Prepared for

nationalgrid

Final Remedial Investigation Report for the Patchogue Former MGP Site Patchogue, Suffolk County, New York

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Prepared by

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ACRONYMS

AST	Aboveground Storage Tank
bgs	below ground surface
BTEX	benzene, ethylbenzene, toluene, and xylenes
CaPAH	Carcinogenic PAH
Cfs	cubic feet per second
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
DPW	Department of Public Works
DUSR	Data Usability Summary Report
Eco-SSL	Ecological Soil Screening Level
ELAP	Environmental Laboratory Approval Program
F&N	Fenley and Nicol
FWRIA	Fish and Wildlife Resource Impact Analysis
HASP	Health and Safety Plan
LEL	Lowest Effect Level
LILCO	Long Island Lighting Company
MGP	Manufactured Gas Plant
msl	mean sea level
MSSC	Most Stringent Sediment Criteria
NAPL	Non-Aqueous Phase Liquid
NHP	Natural Heritage Program
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSNHP	New York State Natural Heritage Program
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
Pcf	pounds per cubic foot
PID	Photoionization Detector
PRAP	Proposed Remedial Action Plan
PSA	Preliminary Site Assessment
QAPP	Quality Assurance Project Plan
QHHEA	Qualitative Human Health Exposure Assessment
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
SAV	Submergent Aquatic Vegetation
SEL	Severe Effect Level
SVOC	Semi-volatile Organic Compound
TCN	total cyanide
TCL	Target Compound List
TOC	Total Organic Carbon
USEPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service

ACRONYMS (cont'd)

USGS	United States Geological Survey
VOC	Volatile Organic Compound
VHB	Vanasse Hangen Brustlin, Inc.
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

This Remedial Investigation Report (RIR) was prepared for the Patchogue Former MGP Site, 234 West Main Street in Patchogue, Town of Brookhaven, Suffolk County, New York. National Grid (formerly KeySpan) entered into Order on Consent D1-001-99-05 with the New York State Department of Environmental Conservation (NYSDEC) to conduct a Preliminary Site Assessment (PSA) of this manufactured gas plant (MGP) site in 2001. After NYSDEC acceptance of the PSA Report in 2002, it was determined a Remedial Investigation (RI) was required to further define the impacts of the prior operations. The RI was completed in 2008. National Grid owns the property, located in a mixed commercial, residential area.

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. Field activities were conducted in accordance with the requirements of the Remedial Investigation Work Plan (RIWP), Quality Assurance Project Plan (QAPP) and the Environmental Health and Safety Plan (HASP) for the site investigation.

The PSA, conducted in 2001-2002, consisted of a detailed record review, site reconnaissance, field survey, sample collection, sample analysis and reporting. Site sampling activities included soil, groundwater, surface water, sediment, and test trench sampling and analysis. During the RI in 2008, additional soil, groundwater, sediment, surface water, and soil vapor samples were collected. Test trenches were excavated to identify the location of the former gas holder and determine if there were remnants of the former structure.

Summary of 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 Qualitative Human Health Exposure Assessment (QHHEA) and a Fish and Wildlife Resources Impact Analysis (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 potentially harmful materials. 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.

Summary of Findings by Media:

Surface Soils: A total of 32 surface soil samples were collected during the RI from the interval 0 to 6 inches below ground surface (bgs). Some were collected from the top two inches (for development of the QHHEA), and some were collected from the 0 to 6 inch interval (for development of the FWRIA). Total BTEX (benzene, toluene, ethylbenzene, and xylenes) in surface soils was detected in very low concentrations in only one of the 32 surface soil samples. Total polynuclear aromatic hydrocarbons (PAHs) ranged from non-detect in three samples to 168.1 mg/kg in sample PASB-28-0-0.2. 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. Based on the qualitative and quantitative results of the PSA and RI, sufficient information exists so that no further investigation of surface soil is necessary or recommended. Sufficient data has been obtained to determine quantitatively the risk associated for each receptor. The redevelopment of the site could potentially expose future receptors to surface soil

Subsurface Soil: A total of 58 subsurface soil samples were collected during the RI. The subsurface soil samples were analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), total organic carbon (TOC), and total cyanide (TCN). Total BTEX ranged from non-detect in 40 of the 58 samples to 342.1 mg/kg in sample PASB-25-1-6. Total PAHs 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. The logs of the borings from the core area indicate the core area is impacted visually with residual MGP impacts, including staining, sheen, blebs, globs, lenses, and coating. This area generally corresponds with the historical location of the gas holder, purifier house boiler, and oil tanks. Within this visually impacted area, tar saturated soil or solid tar was observed in some locations as well. These impacts were identified in the subsurface sand, predominantly in the upper 11 feet bgs. However, sheens and staining extend approximately 15 feet bgs at PASB-25 and 20 feet bgs at PASB-30.

Cross Sections A-A' and B-B' on Figure 5-1 depict the horizontal and vertical extent of visually impacted soil in the core area of the site. It is recommended that this visually impacted soil be removed and replaced with clean soil. Removal of impacted soil will eliminate the secondary source of MGP impacts to soil, groundwater, and sediment.

Test Trenches: 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 the RI.

Groundwater: Two rounds of groundwater samples were collected from each of the 14 overburden monitoring wells installed during the RI. The first round of sampling was conducted in March 2008 on all of the monitoring wells that had been installed to date

(MW-1, MW-2S, MW-2D, MW-3, MW-4S, MW-4D, MW-5, and MW-6). The second round of sampling was conducted in July 2008, and included all 14 monitoring wells. Each groundwater sample from both rounds was analyzed for TCL VOCs, TCL SVOCs, and TCN. During both rounds of sampling, several VOCs and SVOCs were detected above NYSDEC Ambient Water Quality Standards and Guidance Values for Class GA Groundwater. Contaminant levels in monitoring wells located downgradient of the source area are low and will diminish after the source area has been remediated. Drinking water in Patchogue is provided through the municipal water supply which relies on a single-source aquifer. The one public supply well identified during the well search is located hydraulically side-gradient of groundwater flow at the site. Two potable 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 above analysis, bi-annual groundwater sampling of all 14 monitoring wells is recommended. The groundwater samples will be analyzed for BTEX, PAHs, and TCN, and compared to NYSDEC Ambient Water Quality Standards and Guidance Values for Class GA Groundwater.

Sediments: Ten sediment samples (plus one duplicate) were collected during the RI. The ten sediment sampling locations were based on results of probing the stream for sheens and discussions with NYSDEC. Four sampling locations (SED-1 through SED-4) are upgradient of the former wastewater treatment plant (WWTP) outfall, and six locations (SED-5 through SED-10) are downgradient. VOCs and SVOCs were detected above criteria in sediment samples collected upstream of the site, as well as downstream. The sediment sample collected furthest downstream, PASED-10, did not have concentrations of constituents above criteria.

Based on the dispersion of contaminants both upstream and downstream of the site, combined with the determination that the sediment will not impact ecological or human health receptors, no further investigation of sediment is recommended. The remedial action objectives for the Site will minimize or isolate the source of any future site-related impacts to the sediment.

Surface Water: Five surface water samples (plus one duplicate) were collected during the RI and analyzed for TCL VOCs, TCL SVOCs, and TCN. None of the samples were found to contain any constituents above NYSDEC Ambient Water Quality Standards and Guidance Values for Class C Surface Water. Toluene was the only compound that was detected. No further investigation of surface water is recommended. The remedial action objectives for the Site will minimize or isolate the source of any future site-related impacts to the surface water.

Soil Gas: Three soil gas samples were collected, one from beneath the concrete slab of a former building on-site on January 31, 2008, and two samples were collected from beneath the concrete slab of the building located off-site to the east in July 2008 and May 2009. Based on the VOCs detected and their concentrations, an additional sub-slab sample, indoor air sample, and ambient air sample were collected during the heating

season in November 2009 from "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 is recommended as part of the remedial investigation phase.

Qualitative Human Health Exposure Assessment: A QHHEA was performed to evaluate the potential exposure pathways for human receptors relative to the chemicals of potential concern (COPCs) identified for each impacted exposure media given the current and potential future use of the site. None of the detections for TCN or polychlorinated biphenyls (PCBs) exceeded the applicable NYSDEC criteria within any of the sampled exposure media. Various VOCs, SVOCs, and metals are located at elevated levels within various exposure media, particularly the on-site surface soil, subsurface soil, and groundwater and the off-site sediments. The on-site exceedances presented are located within the core and southern areas of the site.

Soil gas samples collected from beneath the concrete slabs located in the northern area and east of the 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 exposure media are likely. The results of the QHHEA will be used to support future site management decision-making.

Fish and Wildlife Resources Impact Analysis: A FWRIA was conducted in two steps to: (1) 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; 2) 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 confirmation of ambient water quality exceedance.

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 is 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.

Recommendations

Given the nature and extent of the contamination, based on the results of the PSA and RI, and the limited size of the impacted area, a Focused Feasibility Study should be developed and submitted to NYSDEC to present the remedial alternatives for this Site. NYSDEC will then select a preferred alternative and present it to the public, for comment, in the form of a Proposed Remedial Action Plan (PRAP).

1.0 Introduction

The Patchogue Former MGP Site is located at 234 West Main Street in a mixed commercial and residential area in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York (Figure 1-1). Ownership of the facility was through the Patchogue Gas Company, either independently (1904 through 1926) or under control of the Long Island Lighting Company (LILCO) (1927). Routine Lowe water gas production stopped in 1914; high pressure gas purchased from Suffolk Gas & Electric (Bayshore) 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. As can be seen on the 1926 Sanborn map provided in the Preliminary Site Assessment (PSA) (VHB, 2002), a group of seven horizontal aboveground storage tanks were installed sometime after 1910. The 60,000 cubic foot gas holder initially present on the site is consistent with the limited production of water gas at the facility. The gas sphere present during later operations stored gas under high pressure, and is consistent with the use of the Patchogue facility for distribution of gas produced elsewhere.

LILCO sold the property in 1976 but retained 7,800 square feet of easements for existing facilities. National Grid re-purchased the entire property in 2004 and maintains control and access to the property. LILCO was acquired by Brooklyn Union Gas in 1999 and the two merged to form KeySpan, which was acquired by National Grid in 2008.

National Grid (formerly KeySpan) entered into an Order on Consent D1-001-99-05 with the New York State Department of Environmental Conservation (NYSDEC) to conduct a PSA of the Former Patchogue MGP Site. The PSA was conducted in 2001 and the results were documented and submitted to the NYSDEC in the March 2002 report entitled Preliminary Site Assessment Report (VHB, 2002). In 2006, National Grid demolished two on-site aboveground structures (a warehouse and detached garage). The concrete slabs for both structures remain in place.

1.1 Overview of Report Organization

This Remedial Investigation Report (RIR) incorporates the data collected during previous investigations, as well as data collected during the RI. Section 1 provides an overview of the site, including location, description, and history of the site. Section 2 describes the RI field investigation program. Section 3 utilizes the data generated during the PSA and the RI to describe the site geology and hydrogeology. Section 4 describes the nature and extent of contamination in various media at the site. A conceptual site model is presented in Section 5. A Qualitative Human Health Exposure Assessment (QHHEA) and a Fish and Wildlife Resource Impact Analysis (FWRIA) were conducted as a part of the Remedial Investigation (RI), and are presented in Section 6. A summary of RI findings and conclusions are presented in Section 7. Section 8 provides a list of references used to prepare this RIR.

1.2 Remedial Investigation Program Objectives

The purpose of the RI was to further identify and delineate the nature and extent of manufactured gas plant (MGP) impacts on- and off-site. Field activities were conducted in accordance with the requirements of the Remedial Investigation Work Plan (RIWP), Quality Assurance Project Plan (QAPP) and the Environmental Health and Safety Plan (HASP) for the site investigation

1.3 Site Description and History

1.3.1 Site Description

The Patchogue Former MGP Site is located at 234 West Main Street south of Main Street, east of River Avenue, and adjacent to Patchogue River in the Village of Patchogue, Town of Brookhaven, Suffolk County, New York (see Figure 1-1). The site is 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 10 feet above mean sea level (msl) and the site has a relatively flat topography. The site is located along the Patchogue River just south of where the river exits Patchogue Lake. An overflow pond is also located south/southwest of the site. The site is currently vacant and the southern area of the property is overgrown with brush and trees. Two concrete slabs are located adjacent to one another in the northern area of the site and are approximately 240 feet by 60 feet in combination. The site is secured by locked perimeter fencing, and private properties border the site.

To facilitate further discussion of the site and the results of the PSA and RIR, the site will be described as consisting of three areas: the northern area, the 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 and enclosed with a cyclone fence. This area has been cleared, although two concrete slabs remain from recently razed buildings. This area is elevated with fill materials. The core area comprises the central portion of the site, where most former MGP structures were located. It is a rectangular area and surrounded by a large cyclone fence. The core area is sparsely vegetated by herbaceous plants and grasses and is uneven due to fill material. The southern area is the tapered end of the National Grid property south of the fence, with the south-southwest flowing Patchogue River forming the eastern boundary of this area. This area has considerable concrete debris as well as dense tree and brush overgrowth. Adjacent to the site to the west is a very steep hill which is filled with trash and debris beyond which is a residential area and municipal storage yard. The site is bordered to the east by the Patchogue River and small industrial properties.

The surrounding area is primarily used for commercial and residential purposes. A commercial/industrial area is located north of the site and a residential area lies south of the site. *Above All Store Fronts* and the Patchogue River border the site to the east, while Costanza Marine Contractors is situated to the west. The River Avenue Elementary School is located approximately one-tenth of a mile southwest and upgradient of the site,

with residential homes between the site and the school. The Village of Patchogue's waste water treatment plant (WWTP) is located upstream of the site on the eastern side of the Patchogue River.

1.3.2 Operational History

The following is a brief summary of operations conducted at the site from 1904 until present based on the available records:

- 1904 Earliest records of site use for coal gasification
- 1904 – 1926 Site owned and operated by Patchogue Gas Company
- 1914 Site converted into a high pressure gas distribution facility
- 1915 – 1918 Site used to store and distribute high pressure gas produced off-site
- 1922 – 1925 Site used to produce emergency water gas
- 1926 Eight gas aboveground storage tanks (ASTs) installed on-site
- 1976 Long Island Lighting Company sold the site and MGP and gas distribution operations ceased. Site sold to third party.
- 1976 – 2006 Site used as a refrigeration-scrap storage yard
- 2005 Site re-acquired by KeySpan
- 2006 KeySpan demolished a warehouse and detached garage
- Present Inactive and vacated site with concrete slabs remaining at the ground surface

1.3.3 Previous Site Investigations

In July 2001, KeySpan (now National Grid) completed a PSA and a limited sampling program at the site and submitted the results to the NYSDEC in a PSA Report in March 2002. The PSA consisted of a detailed record review, site reconnaissance, field survey, sample collection, sample analysis, and reporting. Site sampling activities included surface soil, subsurface soil, groundwater, surface water, sediment, and test trench sampling and analysis. The 2001 sampling efforts for the PSA 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.

During the PSA, 13 surface soil samples were collected from 0 to 2 inches below ground surface (bgs). Fourteen subsurface soil borings were installed and continuous core samples were collected for purposes of detecting the presence of contaminants and MGP wastes or foreign debris in the subsurface, and to determine the physical characteristics of the soil. Seven temporary monitoring wells were installed on-site 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 between 0 and 12 feet bgs, depending on the local groundwater elevation. Three 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 downgradient of the site. Three narrow and shallow test trenches were installed and sampled on-site. Seven composite samples were collected along the three test trenches at depths ranging from 0.5 to 3.0 feet bgs.

Samples from all media were analyzed for benzene, ethylbenzene, toluene, and xylenes (BTEX), polynuclear 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, one groundwater sample was collected upgradient of the site and analyzed for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), the RCRA 8 metals, and TCN.

Laboratory analysis of the samples collected during the PSA indicated the presence of BTEX in a limited number of surface and subsurface soils; 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, tetrachloroethene, and trichloroethene were detected in groundwater upgradient of the site, below the New York State Department of Environmental Conservation (NYSDEC) principal organic contaminant standard for groundwater.

2.0 Field Investigation Program

During the RI, samples were collected from various media and analyzed by an off-site analytical laboratory certified by the New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP). Sample identification nomenclature consists of the following components.

1. Site Identification - The first component consists of a two digit designation which identifies the site. For this RI, the designation "PA" was used as the identification for the Patchogue Former MGP Site.

2. Sample Type - The second component, which identifies the sample type, consists of a two, three or four letter code as follows:

    - SB – Surface or Subsurface Soil Sample
    - SB-MW – Soil Boring – Monitoring Well Soil Sample
    - GWMW – Groundwater Monitoring Well Sample
    - SW – Surface Water Sample
    - SED – Sediment Sample
    - SV – Soil Vapor

3. Sample Location - The third component identifies the sample location. A one or two digit number was used to identify each sampling location.

4. Sample Depth – The fourth component only applies to soil samples, and identifies the sample interval, in feet, from which the sample was collected.

An example of sample designation is: PASB-26-4-6, which represents the soil boring location collected from a depth of 4 to 6 feet bgs at the Patchogue site. Duplicate samples were given the same first three components of the original sample ID, but the sample depth was changed such that the duplicate samples are considered “blind.” The duplicate samples were noted in the site logbook. Duplicate sample results are included in the data tables after the original sample.

2.1 Organization and Overview of Field Program Activities

During the RI field program, a NYSDEC representative and a National Grid Project Manager were on-site during the majority of the field program. The RIWP was implemented with modifications and additions agreed to via conversations between TtEC, NYSDEC, and National Grid. The RIWP elements are summarized as follows:

- MW-1, MW-2S, MW-3 and MW-4S were installed with a Geoprobe 7720DT at the northwest corner of the northern area, the northwest corner of the core area, east of the core area on the adjacent property next to Patchogue River, and east of the southern area on the adjacent property next to Patchogue River, respectively.

- Samples were collected from soil boring PASB-20 (completed to 25 feet bgs) in the former holder area (the southern portion of the core area) and PASB-19 (completed to 10 feet bgs) in the southern area and analyzed on a 48-hour lab turnaround. The samples from PASB-20 were analyzed for TCL VOCs, TCL SVOCs, total organic carbon (TOC) and TCN and the sample from PASB-19 was analyzed for mercury (Hg) only, in order to verify mercury results from the PSA (VHB, 2002).

- As per the RIWP, the 13 soil borings (PASB-21 through PASB-33) were sampled for TCL VOCs, TCL SVOCs, TOC, and TCN either near the water table, or if impacted (based upon visual characteristics, odor and photoionization detector (PID) readings) from the impacted zone and first clean zone below. Some impacts were noted in borings PASB-25 through PASB-33 along the northern and eastern portion of the core area. These borings were advanced to a depth of 25 feet bgs.

- Surface soil samples from 0 to 2 inches bgs (for development of the QHHEA) and 0 to 6 inches bgs (for development of the FWRIA) were collected at the 25-foot soil boring locations for TCL VOCs, TCL SVOCs, TOC, and TCN.

- Three samples (PASB-23-15-20, PASB-24-10-15, and PASB-27-15-20) were collected from the natural sand and gravel underlying the fill for geotechnical parameters.

- Concrete rubble and an associated soil pile were removed from the southern area, initially by Lazer personnel and then by a Fenley and Nicol (F&N) operator. Approximately 30 cubic yards of concrete was removed from the site. A soil pile, consisting largely of sand, organic silt and discarded carpets, approximately 80 cubic yards in volume, was also removed from the site. A composite sample of the material was sent to an offsite laboratory to characterize the material for disposal.

- Soil borings were advanced along the western boundary (PASB-16 and PASB-17 in the core area and PASB-18 in the southern area); each of these three borings was advanced to approximately 8 to 10 feet bgs. No apparent MGP impacts were identified. Confirmation samples were collected from PASB-16 for TCL VOCs, TCL SVOCs, TOC, TCN, TAL metals and PCBs.

- Sediment probe transects were completed in the Patchogue River adjacent to the site. In addition, five sediment samples were collected upstream from the site and five sediment samples were collected adjacent to and downstream of the site.

    - Sediment samples were collected adjacent to the WWTP fence, approximately 80 feet south of the WWTP outfall, near the site where

sheens were observed, and 440 feet south of the WWTP. In addition, a sample was collected from organic silt 25 feet north of the west side of the railroad abutment in a ponded area of the Patchogue River.

  - Upstream samples were collected from just above the West Main Street bridge and just below the bridge near a small outfall pipe. Two sediment samples were also collected from Patchogue Lake, the river's headwaters to the north. Typically the sediment samples were high in sand composition, sometimes with organic silts. There were no visual impacts. Samples were analyzed for BTEX, PAHs, and TCN.

- An 8-hour soil vapor sample was collected using a 6-liter Summa canister from beneath the slab of the northern razed building in the northern area. The sample was analyzed for TO-15.

Additional sampling, completed in July 2008, based upon the results of the initial field effort, included:

- PASB-34 was completed to 25 feet bgs in the southern portion of the northern area. No apparent MGP impacts were encountered. A confirmatory sample was collected and analyzed for TCL VOCs, TCL SVOCs, TOC, and TCN.

- PASB-27 was moved from between PASB-26 and PASB-28 along the eastern core area fence to south of PASB-26.

- Additional soil borings (PASB-35, PASB-36, and PASB-37) were completed on the adjacent storefront fabricators' property approximately 10 to 15 feet east of the fence across from PASB-27, PASB-26 and PASB-28, respectively. Apparent minor MGP impact was noted at these locations and two samples from each boring were collected for TCL VOCs, TCL SVOCs, TOC, and TCN. PASB-38 was installed on this property north of PASB-37 across from the core area gate. No MGP impact was observed. One confirmatory sample was collected and analyzed for TCL VOCs, TCL SVOCs, TOC, and TCN.

- Two additional monitoring wells with pre-packed screens (MW-5 and MW-6) were installed in apparent MGP-impacted areas (adjacent to PASB-25 and PASB-31, respectively), and screened from 5 to 15 feet bgs and from 5 to 20 feet bgs, respectively. Two deeper monitoring wells (MW-2D and MW-4D) were installed adjacent to their shallow counterparts and screened from 20 to 25 feet bgs. In addition, confirmatory samples for TCL VOCs, TCL SVOCs, TOC, TCN were collected at these locations.

- Two test trenches were excavated to confirm the location of the gas holder in the western part of the core area.

- An 8-hour soil gas sample was collected from beneath the slab of the building to the east of the site using a 6-liter Summa canister. The sample was analyzed for TO-15.

- Sediment sampling was attempted using a slide-hammer coring device with a check valve. The check valve blocked sufficient intake of sediment, so a spade shovel was used to collect sediment from 0 to 6 inches, and a sample was collected from the sediment which was not in direct contact with the shovel.

- Five surface water samples were collected from upstream, along the site, and downstream of the site, and were analyzed for TCL VOCs, TCL SVOCs, and TCN.

- Monitoring wells MW-5 and MW-6 were installed to characterize the groundwater in the central area of the site.

- Three shallow monitoring wells (MW-7S, MW-8S, and MW-9S) and three deep monitoring wells (MW-7D, MW-8D, and MW-9D) were installed in soil borings to further delineate the extent of MGP-impacts.

In May and November 2009, additional sampling was conducted. A sub-slab soil vapor sample was collected from below the slab of the building located on the adjacent property to the east in May 2009. In November 2009, three soil borings were advanced on an off-site property to the east of the Site across the Patchogue River. A sub-slab soil vapor port was installed in the building on the adjacent property to the east and samples were collected from the sub-slab soil vapor, the indoor air, and the ambient air.

2.2 Field Methods/Procedures

2.2.1 Installation of Soil Borings

During the RI, 37 soil borings were installed to delineate the lateral and vertical extent of MGP-related impacts. The locations of surface soil samples and soil borings are depicted on Figures 2-1 and 2-2, respectively. Soil borings were completed using direct push technology and soil boring logs are presented in Appendix A. Details regarding specific borings are presented below.

Results from the PSA indicated MGP-related impacts in the vicinity of the former MGP structures at the site. During the RI, 13 soil borings (PASB-20, PASB024, PASB-27, PASB-28, PASB-28A, PASB-29, PASB-30, PASB-31, PASB-31A, PASB-32, PASB-33, PASB-42, and PASB-43) were advanced approximately 15 to 25 feet bgs in the vicinity of these structures. Soil samples were collected from the top 0 to 2 inches (for development of the QHHEA), 0 to 0.5 feet (for development of the FWRIA), at the interval showing greatest potential of MGP impacts (based on visual examination and PID readings) and at the deepest sampling interval (bottom delineation). In the event

visual examination and PID screening indicated no evidence of impacts, a sample was collected immediately above the water table.

One boring (PASB-23) was advanced approximately 25 feet bgs at the southern terminus of test trench C-C'. One soil sample was collected at the interval showing greatest potential of MGP impacts (based on visual examination and PID readings). In the event visual examination and PID screening indicated no evidence of impacts, a sample was collected immediately above the water table.

One soil boring was advanced near each of four PSA locations, PASB-04, PASB-05, PASB-06, and PASB-07 (RI borings PASB-25, PASB-22/PASB-22A, PASB-26 and PASB-21, respectively), to vertically delineate potential MGP-related impacts observed at these locations during the PSA. Soil samples were collected from the top 0 to 2 inches (for development of the QHHEA), 0 to 0.5 feet (for development of the FWRIA), at the interval showing greatest potential of MGP impacts (based on visual examination and PID readings) and at the deepest sampling interval (bottom delineation).

Three soil borings (PASB-16, PASB-17, and PASB-18) were advanced to a depth of 10 feet bgs except for PASB-18 which went to 7.5 feet bgs along the southeastern boundary of the site. The lithology at these locations was visually characterized, and visual and PID screening were conducted for MGP-related impacts. In addition, one sample was collected from PASB-16 and analyzed for TCL VOCs, TCL SVOCS, TOC, and TCN.

One boring (PASB-19) was advanced to 10 feet bgs adjacent to PASB-10 to verify the mercury results reported in the PSA (VHB, 2002) for subsurface soil at this location. One soil sample was collected at the 2-4 feet bgs interval, and one sample was collected at the bottom of the boring. These samples were analyzed for mercury only.

One boring (PASB-34) was advanced to 25 feet bgs on the southern part of the northern area to delineate impacts upgradient of PASB-31. The soil was screened for MGP-related impacts. One sample was collected from 4 to 6 feet bgs and analyzed for TCL VOCs, TCL SVOCs, TOC, and TCN.

Nine borings (PASB-35, PASB-36, PASB-37, PASB-38, PASB-39, PASB-40, PASB-41, PASB-44, and PASB-45) were advanced to 25 feet bgs to delineate MGP-related impacts on the adjacent property east of the core area. Soil samples were collected from these borings and analyzed for TCL VOCs, TCL SVOCs, TOC, and TCN.

One soil boring (PASB-46) was advanced to 25 feet bgs in the western part of the core area downgradient of the former gas holder to delineate MGP-related impacts. Soil samples were collected from the top 0 to 2 inches and 0 to 6 inches and from 6 to 8 feet bgs and analyzed for TCL VOCs, TCL SVOCs, TOC, and TCN.

Three soil samples (PASB-23-15-20, PASB-24-10-15, and PASB-27-15-20) were also analyzed for geotechnical parameters (grain size, porosity, specific gravity and bulk density). The soil boring locations are presented on Figure 2-2.

Three soil borings (PASB-47, PASB-48, and PASB-49) were advanced 20 feet bgs on the off-site property located east of the Patchogue River across from the Site to delineate MGP-related impacts. Soil samples were not collected because MGP-related impacts were not identified based on field screening techniques.

2.2.2 Test Trenches

As part of the RI, two test trenches, Trench 1 and Trench 2, were extended west to east and southwest to northeast, respectively, to determine the location of the former gas holder. The locations of the test trenches are presented on Figure 2-3 and test trench logs are in Appendix B.

2.2.3 Installation of Monitoring Wells

Fourteen monitoring wells were installed at the site during the RI. Appendix C contains the monitoring well construction diagram for each monitoring well installed during the RI. MW-1 was installed upgradient of the former gas holder area in the northern area and MW-3, MW-4S, and MW-4D were installed downgradient of this area in the core and southern areas. MW-2S and MW-2D were installed in the northwest corner of the core area to monitor upgradient water quality. MW-5 and MW-6 were installed in the core area of the site in the visually impacted area. MW-7S and MW-7D were installed in the western part of the core area downgradient of the former holder. MW-8S, MW-8D, MW-9S, and MW-9D were installed east of the core area of the site on the adjacent property.

The monitoring wells were logged by a geologist during installation. If any visual impacts or PID readings above background were encountered during installation, a soil sample was collected and submitted for TCL VOCs, TCL SVOCs, TOC, and TCN. Installation was accomplished using direct push methods. The shallow and deep monitoring wells were installed as 2-inch PVC wells with 0.020-inch slotted screens. The screened intervals are as follows:

- MW-1: 7 to 12 feet bgs
- MW-2S, MW-3, and MW-4S: 5 to 10 feet bgs
- MW-2D, MW-4D, MW-7D, MW-8D, and MW-9D: 20 to 25 feet bgs
- MW-5: 5 to 15 feet bgs
- MW-6: 5 to 20 feet bgs
- MW-7S, MW-8S, and MW-9S: 4 to 9 feet bgs

The monitoring well locations are presented on Figure 2-4.

2.2.4 Low-Flow Groundwater Sampling

The 14 monitoring wells were sampled to evaluate groundwater quality. A full round of synoptic groundwater level measurements was collected prior to sampling. Non-aqueous

phase liquid (NAPL) was not observed in any of the monitoring wells. Each monitoring well was screened with a PID immediately upon opening the casing.

Groundwater sampling was performed following low-flow sampling techniques using a peristaltic pump, and the following parameters were recorded via field instrumentation until stabilization requirements were met: temperature, redox potential, dissolved oxygen, pH and turbidity. Groundwater samples were collected using a dedicated bailer and analyzed for TCL VOCs, TCL SVOCs, and TCN at a NYSDOH/ELAP certified laboratory. Purge water was collected in five-gallon buckets and transferred to 55-gallon steel drums for disposal.

2.2.5 Sediment Sampling

The sediment in the Patchogue River was probed in transects at regular intervals, spaced approximately 20 feet apart, by inserting a threaded metal rod 1 to 2 feet into the sediment and observing the occurrence of sheens which may be related to MGP impacts. The probing was conducted along the reach extending from a point upstream of PASW/SD-1 at the crossing of West Main Street to a point downstream of PASW/SD-3 in proximity to the Long Island Railroad crossing (approximately 0.25 miles downstream of the site) (Figure 2-5).

Eleven RI sediment grab samples (ten samples and one duplicate) were collected from Patchogue River based on the results of the probing (Figure 2-6). Four sediment samples (SED-1 to SED-4) were collected upstream of the site. These background samples were located to evaluate the influence of both non-point and point sources upgradient of the site on the river, and their location was determined during the field investigation. Six (SED-5 to SED-10) samples were collected adjacent to the site or downstream of the site. These locations were determined based on results of the sediment probing. All sediment samples were analyzed for BTEX, PAHs, and TCN.

2.2.6 Surface Water Sampling

Per NYSDEC request, five surface water samples were collected during the RI. Two samples (SW-1 and SW-2) were collected upgradient of the site, and three samples (SW-3, SW-4, and SW-5) were collected sidegradient or downgradient of the site (Figure 2-7). All surface water samples were analyzed for TCL VOC, TCL SVOCs and TCN.

2.2.7 Soil Vapor Samples

One soil vapor sample (SV-1) was collected from beneath a slab located on the northern area during the February 2008 RI. Based on discussions with NYSDOH, five additional sample locations for soil vapor were proposed prior to the sampling in July 2008. Due to the groundwater level, four of the five locations could not be completed. The fifth location, SV-6, was collected from beneath the slab of the building located on the adjacent property to the east. A third sample, SV-07, was collected on May 12, 2009

from beneath the slab of this same building. In November 2009, a permanent sub-slab vapor port was installed in the vicinity of SV-07. A sub-slab soil vapor sample (SV-8), an indoor air sample (IA112509), and an ambient air sample (AA112509) were collected from the building on the adjacent property to the east. All of the soil vapor and air samples were analyzed for TO-15 (Figure 2-8).

2.2.8 Surveying

A New York State licensed land surveyor was retained to survey the vertical and horizontal locations of the RI monitoring wells, soil borings, sediment sample locations, surface water sample locations, and soil vapor sample locations and other pertinent site features/information essential for completion of this RIR. In addition, the elevation of a reference point for each monitoring well (the top of the well casing) was surveyed to aid in determining groundwater elevations. A topographic survey was conducted on January 29 and 30, 2008. A survey of the off-site property and the soil borings advanced in November 2009 was completed and incorporated into the figures presented in this RI report.

3.0 Site Geology and Hydrogeology

3.1 Geology

The site is essentially flat and has an elevation of less than 10 feet msl. Three geotechnical samples (PASB23-15-20, PASB24-10-15, and PASB27-15-20; see Figure 2-1) were collected during the RI and analyzed for grain size, bulk density, porosity and specific gravity. Results of these analyses are included in Appendix D. The three geotechnical samples are described as tan, poorly graded sand. Bulk density in the three samples ranged from 103.3 pounds per cubic foot (pcf) to 112.7 pcf. Porosity ranged from 0.338 to 0.398, and specific gravity ranged from 2.73 to 2.76.

Cross-Sections A-A' and B-B' (located on Figure 2-2) are presented on Figures 3-1 and 3-2, respectively. Cross-Section A-A' transects the central portion of the site, from PASB-24 in the north to PASB-22 in the south. Cross-Section B-B' transects the central portion of the site, from MW-2D in the west to PASB-40 in the east. As depicted in Figures 3-1 and 3-2, fill consisting of sand, silt, gravel and debris covers the top 2 to 5 feet of the central portion of the site. Peat was observed in the top 2 feet of the western portion of the site, near MW-2D. Below the fill and peat, sand was encountered to the bottom of the borings, approximately 25 feet bgs.

3.2 Hydrogeology

Nine shallow monitoring wells and five deep monitoring wells were installed during the RI. The shallow monitoring wells were screened across the water table and the deep monitoring wells were screened approximately 20 to 25 feet bgs. Groundwater levels measured on July 14, 2008 in the shallow monitoring wells ranged from 2.78 feet msl (MW-4S) to 5.41 feet msl (MW-1) (see Table 3-1). The groundwater flows in a south-southeast direction towards the Patchogue River (see Figure 3-3). The groundwater in the deep monitoring wells ranged from 2.86 feet msl (MW-2D) to 4.43 feet msl (MW-4D). Groundwater also flows south-southeast towards MW-4D in the deeper zone.

On-site groundwater is not currently used as a drinking water source, nor is it expected to be in the future. The Village of Patchogue relies on a public water source (e.g., a municipal supply system) for potable water use which relies on a single-source aquifer. In addition, the Village of Patchogue's Department of Public Works (DPW) indicated that the installation of private wells on-site (or anywhere within the Village) is prohibited. A well search was conducted at the NYSDEC Region 1 Headquarters for wells within a 1-mile radius from the center of the Site. Figure 3-4 shows the results of the well search and Appendix E contains the well records for the applicable wells.

A public supply well (Well No. 60486) was located southwest of the Site. This public supply well would not be impacted by contaminants present in the groundwater at the Site because groundwater is flowing from the Site in a south-southeast direction. Fourteen wells were identified as "other" because their uses ranged from air conditioning to test wells. Four wells were identified as potable wells. Two of these wells are located north or northeast of the Site; therefore, groundwater contaminants will not impact them.

The other two wells are located south-south and southeast of the Site. Both of the wells were installed in the early 1980s and information was not available indicating whether they are currently used as a potable water source. The well southeast of the Site, Well No. 72499, is across the Patchogue River approximately 330 feet from the site boundary and the well south of the Site, Well No. 71407, is approximately 1,050 feet from the site boundary. The contaminants present in groundwater at the Site will diminish before impacting either of these wells.

4.0 Nature and Extent

All the samples collected during the RI were collected in accordance with the RIWP and QAPP and were analyzed by a NYSDOH/ELAP certified laboratory. The laboratory data were validated and a Data Usability Summary Report (DUSR) for the RI data is included in Appendix F. The laboratory data Form 1s are provided in Appendix G.

The analytical data received from the certified laboratory was compared against applicable United States Environmental Protection Agency (USEPA) and NYSDEC regulatory standards and guidelines. A summary of these standards and guidelines used to evaluate the specific data are described individually below.

- *Soil Data* – Analytical results for soil samples were compared to NYSDEC Remedial Program Soil Cleanup Objectives, which are divided into three separate criteria – Protection of Public Health (Commercial), Protection of Ecological Resources, and Protection of Groundwater. All three criteria are included in the tables. Shading in the tables indicates an exceedance of at least one of the three criteria.

- *Groundwater Data* –Analytical results for groundwater samples were compared to NYSDEC Ambient Water Quality Standards and Guidance Values for Class GA Groundwater. Shading in the tables indicates an exceedance of this criterion.

- *Sediment Data* – Analytical results for sediment samples were compared to NYSDEC Most Stringent Sediment Criteria presented in the NYSDEC Technical Guidance for Screening Contaminated Sediments. Shading in the tables indicates an exceedance of this criterion.

- *Surface Water* – Analytical results for surface water samples were compared to NYSDEC Ambient Water Quality Standards and Guidance Values for Class C Surface Waters. Shading in the tables indicates an exceedance of this criterion.

- *Soil Vapor* – Analytical results for soil vapor samples were compared to *NYSDOH 2003: Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes, Indoor Air and Outdoor Air* (NYSDOH, 2006). The 25th to 95th percentile ranges are presented in the table for both indoor and outdoor air. Bold in the table indicates an exceedance of the 95th percentile for outdoor air and shading in the table indicates an exceedance of the 95th percentile for indoor air.

4.1 Soil Borings

4.1.1 Surface Soil Samples

A total of 32 surface soil samples were collected during the RI from the interval 0 to 6 inches bgs. Some were collected from the top 2 inches (for development of the QHHEA), and some were collected from the 0 to 6-inch interval (for development of the FWRIA). The surface soil samples were analyzed for TCL VOCs, TCL SVOCs and TCN. Tables 4-1, 4-2, 4-3 and 4-4 present the laboratory results for these analyses. Figure 4-1 depicts each surface soil sample location, as well as the total BTEX and total PAHs for each sample.

Total BTEX ranged from non-detect in 31 of the 32 samples to 0.175 mg/kg in sample PASB-30-0-0.2 (Tables 4-1 and 4-2, and Figure 4-1). Total PAHs ranged from non-detect in three samples to 168.1 mg/kg in sample PASB-28-0-0.2, which was collected from 0 to 2 inches bgs. The next highest concentration of total PAHs in surface soil was 148 mg/kg in sample PASB-33-0-0.2. Samples were collected from the 0 to 6-inch interval from both locations. Total PAHs in both samples were found to be less than 100 mg/kg. Total carcinogenic PAHs (CaPAHs) ranged from non-detect in eight samples to 88 mg/kg in sample PASB-28-0-0.2. 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 during the RI from the northern area of the site. Laboratory analysis of surface soil sample PASS-01 collected during the PSA did not reveal the presence of any constituents above NYSDEC soil criteria.

Olfactory impacts were identified in the surface soil samples collected from the core area during the RI. None of the surface soil samples collected from the core area were found to contain constituents above NYSDEC soil criteria, except PASB-23-0-0.2. Methylene chloride was detected in this sample above NYSDEC soil criteria for protection of groundwater.

None of the surface soil samples collected from the southern area were found to contain constituents above NYSDEC soil criteria, nor were any visual or olfactory impacts identified during the RI or PSA.

4.1.2 Subsurface Soil Samples

A total of 58 subsurface soil samples were collected during the RI. The subsurface soil samples were analyzed for TCL VOCs, TCL SVOCs, and TCN. Tables 4-5, 4-6, and 4-7 present the laboratory results for these analyses. Tables 4-8, 4-9, 4-10, and 4-11 present the laboratory results for TOC, PCBs, metals and mercury detected in subsurface soil. Figures 4-2 and 4-3 depict each subsurface soil sample location, as well as the total BTEX and total PAHs for each sample.

The highest concentrations of BTEX and PAHs were detected in subsurface soil in the core area. Total BTEX ranged from non-detect in 40 of the 58 samples to 342.1 mg/kg in sample PASB-25-1-6 (Tables 4-5 and 4-6 and Figures 4-2, 4-3, and 4-4). Total PAHs ranged from non-detect in 16 samples to 16,410 mg/kg in sample PASB-22-3-5, which was collected from 3 to 5 feet bgs. The next highest concentration of total PAHs in subsurface soil was 7,596 mg/kg in sample PASB-25-1-6. Total CaPAHs ranged from non-detect in 29 samples to 2,670 mg/kg in sample PASB-22-3-5. Cyanide concentrations in the 58 subsurface soil samples ranged from non-detect in 50 samples, to 5.74 mg/kg in sample PASB-41-6-8.

No visual or olfactory impacts were identified in the subsurface soil samples collected from the northern area during the RI, and analytical results for these samples did not indicate impacts.

The boring logs from the sample locations in the core area indicate the core area is impacted with residual MGP impacts, including staining, sheen, blebs, lenses and coating. This area generally corresponds with the historical location of the gas holder, purifier house, and oil tanks. Within this area, tar saturated soil or solid tar was observed in subsurface soil at PASB-05, PASB-06, PASB-22, and PASB-29. Petroleum impacted subsurface soils were observed in the off-site portion of the core area at PASB-41, PASB-44, and PASB-45.

None of the sample locations in the southern area exhibited residual MGP impacts. None of the subsurface soil samples collected from the southern area were found to contain constituents above NYSDEC soil criteria, except PASB-MW4D-5-10. Acetone was detected in this sample above NYSDEC soil criteria for protection of groundwater.

None of the sample locations across the Patchogue River from the Site to the east exhibited residual MGP impacts. Therefore, soil samples were not collected from these borings.

Samples were not collected from test trenches during the RI. However, samples were collected from test trenches during the PSA and this data is presented on Figure 4-4.

4.2 Low Flow Groundwater Sampling

Two rounds of groundwater samples were collected from the 14 monitoring wells installed during the RI. The first round of sampling was conducted in March 2008 on all of the monitoring wells that had been installed to date (MW-1, MW-2S, MW-2D, MW-3, MW-4S, MW-4D, MW-5, and MW-6). The second round of sampling was conducted in July 2008, and included all 14 monitoring wells. Each groundwater sample from both rounds was analyzed for TCL VOCs, TCL SVOCs, and TCN. Total BTEX and Total PAH results are shown on Figure 4-5.

Laboratory analysis of the samples collected from several wells did not detect any constituents (VOC, SVOC or cyanide) above NYSDEC Water Quality Standards for

Class GA Groundwater (Tables 4-12, 4-13, and 4-14). These monitoring wells are MW-1 (two rounds of sampling), MW-2S (two rounds of sampling), MW-2D (two rounds of sampling), MW-4S (two rounds of sampling), MW-4D (two rounds of sampling), MW-7S (one round of sampling), MW-7D (one round of sampling), MW-8S (one round of sampling), MW-8D (one round of sampling) and MW-9D (one round of sampling).

Trichloroethene was detected above NYSDEC Water Quality Standards for Class GA Groundwater in the sample collected from MW-3 during both rounds of sampling. Specifically, trichloroethene was detected at 7.4 J ug/L in March 2008 and 5.1 ug/L in July 2008, both above the standard of 5 ug/L.

During both rounds of sampling in samples from MW-5, several BTEX and SVOCs were detected at concentrations above NYSDEC Water Quality Standards for Class GA Groundwater. Benzene, toluene, ethyl benzene, m/p-xylenes, o-xylene and isopropylbenzene were detected above standards. In addition, acetophenone, naphthalene, 1,1-biphenyl, acenaphthene, fluorine, phenanthrene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene and indeno(1,2,3-cd)pyrene were detected above their standard.

During the first round of sampling in samples from MW-6, several BTEX and PAHs were detected at concentrations above NYSDEC Water Quality Standards. Benzene, ethyl benzene, m/p-xylenes, o-xylene and isopropylbenzene were detected above standards. These compounds were not detected above standards during the second round of groundwater sampling. In addition, 1,1-biphenyl, acenaphthene, phenanthrene, benzo(a)anthracene and chrysene were detected above their standards.

MW-9S exhibited concentrations of acetone above standards during the second round of sampling. Acetone was detected at a concentration of 200 ug/L and 250 ug/L in its duplicate sample, above the NYSDEC Water Quality Standard of 50 ug/L.

4.3 Sediment Sampling

On February 6, 2008, representatives of the NYSDEC and the Suffolk County Department of Health observed the probing of sediments downgradient of the former WWTP outfall. Probing of the sediment was conducted for a distance of 440 feet downstream of the WWTP. The sediments on each side of the Patchogue River were probed every 20 feet (Figure 2-2). A description of the observations is included in Appendix H. In general, 2 to 3 feet of soft sediment were encountered.

In the study area, the Patchogue River is approximately 2 to 3 feet deep with occasional deeper areas. Fallen trees are present along much of the reach. The substrate varies from packed sand and gravel to soft sediment. Sporadic sheens diminished downstream, with a slight indication occurring at 440 feet below the WWTP. The river 1/4 mile downstream, near the railroad and Division Street, had apparently been dredged and was too deep to be readily accessible.

Slight to heavy sheens were observed along much of the riverbed, however these areas did not exhibit the odors that are typically associated with MGP impacts. Sediment samples were collected from the first upstream transect (SED-5), as well as from a location adjacent to the storm drain outfall from the parking lot east of the site (SED-7). Three sediment sample locations (SED-6, SED-8, and SED-9) correspond with locations where heavy sheen was observed during probing. One sediment sample (SED-10) was also collected downstream, near the Long Island Railroad abutment.

Four sediment sample locations (SED-1, SED-2, SED-3, and SED-4) were upstream of the site, north of the study area. Upstream samples were collected from just above the West Main Street bridge and just below the bridge near a small outfall pipe. Two sediment samples were collected from Patchogue Lake, the river's headwaters to the north. Typically the sediment samples were high in sand composition, sometimes with organic silts. There were no visual impacts.

All sediment samples were analyzed for BTEX, PAHs, and TCN. Tables 4-15 to 4-17 present the laboratory data results, and compare them to the NYSDEC Most Stringent Sediment Criteria (MSSC). None of the sediment samples were found to contain BTEX or cyanide above the MSSC. Figure 4-6 depicts Total BTEX and Total PAH results.

Several of the sediment samples were found to contain PAHs above MSSC. Specifically naphthalene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene and indeno(1,2,3-cd)pyrene were detected in at least one sediment sample above MSSC. Naphthalene and acenaphthene were only detected above MSSC in one sample (PASED5 at 1.6 J mg/kg, and 2.5 J mg/kg, above the MSSC of 0.3 mg/kg and 1.4 mg/kg, respectively). Fluorene concentrations in sediment ranged from non-detect to 3.2 mg/kg, and was detected twice (PASED5 and PASED7) above MSSC. Phenanthrene was detected three times above the MSSC of 1.2 mg/kg, with concentrations ranging from non-detect to 19 mg/kg. Anthracene was detected three times (PASED3, PASED5 and PASED7) above MSSC of 1.07 mg/kg, with concentrations ranging from non-detect to 5.2 mg/kg. Fluoranthene was detected twice (PASED3 and PASED5) above the MSSC of 10.2 mg/kg, with concentrations ranging from non-detect to 26 mg/kg. Pyrene was detected in two samples (PASED3 and PASED5) above the MSSC of 9.61 mg/kg, with concentrations ranging from non-detect to 25 mg/kg. Benzo(a)anthracene was detected in eight sediment samples above the MSSC of 0.12 mg/kg, with concentrations ranging from non-detect to 11 mg/kg. Chrysene was detected in eight samples above the MSSC of 0.013 mg/kg, with concentrations ranging from non-detect to 12 mg/kg. Benzo(b)fluoranthene was detected in eight sediment samples above the MSSC of 0.013 mg/kg, with concentrations ranging from non-detect to 9.6 mg/kg. Benzo(k)fluoranthene was detected in seven sediment samples above the MSSC of 0.013 mg/kg, with concentrations ranging from non-detect to 3.4 mg/kg. Benzo(a)pyrene was detected in eight sediment samples above the MSSC of 0.013 mg/kg, with concentrations ranging from non-detect to 8.1 mg/kg. Indeno(1,2,3-cd)pyrene was detected in eight sediment samples above the MSSC of 0.013 mg/kg, with concentrations ranging from non-detect to 5.7 mg/kg.

4.4 Surface Water Sampling

Five surface water samples (and one duplicate) were collected during the RI and analyzed for TCL VOCs, TCL SVOCs, and TCN. Figure 2-7 presents the surface water sampling locations. Tables 4-18 to 4-20 present the detected compounds and compare them to the NYSDEC Water Quality Standards for Class C Surface Water. None of the samples were found to contain any constituents above these criteria. In fact, toluene was the only compound that was detected, at a concentration of 2.4 ug/L, which is less than half the maximum contaminant level for toluene (5 ug/L) in drinking water Also, MGP-related contamination was not detected in the next samples downstream, less than 200 feet away. Figure 4-7 depicts the Total BTEX and Total PAH results.

4.5 Soil Vapor Sampling

Four soil gas samples were collected, one from beneath the concrete slab of a former building on-site (SV-1 in the northern area), and three samples (SV-6, SV-7, and SV-8) were collected from beneath the concrete slab of the building located off-site to the east of the core area (see Figure 2-8). The first soil gas sample was collected on January 31, 2008, the second soil gas sample was collected on July 11, 2008, the third soil gas sample was collected on May 12, 2009, and the fourth soil gas sample was collected on November 25, 2009. The samples were collected in accordance with the RIWP and QAPP and analyzed for VOCs using TO-15.

Six VOCs were detected in SV-1 above Outdoor Air criteria ranging in concentration from 2.73 ug/m^3 (1,1,1-trichloroethane) to 271.96 ug/m^3 (dichlorodifluoromethane) and three of these VOCs were also above Indoor Air criteria. Eleven VOCs were detected in SV-6 above Outdoor Air criteria ranging from 2.34 ug/m^3 (styrene) to 162.01 ug/m^3 (acetone) with eight of these VOCs also above Indoor Air criteria. Three VOCs, 1,1,1-trichloroethane, tetrachloroethene, and trichloroethene, were detected above Outdoor Air criteria in sample SV-7 with concentrations of 4.15 ug/m^3, 9.22 ug/m^3, and 21.6 ug/m^3, respectively. Tetrachloroethene and trichloroethene also exceeded Indoor Air criteria in SV-7. Twenty VOCs were detected in SV-8 above Outdoor Air criteria ranging in concentration from 0.84 ug/m^3 (1,4-dichlorobenzene) to 87.4 ug/m^3 (acetone) with five of the 20 VOCs also above Indoor Air criteria. Table 4-21 presents the laboratory data and criteria for VOCs from the soil gas sampling.

The indoor air sample was compared to Indoor Air criteria only and one VOC, 1,4-dichlorobenzene, was detected above criteria with a concentration of 4.93 ug/m^3. 1,4-Dichlorobenzene was not detected in the ambient air sample but has been detected intermittently in the soil gas samples. The ambient air sample was compared to Outdoor Air criteria only and nine VOCs were detected above criteria ranging in concentration from 0.85 ug/m^3 (styrene) to 35.3 ug/m^3 (1,2,4-trimethylbenzene). Table 4-21 presents the detections for the indoor and ambient air samples.

5.0 Conceptual Site Model

This section presents a conceptual site model (CSM) in Figure 5-1, which describes on-site areas impacted by MGP and dissolved BTEX and PAHs, as well as the transport mechanisms associated with these compounds.

5.1 Introduction

The CSM is based on qualitative and quantitative investigation results from the PSA and RI. Operations at the site began about 1904 and continued until 1976. During that time, the site was used as a high pressure gas storage and distribution facility, as well as an emergency water gas production facility.

5.2 MGP Sources of Contamination

Releases from process equipment, tanks and piping during the transfer and distribution process may have resulted in MGP residuals impacting the site soils. Based on the physical and chemical distribution of contaminants identified in the RI, it appears most of the MGP impacted area corresponds with the former gas holder, purifier house, and oil tanks in the core area.

The investigation results indicate surface soil, soil vapor, sediment and surface water are not significant contaminant transport mechanisms and thus are not considered below.

5.3 Hydrogeologic Setting

As part of the RI, nine shallow monitoring wells and five deep monitoring wells were installed. Groundwater levels in the shallow monitoring wells ranged from 2.78 feet msl (MW-4S) to 5.41 feet msl (MW-1), with groundwater flow towards the Patchogue River in a south-southeast direction. The groundwater in the deep monitoring wells ranged from 2.86 feet msl (MW-2D) to 4.43 feet msl (MW-4D), and also indicate flow in a south-southeast direction.

Fill consisting of sand, silt, gravel and debris covers the top two to five feet of the central portion of the site. Peat was observed in the top two feet of the western portion of the site, near MW-2D. Below the fill and peat, sand was encountered to the bottom of the borings, approximately 25 feet bgs.

5.4 Fate and Transport of MGP Impacts in the Subsurface

MGP-related substances such as tar or oil discharged at the site will migrate vertically through the soil column. As it migrates downward, some becomes trapped in the pore spaces of the site sands. More dense MGP substances, such as tar, continue migrating downward below the water table due to the force of gravity. As the tar enters the water table, it disperses laterally in the direction of groundwater flow, in addition to vertically downward.

5.5 Summary of MGP-Related Impacts

As reflected in Figure 5-1, MGP-related impacts (specifically tar staining, sheen and tar/naphtha odors) were observed in borings PASB-04, PASB-05, PASB-06, PASB-22A, PASB-20, PASB-25, PASB-29, PASB-30, PASB-31, PASB-31A, PASB-33, PASB-36, PASB-40, and PASB-42. These locations generally correspond with the former locations of the gas holder, purifier house boiler, and oil tanks in the core area. These impacts were identified in the subsurface sand, predominantly in the top 11 feet of soil. However, sheens and staining extend approximately 15 feet bgs surrounding PASB-25, and 20 feet bgs surrounding PASB-30. A second source area was identified in the vicinity of PASB-41, PASB-44, and PASB-45 as shown on Figure 5-1. Based on the field screening results, these impacts are likely petroleum-related impacts.

Saturated tar or solid tar was observed in soil borings PASB-5, PASB-22 and PASB-29. These locations correspond with the former locations of the purifier house and oil tanks.

Based on the observations and laboratory data from the soil borings along the eastern property border in the core area, there has been some limited migration of MGP-related material from the site to the east. MGP impacts on-site are concentrated in the northeastern portion of the core area, in the vicinity of the historic structures (gas holder, purifier house, and oil tanks) associated with MGP production.

5.6 Fate and Transport of Dissolved Phase BTEX and PAHs

Although a small portion of BTEX and PAHs in surface soils will volatilize, the main transport or migration pathway is through dissolution due to direct infiltration of precipitation and groundwater flow. In soils with relatively low TOC content, such as sand, soluble organic compounds such as BTEX and low molecular weight PAHs tend to stay in solution and migrate with groundwater flow. High molecular weight PAHs which are less soluble tend to remain relatively immobile.

5.7 Summary of Dissolved BTEX and PAH Distribution

As reflected in Figures 4-1, 4-2, and 4-3, total BTEX is below 1,000 mg/kg across the site. However, as shown in Figure 5-1, total PAHs in soil exceeded 1,000 mg/kg in soil borings PASB-5 (at 5-7’ bgs), PASB-22 (at 3-5’ bgs), PASB-25 (at 1-6’ bgs), PASB-26 (at 4-6’ bgs), PASB-30 (at 4-6’ bgs), and PASB-36 (at 6-8’ bgs). These locations generally correspond with the former locations of the purifier house and oil tanks in the core area. Soil samples collected at each of these locations from intervals deeper than those listed above are less than 1,000 mg/kg for total PAHs.

6.0 Exposure Assessment

A QHHEA and a FWRIA were conducted as part of the RI. This section discusses the results of these assessments.

6.1 Qualitative Human Health Exposure Assessment

A QHHEA was conducted to evaluate the complete and potentially complete pathways associated with human exposure to identified chemicals of potential concern (COPCs) at the site. The QHHEA describes the potential for contact between the current and potential future site users (herein referred to as "receptors") and the exposure media found to be impacted by past operations at the site. The QHHEA is based on the sampling performed for the PSA conducted in March 2002 by Vanasse Hangen Brustlin, Inc. (VHB) and the sampling conducted as part of the RI. Additional information with respect to site conditions and the potential for exposure was compiled during visits to the site by TtEC staff during 2008. The results of the QHHEA will be used to support future site management decision-making.

This QHHEA presents: (1) a summary of the sampling and laboratory analyses that have been performed relative to the identified exposure media; (2) a conceptual site model of current and potential future exposures at the site; and (3) a detailed description of the receptors and the scenarios by which these site users may be exposed to the COPCs identified for the site.

6.1.1 Analytical Results

Detected analytes were defined as those concentrations indicating a qualifying code of "J" (estimated), "D" (diluted sample), or without any qualifying code within both the 2001 PSA (provided in Appendix I) and the 2008 RI data. Analytes with a qualifying code of "R" were not used.

The following subsections present the results of a comparison of the sampling data to appropriate NYSDEC criteria and/or standards protective of public health (specific to a commercial worker), groundwater, surface water, sediment, and air for each associated exposure medium sampled (NYSDEC, 1999, 2006, 2008b, 2008c). Samples with concentrations exceeding one or more of the applicable criteria are identified for each chemical family (e.g., VOCs, SVOCs, and total metals). Neither TCN nor PCBs had any detections exceeding the NYSDEC criteria within any of the media sampled.

Sample locations are identified for each chemical exhibiting an exceedance of the criteria. The location ID is noted following the hyphen. For example, sample location "PASB-03" is the third soil boring collected at the site. Groundwater sample IDs may or may not include an "S" or "D", indicating a "shallow" or "deep" sample, respectively. In addition, test trench samples include "A", "B", or "C" to indicate the test trench from which the sample was collected.

6.1.1.1 Surface Soil

Table 1 summarizes the results of the PSA and RI sampling with respect to the surface soil based on a comparison of the detected chemicals to the available NYSDEC Soil Criteria for the Protection of Public Health and for the Protection of Groundwater (NYSDEC, 2008b):

Table 1: Comparison of Detected Surface Soil Data to NYSDEC Soil Criteria

Chemicals Exceeding NYSDEC Soil Criteria	Locations of Exceeding Criteria Protective of Public Health [Commercial]	Locations of Exceeding Criteria Protective of Groundwater
VOCs[1]		
Methylene Chloride	-	PASB-23
SVOCs [2]		
Benzo(a)anthracene	PASS-12, PASB-28, PASB-33	-
Benzo(a)pyrene	PASS-08, PASS-12, PASS-14, PASB-23, PASB-28, PASB-33	PASS-14, PASB-28, PASB-30
Benzo(b)fluoranthene	PASB-28, PASB-33	PASS-12, PASB-23, PASB-31, PASB-28, PASB-33
Benzo(k)fluoranthene	-	PASS-12, PASS-14, PASB-28, PASB-33
Dibenz(a,h)anthracene	PASS-08, PASS-12, PASB-33	-
Indeno(1,2,3-c,d)pyrene	PASS-14, PASB-28	PASS-14, PASB-28
Phenol	-	PASB-46
Naphthalene	-	PASS-14
Total Metals [3]		
Lead	-	PASS-12
Mercury	-	PASS-08, PASS-12

NOTES:
[1] Two detected VOCs did not have NYSDEC Soil Criteria Protective of Public Health (Commercial) or Groundwater
[2] Ten detected SVOCs did not have NYSDEC Soil Criteria Protective of Public Health (Commercial) or Groundwater
[3] One detected metal did not have a NYSDEC Soil Criterion Protective of Public Health (Commercial) or Groundwater and another detected metal did not have a NYSDEC Soil Criterion Protective of Groundwater

From the 2001 PSA data, three of the 13 surface soil samples (PASS-08, PASS-12, PASS-14) were identified as containing compounds with concentrations in excess of the NYSDEC soil criteria protective of Public Health and/or Groundwater (NYSDEC, 2008b). Two of these samples were collected outside of the Patchogue Former MGP Site boundary to the south, as indicated on Figure 2-1. Sampling conducted in 2008 for the RI identified 12 surface soil samples with concentrations in excess of the NYSDEC soil criteria. These samples were collected within the core area of the site as indicated on Figure 2-1.

Based on these comparisons, the potential COPCs for the surface soil with respect to the protection of public health (i.e., with respect to a potential future commercial worker) or groundwater are:

- VOCs – methylene chloride
- SVOCs – benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, phenol, and naphthalene
- Total Metals – lead and mercury

These constituents appear to be located at elevated levels primarily within the core area of the site.

6.1.1.2 Subsurface Soil

Based on subsurface soil borings, residual impacts (e.g., stained soils, sheens, tars/oils, and odors) potentially attributable to the former MGP operations were present from 3 to 20 feet bgs.

Table 2 summarizes the results of the PSA and RI sampling with respect to the subsurface soil based on a comparison of the concentration of the detected chemicals to the available NYSDEC Soil Criteria for the Protection of Public Health and for the Protection of Groundwater (NYSDEC, 2008b):

Table 2: Comparison of Detected Subsurface Soil Data to NYSDEC Soil Criteria

Chemicals Exceeding NYSDEC Soil Criteria	Locations of Exceeding Criteria Protective of Public Health [Commercial]	Locations of Exceeding Criteria Protective of Groundwater
VOCs[1]		
Acetone	-	PASB-23, PASB-29, PASB-31, PASB-35, PASB-38, PASB-40, PASB-45, PASB-46
Benzene	-	PASB-04, PASB-22, PASB-25, PASB-28, PASB-36
2-Butanone	-	PASB-45
Ethylbenzene	-	PASB-04, PASB-22, PASB-25, PASB-26, PASB-29, PASB-30, PASB-36, PASB-41, PASB-45
Toluene	-	PASB-04, PASB-22, PASB-25, PASB-28, PASB-30, PASB-36
Methylene Chloride	-	PASB-22
Xylenes	-	PASB-04, PASB-22, PASB-25, PASB-26, PASB-29, PASB-30, PASB-41
SVOCs [2]		
Acenaphthylene	-	PASB-22
Acenaphthene	PASB-25	PASB-22, PASB-25, PASB-26, PASB-30
Anthracene	PASB-22, PASB-25	PASB-22, PASB-25
Benzo(a)anthracene	PASB-04, PASB-05, PASB-25, PASB-26, PASB-28, PASB-30, PASB-31, PASB-33, PASB-36, PASB-37, PASB-41, PASB-45	PASB-22
Benzo(a)pyrene	PASB-02, PASB-03, PASB-04, PASB-05, PASB-06, PASB-08, PASB-22, PASB-25, PASB-26, PASB-28, PASB-30, PASB-31, PASB-33, PASB-36, PASB-37, PASB-41, PASB-45	PASB-04, PASB-05, PASB-14, PASB-22, PASB-25, PASB-26, PASB-28, PASB-30, PASB-36, PASB-41, PASB-45
Benzo(b)fluoranthene	PASB-02, PASB-03, PASB-04, PASB-05, PASB-06, PASB-22, PASB-25, PASB-26, PASB-28, PASB-30, PASB-33, PASB-36, PASB-37, PASB-41, PASB-45	PASB-02, PASB-03, PASB-04, PASB-05, PASB-06, PASB-22, PASB-23, PASB-25, PASB-26, PASB-28, PASB-30, PASB-31, PASB-33, PASB-36, PASB-37, PASB-41, PASB-45
Benzo(k)fluoranthene	PASB-22, PASB-33	PASB-04, PASB-05, PASB-22, PASB-25, PASB-26, PASB-28, PASB-30, PASB-33, PASB-36, PASB-37, PASB-41, PASB-45
Chrysene	PASB-04, PASB-05, PASB-25, PASB-26, PASB-30, PASB-36, PASB-45	PASB-22
Dibenz(a,h)anthracene	PASB-03, PASB-04, PASB-05, PASB-06, PASB-08, PASB-14, PASB-22, PASB-25, PASB-30, PASB-31, PASB-33, PASB-36, PASB-37, PASB-41, PASB-45	PASB-26, PASB-28
Fluoranthene	PASB-22	PASB-22

Table 2: Comparison of Detected Subsurface Soil Data to NYSDEC Soil Criteria		
Chemicals Exceeding NYSDEC Soil Criteria	**Locations of Exceeding Criteria Protective of Public Health [Commercial]**	**Locations of Exceeding Criteria Protective of Groundwater**
Fluorene	PASB-22, PASB-36	PASB-22
Indeno(1,2,3-c,d)pyrene	PASB-04, PASB-05, PASB-22, PASB-25, PASB-26, PASB-28, PASB-30, PASB-36, PASB-37, PASB-45,	PASB-04, PASB-05, PASB-22, PASB-25, PASB-26, PASB-28, PASB-30, PASB-36, PASB-45
Naphthalene	PASB-22, PASB-25, PASB-30	PASB-04, PASB-05, PASB-06, PASB-22, PASB-25, PASB-26, PASB-27, PASB-30, PASB-36, PASB-41
Phenanthrene	PASB-22, PASB-25, PASB-36	PASB-22, PASB-25
Pyrene	PASB-22, PASB-36	PASB-22
Total Metals [3]		
Arsenic	PASB-05, PASB-09	PASB-05, PASB-09
Barium	PASB-14	-
Lead	-	PASB-10, PASB-11
Mercury	PASB-10	PASB-09, PASB-10
NOTES: [1] Eight detected VOCs did not have NYSDEC Soil Criteria Protective of Public Health (Commercial) or Groundwater [2] Eight detected SVOCs did not have NYSDEC Soil Criteria Protective of Public Health (Commercial) or Groundwater [3] Six detected metals did not have a NYSDEC Soil Criterion Protective of Public Health (Commercial) or Groundwater and another detected metal did not have a NYSDEC Soil Criterion Protective of Groundwater		

Based on the 2001 PSA data, 10 of the 15 subsurface soil samples were identified as containing chemicals with concentrations in excess of the NYSDEC soil criteria protective of Public Health and/or Groundwater (NYSDEC, 2008b). These samples were collected primarily in the core area of the site. Sampling conducted in 2008 for the RI identified 20 subsurface soil samples with concentrations in excess of NYSDEC soil criteria. These samples were collected within the core area of the site as well as off-site to the east.

The potential COPCs for the subsurface soil with respect to the protection of public health (i.e., with respect to a potential future commercial worker) or groundwater are:

- VOCs – acetone, 2-butanone, benzene, toluene, ethylbenzene, xylenes, and methylene chloride
- SVOCs – acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, phenol, and pyrene
- Total Metals – arsenic, barium, lead, and mercury

These constituents appear to be located at elevated levels primarily in the core and southern portions of the site (as indicated above).

6.1.1.3 Groundwater

On-site groundwater is not presently used as a drinking water source, nor is it expected to be used in the future. The Village of Patchogue relies on public water sources for its potable water which is obtained from a single-source aquifer. A well search was conducted as discussed in Section 3.2. Based on the results of the well search, the public

supply well within a 1-mile radius of the Site will not be impacted as it is located hydraulically side-gradient of groundwater flow at the Site. The nearest potable wells will not be impacted as the contaminants present will diminish prior to impacting these wells. Although there is no potential for current or future use of groundwater at the site as a source of drinking water, there is a need to evaluate potential exposure and impact on the groundwater as a resource. This evaluation was conducted by comparing the detection concentrations of the chemicals in the groundwater to the NYSDEC Water Quality Standards (Class GA) (NYSDEC, 2008c). Table 3 summarizes the results of the PSA and RI sampling with respect to the groundwater based on this comparison:

Table 3: Comparison of Detected Groundwater Data to NYSDEC Water Quality Standards (Class GA)

Chemicals Exceeding the NYSDEC Water Quality Standard	Locations of Exceeding NYSDEC Class GA Water Quality Standards
VOCs[1]	
Acetone	PAMW-09S, PAMW-19S
Benzene	PAMW-05, PAMW-06, PAMW-07
Ethylbenzene	PAMW-05, PAMW-06, PAMW-07
Isopropylbenzene	PAMW-05, PAMW-06, PAMW-07
Toluene	PAMW-05, PAMW-07
Xylenes	PAMW-05, PAMW-06, PAMW-07
Trichloroethene	PAMW-03
SVOCs [2]	
1,1-Biphenyl	PAMW-05, PAMW-06, PAMW-07
Acenaphthene	PAMW-05, PAMW-06, PAMW-07
Benzo(a)anthracene	PAMW-05, PAMW-06, PAMW-07, PAMW-09S, PAMW-19S
Benzo(a)pyrene	PAGP-02, PAMW-05, PAMW-06, PAMW-07, PAMW-09S, PAMW-19S
Benzo(b)fluoranthene	PAGP-02, PAMW-05, PAMW-06, PAMW-07, PAMW-09S
Benzo(k)fluoranthene	PAGP-02, PAMW-05, PAMW-06, PAMW-07
Chrysene	PAMW-05, PAMW-06, PAMW-07, PAMW-09S, PAMW-19S
Dibenz(a,h)anthracene	PAMW-05, PAMW-06, PAMW-07
Fluoranthene	PAMW-05, PAMW-07
Fluorene	PAMW-05, PAMW-07
Indeno(1,2,3-c,d)pyrene	PAMW-05, PAMW-06, PAMW-07
Phenanthrene	PAMW-05, PAMW-06, PAMW-07
Phenol	PAMW-07
Pyrene	PAMW-05, PAMW-07
Naphthalene	PAMW-05, PAMW-07
Total Metals [3]	
Lead	PAGP-02, PAGP-04

NOTES:
[1] Two detected VOCs did not have NYSDEC Water Quality Standards (Class GA)
[2] Seven detected SVOCs did not have NYSDEC Water Quality Standards (Class GA)
[3] None of the detected metals did not have NYSDEC Water Quality Standards (Class GA)

Based on the 2001 PSA data, two of the seven groundwater samples (PAGP-02 and PAGP-04) were identified as containing chemicals with concentrations in excess of the NYSDEC Class GA Water Quality Standard (NYSDEC, 2008c). Sample PAGP-02 was collected in the northeast corner of the core area of the site and sample PAGP-04 was collected in the northern area of the site, as indicated on Figure 2-4. Sampling conducted in 2008 for the RI identified 5 groundwater samples with concentrations in excess of NYSDEC water quality criteria. These samples were collected within the core area of the site, as indicated on Figure 2-4.

The potential COPCs for the groundwater with respect to overall water quality are:

- VOCs – acetone, benzene, ethylbenzene, isopropylbenzene, toluene, xylenes, and trichloroethene
- SVOCs – 1,1-biphenol, acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, phenol, and pyrene
- Total Metals – lead

These constituents were located at elevated levels only at certain locations across the site (as indicated above).

6.1.1.4 Surface Water

Table 4 summarizes the results of the PSA and RI sampling with respect to the surface water based on a comparison of detected concentrations of the chemicals to the available NYSDEC Class GA Water Quality Standards (NYSDEC, 2008c).

Table 4: Comparison of Detected Surface Water Data to NYSDEC Water Quality Standards (Class GA)

Chemicals Exceeding the NYSDEC Water Quality Standard	Locations of Exceeding NYSDEC Class GA Water Quality Standards
Total Metals [1]	
Cadmium	PASW-04
Lead	PASW-04
Mercury	PASW-04
Selenium	PASW-04

NOTES:
[1] None of the detected metals did not have NYSDEC Water Quality Standards (Class GA)

From the 2001 PSA data, only one of the four surface water samples (PASW-04) was identified as containing chemicals (cadmium, lead, mercury, and selenium) with concentrations in excess of the NYSDEC Class GA Water Quality Standard (NYSDEC, 2008c). This sample, as well as the other three surface water samples, were collected in the Patchogue River, off-site to the east, as indicated on Figure 2-7. Sampling conducted in 2008 for the RI indicated that none of the surface water samples had concentrations in excess of NYSDEC water quality criteria. These RI samples were collected within the Patchogue River upstream, adjacent to, and downstream of the site, as indicated on Figure 2-7.

The only contaminants detected in surface water above NYSDEC Class GA Water Quality Standards were non-MGP-related metals, and these were only detected at one location, a ponded area south of the site (described in the PSA as the overflow pond). Furthermore, this ponded area was sampled during the PSA, but a connection to the site has not been determined. Therefore, this pathway will not be considered further.

6.1.1.5 Sediment

Table 5 summarizes the results of the PSA and RI sampling with respect to the sediment based on a comparison of detected concentrations of the chemicals to the available NYSDEC Most Stringent Sediment Criteria, based on one percent total organic carbon content (NYSDEC, 1999):

Table 5: Comparison of Detected Sediment Data to NYSDEC Most Stringent Sediment Criteria

Chemicals Exceeding the NYSDEC Most Stringent Sediment Criteria	Locations of Exceeding NYSDEC Most Stringent Sediment Criteria (Location(s) of Exceedance)
SVOCs [1]	
Acenaphthene	SED-05
Anthracene	SED-03, SED-05, SED-07
Benzo(a)anthracene	SED-03, SED-04, SED-05, SED-06, SED-07, SED-08, SED-09, SED-11
Benzo(a)pyrene	PASD-01, PASD-02, PASD-03, SED-03, SED-04, SED-05, SED-06, SED-07, SED-08, SED-09, SED-11
Benzo(b)fluoranthene	PASD-01, PASD-02, PASD-03, SED-03, SED-04, SED-05, SED-06, SED-07, SED-08, SED-09, SED-11
Benzo(k)fluoranthene	PASD-01, PASD-02, PASD-03, SED-03, SED-04, SED-05, SED-07, SED-08, SED-09, SED-11
Chrysene	SED-03, SED-04, SED-05, SED-06, SED-07, SED-08, SED-09, SED-11
Fluoranthene	SED-03, SED-05
Fluorene	PASD-01, PASD-02, PASD-03, SED-03, SED-05, SED-07
Indeno(1,2,3-c,d)pyrene	PASD-01, PASD-02, PASD-03, SED-03, SED-04, SED-05, SED-06, SED-07, SED-08, SED-09, SED-11
Naphthalene	PASD-01, SED-05
Phenanthrene	PASD-03, SED-03, SED-05, SED-07
Phenol	SED-07
Pyrene	SED-03, SED-05
Total Metals [2]	
Arsenic	PASD-01
Lead	PASD-02, PASD-03, PASD-04

NOTES:
[1] Four detected SVOCs did not have NYSDEC Most Stringent Sediment Criteria
[2] One of the detected metals did not have a NYSDEC Most Stringent Sediment Criteria

From the 2001 PSA data, chemicals with concentrations in excess of the NYSDEC Most Stringent Sediment Criteria (NYSDEC, 1999) were identified in all four sediment samples. Three of these samples were collected off-site within the Patchogue River and other sample was collected in a ponded area south of the Patchogue Former MGP Site, as indicated on Figure 2-6. Sampling conducted in 2008 for the RI identified eight sediment samples with concentrations in excess of these same NYSDEC sediment criteria. These samples were collected in the Patchogue River, as indicated on Figure 2-6.

The potential COPCs for the sediment with respect to the NYSDEC Most Stringent Sediment Criteria are:

- SVOCs – acenaphthene, anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, chrysene, fluoranthene, fluorine, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, phenol, and pyrene

- Total Metals – arsenic and lead

These constituents were located at elevated levels off-site and downstream of the site (as indicated above).

6.1.1.6 Test Trenches

Table 6 summarizes the results of the PSA sampling with respect to the test trench soil samples collected in 2001, based on a comparison of the detected concentrations of the chemicals to the available NYSDEC Soil Criteria for the Protection of Public Health and for the Protection of Groundwater (NYSDEC, 2008b):

Table 6: Comparison of Detected Test Trench Soil Data to NYSDEC Soil Criteria

Chemicals Exceeding NYSDEC Soil Criteria	Locations of Exceeding Criteria Protective of Public Health [Commercial]	Locations of Exceeding Criteria Protective of Groundwater
VOCs[1]		
Ethylbenzene	-	A`TOA`+16`E DL
SVOCs [2]		
Benzo(a)anthracene	A`TOA`+16`E DL, CTOC+30`S, C` to C`+10`N, C`+70`TO80`N	-
Benzo(a)pyrene	A`TOA`+16`E, BTOB+05`S, CTOC+30`S, C` to C`+10`N, C`+27` to C`+40`N, C`+70`TO80`N	A`TOA`+16`E
Benzo(b)fluoranthene	A`TOA`+16`E, CTOC+30`S, C`TOC`+10`N, C`+70`TO80`N	A`TOA`+16`E, BTOB+05`S, C`+27` to C`+40`N, CTOC+30`S, C`TOC`+10`N, C`+70`TO80`N
Benzo(k)fluoranthene	A`TOA`+16`E	A`TOA`+16`E, CTOC+30`S, C` to C`+10`N, C`+27` to C`+40`N, C`+70`TO80`N
Chrysene	A`TOA`+16`E	-
Dibenz(a,h)anthracene	A`+16`E, CTOC+30`S, C` to C`+10`N, C`+70`TO80`N	-
Indeno(1,2,3-c,d)pyrene	A`TOA`+16`E	-
Total Metals [3]		
Arsenic	A`TOA`+16`E, C`+27`TO40`N, C`+70`TO80`N	A`TOA`+16`E, C`+27`TO40`N, C`+70`TO80`N
Mercury	BTOB+05`S	BTOB+05`S

NOTES:
[1] All of the detected VOCs had NYSDEC Soil Criteria Protective of Public Health (Commercial) or Groundwater
[2] Two detected SVOCs did not have NYSDEC Soil Criteria Protective of Public Health (Commercial) or Groundwater
[3] One detected metal did not have a NYSDEC Soil Criterion Protective of Groundwater

Sampling conducted for the PSA in 2001 indicated that 6 of the 7 test trench samples contained chemicals with concentrations in excess of the NYSDEC soil criteria protective of Public Health and/or Groundwater (NYSDEC, 2008b). In addition, evidence of former MGP structures (e.g., gas holder and purifier house) and MGP-related materials (e.g., tar seams, black and blue stained soils with petroleum/naphthalene odors, brick and glass fragments) were observed within the test trenches. The samples from all three test trenches were collected inside the Patchogue Former MGP Site boundary in the core area of the site, as indicated on Figure 2-3.

The potential COPCs for the test trench soil with respect to the protection of public health (i.e., with respect to a potential future commercial worker) and/or groundwater are:

- VOCs – ethylbenzene
- SVOCs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene
- Total Metals – arsenic and mercury

These constituents were located at elevated levels in the core area of the site.

6.1.1.7 Soil Gas Vapors

Soil gas was sampled in January and July 2008, May 2009, and November 2009. An indoor air sample and ambient air sample were also collected in November 2009 as part of the soil vapor investigation. VOCs were detected in thesoil vapor, indoor air, and ambient air samples and concentrations were above NYSDOH 2003: Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes, Indoor Air and Outdoor Air (NYSDOH, 2006) for the 95th percentile as shown in Table 7. Locations of the soil vapor samples are depicted on Figure 2-8.

Table 7: Comparison of Detected Soil Vapor Data to NYSDOH Criteria

Chemicals Exceeding NYSDOH Soil Criteria	Locations of Exceeding Criteria For Outdoor Air, 95th Percentile	Locations of Exceeding Criteria For Indoor Air, 95th Percentile
1,1,1-Trichloroethane	SV1-013108, SV-07, SV8	-
1,2,4-Trimethylbenzene	SV1-013108, PASV6, SV8, AA112509	PASV6
1,3,5-Trimethylbenzene	PASV6, SV8, AA112509	PASV6
1,4-Dichlorobenzene	PASV6, SV8	PASV6, IA112509
2,2,4-Trimethylpentane	SV8	-
2-Butanone	PASV6, SV8	-
4-Methyl-2-pentanone	SV1-013108, PASV6, SV8	SV1-013108
Acetone	PASV6, SV8	PASV6
Cyclohexane	SV1-013108, SV8	SV1-013108
Dichlorodifluoromethane	SV1-013108	SV1-013108
Ethylbenzene	PASV6, SV8, AA112509	PASV6
Heptane	SV8	-
Hexane	SV8	-
Methylene Chloride	SV8, AA112509	-
Styrene	PASV6, SV8, AA112509	PASV6
Tetrachloroethene	SV-07, SV8	SV-07, SV8
Tetrahydrofuran	PASV6, SV8, AA112509	SV8
Toluene	PASV6, SV8, AA112509	-
Trichloroethene	SV-07, SV8	SV-07, SV8
Xylenes (m&p)	SV1-013108, PASV6, SV8, AA112509	PASV6, SV8
Xylenes (o)	PASV6, SV8, AA112509	PASV6, SV8

Based on the results from the soil vapor sampling the four soil vapor samples and the indoor air sample were found with VOCs above Indoor Air criteria and the four soil vapor samples and one ambient air sample were found with VOCs above Outdoor Air criteria. Sample PASV6 was found with the majority of the Indoor Air criteria exceedances. Sample SV8 was found with the majority of the Outdoor Air criteria

exceedances. SV-07 had only three exceedances (1,1,1-trichloroethane, tetrachloroethene, and trichloroethene) when compared to criteria. SV1-013108 was collected from below the northern slab located in the northern area. PASV6, SV-07, and SV8 were collected from below the slab of the building located east of the Site, "Above All Store Fronts." The indoor air sample IA112509 was collected from inside "Above All Store Fronts" near the sub-slab vapor sampling port and the ambient air sample AA112509 was collected from outside the building.

6.1.2 Conceptual Site Model

As identified in Section 6.1.1, VOCs, SVOCs, and metals were identified as the chemical groups with COPCs for the surface, subsurface, and test trench soils (herein referred to as "all soil") and the groundwater. SVOCs and metals were identified as COPCs for the sediment exposure medium.

The CSM for the potential human health exposure pathways for the Patchogue Former MGP Site is presented in Table 6-1 and should be referred to throughout the following discussion. This CSM outlines the interactions and linkages between the identified potential COPCs on-site, the potential receptors on-site and the environmental media to which these receptors may be exposed now or in the foreseeable future. The CSM considers the primary sources and release mechanisms resulting in the presence of the COPCs on-site as well as secondary transport and migration processes for these COPCs within and between exposure media at the site. The potential exposure pathways reflected in the CSM are discussed below according to whether they were considered to be incomplete or complete, respectively.

A complete human exposure pathway is composed of the following elements (USEPA, 1989):

- A source and mechanism of chemical release to the environment;
- An environmental transport medium for the released chemical or mechanisms of transfer of the chemical from one medium to another;
- A point of potential contact by humans with the contaminated medium; and
- An effective route of exposure (i.e., ingestion, dermal absorption, or inhalation) for that chemical.

6.1.2.1 Incomplete Exposure Pathways

Based on the PSA and RI sampling data and site visits, the following exposure pathways were judged to be incomplete and were not further considered in this QHHEA:

- The site is a vacant lot and is currently inactive. As such, there are no current potential exposure pathways associated with on-site receptors such as residents or commercial workers.

- As described in Section 3.2, on-site groundwater is not used as a drinking water source, nor is it expected to be used as one at any time in the future. The Village of Patchogue relies on public water sources for its potable water from a single-source aquifer. In addition, the NYSDPW indicated that the installation of private wells on-site (or anywhere within the Village) is prohibited. There is, therefore, no potential for current or future use of groundwater at the site as a source of drinking water. As such, the potential pathways associated with the consumptive use of the groundwater as a drinking water source (i.e., ingestion and dermal absorption via bathing and washing) were not considered to be complete and were not considered further.

- The Patchogue River is classified by the NYSDEC as a class "C" surface water body, meaning it is fresh water/non-tidal water body with best uses for aquatic life propagation and primary/secondary contact recreation. *Corbicula* clams, carp, and minnows were observed during the TtEC site visit. However, fishing access is restricted only to the overpass and the depth and flow would limit fishing at this location. As such, consumption of fish was considered an incomplete pathway.

6.1.2.2 Potentially Complete Exposure Pathways

As described in Section 1.3, the site is currently inactive and a vacant lot. As such, there are no current on-site receptors associated with specific land uses, such as a resident or commercial worker. In addition, the site is enclosed within a perimeter fence, which hinders public access to the site. It is unlikely that a trespasser could get onto the site as the fence gate is locked. Any such trespass is likely to be transient. Another potential current usage involves off-site recreation within the Patchogue River due to the presence of aquatic life and fish species as noted during a TtEC site visit. There is also the potential for future redevelopment of the site for commercial usage. Significant construction and utility work would need to be performed, and exposure pathways associated with such redevelopment were considered.

As noted earlier, only those pathways that are considered complete (i.e., where all four elements are present) provide the potential for exposure and risk. Complete exposure pathways are identified in Table 6-1 for the current or potential future receptors and the identified COPCs in the various exposure media.

Potentially Complete Current / Future Exposure Pathways

Current activity at the site is likely to only involve the limited potential exposure of a trespasser passing through the site. The exposure frequency and duration for a trespasser would be expected to be minimal due to limited access. The trespasser is assumed to only be potentially exposed to COPCs in the surface soil via incidental ingestion, dermal absorption, and inhalation of the volatiles and/or wind-borne soil particulates in the ambient air.

Recreational usage of the Patchogue River (located off-site) was considered a current and likely future use. As a result, the recreator receptor was also identified as a current or potential future receptor. The recreator is assumed to have potential exposures to COPCs within the off-site sediment. The applicable exposure routes identified for this receptor relative to sediment are incidental ingestion and dermal absorption.

Potentially Complete Future Exposure Pathways

A future commercial re-development scenario would affect potential future commercial, construction, and utility workers. The assumption is that both the construction and utility worker would contact all soil and groundwater at the site during the performance of excavation activities. The commercial worker is only assumed to contact the surface soil, since the assumed duties of this receptor would not involve soil disturbance or intrusive activities.

The commercial worker is assumed to have potential exposures to the COPCs within the surface soil. The complete exposure pathways identified for this receptor are associated with incidental ingestion, dermal absorption, the inhalation of volatiles and/or wind-borne soil particulates in the ambient air, and the inhalation of vapors intruding into the indoor air of a future building from the subsurface soil or groundwater.

Potential future construction and utility work on-site is likely in order to prepare the property for commercial reuse. As a result, the construction worker and utility worker receptors were identified as potential future on-site receptors with intermittent outdoor exposures. Direct exposure may be prevented to some degree by protective clothing. There is potential for exposure to all soil during digging and excavation. Given the shallow depth to groundwater on-site (i.e., within 10 feet bgs), groundwater may pool up in near-surface trenches or excavations. The construction worker and utility worker are assumed to have potential exposures to the COPCs within the all soil or groundwater. The complete exposure pathways identified for both of these receptors are incidental ingestion, dermal absorption, and the inhalation of volatiles and/or wind-borne soil particulates in the ambient air.

6.1.3 Exposure Profiles for the Target Receptors

The following receptors are associated with the current and potential future use of the site as described in the CSM:

- Commercial Worker
- Utility Worker
- Construction Worker
- Trespasser
- Recreator

Descriptions of each of these receptors relative to their potential for exposure to the various media at the site and the potentially complete exposure pathways are presented in the following subsections.

6.1.3.1 Commercial Worker

The potential future commercial worker is assumed to be an adult (aged 18+ years) working both indoors and outdoors with exposure to the surface soil and indoor air exposure media. This receptor is assumed to perform duties that would not involve intrusive activities or disturbance to the ground surface or contact with the groundwater. Since this receptor would only be present on site, potential exposure to the off-site sediment (i.e., Patchogue River) is not considered. Both direct contact (incidental ingestion and dermal absorption) and indirect exposure (inhalation of soil particulates and/or volatiles) are possible for the commercial worker relative to the surface soil.

6.1.3.2 Utility Worker

The potential future utility worker is assumed to be an adult (aged 18+ years) working outdoors periodically on-site conducting utility-related activities, such as the repair or replacement of underground storage utilities. Due to the shallow depth to groundwater at the site, utility-related activities are also likely to intrude into the saturated zone, allowing potential contact and exposure to the groundwater. Utility workers excavating in the saturated zone may get wet and continue to work. In addition, excavation activities may create pooled pockets of groundwater that may release volatiles into the ambient air. While some potential for dermal absorption and volatiles inhalation may exist, it is not likely that incidental ingestion of groundwater would occur during these activities. Since this receptor is assumed to only be present on site, there would be no potential exposure to the off-site sediment. Both direct contact exposures (incidental ingestion and dermal absorption) and indirect contact exposures (inhalation of wind-borne soil particulates and/or volatiles in the ambient air) are assumed to apply to the utility worker's interaction with soil.

6.1.3.3 Construction Worker

The potential future construction worker is assumed to be an adult (aged 18+ years) working outdoors periodically on site conducting future excavation/construction activities. Construction activities are likely to intrude into the subsurface zone, creating potential contact and exposure to the groundwater. Construction workers excavating in the saturated zone may contact groundwater and continue to work. In addition, excavation activities create pockets of pooled groundwater that may release volatiles into the ambient air. While some potential for dermal absorption and volatiles inhalation may exist, it is not likely that incidental ingestion of groundwater would occur during these construction activities. Since this receptor is assumed to only be present on-site, there would be no potential exposure to the COPCs identified within off-site sediment. Both direct contact exposures (incidental ingestion and dermal absorption) and indirect contact

exposures (inhalation of wind-borne soil particulates and/or volatiles within the ambient air) are assumed to apply to the construction worker's interaction with soil.

6.1.3.4 Trespasser

The current or potential future trespasser was defined as an adolescent (aged 12 to 18 years) who may reside near the site. The trespasser was assumed to have potential exposure to the surface soil while walking through the site. The trespasser is assumed to not undertake any activities that would disturb the ground surface or result in exposure to groundwater. Since this receptor would only be present on-site, there would be no potential exposure to the off-site sediment. Both direct contact exposures (incidental ingestion and dermal absorption) and indirect contact exposures (inhalation of soil particulates and/or volatiles) are associated with complete pathways for the trespasser the surface soil. The two adjacent concrete slabs located in the northern area of the site provide a barrier to current contact and exposure to the surface soil and may also prevent soil from being resuspended by the wind.

6.1.3.5 Recreator

The current or potential future recreator was defined as an adolescent (aged 12 to 18 years) or an adult (aged 18+ years) who may reside or make use of the off-site properties. The recreator is assumed to access the Patchogue River to fish. The recreator was assumed to be potentially exposed to the sediment. This exposure is expected to be insignificant due to limited duration and frequency. Since this receptor would only be engaged in off-site activities, the recreator would have no potential exposure to the on-site soil and groundwater. Direct contact exposures (incidental ingestion and dermal absorption) are assumed to apply to the recreator relative to the sediment.

6.1.4 Summary

This QHHEA evaluates the potential exposure pathways for human receptors relative to the COPCs identified for each impacted exposure media given the current and potential future use of the site.

Site sampling activities were conducted to support the 2001 PSA and the 2008 RI. Table 7 identifies the chemicals whose detected concentration in each exposure medium exceeded the applicable NYSDEC criteria for that medium.

Table 8: Summary of COPCs Exceeding Applicable NYSDEC Criteria by Exposure Medium

COPCs Exceeding NYSDEC Criteria	Surface Soil (On-site)	Subsurface Soil (On-site)	Test Trenches (On-site)	Groundwater (On-site)	Sediment (Off-site)
VOCs					
acetone		X		X	
benzene		X		X	
2-butanone		X			
ethylbenzene		X	X	X	
isopropylbenzene				X	

Table 8: Summary of COPCs Exceeding Applicable NYSDEC Criteria by Exposure Medium					
COPCs Exceeding NYSDEC Criteria	**Surface Soil (On-site)**	**Subsurface Soil (On-site)**	**Test Trenches (On-site)**	**Groundwater (On-site)**	**Sediment (Off-site)**
methylene chloride	X	X			
toluene		X		X	
xylenes		X		X	
trichloroethene				X	
SVOCs					
acenaphthene		X		X	X
acenaphthylene		X			
anthracene		X			X
benzo(a)anthracene	X	X	X	X	X
benzo(a)pyrene	X	X	X	X	X
benzo(b)fluoranthene	X	X	X	X	X
benzo(k)fluoranthene	X	X	X	X	X
1,1-biphenyl				X	
chrysene		X	X	X	X
dibenz(a,h)anthracene	X	X	X	X	
fluoranthene		X		X	X
fluorene		X		X	X
indeno(1,2,3-cd)pyrene	X	X	X	X	X
naphthalene	X	X		X	X
phenanthrene		X		X	X
phenol	X			X	X
pyrene		X		X	X
Total Metals					
arsenic		X	X		X
barium		X			
cadmium					
lead	X	X		X	X
mercury	X	X	X		
selenium					

None of the detections for TCN or PCBs exceeded the applicable NYSDEC criteria within any of the sampled exposure media. As indicated in Table 7, various VOCs, SVOCs, and metals are located at elevated levels within various exposure media, especially the on-site subsurface soil and groundwater and the off-site sediments. The specific locations of these exceedances of the criteria are presented in Sections 4.0 and 6.1.1. In general, the on-site exceedances presented are located within the core and southern areas of the site, which make up the majority of the property.

Soil gas samples collected from beneath the concrete slabs located in the northern and core areas of the site indicated detections of VOCs. Additional sampling was conducted in November 2009, during the heating season, including indoor air sampling and ambient air sampling. One VOC was detected in the indoor air above Indoor Air criteria but it is not a MGP-related constituent.

In consideration of the COPCs identified for each exposure medium in Table 7, the CSM in Table 6-1, and the receptor exposure profiles detailed in Section 6.1.3, the potential exists for direct and indirect contact with the on-site and off-site exposure media for the respective current or potential future receptors. The results of the QHHEA will be used to support future site management decision-making.

6.2 Fish and Wildlife Resources Impact Analysis

This section presents the FWRIA Step I A-D through Step II A-B in accordance with guidance provided in the FWRIA for Inactive Hazardous Waste Sites guidance document (NYSDEC, 1994).

The objectives of Step I of the FWRIA are: (1) to identify fish and wildlife resources that may potentially be affected by site-related contaminants, and (2) if such resources are present, provide the necessary information for inclusion in the FWRIA and RI. The objectives of Step II A-B of the FWRIA are: 1) to identify contaminant transport pathways from the Site to areas supporting fish and wildlife resources, and 2) perform a criteria-specific comparison of contaminant concentrations to appropriate ecological benchmark criteria and guidance values.

An ecological reconnaissance was performed by TtEC ecologists on July 15, 2008 to identify fish and wildlife resources associated with the site. The objective of the site reconnaissance was to determine the potential for exposure or impacts from site-related contaminants associated with historical MGP operations. Information collected through correspondence with state and federal agencies and during the site reconnaissance was used to identify fish and wildlife resources present on and in close proximity to the site.

6.2.1 Site Habitat Characterization

6.2.1.1 Physical Environment and Land Use

The site is located in a mixed commercial, light industrial and residential land use area. The site is currently vacant and the southern area of the site is covered with overgrown brush and vegetation. The site covers an estimated 3.6 acres. Development on the site is limited to concrete slabs located in the northern area of the property where the former facility structures for offices and storage formerly stood. The remaining areas of the site remain fallow and overgrown with opportunistic vegetative growth.

6.2.1.2 Description of Fish and Wildlife Resources

Habitat Covertypes and Wildlife Observations

A field reconnaissance was performed on July 15, 2008 to document the habitats, land uses and ecological receptors present on the site. Vegetation cover-types were identified based upon the dominant vegetation observed on the site. During the reconnaissance, direct (e.g., visual observation of individuals) and indirect (e.g., birdsong, nests, dens, tracks, etc.) observations of wildlife were recorded. Appendix J contains a photo log of the field reconnaissance made on July 15, 2008.

Dominant vegetation covertypes present on the site included: upland marginal deciduous forested areas, riparian deciduous forest along Patchogue River, open fallow fields dominated by opportunistic herbaceous weeds and wildflowers, and isolated fragments of emergent wetland.

Upland Marginal Deciduous Forested Areas

Upland marginal deciduous forest areas were present along the property boundaries where historical development had not occurred on the site. These areas were closely associated with the property boundaries and took on the appearance of narrow corridors of dense stands of native and opportunistic species of deciduous trees and shrubs. The dominant tree species was Norway maple (*Acer platanoides*), which occurred in both the primary and secondary canopies of these areas. Other species present though in less abundance included: catalpa (*Catalpa catalpa*), white mulberry (*Morus alba*), silver maple (*Acer saccharinum*), cherry (*Prunus* sp.) and tree of heaven (*Ailanthus altissima*). Dominant shrub and vine species dominating the under story in these areas included: poison ivy (*Rhus toxicoldendron*), multiflora rose (*Rosa multiflora*), Japanese knotweed (*Fallopia japonica*), smooth sumac (*Rhus glabra*), common reed (*Phragmites australius*), wild grape (*Vitis sp.*), mugwort (*Artemisia sp*.) and raspberry (*Rhubus sp*.). Of the above species, multi-flora rose was the most abundant shrub species in these areas. All of the species observed are common in urban areas and are tolerant of disturbed soils.

Riparian Deciduous Forest

This covertype dominated the riparian areas contiguous to the Patchogue River. The primary canopy was dominated by large red maple (*Acer rubrum*), silver maple and catalpa trees. Under-story trees included saplings of honey locust (*Gleditsia triacanthos*), red maple, and silver maple. This covertype was characterized by a very dense shrub and vine layer in the understory. Species that dominated this layer included poison ivy, multiflora rose, Japanese knotweed, smooth sumac, common reed, wild grape, mugwort and raspberry. Where breaks in the upper canopy and saturated soils occurred, lush stands of jewelweed (*Impatiens capensis*), rice-cut grass (*Homalocenchrus oryzoides*), and common reed replaced the dense shrub layer in this area.

Open Fallow Field

This cover-type dominated the inner core area of the site and represented the largest most continuous covertype present. Dominant vegetation was comprised of mixed herbaceous and woody plants with no overhead canopy. Dominant herbaceous species included mugwort, crown vetch (*Securigera varia*), butter-n-eggs (*Linaria linaria*), queen Anne's lace (*Daucus carota*), plaintain (*Plantago sp*.), asters (*Aster sp*.), common reed grass, wild strawberry (*Fragaria sp*.) and common mullein (*Verbascum thapsus*). In addition to these herbaceous species, saplings of quaking aspen (*Populus tremuloides*), cottonwood (*Populus deltoides*), and catalpa were also present.

Emergent Wetland Area

A small emergent wetland area was present on the southern perimeter of an existing concrete slab in the northern area of the property. This small area was confined to an area of less than 0.5 acres and was dominated by broad-leaf cattail (*Typha latifolia*), great

bulrush (*Scirpus validus*), and burreed (*Sparganium sp.*). While no standing water was present, the soils present were saturated and hydric in character.

Open Water Habitats

The channel of the Patchogue River is located east of the site and flows to the south, at one point flowing southwest to parallel the southern periphery of the site property. The river channel was estimated to be 25 to 30 feet wide with water depths ranging from 1 to 3 feet. The stream bank was steep and heavily vegetated. The United States Geological Survey (USGS) flow data from the gauging station on the Patchogue River at the discharge of Great Patchogue Lake reported average discharges of 18 to 23 cubic feet per second (cfs) (http://waterdata.usgs.gov/ny/nwis/monthly). Water transparency was good, with the bottom substrates being comprised of medium to coarse sand with scattered pebbles and cobbles. Asian clam (*Corbicula fluminea*) shells (both living and dead) were abundant in the river sediments. Overhead canopy coverage of the river channel was patchy, with alternating reach intervals of full and partial shade. Where breaks in the canopy allowed for sunlight to penetrate, dense stands of submergent aquatic vegetation (SAV) were present. SAV species observed in the channel included Eurasian water milfoil (*Myriophyllum spicatum*), starwort (*Callitriche sp.*), water celery (*Vallisneria americana*) and clasping leaf pondweed (*Potamogeton richardsonii*). The Patchogue River is classified as a Class C surface water body and supports a warm water fishery with the best designated uses being for fish propagation and survival, and primary and secondary contact recreation (http://www.dec.state.ny.us/website/regs/703.htm). Fish species observed in the river during the site reconnaissance included carp (*Cyprinus carpio*), white sucker (*Catostomus commersonii)* and sunfish (*Family Centrarchidae*). Other species of fish expected in these waters include minnows (*Family Cyprinidae*), largemouth bass (*Micropterus salmoides*) and pickerel (*Esox* sp.). Water quality parameters collected from Patchogue River during the site reconnaissance are summarized in Table 6-2. Land use along the banks of the river was a mixture of commercial, light industrial, and residential development. Storm water from impervious surfaces of these developed areas are collected via open grate storm water collection systems which are routed and discharged to the Patchogue River.

Wildlife Observations

Wildlife observed included avian and mammalian species with species that are common to urban areas dominating the overall observations (Table 6-3).

Avian species dominated the field observations of wildlife at the site and included northern cardinal, northern mockingbird, European starling, red-winged blackbird, tree swallow, house wren, and brown-headed cowbird. Observations of gray squirrels were limited to the forested areas of the site. Raccoon tracks were abundant in both upland and riparian forested habitats indicating this species routinely occurs in both environments.

Threatened and Endangered Fauna or Flora and Significant Habitats

Correspondence with the NYSDEC Significant Habitat Unit and the U.S. Fish and Wildlife Service (USFWS) revealed no threatened or endangered species associated with the site property (Personal correspondence NYSDEC Natural Heritage Program (NHP) to J. Schaffer October 2008e). The USFWS identified ten species of concern present in Suffolk County (Appendix K). None of the species of concern are expected to occur at the Patchogue Former MGP Site because of the lack of supporting habitat.

The New York State Natural Heritage Program (NYSNHP) identified the pirate perch (*Aphredoderus sayanus*), a fish species of special concern in New York, as being present in the Patchogue River upstream from Great Patchogue Lake, approximately one mile upstream from the site. The occurrence of the pirate perch was determined to be highly localized. Populations of three threatened plant species, the showy aster (*Eurybia specitabilis*), Oakes evening-primrose (*Oenothera oakesiana*) and flax-leaf whitetop (*Sericocarpus linifolius*) were identified to be present within two miles of the site (Appendix K).

Observations of Stress

During the ecological site reconnaissance, no obvious evidence of stained soils, leachate seeps or exposed waste was observed on the site. Iron flocculent and staining of sediments were observed in the Patchogue River channel upstream from the site at the Main Street overpass with the river. No staining was observed in the sediments of the river adjacent to the site. No stressed vegetation (i.e., wilted or stunted plants, dead or dying trees or shrubs, stained soils) were observed during the reconnaissance.

6.2.1.3 Description of Fish and Wildlife Resource Value

Value of Habitat to Associated Fauna

A narrow fragmented area of forested vegetation is associated with the riparian areas of the Patchogue River on the site. Given the size of the trees (many greater than 12 inches in diameter), this area has remained undisturbed relative to other parts of the site where development had historically occurred. This corridor area affords some value as resting, foraging, or nesting habitat for wildlife species more tolerant of human disturbance.

Value of Resource to Humans

The waters of the Patchogue River are classified as Class C waters with designated uses to support recreational fishing and primary and secondary contact recreation. The river offers the opportunity for recreational fishing in an urban environment. The river is shallow in depth and thus limits the opportunity for swimming and wading. The developed nature of the surrounding land use and the extent of private property adjoining the river shoreline limits public access to the river for fishing to a limited number of

roadway overpasses. Great Patchogue Lake, located approximately one mile upstream from the site, affords the opportunity for boating and fishing. Currently there are no fish advisories listed for the freshwater portion of the Patchogue River.

6.2.1.4 Identification of Applicable Fish and Wildlife Regulatory Criteria

Tools for assessing environmental media for the protection of ecological resources have been established for specific contaminants. Subpart 375-6.6 Remedial Program Soil Cleanup Objectives (*http://www.dec.ny.gov/regs/15507*) has been established by NYSDEC and are applied for the assessment of contaminant concentrations in soils for the protection of ecological resources. A secondary screening-level source for evaluating risk from contaminants in soils to terrestrial ecological resources is USEPA's Ecological Soil Screening Levels (Eco-SSLs) (USEPA, 2003).

The NYSDEC has published technical guidance for screening contaminated sediments in freshwater and marine environments (http://www.dec.ny.gov/docs/wildlife_pdf/seddoc.pdf). These values include general and site-specific derivation for screening values considered protective of benthic organisms and bioaccumulation within food chains. A secondary source for sediment screening values is Persaud et al. (1993). Secondary guidance for screening criteria was the USEPA (2005) equilibrium partitioning guidance for derivation of sediment quality criteria for PAHs.

NYSDEC ambient water quality criteria were used to compare to detected contaminants in the surface waters of the Patchogue River for samples collected during the PSA. In the absence of NYSDEC criteria, secondary tier II values as cited in Suter and Tsao (1996) were applied. For metals with criteria that were derived from site specific hardness, the USGS's water quality database (https://waterdata.usgs.gov – USGS Water Quality Data for NYS) was consulted for measured hardness of surface waters of the Patchogue River. A hardness value of 50 mg/L $CaCO_3$ was applied based upon the USGS database for the Patchogue River below Great Patchogue Lake.

6.2.2 Contaminant Specific Impact Assessment

6.2.2.1 Pathway Analysis

Results of the ecological site reconnaissance determined that both fish and wildlife resources are associated with habitats on or adjacent to the site. The significance of the site to act as an important fish and wildlife habitat are limited by the following observations:

- The vacant nature of the site and some limited terrestrial habitats for wildlife in an otherwise urban land use setting.
- The small size of site and presence of impervious concrete slabs also limits the value of the available open space for wildlife.

- The site is surrounded by a mixture of commercial, light industrial and residential land uses. The lack of contiguous areas of open space results in fragmentation of areas of open space for potential wildlife habitats.
- The Patchogue River occurs along the southern perimeter of the site and supports a warm water fishery.
- The site is anticipated to be redeveloped following successful clean-up and closure.

Environmental media that are associated with potential exposure of ecological receptors to any site related contaminants include exposed surface soils (0 to 0.5 ft. below ground surface) present on the site and surface water and sediments of the Patchogue River. These are the primary media that present potentially complete pathways for terrestrial and/or aquatic wildlife and fish to be exposed to contaminants from the former MGP operations at the site.

Contaminants of Concern

Contaminants associated with the MGP operations at the site include a variety of SVOCs and VOCs, along with cyanide and metals. The most important group of SVOCs is PAHs which are among the principal contaminants of coal tar. A common contaminant associated with former MGP sites is cyanide and it can occur at high concentrations in the presence of MGP-related by-products. VOCs often associated with MGP operations are benzene, toluene, ethyl benzene and xylene (collectively, these four compounds are referred to as BTEX).

Sources of Contaminants

The site historically was occupied by a MGP operated by the Patchogue Gas Company during the early nineteenth century 1904 to 1926 (VHB, 2002). Structures at the site included the presence of gas holders at the site. These holders and other buildings were demolished and removed and the site is currently vacant. MGP-related waste associated with coal gas production could include coal tar and ash from the combustion of coal. Contaminants associated with MGP residuals include BTEX, PAHs, cyanide, and metals.

Potential Pathways of Contaminant Migration and Exposure

Environmental media considered important in the exposure of ecological receptors to site-related contaminants include surface soils at the site, and surface water and sediments of the Patchogue River in the vicinity of the site. Potential movement of soil-bound contaminants via surface water runoff to the River is a viable migration mechanism for the transport of PAHs and metals from the uplands into the adjoining aquatic habitat. The presence of contaminants related to MGP operations in the surface soils could result in direct absorption and incidental ingestion of VOCs or PAHs by ecological receptors in upland habitats.

PAHs are hydrophobic and strongly partition to organic matter in solid phase media. PAHs are not expected to bioaccumulate to a significant degree given that most vertebrates can metabolize these compounds at rates that exceed their bioaccumulation potential (Eisler, 1987). Many of the MGP-related contaminants could impact benthic communities in sediments. Coal tar is a characteristic NAPL that can be mobilized along groundwater gradients and migrates via groundwater and eventually discharges to surface water. Coal tar is a complex mixture that includes PAHs, BTEX, and other metals formed from the incomplete combustion of coal. Based upon the sources of contaminants, historical MGP operations, and fate and transport characteristics of the contaminants, it would be expected that PAHs, and BTEX associated with this material would have the potential to impact terrestrial and aquatic ecological receptors. To assess the potential risks associated with these ecological exposures, a criteria-specific analysis was used to compare detected concentrations of contaminants to applicable soil and sediment screening criteria.

6.2.3 Criteria-Specific Analysis

Analytical results from the PSA (VHB, 2002) and this RI for surface soil (0 to 0.5 feet.), surface water, and sediments were compared to numerical screening criteria considered protective of ecological resources.

6.2.3.1 Surface Soil Screening

Analyses for soils included BTEX, PAHs and cyanide. The NYSDEC remedial program soil cleanup objectives for the protection of ecological resources were used to screen the surface soil. USEPA's Eco-SSLs (USEPA, 2003) for PAHs were used as a secondary source for soil screening values. No site-specific background data on ambient levels of PAHs or VOCs were collected from the surrounding areas around the site, therefore no comparison to background concentrations could be made.

No VOCs were detected in the surface soil samples collected from the site (Table 6-4). Screening level comparisons to ecological screening values for PAHs are presented in Table 6-5. Concentrations in 11 soil samples (PASB-23-0-0.2, PASB-23-0.05, PASB-28-0-0.2, PASB-28-0-0.5, PASB-29-0-0.5, PASB-30-0-0.2, PASB-30-0-0.5, PASB-31-0-0.2, PASB-31-0-0.5, PASB-330-0.2 and PASB-33-0-0.5) out of a total of 32 samples exceeded the USEPA Eco-SSL criterion for pyrene (Table 6-5). Soil sample PASB-28-0-0.2 exceeded the pyrene criterion by an order of magnitude (i.e., 10 times).

Concentrations in six soil samples (PASB-23-0.05, PASB-28-0-0.2, PASB-28-0-0.5, PASB-30-0-0.5, PASB-33-0-0.2 and PASB-33-0-0.5) out of a total of 32 samples exceeded the USEPA Eco-SSL criterion for benzo(a)anthracene. Soil samples PASB-28-0-0.2 and PASB-33-0-0.2 exceeded the criterion by one order of magnitude. Similarly, concentrations of chrysene in nine soil samples (PASB-23-0.05, PASB-28-0-0.2, PASB-28-0-0.5, PASB-29-0-0.5, PASB-30-0-0.2, PASB-30-0-0.5, PASB-31-0-0.2, PASB-33-0-0.2, and PASB-33-0-0.5) exceeded the USEPA Eco-SSL criterion for chrysene. The

concentration of chrysene at PASB-28-0-0.2 exceeded the criterion by an order of magnitude (Table 6-5).

Concentrations in nine (PASB-23-0.05, PASB-28-0-0.2, PASB-28-0-0.5, PASB-29-0-0.5, PASB-30-0-0.5, PASB-31-0-0.2, PASB-31-0-0.5, PASB-33-0-0.2 and PASB-33-0-0.5) out of 32 soil samples exceeded the USEPA Eco-SSL criterion for benzo(b)fluoranthene (Table 6-5). Soil samples PASB-28-0-0.2 and PASB-33-0-0.2 exceeded the criterion by an order of magnitude. Benzo(k)fluoranthene exceeded the USEPA Eco-SSL at PASB-28-0-0.2, PASB-28-0-0.5, PASB-33-0-0.2 and PASB-33-0-0.5.

Concentrations in four soil samples (PASB-28-0-0.2, PASB-28-0-0.5, PASB-33-0-0.2, and PASB-33-0-0.5) out of a total of 32 exceeded the USEPA Eco-SSL criterion and the NYSDEC soil criterion for benzo(a)pyrene. Soil sample PASB-28-0-0.2 exceeded the USEPA Eco-SSL criterion by one order of magnitude. Additionally, concentrations of indeno(1,2,3-cd)pyrene exceeded the USEPA Eco-SSL at PASB-28-0-0.2 and PASB-28-0-0.5, respectively. The concentration of dibenz(a,h)anthracene in soil sample PASB-31-0-0.2 exceeded the USEPA Eco-SSL criterion.

6.2.3.2 Surface Water Screening

A single detection of toluene (2.4 ug/l) at PASW2 from the Patchogue River was noted during RI sampling event. This was the only detection out of six samples collected and it did not exceed the Tier II screening level for the protection of aquatic life for this VOC compound (Table 6-6).

Comparison of detected concentrations of metals to NYSDEC ambient water criteria revealed exceedances of acute and chronic values for cadmium and lead at PASW-4 (Table 6-7). The concentrations of both metals at this location were significantly elevated. Sampling at this location was from an overflow pond that may be contributing metals from other sources to the river. Additionally, accidental entrainment of particulates during sampling may have contributed to the elevated nature of the metals observed as total metals analysis was performed on the samples.

6.2.3.3 Sediment Screening

Analytical data for surface sediments were compared to NYSDEC sediment quality guidance values for the protection of benthic organisms and for the protection of wildlife and human health from bioaccumulation. Where NYSDEC criteria were not available for specific PAH compounds, USEPA sediment quality criteria for PAHs were used for the screening analysis. NYSDEC criteria that required organic carbon normalization for derivation used a default concentration of one percent organic carbon content in the absence of site-specific TOC data.

NYSDEC metals criteria consisted of the lowest effect level (LEL) and severe effect level (SEL). The chronic or LEL criterion corresponds to concentrations below which biological effects on benthic communities are not anticipated to occur. The acute level or

SEL screening criteria represent thresholds above which biological effects on benthic communities are likely to occur. Concentrations of contaminants which are detected between the LEL and SEL values are considered uncertain regarding their potential for biological effects on benthic communities. Four locations (SED-1, SED-2, SED-3, and SED-4) were sampled above the Main Street overpass of the Patchogue River to characterize background concentrations of BTEX and PAHs. No background data was collected for metals sampled during the PSA (VHB, 2002).

No BTEX compounds were detected in sediment samples adjacent to the site or in the upstream background samples (Table 6-8).

Table 6-9 presents the detections for PAHs and cyanide in sediments during sampling performed in support of the RI. The upstream background concentrations of fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene and indeno(1,2,3-cd)pyrene exceeded one or more of the NYSDEC sediment screening levels (Table 6-9).

Aquatic Life Toxicity Screening for Sediments

Three samples (PASD-01, PASD-04D, and PASED5) had concentrations that exceeded the NYSDEC chronic toxicity level for naphthalene (Table 6-9). The concentration of acenaphthylene observed at location PASED5 exceeded the NYSDEC chronic toxicity level for this compound. Three samples (PASD-03, PASD-04D, and PASED5) had concentrations that exceeded background for both of these compounds. Concentrations in PASD-03 and PASD-04D exceeded the NYSDEC chronic toxicity level by one order of magnitude. The concentration of fluorene observed in PASED5 exceeded the NYSDEC acute toxicity level by one order of magnitude. Concentrations in three samples (PASD-01, PASD-02, PASED-7) exceeded the NYSDEC chronic toxicity level by one order of magnitude, but did not exceed maximum background concentration (Table 6-9).

The concentration of benzo(a)anthracene, chrysene, phenanthrene, pyrene and fluoranthene observed in sample PASED5 exceeded background and the NYSDEC chronic toxicity levels by one or more orders of magnitude. Concentrations in two samples (PASD-03 and PASED-7) exceeded the NYSDEC chronic toxicity level but did not exceed the background concentration for these compounds. The concentration of anthracene in PASED5 exceeded both the background range and the NYSDEC chronic toxicity level for this compound. The concentration of anthracene observed in PASED7 exceeded the NYSDEC chronic toxicity value, but did not exceed background.

Concentrations of benzo(a)anthracene in two samples, PASED8 and PASED9 did not exceed background, but did exceed the NYSDEC acute and chronic toxicity levels by an order of magnitude. Concentrations in three samples (PASD-04D, PASED6 and PASED7) did not exceed background but did exceed the NYSDEC chronic toxicity level. The upstream background concentration of benzo(a)pyrene did not exceed the USEPA chronic toxicity level. The concentration of benzo(a)pyrene in sample PASED5 exceeded background but did not exceed the USEPA chronic toxicity level. All other samples did

not exceed the USEPA chronic toxicity levels. The upstream background concentration of indeno(1,2,3-cd)pyrene did not exceed the USEPA chronic toxicity level. Concentrations in five samples (PASD-01, PASD-02, PASD-03, PASED5, and PASED8) exceeded background but did not exceed the USEPA chronic toxicity level.

Wildlife and Human Bioaccumulation

The NYSDEC does not have wildlife bioaccumulation criteria for PAH compounds that would be protective of piscivorous species consuming fish exposed to PAHs in aquatic ecosystems. The human bioaccumulation criteria are based upon the protection of human health from the consumption of fish exposed to contaminants in surface water or sediments. As discussed in Section 6.2.2.1, PAHs are not expected to bioaccumulate to a significant degree given that most vertebrates can metabolize these compounds at rates that exceed their bioaccumulation potential (Eisler, 1987). The upstream background concentration of benzo(a)anthracene exceeded the NYSDEC human bioaccumulation level by two orders of magnitude (Table 6-9). The concentration of benzo(a)anthracene observed in PASED5 exceeded both the background and the NYSDEC human bioaccumulation level by three orders of magnitude. Concentrations in (PASED8 and PASED9) did not exceed background, but did exceed the NYSDEC human bioaccumulation level by two orders of magnitude.

The upstream background concentration of chrysene exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. The concentration of chrysene observed PASED5 exceeded background and exceeded the NYSDEC human bioaccumulation level by three orders of magnitude. Concentrations in two samples (PASED8 and PASED9) did not exceed background but did exceed the NYSDEC human bioaccumulation level by two orders of magnitude.

The upstream background concentration of benzo(b)fluoranthene exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. Concentrations in seven samples (PASD-01, PASD-4D, PASED5, PASED6, PASED7, PASED8 and PASED9) did not exceed background but exceeded the NYSDEC human bioaccumulation level. Concentrations at in three samples (PASED5, PASED8, and PASED9) exceeded the NYSDEC human bioaccumulation level by two orders of magnitude.

The upstream background concentration of benzo(k)fluoranthene exceeded the NYSDEC human bioaccumulation level by two orders of magnitude (Table 6-9). The concentration of benzo(k)fluoranthene observed in sample SED-5 only slightly exceeded the background concentrations of this compound and exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. Concentrations in seven samples (PASD-01, PASD-02, PASD-03, PASD-04D, SED-7, SED-8, and SED-9) did not exceed background but exceeded the NYSDEC human bioaccumulation level. Concentrations in PASED8 exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. Concentrations in six samples (PASD-01, PASD-02, PASD-03, PASD-04D, PASED7 and PASED9) exceeded the NYSDEC human bioaccumulation level by an order of magnitude.

The upstream background concentration of benzo(a)pyrene exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. The concentration of benzo(a)pyrene in sample PASED5 exceeded background and exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. Concentrations in eight samples (PASD-01, PASD-02, PASD-03, PASD-04D, PASED6, PASED7, PASED8 and PASED9) did not exceed background but exceeded the NYSDEC human bioaccumulation level (Table 6-9). Concentrations in five samples (PASD-01, PASD-02, PASD-03, PASED8, and PASED9) exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. Concentrations at two locations (PASED6 and PASED7) exceeded the NYSDEC human bioaccumulation level by one order of magnitude.

The upstream background concentration indeno(1,2,3-cd)pyrene exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. Concentration in five samples (PASD-01, PASD-02, PASD-03, PASED5 and PASED8) slightly exceeded background concentrations and exceeded the NYSDEC human bioaccumulation level by two orders of magnitude. Concentrations in four samples (PASD-04D, PASED6, PASED7 and PSED9) did not exceed background but exceeded the NYSDEC human bioaccumulation level. Concentrations in two samples (PASED6 and PASED9) exceeded the NYSDEC human bioaccumulation level by one order of magnitude (Table 6-9).

One sample, PASD-01, had a concentration of arsenic that exceeded the NYSDEC LEL. Four samples (PASD-02, PASD-03, PASD-04, and PASD-04 D) had concentrations that exceeded the NYSDEC LEL for lead (Table 6-10). NYSDEC SEL criteria for metal analytes were not exceeded at any sampling location. (Table 6-10).

6.2.4 Summary and Conclusions

6.2.4.1 Summary

The Patchogue Former MGP Site is located on Main Street in the Village of Patchogue, Long Island NY. The site is approximately 3.6 acres in area and is bordered on three sides by mixed commercial, light industrial and residential land uses. The Patchogue River is located east of the site.

Vegetation cover-types on the site include marginal deciduous forests, open fallow fields, riparian deciduous forest, and emergent wetlands. Concrete slabs from former building structures remain on the site and the vehicular and pedestrian traffic limit the value of these covertypes as significant habitat. Wildlife observed on the site was dominated by avian species that are highly tolerant of human disturbance. The most significant habitat is the aquatic habitat associated with Patchogue River. The river is classified as a Class C water body. Designated uses for Class C water bodies include recreational fishing, and primary and secondary recreation. No fish advisories are in place for the freshwater portion of the Patchogue River. The river has a warm water fishery with minnows, sunfish, bass and suckers dominating the fish community. In addition to fish, Asian clams were noted to be very abundant in the river in the vicinity of the site. No visible

signs of stress were observed in the terrestrial or aquatic habitats observed. The current fallow nature of the site provides the opportunity for local wildlife species to use the limited vegetation cover types present. The Patchogue River in the vicinity of the site supported very dense stands of SAV where the overhead canopy allowed sufficient ambient light to penetrate to the river.

Screening of the surface soils, sediments and surface water revealed the following:

Surface Soils

BTEX was detected at one location in on-site surface soils. PAH compounds were detected in surface soils at concentrations that exceeded corresponding NYSDEC and/or USEPA Eco-SSL ecological screening values. Locations where exceedances were of particular significance included PASB-23-0.05, PASB-28-0-0.2, PASB-28-0-0.5, PASB-30-0-0.5, PASB-33-0-0.2 and PASB-33-0-0.5. While PAHs were detected at these locations, concentrations of these compounds were low (total PAHs were less than 3 mg/Kg) with the exception of PASB-23, PASB-28, PASB-29, and PASB-33, where these compounds occurred at concentrations greater than 29 mg/Kg.

Cyanide was detected at concentrations of 1.09 and 2.44 mg/Kg at PASB-32 and PASB-33. All other locations had cyanide concentrations below detection limits.

Surface Water

Toluene was detected at 2.4 ug/L at PASW-02, which did not exceed the secondary tier II value for this compound.

Metals (measured as total metals) that exceeded NYSDEC ambient water quality criteria included cadmium and lead. Concentrations of these metals exceeded corresponding criteria by several orders of magnitude. These exceedances were only noted at PASW-04 where entrained particles may have contributed to the elevated concentrations observed.

Sediments

No BTEX compounds were detected in sediments from the Patchogue River.

PAH compounds were the most widely distributed compounds detected in the sediments of the river. The background locations above the site revealed that concentrations of these compounds exceeded NYSDEC or USEPA screening criteria. The concentrations observed suggest that multiple anthropogenic sources are contributing these compounds to the river from the developed areas upstream of and surrounding the site.

Sample locations where PAH concentrations exceeded NYSDEC acute and chronic toxicity levels included SED-5, SED-8 and SED-9. However, none of the detected concentrations exceeded the site-specific background concentration for these compounds.

The analytical results for samples collected during the PSA revealed LEL exceedances only for lead in the sediments of the river. No SEL exceedances were noted.

6.2.4.2 Conclusion

Results of 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 confirmation of ambient water quality exceedances.

There are potentially complete exposure routes in the limited habitats present. However, given the small size of the site, limited terrestrial habitat present and the limited number of criteria exceedances in surface soils, sediments and surface soils, further characterization of the site for the FWRIA is 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.

7.0 Summary and Conclusions

During the RI, samples were collected from surface soil, subsurface soil, groundwater, sediments, surface water, and soil vapor. Recommendations by media are outlined below.

7.1 Surface Soil

A total of 32 surface soil samples were collected during the RI from the interval 0 to 6 inches bgs and analyzed for TCL VOCs, TCL SVOCs, and TCN. The highest concentration of total BTEX was 0.175 mg/kg (PASB-30-0-0.2). The highest concentration of total PAHs was 168.1 mg/kg (PASB-28-0-0.2). The highest concentration of CaPAHs was 88 mg/kg (PASB-28-0-0.2). The highest concentration of cyanide was 3.40 mg/kg (PASB-32-0-2).

Based on the qualitative and quantitative results of the PSA and RI, further investigation of surface soil is not recommended. The redevelopment of the site would expose future receptors to surface soil. However, sufficient data has been obtained to determine quantitatively the risk associated for each receptor.

7.2 Subsurface Soil

A total of 58 subsurface soil samples were collected during the RI from intervals greater than 6 inches bgs and analyzed for TCL VOCs, TCL SVOCs, and TCN.

The highest concentration of total BTEX was 342.1 mg/kg (PASB-25-1-6). The highest concentration of total PAHs was 16,410 mg/kg (PASB-22-3-5). The highest concentration of total CaPAHs was 2,670 mg/kg (PASB-22-3-5). The highest concentration of cyanide was 5.74 mg/kg (PASB-41-6-8) in subsurface soil.

The boring logs from the subsurface soil samples from the core area indicate the core area is impacted visually with residual MGP impacts, including staining, sheen, blebs, globs, lenses and coating. This area generally corresponds with the historical location of the gas holder, purifier house boiler, and oil tanks. Within this visually impacted area, tar saturated soil or solid tar was observed in some locations as well. These impacts were identified in the subsurface sand, predominantly in the top 11 feet of soil. However, sheens and staining extend approximately 15 feet bgs at PASB-25 and 20 feet bgs at PASB-30. Cross-Sections A-A' and B-B' on Figure 5-1 depict the horizontal and vertical extent of visually impacted soil in the core area of the site

It is recommended that the visually impacted soil be removed and replaced with clean soil. Removal of impacted soil will eliminate the secondary source of MGP impacts to soil, groundwater, and sediments.

7.3 Groundwater

Two rounds of groundwater samples were collected from each of the 14 overburden monitoring wells installed during the RI. Each groundwater sample from both rounds

was analyzed for TCL VOCs, TCL SVOCs and cyanide. During both rounds of sampling, several VOCs and SVOCs were detected above NYSDEC Water Quality Standards for Class GA Groundwater. Contaminant levels in monitoring wells located downgradient of the source area are low and will diminish after the source area has been remediated. Drinking water in Patchogue is provided through the municipal water supply which relies on a single-source aquifer. The one public supply well identified during the well search is located hydraulically side-gradient of groundwater flow at the site. Two potable 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 above, bi-annual groundwater sampling of all 14 monitoring wells is recommended. The groundwater samples will be analyzed for BTEX, PAHs, and TCN and compared to NYSDEC Ambient Water Quality Standards and Guidance Values for Class GA Groundwater.

7.4 Sediment

Ten sediment samples were collected during the RI and analyzed for BTEX, PAHs, and TCN. VOCs and SVOCs were detected above the MSSC in sediment samples collected upstream of the site, as well as downstream. The sediment sample collected farthest downstream, PASED-10, did not have any concentrations of constituents above these criteria.

Based on the dispersion of contaminants both upstream and downstream of the site, combined with the determination that the sediment will not impact ecological or human health receptors, no further investigation of sediment is recommended. The remedial action objectives for the Site will minimize or isolate the source of any future site-related impacts to the sediment.

7.5 Surface Water

Five surface water samples were collected during the RI and analyzed for TCL VOCs, TCL SVOCs, and TCN. No constituents were detected above NYSDEC Ambient Water Quality Standards and Guidance Values for Class C Surface Water. No further investigation of surface water is recommended. The remedial action objectives for the Site will minimize or isolate the source of any future site-related impacts to the surface water.

7.6 Soil Vapor

Three soil gas samples were collected during the RI and analyzed using TO-15. Based on the constituents detected and their concentrations, an additional sub-slab sample, indoor air sample, and ambient air sample were collected during the heating season in November 2009 from "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 is recommended as part of the remedial investigation phase.

7.7 Qualitative Human Health Exposure Assessment

A QHHEA was performed to evaluate the potential exposure pathways for human receptors relative to the COPCs identified for each impacted exposure media 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 exposure media. Various VOCs, SVOCs, and metals are located at elevated levels within various exposure media, particularly the on-site surface soil, subsurface soil, and groundwater and the off-site sediments. The on-site exceedances presented are located within the core and southern areas of the site. Some of the surface soil sample exceedances will be removed as part of the remedy for the site. However, those locations which remain may need to be addressed. The visual impacts identified in the subsurface soil will be removed as part of the final remedy. Groundwater, as discussed above, will be monitored, and the sediments will not be further investigated.

Soil gas samples collected from beneath the concrete slabs located in the northern area and east of the core area of the site indicated detections of VOCs.

In consideration of the COPCs identified for each exposure medium, the CSM for the QHHEA (Table 6-1), and the exposure profiles for current and potential human receptors, direct and indirect contact with the on-site and off-site exposure media are likely. The results of the QHHEA will be used to support future site management decision-making.

7.8 Fish and Wildlife Resources Impact Analysis

A FWRIA was conducted in two steps to: (1) 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 section of the RI; 2) 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 confirmation of ambient water quality exceedance;

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 is 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.

7.9 Remedial Action

Given the nature and extent of the contamination, based on the results of the PSA and RI, and the limited size of the impacted area, a Focused Feasibility Study should be developed and submitted to NYSDEC to present the remedial alternatives for this site. NYSDEC will then select a preferred alternative and present it to the public, for comment, in the form of a Proposed Remedial Action Plan (PRAP).

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Appendix A

Boring Logs

Appendix B

Test Trench Logs

Appendix C

Monitoring Well Construction Diagrams

Appendix D

Geotechnical Data

Appendix E

Well Records

Appendix F

Data Usability Summary Reports

Appendix G

Laboratory Data Form 1s

Appendix H

Patchogue River Probing Observations

Appendix I

PSA Data Tables

Appendix J

FWRIA Photo Log

Appendix K

FWRIA Species of Concern