

6.0 CONCEPTUAL SUMMARY

6.1 Introduction

This section presents a conceptual model that describes the evolution of current environmental conditions at and immediately adjacent to the site. The model is based on historical site information along with the qualitative and quantitative results of the various site assessments and investigations. The model was developed to provide an integrated summary of the key processes that have resulted in the existing conditions at the site and the affected off-site areas. In brief, the model addresses potential on-site source areas along with the key fate and transport mechanisms that are responsible for the migration of MGP-related materials and chemicals and their distribution in the environment.

While details regarding site history are limited, the site was initially developed in 1859, and was reportedly 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. 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 some time in the early 1960s. In 1998, KeySpan acquired the former MGP property through a merger with LILCO.

6.2 Hydrogeologic Setting

Historical records indicate that the Sag Harbor area consisted of large tracts of marshland which have been filled in since the 1730s to allow for development (Bill Bleyer, LI History.com; Sag Harbor Express, July, 1998). As a result, the site and surrounding properties are directly underlain by fill material consisting primarily of sand and silt along with varying amounts of

clay, cobbles, brick, coal, ash and wood. The fill material is between 4 and 8 feet in thickness and rests directly on a peat deposit in most locations.

The peat deposit consists of a highly organic material containing plant fibers and roots, and occurs in conjunction with a fine-grained inorganic silt/clay sediment that are collectively referred to as the peat/silt/clay unit. The peat/silt/clay unit is found throughout the majority of the site, as well as areas to the south. It has an observed thickness of 0.5 to 14 feet. It is believed that the peat/silt/clay unit is associated with areas of mud flats, tidal wash and areas of salt grass that were filled during the development of Sag Harbor, discussed above. The unit appears to be absent in off-site areas to the north and northwest and appears to be absent or relatively thin within a portion of the site centered near the former Gas Holder No. 3 and the former Tar Separating Tank. The areas where the peat/silt/clay unit was found to be absent may have been associated with sandy tidal channels separating the tidal marshes and/or shallow sandy embayments similar to the setting presently found in the undeveloped portions of Sag Harbor Cove. Similar to the tidal marsh areas, the tidal channels and shallow embayments were filled during the development of Sag Harbor.

Where present, the peat/silt/clay unit appears to act as a confining layer, limiting the vertical flow of groundwater, as well as the vertical migration of MGP-related chemical constituents. Below the peat/silt/clay unit exists the shallow sand unit which consists of fairly well sorted fine to medium grained quartz sand characteristic of highly permeable glacial sands found throughout much of the south fork of Long Island. The shallow sand unit contains a number of discontinuous fine-sand/silt lenses. Due to their discontinuous nature, the fine-sand/silt lenses do not represent an effective confining layer.

Groundwater at the site ranges in depth from approximately 0.5 to 1.6 feet below ground surface (bgs). Groundwater flow is tidally influenced within the site as well as in areas to the north and northwest. Due to tidal influences, as well as the presence of the peat/silt/clay unit, groundwater flow within the site and surrounding area is relatively complex. However, throughout the tidal cycle, the predominant direction of groundwater flow is to the northwest

towards Sag Harbor Cove. In addition, groundwater appears to flow to the south and also to the west. A localized easterly component of flow also exists along the eastern property boundary.

6.3 Fate and Transport of Nonaqueous Phase Liquids

Low viscosity tar and oil that may have been discharged at the site would have behaved as NAPLs migrating vertically through the soil column under the force of gravity until contacting the water table which is less than 2 feet below grade across the majority of the site. If denser than water, the NAPL would likely continue to migrate below the water table and through the fill material reaching the peat/silt/clay unit where vertical migration would likely be impeded. The NAPL would likely become trapped in the pore spaces of the peat/silt/clay unit as well as the fill material. However, due to the relatively shallow nature of the peat/silt/clay unit, the accumulation of NAPL within and above this stratum may promote lateral movement of the NAPL away from source areas. In areas where the peat/silt/clay unit is absent or relatively thin, the dense NAPL (or DNAPL) may continue to migrate vertically through the confining unit and into the underlying shallow sand unit. Vertical migration may continue until the volume required to sustain gravity-driven migration becomes inadequate either due to solubilization or the loss of mass as the result of the DNAPL being immobilized in pore spaces.

NAPL which is less dense than water (LNAPL) that reaches the groundwater water table tends to spread laterally on the surface of the water table. The LNAPL would become further immobilized in soil pores as the water table naturally fluctuated in the vertical direction in response to changes in rates of groundwater recharge as well as tidal influences. This would create a vertical zone of residual LNAPL, typically referred to as a “smear zone.”

Upon release, NAPLs typically distribute quickly within the subsurface (P.V. Noort, et al., 1994). Therefore, given that gas production operations ceased at least 70 years ago, it can be concluded that virtually all the NAPL present in the subsurface is likely to be at residual saturation levels within subsurface soil, and therefore, relatively immobile.

The majority of on-site locations included at least one sample collected above the peat/silt/clay unit which exhibited some evidence of NAPL. However, the strongest evidence of NAPL was observed within the eastern portion of the site centered around the former Tar Separating Tank, Gas Holder No. 3 and Generator Room/Crude Oil Tank area. Soil recovered north and to a lesser extent south of these former MGP structures suggests that lateral migration of NAPL has occurred in these areas above the peat/silt/clay unit. While isolated zones of NAPL saturated soil were encountered above the peat/silt/clay unit throughout much of the site, shallow on-site monitoring wells exhibited little evidence of any measurable separate-phase NAPL. This indicates that while NAPL is present above the peat/silt/clay unit, it appears to be currently in a relatively immobile residual saturation state trapped within subsurface soil. Therefore, continued off-site migration of NAPL is unlikely beyond its current extent. However, intrusive groundwork or other activities, which create heavy ground vibrations could potentially mobilize DNAPLs in the subsurface.

Considerably fewer locations revealed the presence of NAPL below the peat/silt/clay unit. This suggests that the stratum likely behaves as a partial confining unit limiting or retarding the vertical migration of NAPL. The majority of borings exhibiting NAPL below the peat/silt/clay unit are located in the eastern portion of the site where this unit is relatively thin or possibly absent. The only off-site boring exhibiting any significant evidence of NAPL at saturated levels below the peat/silt/clay unit was SHSB-15, located directly north of the eastern portion of the site, again in an area where this stratum is relatively thin. These field observations suggest that vertical migration of NAPL may continue in areas where the peat/silt/clay is thin or absent. However, no intermediate or deep monitoring wells set below the peat/silt/clay unit exhibited measurable separate-phase NAPL, indicating that while NAPL has been observed below this stratum in subsurface soil, it appears to be currently in a relatively immobile residual saturation state.

Within the immediate vicinity of the former Tar Separating Tank located in the eastern portion of the site, NAPL-saturated soil was encountered immediately above and within a fine-sand/silt lens at approximately 50 feet bgs, suggesting that this stratum may be acting as a DNAPL trap. However, soil borings SHSB-20, SHSB-21 and SHSB-22, completed as part of

the supplemental field program in order to further define the presence of this deep NAPL zone did not encounter NAPL-saturated conditions at this interval. Soil recovered from SHSB-21 completed to the northeast of the former Tar Separating Tank did exhibit a slight sheen and naphthalene-like odor above and within this fine sand/silt lens. Based on this information, the extent of the NAPL-saturated conditions observed at a depth of 50 feet during the installation of SHMW-02D appear to be localized to immediately below the former Tar Separating Tank, and there does not appear to be a significant quantity of DNAPL trapped above and/or within this fine sand/silt lens. Furthermore, staining, odors and/or sheens were not observed within soil recovered from the three supplemental field program borings below a depth of 55 feet.

6.4 Fate and Transport of BTEX and PAHs

While the loss of BTEX and PAH compounds from on-site source areas through volatilization may occur, the primary transport mechanism or migration pathway for these compounds is dissolution through direct infiltration of precipitation, as well as groundwater flow through the soil containing the residual NAPL and sorbed BTEX and PAH compounds. Soil within the BTEX/PAH source areas which include organic-rich peat deposits and fill material with relatively high levels of total organic carbon (TOC) will have a relatively high capacity to adsorb and retain much of the BTEX/PAHs, limiting their off-site migration in groundwater. Due to these conditions, the relatively soluble compounds such as BTEX and low molecular weight PAHs which become dissolved in groundwater will have a much greater propensity to stay in solution and migrate via the natural flow of groundwater. In contrast, the high molecular weight PAHs with lower rates of solubility and a higher potential for sorption would have a tendency to remain within the immobile NAPL present in the soil matrix or only migrate a limited distance from this source and become sorbed onto organic material present in the soil. This is supported by the groundwater data which indicates on-site and near-site groundwater collected from areas which contain evidence of NAPL exhibit elevated levels of BTEX and low molecular weight PAHs in addition to relatively high concentrations of high molecular PAHs. In contrast, off-site groundwater data collected at least 50 feet from the site indicates the majority of groundwater exhibiting BTEX and PAHs primarily contain low molecular weight PAHs such as naphthalene, 2-methylnaphthalene and acenaphthylene.

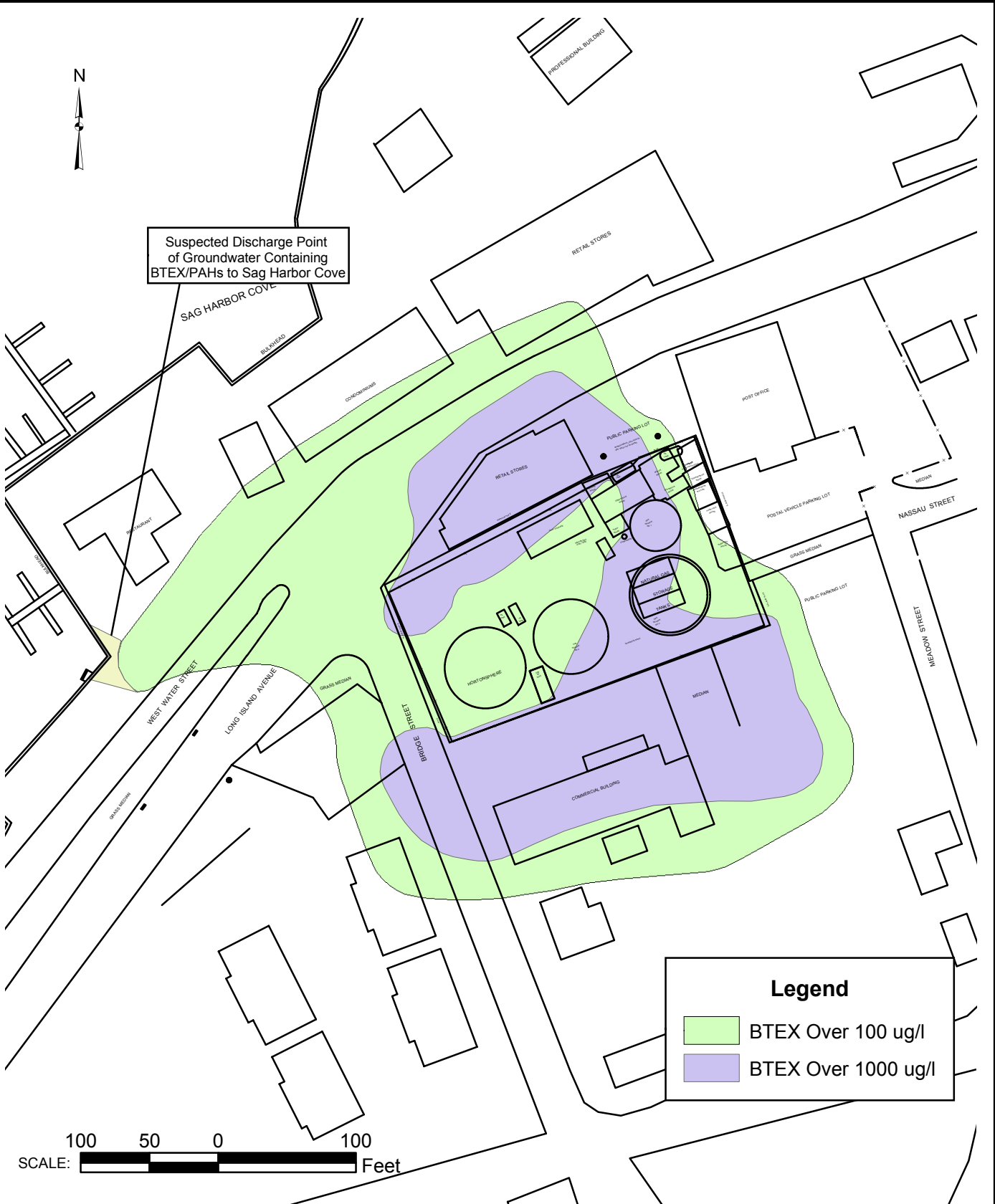
As discussed above, dissolution of BTEX and PAHs from the on-site source areas into groundwater is the major transport mechanism for these compounds. This process has been ongoing since the compounds entered the subsurface environment a minimum of 70 years ago. Therefore, it can be concluded that dissolution along with volatilization and biodegradation processes, (collectively referred to as “weathering”) have been continuously reducing the overall concentration of these compounds within on-site source areas. Historical on-site groundwater data, while limited, does suggest that BTEX and PAH concentrations within the site have decreased in on-site groundwater over the 7-year period for which data is available. However, additional future monitoring would be needed to confirm these trends in BTEX and PAH concentrations.

Due to the relatively complex nature of groundwater flow and the presence of on-site source areas, a diffuse off-site zone of groundwater containing BTEX and PAHs exists primarily to the northwest, west and south of the site. BTEX and PAHs are found within the shallow groundwater zone (i.e., above the peat/silt/clay unit) and within the intermediate groundwater zone (i.e., below the peat/silt/clay unit); however, concentrations of these compounds were generally found to be higher in the shallow groundwater zone. This is likely due to the semi-confining nature of the peat/silt/clay unit as well as the upward or groundwater discharging conditions observed in the intermediate and deep groundwater zones.

Figures 6-1 and **6-2** depict this diffuse groundwater zone, with **Figure 6-1** representing the areal extent of BTEX and **Figure 6-2** representing the areal extent of PAHs. As indicated by these figures, BTEX and PAHs have primarily migrated to the northwest and west toward Sag Harbor Cove. Based on the supplemental field program data, groundwater containing relatively low levels of BTEX and PAHs appears to be discharging to a relatively narrow zone of Sag Harbor Cove to the west of the site, as illustrated on **Figures 6-1** and **6-2**. However, surface water and pore water sampling conducted in the suspected discharge area of the cove revealed only trace concentrations of BTEX in surface water (i.e., not exceeding 1 ug/l) and only trace concentrations of PAHs in pore water (i.e., not exceeding 4 ug/l). The lack of BTEX and PAHs in Sag Harbor Cove is likely attributable to the following:



Suspected Discharge Point
of Groundwater Containing
BTEX/PAHs to Sag Harbor Cove



\\NH\cadwork\GIS_Arcview\Projects\1620-D Sag Harbor\Maps - Fig 6 - 1.mxd

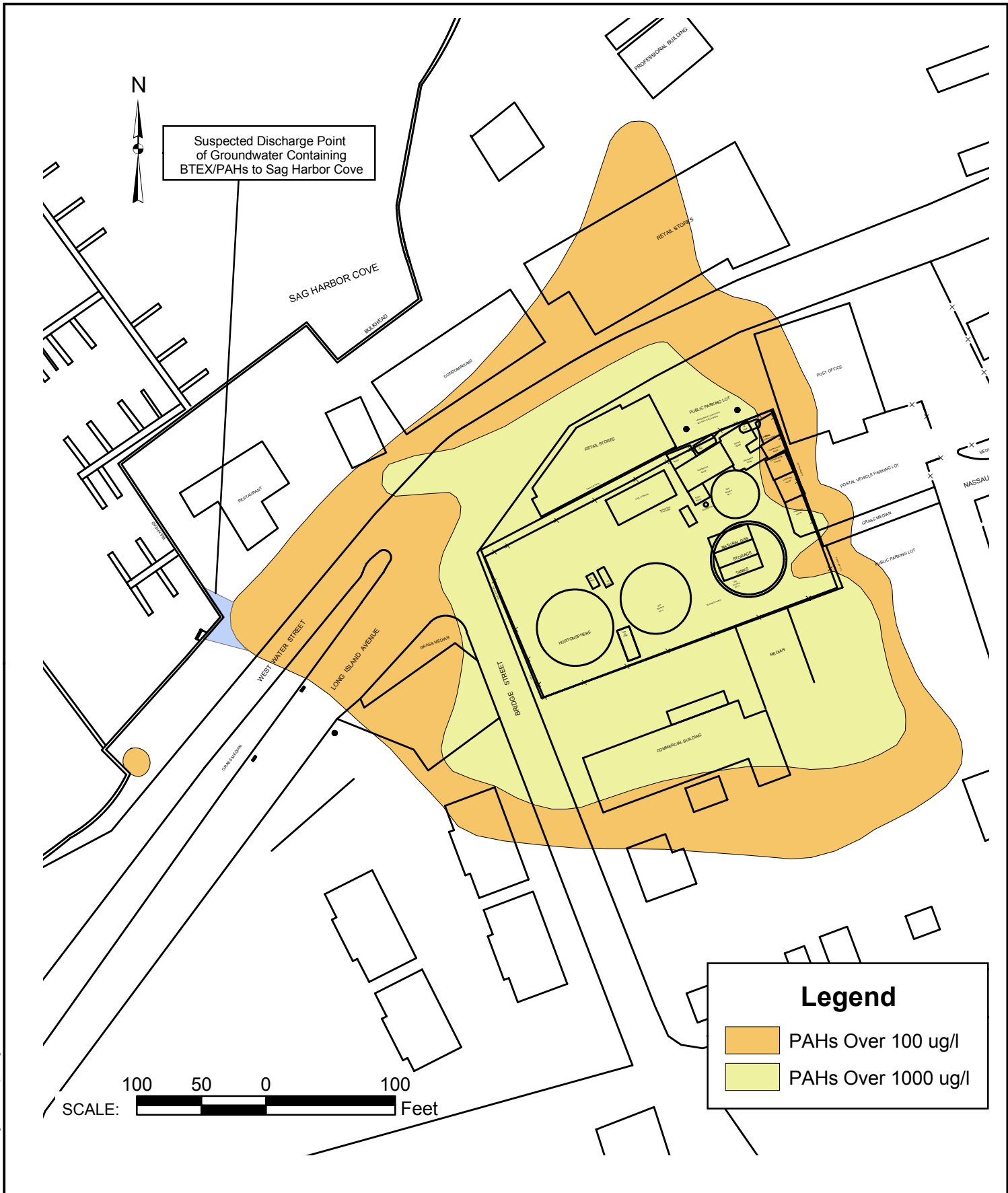


SAG HARBOR FORMER MGP SITE FINAL REMEDIAL INVESTIGATION
SAG HARBOR, NEW YORK

AREAL EXTENT OF BTEX IN GROUNDWATER

FIGURE 6-1

\\NA\cadwork\GIS_Acview Projects\1620-D Sag Harbor\Maps - Fig 6-2.mxd



- BTEX and PAH concentrations in groundwater discharging to the Sag Harbor Cove are relatively low.
- Groundwater containing BTEX and PAHs is rapidly diluted as a result of mixing with surface water and other water sources which also discharge to the cove.
- BTEX dissolved in surface water will have the propensity to volatilize from the water and undergo biological decay. Studies have shown that BTEX compounds readily degrade through natural processes within surface water.

Migration of BTEX and PAHs to the south of the site is also apparent. This appears to be attributable to a southern component of groundwater flow in the extreme southeastern portion of the site. However, it should be noted that during periods of high precipitation, there appears to be a more prominent southerly groundwater flow due to localized mounding of the water table, which may also have an influence on groundwater contaminant concentrations south of the site.

Southern migration of BTEX and PAHs may also have been influenced by the downward slope that appears to exist along the top of the peat layer that extends to the south of the site. In the southeastern portion of the site, in the former location of Gas Holder No. 3, the top of the peat layer appears to exist at approximately 2.2 feet below mean sea level. In the location of SHSB-38, to the east of the former Long Island Fisherman site, the top of the peat layer appears to exist at approximately 3.8 feet below mean sea level. As a result, this approximate 1.6 feet elevation change along the top of the peat layer, which acts as a confining unit when present in significant thicknesses, could further influence the southern trend of migration. Similar conditions exist at SHSB-12 and SHSB-33, located south of the site and just north of the building on the former Long Island Fisherman site.