrogeologic conditions, are integrated into the following sections which describe the fate and transport of chemicals detected in soil and groundwater at the site. The fate and transport model proposed below identifies:

- Several possible on-site sources for NAPL;
- Possible areas of the site where the NAPL may have originated;
- The modes of NAPL migration away from these source areas;
- Leaching of the more mobile constituents (e.g., BTEX compounds) present in the source material(s);
- Migration of these dissolved constituents through vadose zone soil to groundwater, and, ultimately; and
- The off-site migration and attenuation of the dissolved chemicals in groundwater.

5.2 Transport and Fate of NAPL

Low viscosity tars and oils associated with the former MGP site would have behaved as NAPLs, migrating vertically down through the soil column under the force of gravity. The vertical migration would have continued until the NAPL reached the water table, currently at approximately 28 to 32 feet below grade or, depending on the specific gravity and mass of the NAPL released, until it encountered a low permeability soil layer. Soil underlying the site consists of relatively porous glacial outwash sands with relatively high permeability gravel-rich sand lenses and relatively minor and less prevalent lower permeability silty-sand and clay lenses. Due to the predominance of high-permeability sand and gravel immediately underlying the site, vertical migration of NAPL likely occurred rapidly with minimal "pooling" above isolated silty-sand and/or clay lenses. Coarse gravel lenses would likely have acted as preferential pathways for the migrating NAPL. Upon entering a gravel lens the NAPL would likely have migrated laterally within the gravel lenses (the path of highest permeability and, thus, the least resistance to flow) or until the mass (head) of NAPL within the gravel lenses induced the NAPL to resume vertical migration into the less permeable sand surrounding the gravel lenses.

During its downward migration through the unsaturated soil column, a portion of the NAPL typically becomes trapped in pore spaces along its migration path in response to capillary forces. The NAPL residue trapped in the pore spaces occurs as small droplets or blebs. When NAPL encounters water-saturated sediments, such as at the water table or at perched water, the ability of the NAPL to displace water from the pore spaces and continue its vertical migration can be diminished. Similarly, the presence of low-permeability lenses in the migration pathway also impedes the vertical movement of NAPL. In both cases, a local zone or pool of immobile residual NAPL may form.

If the specific gravity of a NAPL is less than or equal to that of water, light NAPL (or LNAPL) would tend to spread horizontally when it reaches the water table. The LNAPL would become further immobilized in soil pores as the water table naturally fluctuated in response to seasonal changes to the rate of groundwater recharge. This would create a vertical zone of residual LNAPL, typically referred to as a "smear zone."

Tars or oils which were more dense than water could continue to migrate past the water table into the saturated soil column until either the mass of NAPL required to overcome capillary forces and hydrophobic effects becomes depleted, thus preventing continuation of gravity-driven migration, or it encounters an impermeable lithology (e.g., silty sand, clay, silt, etc.).

Once NAPL encounters the water table, its migration is influenced by the permeability of the aquifer sediments and the rate and direction of groundwater flow. The natural flow of groundwater can have a notable influence on the bulk migration of NAPL. The combined effect of variable permeability of the aquifer sediments and the influence of groundwater flow can produce irregular-shaped and unevenly distributed "fingers" (ganglia) or "lobes" of NAPL extending vertically or downgradient away from the source area or the initial point of entry into the water table.

Upon release, NAPL typically distributes quickly within the subsurface (P.V. Noort, et al., 1994). As discussed below, areas of subsurface soil exhibiting NAPL at saturated levels were encountered primarily in soil borings located at or near former MGP structures in the southern and western portions of the site. As discussed in **Section 1.4.1**, the majority of former MGP structures and operations were located in the southernmost portion of the site.

Shallow Soil

As shown on **Drawing 4A1**, NAPL and/or tar was observed at saturated levels in the 0 to 8 feet shallow soil zone primarily within the vicinity of former MGP structures, including:

- Drainage Sump located in the northwestern corner of the site.
- Drip Oil Tanks located along the western property boundary.
- Tar Separator located in the south-central portion of the site.
- Oxide Purifier Boxes and Tar Extracting facilities located along the boundary of the KeySpan property and the sold property in the southernmost portion of the site.
- Northernmost Cooling Spray Pond.
- Main Gas Holder.
- Relief Holder.
- Southeastern portion of the Coal Storage Area.

As discussed in **Section 4.0**, the above-listed areas generally exhibited the highest BTEX and PAH concentrations observed in shallow subsurface soil. Based on the presence of saturated NAPL in shallow soil, as well as BTEX and PAH concentrations in subsurface soil, the above listed areas are considered potential source areas. **Drawing 4A1** indicates the northernmost third of the site is free of saturated NAPL, as well as staining, odors or sheens. **Drawing 4B1** indicates more isolated zones of tar saturation based on visual observations in the 8 to 16 foot bgs interval. These observations suggest that vertical NAPL migration through the shallow soil on-site occurs along isolated pathways. The isolated nature of the NAPL saturated zone is also apparent in **Drawing 4C1** which depicts NAPL observations in the 16 to 24 foot interval. **Drawing 4C1** also indicates a widening of NAPL observation downgradient of the site. This observation is also illustrated by the north-south cross sections provided on **Drawings 4F** and **4G**.

Saturated NAPL in shallow off-site areas was generally not observed. However, HISB-42, located within the LIRR Right of Way and adjacent to Oswego Oil Service Corporation, indicated a thin layer of NAPL approximately 1-foot below grade. Also at the HIMW-11 well cluster, NAPL saturated soils were observed in the 16 to 24 foot interval. It is possible that these NAPL observations in HIMW-11 cluster are associated with a number of documented petroleum releases, which have occurred at Oswego Oil Service Corporation (additional details concerning these documented spills are provided in **Section 1.6 and 2.5**). Soil borings completed within the Village of Garden City property located to the west of the site indicated shallow soil in this area to be generally free of NAPL saturated materials, and generally free of staining, odors, sheens, etc. One exception was shallow soil recovered from HISB-22 located at the bottom of the Village of Garden City recharge basin which exhibited soil staining and naphthalene-like odor.

<u>Intermediate Soil</u>

The review of **Drawings 4C1** (16 to 24 feet) and **Drawing 4D1** (24 to 34 feet) illustrate that the majority of NAPL-saturated soil conditions exist at the water table. **Drawing 4D1** illustrates that the majority of soil borings exhibiting NAPL-saturated conditions within the intermediate soil zone were completed in the southern portion of the site, and areas located immediately downgradient of this area including the medical office building parking lot to the south. Note that the majority of former MGP structures and operations were located in the southernmost portion of the site. In addition, NAPL-saturated conditions were observed in the vicinity of the former drainage sump and drip oil tanks located in the western portion of the site. Note that the 24 to 34 feet intermediate zone (**Drawing 4D1**) includes the water table which ranges from 28 to 32 feet below grade at most on-site and near-site locations.

As shown on **Drawing 4H**, which includes the north-south cross section along the western property line of the site, the former drainage sump (HISB-08) and the former drip oil tanks (HISB-14), both contain NAPL-saturated soil within the intermediate soil zone. Furthermore, fluid level gauging conducted at HIMW-01S located within this portion of the site identified a separate-phase DNAPL layer in this shallow well. Refer to **Section 4.3.1** for further detail concerning the DNAPL in HIMW-01S. This data indicates that the former drip oil tanks and drainage sump are to be considered significant NAPL source areas.

As indicated by soil recovered from HISB-15, located at the former tar separator in the south-central portion of the site, NAPL-saturated soil was encountered in close proximity to the water table in this area as well. As shown on the north-south cross section provided on **Drawing 4G**, staining of soil along with NAPL-saturated soil is present throughout the unsaturated soil column downgradient of the former tar separator, indicating this is another potential NAPL-source area. Borings completed immediately downgradient of this area (HISB-16 and HISB-29) also indicate soil staining and NAPL-saturated conditions throughout the unsaturated soil column with NAPL-saturated soil observed at the water table. However, NAPL-saturated conditions are not observed more than several feet below the water table, which is more characteristic of a LNAPL smear zone. These observations would suggest that NAPL released from on-site source areas migrated through the unsaturated soil with little pooling until reaching the water table. As discussed previously, the ability of a NAPL to continue its vertical migration through the soil column after encountering a water-saturated zone (i.e., the water table) can be diminished due to the fact that the NAPL must overcome capillary forces, hydrophobic effects and finally displace the water from the soil pore spaces. Based on the fact that the penetration of NAPL below the water table appears to be minimal, it is likely that the mass of NAPL that reached the water table was not sufficient to overcome these forces and, as a result, pooled at or near the groundwater interface. Also a high percentage of gravel noted in soils at the water table may provide for a higher permeability zone to facilitate lateral spreading of the NAPL. However, it is likely that, after reaching the water table, limited horizontal migration of the NAPL occurred (primarily in a southern direction along with the natural flow of groundwater) until the mass of the NAPL became depleted to the point where it essentially became immobilized.

Drawing 4C1 indicates that the extent of saturated NAPL within the southeastern portion of the former coal storage area is relatively shallow in depth with only soil staining and odors observed at HISB-11 below a depth of 16 feet. This observation is consistent with soil and groundwater data collected from this area which indicates that elevated levels of BTEX and PAHs are restricted to shallow subsurface soil and groundwater within this portion of the site.

Soil recovered from soil borings HISB-41, HISB-42 and HIMW-11D, which were completed in close proximity to Oswego Oil Service Corp., also exhibited NAPL at saturated levels at or near the water table. However, this material exhibited a distinct petroleum-like odor, suggesting that the NAPL detected at these locations may be attributed to releases of petroleum products, such as diesel fuel or fuel oil. As discussed in **Section 4.2.3**, petroleum fingerprint analysis of samples collected from HISB-41 and HIMW-11D indicate that the hydrocarbons present at these locations are characteristic of diesel fuel. Furthermore, petroleum fingerprint analysis of an LNAPL sample collected from off-site monitoring well HIMW-10S located southeast of the Oswego Oil Service Corporation facility indicates this material to be most characteristic of No. 2 fuel oil. As discussed in **Section 1**, Oswego Oil Service Corporation is an active NYSDEC petroleum spill site.

The east-west geologic cross section provided on **Drawing 4F** indicates NAPL-saturated soil is present at or near the water table throughout the southernmost portion of the site as indicated by soil borings HIMW-06D, HISB-32, HIMW-07D/HISB-34 and HISB-35. However, similar to other on-site areas, NAPL-saturated conditions do not extend more than several feet below the water table. Shallow monitoring wells HIMW-06S and HIMW-07S, both of which are located along the southern boundary of the site, contained measurable DNAPL layers. Refer to **Section 4.3.1** for further detail concerning the DNAPL in these wells.

Drawing 4H indicates that off-site NAPL migration within the intermediate soil zone extends downgradient of the site with NAPL observed at saturated levels at HISB-47, located approximately 450 feet downgradient of the site boundary. Consistent with the former tar separator source area, NAPL distribution within and downgradient of the southernmost portion of the site generally extends a limited distance into the water table with the most significant evidence of saturated NAPL being present at or near the water table. These observations are characteristic of an LNAPL smear zone or where the mass of a DNAPL was insufficient to continue vertical migration through saturated soil below the water table.

While NAPL-saturated soil was not encountered within the intermediate soil zone in off-site borings completed to the west and southwest of the site, soil staining and/or odors were observed at or near the water table, at soil borings HISB-21, HISB-22, HISB-24 and HISB-27. These observations are consistent with groundwater data collected from this area which indicated the presence of BTEX and PAHs in the shallow and intermediate groundwater zones.

Deep Soil

Drawing 4E1 indicates that NAPL at saturated levels in on-site subsurface soil below a depth of 34 feet is limited to HISB-14 located in the vicinity of the former drip oil tanks. However, subsurface soil exhibiting NAPL blebs, globs, lenses, sheens and/or grain coatings was observed in the vicinity of the former drainage sump below a depth of 34 feet. Furthermore, soil exhibiting staining and/or naphthalene/hydrocarbon-like odors was observed west and south (downgradient) of this area at soil borings HISB-21, HISB-24, HISB-26, HISB-27 and HISB-28. As shown on the east-west cross section provided on **Drawing 4F**, soil staining and/or naphthalene/hydrocarbon odors were observed at HISB-28/HIMW-05D up to a depth of 106 feet below grade. Finally, the analysis of the groundwater sample collected from HIMW-05D, screened from 130 to 140 feet below grade, contained detectable levels of BTEX and PAHs.

Within the southernmost portion of the site and downgradient areas, soil below a depth of 34 feet did not exhibit NAPL at saturated levels but did exhibit soil staining and/or naphthalene/hydrocarbon odors. In addition, several soil samples collected from this area exhibited tar/NAPL blebs, globs, lenses, grain coating and/or sheens. Again, this distribution of NAPL is characteristic of a LNAPL smear zone or where the mass of a DNAPL was insufficient to continue vertical migration through saturated soil below the water table. NAPL at saturated levels was observed below a depth of 34 feet at HISB-40 and HISB-41, which were located southwest of the site and in close proximity to Oswego Oil Service Corporation. As discussed previously, this oil storage facility is listed as an active petroleum spill site by the NYSDEC.

5.3 Fate and Transport of Chemical Constituents

The soil and groundwater chemical data discussed in **Section 4.0** indicated that elevated concentrations of BTEX and PAHs were detected in soil vapor, soil and groundwater samples co-located with or downgradient from soil exhibiting NAPL at saturated levels as well as soil staining, odors and sheens. This indicates that the primary source of these chemical compounds detected in soil and groundwater samples during the initial RI and Supplemental Remedial Investigation Field Program is residual NAPL. The fate and transport of these chemical compounds is discussed below.

5.3.1 Transport of Chemical Constituents from Soil to the Atmosphere

While some volatile emissions may intermittently discharge to the atmosphere within the site, volatilization does not appear to be either a major migration or exposure pathway for BTEX and low molecular weight PAHs. This is supported by the fact that, although VOCs were detected in shallow soil gas samples, elevated VOC concentrations were not detected in air during the on-site and off-site ambient air sampling performed as part of the Remedial Investigation. Additionally, results from ambient air monitoring performed during the 1992 Field Investigation showed that VOCs were not detected. This is explained by the findings that BTEX and, to a lesser degree, low molecular weight PAH compounds, may volatilize from residual NAPL and/or soil containing these compounds in a sorbed phase. Also, the majority of the source was located several feet below grade and, therefore, is not directly exposed to the atmosphere. Moreover, because the concentrations of these chemicals in the soil vapor are diluted as the soil vapor migrates through the soil column, the mass of BTEX and PAHs removed from soil and NAPL via evaporation is minimal. Migration of BTEX and PAHs through the soil column above the residual NAPL and released to the atmosphere may be further limited by fill material and topsoil cover, which likely acts as a partial barrier.

5.3.2 Transport of Chemical Constituents from Soil to Groundwater

While volatilization of BTEX and PAH compounds from on-site sources may occur, the primary transport mechanism or migration pathway for these compounds is dissolution into infiltrating precipitation and groundwater flowing through soil containing residual NAPL and sorbed BTEX and PAH compounds.

Precipitation that infiltrates the vadose zone ultimately reaches the water table and becomes incorporated into the groundwater, thus contributing dissolved chemicals to groundwater. Similarly, groundwater flowing through soil in the underlying aquifer may leach BTEX and low molecular weight PAHs from soil and/or NAPL containing these chemical constituents. The degree of leaching and the resulting concentrations are dependent upon the solubility of the individual BTEX and/or PAH compounds, as listed in **Table 5-1**. Based on a review of **Drawings 4D (1,2,3)** through **4G**, groundwater in contact with soil exhibiting evidence of NAPL invariably contained elevated levels of BTEX and PAHs.

5.3.3 Evolution and Attenuation of the Off-site BTEX/PAH Plume

Once incorporated as dissolved constituents of groundwater, chemicals are transported by groundwater. However, the overall concentrations of the dissolved constituents become reduced through advective dispersion and dilution as well as adsorption to organic carbon in the aquifer matrix as the groundwater migrates downgradient away from a source area. Furthermore, the mass of dissolved chemicals in groundwater such as BTEX and the low molecular weight PAHs can be reduced through attenuation resulting from biodegradation. Although the more volatile chemicals can be removed from the groundwater and transferred to the soil gas by volatilization, mass removal by this process is comparatively minor in most aquifer systems and therefore is not considered further in this discussion.

Research concerning the evolution of hydrocarbon groundwater plumes similar to the BTEX/PAH plume downgradient from the site indicates that:

- Plumes tend to reach a stable shape and size even when a source is present;

- Natural biodegradation occurring within aquifers can be responsible for the reduction of 80 to 100 percent of the hydrocarbon mass of a plume within 1 to 1.5 years after source removal. Volatilization and advective dispersion each could account for only 3 to 5 percent of the BTEX losses in the plumes studied (P.M. McAllister, C.Y. Chang, 1994; J.P. Salanitro, 1993; Rifai, et at. 1988); and

- Plumes "shrink" or narrow (frequently longitudinally) when a source is reduced or removed.

As shown on **Drawings 4K1** through **4M2**, groundwater concentrations of BTEX and PAHs are generally highest on-site or at potential source areas and decrease as the groundwater migrates downgradient. These observed downgradient decreases in concentrations are primarily due to dilution and dispersion within the aquifer. It is noted that dispersion is constrained to the corridor of water flowing directly downgradient from the site, with minimal longitudinal dispersion. The elongate plume shape depicted in **Drawing 4N** is typical of relatively soluble chemicals, such as BTEX and low-molecular weight PAHs, migrating through moderately to highly transmissive aquifers.

5.3.4 Attenuation Due to Sorption by Organic Carbon in the Aquifer Matrix

As described above, the migration rate of organic compounds in groundwater is controlled, in part, by its affinity to adsorb to organic carbon in the aquifer matrix and to its relative adsorption and de-sorption rates. The distribution of an organic compound between the aquifer matrix and a coexisting aqueous phase is represented by the organic carbon sorption coefficient, or K_{oc}, for that compound. The K_{oc} is defined as the ratio of adsorbed chemical per unit weight of organic carbon in the aquifer matrix to the dissolved aqueous concentration of the compound. Therefore, using the total organic carbon content of the aquifer matrix, the dissolved concentration of a compound in groundwater, and the compound-specific K_{oc}, the amount of chemical compounds sorbed to the aquifer can be calculated.

The sorption of organic compounds is reversible and eventually the organic compound de-sorbs back into the groundwater. Due to the sorption and de-sorption processes the migration rates of organic chemicals are retarded relative to the un-attenuated natural rate of groundwater flow. The degree to which the migration rate of a particular organic compound is retarded depends on the groundwater flow rate, the extent to which the compound adsorbs to organic carbon in the aquifer matrix, and the relative sorption/de-sorption rates of the compound to the organic carbon. The degree of retardation of a particular compound can be determined by calculating the compound's retardation factor (R_f) using the equation below.

$R_f = 1 + (\rho s/ne)K_d$

Where:

K_d = contaminant distribution coefficient and equals the K_{oc} multiplied by the fraction of organic carbon (f_{oc}) in the aquifer matrix; f_{oc} equals TOC (in units of mg/kg) multiplied by 10^{-6};

ρs = bulk density of the aquifer matrix; and

ne = effective porosity of the aquifer material

The retardation factor represents the number of times chemical compounds migrate more slowly as compared to the rate of groundwater flow.

For the purpose of estimating the ability of organic carbon to attenuate and reduce the migration rates of BTEX and PAHs in the groundwater plume downgradient from the site, the retardation factor for benzene was calculated. Benzene was selected for this purpose as it is the most soluble of the BTEX compounds, and therefore is the least likely to be affected by adsorption to organic carbon. The retardation factors for benzene in the Upper Glacial aquifer at the site were calculated using the equation presented above, site-specific data, and several underlying assumptions.

Using the K_{oc} value for benzene from **Table 5-1**, the retardation factor for benzene was calculated to be 4.45. Based on this R_f and the groundwater flow velocity of 1.2 feet/day (438 feet/year), as discussed in **Section 3.0**, it is estimated that benzene will migrate 91.6 feet/year in the Upper Glacier aquifer. By dividing the annual groundwater flow velocity by the R_f, it is estimated that during the 47 years since operations at the site have ceased, benzene would have traveled approximately 4,622 feet. This is a conservative estimate of migration distance since the site operations actually began in 1906, or approximately 96 years ago. Assuming benzene began migrating in groundwater during the initial site operations and that its migration was retarded by adsorption to organic carbon, benzene would have migrated approximately 9,440 feet. The actual distance that benzene would have migrated from the site assuming attenuation by organic carbon is likely to be some intermediate distance between these two distances.

The groundwater plume extends approximately 3,800 feet downgradient from the southern site boundary, as shown on **Drawing 4N**. In either case, the benzene in groundwater clearly has been attenuated. The migration rate of benzene is moderately retarded relative to the groundwater flow rates. In keeping with the lower solubilities and/or higher K_{oc} values for the other BTEX compounds and low molecular weight PAHs, the degree of attenuation of these compounds due to sorption to organic carbon is likely to be even higher.

<u>Biodegradation</u>

Biodegradation of BTEX and naphthalene in groundwater has been documented in numerous case studies (Salanitro, 1993; Benson, et al., 1995; McAllister and Chiang, 1994; Borden, et al., 1995; Novak, et al., 1993; Buschbeck, et al., 1993; Weidemier, et al., 1994a; Weidemier, et al., 1994b; Hadley and Armstrong, 1991; Davis, et al., 1994; Weidemier, et al., 1995; Testa and Colligan, 1995; Cheng, et al., 1994; Sims, et al., 1994; Gabert, 1994; and Brubaker, 1991). During aerobic biodegradation of the organic chemicals, oxygen is consumed in a process that converts the chemical constituents into carbon dioxide and water. Accordingly, in groundwater containing dissolved BTEX, and where biodegradation is actively occurring, dissolved oxygen concentrations will be lower inside the plume as compared to those outside the plume.

Based on data presented on **Drawing 4N**, BTEX and/or low-molecular weight PAHs were either not detected or were present at trace levels in upgradient groundwater represented by piezometers PZ-02 and PZ-03, and monitoring wells HIMW-02 and HIMW-03. In contrast, total BTEX and total PAH concentrations within the plume were detected between 0.1 and 2497.7 mg/l. Additionally, groundwater data indicates BTEX and PAH concentrations decrease rapidly with increasing distance from the site. It is assumed that this rate of decrease is not solely the result of dispersion and dilution. Other naturally occurring processes, such as biodegradation, are likely actively reducing the levels of these compounds. In fact, dissolved oxygen measurements obtained from upgradient groundwater exhibit oxygen concentrations as high as 9.0 mg/l, whereas dissolved oxygen levels between 0.5 mg/l and 0.0 mg/l were measured in groundwater at wells where the highest concentrations of total BTEX and PAHs were detected. Dissolved oxygen concentrations are invariably lower within the plume as compared to those outside the plume. Therefore, dissolved oxygen migrating onto the site from upgradient areas is being almost completely consumed. An inverse correlation between dissolved oxygen and hydrocarbon concentrations has been identified as a key indicator of aerobic biodegradation (P.M. McAllister, C.Y. Chang, 1994). It is concluded that this significant reduction of dissolved oxygen is the result of active biodegradation of BTEX and PAHs in the subsurface at the site.

The natural processes including dispersion/dilution and attenuation by organic carbon/biodegradation are actively reducing the areal distribution of dissolved oxygen and the concentrations of BTEX and PAHs in off-site groundwater. These processes will likely continue to attenuate the plume in the future. However, it should be noted that additional geochemical data would be required to determine the rate at which natural attenuation is occurring.

5.4 Weathering of Source Areas

As discussed above, dissolution of BTEX and PAHs from source areas is the major transport mechanism for these compounds. This process has been ongoing since the compounds entered the subsurface environment. Therefore, it can be concluded that dissolution along with volatilization and biodegradation processes, collectively referred to as "weathering," have been continuously reducing the overall concentration of these compounds within source areas.

5.5 Processes Controlling the Vertical Distribution of the BTEX/PAH Plume

As discussed in **Section 4.3**, the highest BTEX and PAH concentrations were observed in shallow groundwater in the southernmost portion of the site and the medical office building parking lot to the south of the site. In addition, NAPL at saturated levels has been identified at and immediately below the water table in this area. Groundwater samples exhibiting the highest BTEX/PAH concentrations were collected from areas where NAPL at saturated levels was observed at or near the water table. Comparison of BTEX and PAH groundwater concentrations observed in areas exhibiting NAPL at saturated levels with published solubility data for each specific chemical compound indicates that a number of these compounds were detected at concentrations well above their maximum solubility in water. Based on this comparison, as well as field observations, the BTEX and PAH concentrations observed in groundwater within these areas do not represent true dissolved-phase concentrations, but are likely biased high due to the presence of NAPL in collected samples (i.e., sheens, separate phase layers and/or blebs). The presence of NAPL at the water table does not appear to extend farther downgradient than groundwater probe HIGP-47, located approximately 450 feet south-southeast of the site. Beyond HIGP-47, the plume appears to exist only in a dissolved phase. The vertical distribution of dissolved BTEX/PAH compounds in groundwater presented on **Drawing 4N** indicates that the dissolved plume is primarily constrained to the Upper Glacial Aquifer. The detection of BTEX and/or PAHs in the deep groundwater zone (greater than 95 feet in depth) is generally limited to groundwater sampling locations near discrete intervals exhibiting soil staining and sheens, such as at monitoring well HIMW-05D, and in downgradient portions of the site where a slight to moderate vertical downward gradient occurs.

The dissolved BTEX/PAH plume extends in a southerly direction consistent with the natural flow of groundwater in the Upper Glacial aquifer. South of Atlantic Avenue, the highest BTEX and PAH concentrations appear to be primarily within the intermediate groundwater zone and in the Glacial sediments at or near the Glacial/Magothy interface. In this portion of the plume, shallow groundwater at or near the water table exhibits little to no BTEX and/or PAHs. This is likely due to the fact that BTEX and PAHs are being diluted as the result of aquifer recharge infiltrating from the ground surface throughout the plume area. Furthermore, rates of biological degradation are likely to be higher in shallow groundwater due to the availability of free oxygen. South of monitoring well cluster HIMW-14, BTEX and PAH concentrations drop to below 130 ug/l in all groundwater zones with the highest concentrations generally remaining within the intermediate groundwater zone at or near the Glacial/Magothy interface. The vertical migration of BTEX and PAHs into the Upper Magothy subunit is limited by the relatively low vertical hydraulic conductivity of this unit. However, the highest total BTEX concentration observed at the downgradient limits of the plume of 94 ug/l was detected in the deep well of well cluster HIMW-15. Further downgradient of HIMW-15, all groundwater samples exhibited non-detectable levels of BTEX and PAHs.

As discussed in **Section 3.5**, a relatively strong downward vertical head was observed in monitoring well HIMW-12D. Cross section B-B', shown on **Drawing 3B,** indicates that the Upper Magothy aquifer sediments at this location contain a number of more permeable sand-rich lenses which may act as localized vertical groundwater flow pathways. Groundwater carrying low concentrations of BTEX and PAHs may travel vertically through the sand-rich lenses in the vicinity of HIMW-12 and migrate horizontally downgradient through the sand-rich lenses within the Upper Magothy subunit and thus, produce the observed distribution of chemical constituents at low to trace concentrations in downgradient portions of the plume at well cluster HIMW-15.

While low level BTEX and PAHs may be able to migrate vertically into the more permeable sand-rich lenses of the Upper Magothy subunit, it is unlikely these compounds would penetrate the clay-rich Lower Magothy subunit. As discussed in **Section 3.4**, geotechnical analysis of the strata indicates a very low vertical hydraulic conductivity of only 2.0×10^{-7} cm/sec.

5.6 Village of Garden City Public Supply Wells

5.6.1 Introduction

As discussed in **Section 1.5.9**, there are two public supply wells located approximately 200 feet west (side-gradient) of the Hempstead Intersection Street Former MGP site. Both wells, N-10033 and N-10034, are operated by the Village of Garden City and are screened from 439 to 541 feet and 489 to 570 feet below grade, respectively, within the Magothy aquifer. Investigations and studies conducted to date have shown that due to the low permeable nature of the sediments that comprise the upper portion of the Magothy aquifer, it is unlikely that site-related constituents would be able to reach the screen zones of these supply wells. As discussed in **Section 1.7.5**, LILCO (a KeySpan predecessor company) had a contaminant fate study performed in 1995 in order to assess the potential of site-related chemical compounds impacting the water quality of the two supply wells. As part of this Remedial Investigation, a water level study was performed in order to determine if pumping of the two supply wells influenced water levels in the glacial and shallow zone of the Magothy aquifer. Groundwater modeling was also performed and summarized in the October 2006 Capture Zone Analysis Reports (**Appendix H**). A review of Nassau County Department of Health (NCDOH) water quality data was also performed as part of the Remedial Investigation to determine if site-related compounds have been detected in samples collected from the supply wells. The following sections discuss the results of each of these efforts.

5.6.2 May 1995 Contaminant Fate Study

Under contract with LILCO, P.W. Grosser Consulting Engineer & Hydrogeologist, P.C., completed a contaminant fate study and prepared a report entitled "Contaminant Fate Report Hempstead Gas Plant." Grosser's Contaminant Fate study was designed to evaluate the chemical characteristics of the compounds, the hydraulic properties of the aquifers underlying the site and the supply well construction details to determine if the detected contaminants could impact the two public water supply wells located approximately 200 feet west of the former MGP site. As part of the study, analytical modeling was undertaken to predict solute front velocities and travel times of each of the identified chemicals of concern at the site. According to P.W. Grosser's conclusions, "results of the modeling indicate that the two public supply wells should not be impacted by the chemicals of concern identified at the LILCO site" (P.W. Grosser, Contaminant Fate Report, May 1995). The relatively high adsorption rates of the PAHs together with the impermeable clay layer between the screened interval of the wells and the contaminants detected at the water table appeared to effectively impede any movement of the compounds to the wells. According to the P.W. Grosser report, when the travel times representing worst case scenarios were applied, it was concluded that it will take benzene approximately 325 to 1,368 years to reach the screened interval of the public supply wells. The P.W. Grosser study stated that the findings were supported by routine sampling of the public water supply wells for BTEX, which was not detected in these wells.

5.6.3 Continuous Water Level Gauging Study

Continuous water level gauging was performed in monitoring well clusters HIMW-01 (excluding well HIMW-01S), HIMW-03 and HIMW-04, to determine if the pumping of groundwater from the Village of Garden City public water supply wells N-10033 and N-10034, which are located due west of the site, was producing measurable effects on water levels in on-site or off-site monitoring wells. It was thought that if operation of the public supply wells was influencing water levels in the monitoring wells, then operation of the public supply wells may also be inducing vertical migration of chemical constituents present in shallow groundwater at the site to the supply wells. Water levels were measured continuously every 15 minutes in the monitoring wells using pressure transducers and data loggers. The continuous gauging was conducted during January 17-19, 2001. The water level data is plotted versus time to produce the hydrographs shown on **Figure 5-1**.

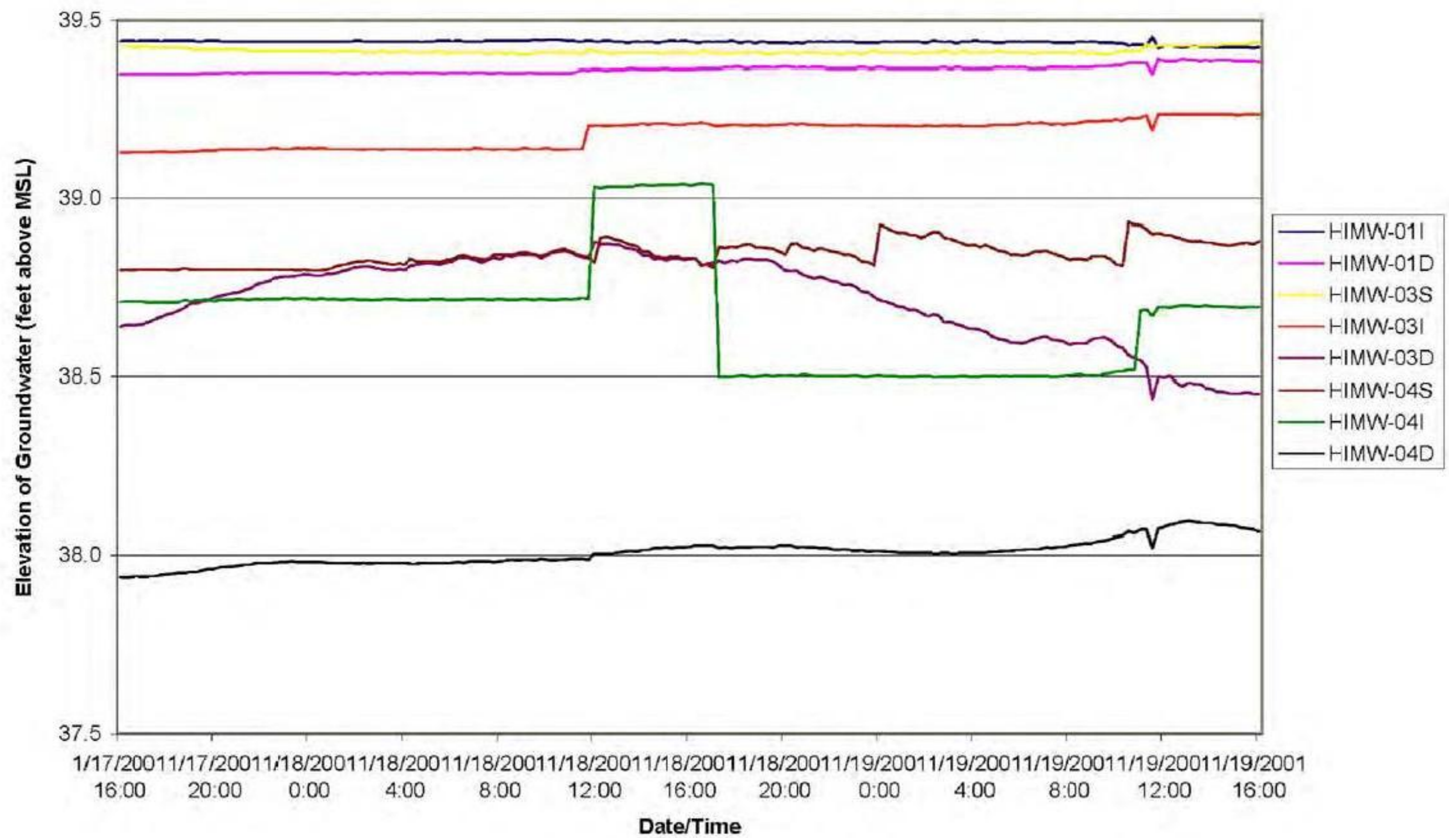
The pumping supply wells N-10033 and N-10034 are located approximately 160 feet and 230 feet west of the site, respectively, and are screened from 439 to 541 feet and 489 to 570 feet below ground surface. The off-site monitoring wells nearest the public supply wells are HIMW-03D and HIMW-04D. Screened sections of these wells are 10 feet long and start at 133 and 167 feet below ground surface, respectively. Accordingly, the screened sections of the supply and monitoring wells are separated vertically by a minimum of 272 feet, which includes approximately 200 feet of the low permeability sediments that comprise the Lower Magothy subunit. Monitoring well cluster HIMW-03 is located approximately 90 feet due east of public supply well N-10034 and approximately 125 feet south of public supply well N-10033. Monitoring well cluster HIMW-04 is located approximately 2,200 feet southwest (downgradient) from public supply well N-10034 and approximately 3,800 feet southwest (downgradient) from public supply well N-10033.

Total precipitation measured at the nearest National Oceanographic and Atmospheric Administration (NOAA) meteorological station located in New York City showed that 0.03-inch of rain was recorded on January 18, 2001 and that 0.83 inch of rain was recorded on January 19, 2001. At various periods during the gauging study, water levels were measured manually as an independent confirmation of the water levels measured by the transducers and recorded by the data logger. All manual measurements confirmed that the transducers/data loggers were working properly.

During January 19, 2001 the Village of Garden City Department of Public Works turned off the pump in public supply well N-10034 to allow for routine maintenance. It was anticipated that, if the operation of the public supply wells was influencing water elevations in the monitoring wells, then after the pump was turned off, water elevations in the affected monitoring wells would increase. The pump in public supply well N-10034 was turned off on January 19, 2001 at 11:15 a.m. and was restarted at 11:45 a.m. Excluding the instantaneous changes to water levels shown on the hydrographs on **Figure 5-1** as small spikes and abrupt breaks, no apparent changes in water levels in monitoring wells HIMW-03D and HIMW-04D were detected during the period that the public supply well pump was turned off. It is noted that the spikes in the hydrographs that occurred during the pump outage represent small instantaneous changes in water levels produced by either displacement of water when the probe used during manual measurements intercepted the water surface in the wells or as the result of an inadvertent repositioning of the transducer in the well. The capture zone modeling effort referred to in Section 1.5.9 will provide additional clarification regarding the radius of influence of the production wells.

FIGURE 5-1
HEMPSTEAD INTERSECTION STREET FORMER MGP SITE REMEDIAL INVESTIGATION

GROUNDWATER LEVELS IN MONITORING WELLS, JANUARY 17-19, 2001



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.

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GARDEN CITY/HEMPSTEAD, NEW YORK

GROUNDWATER LEVELS IN MONITORING
WELLS, JANUARY 17-19, 2001

Drn. By: JJ	Scale: AS SHOWN	Proj. No.: 02522.013.024
Ck'd By: JMP	Date: FEBRUARY 2005	Fig. No.: 5-1

As shown on **Figure 5-1**, the water level in deep monitoring well HIMW-03D increased by approximately 0.4 foot after the first day and then returned to the pre-study water levels measured at the onset of gauging. The water level in monitoring well HIMW-04D showed a slight but steady increase of approximately 0.1 foot. Although the cause of these minor changes cannot be readily discerned, they are not consistent with a response to pumping, as discussed above. No measurable changes of water levels in the other monitoring wells were detected. Although the water table is shallow and the vadose zone sediments are relatively permeable, no response was detected in the shallow wells. This may indicate that recharge by precipitation takes longer than the two-day gauging period. Accordingly, the results are inconclusive with respect to recharge rates.

Based on the relatively minor water level changes in nearby monitoring wells, the large distance separating the screen zones of pumping and monitoring wells, and the presence of approximately 200 feet of low permeability Lower Magothy sediments between the screen zones of the monitoring and public supply wells, it is concluded that the potential for chemicals in groundwater at the site to impact the public supply wells is very low or non-existent.

5.6.4 October 2006 Village of Garden City and Village of Hempstead: Capture Zone Analysis Reports

H2M Group analyzed groundwater flow in the vicinity of the former MGP site (see **Appendix H**) relative to the Village of Garden City's public water supply wells located approximately 200 feet west of the former MGP site, and the Village of Hempstead Clinton Street public water supply wells located approximately 4000 feet east of the site. Computer modeling was used to simulate groundwater flow in the aquifer system, which is the source for the public supply water wells. The modeling results indicate that the area of the former MGP site related impacts is outside of the groundwater capture zone of the water supply wells, assuming normal pumping rates based on historical data. Under the theoretical maximum pumping conditions that were modeled, the supply well capture zones move closer to the area of the former MGP site. For the adjacent Village of Garden City wells, H2M's modeling indicated that the capture zones have the potential to extend into the area of the former MGP site (at 100 and 200 feet below ground surface) under theoretical maximum pumping conditions, if those maximum pumping conditions persisted for 16 years. However, there isn't a precedent for this type of well operation for these wells or other local wells. In addition, the worst case scenario evaluated is very conservative in nature and the maximum pumping scenario is unlikely to occur for an extended time period (e.g. 16 years) because of the following reasons:

- The possibility of the Village of Garden City and/or Hempstead requiring the maximum pumping rates necessary to create the worst-case scenario is very remote since the residential and commercial community served by these wells is at or near maximum growth potential and local water supply demand is therefore not expected to increase significantly over time;

- Good engineering practice and applicable guidance documents for the water supply industry call for redundancy in water supply systems which would reduce the likelihood of any one system operating at full capacity for more than a few years time;
- There is little known precedent for water purveyors in the local region to operate a given pumping system at maximum output for the timeline required to create the worst-case scenario; and
- The model conservatively focuses on groundwater flow instead of contaminant migration and does not account for natural contaminant attenuation factors such as dispersion, advection, and adsorption, which can significantly limit contaminant mobility through the subsurface environment.

5.6.5 Water Quality for Water Supply Wells

NCDH routinely samples groundwater from public supply wells as a proactive maintenance measure and to ensure the production of good quality drinking water for the residents of Nassau County. The samples collected are analyzed for an extensive list of chemicals and physical parameters. The list of chemicals analyzed includes the BTEX compounds. The NCDH has been collecting water samples from public supply wells N-10033 and N-10034 three to four times each year since January and February 1992, respectively. The results of the NCDOH sampling and analysis show that BTEX compounds have never been detected in these wells.

6.0 CONCEPTUAL SITE MODEL

This section presents the conceptual site model and 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 in the site Remedial Investigation.

The conceptual model consolidates and integrates the results of the Remedial Investigation and Supplemental Remedial Investigation Field Program, including chemical fate and transport, and the observed on-site and off-site hydrogeologic conditions to explain the observed distribution of physical impacts and chemical constituents detected in soil and groundwater at the site. In brief, the model presented in this section identifies:

- The on-site and off site source areas where the NAPL originated;
- The NAPL transport mechanisms from these sources areas;
- The dissolution of the more mobile constituents (e.g., BTEX compounds) present in the source material(s), and the off-site migration and attenuation of the dissolved chemical constituents in groundwater; and
- Potential exposure pathways for observed soil and groundwater impacts.

NAPL does not readily dissolve in water, but exists as a separate fluid phase. MGP tar and oil released in a soil/water environment behaves as a NAPL. NAPL that is less dense than water is light non-aqueous phase liquid or LNAPL. NAPL with a density greater than water is dense non-aqueous phase liquid or DNAPL. Being lighter than water, LNAPL floats on water. DNAPL, denser than water, tends to sink through water.

As previously shown on **Drawings 4A1, 4B1, 4C1, 4D1 and 4E1**, NAPL is present at or near saturated levels in the 0 to 8 foot shallow soil zone, and in each of the deeper soil zones, primarily beneath and within the vicinity of former MGP structures. **Drawing 6A** presents a composite view for all soil zones and the areas observed to contain NAPL saturated or near saturated soils, as well as their relation to the former MGP structures.

These areas also generally exhibited the highest BTEX and PAH concentrations observed in shallow subsurface soil. Shallow soils in these areas represent potential sources for the release of volatile organics to soil vapor, and the dissolution of BTEX and PAHs into the groundwater via surface water infiltration. The shallow nature of these source areas also makes them key contributors to the identified potential exposure pathways, including the potential for direct contact, and inhalation. It appears that NAPL collected beneath and adjacent to the former structures until sufficient material accumulated to facilitate migration.

Shallow soils saturated with NAPL (including BTEX and PAHs) are also present off-site within the adjacent LIRR right of way and near the Oswego Oil Service Corporation, to the east of the site. These off-site NAPL impacts are believed to be principally associated with several documented petroleum releases at the Oswego Oil Service Corporation, and represent an additional non-MGP source of impacts to soil and groundwater.

Tar and oil associated with the former MGP site are DNAPL and will migrate vertically down through the soil column under the force of gravity. During its downward migration through the unsaturated soil column, DNAPL residues typically become trapped in the pore spaces as staining or small droplets or blebs. The predominance of high-permeability sand and gravel underlying the site appears to have allowed for isolated and narrow preferential pathways for the DNAPL. This interpretation is based on observations in the 8 foot to 24 foot interval where there is less frequent NAPL observations, especially in locations that are not directly adjacent to and beneath the former MGP structures (source areas).

When DNAPL encounters water-saturated soil at the water table, capillary forces can diminish the ability of the DNAPL to displace water from the pore spaces causing a local zone or accumulation of DNAPL saturated soil. This appears to be the case at the Hempstead site where a second zone of DNAPL accumulation exists at and above the water table in the 24 to 34 foot depth zone. Under these conditions, DNAPL saturation will typically increase until resistance at the water table is overcome by DNAPL hydrostatic pressure and there is penetration into the water saturated zone. Deep penetration into the water table appears to be isolated at this site, primarily to areas directly adjacent to and beneath the former MGP structures (source areas). The NAPL penetration below the water table in these areas appears to be limited to isolated "stringers" or "ganglia" extending down into the saturated zone. These isolated "stringers" and "ganglia" have resulted in the dissolved phase chemical constituents plume being as deep as presently observed. This suggests that the hydrostatic forces at the water table interface, and a corresponding stratigraphic transition from sands and gravel to finer-grained sands and silts near the water table, provides resistance to limit DNAPL penetration into the saturated zone.

Drawing 6B has been prepared to illustrate, in concept, the DNAPL migration mechanisms described above. This drawing illustrates in a cross sectional view the interpreted distribution of the shallow and deeper zones containing DNAPL saturated or near saturated soils. Also depicted are the isolated vertical migration pathway from the shallow to the deeper zones and stringers that extend into the saturated zone. This interpretation is based on the previously presented **Drawings 4A1, 4B1, 14C1, 4D1 and 4E1** which depict the areas where the investigation observed subsurface soil with NAPL saturated conditions and NAPL residues in the shallow (0 to 8 ft-bgs), intermediate (8 to 16 ft-bgs and 16 to 24 bgs) and deep (24 to 34 ft-bgs and greater than 34 feet deep) soil zones, respectively. Consistent with **Drawings 4D1 and 4J**, this illustration indicates that off-site horizontal NAPL migration at the water table zone extends approximately 450 feet downgradient of the site, and the thickness of NAPL saturated soils decreases significantly away from the MGP source areas.

While BTEX and, to a lesser degree, low molecular weight PAH compounds have some volatility, the majority of the source material is located several feet below grade and is not directly exposed to the atmosphere. Under such conditions, the mass of BTEX and PAHs released from soil and NAPL via evaporation is minimal. This is supported by the fact that although VOCs were detected in some shallow soil gas samples, elevated VOC concentrations were not detected in air during the on-site and off-site ambient air sampling performed as part of the Remedial Investigation.

While volatilization may occur from NAPL, and BTEX and PAH compounds, the primary transport mechanism or migration pathway is dissolution into infiltrating precipitation and groundwater flowing through soil containing residual NAPL. Once incorporated as dissolved constituents of groundwater, the BTEX and PAH constituents are transported by groundwater forming a contaminant plume or impacted zone.

Research concerning the evolution of hydrocarbon groundwater plumes similar to the BTEX/PAH plume downgradient from the site indicates that:

- Plumes tend to reach a stable shape and size even when a source is present;
- Natural biodegradation occurring within aquifers can contribute to the reduction of the hydrocarbon mass of a plume by 80 to 100 percent within 1 to 1.5 years after the absolute and complete source removal. Volatilization and advective dispersion each could account for only 3 to 5 percent of the BTEX losses in the plumes studied (P.M. McAllister, C.Y. Chang, 1994; J.P. Salanitro, 1993; Rifai, et at. 1988); and
- Plumes "shrink" or narrow (frequently longitudinally) when a source is reduced or removed.

Drawings 6C and **6D** illustrate in a cross sectional view, using colored shading for varying ranges of concentrations, how the concentrations of BTEX and PAHs are generally highest on-site near the source areas and decrease rapidly as the groundwater migrates downgradient. The observed decrease in concentrations occurs with both horizontal and vertical distance from the site. The elongate plume shape depicted both in plan view in previously presented **Drawing 4N** and here in cross sections in **Drawings 6C** and **6D** are typical of relatively soluble chemicals, such as BTEX and low-molecular weight PAHs, migrating through moderately to highly transmissive aquifers.

Groundwater data indicates BTEX and PAH concentrations decrease rapidly with increasing distance from the site. This rate of decrease is not solely the result of sorption to organic matter and dispersion and dilution. Naturally occurring biodegradation is also actively reducing the levels of these compounds. This is supported by dissolved oxygen measurements which are invariably lower within the plume as compared to those outside the plume. This indicates that dissolved oxygen migrating onto the site from upgradient areas is being consumed. An inverse correlation between dissolved oxygen and hydrocarbon concentrations has been identified as a key indicator of aerobic biodegradation (P.M. McAllister, C.Y. Chang, 1994). It is concluded that the observed reduction of dissolved oxygen is the result of active biodegradation of BTEX and PAHs in the subsurface at the site.

The observed MGP related NAPL and site hydrogeologic conditions support a conceptual site model summarized below:

1. NAPL associated with the former MGP site accumulated in the shallow site soils around the identified source areas until their sorbtive capacity was exceeded and the NAPL migrated vertically downward. The heaviest NAPL which has a tar consistency did not tend to migrate out of the shallow soils. NAPL and NAPL residual remains at or near saturated conditions in the shallow soil beneath the former source areas.

2. The vertical migration of NAPL from the near-surface source area soils appears to have occurred via isolated and relatively thin pathways. These vertical pathways can be envisioned as vertical columns extending down from the mass of material accumulated in

the near-surface source area soils. This is based on encountering significantly fewer instances of NAPL saturation in the deeper soils from 8 to 24 ft-bgs. In contrast to the shallow source area soils, the soils in the 8 to 24-foot zone exhibited isolated occurrences of near-saturated residual NAPL. This is because the vertical migration pathways are likely narrow and isolated, and as a result of this the borings did not frequently intercept these vertical pathways.

3. The vertical migration of the NAPL was impeded when it encountered the soils at and just above the water table and NAPL has accumulated to saturated and near saturated levels. Based on the observed conditions, the majority of the NAPL saturated soils occur just below 24 ft-bgs and extend down to the water table encountered an average of 30 ft-bgs. Although beneath the former source areas, some NAPL penetration into the saturated zone has occurred, NAPL has preferentially migrated horizontally along the slope of the water table extending approximately 450 feet beyond the southern site boundary. The NAPL saturation extending south of the site occurs as a thin (0 to 6-inch thick) layer at the water table interface. The NAPL in this zone exists in saturated or near saturated conditions as indicated by the fact that, although very viscous, it flows into wells screened in this area. While the NAPL is a DNAPL, it has preferred to migrate horizontally along the water table as evidenced by only isolated observations of NAPL penetration deeper into the water table primarily beneath the source areas.

4. The thickness of the NAPL saturated soils decreases significantly away from the source areas. In particular, the thickness of NAPL saturated soils off-site in the central portion of the Medical Office Bldg. parking lot is less than 1 foot compared to multiple feet thickness near the southern property line.

5. The saturated and near saturated NAPL soils in the shallow source areas and at or just above the water table are sources of dissolved phase chemical constituents (BTEX and PAH). This has resulted in the plume of dissolved phase constituent, in the shallow zone, that extends approximately 3800 feet from the site in a southwestern direction.

6. Potential exposure pathways created by the surface and near-surface source area soils will need to be addressed in the remedial plan for the site. Considering that the NAPL accumulation at the water table, and the dissolved phase plume are both at a significant depth away from the surface environment (and because the shallow groundwater is not used for drinking purposes), they are not associated with the identified potentially complete exposure pathways.

7. The shallow source area soils present the greatest potential for risk via direct contact with the soils, release of volatile organic vapors and the potential for continuing release of NAPL and dissolve phase constituents to the groundwater.

Addressing the near surface source area soils will have the greatest potential to significantly reduce the identified exposure pathways associated with the current and possible future site uses. The NAPL accumulated at and just above the water table has significantly less potential to impact current and future site uses. Considering this, the remedial alternatives evaluated for this should focus on reducing the mobility of this material, and reducing the dissolution of chemical constituents from the NAPL into the groundwater and mitigate future impacts to groundwater.

Although shallow groundwater near the site is not used for drinking purposes, and doesn't provide a potentially complete exposure pathway, alternatives to mitigate the extent of the observed plume should also be evaluated.

Remedial action(s) will be selected for the site based on the results of a Remedial Technology Evaluation, the next step in the site remediation program. In order to eliminate the identified existing and future potential exposure pathways, the Remedial Technology Evaluation will identify remedial options to address the source area shallow soil contamination. The Remedial Technology Evaluation will also evaluate alternatives to enhance attenuation of dissolved constituents in the existing groundwater plume; to reduce the mobility of NAPL accumulated at or just above the water table, and mitigate the dissolution of chemical constituents from the NAPL accumulation at the water table.

7.0 CONCLUSIONS

Based on the investigations to characterize the site conditions and identify impacts to soil and groundwater within and beyond the site the following conclusions are reached:

1. This Final RIR, considering together the results of the Remedial Investigation and Supplemental Investigation, provides an understanding of the nature and extent of the chemical constituents in the environment and identify the potential human exposure pathways and environmental risks in sufficient detail to support development and evaluation of potential remedial alternatives for the site.

    - Surface and near surface soils containing chemical constituents attributable to the former MGP operations are predominantly in areas associated with its former structures and areas of operation. Near surface soil with chemical constituents attributable to the former MGP are primarily located in close proximity to and beneath the former structures and waste water disposal areas located in the western and southern portions of the site. Field observations for these areas included odors, staining and/or sheens, as well as blebs, tar/oil droplets and/or NAPL. Lead levels slightly above the typical concentration of lead in the Eastern United States was identified in surface soils (0 to 6 inches bgs) in only one area of the site.

    - The highest concentration of MGP related residuals or NAPL were observed in two intervals: the upper 8 feet of site soils at locations proximate to the former operations, and in a zone at or near the water table interface approximately 30 feet beneath the site and extending approximately 450 feet downgradient to the south of the site.

    - Off-site sources of petroleum products and related chemical constituents from petroleum storage facilities east of the site and owned by a third party contribute to soil and groundwater impacts at the eastern edge of the site. These off-site sources have caused petroleum related NAPL and chemical constituent impacts including BTEX and PAH to soil and groundwater east of the eastern site boundary and have contributed dissolved phase petroleum constituents (BTEX and PAHs) to the site and downgradient groundwater plume.

    - Groundwater is impacted by dissolved phase MGP related chemical constituents beneath the southern portions of the site and extending off-site in the direction of groundwater flow to the southwest as a 600 to 800 feet wide plume for a distance of 3,800 feet. The dissolved phase groundwater plume exists primarily within the shallow and intermediate groundwater zones. The highest levels of groundwater impacts are located at or near the water table interface beneath and just south of the southwestern portions of the site and is associated with the residual NAPL in the soil matrix.

- 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.

2. The impacts from MGP and petroleum related materials and chemical constituents present potential direct contact and inhalation exposures for current and possible future site use scenarios, and adjacent area populations.

   - The results of the RI indicate that chemical constituents attributable to the former MGP operations are present in soil and groundwater at and downgradient (primarily to the south and southwest) of the site.

   - Chemical constituents attributable to non-MGP related off-site sources, including past and present commercial and industrial operations, past and present petroleum storage facilities, as well as chemicals generated by car and truck traffic and other internal combustion engines are also present in soil and groundwater adjacent to and downgradient of the site.

   - Potential pathways through which wildlife could be exposed to potentially hazardous materials related to former MGP activities do not warrant remedial activities because of the level of urbanization in the community and the transient nature of wildlife present.

3. The results of the investigation indicate that drinking water supplies in the community have not been impacted by chemical constituents from the site. Groundwater flow modeling performed by H2M Group (H2M) (see **Appendix H**) also 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 modeled by H2M, assuming normal pumping rates based on historical data.

4. There are no significant or imminent threats to human health that warrant an interim remedial action. The on-site risks are associated with potential contact with near surface soils, which risk is presently limited through access restrictions, surface cover in work areas and employee training.

5. The potential exposure pathways can be mitigated or eliminated by known remediation technologies that will be evaluated in the next phase of the project. Reducing or eliminating the observed impacts in the near surface source area soils has the greatest potential to significantly reduce the identified exposure pathways associated with the current and possible future site uses.

8.0 RECOMMENDATIONS

Based on the conclusions, the following recommendations are made for the site and its impacts:

- A Remedial Technology Evaluation is recommended to determine the recommended remedial measures to address NAPL, soils, and groundwater impacts from site related operations.

- To address the near surface impacts, it is recommended that the Remedial Technology Evaluation consider individually and in combination such technologies as the removal and disposal of the impacted soils, the use of a non-contact barrier over the site and the use of an in-situ treatment technology.

- The Remedial Technology Evaluation should evaluate remedial alternatives to reduce or eliminate the release of dissolved phase constituents from the accumulated NAPL material near the water table interface. Alternatives to consider include methods of NAPL removal, and in situ control and/or stabilization.

- The Remedial Technology Evaluation should also evaluate the feasibility of remedial alternatives to reduce the dissolved phase plume by enhancing the naturally occurring biodegradation.

- The Remedial Technology Evaluation will need to consider the contributions of the adjacent off-site sources of NAPL and chemical constituents associated with the nearby fuel terminals east of the site. These sources should be addressed by the responsible party so that the site remediation plan can be more effective.

- In conjunction with the Remedial Technology Evaluation, additional soil gas sampling is recommended near on-site locations where extensive impacts have been identified, as well as at the adjacent Village of Garden City property, and the areas east of and west of the Medical office Building.

- Quarterly monitoring of selected groundwater wells is recommended, including groundwater measurements, NAPL measurements and NAPL recovery. Additionally, quarterly groundwater sampling should be conducted for the center line area of the groundwater plume to monitor the concentration and extent of previously identified chemical constituents and to monitor natural attenuation parameters to determine the extent of natural attenuation. The monitoring and sampling program should be conducted over a two year period to provide a database to be utilized as part of the Remedial Technology Evaluation. After the two years of data is collected, the program should be scaled to be consistent with the site data needs at that time.

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APPENDIX A

Database Search Report

APPENDIX B

FOIL File Request

APPENDIX C

Qualitative Human Exposure Assessment/Fish and Wildlife Resources Impact Analysis

APPENDIX D

Cut and Plug IRM Analytical Results

APPENDIX E

Boring Logs

APPENDIX F

Analytical Methods and Detection Limits

APPENDIX G

Analytical Results - Data Summary tables

APPENDIX H

Water Supply wells – Capture Zone Analysis Reports