

9.0 Summary and Conclusions

This section summarizes the Remedial Investigation findings for the Current Site. An overview of the nature and extent of COCs is presented by area of concern and by media, and known and potential source areas are identified.

9.1 Site Geology

- Historic fill material covers the majority of the Current Site in a layer typically ranging from 0 to 15 feet thick.
- The fill is composed of mostly poorly graded sand, silt, and gravel with varying amounts of anthropogenic material: coal fragments, concrete slabs, wood pieces, wood fragments, brick fragments, glass, and other urban fill debris.
- Meadow mat is present beneath the fill. The meadow mat consists of varying amounts of a densely compacted, decomposed vegetative material (peat), organic clays, marine clays with shell fragments, and silt and is brown/tan or grey in color with a distinctive organic-like odor. The unit acts to separate the underlying native soils from the overlying fill. The meadow mat likely represents the former ground surface prior to development (filling) in the Current Site area. This layer ranges from five to fifteen feet thick, was encountered 15 to 20 ft bgs, and was observed in all Current Site borings with the exception of SB-5. The distribution of the unit is consistent with the historic marshy environment of this area.
- Beneath the bottom of the meadow mat are units of glacial outwash dominated by sands and silts. The units vary in composition, occurring as tan and grey interbedded sand and silt and as well-graded to poorly-graded sands and silt zones. These zones vary in depth and distribution across the RI Study Area, and are not defined by clear boundaries.
- A stiff, gray, high plasticity clay and silty clay was encountered from 121 to 135 ft bgs at the RI Study Area. This 14-foot thick unit is interpreted to be the Gardiners Clay. The unit is expected to be laterally continuous beneath the RI Study Area, have very low permeability, and represent a confining unit defining the lower extent of the sand/silt aquifer.
- Below the Gardiners Clay is a brown, well-graded, medium to coarse sand and gravel. This unit is interpreted to be the Jameco Gravel. The unit is expected to be laterally continuous beneath the RI Study Area. A silty sand was encountered within the upper Jameco Gravel.

9.2 Site Hydrogeology

- The Current Site is almost entirely covered by buildings or pavement. Therefore, little to no precipitation is captured through infiltration, but instead flows across the Current Site from east to west towards the Gowanus Canal via sheet flow, and is captured by an on-site storm water drainage system.
- The surface of the groundwater table was encountered between 1.9 and 10.93 ft bgs across the Current Site. The Gowanus Canal surface water elevation was roughly between 2 ft and 6 ft lower than the groundwater table elevation at adjacent wells.

- Three groundwater zones beneath the Current Site were evaluated during the RI using shallow wells screened across the water table surface in the fill, at depths generally ranging from 3 to 15 ft bgs; intermediate wells screened directly below the meadow mat and within the sand/silt unit at depths generally ranging from 25 to 50 ft bgs; and deep wells screened within the sand/silt unit at depth from 60 to 70 ft. Additionally, one deep well screened from 115 to 120 ft bgs, directly above the Gardiners Clay, and one deep well screened from 142 to 147 ft bgs, within the Jameco Gravel directly below the Gardiners Clay, were used to evaluate deeper groundwater quality beneath the Current Site.
- Groundwater flows from the east to the west across the Current Site under all tidal conditions.
- Average horizontal hydraulic gradients calculated from the measurements collected during high tide (September 29, 2010) and low tide (March 14, 2012) were 5.77×10^{-3} ft/ft in shallow zone wells, 3.16×10^{-3} ft/ft in intermediate zone wells, and 2.02×10^{-3} ft/ft in deep zone wells. A generally downward vertical hydraulic gradient is present along the central and eastern Current Site boundaries and an upward vertical hydraulic gradient is present adjacent to the Gowanus Canal and represents groundwater discharge into the canal.
- The geometric means of the calculated hydraulic conductivity of the shallow, intermediate, and deep zones were 17.9 ft/day, 10.0 ft/day, and 11.9 ft/day, respectively.
- Based on tidal cycle monitoring, the strongest tidal effects are noted in the groundwater levels in the intermediate and deep zone wells. Groundwater elevations in the deep zone wells are influenced as far as 725 ft from the canal, and fluctuate by more than a foot. The water levels in the intermediate zone wells also have fluctuations of about one foot, but the influence appears to dissipate between 410 ft and 425 ft from the canal. The tidal influence in the shallow zone, above the meadow mat, is less pronounced, with water level fluctuations of less than a foot and slightly irregular compared to the intermediate and deep zone responses. The tidal influence in the shallow zone dissipates by 200 ft from the canal.

9.3 Nature and Extent of Constituents of Interest

Four media were investigated at the Current Site: surface soil, subsurface soil, groundwater, and sub-slab vapor/air. Conclusions for each media are summarized below.

9.3.1 Surface Soil

- Three surface soil samples were collected and analyzed during the RI.
- Sample analytical results indicate that VOCs, including BTEX, were not detected in the surface soil samples except for an estimated concentration of 1,1-dichloroethene in SS-2 that did not above the Commercial Use SCO. The VOC 1,1-dichloroethene is not MGP related.
- PAHs were detected at concentrations below Commercial Use SCOs in each surface soil sample and ranged in total PAH concentration from 4.9 to 8.2 mg/kg. Few other SVOCs were detected at concentrations below the Commercial Use SCOs.
- Metals and total cyanide were detected in each surface soil sample at concentrations below Commercial Use SCOs.
- One surface soil sample (SS-1) was also analyzed for pesticides, herbicides, and PCBs. One pesticide and two PCB aroclors were detected in sample SS-1 at concentrations below the Commercial Use SCOs (if listed).

- The majority of the Current Site is covered with impervious materials and has been redeveloped since the cessation of MGP operations. The surface soil sample results illustrate that the present day surface soil quality has not been impacted by the former MGP operations.

9.3.2 Subsurface Soil

A total of 80 subsurface soil samples (77 samples and three duplicate samples) were collected from the borings and test pits advanced as part of the RI.

- Concentrations of individual BTEX compounds were only detected above the Commercial Use SCOs in four of the 80 subsurface samples collected. These four samples were collected from borings located immediately west of the Previously Remediated Area. These samples were collected at depths coincident with tar saturated visible impacts and were delineated horizontally and vertically.
- Twenty-two of the 80 samples contained concentrations of one or more PAH compound above the applicable Commercial Use SCOs. Thirteen samples collected from ten locations contained total PAH concentrations that are above the NYSDEC CP-51 total PAH alternative criterion of 500 mg/kg. All of these thirteen samples, except SB-6 (4-5), were collected from soils visibly impacted with tar and/or soils with a strong hydrocarbon or naphthalene-like odor. The vertical extent of the PAH concentrations that are above the Commercial Use SCOs and the CP-51 total PAH criterion was delineated at each location. The horizontal extent of soils containing PAHs at concentrations above Commercial Use SCOs and the CP-51 total PAH alternative criterion has not been delineated to the west-southwest near 13th Street at SB-6 and SB-7 (although these may represent impacts from another source such as weathered heavy fuel oils or lubricating oils or more weathered impacts than other samples that contain total PAH concentrations above 500 mg/kg) or to the west along the Gowanus Canal at SB-9. PAHs were not detected at concentrations above the criteria to the north of the former MGP in the Lowes parking lot (Block 1007, Lot 1)
- PAH concentrations detected in the soil sample collected from 37 to 37.5 ft bgs in boring SB-19 on the west side of the Gowanus Canal are above the Commercial Use SCOs and CP-51 alternate total PAH criterion. This sample was collected from soils described as tar coated and tar saturated. The general extent of the impacts in SB-19 has been delineated.
- Metals were detected in all of the 80 subsurface soil samples collected and analyzed during the RI. Arsenic was detected at concentrations above its Commercial Use SCO in three samples (SB-3(59-60), SB-7(4-5), and SB-8(34-35)) and barium and lead were detected at concentrations above their Commercial Use SCOs in one sample, SB-13(4-5). None of the metal detections above the Commercial Use SCOs are considered to be MGP-related.
- Free cyanide was detected in nine of the 80 subsurface soil samples collected during the RI. All but one of the detected concentrations were estimated and ranged from 0.395 to 7.35 mg/kg in SB-7(10-12). Part 375-6 does not include SCOs for free cyanide, however detected free cyanide concentrations are below the Unrestricted and Commercial Use SCOs of 27 mg/kg for total cyanide.
- PCBs, pesticides, and herbicides were not detected above the reporting limit in any of the 13 subsurface soil samples analyzed for these parameters except for an estimated concentration (0.022 mg/kg) of Aroclor 1254 in the subsurface soil sample collected from 142 to 144 ft bgs in MW-4D2. No Unrestricted Use or Commercial Use SCOs are listed for individual aroclors; however the total PCB Unrestricted Use SCO is 0.1 mg/kg and the total PCB Commercial Use SCO is 1.0 mg/kg.

Based on visible impacts and subsurface soil analytical results, MGP-related impacts are visually evident in subsurface soil in three areas:

1. west and south of the Previously Remediated Area
2. in the vicinity of the former tar tanks along the Gowanus Canal
3. in the northern corner of Block 1007, Lot 1, adjacent to the Gowanus Canal

The vertical extent of these impacts has been delineated. The horizontal extent of subsurface soil visible impacts has been delineated. The horizontal extent of subsurface soil analytical impacts has generally been delineated although the distribution, source, and extent of impacts immediately adjacent to the Gowanus Canal and along the southwestern boundary of the Current Site near SB-6 and SB-7 is uncertain. Several sources of potential contamination to the Gowanus Canal have been identified as summarized in Appendix A and include tar and MGP-related impacts. Other potential historic and current sources of impacts to the Gowanus Canal and the flushing and dredging operations within the canal, as presented in Section 2, complicate the interpretation of visible and analytical impacts within and adjacent to the canal.

Visible impacts in the northern corner of the parking lot (Block 1007, Lot 1) adjacent to the Gowanus Canal and within the former Cranston Asphalt Manufacturing Company site do not appear to be connected with the visible impacts noted in Previously Remediated Area or areas investigated during this RI, based on the distribution of visible impacts illustrated in cross section and by elevation as described in subsection 5.1.

Drilling and subsurface investigations could not be performed beneath the Pathmark building to further evaluate the distribution of impacts. The impacts observed adjacent to the canal in the SB-9 area are at an elevation slightly above the elevation of the bottom of the canal and continue to approximately 30 feet below the bottom of the canal. Based on these elevations, the SB-9 area impacts may have migrated from former MGP structures and may have migrated from the canal to the Current Site. Visible impacts observed in SB-19 on the west side of the canal are within the same elevation as the impacts noted in SB-9. LNAPL collected from MW-20S (west of SB-19) is not tar-related, based on forensic testing demonstrating, along with the historic and current use of the property and adjacent properties, that there are other sources of the impacts observed on the western side of the canal. For example, the Bayside Coal and Fuel Company Smith Street Terminal property north of the SB-20 well has a documented remedy (see Section 2.7) to collect floating product (LNAPL) from the water table.

The visible impacts observed south of SB-9 in SB-4, MW-4D1, and MW-4D2 may originate from the former tar tanks near SB-9 and/or other former structures beneath the Pathmark building, the former Brooklyn Alcatraz Asphalt operations, or the impacts within the Gowanus Canal. Tar impacts were noted in borings in sediment beneath the canal and northwest of the canal at SB-19 at an elevation consistent with visible impacts noted in SB-4. Based on the elevation of the observed impacts in and adjacent to both sides of the canal (SB-4/MW-4 on the east side and SB-19 on the west side), the historical and current use of the properties surrounding the Canal, the redistribution of impacted sediments within the canal due to tidal fluxes, the Flushing Tunnel, and CSOs, the distribution and source of these impacts is uncertain and could also include the canal itself. As noted above, LNAPL collected from MW-20S (near SB-19) is not tar-related based on forensic testing suggesting, that there are other sources of the impacts observed on the western side of the canal (see above).

9.3.3 Groundwater

Groundwater samples collected beneath and adjacent to the RI Study Area contain MGP-related and other compounds at concentrations above the AWQSGVs. The compounds that may be MGP related and that are

above AWQSGVs include BTEX, PAHs, and limited occurrences of cyanide (two locations in the shallow zone only). Compounds unrelated to MGP operations that were detected in groundwater samples, at concentrations above the AWQSGVs, include chlorinated VOCs and MTBE. All of these compounds were detected in the shallow, intermediate, and deep groundwater zones sampled during the RI.

Shallow zone groundwater sample impacts are present in the vicinity of and downgradient of former MGP structures, along the southwestern property boundary, in the northern corner of the Lowes parking lot, and also in upgradient monitoring well MW-1S. Groundwater collected from MW-1S also contained MTBE, a gasoline additive, suggestive of an additional VOC source in the vicinity. The NYCDOS UST NYSDEC Spill site may contribute to impacts detected in the sample collected from MW-1S.

In general the greatest groundwater impacts were detected in the intermediate zone, consistent with the most visibly impacted soil horizon. Groundwater impacts were not noted in the groundwater samples collected from the intermediate and deep zones at upgradient locations MW-11 and MW-1D. MGP-related impacts in the deep zone groundwater samples appear to be limited to the area of the former tar tanks adjacent to the Gowanus Canal (MW-9D), and chlorinated VOCs appear to be more widespread than non-chlorinated VOCs, although low, the benzene concentrations were detected above the AWQSGVS in the groundwater samples collected from deep wells in the parking lot north-northeast of the former MGP areas (Block 1007 Lot 1). Groundwater impacts are evident at the southwestern and western edge of the Current Site along the Gowanus Canal in samples collected from all of the groundwater zones investigated during the RI. No impacts were noted in either of the two wells screened below 115 ft bgs.

Primary field parameters used to document the potential for natural intrinsic biodegradation of dissolved organic compounds in groundwater under a MNA approach include DO and ORP. DO is the preferred TEA used by microbes during natural degradation of organic compounds, therefore, reduced DO levels within and near known former source areas indicate that aerobic biodegradation is occurring/has occurred in areas most impacted by the dissolved COIs. ORP is a measure of the energy yield in the groundwater available to the microbes during the respiration process. Highly positive ORP values indicate areas where reactions are taking place under aerobic conditions (high energy yield to microbes), while lower to negative values indicate areas where anaerobic reactions (lower energy yield to microbes) predominate.

The patterns of the DO and ORP results combined with groundwater flow directions in each aquifer zone support the conceptual model that intrinsic biodegradation of dissolved phase COIs is occurring in shallow, intermediate, and deep groundwater zones beneath the RI Study Area.

9.3.4 Sub-Slab Vapor/Indoor Air

Samples of sub-slab vapor were collected from four locations within the Current Site. The soil vapor samples were collected immediately below the foundation slab of the occupied structures that are currently used for commercial purposes. Compounds were detected, but only one compound, carbon disulfide (SV-1), is above the NYSDOH background indoor air concentration levels for non-residential buildings.

Indoor air samples were collected from within each of the occupied structures in conjunction with the sub-slab soil vapor samples. Based on the collected data, there were no MGP-related constituents detected in indoor air above background concentrations. However, four non-MGP-related compounds (1,4-dichlorobenzene, 1,2-dichloropropane, chloroform, and trichlorofluoromethane [Freon 11]) were detected in indoor air above background concentrations. One or more of these compounds were detected in indoor air samples IA-1, IA-2, and IA-3 collected from the building located at Block 1007, Lot 172 (IA-1 and IA-2) and the western portion of the building located at Block 1025, Lot 26 (IA-3). In general, with the exceptions noted

above, the concentrations of VOCs detected in the indoor air samples are comparable to those detected in the ambient air samples and what is typically found in indoor air of non-residential buildings.

9.4 Potential Source Areas

Based on the visible impacts and the subsurface soil and groundwater analytical results, potential MGP-related source areas include:

- the Previously Remediated Area (adjacent to and in the vicinity of Holders No. 1 through No. 3) on Block 1007, Lots 118, and 219)
- the impacted area on Block 1025, Lots 1, 16, 20, and 100, west of and due to migration of MGP residuals from former Holders No. 1 through No. 3 prior to remediation of these structures
- the former tar tanks along the Gowanus Canal on Block 1007, Lot 172
- the impacted area adjacent to the canal and adjacent to the former BAAC site (on Block 1025, Lot 1)
- the northern corner of the Lowes parking lot adjacent to the Gowanus Canal on Block 1007, Lot 1
- the Gowanus Canal and impacts therein that have originated from multiple sources of NAPL and PAHs

According to the historical figures, former MGP structures were previously located in the area of the Pathmark building on Block 1007 Lot 172. These former MGP structures were not investigated during the RI due to access limitations, the hours of operation and the retail nature of the Pathmark Supermarket. It is not known if these former structures are a potential source of contamination.

9.5 Human Health Exposure Assessment

A qualitative human health exposure assessment was performed for the Current Site. Complete exposure pathways have not been identified for Current Site and off-Current Site commercial industrial workers, visitors and trespassers, and off-Current Site residential receptors.

Current Site and off-Current Site construction workers who perform excavation work on or adjacent to the former MGP may potentially be exposed to PAHs, metals, and/or VOCs in subsurface soil and groundwater if subsurface excavation work is needed to repair or replace underground gas lines or other utilities or equipment adjacent to or at the Current Site. Only properly trained field personnel should complete the subsurface utility work in MGP-impacted areas adjacent to or at the Current Site, using methods specified in a site-specific HASP until the area has been cleared of MGP-impacted soils and groundwater. Areas where soil impacts are consistent with the urban setting and are not attributable to the former Metropolitan Works MGP site would not be subject to this restriction.

9.6 Fish and Wildlife Resource Impacts Assessment

A FWRIA is not necessary for this RI since the USEPA is addressing concerns within the Gowanus Canal due to its Superfund Site status.

9.7 Conclusions

The objectives of the RI have been fulfilled and the nature and general extent of MGP-related impacts at the Current Site have been adequately defined.

Conditions that would warrant an IRM were not observed during the RI. Areas containing MGP-related residuals are covered by asphalt or developed property and therefore do not pose an immediate risk to receptors as the residuals are isolated from human contact. Potable water in the Current Site area is provided by the City of New York.

10.0 Recommendations

Following approval of this report by the NYSDEC and NYSDOH, the next step on the process is an FS evaluation of remedial options to evaluate portions of the Current Site where No Further Action (NFA) conditions cannot be established. As part of the FS, National Grid will evaluate the use of a barrier wall along the western border of the Historic MGP site to limit potential future migration of free-phase NAPL between the canal and the Current Site.

Interim Site Management Plan(s) should be developed for various current property owners, as needed in consultation with the NYSDEC and NYSDOH to ensure that potentially complete exposure pathways, e. g., construction worker exposure are properly managed.