Feasibility Study

Sag Harbor Former MGP Site

Sag Harbor
Suffolk County, New York
NYSDEC Consent Index No. D1-0002-98-11
Site Number 1-52-159

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Abbreviations and Acronyms

ACO	Administrative Order on Consent
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
COCs	Contaminants Of Concern
DNAPL	Dense Non-Aqueous Phase Liquid
EPA	United States Environmental Protection Agency
FS	Feasiblity Study
FWRIA	Fish and Wildlife Resources Impacts Analysis
ISCO	In-Situ Chemical Oxidation
LILCO	Long Island Lighting Company
LIPA	Long Island Power Authority
MGP	Manufactured Gas Plant
NAPL	Non-aqueous Phase Liquids
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PAH	Polycyclic Aromatic Hydrocarbon
QHEA	Qualitative Human Exposure Assessment
SVOC	Semivolatile Organic Compound
VOC	Volatile Organic Compound
RI	Remedial Investigation

MEASUREMENTS

msl	mean sea level
ppb	Parts Per Billion
ppm	Parts Per Million
ug/L	Micrograms per liter

Executive Summary

This report presents a Feasibility Study (FS) for the KeySpan Corporation (KeySpan) Sag Harbor Former Manufactured Gas Plant (MGP) Site in Sag Harbor, Suffolk County, New York (the Site). This report has been prepared in accordance with the Order on Consent, Index No. D1-0002-98-11 (the Order).

This FS was prepared in accordance with the New York State Department of Environmental Conservation (NYSDEC)-approved Remedial Investigation/Feasibility Study (RI/FS) Work Plan and in a manner consistent with appropriate USEPA and NYSDEC technical and administrative guidance documents, including *Draft DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002)*.

Consistent with the Order, an RI and an assessment of potential impacts on human health and ecological conditions were previously conducted and reported in the *Final Remedial Investigation Report (D&B, 2003)*. There are site-related chemical constituents present in the soil and groundwater beneath the site and surrounding properties and there are existing and potential pathways of exposure to these constituents. Groundwater is very close to the ground surface and there are potential exposures to chemicals in indoor air that have volatilized from groundwater. Other potential exposure pathways include direct contact with soil or groundwater.

The Order requires submittal of ". . .a complete Feasibility Study evaluating on-Site and off-Site remedial actions to eliminate, to the maximum extent practicable, all health and environmental hazards and potential hazards associated with disposal of hazardous materials at the Site." Following the procedures described in the guidance documents and regulations, this FS evaluated various technologies and combinations of technologies that could achieve the remedial requirements for the site to the extent practicable.

The regulations and guidance provide a methodical, step-wise process to establish remedial objectives for the site, identify and screen potential remedial technologies applicable to the site, develop a range of comprehensive remedial alternatives, evaluate and compare the alternatives, and recommend a remedy. The application of this process to the site is presented in the body of the document, including presentation of the alternatives considered and their evaluation against regulatory-defined criteria.

Taking into account the RI findings, the current and future exposure scenarios, the requirements of the Order, and the applicable regulatory requirements, the following remedy, out of five alternatives considered, is recommended for the site.

- Excavate on-site and off-site contamination source areas to a depth of approximately 10 feet and thermally treat and dispose of the excavated material off site. These measures will prevent potential future exposure to readily accessible impacted soils, will reduce the contaminant mass at the site, will reduce the shallow groundwater contamination in the site area, and will reduce the potential volatilization of contaminants to indoor air.

- Recover dense non-aqueous phase liquid (DNAPL) tar where it will readily flow into a well. This measure will remove contaminants from the subsurface and will reduce the potential for future migration of tar.

- Implement a long-term groundwater, DNAPL, and indoor air monitoring program to ensure that the remedy remains protective of human health and the environment. KeySpan will evaluate the monitoring data on an ongoing basis and provide periodic reports of site conditions in accordance with State regulatory requirements.

- Establish institutional controls to prohibit the use of groundwater, to restrict use of the site, and to limit potential contact with subsurface materials. These control measures will ensure that the remedy will remain protective of public health. KeySpan will establish mechanisms such as deed restrictions with property owners, and will institute a monitoring and reporting program to verify that these measures are maintained throughout the life of the remedy.

This remedial alternative is identified as Alternative 2A in the body of this report.

Implementation of this proposed remedial alternative will achieve the following Remedial Action Objectives (RAOs) developed for the site in accordance with regulatory requirements:

- Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of volatiles from, contaminated groundwater.
- Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.
- Remove, to the extent practicable, the source of groundwater contamination.
- Prevent, to the extent practicable, ingestion/dermal contact with or inhalation of particulates/dust from contaminated soil.
- Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.

- Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater

The estimated cost to implement this remedy is $10.7 million.

This remedy will achieve the RAOs and prevent potential exposures to site-related contaminants. There will be short-term effects on the community during remediation. To successfully implement the proposed remedial alternative, surrounding property owners and occupants must grant access to conduct the remedy and agree to long-term monitoring and institutional controls. Excavating soil to the target depth will require removal of large volumes of groundwater. The removed groundwater has to be continuously treated using a several hundred gallons per minute temporary treatment system. The ability to discharge the treated waters to Sag Harbor Cove is critical to the implementation of the recommended remedy. In addition, decommissioning and removal of current gas storage equipment on site, securing agreements with off-site property owners and management of solid waste are key challenges to successful implementation of the recommended remedy.

1. Purpose

1.1 Introduction

This report presents a Feasibility Study (FS) for the KeySpan Corporation (KeySpan) Sag Harbor Former Manufactured Gas Plant (MGP) Site in Sag Harbor, Suffolk County, New York (the Site). This report has been prepared in accordance with the Order on Consent, Index No. D1-0002-98-11, (the Order) signed by KeySpan and the New York State Department of Environmental Conservation (NYSDEC).

The Site is located on the north shore of the south fork of Long Island, on the east side of Bridge Street at its intersection with West Water Street and Long Island Avenue, approximately 200 feet inland (south) of the confluence of Sag Harbor Cove with Sag Harbor Bay. A site location map is shown on Figure 1-1.

A detailed history of the site was presented in the *Sag Harbor Former Manufactured Gas Plant Site Remedial Investigation Report* (D&B, 2002). The following is a brief recap of the history presented in that report. The site was initially developed in 1859, and it is said to have been used to manufacture gas from coal or rosin. The Lowe Carbureted Water Gas Process was utilized on site from 1892 to 1930. Gas was manufactured either intermittently or continuously on the site by several successor companies. These companies included the Sag Harbor Gas Light Company (by 1862), UGI of Philadelphia (by 1885), and the Sag Harbor Light Company (by 1914). In 1918, the Long Island Gas Corporation took control of the operation and increased production capacity. In 1929, the Long Island Lighting Company (LILCO) purchased the site and the function of the site shifted from gas manufacturing to serving as a "link" in the gas distribution system. As a result, gas production at the Sag Harbor site ceased and storage capacity at the site was greatly increased. Structures that had been used for the manufacture of gas were later dismantled and removed from the site. In 1998, KeySpan acquired the former MGP property through a merger of Brooklyn Union Gas with LILCO. Currently, a gas storage facility (Hortonsphere) remains active on site, as do supporting facilities.

The December 2003 *Final Remedial Investigation Report Sag Harbor Former MGP Site, New York (DB, 2003)* (RI Report) and the February 2005 *Draft Supplemental Field Program Report Sag Harbor Former MGP Site, New York (GEI, 2005)* (Supplemental Report) summarize the findings of all the investigations and recommend further remedial action to eliminate migration pathways and/or eliminate potential exposure to MGP-related impacts.

1.2 Scope of Feasibility Study

The Order requires KeySpan to "submit a complete Feasibility Study evaluating on-Site and off-Site remedial actions to eliminate, to the maximum extent practicable, all health and environmental hazards and potential hazards associated with disposal of hazardous materials at the site." Further, the Order requires the Feasibility Study to be prepared in accordance with the Department-approved RI/FS Work Plan and in a manner consistent with CERCLA, the NCP, the USEPA guidance document entitled *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, 1988),* and appropriate USEPA and NYSDEC technical and administrative guidance documents.

An RI/FS Work Plan was submitted by KeySpan in November 1999 prior to the start of remedial investigations, which culminated with the preparation of the February 2005 Supplemental Report. This FS was prepared in accordance with the RI/FS Work Plan. The FS was also prepared in accordance with the *NYSDEC Technical and Administrative Guidance Memorandum (TAGM) #4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites* and *Draft DER-10, Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002).* In all areas of significance, the guidance documents and RI/FS Work Plan used in preparing this FS are consistent in their approach and requirements.

Evaluating remedial technologies and developing alternatives for this FS included an assessment of the economic and logistical impacts of implementing the alternatives on the community. Technologies and alternatives that could impact the seasonal life style of the community were less favored. The selected technologies and alternatives were further evaluated to allow flexibility in implementation and management to accommodate the concerns of the Sag Harbor community.

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

1.3 Report Organization

This document has been organized in accordance with *DER-10* Remedy Selection Reporting Requirements Section 4.3(b) and includes the following sections:

- Executive Summary
- Purpose
- Site Description and History
- Summary of Remedial Investigation and Exposure Assessment
- Remedial Goals and Remedial Action Objectives

- General Response Actions
- Identification and Screening of Technologies
- Development and Analysis of Alternatives
- Recommended Remedy

2. Site Description and History

This section presents a summary description of the site, its history, previous investigations, and interim remedial measures. Refer to the December 2003 RI Report for more complete descriptions of the site and its history.

2.1 Site Description

The former MGP property encompasses approximately 0.76 acres and currently includes the following:

An active 100,000-cubic foot spherical gas storage tank (referred to as a Hortonsphere) located on the southwest corner of the site. Gas lines from a regulator located in the northeastern area of the site traversing the northern and central portions of the site and conveying natural gas to the Hortonsphere. A compressor station building located to the east of the regulator. Three natural gas storage tanks that are set on concrete cradles located to the southwest of the compressor station building. The surface of the site is covered with bluestone, and is fully enclosed and secured by an 8-foot-high chain-link fence.

Surrounding properties include:

North - Long Island Avenue and a commercial development consisting of small retail stores, a residence, and residential condominiums
South - A commercial building and residential buildings
West - Bridge Street and residential condominiums
East - A post office, bank, laundromat and a parking lot

The area surrounding the Sag Harbor former MGP site includes a variety of land uses including residential, commercial, industrial, and recreational. A site layout map showing the site and surrounding areas, current structures, and other relevant site features is provided in Figure 2-1.

2.2 Site History

A summary of the Sag Harbor MGP history based on D&B's Remedial Investigation Report is presented below. A more detailed discussion of the MGP history is presented in D&B's Report.

The site was initially developed in 1859, and it is said to have been used to manufacture

gas from coal or rosin. The Lowe Carbureted Water Gas Process was utilized on-site from 1892 to 1930. Gas was manufactured either intermittently or continuously on the site by several successor companies. These companies included the Sag Harbor Gas Light Company (by 1862), UGI of Philadelphia (by 1885) and the Sag Harbor Light Company (by 1914). In 1918, the Long Island Gas Corporation took control of the operation and increased production capacity. In 1929, the Long Island Lighting Company (LILCO) purchased the site and the function of the site shifted from gas manufacturing to serving as a "link" in the gas distribution system. As a result, gas production at the Sag Harbor site ceased and storage capacity at the site was greatly increased. Structures that had been used for the manufacture of gas were later dismantled and removed from the site. In 1998, KeySpan acquired the former MGP property through a merger of Brooklyn Union Gas with LILCO. Additional details regarding the history of the site are provided in the December 2003 RI Report.

2.3 Future Use

KeySpan is planning to upgrade portions of its gas distribution system on eastern Long Island in 2005. After these upgrades have been completed, the regulator station, Hortonsphere and storage tanks will no longer be needed for gas distribution and will be removed. The pylons and footings supporting the tanks, as well as any underground piping, will remain on site and will be removed during the remediation.

At this time, KeySpan does not have specific future plans for its property. The remedy chosen for the Site will support a variety of future uses. Any specific use will need to be consistent with the engineering and institutional controls that constitute important components of the remedy.

3. Summary of Remedial Investigation and Exposure Assessment

3.1 Introduction

Remedial Investigations have been conducted at the Site since 1988. The findings of those investigations are integrated into the December 2003 RI Report, which presents a conceptual site model and comprehensive depiction of the nature and extent of contamination at the Site. The December 2003 RI Report also includes Qualitative Human Health and Ecological Risk Assessments. This section summarizes the findings presented in the December 2003 RI Report and the February 2005 Supplemental Report that are relevant to developing and analyzing remedial alternatives. Refer to the December 2003 RI Report and the February 2005 Supplemental Report for a complete discussion of the remedial investigations conducted at the site.

3.2 Nature and Extent of Contamination

MGP-related contaminants are present in the subsurface beneath the former site and surrounding properties. The following sections describe the distribution of contaminants in the site area and the nearby off-site properties.

3.2.1 NAPL Source Material

The physical and chemical distribution of contaminants at the Sag Harbor former MGP suggests the presence of five separate source areas of tar-saturated material in the subsurface. The five source areas are:

- The vicinity of the former tar separating tank
- The vicinity of the former generator room/crude oil tank
- The vicinity of the former gas holders No. 2 and 3
- The vicinity of the former Gas Purifying Houses
- The vicinity of former Gas/Oil tanks

These source areas are defined by significant zones of tar-saturation and the presence of dense non-aqueous phase liquid (DNAPL) and light non-aqueous phase liquid (LNAPL), which coincide with the highest concentrations of polycyclic aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene, and xylene (BTEX) recorded in the subsurface and groundwater. The areal extent of NAPL impacts is depicted on Figure 3-1. Figure 3-1 is a depth-integrated composite of the broadest observed lateral extent of visually identifiable

NAPL related impacts in soil and groundwater, including tar saturation, and blebs, sheens and staining.

The extent of NAPL related impacts in soil and groundwater are inferred in the off-site Retail Stores (located northwest of the site) and adjacent parking lot areas based on observations at wells and soil borings along Long Island Avenue and Bridge Street. The approximate limits of off-site properties requiring groundwater contact or use restriction is depicted in Figure 3-1 as requiring institutional and/or engineering controls. During the remedial design phase additional efforts may be made to refine the inferred extents of off-site migration.

3.2.2 Surface Soil

PAHs were identified as the contaminants of concern (COCs) in surface soil. These contaminants were detected throughout the site with higher concentrations in the vicinity of some of the former MGP structures. The site is fenced and the surface of the site is covered with approximately 6 to 8 inches of bluestone almost eliminating the possibility of exposure to surface soils.

3.2.3 Subsurface Soil

BTEX, PAHs, metals, and cyanide were identified as COCs in subsurface soil. COCs were found to extend to depths of approximately 85 feet below grade in the area of the former gas works and to much shallower depths in off-site areas. In general, the distribution of BTEX and PAHs in soil coincides with the presence of DNAPL. BTEX constituents in subsurface soils not associated with DNAPL are typically mobile and not particularly persistent in the surrounding environment due to their high volatility, low adsorption to soils, and high water solubility. With few exceptions, the PAHs associated with the site will be relatively persistent in the soil matrix and associated with DNAPL. This is primarily due to their generally low water solubility and high sorption to soils. Metals in soil are also anticipated to be relatively persistent.

3.2.4 Groundwater

BTEX, PAHs, metals, and cyanide have been identified as COCs in groundwater. Groundwater contamination is present beneath the site as well as in off-site areas. The tidal influence on site groundwater has had a significant effect on limiting the migration of dissolved phase impacts off-site. The inversion that occurs at high tide creates ebb and flow of groundwater over the impacted areas and limits the migration of dissolved phase impacts off site. This tidal-induced effect decreases with depth and has limited influence on the deep groundwater zone.

The dissolved-phase groundwater contaminant concentrations within the area of DNAPL impacts are likely in a steady-state condition, where the rate of dilution from inflowing clean water equals the rate of dissolution of contaminants from the DNAPL. The likely age of the release (greater than 40 years) would have allowed the groundwater system on the site to reach steady state. Although it is possible that the dissolved phase plume could reach Sag Harbor Cove under steady state conditions, RI and subsequent field activities have shown no evidence of impacts to Sag Harbor Cove.

3.3 Qualitative Human Exposure Assessment

A qualitative human exposure assessment is included in the December 2003 RI Report. Based on the assessment, the following existing or potential exposure pathways are significant and require remedial action for their elimination or mitigation:

- Ingestion/dermal contact with, or inhalation of particulate/dust from contaminated surface soil
- Ingestion/dermal contact with, or inhalation of particulate/dust from contaminated subsurface soil
- Ingestion/dermal contact with, or inhalation of volatiles from contaminated groundwater
- Inhalation of vapors emanating from contaminated soil
- Inhalation of vapors emanating from contaminated groundwater
- Ingestion, dermal contact and inhalation of volatiles emanating from NAPL present in the subsurface

Refer to the exposure assessment in the RI Report for a more detailed discussion of the potentially exposed populations. Exposure to subsurface soil and groundwater would be expected to occur only during potential future ground-intrusive activities. Groundwater is not now used for consumptive purposes, nor is it reasonable to expect that it would be in the future.

3.4 Fish and Wildlife Resources Impact Analysis

A fish and wildlife resources impact analysis was also included in the December 2003 RI Report. The analysis concluded that the Site is having no significant impact on fish and/or wildlife resources.

3.5 Summary of Impacted Media and Contaminants of Concern

Based on the findings of the remedial investigations and exposure assessments, the impacted media requiring remedial action are surface soil, subsurface soil, NAPL source material, and groundwater. Potential human exposure to contaminants present in these media at the site and off site requires mitigation via remedial action. There are no potential ecological exposures of significance. The potential exposure to groundwater is only anticipated to occur through infrequent ground intrusive construction-related activities. Contaminants of concern are the volatile organics BTEX, PAH, metals, and cyanide.

4. Remedial Goals and Remedial Action Objectives

4.1 Remedial Goals

The NYSDEC's Remedy Selection guidance puts forth the following remedial goals:

- Restoration of the site to pre-disposal/pre-release conditions, to the extent feasible and authorized by law.

- At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site through the proper application of scientific and engineering principles.

- Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.

Restoration to pre-disposal/pre-release conditions will be extremely difficult, if not infeasible at the site, and may present considerable risks to the community. This lack of feasibility is primarily attributable to the great depths to which some contaminants have migrated downward in the over 130 years since they may have first been released at the site. The risk to the community relates to concerns that soil and material removal at these great depths could have serious adverse consequences to the geological structures supporting this area of the Sag Harbor. However, a remedial alternative to achieve this level of remediation will be analyzed in this FS to provide a sense of the scale of such an undertaking and the detrimental effects such an alternative would have on the local community. The detrimental effects considered included technical, economic, and logistical impacts on the seasonal activities of the Sag Harbor community, the risk of exposure during excavation, handling, management, transport, and discharge of material at the site.

The Site Remedial Goals, therefore, are (1) eliminate or mitigate all significant threats to public health and the environment; and, (2) remove or eliminate, to the extent feasible, identifiable sources of contamination, regardless of intended use of the site or presumed risk. These goals establish the site-specific Standards, Criteria and Guidelines (SCGs) for determining the success of the final remedy, in accordance with TAGM 4030 and NYSDEC's determination of what is feasible for the site

4.2 Remedial Action Objectives

Remedial Action Objectives (RAOs) are medium-specific or operable-unit specific objectives for the protection of public health and the environment of the Sag Harbor community. The RAOs for the Site support and are consistent with the Site Remedial Goals presented above. Based on the findings of the Remedial Investigations, and the Human Health and Ecological Risk Assessments, the following RAOs have been developed for the Site:

GROUNDWATER

- Prevent, to the extent practicable, ingestion/dermal contact with or inhalation of volatiles from contaminated groundwater.
- Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.
- Remove, to the extent practicable, the source of groundwater contamination.

SOIL

- Prevent, to the extent practicable, ingestion/dermal contact with or inhalation of particulates/dust from contaminated soil.
- Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.

VAPOR/AIR

- Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.

5. General Response Actions

5.1 General Response Actions

General response actions describe those actions that will satisfy the RAOs. General response actions are medium-specific. The general response actions are evaluated in the context of the volume or areas of media to which they might be applied. The general response actions described below include No Action, Excavation, Treatment, Containment, and Institutional Controls.

5.1.1 No Action

In many feasibility studies, the no action response is typically identified and carried through the evaluation process as a point of comparison for other actions.

5.1.2 Excavation

Excavation is applicable to the soil and contaminant source areas at the Site and off Site including the retail stores and adjoining parking areas. Excavation of impacted soils, structures, and contaminant source areas in the unsaturated zone would be accomplished using conventional construction equipment and methods. Excavation in the saturated zone would require significant earth support and dewatering systems. Given the high hydraulic conductivity, high water table, and tidal influence of Sag Harbor Cove at the Site, and the vertical extent of contamination, excavation of all impacted soils and NAPL is infeasible. Soil or source materials removed by excavation would need to be further remediated by disposal or treatment.

5.1.3 Treatment

Treatment is applicable to the soil, groundwater, and source materials. Treatment alters the physical and/or chemical nature of the media to cause a change in contaminant mass, mobility, or toxicity. Treatment can be accomplished in-situ or ex-situ. Examples of in-situ treatment include chemical oxidation and stabilization. Ex-situ treatment technologies include thermal desorption and incineration.

5.1.4 Containment

Containment is applicable to the NAPL contaminant sources, groundwater, and soil at the site. For NAPL and groundwater, containment actions involve isolation of contaminants by constructing and maintaining physical barriers or systems that prevent potential migration.

These include sheet pile walls, soil-bentonite cutoff walls, and active hydraulic control. For soil, containment actions include constructing cover systems or other barriers to prevent contact with the soil.

5.1.5 Institutional Controls

Institutional controls are applicable to soil, NAPL sources and groundwater. These actions include access control measures, deed restrictions, and established procedures for managing ground-intrusive work. Specific institutional controls would be tailored to the remedy chosen and the ultimate re-use of the property. More information on typical institutional controls that may be appropriate for the site is provided below. These controls could be used for the Site and applicable off-Site areas, including the retail stores, post office, restaurant, commercial building, two condominium buildings and other structures including Long Island Avenue, Bridge Street, and other Village rights of way located within the envelope of properties requiring institutional controls or engineering controls (see Figure 3-1).

Access control measures, such as fencing, security, and general monitoring of the site, help to prevent someone who is not knowledgeable of site conditions from performing ground-intrusive work and creating a potential exposure pathway to remaining contaminants.

A deed restriction and/or environmental easement is a legal instrument that would serve to notify any potential future property owners of the environmental conditions and any use restrictions placed on the site, such as a prohibition on using groundwater beneath the site.

Procedures for managing ground-intrusive work include establishing a protocol for overseeing worker and public health and safety, having a plan for managing any contaminated soil or groundwater removed during the work, and establishing a mechanism, such as including the site area in the “one-call” system, to notify people who may otherwise be unaware of conditions at the site prior to conducting ground-intrusive work.

An important component of any institutional control program is ongoing monitoring of the effectiveness of the controls. This includes annually certifying that the controls are in place and are effective.

6. Identification and Screening of Technologies

6.1 Introduction

This section evaluates potentially applicable technologies to determine those that can be effectively implemented at the Site to achieve the remediation goals. Information presented in the Remedial Investigation on contaminant types, distribution, and location, and on the Site's physical characteristics, is used to screen the technologies to determine which can be successfully implemented and which will not be feasible.

6.2 Technology Identification and Screening

Technology identification and screening involves the following steps:

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

6.2.1 Technical Issues

The primary technical issues affecting the implementability and effectiveness of potential technologies at the site are: the physical and chemical nature of the source material and NAPL; the shallow depth to groundwater, highly permeable soil, and tidal influence on groundwater; the deep vertical extent of contamination; and potential future uses of the property.

MGP-derived NAPLs are complex chemical mixtures. The NAPLs present in the subsurface are not uniform in either their physical or chemical characteristics, likely having origins from different processes over a long time span. The weathering and mixing with soil and groundwater that has occurred over time has made these NAPLs even less of a pure, consistent product. This complexity and the predominance of relatively "heavy" organics within the NAPL means that many remedial treatment technologies that have been proven for less complex, or "lighter," contaminants will not be effective on the NAPLs at the Site.

The hydrogeologic characteristics of the site pose several challenging issues. The relatively shallow depth to groundwater means that any significant excavation beyond 1 to 2 feet will require construction dewatering and earth support systems. Dewatering is most readily

implementable when a significant stratum of relatively low permeability soil is within a reasonable depth from the surface. When vertical barriers can be constructed to tie into this stratum, groundwater control within an excavation can be more efficiently maintained. At the Site, no strata of low permeability soils were found to exist within at least 150 feet of the ground surface which was investigated except for a peat layer of thickness varying from 0 to 4 feet. The volume of water recovered during excavation can range from as much as 300 to 900 gallons per minute depending on the areal extent and depth of excavation. The existing Village of Sag Harbor wastewater treatment plant is capacity-limited and will be unable to accept this flow rate. Piping capacity in the site area would also be a limiting factor. Therefore, the water must be discharged to surface water, i.e., Sag Harbor Cove. A treatment system will be required to process the water before discharge to the Cove. Therefore, the excavation techniques, excavation sequence, groundwater recovery, management, treatment and disposal issues will be significant components in any remedy involving excavation below the water table.

The relatively high hydraulic conductivity of the Site soils also poses issues for potential in-situ technologies, such as chemical oxidation, that require control of the subsurface environment. The tidal influence also poses challenges to in-situ technologies and containment technologies that involve hydraulic control.

The remedial investigations have shown that contamination extends vertically to over 85 feet in the vicinity of monitor well SHMW-02I in the Site area. This isolated contamination is well beyond the reach of conventional and even most specialized construction equipment. However, as stated in the December 2003 RI Report, the contamination present at such depths poses little risk. For this FS, contamination below a depth of 36 feet is not considered to pose significant risk. No horizontal migration of tar has been observed below this depth, nor would any be reasonably expected in the future. The remote potential for migration exists, however, and this FS will consider alternatives that prevent potential migration over a range of depths.

6.2.2 Technology Identification

Potential remedial technologies were identified from experience and review of available technical publications. The technologies are categorized according to the general response actions developed in Section 5 and are summarized in Table 6-1.

6.2.3 Technology Screening

Table 6-1 also presents a screening evaluation of the technologies, according to the following criteria: effectiveness, implementability, and cost. As shown on Table 6-1, technologies that are not considered implementable or effective will not be retained for further analysis.

6.3 Summary of Retained Technologies

The technologies retained for further analysis are:

- Excavation
- Off-site low temperature thermal desorption and disposal/recycle
- Engineered cover system
- NAPL recovery
- Vertical containment (various construction methods)
- In-situ stabilization
- Monitoring
- Institutional controls

In the next section, these technologies are combined into comprehensive site-wide alternatives.

7. Development and Analysis of Alternatives

7.1 Introduction

This section assembles retained remedial actions and technologies into a list of site-wide remedial alternatives. These alternatives are then described in detail and then evaluated against seven criteria as specified in DER-10. Lastly, a comparative analysis of the alternatives is presented.

7.2 Remedial Alternatives

In consideration of technological, Site, medium, and contaminant-specific factors, the following alternatives were developed for consideration and evaluation. To achieve the NYSDEC's overall remedial goal: "Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site," alternatives 1A through 4 include excavation and off-site low temperature thermal desorption and disposal/recycle of contaminant source material and removal of relic MGP structures. Off-site treated soils will not return to the Site. Clean backfill will be imported to the Site. Alternative 1A includes construction of an engineered cover system to limit disturbance of and prevent exposure to impacted soils. Alternatives 1A through 3 also include long-term monitoring plans and institutional controls to limit subsurface disturbance and, when disturbance is necessary, to have a protocol in place to control potential exposure to contaminants. Alternatives 1A and 2A also include passive NAPL recovery. In situ stabilization is included for off-site source areas as a variation for Alternatives 1A and 2A. The alternatives are:

1. NAPL recovery, engineered cap, shallow containment cells to peat/silt/clay layer on-site, institutional controls, continued groundwater and indoor air monitoring and either:
    A. Unsaturated/saturated excavation of off-site source areas to a maximum depth of 8 to 10 feet below grade, or
    B. In-situ stabilization of off-site source areas to a maximum depth of 8 to 10 feet below grade.
2. NAPL recovery, institutional controls, and continued groundwater and indoor air monitoring and either:
    A. Excavation of on-site and off-site source areas to a maximum depth of 8 to 10 feet below grade, or

   B. Excavation of on-site source areas to a maximum depth of 8 to 10 feet below grade and in-situ stabilization of on-site and off-site source areas to a maximum depth of 36 feet below grade.
3. Excavation of source areas and structures to between 8 and 10 feet below grade, in-situ stabilization of source areas to 60 feet below grade, and continued groundwater monitoring of deep zone.
4. Restore site to pre-release conditions.
5. No Action.

The economic and logistical impact to the neighboring properties and Sag Harbor community were considered during development of the alternatives. For example, during excavation, considerable amounts of water will be generated due to shallow groundwater conditions in the excavation area and the only practicable alternative for managing treated groundwater is to discharge it to Sag Harbor Cove. The community will be concerned about increased truck traffic, business disruption and other issues. These types of impacts to the community, in addition to preventing potential exposure to contaminants, were considered during the evaluation of the alternatives.

7.3 Description of Alternatives

Each of the five alternatives is described in more detail below, using the context of Section 4.2(a)5(i) of the NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation.

7.3.1 Alternatives 1A and 1B: Containment Barrier System/Engineered Cap/Shallow Off-Site Source Excavation (10')/Retail Store Vapor Management/NAPL Recovery

These alternatives include construction of containment barriers around and an engineered cap over on-site NAPL/tar sources, excavation of off-site contaminant source material (to a maximum of approximately 10 feet below grade), a long-term groundwater and indoor air monitoring program, a NAPL monitoring and passive recovery program, and institutional controls to manage future subsurface disturbance and resultant potential exposures.

Alternate B includes construction of a sub-slab ventilation system for the retail stores, and in-situ stabilization of off-site contaminant source material (to approximately 10' below grade) as a variation to excavation in certain off-site areas. Eventual new construction on site would include engineered vapor management. With respect to the guidance, the alternative is described as follows:

Size and configuration: Figures 7-1A and 7-1B illustrate the conceptual plans of Alternatives 1A and 1B. The containment barrier(s) will extend to between 8 and 10 feet bgs around the perimeter of the KeySpan-owned property. The entire area of the Site will be disturbed to construct the cap and excavate off site. Construction of the engineered cover system across the site will include 2 feet of clean soil with a geotextile construction barrier underlying an asphalt pavement. Excavation of impacted off-site soils will occur over an approximately 11,000 square feet area. In Alternative 1B only 6,500 square feet area will be excavated and the rest will be stabilized in-situ. A sub-slab ventilation system will be installed below the retail store area in Alternative 1B.

NAPL will be collected via extraction wells. The locations and screen intervals of the extraction wells will be determined during the remedial design phase. The collection system will be passive in nature, collecting on a periodic basis only free NAPL which readily enters an extraction well (i.e., no mobility enhancers would be injected into the subsurface to increase the rate and quantity of extraction).

Institutional controls would be implemented and long-term groundwater and indoor air monitoring would be conducted on the site and adjacent areas under both alternates A and B. Due to the high water table in the area of the site, sub-slab vapor sampling is not feasible. Buildings located over remaining contamination will be subject to long-term periodic air monitoring. During the design phase, sub-slab venting may be evaluated as a means of reducing the frequency of long-term periodic air monitoring.

- **Time for remediation:** The estimated time to complete all construction-related remediation activities is 1 year, pending access to non-owned properties and potential seasonal construction constraints. Monitoring, NAPL recovery, operation of the sub-slab ventilation system, and maintenance of institutional controls will continue indefinitely.

- **Spatial requirements:** The alternative will require substantial room for equipment and material storage, access, logistics, and operation. The Site can accommodate these needs, but careful staging and sequencing of the work will be required. When excavation is performed adjacent to Bridge Street or Long Island Avenue, it will likely be necessary to temporarily close lanes to traffic for several weeks to accommodate construction equipment and control access to the areas undergoing remediation.

Access to the retail stores and temporary disruption of business activity will be required to install the sub-slab ventilation system. The stores would need to be vacated, trenches cut through the floors, venting pipes installed, and the spaces restored.

- **Options for disposal:** Options for disposal of excavated and removed solid materials are readily available. Groundwater extracted during excavation dewatering can be treated on-site using readily available technology. The treated groundwater must be discharged to Sag Harbor Cove, as capacity is unavailable in the sanitary sewer system.

- **Permit requirements:** No significant technical permit requirements are anticipated that would limit the effectiveness or implementability of this alternative. The work area must accommodate a temporary treatment system for the dewatering effluent. The system would operate around the clock during excavation activity.

- **Limitations:** Deactivation and removal of the existing gas distribution infrastructure, temporary lane closures of Bridge Street and Long Island Avenue, and extensive dewatering activities during excavation will be necessary to implement this alternative. Approval to discharge treated groundwater to Sag Harbor Cove must be granted. The owner and tenants of the retail stores must agree to the proposed remedy and grant access for installation and operation of the sub-slab ventilation system. Affected neighbors must grant continued access for monitoring and accept institutional controls.

- **Ecological impacts**: This alternative is not anticipated to have any significant beneficial or adverse impacts on fish and wildlife resources.

7.3.2 Alternatives 2A and 2B: Source Excavation (10') On-site and Off-site Including Retail Store Area/In Situ Stabilization/NAPL Recovery/Institutional Controls/Monitoring

These alternatives include excavation of on-site and off-site contaminant source material and former MGP structures (to a maximum of approximately 10 feet below grade) and/or in-situ stabilization of source material, a long-term groundwater and indoor air monitoring program, and institutional controls to manage future subsurface disturbance and resultant potential exposures. If holder foundations or other former MGP structures that may contain source material extend beyond 10 feet, excavations will be deepened as necessary to inspect and/or remove the full depth of the structure.

Alternative 2A will include excavation of both on-site and off-site source material including the retail store area. Alternative 2B uses a sub-slab ventilation system under the retail stores and substitutes in-situ stabilization for excavation in selected off-site areas.

With respect to the guidance, the alternative is described as follows:

- **Size and configuration:** Figures 7-2A and 7-2B illustrate the conceptual plans of these alternatives. Alternative 2A includes excavation of soils across the site and in the current retail store area, with excavation extending over an area of approximately 46,000 square feet. Alternative 2B uses a sub-slab ventilation system under the retail stores and substitutes in-situ stabilization for excavation in selected off-site areas.

  In-situ stabilization will extend to a maximum depth of 36 feet. NAPL will be collected via extraction wells. The locations and screen intervals of the extraction wells will be determined during the remedial design phase. The collection system will be passive in nature, collecting on a periodic basis only free NAPL which readily enters an extraction well (i.e., no mobility enhancers would be injected into the subsurface to increase the rate and quantity of extraction).

  Institutional controls would be implemented and long-term groundwater and indoor air monitoring would be conducted on the site and adjacent areas under both alternates A and B. Due to the high water table in the area of the site, sub-slab vapor sampling is not feasible. Buildings located over remaining contamination will be subject to long-term periodic air monitoring. During the design phase, sub-slab venting may be evaluated as a means of reducing the frequency of long-term periodic air monitoring.

- **Time for remediation:** The estimated time to complete all construction-related remediation activities is 1 to 2 years pending access to non-owned properties and potential seasonal construction constraints. Monitoring, NAPL recovery, and maintenance of institutional controls will continue indefinitely.

- **Spatial requirements:** The alternatives will require substantial room for equipment and material storage, access, logistics, and operation. The Site can accommodate these needs, but careful staging and sequencing of the work will be required. Temporary access to adjacent areas that will not be excavated would be helpful in providing space for equipment and material laydown and storage space and temporary offices. When excavation is performed adjacent to Bridge Street or Long Island Avenue, it will likely be necessary to temporarily close lanes to traffic for

several weeks to accommodate construction equipment and control access to the areas undergoing remediation.

Under alternate A, the businesses occupying the retail stores would be temporarily displaced; however, for a longer period than alternate B. The stores would need to be vacated, the buildings removed, excavation of source material, sub-slab venting pipes installed, and the buildings restored.

Under alternate B, access to the retail stores and temporary disruption of business activity will be required to install the sub-slab ventilation system. The stores would need to be vacated, trenches cut through the floors, venting pipes installed, and the spaces restored.

- **Options for disposal:** Options for disposal of excavated and removed solid materials are readily available. Groundwater extracted during excavation dewatering can be treated on site using readily available technology. The treated groundwater must be discharged to Sag Harbor Cove, as capacity is unavailable in the sanitary sewer system.

- **Permit requirements:** The work area must accommodate a large temporary treatment system for the dewatering effluent. The treatment system requires a capacity of at least 300 gallons per minute, with redundant equipment. The system would operate around the clock during excavation activity.

- **Limitations:** Deactivation and removal of the existing gas distribution infrastructure, temporary lane closures of Bridge Street and Long Island Avenue, and extensive dewatering activities during excavation will be necessary to implement this alternative. Approval to discharge treated groundwater to Sag Harbor Cove must be granted. The owner and tenants of the retail stores must agree to the proposed remedy and grant access for either excavation or installation and operation of the sub-slab ventilation system. Affected neighbors must grant continued access for monitoring and accept institutional controls.

- **Ecological impacts**: This alternative is not anticipated to have any significant beneficial or adverse impacts on fish and wildlife resources.

7.3.3 Alternative 3: On-Site and Off-Site Source Excavation (10')/On-Site In-Situ Stabilization/Retail Store Vapor Management/Monitoring

This alternative includes excavation of on-site and off-site contaminant source material and former MGP structures (to approximately 10' below grade), in-situ stabilization of source material below 10 feet to minimize potential migration, a long-term groundwater and indoor air monitoring program, construction of a sub-slab ventilation system for the retail stores, and institutional controls to manage future subsurface disturbance and resultant potential exposures. If holder foundations or other former MGP structures that may contain source material extend beyond 10 feet, excavations will be deepened as necessary to inspect and/or remove the full depth of the structure. The stabilization will apply to source areas up to 60 feet bgs. With respect to the guidance, the alternative is described as follows:

- **Size and configuration:** Figure 7-3 illustrates the conceptual plans of this alternative. The entire area of the Site will be disturbed to complete the excavation. Excavation of impacted soils and former MGP structures will occur over approximately 34,000 square feet of Site area. The stabilization will be conducted through a grid of closely-spaced vertical injection points over a large portion of the site. Typically, a large-diameter auger system or a jet-grouting approach is used to conduct stabilization. A sub-slab ventilation system will be installed below the retail store area.

  Institutional controls would be implemented and long-term groundwater and indoor air monitoring would be conducted on the site and adjacent areas. Due to the high water table in the area of the site, sub-slab vapor sampling is not feasible. Buildings located over remaining contamination will be subject to long-term periodic air monitoring. During the design phase, sub-slab venting may be evaluated as a means of reducing the frequency of long-term periodic air monitoring.

- **Time for remediation:** The estimated time to complete all construction-related remediation activities is 1 to 2 years pending access to non-owned properties and potential seasonal construction constraints. Monitoring and maintenance of institutional controls will continue indefinitely.

- **Spatial requirements:** The alternative will require substantial room for equipment and material storage, access, logistics, and operation. The Site can accommodate these needs, but careful staging and sequencing of the work will be required. Temporary access to adjacent areas that will not be excavated would be helpful in providing space for equipment and material laydown and storage space and temporary offices. When excavation is performed adjacent to Bridge Street or Long

Island Avenue, it will likely be necessary to temporarily close lanes to traffic for several weeks to accommodate construction equipment and control access to the areas undergoing remediation.

Access to the retail stores and temporary disruption of business activity will be required to install the sub-slab ventilation system. The stores would need to be vacated, trenches cut through the floors, venting pipes installed, and the spaces restored.

- **Options for disposal:** Options for disposal of excavated and removed solid materials are readily available. Groundwater extracted during excavation dewatering can be treated on-site using readily available technology. The treated groundwater must be discharged to Sag Harbor Cove, as capacity is unavailable in the sanitary sewer system.

- **Permit requirements:** The work area must accommodate a large temporary treatment system for the dewatering effluent. The treatment system requires a capacity of at least 300 gallons per minute, with redundant equipment. The system would operate around the clock during excavation activity.

- **Limitations:** Deactivation and removal of the existing gas distribution infrastructure, temporary lane closures of Bridge Street and Long Island Avenue, and extensive dewatering activities during excavation will be necessary to implement this alternative. Approval to discharge treated groundwater to Sag Harbor Cove must be granted. The owner and tenants of the retail stores must agree to the proposed remedy and grant access for installation and operation of the sub-slab ventilation system. Affected neighbors must grant continued access for monitoring and accept institutional controls.

- **Ecological impacts**: This alternative is not anticipated to have any significant beneficial or adverse impacts on fish and wildlife resources.

7.3.4 Alternative 4: Restore to Pre-release Conditions

This alternative includes the removal via excavation of all impacted material associated with the Site. With respect to the guidance, the alternative is described as follows:

- **Size and configuration:** The majority of the Site will be disturbed for excavation activities. Removal activities will consist of excavating contaminant source area to approximately 10 feet and to the extent of impact beneath the Tar Separating Tank

estimated to be 85 feet below grade with on-site or off-site thermal treatment. The total excavation volume is estimated at approximately 460,000 cubic yards for off-site transport and thermal treatment.

- **Time for remediation:** The estimated time to complete all construction-related remediation activities is 3 to 8 years pending on access to non-owned properties and the deactivation and removal of the existing gas distribution infrastructure.

- **Spatial requirements:** The alternative will require substantial room for equipment and material storage, access, logistics, and operation. The Site itself can probably not accommodate all these needs and access to additional support areas must be obtained. When work is performed along and adjacent to Bridge Street or Long Island Avenue, it will be necessary to temporarily close lanes to traffic for several months to accommodate construction equipment and control access to the areas undergoing remediation.

- **Options for disposal:** Options for disposal of this high volume of excavated and removed materials may be limited. Regional facilities may not be able to handle the throughput required. It would not be feasible to transport and dispose of such large volumes of liquid waste off site. Liquid wastes would have to be treated on site and discharged locally.

- **Permit requirements:** Technical permit requirements associated with the alternative are substantial, particularly the design and construction of adequate earth support and the treatment and disposal of dewatering system effluent.

- **Limitations:** This alternative will have significant negative impacts on traffic in the community. Disposal of excavated soils and delivery of backfill material and supplies will require a substantial quantity of transport vehicle traffic into, through, and out of the Village of Sag Harbor over limited access routes for the area for a period of 3 to 8 years. Dewatering and earth support considerations have the greatest degrees of uncertainty in this alternative. More detailed analysis of the alternative would likely identify many technical and cost barriers to its implementability. Temporary lane closures of Bridge Street and Long Island Avenue, and extensive dewatering activities during excavation will be necessary to implement this alternative.

- **Ecological impacts**: This alternative is not anticipated to have any significant beneficial or adverse impacts on fish and wildlife resources.

7.3.5 Alternative 5: No Action

This alternative includes institutional controls to manage future subsurface disturbance and resultant potential exposures. With respect to the guidance, the alternative is described as follows:

- **Size and configuration:** Institutional controls would include restricting the use of all parcels impacted by Site former MGP operations to ensure developers or users do not disturb contamination remaining at the Site, developing a Site-specific Health and Safety Plan, and implementing a long-term monitoring plan.
- **Time for remediation:** Not applicable.
- **Spatial requirements:** Not applicable.
- **Options for disposal:** Not applicable.
- **Permit requirements:** No significant technical permit requirements are anticipated.
- **Limitations:** Affected neighbors must grant continued access for monitoring and accept institutional controls.
- **Ecological impacts**: This alternative is not anticipated to have any significant beneficial or adverse impacts on fish and wildlife resources.

7.4 Evaluation Criteria

TAGM # 4030 Section 5.1.1 requires a detailed analysis of remedial alternatives against seven criteria and specifies specific factors to consider for each criterion. The seven criteria, also described in the NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, are:

7.4.1 Overall Protection of Public Health and the Environment

This criterion is an evaluation of the remedy's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure are eliminated, reduced, or controlled through removal, treatment, engineering controls or institutional controls. The remedy's ability to achieve each of the RAOs is evaluated.

7.4.2 Compliance with Standards, Criteria, and Guidance (SCGs)

Compliance with SCGs addresses whether or not a remedy will meet applicable environmental laws, regulations, standards, and guidance. All SCGs for the site will be listed along with a discussion of whether or not the remedy will achieve compliance. For those SCGs that will not be met, provide a discussion and evaluation of the impacts of each, and whether waivers are necessary.

7.4.3 Long-term Effectiveness and Permanence

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

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

7.4.4 Reduction of Toxicity, Mobility or Volume with Treatment

The remedy's ability to reduce the toxicity, mobility, or volume of site contamination is evaluated. Preference should be given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the site.

7.4.5 Short-term Effectiveness

The potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation are evaluated. A discussion of how the identified adverse impacts and health risks to the community or workers at the site will be controlled, and the effectiveness of the controls, should be presented. Provide a discussion of engineering controls that will be used to mitigate short-term impacts (i.e., dust control measures). The length of time needed to achieve the remedial objectives is also estimated.

7.4.6 Implementability

The technical and administrative feasibility of implementing the remedy is evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of

the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, etc.

7.4.7 Cost

Capital, operation, maintenance, and monitoring costs are estimated for the remedy and presented on a present worth basis.

7.5 Evaluation of Alternatives

7.5.1 Alternative 1A: Containment Barrier System/Engineered Cap/Shallow Off-site Source Excavation (10')/NAPL Recovery

- Overall Protection of Public Health and the Environment. The alternative eliminates or effectively controls the potential exposure pathways by removing source material, constructing an engineered soil cover system over the site, and establishing institutional controls. Long-term groundwater and indoor air monitoring provides assurances that the remedy continues to be effective.

The alternative achieves each RAO as described below:

- *Prevent, to the extent practicable, ingestion/dermal contact with or inhalation of volatiles from contaminated groundwater.* Affected groundwater beneath the Site is not currently used for water supply and institutional controls will prevent its use in the future. Incidental contact during construction would be managed via worker health and safety plans. While current data indicate that site-related contaminants are not causing indoor air problems in the retail stores, this remedy does not proactively prevent the potential migration of contaminants in the future. The effectiveness of the remedy in achieving this objective over the long-term will be measured by the groundwater and indoor air monitoring program.

- *Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.* This alternative would provide NAPL migration prevention by recovering flowable NAPL from wells and constructing a barrier system around on-site source areas.

- *Remove, to the extent practicable, the source of groundwater contamination.* Excavation of the off-site source material will not remove, to the extent practicable, the source of groundwater contamination. However, NAPL

recovery will aid in removing source material - which contributes to groundwater contamination.

- *Prevent, to the extent practicable, ingestion/dermal contact with or inhalation of particulates/dust from contaminated soil.* The cover system, excavation, and institutional controls will achieve this objective.

- *Prevent to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.* The removal of off-site source material, site cover system and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.* The removal of off-site source material, site cover system, engineered vapor management, and institutional controls will achieve this objective.

- ***Compliance with Standards, Criteria, and Guidelines (SCGs).*** With respect to each SCG:

  - *At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site through the proper application of scientific and engineering principles.* The alternative eliminates or mitigates all potential significant threats.
  - *Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.* Contaminant source areas are not removed to the extent feasible.

- ***Long-Term Effectiveness and Permanence.*** There will be no significant threats, exposure pathways, or risks to the community and the environment from the remaining contamination. The proposed institutional controls are readily implementable. Maintenance of a site cover system is straightforward and readily achievable. The RAOs can continue to be met in the future by maintaining the cover system and the institutional controls.

- ***Reduction of Toxicity, Mobility or Volume with Treatment.*** Off-site thermal desorption and disposal/recycle of the excavated materials and a perimeter site containment barrier will reduce toxicity, mobility and volume significantly. The

passive recovery of NAPL will also reduce the toxicity and volume of source material.

- ***Short-Term Effectiveness.*** The alternative will require intensive construction activity and some potential short-term impacts are expected. These potential impacts can be managed through careful planning and controls, such as suppression of odors, suppression of fugitive dust, perimeter air monitoring, and implementation of health and safety and community awareness plans.

- ***Implementability.*** The alternative is technically implementable. The technologies are available commercially from multiple sources. Obtaining consent to discharge treated groundwater to Sag Harbor Cove may be difficult. The ability to obtain short and long-term access from the owner and tenants of the retail stores and other parties affected by institutional controls and/or monitoring is unknown.

- ***Cost.*** The estimated cost is $6.1 million and is summarized in Table 7-1 and Table A-1.

7.5.2 Alternative 1B: Containment Barrier System/Engineered Cap/Shallow Source Excavation (10')/In Situ Stabilization of Off-site Source/Retail Store Vapor Management/NAPL Recovery

- ***Overall Protection of Public Health and the Environment.*** The alternative eliminates or effectively controls the potential exposure pathways by removing source material, constructing an engineered soil cover system over the site and a sub-slab ventilation system under the retail stores, and establishing institutional controls. Long-term groundwater and indoor air monitoring provides assurances that the remedy continues to be effective.

The alternative achieves each RAO as described below:

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of volatiles from contaminated groundwater.* Affected groundwater beneath the Site is not currently used for water supply and institutional controls will prevent its use in the future. Incidental contact during construction would be managed via worker health and safety plans. The sub-slab ventilation system will mitigate potential inhalation exposures to those using the retail stores. The effectiveness of the remedy in achieving this objective over the long-term will be measured by the groundwater and indoor air monitoring program.

- *Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.* This alternative would provide NAPL migration prevention by recovering flowable NAPL from wells, excavation, and stabilization of off-site source areas and constructing a barrier system around on-site source areas.

- *Remove, to the extent practicable, the source of groundwater contamination.* Excavation and stabilization of the off-site source material will not remove, to the extent practicable, the source of groundwater contamination. However, NAPL recovery will aid in removing source material - which contributes to groundwater contamination.

- *Prevent, to the extent practicable, ingestion/dermal contact with or inhalation of particulates/dust from contaminated soil.* The cover system, stabilization, excavation, and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.* The removal of off-site source material, site cover system and institutional controls will achieve this objective. The removal and stabilization of off-site source material, site cover system, engineered vapor management, and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.* The removal and stabilization of off-site source material, site cover system, engineered vapor management, and institutional controls will achieve this objective.

- ***Compliance with Standards, Criteria, and Guidelines (SCGs).*** With respect to each SCG:

  - *At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site through the proper application of scientific and engineering principles.* The alternative eliminates or mitigates all potential significant threats.

  - *Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.* Contaminant source areas are not removed to the extent feasible.

- ***Long-Term Effectiveness and Permanence.*** There will be no significant threats, exposure pathways, or risks to the community and the environment from the remaining contamination. The proposed institutional controls are readily implementable. Maintenance of a site cover system is straightforward and readily achievable. Once installed, the sub-slab ventilation system should function for the life of the building. The RAOs can continue to be met in the future by maintaining the cover system, sub-slab ventilation system, and the institutional controls.

- ***Reduction of Toxicity, Mobility or Volume with Treatment.*** Off-site thermal desorption and disposal/recycle of the excavated materials and a perimeter site containment barrier will reduce toxicity, mobility, and volume significantly. The passive recovery of NAPL and stabilization will also reduce the toxicity and volume of source material.

- ***Short-Term Effectiveness.*** The alternative will require intensive construction activity and some potential short-term impacts are expected. These potential impacts can be managed through careful planning and controls, such as suppression of odors, suppression of fugitive dust, perimeter air monitoring, and implementation of health and safety and community awareness plans.

  The installation of the sub-slab ventilation system will cause significant short-term disruption to the retail stores.

- ***Implementability.*** The alternative is technically implementable. The technologies are available commercially from multiple sources. Obtaining consent to discharge treated groundwater to Sag Harbor Cove may be difficult. The ability to obtain short and long-term access from the owner and tenants of the retail stores and other parties affected by institutional controls and/or monitoring is unknown.

- ***Cost.*** The estimated cost is $7.5 million and is summarized in Table 7-1 and Table A-2.

7.5.3 Alternative 2A: Source Excavation – On-Site and Off-Site (10') including Retail Store Area/NAPL Recovery

- ***Overall Protection of Public Health and the Environment.*** The alternative eliminates or effectively controls the potential exposure pathways by removing source material and establishing institutional controls. Long-term groundwater and indoor air monitoring provides assurances that the remedy continues to be effective.

The alternative achieves each RAO as described below:

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of volatiles from contaminated groundwater.* Affected groundwater beneath the Site is not currently used for water supply and institutional controls will prevent its use in the future. Incidental contact during construction would be managed via worker health and safety plans. The effectiveness of the remedy in achieving this objective over the long-term will be measured by the groundwater and indoor air monitoring program.

- *Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.* This alternative would provide NAPL migration prevention by recovering flowable NAPL from wells and removal during source area excavation.

- *Remove, to the extent practicable, the source of groundwater contamination.* Excavation of shallow source material will remove, to the extent practicable, the source of groundwater contamination. In addition, NAPL recovery will aid in removing source material - which contributes to groundwater contamination.

- *Prevent, to the extent practicable, ingestion/dermal contact with or inhalation of particulates/dust from contaminated soil.* The removal of shallow source material and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.* The removal of shallow source material and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.* The removal of shallow source material and institutional controls will achieve this objective.

- ***Compliance with Standards, Criteria, and Guidelines (SCGs).*** With respect to each SCG:

  - *At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site*

through the proper application of scientific and engineering principles. The alternative eliminates or mitigates all potential significant threats.

- *Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.* Contaminant source areas are removed, to the extent feasible; however, further analysis of dewatering and earth support requirements for excavation into the saturated zone may identify administrative, technical, or cost barriers to feasibility.

- ***Long-Term Effectiveness and Permanence.*** The magnitude of the remaining risks is small. The proposed institutional controls are readily implementable. The RAOs can continue to be met in the future by maintaining the institutional controls.

- ***Reduction of Toxicity, Mobility or Volume with Treatment.*** Off-site thermal desorption and disposal/recycle of the excavated materials will reduce toxicity, mobility, and volume significantly.

- ***Short-Term Effectiveness.*** The alternative will require intensive construction activity and short-term impacts are expected. These impacts can be managed through careful planning and controls, such as suppression of odors, suppression of fugitive dust, perimeter air monitoring, and implementation of health and safety and community awareness plans. The occupants of the retail stores will be displaced.

- ***Implementability.*** The alternative is technically implementable, although the excavation will present challenges in earth support and dewatering due to the shallow water table. Obtaining consent to discharge treated groundwater to Sag Harbor Cove may be difficult. The ability to obtain short and long-term access from the owner and tenants of the retail stores and other parties affected by excavation, institutional controls and/or monitoring is unknown.

- ***Cost.*** The estimated cost is $10.7 million and is summarized in Table 7-1 and Table A-3.

7.5.4 Alternative 2B: Source Excavation – On-Site and Off-Site (10')/In Situ Stabilization of Off-Site Source Areas (36')/Retail Store Vapor Management/NAPL Recovery

- ***Overall Protection of Public Health and the Environment.*** The alternative eliminates or effectively controls the potential exposure pathways by removing and

stabilizing source material, constructing a sub-slab ventilation system under the retail stores, and establishing institutional controls. Long-term groundwater and indoor air monitoring provides assurances that the remedy continues to be effective.

The alternative achieves each RAO as described below:

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of volatiles from contaminated groundwater.* Affected groundwater beneath the Site is not currently used for water supply and institutional controls will prevent its use in the future. Incidental contact during construction would be managed via worker health and safety plans. The sub-slab ventilation system breaks the potential inhalation pathway at the retail stores. The effectiveness of the remedy in achieving this objective over the long-term will be measured by the groundwater and indoor air monitoring program.

- *Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.* This alternative would provide NAPL migration prevention by stabilizing source material, recovering flowable NAPL from wells and removal during source area excavation.

- *Remove, to the extent practicable, the source of groundwater contamination.* Excavation of shallow source material will remove, to the extent practicable, the source of groundwater contamination. In addition, NAPL recovery will aid in removing source material - which contributes to groundwater contamination.

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of particulates/dust from contaminated soil.* The removal of shallow source material, stabilization, and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.* The removal of shallow source material, stabilization of source material to a maximum depth of 36'and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.* The removal of shallow source material, stabilization of source material to a maximum depth of 36

feet, the sub-slab ventilation system, and institutional controls will achieve this objective.

- ***Compliance with Standards, Criteria, and Guidelines (SCGs).*** With respect to each SCG:

  - *At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site through the proper application of scientific and engineering principles.* The alternative eliminates or mitigates all potential significant threats.

  - *Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.* Contaminant source areas are removed, to the extent feasible; however, further analysis of dewatering and earth support requirements for excavation into the saturated zone may identify administrative, technical, or cost barriers to feasibility.

- ***Long-Term Effectiveness and Permanence.*** The magnitude of the remaining risks is small. The proposed institutional controls are readily implementable. The RAOs can continue to be met in the future by maintaining the institutional controls.

- ***Reduction of Toxicity, Mobility or Volume with Treatment.*** Off-site thermal desorption and disposal/recycle of the excavated materials will reduce toxicity, mobility and volume significantly.

- ***Short-Term Effectiveness.*** The alternative will require intensive construction activity and some potential short-term impacts are expected. These potential impacts can be managed through careful planning and controls, such as suppression of odors, suppression of fugitive dust, perimeter air monitoring, and implementation of health and safety and community awareness plans.

- ***Implementability.*** The alternative is technically implementable, although the excavation will present challenges in earth support and dewatering due to the shallow water table. Obtaining consent to discharge treated groundwater to Sag Harbor Cove may be difficult. The ability to obtain short and long-term access from the owner and tenants of the retail stores and other parties affected by excavation, institutional controls and/or monitoring is unknown.

- ***Cost.*** The estimated cost is $12.3 million and is summarized in Table 7-1 and Table A-4.

7.5.5 Alternative 3: On-Site and Off-Site Source Excavation (10')/On-Site In-Situ Stabilization/Retail Store Vapor Management/Monitoring

- ***Overall Protection of Public Health and the Environment.*** The alternative eliminates or effectively controls the potential exposure pathways by removing and stabilizing source material, constructing a sub-slab ventilation system under the retail stores, and establishing institutional controls. Long-term groundwater and indoor air monitoring provides assurances that the remedy continues to be effective.

The alternative achieves each RAO as described below:

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of volatiles from contaminated groundwater.* Affected groundwater beneath the Site is not currently used for water supply and institutional controls will prevent its use in the future. Incidental contact during construction would be managed via worker health and safety plans. The sub-slab ventilation system breaks the potential inhalation pathway at the retail stores. The effectiveness of the remedy in achieving this RAO over the long-term will be measured by the groundwater and indoor air monitoring program.

- *Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.* Source removal and in-situ stabilization will prevent some NAPL migration. However, stabilizing soils to great depths in tidally influenced hydrogeologic conditions will be difficult and the marginal benefit to human health and the environment of stabilizing to greater depths is minimal, given the demonstrated lack of horizontal movement at these depths over the past decades.

- *Remove, to the extent practicable, the source of groundwater contamination.* Excavation of the source material and former MGP structures will remove, to the extent practicable, the source of groundwater contamination.

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of particulates/dust from contaminated soil.* Excavation and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.* Excavation and institutional controls will achieve this objective.

- *Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.* Exposure to impacted soils is prevented by removing shallow source material and constructing a sub-slab ventilation system in the retail store area.

- ***Compliance with Standards, Criteria, and Guidelines (SCGs).*** With respect to each SCG:

  - *At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site through the proper application of scientific and engineering principles.* The alternative eliminates or mitigates all potential significant threats.

  - *Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.* Contaminant source areas are removed, to the extent feasible.

- ***Long-Term Effectiveness and Permanence.*** There will be no significant threats, exposure pathways, or risks to the community and the environment from the remaining contamination. The proposed institutional controls are readily implementable. The groundwater and indoor air monitoring program will measure long-term effectiveness.

- ***Reduction of Toxicity, Mobility or Volume with Treatment.*** Off-site thermal desorption and disposal/recycle of the excavated materials will reduce toxicity, mobility, and volume significantly. The in-situ stabilization will also reduce the mobility of source material in the deeper zones.

- ***Short-Term Effectiveness.*** The alternative will require intensive construction activity and short-term impacts are expected. These impacts can be managed through careful planning and controls, such as suppression of odors, suppression of fugitive dust, perimeter air monitoring, and implementation of health and safety and community awareness plans.

- ***Implementability.*** The alternative is technically implementable and the technologies are available commercially from multiple sources. The excavation will present challenges in earth support and dewatering due to the shallow water table. Obtaining consent to discharge treated groundwater to Sag Harbor Cove may be difficult. The ability to obtain short and long-term access from the owner and tenants of the retail stores and other parties affected by excavation, institutional controls and/or monitoring is unknown.

- ***Cost.*** The estimated cost is $33.3 million and is summarized in Table 7-1 and Table A-5.

7.5.6 Alternative 4: Restore to Pre-release Conditions

- ***Overall Protection of Public Health and the Environment.*** The alternative eliminates or effectively controls the potential exposure pathways by removing all MGP impacts.

The alternative achieves each RAO as described below:

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of volatiles from contaminated groundwater.* All source material will be removed during excavation activities, leaving nothing to contribute to the contamination of groundwater.

- *Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.* All NAPL within the site boundaries would be removed.

- *Remove, to the extent practicable, the source of groundwater contamination.* All sources will be removed during excavation and dewatering activities.

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of particulates/dust from contaminated soil.* All contaminated soil will be removed.

- *Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.* All impacted soils will be removed via excavation.

- *Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.* All impacted soils will be removed via excavation.

- ***Compliance with Standards, Criteria, and Guidelines (SCGs).*** With respect to each SCG:

  - *At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site through the proper application of scientific and engineering principles.* The alternative eliminates or mitigates all potential significant threats.

  - *Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.* Contaminant source areas are removed, but dewatering and earth support requirements for excavation into the saturated zone at depth will not be feasible as previously detailed in section 5.1.2.

- ***Long-Term Effectiveness and Permanence.*** There are no remaining risks at the completion of remedial activities.

- ***Reduction of Toxicity, Mobility or Volume with Treatment.*** Off-site thermal desorption and disposal/recycle of the excavated materials will eliminate toxicity, mobility, and volume.

- ***Short-Term Effectiveness.*** The alternative will require very intensive and prolonged construction activity. The ability to effectively manage these extensive impacts over a sustained period is doubtful.

- ***Implementability.*** The alternative is technically impracticable. The depth of excavation required and lack of a structural and hydrologic confining layer at depth prohibit the practical implementability of this alternative. The disruption to the area during the period of implementation would probably not be tolerated.

- ***Cost.*** The estimated cost is at least $69 million. A detailed estimate for this alternative has not been prepared. The listed cost was determined solely on a unit rate of $150 per cubic yard of excavated material (approximately 460,000 CY) to provide a rough relative cost for comparison purposes. This alternative will not be brought forward in the evaluation process.

7.5.7 Alternative 5: No Action

- ***Overall Protection of Public Health and the Environment.*** The alternative controls the potential exposure to contaminants via institutional controls.

The alternative achieves each RAO as described below:

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of volatiles from contaminated groundwater.* Affected groundwater beneath the Site is not currently used for water supply and institutional controls will prevent its use in the future. Incidental contact during construction would be managed via worker health and safety plans. No direct action is taken to prevent potential inhalation of volatiles via the indoor air pathway.

- *Prevent, to the extent practicable, the migration of NAPL beyond the boundaries of the site.* The alternative does not achieve this objective.

- *Remove, to the extent practicable, the source of groundwater contamination.* No source material is removed.

- *Prevent, to the extent practicable, ingestion/dermal contact with, or inhalation of particulates/dust from contaminated soil.* Direct contact is prevented solely through institutional controls. No source material is removed.

- *Prevent, to the extent practicable, migration of contaminants that would result in surface water contamination of Sag Harbor Cove.* Exposure is prevented solely through institutional controls. No source material is removed.

- *Prevent, to the extent practicable, inhalation of or exposure to vapors emanating from contaminated soil or groundwater.* Exposure is prevented solely through institutional controls. No source material is removed.

- ***Compliance with Standards, Criteria, and Guidelines (SCGs).*** With respect to each SCG:

  - *At a minimum, to eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed at the site*

through the proper application of scientific and engineering principles. The alternative does not eliminate or mitigate all potential significant threats.

- *Where an identifiable source of contamination exists at a site, it should be removed or eliminated, to the extent feasible, regardless of presumed risk or intended use of the site.* The alternative does not remove any sources of contamination.

- ***Long-Term Effectiveness and Permanence.*** The magnitude of the remaining risks is high in comparison to the other evaluated alternatives given the lack of source material removal.

- ***Reduction of Toxicity, Mobility or Volume with Treatment.*** This alternative will not address the reduction of toxicity, mobility, or volume.

- ***Short-Term Effectiveness.*** The alternative can be readily implemented, and little to no short-term impacts are expected.

- ***Implementability.*** The alternative is technically implementable.

- ***Cost.*** The cost to implement this task is minimal, but the alternative does not satisfy the evaluation criteria and will not be brought forward in the evaluation process.

7.6 Comparison of Alternatives

Table 7-1 summarizes estimated remedial costs for the remaining alternatives. Table 7-2 presents a comparative matrix of the remaining alternatives with the evaluation criteria. A qualitative scoring system has been used to give a general sense of how the alternatives differ in meeting each of the criteria. This scoring system is somewhat subjective, but can provide some insights into the relative strengths and limitations of the alternatives. The main evaluation categories are normalized so that each carries equal weight in the evaluation process. Each of the alternatives satisfies the criteria to some degree. The primary differences are found in long-term effectiveness, reduction of contaminant mobility, implementability, and cost.

8. Recommended Remedy

Based on the results of the comparative analysis presented in Table 7-2, Alternative 2A (Source Excavation – On-Site and Off-Site (to 10') including Retail Store Area/NAPL Recovery) is the recommended remedy.

Alternative 2A received the best overall score of the evaluated alternatives. The alternative's level of overall protection of human health and the environment, reduction of contaminant mobility, and long term effectiveness offset the fact that this alternative will be more difficult and costly to implement compared to most of the other alternatives evaluated. The remedy achieves the SCGs and RAOs and is technically feasible. The combined elements of the remedy effectively prevent potential exposures to site related contaminants.

The proposed excavation will prevent potential future exposure to readily accessible impacted soils, will reduce the contaminant mass at the site, will reduce the shallow groundwater contamination in the site area, and will reduce the potential volatilization of contaminants to indoor air. DNAPL recovery will remove contaminants from the subsurface and will reduce the potential for future migration of tar. Institutional controls to prohibit the use of groundwater, to restrict use of the site, and to limit potential contact with subsurface materials, together with the long-term groundwater, DNAPL, and indoor-air monitoring program, will ensure that the remedy remains protective of human health and the environment.

Alternatives 1A and 1B fail to meet the RAOs because source material that can be removed is not. While capping and containing this material prevents exposure, they are not the best long-term alternatives.

Alternative 2B relies on the long term operation and maintenance of a sub-slab ventilation system to prevent potential indoor air exposures. While potentially less disruptive to the retail stores than alternative 2A, removal of potential source material is preferable to an engineering control.

The in-situ stabilization provided in Alternative 3 provides no additional benefit in terms of source removal; it only decreases contaminant mobility in the stabilized areas. Given that significant horizontal migration has not taken place over the decades since the plant was in operation, potential mobility of the deeper material is not a significant concern. The limited benefit realized by preventing the potential mobility of deeper material is not justified by the three-fold increase in the remediation cost.

All the alternatives, including 2A, result in short-term impacts to the community, especially the surrounding properties. To successfully implement the proposed remedial alternative, surrounding property owners and occupants must grant access to conduct the remedy and agree to long-term monitoring and institutional controls. Excavating soil to the target depth will require a large, continuously operated temporary treatment system for the dewatering effluent. The ability to discharge several hundred gallons per minute of treated water to Sag Harbor Cove is critical to the implementation of the remedy.

References

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Tables

Table 6-1
Summary of Remedial Technology Screening
Sag Harbor Former MGP Site
Sag Harbor, New York

Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
Excavation	Excavation above peat/silt/clay unit only	Effective in elimination of exposure pathway via direct contact and providing long-term protection of human health. Involves excavation to depth of about 8 to 10 feet in much of the site area as well as adjacent properties to the north and south. Residual contaminants may pose future threat to construction workers depending on site usage. Combined with institutional controls or cap to prevent groundwater contact, RAOs can be met.	Technology proven and readily implemented. Large scale removal necessary and will require dewatering and dust, emissions and odor controls.	Medium relative to other removal options.	Retained for alternative development.
	Deep Excavation below peat/silt/clay unit (max 60')	Effective in elimination of exposure pathway and providing long-term protection of human health. Involves removal to a depth of about 60 feet in areas of source material below the former tar separating tank. While impacts have been identified as deep as 85 feet, impacts to groundwater drop off significantly past 60 bgs. RAOs can be met with natural attenuation monitoring for residual groundwater contamination and institutional controls to restrict groundwater use in the immediate area.	Technology proven, but difficult to implement. Very large scale removal necessary and will require dust, emissions and odor controls. Hydraulic control of tidally influenced aquifer with possible upward (discharging) vertical gradient will require large scale dewatering operation.	High relative to other removal options.	Not Retained.
	Deep Excavation below peat/silt/clay unit (max 90')	Effective in elimination of exposure pathway and providing long-term protection of human health. Involves removal to a depth of about 90 feet in areas of source material below the former tar separating tank to restore site to pre-release conditions. RAOs can be met with natural attenuation monitoring for residual groundwater contaminants.	Technology proven, but difficult to implement. Excavation below 60 feet may pose technical challenges. Further, hydraulic control necessary to carry out such deep excavation in a tidally influenced aquifer may be insurmountable and infeasible.	Very high relative to other removal options.	Not Retained.

Table 6-1
Summary of Remedial Technology Screening
Sag Harbor Former MGP Site
Sag Harbor, New York

Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
Ex-Situ Treatment	Off-site Low Temperature Thermal Desorption	Effective form of treatment of soils with low to high concentrations of organic contamination. Technology has been used at similar sites effectively.	Technology proven, but lack of locally permitted facility may make transportation of soils for treatment an issue.	Medium compared to other ex situ treatment technologies.	Retained for alternative development.
	On-site Low Temperature Thermal Desorption	Effective form of treatment of soils with low to high concentrations of organic contamination. Technology has been used at similar sites effectively.	Due to proximity of local population, size of the land area, permitting of temporary facility may be difficult.	Low to Medium compared to other ex situ technologies.	Not Retained.
	Slurry Phase Bioreactors	Technology in developmental stage for MGP waste streams. High concentrations of contaminants and breakdown of five ring benzene compounds will reduce effectiveness. Effectiveness should be field tested before implementation.	Technology not proven. Bioreactor can be constructed on-site.	Costs may be high compared to other ex-situ technologies.	Not Retained.
In-Situ Treatment	Dynamic Underground Stripping	Effective on small areas. Injecting steam in the subsurface will have a small radius of influence due to tidal fluctuations and high hydraulic conductivity.	Readily implemented. However, high groundwater table may result in insufficient freeboard to collect vapors.	Capital costs may be medium. Operation and maintenance costs may be high when compared to other in situ technologies.	Not Retained.
	Surfactant/ Cosolvent flushing	Effective in enhancing DNAPL solubility and mobility. Is not effective in soils with low permeability including the peat/silt/clay unit. When combined with other recovery technologies may achieve RAOs. Tidal action and discharging aquifer conditions will make delivery, contact and recovery difficult.	Technology proven in controlled settings. Tidal action will be difficult to control the process.	High capital costs when compared to other alternatives.	Not Retained.
	Chemical Oxidation	Effective in destroying source material and meeting the RAOs at similar sites. High natural organic content of peat material and high contaminant concentrations will increase soil-oxidant demand. Tidal influences will make delivery and contact with target source material difficult.	Technology proven. High natural organic content will reduce effectiveness – hence not viable.	High capital and operating costs compared to other alternatives.	Not Retained.

Table 6-1
Summary of Remedial Technology Screening
Sag Harbor Former MGP Site
Sag Harbor, New York

Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
	Six Phase Heating	Effective in shallow depths (less than 40 feet) and low volumes. Technology is not proven below the water table.	Technology proven but the high water table in the site area will make it difficult to implement.	High compared to other alternatives.	Not Retained.
Engineering Control	Engineered cap/cover system	Effective at controlling the pathways for future worker and trespasser exposure. Will need to be flexible to include redevelopment plans for the site.	Technology proven and readily implemented.	Low compared to other technologies.	Retained for alternative development.
Containment	DNAPL tar Recovery	Effective at capturing subsurface fluids. Saturation of DNAPL tar in the low permeable peat/silt/clay unit will be difficult to capture without mobility enhancement. May capture more water than DNAPL tar. Tidal influence and flow direction changes may reduce effectiveness.	Technology proven and readily implemented. Will require extensive on-site treatment for high volumes of fluids anticipated.	Low installation costs, but higher operation and maintenance costs relative to other technologies.	Retained for alternative development.
	Hydraulic Control	Effective in maintaining hydraulic gradient into the contained area. Shallow groundwater elevation and tidal effects at Sag Harbor may require complex modeling and pumping arrangements. In addition, the volume of water may require building a large dedicated water treatment plant at least orders of magnitude larger than the existing Sag Harbor Wastewater Treatment Plant with considerable changes to the underground piping infrastructure will be necessary.	Technology proven and readily implemented.	Medium capital cost, high long-term maintenance cost relative to other technologies.	Not Retained.
	Containment Barriers	Effective at meeting RAO for preventing migration and terminating exposure. Minimal disturbance of soils. Continuity and compatibility may are concerns. Depth of impacts (<60 feet) below the Tar Separating Tank may pose a problem	Technology proven and readily implemented. However tidal effects and hydraulic conductivity may pose a problem	Medium relative to other containment technologies.	Retained for alternative development.
	In-Situ Stabilization	Effective at meeting RAO for preventing migration and terminating exposure. However, large-scale construction may pose difficulties.	Technology proven but compatible site-specific materials may be needed.	High relative to other containment technologies.	Retained for alternative development.

Table 6-1
Summary of Remedial Technology Screening
Sag Harbor Former MGP Site
Sag Harbor, New York

Response Action	Technology	Effectiveness	Implementability	Cost	Status for Alternative Development
Institutional Controls	Access Controls Deed Restrictions Health & Safety Plans Long-Term Monitoring Notifications	Effective in preventing potential exposures to future construction or utility workers. Not effective in limiting migration.	Readily implementable.	Low. Monitoring to be performed semi-annually.	Retained for alternative development.

Table 7-1
Estimated Remedial Component Costs
Sag Harbor Former MGP Site
Sag Harbor, New York

Cost Component in Millions	Remedial Alternative 1a Shallow Off-site Source Removal (10'), NAPL Recovery, Cap, Barrier (10') and LT Monitoring	Remedial Alternative 1b Shallow Off-site Source Removal (10'), Off-site In situ Stabilization (20'), Retail Store Vapor Barrier, NAPL Recovery, Cap, Barrier (10') and LT Monitoring	Remedial Alternative 2a Shallow On-Site and Off-Site Source Removal (10') including Retail Store Area, NAPL Recovery, and LT Monitoring	Remedial Alternative 2b Shallow On-Site and Off-Site Source Removal (10'), In Situ Stabilization Off-Site, Retail Store Vapor Barrier, NAPL Recovery, and LT Monitoring	Remedial Alternative 3 Shallow Off-Site Source Removal (10'), In Situ Stabilization (0-60') On-Site, Retail Store Vapor Barrier and LT Monitoring
Capital Cost	$3.0	$4.0	$7.0	$8.2	$25.0
O & M Cost[1]	$1.8	$2.0	$1.5	$1.7	$1.7
Contingency Cost	$1.2	$1.5	$2.1	$2.5	$6.7
Total Cost	$6.1	$7.5	$10.7	$12.3	$33.3

1 Operating and Maintenance Cost discounted at 5% over 30 years.

Table 7-2
Remedial Action Alternatives – Comparative Analysis
Sag Harbor Former MGP Site
Sag Harbor, New York

Criteria	Sub-Criteria	Rating[1]					Comparison Statement
		Alt. 1a: Excavation (Off-Site), NAPL Barriers, Cap, NAPL Recovery, GW/Air Monitoring	Alt. 1b: Stabilization (off-site), NAPL Barriers, Cap, NAPL Recovery, Retail Store Vapor Barrier, GW/Air Monitoring	Alt. 2a: Excavation (On- and Off-Site) including Retail Store Area, NAPL Recovery, Institutional Controls, GW Monitoring	Alt. 2b: Excavation (On-Site), In-Stabilization (On- and Off-Site), NAPL Recovery, Retail Store Vapor Barrier, Institutional Controls, GW Monitoring	Alt. 3: Excavation (Off-Site), In-Situ Stabilization (On-Site to 60 ft), Retail Store Vapor Barrier, GW Monitoring in the deep zone	
Overall Protection of Human Health and the Environment		3	4	1	2	5	All of the alternatives with shallow source excavations and migration barriers are protective of human health and the environment.
	Score[2]	**3**	**4**	**1**	**2**	**5**	
New York State or Site-Specific SCGs	Soil	4	5	1	2	2	Alternatives were ranked based on the volume of source material removed, treated, and/or stabilized.
	Groundwater	4	5	1	2	3	Alternatives were ranked based on whether they included NAPL recovery or NAPL migration barriers, depth of barriers, NAPL recovery, and quantity of source removal/ treatment/stabilization.
	Score	**4**	**5**	**1**	**2**	**2.5**	
Long-Term Effectiveness and Permanence	Permanence of Remedial Alternative	4	5	1	2	3	All of the alternatives are expected to be a permanent remedy for the Site; however the alternatives that include a barrier along with NAPL collection help prevent migration of remaining contaminants.
	Magnitude of Remaining Risk	4	4	1	2	3	
	Adequacy of Controls	1	1	1	1	1	All alternatives will provide equal controls, except for No Action Alternative
	Reliability of Controls	1	1	1	1	1	All alternatives will provide equal controls, except for No Action Alternative
	Score	**2.5**	**2.75**	**1**	**1.5**	**2**	

Table 7-2
Remedial Action Alternatives – Comparative Analysis
Sag Harbor Former MGP Site
Sag Harbor, New York

Criteria	Sub-Criteria	Rating[1]					Comparison Statement
		Alt. 1a: Excavation (Off-Site), NAPL Barriers, Cap, NAPL Recovery, GW/Air Monitoring	Alt. 1b: Stabilization (off-site), NAPL Barriers, Cap, NAPL Recovery, Retail Store Vapor Barrier, GW/Air Monitoring	Alt. 2a: Excavation (On- and Off-Site) including Retail Store Area, NAPL Recovery, Institutional Controls, GW Monitoring	Alt. 2b: Excavation (On-Site), In-Stabilization (On- and Off-Site), NAPL Recovery, Retail Store Vapor Barrier, Institutional Controls, GW Monitoring	Alt. 3: Excavation (Off-Site), In-Situ Stabilization (On-Site to 60 ft), Retail Store Vapor Barrier, GW Monitoring in the deep zone	
Reduction of Toxicity, Mobility, and Volume	Amount of material destroyed or treated	5	5	1	3	2	All alternatives are relatively equal in volume of material treated or destroyed, but Alternative 2b will treat more contaminants due to the depth of in-situ stabilization and excavation on- and off-site.
	Degree of Toxicity, Mobility, or Volume reduced	4	5	2	1	3	Alternative 1a reduces migration more than Alternatives: 1b, 2a, and 2b. However, Alternatives: 2a and 2b provide a greater reduction in mobility than 1 does in regards to toxicity and volume.
	Irreversibility	1	1	1	1	1	All alternatives are permanent.
	Residuals Remaining	4	5	1	2	3	Other than Restore to Pre-Release Conditions Alternative, Alternatives: 2a and 2b would remove the largest volume of impacted materials from the Site.
	Score	**3.5**	**4**	**1.25**	**1.75**	**2.25**	
Short-Term Impacts and Effectiveness	Protection of Community during Remedial Action	2	1	5	4	3	Except for Alternative 1b and No Action Alternative, all alternatives require some degree of excavation and off-site transport of impacted soils that will potentially impact the community and will require the implementation of appropriate controls during construction (air monitoring, dust suppression, etc.) and times when portions of local roads will be closed.
	Environmental Impacts	1	1	1	1	1	There are no foreseeable adverse environmental impacts for any alternative. Except for No Action Alternative.
	Time Required to Meet Remedial Objectives	1	2	4	3	5	All alternatives have long term monitoring so the ratings are based on the completion of intrusive remedial objectives.
	Protection of Workers	2	1	5	4	3	Alternatives: 1b and 3 have the least amount of construction activity, other than No Action Alternative.
	Score	**1.5**	**1.25**	**3.75**	**3**	**3**	

Table 7-2
Remedial Action Alternatives – Comparative Analysis
Sag Harbor Former MGP Site
Sag Harbor, New York

Criteria	Sub-Criteria	Rating[1]					Comparison Statement
		Alt. 1a: Excavation (Off-Site), NAPL Barriers, Cap, NAPL Recovery, GW/Air Monitoring	Alt. 1b: Stabilization (off-site), NAPL Barriers, Cap, NAPL Recovery, Retail Store Vapor Barrier, GW/Air Monitoring	Alt. 2a: Excavation (On- and Off-Site) including Retail Store Area, NAPL Recovery, Institutional Controls, GW Monitoring	Alt. 2b: Excavation (On-Site), In-Stabilization (On- and Off-Site), NAPL Recovery, Retail Store Vapor Barrier, Institutional Controls, GW Monitoring	Alt. 3: Excavation (Off-Site), In-Situ Stabilization (On-Site to 60 ft), Retail Store Vapor Barrier, GW Monitoring in the deep zone	
Implementability	Technical Feasibility	1	3	2	4	5	Alternatives: 1a and 2a are the least construction intensive alternative with the highest technical feasibility.
	Administrative Feasibility	2	1	5	4	3	Other than No Action Alternative and Alternatives: 1a, 2a, and 2b are the least intrusive.
	Availability of Services	1	2	3	3	3	The majority of site work will be completed with conventional construction equipment, those alternatives requiring the use of specialized equipment for work at depth may have slightly less available.
	Score	**1.3**	**2.0**	**3.3**	**3.7**	**3.7**	
Cost	Capital Costs	1	2	3	4	5	Capital costs for construction dewatering and treatment of impacted soils drive the costs of the remedies. Those alternatives with larger excavation volumes, disposal volumes, and/or dewatering costs have increased associated capital costs.
	O&M costs	3	3	1	1	3	All alternatives will require similar post remedy monitoring programs. Except for No Action Alternative.
	Score	**2.0**	**2.5**	**2.0**	**2.5**	**4.0**	
Total Score		**17.8**	**21.5**	**13.3**	**16.4**	**22.4**	

Note:

1. Sub-criteria score are based on a qualitative forced ranking scale. The alternative with the best rating receives a score of 1, the 2nd best – a score of 2, and so on. If alternatives are equal in rating, ties are included (i.e., if Alternative 1 is the best, it receives a score of 1, but if Alternatives 3 and 4 are the next equal in scale, then they both will receive a score of 2, the next rated Alternative will receive a 4 since it is the fourth rated Alternative). The tie scoring system is used to prevent the last place rated alternative from receiving a score of 2, if all of the other alternatives are justifiably scored with the highest rating.
2. Sub-criteria scores for each major criteria are summed, and then divided by the number of sub-criteria so that the main criteria receive the same overall weighting, regardless of the number of sub-criteria.

Figures

0 2000 4000

SCALE, FEET

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FEASIBILITY STUDY
SAG HARBOR FORMER MGP SITE
SAG HARBOR, NEW YORK

KEYSPAN CORPORATION

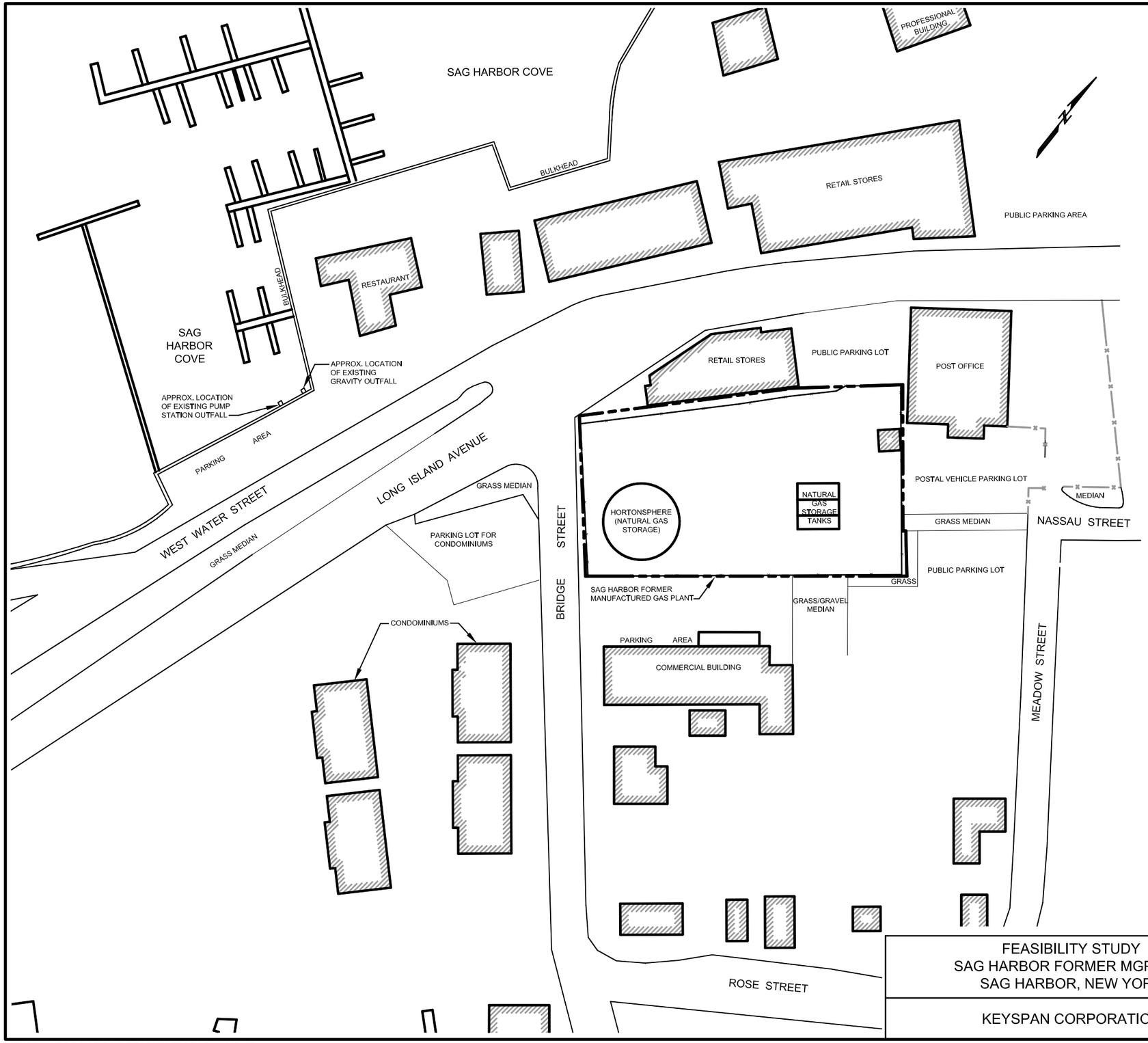
GEI Consultants

Project 982482-4-1501

SITE LOCATION MAP

September 2005 Figure 1-1

KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-LOC.CDR



LEGEND

- LOCATION OF EXISTING STRUCTURE
- CURRENT SITE BOUNDARY
- FENCE

0 80 160

SCALE, FEET

SOURCE:

BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION.

FEASIBILITY STUDY
SAG HARBOR FORMER MGP SITE
SAG HARBOR, NEW YORK

KEYSPAN CORPORATION

GEI Consultants

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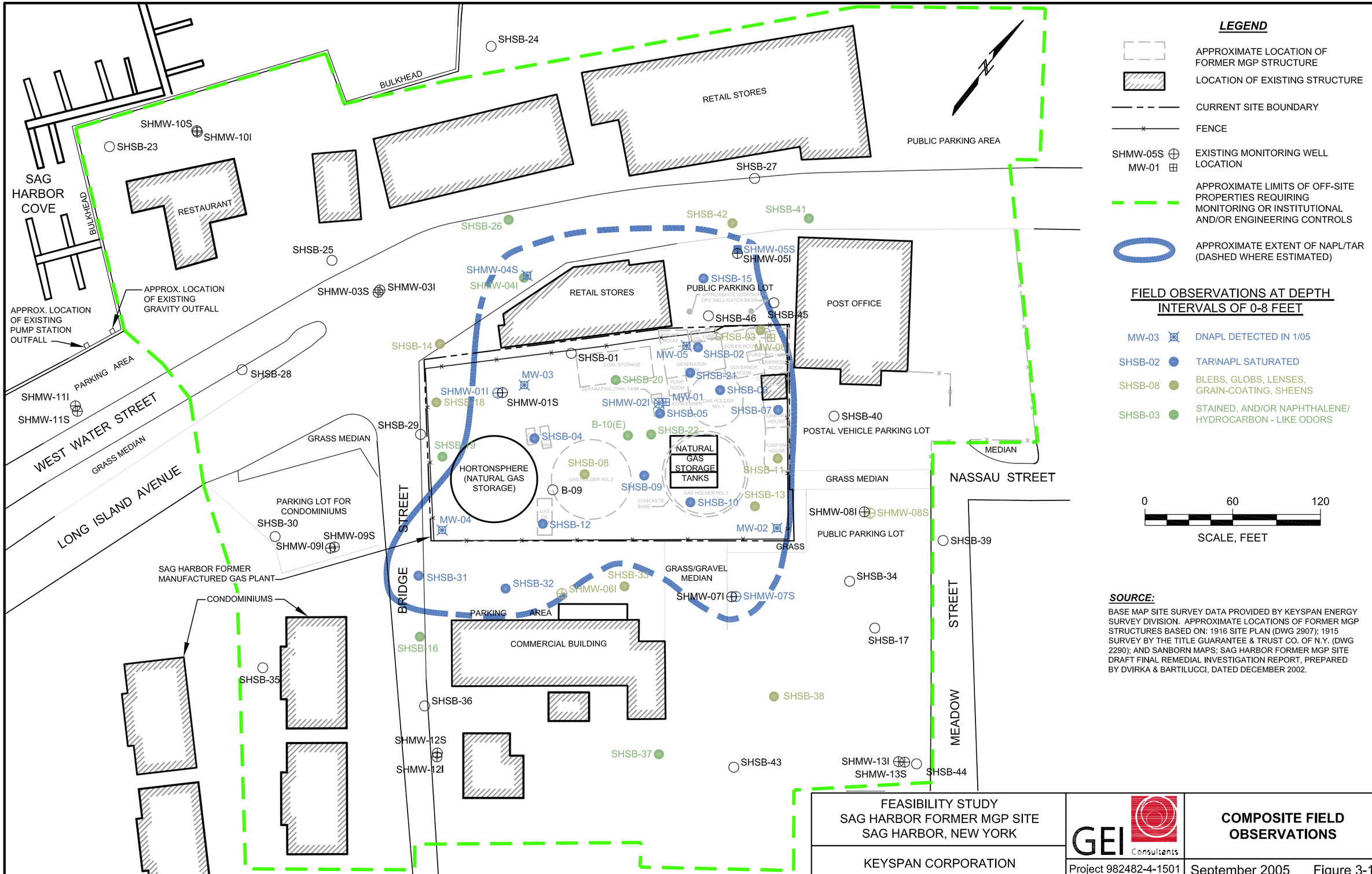
SITE LAYOUT MAP

September 2005 Figure 2-1

KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-LAYOUT



FEASIBILITY STUDY
SAG HARBOR FORMER MGP SITE
SAG HARBOR, NEW YORK

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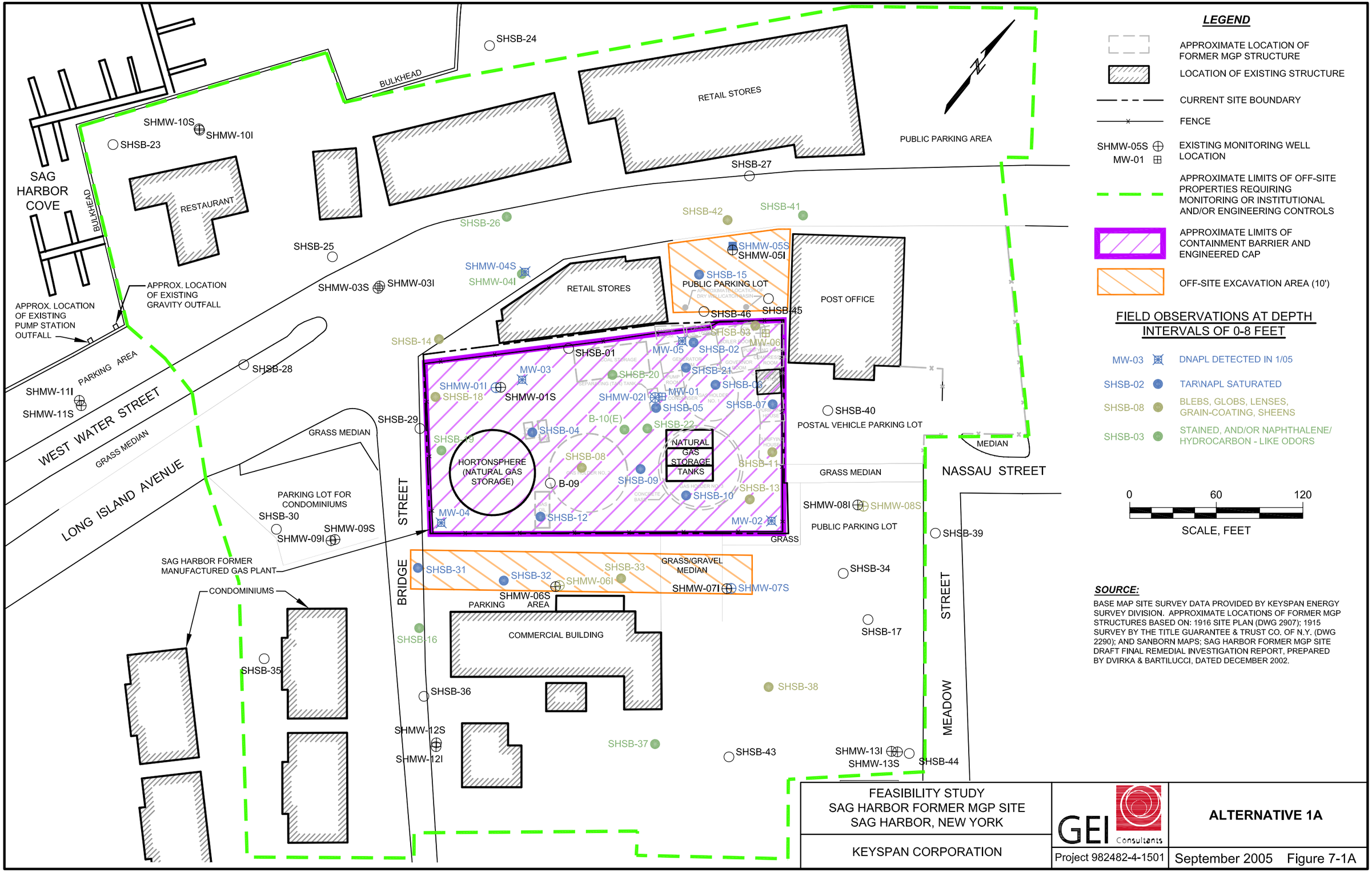
COMPOSITE FIELD OBSERVATIONS

September 2005 Figure 3-1

KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-REM ALT-r. 9-08-05.dwg



LEGEND

- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE
- LOCATION OF EXISTING STRUCTURE
- CURRENT SITE BOUNDARY
- FENCE
- SHMW-05S / MW-01 — EXISTING MONITORING WELL LOCATION
- APPROXIMATE LIMITS OF OFF-SITE PROPERTIES REQUIRING MONITORING OR INSTITUTIONAL AND/OR ENGINEERING CONTROLS
- APPROXIMATE LIMITS OF CONTAINMENT BARRIER AND ENGINEERED CAP
- OFF-SITE EXCAVATION AREA (10')

FIELD OBSERVATIONS AT DEPTH INTERVALS OF 0-8 FEET

- MW-03 — DNAPL DETECTED IN 1/05
- SHSB-02 — TAR\NAPL SATURATED
- SHSB-08 — BLEBS, GLOBS, LENSES, GRAIN-COATING, SHEENS
- SHSB-03 — STAINED, AND/OR NAPHTHALENE/ HYDROCARBON - LIKE ODORS

0 60 120

SCALE, FEET

SOURCE:

BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON: 1916 SITE PLAN (DWG 2907); 1915 SURVEY BY THE TITLE GUARANTEE & TRUST CO. OF N.Y. (DWG 2290); AND SANBORN MAPS; SAG HARBOR FORMER MGP SITE DRAFT FINAL REMEDIAL INVESTIGATION REPORT, PREPARED BY DVIRKA & BARTILUCCI, DATED DECEMBER 2002.

FEASIBILITY STUDY
SAG HARBOR FORMER MGP SITE
SAG HARBOR, NEW YORK

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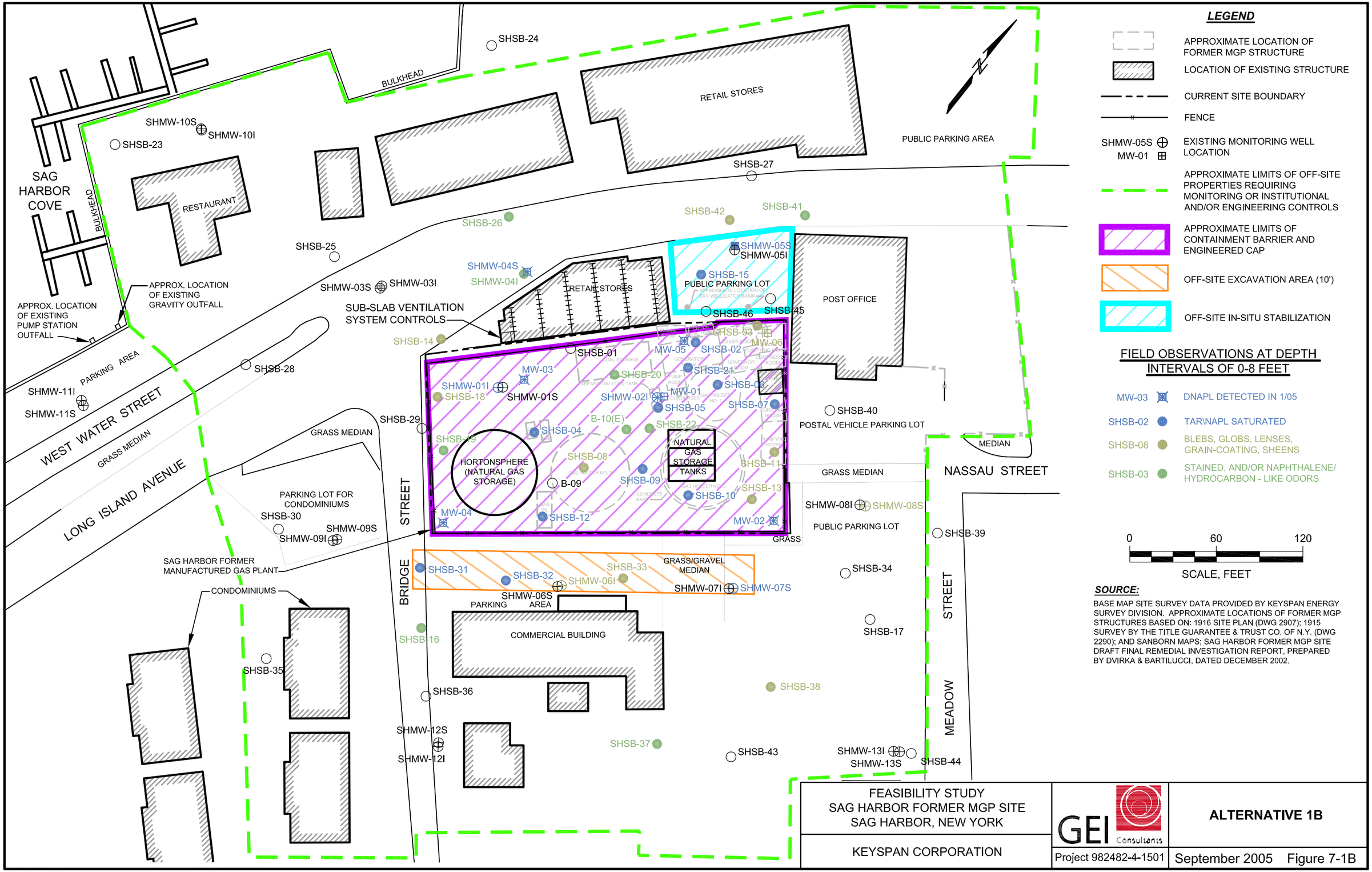
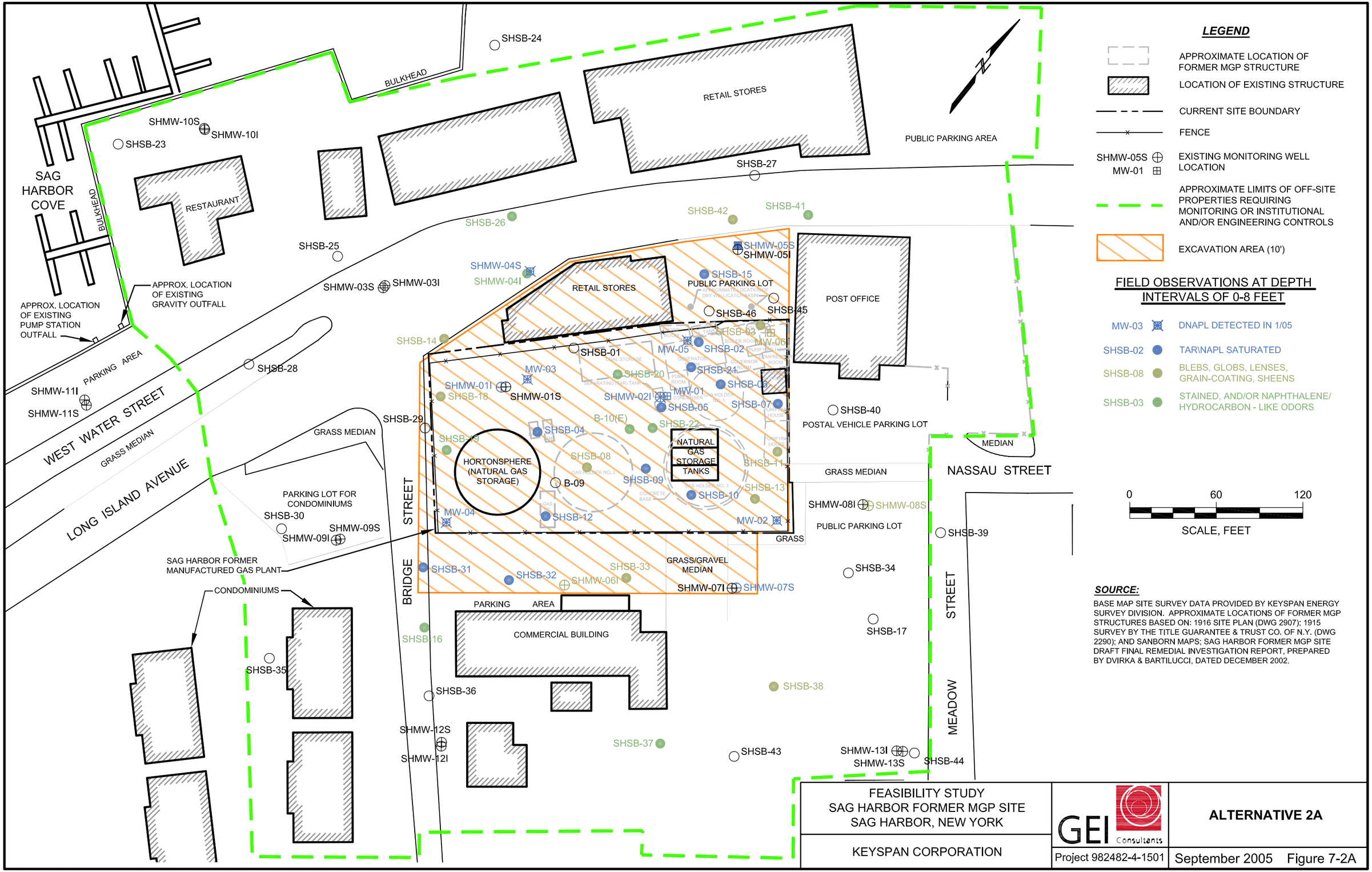
ALTERNATIVE 1A

September 2005 Figure 7-1A

KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-REM ALT- r. 9-08-05.dwg



KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-REM ALT-r. 9-08-05.dwg



LEGEND

- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE
- LOCATION OF EXISTING STRUCTURE
- CURRENT SITE BOUNDARY
- FENCE
- SHMW-05S / MW-01 — EXISTING MONITORING WELL LOCATION
- APPROXIMATE LIMITS OF OFF-SITE PROPERTIES REQUIRING MONITORING OR INSTITUTIONAL AND/OR ENGINEERING CONTROLS
- EXCAVATION AREA (10')

FIELD OBSERVATIONS AT DEPTH INTERVALS OF 0-8 FEET

- MW-03 — DNAPL DETECTED IN 1/05
- SHSB-02 — TAR\NAPL SATURATED
- SHSB-08 — BLEBS, GLOBS, LENSES, GRAIN-COATING, SHEENS
- SHSB-03 — STAINED, AND/OR NAPHTHALENE/ HYDROCARBON - LIKE ODORS

SOURCE:

BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON: 1916 SITE PLAN (DWG 2907); 1915 SURVEY BY THE TITLE GUARANTEE & TRUST CO. OF N.Y. (DWG 2290); AND SANBORN MAPS; SAG HARBOR FORMER MGP SITE DRAFT FINAL REMEDIAL INVESTIGATION REPORT, PREPARED BY DVIRKA & BARTILUCCI, DATED DECEMBER 2002.

FEASIBILITY STUDY
SAG HARBOR FORMER MGP SITE
SAG HARBOR, NEW YORK

KEYSPAN CORPORATION

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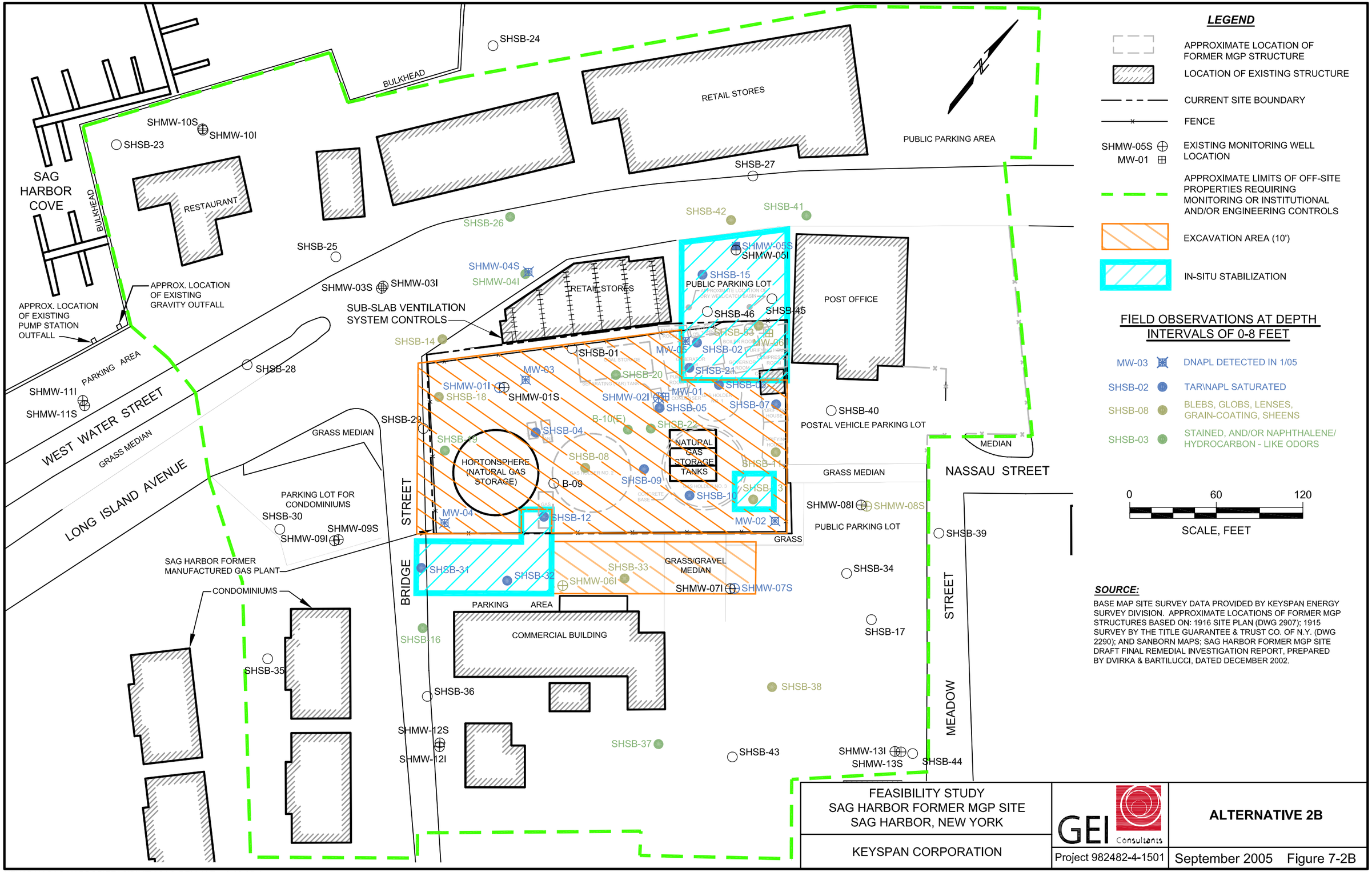
ALTERNATIVE 2A

September 2005 Figure 7-2A

KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-REM ALT-r. 9-08-05.dwg



SOURCE:

BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON: 1916 SITE PLAN (DWG 2907); 1915 SURVEY BY THE TITLE GUARANTEE & TRUST CO. OF N.Y. (DWG 2290); AND SANBORN MAPS; SAG HARBOR FORMER MGP SITE DRAFT FINAL REMEDIAL INVESTIGATION REPORT, PREPARED BY DVIRKA & BARTILUCCI, DATED DECEMBER 2002.

FEASIBILITY STUDY
SAG HARBOR FORMER MGP SITE
SAG HARBOR, NEW YORK

KEYSPAN CORPORATION

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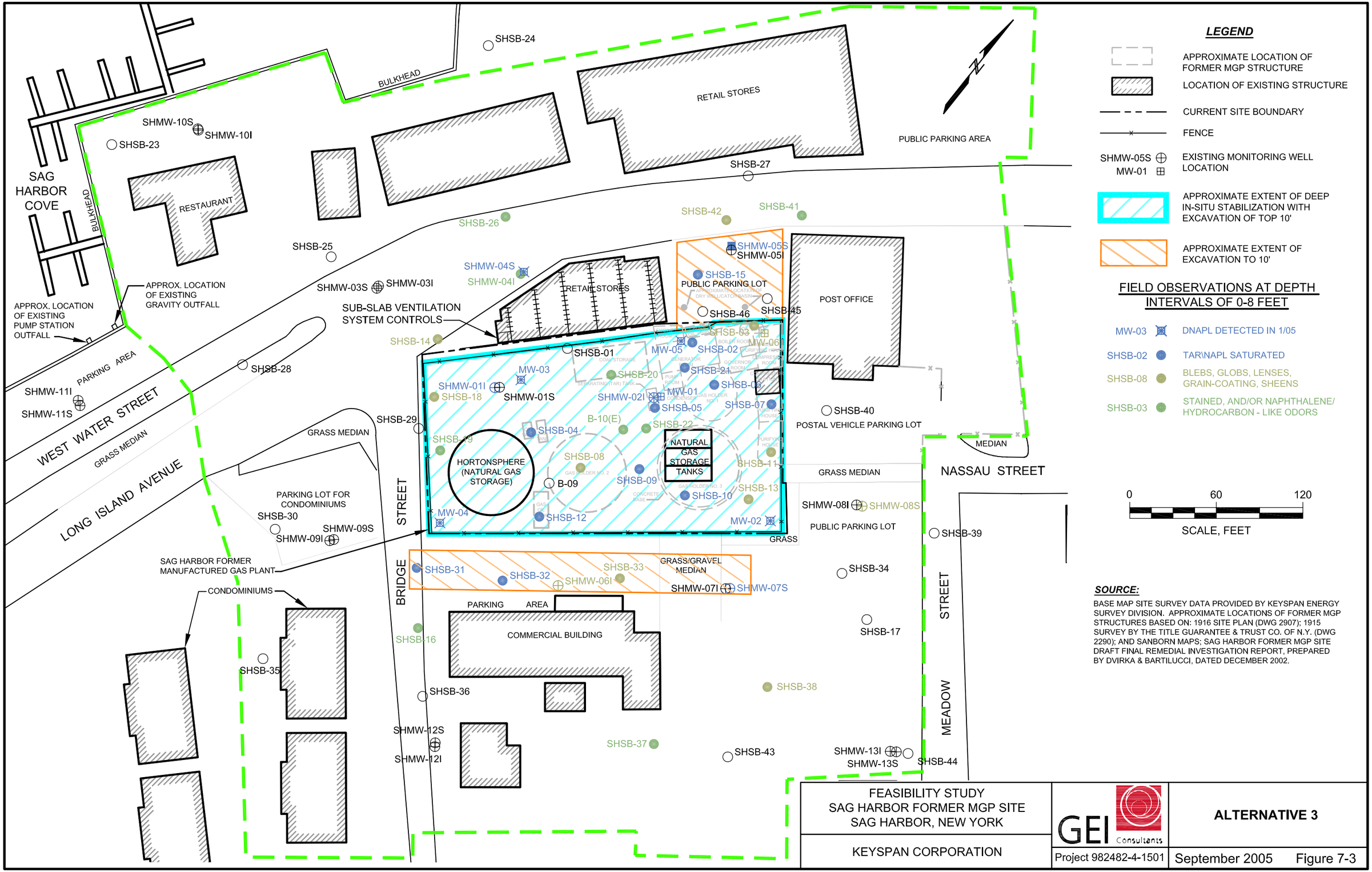
ALTERNATIVE 2B

September 2005 Figure 7-2B

KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-REM ALT-r. 9-08-05.dwg



LEGEND

- APPROXIMATE LOCATION OF FORMER MGP STRUCTURE
- LOCATION OF EXISTING STRUCTURE
- CURRENT SITE BOUNDARY
- FENCE
- SHMW-05S / MW-01 — EXISTING MONITORING WELL LOCATION
- APPROXIMATE EXTENT OF DEEP IN-SITU STABILIZATION WITH EXCAVATION OF TOP 10'
- APPROXIMATE EXTENT OF EXCAVATION TO 10'

FIELD OBSERVATIONS AT DEPTH INTERVALS OF 0-8 FEET

MW-03	DNAPL DETECTED IN 1/05
SHSB-02	TAR\NAPL SATURATED
SHSB-08	BLEBS, GLOBS, LENSES, GRAIN-COATING, SHEENS
SHSB-03	STAINED, AND/OR NAPHTHALENE/ HYDROCARBON - LIKE ODORS

SOURCE:

BASE MAP SITE SURVEY DATA PROVIDED BY KEYSPAN ENERGY SURVEY DIVISION. APPROXIMATE LOCATIONS OF FORMER MGP STRUCTURES BASED ON: 1916 SITE PLAN (DWG 2907); 1915 SURVEY BY THE TITLE GUARANTEE & TRUST CO. OF N.Y. (DWG 2290); AND SANBORN MAPS; SAG HARBOR FORMER MGP SITE DRAFT FINAL REMEDIAL INVESTIGATION REPORT, PREPARED BY DVIRKA & BARTILUCCI, DATED DECEMBER 2002.

FEASIBILITY STUDY
SAG HARBOR FORMER MGP SITE
SAG HARBOR, NEW YORK

KEYSPAN CORPORATION

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Project 982482-4-1501

ALTERNATIVE 3

September 2005 Figure 7-3

KEYSPAN\SAG HARBOR\FEASIBILITY\SAG-REM ALT-r. 9-08-05.dwg

Appendix A

Remedial Alternative Cost Estimates

Table A-1a
Detailed Cost Estimate for Remedial Alternative 1a
Sag Harbor Former MGP Site
Sag Harbor, New York

Remedial Component	Unit	Unit Price	Remedial Alternative 1a Shallow Off-Site Source Removal (10'), NAPL Recovery, Cap, Barrier (50') and LT Monitoring Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$300,000	1	$300,000
2 Permitting and Regulatory submittals	Lump Sum	$30,000	1	$30,000
3 Pre Construction Analytical Sampling	Lump Sum	$30,000	1	$30,000
			Subtotal	$360,000
			% Total Cost	6%
Construction Management				
1 Construction Oversight	Day	$1,920	68	$130,560
2 Air Monitoring during excavations	Day	$1,500	38	$57,000
3 Air Logics Air System	Month	$30,000	2	$60,000
3 Site Survey (Preconstruction and Post-Remediation)	Acre	$5,000	0.76	$3,800
			Subtotal	$251,360
			% Total Cost	4%
General Conditions				
1 Mobilization/Demobilization	Lump Sum	$300,000	1	$300,000
2 Site Preparation	Lump Sum	$20,000	1	$20,000
3 Demolition (concrete structures as encountered)	Lump Sum	$50,000	1	$50,000
4 Temporary Offices	Month	$3,000	3	$9,000
5 Temporary Utilities	Lump Sum	$25,000	1	$25,000
			Subtotal	$404,000
			% Total Cost	7%
REMEDIAL COMPONENTS				
Engineered Cap (On-Site)				
1 Excavation of impacted soil from 0-2 feet	Cubic Yard	$25	2,452	$61,307
2 Construction of Asphalt Cap, Geotextile, Base, Binder, and Wearing Course	Square Foot	$4	33,106	$132,422
3 Backfill	Cubic Yard	$30	2,207	$66,211
4 Disposal Costs Hauling and Thermal Treatment	Ton	$75	3,678	$275,880
			Subtotal	$535,820
			% Total Cost	9%
Shallow Source Excavation (0-10') Off-Site				
1 Clear Excavation Area	Lump Sum	$7,500	1	$7,500
2 Relocation of Power Lines other utilities in the remediation area	Lump Sum	$50,000	1	$50,000
3 Excavation of impacted soils from 0-10 feet	Cubic Yard	$25	4,699	$117,463
4 Backfill	Cubic Yard	$30	5,638	$169,147
5 Disposal Costs Hauling and Thermal Treatment	Ton	$75	7,048	$528,583
6 Dewatering	1000 gallons	$300	1,080	$324,000
			Subtotal	$1,196,693
			% Total Cost	20%
Miscellaneous Solid Waste Disposal				
1 Disposal Costs and Hauling of Bulky Waste	Ton	$75	1,000	$75,000
			Subtotal	$75,000
			% Total Cost	1%
NAPL Recovery System				
1 NAPL Recovery System - 3 wells	Lump Sum	$75,000	1	$75,000
			Subtotal	$75,000
			% Total Cost	1%
Subsurface NAPL Migration Barrier (On-Site)				
1 Soil Bentonite Wall (0 - 10 feet)	Cubic Yard	$150	858	$128,750
2 Wastage Handling and Disposal (25% of wall)	Cubic Yard	$80	215	$17,167
			Subtotal	$145,917
			% Total Cost	2%
Long-term Groundwater and Indoor Air Monitoring and Reporting Costs				
1 Periodic Monitoring, Reporting, and Maintenance (I=5%)	Year	$120,000	30	$1,844,694
			Subtotal	$1,844,694
			% Total Cost	30%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$3,043,790
Total O & M costs				$1,844,694
Total No Contingency Costs				$4,888,484
Contingency (25%)			25%	$1,222,121
			% TOTAL COSTS	**20%**
			TOTAL COST	**$6,110,605**

Table A-1b
Detailed Cost Estimate for Remedial Alternative 1b
Sag Harbor Former MGP Site
Sag Harbor, New York

Remedial Component	Unit	Unit Price	Remedial Alternative 1b: Shallow Off-Site Source Removal (10'), Off-Site In situ Stabilization (20'), NAPL Recovery, Cap, Barrier (50') and LT Monitoring	
			Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$300,000	1	$300,000
2 Permitting and Regulatory submittals	Lump Sum	$30,000	1	$30,000
3 Pre Construction Analytical Sampling	Lump Sum	$30,000	1	$30,000
			Subtotal	$360,000
			% Total Cost	5%
Construction Management				
1 Construction Oversight	Day	$1,920	98	$188,160
2 Air Monitoring during excavations	Day	$1,500	68	$102,000
3 Air Logics Air System	Month	$30,000	4	$120,000
4 Site Survey (Preconstruction and Post-Remediation)	Acre	$5,000	0.76	$3,800
			Subtotal	$413,960
			% Total Cost	5%
General Conditions				
1 Mobilization/Demobilization	Lump Sum	$300,000	1	$300,000
2 Site Preparation	Lump Sum	$20,000	1	$20,000
3 Demolition (concrete structures as encountered)	Lump Sum	$50,000	1	$50,000
4 Temporary Offices	Month	$3,000	5	$15,000
5 Temporary Utilities	Lump Sum	$25,000	1	$25,000
			Subtotal	$410,000
			% Total Cost	5%
REMEDIAL COMPONENTS				
Engineered Cap (On-Site)				
1 Excavation of impacted soil from 0-2 feet	Cubic Yard	$25	2,452	$61,307
2 Construction of Asphalt pavement with soil Cap, Geotextile, Base, Binder, and Wearing Course	Square Foot	$4	33,106	$132,422
3 Backfill	Cubic Yard	$30	2,207	$66,211
4 Disposal Costs Hauling and Thermal Treatment	Ton	$75	3,678	$275,880
			Subtotal	$535,820
			% Total Cost	7%
Source Excavation (0-10') and In Situ Stabilization (0-20') Off-Site				
1 Clear Excavation Area	Lump Sum	$7,500	1	$7,500
2 Relocation of Power Lines other utilities in the remediation area	Lump Sum	$50,000	1	$50,000
3 Excavation of impacted soils from 0-10 feet	Cubic Yard	$25	2,367	$59,167
4 Backfill	Cubic Yard	$30	2,840	$85,200
5 Disposal Costs Hauling and Thermal Treatment	Ton	$75	3,550	$266,250
6 Dewatering	1000 gallons	$300	360	$108,000
7 Vacuum Extraction Horizontal Wells - 6 wells	Linear foot	$40	240	$9,600
8 Protective Enclosure for SVE wells and controls	Each	$215	6	$1,290
9 SVE Piping and headers installed in trenches	Linear foot	$5	300	$1,500
10 Vapor recovery system (5 hp, 240 cfm)	Each	$7,000	1	$7,000
11 Carbon adsorption system (vapor) (dual bed 500 cfm, 1000 lb fill each) HDPE	Each	$12,500	1	$12,500
12 Knockout tank, control, pumps and fittings (100 gal capacity with controls)	Each	$15,000	1	$15,000
13 Liquid carbon adsorption system (5 gpm, 85 lb fill each, disposable drums)	Each	$700	2	$1,400
14 Shed for blower and controls (10' x 10')	Square foot	$100	100	$10,000
15 In Situ Stabilization of impacted soils from 0-20 feet	Cubic Yard	$300	4,664	$1,399,111
			Subtotal	$2,033,518
			% Total Cost	27%
Miscellaneous Solid Waste Disposal				
1 Disposal Costs and Hauling of Bulky Waste	Ton	$75	1,000	$75,000
			Subtotal	$75,000
			% Total Cost	1%
NAPL Recovery System				
1 NAPL Recovery and Treatment System - 3 wells	Lump Sum	$75,000	1	$75,000
			Subtotal	$75,000
			% Total Cost	1%
Subsurface NAPL Migration Barrier (On-Site)				
1 Soil Bentonite Wall (0 - 10 feet)	Cubic Yard	$150	858	$128,750
2 Wastage Handling and Disposal (25% of wall)	Cubic Yard	$80	215	$17,167
			Subtotal	$145,917
			% Total Cost	2%
Long-term Groundwater and Indoor Air Monitoring and Reporting Costs				
1 Periodic Monitoring, Reporting, and Maintenance (I=5%)	Year	$120,000	30	$1,844,694
2 O & M for SVE system (Carbon change, lab analytics, blower maintenance)	Year 1	$30,000	1	$30,000
3 O & M for SVE system (Carbon change, analytics, blower maintenance) (I=5%)	Years 2,3,4,5	$30,000	3.55	$106,380
			Subtotal	$1,981,074
			% Total Cost	26%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$4,049,215
Total O & M costs				$1,981,074
Total No Contingency Costs				$6,030,289
Contingency (25%)			25%	$1,507,572
			% TOTAL COSTS	**20%**
			TOTAL COST	**$7,537,861**

Table A-2a
Detailed Cost Estimate for Remedial Alternative 2a
Sag Harbor Former MGP Site
Sag Harbor, New York

Remedial Component	Unit	Unit Price	Remedial Alternative 2a Shallow On-Site and Off-Site Source Removal (10'), NAPL Recovery, and LT Monitoring Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$300,000	1	$300,000
2 Permitting and Regulatory submittals	Lump Sum	$30,000	1	$30,000
3 Pre Construction Analytical Sampling	Lump Sum	$30,000	1	$30,000
			Subtotal	$360,000
			% Total Cost	3%
Construction Management				
1 Construction Oversight	Day	$1,920	210	$403,200
2 Air Monitoring during excavations	Day	$1,500	180	$270,000
3 Air Logics Air System	Month	$30,000	9	$259,200
3 Site Survey (Preconstruction and Post-Remediation)	Acre	$5,000	0.76	$3,800
			Subtotal	$936,200
			% Total Cost	9%
General Conditions				
1 Mobilization/Demobilization	Lump Sum	$300,000	1	$300,000
2 Site Preparation	Lump Sum	$20,000	1	$20,000
3 Demolition (concrete structures as encountered)	Lump Sum	$50,000	1	$50,000
3a Demolition (Retail store concrete structures as encountered)	Lump Sum	$300,000	1	$300,000
4 Temporary Offices	Month	$3,000	10	$28,920
5 Temporary Utilities	Lump Sum	$50,000	1	$50,000
			Subtotal	$748,920
			% Total Cost	7%
REMEDIAL COMPONENTS				
Shallow Source Excavation (0-10') On-site				
1 Relocation of Power Lines and/or other utilities in the remediation area	Lump Sum	$10,000	1	$10,000
2 Excavation of impacted soils from 0-10 feet	Cubic Yard	$25	12,261	$306,533
3 Backfill	Cubic Yard	$30	14,714	$441,408
4 Disposal Costs Hauling and Thermal Treatment	Ton	$75	18,392	$1,379,400
5 Dewatering	1000 gallons	$300	3,600	$1,080,000
			Subtotal	$3,217,341
			% Total Cost	30%
Shallow Source Excavation including Retail Store Area (0-10') Off-Site				
1 Clear Excavation Area	Lump Sum	$7,500	1	$7,500
2 Relocation of Power Lines other utilities in the remediation area	Lump Sum	$50,000	1	$50,000
3 Excavation of impacted soils from 0-10 feet	Cubic Yard	$25	7,532	$188,296
4 Backfill	Cubic Yard	$30	9,038	$271,147
5 Disposal Costs Hauling and Thermal Treatment	Ton	$75	11,298	$847,333
6 Dewatering	1000 gallons	$300	761	$228,170
			Subtotal	$1,592,446
			% Total Cost	15%
Miscellaneous Solid Waste Disposal				
1 Disposal Costs and Hauling of Bulky Waste	Ton	$75	1,000	$75,000
			Subtotal	$75,000
			% Total Cost	1%
NAPL Recovery System				
1 NAPL Recovery and Treatment System - 3 wells	Lump Sum	$75,000	1	$75,000
			Subtotal	$75,000
			% Total Cost	1%
Long-term Groundwater and Indoor Air Monitoring and Reporting Costs				
1 Periodic Monitoring, Reporting, and Maintenance (I=5%)	Year	$100,000	30	$1,537,245
			Subtotal	$1,537,245
			% Total Cost	14%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$7,004,908
Total O & M costs				$1,537,245
Total No Contingency Costs				$8,542,153
Contingency (25%)			25%	$2,135,538
			% TOTAL COSTS	**20%**
			TOTAL COST	**$10,677,691**

Table A-2b
Detailed Cost Estimate for Remedial Alternative 2b
Sag Harbor Former MGP Site
Sag Harbor, New York

Remedial Component	Unit	Unit Price	Remedial Alternative 2b Shallow On-Site and Off-site Source Removal (10'), In Situ Stabilization Off-Site, NAPL Recovery, and LT Monitoring	
			Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$300,000	1	$300,000
2 Permitting and Regulatory submittals	Lump Sum	$30,000	1	$30,000
3 Pre Construction Analytical Sampling	Lump Sum	$30,000	1	$30,000
			Subtotal	$360,000
			% Total Cost	3%
Construction Management				
1 Construction Oversight	Day	$1,920	180	$345,600
2 Air Monitoring during excavations	Day	$1,500	150	$225,000
3 Air Logics Air System	Month	$30,000	7	$216,000
3 Site Survey (Preconstruction and Post-Remediation)	Acre	$5,000	0.76	$3,800
			Subtotal	$790,400
			% Total Cost	6%
General Conditions				
1 Mobilization/Demobilization	Lump Sum	$300,000	1	$300,000
2 Site Preparation	Lump Sum	$20,000	1	$20,000
3 Demolition (concrete structures as encountered)	Lump Sum	$50,000	1	$50,000
4 Temporary Offices	Month	$3,000	8	$24,600
5 Temporary Utilities	Lump Sum	$50,000	1	$50,000
			Subtotal	$444,600
			% Total Cost	4%
REMEDIAL COMPONENTS				
Shallow Source Excavation (0-10') On-site				
1 Relocation of Power Lines and/or other utilities in the remediation area	Lump Sum	$50,000	1	$50,000
2 Excavation of impacted soils from 0-10 feet	Cubic Yard	$25	12,261	$306,533
3 Backfill	Cubic Yard	$30	14,714	$441,408
4 Disposal Costs Hauling and Thermal Treatment	Ton	$75	18,392	$1,379,400
5 Dewatering	1000 gallons	$300	3,600	$1,080,000
			Subtotal	$3,257,341
			% Total Cost	26%
Shallow Source Excavation (0-10'), Sub-slab Ventilation for Retail Store and In Situ Stabilization Off-Site				
1 Clear Excavation Area	Acre	$7,500	0.29	$2,186
2 Relocation of Power Lines other utilities in the remediation area	Lump Sum	$50,000	1	$50,000
3 Excavation of impacted soils from 0-10 feet	Cubic Yard	$25	2,367	$59,167
4 Backfill	Cubic Yard	$30	2,840	$85,200
5 Disposal Costs Hauling and Thermal Treatment	Ton	$75	3,550	$266,250
6 Dewatering	1000 gallons	$300	456	$136,902
7 Vacuum Extraction Horizontal Wells - 6 wells	Linear foot	$40	240	$9,600
8 Protective Enclosure for SVE wells and controls	Each	$215	6	$1,290
9 SVE Piping and headers installed in trenches	Linear foot	$5	300	$1,500
10 Vapor recovery system (5 hp, 240 cfm)	Each	$7,000	1	$7,000
11 Carbon adsorption system (vapor) (dual bed 500 cfm, 1000 lb fill each) HDPE	Each	$12,500	1	$12,500
12 Knockout tank, control, pumps and fittings (100 gal capacity with controls)	Each	$15,000	1	$15,000
13 Liquid carbon adsorption system (5 gpm, 85 lb fill each, disposable drums)	Each	$700	2	$1,400
14 Shed for blower and controls (10' x 10')	Square foot	$100	100	$10,000
15 In Situ Stabilization of impacted soils from 0-36 feet	Cubic Yard	$300	8,395	$2,518,400
			Subtotal	$3,176,394
			% Total Cost	26%
Miscellaneous Solid Waste Disposal				
1 Disposal Costs and Hauling of Bulky Waste	Ton	$75	1,000	$75,000
			Subtotal	$75,000
			% Total Cost	1%
NAPL Recovery System				
1 NAPL Recovery and Treatment System - 3 wells	Lump Sum	$75,000	1	$75,000
			Subtotal	$75,000
			% Total Cost	1%
Long-term Groundwater and Indoor Air Monitoring and Reporting Costs				
1 Periodic Monitoring, Reporting, and Maintenance (I=5%)	Year	$100,000	30	$1,537,245
2 O & M for SVE system (Carbon change, lab analytics, blower maintenance)	Year 1	$30,000	1	$30,000
3 O & M for SVE system (Carbon change, analytics, blower maintenance) (I=5%)	Years 2,3,4,5	$30,000	3.55	$106,380
			Subtotal	$1,673,625
			% Total Cost	14%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$8,178,736
Total O & M costs				$1,673,625
Total No Contingency Costs				$9,852,361
Contingency (25%)			25%	$2,463,090
			% TOTAL COSTS	**20%**
			TOTAL COST	**$12,315,451**

Table A-3
Detailed Cost Estimate for Remedial Alternative 3
Sag Harbor Former MGP Site
Sag Harbor, New York

Remedial Component	Unit	Unit Price	Remedial Alternative 3 Shallow Off-Site Source Removal (10'), In Situ Stabilization (0-60') On-Site, and LT Monitoring Quantity	Total Cost
COMMON COST COMPONENTS				
Preconstruction				
1 Engineering Design, Plans, Specs, Bid	Lump Sum	$300,000	1	$300,000
2 Permitting and Regulatory submittals	Lump Sum	$30,000	1	$30,000
3 Pre Construction Analytical Sampling	Lump Sum	$30,000	1	$30,000
			Subtotal	$360,000
			% Total Cost	1%
Construction Management				
1 Construction Oversight	Day	$1,920	180	$345,600
2 Air Monitoring during excavations	Day	$1,500	150	$225,000
3 Air Logics Air System	Month	$30,000	7	$216,000
3 Site Survey (Preconstruction and Post-Remediation)	Acre	$5,000	0.76	$3,800
			Subtotal	$790,400
			% Total Cost	2%
General Conditions				
1 Mobilization/Demobilization	Lump Sum	$300,000	1	$300,000
2 Site Preparation	Lump Sum	$20,000	1	$20,000
3 Demolition (concrete structures as encountered)	Lump Sum	$50,000	1	$50,000
4 Temporary Offices	Month	$3,000	8	$24,600
5 Temporary Utilities	Lump Sum	$50,000	1	$50,000
			Subtotal	$444,600
			% Total Cost	1%
REMEDIAL COMPONENTS				
Shallow Source Excavation (0-10') Off-site and Sub-slab Ventilation for Retail Store				
1 Clear Excavation Area	Acre	$7,500	0.29	$2,186
2 Relocation of Power Lines and/or other utilities in the remediation area	Lump Sum	$10,000	1	$10,000
3 Excavation of impacted soils from 0-10 feet	Cubic Yard	$25	4,699	$117,463
4 Backfill	Cubic Yard	$30	5,638	$169,147
5 Disposal Costs Hauling and Thermal Treatment	Ton	$75	7,048	$528,583
6 Dewatering	1000 gallons	$300	1,080	$324,000
7 Vacuum Extraction Horizontal Wells - 6 wells	Linear foot	$40	240	$9,600
8 Protective Enclosure for SVE wells and controls	Each	$215	6	$1,290
9 SVE Piping and headers installed in trenches	Linear foot	$5	300	$1,500
10 Vapor recovery system (5 hp, 240 cfm)	Each	$7,000	1	$7,000
11 Carbon adsorption system (vapor) (dual bed 500 cfm, 1000 lb fill each) HDPE	Each	$12,500	1	$12,500
12 Knockout tank, control, pumps and fittings (100 gal capacity with controls)	Each	$15,000	1	$15,000
13 Liquid carbon adsorption system (5 gpm, 85 lb fill each, disposable drums)	Each	$700	2	$1,400
14 Shed for blower and controls (10' x 10')	Square foot	$100	100	$10,000
			Subtotal	$1,199,669
			% Total Cost	4%
In Situ Stabilization (0 - 60') On-Site				
1 Relocation of Power Lines other utilities in the remediation area	Lump Sum	$10,000	1	$10,000
2 In Situ of impacted soils from 0-60 feet	Cubic Yard	$300	73,568	$22,070,400
			Subtotal	$22,080,400
			% Total Cost	66%
Miscellaneous Solid Waste Disposal				
1 Disposal Costs and Hauling of Bulky Waste	Ton	$75	1,000	$75,000
			Subtotal	$75,000
			% Total Cost	0%
Long-term Groundwater and Indoor Air Monitoring and Reporting Costs				
1 Periodic Monitoring, Reporting, and Maintenance (I=5%)	Year	$100,000	30	$1,537,245
2 O & M for SVE system (Carbon change, lab analytics, blower maintenance)	Year 1	$30,000	1	$30,000
3 O & M for SVE system (Carbon change, analytics, blower maintenance) (I=5%)	Years 2,3,4,5	$30,000	3.55	$106,380
			Subtotal	$1,673,625
			% Total Cost	5%
REMEDIAL COST SUMMARY				
Total Capital costs without contingency				$24,950,069
Total O & M costs				$1,673,625
Total No Contingency Costs				$26,623,694
Contingency (25%)			25%	$6,655,923
			% TOTAL COSTS	**20%**
			TOTAL COST	**$33,279,617**