Focused Feasibility Study
Patchogue Former Manufactured Gas Plant Site
NYSDEC Site No. 1-52-182
Village of Patchogue
Suffolk County, New York

Prepared for

National Grid, Hicksville, New York

May 2011

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175 East Old Country Road

Hicksville, New York 11801

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Project Number: 138893.306

Brown AND Caldwell

Associates

110 Commerce Drive

Allendale, New Jersey 07401

Certification Statement

I, Jeffrey Caputi, certify that I am currently a NYS registered professional engineer, this Focused Feasibility Study was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10), and all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

Jeffrey R. Caputi, P.E., CHMM, QEP
N.Y.P.E. License Number 082196

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Date

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List of Abbreviations

AST	Aboveground Storage Tank
AWQS	Ambient Water Quality Standards
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
BC	Brown and Caldwell Associates
BUG	Brooklyn Union Gas
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response Compensation and Liabilities Act
COCs	Contaminants Of Concern
COPC	Chemicals of Potential Concern
COPEC	Chemicals of Potential Ecological Concern
DER-10	Division of Environmental Remediation, DER-10, Technical Guidance for Site Investigation and Remediation (May 2010)
FFS	Focused Feasibility Study
HASP	Health and Safety Plan
ISS	In-Situ Solidification
IC/EC	Institutional Controls and Engineering Controls
msl	Mean Sea Level
MGP	Manufactured Gas Plant
NAPL	Non-Aqueous Phase Liquids
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
POTW	Publicly Owned Treatment Works
PSA	Preliminary Site Assessment
QHHEA	Qualitative Human Health Exposure Assessment
RAO	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RDWP	Remedial Design Work Plan
RI	Remedial Investigation
RIR	Remedial Investigation Report
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SCGs	Standards, Criteria, and Guidance
SMP	Site Management Plan
SSM	Shallow-Zone Soil Mixing
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List

TAGM	Technical and Administrative Guidance Memorandum
TCN	Total Cyanide
VOC	Volatile Organic Compound
WWTP	Wastewater Treatment Plant

Executive Summary

This Focused Feasibility Study (FFS) documents the development, evaluation and recommendation of a remedial alternative to address environmental impacts at the Patchogue Former Manufactured Gas Plant (MGP) Site (the Site). The Site is located at 234 West Main Street in the Village of Patchogue, Suffolk County, New York and was the location of a coal gasification plant and high pressure gas distribution facility from the early 1900's until the 1970's, when operations ceased.

This FFS has been prepared in accordance with the requirements of Order on Consent D1-001-99-05 signed between KeySpan Corporation (a predecessor company of National Grid) and the New York State Department of Environmental Conservation (NYSDEC). The Order on Consent was signed September 30, 1999. The development of an FFS is a requirement of the Order on Consent based on the findings of the presence of contamination requiring remedial action. The recommendation to prepare the FFS was presented in the NYSDEC-approved "Final Remedial Investigation Report for the Patchogue Former MGP Site, Patchogue, Suffolk County, New York" (RIR) dated December 2009 as prepared by TetraTech EC, Inc. The RIR also presented a summary of previous assessment/investigation activities conducted prior to the RI on the Site. The results of this previous assessment/investigation were documented in a Preliminary Site Assessment (PSA) prepared by Vanasse Hangen Brustlin, Inc. (VHB) and dated March 2002.

As detailed in the RIR, the Site is informally divided into three areas: the Northern Area, the Central/Core Area, and the Southern Area. The majority of the former MGP operations occurred within the Central/Core Area of the Site. The results of the RI and subsequent pre-design investigations indicated that impacts consistent with former MGP operations are present at the Site. With regard to specific environmental media of concern, soils impacted by MGP-tar (source materials) were visually noted in the subsurface soils in portions of the Central/Core Area (i.e., the area of the former MGP operations). The tar is characterized as a non-aqueous phase liquid (NAPL). The majority of the tar/NAPL mass is situated in the upper ±5 to ±10 feet of soil below ground surface (bgs). At depths below ±10 feet bgs, tar/NAPL was encountered less frequently, usually as thin layers, lenses, grain coatings or blebs, separated by intervals of soil with no visible impacts. Locally, the tar/NAPL was encountered at depths of nearly 23 feet bgs. Laboratory analyses of soil samples obtained from this area indicated that concentrations of BTEX (benzene, toluene, ethylbenzene and xylenes) compounds and PAH (polycyclic aromatic hydrocarbon) compounds above NYSDEC Soil Cleanup Objectives (SCO) are associated with the soils where tar/NAPL was encountered, and that in intervals where no tar/NAPL was observed, the concentrations in soil samples were either non-detect or below SCOs. Based on the above, soils at the Site, specifically in the Central/Core Area of the Site, are a medium of concern to be addressed as part of the FFS process.

Isolated impacts to groundwater were detected in two monitoring wells (MW-5 and MW-6) in the area of the tar-impacted soils. As such, because of the isolated exceedances of the Class GA groundwater quality criteria noted in samples from these two wells, groundwater a medium of concern to be addressed as part of the FFS process. However, it should be noted that the groundwater concentrations were considered low and are anticipated to diminish after the tar-impacted soils (source material) are addressed.

Sediments were sampled both upstream and downstream of the Site with the results noting minor impacts in both areas. The RIR determined that sediments will not impact ecological or human health receptors and, therefore, are not an environmental medium of concern and will not require remedial activities. Further evaluation activities were performed with regard to the sediments as part of a pre-design investigation performed as part of this FFS. This additional evaluation determined that based on groundwater monitoring at wells located adjacent to the river, analytical results from samples obtained from these wells, the observations from the sediment probing activities and the distribution of PAHs noted during the sediment sampling activities, no indications of a subsurface migration pathway for MGP impacts from Site to the river have been identified. Based on the above, neither the former MGP operations that were conducted on-Site nor the current status of the Site appears to have had an impact on the sediments. Therefore, the sediments within the Patchogue River are not a medium of concern to be addressed as part of this FFS.

Surface water sampling revealed no exceedances of NYSDEC Ambient Water Quality Standards and Guidance Values for Class C Surface Water. Therefore, surface water is not an environmental medium to be addressed as part of the FFS process.

Lastly, sub-slab soil gas, indoor air and ambient air samples were collected on-Site and off-Site. Volatile organic compounds (VOCs) were detected in the indoor air sample. MGP-related constituents were not detected at concentrations above indoor air screening criteria.

The FFS has been prepared in accordance with the substantive portions of Title 6 of the New York Code of Rules and Regulations Part 375 for remedial action selection, as well as the NYSDEC's "Technical and Administrative Guidance Memorandum (TAGM) #4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites" dated May 1990 and the *"Division of Environmental Remediation, DER-10, Technical Guidance for Site Investigation and Remediation"* dated May 2010.

In addition, the general framework for the FFS was discussed during a March 9, 2010 conference call among representatives of the NYSDEC, National Grid, and Brown and Caldwell Associates (BC). The technical aspects of this discussion, as well as the findings of pre-design investigation activities, have been incorporated into the FFS. This included the decision to excavate soil on the adjacent property (east of the Site) where petroleum impacts were identified and were assumed to be associated with on-Site historic operations. The Draft FFS was submitted to the NYSDEC on June 28, 2010. Based on discussions generated from the NYSDEC's review of the document, additional investigation activities (Supplemental Pre-Design Investigation) were conducted to further refine the horizontal and vertical limits of the impacted materials to be addressed in the FFS. Based on the additional information gathered as a result of the supplemental investigation activities, refinements to the remedial alternatives to be evaluated and further evaluation of potential remedial technologies, the June 2010 Draft FFS was revised and resulted in a Revised Draft FFS. The Revised Draft FFS was submitted to the NYSDEC on March 4, 2011. Based on comments received from the NYSDEC following their review of the Revised Draft FFS, this FFS (Final Report) was generated.

The FFS includes the establishment of remedial action objectives (RAOs) to address the risks posed by the presence of contaminants at concentrations in excess of the cleanup objectives and cleanup levels established for the Site (6 NYCRR Part 375 (soils) and NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 (groundwater)). The NYSDEC remedial program identifies the goal for site remediation under 6 NYCRR Sub-Part 375-2.8(a) as "…restore that site to pre-disposal conditions, to the extent feasible. At a minimum, the remedy selected shall eliminate or mitigate all significant threats to the public health and to the environment presented by contaminants disposed at the site through the proper application of scientific and engineering principles and in a manner not inconsistent with the national oil and hazardous substances pollution contingency plan as set forth in section 105 of CERCLA, as amended as by SARA."

Where site restoration to pre-release conditions is not feasible, the NYSDEC may approve an alternative criteria based on the site specific conditions as stated in 6 NYCRR Sub-Part 375-2-8(b)(1): "The remedial party may propose site-specific soil cleanup objectives which are protective of public health and the environment based upon other information."

General response actions (GRAs) are then developed for the impacted media (soil and groundwater) that can address the RAOs. The RAOs developed for soil and groundwater on the Site are as follows:

Public Health Protection

Groundwater

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards
- Prevent contact with contaminated groundwater.

Soil

- Prevent ingestion/direct contact with contaminated soil.

Soil Vapor

- Address exposures to the public related to soil vapor intrusion into buildings.

Environmental Protection

Groundwater

- Remove the source of ground or surface water contamination.
- Restore the groundwater aquifer to meet ambient groundwater quality criteria, to the extent feasible.

Soil

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

NAPL

- Remove free product/NAPL identified at the site to the extent technically practicable.
- Eliminate through removal, treatment and/or containment the free product/NAPL as source of contamination to other environmental media.

Soil Vapor

- Eliminate, to the extent practicable, the impact of contaminants in soil or groundwater to soil vapor.

The recommended remedial alternative for the Site was developed to meet the above RAOs.

The identification and screening of technologies applicable to each GRA is the next step in the FFS process. Following the identification of process options for the retained technologies, representative process options are combined to form remedial alternatives. The remedial alternatives evaluated for the Site included:

1. **Alternative 1** – No Action
2. **Alternative 2** – Engineering and Institutional Controls, Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials
3. **Alternative 3** – Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)
4. **Alternative 4** – Excavation of MGP Tar-Impacted Source Materials
5. **Alternative 5** – In-Situ Solidification of MGP Tar-Impacted Source Materials

In addition, each of the above remedial alternatives, with the exception of Alternative 1, included three common elements, as follows:

- **Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials** – Each alternative, with the exception of Alternative 1, includes addressing the off-Site impacts identified during the remedial investigation activities on the property to the east of the Site.
- **Post-Remedial Groundwater Monitoring Program** – A groundwater monitoring program to monitor the groundwater for MGP-related contaminants after implementation of the remedial alternative is included with each alternative with the exception of Alternative 1 (No Action).
- **Engineering and Institutional Controls** – The establishment of engineering and institutional controls at the Site are also a common component of all alternatives with the exception of Alternative 1 (No Action) and Alternative 3 (since this alternative includes remediation to pre-disposal conditions).

Recommended Remedial Alternative

The remedial alternatives are screened based on criteria consistent with the guidelines established in TAGM 4030. Based on the results of the comparative analysis, Alternative 5 --In-Situ Solidification (ISS) of MGP Tar-Impacted Source Materials--is the recommended remedy. Alternative 5 achieves the RAOs established for the Site and complies with the SCGs (Section 4). Alternative 5 achieves the RAOs for the Site through the ISS of all identified MGP tar-impacted source materials by mixing the MGP tar-impacted soils with solidification agents (e.g., cement, bentonite, and/or other additives) to reduce the mobility of the constituents in the soil. The reduction in mobility coupled with the decrease in hydraulic conductivity of the solidified mass would limit the interaction between constituents and groundwater. Alternative 5 also includes engineering and institutional controls to address any residual impacts that may remain on the Site after implementation of the recommended remedial alternative. The engineering controls will consist of the establishment of an soil cap over the portion of the Site formerly subject to filling activities. The institutional controls will consist of the establishment of an environmental easement to limit future use of the Site and the development of a Site Management Plan, including a Health and Safety Plan, to govern future soil disturbing activities. Solidifying the source material is anticipated to address the isolated exceedances of the Class GA groundwater quality criteria identified in samples from MW-5 and MW-6. Alternative 5 presents the best overall protection of public health and the environment during implementation of the remedial alternative (short-term impacts), and reduces the toxicity and mobility of impacted media, while offering long-term permanence by solidifying the source materials in a solid matrix.

In summary, Alternative 5, the recommended remedy, includes the following:

- Excavation and off-site disposal of on-site fill materials to a depth of two feet bgs from the Central/Core Area to allow for installation of a soil cap.
- In-situ solidification of MGP tar-impacted source materials.
- Excavation and off-site disposal of petroleum -impacted source materials on the adjacent property to the east (off-site).
- Engineering controls (soil cap (on-site) and pavement cap (off-site), fencing with lockable gates).
- Institutional controls (environmental easement, Site Management Plan (SMP), and Health and Safety (HASP);
- Post-remedial groundwater monitoring program.

Section 1

Introduction

1.1 Introduction and Scope

This Focused Feasibility Study (FFS) documents the development, evaluation and recommendation of a remedial alternative to address environmental impacts at the Patchogue Former Manufactured Gas Plant (MGP) Site (i.e., herein referred to as the Site). The Site is located at 234 West Main Street in the Village of Patchogue, Suffolk County, New York. This FFS has been prepared in accordance with the requirements of Order on Consent D1-001-99-05 signed between KeySpan Corporation (a predecessor company of National Grid) and the New York State Department of Environmental Conservation (NYSDEC). The Order on Consent was signed September 30, 1999. The development of an FFS is a requirement of the Order on Consent based on the findings of the presence of contamination requiring remedial action. The recommendation to prepare the FFS was presented in the NYSDEC-approved "Final Remedial Investigation Report for the Patchogue Former MGP Site, Patchogue, Suffolk County, New York" (RIR) dated December 2009 as prepared by TetraTech EC, Inc.

1.2 Applicable Regulations

The FFS has been prepared in accordance with the substantive portions of Title 6 of the New York Code of Rules and Regulations Part 375 for remedial action selection as well as the NYSDEC's "Technical and Administrative Guidance Memorandum (TAGM) #4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites)," dated May 1990, and the "Division of Environmental Remediation, DER-10, Technical Guidance for Site Investigation and Remediation" dated May 2010.

In addition, the general framework for the FFS was discussed during a March 9, 2010 conference call between representatives of the NYSDEC, National Grid, and Brown and Caldwell Associates (BC). The technical aspects of this discussion, as well as the findings of pre-design investigation activities, have been incorporated into the FFS. The Draft FFS was submitted to the NYSDEC on June 28, 2010. Based on discussions generated from the NYSDEC's review of the document, additional investigation activities (Supplemental Pre-Design Investigation) were conducted to further refine the horizontal and vertical limits of the impacted materials to be addressed in the FFS. Based on the additional information gathered as a result of the supplemental investigation activities, refinements to the remedial alternatives to be evaluated and further evaluation of potential remedial technologies, the June 2010 Draft FFS was revised and resulted in a Revised Draft FFS. The Revised Draft FFS was submitted to the NYSDEC on March 4, 2011. Based on comments received from the NYSDEC based on their review of the Revised Draft FFS, this FFS (Final Report) was generated.

1.3 Purpose and Report Organization

The purpose of this FFS is to identify and evaluate remedial alternatives to address environmental impacts related to the former MGP, these being primarily the presence of coal tar in the form of dense non-aqueous phase liquids (DNAPLs) underlying the Site. As discussed in the December 2009 RIR prepared by TetraTech EC, Inc. and summarized in this FFS Report, the principal area of DNAPL (i.e., tar) was found to be in soils located beneath and in the Central/Core Area of the Site in the area of the former MGP operations.

The FS process begins with the establishment of remedial action objectives (RAOs) to address the risks posed by the presence of contaminants at concentrations in excess of the cleanup objectives and cleanup levels established for the Site (6 NYCRR Part 375 (soils) and NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 (groundwater)). General response actions (GRAs) are then developed for the impacted media that can address the RAOs. The identification and screening of technologies applicable to each GRA is the next step in the FS process. Following the identification of process options for the retained technologies, representative process options are combined to form a remedial alternative. The remedial alternatives are screened to determine which alternatives are candidates for detailed evaluation consistent with the guidelines established in TAGM 4030. The detailed evaluation is conducted by applying the following criteria:

- Overall protection of public health and the environment;
- Compliance with Standards, Criteria and Guidelines (SCGs);
- Short-term effectiveness;
- Long-term effectiveness;
- Reduction of toxicity, mobility or volume through treatment;
- Implementability;
- Cost; and
- Land use

The results of this FFS will be used for the selection of a final remedial action for the Site, the preparation of a Record of Decision (ROD) by the NYSDEC, and the preparation of a remedial design, as described in the Order on Consent.

This FFS Report is comprised of eight sections and was organized in accordance with Section 4.4(b) of DER-10 “Remedy Selection Reporting Requirements”. The organization and content of the report are as follows:

- **Executive Summary** - This section includes a brief summary of the FFS.
- **Section 1** - Introduction and Scope - This section describes the scope of this report.
- **Section 2** - Site Description and History- This section describes the Site features, location, surrounding area and other historical site information.
- **Section 3** - Summary of Remedial Investigations and Exposure Assessments - This section summarizes the previous site and remedial investigations (including contaminants of concern and area extent) and potential exposures to contaminated media.
- **Section 4** - Remedial Action Goals and Objectives - This section lists the goals and objectives of the remedial alternatives evaluated for this Site.
- **Section 5** - General Response Actions - This section describes the general types of remedial actions that were evaluated for this Site.
- **Section 6** - Technology Identification and Screening - This section includes a listing of potential remedial technologies that met the general response actions and a preliminary evaluation of each technology with regard to effectiveness, implementability and cost.
- **Section 7** - Remedial Alternatives Development and Analysis - This section includes a description of the remedial alternatives assembled from the technology screening and the evaluation of each remedial alternative with regard to the evaluation criteria in DER-10.
- **Section 8** - Recommended Remedial Alternative - This section describes the remedial alternative recommended for implementation at this Site and the basis for the recommendation.

Section 2

Site Description and History

2.1 Site Description

The Patchogue Former MGP Site is located at 234 West Main Street in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York (Figure 2-1). The Site is located in a mixed commercial and residential area, and is currently undeveloped and vacant. The perimeter of the Site is secured with a locked perimeter fence. The Site is rectangular in shape and encompasses approximately 3.6 acres with a maximum length (north-south) of approximately 680 feet and a maximum width (east-west) of 180 feet. The average elevation of the Site is 5 feet above mean sea level (msl) with relatively flat topography. The Site is, in general, bordered as follows:

- To the north by West Main Street beyond which is a property occupied by Briarcliff College and Patchogue Lake;
- To the east by an unpaved access driveway and two commercial properties beyond which is the Patchogue River;
- To the south by a residential area and an overflow pond to the south/southwest; and
- To the west by a steep slope beyond which are a residential area and a municipal storage yard.

As detailed in the RIR, the Site is informally divided into three areas: the Northern Area, the Central/Core Area, and the Southern Area. The Northern Area is a rectangular area comprising the northern portion of the Site bordered by West Main Street on the north, an unpaved access road beyond which is a commercial property to the east, the Central/Core Area to the south and a commercial area of Patchogue, fronting West Main Street, to the west. The Northern Area is enclosed with a chain link fence and is mostly clear of vegetation. The surface is comprised of two adjacent concrete slabs with a combined size of approximately 240 feet by 60 feet.

The Central/Core area consists of the central portion of the Site where the majority of the former MGP structures were located. The Central/Core Area is bounded by the Northern Area to the north, a commercial property and the Patchogue River to the east, the Southern Area to the south and commercial/residential area of Patchogue to the west. The Central/Core area is rectangular in shape and is enclosed by a chain-link fence. This area is sparsely vegetated and the ground surface, comprised by fill, is uneven. A steep slope runs along the western boundary of the Site, beyond which is a residential area and municipal storage yard.

The Southern Area is bounded to the north by the Central/Core Area and comprises the tapered end of the property with the Patchogue River forming the eastern boundary of this area and with commercial/residential areas to the west. This area has considerable concrete debris and dense vegetation. The overall layout of the Site is shown on Figure 2-2.

2.2 Site History

A detailed description of the Site history is presented in the RIR (TetraTech EC, Inc., 2009) and is summarized below for reference.

As stated in the RIR and PSA and per information provided by National Grid, the MGP was constructed by the Patchogue Gas Company in approximately 1906 and produced gas continuously through 1917. It was then operated on a standby basis until 1925 when it was modified to a gas distribution facility. The Site was owned and operated by the Patchogue Gas Company either independently (1904 through 1926) or under ownership of the Long Island Lighting Company (LILCO, 1927). In 1914, the facility was converted into a high pressure gas distribution and storage facility. High pressure gas purchased from Suffolk Gas & Electric (Bay Shore) was distributed from the Patchogue Plant from 1915 through 1917. From 1918, the gas supplier is identified only as LILCO. From 1922 through 1925, emergency gas production occurred at the Site.

Retorts are reported to have been identified on the Site during review of Sanborn Maps which suggests that the initial gas production process was coal gasification. However, the Lowe water gas process was listed in Brown's Directory as being used at the Site. A boiler (a typical water gas plant facility feature) is depicted in the Retort House on a Sanborn Map. Based on the time when gas production started, the water gas process is likely to have been used.

Review of a 1926 Sanborn Map included in the PSA (VHB, 2002) indicated a group of seven horizontal aboveground storage tanks (ASTs) were installed sometime after 1910. According to documentation from KeySpan (now National Grid), these ASTs were used for additional gas storage capacity at the Site and are incorrectly labeled as "oil tanks" on the Sanborn Maps.

The 60,000 cubic foot gas holder, initially present on the Site, is consistent with the limited production of water gas at the facility. A gas sphere present at the Site during later operations stored gas under high pressure and is consistent with the use of the Patchogue facility for distribution of gas produced elsewhere.

The distribution facility remained until the 1970s when LILCO sold the property to third parties. From the mid-1970s through early 2005, the Site was used as a refrigeration equipment and scrap storage yard. LILCO was acquired by Brooklyn Union Gas in 1999 and the two merged to form KeySpan. KeySpan reacquired the Site in 2005 for purposes of remediation. National Grid acquired KeySpan in 2008 and currently maintains ownership of the Site.

On September 30, 1999, KeySpan (a predecessor company to National Grid) entered into Order on Consent D1-001-99-05 with NYSDEC to conduct a Preliminary Site Assessment (PSA) of the Former Patchogue MGP Site. The PSA was conducted in 2001 and the results were documented and submitted to the NYSDEC in March 2002 in a report titled "Preliminary Site Assessment Report" (VHB, 2002). In 2008, RI activities were performed and the results were documented and submitted to the NYSDEC in the RI Report (TetraTech EC, December 2009).

Section 3

Summary of Remedial Investigations and Exposure Assessments

3.1 Summary of Remedial Investigation

The Final Remedial Investigation Report (RIR), as prepared by TetraTech EC, Inc., was submitted to the NYSDEC in December 2009. The RI included the sampling and analysis of soils, sediments from the Patchogue River, groundwater, surface water, and soil vapor. The purpose of the RI, as stated in the RIR, was to identify and delineate the nature and extent, on and off-Site, of impacts from the former on Site MGP operations.

The RIR also presented a summary of previous assessment/investigation activities conducted prior to the RI on the Site. The results of this assessment/investigation were documented in a Preliminary Site Assessment (PSA) prepared by VHB and dated March 2002.

This section presents a summary of the previous investigations performed at the Site. The following summaries of the investigation activities were obtained from the RIR (TetraTech EC, Inc., 2009).

3.1.1 Preliminary Site Assessment

In July 2001, KeySpan (a predecessor company of National Grid) performed a PSA (VHB, 2002) and a limited sampling program at the Site. The results were submitted to the NYSDEC in a PSA Report dated March 2002 prepared by VHB. The PSA included a detailed records review, site reconnaissance, field survey, sample collection, sample analysis, and reporting. Sampling activities included the collection of surface soil, subsurface soil, groundwater, surface water, sediment, and test trench sampling and laboratory analysis of the samples. The sampling efforts also included the collection of samples from areas indicating visible residual impacts (e.g., stained soils, sheens, tars/oils, and odors) potentially attributable to the former MGP operations.

As detailed in the PSA, the following sampling activities were conducted:

- Thirteen (13) surface soil samples were collected from a depth interval of 0 to 2 inches below ground surface (bgs);
- Fourteen (14) soil borings were installed and continuous core samples were collected for purposes of detecting the presence of contaminants, MGP wastes and/or foreign debris in the subsurface as well as determining the physical characteristics of the soil;
- Seven temporary monitoring wells were installed to assess the potential for both on-Site migration from upgradient sources (to the north and west) and off-Site migration of chemicals associated with the historical MGP operations (to the south and east). The wells were screened at depths between zero and 12 feet bgs depending on the local groundwater elevation;
- Three (3) sediment and surface water samples were collected from the Patchogue River at locations both upstream and downstream of the Site;

- A fourth sediment and surface water sample was gathered from the overflow pond located south/southwest and hydraulically downgradient of the Site;
- Three (3) narrow and shallow test trenches were installed on-Site and sampled. Seven composite samples were collected from the three test trenches at depths ranging from 0.5 to 3.0 feet bgs; and
- One (1) groundwater sample was collected upgradient of the Site.

Samples from all environmental media were analyzed for benzene, ethylbenzene, toluene, and xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs), the Resource Conservation and Recovery Act (RCRA) eight metals (i.e., total arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), and total cyanide (TCN). In addition, the groundwater sample obtained from the area upgradient of the Site was analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), the RCRA eight metals, and TCN.

As detailed in the PSA, laboratory analysis of the samples collected indicated the presence of BTEX in a limited number of surface and subsurface soil samples; PAHs in surface and subsurface soils, groundwater and sediment; and inorganic constituents in all media (surface and subsurface soil, groundwater, surface water and sediment). In addition, chlorinated VOCs, including total 1,2-dichloroethene (1,2-DCE), tetrachloroethene (PCE), and trichloroethene (TCE) were detected in groundwater upgradient of the Site at concentrations below the NYSDEC principal organic contaminant standard for groundwater.

3.1.2 Remedial Investigation

The RIR (TetraTech EC, Inc., 2009) summarizes the remedial investigations conducted in 2008. The purpose of the RI was to further identify and delineate the nature and extent of MGP impacts on- and off-Site, the fate and transport of the MGP impacts, and to identify former MGP structures. The brief summary below was obtained from the RIR and is sorted by medium or assessment type.

Site Geology

The Site is essentially flat with an elevation less than 10 feet msl. A general description of the stratigraphy of the Site notes a two to five foot fill layer consisting of sand, silt, gravel and debris covering the Central/Core area of the Site. Peat was observed in the top two feet of the western portion of this Central/Core area. Sand was noted to underlie the fill and peat to a depth of at least 25 feet bgs which was the terminal depth of the RI borings. Although not noted in the RIR, the peat is likely part of recent floodplain deposits associated with the Patchogue River. The underlying sand is likely Pleistocene Age glacial outwash deposits.

Site Hydrogeology

Groundwater monitoring wells were installed as part of the RI activities. Shallow wells were screened across the water table; deep wells were screened approximately 20 to 25 feet bgs. Groundwater levels obtained in 2008 measured between 2.78 and 5.41 feet msl. Groundwater flow was noted to be in a south southeast direction towards the Patchogue River.

On-Site groundwater is not utilized as a drinking water source. The Village of Patchogue is serviced by a public, municipal water source. The Village of Patchogue's Department of Public Works indicated that the installation of private water wells is prohibited.

Surface Soils

A total of 32 surface soil samples were collected during the RI along the Central/Core Area and Southern Area from the depth interval of 0 to 6 inches bgs. Some were collected from the top two inches (for development of the Qualitative Human Health Exposure Assessment (QHHEA)) with the remainder collected from the 0 to 6 inch interval (for development of the Fish and Wildlife Resources Impact Analysis (FWRIA). BTEX compounds in surface soils was detected at very low concentrations in only one (PASB 30) of the 32 surface soil samples. The concentrations of total PAHs ranged from non-detect in three samples to 168.1 mg/kg in sample PASB-28-0-0.2. The location of this soil sample, as well as the locations of RI samples referenced in this summary is shown on Figure 3-1. The sample designation references the sample location (PASB-28) and the depth of the sample (0 to 0.2 feet bgs). Cyanide concentrations in the 32 surface soil samples ranged from non-detect in 22 samples to 3.40 mg/kg in sample PASB-32-0-2.

No surface soil samples were collected from the Northern Area of the Site during the performance of the RI. Laboratory analysis of a soil sample collected during the PSA from this area did not reveal the presence of any contaminants at concentrations in excess of NYSDEC criteria (NYSDEC Remedial Program Soil Cleanup Objectives, Restricted Use Cleanup Objectives, 2008).

Analytical results from the surface soil samples collected from the Central/Core Area and the Southern Area did not reveal the presence of contaminants at concentrations in excess of NYSDEC soil criteria (referenced above) in any of the surface soil samples with the exception of one. The one soil sample was obtained from location PASB-23-0-0.2, located within the Central/Core Area of the Site, and noted a concentration of methylene chloride in excess of NYSDEC soil criteria (referenced above).

With regard to surface soils, the RI concluded that based on the qualitative and quantitative results of the PSA and RI, sufficient information existed that no further investigation of surface soil was necessary or recommended. Further, the RI determined that sufficient data were obtained to quantitatively assess the risk associated for each receptor. It was determined that, without remedial activities, redevelopment of the Site would potentially expose future receptors to surface soils.

Subsurface Soils

A total of 58 subsurface soil samples were collected during the RI. The subsurface soil samples were analyzed for TCL VOCs, TCL SVOCs, total organic carbon (TOC), and TCN. Total BTEX concentrations ranged from non-detect in 40 of the 58 samples to 342.1 mg/kg in sample PASB-25-1-6. Total PAHs concentrations ranged from non-detect in 16 samples to 16,410 mg/kg in sample PASB-22-3-5. Cyanide concentrations in the 58 surface soil samples ranged from non-detect in 50 samples to 5.74 mg/kg in sample PASB-41-6-8.

No field indications (i.e., visual, olfactory, etc.) were identified in the subsurface soil samples obtained in the Northern Area. Analytical results from subsurface soil samples collected from the Northern Area verified the absence of impacts as no contaminants were noted at concentrations exceeding the applicable cleanup criteria (NYSDEC Remedial Program Soil Cleanup Objectives, Restricted Use Cleanup Objectives, 2008).

The logs of the borings from the Central/Core area of the Site indicate that inspection of the soil cores identified residual MGP impacts in this area including staining, sheens, blebs, globs, lenses, and tar coating of soils. The Central/Core area of the Site generally corresponds with the historical location of the gas holder, purifier house boiler, and gas storage tanks. Within this area where MGP impacts are visually evident, tar saturated soil or solid tar was observed in some locations. These impacts were identified in the subsurface sand, predominantly in the upper 11 feet bgs. However, sheens and staining were noted to extend approximately to depths of 15 feet bgs at boring location PASB-25 and 20 feet bgs at boring location PASB 30.

With regard to the Southern Area, none of the subsurface soil samples exhibited MGP visible or analytical impacts. Further, results from the analysis of subsurface soil samples obtained from the Southern Area did not reveal the presence of any contaminants at concentrations in excess of applicable NYSDEC cleanup criteria (referenced above) with the exception of one sample. The one sample, PASB-MW4D-5-10 noted the presence of acetone at a concentration in excess of NYSDEC criteria (referenced above).

Subsurface soil borings were also installed on the eastern side of the Patchogue River opposite the Site. No evidence of impacts was noted in these borings. Therefore, no soil samples were collected for laboratory analysis.

Two test trenches were excavated and identified the location of the former gas holder. Trench 1 extended east to west in the vicinity of the holder and Trench 2 extended southwest to northeast intersecting Trench 1. No soil samples were collected for analysis from the trenches. During investigation activities performed during the PSA, MGP impacts were observed in the trenches.

Geologic cross-sections noting the stratigraphy of the Site as well as visual observations of MGP-impacts documented during the performance of the PSA and RI are presented on Figure 3-2. The locations and alignment of the cross-sections are depicted on Figure 3-1.

Groundwater

Two rounds of groundwater samples were collected from the overburden monitoring wells installed during the RI. The first round of sampling was conducted in March 2008 on the eight existing monitoring wells that had been installed to date. The second round of sampling was conducted in July 2008 and included a total of 14 monitoring wells including wells installed subsequent to the March 2008 sampling event. All groundwater samples collected from both rounds was analyzed for TCL VOCs, TCL SVOCs, and TCN. Concentrations of BTEX and some PAH compounds were detected above the New York State Ambient Water Quality Standards (AWQS) and Guidance Values for Class GA Groundwater (Class GA criteria) at only two wells, MW-5 and MW-6. These wells are located near the center of the former MGP. The concentrations of some PAH compounds were also above the Class GA criteria at MW-9S located adjacent to the Patchogue River. However, these compounds were not detected in samples collected from MW-9S during subsequent monitoring events (March 2009 and September 2009). Phenol concentrations were also detected above the Class GA criteria in MW-5 during one sampling event. Trichloroethene (TCE) was detected in samples obtained from MW-3 which is also located adjacent to the Patchogue River. TCE is not considered as being potentially related to the Site.

The RI noted contaminant levels in monitoring wells located downgradient of the Central/Core area to be relatively low. The RI concluded that these contaminants will diminish after the soil source materials are remediated. Further, drinking water in Patchogue is provided through the municipal water supply which relies on a single-source aquifer. The one public water supply well identified during a well search was determined to be located hydraulically side-gradient of groundwater flow at the Site. The RI determined that two potable water wells located downgradient of the Site will not be impacted by contaminants from the Site based on their distance from the Site.

Based on the results detailed in the RIR and summarized above, the RIR recommended bi-annual groundwater sampling of all 14 monitoring wells. Laboratory analysis of the samples was recommended to include BTEX, PAHs, and TCN with the results compared to NYSDEC AWQS and Guidance Values for Class GA Groundwater.

Sediments

Ten sediment samples (plus one duplicate) were collected from the Patchogue River during the RI. The ten sediment sampling locations were selected based on results of probing the stream for the presence of sheens and discussions with NYSDEC. Four sampling locations (SED-1 through SED-4) were located upstream of the Site at locations upstream and downstream of the West Main Street Bridge over the Patchogue River. The remaining six locations (SED-5 through SED-10) were located downstream of the sidegradient. Results of the analysis of the sediment samples noted VOCs and SVOCs detected at concentrations above regulatory criteria in nine of the ten sediment samples collected upstream as well as downstream of the Site. The sediment sample collected furthest downstream, SED-10, did not note concentrations of constituents above criteria. As discussed in Section 3.3, the impacts identified in the river sediments are indicative of contributions from urban sources and not of a localized MGP source.

The RI determined that based on the dispersion of contaminants both upstream and downstream of the Site combined with the determination that the sediments will not impact ecological or human health receptors, no further investigation of sediment was recommended.

Surface Water

Five surface water samples (plus one duplicate) were collected from the Patchogue River during the RI and analyzed for TCL VOCs, TCL SVOCs, and TCN. Laboratory analysis of the samples did not reveal the presence of any constituents to be present at concentrations above the NYSDEC AWQS and Guidance Values for Class C Surface Water. Toluene was the only compound that was detected during the analysis. No further investigation of surface water was recommended. The RIR concluded that the remedial action to address Site source contamination will minimize any future potential impacts to the sediments in the Patchogue River.

Soil Vapor and Indoor Air

Three soil gas samples were collected. The first sample (SV-1), collected on January 31, 2008, was obtained from beneath the concrete slab of a former building located on Site. This building was located on the northern portion of the Site. The two remaining samples (SV-6 and SV-7) were collected from beneath the concrete slab of the building located to the east of the Site during two events conducted in July 2008 and May 2009. Based on the VOCs detected and their concentrations, an additional sub-slab sample (SV-8) as well as an indoor air sample, and ambient air sample were collected during the heating season in November 2009 from the building to the east of the Site (“Above All Store Fronts”). The soil vapor results were similar to previous samples collected. VOCs were detected in the indoor air sample but MGP-related constituents were not detected at concentrations above indoor air screening criteria. Therefore, no further investigation was recommended as part of the remedial investigation phase.

Qualitative Human Health Exposure Assessment

A QHHEA was performed to evaluate the complete and potentially complete exposure pathways for human receptors relative to the chemicals of potential concern (COPCs) identified for each impacted medium given the current and potential future use of the Site. None of the detections for TCN or PCBs exceeded the applicable NYSDEC criteria within any of the sampled environmental media. Various VOCs, SVOCs, and metals are present at elevated concentrations within various environmental media, particularly the on-Site surface soil, subsurface soil, groundwater and off Site sediments. The on Site exceedances present are located within the Central/Core and Southern areas of the Site.

Soil gas samples collected from beneath the concrete slabs located in the northern area and the off Site building located to the east of the Central/Core area of the Site indicated detections of VOCs. In consideration of the COPCs identified for each exposure medium, the Conceptual Site Model and the exposure profiles for current and potential human receptors, direct and indirect contact with the on Site and off Site soils are likely exposure pathways.

Fish and Wildlife Resources Impact Analysis

A FWRIA was conducted in two steps. The first step was to identify fish and wildlife resources that may potentially be affected by Site related contaminants and, if such resources are present, provide the necessary information for inclusion in the FWRIA part of this RI. The second step was to identify contaminant transport pathways from the Site to areas supporting fish and wildlife resources, and perform a criteria-specific comparison of contaminant concentrations to appropriate ecological benchmark criteria and guidance values.

The FWRIA identified the following:

- Fish and wildlife resources are associated with the Patchogue Former MGP Site. The environmental receptors associated with the Site consist of species common to developed areas.
- Exposure pathways were determined to be complete for surface soils, surface water, and sediments.
- Elevated concentrations of PAHs exceeded corresponding soil criteria at a limited number of sample locations in soils across the Site.
- Historical surface water detections of cadmium and lead exceeded NYSDEC ambient water quality criteria for these metals at a single sampling location. These exceedances may be related to the entrainment of particulate matter into the sample bottle rather than representing ambient water quality exceedances. Given the small size of the Site, limited terrestrial habitat present and the limited number of criteria exceedances in surface soils, sediments and surface water, further characterization of the Site for the FWRIA was not recommended. Under current exposure conditions, the presence of contamination in the surface soils, surface water and sediments associated with the Patchogue Former MGP Site do not pose a significant risk to the fish and wildlife resources present.

Summary of the RI Key Findings

- The RI developed sufficient information to identify and delineate impacts to surface and subsurface soils, groundwater, sediments, surface water and soil gas, as well as, complete a QHHEA and a FWRIA.
- The Site exhibits the characteristics of a former MGP site including the presence of hydrocarbons and other compounds associated with such use. These materials were found in subsurface soils above criteria requiring further study or action.
- There are current and potential pathways through which human receptors can be exposed to the noted contamination. These pathways may require additional study or remedial action, although there are no imminent hazards to human health.
- The results of the QHHEA will be used to support future Site management decision-making.
- The presence of contaminants in the soils, groundwater, sediments and surface water does not present a risk to the transient fish and wildlife present in the environment on or near the Site.

3.2 Summary of the FFS Pre-Design Investigation Activities

Initial pre-design investigation (PDI) activities were implemented in May 2010 to supplement the information gathered during the Preliminary Site Assessment (PSA) and Remedial Investigation (RI) activities conducted from July 2001 through July 2008. The PDI activities were intended to facilitate development of a remedial alternative for the Site. Initial PDI activities were conducted in accordance with the NYSDEC-approved letter work plan dated May 10, 2010. Components of the PDI included: 1) drilling of 11 soil borings; 2) continuous monitoring of water levels in the Patchogue River and monitoring wells located on the Site; and 3) in-situ hydraulic conductivity testing (i.e., slug tests) of six monitoring wells.

Following NYSDEC's review of the results and findings of the initial PDI, and subsequent discussions on August 25, 2010 between the NYSDEC, National Grid and BC, it was agreed that additional delineation to further define the horizontal and vertical extent of MGP-related impacts at the Site would be beneficial in refining the areas to be addressed by a remedial alternative. These supplemental PDI (SPDI) activities were conducted in accordance with the NYSDEC-approved addenda to the May 10, 2010 letter work plan, dated September 14 and September 24, 2010. The work plan was further modified via an email from BC to the NYSDEC dated October 1, 2010). Components of the SPDI included: 1) drilling of 26 soil borings; 2) analysis of soil samples from each of these borings for BTEX and PAH compounds; and 3) collection of discrete-depth groundwater samples from three locations and three depth intervals at each location and analysis of these samples for BTEX and PAH compounds.

A summary of the findings from the initial PDI and the SPDI is provided in the following subsections.

3.2.1 Soil Borings

The locations of the 11 PDI soil borings (SB-101 through SB-110 and SB-108A), the 26 SPDI soil borings (SB-111 through SB-136) as well as all soil borings from the PSA and RI are depicted on Figure 3-1, along with the borings from the PSA and the RI. Soil borings for the PDI and SPDI were drilled using a GeoProbe® direct-push rig owned and operated by Zebra Environmental. A Macrocore® soil sampling tool was used to collect the soil samples. Soil samples for the PDI and SPDI were visually assessed and field screened for indications of MGP-related impacts, or other impacts, based on appearance, odors or organic vapor concentration measurements using a photoionization detector (PID). Boring logs for each soil boring location drilled during the PDI/SPDI are provided in Appendix A.

Two soil samples were selected for laboratory analysis from each soil boring drilled during the SPDI (i.e., SB-111 through SB-136) based on field screening; generally one sample was collected from an interval where field screening indicated impacts (if any) and one was collected from an interval below these impacts. No soil samples were collected for laboratory analysis during the PDI. The soil samples were analyzed for BTEX compounds via USEPA Method 8260B and for PAH compounds via USEPA Method 8270C. The analyses were conducted by Lancaster Laboratories, a laboratory certified by the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) (New York Certification Number 10670).

Of the 37 soil borings completed as part of the PDI/SPDI, NAPL and/or solid tar was observed at twenty-four (24) of the locations. Table 3-1 provides a summary of the NAPL/tar observations. In general, NAPL was observed as a coating on coarser grained soils (e.g., coarse sand and/or gravel). The NAPL was often encountered as discrete thin layers aligned along bedding separated by unimpacted soil intervals. Figure 3-2 indicates the borings where NAPL/tar was encountered during investigation activities (SPDI, PDI, RI and PSA) with a notation regarding the depth of the deepest NAPL encountered posted adjacent to each boring. Figure 3-3 provides three cross-sections through the Site which depict the stratigraphy and the horizontal and vertical distribution of the NAPL.

Table 3-2 provides the results of the soil analyses from the SPDI samples. In addition, total BTEX and total PAH concentrations for these soil samples, as well as soil samples analyzed during the PSA and RI are posted on the cross-sections in Figure 3-3. Figure 3-4 depicts the borings where concentrations of one or more BTEX or PAH compounds exceed the 6 NYCRR Part 375 Soil Cleanup Objective (SCOs) for unrestricted use as well as the depth of the deepest sample for which the measured concentration exceeded the SCO. These analyses indicate that elevated BTEX and PAH concentrations are associated with intervals where NAPL was encountered. Concentrations of BTEX and PAH compounds in soil samples collected from intervals that are not impacted by NAPL are typically non-detect, or if detected, are below the SCO for unrestricted use.

The overburden deposits encountered were consistent with the descriptions in boring logs from the RI and PSA. Although not noted in the RI Report, the peat and related deposits identified below the fill, as discussed in Section 3.1.2, may be part of recent floodplain deposits associated with the Patchogue River. The underlying sand and gravel are likely glacial outwash sediments deposited during the Pleistocene Epoch.

3.2.2 Monitoring of Surface Water and Groundwater Levels

Continuous monitoring of water levels in the Patchogue River and monitoring wells located on the Site was conducted for a period of three days to evaluate water level fluctuations over time. In-Situ Level TROLLS® were installed in three monitoring wells located near the river channel (MW-3, MW-4S, and MW-4D), a well located upland from the river (MW-5), and in the two staff gauges (SG-1 and SG-2) installed by BC. Manual water level measurements were also made in on-Site monitoring wells and the staff gauges at the beginning and end of the three day continuous monitoring period. Hydrographs of the continuous monitoring data are presented as Figures 3-5 and 3-6. A summary of the manual water level data is provided as Table 3-3.

As discussed in Section 3.1.2, groundwater at the Site typically flows from northwest to southeast and discharges to the Patchogue River. Water table elevations are above the river level, ranging from approximately 4.5 feet NAVD in the northwestern part of the Site to approximately 2.5 to 3 feet NAVD in the southeast portion of the Site adjacent to the river (e.g., see data from 9/8/10 in Table 3-3). However, throughout the course of the continuous monitoring period, dewatering was being conducted on the Village of Patchogue wastewater treatment facility (WWTF) property east of the river as part of a construction project. The water generated from the dewatering activities was ultimately discharged to the river. This dewatering resulted in groundwater levels throughout the entire Site being drawn down below the level of the river with wells closest to the river and the WWTF being drawn down as much as approximately five feet below the river level (see Figure 3-5). The pattern of groundwater elevations from the time of these measurements indicated that the dewatering operations were drawing groundwater from the area of the Site under the river toward the area of dewatering. Under these conditions, the adjacent section of the river would have tended to lose water to the groundwater system (i.e., a losing stream), rather than receiving groundwater discharge (i.e., a gaining stream) as it typically does based on data from the RI and earlier groundwater monitoring events. Additional information regarding the dewatering operations, and the effect of these operations on groundwater conditions beneath the Site, are discussed further below in Section 3.2.5 - Groundwater Monitoring. To provide a representation of groundwater level measurements under typical site conditions (i.e., conditions where water levels are unaffected by dewatering) for comparison, manual water level measurements collected by GEI during the September 2010 monitoring event are also included in Table 3-3. The September 2010 groundwater level measurements were used to represent the water table in the cross-sections provided in Figures 3-3.

In-Situ Hydraulic Conductivity Tests (Slug Tests)

In-situ hydraulic conductivity tests, or "slug tests", were performed on six of the existing Site monitoring wells (MW-2S, MW-3, MW-4S, MW-5, MW-7S, and MW-9S) to evaluate the horizontal hydraulic conductivity of the adjacent formation. Rising head slug tests were conducted and the data generated was input into AQTESOLV® software for hydraulic conductivity calculations. The slug test analyses are provided in Appendix B. A summary of the slug test results in presented on Table 3-4. At the time the slug tests were conducted, the effect of the dewatering operations at the WWTF on the groundwater levels across the Site (see discussion above) was not realized. Some of the slug tests may have been affected by the dewatering operations. Also, at two of the wells, MW-2S and MW-4S, the initial drawdown that was recorded from removal of the slug was very small, resulting in insufficient recovery data from which to estimate hydraulic conductivity. This may have been due to a very rapid water level recovery after the slug was removed, which is an indicator of a highly permeable formation.

Discrete-Depth Groundwater Sampling

Discrete-depth groundwater samples were collected at three (3) locations on the eastern side of the former MGP facility, and were designated as GW-1, GW-2, and GW-3. The three locations, as depicted in Figure 3-1, are located adjacent to the eastern property boundary within or directly adjacent to (east of), and downgradient of with regard to groundwater flow of, the footprint of the former MGP facility. The locations are positioned directly adjacent to soil borings where NAPL has been encountered.

At each location, discrete-depth groundwater samples were collected at three depth intervals: 10 to 12 feet, 16 to 18 feet, and 22 to 24 ft below ground surface (bgs). The groundwater samples were collected using a GeoProbe® screen point sampler. The screen point sampler was placed within the steel rod of a GeoProbe® direct-push rig. The end of the rod was sealed with a disposable steel drive point. The drive point was then driven into the subsurface to a depth equal to the bottom of the targeted sample interval. Once at this depth, the rod was retracted upward two feet to expose the stainless steel screen of the sampler and thus allow groundwater from the targeted depth interval to flow into the screen and up into the rods. Dedicated polyethylene tubing, equipped with a stainless steel check valve, was then lowered to the bottom of the screen. The screen and rods were then purged by oscillating the tubing/check valve, in an up and down motion, until three to five borehole volumes of water were removed and there was no further visible decrease in the turbidity of the purged groundwater with continued purging. Following purging, a groundwater sample was collected from the tubing directly into the sample container provided by the laboratory. A separate hole was drilled with the direct push equipment for each depth interval that was sampled at each location (i.e., three direct-push boreholes at each of the three locations). The GeoProbe® direct-push rig and associated equipment is owned and operated by Zebra Environmental.

Collected groundwater samples were analyzed for BTEX compounds via USEPA Method 8260B and for PAH compounds via USEPA Method 8270C. The analyses were conducted by Lancaster Laboratories, a NYSDOH ELAP-certified laboratory.

Table 3-5 provides a tabulation of the groundwater quality data from the discrete-depth groundwater samples. The data obtained from the analysis of the discrete-depth samples should be considered for screening purposes only. Groundwater samples collected in this manner are not likely as representative of the actual dissolved phase concentrations migrating in groundwater as those collected from monitoring wells due to the disturbance of the adjacent deposits at the time of sampling and the relatively higher turbidity, and because for the samples from the deeper intervals, the sample probe was driven through more highly impacted material in the shallower interval, possibly resulting in the dragging down of constituents in the borehole on the sampling equipment. The results from each location are summarized as follows:

- **GW-1:** At the northernmost location, designated GW-1, no BTEX compounds were detected at any of the depth intervals. Low levels, below the NYSDEC Class GA groundwater quality criteria, of a few PAH compounds were detected in the shallowest sample at GW-1 (10 to 12 feet bgs).

  No PAH compounds were detected in the groundwater samples from the two deeper depth intervals that were sampled at GW-1 (i.e., 16 to 18 feet and 22 to 24 feet bgs).

- **GW-2:** BTEX compounds were detected in the upper two sample intervals; the concentrations of benzene and ethylbenzene were slightly above the Class GA groundwater quality criteria in the 16 to 18 foot interval. Concentrations of all BTEX compounds were below these criteria in the 10 to 12 foot interval. No BTEX compounds were detected in the deepest sample interval (22 to 24 feet).

  Concentrations of several PAH compounds were detected above the Class GA groundwater quality criteria in both the 10 to 12 foot and 16 to 18 foot intervals. Concentrations of PAH compounds in the 16 to 18 foot interval were substantially less than in the 10 to12 foot interval. No PAH compounds were detected in the groundwater sample from the deepest interval (22 to 24 feet) at GW-2. Total PAH concentrations detected in the 10 to 12 foot and 16 to 18 foot depth intervals at GW-2 are higher than those detected previously in groundwater samples from site monitoring wells with the exception of wells MW-5 and MW-6, both of which have been found on occasion to contain NAPL.
- **GW-3:** In the sample from the shallowest sample interval (10 to 12 foot) at GW-3 toluene, ethylbenzene and xylenes were detected at concentrations above the Class GA groundwater quality criteria. The total BTEX concentration at this interval is the highest encountered in groundwater at the site (86 µg/L) with the exception of samples from well MW-5, a well in which NAPL has been observed on occasion. BTEX concentrations decrease with depth at GW-3; in the 16 to 18 foot interval, total BTEX was detected at 12 µg/L with the xylenes concentration being slightly above the Class GA groundwater quality criteria. In the 22 to 24 ft interval, no BTEX compounds were detected.

  The concentration of some individual PAH compounds were detected above the Class GA groundwater quality criteria in all three depth intervals sampled at GW-3. Total PAH concentrations decrease substantially with depth, from 1,850 µg/L in the 10 to 12 foot interval to 398 µg/L in the 22 to 24 foot interval.

The elevated concentrations of BTEX and PAH compounds in groundwater noted at GW-2 and GW-3 reflect the proximity of these sampling points to NAPL that was identified in the subsurface during the RI and PDI/SPDI activities. The general decrease in BTEX and total PAH concentration with depth reflects the vertical distribution of the NAPL that is the source of these constituents; the majority of the NAPL mass is situated in the upper 10 to 12 feet of the overburden soils with the NAPL mass decreasing substantially with depth. Data from the discrete-depth groundwater samples is discussed in the context of overall site groundwater quality in Section 3.2.5.

3.2.3 Groundwater Monitoring

Groundwater monitoring was conducted on the Site during the RI (March 2008 and July 2008 sampling events) and was continued on a semi-annual basis thereafter (March 2009, September 2009, March 2010, and September 2010). A summary of the semi-annual groundwater monitoring is presented in Groundwater Monitoring Reports prepared by GEI and dated July 2009, December 2009, June 2010, and November 2010. During the monitoring events water levels were measured in the wells and at the staff gauges; NAPL gauging was conducted in each well; and groundwater samples were collected for laboratory analysis from each well with the exception of those wells where NAPL was encountered.. Based on the results of the groundwater monitoring conducted in September 2010, as described further below, National Grid increased the frequency of the groundwater monitoring to quarterly, with the first quarterly monitoring event being conducted during the first week of January 2011.

Figures 3-7 and 3-8 provide representations of total BTEX and total PAH concentrations in groundwater, respectively, for the September 2009 groundwater monitoring event. At locations where more than one well is present (i.e., a shallow and a deep well in a cluster), the data from the sample with the highest concentration were used to develop the isoconcentration contours although the data from the well with the lower concentration were also posted. The distribution of constituents in September 2009, as depicted on Figures 3-7 and 3-8, is typical of the previous monitoring events conducted since the beginning of the RI. Dissolved-phase BTEX and PAH compounds were detected in groundwater within a limited area near the center of the Site and did not extend downgradient to the wells closer to the Patchogue River. The groundwater flow direction estimated from the water levels measured during this event is from north-northwest to south-southeast across the Site towards the Patchogue River. Groundwater levels measured in wells adjacent to the river were higher than the river level indicating that the groundwater flow eventually discharges to the Patchogue River adjacent to the Site. This groundwater flow direction is similar to that interpreted from data for previous monitoring events.

As mentioned in Section 3.2.2, Monitoring of Surface Water and Groundwater Levels, water level measurements collected during the March 2010 monitoring event indicated that the water table was several feet lower than typical at the Site. In addition, the groundwater flow direction was to the southeast representing a shift counterclockwise from the direction of groundwater flow measured during all previous monitoring events. Further, the groundwater levels in the wells located adjacent to the Patchogue River were below the river level indicating that the groundwater was no longer discharging to the river but rather to a sink on the eastern side of the river. The cause of this change in groundwater flow conditions was attributed to the operation of a temporary dewatering system as part of the construction of new facilities at the Village of Patchogue WWTF.

Based on a review of the dewatering plan attached to the NYSDEC Long Island Wells and Freshwater Wetlands permits for the installation and operation of this system, six dewatering wells were planned to be used operating at a pumping rate of approximately 560 gallons per minute (gpm) at each individual well (a total of 3,360 gpm for the system). The plan also included routing the extracted groundwater to a settling tank and then discharging the groundwater via a diffuser structure to the Patchogue River at a location adjacent to the WWTF. This discharge was observed by BC during the May 2010 drilling activities described above. The dewatering operations apparently began in March 2010 prior to the start of field activities for the March 2010 groundwater monitoring event (March 25, 2010). The dewatering activities apparently continued for several months and ended prior to the September 2010 groundwater monitoring event. Additional inquiries are in progress with the Village of Patchogue to obtain information on the actual operation of the dewatering system (e.g., pumping rates, duration, specific timing of operation, etc.). Water levels measured during the September 2010 monitoring event indicate that after the dewatering operation ended, groundwater flow beneath the site returned to its pre-dewatering pattern of south-southeast flow across the Site with groundwater discharging to the Patchogue River.

Figures 3-9 and 3-10 provide representations of total BTEX and total PAH concentrations in groundwater, respectively, for the September 2010 groundwater monitoring event. In addition, these figures include the data from the discrete-depth groundwater samples collected in October 2010, as described above. Similar to Figures 3-7 and 3-8, at locations where more than one well is present (i.e., a shallow and a deep well in a cluster), the data from the sample with the highest concentration was used to develop the isoconcentration contours, although the data from the well with the lower concentration is also posted. Similarly, for the discrete-depth samples locations, the maximum value from the three sample depth intervals was used to develop the isoconcentration contours, although the values from all three intervals are included on the figures. As previously discussed, data from the discrete-depth samples should be considered for screening purposes only as concentrations detected in groundwater samples collected in this manner may be biased high relative to the actual dissolved phase concentrations migrating in groundwater.

The detections of BTEX and PAH compounds in groundwater, as depicted in Figures 3-9 and 3-10, are more widely distributed than depicted in Figures 3-7 and 3-8, which as stated above, are representative of data from monitoring events prior to September 2009. In particular, BTEX and PAH compounds were detected in samples from some wells located adjacent to the river, where previously, these compounds were not detected in these wells. It is likely that this change in the distribution of constituents in groundwater is a result of the dewatering operation conducted at the WWTF across the river. The dewatering caused a substantial change in groundwater flow direction and velocity at the Site relative to the steady-state conditions (pre-dewatering). This change likely drew dissolved-phase constituents toward the dewatering system from the source area in the center of the Site, and possibly from other sources not related to the former MGP, and increased their migration speed such that they traveled a farther distance from the source area than typical before natural attenuation processes could reduce them to non-detect levels.

Based on this understanding of groundwater flow, it was anticipated that once the dewatering operations had ceased, concentrations of constituents in groundwater would re-equilibrate with steady-state (i.e., pre-dewatering) groundwater flow conditions and eventually return to levels similar to those prior to dewatering. To assess this, National Grid increased the frequency of the groundwater monitoring to quarterly with the first quarterly monitoring event conducted during the first week of January 2011. Figures 3-11 and 3-12 provide representations of total BTEX and total PAH concentrations, respectively, in groundwater, for the January 2011 groundwater monitoring event. Groundwater quality data from the January 2011 monitoring event indicates that the concentrations of constituents in groundwater adjacent to the river have decreased to approximately the levels measured prior to the dewatering operation. Concentrations were noted to be either non-detected or below the Class GA groundwater quality criteria. Quarterly monitoring will continue to confirm these findings.

3.3 Patchogue River Sediment Evaluation

The data and conclusions provided in the RIR indicate that the sediment in the Patchogue River is not a medium that needs to be directly addressed in the FFS process. In support of this conclusion, National Grid conducted an assessment of the Patchogue River and the river sediments for the reach of the river near the Site, based on data provided in the RIR, the PSA Report, and observations during a visit to the area of the Site on May 18, 2010, to confirm this conclusion and to assess the potential for future impacts.

3.3.1 Description of Patchogue River and Surrounding Area

The reach of the Patchogue River near the Site flows southward from Great Patchogue Lake, located north of the Site, to Patchogue Bay. Flow exits Great Patchogue Lake via an overflow structure in the dam, and enters a culvert which passes for approximately 350 feet underneath Holbrook Road and the parking lot for Briarcliffe College. The river flow then enters a portion of the channel where the banks are comprised of wooden bulkheads. The river flows underneath West Main Street (County Road 85) through a culvert, and then back into a channel with bulkheads on either side. The bulkheaded banks end several hundred feet downstream of the culverted section of the river under West Main Street. South of the bulkheaded section, the channel widens somewhat and bends slightly to the southwest. Approximately 1,000 feet downstream of West Main Street, the river bends to the southwest and then to the south toward Patchogue Bay. In the area near the Site, the channel is approximately 25 to 30 feet wide and the water depth ranges from approximately one to three feet. The stream bank is locally steep and heavily vegetated. Brush and trees line the banks and fallen trees are present in the river. Large patches of submerged aquatic vegetation are present. This reach of the river is freshwater; no tidal affects were observed during the site visit or during field activities described in Section 3.3. The river is designated by the NYSDEC as a Class C surface water, wherein the best usage of the waters is fishing. These waters are to be suitable for fish, shellfish and wildlife propagation and survival. The water quality is to be suitable for primary and secondary recreational contact (unless other factors limit this use).

The area surrounding this reach of the Patchogue River is urban. The river receives storm water drainage from storm sewers or direct runoff from commercial and industrial properties, parking lots and roadways that are near and adjacent to the river. Commercial operations that are either directly adjacent to, or in close proximity to the river include: a tire and automotive repair shop and associated yard; a metal fabricating shop and associated yard (property located immediately east of the access driveway which borders the eastern portion of the Site); a facility that fabricates storefront signs and glass (property located immediately adjacent to (east of) the Site; and warehouses with loading docks for tractor trailers and associated parking lots. Also, the Village of Patchogue's WWTF is located adjacent to the east bank of the river and discharges its effluent to the Patchogue River in this reach at a point approximately due east of the Site.

Sediment in the river has been described as predominantly sand and gravel. In some locations, it is hard packed but in others it is softer. Fine-grained sediments (i.e., silt and/or clay sized grains) are likely present to some degree but the generally swift flow and the straight to broadly-curving channel are not conducive to the deposition of fine-grained sediments.

3.3.2 Assessment of Impacts to Patchogue River Sediments

As detailed in the RIR, during RI field activities conducted in February 2008, sediment probing was conducted in a segment of the Patchogue River near the Site. The probing was conducted by inserting a threaded metal rod into the sediments (up to several feet depending on the location), withdrawing the rod, and making observations in the water and on the rod with regard to the presence of sheens or indications of the presence of potential MGP related impacts. Representatives of the NYSDEC and the Suffolk County Department of Health Services were present during this activity. The probing was conducted along 24 cross-stream transects spaced approximately 20 feet apart from each other. As depicted on Figure 2-5 of the RIR, the furthest upstream transect was located adjacent to the WWTF property; the furthest downstream transect was located approximately 440 feet downstream of the WWTF property.

Observations from the probing noted that the rod could be pushed two to three feet into the sediment. Sheens of varying degree in intensity were noted at some point along 19 of the 24 transects. Typically, the sheens were described as "trace" to "moderate" but locally they were described as "heavy". The sheens were noted as being petroleum-related and did not exhibit odors associated with MGP impacts.

As discussed in Section 3.1 of this FFS, 13 sediment samples were collected from the Patchogue River during the RI and PSA activities. The locations of four of these samples were selected to represent upstream conditions. Total PAH (polycyclic aromatic hydrocarbon) concentrations in the sediment ranged from not detected to 140 mg/kg. The highest total PAH concentrations were measured just downstream from the outfall of the WWTF into the Patchogue River at location SED-5 (140 mg/kg). The second highest total PAH concentration (77.9 mg/kg) was detected at one of the upstream samples, SED-3, located directly upstream of the West Main Street bridge. Storm sewer pipes empty into the river at this location. No benzene, toluene, ethylbenzene, or xylene (BTEX) compounds were detected in the sediment.

The concentration levels of the PAH compounds, and the distribution of these concentrations and the observed sheens, are indicative of sediments impacted by urban runoff of petroleum substances and substances derived from the combustion of petroleum. They are not indicative of a localized MGP source such as the Site. This is further supported by data from the Site. Data from the RIR and semi annual groundwater monitoring events conducted at the Site indicates that there are no substantial impacts from the Site in the soil or groundwater adjacent to the river. Boring PASB-45, located adjacent to the river bank, did encounter soil with some black staining in the five to seven foot depth interval. In addition, a sample from this interval indicated a total PAH concentration of 954 mg/kg. However, monitoring well MW-9S was installed at this location with a screened interval from four to nine feet bgs, directly across the stained soil interval, and groundwater monitoring data from this well historically had indicated no detections for PAH and BTEX compounds to indicate the Site is acting as a source of the sediment impacts noted in the River. In addition, no other indicators of impacts (e.g., no sheen, NAPL, etc.) were noted in MW-9S. Further, in support of the Site not being a source of impacts to the sediments in the Patchogue River, groundwater monitoring at the other wells located adjacent to the river bank (i.e., MW-9D, MW-4S, MW-4D, and MW-3) historically have not indicated any detections of PAH or BTEX compounds and no indications of NAPL or sheens were noted at any of these locations. At three of these wells (MW-3, MW-4D, and MW-9S), the concentrations of some BTEX and/or PAH compounds were detected for a short period in 2010 coinciding with the operation of the large scale temporary dewatering system at the Village of Patchogue WWTF, as described in Section 3.2.5. The concentrations measured in samples from these wells have since decreased to either non-detected or levels below the Class GA groundwater quality criteria.

In summary, based on groundwater monitoring at wells located adjacent to the river, analytical results from samples obtained from these wells, the observations from the sediment probing activities and the distribution of PAHs noted during the sediment sampling activities, no indication of a subsurface migration pathway for MGP impacts from Site to the river has been identified. Based on the above, neither the former MGP operations conducted on the Site nor the current status of the Site appear to have had an impact on the sediments.

3.3.3 Groundwater Seepage Velocity/Time of Travel Analysis

The rate and time of groundwater flow from the area of former MGP operations on the Site to the river was estimated to assess if dissolved phase constituents associated with the impacts at the former MGP would be expected to have already been detected at the monitoring wells adjacent to the river under natural groundwater flow conditions. Further, this estimation served to evaluate if MGP-related contaminants may be continuing to migrate and be detected at wells near the river some time in the future, or if these contaminants are naturally attenuating before they reach the area of the river. The highest concentrations of dissolved phase constituents in groundwater have been detected in samples from monitoring wells MW-5 and MW-6, which are located within the area of former MGP operations, proximal to the area where the greatest degree of impacts to the subsurface have been observed (e.g., tar). For this evaluation, the distance from MW-6 to the river, measured along a line approximately parallel to groundwater flow (i.e., a line extending southeast from MW-6 through the location of MW-3) was used as the distance over which to estimate the time of groundwater flow. This distance is approximately 220 feet.

For the estimate, the groundwater seepage velocity (Vs) was calculated based on estimates of hydrogeologic conditions at the Site. The seepage velocity is the average velocity that a particle of groundwater will move in the subsurface in the direction of groundwater flow. The following equation was used to calculate seepage velocity:

$V_s = Ki/n_e$ (Cedergren, 1977)

Where: K = hydraulic conductivity (cm/s or ft/day)

i = horizontal hydraulic gradient (dimensionless)

n_e = effective porosity (dimensionless)

cm/s = centimeters per second

ft/day = feet per day

As discussed in Section 3.1.2, the sand deposits beneath the Site are likely glacial outwash deposits. The slug testing conducted as part of the PDI described in Section 3.2 indicates that these sands are highly permeable. Estimates by the U.S. Geological Survey (USGS) (Bruxton and Smolensky, 1999) of the average hydraulic conductivity of these glacial outwash deposits in Long island, and their specific yield, are 250 feet/day (8×10^{-2} cm/s) and 0.30, respectively. The specific yield is considered a good estimator of effective porosity, particularly in coarse-grained deposits such as the outwash. From the groundwater level contour maps presented in the RIR and in subsequent groundwater monitoring reports (GEI, July 2009 and December 2009), the approximate range in hydraulic gradient is from 0.005 to 0.008 ft/ft. Using this information and the equation described above, seepage velocities were calculated for the range of hydraulic gradients (0.005 and 0.008), as provided in Table 3-6 below. Estimates of the time for groundwater to travel from MW-6 to the river were also determined for each of the calculated seepage velocities; this was calculated by dividing the travel distance (220 feet) by the seepage velocity.

The seepage velocity estimates indicate that a particle of groundwater in the vicinity of MW-6 would reach the river in less than 60 days. Given that the releases of MGP constituents to the subsurface occurred approximately 80 or more years ago, any associated dissolved phase constituents would have reached the wells between MW-6 and the river long ago. This implies that the dissolved phase impacts identified in MW-6 are attenuated rapidly in the subsurface.

Of the variables that are input into the seepage velocity equation, the value of hydraulic conductivity is known to have the potential for the greatest degree of variation. Because a lower hydraulic conductivity would increase the calculated travel time, a sensitivity analysis was conducted in which the seepage velocities were also calculated using a hydraulic conductivity one order of magnitude less (25 ft/day) than the average used by USGS. Using this lower hydraulic conductivity, the estimated time for a particle of groundwater in the vicinity of MW-6 to reach the river would be approximately one to one and a half years (see Table 3-6). This further supports the implications that the dissolved phase MGP-related constituents would have already reached the downgradient wells and that they attenuate rapidly in the subsurface.

3.4 Conceptual Site Model

A Conceptual Site Model (CSM) was included as part of the RIR and included the results from the PSA (VHB, 2002) as well as the RI activities (TetraTech EC, Inc., 2009). The CSM has been updated based on the findings of the PDI and SPDI, and incorporates the data from the previous investigations. The CSM is discussed below.

MGP related tar/NAPL, was observed at investigation locations generally corresponding with the former locations of MGP-related structures located in the Central/Core Area. The NAPL is present in two portions of the Central/Core Area as shown on Figure 3-2. These areas are:

- The larger of the two areas located in the central and northeastern part of the Central/Core Area. The area is located in the vicinity of the former purifier house and east of the former gas holder extending eastward in a limited area onto the adjacent property ; and
- The smaller of the two areas (significantly smaller than the previously described area) located in the northwestern corner of the Central/Core Area.

In the central and northeastern part of the Central/Core Area, the majority of the NAPL mass is situated in the upper ±5 to ±10 feet of the soil as shown on geologic cross-section presented as Figure 3-3). Within this depth interval, NAPL is present in zones or layers which are either saturated with NAPL or where the NAPL occurs at lower degrees of saturation in the form of grain coatings and blebs. The zones and layers containing NAPL within this interval are often separated by layers where no visible impacts are discernable. At depths below approximately 10 feet bgs, NAPL was encountered less frequently, and where present, occurs in very thin layers or lenses or as blebs or globules separated by intervals of soil where no visible impacts are discernable. Lenses, thin layers, or blebs of NAPL were locally encountered at depths greater than 20 feet bgs in a narrow area between borings SB-128 and SB-115 and at one location in the northern portion of the Central/Core Area, in soil boring SB-122 (refer to Figure 3-2). The deepest NAPL encountered in the soil were NAPL blebs at a depth of 22.4 feet bgs in boring SB-132 (refer to Figure 3-3).

NAPL was encountered in the northwest corner of the Central/Core Area within the upper approximately seven feet of soil at a few closely spaced borings (i.e., MW-2X, SB-108A, and SB-111). At MW-2X and SB-108A, NAPL was observed as tarry globules, black and hardened tar, and as grain coatings within the upper five feet of soil. At SB-111, NAPL was only encountered as a 0.2 foot thick layer at a depth interval of 7.1 to 7.3 feet bgs (refer to Figure 3-3).

Analyses of soil samples obtained during the investigation activities indicate that elevated BTEX and PAH concentrations (concentrations in excess of the SCO) in the soil are associated with intervals where NAPL was encountered (refer to Figure 3-3). Concentrations of BTEX and PAH compounds in soil samples collected from intervals that are not impacted by NAPL are typically non-detect, or if detected, are below the SCO for unrestricted use.

As described in Section 3.2.5, some dissolved phase BTEX and PAH compounds have been detected in groundwater at concentrations above the Class GA groundwater quality criteria at well locations within the Central/Core Area (i.e., MW-5 and MW-6). On occasion, traces of NAPL have been identified in these wells. The dissolved phase compounds are apparently attributable to contributions from the NAPL in the subsurface. Downgradient of the Central/Core Area, concentrations of dissolved phase compounds in groundwater decrease to below the Class GA groundwater quality criteria, or to non-detect levels, before reaching the Patchogue River. This trend indicates that the BTEX and PAH compounds are undergoing natural attenuation and are not impacting the Patchogue River.

3.5 Summary of the Impacted Media and Contaminants of Concern

As stated in the RIR, releases from process equipment, tanks and piping during the former transfer and distribution processes may have resulted in MGP residuals impacting Site soils. MGP tar/NAPL impacts were observed in subsurface soil at soil borings detailed in Section 3.4 and, Table 3-1, and as depicted in Figures 3-2 and 3-3. The locations where MGP impacts were observed during the investigation activities are concentrated in the former locations of the MGP-related structures such as the gas holder, purifier house boiler, and tanks in the Central/Core Area of the Site. These impacts were observed in the subsurface soils , predominantly in the upper ±10 feet of soil. Locally, these impacts are present at depths up to nearly 23 feet bgs, although as described in Section 3.4, the intervals of deeper impact are thin and less frequent.

Groundwater sampling conducted during the RI and subsequent SPDI and quarterly monitoring activities indicates that dissolved phase BTEX and PAH compounds are present at concentrations above the Class GA groundwater quality criteria in the Central/Core Area of the Site. These elevated groundwater concentration are coincident with the locations where NAPL was encountered in the subsurface. As indicated in the RIR, the RI investigation indicates surface soil, soil vapor, and surface water are not significant contaminant transport mechanisms and thus are not considered impacted media and will not be addressed in the FFS. In addition, the RIR and the evaluation of the Patchogue River sediments discussed in the section above also support that sediment is not a medium of concern at the Site and thus will not be addressed in the FFS.

In summary, based on the findings of the site investigations (i.e., the PSA, RI and PDI/SPDI), exposure assessments and the evaluation of the river sediments, the impacted media that will be addressed in this FFS include surface soils, subsurface soil, source material, and groundwater. The surface soils include the areal extent of the portion of the Site subject to previous filling activities and the former MGP operations area (the Central/Core Area of the Site). The surficial soils include soils to a depth of two feet. This layer includes impacted areas presumably from the former MGP operations and other historical Site activities. The impacted subsurface soils include those soils in the two portions of the Central/Core Area (i.e., the relatively large area occupying the central and northeastern part of the Central/Core Area, and the smaller area in the northwestern corner of the Central/Core Area). The depth of impacted soil ranges from ground surface to nearly 23 feet bgs. The impacted soil contains NAPL/tar and associated stains, sheens and odors, as well as concentrations of BTEX and PAH compounds above SCOs. Tar-impacted source material (source material) is considered to be the tar/NAPL identified during visual observations noted as part of the investigation activities and described in the boring logs as blebs, black saturated, globs and tar material. The remedial alternative development and analysis will focus on MGP tar/NAPL-impacts as the source material of impacts to soils and groundwater. Groundwater will be remediated by the treatment or removal of MGP tar impacts as the potential source to groundwater. The effectiveness of the remedy will be assessed through a post-remedial groundwater monitoring program.

Section 4

Remedial Action Goals and Objectives

4.1 Remedial Action Goals

The NYSDEC remedial program identifies the goal for site remediation under 6 NYCRR Sub-Part 375-2.8(a) as "…restore that site to pre-disposal conditions, to the extent feasible. At a minimum, the remedy selected shall eliminate or mitigate all significant threats to the public health and to the environment presented by contaminants disposed at the site through the proper application of scientific and engineering principles and in a manner not inconsistent with the national oil and hazardous substances pollution contingency plan as set forth in section 105 of CERCLA, as amended as by SARA."

Where site restoration to pre-release conditions is not feasible, the NYSDEC may approve alternative criteria based on the site specific conditions as stated in 6 NYCRR Sub-Part 375-2-8(b)(1): "The remedial party may propose site-specific soil cleanup objectives which are protective of public health and the environment based upon other information."

4.2 Remedial Action Objectives

As defined in DER-10, Remedial Action Objectives (RAOs) are medium-specific or operable-unit specific objectives for the protection of public health and the environment. RAOs are developed based on the Standards, Criteria and Guidance (SCGs) to address contamination identified at the Site in consideration of the intended land use.

Activities at the Site are being performed under an Order on Consent, Index Number D1-001-99-05, dated September 1999. In accordance with 6 NYCRR 375-1, NYSDEC-issued permits are not required for environmental remedial activities conducted at this Site. Rather, the activities are evaluated and implemented based on the substantive elements of the applicable and relevant and appropriate state environmental laws and regulations. Federal applicable, relevant and appropriate requirements (ARARs) must be complied with fully, including the requirements to obtain permits, if necessary. Since New York does not have ARARs in its statute, these State environmental laws and regulations, in conjunction with the Federal environmental laws and regulations, are collectively referred to as Standards, Criteria and Guidance (SCGs). SCGs are defined in DER-10. Standards and Criteria are New York State regulations or statutes which dictate the cleanup standards and other substantive environmental protection requirements, criteria, or limitations which are generally applicable, consistently applied, officially promulgated and are directly applicable to a remedial action. Guidance are non-promulgated criteria and guidance that are not legal requirements; however, those responsible for investigation and/or remediation of the site should consider guidance that, based on professional judgment, are determined to be applicable to the site.

The site-specific SCGs applied to this Site are:

- DER-10: Technical Guidance for Site Investigation and Remediation
- TAGM 4030: Selection of Remedial Actions at Inactive Hazardous Waste Sites,

- 6 NYCRR 375-1: General Remedial Program Requirements,
- 6 NYCRR 375-2: Inactive Hazardous Waste Disposal Site Remedial Program,
- 6 NYCRR 375-6: Remedial Program Soil Cleanup Objectives, and
- NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 (groundwater).

Based on the SCGs, the RAOs developed for soil and groundwater on the Site are listed below.

Public Health Protection

Groundwater

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards
- Prevent contact with contaminated groundwater.

Soil

- Prevent ingestion/direct contact with contaminated soil.

Soil Vapor

- Address exposures to the public related to soil vapor intrusion into buildings.

Environmental Protection

Groundwater

- Remove the source of ground or surface water contamination.
- Restore the groundwater aquifer to meet ambient groundwater quality criteria, to the extent feasible.

Soil

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

NAPL

- Remove free product/NAPL identified at the site to the extent technically practicable.
- Eliminate through removal, treatment and/or containment the free product/NAPL as source of contamination to other environmental media.

Soil Vapor

- Eliminate, to the extent practicable, the impact of contaminants in soil or groundwater to soil vapor.

The recommended remedial alternative for the Site will be developed to meet the above RAOs.

Section 5

General Response Actions

Based on the results of the investigation activities on the Site, soil and groundwater have been determined to be the impacted media of concern at the Site and are considered for general response actions. MGP-impacted soils are present over approximately 0.5 acres of the Site and are generally located in the Central/Core area of the Site, as well as the off site on the commercial property to the east. MGP-impacted soils were observed in surface soils and in the subsurface generally within the five to ten foot depth interval. The deepest impacts are observed at approximately 23 feet.

The general response actions discussed below will be evaluated as means of achieving the RAOs. A brief description of the general response action and example technologies are presented below.

5.1 No Action

No Action would not involve any treatment, containment, removal or disposal but would implement reviews for periodic re-evaluation of Site conditions. Limited action involves institutional controls that restrict access to impacted areas through physical and/or administrative measures; it also includes long-term monitoring.

5.2 Treatment

Treatment alters the physical and/or chemical nature of the medium to produce a reduction in contaminant mass, mobility, or toxicity. Treatment can be accomplished in-situ or ex-situ and can involve physical, chemical, thermal and/or biological processes. Examples of in-situ treatment technologies include chemical oxidation, soil vapor extraction, bioremediation, electrical resistance heating, and solidification. In situ treatment would be applicable to source materials, soils and groundwater.

Ex-situ treatment technologies include thermal desorption, incineration, solidification, and biopiles. Ex-situ treatments may require the installation of large treatment systems and/or large staging areas, and due to the small size of the Site, may be not feasible. Ex-situ treatments would also require extensive handling of the excavated soils which may generate significant odors as well as increase risk of impacts to Site workers and adjacent properties. Therefore, ex-situ treatment is not considered to be a viable general response action as applied on site. Ex-situ treatment may be applied off site as described in Section 5.6.

5.3 Containment

Containment alternatives include control, isolation and encapsulation technologies. Containment technologies provide protection of public health and the environment by reducing mobility of contaminants and/or eliminating pathways of exposure. The containment technologies applicable to the Site would consist of barriers or systems that isolate the migration of impacted groundwater and NAPL. These technologies can include sheet pile was and other subsurface barriers. There are various types of subsurface barriers including sheet pile walls and slurry trench cut-off walls. Barrier walls are not considered to be applicable at this Site as the RAOs are focused on removing the source of groundwater contamination and preventing contact with impacted soil and groundwater rather than on controlling migration. Further, there is no confining layer present at the Site which would allow for a barrier wall to be keyed into to minimize migration.

Barriers also are response actions that minimize the potential for human exposures to the contaminated media by implementing physical barriers to prevent contact with the impacted media and/or migration of contaminants to potential receptors. Examples of these barriers include asphalt or concrete pavement, soil caps or geosynthetic liners. Pavement or geosynthetic liners are physical barriers with low permeability properties that are typically used at sites where infiltration of stormwater through impacted soil to groundwater needs to be minimized. Since impact to groundwater from the vadose zone soils at the Site is not a primary concern, a low permeability barrier would not be necessary. Engineering controls would require monitoring and maintenance to maintain its protectiveness. Periodic certifications would be required to document the effectiveness of the engineering controls. This response action is applicable to source materials, soil and groundwater at the Site.

5.4 Excavation

This response action consists of the removal and subsequent treatment or off-site disposal of impacted soils. Excavation in the unsaturated zone can be accomplished using conventional construction equipment and methods. Due to the high groundwater table at the Site, excavation below the water table would require significant earth support and, depending on the depth of the excavation beneath the water table, may require dewatering. If dewatering is required, extracted groundwater may require treatment and disposal. Excavations would also require the replacement of excavated material with clean fill from off-site sources. Excavation is applicable to source materials and soil.

5.5 Extraction

This response action consists of the removal of contaminated media using recovery wells or collection trenches with associated pumps and piping. This response action would be applicable to groundwater and potentially to NAPL where present above residual saturation. Groundwater extraction is not deemed necessary because natural attenuation is occurring, as described in Section 3 of this FFS. Further, NAPL is mostly present below residual saturation so extraction of groundwater would have a very limited benefit. On-site NAPL and groundwater are anticipated to be addressed through other general response actions. Therefore, extraction is not considered for further evaluation.

5.6 Disposal

This response action is typically combined with other response actions. Disposal consists of transporting excavated, treated, or extracted contaminated media off-site to a landfill, treatment facility, or recycling facility licensed and permitted to accept the various type of wastes. For the Site, disposal would be a component of the excavation, extraction, and possibly treatment response actions. This response action is applicable to source materials, soil and groundwater at the Site. Institutional Controls

5.7 Institutional Controls

Institutional controls are response actions that minimize the potential for human exposures to the contaminated media by establishing legal and administrative actions on the Site's future use. Types of institutional controls include access controls, environmental easements, and established procedures for managing future ground-intrusive activities (e.g., Site Management Plan, Health and Safety Plans, etc.).

Institutional controls will also establish protection of engineering controls that may be part of the remedy, restrict the use of on-site groundwater, and restrict future use of the Site. Periodic certification would be required to document the continued effectiveness of the institutional controls. This response action is applicable to soil and groundwater at the Site.

Remedial Action Objectives	General Response Actions							
	No Action	Treatment	Containment	Excavation	Extraction	Disposal	Institutional Controls	
Prevent, to the extent practicable, ingestion/direct contact with contaminated soil.	X	X	X	X		X	X	
Remove/treat, to the extent practicable, the source of groundwater contamination.		X		X		X		
Prevent, to the extent practicable, contact with, or ingestion of contaminated groundwater.	X	X	X		X	X	X	

Section 6

Technology Identification and Screening

6.1 Introduction

This section presents potentially applicable technologies and the results of the screening evaluation conducted to determine which technologies could be successfully implemented at the Site. The technologies were evaluated based on site-specific conditions, implementability, effectiveness (i.e., whether the RAOs can be attained), and cost. At the conclusion of the screening process, the technologies that have been retained were assembled into Site-wide remedial alternatives for further evaluation.

6.2 Technology Identification and Screening

The remedial technology types associated with each of the GRAs identified in Section 5, typically considered for the cleanup of contaminated soil and source materials (i.e., soils impacted with MGP tar) were developed from experience on other hazardous waste sites, knowledge of developing and emerging technologies, and the professional judgment of engineers performing the FFS. Technology identification and screening involved the following steps:

- Assessment of technical issues posed by the Site and contaminants.
- Identification of potentially applicable technologies.
- Preliminary screening of the technologies with respect to effectiveness, implementability, and cost.

6.2.1 Site-Specific Technical Issues

The technical issues affecting the implementability and effectiveness of potentially applicable technologies at the Site include the following:

- Hydrogeologic characteristics;
- Proximity to the river;
- Size of the Site;
- Impacts to adjacent properties;
- Characteristics of the Site media; and
- Characteristics of the contaminants of concern (COCs).

Each of the Site-specific technical issues is discussed in further detail in the following paragraphs.

The hydrogeologic characteristics of the Site pose several challenging issues. Due to the high groundwater table at the Site, excavation deeper than approximately five feet bgs will require construction dewatering. The soils at the Site, beneath the fill layer, are mostly sandy with little gravel.

These types of materials can transmit substantial volumes of groundwater. Therefore, the quantity of extracted water from the dewatering system may potentially be a significant. Extracted groundwater may require treatment prior to disposal. Disposal options will also require evaluation.

In addition, the Patchogue River borders the Site along the southeastern boundary and could pose implementation difficulties for some technologies. Technologies that would involve extraction or hydraulic containment of the groundwater would be difficult to effectively implement due the high hydraulic conductivity of the sandy soils and the nearby river; these conditions would require high rates of groundwater pumping to provide sufficient extraction or hydraulic containment.

The small size and configuration of the Site limits the type of technologies and work activities that can be performed. In general, the Site is relatively narrow. At the entrance to the central/core area (i.e., the portion of the Site subject to remedial activities), the Site is approximately is approximately 175 feet wide, including the sloped area along the western boundary which would be unusable space. Depending on the actual size of remediation area, the amount of space remaining available for operations, staging and work areas outside of the Central/Core area may be limited.

Implementation of some remedial technologies would pose increased risk of disturbance to adjacent property owners. Active commercial businesses are present on the properties to the northwest and east of the Site. The business on the property to the east of the Site uses specialty glass etching equipment that would be especially sensitive to significant earth disturbances and vibrations. In addition, due to the nature of MGP impacted soils at the Site, disturbance or excavation of the soils may generate odors during work activities. To minimize the generation and migration of odors off-Site, technologies that would involve extensive handling of soils (like ex-situ treatments) may require additional controls for treatment or mitigation of odors. Due to the close proximity of the adjacent properties, minimizing odors and other disturbances may be difficult with certain technologies.

The characteristics of the impacted Site media (soils and groundwater) were considered in selection of the remedial technologies used in formulation of a remedial alternative. Different types of soils are amenable to different types of treatment technologies. For example, in considering in-situ treatment technologies, coarse grain and granular soils are more suitable for soil vapor extraction, thermal conductivity heating (with vapor recovery) or chemical oxidation where the flow rate of either air or liquid is critical for optimal treatment effectiveness. Clay or silt type soils, on the other hand, would be more amenable to electrical resistance heating, for which this technology relies on the electrical resistance in the soil created during operation.

The characteristics of the contaminants of concern were also considered in the feasibility study. The contaminants may be present in several phases, (i.e., liquid, solid or viscous material). The phase of the contaminants may affect the implementability or treatability of the material, therefore, this is also considered during the remedial technology selection process. For example, chemical oxidation or bioremediation may be less effective at treating solid or viscous tar material since this technology relies on a chemical or biological reaction, and not a physical mixing, and therefore, may initially address only the outer layer of blebs or globs, and would likely require multiple applications.

The technologies retained for the preliminary screening include consideration of the technical issues discussed above.

6.2.2 Preliminary Technology Screening

The technologies are evaluated based on effectiveness, implementability, and cost. Table 6-1 presents a screening evaluation of the technologies for each of the GRAs as discussed in Section 5.0. The technologies that are not considered implementable or effective were not retained for further evaluation.

6.3 Summary of Retained Technologies

As presented in Table 6-1, the general response actions and technologies retained for remedial alternative development and evaluation are:

- Excavation
- Disposal
- Treatment
- Engineering Controls
- Institutional controls

These technologies were used to develop the remedial alternatives presented in Section 7.0.

Section 7

Remedial Alternatives Development and Analyses

This section presents the remedial alternatives developed from the retained remedial technologies detailed in Section 6.3 of this Report. Each remedial alternative was further defined by remedial components with respect to the criteria set forth in 6 NYCRR Subpart 375-2.8(c)(2)(i) and in general accordance with Section 4.3(a) of the DER-10 and is presented in Table 7-1. The alternatives were then evaluated against the eight criteria outlined 6 NYCRR Subpart 375-2.8(f) and a comparative analysis of the alternatives was performed.

7.1 Development of Remedial Alternatives

Each remedial alternative was developed to address the Site RAOs (see Section 4) and to the extent practicable, remove, contain, or treat source material in the subsurface. In consideration of technical implementation, media, specific contaminants, and Site conditions, the following alternatives were developed for consideration and evaluation:

1. **Alternative 1 – No Action.** No remedial activities at the Site. Impacted soils at the Site will remain in-place.
    a. No engineering or institutional controls.
    b. No groundwater monitoring program.
2. **Alternative 2 – Engineering and Institutional Controls, Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials**
    a. Excavation and off-site disposal of on-site fill materials to a depth of two feet bgs from the Central/Core Area to allow for installation of a soil cap.
    b. Excavation and off-site disposal of MGP tar and petroleum- impacted source materials on the adjacent property to the east (off site).
    c. Engineering controls (soil cap (on-site) and pavement (off site)).
    d. Institutional controls (environmental easement).
    e. Post-remedial groundwater monitoring program.
3. **Alternative 3 – Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)**
    a. Excavation of fill materials to a depth of two feet bgs from the Central/Core Area.
    b. Excavation and off-site disposal of on-site MGP-impacted soils (tars, stains, and sheens) from various depths ranging from surface grade to 23 feet bgs.
    c. Excavation and off-site disposal of MGP tar and petroleum -impacted source materials on the adjacent property to the east (off site).
    d. Dewatering of groundwater during excavation activities (with off-site transportation and disposal of collected groundwater
    e. One year (quarterly) of post-remedial groundwater monitoring program

4. **Alternative 4 – Excavation of MGP Tar-impacted Source Materials**
   a. Excavation and off-site disposal of on-site fill materials to a depth of two feet bgs from the Central/Core Area to allow for installation of a soil cap.
   b. Excavation and off-site disposal of on-site MGP tar-impacted source materials.
   c. Excavation and off-site disposal of MGP tar and petroleum -impacted source materials on the adjacent property to the east (off site).
   d. Engineering controls (soil cap (on site) and pavement (off site)).
   e. Institutional controls (environmental easement).
   f. Post-remedial groundwater monitoring program.
5. **Alternative 5 – In-Situ Solidification (ISS) of MGP Tar-Impacted Source Materials**
   a. Excavation and off-site disposal of on-site fill materials to a depth of two feet bgs from the Central/Core Area to allow for installation of a soil cap.
   b. In-situ solidification of MGP tar-impacted source materials.
   c. Excavation and off-site disposal of MGP tar and petroleum -impacted source materials on the adjacent property to the east (off-site).
   d. Engineering controls (soil cap (on-site) and pavement cap (off-site), fencing with lockable gates).
   e. Institutional controls (environmental easement, Site Management Plan (SMP), and Health and Safety (HASP));
   f. Post-remedial groundwater monitoring program.

7.1.1 Remedial Alternatives

The five remedial alternatives developed for evaluation are described in detail below. Figures 7-1 through 7-4 show the remedial areas for Alternatives 2 through 5.

7.1.1.1 Common Elements of the Remedial Alternatives

With the exception of Alternative 1, the remedial alternatives to be evaluated as part of this FFS include two common elements. These components are as follows:

- **Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials** – Each alternative, with the exception of Alternative 1 (No Action), would include addressing off-site impacts consisting of MGP tar- and petroleum-impacted source materials identified during the RI and PDI activities on the property to the east of the Site. These impacts consist of MGP-related tar (NAPL) and petroleum-related NAPL which are locally commingled. The limits of the proposed off-site remedial activities are depicted on Figures 7-1 through 7-4. The remedial actions to be performed on the adjacent property will include excavation or solidification of the identified impacts, backfill (in alternatives involving excavation) with materials meeting regulatory requirements and restoration of the Site to pre-remedial conditions.
- **Post-Remedial Groundwater Monitoring Program** – The RI Report and subsequent groundwater monitoring indicate that groundwater impacts at the Site appear to be localized around monitoring well MW-5 and MW-6. MW-5 and MW-6 are located within the areas which will be subject to remedial activities. Once the remedial activities are implemented, groundwater impacts are anticipated to be addressed by either the removal or solidification of the source materials. A groundwater monitoring program to assess the effects of the remedial activities on groundwater and monitor for the change in concentration of MGP-related constituents is included with each alternative with the exception of Alternative 1.

The remedial alternatives evaluated as part of this FFS, with the exception of Alternatives 1 and 3 include the following common element:

- **Engineering and Institutional Controls** – The establishment of engineering and institutional controls at the Site is also a common component of all alternatives with the exception of Alternatives 1 and 3. A description and evaluation of the engineering and institutional controls is presented in Section 7.2

7.1.2 Remedial Alternatives

The five remedial alternatives developed for evaluation are described in detail below. Figures 7-1 through 7-4 show the remedial areas for Alternatives 2 through 5. Each alternative has been defined with respect to the parameters set forth in DER-10 Chapter 4 Section 4.3(a)(5)(ii). These parameters include: (1) size and configuration; (2) remediation time; (3) spatial requirements; (4) disposal options; (5) permit requirements; (6) limitations; and (7) beneficial and/or adverse impacts on fish and wildlife resources. A summary of the alternatives evaluation with respect to the seven aforementioned criteria is presented in Table 7-1.

Alternative 1 – No Action

This alternative does not include any remedial measures. No active remediation, engineering or institutional controls are implemented under this alternative. The evaluation of the No Action alternative is required by CERCLA as a baseline for comparison with other remedial alternatives. In addition, NYSDEC requires this evaluation stating that the No Action alternative should evaluate the adverse (or beneficial) site changes that may occur in the absence of a proposed remedial action.

7.1.2.1 Alternative 2 - Engineering and Institutional Controls, Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials

Alternative 2 includes a two foot deep soil excavation over the portions of the Central/Core Area that were subject to previous filling activities for the establishment of a soil cap (i.e., an engineering control). The alternative does not include any other active remediation on the Site. This alternative includes the establishment of institutional controls to address MGP-impacted soils that will remain on the Site after implementation of the remedial alternative. Further, off-site MGP and petroleum NAPL impacted soils would be subject to excavation and off-site disposal/treatment. The post-remedial groundwater monitoring program, a common element of this alternative as well as Alternative3, would be implemented for a period of one year on a quarterly basis to assess the effects of the implementation of the remedial alternative on groundwater. A description of the engineering and institutional controls is presented in Section 1.4.

A conceptual plan of Alternative 2 is depicted on Figure 7-1.

Soils generated from the excavation of the off-site MGP and petroleum NAPL-impacted soils would either be directly loaded into transport trucks, if waste characterization has been performed, or staged on-Site for waste characterization. Excavated soils would be transported and disposed off-Site at an approved landfill or treatment facility. The off-site excavation would be backfilled with excavated materials meeting the regulatory requirements for reuse (no visible impacts) and/or imported fill materials.

7.1.2.2 Alternative 3 – Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)

Alternative 3 includes the removal of MGP source materials (e.g., soils impacted by NAPL) and impacted soils (e.g., soils with sheens, stains, odors) on the Site. This alternative would restore the Site to “pre-release conditions”. The limits of the source material and MGP-impacted soils are based on documented observations of MGP-impacts in the soil borings and test pits. This alternative includes a two foot deep soil excavation over the portions of the Central/Core Area that was subject to previous filling activities and soil excavation in targeted areas ranging from a depth of five feet bgs to the deepest excavation of approximately 23 feet in the central portion of the Core Area. The approximate areal limits of excavation necessary to remove MGP tar impacted soils, as well as the excavation depths, are depicted on Figure 7-2. This alternative also includes a post-remedial groundwater monitoring program for one year and the remediation of off-Site MGP and petroleum NAPL impacted soils on the adjacent property to the east. A conceptual plan of Alternative 3 is depicted on Figure 7-2.

Based on the hydrogeologic characteristics of the Site (i.e., high groundwater table and soil types), excavation deeper than approximately five feet bgs will encounter the groundwater table. Dewatering will be necessary for excavation below the groundwater table. Depending on the volume of collected groundwater, there are several options for disposal. If the volume of collected groundwater is manageable, it may be temporarily stored on-Site in tanks, characterized, and transported off-Site for treatment or disposal. If an excessive volume of collected groundwater requires management, it may not be efficient to temporarily store, transport and dispose of large volumes water. On-Site treatment and disposal of collected groundwater at the local publicly owned treatment works (POTW) may be an option. However permits for a discharge to the POTW may be difficult to obtain. Other options for managing the removed groundwater may include treatment and discharge to the adjacent surface water or reinjection into the subsurface at the Site.

In deeper excavation areas, excavation support systems (e.g., sheet piling, trench boxes) would be required to stabilize excavation walls. Sheet piling would be the most feasible support structure to install and would consist of steel or polyethylene pre-fabricated systems. The installation depth and method would be based on soil properties and the targeted depth of the excavation area and would be selected during the remedial design process.

Excavated soils would either be staged on-Site for waste characterization or, if waste characterization is performed in-situ prior to the start of the remedial actions, directly loaded into trucks. Excavated soils would be disposed off-Site at an approved landfill or treatment facility. The excavation would be backfilled with materials meeting regulatory requirements to pre-remedial grade.

7.1.2.3 Alternative 4 – Excavation of MGP Tar-impacted Source Materials

Alternative 4 includes the removal of MGP tar-impacted source material identified during the RI and PDI activities. The approximate limits of the area subject to excavation activities are depicted on Figure 7-3. The depths of the excavations vary across the Site from nine feet bgs to 23 feet bgs.

This alternative also includes a two foot deep soil excavation over the portions of the Central/Core Area that was subject to previous filling to allow for the construction of a soil cap, and includes the common elements (i.e., engineering and institutional controls, a post-remedial groundwater monitoring program (for three years), as well as remediation of off-Site MGP and petroleum-impacted soil on the adjacent property to the east). A conceptual plan of Alternative 4 is depicted on Figure 7-3.

Based on the hydrogeologic characteristics of the Site (i.e., high groundwater table and soil types), excavation deeper than approximately five feet bgs will encounter the groundwater table. Based on the significant volume of water that would be required to be extracted via a dewatering system, treated on-site and disposed of off-site, excavation activities to occur within the water table will be performed through the water (i.e.., in the wet). Saturated soils that are encountered will be staged adjacent to the excavation area and will be allowed to drain by gravity back into the excavation until the soil is suitable for handling. Drier soils may be used to mix with wet soils in order to meet moisture content parameters for the off-site disposal facility. Further, soil amendments to control moisture may be considered for use.

In deeper excavation areas, excavation support systems (e.g., sheet piling, trench boxes) would be required to stabilize excavation walls. Sheet piling would be the most feasible support structure to install and would consist of steel or polyethylene pre-fabricated systems. The installation depth and method would be based on soil properties and the targeted depth of the excavation area and would be selected during the remedial design process.

Excavated soils would either be directly loaded into transport trucks, if waste characterization has been performed, or staged on-Site for waste characterization. Excavated soils would be transported and disposed off-Site at an approved landfill or treatment facility. The excavation would be backfilled with excavated materials meeting the regulatory requirements for reuse (no visible impacts) and/or imported fill materials. At the completion of backfilling activities, a soil cap would be installed over the portions of the Site that were subject to the two foot surficial soil removal described above and depicted on Figure 7-3. The cap may consist of soil, stone or a combination of both. The cap would also include a demarcation layer between the cap and the underlying soils.

7.1.2.4 Alternative 5 – In-Situ Solidification of MGP Tar-impacted Source Materials

Alternative 5 includes the in-situ mixing of MGP tar-impacted soils with solidification agents (e.g., cement, bentonite, and/or other additives) to reduce the mobility of the constituents in the soil. The reduction in mobility coupled with the decrease in hydraulic conductivity of the solidified mass would limit the interaction between constituents and groundwater. The targeted treatment area for this alternative would be similar to Alternative 4. The targeted treatment depth would be 23 feet below grade.

This alternative also includes a two foot deep soil excavation over the portions of the Central/Core Area that was subject to previous filling for the construction of a soil cap, and includes the common elements described in Section 7.1.2 (i.e., engineering and institutional controls, a post remedial groundwater monitoring program (for three years), as well as remediation of off-Site MGP and petroleum-impacted soil on the adjacent property to the east). In addition, this alternative will include the implementation of engineering controls (soil cap). A conceptual plan of Alternative 5 is depicted on Figure 7-4.

Prior to implementation, a site-specific bench-scale treatability study would be necessary to confirm that the selected solidification agents are compatible with the site constituents and would be effective in reducing mobility of the constituents. ISS application can be performed using a variety of technologies. For the Site, shallow-zone soil mixing (SSM) would likely be the implementation method. SSM uses large diameter augers (e.g., six to 12-foot diameter). The augers mix the soil with the stabilizing agents as the agents are injected through the auger shafts.

In addition to the solidification of target soil, ISS would require either pre-excavation or management of spoils at the surface to accommodate the swelling of the ISS treatment zone, which is typically 20 to 40% for soil-mixing applications. The excavated soils from the ISS pre-excavation would either be staged on Site for waste characterization or, if waste characterization was previously performed in-situ, directly loaded into trucks. Excavated soils would be disposed off-Site at an approved landfill or treatment facility. Similar to Alternatives 2 and 4, a soil cap then would be installed.

7.2 Institutional and Engineering Controls

The section presents a description of the institutional and engineering controls proposed for the remedial alternatives and an evaluation in accordance with the DER-10 “Development and Evaluation of Alternatives” Section 4.3(b).

Engineering Controls

The proposed engineering controls for the selected remedial alternative would include the installation of a soil cap over the portion of the Site previously subject to filling activities. The cap will serve to prevent exposure to impacted materials which may remain at the Site after completion of the remediation. The limits of the cap are depicted on Figures 7-2 through 7-4. The cap will be constructed by removing two feet of the existing fill material and restoring the area to pre-existing grade with clean backfill materials. The cap may consist of soil, stone, or a combination of both. The soil cap would also include a demarcation layer between the cap and the underlying soils. The final components of the cap will be developed during the design phase of the project. Additional engineering controls would include establishment of fencing with lockable gates to prevent unauthorized access to the Site.

These engineering controls will require monitoring and maintenance to remain protective of the public health and environment. These engineering controls are readily implementable and relatively simple to monitor and maintain. Monitoring of the engineering controls would include periodic inspections performed by the Site owner, manager, or designated representative. The inspections would be performed to document the existing conditions of the engineering controls and disturbances, if any, and recommended repairs, as needed. Maintenance of the engineering controls would include repair fencing and repairs to the engineered soil cap and would be performed by National Grid or a designated representative.

Institutional Controls

The proposed institutional controls for the remedial alternatives would include the establishment of an environmental easement(s) to restrict future uses of the property and development of a Site Management Plan (SMP) and a Health and Safety Plan (HASP) to manage future invasive activities at the Site. The environmental easement would restrict the use of Site groundwater and would restrict future uses of the Site. The SMP and HASP would describe the required procedures for performing ground-intrusive work and would include worker and public health and safety, handling and management of impacted soil or groundwater, notification of authorities and responsible parties, site restoration and documentation. The SMP would identify the ECs/ICs required to be maintained in order to manage the potential risks related to future earth disturbing activities from residual contamination that may remain on-site after the implementation of the recommended remedial alternative. The SMP would include:

- Procedures to manage remaining impacted soils, if any, related to future earth disturbing activities performed related to site development. Included would be procedures for handling, management, disposal of impacted soils as well as health and safety aspects related to on-site workers and the surrounding community;
- Institutional controls to maintain site use restrictions as identified in the environmental easement;
- Schedule and requirements for the monitoring and certification of ECs/ICs so they remain protective of public health and the environment; and
- Requirements of the post-remedial groundwater monitoring program.

These institutional controls will require monitoring and enforcement to remain protective of the public health and environment. These institutional controls are readily implementable and relatively simple to monitor and enforce. Monitoring and enforcement of the institutional controls would be performed by National Grid or a designated representative.

Evaluation and Cost

Engineering and institutional controls are effective means of controlling Site use and access. The effectiveness and reliability of the institutional and engineering controls would be demonstrated through the quality of the implemented controls and the requirements of the monitoring and maintenance plans. In combination with monitoring and maintenance plans and notification and enforcement procedures, the proposed engineering and institutional controls would remain protective of public health and environment indefinitely.

Implementation costs of institutional and engineering controls are generally less than most remediation systems; however, costs would depend on the size of the Site and complexity of the engineering controls. The cost of implementation of the proposed institutional and engineering controls for the remedial alternatives is included in the cost estimates presented in Appendix C.

7.3 Evaluation Criteria

The evaluation of each remedial alternative considers the following criteria consistent with DER-10 guidance:

- Overall Protectiveness of Public Health and the Environment
- Compliance with SCGs
- Reduction of Toxicity, Mobility, or Volume of Contamination
- Short-Term Impacts and Effectiveness
- Long-Term Effectiveness and Permanence
- Implementability
- Cost Effectiveness
- Land Use

Detailed descriptions of the relative criteria to this FFS are provided below.

Overall Protectiveness of Public Health and the Environment

This criterion is an evaluation of the remedy's ability to protect public health and the environment, assessing if risks posed through each existing or potential pathway of exposure are eliminated, reduced or controlled through removal, treatment, engineering controls or institutional controls. It evaluates the remedy's ability to achieve each of the remedial goals identified in Section 4.1. The overall assessment of protection overlaps with, and is based on, assessments performed under other evaluation criteria, particularly long-term effectiveness and permanence, short-term effectiveness, and compliance with SCGs. The remedy's ability to achieve each of the RAOs is evaluated.

Compliance with Standards, Criteria, and Guidance (SCG)

This criterion is an evaluation of the remedy's ability to comply with SCGs and determines whether a remedy will meet applicable environmental laws, regulations, standards, and guidance. SCGs for the Site will be evaluated to determine whether the remedy will achieve compliance. For those SCGs that are not met, an evaluation of the impacts of each and whether waivers are necessary is performed. Refer to Section 4.2 for discussion of applicable SCGs.

Reduction of Toxicity, Mobility, or Volume with Treatment

This criterion evaluates the remedy's ability to reduce the toxicity, mobility or volume of Site contamination. The evaluation focuses on the following specific factors for a particular remedial alternative:

- The amount of contaminated materials that will be destroyed or treated;
- The degree of expected reduction in toxicity, mobility, or volume;
- The degree to which the treatment will be irreversible; and
- The type and quantity of treatment residuals that will remain following treatment.

Preference should be given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the Site.

Short-Term Impacts and Effectiveness

This criterion evaluates the potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation. The evaluation includes how identified adverse impacts and health risks to the community or workers, if any, at the Site will be controlled, and the effectiveness of the controls. Further, this criterion considers engineering controls that will be used to mitigate short-term impacts (i.e., dust control measures). The length of time needed to achieve the remedial objectives is estimated and included in the evaluation.

Long-Term Effectiveness and Permanence

This criterion evaluates the long-term effectiveness of the remedy after implementation. If wastes or treated residuals remain on-Site after the selected remedy has been implemented, the following items are evaluated:

- The magnitude of the remaining risks (i.e., will there be any significant threats, exposure pathways, or risks to the community and environment);
- The adequacy of the engineering and institutional controls intended to limit the risk;
- The reliability of these controls; and
- The ability of the remedy to continue to meet RAOs in the future.

Implementability

This criterion evaluates the technical and administrative feasibility of implementing the remedy. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. Administrative feasibility includes the availability of the necessary personnel and material along with potential difficulties in obtaining specific operating approvals, access for construction, permits, etc. for remedy implementation.

Cost Effectiveness

This criterion includes an evaluation of the capital, operation, maintenance and monitoring costs. These costs are developed and presented on a present worth basis for comparison purposes. Under this criterion, capital, operation, maintenance and monitoring costs for the remedy are estimated and presented on a present worth basis. The estimated costs are considered a Class 4 Cost Estimate with an expected accuracy of 30 to +50%, which is consistent with USEPA's RI/FS Guidance (USEPA, 1988). A contingency of 15% was applied to address unforeseen costs and account for uncertainty. Present worth costs are estimated using a discount factor of 3%.

Land Use

This criterion includes an evaluation of the current, intended and reasonably anticipated future use of the Site and its surroundings, as it relates to the alternative or remedy, when unrestricted levels would not be achieved.

7.4 Evaluation of Remedial Alternatives

The section compares the relative performance of each remedial alternative using the specific evaluation criteria presented in Section 7.3. Comparisons are presented in a qualitative manner and identify substantive differences between the alternatives. As part of the evaluation, consideration was given to the alternative to determine if it satisfies the criteria, meets the minimum applicability standards and is suitable for the Patchogue Site based on site specific conditions. The detailed evaluation of each of the alternative against the criteria is presented on Table 7-2. A summary discussion of the evaluation is included in the following subsections. Each of the criteria is listed and a summary of the results of the evaluation is presented. The alternative that meets the criteria with the highest rating is discussed first, and the alternatives in descending criteria rating are listed subsequently.

Overall Protectiveness of Public Health and Environment

Alternative 3 was considered to offer the greatest overall protectiveness of public health and environment as this alternative includes the removal of all MGP impacted materials to restore the Site to pre-release conditions. Alternatives 4 and 5 were both considered highly acceptable, as well, since these two alternatives include either removal or treatment of the MGP-tar impacted source materials, the installation of engineering controls (capping) over the areas where residually impacted material will remain in place, and implementation of institutional controls (i.e., Environmental Easement, SMP and HASP). Alternative 2 will satisfactorily meet these criteria through the implementation of engineering and institutional controls. These controls would minimize the risk of exposure to impacted materials that would remain in-place after the implementation of Alternative 2. Alternative 1 does not satisfy this evaluation criteria as it includes no active remedial actions or engineering or institutional controls to minimize potential exposure risks. Therefore, Alternative 1 is not protective of public health and the environment.

Compliance with SCGs

Alternative 3 offers the greatest ability to meet this evaluation criteria and is the only alternative that fully complies with chemical, action and location specific SCGs as all MGP impacted materials would be removed and the Site restored to pre-release conditions. Alternatives 4 and 5 partially comply with the chemical specific SCGs as the MGP tar-impacted source materials will be removed or treated. However, after implementation of Alternatives 4 and 5, MGP impacted materials will remain on-site satisfying the action and location specific SCGs. Alternative 2 also partially complies with the SCGs. Alternative 1 does not comply with chemical specific, action or location SCGs since this alternative includes no remedial actions.

Long-Term Effectiveness and Permanence

Alternative 3 offers long term permanence as all impacted materials will be removed from the Site. Long-term effectiveness and permanence would also be realized through the implementation of Alternative 4 and 5 as the MGP tar-impacted source materials would be either removed or treated and the residually impacted materials address via engineering and institutional controls. Alternatives 3, 4, and 5 offer long-term effectiveness and permanence with regard to groundwater impacts as the source of the impacts would be either removed and/or treated. Therefore, Alternatives 3, 4, and 5 are considered to have a high degree of long term effectiveness and permanence. Alternative 2 would not allow for attainment of an RAO and the long term effectiveness of minimizing human health risks are dependent on adherence to the use of engineering and institutional controls. Therefore, this alternative is considered to have a below satisfactory compliance with this criteria. Alternative 1 does not comply with this criteria and is considered unsatisfactory since no actions would be conducted for this alternative.

Reduction of Toxicity, Mobility or Volume of Contamination

Alternative 3, 4, and 5 offer reduction in either toxicity, mobility and volume of contamination. Alternatives 3 and 4 provide for the reduction in toxicity, mobility and volume of contaminated materials as both alternatives include removal of impacted material from the Site. Alternative 5 provides for reduction in toxicity and volume of contamination as the solidification of the materials will mix the impacts into a low permeability, low leachability matrix. Implementation of Alternatives 3, 4 or 5 are expected to reduce the toxicity and volume of impacted groundwater by removing or treating the source of the isolated groundwater impacts at the Site. Alternatives 1 and 2 do not offer any reduction in toxicity, mobility or volume of contamination as these alternatives do not include any removal or treatment of the impacted soils.

Short-Term Impacts and Effectiveness

No short-term impacts would be realized through the implementation of Alternative 1 since no on-site activities or construction would be performed. Alternative 2 offers the least amount of impacts of the remaining alternatives due to the small amount of remedial operations that need to be conducted at the Site. Alternative 5 would result in minor impacts to the local community during the implementation of the in-situ soil solidification including some traffic impacts during mobilization and operation of the equipment at the Site, noise impacts during operation of the augering equipment and the reagent mixing operations, and dust and odor impacts during treatment. These impacts would be controllable with the use of proper engineering controls during construction (i.e., odor suppression foams, noise reduction equipment on machinery, etc.). Odors may also be addressed by using a shroud over the augering equipment that would control vapor emissions if they became an issue. Final impact mitigation measures will be developed during the remedial design process.

Alternatives 3 and 4 would present the most short term impacts to the surrounding community with Alternative 3 resulting in more impacts due to the larger size of the remedial area, the larger remedial operations and the longer duration of implementation. Short-term impacts that will be realized during the implementation of these alternatives include:

- impacts from disturbance of source materials and associated impacted soils;
- impacts from noise, dust and odors generated by construction equipment and impacted soils;
- impacts from the large amount of truck/construction vehicle traffic due to the large number of processes (i.e., soil handling, soil conditioning, staging, stockpiling, blending/stabilizing, treatment of groundwater associated with dewatering activities, loading for off-site disposal, deliveries of backfill, etc.); and
- potential impacts to occupants of the neighboring property due to the fact that the implementation of these alternatives may require portions of their property to be utilized as the Site is not of sufficient size to contain all operations necessary to implement Alternatives 3 and 4.

Alternative 5 would realize some of these impacts also due to processes associated with the in-situ solidification but on a smaller scale.

Implementability

Technical Feasibility

All of the remedial alternatives being considered in this FFS are technically feasible to implement. Alternatives 1 and 2 are technically feasible since they require minimal or limited field activities. The technology (in-situ solidification) to implement Alternative 5 is considered feasible since this technology has been demonstrated to be effective at other sites and can be implemented at the Patchogue MGP site. The site is accessible for truck access and the topography is generally level so the equipment can be used at the site. The site is considered small in area for this type of treatment, and maneuvering the equipment to treat the remedial area may present some challenges. After the in-situ solidification activities are completed, excavation of the top layer of soil will also be required to remove the swell material and present an unstabilized corridor for the installation of utilities and subsurface features (i.e., foundations). Management of these activities at a small site, such at the Patchogue site, will require extensive planning and coordination.

Alternatives 3 and 4 will include the mobilization and daily use of a significant quantity and different types of large equipment. For the excavation activities, cranes will be required for the installation and movement of sheet pile support systems for the excavation. Excavators and backhoes will be required for the excavation of the soils. Front loaders and pug mills will be required for the soil conditioning of the saturated soils. Front loaders and transport trucks will be needed for off-site transportation of the excavated soils. Portable tanks and tanker trucks will be required for the handling and off-site transport for the dewatering activities. If pre-treatment of the water is required, an on-site pretreatment unit will be required. The logistics of managing the quantity of equipment needed to excavate will present difficulties since the available area of the site in which to work is limited. Adequate space to conduct these activities simultaneously may not be available at the Patchogue site.

Administrative Feasibility

Each of the alternatives is administratively feasible to implement. Alternative 1 would require the least administrative activities as there is no remedial action to be performed as part of the alternative. Alternatives 2, 3, 4 and 5 will require obtaining permits and approvals from local agencies for the excavation and in-situ treatment activities. In addition, dewatering activities and off-site disposal of soil and water will require coordination, sampling and characterization of the material for acceptance at a disposal facility.

Cost Effectiveness

The estimated capital costs for implementation of a remedial action (excluding Alternative 1) ranged from $1,270,000 to $11,660,000. (There are no costs associated with Alternative 1.) The least costly alternative is Alternative 2, which includes the implementation of engineering and institutional controls. Long term routine inspections, maintenance and monitoring would be required (estimated at 30 years) to monitor the integrity of the engineering controls. The estimated annual cost is $91,000. The total estimated costs for Alternative 2 are $3,050,000.

Alternative 4 is ranked second for cost effectiveness. The estimated costs for excavation of the MGP tar-impacted material and installation of a cap over the remainder of the site are $4,390,000. The estimated annual costs for Alternative 4 are the same as Alternative 5 ($91,000). The total estimated costs for Alternative 4 are $5,170,000.

Alternative 5 is ranked third for cost effectiveness. This estimated capital cost for this alternative is $5,150,000. Annual costs for Alternative 5 are estimated at $91,000 for continued inspection, maintenance of the engineering controls, and groundwater monitoring (includes 3 years of groundwater monitoring and 30 years of inspection and maintenance of engineering controls). The total estimated costs for Alternative 5 are $5,930,000.

The most costly alternative is Alternative 3 which is estimated at $11,660,000, due to the fact that this alternative addressed both the MGP tar-impacted material and the MGP impacted material (material impacted by sheens, stains and odors related to MGP tar). The largest volume of soil would be excavated by implementing this alternative. However, the annual costs are reduced since inspections and maintenance activities are expected to be less (estimated at $60,000 for 1 year of groundwater monitoring). The total estimated costs for Alternative 3 are $11,720,000.

A summary of the estimated costs for each of the alternatives is shown on Table 7-2. Detailed cost estimates are included in Appendix C- Remedial Alternative Cost Estimates.

Land Use

At present, the site zoned as industrial property. The site is currently zoned “industrial” and is vacant. The majority of the site is grass covered and the perimeter is fenced. The potential future uses of the site have not been evaluated. The site may be developed in the future. However, potential future uses and construction design must be in accordance with the requirements of the engineering and institutional controls. For example, if future development requires disturbance of the soil cap, the cap must be replaced. The in-situ soil solidification area will remain as a stabilized mass and, therefore, future development will be required to incorporate this into subsurface development plans (utilities and foundations). Of note, Alternative 5 includes the excavation of the top layer of the stabilized mass so that a four feet layer of clean soil will be present over the mass.

Section 8

Recommended Remedial Alternative

Based on the results of the comparative analysis conducted as part of the FFS process, as summarized in Section 7.4 and on Table 7-2, Alternative 5 (In-Situ Solidification (ISS) of MGP Tar -Impacted Source Materials) is the recommended alternative. Alternative 5 achieves the RAOs established for the Site and complies with the SCGs (Section 4). Alternative 5 achieves the RAOs for the Site through in-situ mixing of MGP tar-impacted soils with solidification agents (e.g., cement, bentonite, and/or other additives) to reduce the mobility of the constituents in the soil. The reduction in mobility coupled with the decrease in hydraulic conductivity of the solidified mass would limit the interaction between constituents and groundwater. Alternative 5 also includes engineering and institutional controls. The engineering controls will consist of the establishment of a soil cap over the portion of the Site formerly subject to filling activities. The institutional controls will consist of the establishment of an environmental easement to limit future use of the Site and the development of a Site Management Plan, including a Health and Safety Plan, to govern future soil disturbing activities. Solidifying the source materials will minimize the interaction between the groundwater and the source materials and eliminate potential continuing sources of soil and groundwater contamination.

Solidification of the source material is anticipated to address the isolated exceedances of the Class GA groundwater quality criteria identified in groundwater samples from MW-5 and MW-6. Alternative 5 represents the most cost-effective alternative and provides overall protection of public health and the environment; reduction in toxicity and mobility of impacted media; and long-term effectiveness and permanence.

Alternative 3 would restore the Site to pre-release conditions. However, this alternative is not recommended due to the potentially significant risks associated with implementation and associated short-term impacts. Implementation of this alternative would require substantial earth moving activities, dewatering and earth/excavation support systems. Alternative 3 presents the highest cost of the all the alternatives and does not offer significant additional protection of public health and the environment when compared to Alternative 5. Alternative 2 is not recommended. Although it represents the least expensive alternative and could be implemented with minimal short-term impacts, this alternative would result in the untreated MGP tar-impacted source material remaining at the Site and, therefore, would be less effective in mitigating long-term risks to public health and environment. Although potential future impacts to public health and the environment would be minimized through engineering and institutional controls, the additional risk reduction achieved by Alternative 2 is commensurate with the increased cost when compared to Alternative 5.

Alternative 4 does not provide additional protection of public health and the environment when compared to Alternative 5. Alternative 4 would remove the contaminants on Site rather than solidifying them as with Alternative 5. However, the short term impacts to the surrounding community during implementation of Alternative 4 would be substantial when compared to Alternative 5. In summary, Alternative 5, the recommended remedy, includes the following:

- Excavation and off-site disposal of on-site fill materials to a depth of two feet bgs from the Central/Core Area to allow for installation of a soil cap.
- In-situ solidification of MGP tar-impacted source materials.
- Excavation and off-site disposal of MGP tar and petroleum -impacted source materials on the adjacent property to the east (off site).
- Engineering controls (soil cap (on site) and pavement cap (off-site), fencing with lockable gates).
- Institutional controls (environmental easement, Site Management Plan (SMP), and Health and Safety (HASP));
- Post-remedial groundwater monitoring program.

The limits of the proposed remedial activities, excavations and associated depths associated with the recommended remedy, Alternative 5, are depicted on Figure 7-4.

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Tables

TABLE 3-1
SUMMARY OF NAPL/TAR OBSERVATIONS
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Location	Depth (ft., BGS)	Description
PASB-06	4-8	Petroleum.
	8-12	Petroleum.
PASB-22A	3-5	Black tar saturated wood shavings and soil, naphthalene-like odor.
	5-8	Black tar saturated soil, naphthalene-like odor.
	8-8.2	Black tar saturated soil.
	8.4-8.8	Black tar saturated soil.
PASB-26	4.5-5	Oily appearance.
PASB-28	0-5	Black saturated.
PASB-29	0-5	Black saturated.
	5-6	Black saturated.
PASB-30	2-5	Oily appearance, moderately strong odor.
	8-8.5	Gray black oily zone.
	9-9.6	Gray black oily zone.
PASB-36	0-5	Trace tarry material.
	5.5-5.6	Oily appearance.
PASB-37	2-5	Slight oily appearance.
PASB-41	6-6.5	Saturated with oil.
	8-8.5	Oil coated.
MW-2X	0-5	Some tarry globules, strong odor.
Test Pit C'+27'N	3.5	Minor amounts of tar.
SB-102	6.2-6.5	Slight NAPL coating on grains, sheen on soil grains, moderate to strong tar-like odor.
SB-103	3.7	Brown NAPL coating grains, rainbow sheen, moderate to strong tar-like odor.
	5.9-6.5	Black stained, NAPL coating on soil grains. Brown NAPL on coarser material.
	6.6-7.2	Black stained, slight NAPL coating on grains, moderate tar-like odor.
SB-108A	1.75-1.9	Black hardened tar, moderate tar-like odor.
	2.5-2.6	NAPL coating grains, sheen/blebs on liner. Moderate to strong tar-like odor.
SB-109	3.6-3.8	Minor black staining, hardened tar, moderate tar-like odor.
SB-111	7.1-7.3	Band of NAPL saturated soils (tacky), moderate tar-like odor

TABLE 3-1
SUMMARY OF NAPL/TAR OBSERVATIONS
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Location	Depth (ft., BGS)	Description
SB-115	2-2.5	Soils slightly coated with NAPL.
	10.85	Band of soil coated with tacky NAPL, sheen, faint tar-like odor.
	11.45	Band of soil coated with tacky NAPL, sheen, faint tar-like odor.
	20	Few small specks of NAPL.
SB-116	11.9	Band of soils coated with NAPL, sheen.
	12.2	Band of soils coated with NAPL, sheen, faint/moderate tar-like odor.
	20.5	Very few specks of tacky NAPL.
SB-117	2.6-2.7	Soils coated with NAPL.
SB-118	2.3-3.2	Black stained and NAPL coated soils.
	5-10	NAPL coated sand grains, moderate/strong tar-like odor.
	11.3	Lens of NAPL coated soils.
	11.6	Lens of NAPL coated soils (more viscous than observed at 11.3').
	15-15.5	Thin band of black viscous NAPL coated soils, moderate tar-like odor.
SB-119	1.1-1.3	NAPL coated soils.
	1.3-3	NAPL coating/NAPL saturated, moderate tar-like odor.
	5-5.9	NAPL coated soils.
	7.4	Band/lens of NAPL.
	10.7	Black staining, sheen and NAPL coating on gravel.
	10.9	Band/lens of tacky NAPL within coarser grained material, moderate tar-like odor.
SB-120	3-3.1	NAPL coating, blebs/sheen extending from saturated soil grains.
	5-6.7	NAPL coating/saturated, moderate tar-like odor.
	10-10.7	Bands of black staining/NAPL coated soils, sheen.
	11.3-11.4	Black staining, NAPL (tacky to touch).
	12.2-12.3	Lens of NAPL (tacky to touch).
	15.9-16.1	NAPL saturated (tacky to touch).
	16.5	Lens of tacky NAPL.
SB-121	2.4-2.9	NAPL coating soil, moderate tar-like odor.
	5-5.4	NAPL coating on soil grains, moderate tar-like odor.
	11.5-11.7	Globules of viscous NAPL (tacky to touch).
	11.7	Lens of NAPL.
	15.2-17	Lenses of tacky NAPL concentrated around coarser grained material, sheen throughout, moderate tar-like odor.
SB-122	2.2-3.9	NAPL coating soil grains, moderate/strong tar-like odor.
	5-5.7	NAPL saturated, strong tar-like odor.
	5.7-6.9	NAPL coating on soil grains, sheen throughout.
	5.9	NAPL saturated.
	6.2	NAPL saturated.
	6.6	NAPL saturated.
	10.8-10.9	Tacky coating on soils, sheen.
	11.2-11.5	NAPL saturated (tacky).

TABLE 3-1
SUMMARY OF NAPL/TAR OBSERVATIONS
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Location	Depth (ft., BGS)	Description
	11.7	Lense of tacky NAPL.
	11.8	Lense of tacky NAPL.
	16.05-16.1	Lenses of tacky NAPL, moderate tar-like odor.
	20.65-20.75	Lenses/bands of NAPL coated soils.
SB-123	1.9-2.2	NAPL saturated.
	1.9-3.2	NAPL coating on soil grains.
	5-6.1	NAPL coating on soil grains, moderate tar-like odor.
	6.1-8.1	Sporadic blebs of NAPL and sheen concentrated around gravel.
	11.2	Few NAPL blebs on coarse grained material.
	11.9-12	Bands of black staining, slight NAPL coating, sheen, moderate tar-like odor.
	12.6	Bands of black staining, slight NAPL coating, sheen, moderate tar-like odor.
	15.6-16	NAPL coating, sheen, moderate tar-like odor.
	16-16.5	NAPL saturated.
	16.9-17.2	NAPL saturated.
SB-124	12.9	Few NAPL blebs and sheen on soil grains, moderate tar-like odor.
SB-125	15.4-15.8	Very few spots of NAPL coated soils (tacky), faint tar-like odor.
	20.7-20.8	Band of soils coated with tacky NAPL.
SB-126	2.9-3.3	NAPL coating sand and gravel (tacky to touch, moderate/strong tar-like odor.
	5.6-6.8	NAPL coated/saturated, moderate tar-like odor.
	8.1	NAPL saturated.
SB-127	5.7-6	NAPL coating sand and gravel (tacky to touch, moderate/strong tar-like odor.
SB-128	6.9	Soils heavily coated with NAPL.
	15.9-16	Bands of soil heavily coated with NAPL.
	20.22	Bands of soils coated with tacky NAPL, sheen, faint tar-like odor.
SB-129	6	NAPL coated soils.
	6.2-6.4	NAPL saturated soils.
	6.4-7.5	Sheen and NAPL blebs throughout.
	6.8	Soils heavily coated with NAPL.
	15.7-16	Bands and spots of NAPL coated soils (tacky), moderate tar-like odor.
	22.05	Thin band of stringy NAPL with sheen surrounding it, faint tar-like odor.
SB-130	5-6.6	Soils heavily coated with NAPL.
	15.9	Lens/band of black stained soils, slightly coated with NAPL.
	17.2	Thin band of tacky NAPL.
SB-131	1.2-2	Slight NAPL coating on soil grains, slight tar-like odor.
	2-2.8	Heavy NAPL coating on soils, moderate tar-like odor;.
	10.95	Band of tacky NAPL.
	11.3	Spots of NAPL coated soils and sheen.
	11.6	Spots of NAPL coated soils and sheen.

TABLE 3-1
SUMMARY OF NAPL/TAR OBSERVATIONS
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Location	Depth (ft., BGS)	Description
	11.65	Spots of NAPL coated soils and sheen.
	11.8	Spots of NAPL coated soils and sheen.
	15.6-15.75	Band of NAPL coated soils, slight tar-like odor;.
	16.3-16.4	Band of NAPL saturated soils.
	20.95-21	Bands of soils heavily coated with NAPL.
	21.55-21.7	NAPL saturated soils.
	21.85	Band of soil heavily coated with NAPL.
	22	Spots of NAPL coated soils.
	22.2-22.3	Spots of NAPL coated soils, sheen.
SB-132	2.4-2.6	Soils slightly coated with NAPL.
	5-5.4	NAPL saturated soils.
	5.4-6.1	Sheen throughout, few bands of soils coated with NAPL.
	15.7	Band of soils coated with NAPL, sheen, moderate tar-like odor.
	20.6-20.7	NAPL saturated soils (slightly tacky).
	21.7-22.4	Sheen extending from saturated soils, several NAPL blebs extending from soils.
SB-133	1.2-2	Slight NAPL coating, faint tar-like odor;.

Notes:
BGS - below ground surface
NAPL - non-aqueous phase liquid

TABLE 3-2
SUBSURFACE SOIL ANALYTICAL RESULTS
SUPPLEMENTAL PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	Units	SB-111 7-9 10/4/2010	SB-111 15-17 10/4/2010	SB-111 DUP 15-17 10/4/2010	SB-112 1-3 10/4/2010	SB-112 10-12 10/4/2010	SB-113 1-3 9/30/2010	SB-113 20-22 9/30/2010	SB-114 1-3 9/30/2010	SB-114 20-22 9/30/2010
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	mg/kg	0.029 U	0.0006 U	0.0006 U	0.0006 U	0.0006 U	0.0006 J	0.0006 U	0.0009 J	0.0006 U
Toluene	mg/kg	0.059 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 J	0.001 U	0.001 J	0.001 U
Ethylbenzene	mg/kg	0.059 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 J	0.001 U	0.002 J	0.001 U
Xylenes, Total	mg/kg	0.059 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.006	0.001 U
Total BTEX	mg/kg	ND	ND	ND	ND	ND	0.0026	ND	0.0099	ND
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	mg/kg	32	0.041 U	0.040 U	0.038 U	0.041 U	0.17 J	0.041 U	0.11 J	0.042 U
Acenaphthylene	mg/kg	150	0.041 U	0.040 U	1.2	0.041 U	3.2	0.041 U	0.84	0.042 U
Anthracene	mg/kg	150	0.041 U	0.040 U	1	0.041 U	2.2	0.041 U	0.89	0.042 U
Benzo(a)anthracene	mg/kg	130	0.041 U	0.040 U	3.1	0.041 U	12	0.041 U	2	0.042 U
Benzo(a)pyrene	mg/kg	97	0.041 U	0.040 U	3.4	0.041 U	8	0.041 U	2.1	0.042 U
Benzo(b)fluoranthene	mg/kg	83	0.041 U	0.040 U	3.9	0.041 U	14	0.041 U	3.4	0.042 U
Benzo(g,h,i)perylene	mg/kg	51	0.041 U	0.040 U	2.7	0.041 U	9.1	0.041 U	2.1	0.042 U
Benzo(k)fluoranthene	mg/kg	34	0.041 U	0.040 U	1.5	0.041 U	4.4	0.041 U	1.5	0.042 U
Chrysene	mg/kg	120	0.041 U	0.040 U	3.7	0.041 U	15	0.041 U	2.6	0.042 U
Dibenzo(a,h)anthracene	mg/kg	13	0.041 U	0.040 U	0.65	0.041 U	1.6	0.041 U	0.52	0.042 U
Fluoranthene	mg/kg	200	0.041 U	0.040 U	2.5	0.041 U	14	0.041 U	2	0.042 U
Fluorene	mg/kg	160	0.041 U	0.040 U	0.16 J	0.041 U	0.62 J	0.041 U	0.16 J	0.042 U
Indeno(1,2,3-cd)pyrene	mg/kg	47	0.041 U	0.040 U	2.5	0.041 U	8.6	0.041 U	2	0.042 U
Naphthalene	mg/kg	20	0.041 U	0.040 U	0.087 J	0.041 U	1.5	0.041 U	0.34	0.042 U
Phenanthrene	mg/kg	680	0.041 U	0.040 U	0.52	0.041 U	3	0.041 U	0.6	0.042 U
Pyrene	mg/kg	370	0.041 U	0.040 U	4.1	0.041 U	19	0.041 U	3.7	0.042 U
Total PAHs	mg/kg	2337	ND	ND	31	ND	116	ND	25	ND
Inorganic Constituents										
Cyanide, Total	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 3-2
SUBSURFACE SOIL ANALYTICAL RESULTS
SUPPLEMENTAL PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	Units	SB-115 10-12 9/30/2010	SB-115 25-27 9/30/2010	SB-116 11-13 9/30/2010	SB-116 21-23 9/30/2010	SB-117 2-3 10/4/2010	SB-117 20-22 10/4/2010	SB-118 15-17 9/27/2010	SB-118 22-24 9/27/2010	SB-119 11-13 9/28/2010
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	mg/kg	0.0006 U	0.0006 U	0.0006 U	0.0006 U	0.002 J	0.0006 U	0.001 J	0.0007 U	0.0006 U
Toluene	mg/kg	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.004 J	0.001 U	0.001 U
Ethylbenzene	mg/kg	0.002 J	0.001 U	0.001 J	0.001 U	0.001 J	0.001 U	0.022	0.001 U	0.002 J
Xylenes, Total	mg/kg	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.021	0.001 U	0.002 J
Total BTEX	mg/kg	0.002	ND	0.001	ND	0.003	ND	0.048	ND	0.004
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	mg/kg	2.1	0.041 U	6.7	0.11 J	73	0.17 J	2.9	0.041 U	0.14 U
Acenaphthylene	mg/kg	4.1	0.041 U	17	0.13 J	51	0.27	25	0.16 J	7
Anthracene	mg/kg	37	0.041 U	46	0.041 U	150	0.08 J	61	0.72	180
Benzo(a)anthracene	mg/kg	21	0.041 U	110	0.041 U	260	0.083 J	55	0.41	41
Benzo(a)pyrene	mg/kg	13	0.041 U	72	0.15 J	190	0.11 J	47	0.31	33
Benzo(b)fluoranthene	mg/kg	11	0.041 U	61	0.12 J	170	0.086 J	41	0.33	28
Benzo(g,h,i)perylene	mg/kg	4.3	0.041 U	22	0.40	94	0.15 J	23	0.15 J	14
Benzo(k)fluoranthene	mg/kg	4.6	0.041 U	26	0.041 U	79	0.042 U	18	0.057 J	11
Chrysene	mg/kg	21	0.041 U	95	0.041 U	260	0.074 J	47	0.47	48
Dibenzo(a,h)anthracene	mg/kg	1.4	0.041 U	7.6	0.041 U	24	0.042 U	5.2	0.041 U	3.4
Fluoranthene	mg/kg	36	0.041 U	150	0.041 U	400	0.14 J	120	0.81	68
Fluorene	mg/kg	15	0.041 U	9.4	0.041 U	92	0.078 J	22	0.15 J	6.1
Indeno(1,2,3-cd)pyrene	mg/kg	4.2	0.041 U	23	0.22	93	0.06 J	17	0.1 J	11
Naphthalene	mg/kg	0.067 J	0.041 U	0.4 U	0.041 U	4.8 J	0.042 U	1.6 J	0.041 U	3.7
Phenanthrene	mg/kg	77	0.041 U	140	0.041 U	370	0.10 J	200	1.4	60
Pyrene	mg/kg	43	0.041 U	200	0.11 J	620	0.27 J	150	1.1	88
Total PAHs	mg/kg	295	ND	986	1.2	2931	1.7	836	6.167	602
Inorganic Constituents										
Cyanide, Total	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 3-2
SUBSURFACE SOIL ANALYTICAL RESULTS
SUPPLEMENTAL PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	Units	SB-119 22-24 9/28/2010	SB-120 15-17 9/27/2010	SB-120 22-24 9/27/2010	SB-121 2-4 9/28/2010	SB-121 15-17 9/28/2010	SB-121 22-24 9/28/2010	SB-121 DUP 22-24 9/28/2010	SB-122 20-22 9/28/2010	SB-122 25-27 9/28/2010
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	mg/kg	0.0006 U	0.033 U	0.0006 U	0.031 U	0.006 UJ	0.0006 U	0.0006 U	0.0007 U	0.0006 U
Toluene	mg/kg	0.001 U	0.065 U	0.001 U	0.062 U	0.012 UJ	0.001 U	0.001 U	0.002 J	0.001 U
Ethylbenzene	mg/kg	0.001 U	0.08 J	0.001 U	2.1	0.012 UJ	0.001 U	0.001 U	0.003 J	0.001 U
Xylenes, Total	mg/kg	0.001 U	0.065 U	0.001 U	2.1	0.012 UJ	0.001 U	0.001 U	0.005 J	0.001 U
Total BTEX	mg/kg	ND	0.08	ND	4.2	ND	ND	ND	0.01	ND
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	mg/kg	0.041 U	12	0.041 U	32	0.15 J	0.041 U	0.04 U	0.41 U	0.041 U
Acenaphthylene	mg/kg	0.041 U	82	0.041 U	14	0.36	0.041 U	0.04 U	1.4 J	0.041 U
Anthracene	mg/kg	0.2 J	76	0.041 U	47	1.4	0.041 U	0.04 U	4.4	0.041 U
Benzo(a)anthracene	mg/kg	0.052 J	74	0.041 U	49	2	0.041 U	0.04 U	16	0.07 J
Benzo(a)pyrene	mg/kg	0.041 U	60	0.041 U	37	1.5	0.041 U	0.04 U	11	0.047 J
Benzo(b)fluoranthene	mg/kg	0.041 U	49	0.041 U	35	1.4	0.041 U	0.04 U	9.9	0.043 J
Benzo(g,h,i)perylene	mg/kg	0.041 U	28	0.041 U	21	0.85	0.041 U	0.04 U	4.9	0.041 U
Benzo(k)fluoranthene	mg/kg	0.041 U	25	0.041 U	13	0.71	0.041 U	0.04 U	3.9	0.041 U
Chrysene	mg/kg	0.066 J	50	0.041 U	42	1.8	0.041 U	0.04 U	13	0.05 J
Dibenzo(a,h)anthracene	mg/kg	0.041 U	6.4	0.041 U	4.4	0.19 J	0.041 U	0.04 U	1.2 J	0.041 U
Fluoranthene	mg/kg	0.1 J	160	0.041 U	110	3.4	0.041 U	0.04 U	19	0.08 J
Fluorene	mg/kg	0.041 U	64	0.041 U	33	0.17 J	0.041 U	0.04 U	0.41 U	0.041 U
Indeno(1,2,3-cd)pyrene	mg/kg	0.041 U	22	0.041 U	15	0.61	0.041 U	0.04 U	3.6	0.041 U
Naphthalene	mg/kg	0.041 U	9.2	0.041 U	91	0.18 J	0.041 U	0.04 U	0.41 U	0.041 U
Phenanthrene	mg/kg	0.097 J	390	0.041 U	140	2.2	0.041 U	0.04 U	0.68 J	0.041 U
Pyrene	mg/kg	0.13 J	200	0.041 U	130	4.7	0.041 U	0.04 U	27	0.12 J
Total PAHs	mg/kg	0.645	1308	ND	813	22	ND	ND	116	0.41
Inorganic Constituents										
Cyanide, Total	mg/kg	NA	NA	NA	0.0002 U	NA	NA	NA	NA	NA

TABLE 3-2
SUBSURFACE SOIL ANALYTICAL RESULTS
SUPPLEMENTAL PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	Units	SB-123 15-17 9/28/2010	SB-123 20-22 9/28/2010	SB-124 2-4 9/27/2010	SB-124 22-24 9/27/2010	SB-125 20-22 9/30/2010	SB-125 25-27 9/30/2010	SB-126 5-7 9/27/2010	SB-126 22-24 9/27/2010	SB-127 5-7 9/27/2010
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	mg/kg	0.031 U	0.0006 U	0.026 U	0.0006 U	0.0006 U	0.0006 U	0.8 J	0.0006 U	0.72
Toluene	mg/kg	0.062 U	0.001 U	0.053 U	0.001 U	0.017	0.001 U	9.9	0.001 U	0.89
Ethylbenzene	mg/kg	0.065 J	0.001 U	0.053 U	0.001 U	0.004 J	0.001 U	140	0.001 U	13
Xylenes, Total	mg/kg	0.062 U	0.001 U	0.053 U	0.001 U	0.001 U	0.001 U	170	0.001 U	13
Total BTEX	mg/kg	0.065	ND	ND	ND	0.021	ND	321	ND	28
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	mg/kg	320	0.12 J	1.6	0.041 U	19	0.042 U	330	0.042 U	160
Acenaphthylene	mg/kg	92	0.21	0.038 U	0.041 U	100	0.042 U	39	0.042 U	19
Anthracene	mg/kg	320	0.46	0.2	0.041 U	180	0.042 U	140	0.042 U	300
Benzo(a)anthracene	mg/kg	180	0.34	0.038 U	0.041 U	130	0.042 U	110	0.042 U	52
Benzo(a)pyrene	mg/kg	140	0.31	0.038 U	0.041 U	99	0.042 U	85	0.042 U	43
Benzo(b)fluoranthene	mg/kg	110	0.26	0.038 U	0.041 U	81	0.042 U	71	0.042 U	38
Benzo(g,h,i)perylene	mg/kg	63	0.21	0.038 U	0.041 U	42	0.042 U	37	0.042 U	19
Benzo(k)fluoranthene	mg/kg	41	0.11 J	0.038 U	0.041 U	29	0.042 U	28	0.042 U	14
Chrysene	mg/kg	190	0.34	0.038 U	0.041 U	130	0.042 U	84	0.042 U	120
Dibenzo(a,h)anthracene	mg/kg	15	0.039 U	0.038 U	0.041 U	10	0.042 U	9.2	0.042 U	4.4
Fluoranthene	mg/kg	350	0.58	0.07 J	0.041 U	250	0.042 U	230	0.042 U	120
Fluorene	mg/kg	320	0.062 J	0.51	0.041 U	140	0.042 U	160	0.042 U	85
Indeno(1,2,3-cd)pyrene	mg/kg	60	0.14 J	0.038 U	0.041 U	39	0.042 U	29	0.042 U	15
Naphthalene	mg/kg	32	0.039 U	4	0.041 U	2.2	0.042 U	1700	0.042 U	660
Phenanthrene	mg/kg	900	0.84	1.1	0.041 U	600	0.052 J	700	0.042 U	300
Pyrene	mg/kg	420	0.96	0.053 J	0.041 U	290	0.054 J	270	0.042 U	140
Total PAHs	mg/kg	3553	4.942	7.5	ND	2141	0.11	4022	ND	2089
Inorganic Constituents										
Cyanide, Total	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 3-2
SUBSURFACE SOIL ANALYTICAL RESULTS
SUPPLEMENTAL PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	Units	SB-127 22-24 9/27/2010	SB-128 20-22 9/29/2010	SB-128 25-27 9/29/2010	SB-129 22-24 9/29/2010	SB-129 26-28 9/29/2010	SB-130 16-18 9/29/2010	SB-130 20-22 9/29/2010	SB-130 DUP 20-22 9/29/2010	SB-131 21-23 9/29/2010
Volatile Organic Compounds (VOCs)										
BTEX										
Benzene	mg/kg	0.0006 U	0.03 U	0.0006 U	0.0007 U	0.0006 U	0.0006 U	0.0007 U	0.0006 U	0.002 J
Toluene	mg/kg	0.001 U	0.06 U	0.001 U	0.001 U	0.001 U	0.003 J	0.001 U	0.001 U	0.037
Ethylbenzene	mg/kg	0.001 U	0.06 U	0.001 U	0.001 U	0.001 U	0.013	0.001 U	0.001 U	0.028
Xylenes, Total	mg/kg	0.001 U	0.06 U	0.001 U	0.001 U	0.001 U	0.013	0.001 U	0.001 U	0.016
Total BTEX	mg/kg	ND	ND	ND	ND	ND	0.029	ND	ND	0.081
Polycyclic Aromatic Hydrocarbons (PAHs)										
Acenaphthene	mg/kg	0.04 U	3.1	0.041 U	1.3 J	0.042 U	0.41 U	0.042 U	0.041 U	21
Acenaphthylene	mg/kg	0.04 U	19	0.041 U	11	0.042 U	1.4 J	0.042 U	0.041 U	90
Anthracene	mg/kg	0.04 U	17	0.041 U	36	0.042 U	3.2	0.12 J	0.19 J	230
Benzo(a)anthracene	mg/kg	0.04 U	17	0.041 U	37	0.048 J	4.4	0.042 U	0.042 J	220
Benzo(a)pyrene	mg/kg	0.04 U	13	0.041 U	27	0.042 U	3.4	0.042 U	0.041 U	170
Benzo(b)fluoranthene	mg/kg	0.04 U	11	0.041 U	23	0.042 U	2.6	0.042 U	0.041 U	150
Benzo(g,h,i)perylene	mg/kg	0.04 U	5.7	0.041 U	13	0.042 U	1.4 J	0.042 U	0.041 U	56
Benzo(k)fluoranthene	mg/kg	0.04 U	4.6	0.041 U	9.7	0.042 J	1.2 J	0.042 U	0.041 U	50
Chrysene	mg/kg	0.04 U	14	0.041 U	33	0.042 U	3.2	0.042 U	0.042 J	160
Dibenzo(a,h)anthracene	mg/kg	0.04 U	1.5 J	0.041 U	3.3	0.042 U	0.41 U	0.042 U	0.041 U	18
Fluoranthene	mg/kg	0.04 U	30	0.041 U	75	0.086 J	5.7	0.057 J	0.068 J	390
Fluorene	mg/kg	0.04 U	21	0.041 U	6.6	0.042 U	0.63 J	0.042 U	0.041 U	160
Indeno(1,2,3-cd)pyrene	mg/kg	0.04 U	5.4	0.041 U	12	0.042 U	1.3 J	0.042 U	0.041 U	57
Naphthalene	mg/kg	0.04 U	2.6	0.041 U	0.41 U	0.042 U	0.41 U	0.042 U	0.041 U	3.3 J
Phenanthrene	mg/kg	0.04 U	78	0.041 U	120	0.092 J	5.7	0.08 J	0.12 J	830
Pyrene	mg/kg	0.04 U	38	0.041 U	93	0.12 J	7.9	0.072 J	0.088 J	460
Total PAHs	mg/kg	ND	281	ND	501	0.388	42	0.33	0.55	3065
Inorganic Constituents										
Cyanide, Total	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 3-2
SUBSURFACE SOIL ANALYTICAL RESULTS
SUPPLEMENTAL PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Constituent	Units	SB-131 25-27 9/29/2010	SB-132 21-23 9/29/2010	SB-132 25-27 9/29/2010	SB-133 15-17 9/28/2010	SB-133 22-24 9/28/2010	SB-134 5-7 10/6/2010	SB-135 5-7 10/6/2010	SB-136 5-7 10/6/2010
Volatile Organic Compounds (VOCs)									
BTEX									
Benzene	mg/kg	0.0006 U	0.0006 UJ	0.0006 U	0.0006 U	0.0006 U	0.0006 U	0.0006 U	0.0006 U
Toluene	mg/kg	0.001 U	0.017 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Ethylbenzene	mg/kg	0.001 U	0.009 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Xylenes, Total	mg/kg	0.001 U	0.007 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total BTEX	mg/kg	ND	0.033	ND	ND	ND	ND	ND	ND
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	mg/kg	0.04 U	6.9	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Acenaphthylene	mg/kg	0.04 U	26	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Anthracene	mg/kg	0.04 U	60	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Benzo(a)anthracene	mg/kg	0.04 U	61	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Benzo(a)pyrene	mg/kg	0.04 U	40	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Benzo(b)fluoranthene	mg/kg	0.04 U	33	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Benzo(g,h,i)perylene	mg/kg	0.04 U	19	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Benzo(k)fluoranthene	mg/kg	0.04 U	14	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Chrysene	mg/kg	0.04 U	45	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Dibenzo(a,h)anthracene	mg/kg	0.04 U	4.9	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Fluoranthene	mg/kg	0.073 J	120	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Fluorene	mg/kg	0.04 U	71	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Indeno(1,2,3-cd)pyrene	mg/kg	0.04 U	17	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Naphthalene	mg/kg	0.04 U	0.66 J	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Phenanthrene	mg/kg	0.096 J	270	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Pyrene	mg/kg	0.093 J	140	0.04 U	0.041 U	0.041 U	0.041 U	0.041 U	0.041 U
Total PAHs	mg/kg	0.262	928	ND	ND	ND	ND	ND	ND
Inorganic Constituents									
Cyanide, Total	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
U - The analyte was analyzed for, but was not detected.
UJ - The analyte was not detected above the reported sample method dectection limit. Howeveer, based on data validation, the reported method detection limit is approximate and may or may not represent the actual limit of the quantitation necessary to accurately and precisely measure the analyte in the sample.
J - Estimated concentration. The result is below the quantitation limit but above the method detection limit.
ND - Not detected.
NA - Not analyzed.

TABLE 3-3
WATER ELEVATIONS
PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

			5/18/2010		5/20/2010		9/23/2010 [a]	
Well ID	Top of Casing Elevation (ft., NAVD)	Screened Interval (ft., BGS)	Depth to Water (ft., BTOC)	Water Elevation (ft., NAVD)	Depth to Water (ft., BTOC)	Water Elevation (ft., NAVD)	Depth to Water (ft., BTOC)	Water Elevation (ft., NAVD)
MW-1	11.23	7-12	8.19	3.04	NM	--	5.81	5.42
MW-2S	8.97	5-10	7.63	1.34	7.28	1.69	4.44	4.53
MW-2D	8.23	20-25	7.03	1.20	6.67	1.56	3.81	4.42
MW-3	5.39	5-10	8.01	-2.62	7.39	-2.00	2.38	3.01
MW-4S	7.74	5-10	8.81	-1.07	8.29	-0.55	4.94	2.80
MW-4D	7.57	20-25	9.13	-1.56	8.65	-1.08	4.70	2.87
MW-5	7.93	5-15	8.41	-0.48	7.94	-0.01	4.09	3.84
MW-6	8.08	5-20	NM	--	6.98	1.10	3.71	4.37
MW-7S	8.21	4-9	8.09	0.12	7.63	0.58	4.42	3.79
MW-7D	8.09	20-25	7.83	0.26	7.44	0.65	4.26	3.83
MW-8S	4.86	4-9	NM	--	5.65	-0.79	0.88	3.98
MW-8D	4.77	20-25	NM	--	5.35	-0.58	0.71	4.06
MW-9S	4.47	4-9	7.91	-3.44	7.22	-2.75	1.42	3.05
MW-9D	4.66	20-25	8.31	-3.65	13.98	-9.32	1.41	3.25
SG-1	5.23	NA	3.28	1.95	3.21	2.02	NM	--
SG-2	5.16	NA	2.89	2.27	2.86	2.30	NM	--

Notes:
NAVD - North American Vertical Datum
BGS - Below Ground Surface
BTOC - Below Top of Casing
NM - Not measured
NA - Not applicable
(a) - 9/23/10 water level data from: "Groundwater Monitoring Report, Second Semiannual 2010 Sampling Event, Patchogue Former MGP Site" (GEI , November 2010)

TABLE 3-4
SUMMARY OF IN-SITU HYDRAULIC CONDUCTIVITY TEST RESULTS
PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

Location ID	Screened Interval (ft., bgs)	Test Date	Hydraulic Conductivity (cm/sec)
MW-3	5-10	5/20/2010	1.1E-02
MW-5	5-15	5/20/2010	2.7E-03
MW-7S	4-9	5/20/2010	2.5E-03
MW-9S	4-9	5/20/2010	6.4E-03
		Geometric Mean	**4.6E-03**

Notes:
bgs - below ground surface
cm/sec - centimeters per second

TABLE 3-5
GROUNDWATER ANALYTICAL RESULTS
SUPPLEMENTAL PRE-DESIGN INVESTIGATION
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

	Class GA Groundwater Criteria			Loc ID	GW-1	GW-1	GW-1-DUP	GW-1	GW-2	GW-2	GW-2	GW-3	GW-3	GW-3
	TOGS 1.1.1	NYS Part 703		Depth	10-12	16-18	16-18	22-24	10-12	16-18	22-24	10-12	16-18	22-24
Constituent	Guidance	Standard	Units	Date	10/4/2010	10/4/2010	10/4/2010	10/4/2010	10/5/2010	10/5/2010	10/5/2010	10/5/2010	10/5/2010	10/5/2010
Volitile Organic Compounds														
BTEX														
Benzene	NE	1	µg/L		0.5 U	0.5 U	0.5 U	0.5 U	0.8 J	**4 J**	0.5 U	0.5 U	0.5 J	0.5 U
Toluene	NE	5	µg/L		0.7 U	0.7 U	0.7 U	0.7 U	0.7 U	2 J	0.7 U	**19 J**	2 J	0.7 U
Ethylbenzene	NE	5	µg/L		0.8 U	0.8 U	0.8 U	0.8 U	4 J	**6**	0.8 U	**38**	3 J	0.8 U
Xylenes, Total	NE	5	µg/L		0.8 U	0.8 U	0.8 U	0.8 U	4 J	4 J	0.8 U	**29**	**6**	0.8 U
Total BTEX	NE	NE	µg/L		ND	ND	ND	ND	8.8	16	ND	86	12	ND
Semi-Volatile Organic Compounds (SVOCs)														
Polycyclic Aromatic Hydrocarbons (PAHs)														
Acenaphthene	20	NE	µg/L		6	10 U	10 U	10 U	**140**	**29 J**	10 U	**350**	**110**	**29 J**
Acenaphthylene	NE	NE	µg/L		1 J	10 U	10 U	10 U	140	15 J	10 U	31 J	100	73
Anthracene	50	NE	µg/L		10 U	10 U	10 U	10 U	**120**	**52**	10 U	29 J	**58**	32 J
Benzo(a)anthracene	0.002	NE	µg/L		10 U	10 U	10 U	10 U	**48 J**	**17 J**	10 U	10 U	**52**	10 U
Benzo(a)pyrene	NE	0	µg/L		10 U	10 U	10 U	10 U	**34 J**	**12 J**	10 U	10 U	**15 J**	10 U
Benzo(b)fluoranthene	0.002	NE	µg/L		10 U	10 U	10 U	10 U	**28 J**	**10 J**	10 U	10 U	**15 J**	10 U
Benzo(g,h,i)perylene	NE	NE	µg/L		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	0.002	NE	µg/L		10 U	10 U	10 U	10 U	**11 J**	10 U	10 U	10 U	10 U	10 U
Chrysene	0.002	NE	µg/L		10 U	10 U	10 U	10 U	**53**	**18 J**	10 U	10 U	**33 J**	**11 J**
Dibenzo(a,h)anthracene	NE	NE	µg/L		10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	50	NE	µg/L		10 U	10 U	10 U	10 U	**120**	45 J	10 U	37 J	**170**	25 J
Fluorene	50	NE	µg/L		4 J	10 U	10 U	10 U	**83**	10 J	10 U	**110**	26 J	18 J
Indeno(1,2,3-cd)pyrene	0.002	NE	µg/L		10 U	10 U	10 U	10 U	**12 J**	10 U	10 U	10 U	10 U	10 U
Naphthalene	10	NE	µg/L		10 U	10 U	10 U	10 U	**97**	**28 J**	10 U	**1000**	**57**	**60**
Phenanthrene	50	NE	µg/L		2 J	10 U	10 U	10 U	**410**	**100**	10 U	**250**	**440**	**120**
Pyrene	50	NE	µg/L		1 J	10 U	10 U	10 U	**150**	**60**	10 U	43 J	**210**	30 J
Total PAHs	NE	NE	µg/L		14	ND	ND	ND	1446	396	ND	1850	1286	398

Notes:
J - Estimated concentration. The result is below the quantitation limit but above the practical quantitation limit or the method detection limit.
U - The analyte was analyzed for, but was not detected.
µg/L - micrograms per liter
ND - Not detected.
NE - Not established.

Boxed concentrations are above New York State Class GA Groundwater Standards or Guidance values.

TABLE 3-6
GROUNDWATER SEEPAGE VELOCITY AND TRAVEL TIME ESTIMATES
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

K	i	n_e	V_s		Time to flow from area of MW-6 to River (±220 ft.)	
(cm/s)			(cm/s)	(ft/d)	(days)	(years)
Estimates based on average K from USGS (Bruxton and Smolensky, 1999)						
8.00E-02	0.005	0.3	0.0013	3.78	58	0.2
8.00E-02	0.008	0.3	0.0021	6.05	36	0.1
Sensitivity Analysis (K value reduced by 10x)						
8.00E-03	0.005	0.3	0.0001	0.3780	582	1.6
8.00E-03	0.008	0.3	0.0002	0.6047	364	1.0

K =hydraulic conductivity
n_e =effective porosity
i =horizontal hydraulic gradient
V_s =estimated seepage velocity (estimated using formula in Cedergen, 1977)

References:

Bruxton, H.T., and Smolensky, D.A., 1999, Simulation of the Effects of Development of the Groundwater Flow System or Long Island, New York: U.S. Geological Survey Water-Resources Investigations Report 98-4069., 57 p.

Cedegren, H, 1977. Seepage, Drainage and Flow Nets. John Wiley & Sons, Inc., New York, 534 p.

TABLE 6-1
TECHNOLOGY IDENTIFICATION AND SCREENING SUMMARY
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

General Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
Treatment	Chemical Oxidation *(applicable to soil and groundwater)* Involves applying reagent(s) to subsurface soils via injection wells or trenches. Treatability testing (bench and pilot) would be required to evaluate various treatment compounds and treatment characteristics (i.e., rebound, radius of influence, etc.). Potential oxidants include persulfate, permanganate, ozone, and Fenton's Reagent.	Effective at treating impacted soils in the saturated zone but is highly dependent on the type of delivery system and distribution in the subsurface. Requires bench-scale and/ or pilot-scale testing to confirm treatability. Effectiveness for tar-impacted soils is limited and not applicable for heavily impacted soils.	Technology proven in saturated zones and is readily implemented to targeted depths. Treatment of tar-saturated and heavily impacted soils would require multiple injections and excessive quantities of reagents.	Low capital costs compared to other technologies. Material costs (reagents) for tar-impacted area treatment would be prohibitive if multiple rounds of injections and large quantities of reagents are required to effectively treat the target areas.	Not Retained
	Bioremediation *(applicable to soil and groundwater)* Involves the application of nutrients and other materials to enhance the population of microorganisms that use the contaminants as a food source. Technology is generally applied to treat contaminants in the saturated zone.	Effective at treating moderately impacted soil and groundwater, however, tar-impacted area treatment effectiveness is limited. Bench scale testing and/or pilot scale testing would be required to confirm treatability effectiveness.	Technology proven in saturated zones and is readily implemented. Treatment duration would be extensive. Long-term monitoring may be required.	Moderate capital costs. Due to long-term treatment durations, monitoring costs are high compared to other technologies	Not Retained
	Electric Resistance Heating *(applicable to soil)* Involves the installation of an array of subsurface electrodes and passes electric current between the electrodes to generate resistance in the soils which in turn produces heat to volatize and mobilize contaminants. Mobilized contaminants are recovered via vacuum extraction and treated above ground.	Effective at treating VOC impacted soils and groundwater. However, effectiveness for tar-impacted soils treatment is limited due to the nature of tar material (i.e., viscosity and hardness) and the limited effectiveness of treatment to penetrate into tar masses.	Technology proven and implementable. Technology is more effective for large treatment volumes since capital and system installation costs are high.	High capital costs and operating costs for smaller treatment volumes. Electrical power usage costs may be high.	Not Retained

General Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
	Solidification *(applicable to soil)* Involves in-situ mixing of soil with solidification agents (e.g., cement, bentonite, or a mixture of both) to reduce the mobility of contaminants. Soil mixing can be performed using soil augers and injector head systems.	Effective at preventing migration of contaminants in soil. Bench scale testing would be required to confirm treatability. Would be effective at attaining RAOs.	Technology proven and readily implemented to targeted depths. Generally used for large sites with unrestricted access and areas for staging and equipment laydown.	Generally high costs. Cost varies based on depths of treatment and subsurface conditions. Mobilization costs for equipment are high.	Retained
Containment	Subsurface Barrier Wall *(applicable to soil)* Involves the installation of physical barrier to contain impacted media and to reduce mobility of contaminants. Barrier wall options include slurry walls, steel sheet pile, etc.	Effective at containing NAPL and groundwater in combination with extraction. Reduces mobility of contaminants by reducing contact with groundwater. Not effective for contaminant mass or toxicity reduction.	Technology proven and readily implemented at sites where a low permeability layer is present into which the barrier is installed in order to limit groundwater flow or prevent NAPL migration. A low permeability layer is not present at this site.	Moderate costs compared to other treatment technologies.	Not Retained
	Engineered Soil Cap *(applicable to soil and groundwater)* Consists of physical barriers that prevent contact with the impacted soil and groundwater. Also prevents migration via erosion and may be designed to restrict infiltration.	Effective at preventing direct contact with impacted soils and groundwater. Does not reduce toxicity, mobility or volume. Most effective when combined with other remediation technologies.	Technology proven and readily implemented.	Soil cap cost is low compared to other capping technologies.	Retained

TABLE 6-1
TECHNOLOGY IDENTIFICATION AND SCREENING SUMMARY
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

General Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
Excavation	Excavation (unsaturated zone) *(applicable to soil)* Involves soil excavation up to a depth of approximately five feet below grade and properly permitted off-site disposal (treatment facilities, landfills, etc.).	Effective at reducing the volume of tar-impacted source material and impacted soil. Would be capable of attaining RAOs.	Technology proven and readily implemented.	Medium compared to other technologies, Dewatering may be necessary due to high groundwater table.	Retained
	Excavation (Saturated Zone) *(applicable to soil)* Involves soil excavation up to a depth of 23 feet below grade and properly permitted off-site disposal (treatment facilities, landfills, etc.). Excavation below 5 feet may require dewatering and earth support structures to stabilize excavation.	Effective at reducing the volume of tar-impacted source material and impacted soil. Would be capable of attaining RAOs.	Technology proven and readily implemented. Would require earth support structures (e.g., sheet-piling), extensive dewatering and treatment or off-site disposal of collected groundwater.	High compared to other technologies. Earth support structures, dewatering and water disposal would increase costs significantly.	Retained
Extraction	Groundwater or NAPL Includes the removal of groundwater or NAPL present in the subgrade. Systems can be use either wells, collection trenches or sumps equipped with pumps for active extraction periodic extraction via a pump, vacuum truck or other type of mechanical extraction.	N/A- Groundwater or NAPL extraction is not necessary at this site.	N/A- Groundwater or NAPL extraction is not necessary at this site.	N/A- Groundwater or NAPL extraction is not necessary at this site.	Not Retained

TABLE 6-1
TECHNOLOGY IDENTIFICATION AND SCREENING SUMMARY
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

General Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
Disposal	Off-Site Disposal *(applicable to soil or excavation dewatering)* Includes the transporting of materials to be disposed from excavation, treatment or extraction systems. Materials may be disposed at a permitted landfill, treatment or recycling facility. This option is generally combined with excavation or extraction technologies.	Off-site treatment/disposal is an effective means of reducing the volume of tar-impacted source material and impacted soil since it would be removed from the site. Also, water pumped from the excavation area during implementation may be effectively disposed off-site. Temporary tanks may be required on site to coordinate disposal activities.	Off-site treatment/disposal is readily implemented.	The costs for off-site treatment/disposal depend on the characteristics of the material. Typical costs for off-site disposal of non-hazardous material are medium compared to other technologies. Disposal of hazardous materials is high compared to in-situ treatment technologies.	Retained
Institutional Controls	Environmental Easement *(applicable to soil and groundwater)* Establishes restrictions on future site access and use. Provides notice to future owners regarding the presence of contaminants and any compliance monitoring requirements. Long-term monitoring and maintenance would be required.	Reduces potential human exposure to impacted soils and groundwater. Does not reduce toxicity, mobility or volume. Most effective when combined with other remediation technologies.	Readily implemented.	Low capital and maintenance costs.	Retained

TABLE 7-1
SUMMARY OF REMEDIAL ALTERNATIVES
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

PARAMETER	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Engineering and Institutional Controls and Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials	ALTERNATIVE 3 Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)	ALTERNATIVE 4 Excavation of MGP Tar-Impacted Source Material	ALTERNATIVE 5 In-Situ Solidification (ISS) of MGP Tar-Impacted Soils and Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials
Size and Configuration	None	On-site impacts would be addressed via the implementation of engineering and institutional controls. No active remedial activities would be conducted on the Site with the exception of limited excavation activities to establish an environmental cap (engineering control) on the Site. Active remedial activities would be limited to the adjacent property to the east of the Site to remove MGP tar- and petroleum impacted source materials. Off-site remedial activities would include the excavation and off-site disposal of MGP and petroleum impacted source materials. Excavation would be conducted to a depth of approximately nine feet bgs. On-site excavation area (soil cap) = 35,800 sf Off-site excavation area = 2,440 sf On-site volume of impacted media = 2,700 cy Off-site volume of impacted media = 970 cy	Active remedial activities (excavation and off-site disposal) would be conducted in the Central/Core Area of the Site to address MGP-impacted soils (i.e., tar-impacted source materials, soils impacted with odors, sheens, stains, etc.). Further, off-site remedial activities would be conducted to address MGP and petroleum related impacted soils identified on the adjacent site to the east. On-site removal activities would be conducted to depth intervals corresponding with MGP-related impacted soils, generally ranging between four and 23 feet bgs. Off-site removal activities would be conducted to a depth of nine feet bgs. Further removal activities (two foot depth) would be conducted to establish a soil cap over areas subject to previous historic filling activities. On-site excavation area (soil cap) = 19,100 sf On-site excavation area (MGP-related impacted materials) = 18,100 sf Off-site excavation area = 4,900 sf On-site volume of impacted media = 10,170 cy Off-site volume of impacted media = 1,630 cy	Active remedial activities (excavation and off-site disposal) would be conducted in the Central/Core Area of the Site to address MGP-tar impacted source materials. Further, off-site remedial activities would be conducted to address MGP tar-and petroleum-impacted source materials identified on the adjacent site to the east. On-site removal activities would be conducted to depth intervals corresponding with MGP tar-impacted source materials, generally ranging between four and 23 feet bgs. Off-site removal activities would be conducted to a depth of nine feet bgs. Further removal activities (two foot depth) would be conducted to establish a soil cap over areas subject to previous historic filling activities. On-site excavation area (soil cap) = 24,160 sf On-site excavation area (MGP tar-impacted source materials) = 11,710 sf Off-site excavation area = 2,440 sf On-site volume of impacted media = 8,590 cy Off-site volume of impacted media = 800 cy	Active remedial activities (in-situ solidification (ISS)) would be conducted in the Central/Core Area of the Site to address MGP tar impacted source materials. Further, off-site remedial activities would be conducted to remove MGP tar- and petroleum-impacted source materials identified on the adjacent site to the east. On-site ISS activities would be conducted to depth intervals corresponding with MGP tar-impacted source materials, generally ranging between four and 23 feet bgs. Off-site removal activities would be conducted to a depth of nine feet bgs. Further removal activities (two foot depth) would be conducted to establish a soil cap over areas subject to previous historic filling activities. On-site excavation area (soil cap) = 24,160 sf On-site ISS area (MGP tar-impacted source materials) = 11,710 sf Off-site excavation area = 2,440 sf On-site volume of impacted media = 11,200 cy Off-site volume of impacted media = 800 cy
Remediation Time	None	The estimated time to complete implementation of Alternative 2 is two months. A post-remedial groundwater monitoring program would be conducted to assess if groundwater impacts on the Site may decrease due to natural attenuation or, if increasing trends are indentified, the need to perform additional remedial activities with respect to groundwater. The groundwater monitoring program was estimated to include semi-annual monitoring events and to continue for 30 years. Site inspections and maintenance of the cap were estimated to continue for 30 years.	The estimated time to complete implementation of Alternative 3 is nine months. Contaminant concentrations in groundwater are expected to decrease with time after removal of the MGP- and petroleum-related impacted materials. A post-remedial groundwater monitoring program would be conducted until groundwater trends note a decreasing concentration pattern. The groundwater monitoring program was estimated to include quarterly monitoring events and continue for a period of one year.	The estimated time to complete implementation of Alternative 4 is six months. Contaminant concentrations in groundwater are expected to decrease with time after removal of the MGP- and petroleum-related impacted materials. A post-remedial groundwater monitoring program would be conducted until groundwater trends note a decreasing concentration pattern. The groundwater monitoring program was estimated to include quarterly monitoring events and continue for a period of three years. Site inspections and maintenance of the cap were estimated to continue for 30 years.	The estimated time to complete implementation of Alternative 5 is four months. Contaminant concentrations in groundwater are expected to decrease with time after removal of the MGP- and petroleum-related impacted materials. A post-remedial groundwater monitoring program would be conducted until groundwater trends note a decreasing concentration pattern. The groundwater monitoring program was estimated to include quarterly monitoring events and continue for a period of three years. Site inspections and maintenance of the cap were estimated to continue for 30 years.
Spatial Requirements	None	Space for equipment and material storage, access, excavation and soil management activities would be required. With proper planning and staging, the Site can accommodate the proposed remedial activities.	Space for equipment and material storage, access, excavation and soil management activities would be required. With proper planning and staging, the Site can accommodate the proposed remedial activities.	Space for equipment and material storage, access, excavation and soil management activities would be required. With proper planning and staging, the Site can accommodate the proposed remedial activities.	Space for equipment and material storage, access, ISS equipment, excavation and soil management activities, mixing plant, and spoils management activities would be required. With proper planning and staging, the Site can accommodate the proposed remedial activities.

TABLE 7-1
SUMMARY OF REMEDIAL ALTERNATIVES
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

PARAMETER	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Engineering and Institutional Controls and Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials	ALTERNATIVE 3 Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)	ALTERNATIVE 4 Excavation of MGP Tar-Impacted Source Material	ALTERNATIVE 5 In-Situ Solidification (ISS) of MGP Tar-Impacted Soils
Disposal Options	None	Non-hazardous and hazardous disposal facilities and treatment facilities for the disposal of excavated and removed materials are readily available.	Non-hazardous and hazardous disposal facilities and treatment facilities for the disposal of excavated and removed materials are readily available. Excavation below the groundwater table will require extensive dewatering. Treatment, transportation and disposal of large volumes of collected water may not be efficient due to high disposal costs and potential restrictions from disposal facilities.	Non-hazardous and hazardous disposal facilities and treatment facilities for the disposal of excavated and removed materials are readily available. Excavation below the groundwater table will require extensive dewatering. Treatment, transportation and disposal of large volumes of collected water may not be efficient due to high disposal costs and potential restrictions from disposal facilities.	Non-hazardous and hazardous disposal facilities and treatment facilities are readily available. Some excavation of soils will be required due to the anticipated swell of in-situ solidified soils. Excavation below the groundwater table will require extensive dewatering. Treatment, transportation and disposal of large volumes of collected water may not be efficient due to high disposal costs and potential restrictions from disposal facilities.
Substantive Permit Requirements	None	No significant technical permit requirements are anticipated that would limit the effectiveness or implementability of this alternative.	Technical permit requirements associated with treatment and disposal of dewatering system effluent could be significant and may affect the implementability of this alternative.	Technical permit requirements associated with treatment and disposal of dewatering system effluent could be significant and may affect the implementability of this alternative.	Technical permit requirements associated with treatment and disposal of dewatering system effluent could be significant and may affect the implementability of this alternative.
Limitations	None	Access to the adjacent property owned by Others would be required to implement this remedial alternative.	Access to the adjacent property owned by Others would be required to implement this remedial alternative. Excavation support requirements may present technical problems and/or significant cost impediments to the feasibility of implementation of this alternative.	Access to the adjacent property owned by Others would be required to implement this remedial alternative. Excavation support requirements may present technical problems and/or significant costs impediments to the feasibility of implementation of this alternative.	Access to the adjacent property owned by Others would be required to implement this remedial alternative. Excavation support requirements may present technical problems and/or significant costs impediments to the feasibility of implementation of this alternative.
Beneficial and/or Adverse Impacts on Fish and Wildlife Resources	No remedial activities will be performed as part of this alternative. Therefore, there will be no beneficial or adverse impacts on fish and wildlife resources, beyond existing conditions.	Given the small size of the area and the limited terrestrial habitat, the adverse effects from implementation of the alternative are anticipated to be minimal.	Given the small size of the area and the limited terrestrial habitat, the adverse effects from implementation of the alternative are anticipated to be minimal.	Given the small size of the area and the limited terrestrial habitat, the adverse effects from implementation of the alternative are anticipated to be minimal.	Given the small size of the area and the limited terrestrial habitat, the adverse effects from implementation of the alternative are anticipated to be minimal.

Notes:

1. *Area and volumes presented in the table are preliminary estimates.*
2. *The conceptual plan for each alternative, with the exception of Alternative 1, is presented as Figures 7-1 through 7-4.*

TABLE 7-2
REMEDIAL ALTERNATIVES EVALUATION
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

EVALUATION CRITERIA	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Engineering and Institutional Controls and Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials	ALTERNATIVE 3 Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)	ALTERNATIVE 4 Excavation of MGP Tar-Impacted Source Materials	ALTERNATIVE 5 In-Situ Solidification(ISS) of MGP Tar-Impacted Source Materials
Overall Protectiveness of Public Health and Environment	• Alternative does not achieve protection over time since the volume of MGP-impacted soils would not be eliminated, reduced or contained. • Potential for direct contact with impacted soils would remain.	• Engineering controls (EC) in the form of a soil cap and the existing fencing with lockable gates would prevent access to the Site by unauthorized personnel and minimize the potential for direct contact hazards for the impacted soil that will remain on-site. • Institutional controls (IC) would limit the types of future usage of the Site and minimize impacts from future soil disturbance. Potential future direct contact exposure with impacted soils and groundwater would be managed via an Environmental Easement, Health and Safety Plan (HASP) and Site Management Plan (SMP).	• Alternative 3 would achieve protection after implementation as it would remove all MGP tar-impacted and petroleum impacted soils and eliminate existing pathways of exposure to public health and the environment. • Potential for direct contact would be eliminated. • ECs and ICs would not be required as all MGP- and petroleum impacted soils would be removed. • This alternative includes removal of the source of the isolated groundwater contamination (MGP tar- impacted soils and source materials).	• Alternative would achieve protection via the combination of the removal of MGP tar-impacted source materials and the ECs (soil cap) and ICs (Environmental Easement, HASP, SMP). Residually MGP-impacted materials would remain on-Site. • Engineering controls (EC) in the form of a soil cap and the existing fencing with lockable gates would prevent access to the Site by unauthorized personnel and minimize the potential for direct contact hazards with impacted soil that will remain on-site. • ICs would limit the types of future development for the Site and minimize impacts from future soil disturbance and direct contact with impacted soils and groundwater. • This alternative includes removal of the source of the isolated groundwater contamination (MGP tar-impacted soils).	• Alternative would achieve protection via the solidification and immobilizing of the removal of MGP tar-impacted source materials and the ECs (soil cap) and ICs (Environmental Easement, HASP, SMP). Residually MGP-impacted materials would remain on-Site. • Engineering controls (EC) in the form of a soil cap and the existing fencing with lockable gates would prevent access to the Site by unauthorized personnel and minimize the potential for direct contact hazards with impacted soil that will remain on-site. • ICs would limit the types of future development for the Site and minimize impacts from future soil disturbance and direct contact with impacted soils and groundwater. • This alternative includes stabilization of the source of the isolated groundwater contamination (MGP tar-impacted soils).
Compliance with the SCGs	• This alternative does not comply with action, location or chemical-specific SCGs. The source of the soil and groundwater contamination would not be removed.	• The alternative does not fully comply with chemical-specific SCGs as MGP-impacted materials will remain on-Site. Remedial activities would be implemented in accordance with action and location-specific SCGs.	• This alternative complies with chemical, action and location-specific SCGs. • The alternative eliminates threats to public health or the environment from MGP- and petroleum-impacted soils at the Site and the adjacent off-site property to the east. • The source of soil and groundwater contamination at the Site and the adjacent off-site property to the east would be removed.	• The alternative does not fully comply with chemical-specific SCGs as MGP-impacted materials will remain on-Site. Remedial activities would be implemented in accordance with action and location-specific SCGs. • The identified source of contamination would be removed (MGP tar-impacted soils). Residually impacted soil (stained soil, sheens, odors) would remain in-place below the soil cap and documented in the Environmental Easement.	• The alternative does not fully comply with chemical-specific SCGs as MGP-impacted materials will remain on-Site. Remedial activities would be implemented in accordance with action and location-specific SCGs. • The identified source of contamination would be stabilized (MGP tar-impacted soils). Residually impacted soil (stained soil, sheens, odors) would remain in-place below the soil cap and documented in the Environmental Easement.
Long-Term Effectiveness and Permanence	• This alternative would not result in the attainment of RAOs established for the Site. • Existing fencing and lockable gates would minimize exposure to public. Exposure to trespassers would not be reduced. • Groundwater impacts may decrease with time; however remaining impacted soils may continue to be a potential source for groundwater contamination.	• This alternative would not result in the attainment of RAOs established for the Site. • Long-term effectiveness in minimizing the human health risk would depend on maintenance of and adherence to the use of the ECs as well as to the requirements of the ICs. • Groundwater impacts may decrease with time; however remaining impacted soils may continue to be a potential source for groundwater contamination.	• This alternative would result in the attainment of RAOs established for the Site. • There would be no long-term risks associated with the Site after remediation as all MGP and petroleum-impacted soils would be removed. • Source to groundwater contamination would be removed. • Isolated groundwater impacts are anticipated to be addressed through the implementation of this alternative. Post-remedial groundwater monitoring would be performed for a limited time (one year) to confirm decreasing trends in isolated area of groundwater contamination.	• This alternative would result in the attainment of RAOs established for the Site. • Long-term effectiveness in minimizing human health risk would depend on adherence to the use of the ECs and strict adherence to the requirements of the ICs. • The soil cap and the existing fencing and lockable gates would minimize direct contact exposure to public. • Isolated groundwater impacts are expected to decrease with time due to the removal of MGP-tar impacted soils. Post-remedial groundwater monitoring program would be performed to assess groundwater impacts until decreasing trends are identified.	• This alternative would result in the attainment of RAOs established for the Site. • Long-term effectiveness in minimizing human health risk would depend on adherence to the use of the ECs and strict adherence to the requirements of the ICs. • The soil cap and the existing fencing and lockable gates would minimize direct contact exposure to public. • Isolated groundwater impacts are expected to decrease with time due to the stabilization of MGP-tar impacted soils. Post-remedial groundwater monitoring program would be performed to assess groundwater impacts until decreasing trends are identified. • Treatability tests would be necessary to confirm that the selected stabilization reagents would be compatible with Site contaminants and ensure the effectiveness, permanence and reliability.

TABLE 7-2
REMEDIAL ALTERNATIVES EVALUATION
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

EVALUATION CRITERIA	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Engineering and Institutional Controls and Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials	ALTERNATIVE 3 Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)	ALTERNATIVE 4 Excavation of MGP Tar-Impacted Source Materials	ALTERNATIVE 5 In-Situ Solidification (ISS) of MGP Tar-Impacted Source Materials
— Reduction in Toxicity, Mobility, or Volume with Treatment	• This alternative does not provide for a reduction in the toxicity, mobility, or volume of impacted soils. The source of the isolated groundwater impacts on-site and potential source of future groundwater contamination would not be removed.	• This alternative provides a slight reduction in the toxicity, mobility, and volume of impacted soils on the Site via the removal of the materials to facilitate the installation of the soil cap. The majority of the source of contamination would not be removed. • A reduction in the toxicity, mobility and volume of off-site impacted materials would be realized through the excavation of MGP tar- and petroleum impacted source materials on the property immediately adjacent to (east of) the Site. • The source of the isolated groundwater impacts on-site and potential source of future groundwater contamination would not be removed.	• This alternative provides for a total reduction in mobility and volume of the impacted soils through physical removal. • Impacted soils would be removed and disposed of or treated off-site resulting in a reduction in the toxicity of the soils. • The source of the isolated groundwater impacts and potential source of future groundwater contamination would be removed.	• This alternative provides for a reduction in the toxicity, mobility, and volume of MGP-impacted soils through the removal of MGP source materials and their off-site treatment/disposal. • Residually impacted soils would remain on-site under the soil cap and may be a potential source for groundwater contamination. The post-remedial groundwater monitoring program will assess adverse impacts to the groundwater.	• This alternative provides for a reduction in the mobility of MGP-impacted soils through their solidification. Although not "reduced", the toxicity and volume of the MGP-tar impacted source materials are addressed through their solidification which will minimize their potential to continue to act as a source to groundwater contamination. Residually impacted soils would remain on-site under the soil cap and may be a potential source for groundwater contamination. The post-remedial groundwater monitoring program will assess adverse impacts to the groundwater.
— Short-Term Impacts and Effectiveness	• No short term impacts to workers or the surrounding community would be realized as no active remedial activities would be performed. • No short term improvement over current site conditions.	• Institutional controls can be implemented relatively quickly and would be immediately effective. • Engineering controls (soil cap, fencing, etc.) could be installed relatively quickly. • Short-term impacts would be realized as a result of the excavation activities to facilitate the installation of the soil cap as well as those to be conducted on the adjacent, off-site property. Potential impacts would include risks to construction workers through direct contact with impacted soils, inhalation of dust and vapors/odors, and impacts to the surrounding community due to construction related noise and increased traffic for the duration of the project. • The risk of exposure to contaminants by site workers would be minimized by implementing engineering (dust and odor control) and institutional controls (HASP and air monitoring). • The time to implement this alternative is approximately two months.	• Short-term impacts would be realized as a result of the excavation activities to remove the MGP and petroleum related impacted soils on the Site and the adjacent, off-site property. Potential impacts would include risks to construction workers through direct contact with impacted soils, inhalation of dust and vapors/odors, and impacts to the surrounding community due to construction related noise and increased truck traffic for the duration of the project. In addition, vibration impacts would most likely occur to the adjacent property owner and business during sheet pile installation. Short-term impacts would also occur for the storage, handling and off-site disposal associated with the dewatering activities. Large quantities of groundwater will be pumped from the excavation areas so that the excavation can be conducted below the water table. The water will be stored in temporary tanks, pumped into trucks and transported to an off-site treatment facility. This activity will include a use of large number of trucks, in addition to those used to transport impacted soils to off-site facilities, resulting in increased noise and traffic in the surrounding community. • The risk of exposure to contaminants by site workers would be minimized by implementing engineering (dust and odor control) of the soil storage areas and institutional controls (HASP). • The time to implement this alternative is approximately nine months. This alternative would achieve the RAOs established for the Site. • Short term impacts are expected to be substantially greater than would be realized during implementation of Alternatives 2, 4, and 5 due to the time frame to complete the remedial alternative as well as the magnitude of the operations.	• Short-term impacts would be realized as a result of the excavation activities to be conducted on the Site and the adjacent, off-site property. Potential impacts would include risks to construction workers through direct contact with impacted soils, inhalation of dust and vapors/odors, and impacts to the surrounding community due to construction related noise and increased truck traffic for the duration of the project. Also, vibration impacts would most likely occur to the adjacent property owner and business during sheet pile installation. • The risk of exposure to contaminants by site workers would be minimized by implementing engineering (dust and odor control) of the soil storage areas and institutional controls (HASP). Odor impacts in the excavation area may occur and the excavation will be conducted under an enclosure with odor control equipment. The odors from the excavation and noise from the odor control equipment will impact the surrounding community. • The time to implement this alternative, thereby achieving RAOs, is approximately six months. • Alternative is anticipated to achieve RAOs after remediation is completed. ECs/ICs will need to be established and post-remedial groundwater monitoring performed to verify decreasing concentration trends in the isolated groundwater contamination. • Short term impacts associated with Alternative 4 are expected to be less than would be realized under Alternative 3 but greater than during implementation of Alternative 5.	• Short-term impacts would be realized as a result of the excavation activities to be conducted on the adjacent, off-site property as well as for the off-site disposal of spoils from the solidification procedure. Potential impacts would include risks to construction workers through direct contact with impacted soils, inhalation of dust and vapors/odors, and impacts to the surrounding community due to construction related noise and increased traffic for the duration of the project. These impacts are expected to be less than would be realized for Alternatives 3 and 4. • The risk of exposure to contaminants by site workers would be minimized by implementing engineering (dust and odor control) and institutional controls (HASP). • The time to implement this alternative, thereby achieving RAOs, is approximately four months. • Alternative is anticipated to achieve RAOs after remediation is completed. ECs/ICs will need to be established and post-remedial groundwater monitoring performed to verify decreasing concentration trends in the isolated groundwater contamination. • Short term impacts are expected to be less than would be realized during implementation of Alternatives 4 and 5.

TABLE 7-2
REMEDIAL ALTERNATIVES EVALUATION
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

EVALUATION CRITERIA	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Engineering and Institutional Controls and Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials	ALTERNATIVE 3 Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)	ALTERNATIVE 4 Excavation of MGP Tar-Impacted Source Materials	ALTERNATIVE 5 In-Situ Solidification (ISS) of MGP Tar-Impacted Source Materials
Implementability					
a) Technical Feasibility	Alternative is easily implementable.	• Implementation of this alternative is technically feasible using conventional technologies. Excavation for soil cap (two foot depth) would not require excavation support structures (e.g., sheeting) or dewatering. However, excavation of off-site soils (nine foot depth) would require excavation support structures and dewatering activities due to the depth of the excavation, high water table, logistics and sandy soil conditions. • The environmental cap can be easily constructed over the designated area. • Establishment of the Environmental Easement as well as the HASP and SMP is easily implementable.	• Excavation is a technically feasible alternative for the Site. However, site logistics and a number of site specific conditions limit the feasibility of large scale excavation. • Excavation at the Site, due to subsurface conditions and high groundwater table, would require extensive excavation support structures. The soil support structure may require installation of complex components to ensure the systems integrity due to Site characteristics. Sheet pile installation may require use of a crane for installation and continued movement of sheet pile cells to accommodate excavation (i.e., “leap frogging”). • The excavated soil will need to be conditioned with amending agents (i.e., cement, kiln dust, fly ash, etc.,) due to the saturation of the soils to facilitate handling and off-site disposal. Equipment and space for the soil conditioning, handling and management will be required on-site. Management and conditioning of soils would be performed under a temporary enclosure to minimize impacts from odors, vapors and noise. • Dewatering activities would be required to conduct the excavation. This activity would generate large quantities of water that would require temporary on-site storage, and transfer into trucks for off-site disposal. The handling and management of this anticipated large quantity of collected water would require extensive coordination due to limited space for on-site temporary storage tanks and the extensive volume of truck traffic in the community. • Implementation of alternative would require extensive odor control measures as odors would most likely be generated during excavation. Management, handling and amending/conditioning of soils would be conducted under a temporary enclosure equipped with a vapor management system. Since the site has limited available space, conducting excavation activities while performing soil conditioning under a structure would present difficulties for site access, truck loading and management, interference with dewatering storage, handling, truck loading and excavation support structure installation and management (sheet pile cell “leap frogging”) • Alternative presents spatial concerns with the small Site area and limited potential excavation work and soil staging areas, limited areas for truck access and waiting/loading areas, temporary water tank storage areas and crane access for sheet piling.	• Excavation is a technically feasible alternative for the Site. However, Site logistics and a number of site specific conditions that limit the feasibility of a large scale excavation. • Excavation at the Site, due to subsurface conditions and high groundwater table, would require extensive excavation support structures. The soil support structure may require installation of complex components to ensure the systems integrity due to Site characteristics. Sheet pile installation may require use of a crane for installation and continued movement of sheet pile cells to accommodate excavation (i.e., “leap frogging”). • The excavated soil will need to be conditioned with amending agents (i.e., cement, kiln dust, fly ash, etc.,) due to the saturation of the soils to facilitate handling and off-site disposal. Equipment and space for the soil conditioning handling and management will be required on-site. Management and conditioning of soils would be performed under a temporary enclosure to minimize impacts from odors, vapors and noise. • Dewatering activities would be required to conduct the excavation. This activity would generate large quantities of water that would require temporary on-site storage, and then transfer into trucks for off-site disposal. The handling and management of this anticipated large quantity of collected water would require extensive coordination due to limited space for on-site temporary storage tanks and the extensive volume of truck traffic in the community. • Implementation of alternative would require extensive odor control measures as odors would most likely be generated during excavation. Management, handling and amending/conditioning of soils would be conducted under a temporary enclosure equipped with a vapor management system. Since the site has limited available space, conducting excavation activities while performing soil conditioning under a structure would present difficulties for site access, truck loading and management, interference with dewatering storage, handling, truck loading and excavation support structure installation and management (sheet pile cell “leap frogging”) • Alternative presents spatial concerns with the small Site area and limited potential excavation work and soil staging areas, limited areas for truck access and waiting/loading areas, temporary water tank storage areas and crane access for sheet piling.	• Treatability tests would be necessary to confirm that Implementation of this alternative is technically feasible due to the high groundwater conditions and high permeability of the site soils. Subsurface characteristics (i.e., high porosity and permeability) would require additional solidification agents (cement) which would hinder injection (pumping) of reagents into subgrade. • Implementation would require excavation activities to remove soils to accommodate swell. These soils would require characterization and off-site disposal. • Alternative presents spatial concerns with the small Site area and limited potential work and staging areas. • The soil cap can be easily constructed over the designated area.

EVALUATION CRITERIA	ALTERNATIVE 1 No Action	ALTERNATIVE 2 Engineering and Institutional Controls and Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Materials	ALTERNATIVE 3 Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)	ALTERNATIVE 4 Excavation of MGP Tar-Impacted Source Materials	ALTERNATIVE 5 In-Situ Solidification (ISS) of MGP Tar-Impacted Source Materials
			• Technical feasibility of the excavation required to implement this alternative is considered low due to extensive support structures required to excavate to the required depths, the large quantity of dewatering needed to conduct the excavation, the area and facilities needed to condition the saturated soils and the limited area available at the site to coordinate and manage the large number of trucks needed to transport soil and water off the site and through the neighboring community.	• Technical feasibility of the excavation required to implement this alternative is considered low due to extensive support structures required to excavate to the required depths, the large quantity of dewatering needed to conduct the excavation, the area and facilities needed to condition the saturated soils and the limited area available at the site to coordinate and manage the large number of trucks needed to transport soil and water off the site and through the neighboring community.	
b) Administrative Feasibility	• Alternative is administratively feasible. • No permits or approvals are required.	• This alternative can be implemented with proper coordination and communication with all project stakeholders. • Coordination would be required to obtain permits and approvals. Due to excavation and off-site disposal activities, coordination with the community and establishment of public relations measures would be required to keep the affected public apprised of the status of the remedial implementation.	• This alternative can be implemented with proper coordination and communication with all project stakeholders. • Coordination would be required to obtain permits and approvals. Due to excavation and off-site disposal activities, coordination with the community and establishment of public relations measures would be required to keep the affected public apprised of the status of the remedial implementation.	• This alternative can be implemented with proper coordination and communication with all project stakeholders. • Coordination would be required to obtain permits and approvals. Due to excavation and off-site disposal activities, coordination with the community and establishment of public relations measures would be required to keep the affected public apprised of the status of the remedial implementation.	• This alternative can be implemented with proper coordination and communication with all project stakeholders. • Coordination would be required to obtain permits and approvals. Due to excavation and off-site disposal activities, coordination with the community and establishment of public relations measures would be required to keep the affected public apprised of the status of the remedial implementation.
— Cost Effectiveness	— Capital Cost = $0 — Operation and Maintenance (O&M) Cost = $0 — Total Net Present Worth = $0	— Capital Cost = $1,270,000 — O&M Cost = $91,000 — Total NPW = $3,050,000	— Capital Cost = $11,660,000 — O&M Cost = $60,000 — Total NPW = $11,720,000	— Capital Cost = $4,390,000 — O&M Cost = $91,000 — Total NPW = $5,170,000	— Capital Cost = $5,150,000 — O&M Cost = $91,000 — Total NPW = $5,930,000
— Land Use	• Site is currently undeveloped and vacant. • Potential future uses of the have not been evaluated.	• Site is currently undeveloped and vacant. • Potential future uses of the Site have not been evaluated. • Site can be redeveloped in accordance with provisions of the ECs and ICs as well as State and Local regulations.	• Site is currently undeveloped and vacant. • Potential future uses of the Site have not been evaluated. • Future site use, after implementation of this alternative, would not be restricted due to site related impacts. Institutional controls would not be needed.	• Site is currently undeveloped and vacant. • Potential future uses of the Site have not been evaluated. • Site can be redeveloped in accordance with provisions of the ECs and ICs as well as State and Local regulations.	• Site is currently undeveloped and vacant. • Potential future uses of the Site have not been evaluated. • Site can be re-developed in accordance with provisions of the ECs and ICs and State and Local regulations. • Site redevelopment may be impeded by presence of stabilized mass. • Disturbance of stabilized mass may affect its function of stabilizing and immobilizing site contamination.

Figures

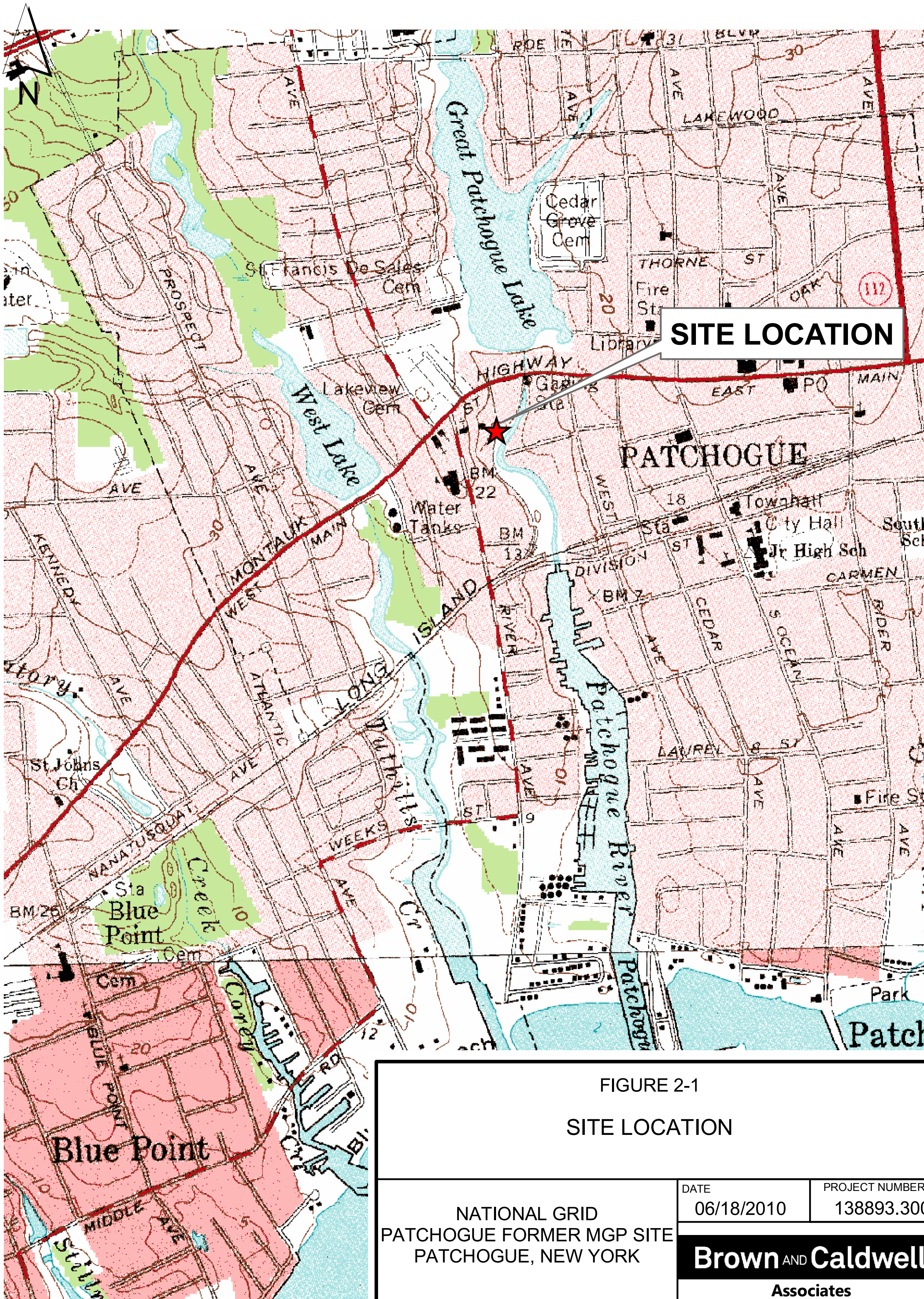


FIGURE 2-1

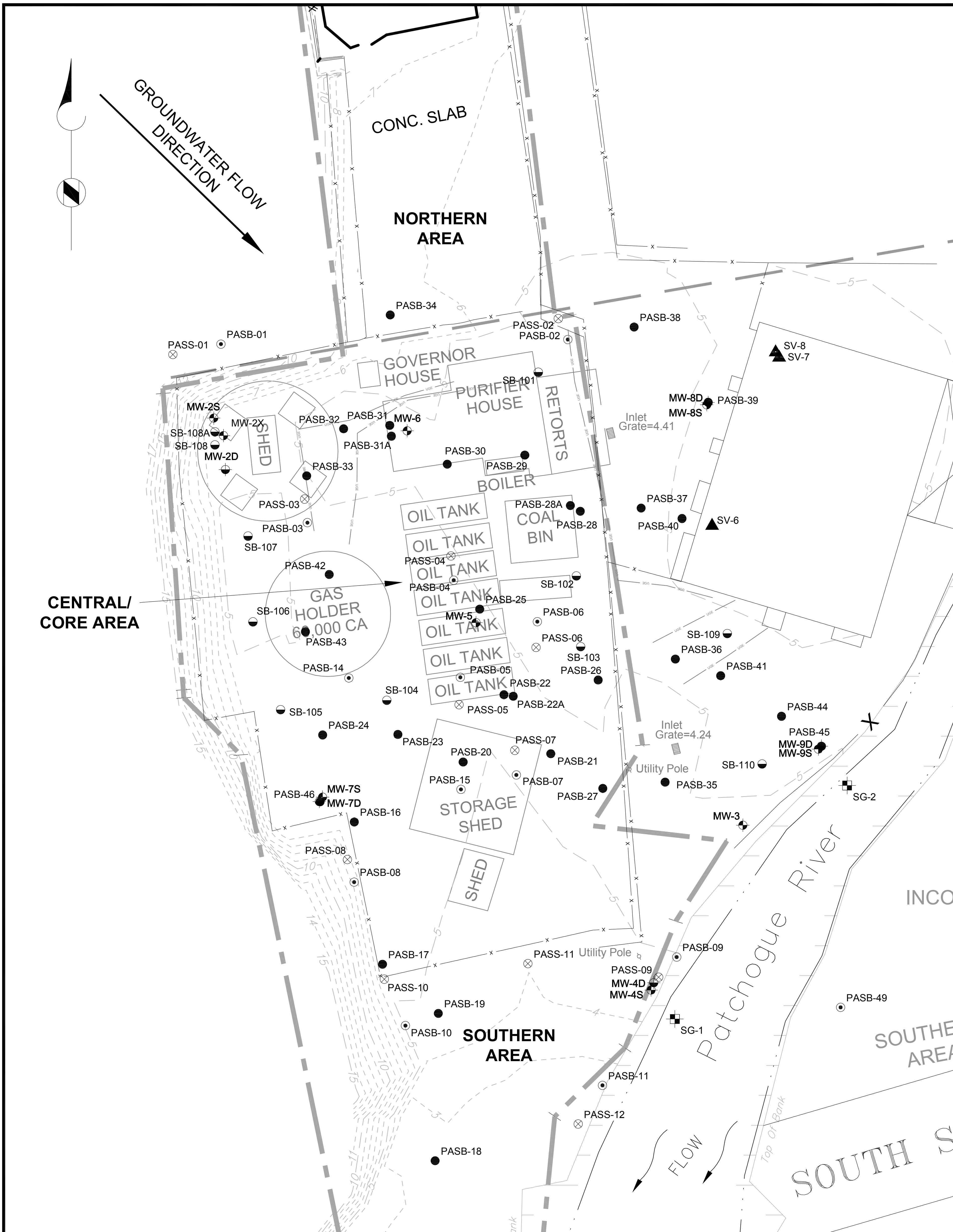
SITE LOCATION

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
06/18/2010	138893.300

Brown AND Caldwell
Associates

P:\GIS\National_Grid\Patchogue\Patchogue_Site_Location.mxd



LEGEND:

FORMER MGP STRUCTURE
PSA SURFACE SAMPLE LOCATION
PSA SUBSURFACE SAMPLE LOCATION
RI SOIL BORING LOCATION
RI SOIL VAPOR SAMPLE LOCATION
RI SHALLOW MONITORING WELL LOCATION
RI DEEP MONITORING WELL LOCATION
PDI STAFF GAUGE
PDI SOIL BORING LOCATION
PROPERTY LINE
FENCE
TOPOGRAPHIC CONTOUR
UNDERGROUND ELECTRIC

FIGURE 2-2
SITE PLAN

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\C-ENGINEERING\REVISED_FOCUS_FEASIBILITY_STUDY\FIGURE 2-2.DWG 05/05/2011 05:28:26PM By:rjames XREFS: Layout: 11X17 - Alt 2

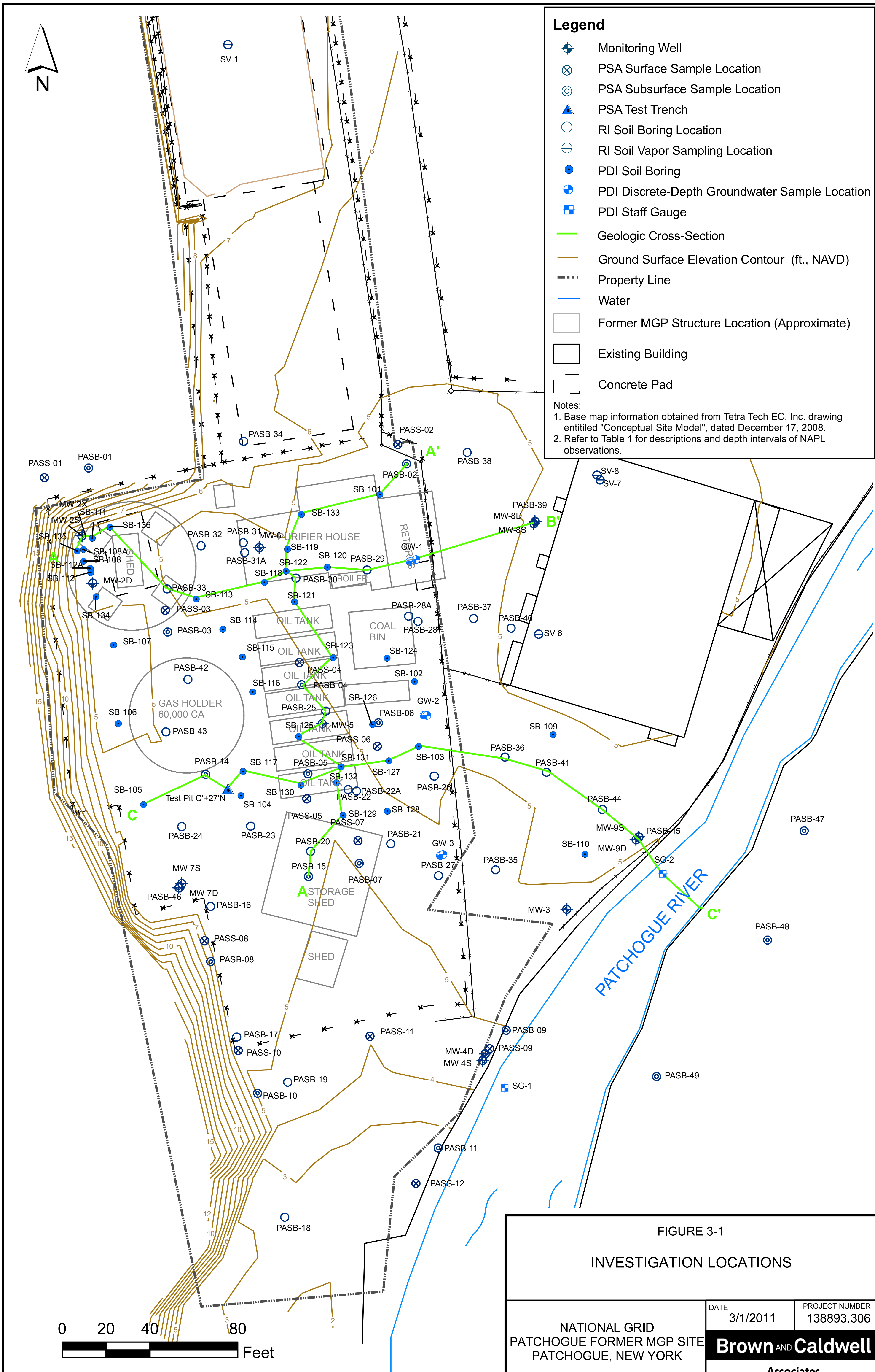


FIGURE 3-1

INVESTIGATION LOCATIONS

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
PATCHOGUE, NEW YORK

DATE 3/1/2011

PROJECT NUMBER 138893.306

Brown AND Caldwell Associates

P:\GIS\National_Grid\Patchogue\Patchogue_inv_locs.mxd

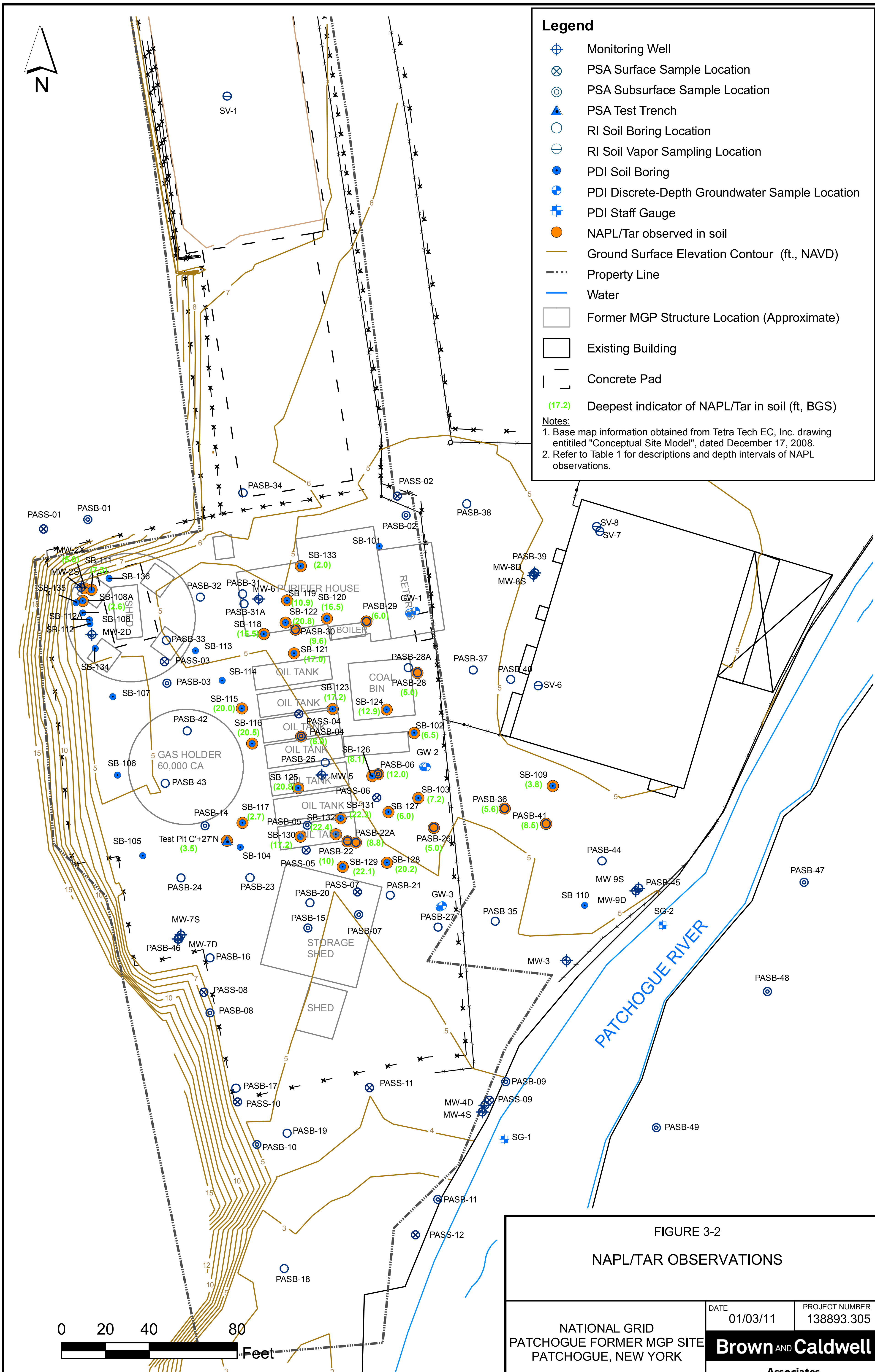
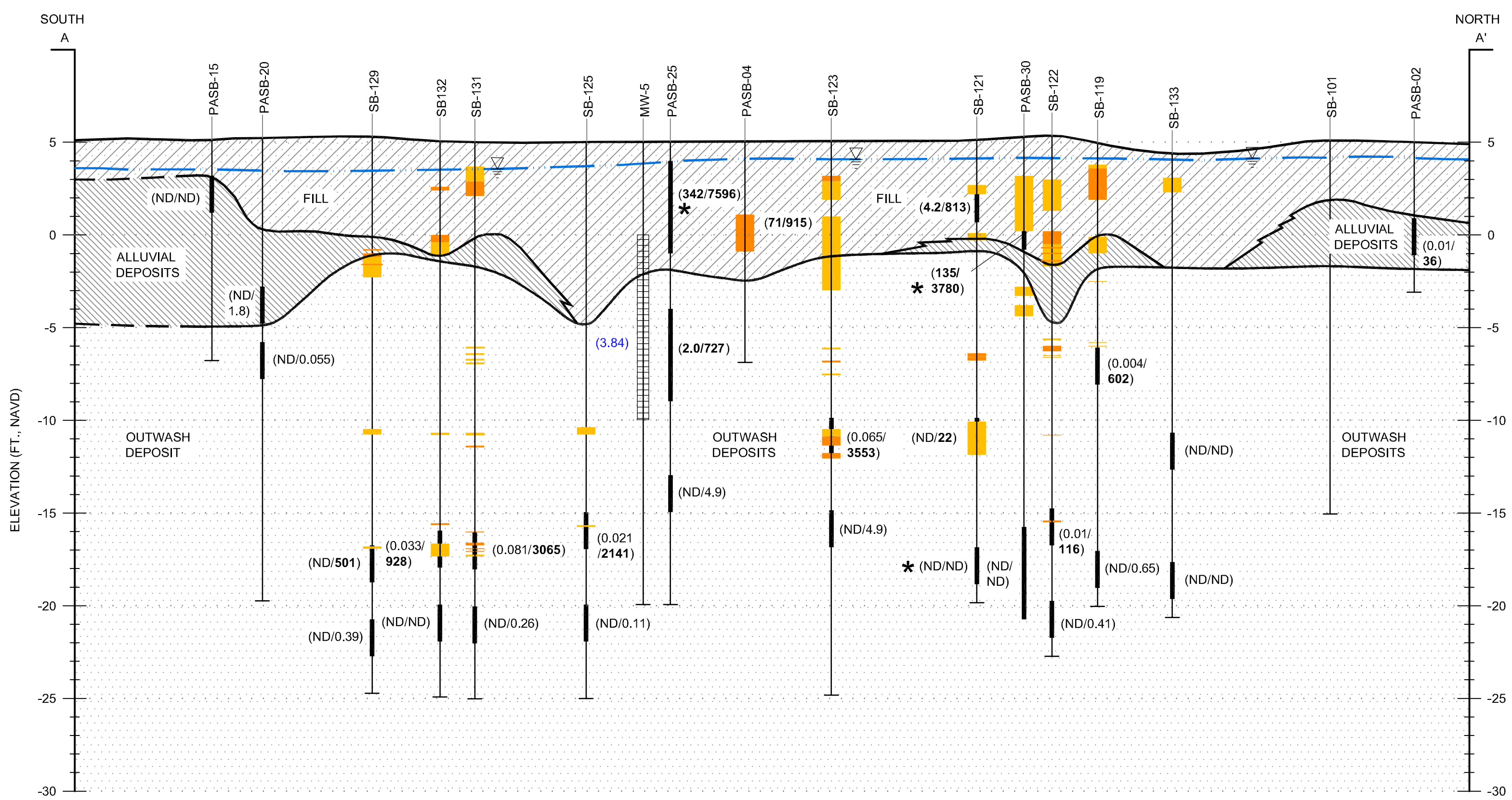


FIGURE 3-2

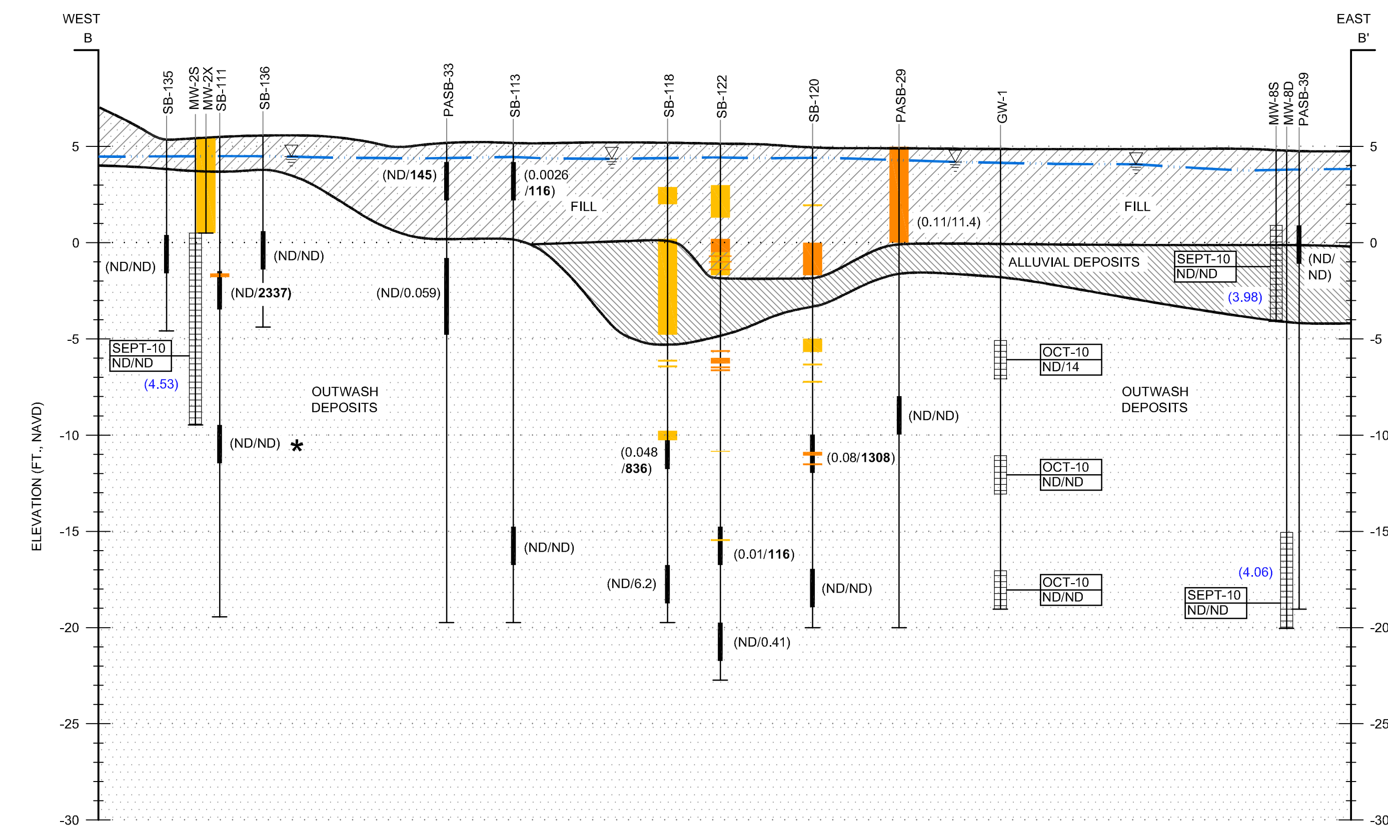
NAPL/TAR OBSERVATIONS

P:\GIS\National_Grid\Patchogue\Patchogue_NAPL_obs.mxd

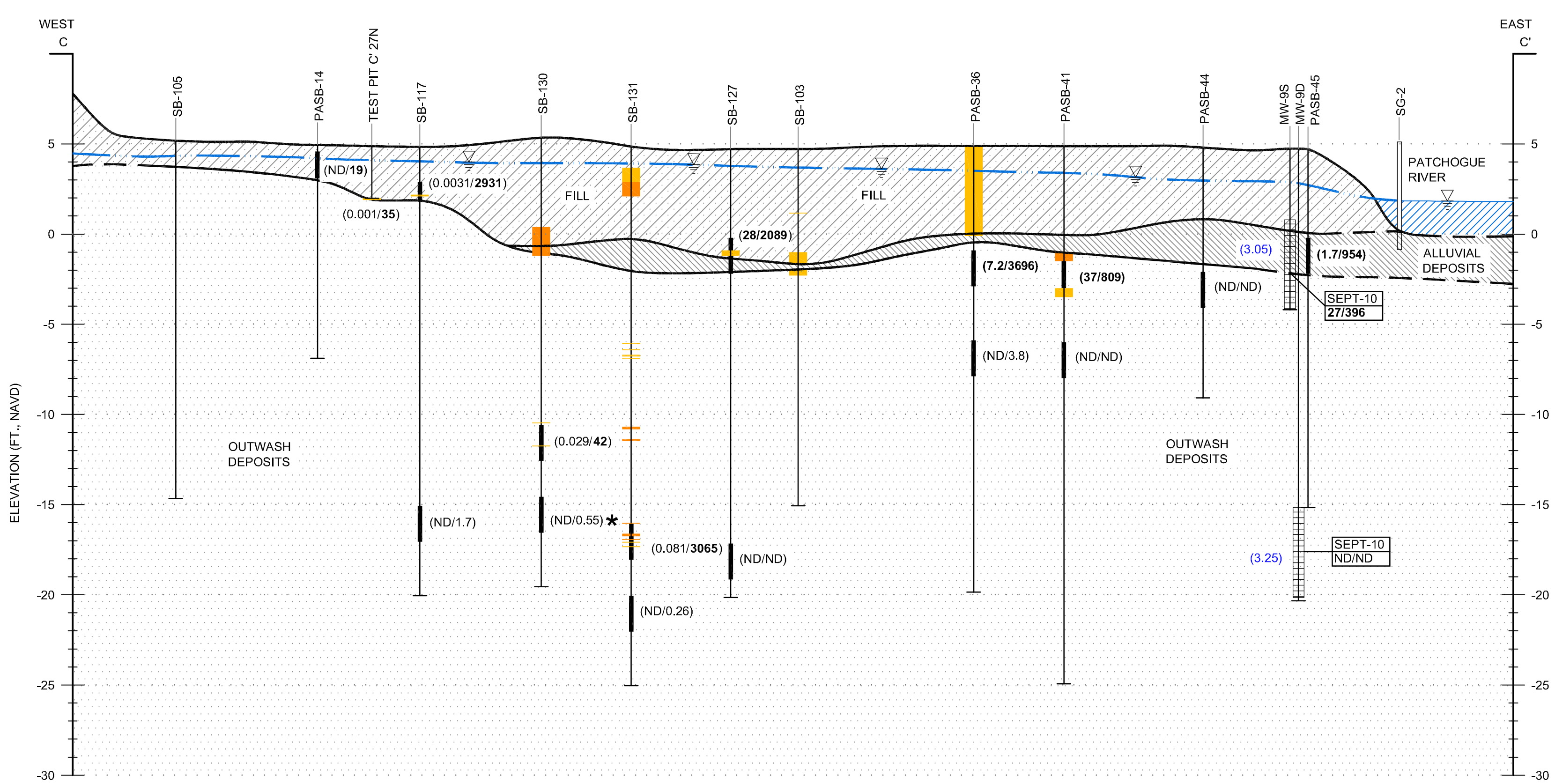
P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\138893-PATCHOGUE\2-SHEETS\B-GEOTECHNICAL\FIG_3-3_GEOLOGICAL CROSS SECTIONS.DWG 05/06/2011 02:10:04PM By:rjames XREFS: Basemap Layout: Layout1



CROSS SECTION A-A'



CROSS SECTION B-B'



CROSS SECTION C-C'

LEGEND:

- MW-7S — MONITORING WELL / SOIL BORING IDENTIFICATION AND APPROXIMATE LOCATION
- GENERALIZED GROUND SURFACE
- WELL SCREEN INTERVAL
- SEPT-10 ND/14 — TOTAL BTEX/TOTAL PAHS IN GROUNDWATER. VALUES REPORTED IN MICROGRAMS PER LITER (ug/L) BOLD VALUE INDICATES ONE OR MORE CONSTITUENT CONCENTRATIONS ABOVE CLASS GA CRITERIA.
- INTERVAL/DISCRETE DEPTH WHERE NAPL/TAR OBSERVED IN SOIL. COLOR OF SYMBOL INDICATES DEGREE OF SATURATION. (DARK ORANGE = HIGH, LIGHT ORANGE = LOW)
- (ND/3.8) — TOTAL BTEX/TOTAL PAH (mg/kg) CONCENTRATION WITHIN SAMPLE INTERVAL. BOLD VALUE INDICATES ONE OR MORE CONSTITUENT CONCENTRATIONS ABOVE PART 375 UNRESTRICTED SOIL CLEANUP OBJECTIVES.
- TOTAL DEPTH OF BOREHOLE
- FILL
- ALLUVIAL DEPOSITS
- OUTWASH DEPOSITS
- WATER TABLE (9/8/2010)
- (3.05) — GROUNDWATER ELEVATION (FT., NAVD)

ABBREVIATIONS:

BTEX	BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE ISOMERS
PAH	POLYCYCLIC AROMATIC HYDROCARBONS
ND	NOT DETECTED
*	HIGHEST TOTAL BTEX OR TOTAL PAH VALUE LISTED FROM ORIGINAL AND DUPLICATE SAMPLE

0 5 10
SCALE IN FEET
VERTICAL

0 40 80
SCALE IN FEET
HORIZONTAL

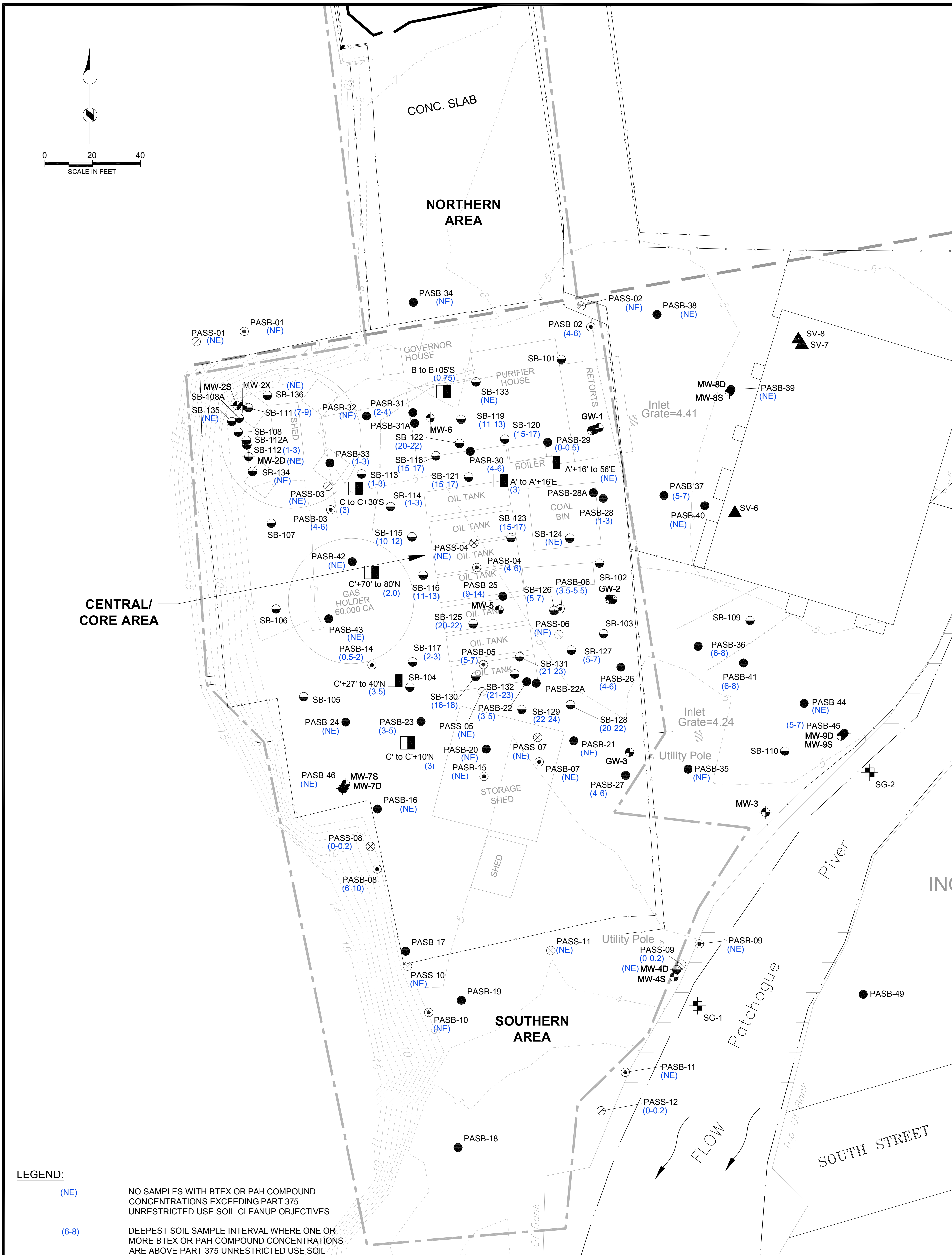
FIGURE 3-3

GEOLOGICAL CROSS SECTIONS

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893.305

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY



LEGEND:

(NE) NO SAMPLES WITH BTEX OR PAH COMPOUND CONCENTRATIONS EXCEEDING PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES

(6-8) DEEPEST SOIL SAMPLE INTERVAL WHERE ONE OR MORE BTEX OR PAH COMPOUND CONCENTRATIONS ARE ABOVE PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVES (VALUES IN ft., bgs)

TEST TRENCH SAMPLE LOCATION

PSA SURFACE SAMPLE LOCATION

PSA SUBSURFACE SAMPLE LOCATION

RI SOIL BORING LOCATION

RI SOIL VAPOR SAMPLE LOCATION

RI SHALLOW MONITORING WELL LOCATION

RI DEEP MONITORING WELL LOCATION

PDI STAFF GAUGE

PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION

PDI SOIL BORING LOCATION

PROPERTY LINE

FENCE

5 TOPOGRAPHIC CONTOUR

UNDERGROUND ELECTRIC

FIGURE 3-4

DEEPEST SAMPLE INTERVAL WITH BTEX AND PAH CONCENTRATION IN SOIL ABOVE UNRESTRICTED USE SCO

	DATE	PROJECT NUMBER
NATIONAL GRID PATCHOGUE FORMER MGP SITE VILLAGE OF PATCHOGUE, NEW YORK	5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\C-ENGINEERING\REVISED_FOCUS_FEASIBILITY_STUDY\FIGURE 3-4_SOIL_ABOVE_SCO.DWG 05/05/2011 06:02:31PM By:rjames XREFS: Layout: 11X17 - Alt 2

138893.305

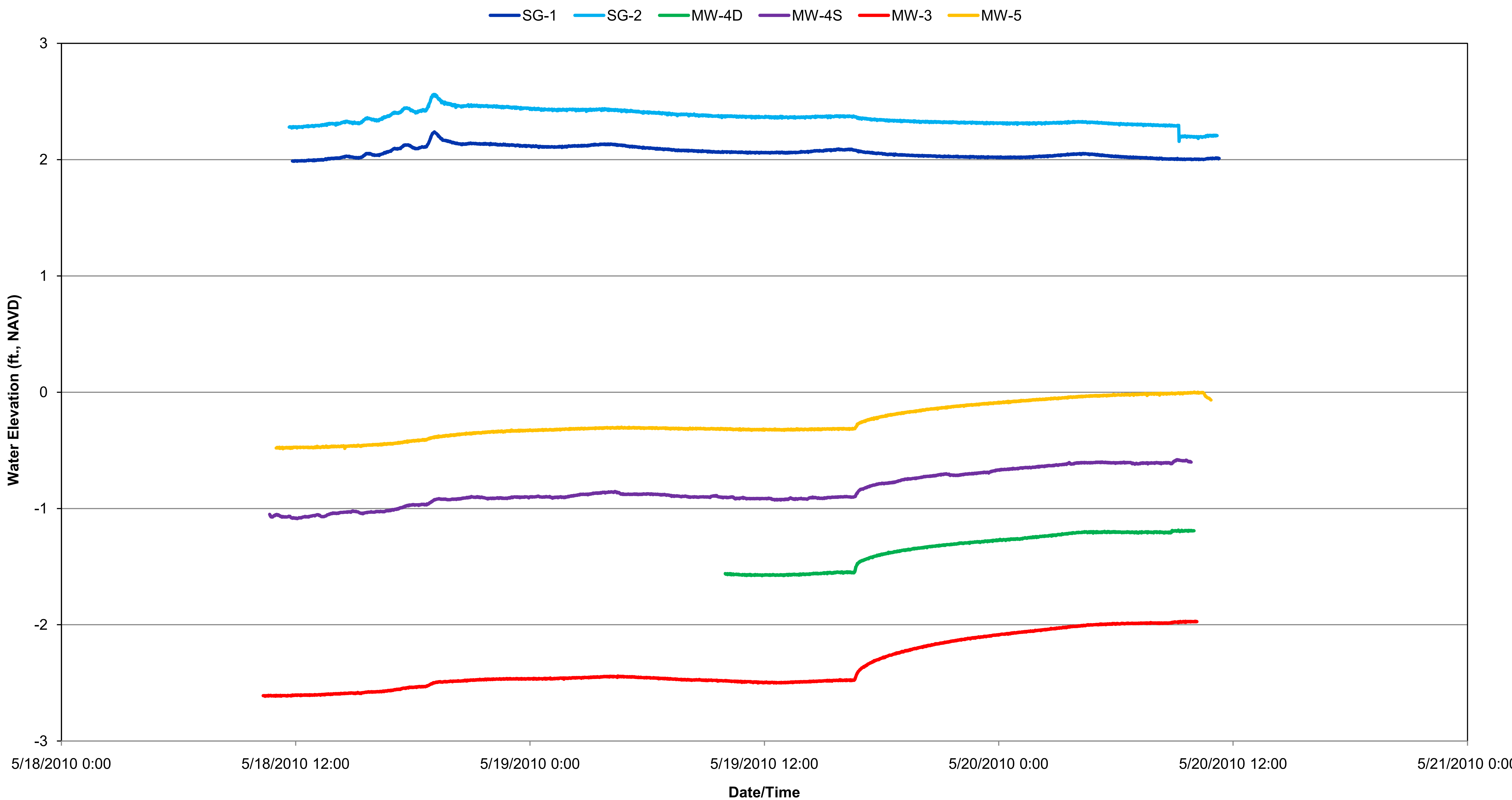


FIGURE 3-5

GROUNDWATER/ SURFACE WATER HYDROGRAPHS – CONTINUOUS MONITORING (MAY 18-20, 2010)

PATCHOGUE FORMER MGP SITE
PATCHOGUE NEW YORK

Brown AND Caldwell Associates

\\BCALL01\projects\National_Grid\Patchogue\GW_Monitoring\WL_Monitoring\GW_SW_interaction.ppt

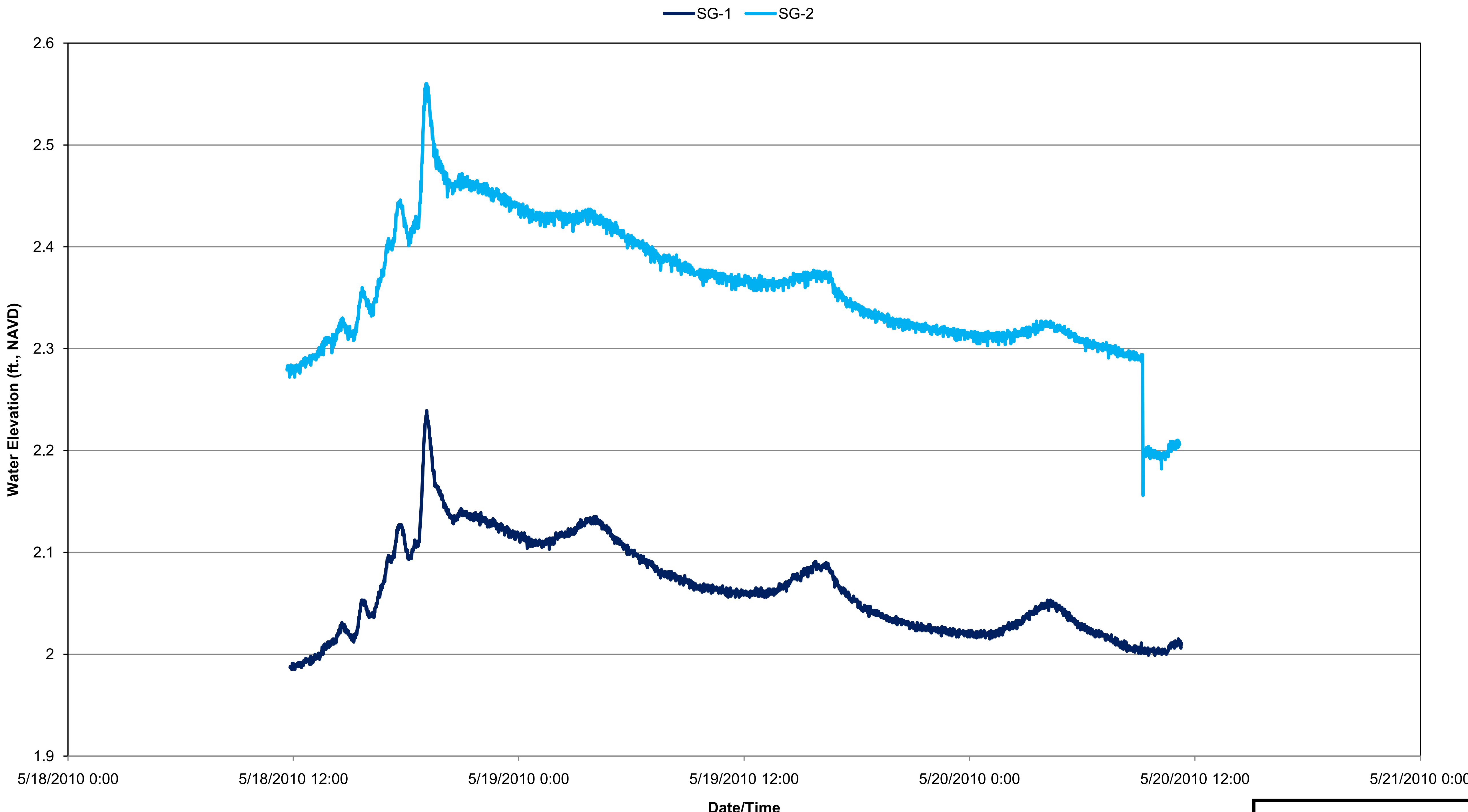
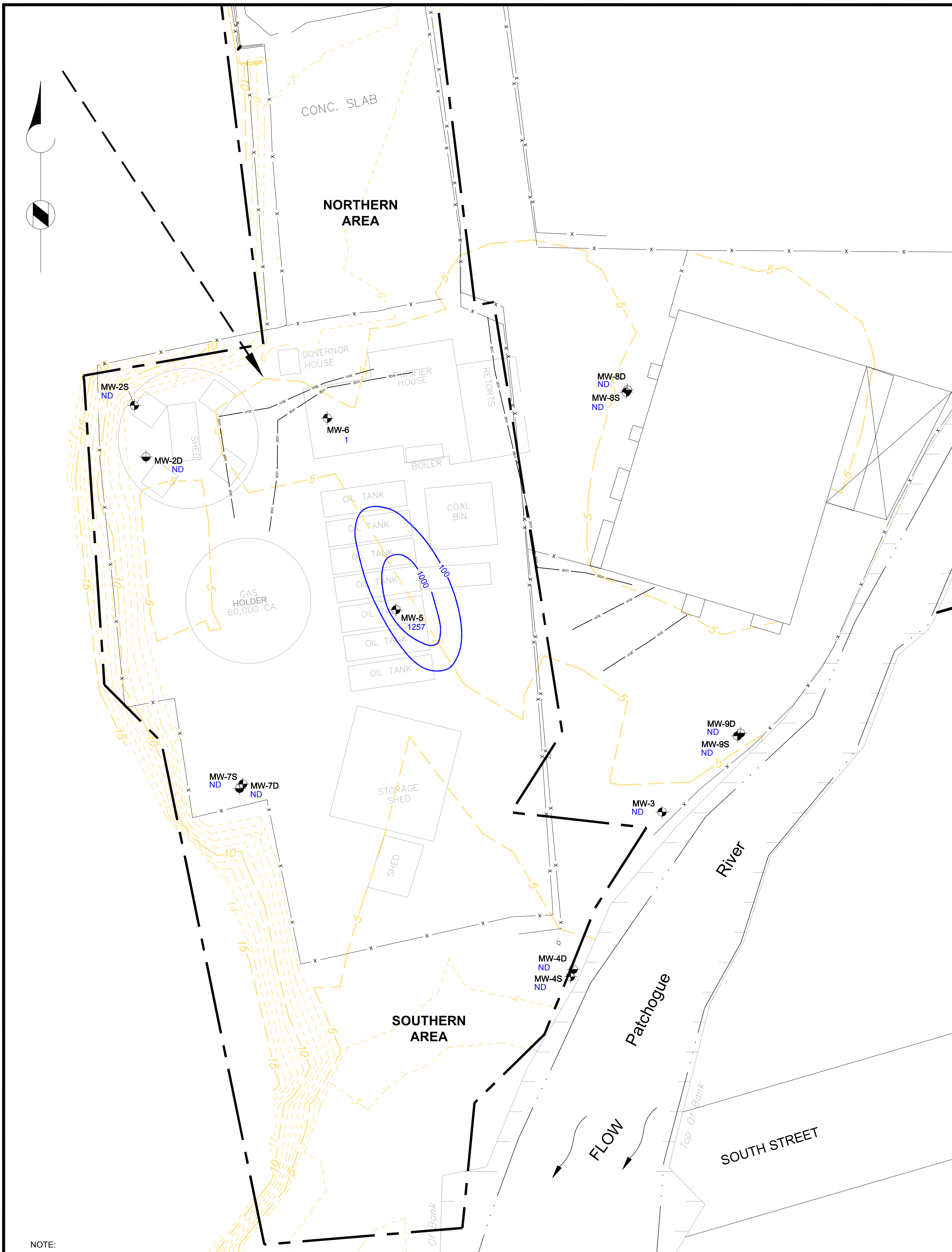


FIGURE 3-6

SURFACE WATER HYDROGRAPHS – CONTINUOUS MONITORING (MAY 18-20, 2010)

PATCHOGUE FORMER MGP SITE
PATCHOGUE NEW YORK

Brown AND Caldwell
Associates



NOTE:

1. AT LOCATIONS WHERE THERE ARE MORE THAN ONE WELL OR SAMPLE INTERVAL, THE SAMPLE WITH THE HIGHEST CONCENTRATION WAS USED TO DEVELOP THE ISOCONCENTRATION CONTOURS.

0 40 80

SCALE IN FEET

	RI SHALLOW MONITORING WELL LOCATION
	RI DEEP MONITORING WELL LOCATION
	PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
	PROPERTY LINE
x x	FENCE
5	TOPOGRAPHIC CONTOUR
UGE UGE UGE	UNDERGROUND ELECTRIC
100	ISOCONCENTRATION CONTOUR (ug/L) (SEE NOTE 1)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
1257	TOTAL BTEX CONCENTRATION (ug/L) IN GROUNDWATER
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
ND	NOT DETECTED

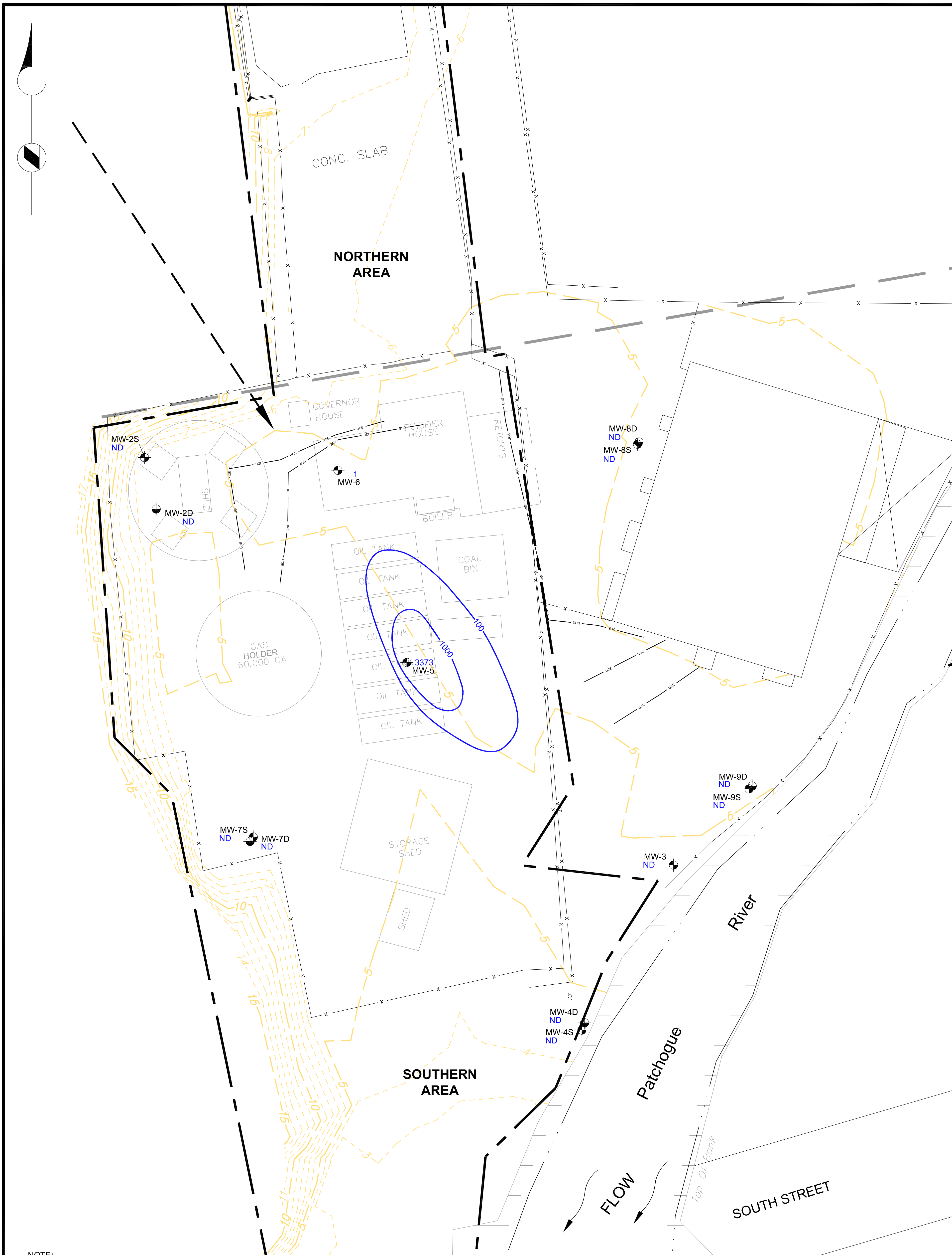
FIGURE 3-7

BTEX IN GROUNDWATER
SEPTEMBER 2009

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY



NOTE:
1. AT LOCATIONS WHERE THERE ARE MORE THAN ONE WELL OR SAMPLE INTERVAL, THE SAMPLE WITH THE HIGHEST CONCENTRATION WAS USED TO DEVELOP THE ISOCONCENTRATION CONTOURS.

0 40 80
SCALE IN FEET

	RI SHALLOW MONITORING WELL LOCATION
	RI DEEP MONITORING WELL LOCATION
	PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
	PROPERTY LINE
x	FENCE
5	TOPOGRAPHIC CONTOUR
UGE	UNDERGROUND ELECTRIC
100	ISOCONCENTRATION CONTOUR (ug/L) (SEE NOTE 1)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
1	TOTAL PAH CONCENTRATION (ug/L) IN GROUNDWATER FROM MONITORING WELL SAMPLE
PAH	POLYCYCLIC AROMATIC HYROCARBONS
ND	NOT DETECTED

FIGURE 3-8

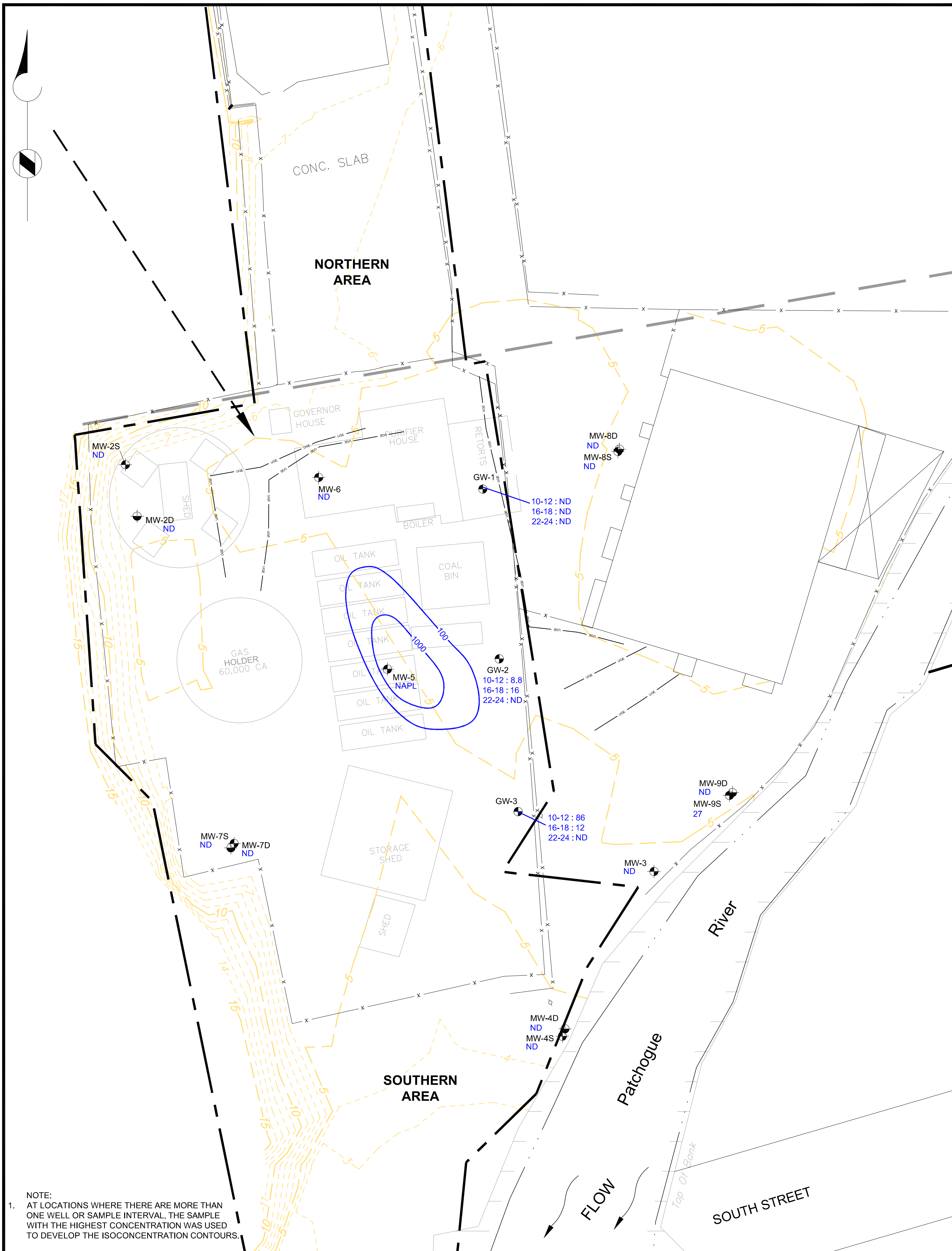
PAH IN GROUNDWATER
SEPTEMBER 2009

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\B-GEOTECHNICAL\FIG_3-8_PAH_IN_GW_SEPTEMBER-2009.DWG 05/05/2011 05:42:27PM By:rjames XREFS: Rev_Basemap_1-12-11 Layout: Layout1



NOTE:
1. AT LOCATIONS WHERE THERE ARE MORE THAN ONE WELL OR SAMPLE INTERVAL, THE SAMPLE WITH THE HIGHEST CONCENTRATION WAS USED TO DEVELOP THE ISOCONCENTRATION CONTOURS.

	RI SHALLOW MONITORING WELL LOCATION
	RI DEEP MONITORING WELL LOCATION
	PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
	PROPERTY LINE
x x	FENCE
5	TOPOGRAPHIC CONTOUR
UGE UGE UGE	UNDERGROUND ELECTRIC
100	ISOCONCENTRATION CONTOUR (ug/L) (SEE NOTE 1)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
27	TOTAL PAH CONCENTRATION (ug/L) IN GROUNDWATER FROM MONITORING WELL SAMPLE
10-12 : 8.8	TOTAL BTEX CONCENTRATION (ug/L) IN GROUNDWATER FROM DISCRETE-DEPTH GROUNDWATER SAMPLES. DEPTH INTERVAL (FT. BELOW GRADE) TO LEFT OF CONCENTRATION.
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
NAPL	NON-AQUEOUS PHASE LIQUID DETECTED IN WELL, NO SAMPLE COLLECTED.
ND	NOT DETECTED

0 40 80
SCALE IN FEET

FIGURE 3-9

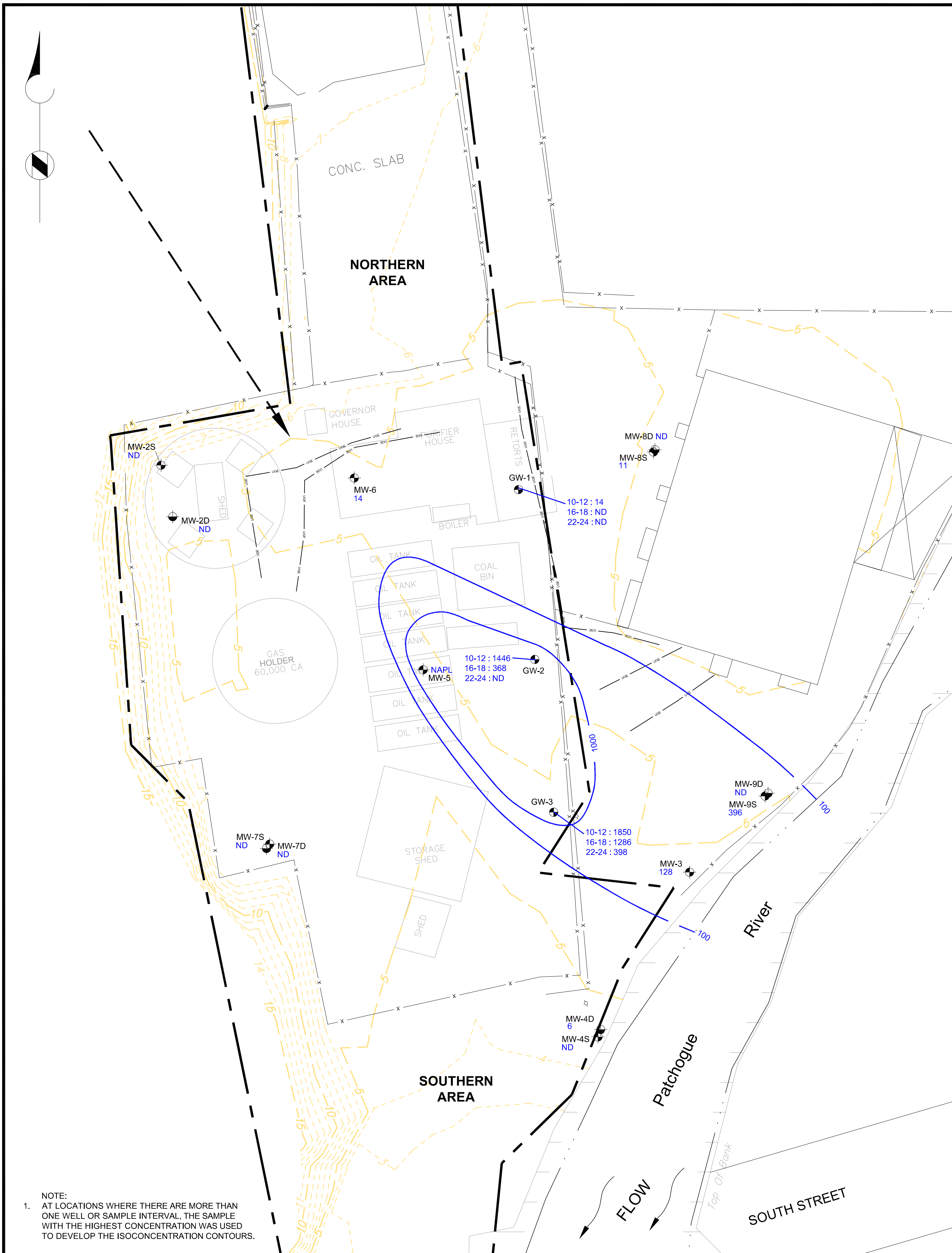
BTEX IN GROUNDWATER
SEPTEMBER/OCTOBER 2010

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE: 5/11
PROJECT NUMBER: 138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\B-GEOTECHNICAL\FIG_3-9_BTEX_IN_GW_SEPTEMBER-2010.DWG 05/05/2011 05:44:27PM By:rjames XREFS: Rev_Basemap_1-12-11 Layout: Layout1



NOTE:
1. AT LOCATIONS WHERE THERE ARE MORE THAN ONE WELL OR SAMPLE INTERVAL, THE SAMPLE WITH THE HIGHEST CONCENTRATION WAS USED TO DEVELOP THE ISOCONCENTRATION CONTOURS.

0 40 80
SCALE IN FEET

RI SHALLOW MONITORING WELL LOCATION

RI DEEP MONITORING WELL LOCATION

PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION

PROPERTY LINE

FENCE

5 — TOPOGRAPHIC CONTOUR

UNDERGROUND ELECTRIC

100 — ISOCONCENTRATION CONTOUR (ug/L) DASHED WHERE INFERRED (SEE NOTE 1)

APPROXIMATE GROUNDWATER FLOW DIRECTION

14 — TOTAL PAH CONCENTRATION (ug/L) IN GROUNDWATER FROM MONITORING WELL SAMPLE

10-12 : 14 — TOTAL PAH CONCENTRATION (ug/L) IN GROUNDWATER FROM DISCRETE-DEPTH GROUNDWATER SAMPLES. DEPTH INTERVAL (FT. BELOW GRADE) TO LEFT OF CONCENTRATION.

PAH — POLYCYCLIC AROMATIC HYROCARBONS

NAPL — NON-AQUEOUS PHASE LIQUID DETECTED IN WELL, NO SAMPLE COLLECTED.

ND — NOT DETECTED

FIGURE 3-10

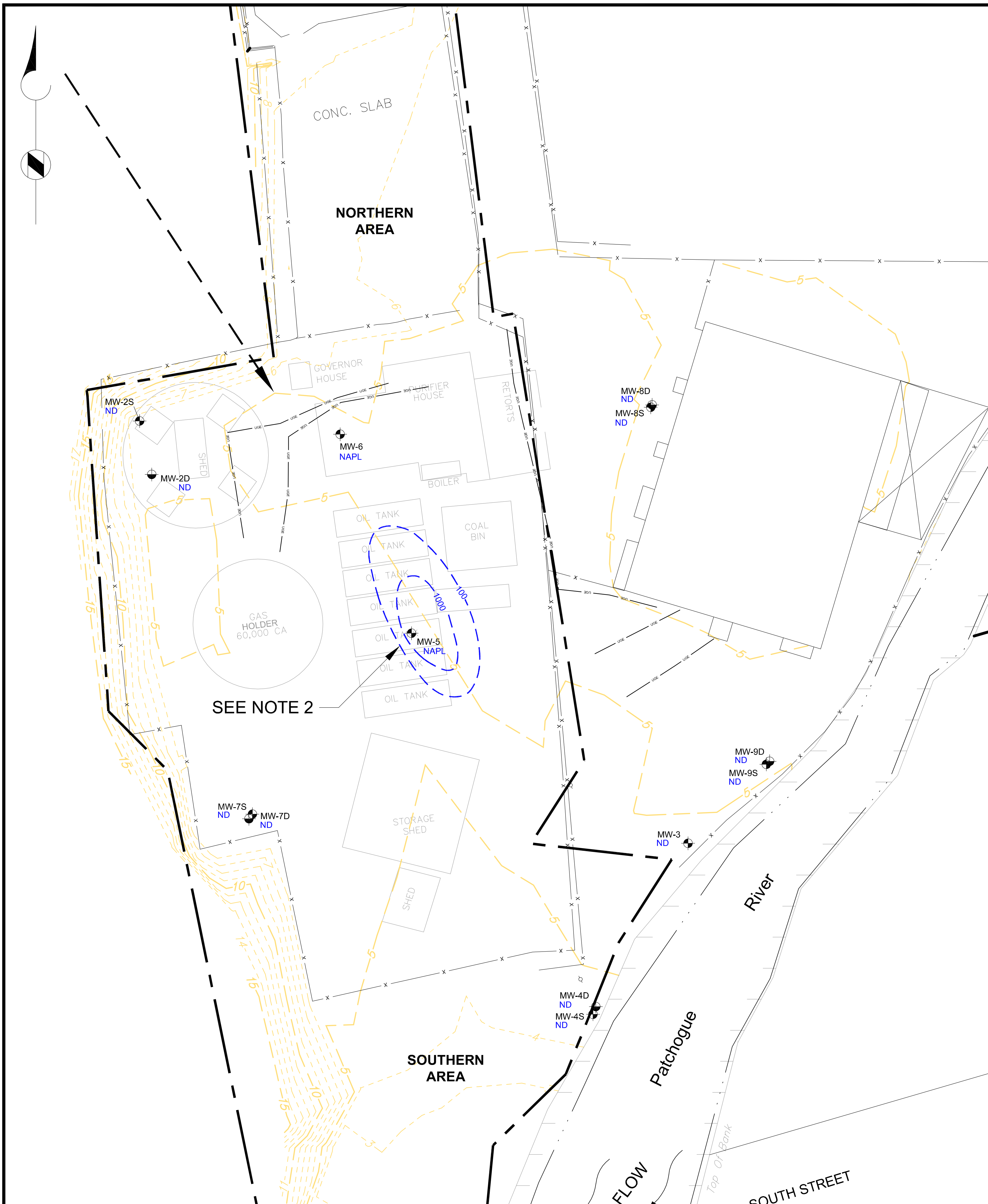
PAH IN GROUNDWATER
SEPTEMBER/OCTOBER 2010

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\B-GEOTECHNICAL\FIG_3-10_PAH_IN_GW_SEPTEMBER-2010.DWG 05/05/2011 05:46:34PM By:rjames XREFS: Rev_Basemap_1-12-11 Layout: Layout1



NOTES:

1. AT LOCATIONS WHERE THERE ARE MORE THAN ONE WELL OR SAMPLE INTERVAL, THE SAMPLE WITH THE HIGHEST CONCENTRATION WAS USED TO DEVELOP THE ISOCONCENTRATION CONTOURS.

2. ISOCONCENTRATION CONTOURS IN VICINITY OF MW-5 ARE INFERRED BASED ON PREVIOUS DATA. NO SAMPLE WAS COLLECTED FROM THIS WELL DURING THE SAMPLING EVENT DUE TO THE PRESENCE OF NAPL IN WELL.

	RI SHALLOW MONITORING WELL LOCATION
	RI DEEP MONITORING WELL LOCATION
	PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
	PROPERTY LINE
x x	FENCE
5	TOPOGRAPHIC CONTOUR
UGE UGE UGE	UNDERGROUND ELECTRIC
100	ISOCONCENTRATION CONTOUR (ug/L) DASHED WHERE INFERRED (SEE NOTE 1)
	APPROXIMATE GROUNDWATER FLOW DIRECTION
1257	TOTAL BTEX CONCENTRATION (ug/L) IN GROUNDWATER FROM MONITORING WELL SAMPLE
BTEXT	BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES
NAPL	NON-AQUEOUS PHASE LIQUID DETECTED IN WELL, NO SAMPLE COLLECTED.
ND	NOT DETECTED

0 40 80

SCALE IN FEET

FIGURE 3-11

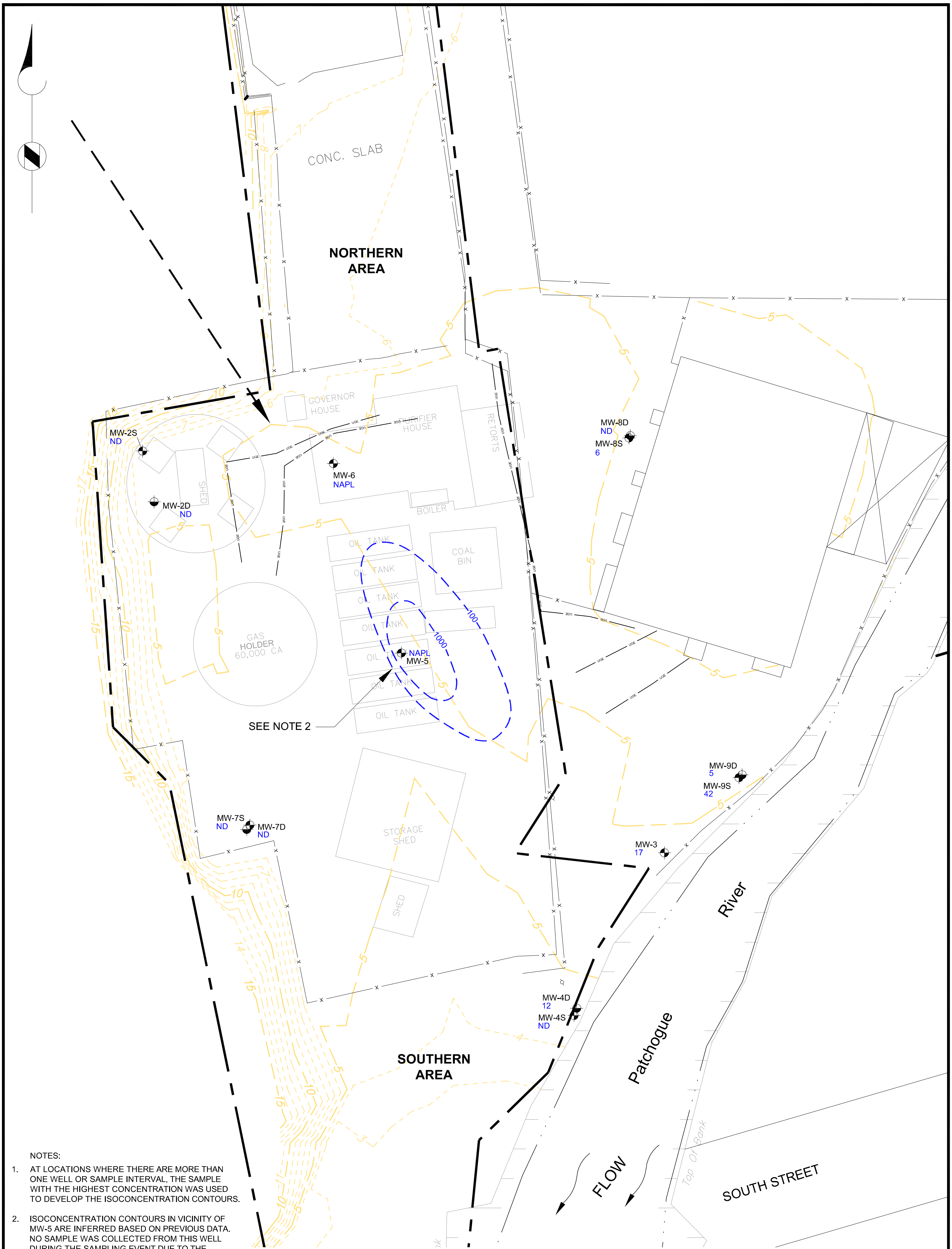
BTEX IN GROUNDWATER
JANUARY 2011

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\B-GEOTECHNICAL\FIG_3-11_BTEX_IN_GW_JANUARY-2011.DWG 05/05/2011 05:48:18PM By:rjames XREFS: Rev_Basemap_1-12-11 Layout: Layout1



NOTES:

1. AT LOCATIONS WHERE THERE ARE MORE THAN ONE WELL OR SAMPLE INTERVAL, THE SAMPLE WITH THE HIGHEST CONCENTRATION WAS USED TO DEVELOP THE ISOCONCENTRATION CONTOURS.
2. ISOCONCENTRATION CONTOURS IN VICINITY OF MW-5 ARE INFERRED BASED ON PREVIOUS DATA. NO SAMPLE WAS COLLECTED FROM THIS WELL DURING THE SAMPLING EVENT DUE TO THE PRESENCE OF NAPL IN WELL.

RI SHALLOW MONITORING WELL LOCATION

RI DEEP MONITORING WELL LOCATION

PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION

PROPERTY LINE

FENCE

5 — TOPOGRAPHIC CONTOUR

UNDERGROUND ELECTRIC

100 — ISOCONCENTRATION CONTOUR (ug/L) DASHED WHERE INFERRED (SEE NOTE 1)

APPROXIMATE GROUNDWATER FLOW DIRECTION

1257 — TOTAL BTEX CONCENTRATION (ug/L) IN GROUNDWATER FROM MONITORING WELL SAMPLE

BTEXT — BENZENE, TOLUENE, ETHYLBENZENE, AND XYLENES

NAPL — NON-AQUEOUS PHASE LIQUID DETECTED IN WELL, NO SAMPLE COLLECTED.

ND — NOT DETECTED

0 40 80

SCALE IN FEET

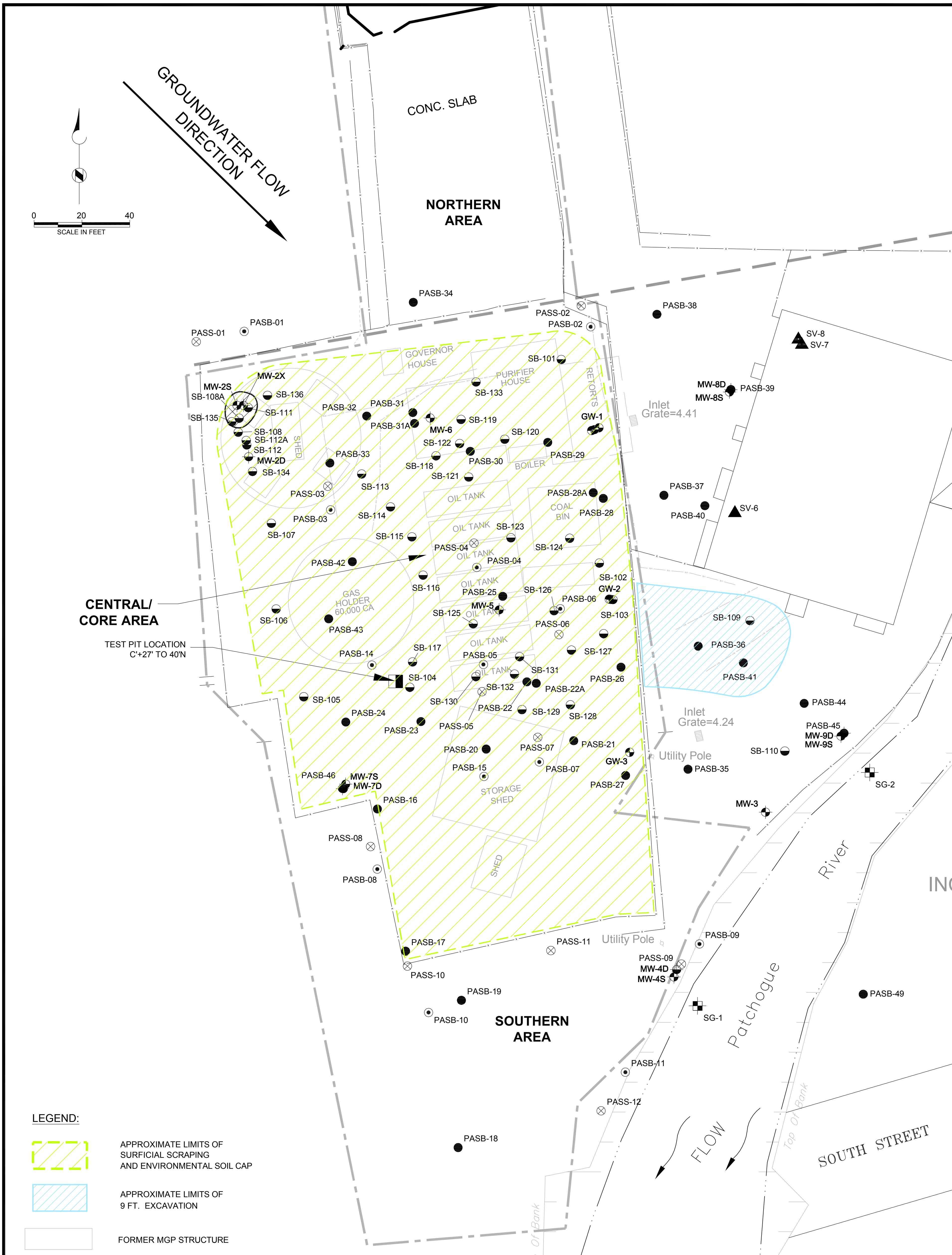
FIGURE 3-12

PAH IN GROUNDWATER
JANUARY 2011

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell ASSOCIATES
ALLENDALE, NEW JERSEY



LEGEND:

	APPROXIMATE LIMITS OF SURFICIAL SCRAPING AND ENVIRONMENTAL SOIL CAP
	APPROXIMATE LIMITS OF 9 FT. EXCAVATION
	FORMER MGP STRUCTURE
	TEST TRENCH SAMPLE LOCATION
	PSA SURFACE SAMPLE LOCATION
	PSA SUBSURFACE SAMPLE LOCATION
	RI SOIL BORING LOCATION
	RI SOIL VAPOR SAMPLE LOCATION
	RI SHALLOW MONITORING WELL LOCATION
	RI DEEP MONITORING WELL LOCATION
	PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
	PDI STAFF GAUGE
	PDI SOIL BORING LOCATION
	PROPERTY LINE
	FENCE
5	TOPOGRAPHIC CONTOUR
	UNDERGROUND ELECTRIC

FIGURE 7-1
ALTERATIVE 2
ENGINEERING AND INSTITUTIONAL CONTROLS, EXCAVATION OF OFF-SITE MGP TAR-AND PETROLEUM-IMPACTED SOURCE MATERIALS

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\C-ENGINEERING\REVISED_FOCUS_FEASIBILITY_STUDY\FIGURE 7-1_ALT 2.DWG 05/05/2011 05:12:53PM By:rjames XREFS: Layout: 11X17 - Alt 6

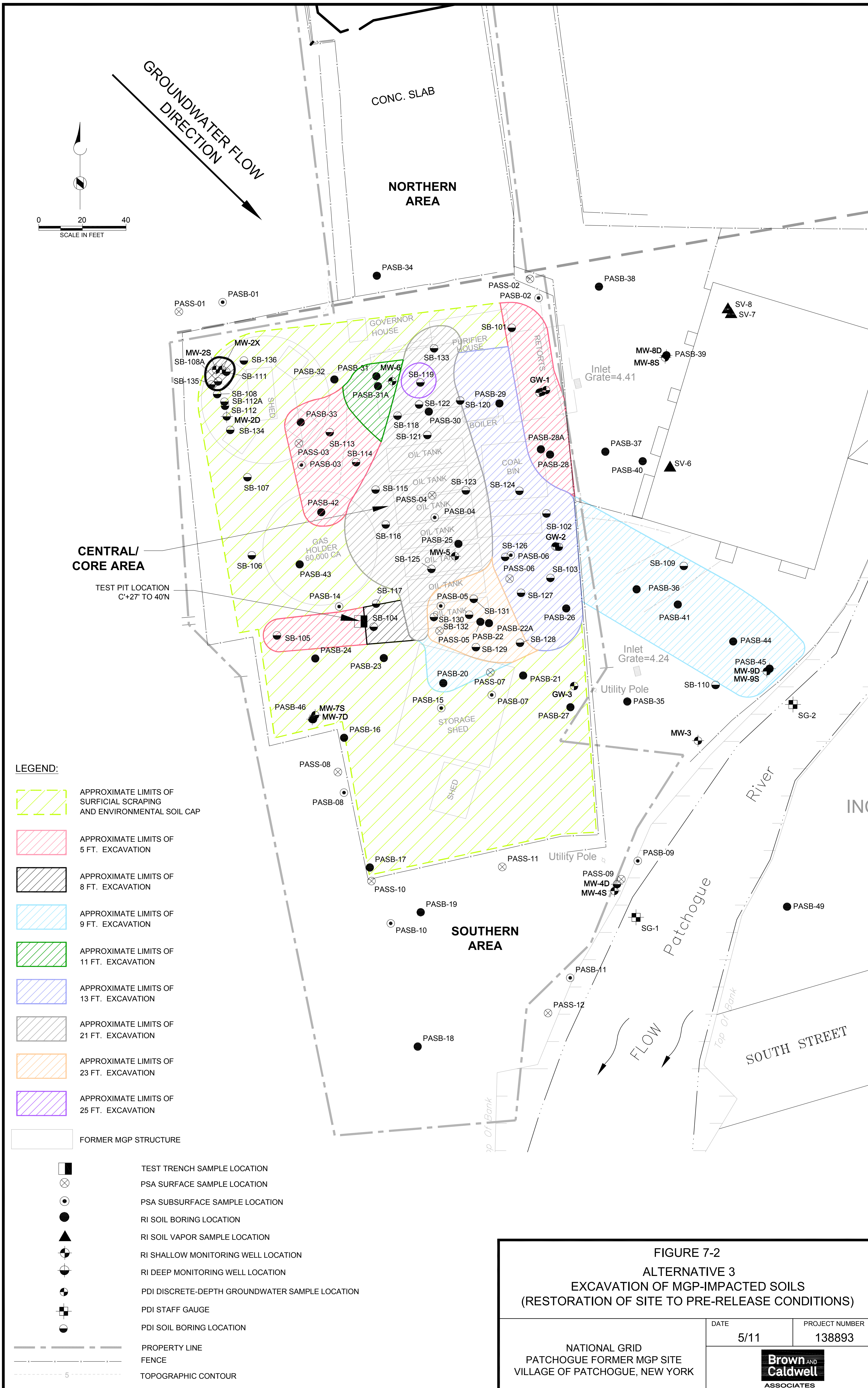


FIGURE 7-2
ALTERNATIVE 3
EXCAVATION OF MGP-IMPACTED SOILS
(RESTORATION OF SITE TO PRE-RELEASE CONDITIONS)

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\C-ENGINEERING\REVISED_FOCUS_FEASIBILITY_STUDY\FIGURE 7-2_ALT 3.DWG 05/05/2011 05:14:19PM By:rjames XREFS: Layout: 11X17 - Alt 6

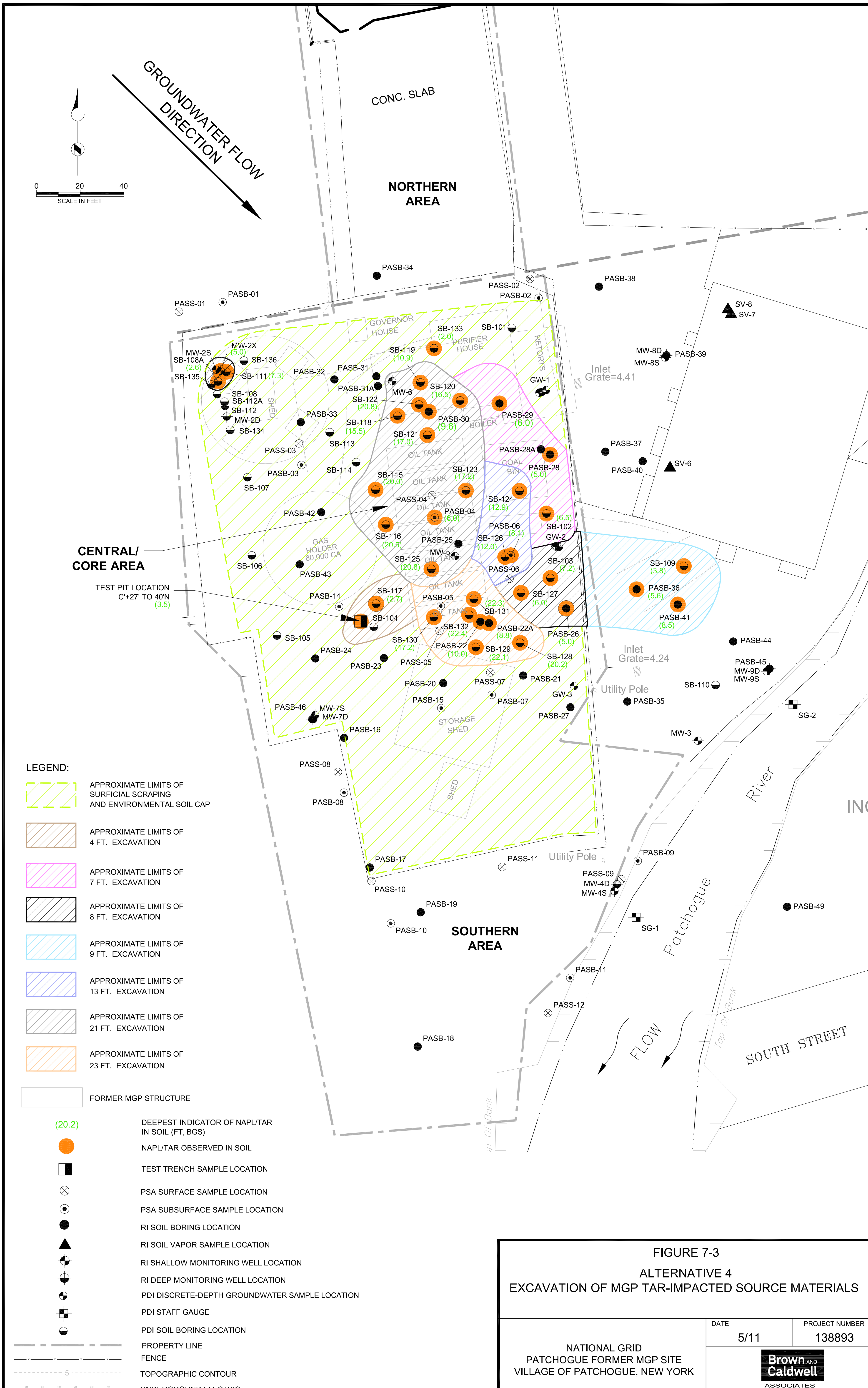


FIGURE 7-3

ALTERNATIVE 4

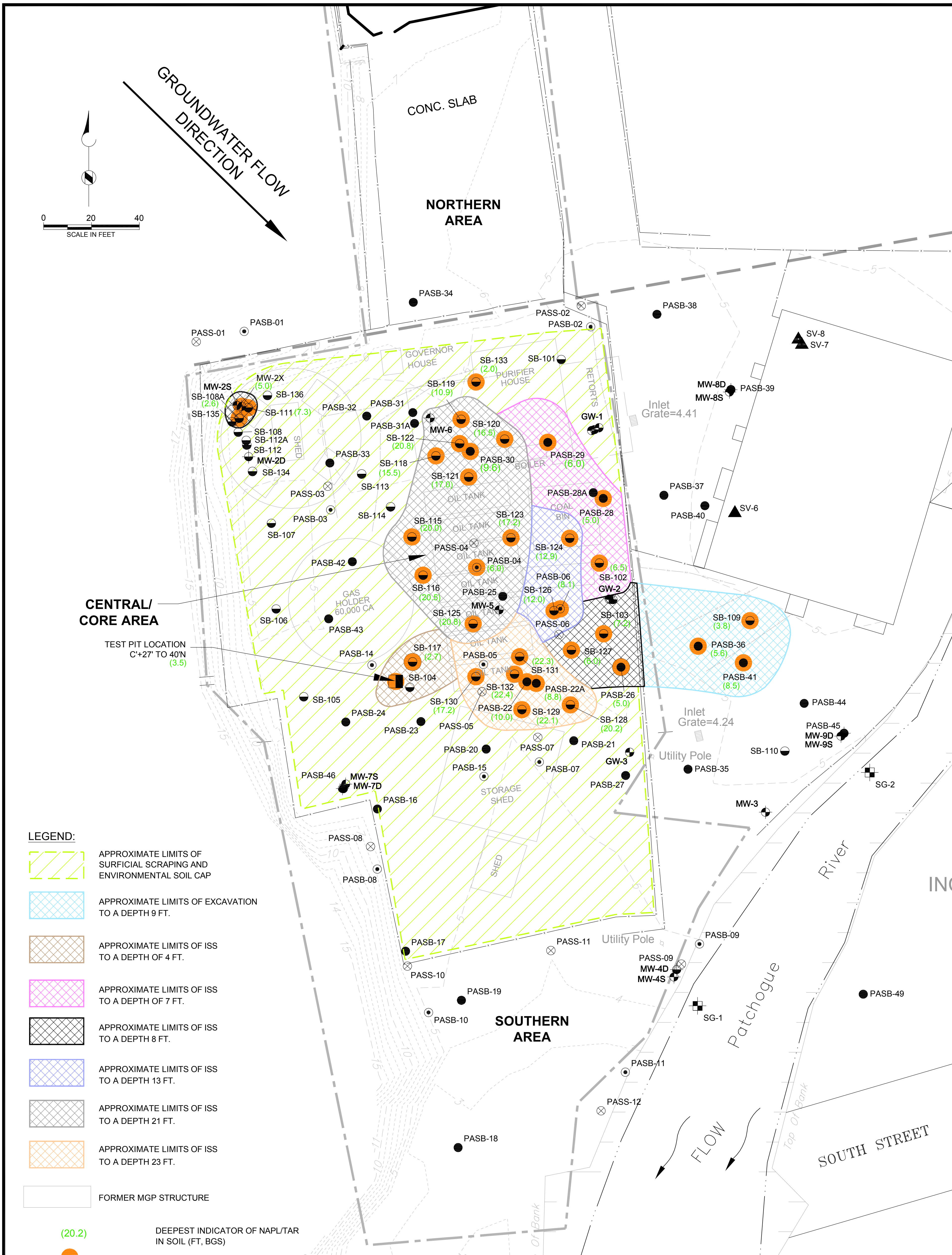
EXCAVATION OF MGP TAR-IMPACTED SOURCE MATERIALS

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell
ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\C-ENGINEERING\REVISED_FOCUS_FEASIBILITY_STUDY\FIGURE 7-3_ALT 4.DWG 05/06/2011 02:07:42PM By:rjames XREFS: Layout: 11X17 - Alt 2



LEGEND:

- APPROXIMATE LIMITS OF SURFICIAL SCRAPING AND ENVIRONMENTAL SOIL CAP
- APPROXIMATE LIMITS OF EXCAVATION TO A DEPTH 9 FT.
- APPROXIMATE LIMITS OF ISS TO A DEPTH OF 4 FT.
- APPROXIMATE LIMITS OF ISS TO A DEPTH OF 7 FT.
- APPROXIMATE LIMITS OF ISS TO A DEPTH 8 FT.
- APPROXIMATE LIMITS OF ISS TO A DEPTH 13 FT.
- APPROXIMATE LIMITS OF ISS TO A DEPTH 21 FT.
- APPROXIMATE LIMITS OF ISS TO A DEPTH 23 FT.
- FORMER MGP STRUCTURE
- (20.2) DEEPEST INDICATOR OF NAPL/TAR IN SOIL (FT, BGS)
- NAPL/TAR OBSERVED IN SOIL
- TEST TRENCH SAMPLE LOCATION
- PSA SURFACE SAMPLE LOCATION
- PSA SUBSURFACE SAMPLE LOCATION
- RI SOIL BORING LOCATION
- RI SOIL VAPOR SAMPLE LOCATION
- RI SHALLOW MONITORING WELL LOCATION
- RI DEEP MONITORING WELL LOCATION
- PDI DISCRETE-DEPTH GROUNDWATER SAMPLE LOCATION
- PDI STAFF GAUGE
- PDI SOIL BORING LOCATION
- PROPERTY LINE
- FENCE
- 5 TOPOGRAPHIC CONTOUR
- UNDERGROUND ELECTRIC

FIGURE 7-4

ALTERNATIVE 5
IN-SITU SOLIDIFICATION (ISS) OF MGP TAR-IMPACTED SOURCE MATERIALS

NATIONAL GRID
PATCHOGUE FORMER MGP SITE
VILLAGE OF PATCHOGUE, NEW YORK

DATE	PROJECT NUMBER
5/11	138893

Brown AND Caldwell ASSOCIATES
ALLENDALE, NEW JERSEY

P:\DRAFTING\NATIONAL_GRID\PATCHOGUE\2-SHEETS\C-ENGINEERING\REVISED_FOCUS_FEASIBILITY_STUDY\FIGURE 7-4_ALT 5.DWG 05/05/2011 06:00:16PM By:rjames XREFS: Layout: 11X17 - Alt 2

Appendix A: Pre-Design Investigation – Boring Logs

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-101 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255243.5 ft.
Luke Caballero	Direct-push	Geoprobe® 6600	Vert Datum: NAVD88	Northing: 219389.2 ft.
			Ground Surface Elev: 4.9 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0	4.9	SP	**FILL**		1	0.4	*Borehole backfilled with bentonite chips.*
		SP	Brown mf SAND, trace Silt, trace Organics.				1.2-1.8' BGS: Black staining and slight tar-like odor.
		GP/SP	Brown cmf SAND, little Gravel (Misc. Fill-brick, coal).				
		GP	Gray/Lt. Gray mfc SAND, little fc Gravel.				
		PT	**ALLUVIAL DEPOSITS** ORGANICS (root material). Wet @ 3.3'				
5	0	SP/GP	Gray/Brown mfc SAND, trace f Gravel.		2	0.4	
		OL	Dk. Brown SILT & CLAY.				
		SP/GP	**OUTWASH DEPOSITS** Brown/Tan cmf SAND, little fmc Gravel (rounded). Wet to saturated @ 8.0'.				
10	-5	SP/GP	Tan/Lt. Brown mfc SAND, trace (+) fmc Gravel (rounded). Saturated.		3	0.4	
15	-10	SP/GP	Tan/Lt. Brown mfc SAND, trace (-) fm Gravel (rounded), trace Silt. Saturated.		4	0.2	
20	-15						

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-102 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 1255259.4 ft. Northing: 219304.1 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
		SP	**FILL** Dk. Brown fm SAND, little (+) Silt, trace Organics (topsoil).		1	50.9	*Borehole backfilled with bentonite chips.*
		SP GP	Gray/Brown fm SAND, some (-) Gravel (angular).				2.2-2.5' BGS: Black staining, moderate to strong tar-like odor.
		SP GP	Brown/Black/Tan cmf SAND, some (-) Gravel (Misc. Fill-coal, cinders). Moist.				2.5-3.0' BGS: Slight to faint tar-like odor.
5	0	SP GP	Gray/Brown mf SAND, trace (-) fm Gravel. Wet at 2.0'		2	10.3	
		SP GP	Lt. Brown/Black cmf SAND, little Gravel (Misc. Fill-brick, coal).				5.8' BGS: Slight tar-like odor.
		SP GP	**OUTWASH DEPOSITS** Brown/Gray cmf SAND, trace Gravel, trace Organics.				6.2-6.5' BGS: Rainbow sheen on soil grains, slight NAPL coating on grains. Moderate to strong tar-like odor.
		SP	Lt. Gray cmf SAND. Wet to saturated.				7.0-7.7' BGS: Black staining, moderate tar-like odor.
10	-5	SP GP	Gray/Black cmf SAND.		3	0.7	
		SP GP	Brown/Orange/Multi-colored cmf SAND and cmf GRAVEL.				
			Lt. Brown/Orange cmf SAND, trace (-) f Gravel, trace Silt. Saturated.				
15	-10	SP GP	Orange mfc SAND, trace (-) Gravel, trace Silt. Saturated.		4	0.7	
20	-15						

Graphic Log: Sample Int, Recovery, Lithology, Backfill

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-103 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 1255261.3 ft. Northing: 219274.5 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)
			FILL			
		SP SM	Brown/Dk. Brown fm SAND, little Silt, little Organics.		1	36.2
		SP GP	Gray mfc SAND, little (+) Gravel. Moist			
		SP SM	Dk. Brown fmc SAND, little Silt, trace Gravel.			
	0	SP	Lt. Gray fmc SAND, wet.			
5		SP	Gray c SAND.			
		SP	Wood.		2	131
		SP	Lt. Gray fmc SAND, moist.			
		GP SP	Black/Dk. Brown cmf SAND, some (+) mf Gravel (Misc. Fill-coal, brick).			
		OL	Lt. Gray/Black cmf SAND.			
			ALLUVIAL DEPOSITS			
		SP	Brown Silty CLAY and ORGANICS (peat).			
	-5		**OUTWASH DEPOSITS**			
10		SP GP	Black fmc SAND.		3	6.3
		SP GP	Lt. Brown/Orange cmf SAND, little (+) Gravel (rounded).			
		SP SM	Orange/Brown cmf SAND, little (+) fmc Gravel (rounded). Saturated.			
			Lt. Brown/Orange fmc SAND, trace Silt, trace (-) Gravel.			
15	-10	SP SM	Lt. Brown/Orange fmc SAND, trace Silt, trace (-) Gravel.		4	3.1
20	-15					

Graphic Log: Sample Int, Recovery, Lithology, Backfill

Remarks

Borehole backfilled with bentonite chips.

2.1' BGS: Slight to moderate tar-like odor.

3.7' BGS: Brown NAPL coating soil grains, rainbow sheen. Moderate to strong tar-like odor.
5.0-5.9' BGS: Black staining, slight tar-like odor.
5.9-6.5' BGS: Black stained, NAPL coating on soil grains. Brown NAPL on coarser material.
6.6-7.2' BGS: Black stained, slight NAPL coating on soil grains, moderate tar-like odor.
7.6-7.7' BGS: Black staining, sheen and tar-like odor.
7.8-9.0' BGS: Spots of sheen on coarser material.

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-104 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type: N/A	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Sampling: Macrocore® Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 1255180.3 ft. Northing: 219252.1 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			FILL		1	0.5	*Borehole backfilled with bentonite chips.*
		SP SM	Brown fm SAND, little Silt, little Organics.				1.6' BGS: Slight tar-like odor.
		SP GP	Dk. Brown/Red fmc SAND, little (+) Gravel, trace Silt (Misc. Fill- brick, wood, coal).				
		SP	Black/Gray cmf SAND. Moist.				
		SP	Dk. Brown fm SAND, little Silt, trace Organics. Fire brick @ 3.0'				
5	0		**ALLUVIAL DEPOSITS**		2	0.2	
		SP SM	Dk. Brown fm SAND, little Silt, trace Organics.				
		SP GP	Gray/Brown/Black fmc SAND, little (-) Silt, little Organics (layered).				7.1' BGS: Sporadic black staining, slight tar-like odor.
			OUTWASH DEPOSITS				
			Tan/Orange cmf SAND, little (+) Gravel (rounded). Saturated.				
10	-5	SP GP	Tan/Orange cmf SAND, little (-) fmc Gravel, trace Silt. Saturated.		3	0.2	
15	-10	SP GP	Tan/Orange fmc SAND, trace (-) Gravel, trace Silt. Saturated.		4	0.0	
20	-15						

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. **SB-105** Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/18/10 - 5/18/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.3 ft.	Easting: 1255136.0 ft. Northing: 219248.2 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0		SP SM	**FILL** Dk. Brown fm SAND, little Silt, trace Organics (topsoil).		1	0.3	*Borehole backfilled with bentonite chips.* 1.5-3.0' BGS: Sporadic black staining, faint tar-like odor.
		SP GP	Gray/Black/Red cmf SAND, little (+) Gravel (Misc. Fill-brick).				
		SP SM	**OUTWASH DEPOSITS** Brown/Tan fmc SAND, little (-) Silt, trace Gravel, Moist.				
5	0	SP SM	Brown/Gray mfc SAND, trace Silt, Saturated.		2	0.4	
		SP SM	Lt. Tan/Beige fmc SAND, trace Silt. Saturated.				
10	-5	SP SM	Lt. Tan/Beige fmc SAND, trace Silt. Saturated.		3	0	
15	-10	SP SM	Lt. Tan/Beige fmc SAND, trace Silt. Saturated, Iron staining.		4	0	
20							

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-106 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.7 ft.	Easting: 1255124.4 ft. Northing: 219284.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			FILL		1	0.6	*Borehole backfilled with bentonite chips.* 0.2-1.1' BGS: Minor black staining, faint tar-like odor.
		SP \SM	Dk. Brown fm SAND, little (+) Silt, trace Organics, Moist.				
		SP \GP	Dk. Brown/Brown cmf SAND, little Gravel (Misc. Fill-brick), little Silt.				
		OL	Dk. Brown SILT & CLAY, litle (+) Organics (peat).				
	0	SP SM	Dk. Brown/Tan mfc SAND, little Silt, trace (+) Gravel (Misc. Fill-coal), Moist.				
5		SP SM			2	0.3	
			OUTWASH DEPOSITS				
		SP	Beige/Tan mfc SAND, trace Silt, Wet.				
		GP	Beige/Tan/Multi-colored cmf SAND, little (-) fm Gravel (rounded), trace Silt. Iron staining. Wet to saturated.				
10	-5	SP GP	Beige/Tan/Multi-colored cmf SAND, little (-) fm Gravel (rounded), trace Silt. Iron staining. Wet to saturated.		3	0.3	
15	-10	SP GP	Beige/Tan/Multi-colored cmf SAND, little (-) fm Gravel (rounded), trace Silt. Iron staining. Wet to saturated.		4	0.2	
20	-15						

Graphic Log: Sample Int | Recovery | Lithology | Backfill

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-107 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.8 ft.	Easting: 1255122.4 ft. Northing: 219320.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
		SP SM	**FILL** Dk. Brown mf SAND, little Silt, little Organics.		1	2.1	*Borehole backfilled with bentonite chips.* 0.2-0.9' BGS: Faint tar-like odor
		SP GP	Dk. Brown/Brown cmf SAND, little Gravel, Moist.				
		SP SM	Brown/Dk. Brown fmc SAND, little Silt, trace f Gravel.				
5	0	SP SM	**OUTWASH DEPOSITS** Tan/Beige mfc SAND, trace Silt, Wet.				
		SP SM	Tan/Beige/Orange fmc SAND, little (-) Silt, trace mf Gravel. Wet to saturated. Iron staining.		2	0.3	
10	-5	SP SM	Beige mfc SAND, little Silt, trace (-) f Gravel. Wet to saturated.		3	0.2	
15	-10	SP SM	Beige mfc SAND, little Silt, trace mf Gravel. Wet to saturated.		4	0.2	
20	-15						

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-108 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	6.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 1255108.6 ft.
Luke Caballero	Direct-push	Geoprobe® 6600	Vert Datum: NAVD88	Northing: 219358.8 ft.
			Ground Surface Elev: 5.4 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Sample Int	Recovery	Lithology	Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**		1					4.3	*Borehole backfilled with / bentonite chips.*
		GP/SP	Brown fmc SAND, little (+) Gravel, trace Silt, Moist.								
		GP/SP	White/Beige fmc SAND, little (+) Gravel (pulverized).								2.5-2.6' BGS: Minor black staining, slight tar-like odor.
		SM/SP	Brown mfc SAND, little Silt, trace Gravel, Wood chips.								
5	0	GP/SP	Brown fmc SAND, little Silt, little Gravel, trace Organics. Moist to wet.		2					0.4	
		GP/GP	Brown fmc SAND, little Silt, little Gravel, trace Organics. Moist to wet.								Geoprobe refusal @ 6.0' BGS. Move over to location SB-108A.
		SP	Lt. Gray/White mf GRAVEL (pulverized concrete), little (+) Sand. Wet.								

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-108A Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	5.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.3 ft.	Easting: 1255108.6 ft. Northing: 219364.2 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	Sample Int	Recovery	Lithology	Backfill	ppm Readings (ppm)	Remarks
		SP	**FILL**		1					27.3	*Borehole backfilled with bentonite chips.*
		SP	Brown fmc SAND, little Organics.								
		GP / SP	Brown/Dk. Brown cmf SAND, little (+) Gravel, trace Silt, trace Organics.								1.75-1.9' BGS: Black hardened tar, moderate tar-like odor.
		GP / GP	Brown/Lt. Brown cmf SAND, little (-) Gravel, trace Silt. Moist to wet.								2.5-2.6' BGS: NAPL coating soil grains, sheen and NAPL blebs on liner. Moderate to strong tar-like odor.
5		SP	Lt. Gray/White mf GRAVEL (pulverized concrete), little (+) Silt.								Geoprobe refusal @ 5.0' BGS.

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-109 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® Hammer Type: N/A	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.		N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.1 ft.	Easting: 1255322.4 ft. Northing: 219280.0 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			Asphalt		1	1.2	*Borehole backfilled with bentonite chips.*
			FILL				
		SP GP	Dk. Brown/Black fm SAND, little (-) Gravel (Misc. Fill-cinders, brick).				1.7-2.5' BGS: Faint petroleum-like odor.
		SP SM	Brown/Tan fm SAND, little (-) Silt, trace Gravel.				
		SP GP	Red/Brown/Purple fmc SAND, little Gravel (Misc. Fill) little Silt. Moist.				3.6-3.8' BGS: Minor black staining, hardened tar, moderate tar-like odor.
5	0		**ALLUVIAL DEPOSITS**		2	0.3	
		SP GP	Red/Purple/Brown fmc SAND, little (+) f Gravel (shells). Moist.				
		SP GP	Red/Purple/Brown fmc SAND, little (+) f Gravel (shells). Moist.				
		PT	Dk. Brown/Brown SILT & CLAY and ORGANICS (peat) . Moist to wet.				
10	-5		**OUTWASH DEPOSITS**		3	1.0	
		SP SM	Tan/Beige fmc SAND, little (-) Silt.				
		SP SM	Dk. Brown fmc SAND, little (+) Silt, trace (+) Organics.				
		SP GP	Tan/Beige cmf SAND, little (+) fmc Gravel. Wet to saturated.				
		SP GP	Tan/Beige cmf SAND, little (+) fmc Gravel, trace Silt. Saturated.				
15	-10	SP GP	Tan/Beige cmf SAND, trace Gravel, trace Silt. Saturated. Iron staining.		4	0.2	
20							

Graphic Log: Sample Int, Recovery, Lithology, Backfill

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-110 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	20.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® Hammer Type: N/A	Development Method:
5/19/10 - 5/19/10	Zebra Env. Corp.		N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 1255337.0 ft. Northing: 219225.5 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			Asphalt		1	0.4	*Borehole backfilled with bentonite chips.*
		SP GP	**ALLUVIAL DEPOSITS** Dk. Brown cmf SAND, little (+) mf Gravel (rounded), Moist.				
		SP	Lt. Brown cmf SAND.				
5	0	SP SM	Brown fm SAND, little Silt, little Organics. Shells @ 3.65-3.7'.		2	0.5	
		SP	Beige mfc SAND.				
		SP	Beige mfc SAND.				
		PT	Dk. Brown f SAND, little Silt & Clay, little Organics (peat).				
		SP SM	**OUTWASH DEPOSITS** Lt. Brown/Tan mfc SAND, little (-) Silt,				
		SP GP	trace (-) Gravel (rounded), Wet.				
10	-5	SP GP	Tan cmf SAND, little (+) fmc Gravel (rounded) trace Silt, wet.		3	0.1	
			Tan/Orange cmf SAND, little (-) fm Gravel (rounded), trace Silt. Saturated. Iron staining.				
15	-10	SP GP	Tan/Lt. Brown cmf SAND, trace f Gravel, trace Silt, Saturated.		4	0.0	
20							

Graphic Log: Sample Int, Recovery, Lithology, Backfill

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-111 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling:	Development Method:
10/4/10 - 10/4/10	Zebra Env. Corp.	Macrocore® **Hammer Type:** N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	
Luke Caballero	Direct-push	Geoprobe® 6600	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD88 **Ground Surface Elev:** 5.5 ft. **Easting:** 1255112.6 ft. **Northing:** 1255112.0 ft. **TOC Elev:** N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
	5	SP GP	**FILL** Lt. Gray fmc SAND, little Gravel (pulverized concrete/rock).		1	1.6	*Borehole backfilled with bentonite chips.* 0.5-1.7' BGS: Sporadic spots of black staining.
		SP GP	Lt. brown fmc SAND, trace (+) fm Gravel. Wet.				
		SP GP	Beige fmc SAND, litte (-) fmc Gravel. Wet.				
5	0	SP GP	Beige/tan mfc SAND, little (-) fm Gravel. Wet to saturated.		2	23.4	Sample SB-111-7-9 collected and submitted for laboratory analysis. 7.1-7.3' BGS: Band of NAPL saturated soils (tacky), moderate tar-like odor. 7.3-8.2' BGS: Sheen extending from saturated soils and within soil core when broken apart.
10	-5	SP GP	Beige mfc SAND, trace (-) fm Gravel.		3	0.2	
15	-10	SP GP	Beige mfc SAND, trace (-) fm Gravel.		4	0.0	Sample SB-111-15-17 collected and submitted for laboratory analysis.
20	-15	SP GP	Beige mcf SAND, trace (+) fm Gravel. Iron staining throughout.		5	0.0	
25							

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-112 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/4/10 - 10/4/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.4 ft.	Easting: 1255112.0 ft. Northing: 219353.8 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6600		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
	5	SP GP	**FILL** Brown fmc SAND, some (-) fmc Gravel, trace Organics. Wet.		1	0.9	*Borehole backfilled with bentonite chips.*
		SP GP	Brown mfc SAND, trace (+) fm Gravel. Wet.				1.4-1.5' BGS: Black staining, faint tar-like odor. Sample SB-112-1-3 collected and submitted for laboratory analysis.
		SP GP	Beige mfc SAND, trace (+) fm Gravel. Wet.				
5	0	SP GP	Beige/tan mfc SAND, trace (+) f Gravel. Wet/saturated. Iron staining.		2	0.7	
10	-5	SP GP	Beige mfc SAND, trace (-) f Gravel. Wet/saturated. Iron staining.		3	0.7	Sample SB-112-10-12 collected and submitted for laboratory analysis.
15	-10	SP GP	Beige mfc SAND, trace (-) f Gravel. Wet/saturated. Iron staining.		4	0.4	
20	-15	SP GP	Beige mfc SAND, trace (-) f Gravel. Wet/saturated. Iron staining.		5	0.0	
25							

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-113 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type:	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Macrocore® / Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 1255160.0 ft. Northing: 219341.6 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			FILL		1	0.0	*Borehole backfilled with bentonite chips.*
		SP	Brown fmc SAND, trace Gravel, trace Organics.				
		SP GP	Gray fmc SAND, some Gravel (angular).				Sample SB-113-1-3 collected and submitted for laboratory analysis.
		SP GP	Black/brown fmc SAND, trace (+) fm Gravel.				1-2.4' BGS: Black staining, faint tar-like odor
		SP GP	Brown fmc SAND, trace (+) fm Gravel.				
5	0	SP	Orange cmf SAND, trace f Gravel. Iron staining.		2	0.0	3.1-3.3' BGS: Black staining, faint tar-like odor
			OUTWASH DEPOSITS				
		SP GP	Tan/orange cmf SAND, little (+) fm Gravel. Wet.				
10	-5	SP GP	Tan/beige fmc SAND, little (-) fm Gravel. Wet.		3	0.0	
15	-10	SP GP	Lt/ brown/tan mfc SAND, trace (+) fm Gravel. Wet.		4	0.0	
20	-15	SP GP	Lt/ brown/tan mfc SAND, trace (+) fm Gravel. Wet.		5	0.0	Sample SB-113-20-22 collected and submitted for laboratory analysis.
25							

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-114 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type: N/A	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.7 ft.	Easting: 1255172.0 ft. Northing: 219327.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0	5	SP SP GP SP GP	**FILL** Brown fmc SAND, trace Gravel, trace Organics. Gray/Brown fmc SAND, some fmc Gravel. Brown fmc SAND, little (-) fm Gravel. Moist to wet.	--	1	1.6	*Borehole backfilled with bentonite chips.* 0.9-2.2' BGS: Black staining, faint tar-like odor. Sample SB-114-1-3 collected and submitted for laboratory analysis.
5	0	SP GP	**OUTWASH DEPOSITS** Tan/Orange mfc SAND, little (+) fm Gravel. Wet. Iron staining throughout.	--	2	0.6	
10	-5	SP	Beige/Tan fmc SAND, trace (-) f Gravel. Iron staining.	--	3	1.8	
15	-10			--	4	0.4	
20	-15	SP	Beige/Tan fmc SAND. Wet. Iron staining.	--	5	0.0	Sample SB-114-20-22 collected and submitted for laboratory analysis.
25							

Graphic Log: Sample Int, Recovery, Lithology, Backfill

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-115 **Page** 1 **of** 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.6 ft.	Easting: 1255181.0 ft. Northing: 219315.3 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
	5	SP GP SP GP SP GP	**FILL** Brown fmc SAND, little (-) Gravel, trace Organics. Gray fmc SAND, some (+) mf Gravel. Brown/Gray/Black fmc SAND, little (-) Gravel. Moist.	--	1	0.5	*Borehole backfilled with bentonite chips.* 1.3' BGS: Black staining, slight/moderate tar-like odor. 2-2.5' BGS: Soils slightly coated with NAPL.
5	0	SP SP	Dk. Brown/Gray fmc SAND, trace mf Gravel. Wet. Brown/Tan mfc SAND, trace (+) fmc Gravel. Wet. Piece of wood.	--	2	0.2	5-5.7' BGS: Faint tar-like odor. Sample SB-115-10-12 collected and submitted for laboratory analysis.
10	-5	SP GP	**OUTWASH DEPOSITS** Tan/Orange mfc SAND, little fm Gravel. Wet.	--	3	13.5	10.85 and 11.45' BGS: Band of soil coated with tacky NAPL, sheen, faint tar-like odor.
15	-10	SP	Tan mfc SAND, trace Gravel. Dk. Red Iron staining.	--	4	0.4	15-20' BGS sample interval: Sheen observed at bottom of acetate liner.
20	-15	SP	Tan mfc SAND, trace Gravel.	--	5	0.0	20' BGS: Few small specks of NAPL.
25	-20	SP	Beige/Tan fmc SAND, trace (-) f Gravel.	--	6	0.0	Sample SB-115-25-27 collected and submitted for laboratory analysis.
30							

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-116 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type: N/A	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.7 ft.	Easting: 1255185.6 ft. Northing: 219299.3 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0	5	SP GP	**FILL** Brown fmc SAND, little (-) fm Gravel, trace Organics.	--	1	1.0	*Borehole backfilled with bentonite chips.*
5	0	NR	No recovery.	--	2	3.2	5-10' BGS: Minimal sample recovery, sheen and black staining observed on acetate liner.
10	-5	SP GP	**OUTWASH DEPOSITS** Brown/Tan fmc SAND, little (+) fm Gravel. Wet to saturated.	--	3	9.7	Sample SB-116-11-13 collected and submitted for laboratory analysis. 11' BGS: Black staining. 11.6-11.7' BGS: Black staining. 11.9' BGS: Band of soils coated with NAPL, sheen. 12-12.2' BGS: Black staining. 12.2' BGS: Band of soils coated with NAPL, sheen, faint/moderate tar-like odor.
15	-10	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet.	--	4	1.4	
20	-15			--	5	0.0	20.5' BGS: Very few specks of tacky NAPL. Sample SB-116-21-23 collected and submitted for laboratory analysis.
25							

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-117 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.9 ft.	Easting: 1255181.2 ft. Northing: 219263.2 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	PID Readings (ppm)	Remarks
0		SP SM	Topsoil.	--	1	5.2	*Borehole backfilled with bentonite chips.*
			FILL				
		SP GP	Black/Gray/Red cmf SAND, some (-) fmc Gravel (Misc. Fill - brick, cinders). Wet.				1.9-2.9' BGS: Black staining, faint tar-like odor.
		ML CL	Dk. Brown SILT and CLAY, little Organics.				2.6-2.7' BGS: Soils coated with NAPL.
		SP GP	Brown/Black fmc SAND, little (-) Gravel (Misc. Fill).				Sample SB-117-2-3 collected and submitted for laboratory analysis.
5	0		**OUTWASH DEPOSITS**				
		SP GP	Gray cmf SAND, little (+) Gravel (rounded).	--	2	0.4	
		SP	Gray/Dk. Gray mfc SAND, trace Gravel, trace Organics.				
		SP GP	Tan/Gray cmf SAND, some (+) fmc Gravel. Wet.				
10	-5	SP	Tan/Orange mfc SAND, trace (+) fm Gravel. Wet. Iron staining.	--	3	0.3	
15	-10			--	4	0.4	
20	-15	SP	Tan fmc SAND, trace (-) f Gravel. Wet.	--	5	0.0	Sample SB-117-20-22 collected and submitted for laboratory analysis.
25	-20						

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-118 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 1255191.0 ft. Northing: 219349.2 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
		SP GP	**FILL** Brown fmc SAND, little Gravel, trace Silt, trace Organics.	--	1	202	*Borehole backfilled with bentonite chips.*
		SP GP	Gray fm SAND, little (+) mf Gravel (angular).				2.3-3.2' BGS: Black stained and NAPL coated soils, moderate tar odor.
		SP GP	Brown fm SAND, little (-) Gravel (Misc. Fill - brick, cinders).				3.2' BGS: Blue-green stained material, sulfur-like odor.
5	0	SP GP	Green/Blue tinge mf SAND, little Gravel (pieces of pulverized quartz).	--	2	62.7	5-10' BGS: NAPL coated sand grains, moderate/strong tar-like odor.
		SP GP	**ALLUVIAL DEPOSITS** Black fmc SAND, little (-) fmc Gravel. Moist to wet.				
10	-5	SP	Black fm SAND.	--	3	9.9	10-10.4' BGS: Black stained soils, moderate tar-like odor.
		SP	**OUTWASH DEPOSITS** Tan/Brown fm SAND. Wet.				11.3' BGS: Lens of NAPL coated soils. 11.6' BGS: Lens of NAPL coated soils (more viscous than observed at 11.3').
15	-10	SP	Tan fmc SAND. Wet to saturated.	--	4	9.7	15-15.5' BGS: Thin band of black viscous NAPL coated soils, moderate tar-like odor. 15.5-16' BGS: Sheen extending from saturated soil grains. Sample SB-118-15-17 collected and submitted for laboratory analysis.
20	-15			--	5	0.0	
							Sample SB-118-22-24 collected and submitted for laboratory analysis.
25							

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BORING LOG

Brown AND Caldwell

Project Name: Patchogue Former MGP Site
Project Number: 138893
Project Location: Patchogue, NY

Permit Number: N/A

Boring No. SB-119
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Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type: N/A	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Sampling: Macrocore®; Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83	Easting: 219364.5 ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT	Vert Datum: NAVD88	Northing: 1255201.5 ft.
			Ground Surface Elev: 4.9 ft.	TOC Elev: N/A ft.

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0		SP	**FILL**	--	1	89.2	*Borehole backfilled with bentonite chips.*
		GP	Brown/Gray fmc SAND, little (-) fmc Gravel (Misc. Fill - brick, cinders).				1.1-1.3' BGS: NAPL coated soils
		SP	Black f SAND and SILT.				1.3-3' BGS: NAPL coating/NAPL saturated, moderate tar-like odor.
		SP	Black fm SAND, trace f Gravel.				
		GP	Green/White cmf GRAVEL (pulverized rock - quartz), little (-) Sand.				
	0	SP					
5		SP	**ALLUVIAL DEPOSITS** Brown mf SAND, trace Organics.	--	2	19.6	5-5.9' BGS: Black stained/NAPL coated soils.
		SM ML	Dk. Brown SILT and f SAND, little Organics.				6.8' BGS: Sheen extending from saturated soils, sporadic specks/blebs of NAPL.
		SP	Gray/Dk. Gray fmc SAND.				7.4' BGS: Band/lens of NAPL.
		GP SP	**OUTWASH DEPOSITS** Tan/Beige SAND and GRAVEL. Wet @ 7.4'.				
10	-5	SP	Tan/Orange fm SAND, trace fm Gravel. Wet.	--	3	9.0	10.7' BGS: Black staining, sheen and NAPL coating on gravel. 10.8' BGS: Band/lens of tacky NAPL within coarser grained material, moderate tar-like odor. Sample SB-119-11-13 collected and submitted for laboratory analysis.
15	-10	SP	Tan fmc SAND, trace f Gravel. Wet. Iron staining.	--	4	0.0	
20	-15	SP	Tan/Orange fmc SAND, trace (-) f Gravel. Wet. Iron staining.	--	5	0.0	20-25' BGS: Spots of sheen on water within acetate liner, but not within soil core when broken apart. Sample SB-119-22-24 collected and submitted for laboratory analysis.
25	-20						

Graphic Log: Sample Int, Recovery, Lithology, Backfill

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. **SB-120** Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 219356.2 ft. Northing: 1255219.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)
		SP GP	**FILL** Brown/Gray fmc SAND, little Gravel.	--	1	139
		GP SP	Red SAND, little Gravel (Misc. Fill - pulverized brick/fire brick).			
		SP	Brown/Gray fm SAND.			
		SP GP	Lt. Gray fm SAND, little (+) fmc GRAVEL, trace Silt. Compact.			
5	0	SP GP	Gray/Brown fmc SAND, little f Gravel (Misc. Fill - brick). Saturated.	--	2	136
		SP	**ALLUVIAL DEPOSITS** Gray/Black fm SAND, trace Organics.			
		GP SP	**OUTWASH DEPOSITS** Brown/Tan cmf SAND and fmc GRAVEL.			
10	-5	SP	Tan fmc SAND. Saturated.	--	3	31.9
15	-10	SP	Tan/Orange fmc SAND.	--	4	17.9
20	-15			--	5	0.0
25	-20					

Graphic Log: Sample Int / Recovery / Lithology; Backfill

Remarks

Borehole backfilled with bentonite chips.

1.7-3' BGS: Black staining, moderate tar-like odor.
3'-3.1 BGS: NAPL coating, blebs/sheen extending from saturated soil grains.
3.1-3.7' BGS: moderate tar-like odor.
5-6.7' BGS: NAPL coating/saturated, moderate tar-like odor.
6.7-8.3' BGS: Black stained soils, sheen throughout, moderate tar-like odor.
8.3-9.5' BGS: Sheen extending from saturated soils, moderate tar-like odor.
10-10.7' BGS: Bands of black staining/NAPL coated soils, sheen, moderate tar-like odor.
10.7-11.3; BGS: Sheen extending from saturated soils.
11.3-11.4' BGS: Black staining, NAPL (tacky to touch).
12.2-12.3' BGS: Lens of NAPL (tacky to touch).
15.9-16.1' BGS: NAPL saturated (tacky to touch), moderate to strong tar-like odor.
16.1-16.8' BGS: Sheen extending from saturated soils, moderate tar-like odor.
16.5' BGS: Lens of tacky NAPL.
Sample SB-120-15-17 collected and submitted for laboratory analysis.
Sample SB-120-22-24 collected and submitted for laboratory analysis.

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-121 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.1 ft.	Easting: 219340.4 ft. Northing: 1255204.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0		SP GP SP GP SP GP	**FILL** Brown fmc SAND, little (+) Gravel, trace Organics. Brown/Gray/Black cmf SAND, little Gravel (Misc. Fill - brick). Dk. Brown/Black fm SAND, little (-) f Gravel.	--	1	85.2	*Borehole backfilled with bentonite chips.* Sample SB-121-2-4 collected and submitted for laboratory analysis. 2.4-2.9' BGS: NAPL coating soil, moderate tar-like odor. 2.4, 2.7' BGS: Sand with blue tinge, faint sulfur-like odor.
5	0	SP ML CL	**ALLUVIAL DEPOSITS** Brown fmc SAND. Dk. Brown SILT and CLAY.	--	2	10.5	5-5.4' BGS: NAPL coating on soil grains, moderate tar-like odor. 5.8-7' BGS: Slight tar-like odor. 7-7.4' BGS: Sheen extending from saturated soil grains, slight tar-like odor
		GP SP	**OUTWASH DEPOSITS** Brown/Tan fmc SAND and GRAVEL. Moist to wet.				
10	-5	SP GP	Tan/Beige mfc SAND, little (+) fm Gravel. Wet. Iron staining.	--	3	2.4	11.5-11.7' BGS: Globules of viscous NAPL (tacky to touch). 11.7' BGS: Lens of NAPL.
15	-10	SP	Tan/Orange mcf SAND, trace (-) f Gravel. Iron staining. Wet to saturated.	--	4	6.7	Sample SB-121-15-17 collected and submitted for laboratory analysis. 15.2-17' BGS: Lenses of tacky NAPL concentrated around coarser grained material, sheen throughout, moderate tar-like odor.
20	-15	SP	Orange/Tan mf SAND, trace (-) f Gravel. Wet to saturated.	--	5	0.0	Sample SB-121-22-24 collected and submitted for laboratory analysis.
25							

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-122 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	28.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type: N/A	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Sampling: Macrocore® Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 219354.3 ft. Northing: 1255200.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
		SP	**FILL**	--	1	210	*Borehole backfilled with bentonite chips.*
		SP GP	Brown mf SAND, trace Gravel, trace Organics.				
		CL	Gray/Brown fmc SAND, little (+) Gravel (Misc. Fill - brick).				2.2-3.9' BGS: NAPL coating soil grains, moderate/strong tar-like odor.
		SP GP	Red CLAY.				
		SP GP	Brown/White fmc SAND, little (+) Gravel (pulverized rock).				
5	0	SP	Brown mf SAND, trace f Gravel. Moist.	--	2	386	5-5.7' BGS: NAPL saturated, strong tar-like odor.
		GP	Green/White GRAVEL (pulverized quartz).				5.7-6.9' BGS: NAPL coating on soil grains, sheen throughout.
		SP	Brown/Black fmc SAND, trace Gravel.				5.9-6, 6.2-6.4, 6.6-6.7' BGS: NAPL saturated.
		SP	Tan/Beige SAND and GRAVEL.				6.9-7.4': Sheen extending from saturated soil grains.
			ALLUVIAL DEPOSITS Black fm SAND. Wet to saturated.				
10	-5	SP GP	**OUTWASH DEPOSITS** Tan/Beige mfc SAND, little (+) f Gravel. Wet to saturated.	--	3	52.4	10.8-10.9' BGS: Tacky NAPL coating on soils, sheen. 11.2-11-5' BGS: NAPL saturated (tacky). 11.7, 11.8' BGS: Lenses of tacky NAPL. 11.8' to 12.3': Sheen extending from saturated soil grains.
15	-10	SP	Tan/Orange mfc SAND. Wet to saturated.	--	4	7.0	15.9' BGS: Black stained soils. 16.05-16.1' BGS: Lenses of tacky NAPL, moderate tar-like odor.
20	-15	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet to saturated.	--	5	10.1	Sample SB-122-20-22 collected and submitted for laboratory analysis. 20.65-20.75' BGS: Lenses/bands of NAPL coated soils, moderate tar-like odor.
25	-20	SP	Tan/Beige mcf SAND. Wet.	--	6	0.0	Sample SB-122-25-27 collected and submitted for laboratory analysis.

Graphic Log: Sample Int | Recovery | Lithology | Backfill

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. **SB-123** Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.1 ft.	Easting: 219315.0 ft. Northing: 1255222.3 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			FILL				*Borehole backfilled with bentonite chips.*
		SP GP	Brown cmf SAND, little (-) Gravel, trace Organics.	--	1	236	1.1-1.9' BGS: Black stained soils, moderate tar-like odor.
		SP GP	Gray fmc SAND, little (+) Gravel.				1.9-3.2' BGS: NAPL coating on soil grains.
		SP GP	Brown/Black fmc SAND, little (-) Gravel (Misc. Fill - brick), trace Organics.				1.9-2.2' BGS: NAPL saturated, moderate tar-like odor.
		SP	Gray/Brown fm SAND, trace (-) Gravel.				
5	0	SP	Gray/Brown fm SAND, trace (-) Gravel., trace Organics.	--	2	36.7	5-6.1' BGS: NAPL coating on soil grains, moderate tar-like odor.
			OUTWASH DEPOSITS				
		GP SP	Tan cmf SAND and fmc GRAVEL. Wet.				6.1- 8.1' BGS: Sporadic blebs of NAPL and sheen concentrated around gravel.
10	-5	SP	Tan/Orange fmc SAND, trace (+) fmc Gravel. Wet.	--	3	4.7	Sample SB-123-15-17 collected and submitted for laboratory analysis. 11.2' BGS: Few NAPL blebs on coarse grained material. 11.9-12, 12.6' BGS: Bands of black staining, slight NAPL coating, sheen, moderate tar-like odor.
15	-10	SP	Orange/Tan fm SAND, trace Gravel.	--	4	24.9	15-15.6' BGS: Sheen, sporadic black staining. 15.6-16' BGS: NAPL coating, sheen, moderate tar-like odor. 16-16.5' BGS: NAPL saturated. 16.5-16.9' BGS: Sheen. 16.9-17.2' BGS: NAPL saturated.
20	-15	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet.	--	5	0.0	Sample SB-123-20-22 collected and submitted for laboratory analysis.
25	-20			--	6	0.0	
30							

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-124 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type: N/A	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Sampling: Macrocore® Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.7 ft.	Easting: 219314.8 ft. Northing: 1255246.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0	4.7		**FILL**	--	1	11.9	0.7-1.7' BGS: Slight tar-like odor. *Borehole backfilled with bentonite chips.*
		SP GP	Gray/Brown cmf SAND, some Gravel.				2.1-2.2' BGS, 3.3'-3.9' BGS: Black staining, moderate to strong tar-like odor.
		SP GP	Black cmf SAND, little (+) fm Gravel (Misc. Fill - cinders). Moist.				Sample SB-124-2-4 collected and submitted for laboratory analysis.
		SP GP	Brown/Tan mfc SAND, trace f Gravel. Moist to wet.				
5	0		**OUTWASH DEPOSITS**	--	2	4.2	6-7' BGS: Sporadic black staining. Moderate/faint tar-like odor.
		SP GP	Lt. Gray fm SAND, little fm Gravel.				
		GP SP	Lt. Gray/Tan cmf SAND and GRAVEL.				
		SP GP	Lt. Tan/Beige cm SAND, little (-) fm Gravel. Wet.				
10	-5	SP GP	Orange/Tan mcf SAND, little (-) f Gravel. Wet to saturated.	--	3	0.2	12.9' BGS: Few NAPL blebs and sheen on soil grains. Moderate tar-like odor.
15	-10	SP	Orange/Tan fmc SAND. Wet to saturated.	--	4	0.0	
20	-15			--	5	0.0	Sample SB-124-22-24 collected and submitted for laboratory analysis.
25	-20						

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BORING LOG

Brown and Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-125 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/30/10 - 9/30/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 219279.0 ft. Northing: 1255206.5 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0	5	SP GP	**FILL** Brown fmc SAND, little (-) Gravel, trace Organics.	--	1	1.3	*Borehole backfilled with bentonite chips.*
		SP GP	Gray fmc SAND, some (+) Gravel.				0-5' BGS: Faint tar-like odor.
		SP GP	Dk. Brown/Black cmf SAND, little (+) Gravel (Misc. Fill - brick, cinders).				
5	0	SP	Brown mfc SAND, trace (+) mf Gravel. Wet.	--	2	0.1	5-6' BGS: Sheen on soil grains and on water, faint tar-like odor.
10	-5	SP	**OUTWASH DEPOSITS** Tan/Orange mfc SAND, trace (+) fm Gravel. Wet. Iron staining.	--	3	0.3	12-12.4' BGS: Faint tar-like odor.
15	-10	SP	Tan/Orange mfc SAND, trace (-) f Gravel. Wet.	--	4	0.3	15.4-15.8' BGS: Very few spots of NAPL coated soils (tacky), faint tar-like odor.
20	-15	SP	Tan/Brown fmc SAND, trace (-) f Gravel.	--	5	9.5	20.7-20.8' BGS: Band of soils coated with tacky NAPL. 20.8-21.2' BGS: Sheen extending from saturated soils, but not within soil core when broken apart. Sample SB-125-20-22 collected and submitted for laboratory analysis.
25	-20	SP	Tan/Orange mfc SAND, trace (+) f Gravel. Wet. Fe staining.	--	6	0.0	Sample SB-125-25-27 collected and submitted for laboratory analysis.
30	-25						

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. **SB-126** Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.5 ft.	Easting: 219284.2 ft. Northing: 1255240.4 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0		SP GP	**FILL** Gray/Brown cmf SAND, some Gravel, trace Organics.	--	1	152	*Borehole backfilled with bentonite chips.* 1.9-2.4' BGS: Sheen, moderate tar-like odor. 1.9-2.4' BGS: Sheen on grains, moderate tar-like odor. 2.9-3' BGS: NAPL coating sand and gravel, tacky to touch, moderate to strong tar-like odor.
		SP GP	Dk. Brown/Black fmc SAND, little (+) fmc Gravel (Misc. Fill - brick, cinders, wood). Moist.				
	0						
5		SP GP	Brown mfc SAND, little (+) f Gravel.	--	2	324	5-6.8' BGS: NAPL coated/saturated, moderate tar-like odor. 8.1' BGS: NAPL saturated. 8.1-8.3' BGS: Black stained soils.
		GP SP	**OUTWASH DEPOSITS** Tan/Brown SAND and GRAVEL. Moist to wet.				
	-5						
10		SP GP	Tan/Brown cmf SAND, little (+) fmc Gravel. Wet.	--	3	18.5	8.3' BGS: Sporadic sheen and black staining throughout, moderate tar-like odor. 11.7, 11.9-12.1, 12.2-12.4' BGS: Spots of sheen and black staining, moderate tar-like odor.
	-10						
15		SP	Orange/Tan fmc SAND. Wet.	--	4	0.0	15-20' BGS: Spots of sheen on sides of core, but not inside core when broken apart. Sample SB-126-5-7 collected and submitted for laboratory analysis.
	-15						
20		SP	Tan/Beige fmc SAND, trace f Gravel. Wet to saturated.	--	5	0.0	Sample SB-126-22-24 collected and submitted for laboratory analysis.
	-20						
25							

Graphic Log: Sample Int | Recovery | Lithology | Backfill

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-127 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/27/10 - 9/27/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.8 ft.	Easting: 219268.1 ft. Northing: 1255247.6 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
		SP GP	**FILL** Lt. Brown/Gray fmc SAND, little (+) cmf Gravel, trace Organics.	--	1	28.3	*Borehole backfilled with bentonite chips.*
		SP GP	Brown/Dk. Brown fmc SAND, little Gravel (Misc. Fill - brick, cinders, glass).				1.8-3.1' BGS: Faint to moderate tar-like odor. 2.8-3.1' BGS: Sheen (especially surrounding coarser grained material).
5	0	SP	Dk. Brown/Gray cmf SAND, trace (+) Gravel (Misc. Fill - cinders, brick).	--	2	76.1	5-5.7' BGS: Sheen, moderate tar-like odor. 5.7'-6 BGS: NAPL saturated, moderate tar-like odor.
		SP SP SM	**ALLUVIAL DEPOSITS** Beige fmc SAND. Wet. Brown fm SAND, little Silt.				6-6.6' BGS: Sporadic sheen, black stained soils. 6.8' BGS: Sheen on outside of soil core, but not inside core when broken apart.
		GP SP	**OUTWASH DEPOSITS** Beige/Tan SAND and GRAVEL.				
10	-5	SP	Tan fm SAND. Wet to saturated.	--	3	2.3	10-15' BGS: Sporadic spots of sheen extending from saturated soils Sample SB-127-5-7 collected and submitted for laboratory analysis.
15	-10	SP	Tan/Orange fmc SAND. Saturated.	--	4	0.0	15-20' BGS: Spots of sheen on outside of soil core, but not inside core when broken apart.
20	-15			--	5	0.0	Sample SB-127-22-24 collected and submitted for laboratory analysis.
25	-20						

Graphic Log: Sample Int, Recovery, Lithology, Backfill

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BORING LOG

Brown and Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-128 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type:	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Sampling: Macrocore® Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.0 ft.	Easting: 219245.1 ft. Northing: 1255247.0 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			FILL				
0	5	SP GP	Gray/Brown fmc SAND, little (+) Gravel, trace Organics.	--	1	6.9	*Borehole backfilled with bentonite chips.*
		SP GP	Black/Gray fmc SAND, little (+) Gravel (Misc. Fill - brick, cinders). Moist to wet.				2-3' BGS: Minor black staining, faint tar-like odor.
		SP GP	Tan/Brown fm SAND, trace (+) fm Gravel. Wet.				
5	0		Black/Gray fmc GRAVEL (pulverized rock), little (-) Sand. Wet.	--	2	60.3	5-6' BGS: Black stained soils, slight tar-like odor.
		SP GP	Gray/Black cmf SAND, little (-) Gravel.				
			ALLUVIAL DEPOSITS				
		ML CL	Dk. Brown SILT and CLAY, little Organics.				6.9' BGS: Soils heavily coated with NAPL.
		SP GP	Lt. Gray fmc SAND, little (+) Gravel (rounded). Spots of tidal marsh @ 7.0 and 7.1'.				7.9' BGS: Sheen extending from saturated soils, faint tar-like odor.
			OUTWASH DEPOSITS				
10	-5	GP SP	Gray SAND and GRAVEL. Wet.	--	3	17.5	10-10.4' BGS: Sheen.
		SP	Tan/Lt. Brown mfc SAND, trace (-) f Gravel.				11.1-11.2' BGS: Minor black staining, faint tar-like odor.
15	-10	SP	Tan/Lt. Brown mfc SAND, trace (-) fm Gravel. Wet to saturated.	--	4	19	15-15.4' BGS: Black stained soils, moderate tar-like odor. 15.8-16' BGS: Black stained soils. 15.9-16' BGS: Bands of soil heavily coated with NAPL. 16-17.5' BGS: Sheen extending from saturated soils.
20	-15	SP	Tan/Orange mfc SAND, trace (+) fm Gravel. Wet.	--	5	10.9	20.2' BGS: Bands of soils coated with tacky NAPL, sheen, faint tar-like odor. Sample SB-128-20-22 collected and submitted for laboratory analysis. Sample SB-128-25-27 collected and submitted for laboratory analysis.
25	-20	SP	Tan/Orange mfc SAND. Wet. Iron staining.	--	6	0.0	
30	-25						

Graphic Log: Sample Int / Recovery / Lithology / Backfill

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. **SB-129** Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.2 ft.	Easting: 219243.2 ft. Northing: 1255226.9 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0			**FILL**	--	1	282	*Borehole backfilled with bentonite chips.*
		SP GP	Brown fm SAND, little Gravel, trace Organics.				
		SP GP	Gray fm SAND, little Gravel.				
		SP GP	Gray/Black fmc SAND, little (+) Gravel (Misc. Fill - brick, cinders).				
		SP GP	Gray/Tan mfc SAND, little Gravel.				3.6' BGS: Sheen, slight tar-like odor.
5	0	SP GP	Black cmf SAND, little (+) mf Gravel (Misc. Fill - cinders). Wet.	--	2	40.2	5-5.3' BGS: Sheen, slight tar-like odor.
		SP GP	**ALLUVIAL DEPOSITS**				6' BGS: NAPL coated soils.
		SP SM	Brown f SAND and SILT, trace Organics.				6.2-6.4' BGS: NAPL saturated soils.
		SP	Brown fm SAND, trace f Gravel. Wet.				6.4-7.5' BGS: Sheen and NAPL blebs throughout.
			OUTWASH DEPOSITS				6.8' BGS: Soils heavily coated with NAPL.
		GP SP	Tan/Beige cmf SAND and GRAVEL.				
10	-5	SP GP	Tan/Orange mfc SAND, little (-) fm Gravel. Wet to saturated.	--	3	45.6	
15	-10	SP GP	Tan fmc SAND, little (+) fm Gravel. Wet.	--	4	132	15.7-16' BGS: Bands and spots of NAPL coated soils (tacky), moderate tar-like odor. 16-17.3' BGS: Sheen extending from saturated soils.
20	-15	SP	Tan/range fmc SAND. Wet. Iron staining.	--	5	65.8	22.05' BGS: Thin band of stringy NAPL with sheen surrounding it, faint tar-like odor. Sample SB-129-22-24 collected and submitted for laboratory analysis.
25	-20			--	6	0.0	Sample SB-129-26-28 collected and submitted for laboratory analysis.
30							

Graphic Log: Sample Int / Recovery / Lithology / Backfill

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-130 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type:	Development Method:
9/29/10 - 9/29/10	Zebra Env. Corp.	Sampling: Macrocore® Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.4 ft.	Easting: 219256.9 ft. Northing: 1255207.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0		SP GP	**FILL** Brown fmc SAND, little Gravel, trace Organics.	--	1	3	*Borehole backfilled with bentonite chips.*
		SP GP	Gray cmf SAND, some fmc Gravel. Moist.				
		SP GP SP	Black/Red/Gray fmc SAND, little (+) Gravel (Misc. Fill - brick, cinders, pulverized rock). Moist.				2.3-2.6' BGS: Minor black staining, faint tar-like odor.
			Gray/Brown mf SAND, trace f Gravel.				
5	0	GP	Black/Gray fm GRAVEL, little (-) Sand.	--	2	73.1	5-5.6' BGS: Minor black staining, faint tar-like odor. 5.6-6' BGS: Soils heavily coated with NAPL. 6.2-7.9' BGS: Sheen and spots of black staining, slight to moderate tar-like odor.
		SP ML CL	**ALLUVIAL DEPOSITS** Dk. Brown SILT and CLAY, little Organics.				
		SP	**OUTWASH DEPOSITS** Tan/Gray mfc SAND, trace fm Gravel.				
		SP GP	Tan/Lt. Brown cmf SAND, some (+) fmc Gravel. Wet.				
10	-5	SP	Tan/Orange mfc SAND, trace (+) fm Gravel. Wet.	--	3	6.7	10-15' BGS: Faint tar-like odor.
15	-10	SP	Tan/Orange fmc SAND, trace (-) f Gravel.	--	4	6.7	15.9' BGS: Lens/band of black stained soil, slightly coated with NAPL. Sample SB-130-16-18 collected and submitted for laboratory analysis. 17.2' BGS: Thin band of tacky NAPL. 17.2-17.8' BGS: Sheen extending from saturated soils.
20	-15	SP	Tan/Orange mfc SAND. Wet.	--	5	0.0	Sample SB-130-20-22 collected and submitted for laboratory analysis.
25							

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** SB-131 **Page** 1 **of** 1

Geologist/Office	**Checked By:**	**Borehole Diameter:**	**Screen Diameter and Type:**	**Slot Size:**	**Total Boring Depth (ft)**
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	**Drilling Contractor:**	**Sampling:** Macrocore®	**Development Method:**
9/29/10 - 9/29/10	Zebra Env. Corp.	**Hammer Type:** N/A	N/A

Driller:	**Drilling Method:**	**Drilling Equipment:**	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD88 **Ground Surface Elev:** 4.9 ft.	**Easting:** 219265.3 ft. **Northing:** 1255226.0 ft. **TOC Elev:** N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0		SP GP	**FILL** Brown/Gray fmc SAND, little (+) fm Gravel, trace Organics.	--	1	59.7	*Borehole backfilled with bentonite chips.* 1.2-2' BGS: Slight NAPL coating on soil grains, slight tar-like odor.
		SP GP	Gray/Dk. Gray cmf SAND, little (+) cmf Gravel (Misc. Fill - brick, cinders). Moist to wet.				2-5.4' BGS: Heavy NAPL coating on soils, moderate tar-like odor.
	0	SP GP	Gray/Brown fm SAND, little (-) f Gravel.				
5		ML CL	**ALLUVIAL DEPOSITS** Brown SILT & CLAY, little (+) Organics.	--	2	3.8	5.6-6.4' BGS: Sheen. 5.6-8.1' BGS: Slight sheen, faint tar-like odor.
		SP	Tan/Beige mfc SAND. Wet.				
		ML CL	Brown SILT & CLAY, little (+) Organics.				
		SP GP	**OUTWASH DEPOSITS** Tan/Beige cmf SAND, some (+) fmc Gravel. Wet to saturated.				
10	-5	SP GP	Tan/Orange cmf SAND, some (+) fmc Gravel.	--	3	60.4	10.95' BGS: Band of tacky NAPL. 11.3, 11.6, 11.65 and 11.8' BGS: Spots of NAPL coated soils and sheen.
		SP GP	Tan/Orange mfc SAND, little (+) fmc Gravel. Wet.				
15	-10	SP	Tan/Orange mfc SAND, trace f Gravel. Wet to saturated.	--	4	14.7	15.6-15.75' BGS: Band of NAPL coated soils, slight tar-like odor. 5.75-16.3' BGS: Sheen. 16.3-16.4' BGS: Band of NAPL saturated soils. 16.4-17.3' BGS: Sheen.
20	-15	SP	Tan/Beige mfc SAND. Wet to saturated.	--	5	11.9	20.95-21' BGS: Bands of soils heavily coated with NAPL. Sample SB-131-21-23 collected and submitted for laboratory analysis. 21.55-21.7' BGS: NAPL saturated soils. 21.85' BGS: Band of soil heavily coated with NAPL. 22' BGS: Spots of NAPL coated soils. 22.2-22.3' BGS: Spots of NAPL coated soils, sheen.
25	-20	SP	Tan/Orange mfc SAND. Wet.	--	6	0.0	Sample SB-131-25-27 collected and submitted for laboratory analysis.
30	-25						

Graphic Log: Sample Int, Recovery, Lithology, Backfill

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BORING LOG

Brown AND Caldwell	**Project Name:** Patchogue Former MGP Site **Project Number:** 138893 **Project Location:** Patchogue, NY	**Permit Number:** N/A	**Boring No.** **SB-132** **Page** 1 **of** 1

Geologist/Office	**Checked By:**	**Borehole Diameter:**	**Screen Diameter and Type:**	**Slot Size:**	**Total Boring Depth (ft)**
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	30.0 ft.

Start/Finish Date	**Drilling Contractor:**	**Sampling:** Macrocore®	**Development Method:**
9/29/10 - 9/29/10	Zebra Env. Corp.	**Hammer Type:** N/A	N/A

Driller:	**Drilling Method:**	**Drilling Equipment:**	**Horiz Datum/Proj:** NYS Plane NAD83 **Vert Datum:** NAVD88 **Ground Surface Elev:** 5.0 ft.	**Easting:** 219258.0 ft. **Northing:** 1255223.9 ft. **TOC Elev:** N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
0	5	SP GP SP GP SP GP	**FILL** Brown fmc SAND, little (+) Gravel, trace Organics. Gray/Black cmf SAND, little (+) Gravel (Misc. Fill - brick, cinders). Moist. Brown mf SAND. Black fmc GRAVEL, little Sand.	--	1	11.9	*Borehole backfilled with bentonite chips.* 1.9-2.4' BGS: Sporadic black staining, faint tar-like odor. 2.4-2.6' BGS: Soils slightly coated with NAPL.
5	0	GP SP ML CL SP GP	Black fmc GRAVEL, little Sand, trace Organics. Tan/Beige mfc SAND, trace f Gravel. **ALLUVIAL DEPOSITS** Brown SILT & CLAY, little Organics. **OUTWASH DEPOSITS** Tan/Orange cmf SAND, little (+) fmc Gravel. Wet.	--	2	104	5-5.4' BGS: NAPL saturated soils. 5.4-6.1' BGS: Sheen throughout, few bands of soils coated with NAPL. 6.3-7.9' BGS: Sheen, few spots of black staining.
10	-5	SP GP	Tan/Orange mfc SAND, little (+) fmc Gravel. Wet.	--	3	1.3	
15	-10	SP	Tan fmc SAND, trace (+) f Gravel. Wet.	--	4	13.1	15.7' BGS: Band of soils coated with NAPL, sheen, moderate tar-like odor. 15.7-17.5' BGS: Sheen. 17.5' BGS: Slight tar-like odor.
20	-15	SP SP	Tan/Orange fmc SAND, trace (+) fmc Gravel. Orange/Tan cmf SAND, trace fmc Gravel. Wet.	--	5	17.5	21.6-21.7' BGS: NAPL saturated soils (slightly tacky). 21.7-22.4' BGS: Sheen extending from saturated soils, several NAPL blebs extending from soils. Sample SB-132-21-23 collected and submitted for laboratory analysis.
25	-20	SP	Tan/Orange mf SAND. Wet.	--	6	0.0	Sample SB-132-25-27 collected and submitted for laboratory analysis.
30	-25						

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-133 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	25.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
9/28/10 - 9/28/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 4.3 ft.	Easting: 219380.1 ft. Northing: 1255207.8 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
			FILL				
0		SP		--	1	2.8	*Borehole backfilled with bentonite chips.*
		GP	Brown cmf SAND, little Gravel (Misc. Fill - brick, cinders), trace Organics.				0.9-2.8' BGS: Faint tar-like odor.
		GP SP	Gray fm GRAVEL, little c Sand.				
		SP	Brown/Tan cmf SAND, trace Gravel, trace Silt, trace Organics.				
	0						
5				--	2	0.7	
		SP GP	Brown/Lt. Brown mfc SAND, little (-) fm Gravel. Wet.				
			OUTWASH DEPOSITS				6.1-6.65' BGS: Spots of sheen on grains, faint tar-like odor.
		SP GP	Brown/Lt. Brown mfc SAND, some (-) fm Gravel. Wet.				
		SP GP	Brown/Lt. Brown mfc SAND, little (-) fm Gravel. Wet.				
	-5						
10		SP	Beige/Tan mfc SAND, trace (-) fmc Gravel. Wet.	--	3	0.0	
	-10						
15		SP	Tan/Orange fmc SAND, trace f Gravel. Wet.	--	4	0.9	15' BGS: Small spots of sheen. 16-3.16.8' BGS: Slight sheen on saturated soils. Sample SB-133-15-17 collected and submitted for laboratory analysis.
	-15						
20		SP	Tan/Beige mfc SAND, trace f Gravel. Wet.	--	5	0.0	
							Sample SB-133-22-24 collected and submitted for laboratory analysis.
	-20						
25							

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-134 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	10.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore® / Hammer Type: N/A	Development Method:
10/6/10 - 10/6/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.1 ft.	Easting: 219342.7 ft. Northing: 1255114.4 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
		SP	**FILL** Dk. Brown fmc SAND, little (+) Gravel, trace Organics. Wet.		1	0.0	*Borehole backfilled with bentonite chips.*
		SP	Brown mfc SAND, little (-) fm Gravel. Moist to wet.				
		SP	Beige mfc SAND, little (-) fm Gravel. Moist to wet. Iron staining.				
5	0	SP	Beige mfc SAND, trace fm Gravel. Wet to saturated.		2	0.0	Sample SB-134-5-7 collected and submitted for laboratory analysis.
10							

BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-135 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	10.0 ft.

Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/6/10 - 10/6/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.4 ft.	Easting: 219363.5 ft. Northing: 1255105.7 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
	5	SP	**FILL** Dk. Brown fm SAND, little Organics.		1	0.0	*Borehole backfilled with bentonite chips.*
		SP GP	Brown/tan mfc SAND, trace (+) fm Gravel.				
		SP GP	Beige mfc SAND, little (+) fm Gravel. Wet.				
5	0	SP GP	Beige/tan mfc SAND, little (-) fm Gravel. Wet.		2	0.0	Sample SB-135-5-7 collected and submitted for laboratory analysis.
10							

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BORING LOG

Brown AND Caldwell	Project Name: Patchogue Former MGP Site Project Number: 138893 Project Location: Patchogue, NY	Permit Number: N/A	Boring No. SB-136 Page 1 of 1

Geologist/Office	Checked By:	Borehole Diameter:	Screen Diameter and Type:	Slot Size:	Total Boring Depth (ft)
C. Mino/Allendale, NJ	JLM	3"	NA	N/A"	10.0 ft.

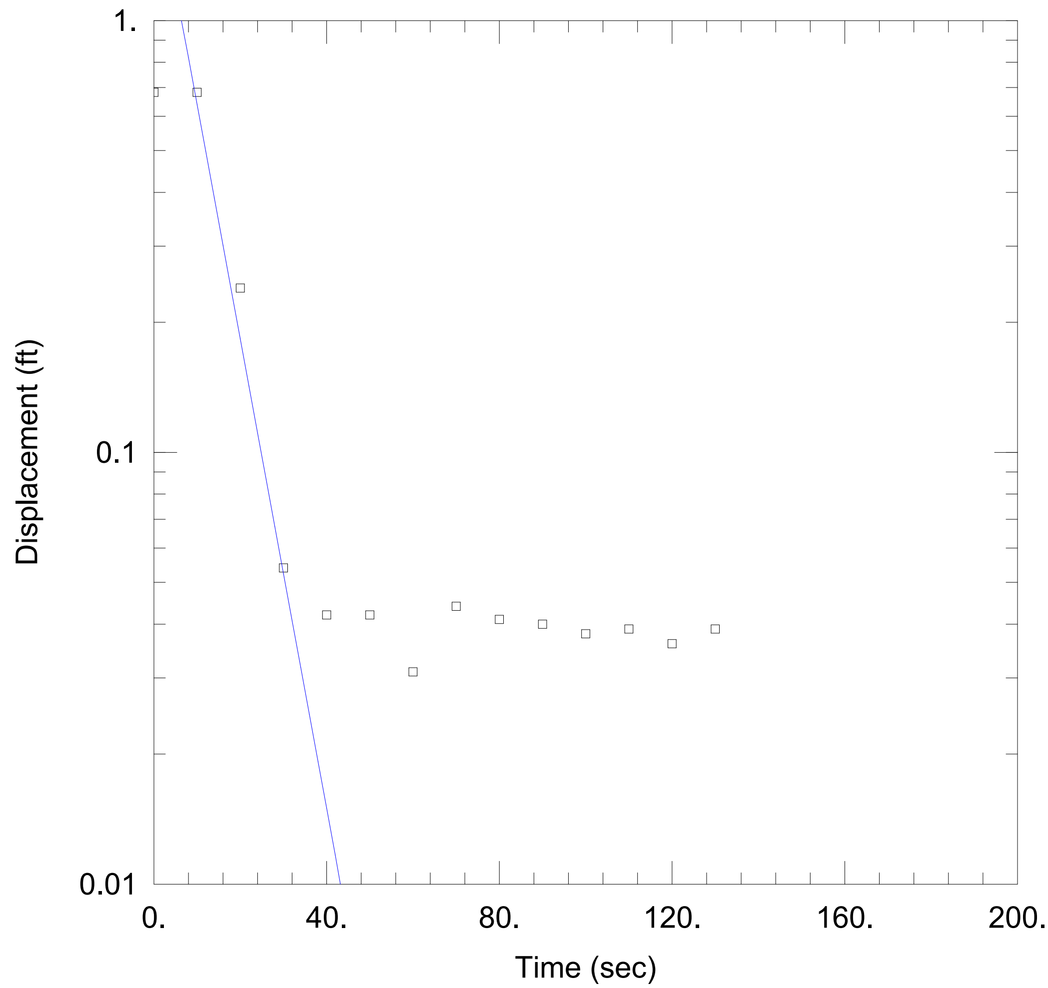
Start/Finish Date	Drilling Contractor:	Sampling: Macrocore®	Development Method:
10/6/10 - 10/6/10	Zebra Env. Corp.	Hammer Type: N/A	N/A

Driller:	Drilling Method:	Drilling Equipment:	Horiz Datum/Proj: NYS Plane NAD83 Vert Datum: NAVD88 Ground Surface Elev: 5.6 ft.	Easting: 219374.5 ft. Northing: 1255120.6 ft. TOC Elev: N/A ft.
Luke Caballero	Direct-push	Geoprobe® 6620DT		

Depth (feet)	Elevation (feet)	USC Soil Type	Description	Blow Counts	Sample No.	ppm Readings (ppm)	Remarks
	5	SP	**FILL** Dk. Brown fm SAND, trace Gravel, tace Organics.		1	0.0	*Borehole backfilled with bentonite chips.*
		SP	Brown fmc SAND, trace fm Gravel, trae (-) Organics. Wet.				
		SP	Beige fmc SAND, trace fm Gravel, trae (-) Organics. Wet.				
5	0	SP GP	Tan/beige mfc SAND, little (-) fm Gravel. Wet.		2	0.0	Sample SB-136-5-7 collected and submitted for laboratory analysis.
10							

Graphic Log: Sample Int, Recovery, Lithology, Backfill

Appendix B: Pre-Design Investigation – Slug Test Data



MW-3

Data Set: P:\National_Grid\Patchogue\Adtl_Inv\Slug_Tests\AQT\MW_3.aqt
Date: 06/16/10 Time: 14:49:58

PROJECT INFORMATION

Company: Brown and Caldwell
Client: National Grid
Project: 138893
Location: Patchogue, NY
Test Well: MW-3
Test Date: 5/20/2010

AQUIFER DATA

Saturated Thickness: 22.46 ft Anisotropy Ratio (Kz/Kr): 1.

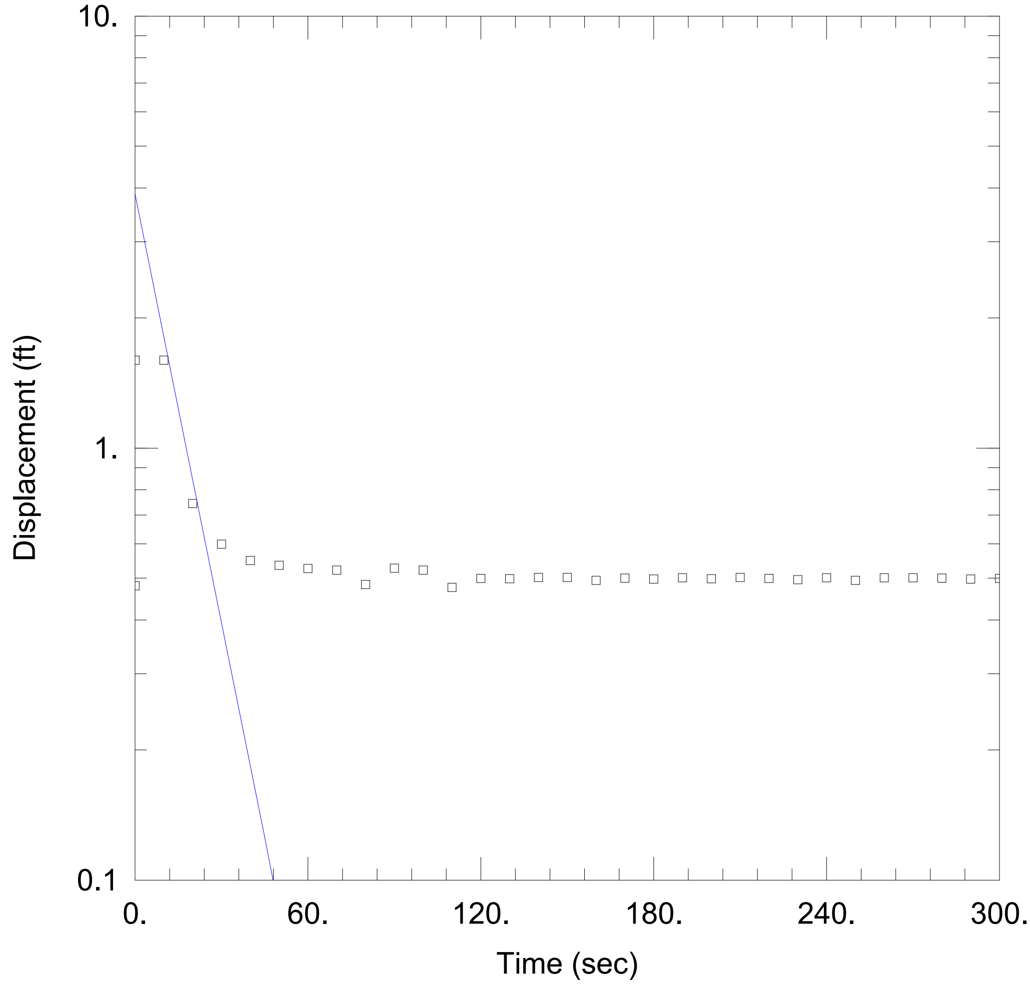
WELL DATA (MW-3)

Initial Displacement: 0.682 ft
Total Well Penetration Depth: 2.46 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 2.46 ft
Screen Length: 2.46 ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.01074 cm/sec y0 = 2.234 ft



WELL TEST ANALYSIS

Data Set: P:\National_Grid\Patchogue\Adtl_Inv\Slug_Tests\AQT\MW_5.aqt
Date: 06/16/10 Time: 14:51:36

PROJECT INFORMATION

Company: Brown and Caldwell
Client: National Grid
Project: 138893
Location: Patchogue, NY
Test Well: MW-5
Test Date: 5/20/2010

AQUIFER DATA

Saturated Thickness: 25.15 ft
Anisotropy Ratio (Kz/Kr): 1.

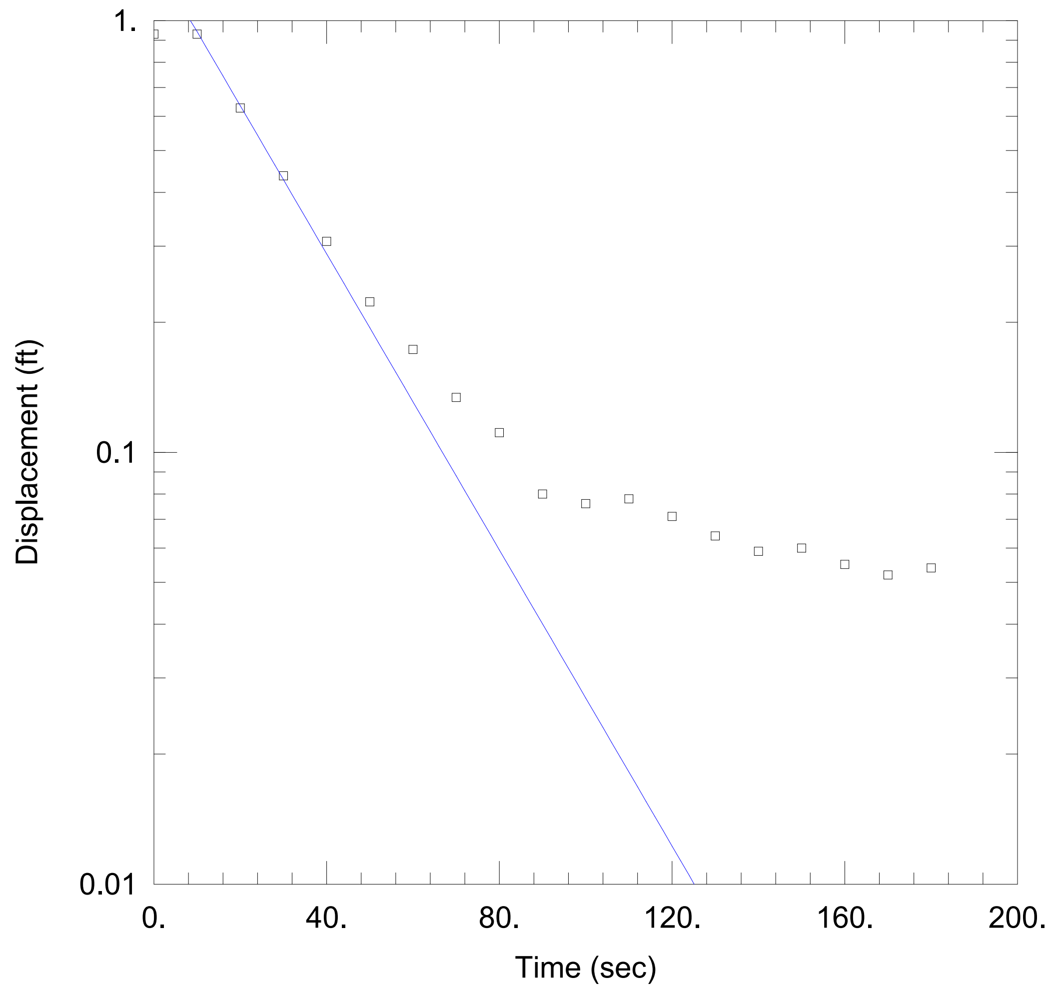
WELL DATA (MW-5)

Initial Displacement: 1.597 ft
Static Water Column Height: 10.15 ft
Total Well Penetration Depth: 10.15 ft
Screen Length: 10. ft
Casing Radius: 0.0833 ft
Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 0.002725 cm/sec
y0 = 3.869 ft



MW-7S

Data Set: P:\National_Grid\Patchogue\Adtl_Inv\Slug_Tests\AQT\MW_7S.aqt
Date: 06/16/10 Time: 14:52:41

PROJECT INFORMATION

Company: Brown and Caldwell
Client: National Grid
Project: 138893
Location: Patchogue, NY
Test Well: MW-7S
Test Date: 5/20/2010

AQUIFER DATA

Saturated Thickness: 25.21 ft Anisotropy Ratio (Kz/Kr): 1.

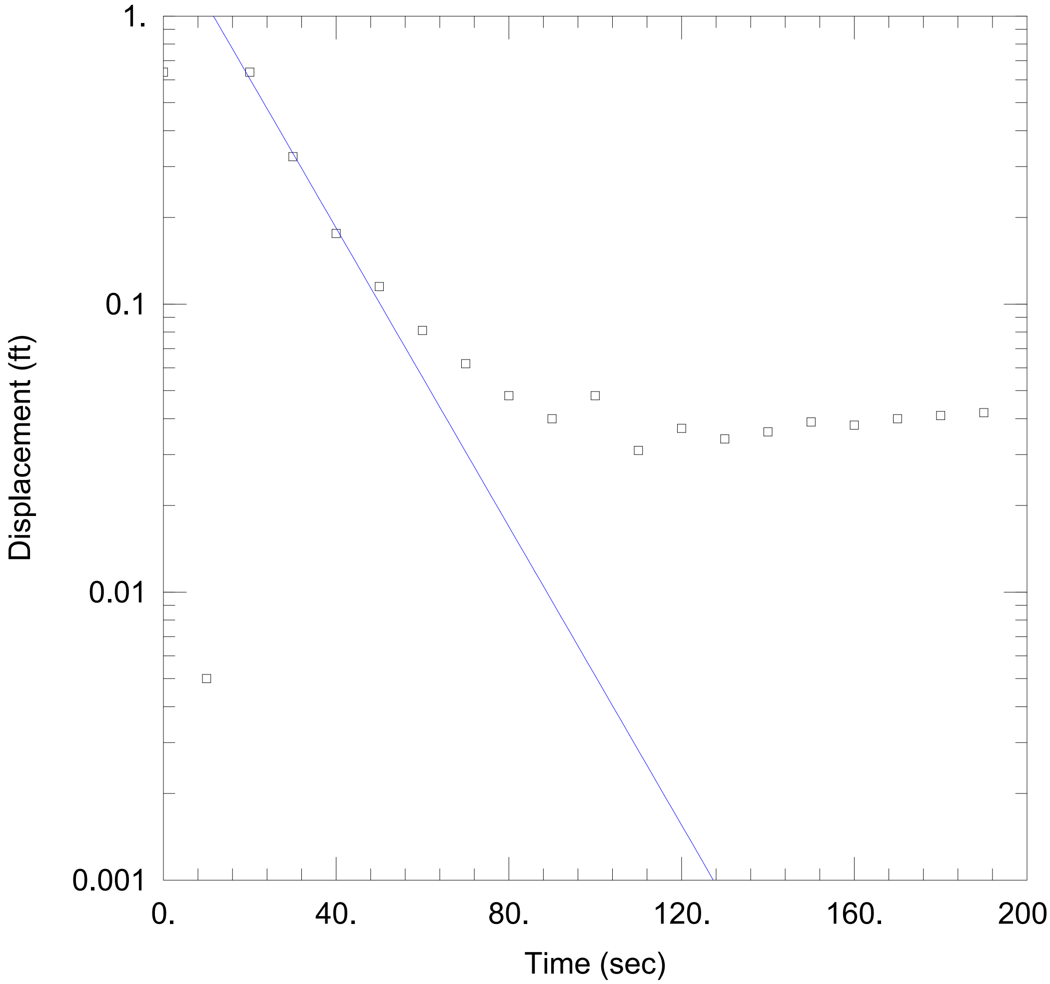
WELL DATA (New Well)

Initial Displacement: 0.93 ft Static Water Column Height: 4.21 ft
Total Well Penetration Depth: 4.21 ft Screen Length: 4.21 ft
Casing Radius: 0.083 ft Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.002484 cm/sec y0 = 1.398 ft



MW-9S

Data Set: P:\National_Grid\Patchogue\Adtl_Inv\Slug_Tests\AQT\MW_9S.aqt
Date: 06/16/10 Time: 14:53:34

PROJECT INFORMATION

Company: Brown and Caldwell
Client: National Grid
Project: 138893
Location: Patchogue, NY
Test Well: MW-9S
Test Date: 5/20/2010

AQUIFER DATA

Saturated Thickness: 22.51 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-9S)

Initial Displacement: 0.638 ft Static Water Column Height: 1.51 ft
Total Well Penetration Depth: 1.51 ft Screen Length: 1.51 ft
Casing Radius: 0.083 ft Well Radius: 0.34 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 0.006381 cm/sec y0 = 1.997 ft

Appendix C: Remedial Alternative Cost Estimates

SUMMARY OF REMEDIAL ALTERNATIVE COST ESTIMATES
FOCUSED FEASIBILITY STUDY
Patchogue Former MGP Site
Village of Patchogue, New York

	Remedial Alternative	Capital Cost	Annual O&M Cost	NPW of O&M[3]	Total NPV
1	No Action	$0	$0	$0	$0
2	Engineering and Institutional Controls, Excavation of Off-Site MGP Tar- and Petroleum - Impacted Source Materials	$1,270,000	$91,000	$1,784,000	$3,050,000
3	Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)	$11,660,000	$60,000	$60,000	$11,720,000
4	Excavation of MGP Tar-Impacted Source Materials	$4,390,000	$91,000	$778,000	$5,170,000
5	In-Situ Solidification of MGP Tar-Impacted Source Material	$5,150,000	$91,000	$778,000	$5,930,000

General Cost Estimate Notes

1) Cost estimates are based on Brown and Caldwell experience, vendor/contractor cost information, and Means Cost Estimating Guides. Costs are in 2010 dollars.

2) Cost estimates are considered Class 4 Cost Estimates with an expected accuracy of -30% to +50%, which is consistent with USEPA's RI/FS Guidance (USEPA, 1988).

3) Present worth based on a 2-yr or 30-year operating period and a 3% discount factor. Per the EPA Guidance, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", July 2000 (EPA 540-R-00-002), for Federal facility sites being cleaned up using Superfund authority, it is generally appropriate to apply the real discount rates found in Appendix C of OMB Circular A-94. Per the Office of Management and Budget website (http://www.whitehouse.gov/omb/circulars/a094/a094.html#8), the real discount rate as of January 2009 is 2.7% (approximately 3%).

ALTERNATIVE 2 - COST ESTIMATE
Engineering and Institutional Controls, Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Material
Patchogue Former MGP Site
Village of Patchogue, New York

CAPITAL COSTS

ITEM [a]	UNIT [c]	QUANTITY [a]	UNIT COST [d]	INSTALLED COST [e]	NOTES [b]
Mobilization and Demobilization	LS	1	$ 20,000	$ 20,000	1
Surveying	LS	1	$ 15,000	$ 15,000	2
Site Clearing and Preparation	LS	1	$ 10,000	$ 10,000	3
Site and Perimeter Air Monitoring	MONTH	2	$ 25,000	$ 50,000	4
Erosion and Sediment Control	LS	1	$ 3,000	$ 3,000	5
Perimeter Utility Trenching					6
Underground Utility Survey and Mapping	LS	1	$ 5,000	$ 5,000	
Trench Excavation	CY	200	$ 25	$ 5,000	
Utility Capping	LS	1	$ 2,000	$ 2,000	
Excavation and Disposal					
Soil Excavation	CY	3,700	$ 25	$ 93,000	7
Waste Characterization Sampling	SAMPLE	5	$ 750	$ 4,000	8
Odor/Dust Suppressant	MONTH	2	$ 12,000	$ 24,000	9
Transportation and Disposal	TON	5,400	$ 75	$ 405,000	10
Site Restoration					
Imported Fill Material	CY	800	$ 30	$ 24,000	11
Engineering Control (Soil Cap)					
Demarcation Layer	SY	35,800	$ 2	$ 72,000	12
Imported Fill Material	CY	2,000	$ 30	$ 60,000	13
Topsoil (6")	CY	660	$ 33	$ 22,000	14
Fertilize, Seed & Mulch	MSF	36	$ 50	$ 2,000	15
Engineering Control (Asphalt Pavement Cap)					16
Demarcation Layer	SY	320	$ 2	$ 1,000	
Imported Fill Material	CY	200	$ 30	$ 6,000	
Asphalt Pavement (4")	SY	320	$ 25	$ 8,000	
Institutional Controls	LS	1	$ 50,000	$ 50,000	17
			SUBTOTAL	$ 881,000	
Engineering Design & Construction Support		15%		$ 132,000	
			SUBTOTAL	$ 1,013,000	
Contingency		25%		$ 253,000	
			TOTAL CAPITAL COSTS	**$ 1,270,000**	

OPERATIONS AND MAINTENANCE COSTS

Quarterly Groundwater Monitoring	ANNUAL	1	$ 60,000	$ 60,000	18
Engineering Controls Inspection and Maintenance	ANNUAL	1	$ 31,000	$ 31,000	19
			TOTAL ANNUAL O&M COSTS	**$ 91,000**	
			O&M NET PRESENT VALUE (30 yrs @ 3% discount rate)	**$1,784,000**	
			TOTAL NET PRESENT VALUE	**$ 3,050,000**	

ALTERNATIVE 2 - COST ESTIMATE
Engineering and Institutional Controls, Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Material
Patchogue Former MGP Site
Village of Patchogue, New York

Notes:

a: Items and quantities included in this estimate are based on preliminary pre-design information, and may change based on preparation of the final design, revisions to the delineation of treatment/excavation areas, and other revisions.

b: Notes are presented in the pages following the cost tables.

c: LS: Lump Sum, LF: Linear Foot, SY: Square Yard, CY: Cubic Yard, MSF: Thousand Square Feet.

d: Unit costs represent Year 2010 dollars and are estimated based on cost estimating guidances and Brown and Caldwell experience.

e: Installed costs are rounded to the nearest hundred, subtotals are rounded to the nearest thousand, and totals are rounded to the nearest ten thousand.

1. Lump sum based on previous project experience; 10% of capital construction costs (not including transportation and disposal). Includes mobilization of contractor's equipment and personnel, submittals, and project administration.

2. Cost based on previous project experience. Includes pre-existing conditions survey, post-excavation survey, final conditions survey.

3. Cost based on Construction Means reference guides and previous project experience. Includes minor site brush and debris clearing, construction access roads, miscellaneous site preparation activities.

4. Costs based on previous project experience. Includes temporary facilities and utilities, health and safety, site and perimeter air monitoring system with 4 stations and analytical sampling.

5. Cost includes silt fence installed along the perimeter of the excavation area and soil stockpiles. Assumes 25% of silt fence will require replacement during construction activities.

6. Trenching will be performed along the perimeter of the surficial scraping area and off-site excavation area. Assumes excavated soils will be staged for off-site disposal. The estimated trench dimensions are 900 linear ft, 2 ft wide and 3 ft deep. Estimated volume of trench excavation = 200 cy ; trenching duration = 5 days.

7. Cost includes excavation and handling of soils. Cost based on previous project experience. Excavation volume estimates are shown in the table below.

ALTERNATIVE 2 - Excavation Volume Est.	Area (sf)	Depth (ft)	Volume (bcy)	Weight* (tons)
Area 1 - Surficial Scraping/Soil Cap Area	35,800	2	2,700	5,300
Area 4 - Excavation to 9 feet	2,900	9	970	1,900
		Total	**3,700**	**7,200**

* Soil weight includes 15% fluff factor and assumes a soil density = 1.7 tons/cy.

8. Includes cost for laboratory analysis for waste characterization. Assumes 1 sample per 1000 cy of excavated soil will be submitted for analysis. Cost based on previous project experience.

9. Includes odor foam suppressant system. Cost based on previous project experience. Cost includes sprayer rental ($3700/month), product ($350/drum) and one full time laborer. Assumes 1 drum/day during excavation activities.

10. Includes cost for transportation and disposal to a Clean Earth LTTD facility. Assumes 15% soil fluff factor and soil density = 1.7 tons/CY.

11. Cost includes certified clean imported fill material. Cost based on previous project experience. Volumes estimates are shown in table below.

Backfill Estimates	Volume (CY)
Backfill -Imported Fill	800

12. Includes cost for installation of a non-woven geotextile to be used as a demarcation layer in soil cap. Cost based on previous project experience.

13. Cost includes 18 inches of certified clean imported fill material for the soil cap. Cost based on previous project experience. Volumes estimates are shown in table below.

14. Cost includes installation of 6 inches of clean imported topsoil for the soil cap. Cost based on previous project experience. Volumes estimates are shown in table below.

15. Cost includes seeding, fertilizing, and mulching topsoil for soil cap. Cost based on previous project experience and cost estimating guides.

Soil Cap Estimates	Area (sf)	Volume (cy)
Demarcation Layer	35,800	-
Imported Fill Material	35,800	2,000
Topsoil (6")	35,800	660
Fertilize, Seed & Mulch	35,800	-

ALTERNATIVE 2 - COST ESTIMATE
Engineering and Institutional Controls, Excavation of Off-Site MGP Tar- and Petroleum-Impacted Source Material
Patchogue Former MGP Site
Village of Patchogue, New York

16. Asphalt pavement cap includes demarcation layer, 20 inches of imported fill material and 4 inches of asphalt pavement. Asphalt pavement cap would be installed on the off-site property. Cost based on previous project experience.

Asphalt Pavement Cap Estimates	Area (sf)	Volume (cy)
Demarcation Layer	2,900	-
Imported Fill Material	2,900	200
Asphalt Pavement (4")	2,900	36

17. Includes costs for preparation of deed restriction documents, HASP, and a Site Management Plan in accordance with the NYSDEC Guidance DER-10 ("Technical Guidance for Site Investigation and Remediation).

18. Includes quarterly groundwater sampling of 5 new monitoring wells. Cost includes 2 field technicians for 1 day per sampling event, laboratory analyses, equipment rental, and reporting. Cost based on previous project experience.

19. Includes soil cap inspection/documentation (assumed 2 inspections per year) and after severe weather events. Includes an allowance of $10,000 for miscellaneous O&M (e.g., cover repairs, seeding). Includes costs for preparation of an annual O&M report in accordance with the NYSDEC Guidance Document DER-10 entitled "Technical Guidance for Site Investigation and Remediation". The O&M report would also include the annual certification of institutional and engineering controls.

Construction Duration*	Volume	Days	Weeks
Site Preparation	N/A	10	2
Soil Excavation	3,700	25	5
Backfill and Cap Installations	3,700	6	1
	TOTAL	**41**	**8**

*Assumes excavation rate of 750 cy/week. Assumes that soil loading and backfilling would be done concurrently with excavation activities.

ALTERNATIVE 3 - COST ESTIMATE
Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)
Patchogue Former MGP Site
Village of Patchogue, New York

CAPITAL COSTS					
ITEM [a]	UNIT [c]	QUANTITY [a]	UNIT COST [d]	INSTALLED COST [e]	NOTES [b]
Mobilization and Demobilization	LS	1	$ 229,000	$ 229,000	1
Surveying	LS	1	$ 25,000	$ 25,000	2
Site Clearing and Preparation	LS	1	$ 15,000	$ 15,000	3
Site and Perimeter Air Monitoring	MONTH	9	$ 25,000	$ 225,000	4
Erosion and Sediment Control	LS	1	$ 10,000	$ 10,000	5
Perimeter Utility Trenching					6
Underground Utility Survey and Mapping	LS	1	$ 5,000	$ 5,000	
Trench Excavation	CY	220	$ 25	$ 6,000	
Utility Capping	LS	1	$ 5,600	$ 6,000	
Excavation Support System (<13 feet)	LS	1	$ 782,000	$ 2,194,000	7
Excavation Support System (>13 feet)	LS	1	$ 2,194,000	$ 782,000	7
Excavation Water Management					
Dewatering System	MONTH	8	$ 23,000	$ 184,000	8
Disposal Fee	GAL	7,830,000	$ 0.25	$ 1,958,000	9
Excavation and Disposal					
Soil Excavation	CY	11,800	$ 25	$ 295,000	10
Backfill Screening Sampling	SAMPLE	24	$ 200	$ 5,000	11
Waste Characterization Sampling	SAMPLE	15	$ 750	$ 12,000	12
Odor/Dust Suppressant	MONTH	8	$ 12,000	$ 96,000	13
Waste Enclosure and Vapor Treatment	MONTH	6	$ 67,000	$ 402,000	14
Transportation and Disposal	TON	18,000	$ 75	$ 1,350,000	15
Site Restoration					
Reuse of Screened Excavated Soils	CY	3,000	$ 5	$ 15,000	16
Imported Fill Material	CY	8,000	$ 30	$ 240,000	17
Topsoil (6")	CY	770	$ 33	$ 25,000	18
Fertilize, Seed & Mulch	MSF	42	$ 50	$ 3,000	19
Asphalt Pavement (4")	SY	500	$ 25	$ 13,000	20
Monitoring Well Installation	EACH	5	$ 2,500	$ 13,000	21
			SUBTOTAL	$ 8,108,000	
Engineering Design & Construction Support		15%		$ 1,216,000	
			SUBTOTAL	$ 9,324,000	
Contingency		25%		$ 2,331,000	
			TOTAL CAPITAL COSTS	**$ 11,660,000**	
OPERATIONS AND MAINTENANCE COSTS					
Quarterly Groundwater Monitoring	ANNUAL	1	$ 60,000	$ 60,000	22
			TOTAL O&M ANNUAL COST	**$ 60,000**	
			TOTAL NET PRESENT VALUE	**$ 11,720,000**	

ALTERNATIVE 3 - COST ESTIMATE
Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)
Patchogue Former MGP Site
Village of Patchogue, New York

Notes:

a: Items and quantities included in this estimate are based on preliminary pre-design information, and may change based on preparation of the final design, revisions to the delineation of treatment/excavation areas, and other revisions.

b: Notes are presented in the pages following the cost tables.

c: LS: Lump Sum, LF: Linear Foot, SY: Square Yard, CY: Cubic Yard, MSF: Thousand Square Feet.

d: Unit costs represent Year 2010 dollars and are estimated based on cost estimating guidances and Brown and Caldwell experience.

e: Installed costs are rounded to the nearest hundred, subtotals are rounded to the nearest thousand, and totals are rounded to the nearest ten thousand.

1. Lump sum based on previous project experience; 5% of capital construction costs (not including transportation and disposal). Includes mobilization of contractor's equipment and personnel, submittals, and project administration.

2. Cost based on previous project experience. Includes pre-existing conditions survey, post-excavation survey, final conditions survey.

3. Cost based on Construction Means reference guides and previous project experience. Includes minor site brush and debris clearing, construction access roads, miscellaneous site preparation activities.

4. Costs based on previous project experience. Includes temporary facilities and utilities, health and safety, site and perimeter air monitoring system with 4 stations and analytical sampling.

5. Cost includes silt fence installed along the perimeter of the surficial scraping area and soil stockpiles. Assumes 25% of silt fence will require replacement during construction activities.

6. Trenching will be performed along the perimeter of surficial scraping area and off-site excavation area. Assumes excavated soils will be staged for off-site disposal. The estimated trench dimensions are 1000 linear ft, 2 feet wide and 3 feet deep. Estimated volume of trench excavation = 220 cy. Trenching duration = 5 days.

7. Cost based on previous project experience. Assumes separate sheet pile installations for excavations <13 ft depth and >13 ft depth. Assumes excavation will be performed in 40 ft x 20 ft areas for depths <13 ft feet and 20 ft x 20 ft areas for depths > 13 feet. Total estimated installed sheetpile = 25,000 sf for excavations < 13 ft deep and 75,000 sf. for excavations > 13 ft deep. Assumes initial sheetpile installation cost is $50/sf and remove/reinstallation cost is $25/sf. Assumes one row of internal bracing along inside perimeter of sheetpile area and assumes bracing will be removed and reused for each area.

8. Assumes that dewatering will be required for excavations deeper than 5 feet and approximately 50% during backfillling activities. Monthly cost based on contractor info and previous project experience. Estimated dewatering rate of 300 gpm for 8 hrs per day for 76 days. Monthly cost includes 7 frac tanks daily, 1 diaphragm pump, and labor.

9. Assumes collected water will be non-hazardous. Disposal fee is based on previous project experience.

10. Cost includes excavation and handling of soils. Cost based on previous project experience. Excavation volume estimates are shown in the table below.

ALTERNATIVE 3 - Excavation Vol. Est.	Area (sf)	Depth (ft)	Volume (bcy)	Weight* (tons)
Area 1 - Surficial Scraping/Soil Cap Area	19,100	2	1,400	2,800
Area 2 - Excavation to 25 feet	200	25	190	400
Area 3 - Excavation to 23 feet	1,400	23	1,190	2,400
Area 4 - Excavation to 20 feet	5,400	20	4,000	7,900
Area 5 - Excavation to 13 feet	4,200	13	2,020	4,000
Area 6 - Excavation to 11 feet	600	11	240	500
Area 7 - Excavation to 9 feet (off-site)	4,900	9	1,630	3,200
Area 8 - Excavation to 8 feet	500	8	150	300
Area 9 - Excavation to 5 feet	5,300	5	980	2,000
		Total	**11,800**	**23,500**

* Soil weight includes 15% fluff factor and assumes a soil density = 1.7 tons/cy.

11. Cost includes laboratory analysis of visually screened soil for possible reuse as backfill. Assumes 1 sample per 500 cy of will be submitted for analysis. Cost based on previous project experience.

12. Includes cost for laboratory analysis for waste characterization. Assumes 1 sample per 1000 cy of excavated soil will be submitted for analysis. Cost based on previous project experience.

13. Includes odor foam suppressant system. Cost based on previous project experience. Cost includes sprayer rental ($3700/month), product ($350/drum) and one full time laborer. Assumes 1 drum/day during excavation activities.

ALTERNATIVE 3 - COST ESTIMATE
Excavation of MGP-Impacted Soils (Restoration of Site to Pre-Release Conditions)
Patchogue Former MGP Site
Village of Patchogue, New York

14. Includes cost for a temporary enclosed framed-structure (71 ft x 115 ft) to stage, characterize, and load excavated soils; includes an air treatment system with GAC with 6 air exchanges per hour. Costs based on vendor estimate and previous project experience.
15. Includes cost for transportation and disposal to a Clean Earth LTTD facility. Assumes 15% soil fluff factor and soil density = 1.7 tons/CY. Total tonnage assumes that 25% of excavated soils will be reused as backfill. See Note 14 below.
16. Assumes 25% of excavated soils can be reused as backfill. Cost includes backfilling from existing stockpiles. Cost based on previous project experience. Volumes estimates are shown in table below.
17. Cost includes certified clean imported fill material. Cost based on previous project experience. Volumes estimates are shown in table below.
18. Cost includes installation of 6 inches of clean imported topsoil for vegetation. Cost based on previous project experience. Volumes estimates are shown in table below.
19. Cost includes seeding, fertilizing, and mulching topsoil. Cost based on previous project experience and cost estimating guides.
20. Asphalt pavement cap includes 4 inches of asphalt pavement. Asphalt pavement cap would be installed on the off-site property. Cost based on previous project experience.

Site Restoration	Area (sf)	Volume (CY)
Excavated Soil for reuse (25% of excavated soils)		3,000
Backfill -Imported Fill		8,000
Topsoil (6")	41,600	770
Fertilize, Seed & Mulch	41,600	
Asphalt Pavement (4")	4,400	54

21. Includes installation of 5 new monitoring wells (25 ft deep). Cost based on previous project experience.
22. Includes quarterly groundwater sampling of 5 new monitoring wells for one year. Cost includes 2 field technicians for 1 day per sampling event, laboratory analyses, equipment rental, and reporting. Cost based on previous project experience.

Construction Duration*	Volume	Days	Weeks
Site Preparation	N/A	15	4
Soil Excavation	11,800	118	24
Backfill and Cap Installations	11,800	30	6
	TOTAL	**163**	**34**

*Assumes excavation rate of 1000 cy/week for backfilling and 500 cy/week for soil excavation. Assumes that soil loading, backfilling, and soil cap installation would partially be done concurrently with excavation activities.

ALTERNATIVE 4 - COST ESTIMATE
Excavation of MGP Tar-Impacted Source Materials
Patchogue Former MGP Site
Village of Patchogue, New York

CAPITAL COSTS

ITEM [a]	UNIT [c]	QUANTITY [a]	UNIT COST [d]	INSTALLED COST [e]	NOTES [b]
Mobilization and Demobilization	LS	1	$ 85,000	$ 85,000	1
Surveying	LS	1	$ 15,000	$ 15,000	2
Site Clearing and Preparation	LS	1	$ 15,000	$ 15,000	3
Site and Perimeter Air Monitoring	MONTH	6	$ 25,000	$ 150,000	4
Erosion and Sediment Control	LS	1	$ 10,000	$ 10,000	5
Perimeter Utility Trenching					6
Underground Utility Survey and Mapping	LS	1	$ 5,000	$ 5,000	
Trench Excavation	CY	200	$ 25	$ 5,000	
Utility Capping	LS	1	$ 4,000	$ 4,000	
Excavation Support System (< 13 feet)	SF	6,700	$ 40	$ 268,000	7
Excavation Support System (>13 feet)	SF	5,500	$ 64	$ 352,000	7
Excavation and Disposal					
Soil Excavation	CY	10,900	$ 25	$ 273,000	8
Backfill Screening Sampling	SAMPLE	22	$ 200	$ 4,000	9
Waste Characterization Sampling	SAMPLE	14	$ 750	$ 11,000	10
Odor/Dust Suppressant	MONTH	4	$ 12,000	$ 46,000	11
Waste Enclosure and Vapor Treatment	MONTH	4	$ 67,000	$ 255,000	12
Transportation and Disposal	TON	16,200	$ 75	$ 1,215,000	13
Site Restoration					
Reuse of Screened Excavated Soils	CY	2,700	$ 5	$ 14,000	14
Imported Fill Material	CY	6,200	$ 30	$ 186,000	15
Engineering Control (Soil Cap)					
Demarcation Layer	SY	2,700	$ 2	$ 5,000	16
Imported Fill Material	CY	1,300	$ 30	$ 39,000	17
Topsoil (6")	CY	450	$ 33	$ 15,000	18
Fertilize, Seed & Mulch	MSF	24	$ 50	$ 2,000	19
Engineering Control (Asphalt Pavement Cap)					20
Demarcation Layer	SY	320	$ 2	$ 1,000	
Imported Fill Material	CY	200	$ 30	$ 6,000	
Asphalt Pavement (4")	SY	320	$ 25	$ 8,000	
Monitoring Well Installation	EACH	5	$ 2,500	$ 13,000	21
Institutional Controls	LS	1	$ 50,000	$ 50,000	22
			SUBTOTAL	$ 3,052,000	
Engineering Design & Construction Support		15%		$ 458,000	
			SUBTOTAL	$ 3,510,000	
Contingency		25%		$ 878,000	
			TOTAL CAPITAL COSTS	**$ 4,390,000**	
OPERATIONS AND MAINTENANCE COSTS					
Quarterly Groundwater Monitoring	ANNUAL	1	$ 60,000	$ 60,000	23
			O&M NET PRESENT VALUE (3 yrs @ 3% discount rate)	**$170,000**	
Engineering Controls Inspection and Maintenance	ANNUAL	1	$ 31,000	$ 31,000	24
			O&M NET PRESENT VALUE (30 yrs @ 3% discount rate)	**$608,000**	
			TOTAL NET PRESENT VALUE	**$ 5,170,000**	

ALTERNATIVE 4 - COST ESTIMATE
Excavation of MGP Tar-Impacted Source Materials
Patchogue Former MGP Site
Village of Patchogue, New York

Notes:

a: Items and quantities included in this estimate are based on preliminary pre-design information, and may change based on preparation of the final design, revisions to the delineation of treatment/excavation areas, and other revisions.

b: Notes are presented in the pages following the cost tables

c: LS: Lump Sum, LF: Linear Foot, SY: Square Yard, CY: Cubic Yard, MSF: Thousand Square Feet.

d: Unit costs represent Year 2010 dollars and are estimated based on cost estimating guidances and Brown and Caldwell experience.

e: Installed costs are rounded to the nearest hundred, subtotals are rounded to the nearest thousand, and totals are rounded to the nearest ten thousand.

1. Lump sum based on previous project experience; 10% of capital construction costs (not including transportation & disposal and IC costs). Includes mobilization of contractor's equipment and personnel, submittals, and project administration.

2. Cost based on previous project experience. Includes pre-existing conditions survey, post-excavation survey, final conditions survey.

3. Cost based on Construction Means reference guides and previous project experience. Includes minor site brush and debris clearing, construction access roads, miscellaneous site preparation activities.

4. Costs based on previous project experience. Includes temporary facilities and utilities, health and safety, site and perimeter air monitoring system with 4 stations and analytical sampling.

5. Cost includes silt fence installed along the perimeter of the surficial scraping area and soil stockpiles. Assumes 25% of silt fence will require replacement during construction activities.

6. Trenching will be performed along the perimeter of surficial scraping area and off-site excavation area. Assumes excavated soils will be staged for off-site disposal. The estimated trench dimensions are 900 linear ft, 2 feet wide and 3 feet deep. Estimated volume of trench excavation = 200 cy. Trenching duration = 5 days.

7. Cost includes assumes excavation will be performed in sections. Cost based on previous project experience. Assumes sheet pile depth is 3 times excavation depth. Assumes separate sheet pile installations for the <10 ft excavations and >20 ft excavations. Assumes remaining excavation will be performed in 40 ft x 20 ft areas for excavation less than 10 feet and 20 ft x 20 ft areas for excavations greater than 10 feet.

8. Cost includes excavation and handling of soils. Cost based on previous project experience. Excavation volume estimates are shown in the table below.

ALTERNATIVE 4 - Excavation Volume Est	Area (sf)	Depth (ft)	Volume (bcy)	Weight* (tons)
Area 1 - Surficial Scraping/Soil Cap Area	24,200	2	1,800	3,600
Area 2 - Excavation to 23 feet	7,300	23	6,220	12,200
Area 3 - Excavation to 13 feet	880	13	420	900
Area 4 - Excavation to 9 feet	4,160	9	1,390	2,800
Area 5 - Excavation to 8 feet	160	8	50	100
Area 6 - Excavation to 7 feet	3,760	7	970	1,900
Area 7 - Excavation to 4 feet	110	4	20	100
		Total	**10,900**	**21,600**

* Soil weight includes 15% fluff factor and assumes a soil density = 1.7 tons/cy.

9. Cost includes laboratory analysis of visually screened soil for possible reuse as backfill. Assumes 1 sample per 500 cy of will be submitted for analysis. Cost based on previous project experience.

10. Includes cost for laboratory analysis for waste characterization. Assumes 1 sample per 1000 cy of excavated soil will be submitted for analysis. Cost based on previous project experience.

11. Includes odor foam suppressant system. Cost based on previous project experience. Cost includes sprayer rental ($3700/month), product ($350/drum) and one full time laborer. Assumes 1 drum/day during excavation activities.

12. Includes cost for a temporary enclosed framed-structure (71 ft x 115 ft) to stage, characterize, and load excavated soils; includes an air treatment system with GAC with 6 air exchanges per hour. Costs based on vendor estimate and previous project experience.

13. Includes cost for transportation and disposal to a Clean Earth LTTD facility. Assumes 15% soil fluff factor and soil density = 1.7 tons/CY. Total tonnage assumes that 25% of excavated soils will be reused as backfill. See Note 14 below.

14. Assumes 25% of excavated soils can be reused as backfill. Cost includes backfilling from existing stockpiles. Cost based on previous project experience. Volumes estimates are shown in table below.

15. Cost includes certified clean imported fill material. Cost based on previous project experience. Volumes estimates are shown in table below.

Backfill Estimates	Volume (CY)
Excavated Soil for reuse (25% of excavated soils)	2,700
Backfill -Imported Fill	6,200

16. Includes cost for installation of a non-woven geotextile to be used as a demarcation layer in soil cap. Cost based on previous project experience.

17. Cost includes 18 inches of certified clean imported fill material for the soil cap. Cost based on previous project experience. Volumes estimates are shown in table below.

18. Cost includes installation of 6 inches of clean imported topsoil for the soil cap. Cost based on previous project experience. Volumes estimates are shown in table below.

19. Cost includes seeding, fertilizing, and mulching topsoil. Cost based on previous project experience and construction estimating guides

Soil Cap Estimates	Area (sf)	Volume (cy)
Demarcation Layer	24,200	-
Imported Fill Material	24,200	1,300
Topsoil (6")	24,200	450
Fertilize, Seed & Mulch	24,200	-

20. Asphalt pavement cap includes 20 inches of imported fill material and 4 inches of asphalt pavement. Asphalt pavement cap would be installed on the off-site property. Cost based on previous project experience.

Asphalt Pavement Cap Estimates	Area (sf)	Volume (cy)
Demarcation Layer	2,900	-
Imported Fill Material	2,900	200
Asphalt Pavement (4")	2,900	36

21. Includes installation of 5 new monitoring wells (25 ft deep). Cost based on previous project experience.

22. Includes costs for preparation of deed restriction documents , HASP, and a Site Management Plan in accordance with the NYSDEC Guidance DER-10 ("Technical Guidance for Site Investigation and Remediation).

23. Includes quarterly groundwater sampling of 5 new monitoring wells. Cost includes 2 field technicians for 1 day per sampling event, laboratory analyses, equipment rental, and reporting. Cost based on previous project experience.

24. Includes soil cap inspection/documentation (assumed 2 inspections per year) and after severe weather events. Includes an allowance of $10,000 for miscellaneous O&M (e.g., cover repairs, seeding). Includes costs for preparation of an annual O&M report in accordance with the NYSDEC Guidance Document DER-10 entitled "Technical Guidance for Site Investigation and Remediation". The O&M report would also include the annual certification of institutional and engineering controls.

Construction Duration*	Volume	Days	Weeks
Site Preparation	N/A	15	3
Soil Excavation	10,900	73	15
Backfill and Cap Installations	10,900	18	4
	TOTAL	**106**	**22**

*Assumes excavation rate of 1500 cy/ week for backfilling and cap installations and 750 cy/week for soil excavation. Assumes that soil loading, backfilling, and cap installations would partially be done concurrently with excavation activities.

ALTERNATIVE 5 - COST ESTIMATE
In-Situ Solidification of MGP Tar-Impacted Source Material
Patchogue Former MGP Site
Village of Patchogue, New York

CAPITAL COSTS

ITEM [a]	UNIT [c]	QUANTITY [a]	UNIT COST [d]	INSTALLED COST [e]	NOTES [b]
Mobilization and Demobilization	LS	1	$ 400,000	$ 400,000	1
Surveying	LS	1	$ 15,000	$ 15,000	2
Site Clearing and Preparation	LS	1	$ 15,000	$ 15,000	3
Site and Perimeter Air Monitoring	MONTH	4	$ 25,000	$ 100,000	4
Erosion and Sediment Control	LS	1	$ 10,000	$ 10,000	5
Perimeter Utility Trenching					6
Underground Utility Survey and Mapping	LS	1	$ 5,000	$ 5,000	
Trench Excavation	CY	220	$ 25	$ 6,000	
Utility Capping	LS	1	$ 4,000	$ 4,000	
Excavation and Disposal					
Surficial Soil Excavation (Soil Cap)	CY	1,800	$ 25	$ 45,000	7
Off-Site Soil Excavation	CY	800	$ 25	$ 20,000	7
Soil Excavation to Accommodate ISS Swelling	CY	1,700	$ 25	$ 43,000	8
Utility Corridor Excavation (after ISS treatment)	CY	1,700	$ 25	$ 43,000	9
Waste Characterization Sampling	SAMPLE	8	$ 750	$ 6,000	10
Odor/Dust Suppressant	MONTH	3	$ 12,000	$ 36,000	11
Transportation and Disposal	TON	10,000	$ 75	$ 750,000	12
In Situ Stabilization					13
Bench Scale Testing	LS	1	$ 50,000	$ 50,000	
Subsurface Obstruction Removal	LS	1	$ 20,000	$ 20,000	
Soil Mixing and Reagents	CY	6,800	$ 275	$ 1,870,000	
Confirmation Soil Sampling	SAMPLE	14	$ 200	$ 3,000	
Backfill to Subgrade	CY	850	$ 10	$ 9,000	
Engineering Control (Soil Cap)	CY				14
Demarcation Layer	SY	2,700	$ 2	$ 5,000	15
Imported Fill Material	CY	1,300	$ 30	$ 39,000	16
Topsoil (6")	CY	450	$ 33	$ 15,000	17
Fertilize, Seed & Mulch	MSF	24	$ 50	$ 2,000	18
Engineering Control (Asphalt Pavement Cap)					19
Demarcation Layer	SY	270	$ 2	$ 1,000	
Imported Fill Material	CY	100	$ 30	$ 3,000	
Asphalt Pavement (4")	SY	270	$ 25	$ 7,000	
Monitoring Well Installation	EACH	5	$ 2,500	$ 13,000	20
Institutional Controls	LS	1	$ 50,000	$ 50,000	21
			SUBTOTAL	$ 3,585,000	
Engineering Design & Construction Support		15%		$ 538,000	
			SUBTOTAL	$ 4,123,000	
Contingency		25%		$ 1,031,000	
			TOTAL CAPITAL COSTS	**$ 5,150,000**	

OPERATIONS AND MAINTENANCE COSTS

Quarterly Groundwater Monitoring	ANNUAL	1	$ 60,000	$ 60,000	22
O&M NET PRESENT VALUE (3 yrs @ 3% discount rate)				**$170,000**	
Engineering Controls Inspection and Maintenance	ANNUAL	1	$ 31,000	$ 31,000	23
O&M NET PRESENT VALUE (30 yrs @ 3% discount rate)				**$608,000**	
TOTAL NET PRESENT VALUE				**$ 5,930,000**	

ALTERNATIVE 5 - COST ESTIMATE
In-Situ Solidification of MGP Tar-Impacted Source Material
Patchogue Former MGP Site
Village of Patchogue, New York

Notes:

a: Items and quantities included in this estimate are based on preliminary pre-design information, and may change based on preparation of the final design, revisions to the delineation of treatment/excavation areas, and other revisions.

b: Notes are presented in the pages following the cost tables.

c: LS: Lump Sum, LF: Linear Foot, SY: Square Yard, CY: Cubic Yard, MSF: Thousand Square Feet.

d: Unit costs represent Year 2010 dollars and are estimated based on cost estimating guidances and Brown and Caldwell experience.

e: Installed costs are rounded to the nearest hundred, subtotals are rounded to the nearest thousand, and totals are rounded to the nearest ten thousand.

1. Lump sum based on previous project experience; 15 - 20% of capital construction costs (not including transportation & disposal and IC costs). Includes mobilization of contractor's equipment and personnel, submittals, and project administration.

2. Cost based on previous project experience.

3. Cost based on Construction Means reference guides and previous project experience. Includes minor site brush and debris clearing, construction access roads, miscellaneous site preparation activities.

4. Costs based on previous project experience. Includes temporary facilities and utilities, health and safety, site and perimeter air monitoring system with 4 stations and analytical sampling.

5. Cost includes silt fence installed along the perimeter of the surficial scraping area and soil stockpiles. Assumes 25% of silt fence will require replacement during construction activities.

6. Trenching will be performed along the perimeter of surficial scraping area and off-site excavation area. Assumes excavated soils will be staged for off-site disposal. The estimated trench dimensions are 900 linear ft, 2 feet wide and 3 feet deep. Estimated volume of trench excavation = 200 cy. Trenching duration = 5 days.

7. Cost includes excavation and handling of soil from surficial scraping/soil cap area and off-site excavaton area. Cost based on previous project experience. Assumes half of soil excavated from surficial scraping will be as backfill. The remaining soil will be disposed off-site. Excavation volume estimates are shown in the table below.

8. Cost includes pre-excavation of soil within the ISS treatment area to accommodate for 25% volume swelling associated with the ISS mixing.

9. Includes excavation of ISS treated soil to a depth of 4 feet to create a utility corridor. Excavated soil will be disposed off-site. Excavation volume estimates are shown in the table below.

Alternative 5 - Excavation & Treatment Vol. Est.	Area (sf)	Depth (ft)	Volume (bcy)	Weight (tons)
Area 1 - Surficial Scraping / Soil Cap (2 ft)	24,160	2	1,800	3,600
Area 2 - Excavation in ISS treatment area (to account for 25% swelling)	11,710	varies	1,700	3,400
Area 3 - Utility Corridor Excavation after ISS treatment (4 ft)	11,710	4	1,700	3,400
Area 4 - Excavation to 9 feet (off-site)	2,440	9	800	1,600
Area 5 - Treatment to 21 feet	4,630	21	3,600	
Area 6 - Treatment to 23 feet	1,850	23	1,600	
Area 7 - Treatment to 13 feet	1,140	13	550	
Area 8 - Treatment to 8 feet	1,340	8	400	
Area 9 - Treatment to 7 feet	2,020	7	500	
Area 10 - Treatment to 4 feet	730	4	100	
		Total Excavation Vol.	**6,000**	
		Total Treatment Vol.	**6,800**	
			Total T&D Vol.	**10,000**

* Soil weight includes 15% fluff factor and assumes soil density = 1.7 tons/cy.

10. Includes cost for laboratory analysis for waste characterization. Assumes 1 sample per 1,000 cy of excavated soil will be submitted for analysis. Cost based on previous project experience.

11. Includes odor foam control system. Cost based on previous project experience.

12. Includes cost for transportation and disposal to a Clean Earth LTTD facility. Assumes 15% soil fluff factor and soil density = 1.7 tons/CY.

13. Cost based on previous project experience and contractors' estimates.

14. Assumes soil removed from surficial scraping will be re-used as the backfill to attain soil cap subgrade elevations (2 ft bgs) after the utlity corridor excavation. Cost based on previous project experience.

15. Includes cost for installation of non-woven geotextile to be used a demarcation layer in soil cap. Cost based on previous project experience.

ALTERNATIVE 5 - COST ESTIMATE
In-Situ Solidification of MGP Tar-Impacted Source Material
Patchogue Former MGP Site
Village of Patchogue, New York

16. Cost includes 18 inches of certified clean imported fill material for the soil cap. Cost based on previous project experience. Volumes estimates are shown in table below.

17. Cost includes installation of 6 inches of clean imported topsoil for the soil cap. Cost based on previous project experience. Volumes estimates are shown in table below.

18. Cost includes seeding, fertilizing, and mulching topsoil. Cost based on previous project experience and construction estimating guides.

Soil Cap Estimates	Area (sf)	Volume (cy)
Demarcation Layer	24,160	-
Imported Fill Material	24,160	1,300
Topsoil (6")	24,160	450
Fertilize, Seed & Mulch	24,160	-

19. Asphalt pavement cap includes 20 inches of imported fill material and 4 inches of asphalt pavement. Asphalt pavement cap would be installed on the off-site property. Cost based on previous project experience.

Asphalt Pavement Cap Estimates	Area (sf)	Volume (cy)
Demarcation Layer	2,440	-
Imported Fill Material	2,440	100
Asphalt Pavement (4")	2,440	30

20. Includes installation of 5 new monitoring wells (25 ft deep). Cost based on previous project experience.

21. Includes costs for preparation of deed restriction documents, HASP, and a Site Management Plan in accordance with the NYSDEC Guidance DER-10 ("Technical Guidance for Site Investigation and Remediation).

22. Includes quarterly groundwater sampling of 5 new monitoring wells. Cost includes 2 field technicians for 1 day per sampling event, laboratory analyses, equipment rental, and reporting. Cost based on previous project experience.

23. Includes soil cap inspection/documentation (assumed 2 inspections per year) and after severe whether events. Includes an allowance of $10,000 for miscellaneous O&M (e.g., cover repairs, seeding). Includes costs for preparation of an annual O&M report in accordance with the NYSDEC Guidance Document DER-10 entitled "Technical Guidance for Site Investigation and Remediation". The O&M report would also include the annual certification of institutional and engineering controls.

Construction Duration*	Volume	Days	Weeks
Site Preparation	N/A	15	3
ISS Treatment	6,800	34	7
Excavation	6,000	20	4
Backfill and Cap Installations	6,000	20	4
	TOTAL	**69**	**14**

*Assumes excavation rate of 750 cy/ week , 1500 cy/week for backfilling and and cap installations and ISS treatment rate of 1,000 cy/week.