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INTERIM REMEDIAL MEASURE DESIGN WORK PLAN

Former Dangman Park MGP Site

Brooklyn, New York

Site No. 224047

Index # A2-0552-0606

September 2, 2016

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Certification

I, Megan A. Miller, PE, certify that I am currently a New York State registered professional engineer and that this *Interim Remedial Measure Design Work Plan* was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER *Technical Guidance for Site Investigation and Remediation* (DER-10).

________________________________ Date ________

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ACRONYMS AND ABBREVIATIONS

ABOx	anaerobic biological oxidation
Arcadis	Arcadis of New York, Inc.
bls	below land surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAMP	Community Air Monitoring Plan
cm/sec	centimeters/second
COC	constituents of concern
CSM	conceptual site model
DER	Division of Environmental Remediation
DWP	Design Work Plan
EMP	Environmental Management Plan
DNAPL	dense non-aqueous-phase liquid
ft	feet
ft/d	feet per day
IDW	investigation-derived waste
IRM	Interim Remedial Measure
LNAPL	light non-aqueous phase liquid
LTTD	low temperature thermal desorption
MGP	Manufactured Gas Plant
NAPL	non-aqueous phase liquid
National Grid	The Brooklyn Union Gas Company d/b/a National Grid NY
NSZD	natural source zone depletion
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
Owner	532 Neptune Associates, LLC (property owner of Block 7273, Lot 1R)
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PID	photoionization detector

PPE	personal protective equipment
PSC	Public Service Commission
RI	Remedial Investigation
SC	Site Characterization
SCG	standards, criteria, and guidance
Site	Former Dangman Park Manufactured Gas Plant
SMP	Site Management Plan
SRB	sulfate reducing bacteria
SRI	Supplemental Remedial Investigation
SUE	subsurface utility engineering
SVOC	semi-volatile organic compounds
TCLP	Toxicity Characteristic Leaching Procedure
µg/L	micrograms per liter
VOC	volatile organic compounds

1 INTRODUCTION

This *Interim Remedial Measure Design Work Plan* (IRM DWP) presents the basis for and a description of the components proposed to represent the remedy for the National Grid former Dangman Park Manufactured Gas Plant (MGP) site (Site) located at 486 Neptune Avenue, Brooklyn, New York. This IRM DWP also includes the anticipated components of the remedial design for the excavation IRM component of the proposed Site remedy. The Site location is shown on Figure 1. The Site boundary for the purposes of this IRM DWP is the approximate former MGP boundary, which encompasses portions of two parcels (Block 7273, Lots 1R and 25) located along Neptune Avenue and W. 5th Street (see Figure 1); neither of these parcels is owned by National Grid.

The Site was operated by the Brooklyn Borough Gas Company and is identified as New York State Department of Environmental Conservation (NYSDEC) Site No. 224047. This IRM DWP has been prepared by Arcadis of New York, Inc. (Arcadis) on behalf of National Grid, in accordance with the requirements of a Multi-Site Order on Consent and Administrative Settlement (Index # A2-0552-0606) that was entered into by National Grid and the NYSDEC in February 2007. This IRM DWP has also been prepared in accordance with the NYSDEC's Division of Environmental Remediation (DER) *Technical Guidance for Site Investigation and Remediation* (DER-10; NYSDEC 2010).

At this time, National Grid understands from the property owner of Block 7273, Lot 1R (532 Neptune Associates, LLC; Owner) that redevelopment plans are in progress for Lot 1R as well as the adjacent lots to the west (which are unrelated to the former MGP). Lot 25 is owned by a different entity and National Grid is not aware of any redevelopment plans for Lot 25. In light of the redevelopment on Lot 1R, National Grid proposes that the appropriate Site remedy is excavation and in-situ treatment Interim Remedial Measures (IRMs), in conjunction with a ground surface cover (e.g., building, asphalt, sidewalk, etc.), Institutional Controls and a Site Management Plan (SMP). Collectively, National Grid's proposed remedial components provide a comprehensive Site remedy that is protective of human health and the environment.

A Site Characterization (SC) and Remedial Investigation (RI) were conducted by National Grid between 2009 and 2013 to delineate the nature and extent of MGP-related impacts for the Site and assess the associated potential impacts to human health and the environment. The RI work and the associated results and assessments are detailed in the RI Report (Arcadis 2014). As presented in the NYSDEC's May 23, 2014 letter to National Grid (NYSDEC 2014a), it is the opinion of the NYSDEC that the nature and extent of MGP-related impacts for this Site have been sufficiently delineated. The RI Report was approved by the NYSDEC in a letter dated August 22, 2014 (NYSDEC 2014b).

During the performance of the SC and RI activities, the Block 7273, Lot 1R shopping center building was not accessible and soil boring drilling could not be performed inside the building. Subsequently, a number of tenant spaces in the building became accessible/vacant, which allowed for the drilling of soil borings inside these tenant spaces. Due to this change in building accessibility, a scope of work was developed to evaluate the distribution (if any) of mobile MGP-related non-aqueous phase liquid (NAPL) near/within the footprints of the former gas holders, which are located beneath the eastern portion of the existing shopping center building. A Pre-Design Investigation Work Plan (Arcadis 2015) was submitted to the NYSDEC on September 14, 2015. In a letter dated September 15, 2015 (NYSDEC 2015), the NYSDEC approved the Pre-Design Investigation Work Plan (Arcadis 2015) but indicated that the title of the work plan should be changed to “Supplemental Remedial Investigation Work Plan” (SRI Work Plan). The field activities associated with the September 14, 2015 SRI Work Plan were conducted between September 21 and December 16, 2015. Additional activities were added to the SRI with NYSDEC-approval,and were subsequently conducted to facilitate evaluation of remedial options and development of the IRM design, including:

- SRI hydrogeologic field activities (slug and specific-capacity testing) to further characterize aquifer hydraulic parameters.
- SRI subsurface utility evaluation work to locate and identify utilities in the back alley of Block 7273, Lot 1R. The work also involved limited exploratory trenching conducted in conjunction with utility installation work performed in the back alley by the Owner (extending the trench depth to approximately 5 feet below land surface [ft bls] during the shallow utility trenching work [approximately 2 ft bls]) in the vicinity of the former tar tank.
- SRI test hole work in the back alley of the shopping center to daylight certain active utilities (i.e., gas and sanitary sewer lines) at specific points and further investigate the former MGP tar tank footprint.

A summary of the SRI hydrogeologic and subsurface utility evaluation work performed and the associated findings are provided in the SRI Report (Arcadis 2016). A summary of the test hole work and associated findings are provided in National Grid’s June 6, 2016 submittal to NYSDEC (copy provided in Appendix B).

Based on the discussions and meetings between National Grid, the Owner, and the NYSDEC that have occurred since the NYSDEC’s public meeting for this Site on February 11, 2015, including the most recent meeting on July 21, 2016, National Grid recommended two IRMs to address the coated and saturated petroleum and coal tar NAPL observed within 15 feet of the present ground surface: excavation and in-situ engineered anaerobic biological oxidation (ABOx). National Grid’s recommendation was presented to the NYSDEC in a letter dated August 15, 2016 and NYSDEC’s concurrence was presented in a letter dated August 18, 2016 (copies of both letters are provided in Appendix B). The basis for and a description of the proposed IRM activities, in conjunction with a ground surface cover (e.g., building, asphalt, sidewalk, etc.), Institutional Controls, and SMP to provide a comprehensive Site remedy, are provided in the following sections of this IRM DWP.

1.1 IRM DWP Organization

The organization of this IRM DWP is presented in the following table.

Table 1 - Report Organization

Section	Description
Section 1 – Introduction	Presents relevant background information, including a summary of Site impacts.
Section 2 – Site Remedy Basis	Presents the basis for the comprehensive Site remedy proposed in this IRM DWP.
Section 3 – Proposed Site Remedy	Presents a description of the proposed Site remedy, and summarizes the additional data needs for the excavation IRM design and implementation.
Section 4 – Excavation IRM Permits and Approvals	Identifies the anticipated permits and approvals necessary to implement the excavation IRM.
Section 5 – Excavation IRM Design Submittals and Schedule	Identifies the remedial design documents to be prepared in support of the excavation IRM, and presents the anticipated project schedule for completing the excavation IRM and implementing the Site remedy.
Section 6 – References	Presents a list of documents used to support preparation of this IRM DWP.

1.2 Background

This section summarizes Site background information relevant to the development and evaluation of remedial alternatives, including Site description, Site history, and RI/SRI conclusions. Details are presented in the RI and SRI Reports.

1.2.1 Site Description

The Site is located at 486 Neptune Avenue in the Borough of Brooklyn, New York City, New York, approximately 1,300 feet southeast of Coney Island Creek and approximately 2,400 feet north of New York Bay (see Figure 1). The Site boundary for the purposes of this IRM DWP is the approximate former MGP boundary, which encompasses portions of two parcels that are identified by Tax Map Number: Block 7273, Lots 1R and 25 (see Figure 2). The Site is generally flat with an elevation of approximately 9 feet above mean sea level (msl). The closest natural surface water body is Coney Island Creek.

The Site is located in the New York City neighborhood of Coney Island, within Brooklyn Community District 13, on approximately 1 acre of land, and is contained within Lots 1R and 25 of Block 7273, which are bounded by Neptune Avenue to the north, W. 5th Street to the east, a residential parcel to the south, and a commercial parcel to the west. The Site is developed with a shopping center and a parking lot for an existing apartment building. However, the shopping center is currently in the process of being vacated and demolished in advance of construction of a new commercial structure. The eastern portion of the shopping center is situated above the former MGP structure locations.

The Site is either paved or developed with buildings. Storm drains are located throughout the parking areas and receive stormwater runoff from the paved areas. The storm drains discharge the stormwater runoff to the New York City sewer system.

Land use and zoning at the Site and the other properties in the area is commercial and residential. Land use to the north is residential and commercial, land use to the east and south is residential, and land use to the west is commercial. The Site is located within a special purpose zoning district designated as the "Special Ocean Parkway District" (New York City Planning Commission Zoning Map, 2013).

1.2.2 Site History

This section discusses the historical use of the Site, with emphasis on the former MGP operations. As detailed in the RI Report and SRI Report, the following documents are sources used to understand Site history:

- Sanborn fire insurance maps
- Aerial photographs (EDR, 2008)
- PSC Reports

Based on a review of available historical information, the Site was used as a MGP site from prior to 1895 until sometime between 1906 and 1930. The 1895 Sanborn map shows two gas holders, a retort house, two oil tanks, a tar tank, an engine room, a purifying house, and a shed. By 1906, the MGP Site was operated by the Brooklyn Borough Gas Company; an additional gas holder, generating house and cistern had been constructed, and the retort house and tar tank were no longer present. The MGP structures were removed sometime between 1906 and 1930. By 1930, the Site was occupied by a club house. By 1966, the Trump Village Shopping Center, which included a dry cleaner for some time, occupied the northern and central portions of the Site. Figure 2 shows the approximate locations of the former MGP structures.

1.2.3 RI Conclusions

This section presents the findings and conclusions presented in the RI and SRI Reports. Figure 2 shows the soil boring, monitoring well, and soil vapor point locations.

1.2.3.1 Geology/Hydrogeology

- The Site subsurface deposits consist of fill material between 5 and 15 feet in thickness underlain primarily by glacial sand deposits. No confining layers were observed during the RI drilling activities.
- There are no groundwater supply wells located at or in the vicinity of the Site. New York City's drinking water is supplied from reservoirs located in upstate New York.
- Beneath the Site, groundwater exists under water-table conditions and ranges from approximately 6.5 to 7.5 ft bls. A local groundwater divide is present on Lot 25 in the vicinity of monitoring well MW-8, located south of the Site. The shallow groundwater flow direction north of the groundwater divide is generally to the northwest, toward Coney Island Creek. The shallow groundwater flow direction south of the groundwater divide is generally to the south, toward New York Bay. Figure 3 shows the configuration of the water table and groundwater flow direction.
- The horizontal groundwater gradient is relatively flat.

1.2.3.2 Nature and Extent of Constituents in Media

Soil

- The principal contaminant is NAPL, which contains compounds known as volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs); the concentrations of VOCs and SVOCs in the subsurface correlate closely with the degree of NAPL present in the soils.
- The extent of NAPL generally corresponds with the footprint of the former MGP operations and areas adjacent to the former MGP operations (Figure 2), with NAPL primarily observed in the vicinity of the northwestern gas holder, cistern and tar tank.
- NAPL saturated or coated soil was not observed in the upper 9 ft and was observed from 9 to 15 ft bls in only five of 54 soil borings (Figure 5).
- NAPL saturated or coated soil was observed below 15 ft in 14 of 54 soil borings. A greater number of NAPL saturated or coated soil core intervals were observed below 15 ft compared to 9 to 15 ft bls, with the deepest NAPL observation at 73.2 ft bls in RI soil boring SB-9 (Figure 6).
- In addition to NAPL, some petroleum coatings were observed in subsurface soils. The origin of this contamination is not fully defined.
- Petroleum NAPL was observed in 7 borings, all located beneath the footprint of the shopping center building (Figure 7). All observations of petroleum NAPL were in the upper 15 ft and deeper than 6 ft bls. The observed petroleum impacts are limited in extent and are not migrating.

Groundwater

- The former MGP operations and the soil and groundwater impacts are located north of the groundwater divide. Soil and groundwater impacts were not encountered south of the groundwater divide.
- The primary VOCs and SVOCs that were detected in groundwater include benzene, toluene, ethylbenzene, xylenes (BTEX), and polycyclic aromatic hydrocarbons (PAHs), respectively. Constituents of concern (COC) concentrations in groundwater diminish rapidly with increasing distance from source areas (i.e., northwestern gas holder; Figure 4). COCs are substantively limited to Block 7273, Lots 1R and 25, where the former MGP was located and appear to be essentially at steady-state.
- The highest concentrations of VOCs and SVOCs were detected in monitoring wells MW-5 and MW-11 (both screened 30 to 40 ft bls); relatively low concentrations were detected in the shallow monitoring wells (e.g., MW-1 through MW-4; screened from 6 to 16 ft bls).
- With the exception of monitoring wells MW-5 and MW-11 (both screened 30 to 40 ft bls), NAPL was not detected in any of the monitoring wells. As documented in the SRI Report, NAPL gauging and recovery activities conducted at monitoring wells MW-5 and MW-11 demonstrated low to no NAPL recharge conditions that do not warrant future NAPL recovery.

Soil Vapor

- MGP-related COCs were detected in vapor samples beneath the floor slab of the shopping center. However, indoor air sampling showed these COCs are not migrating into the overlying buildings at levels that require action to address exposure. MGP-related contaminants detected in indoor air were consistently below typical background indoor air concentrations. In addition, some of these same chemicals are used in cleaners and household products present in the shopping center.
- Chlorinated hydrocarbon vapors were detected both in sub-slab soil vapor and in indoor air. The levels detected in the indoor air are above typical indoor air concentrations but below New York State Department of Health (NYSDOH) guidelines. Chlorinated hydrocarbons are not related to the MGP manufacturing process, and are likely the result of other post-MGP land uses such as dry cleaning.

1.2.3.3 Conceptual Site Model

The conceptual site model (CSM) presented in the July 2014 RI Report (Arcadis 2014) indicated that the three former gas holders, tar tank, and cistern (Figure 2) were likely sources of NAPL releases from the former MGP and that former MGP structures are common sources of NAPL at MGP sites. The RI Report concluded that sufficient data have been obtained during the SC and RI to evaluate potential remedial options that are commensurate with Site conditions.

The CSM was refined in the SRI Report based on the additional data obtained subsequent to completion of the RI. The data obtained since completion of the NYSDEC-approved RI fully corroborates the previously developed conclusions presented in the RI Report and discussed at the NYSDEC's February 11, 2015 public meeting, including the findings that no NAPL was identified in the shallow subsurface (i.e., within upper 5 feet), the horizontal and vertical extent of subsurface NAPL has been defined, and MGP-related impacts appear to be essentially at steady state. The CSM is summarized below.

Former Gas Holders

- A former MGP structure, suspected to be the northwestern gas holder, was encountered during the drilling of soil boring SRI-1 (Figures 5 and 6). Brick and mortar that was not mixed with soil or other materials was observed from approximately 4.5 to 19 ft bls; based on these observations it is suspected that the boring was situated on the gas holder's brick tank. NAPL saturated materials were observed in the 19 to 21 ft bls soil core, suggesting that the gas holder foundation is present at a depth of approximately 21 ft bls and that the structure contains NAPL. This is consistent with the PSC records that indicate that this older holder was constructed as an in-ground holder, with a brick tank.
- Based on SC soil boring SB-2 and SRI soil borings SRI-5, SRI-7, SRI-10, and SRI-11, there is no indication that the northeastern or southern gas holder foundations are present, suggesting that the gas holders were potentially at grade holders that had aboveground tanks. The PSC records indicate that these holders were constructed with steel tanks. Based on the soil boring observations, the northeastern and southern gas holder's foundations are not present, and the areas are not considered to be a source of NAPL at the site.

Former Tar Tank and Cistern

- The former MGP tar tank area was investigated by advancing test holes between May 2 and 5, 2016 as part of the SRI. The results of the test hole work and associated findings were presented to

NYSDEC in a June 6, 2016 submittal from National Grid (copy provided in Appendix B). The test holes were approximately 1 foot in diameter and ranged in depth from approximately 1.5 ft bls to 9.5 ft bls, depending on the objective of the test hole and subsurface conditions encountered (e.g., refusal and presence of groundwater beginning at approximately 6.5 ft bls). The objectives of the test holes were to daylight certain active utilities (i.e., gas and sanitary sewer lines) at specific points and further investigate the former MGP tar tank footprint in the back alley.

Fourteen test holes (TH-5 through TH-18; Figure 2) were advanced to further investigate the former MGP tar tank footprint in the back alley. As detailed in National Grid's June 6, 2016 submittal to NYSDEC (Appendix B), the key findings and conclusions include the following:

- A metal feature(s) (e.g., steel plate) was observed at approximately 3 ft bls at eight (8) of the test hole locations, but the locations were not contiguous.
- Some NAPL was observed at three (3) of the test hole locations (TH-7, TH-13 and TH-17) beginning at approximately 5 to 5.5 ft bls.

· The former cistern area is located adjacent to (and west of) the northwestern gas holder (Figure 2). This area is covered by the shopping center building, and currently not accessible; it will be addressed after demolition of the shopping center building.

NAPL

· The extent of NAPL generally corresponds with the footprint of the former MGP operations and areas adjacent to the former MGP operations. NAPL observations are predominantly adjacent or downgradient of the northwestern gas holder, cistern and tar tank.

· The extent of NAPL-impacted soil was horizontally and vertically delineated in the RI Report and that delineation has been fully corroborated by findings of the subsequent and extensive soil boring programs associated with the SRI conducted by National Grid and the geotechnical investigation conducted by the Owner to support their redevelopment design. During these subsequent investigations, 47 additional soil borings were drilled beyond the 43 drilled during the SC and RI. The extent of NAPL generally corresponds with the footprint of the former MGP operations and areas adjacent to the former MGP operations (see Figures 5 and 6).

· NAPL saturated or coated soil was not observed in the upper 5 ft and was observed in the upper 15 feet in ten soil borings and three test holes (Figure 5). A greater number of NAPL saturated or coated soil core intervals were observed below 15 ft (18 soil boring locations) compared to the upper 15 ft, with the deepest NAPL observation at 73.2 ft bls in RI soil boring SB-9 (Figure 6).

· With the exception of monitoring wells MW-5 and MW-11, NAPL was not detected in the wells. The NAPL gauging and recovery activities that were conducted at monitoring wells MW-5 and MW-11 have demonstrated low to no NAPL recharge conditions that do not warrant future NAPL recovery.

Groundwater

· The highest BTEX and PAH concentrations in groundwater were detected in monitoring wells MW-5 and MW-11 (both screened from 30 to 40 ft bls). The BTEX concentrations were approximately 10 times greater in MW-5 compared to MW-11; benzene concentrations of 6,800 micrograms per liter (µg/L) and 160 µg/L were detected in MW-5 (located immediately downgradient of the former northwestern gas holder and cistern) and MW-11 (located near the southern gas holder and tar tank), respectively. COC concentrations in groundwater diminish rapidly with increasing distance from former MGP structures (Figure 6).

- Relatively lower BTEX and PAH concentrations in groundwater were detected in the shallow monitoring wells (e.g., MW-1 through MW-4; screened from 6 to 16 ft bls). For example, benzene was not detected above 1 µg/L in MW-2 (located downgradient of the former northeastern gas holder).

<u>Petroleum NAPL</u>

- Petroleum NAPL was observed in 7 borings, all located beneath the footprint of the shopping center building. As shown on Figure 7, there were borings located proximate to these 7 borings where petroleum NAPL was not observed. All observations of petroleum NAPL were in the upper 15 ft and deeper than 6 ft bls (i.e., at the approximate seasonal high water table)
- Shallow monitoring well MW-2 is located immediately downgradient of and screened within the interval where petroleum NAPL was observed. No NAPL has been observed in any of the shallow monitoring wells, and the VOC and SVOC concentrations in these wells are relatively low. For example, benzene was not detected above 1 µg/L in the March 2012 groundwater sample collected from MW-2.

<u>Human Health Exposure Assessment</u>

- The Human Health Exposure Assessment (HHEA) completed during the RI (Arcadis 2014) evaluated potential exposures associated with soil, groundwater, exterior soil vapor, and ambient air. Soil, groundwater, soil vapor, and ambient air associated with the Site do not present potentially complete exposure pathways for commercial workers, consumers, or residents based on current land use and are not anticipated to represent complete future exposure pathways for these receptors. Construction and utility workers may be exposed to soil and/or shallow groundwater during intrusive activities. If construction or utility workers excavate beneath the parking lot or existing buildings, additional health and safety measures will be required to reduce the potential for exposure to these contaminants. These additional measures have been implemented at numerous MGP sites throughout New York State, and have proven quite successful (NYSDEC 2015).

Sufficient data have been obtained to develop and evaluate potential IRM options and develop a Site remedy that is appropriate for Site conditions.

2 SITE REMEDY BASIS

This section presents the basis for the components proposed to represent the comprehensive remedy for the Site, and includes the Remedial Action Objectives (RAOs), a discussion regarding the identification of Site remedy components, and a description of the proposed Site remedy components.

2.1 Remedial Action Objectives

The RAOs presented in the following table have been identified through consideration of the results presented in the RI Report and are consistent with the generic RAOs listed on NYSDEC's website (http://www.dec.ny.gov/regulations/67560.html).

Table 2 - Remedial Action Objectives

RAOs for Soil
1. Prevent ingestion/direct contact with contaminated soil.
2. Prevent inhalation of or exposure from contaminants volatilizing from contaminants in soil.
3. Prevent migration of contaminants that would result in groundwater or surface water contamination.
RAOs for Groundwater
1. Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
2. Prevent contact with, or inhalation of volatiles, from contaminated groundwater.
3. Restore the groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable.
4. Remove the source of groundwater or surface water contamination.
RAO for Soil Vapor
1. Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a site.

These RAOs are protective of human health and the environment and have been identified through consideration of the results of the investigation activities, including the results of the HHEA. The Site does not present potentially complete exposure pathways for commercial workers, consumers, or residents based on current land use and are not anticipated to represent complete future exposure pathways for these receptors. Construction and utility workers may be exposed to soil and/or shallow groundwater during intrusive activities. If construction or utility workers excavate beneath the parking lot or existing buildings, additional health and safety measures will be required to reduce the potential for exposure to COCs. Remedial action is required to address this potential exposure pathway.

Remedial action is also required to address the following:

- Coated and saturated petroleum and coal tar NAPL observed within 15 feet of the present ground surface (Figure 5), and the former MGP structure (suspected to be the northwestern gas holder; Figure 6) encountered during the drilling of soil boring SRI-1. These observations of NAPL are considered sources and, therefore, will be addressed by active remedial technologies. As previously identified, the MGP-related impacts at the Site appear to be essentially at steady state, the highest BTEX and PAH concentrations in groundwater were detected in monitoring wells MW-5 and MW-11 (both screened from 30 to 40 ft bls), relatively low COC concentrations in groundwater were detected in the shallow monitoring wells (screened from 6 to 16 ft bls), and COC concentrations in groundwater diminish rapidly with increasing distance from former MGP structures. Additionally, no NAPL has been observed in any of the shallow monitoring wells during the 7-year period that investigation/gauging activities have been conducted.
- Future groundwater use limitations (there is currently no groundwater usage at or in the immediate vicinity of the Site). Dissolved phase groundwater impacts will be minimized by addressing the coated and saturated petroleum and coal tar NAPL observed within 15 feet of the present ground surface. No further remedial action for the groundwater is required because the COC concentrations in groundwater diminish rapidly with increasing distance from source areas (i.e., former MGP structures), the soluble constituents of MGP wastes (BTEX and naphthalene) are amenable to natural decay processes, and there are no current or anticipated future exposures, except for construction and utility workers that may be exposed to soil and/or shallow groundwater during intrusive activities. As noted above and during NYSDEC's February 11, 2015 public meeting, additional health and safety measures are required to reduce the potential for future construction and utility workers exposure to the COCs and these measures have been successfully implemented at numerous MGP sites throughout New York State (NYSDEC 2015).

Finally, no action is required to address MGP-related COCs in soil vapor because: 1) indoor air concentrations detected during the SC were consistently below typical background concentrations; and 2) some of these same chemicals are used in cleaners and household products present in the shopping center building. Chlorinated hydrocarbons were detected during the indoor air sampling conducted during the SC. The chlorinated hydrocarbons detected are likely the result of other post-MGP land uses, such as dry cleaning (NYSDEC 2015). See Section 2.2 for further details on the planned redevelopment of Lot 1R and how soil vapor mitigation is being incorporated into the design.

The above RAOs identified for the Site address the potential exposure pathways and regulatory requirements. The potential Site remedy components are evaluated in the following section based on their ability to meet the RAOs, which is an aspect of the NYSDEC threshold criterion for remedy evaluation (overall protectiveness of human health and the environment).

2.2 Identification of Site Remedy Components

As a result of the discussions and meetings between National Grid, the Owner, and the NYSDEC that have occurred since the NYSDEC's public meeting for this Site on February 11, 2015, including the most recent meeting on July 21, 2016, potential Site remedy components were identified and evaluated. The objective of this reassessment was to determine which remedy components would comprehensively achieve the best balance of the NYSDEC evaluation criteria set forth in 6 NYCRR 375-1.8(f), and effectively address the potential for future exposure to subsurface soil and groundwater containing MGP-related impacts. Retained Site remedy components (remedial technologies) are summarized in the following table.

Table 3 – Retained Site Remedy Components

General Response Action	Technology Type	Technology Process Option
Institutional Controls	Institutional Controls	Deed restrictions, environmental land use restrictions, enforcement and permit controls, informational devices to govern future development of the Site, limit use of groundwater, and manage subsurface activities
In-Situ Containment/Control	Site Cover	Existing and new ground surface cover consisting of structures (buildings, pavement, sidewalk, etc.) or imported clean soil
Removal	Excavation	Physical removal of the former northwestern gas holder; and coated and saturated petroleum and coal tar NAPL observed within 15 feet of the present ground surface
In-Situ Treatment	Engineered Anaerobic Biological Oxidation (ABOx)	ABOx (enhanced biodegradation) through injection/emplacement of sulfate (non-oxygen electron acceptor) to stimulate indigenous sulfate reducing bacteria (SRB) populations to degrade petroleum and MGP-related COCs
Off-Site Treatment/Disposal	Extraction, Thermal Destruction, Off-Site Disposal	Low temperature thermal desorption (LTTD), incineration, solid waste or hazardous waste landfills

Retained remedial technology types and technology process options were combined into a proposed, comprehensive Site remedy that achieves the RAOs. Key site-specific details used to develop the Site remedy are as follows:

- MGP-related impacts appear to be essentially at steady state.
- No contamination was found at ground surface – the buildings and parking lot (i.e., existing Site cover) prevent exposures. In addition, the planned redevelopment will increase existing grade by an additional 4 to 5 feet and include a new vapor barrier.
- Future use of the Site is anticipated to be consistent with current use (restricted residential and commercial), with pavement or structures covering the Site.
- Lot 25 and Lot 1R are owned by different entities, and National Grid is not aware of any redevelopment plans for Lot 25.

- National Grid understands (at this time) from the Owner that the redevelopment on Lot 1R will include the following:

  1) The new building will extend to the Lot 1R line in all directions and will be constructed in two phases. Phase I, which is comprised of the eastern portion of the Site, will include only commercial space and parking areas. Phase II (the western portion of the Site) includes commercial space, parking and the high-rise residential tower. Phase I demolition will begin on October 3, 2016, and be completed by December 2, 2016. The Phase II area will remain in use by existing commercial tenants throughout Phase I construction (August 23, 2016 email thread between the Owner, National Grid and NYSDEC; copy provided in Appendix B).

  2) The utility corridor in the southern portion of the Phase I area (i.e., in the back alley of the shopping center) includes underground utilities (i.e., a natural gas line, water line, sanitary line, stormwater lines, and electric service line) that are currently active and must remain continually active beyond the completion of Phase I work. These utilities will remain in continual use until commercial tenants vacate their Phase II locations, targeted for November 6, 2017 at the earliest (August 23, 2016 email thread between the Owner, National Grid and NYSDEC; copy provided in Appendix B).

  3) Limited excavation area to a depth of approximately 5 feet bls at a location more than 70 ft west of the extent of NAPL.

  4) Raising existing grade approximately 4 to 5 ft, forming a second cap across the MGP site on Lot 1R.

  5) Pile and pile cap design approaches that will not promote NAPL migration (i.e., no expansion of existing extent of NAPL, either vertically or horizontally).

  6) Pile caps will be installed above existing grade and steel piles will be driven to approximately 50 ft below existing grade.

  7) Pile and pile cap installation within the Phase I area will begin on October 20, 2016, in areas outside the planned remediation/excavation areas, and will immediately continue in the IRM areas as soon as excavation is completed. The overlying surface slab construction (and subsequent steel erection, finish work, etc.) in the Phase I area is to be initiated immediately upon pile cap completion. The new slab will cover the entire Phase I footprint including the still active utility corridor and the former MGP footprint (August 23, 2016 email thread between the Owner, National Grid and NYSDEC; copy provided in Appendix B).

  8) Installation of a new vapor barrier and piping that will be stubbed as a contingency measure in the event that further active soil vapor mitigation measures are necessary in the future.

  9) Phase I demolition of the shopping center building to be completed by December 2, 2016, allowing full access for the IRM field work.

  10) Completion of all IRM field work by mid-2017 so as to not hinder redevelopment field work.

- Coated and saturated petroleum and coal tar NAPL observed within 15 feet of the present ground surface (Figure 5) and the former MGP structure (suspected to be the northwestern gas holder;

Figure 6) encountered during the drilling of soil boring SRI-1 are considered sources and will be addressed by the in-situ treatment and excavation IRMs (described in Section 3).

- The HHEA indicates that the greatest potential for exposure to MGP-related COCs is direct contact with subsurface soils and/or shallow groundwater that may be encountered by construction and utility workers during, intrusive activities. Remedial action is required to address this potential exposure pathway. No other potentially complete exposure pathway was identified for MGP-related COCs. Once the redevelopment is complete on Lot 1R, potential exposure to MGP-related COCs will be minimized because the new building will extend to the Lot 1R line in all directions, existing (active) subsurface utilities will be abandoned, and utilities and pile caps associated with the redevelopment will be above current Site grade.

The proposed Site remedy, developed using the retained remedial technologies to address the required action items identified above, was presented in National Grid’s August 15, 2016 letter to NYSDEC (Appendix B) and is summarized in the following section.

3 PROPOSED SITE REMEDY

This section presents a general description of the remedy proposed to be implemented for the Site. As noted in Section 1, based on discussions and meetings between National Grid, the Owner, and the NYSDEC that have occurred since the NYSDEC's public meeting for this Site on February 11, 2015, including the most recent meeting on July 21, 2016, National Grid recommended two IRMs to address the coated and saturated petroleum and coal tar NAPL observed within 15 feet of the present ground surface; excavation and in-situ treatment (engineered ABOx). National Grid's recommendation was presented to the NYSDEC in a letter dated August 15, 2016 and NYSDEC's concurrence was presented in a letter dated August 18, 2016. As also identified in National Grid's letter, and further detailed below, the IRMs will be implemented in conjunction with engineering/institutional controls to constitute the comprehensive Site remedy.

3.1 Proposed IRMs

The proposed IRMs will address the coated and saturated petroleum and coal tar NAPL observed within 15 feet of the present ground surface. No IRM activities are required for Lot 25. National Grid will work with the Lot 1R property owner to secure the necessary access agreement.

The proposed in-situ treatment IRM (engineered ABOx) and excavation IRM are described below, followed by a description of the additional Site remedy components and additional data needs for the excavation IRM.

3.1.1 In-Situ Treatment IRM

The proposed in-situ treatment IRM is engineered ABOx (enhanced biodegradation). Injection/emplacement of gypsum is proposed to address the petroleum NAPL, in conjunction with excavation described in the following subsection where a relatively greater degree of petroleum impacts were observed compared to the other soil borings (Excavation Area 3). Sulfate addition via gypsum will stimulate indigenous SRB populations to degrade petroleum and MGP-related COCs, capitalizing on existing anaerobic (reduced) subsurface conditions to accelerate the ongoing natural source zone depletion (NSZD) within the area of observed petroleum NAPL. The resultant increase in sulfate from the gypsum injection will accelerate the degradation of dissolved phase COCs, which enhances NAPL dissolution.

Gypsum is sparingly soluble (solubility 2,400 mg/L [1,300 mg/L as sulfate]), and when placed as a slurry will gradually dissolve over a long period of time (years). The gypsum is expected to dissolve to its solubility, and then SRB will use the sulfate to degrade dissolved phase petroleum and MGP-related COCs. As the dissolved phase concentrations decrease, more NAPL and sorbed phase mass will dissolve into the groundwater to re-establish equilibrium. Similarly, as the dissolved sulfate is used by the SRB, more gypsum will dissolve.

Gypsum will be emplaced by injection of a weight percent slurry via direct-push drilling at discrete locations within the area of observed petroleum NAPL and soil boring LB-52 (NAPL coated soils were observed from 8.3 to 9.3 feet ft bls). The location of the in-situ treatment area is shown on Figure 1 (yellow shaded area) of National Grid's August 15, 2016 letter to NYSDEC (Appendix B). The proposed details for implementing the engineered ABOx in-situ treatment by gypsum slurry injection are provided in National Grid's September 2, 2016 letter work plan submittal to NYSDEC.

Gypsum will also be emplaced within the backfill of IRM Excavation Areas 2 and 3 (described below and shown on Figure 8) to provide a long-term source of sulfate to the area downgradient of the excavations where petroleum NAPL coated soils were observed, thereby accelerating the ongoing ABOx of MGP-related impacts in this area. Emplacement of gypsum in the backfill is discussed further below as it will be implemented during the excavation IRM.

3.1.2 Excavation IRM

The proposed excavation IRM includes three excavation areas (Figure 8), as described below.

1) **Northwest Holder and Cistern Excavation Area (Area 1):** Excavate the area encompassing the holder footprint (SRI-1), SRI-2, and LB-51 where NAPL saturated or coated materials were observed in the upper 15 feet (Figure 8). This area, which is approximately 6,600 square feet (sf), will be excavated to a maximum depth of approximately 21 ft bls (i.e., bottom of holder; Section 1.2.3.3) for removal of approximately 5,130 cubic yards (CY) of material.

2) **Back Alley Excavation Area (Area 2):** Excavate the area encompassing (from west to east) TH-7, TH-13, TH-17, SB-1, SB-5/MW-11, LB-46, SB-2, and LB-47 where NAPL saturated or coated materials were observed (Figure 8). This area, which is approximately 2,100 sf, will be excavated to a depth of 15 ft bls for removal of approximately 1,170 CY of material. The back alley excavation area will require removal and relocation of the underground electric duct bank installed/encased in concrete during Spring 2016 by the Property Owner. Within approximately 10 feet south of the shopping center back wall is a utility corridor with numerous subsurface utilities: a gas line and associated service lines into the existing (and partially occupied) shopping center building, two electric lines, and a suspected sanitary sewer line (Figure 8; additional details provided in the SRI Report [Arcadis 2016]). As detailed in the August 23, 2016 email thread between the Owner, National Grid and NYSDEC (Appendix B), NYSDEC concluded that any additional remediation in the back alley is infeasible beyond the Excavation Area 2 described herein and shown on Figure 8 because of the active utility corridor and redevelopment plans. Consistent with NYSDEC's request (Appendix B), measures will be implemented during the IRM excavation (e.g., placing an appropriate liner within the excavation) to prevent recontamination of the backfill material by potentially mobile NAPL in the unremediated soils beneath the utility corridor.

3) **SRI-10 and SRI-11 Petroleum NAPL Coated Soil Excavation Area (Area 3):** Excavate the area encompassing SRI-10 and SRI-11 within the current shopping center building footprint (Figure 8). In this area of the Site, a relatively greater degree of petroleum impacts were observed compared to the other 5 SRI soil borings (SRI-3, SRI-6, SRI-7, SRI-8, and SRI-9; Figure 7) where petroleum impacts were observed. This area, which is approximately 1,195 sf, would be excavated to a depth of 15 ft bls for removal of approximately 660 CY of material. The excavation IRM would remove the soil and petroleum NAPL at and in the vicinity of these two soil boring locations; and would be combined with the proposed in-situ treatment IRM (described above) to address remaining MGP-related impacts by capitalizing on existing anaerobic (reduced) subsurface conditions to accelerate the natural rate of biodegradation (i.e., NSZD) within the area of observed petroleum NAPL.

3.1.2.1 Excavation IRM Preparation Activities

Excavation IRM preparation activities will include (but are not limited to) the following:

- Complete decommissioning of the monitoring wells on Lot 1R in accordance with NYSDEC's guidance CP-43 Groundwater Monitoring Well Decommissioning Policy (NYSDEC, 2009). National Grid presented the NYSDEC-approved decommissioning scope/details in a letter dated April 29, 2016 (National Grid 2016a). The well decommissioning on Lot 1R was completed by National Grid in June 2016, except for MW-14 because the well was inaccessible. MW-14 will be abandoned by National Grid during Phase II of the property redevelopment when the location is accessible.
- After Phase I demolition of the shopping center building, conduct a test pit investigation to determine the presence of subsurface structures and possible obstructions in Excavation Areas 1 and 2. A separate work plan will be submitted describing the test pit procedures and proposed test pit locations.
  - Specifically, in Excavation Area 1 the test pits will be used to determine the presence/location of the structure observed at soil boring location SRI-1 (suspected northwestern gas holder) and the adjacent former MGP cistern footprint. Once the presence/location of the structure observed at SRI-1 is determined, IRM Excavation Area 1 (Figure 8) will be shifted (if necessary) such that the structure and the former MGP cistern footprint are within this excavation area. Based on the depth to water at the Site and observations at soil boring location SRI-1, a maximum of 5 feet of material is anticipated to be removed in Excavation Area 1 to determine the presence/absence and location of the structure(s).
  - Test pits will be used in Excavation Area 2 to determine the presence of obstructions, possible structures, and other features. Test pits in this area will be limited by the presence of active utilities in the northern portion of the alley, as well as the electrical line running across the center of the alley. Identification of subsurface features and obstructions will facilitate installation of the excavation support for the IRM.
- Obtain additional waste characterization data (if necessary) and secure approvals for off-site treatment/disposal of structure contents.
- Perform utility mark-out, protection and relocation within and proximate to the IRM excavation areas.

3.1.2.2 Excavation IRM Implementation Activities

Excavation IRM implementation activities will include the following:

- Set-up and permit a temporary water treatment system for on-site treatment and discharge of water generated during excavation activities to the publicly-owned treatment works (POTW). To support the design of the IRM, a groundwater model was constructed and groundwater modeling was performed by Arcadis. The Groundwater Modeling Memorandum is provided in Appendix A. As indicated therein, the estimated excavation dewatering (pumping) rates range from 54 to 178 gallons per minute (gpm). The variability of the pumping rate is dependent on a number of considerations, including the areal extent and depth of excavation, as well as the type of excavation support system.

- Obtain water quality data necessary to permit the temporary on-site treatment system that will discharge treated water generated during excavation activities to the POTW. Water will be treated to meet the requirements for discharge (via sanitary sewer) to the POTW.
- Install excavation support systems.
- Set-up the temporary tent structure, with vapor collection and treatment, over the IRM excavation and materials handling area(s) to reduce the potential for off-site migration of and potential exposures to vapors, dust, and odors during excavation and material handling activities.
- Excavate the three areas identified on Figure 8. The excavations will extend more than 8 feet into the water table, requiring excavation support systems and dewatering.
- Implement measures (e.g., placing an appropriate liner) within Excavation Area 2 to prevent recontamination of the backfill material by potentially mobile NAPL (if any) in the unremediated soils beneath the utility corridor.
- Perform excavation and materials handling activities inside the temporary tent structure. Excavated materials destined for off-site treatment/disposal will be direct-loaded for off-site treatment/disposal, to the extent possible. Materials excavated above the water table may be used as subsurface backfill if not observed to exhibit visual or olfactory evidence of NAPL.
- Dewater and/or amend excavated materials with a soil drying agent (e.g., Portland cement), as needed, to remove free liquids prior to transporting the materials off site for treatment/disposal. The NYSDEC does not allow amendment of soil at MGP sites with lime kiln dust/quick lime containing greater than 50% calcium and/or magnesium oxide (Ca/MgO) due to vapor issues associated with free oxides.
- Employ odor control methods during the excavation. Long-lasting foam spray and/or other vapor/odor control measures will be used to suppress odors and volatile organic vapors originating from the excavation and the excavated materials, as needed. A Community Air Monitoring Plan (CAMP) will be followed throughout implementation of these activities to document and address (as needed) the airborne particulate levels, volatile organic vapor concentrations, and odors resulting from implementation of the IRM.
- Transport excavated materials to a National Grid approved off-site treatment/disposal facility(ies) permitted to accept the materials.
- Treat water generated during excavation on-site and discharge via sanitary sewer to POTW in accordance with permit requirements.
- Restore excavated areas with appropriate fill that meets DER-10 requirements and is suitable for the property development.
- Demobilize all equipment and materials from the Site.

3.2 Proposed Additional Site Remedy Components

In conjunction with the above IRM components, the following are the proposed additional Site remedy components for both Lots 1R and 25:

- Engineering Control in the form of a ground surface cover (e.g., building, asphalt, sidewalk, etc.) on Lots 1R and 25. A ground cover currently exists on both of these lots, and Owner will construct a new ground surface cover on Lot 1R as part of the redevelopment. As previously identified, the redevelopment includes raising the existing grade approximately 4 to 5 ft, forming a second cap across the MGP site on Lot 1R.
- Institutional Controls (e.g., deed restrictions or environmental easements) to govern future development and limit use of groundwater, as well as manage subsurface activities. Institutional controls will be established following the completion of the IRM construction activities. Note that as the properties that comprise the Site are not owned by National Grid, National Grid assumes that NYSDEC will assist National Grid in establishing institutional controls that are acceptable to the Owner.
- SMP that will (in general) document protocols and requirements for the following activities: future subsurface activities that would disturb or damage the ground surface cover, and methods for reducing and repairing any such disturbances; proper management of potentially MGP-impacted material encountered during future subsurface activities; and periodic inspection, certification and reporting. The SMP will be prepared in coordination with the Owner and in accordance with current NYSDEC guidance.

4 EXCAVATION IRM PERMITS AND APPROVALS

The excavation IRM design will be developed to meet applicable standards, criteria, and guidance (SCGs), permits, and approvals. In addition to NYSDEC review/approval of the excavation IRM design submittals (details provided in Section 5), permits and approvals will be necessary to implement the excavation IRM.

Section 1.10 of DER-10 (Exemptions from Obtaining NYS and Local Permits and Other Authorizations) specifies that exemptions may be granted from state and local permits required for the implementation of remedial construction activities, provided that the substantive requirements of the permit programs are followed. The excavation IRM Design will be prepared to meet such requirements and other applicable local, state, and federal rules and regulations. An initial summary of the potential excavation IRM agreements/permits/approvals are provided below (additional permits and approvals may be identified during the development of the excavation IRM Design).

- Access Agreements – An access agreement will be required for implementation of IRM construction activities on Lot 1R.
- Effluent Discharge Permit – Approval for groundwater discharge to sewer (issued by the New York City Department of Environmental Protection [NYCDEP]) will be required for discharge of treated water (via sanitary sewer) to the local POTW.
- Floodplain Permit – Based on the Federal Emergency Management Agency (FEMA) National Flood Insurance Program Flood Insurance Rate Map Number 3604970353F dated September 5, 2007, the Site is located within the limits of a 100-year floodplain. Because the Site is located within this floodplain, federal and local floodplain management laws and regulations are potentially applicable to certain IRM construction activities (e.g., excavation). The need to obtain construction permits for conducting work within a flood plain will be evaluated during the remedial design through consultation with the Owner, NYSDEC and local agencies.
- Building Permit – A local building permit may be required for the construction of a temporary structure (as indicated in Section 3, the IRM excavation activities will be conducted within a temporary structure).
- Roadway/Sidewalk Permits – Local and/or state traffic permits (e.g., temporary occupancy of street for equipment, sidewalk closure, etc.) may be required to implement the IRM.
- Miscellaneous Plans and Approvals – Additional plans/approvals will be prepared/obtained as necessary to implement the IRM (e.g., NYCDEP's Construction Noise Mitigation Plan, Cranes and Derricks Permit, Emissions Reductions Plan, etc.).

5 EXCAVATION IRM DESIGN SUBMITTALS AND SCHEDULE

This section identifies the information anticipated to be included in the excavation IRM Design. Because the proposed excavation IRM is being implemented in conjunction with the Owner's redevelopment of Lot 1R, effective integration of the redevelopment with the IRM is required. The excavation IRM will be conducted in accordance with the NYSDEC-approved design documents, under the supervision and control of National Grid, and will be performed to the satisfaction of the NYSDEC in accordance with the Order on Consent and Administrative Settlement. Accordingly, consistent with the requirements set forth in that document and DER-10, it is anticipated that the following IRM remedial design submittals will be prepared:

- 95% IRM Design Submittal
- Final 100% IRM Design Submittal

The contents of each IRM design submittal are presented below.

5.1 95% Excavation IRM Design Submittal

The 95% Excavation IRM Design Submittal will incorporate the elements of the IRM into a set of plans and specifications, generally including the following information:

- A set of engineering design drawings and technical specifications that represent an accurate identification of existing site conditions and an illustration of the proposed work. These drawings will provide provisions to facilitate coordination with redevelopment activities, to the extent practicable, to minimize adverse impacts to the redevelopment schedule.
- A Contingency Plan, to be implemented if an element of the IRM design fails to achieve its objectives or otherwise fails to protect human health or the environment.
- A Waste Management Plan (WMP) that describes the characterization, handling, treatment, and disposal requirements for various waste materials to be generated as a result of the IRM activities.
- A CAMP in accordance with the NYSDOH generic CAMP to identify the perimeter air monitoring requirements during the implementation of IRM construction activities.
- A Construction Quality Assurance Plan (CQAP) that describes the materials, procedures, and testing necessary for proper construction, evaluation, and documentation during remedial activities.
- A Community Environmental Response Plan (CERP) that presents a summary of the site monitoring and work practices that will be completed to address potential short-term impacts to the surrounding community and/or environmental resources.
- A Health and Safety Plan (HASP) prepared in accordance with the most recently adopted and applicable general industry (29 CFR 1910) and construction (29 CFR 1926) standards of the federal Occupation Safety and Health Administration (OSHA), as well as other federal, state or local applicable statues or regulations.

National Grid has an existing Citizen Participation Plan (CPP) (National Grid, 2015) for this Site that was approved by NYSDEC. The CPP will be updated during the excavation IRM design in 2016. The CPP, along with other key documents and major reports, are posted on the project website at: http://dangmanparkmgpsite.com/

In accordance with DER-10, the 95% Excavation IRM Design Submittal will be stamped and signed by an Arcadis Professional Engineer (PE) registered in the State of New York prior to submittal to NYSDEC for review, as the 95% submission will be used to procure an excavation IRM contractor, unless otherwise agreed-upon between National Grid and NYSDEC to facilitate implementation. As identified in the following subsection, the 100% Excavation IRM Design Submittal will be stamped and signed by a PE.

5.2 Final 100% Excavation IRM Design Submittal

Following NYSDEC review of the 95% Excavation IRM Design Submittal, the Final 100% Excavation IRM Design Submittal will be produced. The Final 100% Excavation IRM Design Submittal will address NYSDEC comments (if any), be stamped and signed by the PE, and used for construction by the contractor.

5.3 Excavation IRM Design Schedule

The preliminary anticipated schedule for completing the activities identified in this IRM DWP regarding the excavation IRM is presented below. National Grid will continue to coordinate with NYSDEC and the Owner to facilitate completion of the milestones, including scheduling of periodic project team meetings and conference calls.

Table 4 - Preliminary Excavation IRM Schedule

Activity	Anticipated Milestone Date
Complete Monitoring Well Abandonment	Substantially Complete June 2016**
NYSDEC Approval of SRI Report	October 2016
NYSDEC Acceptance of Draft IRM Design Work Plan	September 16, 2016
Public Availability Session	Early October 2016
Submit Test Pit Work Plan (Pre-Excavation IRM)*	October 2016
Submit 95% Excavation IRM Design	Late October 2016
Implement Test Pit Work Plan	December 2016
NYSDEC Review Complete 95% IRM Design *	Late November 2016
Submit 100% Excavation IRM Design	Early December 2016
NYSDEC Approval 100% IRM Design Submittal	December 2016
Begin IRM Implementation	January 2017

**Assumes 4-week NYSDEC/NYSDOH review period*
***Monitoring Well Abandonment will be completed during Phase II of the property redevelopment when the final monitoring well (MW-14) is accessible.*

This preliminary excavation IRM schedule is dependent on many factors including (but not limited to), NYSDEC approval of the proposed Site remedy, time to gain property access, and receipt of NYSDEC comments on project submittals. The regular communication and interaction with NYSDEC that is ongoing will continue throughout this project to facilitate submittal development/approvals and effectively advance this project forward.

Following completion of the IRM construction activities, a Final Engineering Report (FER) will be prepared on behalf of National Grid in accordance with DER-10, including the certification identified in DER-10, Section 1.5. The FER will document the complete remedial program, which as proposed herein, includes the excavation and in-situ treatment (ABOx) IRMs, Site cover (engineering control), institutional controls (e.g., environmental easement or deed restriction), and SMP. Future Site activities would then be conducted in accordance with a SMP and institutional controls to be established for the Site.

6 REFERENCES

Arcadis. 2014. Remedial Investigation Report, Former Dangman Park Manufactured Gas Plant Site, Brooklyn, New York, Site No. 224047, Index # A2-0552-0606. July 2014.

Arcadis. 2015. Former Dangman Park Manufactured Gas Plant Site - Property Redevelopment, Pre-Design Investigation Work Plan (now referred to as Supplemental Remedial Investigation Work Plan), Brooklyn, New York, NYSDEC Site No. 224047, Index # A2-0552-0606. September 2015.

Arcadis. 2016. Former Dangman Park Manufactured Gas Plant Site – Supplemental Remedial Investigation Work Plan, Brooklyn, New York, NYSDEC Site No. 224047, Index # A2-0552-0606. May 2016.

Environmental Data Resources, Inc. 2008. Aerial Photo Decade Package from 1954 2006, July 2008.

New York City Planning Commission Zoning Map. December 19, 2013.

National Grid. 2016a. Letter from Katherine Vater, National Grid to William Wu, NYSDEC, RE: Proposed Monitoring Well Decommissioning. April 29, 2016.

National Grid. 2016. Letter from Katherine Vater, National Grid to William Wu, NYSDEC, RE: Supplemental Remedial Investigation Activities – Back Alley. June 6, 2016.

National Grid. 2016. Letter from Katherine Vater, National Grid to William Wu, NYSDEC, RE: Recommended IRMs. August 15, 2016

NYSDEC, 2002. Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants (DER-4), January 11, 2002.

NYSDEC. 2004. Technical & Operational Guidance Series (TOGS) 1.1.1 - Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations, June 2004.

NYSDEC. 2007. DER-15 Presumptive/Proven Remedial Technologies for New York States Remedial Programs.

NYSDEC. 2008. Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (TOGS 1.1.1), Reissued June 1998 and addended April 2000 and June 2004.

NYSDEC. 2009. CP-43, Groundwater Monitoring Well Decommissioning Policy, November 2009.

NYSDEC. 2010a. DER-23, Citizen Participation Handbook for Remedial Programs, January, 2010.

NYSDEC. 2010b. DER-10, Technical Guidance for Site Investigation and Remediation, May 2010.

NYSDEC. 2011. DER-31, Green Remediation. January 20, 2011.

NYSDEC. 2015. Fact Sheet, Remedial Investigation Completed. January 2015.

NYSDEC. 2015. Letter from William Wu, NYSDEC to Katherine Vater, National Grid, RE: Pre-Design Investigation (PDI) Work Plan (ARCADIS, September 14, 2015), Approval with Modifications. September 15, 2015.

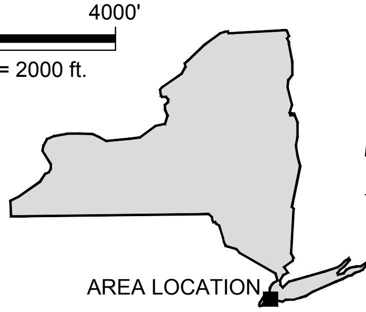
NYSDEC. 2016. Letter from William Wu, NYSDEC to Katherine Vater, National Grid, RE: Former Dangman Park Manufactured Gas Plant Site Recommended IRMs (Received 8/16/2016). August 18, 2016.

FIGURES

REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., CONEY ISLAND, NEW YORK - NEW JERSEY, 2013, LONG ISLAND ZONE NAD 83 (US FOOT).

0 2000' 4000'

Appro□imate Scale: 1 in. = 2000 ft.



NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

SITE LOCATION

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

CITY:SYRACUSE-NY DIV/GROUP:ENV DB:A.SANCHEZ LD:ALS PIC:(Opt) PM:(Re d) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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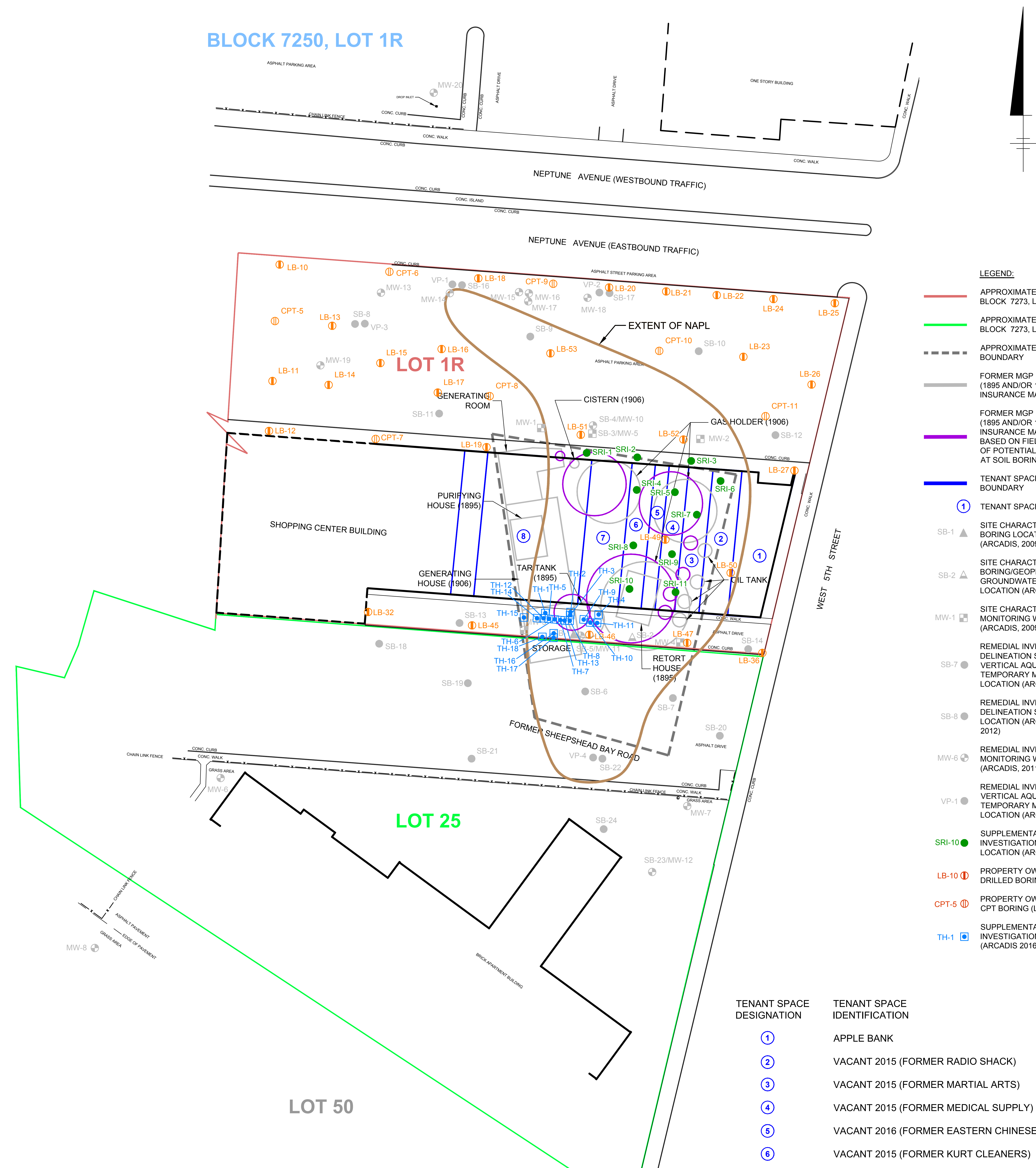

LEGEND:

- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 1R
- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 25
- APPROXIMATE FORMER MGP SITE BOUNDARY
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS)
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS) ADJUSTED BASED ON FIELD OBSERVATIONS OF POTENTIAL GAS HOLDER WALL AT SOIL BORING LOCATION SRI-1
- TENANT SPACE APPROXIMATE BOUNDARY
- 1 TENANT SPACE DESIGNATION
- SB-1 SITE CHARACTERIZATION SOIL BORING LOCATION (ARCADIS, 2009)
- SB-2 SITE CHARACTERIZATION SOIL BORING/GEOPROBE GROUNDWATER SAMPLING LOCATION (ARCADIS, 2009)
- MW-1 SITE CHARACTERIZATION MONITORING WELL LOCATION (ARCADIS, 2009)
- SB-7 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING/ VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2011)
- SB-8 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING LOCATION (ARCADIS, 2011 AND 2012)
- MW-6 REMEDIAL INVESTIGATION MONITORING WELL LOCATION (ARCADIS, 2011, 2012, AND 2013)
- VP-1 REMEDIAL INVESTIGATION VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2012)
- SRI-10 SUPPLEMENTAL REMEDIAL INVESTIGATION SOIL BORING LOCATION (ARCADIS, 2015)
- LB-10 PROPERTY OWNER DRILLED BORING (LANGAN, 2015)
- CPT-5 PROPERTY OWNER CPT BORING (LANGAN, 2015)
- TH-1 SUPPLEMENTAL REMEDIAL INVESTIGATION TEST HOLE (ARCADIS 2016)

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	VACANT 2016 (FORMER EASTERN CHINESE RESTAURANT)
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

NOTES:

1. MONITORING WELL, TEST HOLE AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. THE EXTENT OF NAPL IS BASED ON THE OBSERVATION OF NAPL AND/OR BLEBS IN THE SOIL BORINGS DURING THE SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION. STAINED SOIL OR A SHEEN WERE NOT INCLUDED IN THE MAPPING OF THE EXTENT OF NAPL. THE EXTENT OF NAPL HAS NOT CHANGED FROM THE NYSDEC-APPROVED RI REPORT.
5. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
6. THE PROPERTY OWNER DRILLED AND CPT BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.
7. ALL MONITORING WELL, TEST HOLE AND SOIL BORING LOCATIONS ARE SHOWN; 2015 AND 2016 LOCATIONS (i.e., POST-REMEDIAL INVESTIGATION) ARE SHOWN IN COLOR.

0 60' 120'
SCALE IN FEET

DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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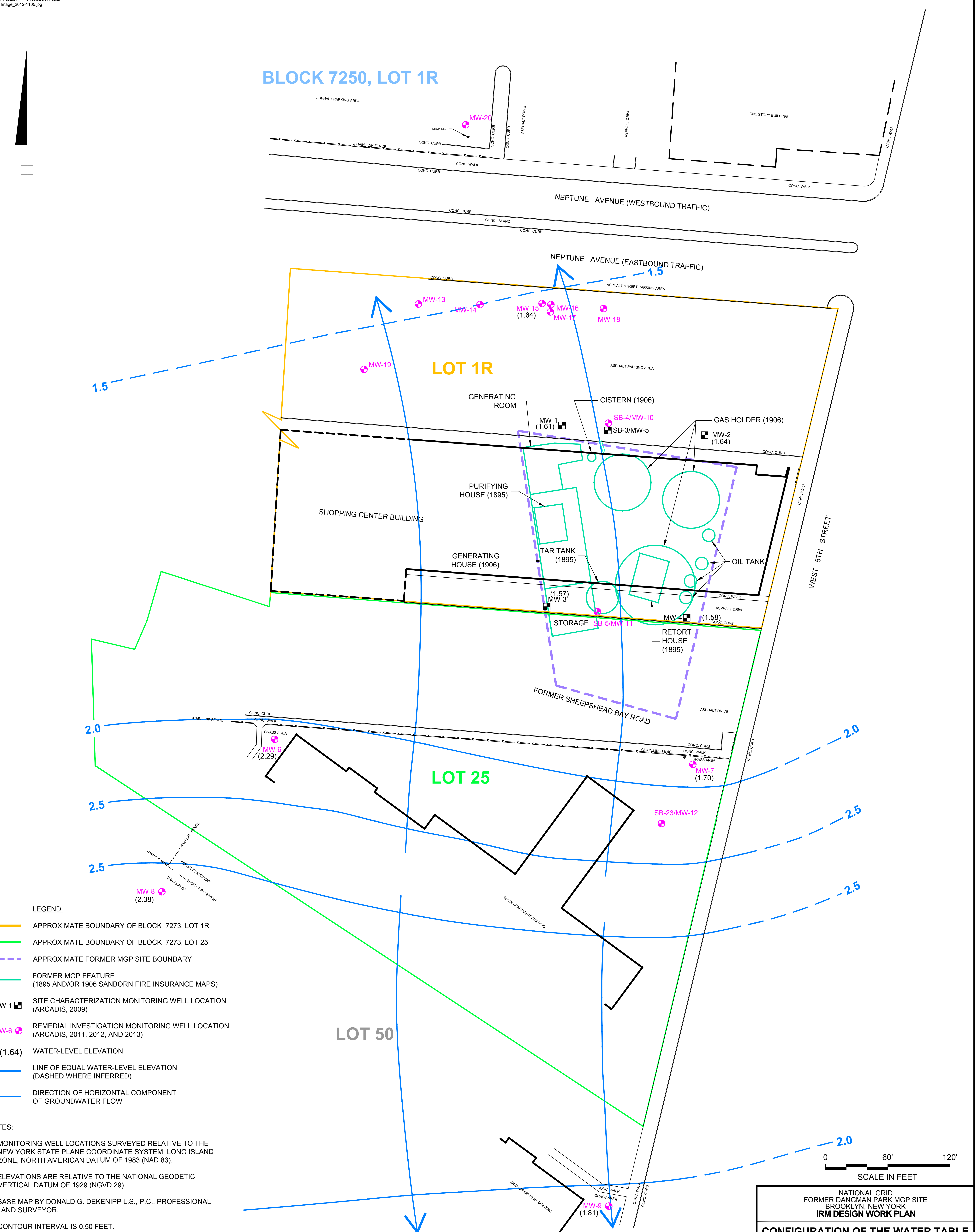


LEGEND:

- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 1R
- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 25
- APPROXIMATE FORMER MGP SITE BOUNDARY
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS)
- MW-1 — SITE CHARACTERIZATION MONITORING WELL LOCATION (ARCADIS, 2009)
- MW-6 — REMEDIAL INVESTIGATION MONITORING WELL LOCATION (ARCADIS, 2011, 2012, AND 2013)
- (1.64) — WATER-LEVEL ELEVATION
- 1.5 — LINE OF EQUAL WATER-LEVEL ELEVATION (DASHED WHERE INFERRED)
- DIRECTION OF HORIZONTAL COMPONENT OF GROUNDWATER FLOW

NOTES:

1. MONITORING WELL LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. ELEVATIONS ARE RELATIVE TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29).
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. CONTOUR INTERVAL IS 0.50 FEET.
5. WATER-LEVEL ELEVATIONS MEASURED ON MARCH 20, 2012.
6. LOCATIONS OF MGP FEATURES ARE APPROXIMATE.
7. MONITORING WELL MW-20 WAS NOT INSTALLED UNTIL NOVEMBER 21, 2013.

0 60' 120'
SCALE IN FEET

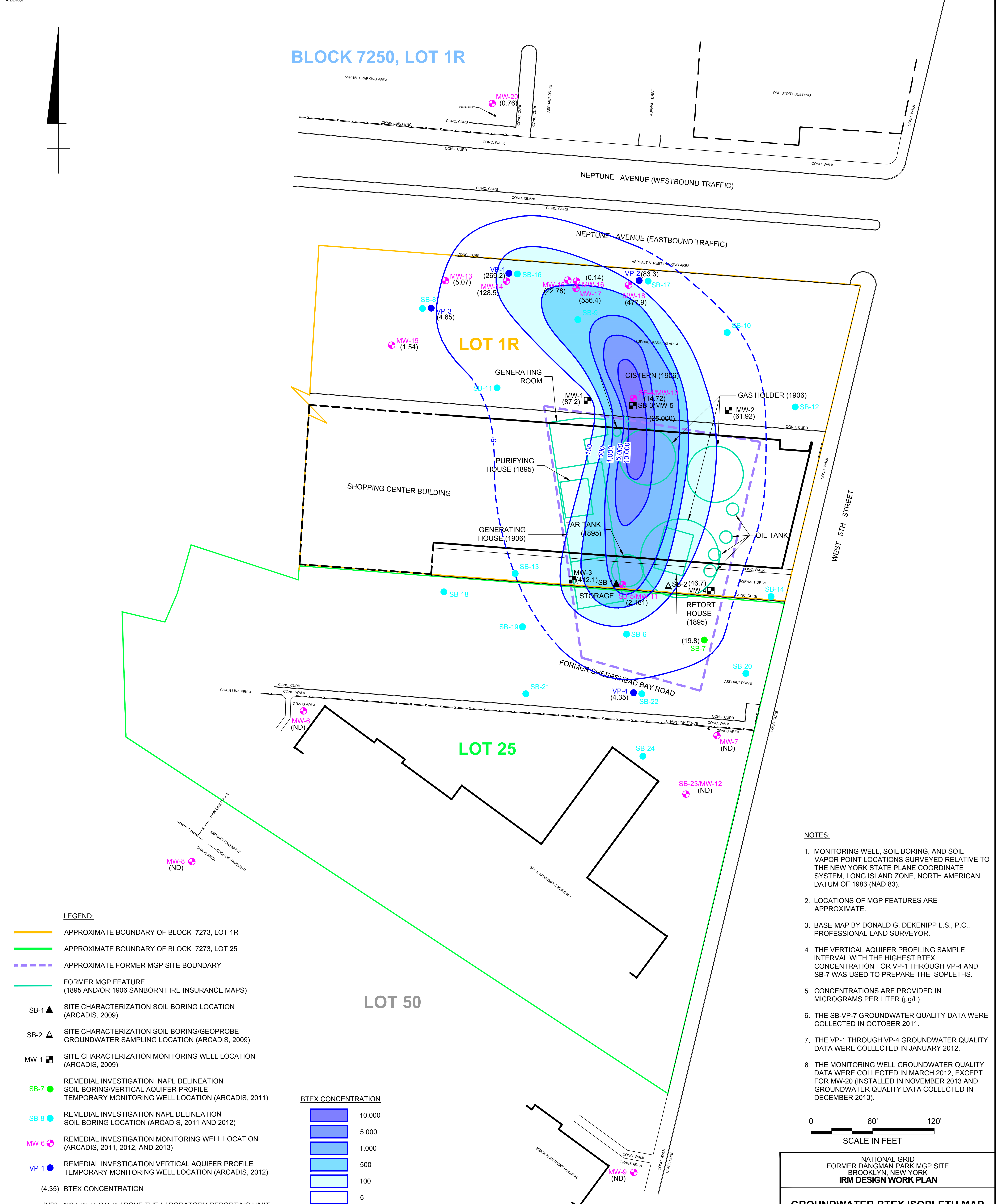
DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

CONFIGURATION OF THE WATER TABLE AND GROUNDWATER FLOW DIRECTION MARCH 2012

ARCADIS Design & Consultancy for natural and built assets

FIGURE 3



LEGEND:

- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 1R
- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 25
- APPROXIMATE FORMER MGP SITE BOUNDARY
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS)
- SB-1 SITE CHARACTERIZATION SOIL BORING LOCATION (ARCADIS, 2009)
- SB-2 SITE CHARACTERIZATION SOIL BORING/GEOPROBE GROUNDWATER SAMPLING LOCATION (ARCADIS, 2009)
- MW-1 SITE CHARACTERIZATION MONITORING WELL LOCATION (ARCADIS, 2009)
- SB-7 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING/VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2011)
- SB-8 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING LOCATION (ARCADIS, 2011 AND 2012)
- MW-6 REMEDIAL INVESTIGATION MONITORING WELL LOCATION (ARCADIS, 2011, 2012, AND 2013)
- VP-1 REMEDIAL INVESTIGATION VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2012)
- (4.35) BTEX CONCENTRATION
- (ND) NOT DETECTED ABOVE THE LABORATORY REPORTING LIMIT

BTEX CONCENTRATION

- 10,000
- 5,000
- 1,000
- 500
- 100
- 5

NOTES:

1. MONITORING WELL, SOIL BORING, AND SOIL VAPOR POINT LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. THE VERTICAL AQUIFER PROFILING SAMPLE INTERVAL WITH THE HIGHEST BTEX CONCENTRATION FOR VP-1 THROUGH VP-4 AND SB-7 WAS USED TO PREPARE THE ISOPLETHS.
5. CONCENTRATIONS ARE PROVIDED IN MICROGRAMS PER LITER (μg/L).
6. THE SB-VP-7 GROUNDWATER QUALITY DATA WERE COLLECTED IN OCTOBER 2011.
7. THE VP-1 THROUGH VP-4 GROUNDWATER QUALITY DATA WERE COLLECTED IN JANUARY 2012.
8. THE MONITORING WELL GROUNDWATER QUALITY DATA WERE COLLECTED IN MARCH 2012; EXCEPT FOR MW-20 (INSTALLED IN NOVEMBER 2013 AND GROUNDWATER QUALITY DATA COLLECTED IN DECEMBER 2013).

0 60' 120'
SCALE IN FEET

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

GROUNDWATER BTEX ISOPLETH MAP

DRAFT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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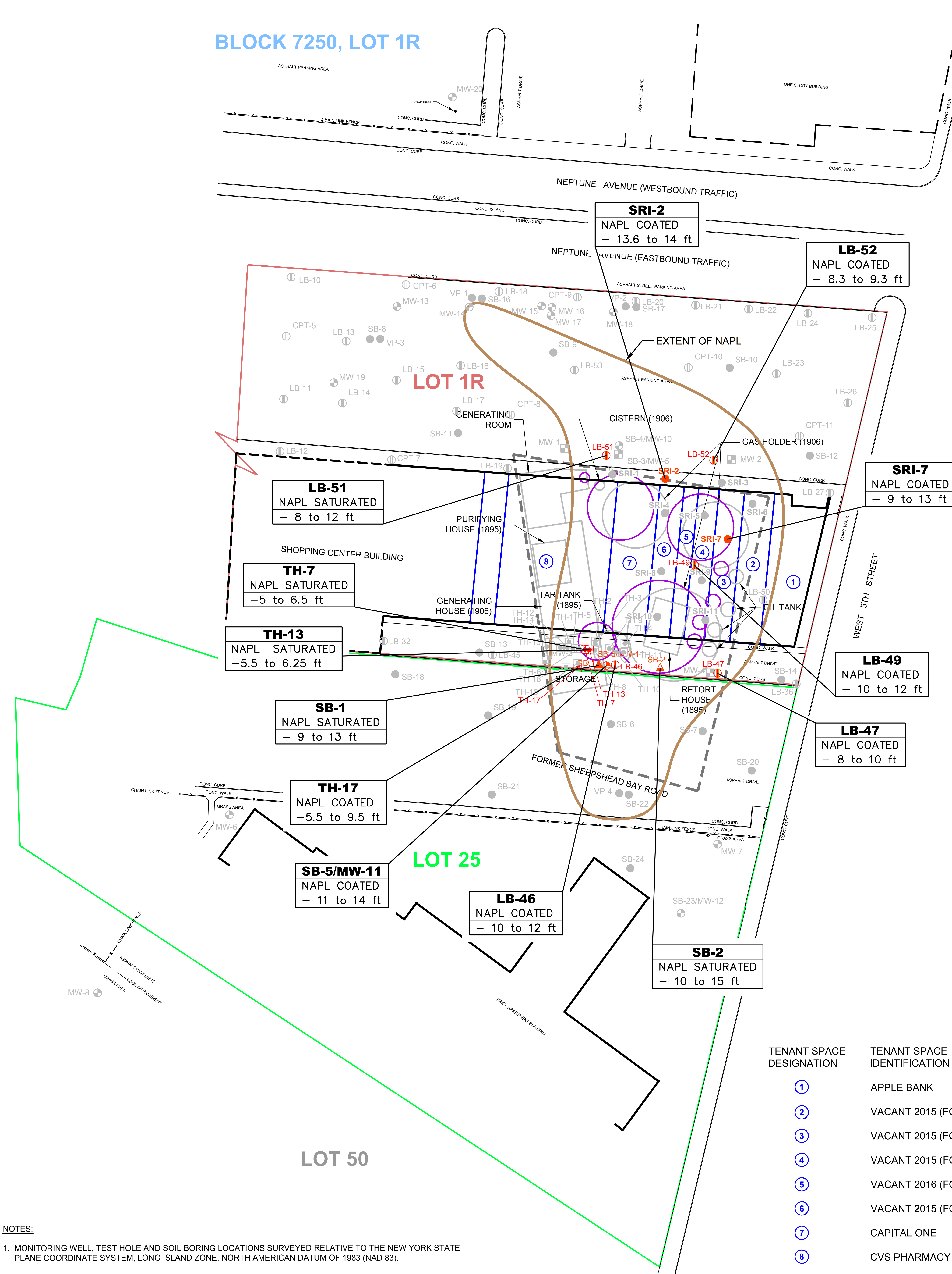

LEGEND:

- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 1R
- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 25
- APPROXIMATE FORMER MGP SITE BOUNDARY
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS)
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS) ADJUSTED BASED ON FIELD OBSERVATIONS OF POTENTIAL GAS HOLDER WALL AT SOIL BORING LOCATION SRI-1
- TENANT SPACE APPROXIMATE BOUNDARY
- 1 TENANT SPACE DESIGNATION
- SB-1 SITE CHARACTERIZATION SOIL BORING LOCATION (ARCADIS, 2009)
- SB-2 SITE CHARACTERIZATION SOIL BORING/GEOPROBE GROUNDWATER SAMPLING LOCATION (ARCADIS, 2009)
- MW-1 SITE CHARACTERIZATION MONITORING WELL LOCATION (ARCADIS, 2009)
- SB-7 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING/ VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2011)
- SB-8 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING LOCATION (ARCADIS, 2011 AND 2012)
- MW-6 REMEDIAL INVESTIGATION MONITORING WELL LOCATION (ARCADIS, 2011, 2012, AND 2013)
- VP-1 REMEDIAL INVESTIGATION VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2012)
- SRI-10 SUPPLEMENTAL REMEDIAL INVESTIGATION SOIL BORING LOCATION (ARCADIS, 2015)
- SRI-2 LOCATION WHERE NAPL SATURATED OR NAPL COATED SOIL WAS OBSERVED
- LB-10 PROPERTY OWNER DRILLED BORING (LANGAN, 2015)
- CPT-5 PROPERTY OWNER CPT BORING (LANGAN, 2015)
- TH-1 SUPPLEMENTAL REMEDIAL INVESTIGATION TEST HOLE (ARCADIS 2016)

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	VACANT 2016 (FORMER EASTERN CHINESE RESTAURANT)
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

NOTES:

1. MONITORING WELL, TEST HOLE AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. THE EXTENT OF NAPL IS BASED ON THE OBSERVATION OF NAPL AND/OR BLEBS IN THE SOIL BORINGS DURING THE SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION. STAINED SOIL OR A SHEEN WERE NOT INCLUDED IN THE MAPPING OF THE EXTENT OF NAPL. THE EXTENT OF NAPL HAS NOT CHANGED FROM THE NYSDEC-APPROVED RI REPORT.
5. SOIL BORING LOCATIONS WITH ASSOCIATED SOIL OBSERVATION BOXES ARE LOCATIONS WHERE NAPL SATURATED OR NAPL COATED SOIL WAS OBSERVED. NAPL COATED INCLUDES LIGHT, MODERATE OR HEAVY COATING.
6. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
7. THE PROPERTY OWNER DRILLED AND CPT BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.

0 60' 120'
SCALE IN FEET

DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

NAPL OBSERVATIONS FROM WATER TABLE TO 15 FT BLS

ARCADIS Design & Consultancy for natural and built assets

FIGURE 5

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
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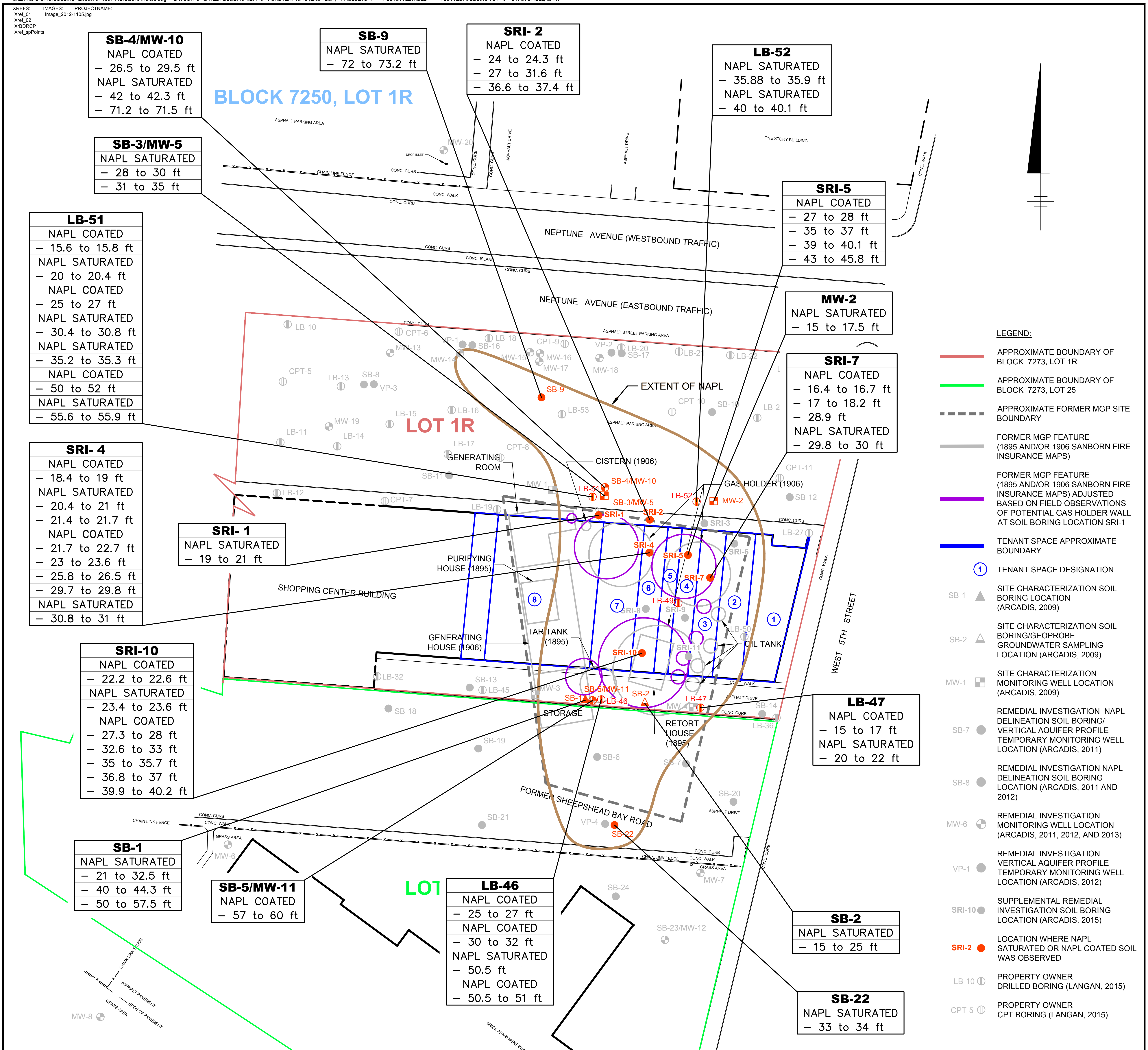

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	VACANT 2016 (FORMER EASTERN CHINESE RESTAURANT)
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

NOTES:

1. MONITORING WELL AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. THE EXTENT OF NAPL IS BASED ON THE OBSERVATION OF NAPL AND/OR BLEBS IN THE SOIL BORINGS DURING THE SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION. STAINED SOIL OR A SHEEN WERE NOT INCLUDED IN THE MAPPING OF THE EXTENT OF NAPL. THE EXTENT OF NAPL HAS NOT CHANGED FROM THE NYSDEC-APPROVED RI REPORT.
5. SOIL BORING LOCATIONS WITH ASSOCIATED SOIL OBSERVATION BOXES ARE LOCATIONS WHERE NAPL SATURATED OR NAPL COATED SOIL WAS OBSERVED. NAPL COATED INCLUDES LIGHT, MODERATE OR HEAVY COATING.
6. WITH THE EXCEPTION OF MONITORING WELLS MW-5 AND MW-11, NAPL WAS NOT DETECTED IN THE WELLS. THE NAPL GAUGING AND RECOVERY ACTIVITIES THAT WERE CONDUCTED AT MONITORING WELLS MW-5 AND MW-11 HAVE DEMONSTRATED LOW TO NO NAPL RECHARGE CONDITIONS THAT DO NOT WARRANT FUTURE NAPL RECOVERY.
7. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
8. THE PROPERTY OWNER DRILLED AND CPT BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.

0 60' 120'
SCALE IN FEET

DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

NAPL OBSERVATIONS BELOW 15 FT BLS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6

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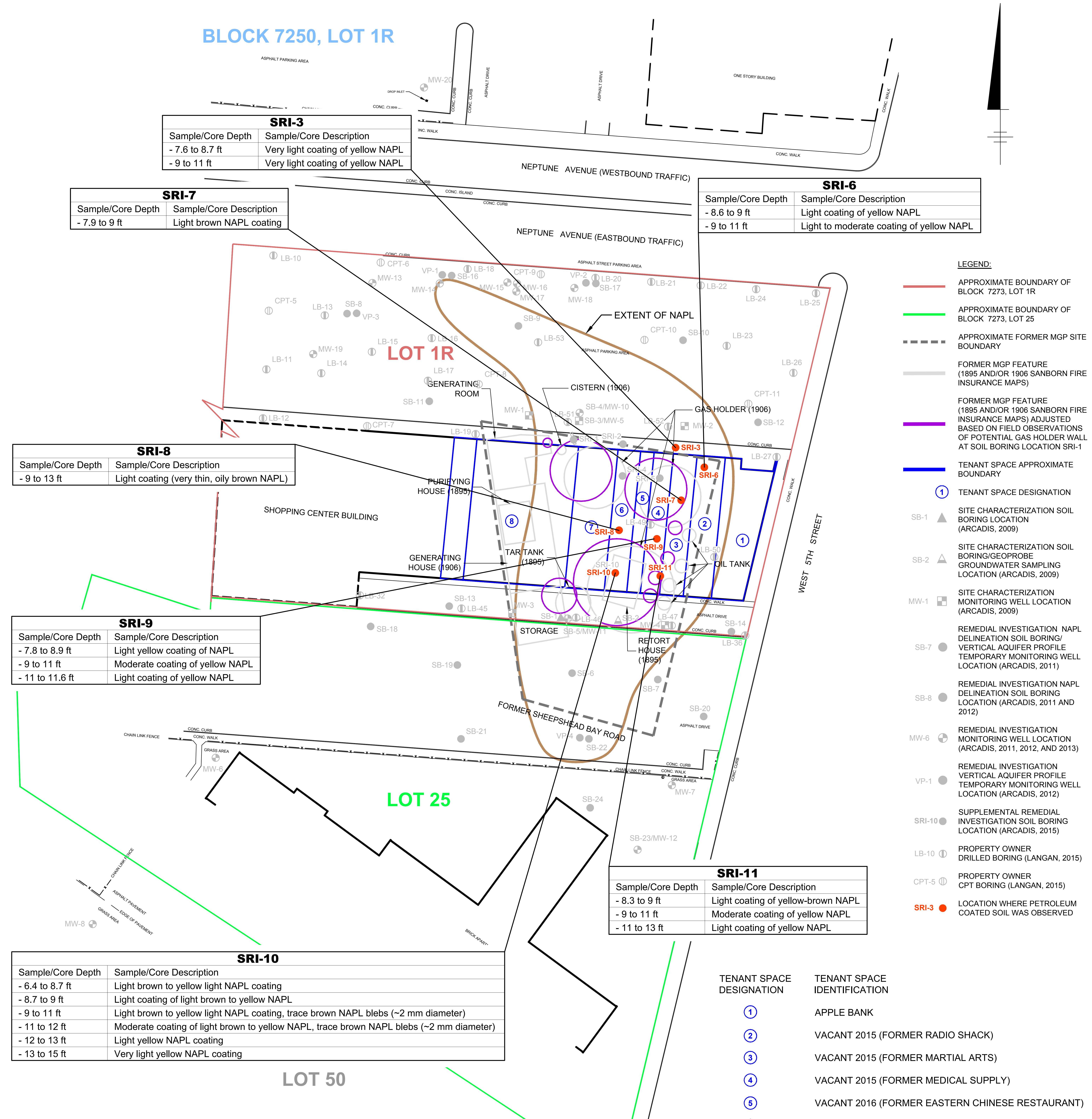


SRI-3

Sample/Core Depth	Sample/Core Description
- 7.6 to 8.7 ft	Very light coating of yellow NAPL
- 9 to 11 ft	Very light coating of yellow NAPL

SRI-7

Sample/Core Depth	Sample/Core Description
- 7.9 to 9 ft	Light brown NAPL coating

SRI-6

Sample/Core Depth	Sample/Core Description
- 8.6 to 9 ft	Light coating of yellow NAPL
- 9 to 11 ft	Light to moderate coating of yellow NAPL

SRI-8

Sample/Core Depth	Sample/Core Description
- 9 to 13 ft	Light coating (very thin, oily brown NAPL)

SRI-9

Sample/Core Depth	Sample/Core Description
- 7.8 to 8.9 ft	Light yellow coating of NAPL
- 9 to 11 ft	Moderate coating of yellow NAPL
- 11 to 11.6 ft	Light coating of yellow NAPL

SRI-11

Sample/Core Depth	Sample/Core Description
- 8.3 to 9 ft	Light coating of yellow-brown NAPL
- 9 to 11 ft	Moderate coating of yellow NAPL
- 11 to 13 ft	Light coating of yellow NAPL

SRI-10

Sample/Core Depth	Sample/Core Description
- 6.4 to 8.7 ft	Light brown to yellow light NAPL coating
- 8.7 to 9 ft	Light coating of light brown to yellow NAPL
- 9 to 11 ft	Light brown to yellow light NAPL coating, trace brown NAPL blebs (~2 mm diameter)
- 11 to 12 ft	Moderate coating of light brown to yellow NAPL, trace brown NAPL blebs (~2 mm diameter)
- 12 to 13 ft	Light yellow NAPL coating
- 13 to 15 ft	Very light yellow NAPL coating

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	VACANT 2016 (FORMER EASTERN CHINESE RESTAURANT)
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

NOTES:

1. MONITORING WELL AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. THE EXTENT OF NAPL IS BASED ON THE OBSERVATION OF NAPL AND/OR BLEBS IN THE SOIL BORINGS DURING THE SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION. STAINED SOIL OR A SHEEN WERE NOT INCLUDED IN THE MAPPING OF THE EXTENT OF NAPL. THE EXTENT OF NAPL HAS NOT CHANGED FROM THE NYSDEC-APPROVED RI REPORT.
5. SOIL BORING LOCATIONS WITH ASSOCIATED SOIL OBSERVATION BOXES ARE LOCATIONS WHERE PETROLEUM NAPL COATED SOIL WAS OBSERVED. NAPL COATED INCLUDES LIGHT OR MODERATE COATING.
6. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
7. THE PROPERTY OWNER DRILLED BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.

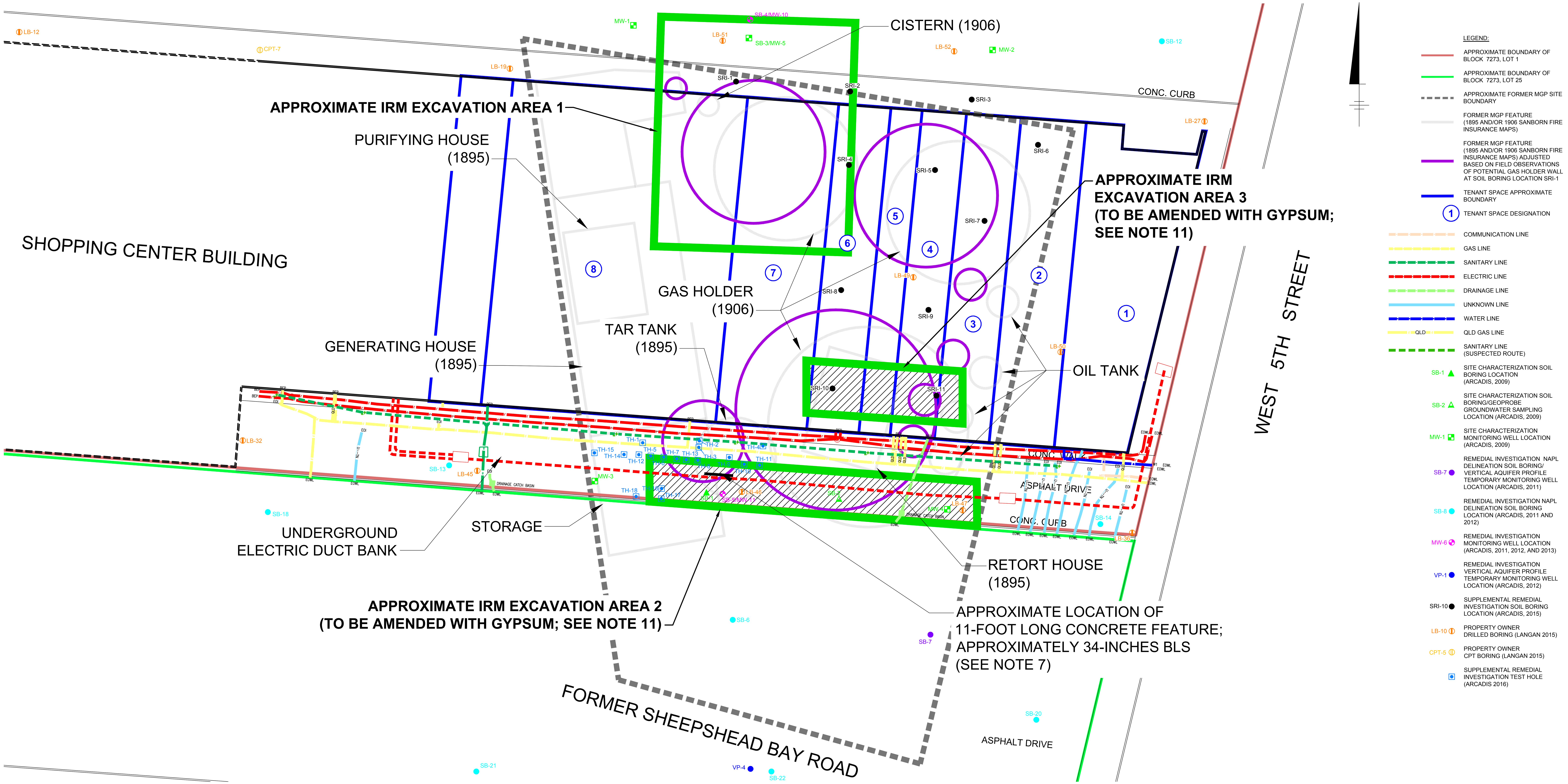
DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

PETROLEUM NAPL OBSERVATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE 7



0 20' 40'
APPROXIMATE SCALE IN FEET

NOTES:

1. MONITORING WELL, TEST HOLE, AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. UTILITY INFORMATION FROM CARDNO FIELD DRAFT DRAWING DATED MARCH 28, 2016; EXCEPT FOR THE APPROXIMATE LOCATION OF THE UNDERGROUND ELECTRIC DUCT BANK, WHICH IS FROM COSENTINI ASSOCIATES DRAWING DATED MARCH 1, 2016 (PROVIDED BY THE PROPERTY OWNER TO NATIONAL GRID).
5. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
6. THE PROPERTY OWNER DRILLED AND CPT BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.
7. THE CONCRETE FEATURE (e.g., POTENTIAL FOUNDATION) WAS OBSERVED ON APRIL 11, 2016 WITHIN A DEEPER SEGMENT OF THE TRENCH EXCAVATED BY PROPERTY OWNER DURING INSTALLATION OF THEIR UNDERGROUND ELECTRIC DUCT BANK. THE OBSERVED CONCRETE FEATURE IS LOCATED BELOW THE ELECTRIC DUCT BANK.
8. ALL UTILITY LOCATIONS ARE APPROXIMATE.
9. TENANT SPACES 2 THROUGH 6 ARE VACANT.
10. IRM EXCAVATION LIMITS TO BE DETERMINED DURING THE REMEDIAL DESIGN.
11. EXCAVATION BACKFILL TO BE AMENDED WITH GYPSUM TO PROVIDE A LONG-TERM, UPGRADIENT SOURCE OF SULFATE FOR ENGINEERED ANAEROBIC BIOLOGICAL OXIDATION IN-SITU TREATMENT.

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	VACANT 2016 (FORMER EASTERN CHINESE RESTAURANT)
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
IRM DESIGN WORK PLAN

EXCAVATION IRM

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8

APPENDIX A

Groundwater Modeling Memorandum

MEMO

Arcadis of New York, Inc.
Two Huntington Quadrangle
Suite 1S10
Melville
New York 11747
Tel 631 249 7600
Fax 631 249 7610

To:

Steven Feldman
Cathy Geraci

Copies:

File

From:

Robert Porsche
Jennifer Walberg

Date:

April 22, 2016

Arcadis Project No.:

B0036704.0001

Subject:

Groundwater Modeling
Former Dangman Park MGP Site
Brooklyn, New York

INTRODUCTION

The former Dangman Park Manufactured Gas Plant (MGP) Site (Site) is located at 486 Neptune Avenue, Brooklyn, New York (**Figure A-1**). The Site boundary for the purposes of this memo is the approximate former MGP boundary, which encompasses portions of two parcels (Block 7273, Lots 1 and 25) located along Neptune Avenue and W. 5th Street. The Site is subject to potential remedial action associated with the former Northwest Holder, Cistern and Tar Tank if one or more of these structures are present. Potential remedial actions include the excavation of non-aqueous phase liquid (NAPL)-impacted soils from these areas, which will likely require control of groundwater during excavation (i.e., dewatering of the excavation areas).

A site-specific groundwater model has been developed to evaluate potential dewatering scenarios to determine the likely pumping rates required to locally lower groundwater levels to facilitate potential excavation activities at the Site's former Northwest Holder and Tar Tank structures.

A site-specific groundwater flow model was developed following a review of available site-specific reports and maps (Smolensky et al, 1989; Cartwright, 2002; U.S. Geological Survey, 2015), which provided a basis for conceptualizing local and regional hydrogeology. Information from the U.S. Geological Survey (USGS) (2015) was used to help define surface water boundary (New York Bay, Gravesend Bay, and

Coney Island Creek) conditions (extent and elevation) in the model. Following model calibration, the sensitivity of model parameters was assessed, and finally, potential dewatering scenarios were evaluated.

CONCEPTUAL SITE MODEL

Coney Island is surrounded by water on all sides: New York Bay to the south, Gravesend Bay and Coney Island Creek to the west-northwest, and Sheepshead Bay to the east-northeast. In addition, a culvert was constructed (circa 1916) to maintain a connection between the east end of Coney Island Creek and Sheepshead Bay prior to covering over (i.e., filling) the former tidal inlet. Similar to Long Island, Coney Island is underlain by (in descending order) the Upper Glacial aquifer, Gardiners Clay unit, Magothy Aquifer, Raritan Clay unit, and Lloyd Aquifer.

From a regional perspective, Coney Island overlies a zone of regional groundwater discharge from the deeper aquifer units (Magothy Aquifer and Lloyd Aquifer) underlying Long Island (north of Coney Island). Regional groundwater flow in this area is to the south from Long Island, with groundwater from the Lloyd and Magothy aquifers moving laterally and vertically upward beneath Coney Island and discharging to New York Bay south of Coney Island's southern shore. However, because the Gardiners Clay confining unit restricts vertical flow between the Upper Glacial aquifer and the underlying Magothy aquifer, the groundwater flow in the Upper Glacial aquifer is essentially a groundwater subsystem where flow is governed by the surrounding surface water receiving bodies. As an island, the local potentiometric surface in the Upper Glacial aquifer is characterized by an east-west trending groundwater divide along the center of the island, and radial groundwater flow toward the surface water receiving bodies that surround the island.

The Site is located slightly west and north of the center of Coney Island. Water-level monitoring has revealed the presence of a groundwater divide south of the Site. In the Upper Glacial aquifer local groundwater flow in the vicinity of the Site is most strongly influenced by Coney Island Creek to the northwest, which is the receiving water body in closest proximity to the Site. As a result of the influence of Coney Island Creek as a groundwater discharge boundary, the groundwater flow direction in the vicinity of the Site is toward the north-northwest. South of the groundwater divide in the vicinity of the Site, the direction of groundwater flow is primarily to the south, discharging to New York Bay. The potentiometric surface in the Upper Glacial aquifer in the vicinity of the Site is characterized by a very flat horizontal hydraulic gradient.

MODEL CONSTRUCTION

For the construction and calibration of the numerical groundwater flow model at the Site, Arcadis selected the simulation program MODFLOW, a publicly-available groundwater flow simulation program developed by the USGS (McDonald and Harbaugh, 1988). MODFLOW is thoroughly documented, widely used by consultants, government agencies and researchers, and is consistently accepted by regulatory agencies. In addition, Arcadis has developed utilities for use with MODFLOW to facilitate the efficient construction and calibration of groundwater models.

The overall model domain consists of a total area of 152,000,000 square feet (ft^2; 3,500 acres; 5.45 square miles) with an active model domain of 88,227,625 ft^2 (2,200 acres; 3.16 square miles). The model extents are shown on **Figure A-2**. The model grid consists of a total of 1,922,376 grid cells and 1,512,936 active domain cells. The model consists of 12 layers; model layer thickness are presented in **Table A-1**.

Grid cell size ranges from 200 feet (ft) by 200 ft near the model boundaries to 10 ft by 10 ft in the area of interest (Site area).

The groundwater flow model has been constructed with the model bottom coincident with the top of the Gardiners Clay unit, a regionally extensive aquitard. Based on a limited number of local groundwater level observations, there is a vertically upward hydraulic gradient from the deeper portion of the Upper Glacial aquifer; which is consistent with the conceptualization of the vertically upward regional groundwater discharge from the Magothy Aquifer south of Coney Island. However, based on the CSM that the upward leakage from the Magothy Aquifer, through the Gardiners Clay unit, and into the Upper Glacial aquifer is a relatively small component of the overall mass balance, the model does not attempt to incorporate this observation.

Hydrologic Boundaries

Boundary conditions must be assigned to define the spatial boundaries of the model on all sides of the model grid. In addition to these boundary conditions, sources and sinks of groundwater such as wells or drains can be included in the model's boundaries. A boundary condition can represent different types of physical boundaries, depending on the rules that govern groundwater flow across the boundary. This model includes two types of boundary conditions: no flow, and recharge (i.e., constant flux boundary), and constant head, and drain (i.e., specified head boundary). The boundary conditions of the model are shown on **Figure A-2**.

The northern, western, and southern model boundaries are coincident with surface water features, Coney Island Creek, Gravesend Bay, and New York Bay, respectively. These natural boundaries are represented in the MODFLOW model using constant head and drain boundary cells. The portion of Coney Island Creek flowing in a culvert between Gravesend Bay and Sheepshead Bay (east of the active model domain) is represented using drain cells. The surface waters of Coney Island Creek, Gravesend Bay and New York Bay are represented using constant head cells (simulated in Model Layers 1 and 2 due to bathymetry depths [NOAA, 2016]) with water level elevations inferred from the Sandy Hook, New Jersey tidal station (station number 8531680). Inferred groundwater flow lines at the eastern model boundary are parallel to the boundary, and flow crossing the boundary is negligible in terms of the overall model mass balance. Therefore, this eastern boundary is represented as a no-flow boundary. Other than on-site dewatering withdrawals (during predictive model simulations), no other withdrawal of groundwater is known to occur within the limits of the model.

Hydraulic Parameters

Site-specific slug testing was conducted during the both the RI (Arcadis, 2014) and SRI (Arcadis, 2016) at eight discrete test locations across the Site. Pneumatic slug tests (PST) were conducted during the RI at temporary monitoring well locations VP-1 and VP-3 at depths ranging from 12 to 90 feet below ground surface (ft bgs), and solid slug tests were conducted during the SRI at monitoring wells MW-1, MW-2, MW-3, and MW-4 (screened from 6 -16 ft bgs), and monitoring wells MW-5 and MW-11 (screened from 30-40 ft bgs).

The slug test results indicated that hydraulic conductivity ranged from 20 to about 780 feet per day (ft/d). The reported hydraulic conductivity values are generally consistent with published values for glacial outwash, and the Upper Glacial aquifer (Fetter, 1988 and Smolensky, 1989).

In constructing the model for the Site, representative values for model parameters were selected from site-specific data and reports collected/prepared by Arcadis and regional reports developed by the USGS.

These model parameters included aquifer recharge and horizontal hydraulic conductivity of the shallow aquifer. The model was initially constructed using the hydraulic conductivity values derived from the PST and solid slug testing efforts described above. To account for the large range of values generated by the solid slug test data, the geometric mean (150 ft/d) was used to describe the “average” hydraulic conductivity, which is appropriate for data sets that reflect a log-normal distribution. During the calibration of the model, hydraulic conductivity zones were modified and parameter values were adjusted within reason to minimize the difference between observed and simulated groundwater elevations.

Assigned model parameters are summarized in **Table A-2**, and final horizontal hydraulic conductivity values range from 2.5 to 150 ft/d; anisotropy ratios vary from 25:1 to 100:1 (i.e., horizontal hydraulic conductivity ranges from 25 times to 100 times greater than vertical hydraulic conductivity) .

Areal recharge from precipitation that infiltrates to the water table was represented as a single recharge zone, with a value of 10.5 inches per year (in/yr). An areal recharge rate of 10.5 in/yr is equivalent to approximately 24 percent of the average annual precipitation rate of 45 inches per year recorded for the period of January 2000 through December 2015 (John F Kennedy International Airport, New York; NOAA Station ID: GHCND:USW00094789). Property zone limits and assigned values were estimated during calibration.

MODEL CALIBRATION/SENSITIVITY ANALYSIS

For best results, the calibration of a model should rely on discrete measurements (water levels) to produce results that are not biased by contouring interpretations. In the calibration of a groundwater flow model, use of point data eliminates the potential for interpretive bias that may result from attempting to match a contoured potentiometric surface (Konikow 1978; Anderson and Woessner 1992). The groundwater flow model for the Site was calibrated using 19 water-level calibration targets measured during March 2012 in monitoring wells distributed throughout the Site (**Table A-3**). This data set was chosen as calibration targets because it is a comprehensive set of water level measurements, and representative of recent groundwater conditions under non-pumping conditions.

As a further goal for the calibration of a model, the principle of parameter parsimony is applied to achieve an adequate calibration of the model through the use of the fewest number of model parameters. It should be noted that the use of greater numbers of model parameters during model calibration creates a situation in which many combinations of model parameter values produce similar calibration results. In this case, the model calibration parameters are called non-unique. Following the principle of parameter parsimony reduces the degree of non-uniqueness and results in more reliable calibrated parameter values. The information gathered for the conceptual site model (CSM) guides any decision to add model parameters (e.g., zones of hydraulic conductivity) to the model during the calibration process. Therefore, the simpler model is preferred.

The groundwater flow model calibration required numerous individual computer simulations. The values and shapes of the various parameter zones in the model were gradually varied until a reasonable solution was achieved that was in agreement with the CSM.

Calibration Results

The 19 water-level targets were used to evaluate the model calibration by analyzing the following: (1) simulated hydraulic head distributions across the Site and surrounding parcels, (2) residual statistics, and (3) sensitivity of estimated hydraulic parameters.

As a part of evaluating the numerical model calibration, simulated potentiometric surface maps were prepared for the entire modeled region to ensure that simulated groundwater flow patterns reasonably reproduced the CSM of the groundwater flow regime. A simulated local potentiometric surface map was prepared to depict groundwater flow conditions in the Upper Glacial aquifer in the vicinity of the Site (**Figures A-3 and A-4**).

From a qualitative perspective, the model reasonably simulates the direction of groundwater flow and accurately simulates the observed head distribution using hydraulic conductivity assignments that are consistent with site-specific studies. Additionally, the model was designed to incorporate representations of near-site natural hydrologic boundaries. Specifically, Coney Island Creek and New York Bay form the northern and southern boundaries of the model, respectively. Use of these boundaries produces a realistic head distribution and groundwater gradient across the Site.

From a quantitative perspective, the groundwater flow model calibration sought to minimize the residual sum of squares computed for the 19 water-level calibration targets. **Table A-3** lists the simulated water elevations and model residuals for each of the calibration targets. Model residuals are calculated by subtracting model-predicted water levels from the observed water levels at the target locations. When the model over-estimates water levels, the residual is negative; when the model underestimates water levels the residual is positive. Based on an evaluation of model statistics, the model meets standard calibration goals; model residuals are generally within about 10 percent of the observed head range (i.e., ±0.082 ft), and 74 percent of the target locations have residuals less than or equal to 0.164 ft (within 20 percent of the observed head range). Residual statistics for the calibrated groundwater flow model also indicate good agreement between simulated and measured groundwater elevations (**Table A-3**).

The residual mean was calculated to be 0.14 ft, and the residual standard deviation was calculated to be 0.195 ft. These statistics indicate that a high degree of calibration has been achieved in this modeling effort. Overall, the model shows a good match to the measured water levels at the Site.

A plot of observed versus simulated water levels for the calibrated model are attached as **Figure A-5**. Ideally (for a perfectly calibrated model), the plot of observed versus simulated water levels should be a straight line oriented at a 45-degree angle. For this model, the shallow observation points fit well (Model Layers 1, 2, and 6), and the deeper model layers (8, 9, and 10) exhibit a somewhat greater divergence, likely due to representation of the surface of the Gardiners Clay unit as an impermeable boundary. The CSM suggests that the Site is located above a regional groundwater discharge area and the observations suggest that there is some upward flux of groundwater from the Magothy aquifer, through the Gardiners Clay unit, and into the Upper Glacial aquifer. As configured, the model does not replicate upward flux through the Gardiners Clay unit. As a result, there is greater discrepancy between observed and simulated water levels in the deeper model layers when compared with the upper model layers.

The local maps of simulated hydraulic head (**Figures A-3 and A-4**) shows the spatial distribution of the residuals across the Site for model layers 1, 2, 6, 8, 9 and 10, representing the Upper Glacial Aquifer.

Sensitivity of Estimated Hydraulic Parameters and Boundary Conditions

A limited sensitivity analysis was conducted following model calibration. The sensitivity analysis evaluated the impact of adjustments to assigned values of hydraulic conductivity and recharge. The range of parameter adjustments and impact to calibration statistics are summarized in **Table A-4**.

Sensitivity to recharge was evaluated by adjusting the calibrated recharge rate ±10 percent. Sensitivity to hydraulic conductivity was evaluated via model-wide parameter adjustments of ±10 percent. When assessing hydraulic conductivity, the assigned anisotropy ratios were maintained; both horizontal and vertical hydraulic conductivity assignments were simultaneously adjusted.

The results of the sensitivity analysis infer that increases in recharge, and decreases in hydraulic conductivity may improve the model calibration (i.e., result in a lower sum squared residual, lower residual mean, and lower residual standard deviation than the calibrated model). However, to achieve this outcome, parameter values would be outside the range of reasonable values.

The calibrated recharge rate is 24 percent of average annual precipitation. Typical recharge rates in urbanized area range from 10 to 30 percent of average annual precipitation, with the percentage selected on the basis of land cover. That is, recharge rates are higher for less developed areas than for urban settings. The model's calibrated recharge rate is already at the upper bound of reasonable recharge rates for an urban setting. Similarly, the results of slug testing suggest that aquifer hydraulic conductivity may be higher than the range of simulated hydraulic conductivity. Therefore, reducing the simulated hydraulic conductivity to improve calibration statistics would require the use of parameter values which are inconsistent with field test results.

The sensitivity analysis suggests that the model calibration is reasonable, adjustment to the assigned parameters is not warranted, and the model is moderately sensitive to adjustments of the tested parameters within 10 percent of the calibrated value.

DEWATERING EVALUATION

To support remedial evaluations, dewatering simulations were performed to evaluate groundwater extraction rates associated with excavation of NAPL-impacted soils at two locations associated with the former MGP Site operations – the Northwest Holder and Tar Tank areas. The simulations evaluated potential excavation depths of 15, 20, and 25 feet below land surface. The dimensions of the excavation of the former Northwest Holder and Tar Tank areas were assumed to occur sequentially, rather than concurrently. Therefore, dewatering of the two areas were simulated as independent events.

The rate of groundwater extraction needed to lower and maintain groundwater levels beneath the proposed excavation bottoms was evaluated through transient model simulations. Drain cell invert elevations were specified approximately 5 ft below the bottom of the proposed excavations, and the model was used to evaluate both the pumping rate required to lower the groundwater level below the proposed excavation bottom, and the duration of groundwater extraction needed to achieve a steady pumping rate. Dewatering simulations were conducted over 30 day periods with a 1.2 multiplier on the time steps. A storativity value of 0.001 and specific yield of 0.15 were specified for the transient dewatering evaluations. For the purposes of this model, simulations of dewatering were performed by representing the excavation support system as interlocked sheet piles. **Table A-5** summarizes the configuration of each of the simulations with respect to the depth of the drain, depth, thickness and permeability of the simulated sheet-pile wall, and associated pumping rate required for dewatering. The simulated dimensions of the sheet pile wall for the former Northwest Holder and Tar Tank excavations are 70 ft by 70 ft and 50 ft by 50 ft, respectively. **Figures A-6 and A-7** show the water-level beneath and in the vicinity of the proposed excavation area for each of the configurations evaluated. The dewatering rates with respect to time are presented in **Figure A-8**. The groundwater elevation beneath each of the excavations after 10 days of simulated pumping for the former Northwest Holder (**Figure A-6**) are -6.90 ft, -11.40 ft, and -16.40 ft relative to the National Geodetic Vertical Datum of 1929 (NGVD 29) for dewatering depths of 15, 20, and 25 ft bgs, respectively. Although the dewatering rate varies over time (**Figure A-8**), the steady state dewatering rates required to maintain the groundwater level beneath the former Northwest Holder are 79 gallons per minute (gpm), 130 gpm, and 178 gpm for excavation depths of 15, 20, and 25 ft bgs, respectively. Similarly, the model predicted groundwater elevation after 10 days of simulated pumping for the former Tar Tank (**Figure A-7**) are -6.90 ft, -11.40 ft, and -16.40 ft relative to NGVD 29 for dewatering depths of 15, 20, and 25 ft bgs, respectively. Although the dewatering rate varies over time (**Figure A-8**), the steady state dewatering rates required to maintain the groundwater level beneath the Tar Tank excavation are 54 gpm, 90 gpm, and 128 gpm for dewatering depths of 15, 20, and 25 ft bgs, respectively.

SUMMARY AND CONCLUSIONS

A summary of the modeling approach and conclusions is provided below:

- The model is based on the CSM that the Gardiners Clay confining unit restricts vertical flow between the Upper Glacial aquifer and the underlying Magothy aquifer, the groundwater flow in the Upper Glacial aquifer is essentially a groundwater subsystem where flow is governed by the surrounding surface water receiving bodies.
- The groundwater flow model has been constructed with the model bottom coincident with the top of the Gardiners Clay unit. The northern, western, and southern model boundaries are coincident with surface water features, Coney Island Creek, Gravesend Bay, and New York Bay, respectively. These natural boundaries are represented in the MODFLOW model using constant head and drain boundary cells. The eastern boundary is represented as a no-flow boundary.
- Model input parameters were derived using representative values from site-specific data and reports collected/prepared by Arcadis and others. The model reasonably simulates the direction of groundwater flow and accurately simulates the observed head distribution using hydraulic conductivity assignments that are consistent with site-specific studies.
- The sensitivity analysis suggests that the model calibration is reasonable, adjustment to the assigned parameters is not warranted, and the model is moderately sensitive to adjustments of the tested parameters within 10 percent of the calibrated value.

A groundwater model was constructed to evaluate the pumping required to dewater two potential excavation areas, the Northwest Holder and Tar Tank areas at the Site. The model was used to evaluate the dewatering requirements associated with three proposed excavation depths at the two excavation areas. Results of the modeling effort demonstrate that reasonable steady-state dewatering rates can be achieved if the proposed excavation areas are bound by sheet-pile walls driven to approximately two times the proposed excavation depth, and groundwater is extracted from wells screened approximately 5 ft below the proposed excavation bottoms. Dewatering of the former Northwest Holder excavation can be maintained at steady-state pumping rates ranging from 79 to 178 gpm, and dewatering of the former Tar Tank excavation can be maintained at steady-state pumping rates ranging from 54 to 128 gpm. Variability of these pumping rates are dependent on the depth of the excavation. Transient simulations indicated that higher initial (early time) dewatering rates are necessary to achieve steady-state pumping conditions (i.e., within approximately two weeks).

REFERENCES

Anderson, M. P. and W. W. Woessner, 1992. *Applied Groundwater Modeling: Simulation of Flow and Advective Transport*, Academic Press, Inc., New York, 381 p.

Arcadis. 2011. Remedial Investigation Work Plan, Former Dangman Park Manufactured Gas Plant Site, Brooklyn, New York, Site No. 224047, Index # A2-0552-0606. September 2011.

Arcadis. 2016. Former Dangman Park Manufactured Gas Plant Site – Supplemental Remedial Investigation Work Plan, Brooklyn, New York, NYSDEC Site No. 224047, Index # A2-0552-0606. May 2016.

Cartwright, R.A., 2002. *History and Hydrologic Effects of Groundwater Use in Kings, Queens, and Western Nassau Counties, Long Island, New York, 1800's through 1997.* Water-Resources Investigations report 01-4096. U.S. Geological Survey. Coram, New York.

Fetter, C.W. 1988. Applied Hydrogeology, Second Edition. University of Wisconsin - Oshkosh.

Konikow, L., 1978. *Calibration of Groundwater Models*, in Proceedings of the Specialty Conferences on Verification of Mathematical and Physical Models in Hydraulic Engineering, College Park, Maryland, August 9-11, 1978.

McDonald, M. G., and A. W. Harbaugh, 1988. *A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model, Techniques of Water-Resources Investigations, Book 6, Chapter A1*. U. S. Geological Survey. Reston, Virginia.

National Oceanic and Atmospheric Administration (NOAA), 2016. Chart 12402- New York Lower Bay Northern Part.

Preliminary Examination for Breakwater at Sea Gate, Coney Island, N.Y. War Department, United States Engineer Office, Second District, New York, NY, December 8, 1916.

Smolensky, D.A., H.T. Buxton, P.K. Shernoff, 1989. *Hydrogeologic Framework of Long Island, New York*, Atlas HA-709

US Geological Survey, 2015. *The National Map.* Accessed April 19, 2015. http://viewer.nationalmap.gov/viewer/

TABLES

FIGURES

Table A-1
Summary of Model Structure
Former Dangman Park MGP Site
Brooklyn, New York

Model Layers	Top (ft NGVD 29)	Bottom (ft NGVD 29)	Top (ft bgs)	Bottom (ft bgs)	Thickness On-Site (ft)
1	8.6	-0.9	0	9.5	9.5
2	-0.9	-6.4	9.5	15	5.5
3	-6.4	-11.4	15	20	5
4	-11.4	-16.4	20	25	5
5	-16.4	-21.4	25	30	5
6	-21.4	-31.4	30	40	10
7	-31.4	-48.9	40	57.5	17.5
8	-48.9	-68.9	57.5	77.5	20
9	-68.9	-83.9	77.5	92.5	15
10	-83.9	-93.9	92.5	102.5	10
11	-93.9	-113.9	102.5	122.5	20
12	-113.9	-168.9	122.5	177.5	55

Abbreviations
ft NGVD 29 = feet National Geodetic Vertical Datum of 1929
ft bgs = feet below ground surface
ft = feet

Table A-2
Groundwater Flow Model Parameters
Former Dangman Park MGP Site
Brooklyn, New York

<table>
<tr><th rowspan="2">Model Layer</th><th colspan="3">Hydraulic Conductivity
(ft/day)</th><th colspan="2">Areal Recharge
(in/yr)</th><th colspan="2">Surface Water Elevation
(ft NGVD 29)</th></tr>
<tr><th>Observed Range</th><th>Modeled Value</th><th>Anisotropy Ratio</th><th>Anticipated Range</th><th>Modeled Value</th><th>Anticipated Range</th><th>Modeled Value</th></tr>
<tr><td>1</td><td rowspan="2">22 to 623</td><td>2.5</td><td>100:1</td><td>6.3 to 10.5</td><td>10.5</td><td>-0.2 to 0</td><td>0</td></tr>
<tr><td>2</td><td>150</td><td>75:1</td><td rowspan="11">NA</td><td rowspan="11">NA</td><td>-0.2 to 0</td><td>0</td></tr>
<tr><td>3</td><td rowspan="3">NM</td><td>150</td><td>75:1</td><td rowspan="10">NA</td><td rowspan="10">NA</td></tr>
<tr><td>4</td><td>150</td><td>75:1</td></tr>
<tr><td>5</td><td>75</td><td>50:1</td></tr>
<tr><td>6</td><td rowspan="2">14 to 778</td><td>75</td><td>50:1</td></tr>
<tr><td>7</td><td>50</td><td>25:1</td></tr>
<tr><td>8</td><td rowspan="2">67 to 89</td><td>50</td><td>25:1</td></tr>
<tr><td>9</td><td>50</td><td>50:1</td></tr>
<tr><td>10</td><td rowspan="3">NM</td><td>70</td><td>50:1</td></tr>
<tr><td>11</td><td>125</td><td>50:1</td></tr>
<tr><td>12</td><td>125</td><td>50:1</td></tr>
</table>

Abbreviations
ft NGVD 29 = feet National Geodetic Datum of 1929
ft/day = feet per day
in/yr = inches per year
NM = Not measured
NA = Not applicable

Table A-3
Calibration Targets and Calculated Results
Former Dangman Park MGP Site
Brooklyn, New York

ARCADIS Design & Consultancy for natural and built assets

Well ID	X (NY LI, NAD 83)	Y (NY LI, NAD 83)	Layer	Observed Groundwater Elevation (ft NGVD 29)	Simulated Groundwater Elevation (ft NGVD 29)	Residual (ft)
MW-6	991475.22	150044.25	1	2.28	1.72	0.56
MW-7	991847.97	150020.09	1	1.69	1.74	-0.06
MW-8	991366.54	149897.35	1	2.37	1.72	0.64
MW-9	991797.21	149594.39	1	1.80	1.74	0.06
MW-1	991752.16	150346.73	2	1.60	1.57	0.03
MW-2	991889.67	150337.3	2	1.63	1.58	0.05
MW-3	991737.39	150172.2	2	1.56	1.58	-0.03
MW-4	991872.29	150161.41	2	1.57	1.59	-0.02
MW-15	991734.85	150464.17	2	1.63	1.55	0.07
MW-5	991796.37	150341.86	6	1.60	1.55	0.05
MW-11	991786.28	150167.3	6	1.56	1.56	0.00
MW-12	991847.97	149963.12	6	1.57	1.57	0.00
MW-16	991741.44	150463.17	6	1.63	1.53	0.09
MW-19	991561.34	150400.83	8	1.55	1.50	0.05
MW-13	991613.68	150463.66	9	1.70	1.48	0.21
MW-14	991673.15	150463.23	9	1.62	1.49	0.13
MW-18	991792.15	150459.26	9	1.64	1.50	0.14
MW-10	991796.81	150348.94	10	1.89	1.49	0.39
MW-17	991740.87	150456.09	10	1.84	1.48	0.35

Model Statistics	
Residual Mean (ft)	0.14
Residual Standard Deviation (ft)	0.20
Range in Observed Groundwater Levels (ft)	0.82
Residual Sum of Squares (ft^2)	1.11

Abbreviations
NY LI, NAD 83 = New York Long Island, North American Datum of 1983
ft NGVD 29 = feet National Geodetic Vertical Datum of 1929
ft = feet
ft^2 = square feet

Table A-4
Groundwater Model Sensitivity Analysis
Former Dangman Park MGP Site
Brooklyn, New York

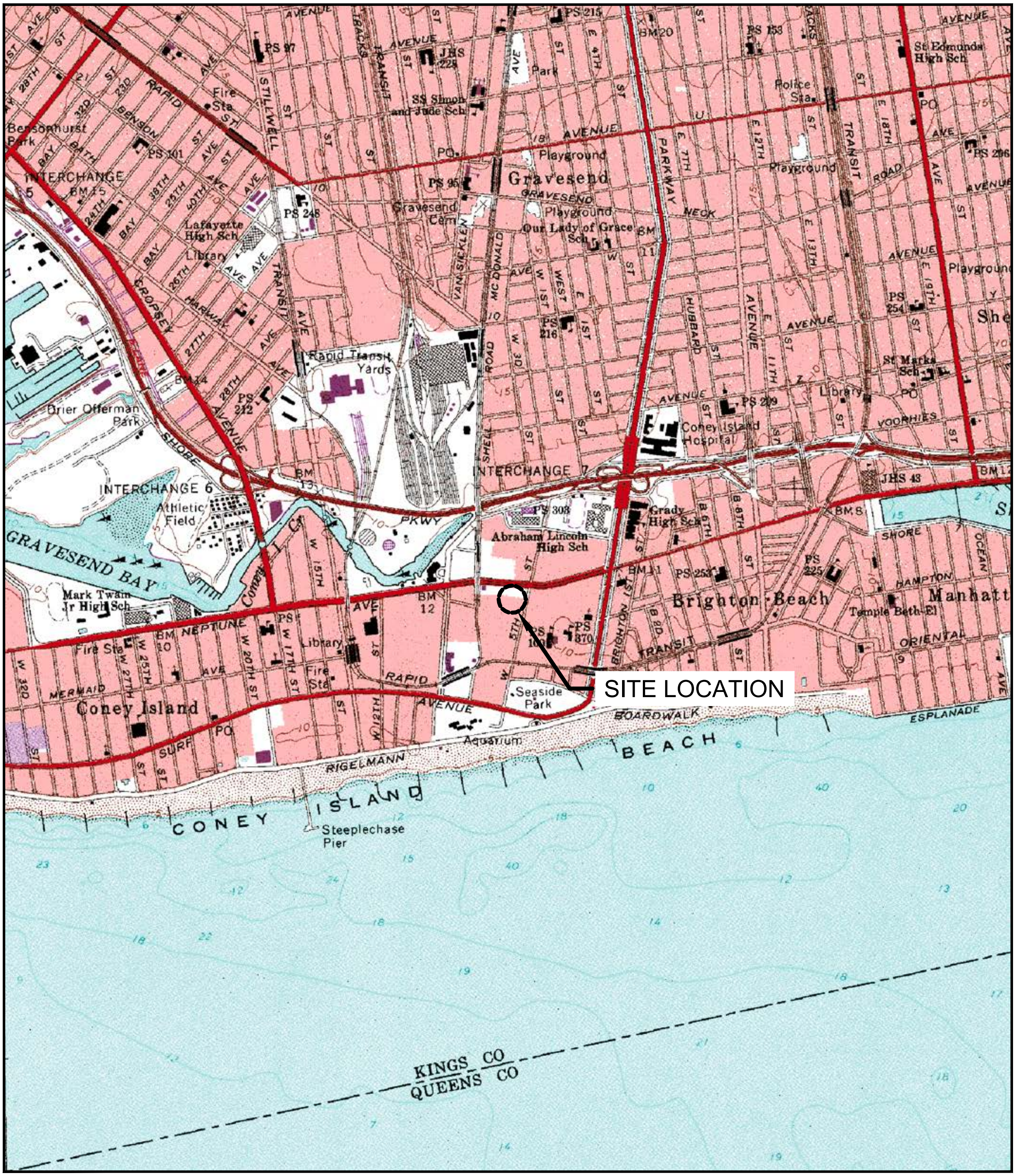
Sensitivity Model Run	Parameter Range			Sum Squared Residual (SSR) (ft^2)			Residual Mean (ft)			Residual Standard Deviation (ft)		
	Low	Baseline	High	Low	Baseline	High	Low	Baseline	High	Low	Baseline	High
Recharge	10% Decrease	0% Change	10% Increase	1.11	1.11	0.88	0.14	0.14	0.09	0.20	0.20	0.19
Hydraulic Conductivity	10% Decrease	0% Change	10% Increase	0.87	1.11	1.39	0.09	0.14	0.19	0.19	0.20	0.20

Abbreviations
ft = feet
ft^2 = square feet

Table A-5
Summary of Dewatering Response
Former Dangman Park MGP Site
Brooklyn, New York

Potential Scenario	Assumed Excavation Depth (ft bgs)	Assumed Drain Depth (ft bgs)	Assumed Hydraulic Conductivity of Sheet Pile (cm/sec)	Assumed Thickness of Sheet Pile (in)	Assumed Sheet Pile Depth (ft bgs)	Potential Former Northwest Holder Excavation-Average Dewatering Rates (gpm)			Potential Former Tar Tank Excavation- Average Dewatering Rates (gpm)		
						5 day	10 day	Steady State	5 day	10 day	Steady State
1	15	20	1.00E-05	0.5	30	85	84	79	56	56	54
2	20	25	1.00E-05	0.5	40	139	137	131	94	93	90
3	25	30	1.00E-05	0.5	50	185	183	178	132	131	128

Abbreviations
ft bgs = feet below ground surface
cm/sec = centimeters per second
in = inches
gpm = gallons per minute



MAP SOURCE: USGS 7.5 MINUTE QUADRANGLE CONEY ISLAND, NEW YORK–NEW JERSEY, 1979

0 2000' 4000'

APPROXIMATE SCALE IN FEET

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK

GROUNDWATER FLOW MODEL

SITE LOCATION

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FIGURE

A-1

CITY:MELVILLE-NY DIV/GROUP:ENR1 DB:ALS LD: PIC:JN PM:SF TM:CK LYR:ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\B0036704\0001\00414\B36704_1_414 A01.dwg LAYOUT: 1 SAVED: 2/24/2014 10:43 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: PDF-LTR PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/2/2014 1:14 PM BY: SANCHEZ, ADRIAN
XREFS: IMAGES: PROJECTNAME: B0036704.0000.00001
CONEY ISLAND.TIF

LEGEND

CONSTANT HEAD BOUNDARY CELL

NO FLOW BOUNDARY CELL

DRAIN CELL

*Drain cells are only in model layer 1. Constant head boundary cells are only in model layers 1 and 2.

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
GROUNDWATER FLOW MODEL

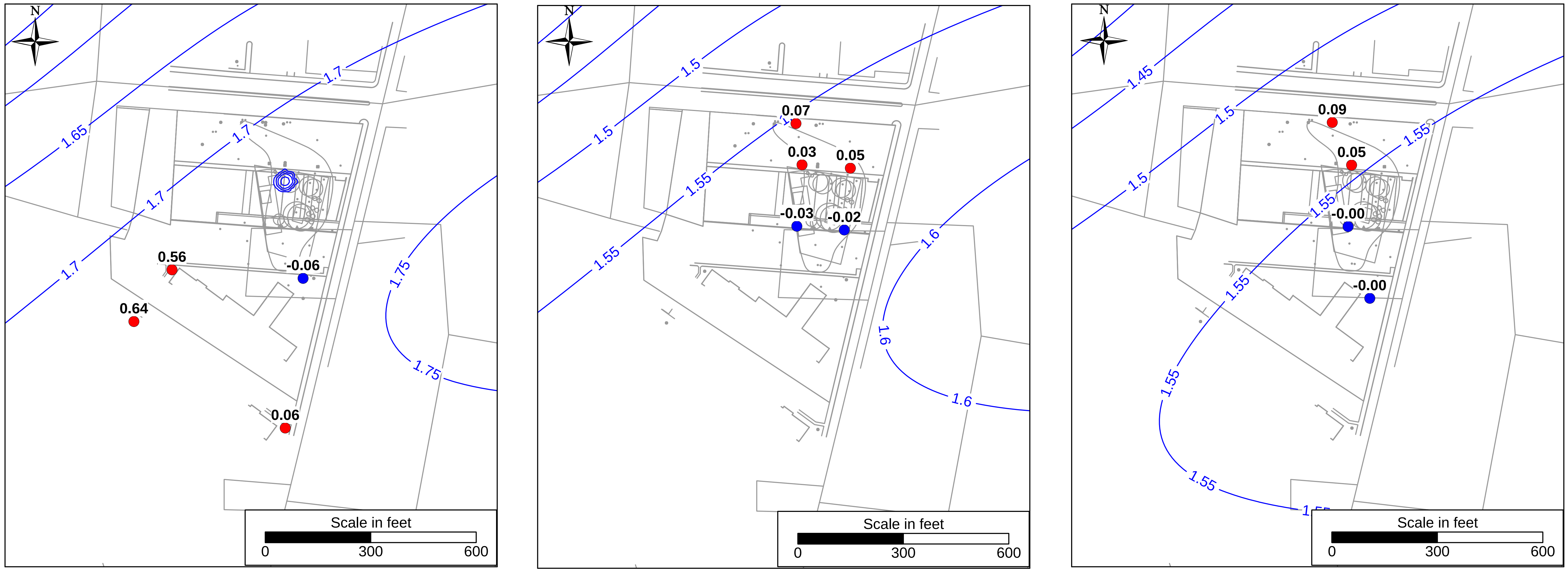
MODEL DOMAIN AND BOUNDARY CONDITIONS - MODEL LAYER 1

ARCADIS Design & Consultancy for natural and built assets

FIGURE

A-2

MODEL LAYER 1 | MODEL LAYER 2 | MODEL LAYER 6



LEGEND

–1.7– SIMULATED GROUNDWATER ELEVATION (ft, NGVD 29; contour interval = 0.05 ft)

-0.05 RESIDUAL LESS THAN ZERO
(ft; Residual = Observed Groundwater Elevation - Simulated Groundwater Elevation)

0.05 RESIDUAL GREATER THAN ZERO (ft)

Abbreviations

ft = feet

ft NGVD 29 = feet National Geodetic Vertical Datum of 1929

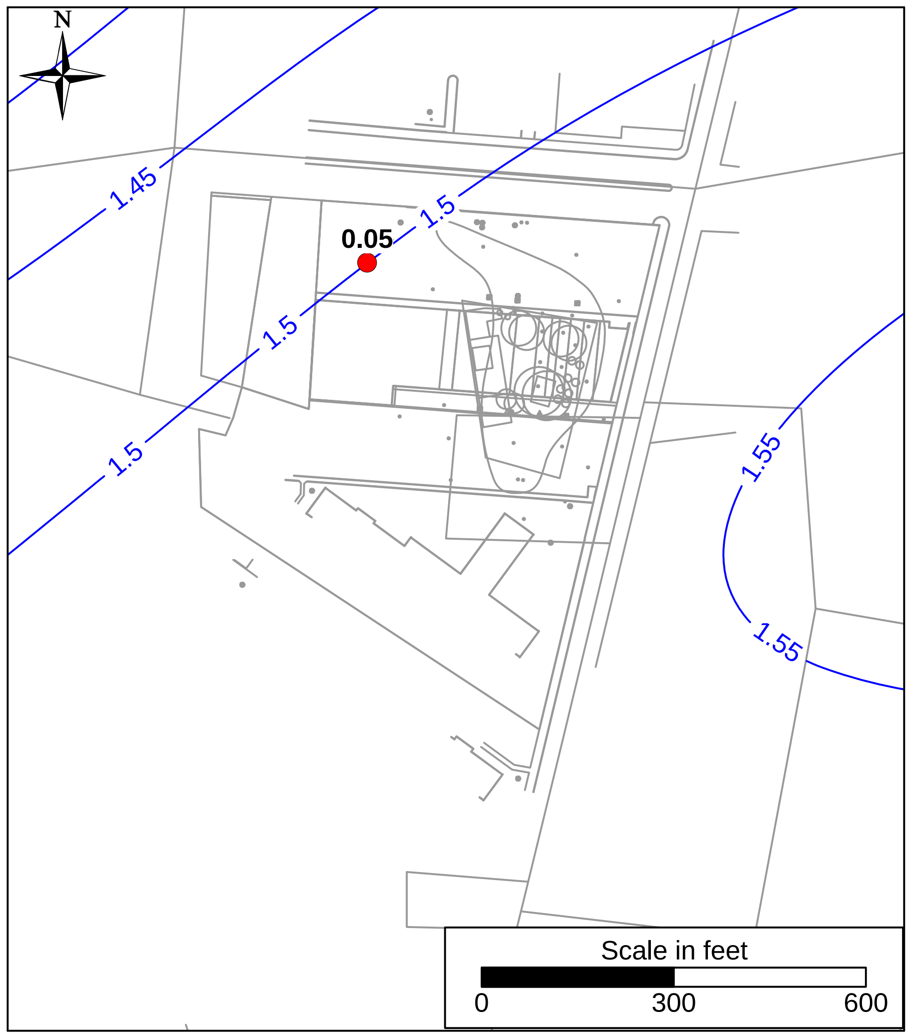
NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
GROUNDWATER FLOW MODEL

SIMULATED POTENTIOMETRIC SURFACE IN UPPER GLACIAL AQUIFER, MODEL LAYERS 1, 2, AND 6

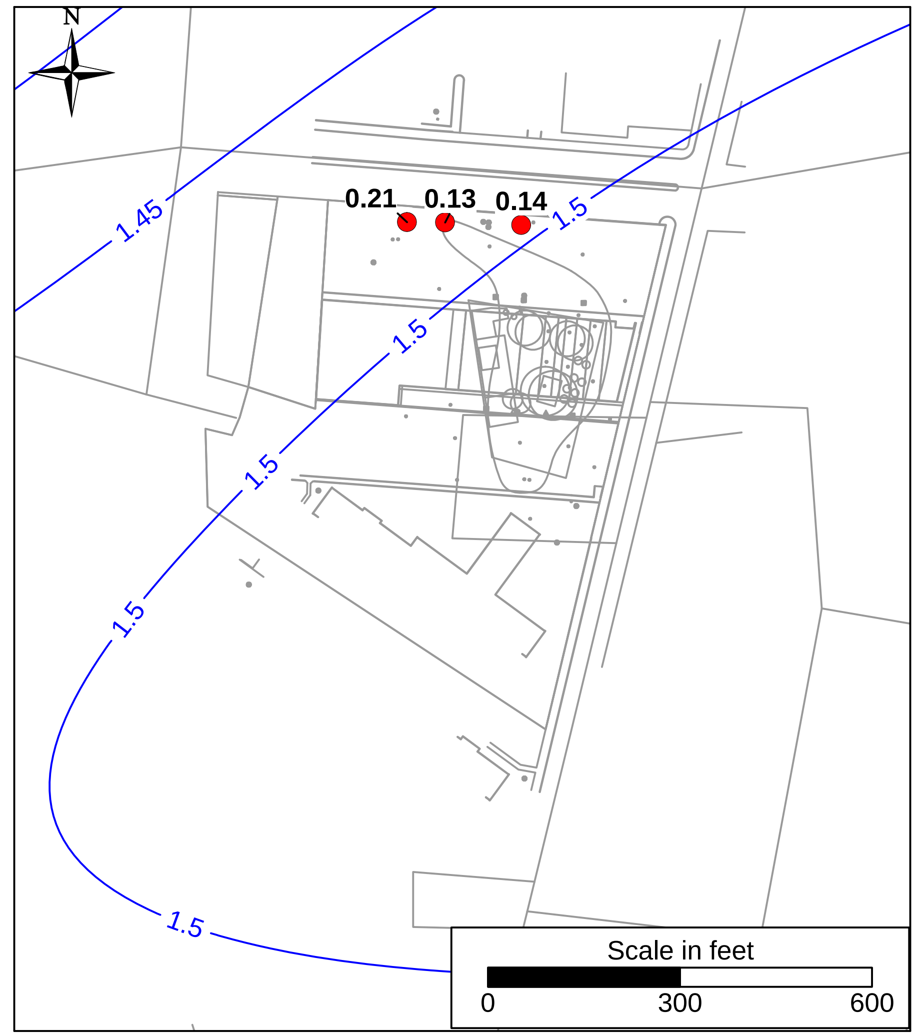
ARCADIS Design & Consultancy for natural and built assets

FIGURE A-3

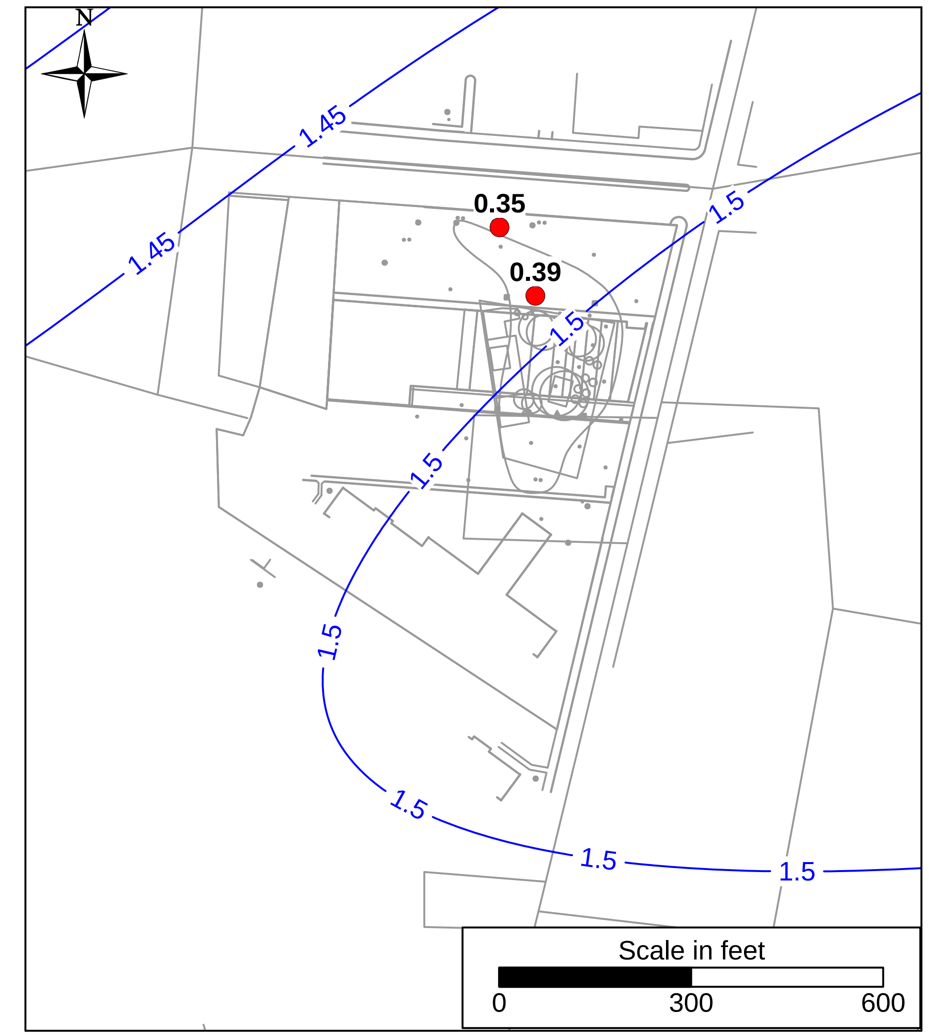
MODEL LAYER 8



MODEL LAYER 9



MODEL LAYER 10



LEGEND

–1.7– SIMULATED GROUNDWATER ELEVATION (ft, NGVD 29; contour interval = 0.05 ft)

-0.05 RESIDUAL LESS THAN ZERO
(ft; Residual = Observed Groundwater Elevation - Simulated Groundwater Elevation)

0.05 RESIDUAL GREATER THAN ZERO (ft)

Abbreviations

ft = feet

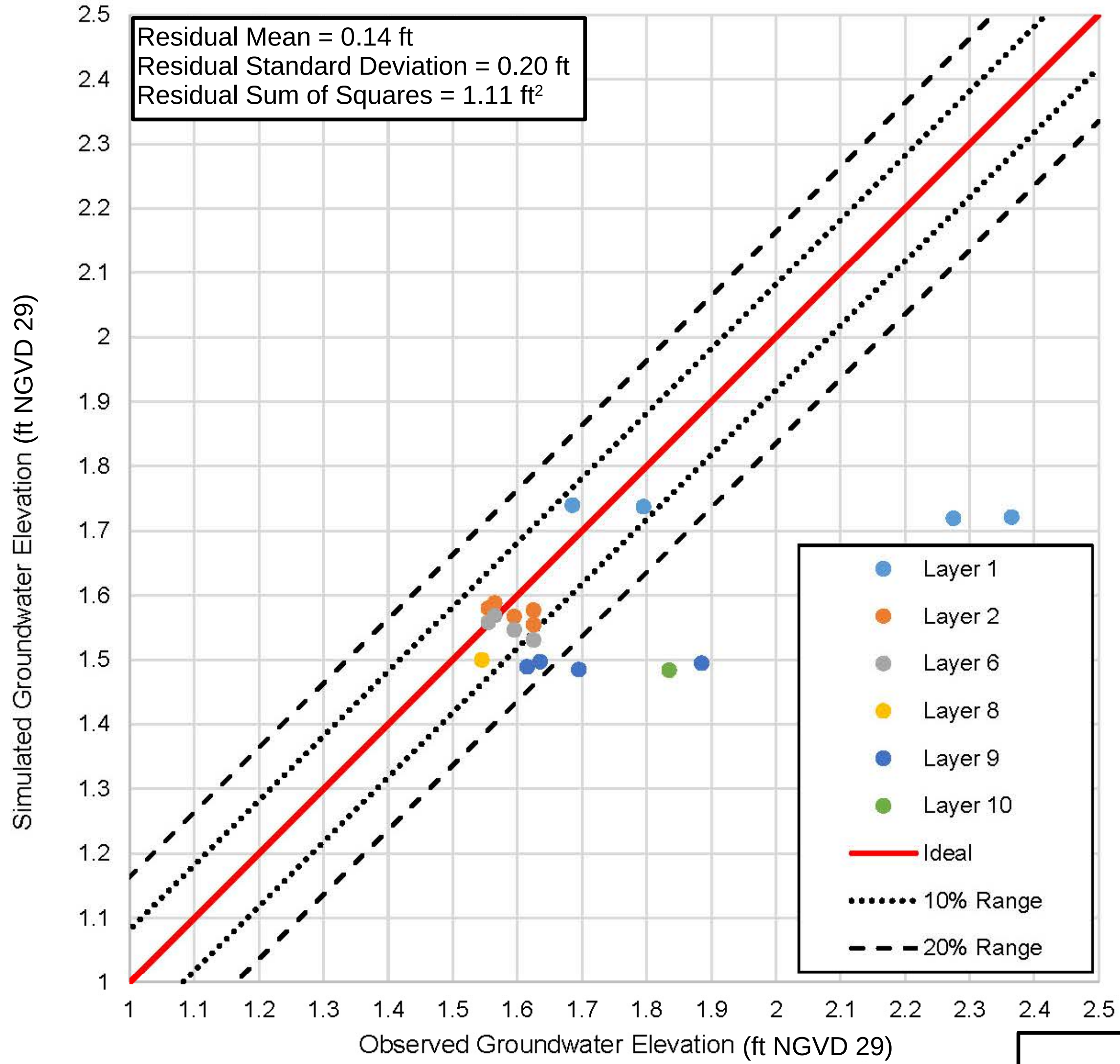
ft NGVD 29 = feet National Geodetic Vertical Datum of 1929

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
GROUNDWATER FLOW MODEL

SIMULATED POTENTIOMETRIC SURFACE IN UPPER GLACIAL AQUIFER, MODEL LAYERS 8, 9, AND 10

ARCADIS Design & Consultancy for natural and built assets

FIGURE
A-4



NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
GROUNDWATER FLOW MODEL

OBSERVED VERSUS SIMULATED GROUNDWATER LEVELS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
A-5

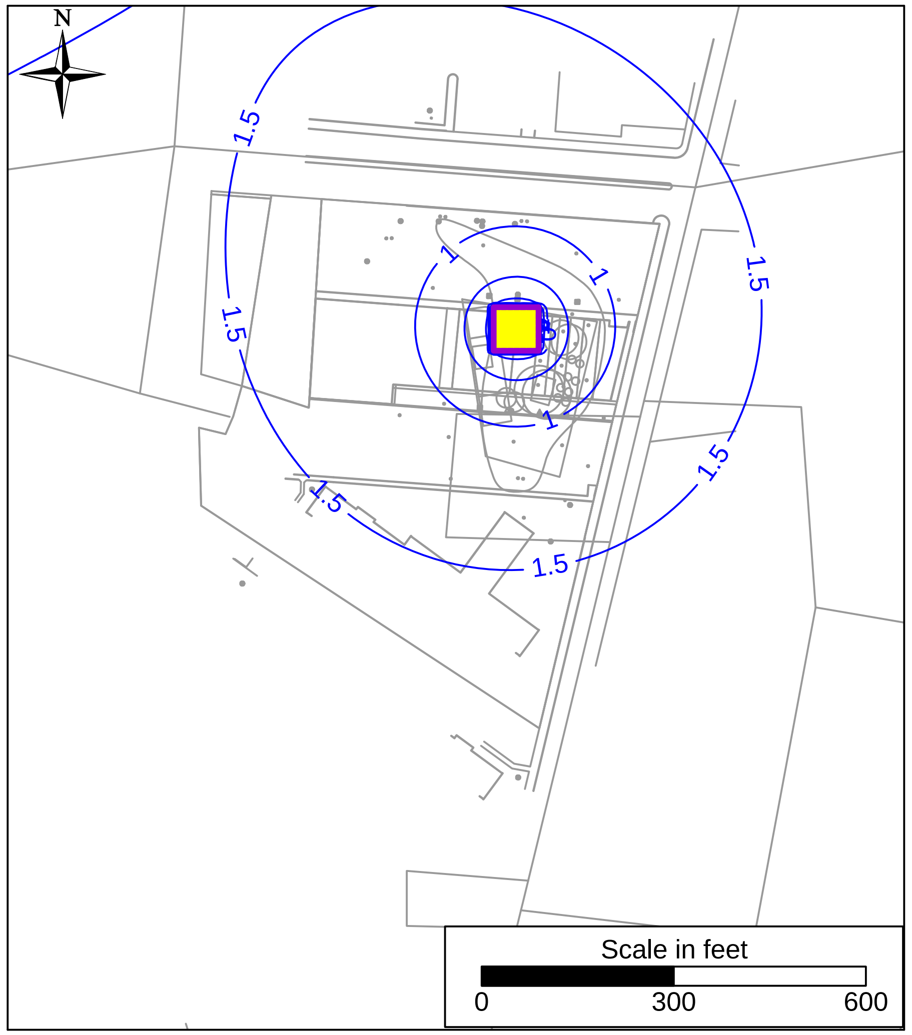
Abbreviations

ft = feet

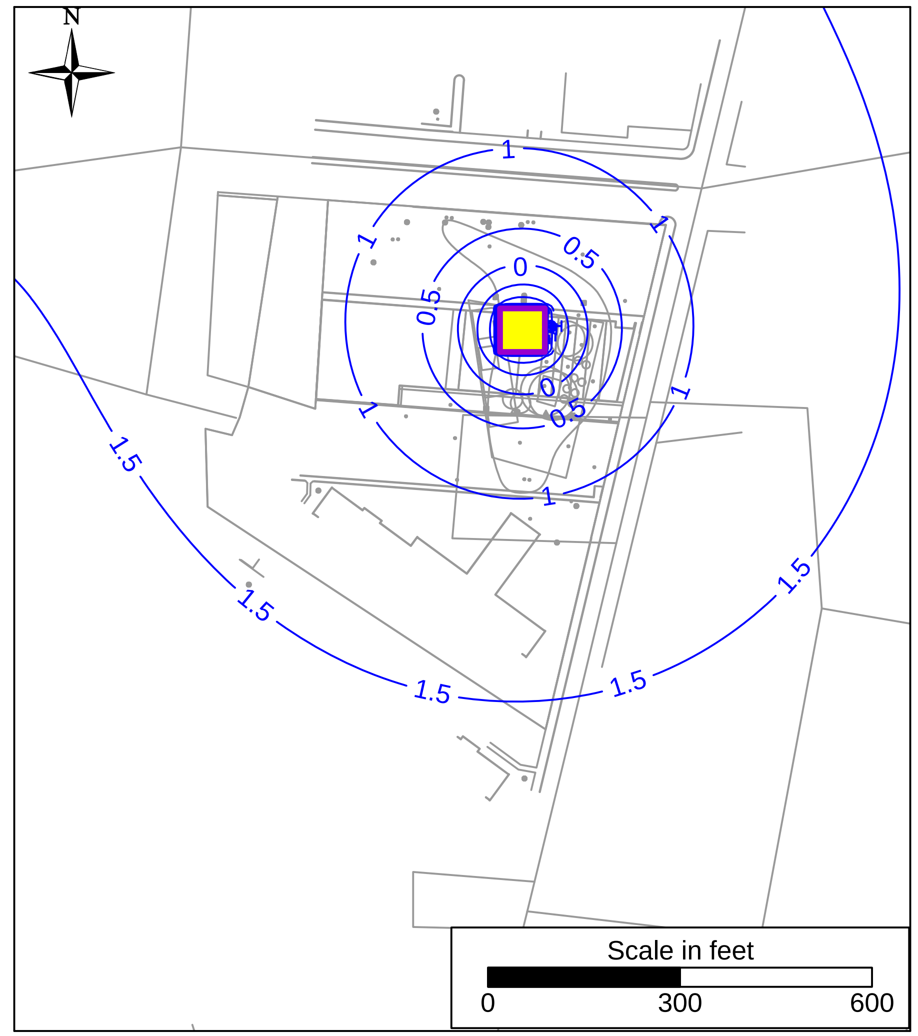
ft^2 = square feet

ft NGVD 29 = feet National Geodetic Vertical Datum of 1929

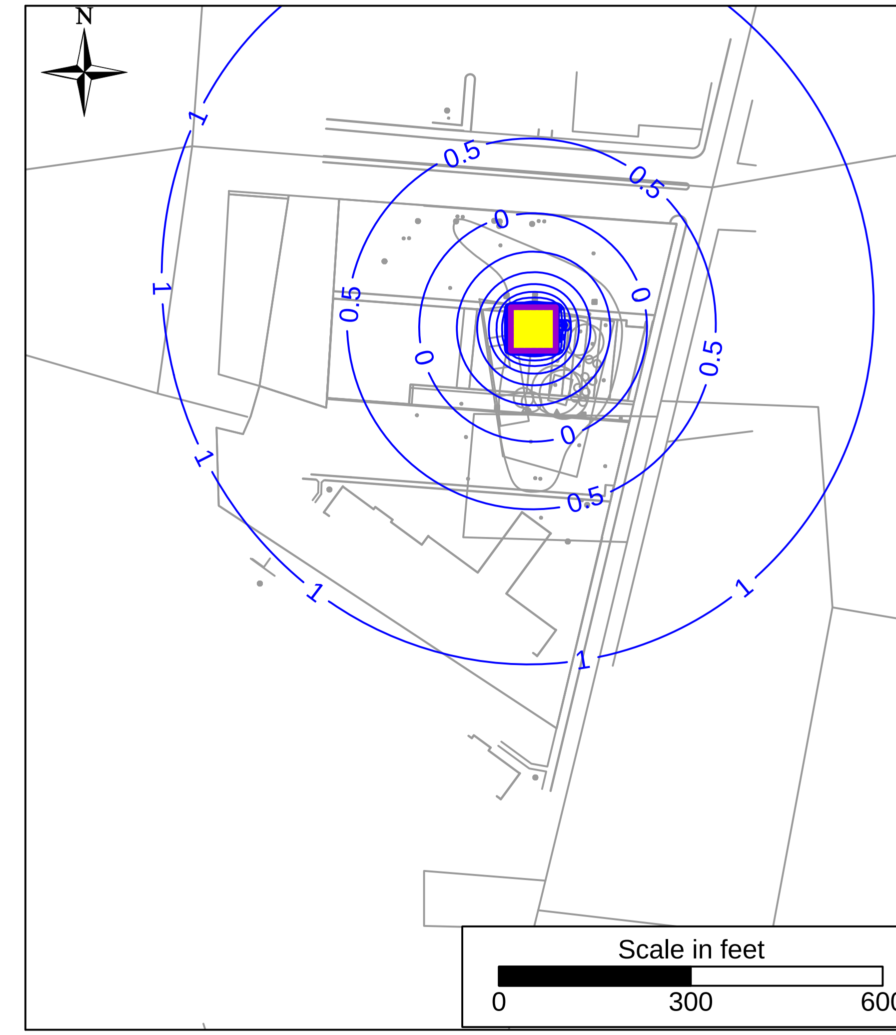
EXCAVATION DEPTH
15 FEET BELOW GROUND SURFACE



EXCAVATION DEPTH
20 FEET BELOW GROUND SURFACE



EXCAVATION DEPTH
25 FEET BELOW GROUND SURFACE



LEGEND

-1.5- SIMULATED GROUNDWATER ELEVATION (ft, NGVD 29)
(Contour interval = 0.5 ft)

SIMULATED DRAIN

HYDRAULIC FLOW BARRIER
(Hydraulic conductivity = 1.00E-05 cm/s; 0.028 ft/day; thickness = 0.5 in)

Abbreviations

ft = feet

ft NGVD 29 = feet National Geodetic Vertical Datum of 1929

cm/s = centimeters per second

ft/day = feet per day

in = inches

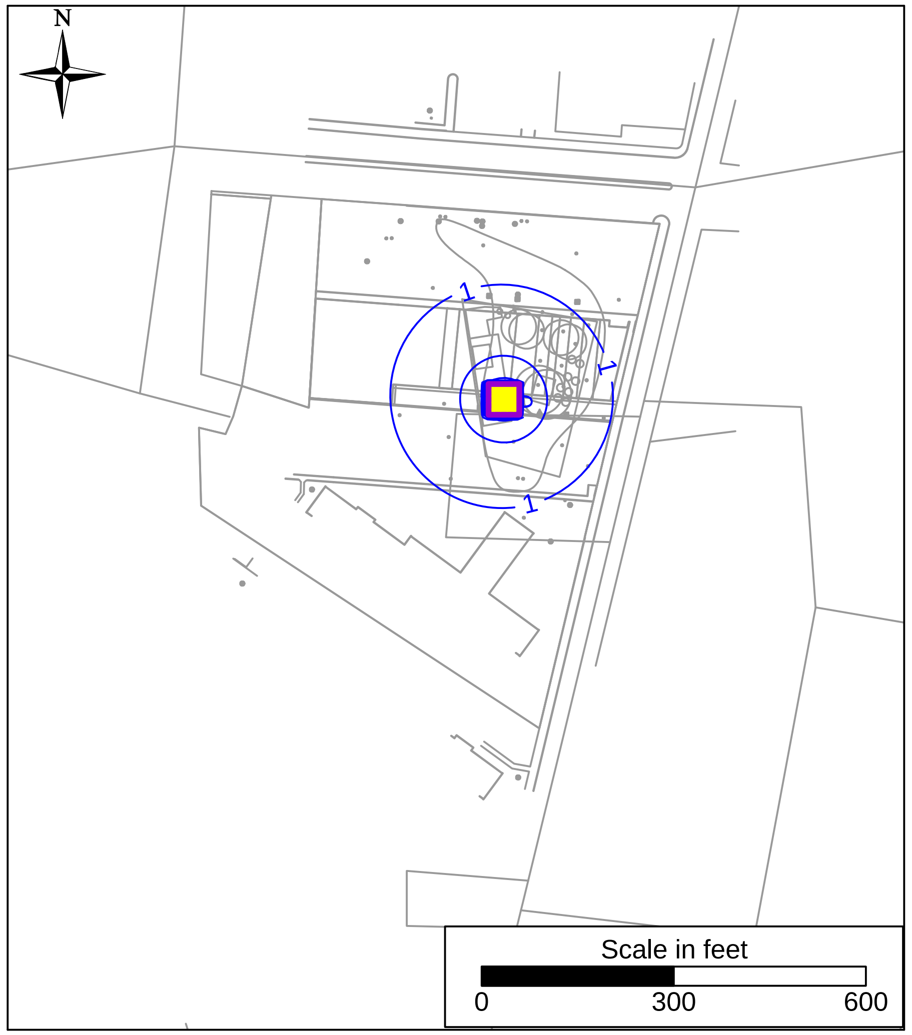
NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
GROUNDWATER FLOW MODEL

SIMULATED DEWATERING RESPONSE AFTER 10 DAYS, POTENTIAL EXCAVATION AT THE FORMER NORTHWEST HOLDER

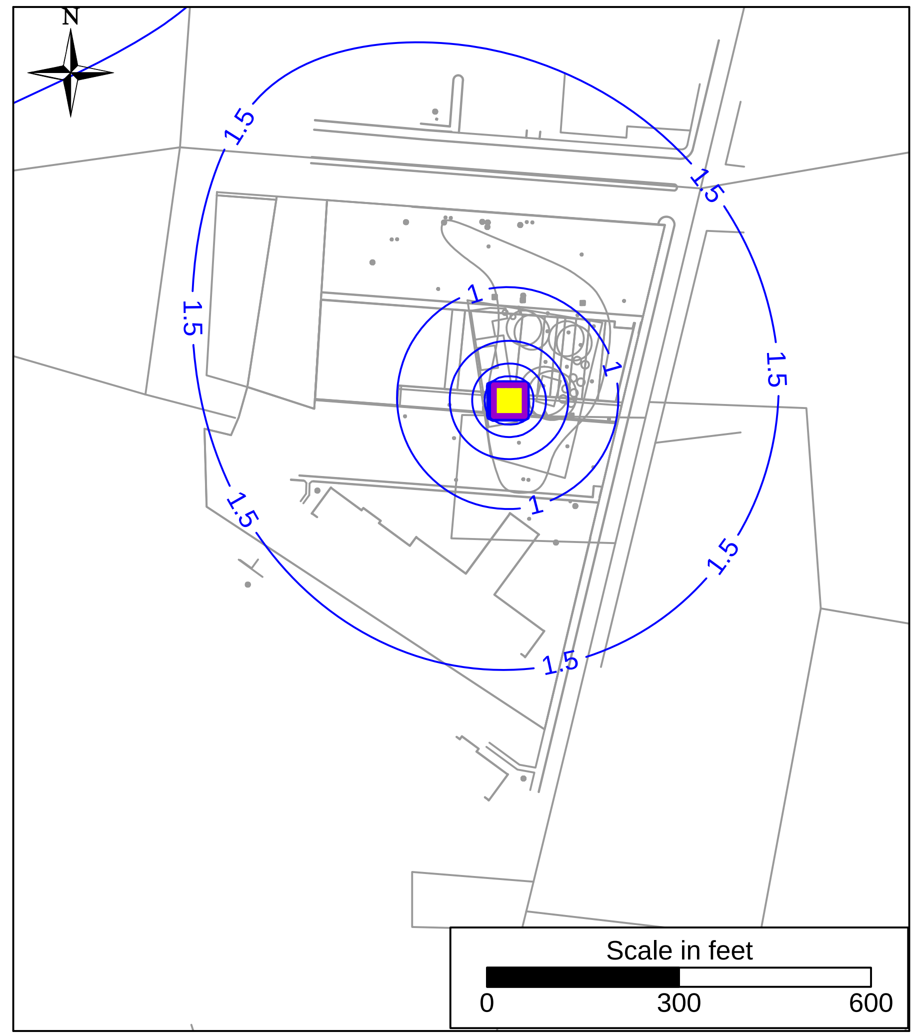
ARCADIS Design & Consultancy for natural and built assets

FIGURE
A-6

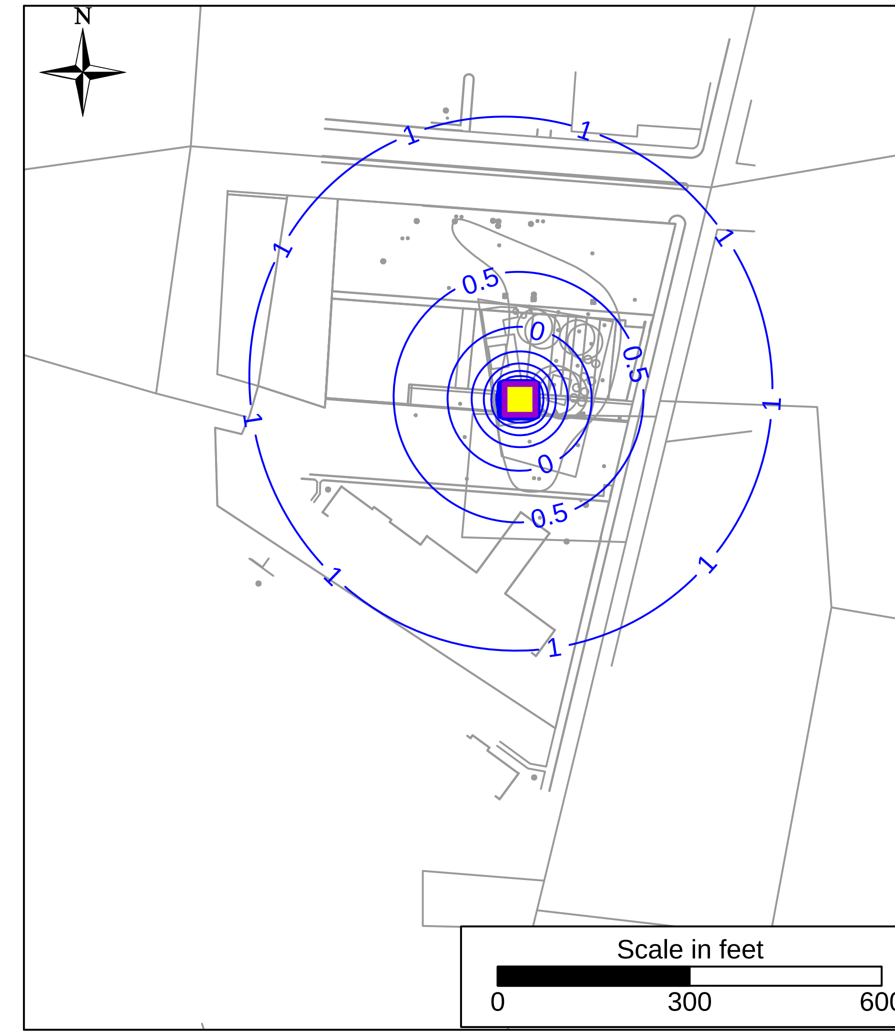
EXCAVATION DEPTH
15 FEET BELOW GROUND SURFACE



EXCAVATION DEPTH
20 FEET BELOW GROUND SURFACE



EXCAVATION DEPTH
25 FEET BELOW GROUND SURFACE



LEGEND

–1.5– SIMULATED GROUNDWATER ELEVATION (ft, NGVD 29)
(Contour interval = 0.5 ft)

SIMULATED DRAIN

HYDRAULIC FLOW BARRIER
(Hydraulic conductivity = 1.00E-05 cm/s; 0.028 ft/day; thickness = 0.5 in)

Abbreviations

ft = feet

ft NGVD 29 = feet National Geodetic Vertical Datum of 1929

cm/s = centimeters per second

ft/day = feet per day

in = inches

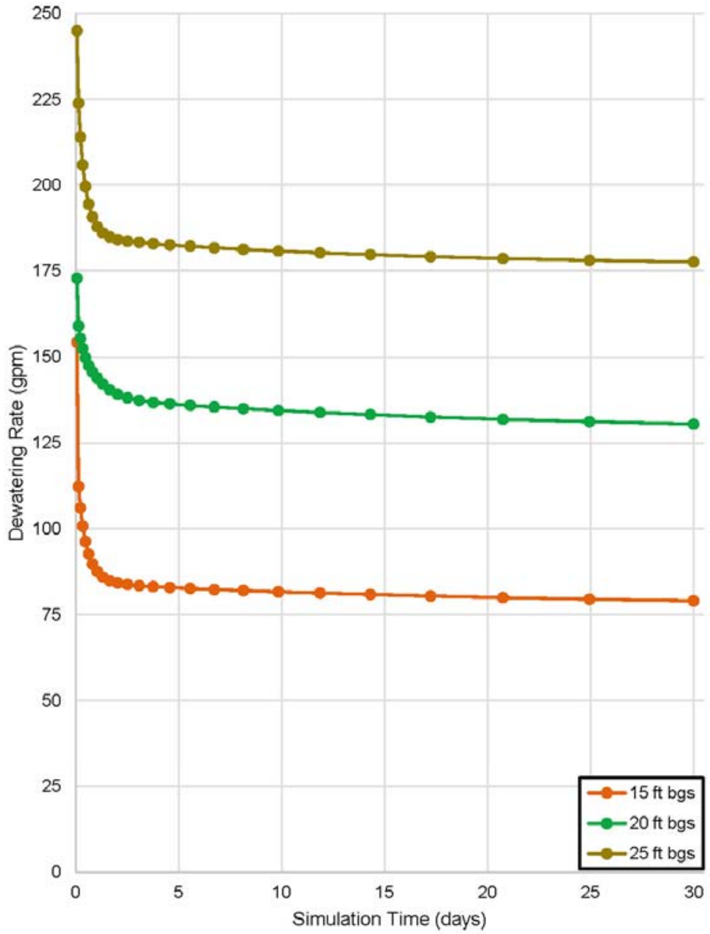
NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
GROUNDWATER FLOW MODEL

SIMULATED DEWATERING RESPONSE
AFTER 10 DAYS, POTENTIAL EXCAVATION AT
THE FORMER TAR TANK

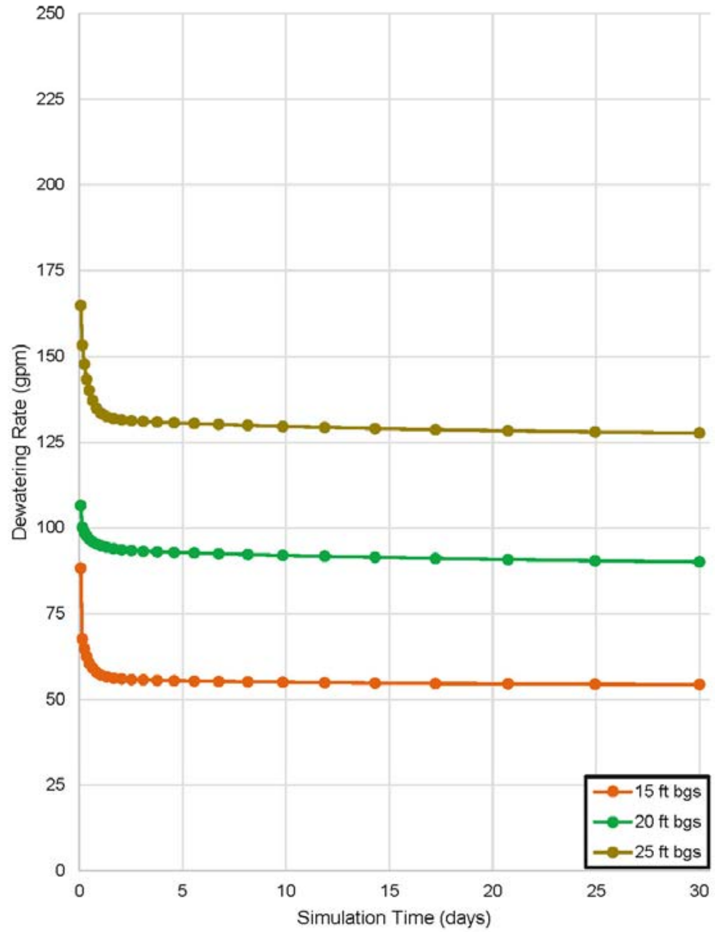
ARCADIS Design & Consultancy for natural and built assets

FIGURE
A-7

Potential Former Northwest Holder Excavation



Potential Former Tar Tank Excavation



Abbreviations

gpm = gallons per minute

ft bgs = feet below ground surface

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
GROUNDWATER FLOW MODEL

SIMULATED DEWATERING RATES OVER TIME

ARCADIS Design & Consultancy for natural and built assets

FIGURE
A-8

APPENDIX B

Project Correspondence

Katherine Vater
Project Manager
Site Investigation and Remediation

June 6, 2016

Mr. William Wu
Environmental Engineer
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau C, 11th Floor
625 Broadway
Albany, NY 12233

Re: Former Dangman Park Manufactured Gas Plant Site - Property Redevelopment
Supplemental Remedial Investigation Activities - Back Alley
Brooklyn, New York
NYSDEC Site No. 224047
Index # A2-0552-0606

Dear Mr. Wu:

This letter transmits documentation of the recently completed Supplemental Remedial Investigation (SRI) field activities and the proposed scope for additional SRI soil borings and test holes in the back alley of Block 7273, Lot 1R that traverses the former Dangman Park Manufactured Gas Plant (MGP) Site (the Site). We are also evaluating the need for test pits, consistent with the New York State Department of Environmental Conservation's (NYSDEC's) September 15, 2015 letter providing approval with modifications to the September 2015 SRI Work Plan.

We anticipate conducting the additional SRI field work in early to mid-June 2016, after receiving the NYSDEC's approval of this letter and agreement from the Owner to access the property. The additional field work is expected to take two days. I will notify you at least 7 days in advance of the scheduled date for commencement of the field activities.

If you have any questions or require any additional information, please contact me at (608) 826-3663 or at katherine.vater@nationalgrid.com.

Sincerely,

Katherine Vater
Project Manager

Enclosure - Supplemental Remedial Investigation Activities - Back Alley (Arcadis, 2016)

cc: Albert DeMarco, NYSDOH
Linda Sullivan, Esq., National Grid
Bonnie Barnett, Esq., Drinker Biddle and Reath LLP
Megan Miller, P.E., Arcadis
M. Cathy Geraci, Arcadis

Ms. Katherine Vater
Project Manager
National Grid
287 Maspeth Avenue
Brooklyn, New York 11211

Arcadis of New York, Inc.
5723 Towpath Road
PO Box 66
Syracuse
New York 13214-0066
Phone 315 446 9120
Fax 315 449 0017
www.arcadis.com

ENVIRONMENT

Subject:
Former Dangman Park Manufactured Gas Plant Site - Property Redevelopment
Supplemental Remedial Investigation Activities - Back Alley
Brooklyn, New York
NYSDEC Site No. 224047
Index # A2-0552-0606

Date:
June 6, 2016

Contact:
Megan A. Miller, P.E.

Phone:
315.671.9422

Email:
Megan.Miller@arcadis.com

Our ref:
B0036704.0001

Dear Ms. Vater:

This letter documents the recent Supplemental Remedial Investigation (SRI) field activities and presents the proposed plan for additional soil borings and test holes in the back alley of Block 7273, Lot 1R that traverses the former Dangman Park Manufactured Gas Plant (MGP) Site (the Site). Arcadis is conducting the SRI on behalf of National Grid. Specifically, this letter presents the following:

- A description of the test holes that were advanced in the back alley between May 2 and May 5, 2016, and the associated findings.

- A proposed plan for additional SRI soil borings and test holes in the back alley to further evaluate if the tar tank is present and contains non-aqueous phase liquid (NAPL). This information is required in an effort to determine the scope of the Interim Remedial Measure (IRM) for the Site that was discussed during the April 8, 2016 meeting between National Grid, the New York State Department of Environmental Conservation (NYSDEC), and the Lot 1R Property Owner (532 Neptune Associates LLC; Owner) and was described in the Draft IRM Design Work Plan submitted to the NYSDEC on May 11, 2016.

DESCRIPTION OF SRI TEST HOLE ACTIVITIES AND SUMMARY OF FINDINGS

Eighteen (18) SRI test holes (TH-1 through TH-18) were advanced in the back alley between May 2 and May 5, 2016, in accordance with National Grid's April 20, 2016 letter that the NYSDEC reviewed (April 22, 2016 email from William Wu, NYSDEC to Katherine Vater, National Grid). The test holes were advanced by Arcadis' subcontractor, ZEBRA Technical Services, LLC (a wholly-owned subsidiary of Cascade Drilling, L.P.; Zebra) using a Vacmasters unit (vacuum excavation) and manual methods (e.g., hand augering). The test holes were approximately 1 foot in diameter and ranged in depth from approximately 1.5 feet below land surface (ft bls) to 9.5 ft bls, depending on the objective of the test hole and subsurface conditions encountered (e.g., refusal and presence of groundwater beginning at approximately 6.5 ft bls). The objectives of the test holes were to daylight certain utilities (i.e., gas and sanitary sewer lines) at specific points and further investigate the former MGP tar tank footprint in the back alley.

Test hole findings were documented in the field by Arcadis and the NYSDEC (William Wu) was on site to observe a portion of the field work. During all intrusive test hole field work, Arcadis conducted community air monitoring in accordance with the project-specific Community Air Monitoring Plan (CAMP) and the results were presented in Arcadis' May 6, 2016 letter to National Grid (copy provided as Attachment 1); there were no exceedances of action levels.

A summary of the test holes and associated findings is provided in the following subsections. The attached site plan (Figure 1) shows the approximate locations of the test holes; the actual locations were recently surveyed by Arcadis' subcontractor, Nelson & Pope, Engineers and Surveyors (N&P) and the site plan will be updated accordingly in future submittals. Table 1 provides a comprehensive summary of the observations.

Test Holes - Daylight Utilities

Test holes TH-1 through TH-4 (Figure 1) were advanced to daylight the gas and sanitary sewer lines in the back alley to complete the Industry Standard of Care - Subsurface Utility Engineering (SUE) services performed by Arcadis, with its subcontractor, Cardno, Inc. (Cardno) to locate and identify utilities in the back alley. As documented in the Draft Supplemental Remedial Investigation Report (Draft SRI Report) submitted to NYSDEC on May 11, 2016, SUE services performed between February 4 and March 2, 2016 provided a comprehensive understanding of the configuration of utilities in the back alley of Block 7273, Lot 1R. The principal utilities of interest are located in the northern portion of the back alley where they traverse the former MGP tar tank footprint (Figure 1). These utilities include a gas line and associated service lines into the building, two (2) electric lines, and a sanitary sewer line. The SUE Investigation Designating Report prepared by Cardno was included in the Draft SRI Report.

Based on the collective results from the SUE services summarized above, test holes TH-1 through TH-4 were used to obtain additional information regarding the gas and sanitary lines. Cardno was on site during the utility daylighting activities to document, collect data and observe the test holes. Cardno's SUE Test Hole Field Data documentation is provided in Attachment 2.

Subsequent to the Cardno SUE services field work (performed between February 4 and March 2, 2016), the Owner excavated a shallow trench oriented east-west and generally bisecting the back alley; and installed an underground electric duct bank south of the gas line (Figure 1). Arcadis was on-site between April 5 and 27, 2016 to observe the subsurface excavations associated with the underground electric duct bank installation conducted by the Owner and to conduct community air monitoring in accordance with the CAMP. In the vicinity of the former MGP tar tank footprint, a concrete feature was encountered at approximately 2.8 ft bls. The approximate observed location of this feature is shown on Figure 1.

Test Holes - Investigate Former MGP Tar Tank Footprint

Test holes TH-5 through TH-18 were advanced to further investigate the former MGP tar tank footprint in the back alley. As shown on Figure 1 and detailed in Table 1, the test hole findings varied. Key findings and conclusions include the following:

- A metal feature(s) (e.g., steel plate) was observed at approximately 3 ft bls at eight (8) of the test hole locations, but the locations were not contiguous. These test hole locations are shown in blue on Figure 1. The metal feature(s) was noted to be hollow-sounding when tapped; the contents (if any) and the specifics of the metal feature(s) are not known.
- Some NAPL was observed at three (3) of the test hole locations (TH-7, TH-13 and TH-17) beginning at approximately 5 to 5.5 ft bls. These test hole locations are shown in red on Figure 1. Further information is required to determine if the NAPL is within a subsurface structure (e.g., the former MGP tar tank).

PROPOSED PLAN FOR ADDITIONAL SRI SOIL BORINGS AND TEST HOLES

Any subsurface investigation in the back alley is substantively restricted and complicated by current Site conditions, including the presence of numerous utilities and the partially occupied Shopping Center Building. In an effort to obtain information in a timely manner to support the Site remedy, additional SRI soil borings and test holes in the back alley are proposed to be completed in conjunction with the Lot 1R monitoring well decommissioning activities planned to commence in early June 2016 in light of the Owner's plans to redevelop the entire footprint of that property (National Grid's April 28, 2016 letter to NYSDEC, approved by NYSDEC in a May 12, 2016 email from William Wu, NYSDEC to Katherine Vater, National Grid).

At a minimum, SRI soil borings will be drilled at or near test hole locations TH-7 and TH-13 where NAPL was observed in an effort to determine if the former tar tank is present and contains source material (NAPL). The soil borings will be drilled by Arcadis' subcontractor, SGS North America, Inc. (SGS), using a direct-push rig to approximately 15 to 20 ft bls. Test holes will be advanced by SGS using manual methods (i.e., hand augering, digging or other manual methods, but not using vacuum excavation) to investigate the edges and potentially below the metal feature(s) observed at numerous test hole locations. Because the objective of the IRM (as discussed during the April 8, 2016 meeting between National Grid, NYSDEC, and the Owner) is to remove source material from below grade former MGP structures, further understanding of the metal feature(s), as well as below and/or within it (them) are important. Pending the findings from these additional SRI soil borings and test holes, a few more locations in the back alley may be investigated using these same methods. Collectively, this field work is expected to be completed within two days.

The additional SRI soil boring and test hole field work will be conducted in accordance with the NYSDEC-approved SRI Work Plan (dated September 14, 2015), which includes a CAMP. Consistent with the CAMP requirements, odor and dust control measures will be available and used when (if) necessary. The work will also be conducted in accordance with the current Arcadis project-specific Health and Safety Plan (HASP).

Soil recovered from the additional SRI soil borings and test holes will be visually characterized for color, texture, and moisture content as identified in the SRI Work Plan. The presence (if any) of visible staining, NAPL, and obvious odors will be noted and the soil will be field screened with a photoionization detector (PID). Consistent with the previous SRI soil borings, no samples will be collected for laboratory analysis. Upon completion at each location, the drilled soil borings will be tremie-grouted to the surface and materials removed from a test hole will be placed back into the test hole with visually clean soils used to cover impacted materials (if present). The ground surface cover (e.g., asphalt) will be repaired as appropriate. As noted above, test hole locations TH-1 through TH-18 were previously surveyed by a NYS-licensed surveyor and therefore no additional surveying is anticipated to be necessary.

Investigation-derived waste (IDW) generated during these field activities will be temporarily stored on site in a 55-gallon drum(s) at a location to be determined with the Owner. The IDW will be transported off-site for treatment/disposal by National Grid's contractor, Environmental Strategies & Applications, Inc. (ESA).

A complete summary of the additional SRI borings and test holes, along with the associated findings, will be provided to the NYSDEC. It is anticipated that this information will be presented in the SRI Report or as an addendum to that report, depending upon project status.

PROPOSED SCHEDULE

We anticipate conducting the field work in early to mid-June 2016, after receiving the NYSDEC's approval of this letter and agreement from the Owner to access the property. This field work is expected to take two days and to be completed in conjunction with the NYSDEC-approved monitoring well decommissioning on Lot 1R.

Please do not hesitate to contact me or Cathy Geraci if you have any questions or require additional information.

Sincerely,

Arcadis of New York, Inc.

Megan A. Miller, P.E.
Vice President

Copies:

Steven Feldman, Arcadis
Christopher Keen, Arcadis
Cathy Geraci, Arcadis
Bonnie Barnett, Esq., Drinker, Biddle and Reath
Leigh Bausinger, Esq., Drinker, Biddle and Reath
Linda Sullivan, Esq., National Grid

Enclosures:

Table

1 Test Hole Findings Summary (TH-1 through TH-18)

Figure

1 Site Plan

Attachments

1 Arcadis May 6, 2016 letter to National Grid Re: Investigation of Utilities and Tar Tank Footprint in Back Alley - Community Air Monitoring Data

2 Cardno's SUE Test Hole Field Data Documentation

TABLE

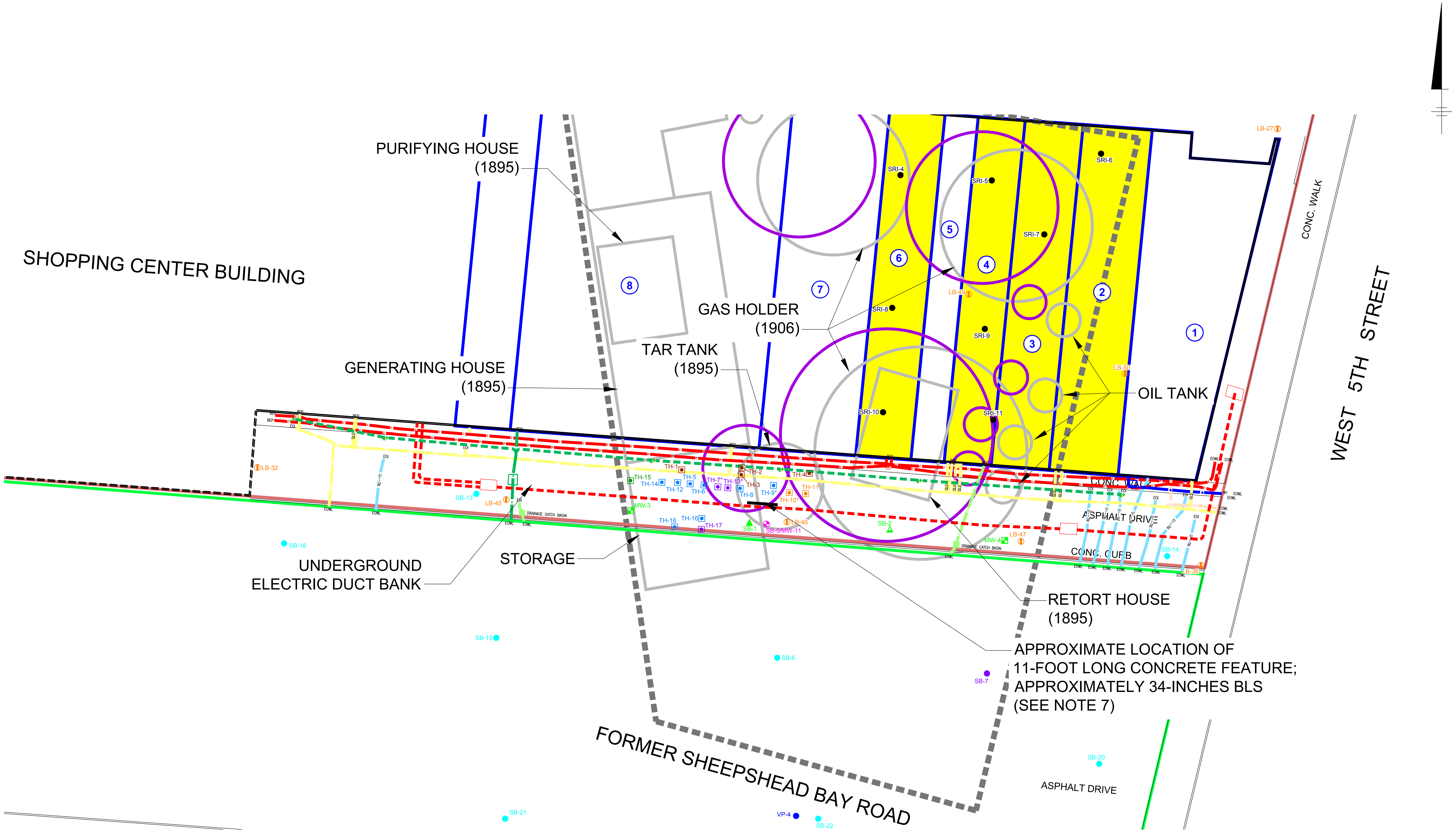
Table 1
Former Dangman Park MGP Site
Test Hole Findings Summary (TH-1 through TH-18; advanced 5/2/16 - 5/5/16)

TH-1	Gas line at 3.32' bls
TH-2	Sanitary sewer line at 3.87' bls
TH-3	Gas line at 3.45' bls
TH-4	Sanitary sewer line at 3.80' bls
TH-5	Metal feature at 3' bls; approximate 1" layer of sand across top of metal feature
TH-6	Metal feature at 3' bls; approximate 1" layer of sand across top of metal feature
TH-7	Brick wall beginning at 3' bls, traversing southern edge of test hole; large concrete blocks from 3' to 4' bls along center/eastern portion of test hole; hand-augered below exposed area between the brick wall and concrete blocks; 5' to 6.5' bls some wood fragments, viscous NAPL, staining, and slight naphthalene-like odor; TD 6.5' bls
TH-8	Metal feature at 3.2' bls
TH-9	Laid-up brick (appears to be a small brick structure, 3 bricks wide, and seemingly linear) at 2' bls, layer of concrete and potential pipe on upper surface of the bricks, naphthalene-like odor from fill material; metal feature at 3' bls
TH-10	Laid-up brick in northern portion of test hole from 2.1' to 3.9' bls, southern portion was soft sand/fill; hand augered from 4' to 7.2' bls in southern portion of test hole; 4.5' to 5' sand, large slag cobbles; staining with naphthalene-like odor from 5' to 6.2' bls, trace staining with naphthalene-like odor from 6.2' to 7.2' bls; TD 7.2' bls
TH-11	Loose bricks at 3' bls; staining and naphthalene-like odor from 5.5' to 6' bls; TD 6.5' bls
TH-12	Metal feature at 3.2' bls
TH-13	Laid-up brick observed at 3.1' bls in northern portion of test hole, depth unknown, staining with naphthalene-like odor at 3.1' bls; hand-augered southern portion of test hole; staining with naphthalene-like odor from 4 -5.5' bls, staining with somewhat viscous NAPL from 5.5' to 6.25' bls; TD 6.25' bls (refusal)
TH-14	Metal feature at 3' bls
TH-15	Concrete at 1.5' bls
TH-16	Metal feature at 3' bls
TH-17	Naphthalene-like odor at 5' to 5.5' bls; NAPL-coated soil and naphthalene-like odor from 5.5' bls to 9.5' bls; TD 9.5' bls
TH-18	Metal feature at 2.8' bls

bls	below land surface
TD	total depth of test hole
(light blue shading)	metal feature observed (e.g., metal plate); feature was noted to sound hollow when tapped
(grey shading)	NAPL observed

Notes:
1. All depth measurements are manual.
2. Depth to top of utility lines identified in Cardno's subsurface utility engineering field data sheets (copy provided as Attachment 2); gas line and sanitary sewer line are 2.3' apart.
3. Depth to groundwater was approximately 6.5' bls.

FIGURE



LEGEND:

- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 1
- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 25
- APPROXIMATE FORMER MGP SITE BOUNDARY
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS)
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS) ADJUSTED BASED ON FIELD OBSERVATIONS OF POTENTIAL GAS HOLDER WALL AT SOIL BORING LOCATION SRI-1
- TENANT SPACE APPROXIMATE BOUNDARY
- 1 TENANT SPACE DESIGNATION
- COMMUNICATION LINE
- GAS LINE
- SANITARY LINE
- ELECTRIC LINE
- DRAINAGE LINE
- UNKNOWN LINE
- WATER LINE
- QLD QLD GAS LINE
- SANITARY LINE (SUSPECTED ROUTE)
- SB-1 SITE CHARACTERIZATION SOIL BORING LOCATION (ARCADIS, 2009)
- SB-2 SITE CHARACTERIZATION SOIL BORING/GEOPROBE GROUNDWATER SAMPLING LOCATION (ARCADIS, 2009)
- MW-1 SITE CHARACTERIZATION MONITORING WELL LOCATION (ARCADIS, 2009)
- SB-7 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING/ VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2011)
- SB-8 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING LOCATION (ARCADIS, 2011 AND 2012)
- MW-6 REMEDIAL INVESTIGATION MONITORING WELL LOCATION (ARCADIS, 2011, 2012, AND 2013)
- VP-1 REMEDIAL INVESTIGATION VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2012)
- SRI-10 SUPPLEMENTAL REMEDIAL INVESTIGATION SOIL BORING LOCATION (ARCADIS, 2015)
- LB-10 PROPERTY OWNER DRILLED BORING (LANGAN 2015)
- CPT-5 PROPERTY OWNER CPT BORING (LANGAN 2015)
- TEST HOLE LOCATION METAL FEATURE ENCOUNTERED AT 3' BLS
- TEST HOLE LOCATION NAPL ENCOUNTERED BELOW 5' BLS
- TEST HOLE LOCATION CONCRETE REFUSAL ENCOUNTERED AT 1' BLS
- TEST HOLE LOCATION STAINED SOIL ENCOUNTERED BELOW 5' BLS
- TEST HOLE LOCATION UTILITY DAYLIGHTED
- * LAID-UP BRICK ENCOUNTERED

0 20' 40'
APPROXIMATE SCALE IN FEET

NOTES:

1. MONITORING WELL, TEST HOLE, AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. UTILITY INFORMATION FROM CARDNO FIELD DRAFT DRAWING DATED MARCH 28, 2016; EXCEPT FOR THE APPROXIMATE LOCATION OF THE UNDERGROUND ELECTRIC DUCT BANK, WHICH IS FROM COSENTINI ASSOCIATES DRAWING DATED MARCH 1, 2016 (PROVIDED BY THE PROPERTY OWNER TO NATIONAL GRID).
5. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
6. THE PROPERTY OWNER DRILLED AND CPT BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.
7. THE CONCRETE FEATURE (e.g., POTENTIAL FOUNDATION) WAS OBSERVED ON APRIL 11, 2016 WITHIN A DEEPER SEGMENT OF THE TRENCH EXCAVATED BY PROPERTY OWNER DURING INSTALLATION OF THEIR UNDERGROUND ELECTRIC DUCT BANK. THE OBSERVED CONCRETE FEATURE IS LOCATED BELOW THE ELECTRIC DUCT BANK.
8. ALL UTILITY LOCATIONS ARE APPROXIMATE.

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	EASTERN CHINESE RESTAURANT
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK
SUPPLEMENTAL REMEDIAL INVESTIGATION

SITE PLAN

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

ATTACHMENT 1

Arcadis May 6, 2016 Letter to National Grid Re: Investigation of Utilities and Tar Tank Footprint in Back Alley – Community Air Monitoring Data

NOTE: NOT INCLUDED WITH IRM DESIGN WORK PLAN

ATTACHMENT 2

Cardno's SUE Test Hole Field Data Documentation

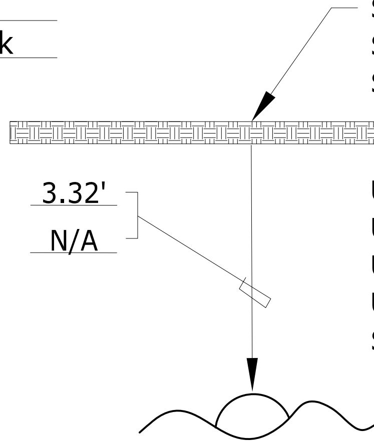
Project Name:	Dangman Park MGP Site	TBE Office:	Burlington, NJ
Client:	Arcadis	Crew Leader:	Caruso
Test Hole Date:	5-3-16	SUE Crew:	Caruso
City-State:	Brooklyn, NY	Truck No:	N/A
Project #:	B0036704.0001.01515	Units:	☑ English ☐ Metric

Cardno Shaping the Future

Subsurface Utility Engineering Test Hole Field Data

TEST HOLE: 1
IDENTIFIED BY: Nail / Disk

SURFACE ELEVATION: N/A
SURFACE TYPE: Asphalt
SURFACE THICKNESS: 8.00"



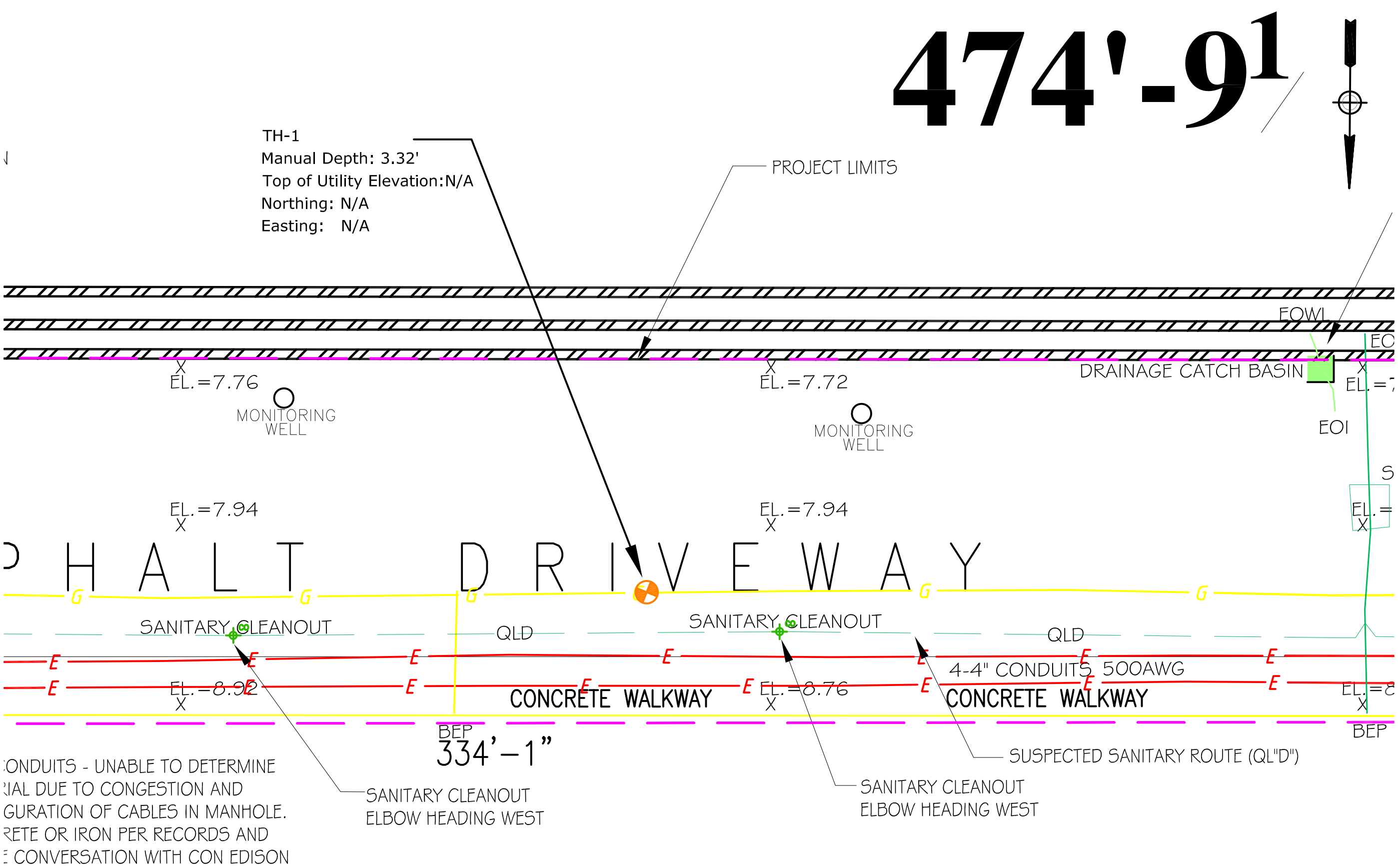
MANUAL DEPTH (TOP): 3.32'
TOP OF UTILITY ELEVATION: N/A

UTILITY REQUESTED: Gas
UTILITY FOUND: Gas
UTILITY SIZE: 4.00"
UTILITY MATERIAL: Steel
SOIL CONDITIONS: Compact,Moist,Sand

PROFILE VIEW - NOT TO SCALE

Note: Test Hole revealed 4.00" steel gas main. Reference pin set over crown of pipe. Gas main encased in sand.

EOI = End of Information; EOWL = End of Work Limit



PLAN VIEW - NOT TO SCALE

Excavator: Zebra
PREPARED BY: Tony Caruso
CHECKED BY: T. Harris

Test Hole 1-1


Utilities Division
Cardno
TBE
Burlington
OFFICE
PROJ# NY09800100
DATE 5.3.16
T.H.# 1
UTIL GAS
MAT'L STEEL
SIZE 4.00"
DEPTH 3.32'
CREW TC
Test Hole 1-2

Test hole 1-3

Project Name:	Dangman Park MGP Site	TBE Office:	Burlington, NJ
Client:	Arcadis	Crew Leader:	Caruso
Test Hole Date:	5-3-16	SUE Crew:	Caruso
City-State:	Brooklyn, NY	Truck No:	N/A
Project#:	B0036704.0001.01515	Units:	☑ English ☐ Metric

Cardno
Shaping the Future

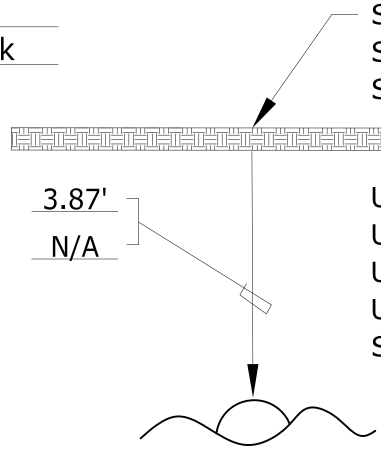
Subsurface Utility Engineering
Test Hole Field Data

TEST HOLE: 2
IDENTIFIED BY: Nail / Disk

SURFACE ELEVATION: N/A
SURFACE TYPE: Asphalt
SURFACE THICKNESS: 8.00"

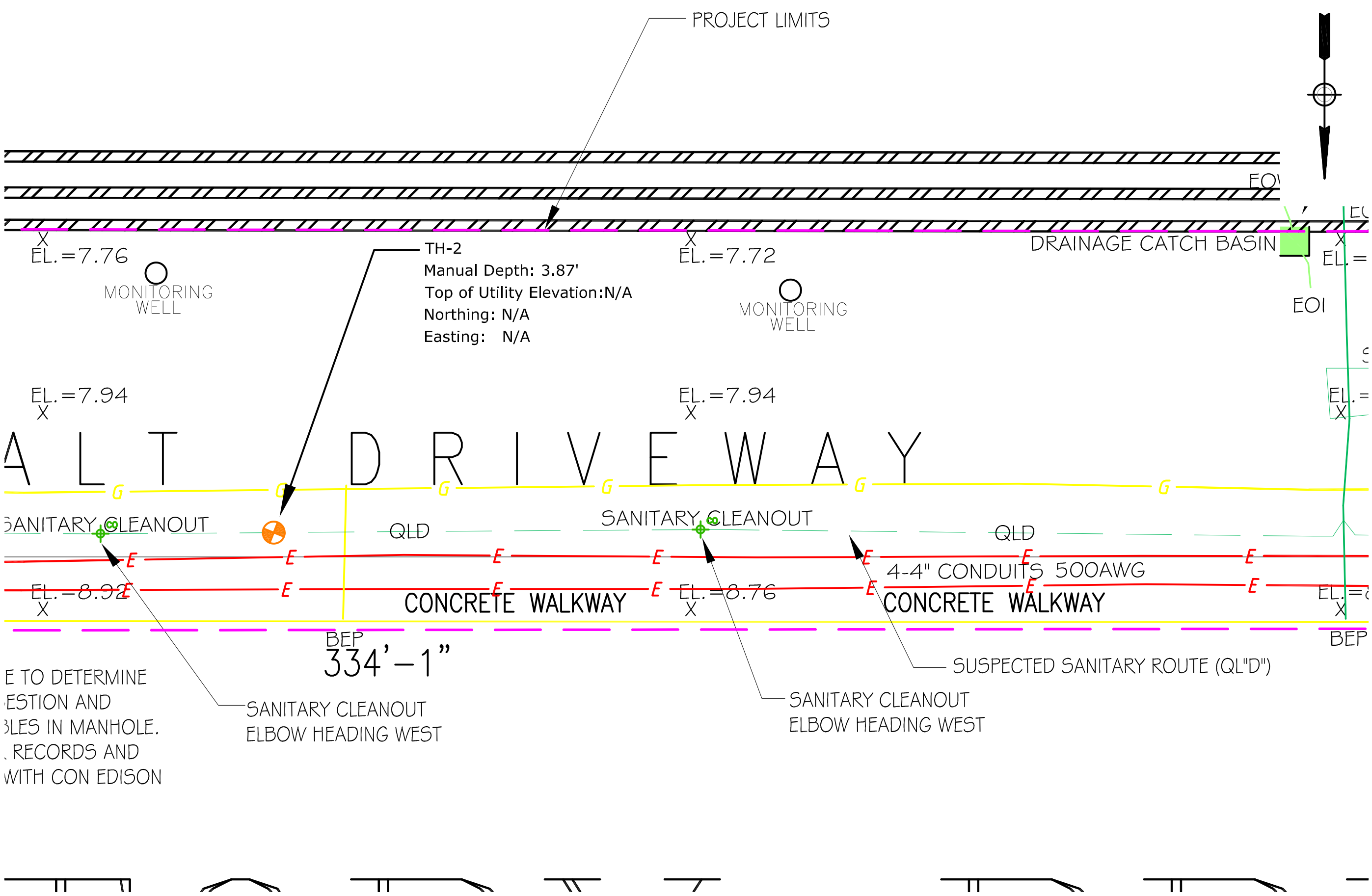
MANUAL DEPTH (TOP): 3.87'
TOP OF UTILITY ELEVATION: N/A

UTILITY REQUESTED: Sanitary
UTILITY FOUND: Sanitary
UTILITY SIZE: 6.00'
UTILITY MATERIAL: Unknown
SOIL CONDITIONS: Compact,Moist,Sand



PROFILE VIEW - NOT TO SCALE

Note: Test Hole revealed 6.00" sanitary pipe. Reference pin set over crown of pipe. Unable to verify pipe material due to dirt and rock surrounding pipe. Did not want to risk damaging pipe by chipping away.
EOI = End of Information; EOWL = End of Work Limit



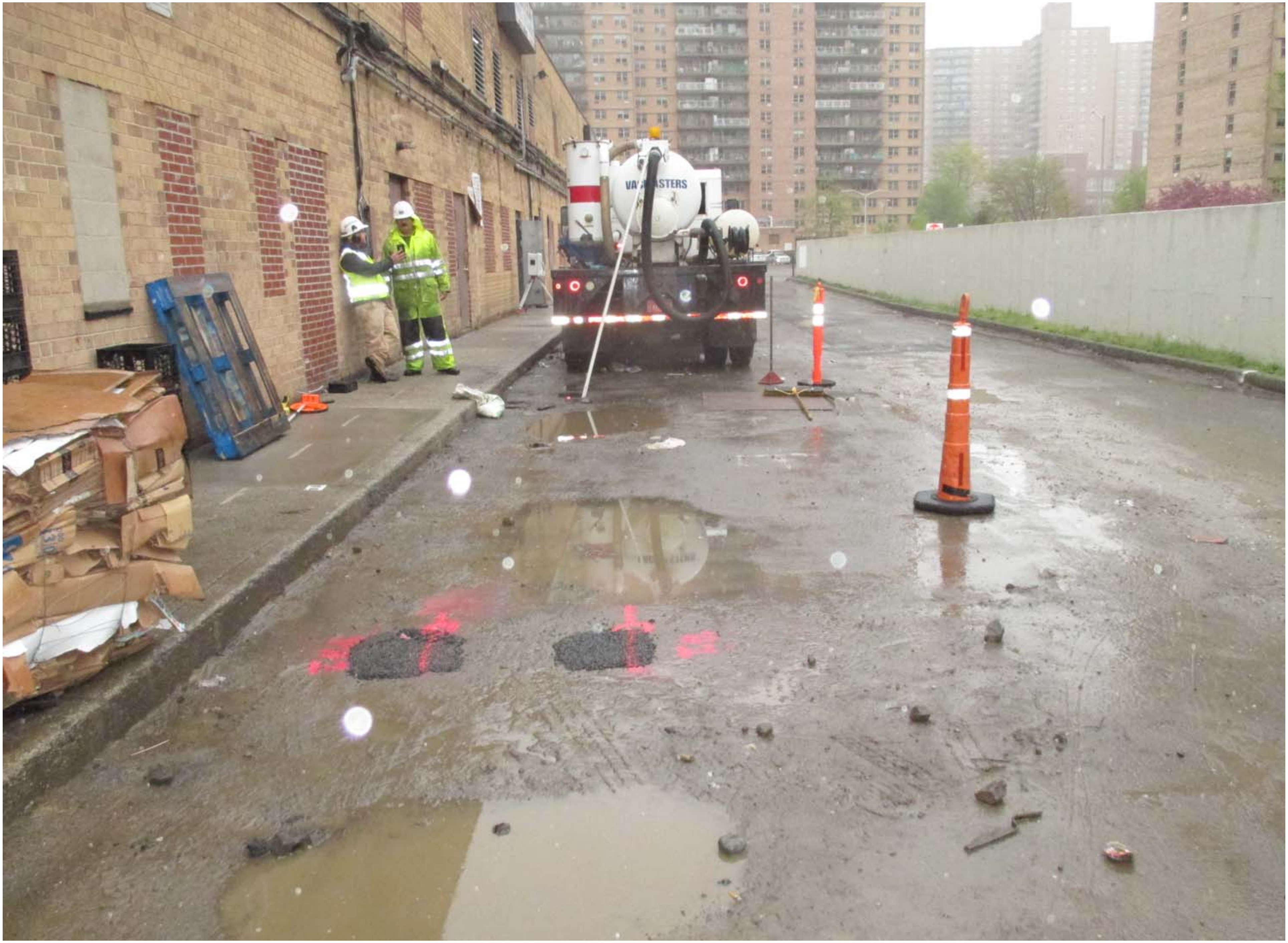
PLAN VIEW - NOT TO SCALE

Excavator:	Zebra	PREPARED BY:	Tony Caruso	CHECKED BY:	T. Harris

Test Hole 2-1


Utilities Division
Cardno TBE
OFFICE
PROJ#
DATE
T.H.#
UTIL
MAT'L
SIZE
DEPTH
CREW
SANITARY
SEE NOTE
6.00"
3.87'
Caruso

Test hole 2-2



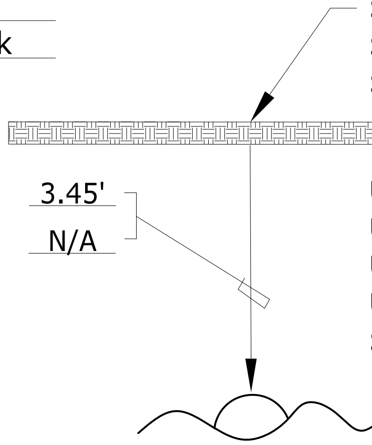
Test hole 2-3

Project Name:	Dangman Park MGP Site	**Subsurface Utility Engineering Test Hole Field Data**	TBE Office:	Burlington, NJ
Client:	Arcadis		Crew Leader:	Caruso
Test Hole Date:	5-3-16		SUE Crew:	Caruso
City-State:	Brooklyn, NY		Truck No:	N/A
Project #:	B0036704.0001.01515		Units:	☑ English ☐ Metric

Cardno Shaping the Future

TEST HOLE: 3
IDENTIFIED BY: Nail / Disk

SURFACE ELEVATION: N/A
SURFACE TYPE: Asphalt
SURFACE THICKNESS: 8.00"



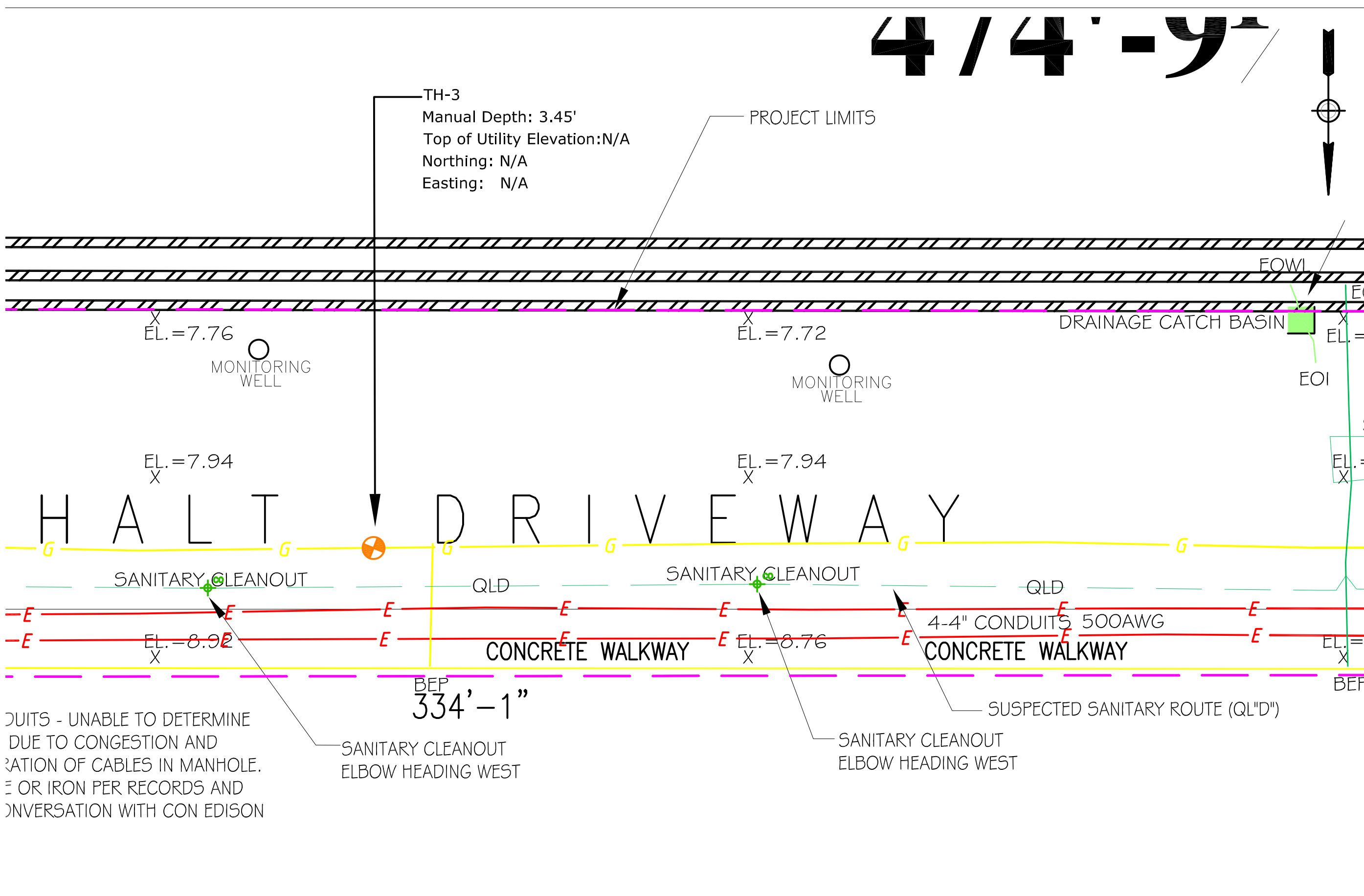
MANUAL DEPTH (TOP): 3.45'
TOP OF UTILITY ELEVATION: N/A

UTILITY REQUESTED: Gas
UTILITY FOUND: Gas
UTILITY SIZE: 4.00"
UTILITY MATERIAL: Steel
SOIL CONDITIONS: Compact,Moist,Sand

PROFILE VIEW - NOT TO SCALE

Note: Test Hole revealed 4.00" steel gas main. Reference pin set over crown of pipe. Gas main encased in sand.

EOI = End of Information; EOWL = End of Work Limit



PLAN VIEW - NOT TO SCALE

Excavator: Zebra
PREPARED BY: Tony Caruso
CHECKED BY: T. Harris

Test Hole 3-1


Utilities Division
Cardno
TBE
Shaping the Future
OFFICE
PROJ# NY09800100
DATE 5.3.16
T.H.# 3
UTIL GAS
MAT'L STEEL
SIZE 4.00"
DEPTH 3.45'
CREW TL
Test Hole 3-2

Test Hole 3-3

Project Name:	Dangman Park MGP Site
Client:	Arcadis
Test Hole Date:	5-3-16
City-State:	Brooklyn, NY
Project#:	B0036704.0001.01515

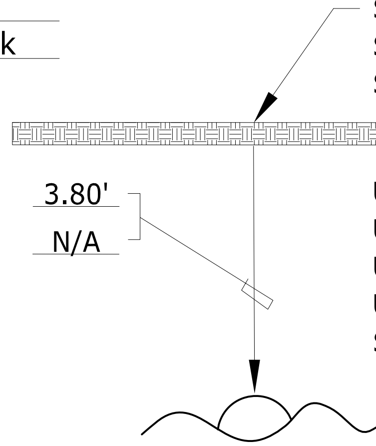
Cardno Shaping the Future

Subsurface Utility Engineering Test Hole Field Data

TBE Office:	Burlington, NJ
Crew Leader:	Caruso
SUE Crew:	Caruso
Truck No:	N/A
Units:	☑ English ☐ Metric

TEST HOLE: 4
IDENTIFIED BY: Nail / Disk

SURFACE ELEVATION: N/A
SURFACE TYPE: Asphalt
SURFACE THICKNESS: 8.00"

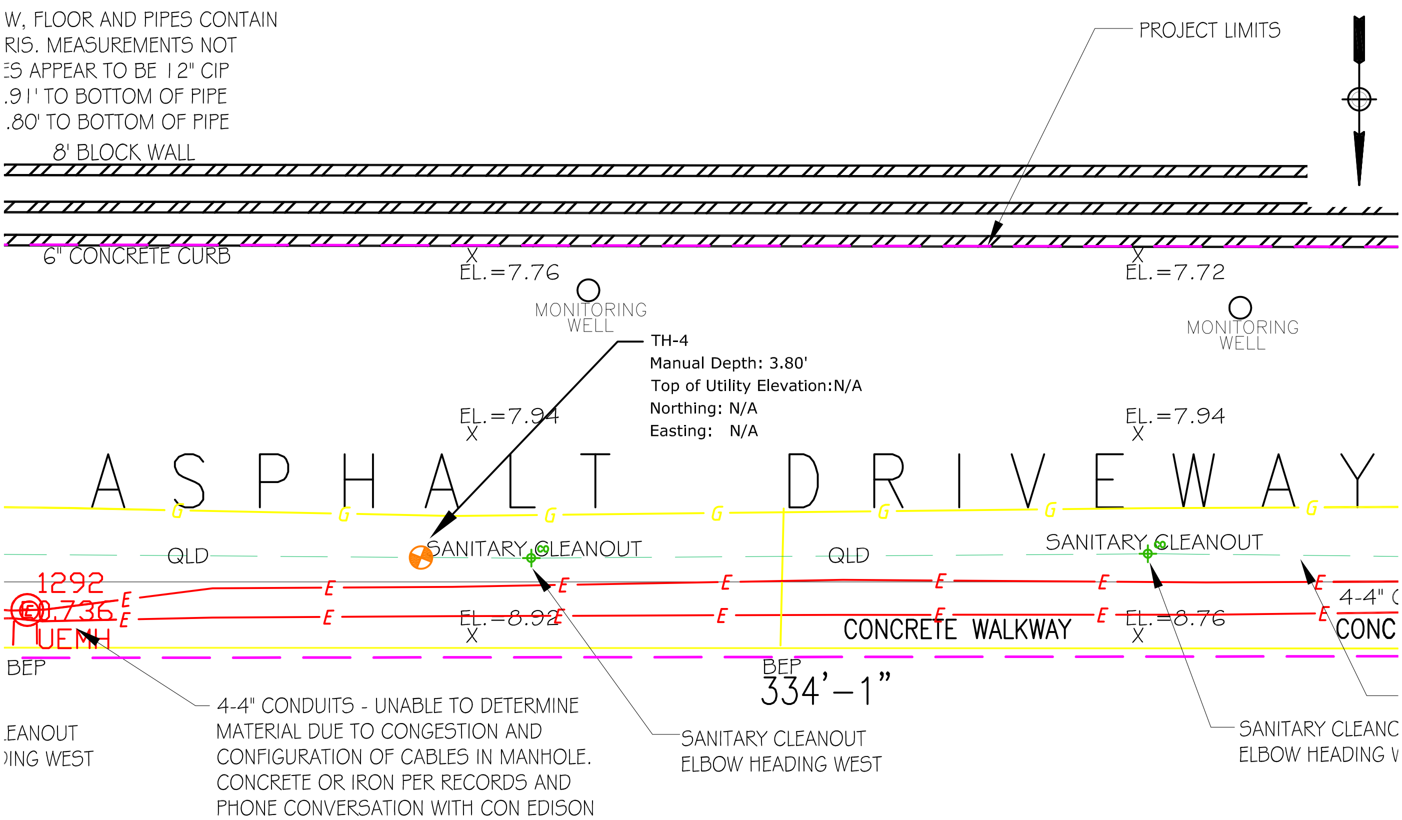


MANUAL DEPTH (TOP): 3.80'
TOP OF UTILITY ELEVATION: N/A

UTILITY REQUESTED: Sanitary
UTILITY FOUND: Sanitary
UTILITY SIZE: 6.00"
UTILITY MATERIAL: Unknown
SOIL CONDITIONS: Compact,Moist,Sand

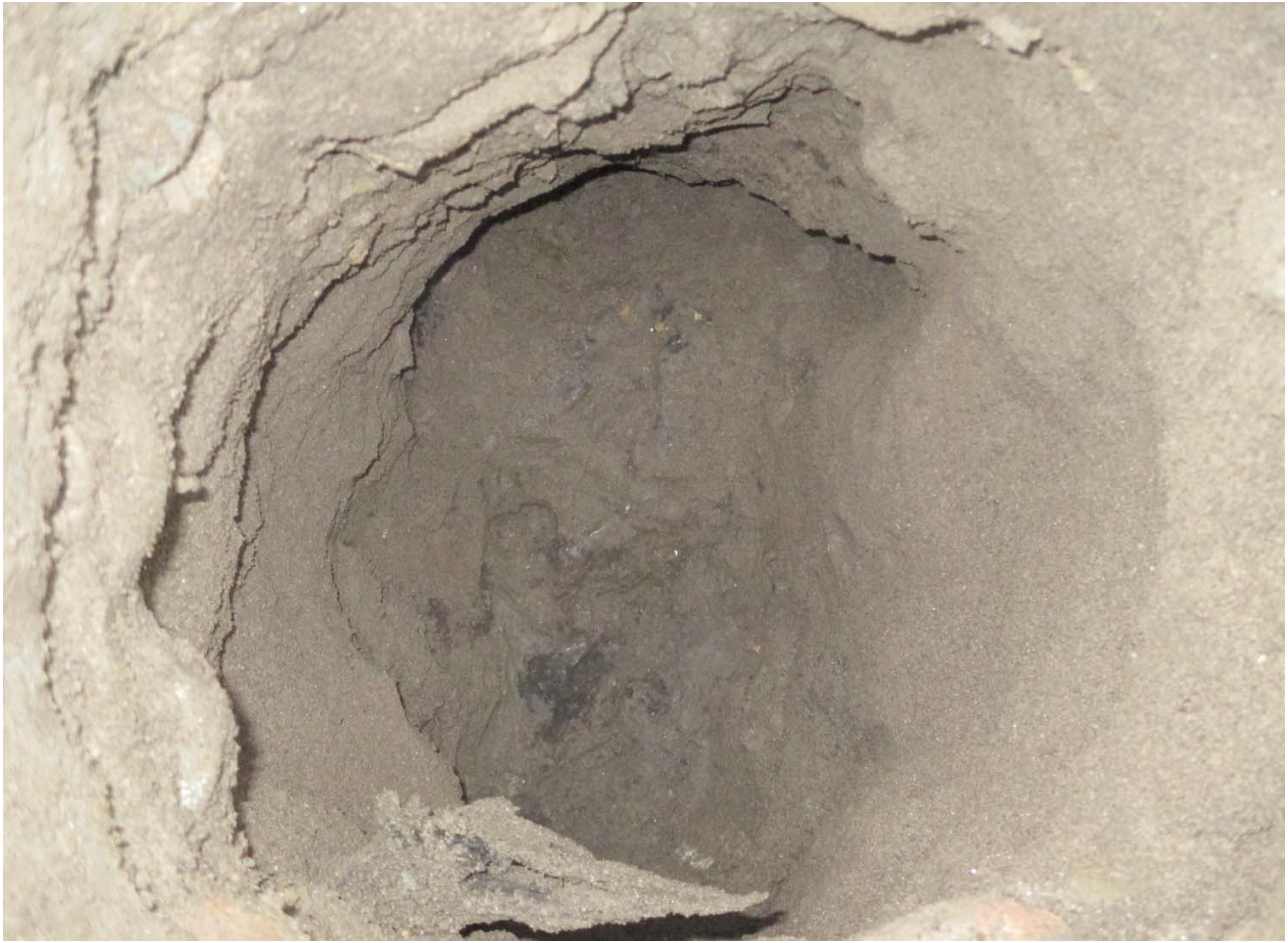
PROFILE VIEW - NOT TO SCALE

Note: Test Hole revealed concrete thrust block. Pipe in bed of concrete. Top of pipe visible. Unable to verify pipe material.
EOI = End of Information; EOWL = End of Work Limit



PLAN VIEW - NOT TO SCALE

Excavator:	Zebra	PREPARED BY:	Tony Caruso	CHECKED BY:	T. Harris



Test Hole 4-1


Utilities Division
Cardno TBE
OFFICE
PROJ# NY098ON00
DATE 5-3-16
T.H.# 4
UTIL SANITARY
MAT'L SEE NOTE
SIZE 6.00"
DEPTH 3.80'
CREW Caruso

Test Hole 4-2

Test hole 4-3

Katherine Vater
Project Manager
Site Investigation and Remediation

August 15, 2016

Mr. William Wu
Environmental Engineer
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remedial Bureau C, 11th Floor
625 Broadway
Albany, NY 12233

Re: Former Dangman Park Manufactured Gas Plant Site - Recommended IRMs
Brooklyn, New York
NYSDEC Site No. 224047
Index # A2-0552-0606

Dear Mr. Wu:

As a follow-up to our July 21, 2016 meeting in Manhattan, New York and as requested during our August 10, 2016 conference call, this letter provides a description of and basis for the two Interim Remedial Measures (IRMs) recommended by National Grid for the Former Dangman Park Manufactured Gas Plant (MGP) site in Brooklyn, New York (Site): Excavation IRM and In-Situ Treatment IRM. The recommended IRMs are described below, and would be implemented in conjunction with a ground surface cover, Institutional Controls (ICs), and a Site Management Plan (SMP) to provide a comprehensive Site remedy that is protective of human health and the environment. The ground surface cover would include new structures (e.g., mixed-use commercial and residential structure) and public areas that will add approximately 4 feet of additional cover, a new building slab, and a vapor barrier that would enhance the existing Site cover.

National Grid's recommended IRMs address the coated and saturated petroleum and coal tar non-aqueous phase liquid (NAPL) observed within 15 feet of the present ground surface. The recommended IRMs are described herein in order to obtain New York State Department of Environmental Conservation (NYSDEC) input/approval prior to submitting a draft work plan for each of the IRMs. The work plan for the Excavation IRM would be a modification of the *Draft Interim Remedial Measure (IRM) Design Work Plan* (Arcadis, May 2016); the work plan for the In-Situ Treatment IRM would be a letter work plan as requested in the NYSDEC (Gardiner Cross) July 25, 2016 e-mail to National Grid (Katherine Vater).

The descriptions of and basis for the recommended IRMs are provided below, followed by a discussion of next steps/schedule.

Recommended Excavation IRM

The recommended Excavation IRM includes three excavation areas (Figure 1). The limits of the two excavation areas described below were discussed during our July 21, 2016 meeting.

1. **Northwest Holder and Cistern Excavation Area (Area 1):** Excavate the area encompassing the holder footprint (SRI-1), SRI-2, and LB-51. This area, which is approximately 6,600 square feet (sf), will be excavated to a maximum depth of approximately 21 feet below land surface (ft bls) (i.e., bottom of holder) for removal of approximately 5,130 cubic yards (CY) of material.

2. **Back Alley Excavation Area (Area 2):** Excavate the area encompassing (from west to east) SB-1, SB-5/MW-11, LB-46, SB-2, and LB-47. This area, which is approximately 2,100 sf, will be excavated to a depth of 15 ft bls for removal of approximately 1,170 CY of material.

   During our July 21, 2016 meeting, the subsurface utilities present in the back alley were discussed (Figure 1). The back alley excavation area will require removal and relocation of the underground electric duct bank installed/encased in concrete during Spring 2016 by the Property Owner.

   Within approximately 10 feet south of the shopping center back wall are numerous subsurface utilities: a gas line and associated service lines into the existing (and partially occupied) shopping center building, two electric lines, and a suspected sanitary sewer line (Figure 1; additional details provided in the *Draft SRI Report*). During the July 21, 2016 meeting, NYSDEC asked if these subsurface utilities would be abandoned as part of the redevelopment. As a follow-up to NYSDEC's question, the Property Owner's Team confirmed to National Grid that the subsurface utilities in the back alley will remain active only until Phase II demolition of the shopping center building (i.e., west of CVS Pharmacy; tenant space #8 on Figure 1) and then they will be abandoned, eliminating the subsurface around these utilities as a potential future human exposure pathway for construction workers.

The third IRM excavation area was briefly discussed during our August 10, 2016 conference call:

3. **SRI-10 and SRI-11 Petroleum NAPL Coated Soil Excavation Area (Area 3):** Excavate the area encompassing SRI-10 and SRI-11 within the current shopping center building footprint. This area, which is approximately 1,195 sf, would be excavated to a depth of 15 ft bls for removal of approximately 660 CY of material.

   In this area of the Site (SRI soil borings SRI-10 and SRI-11), a relatively greater degree of petroleum impacts were observed compared to the other 5 SRI soil borings (SRI-3, SRI-6, SRI-7, SRI-8, and SRI-9) where petroleum impacts were observed. Petroleum NAPL in the form of lightly to moderately coated soils was observed at these 7 soil boring locations drilled below the shopping center building. All observations of petroleum NAPL were in the upper 15 ft and deeper than 6 ft bls (i.e., at the approximate seasonal high water table).

   For reference, provided in Attachment A is the previously provided draft photograph log of the soil cores where petroleum NAPL coated soils were observed, along with the draft figure showing the boring log descriptions most recently provided to NYSDEC in the *Draft Supplemental Remedial Investigation Report* (Arcadis, May 2016).[1] As shown on the figure in Attachment A, petroleum NAPL was not observed in soil borings SRI-4 and SRI-5, located downgradient of 5 locations where petroleum NAPL was observed. Groundwater data for the downgradient shallow monitoring wells (MW-1 and MW-2; screened from 6 to 16 ft bls to straddle the water table) document that volatile organic compound (VOC) and semi-volatile organic compound (SVOC) concentrations in these wells are relatively low (e.g., benzene was not detected above 1 microgram per liter [µg/L] in the March 2012 MW-2 groundwater sample). Additionally, NAPL has not been observed in any of the shallow monitoring wells during the 7-year period that investigation/gauging activities have been conducted.

   Collectively, the data fully support that the lightly to moderately petroleum coated soil observed in some soil cores collected more than 6 ft below the shopping center building is not migrating and not releasing significant VOC and SVOC concentrations to groundwater.

[1] Portable document files (PDFs) of the photograph log and figure were originally transmitted to NYSDEC in my July 18, 2016 e-mail; subsequent to our July 21, 2016 meeting, we noticed that the PDF of the photograph log is not as clear as the Word file. Therefore, the Word file of the photograph log is attached to the e-mail transmittal of this letter.

The greatest depth interval of petroleum NAPL coated was observed in soil boring SRI-10 (6.4 to 15 ft bls); ranging from very light to moderate NAPL coating on soils, with trace brown blebs within some intervals. The soil boring that exhibited the second greatest depth interval that included moderately petroleum NAPL coated soil was SRI-11, located approximately 40 ft east of SRI-10. The Excavation IRM would remove the soil and petroleum NAPL at and in the vicinity of these two soil boring locations (approximately 660 CY); and would be combined with the recommended In-Situ Treatment IRM to address remaining MGP-related impacts by capitalizing on existing anaerobic (reduced) subsurface conditions to accelerate the natural rate of biodegradation (i.e., natural source zone depletion [NSZD]) within the area of observed petroleum NAPL.

The recommended In-Situ Treatment IRM is anaerobic biological oxidation (ABOx), which is further described below. As part of the In-Situ Treatment IRM, the backfill for the excavation area encompassing soil boring locations SRI-10 and SRI-11 and the back alley excavation area would include gypsum (calcium sulfate dihydrate [$CaSO_4$*$2H_2O$]). The gypsum would provide a long-term, upgradient source of sulfate to accelerate the ongoing ABOx of MGP-related impacts below this area of the shopping center building where petroleum NAPL coated soils were observed (Figure 1).

Recommended In-Situ Treatment IRM - Anaerobic Biological Oxidation (ABOx)

As discussed during our August 10, 2016 conference call, we have reviewed the available in-situ options, and Arcadis has recommended ABOx (enhanced biodegradation) through injection/emplacement of sulfate (non-oxygen electron acceptor). The available Site data were reviewed with respect to the applicability of available in-situ treatment technologies. In particular, there are two key Site-specific conditions that strongly support ABOx as the preferred in-situ treatment technology: groundwater is moving slowly (RI Report, approximately 0.09 to 0.5 ft/day); and, shallow groundwater is anaerobic (reduced) based on the oxidation reduction potential (ORP) data collected during groundwater sampling and documented in the RI Report.

ABOx (enhanced biodegradation) through injection/emplacement of sulfate is recommended to address the petroleum NAPL, in conjunction with the Area 3 excavation described above where a relatively greater degree of petroleum impacts were observed compared to the other soil borings (Attachment A). Sulfate addition would stimulate indigenous sulfate reducing bacteria (SRB) populations to degrade petroleum and MGP-related COCs, capitalizing on existing anaerobic (reduced) subsurface conditions to accelerate the ongoing NSZD within the area of observed petroleum NAPL.

Site conditions following the significant removal of NAPL-impacted materials, including slow movement of groundwater, support subsurface emplacement of gypsum to provide a long-term, slow release sulfate source for ABOx of COCs. The gypsum would accelerate NAPL solubilization (phase-change remediation) and enhance the degradation of dissolved phase COCs.

Gypsum is sparingly soluble (solubility 2,400 mg/L [1,300 mg/L as sulfate]), and when placed as a slurry will dissolve over a long period of time (years). The gypsum is expected to dissolve to its solubility, and then SRB will use the sulfate to degrade dissolved phase petroleum and MGP-related COCs. As the dissolved phase concentrations decrease, more NAPL and sorbed phase mass will dissolve into the groundwater to establish equilibrium. Similarly, as the dissolved sulfate is used by the SRB, more gypsum will dissolve.

Gypsum would be emplaced in the near-term by injection of a weight percent slurry via direct-push drilling within the area of observed petroleum NAPL impacts and LB-52 (yellow-shaded area on Figure 1). We plan to collect soil samples for visual observation as requested (NYSDEC July 25, 2016 e-mail to National Grid), and plan to also collect groundwater samples from temporary wells to document pre-injection sulfate concentrations. Additionally, following the DPT injection, confirmatory groundwater samples will be collected from the temporary wells for analysis of sulfate to demonstrate adequate distribution of the gypsum slurry has been achieved. The temporary wells will also be periodically gauged for the absence/presence of NAPL and measurable NAPL (if any) removed to the extent practicable. The gypsum emplaced in the backfill of the IRM excavation recommended for this area and described above, would also provide a long-term, upgradient source of sulfate for ABOx.

Consideration of Chemical Oxidation

In-situ chemical oxidation (ISCO) is not recommended for in-situ treatment at this Site due to implementability and safety concerns. Available chemical oxidants used to accelerate NAPL solubilization (phase-change remediation) and breakdown dissolved phase COCs are persulfate, permanganate, peroxide, and ozone (and some combinations of them). These oxidants are appropriate for MGP-related constituents of concern (COCs), except permanganate, which is ineffective for treatment of aromatics (e.g., benzene). Of the remaining three chemical oxidants, sodium persulfate is the most implementable and safest beneath a structure. Even though sodium persulfate is the best option of the available chemical oxidants, it is a strong oxidant that will persist in the subsurface and cause heat and gas generation. Chemical oxidation is limited by contaminant mass transfer from the NAPL and sorbed phases into the groundwater where the oxidation occurs. Furthermore, the injected sodium persulfate would need to satisfy the stoichiometric requirements of the MGP-related COCs plus other non-productive oxidant demands (e.g., reduced mineralogy) in the shallow groundwater which is currently anaerobic (reduced), likely requiring multiple injection events over an extended period of time.

ISCO with sodium persulfate was eliminated from further consideration because the reasonably anticipated adverse effects outweigh the potential remedial benefit. Introducing sodium persulfate would chemically and physically disturb the current steady-state conditions documented at the Site, particularly below the partially occupied shopping center building that has covered the area of observed petroleum NAPL for more than 50 years. Sodium persulfate reaction chemistry is broad and complex. This complicates any reliable estimate of byproducts and potential metals mobilization, and complicates any reliable evaluation of additional measures that may be needed to ensure continued protection of human health and the environment during implementation of injections. Although the benefit of ISCO will be short-lived, the geochemical influence of a sodium persulfate injection is anticipated to persist long after the injection, possibly years at this Site given the slow movement of groundwater. For example, the acidity associated with decomposition of persulfate and interactions with reduced mineralogy raises concerns about chemical compatibility with the steel piles associated with the redevelopment. After detailed review, these drawbacks resulted in eliminating ISCO from consideration at this Site.

Summary, Next Steps, and Schedule

National Grid's recommended Site remedy includes an Excavation IRM, an In-situ Treatment IRM, ICs and a SMP. In addition to the recommended IRMs summarized herein, any impacts remaining on Lot 1R will be further addressed during redevelopment by an additional 4 ft of cover materials, a new building slab, and soil vapor mitigation measures. Collectively, these recommended remedial components comprehensively achieve the best balance of the NYSDEC evaluation criteria set forth in 6 NYCRR 375-1.8(f), and effectively address the potential for future exposure to subsurface soil and groundwater containing MGP-related impacts. The recommended IRMs will remove a significant quantity (approximately 7,000 CY) of NAPL-impacted materials that would be treated/disposed off-site, treat hundreds of thousands gallons of groundwater generated during excavation dewatering, and oxidize the area of petroleum NAPL over the long-term (years) by providing a sparing soluble source of sulfate (gypsum) both within and upgradient of this area.

As identified in my August 10, 2016 e-mail, the draft work plans for both IRMs (excavation and in-situ treatment) are in progress; we plan to submit those to NYSDEC within two weeks of NYSDEC's concurrence of the recommended IRMs presented herein.

In the meantime, if you have any questions or concerns about the recommended IRMs please contact me at your convenience such that we can incorporate any comments prior to submitting the work plan. I can be reached at (608) 826-3663 or at katherine.vater@nationalgrid.com.

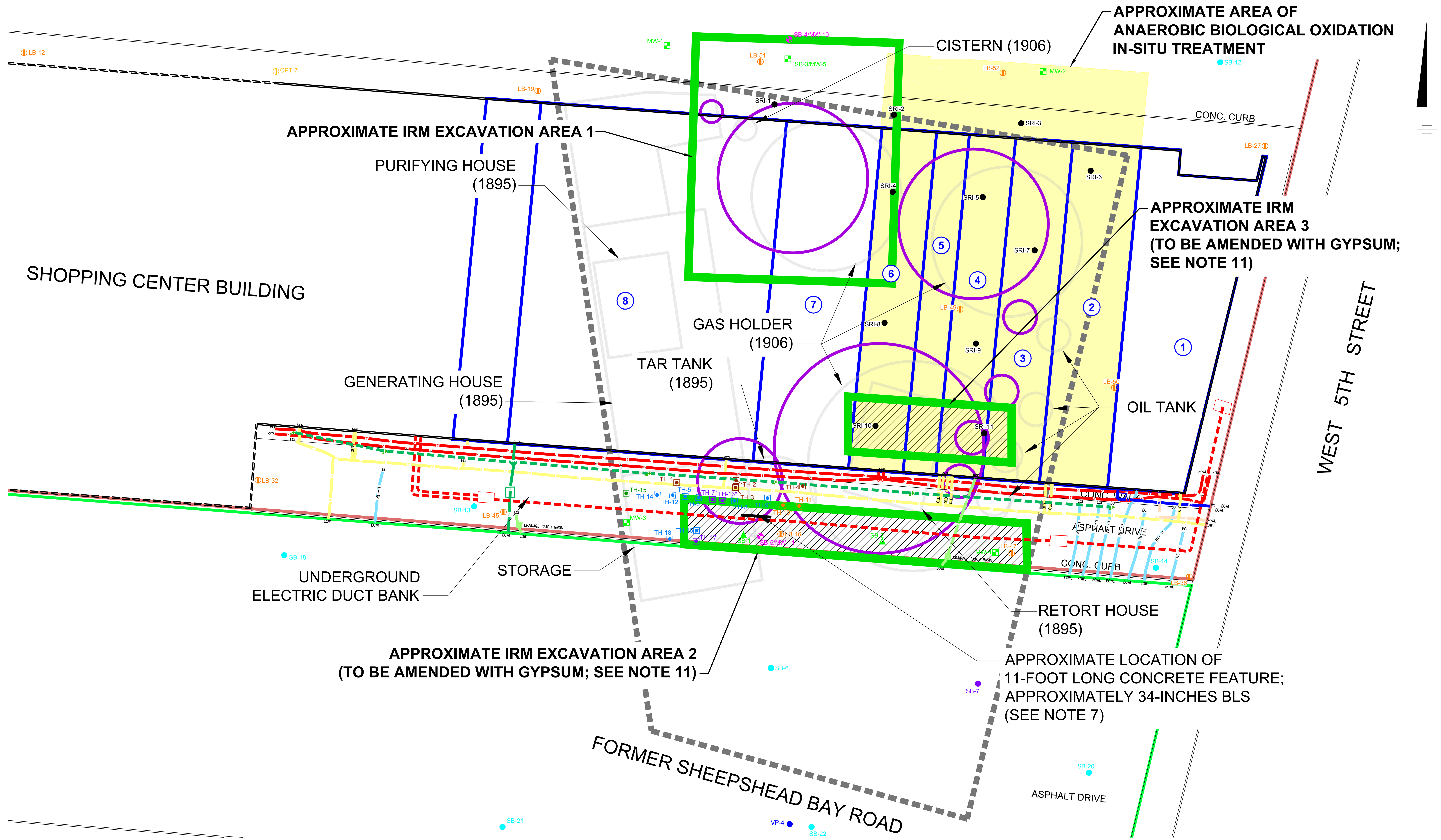
Sincerely,

Katherine Vater
Project Manager

Enclosures:
Figure 1: Excavation and In-Situ Treatment IRMs

Attachment A: Petroleum NAPL Observations - Photograph Log and Figure

cc: Gardiner Cross, NYSDEC
Albert DeMarco, NYSDOH
Linda Sullivan, Esq., National Grid
Bonnie Barnett, Esq., Drinker Biddle and Reath LLP
Steve Feldman, Arcadis
M. Cathy Geraci, Arcadis



LEGEND:

- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 1
- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 25
- APPROXIMATE FORMER MGP SITE BOUNDARY
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS)
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS) ADJUSTED BASED ON FIELD OBSERVATIONS OF POTENTIAL GAS HOLDER WALL AT SOIL BORING LOCATION SRI-1
- TENANT SPACE APPROXIMATE BOUNDARY
- (1) TENANT SPACE DESIGNATION
- COMMUNICATION LINE
- GAS LINE
- SANITARY LINE
- ELECTRIC LINE
- DRAINAGE LINE
- UNKNOWN LINE
- WATER LINE
- QLD — QLD GAS LINE
- SANITARY LINE (SUSPECTED ROUTE)
- SB-1 — SITE CHARACTERIZATION SOIL BORING LOCATION (ARCADIS, 2009)
- SB-2 — SITE CHARACTERIZATION SOIL BORING/GEOPROBE GROUNDWATER SAMPLING LOCATION (ARCADIS, 2009)
- MW-1 — SITE CHARACTERIZATION MONITORING WELL LOCATION (ARCADIS, 2009)
- SB-7 — REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING/ VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2011)
- SB-8 — REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING LOCATION (ARCADIS, 2011 AND 2012)
- MW-6 — REMEDIAL INVESTIGATION MONITORING WELL LOCATION (ARCADIS, 2011, 2012, AND 2013)
- VP-1 — REMEDIAL INVESTIGATION VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2012)
- SRI-10 — SUPPLEMENTAL REMEDIAL INVESTIGATION SOIL BORING LOCATION (ARCADIS, 2015)
- LB-10 — PROPERTY OWNER DRILLED BORING (LANGAN 2015)
- CPT-5 — PROPERTY OWNER CPT BORING (LANGAN 2015)
- TEST HOLE LOCATION METAL FEATURE ENCOUNTERED AT 3' BLS
- TEST HOLE LOCATION NAPL ENCOUNTERED BELOW 5' BLS
- TEST HOLE LOCATION CONCRETE REFUSAL ENCOUNTERED AT 1' BLS
- TEST HOLE LOCATION STAINED SOIL ENCOUNTERED BELOW 5' BLS
- TEST HOLE LOCATION UTILITY DAYLIGHTED
- * LAID-UP BRICK ENCOUNTERED

0 20' 40'
APPROXIMATE SCALE IN FEET

NOTES:

1. MONITORING WELL, TEST HOLE, AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. UTILITY INFORMATION FROM CARDNO FIELD DRAFT DRAWING DATED MARCH 28, 2016; EXCEPT FOR THE APPROXIMATE LOCATION OF THE UNDERGROUND ELECTRIC DUCT BANK, WHICH IS FROM COSENTINI ASSOCIATES DRAWING DATED MARCH 1, 2016 (PROVIDED BY THE PROPERTY OWNER TO NATIONAL GRID).
5. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
6. THE PROPERTY OWNER DRILLED AND CPT BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.
7. THE CONCRETE FEATURE (e.g., POTENTIAL FOUNDATION) WAS OBSERVED ON APRIL 11, 2016 WITHIN A DEEPER SEGMENT OF THE TRENCH EXCAVATED BY PROPERTY OWNER DURING INSTALLATION OF THEIR UNDERGROUND ELECTRIC DUCT BANK. THE OBSERVED CONCRETE FEATURE IS LOCATED BELOW THE ELECTRIC DUCT BANK.
8. ALL UTILITY LOCATIONS ARE APPROXIMATE.
9. TENANT SPACES 2 THROUGH 6 ARE VACANT.
10. IRM EXCAVATION LIMITS TO BE DETERMINED DURING THE REMEDIAL DESIGN.
11. EXCAVATION BACKFILL TO BE AMENDED WITH GYPSUM TO PROVIDE A LONG-TERM, UPGRADIENT SOURCE OF SULFATE FOR ANAEROBIC BIOLOGICAL OXIDATION IN-SITU TREATMENT.

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	VACANT 2016 (EASTERN CHINESE RESTAURANT)
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

DRAFT

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK

EXCAVATION AND IN-SITU TREATMENT IRMs

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1

Attachment A

Petroleum NAPL Observations - Photograph Log and Figure

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York

Photograph: 1

Description: (7.6-8.7') Moderate petroleum-like odor, very light coating of yellow NAPL

Location: SRI-3 (7-9')

Photograph taken by:
Will Stephens

Date: 10/13/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York

Photograph: 2

Description: Moderate petroleum-like odor, very light coating of yellow NAPL

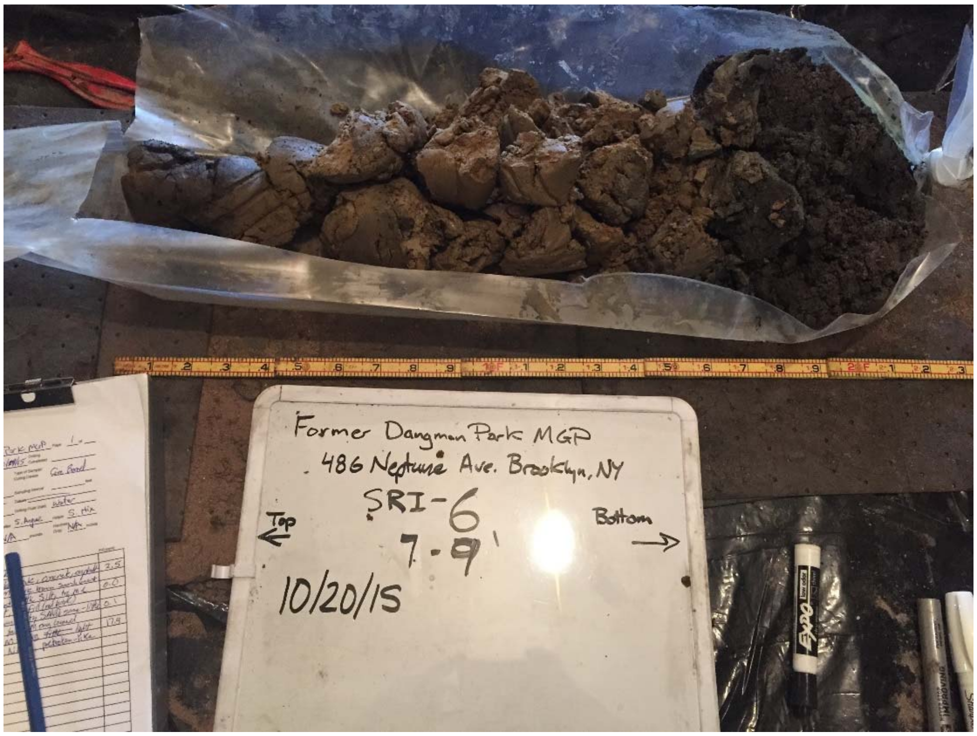
Location: SRI-3 (9-11')

Photograph taken by: Will Stephens

Date: 10/13/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 3

Description: (8.6-9.0') Light coating of yellow NAPL, petroleum-like odor

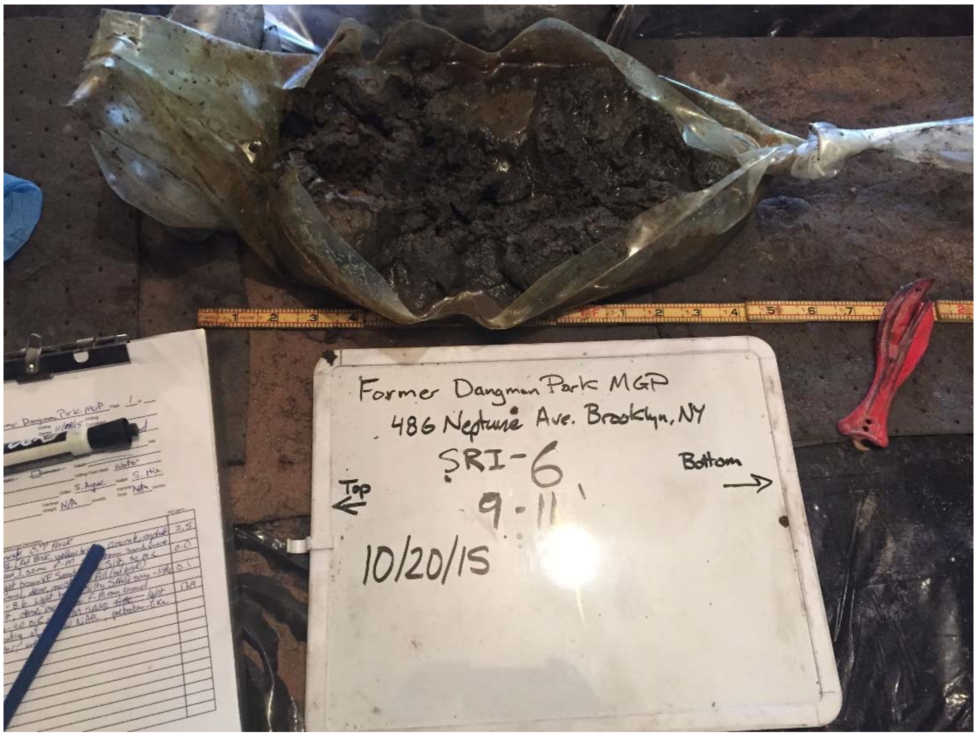
Location: SRI-6 (7-9')

Photograph taken by: Will Stephens

Date: 10/20/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 4

Description: Light to moderate coating of yellow NAPL, moderate petroleum-like odor

Location: SRI-6 (9-11')

Photograph taken by:
Will Stephens

Date: 10/20/2015

National Grid
Former Dangman Park MGP Site
Brooklyn, New York

Photograph: 5

Description: (7.9-9') Moderate petroleum-like odor, light brown NAPL coating

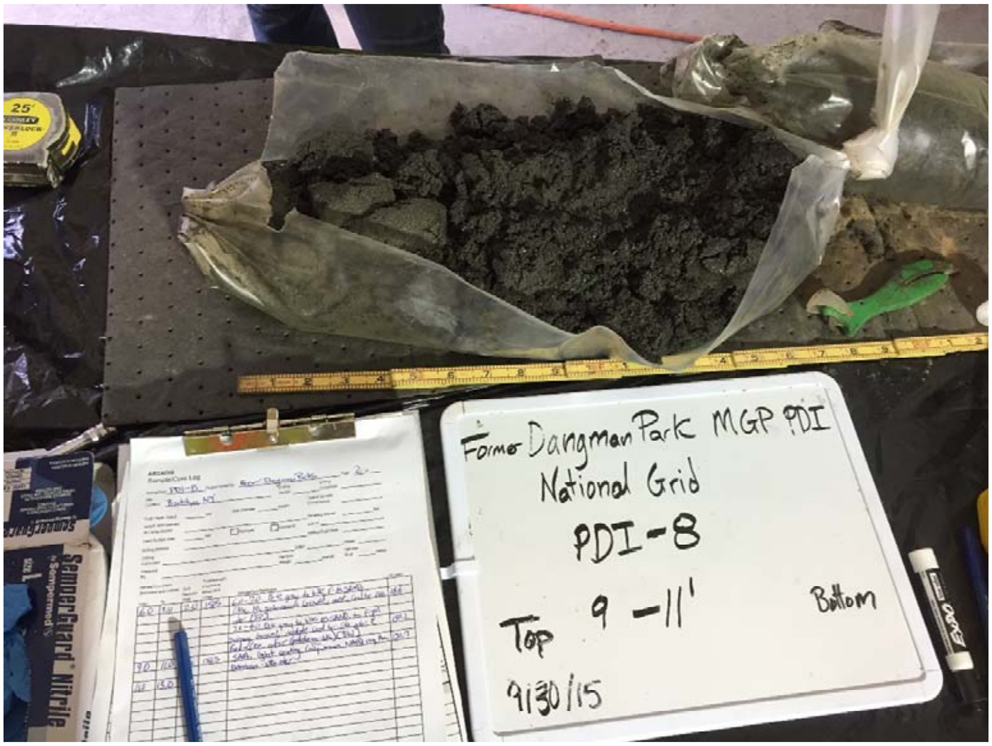
Location: SRI-7 (7-9')

Photograph taken by: Will Stephens

Date: 10/15/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 6

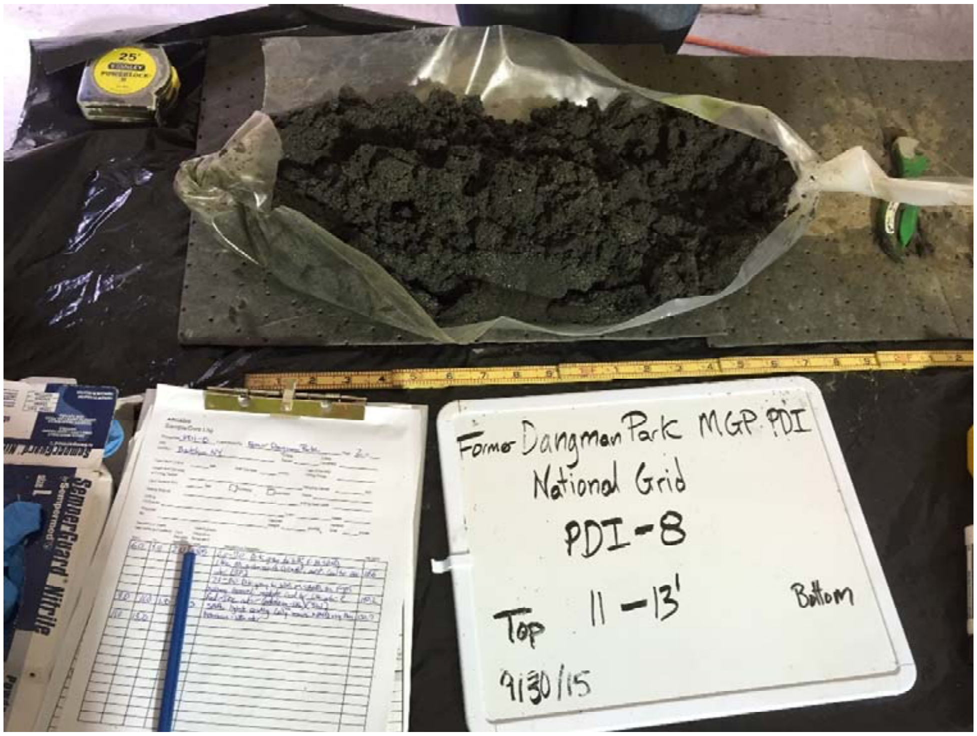
Description: Light coating (very thin, oily brown NAPL), petroleum-like odor

Location: SRI-8 (9-11')

Photograph taken by:
Will Stephens

Date: 9/30/2015

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 7

Description: Light coating (very thin, oily brown NAPL), petroleum-like odor

Location: SRI-8 (11-13')

Photograph taken by: Will Stephens

Date: 9/30/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York

Photograph: 8

Description: (7.8-8.9') Light yellow coating of NAPL, petroleum-like odor

Location: SRI-9 (7-9')

Photograph taken by: Will Stephens

Date: 10/15/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York

Photograph: 9

Description: Moderate coating of yellow NAPL, petroleum-like odor

Location: SRI-9 (9-11')

Photograph taken by: Will Stephens

Date: 10/15/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York

Photograph: 10

Description: (11-11.6') Light coating of yellow NAPL, petroleum-like odor

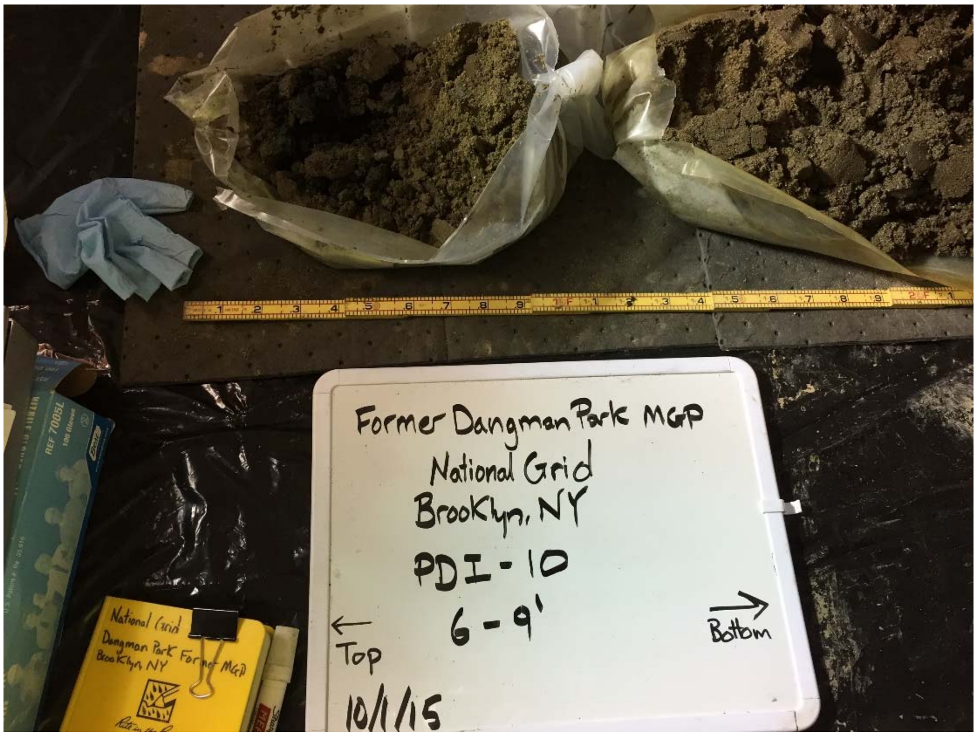
Location: SRI-9 (11-13')

Photograph taken by: Will Stephens

Date: 10/15/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 11

Description: (6.4-8.7') Light brown to yellow light NAPL coating, strong petroleum-like odor

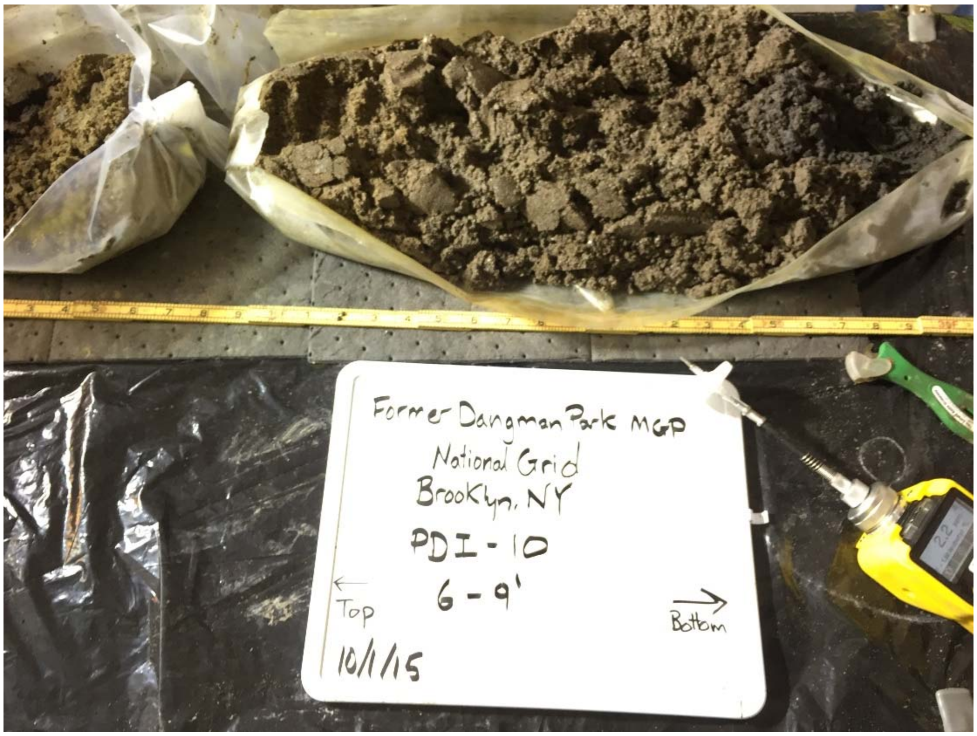
Location: SRI-10 (6-9')

Photograph taken by: Will Stephens

Date: 10/1/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 12

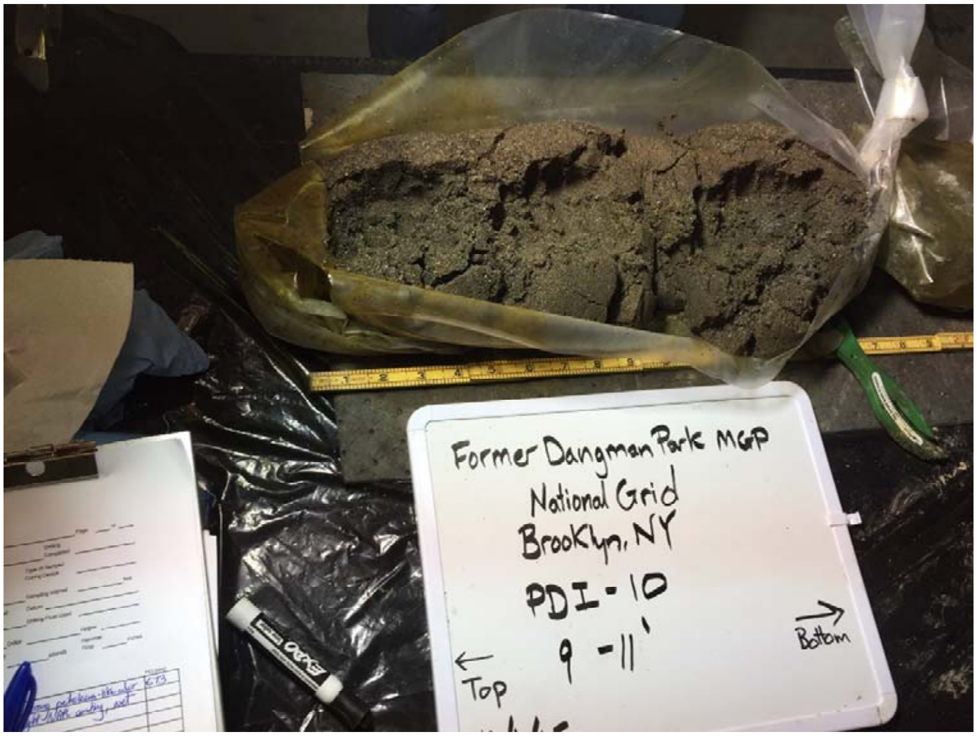
Description: (8.7-9.0') Strong petroleum-like odor, light coating of light brown to yellow NAPL

Location: SRI-10 (6-9')

Photograph taken by:
Will Stephens

Date: 10/1/2015

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 13

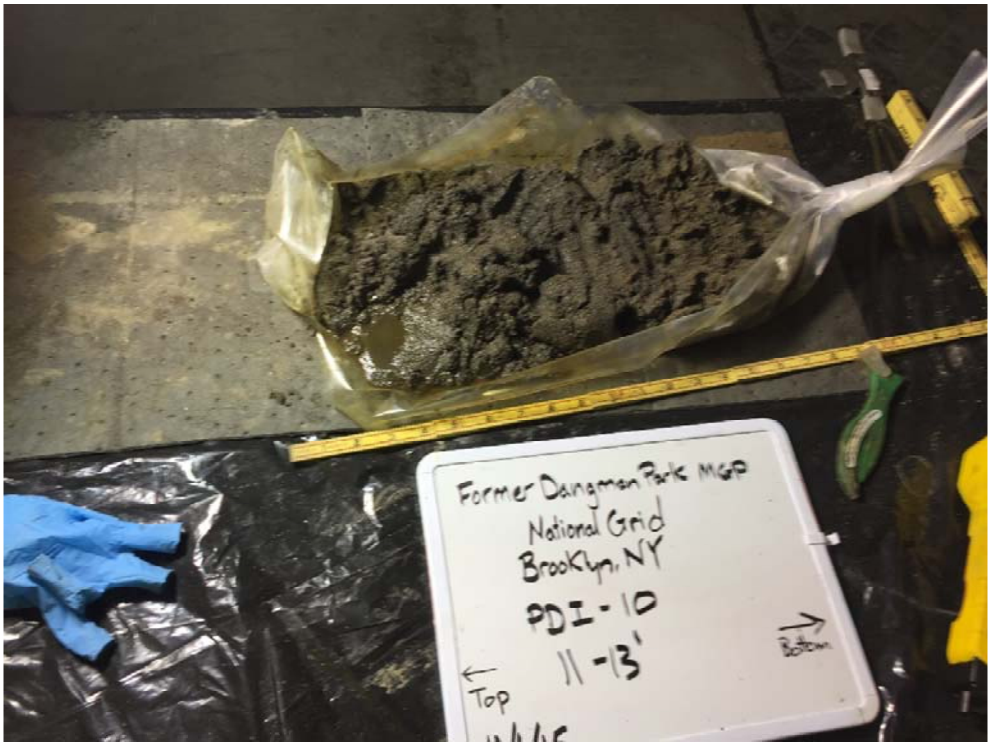
Description: Strong petroleum-like odor, light brown to yellow light NAPL coating, trace brown NAPL blebs (~2 mm diameter)

Location: SRI-10 (9-11')

Photograph taken by: Will Stephens

Date: 10/1/2015

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 14

Description: (11.0-12.0') Moderate coating of light brown to yellow NAPL, trace brown NAPL blebs (~2 mm diameter), petroleum-like odor; (12.0-13.0') Strong petroleum-like odor, light yellow NAPL coating

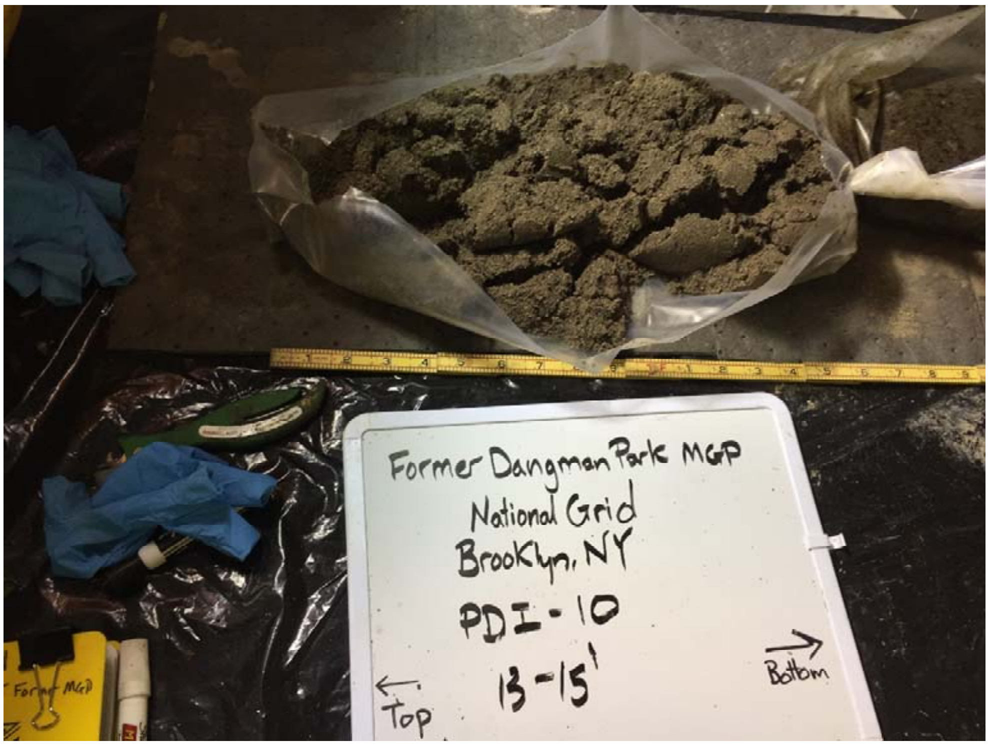
Location: SRI-10 (11-13')

Photograph taken by: Will Stephens

Date: 10/1/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 15

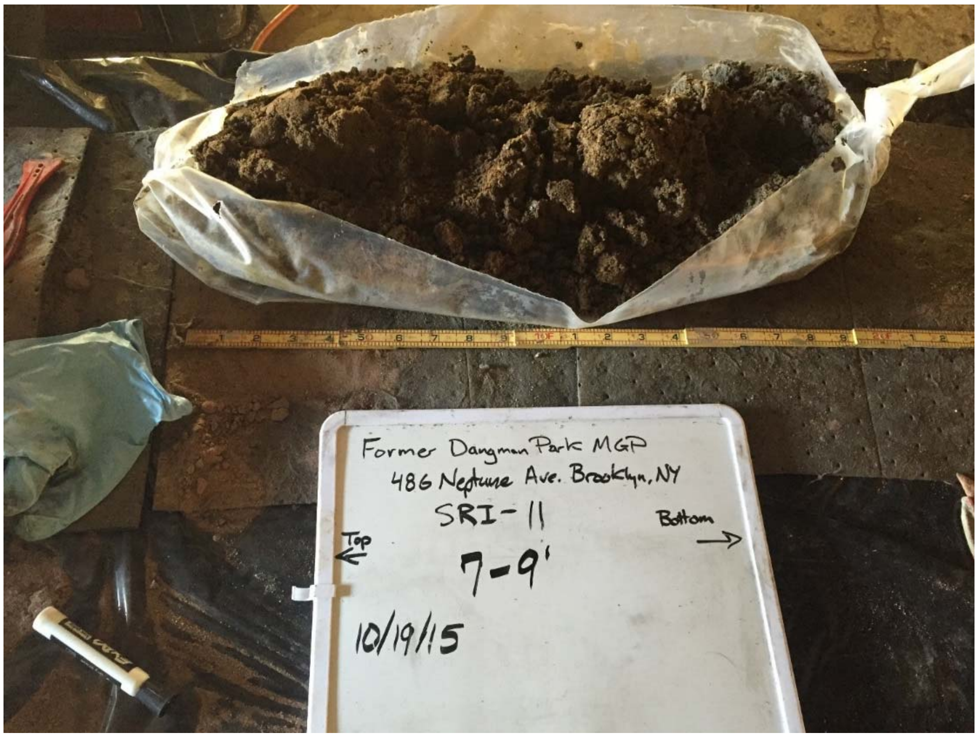
Description: Moderate petroleum-like odor, very light yellow NAPL coating

Location: SRI-10 (13-15')

Photograph taken by: Will Stephens

Date: 10/1/2015

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 16

Description: (8.3-9.0') Moderate petroleum-like odor, light coating of yellow-brown NAPL

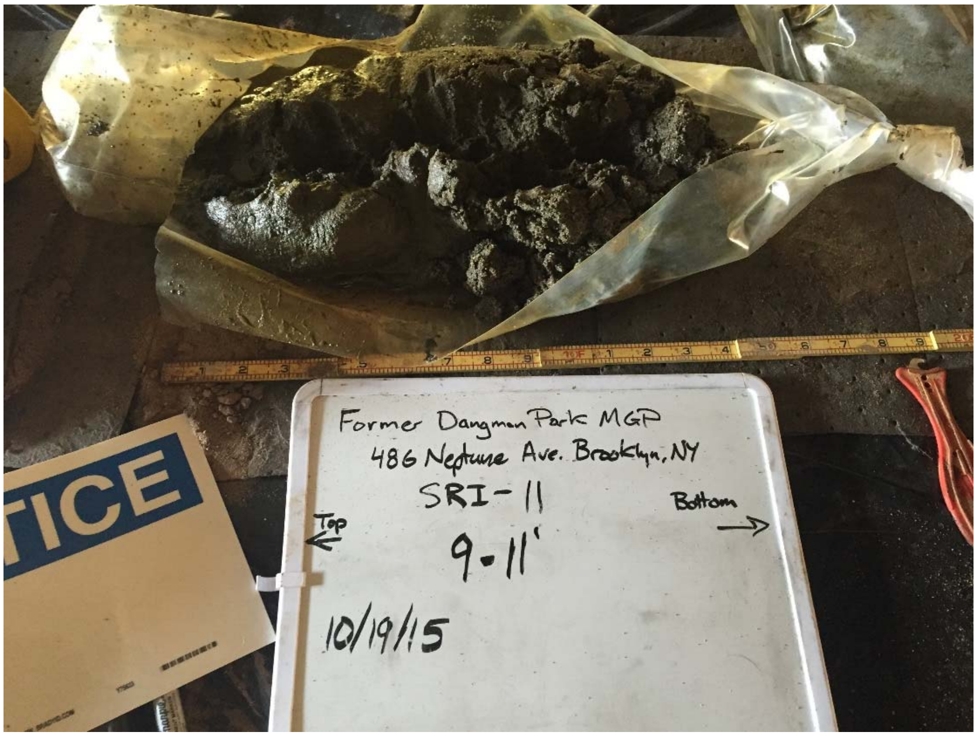
Location: SRI-11 (7-9')

Photograph taken by: Will Stephens

Date: 10/19/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



Photograph: 17

Description: Moderate coating of yellow NAPL, strong petroleum-like odor

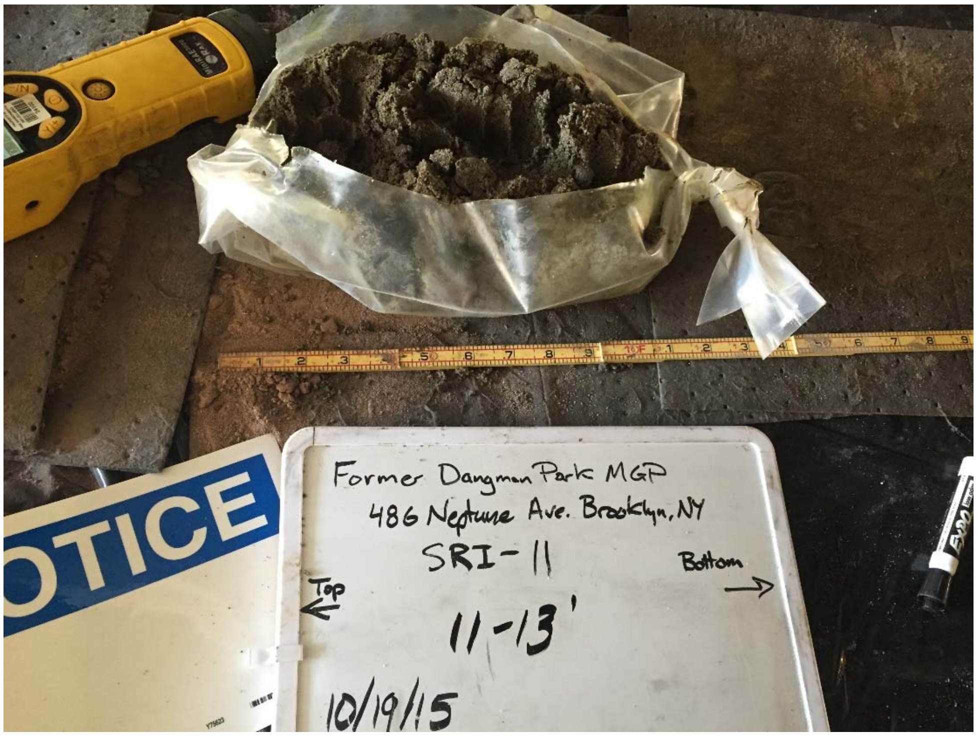
Location: SRI-11 (9-11')

Photograph taken by: Will Stephens

Date: 10/19/2015

PHOTOGRAPH LOG
PETROLEUM NAPL OBSERVATIONS

National Grid
Former Dangman Park MGP Site
Brooklyn, New York



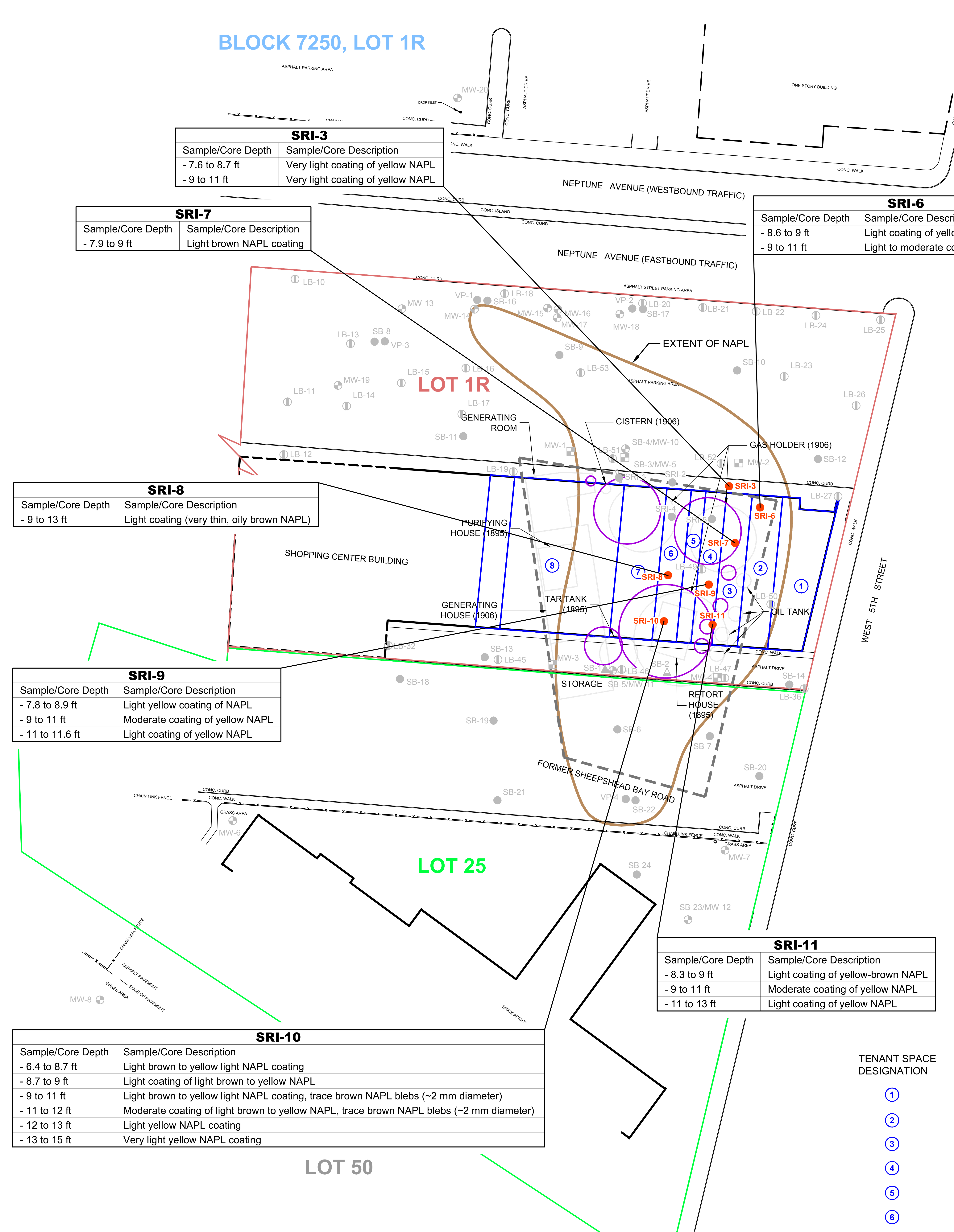
Photograph: 18

Description: Light coating of yellow NAPL, strong petroleum-like odor

Location: SRI-11 (11-13')

Photograph taken by: Will Stephens

Date: 10/19/2015



SRI-3

Sample/Core Depth	Sample/Core Description
- 7.6 to 8.7 ft	Very light coating of yellow NAPL
- 9 to 11 ft	Very light coating of yellow NAPL

SRI-7

Sample/Core Depth	Sample/Core Description
- 7.9 to 9 ft	Light brown NAPL coating

SRI-6

Sample/Core Depth	Sample/Core Description
- 8.6 to 9 ft	Light coating of yellow NAPL
- 9 to 11 ft	Light to moderate coating of yellow NAPL

SRI-8

Sample/Core Depth	Sample/Core Description
- 9 to 13 ft	Light coating (very thin, oily brown NAPL)

SRI-9

Sample/Core Depth	Sample/Core Description
- 7.8 to 8.9 ft	Light yellow coating of NAPL
- 9 to 11 ft	Moderate coating of yellow NAPL
- 11 to 11.6 ft	Light coating of yellow NAPL

SRI-11

Sample/Core Depth	Sample/Core Description
- 8.3 to 9 ft	Light coating of yellow-brown NAPL
- 9 to 11 ft	Moderate coating of yellow NAPL
- 11 to 13 ft	Light coating of yellow NAPL

SRI-10

Sample/Core Depth	Sample/Core Description
- 6.4 to 8.7 ft	Light brown to yellow light NAPL coating
- 8.7 to 9 ft	Light coating of light brown to yellow NAPL
- 9 to 11 ft	Light brown to yellow light NAPL coating, trace brown NAPL blebs (~2 mm diameter)
- 11 to 12 ft	Moderate coating of light brown to yellow NAPL, trace brown NAPL blebs (~2 mm diameter)
- 12 to 13 ft	Light yellow NAPL coating
- 13 to 15 ft	Very light yellow NAPL coating

LEGEND:

- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 1R
- APPROXIMATE BOUNDARY OF BLOCK 7273, LOT 25
- APPROXIMATE FORMER MGP SITE BOUNDARY
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS)
- FORMER MGP FEATURE (1895 AND/OR 1906 SANBORN FIRE INSURANCE MAPS) ADJUSTED BASED ON FIELD OBSERVATIONS OF POTENTIAL GAS HOLDER WALL AT SOIL BORING LOCATION SRI-1
- TENANT SPACE APPROXIMATE BOUNDARY
- 1 TENANT SPACE DESIGNATION
- SB-1 SITE CHARACTERIZATION SOIL BORING LOCATION (ARCADIS, 2009)
- SB-2 SITE CHARACTERIZATION SOIL BORING/GEOPROBE GROUNDWATER SAMPLING LOCATION (ARCADIS, 2009)
- MW-1 SITE CHARACTERIZATION MONITORING WELL LOCATION (ARCADIS, 2009)
- SB-7 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING/ VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2011)
- SB-8 REMEDIAL INVESTIGATION NAPL DELINEATION SOIL BORING LOCATION (ARCADIS, 2011 AND 2012)
- MW-6 REMEDIAL INVESTIGATION MONITORING WELL LOCATION (ARCADIS, 2011, 2012, AND 2013)
- VP-1 REMEDIAL INVESTIGATION VERTICAL AQUIFER PROFILE TEMPORARY MONITORING WELL LOCATION (ARCADIS, 2012)
- SRI-10 SUPPLEMENTAL REMEDIAL INVESTIGATION SOIL BORING LOCATION (ARCADIS, 2015)
- LB-10 PROPERTY OWNER DRILLED BORING (LANGAN, 2015)
- SRI-3 LOCATION WHERE PETROLEUM COATED SOIL WAS OBSERVED

TENANT SPACE DESIGNATION	TENANT SPACE IDENTIFICATION
1	APPLE BANK
2	VACANT 2015 (FORMER RADIO SHACK)
3	VACANT 2015 (FORMER MARTIAL ARTS)
4	VACANT 2015 (FORMER MEDICAL SUPPLY)
5	EASTERN CHINESE RESTAURANT
6	VACANT 2015 (FORMER KURT CLEANERS)
7	CAPITAL ONE
8	CVS PHARMACY

0 60' 120'
SCALE IN FEET

NOTES:

1. MONITORING WELL AND SOIL BORING LOCATIONS SURVEYED RELATIVE TO THE NEW YORK STATE PLANE COORDINATE SYSTEM, LONG ISLAND ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. LOCATIONS OF FORMER MGP FEATURES ARE APPROXIMATE.
3. BASE MAP BY DONALD G. DEKENIPP L.S., P.C., PROFESSIONAL LAND SURVEYOR.
4. THE EXTENT OF NAPL IS BASED ON THE OBSERVATION OF NAPL AND/OR BLEBS IN THE SOIL BORINGS DURING THE SITE CHARACTERIZATION AND REMEDIAL INVESTIGATION. STAINED SOIL OR A SHEEN WERE NOT INCLUDED IN THE MAPPING OF THE EXTENT OF NAPL. THE EXTENT OF NAPL HAS NOT CHANGED FROM THE NYSDEC-APPROVED RI REPORT.
5. SOIL BORING LOCATIONS WITH ASSOCIATED SOIL OBSERVATION BOXES ARE LOCATIONS WHERE PETROLEUM NAPL COATED SOIL WAS OBSERVED. NAPL COATED INCLUDES LIGHT OR MODERATE COATING.
6. TENANT SPACE LOCATIONS SHOWN ARE APPROXIMATE BASED ON INFORMATION OBTAINED BY ARCADIS DURING THE SITE CHARACTERIZATION AND ADDITIONAL INFORMATION PROVIDED BY THE PROPERTY OWNER IN 2015; LOCATIONS WEST OF CVS PHARMACY (#8) ARE NOT SHOWN.
7. THE PROPERTY OWNER DRILLED BORING LOCATIONS ARE APPROXIMATE BASED ON A LANGAN DRAWING DATED OCTOBER 15, 2015.

NATIONAL GRID
FORMER DANGMAN PARK MGP SITE
BROOKLYN, NEW YORK

PETROLEUM NAPL OBSERVATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau C
625 Broadway, 11th Floor, Albany, NY 12233-7014
P: (518) 402-9662 I F: (518) 402-9679
www.dec.ny.gov

August 18, 2016

Ms. Katherine Vater
Project Manager
National Grid – Site Investigation and Remediation
287 Maspeth Ave
Brooklyn, NY 11211-1703

Dear Ms. Vater:

Re: K – Dangman Park MGP
Kings County, site no. 224047
Former Dangman Park Manufactured Gas Plant Site – Recommended IRMs (Received August 16, 2016)

The New York State Department of Environmental Conservation (the Department) has reviewed the referenced letter scope of work. The scope of work is satisfactory to the Department.

However, the Department notes that full excavation of the tar tank area is not feasible at this time, due to the presence of multiple utility lines traversing the area. It is understood that these lines are slated to remain in service during Phase 1 of redevelopment, but may be deactivated as Phase 2 moves forward.

This utility corridor has not been fully investigated, but based on adjacent observations, it appears that the portion of it adjacent to the tar tank may be as contaminated as the rest of the tar tank which has been investigated.

In light of this, when the proposed back alley excavation work has been completed, measures must be taken to prevent recontamination of the backfill material by potentially mobile NAPL in the unremediated soils beneath the utility corridor.

Based on observation of the distribution of source material in the proposed back alley excavation area, a decision will be made as to whether additional remedial work will be required once the adjacent utility corridor is deactivated and becomes available for remediation. It is understood that the developer plans to have the Phase 1 redevelopment completed before the utility deactivation can take place. Given the apparently small size of the contaminated area beneath the utility corridor, and the proximity to the Phase 1 development, the Department would consider a small scale solidification project to address this material if remediation becomes necessary.

Please incorporate this note in the revised IRM work plan that you will submit to the Department. We will review the work plan on an expedited schedule. Please contact me with any questions via email at william.wu@dec.ny.gov, or via phone at (518) 402-9662.

Sincerely,

William Wu
Environmental Engineer 1
Remedial Bureau C
Division of Environmental Remediation

ec: G. Cross, NYSDEC
A. DeMarco, NYSDOH
J. Deming, NYSDOH
S. Feldman, Arcadis of New York, Inc.
M. Cathy Geraci, Arcadis of New York, Inc.

Geraci, Catherine

Subject: FW: EXT || dangman park phase 1 development and back alley gas line

---

From: Wu, William (DEC) [william.wu@dec.ny.gov]
Sent: Tuesday, August 23, 2016 12:06 PM
To: Vater, Katherine
Cc: Cross, Gardiner (DEC)
Subject: RE: EXT || dangman park phase 1 development and back alley gas line

Dear Ms. Vater:

Re: K – Dangman Park MGP, site no. 224047

In light of receiving the recent communication from the property owner regarding the development plans in the back alley, the Department has concluded that additional remediation is infeasible in the back alley beyond what has been proposed in the IRM scope of work letter received August 16, 2016. Nonetheless, as stated in the reply letter from the Department dated August 18, 2016, when the proposed back alley excavation work has been completed, measures must be taken to prevent recontamination of the backfill material by potentially mobile NAPL in the unremediated soils beneath the utility corridor.

Sincerely,

William Wu
Environmental Engineer 1, Division of Environmental Remediation

New York State Department of Environmental Conservation
625 Broadway Floor 11, Albany, NY 12233-7014
P: (518) 402-9662 | F: (518) 402-9679 | william.wu@dec.ny.gov
www.dec.ny.gov | |

From: Vater, Katherine [mailto:Katherine.Vater@nationalgrid.com]
Sent: Monday, August 22, 2016 2:22 PM
To: Wu, William (DEC) <william.wu@dec.ny.gov>
Subject: FW: EXT || dangman park phase 1 development and back alley gas line

William - Below is the response to your question regarding the utilities present at the Dangman Park Site.

Please let me know if you need any further clarification.

Thanks,
Katherine

From: Jacob Cohen [JacobC@cammebys.com]
Sent: Monday, August 22, 2016 2:19 PM
To: Vater, Katherine
Cc: Jack Rothenberg; Daniel J. Smith; Jennifer Coghlan (jcoghlan@sprlaw.com); P. Leigh Bausinger (Leigh.Bausinger@dbr.com); catherine.geraci@arcadis.com
Subject: Re: EXT || dangman park phase 1 development and back alley gas line

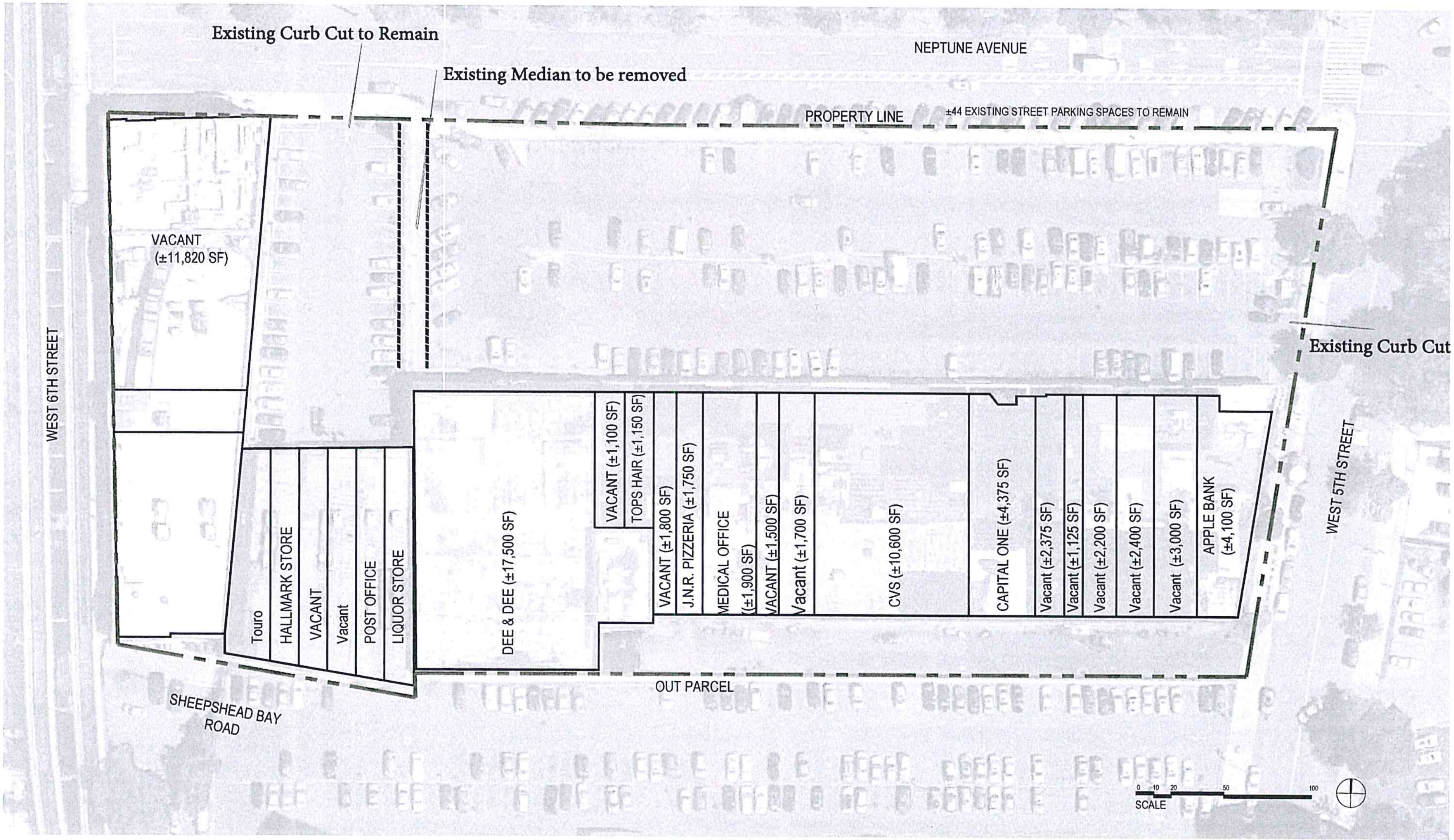
Katherine,

Following is an outline of our plans for construction phasing and schedule for Neptune.

Neptune Phasing / Schedule Summary

- The new building, which will extend to the lot line in all directions, is to be constructed in two phases (see attached figures). Phase I, which is comprised of the eastern portion of the site, will include only commercial space and parking areas. Phase II (the western portion of the site) includes commercial space, parking and the high-rise residential tower. Phase I demolition will begin on October 3, 2016, and be completed by December 2, 2016. The Phase II area will remain in use by existing commercial tenants throughout Phase I construction.
- The utility corridor in the southern portion of Phase I includes underground utilities (i.e., a natural gas line, water line, sanitary line, stormwater lines, and electric service line) that are currently active and must remain continually active beyond the completion of Phase I work. These utilities will remain in continual use until all clients vacate their Phase II locations which is targeted for November 6, 2017 at the earliest.
- Pile and pile cap installation within Phase I will begin on October 20, 2016, in areas outside the planned remediation / excavation areas and will immediately continue in the remediation areas as soon as excavation is completed. The overlying surface slab construction (and subsequent steel erection, finish work, etc.) in Phase I is to be initiated immediately upon pile cap completion. The new slab will cover the entire Phase I footprint including the still active utility corridor and all targeted excavation and injection areas. Therefore, there is absolutely no opportunity for additional, phased, and/or contingent remediation after the start of excavation and injection activities.

Jacob Cohen
Cammeby's Management Co. LLC
600 Ave Z
Brooklyn, NY 11223
p: 718-743-8030 x5155
c: 646-879-2893
jacobc@cammebys.com



PRELIMINARY

THIS CONCEPTUAL STUDY IS FOR PLANNING PURPOSE ONLY.
SITE SPECIFIC INFORMATION SUCH AS SURVEY, EXISTING CONDITIONS, ZONING, AND CODE REQUIREMENTS MUST BE VERIFIED.

SITE PLAN

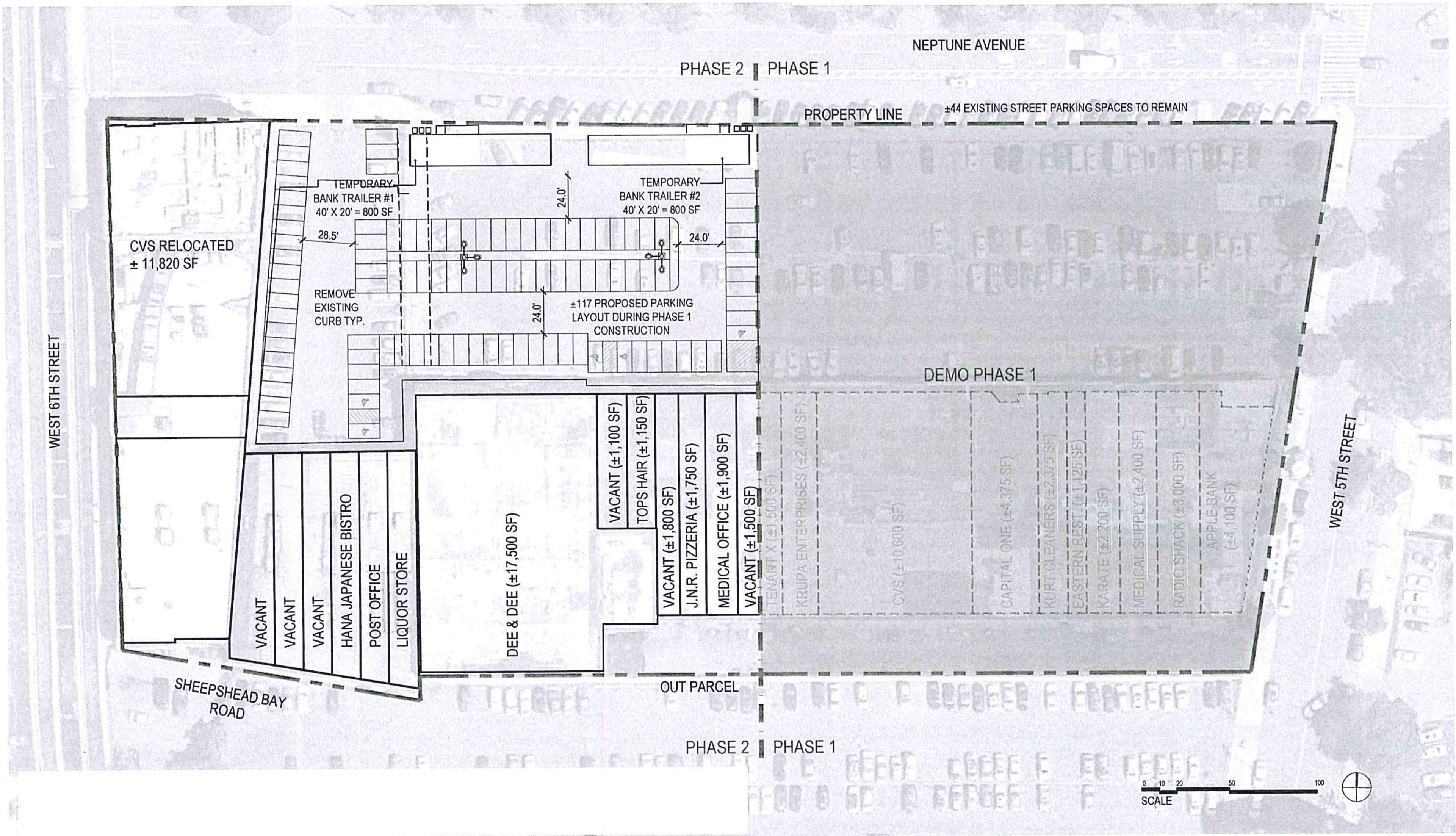
S9 an affiliate of Perkins Eastman Architects, PC

CAMMEBY'S MANAGEMENT CO. LLC

532 NEPTUNE AVENUE
BROOKLYN, NEW YORK

OPTION 2
JULY 13, 2015

1



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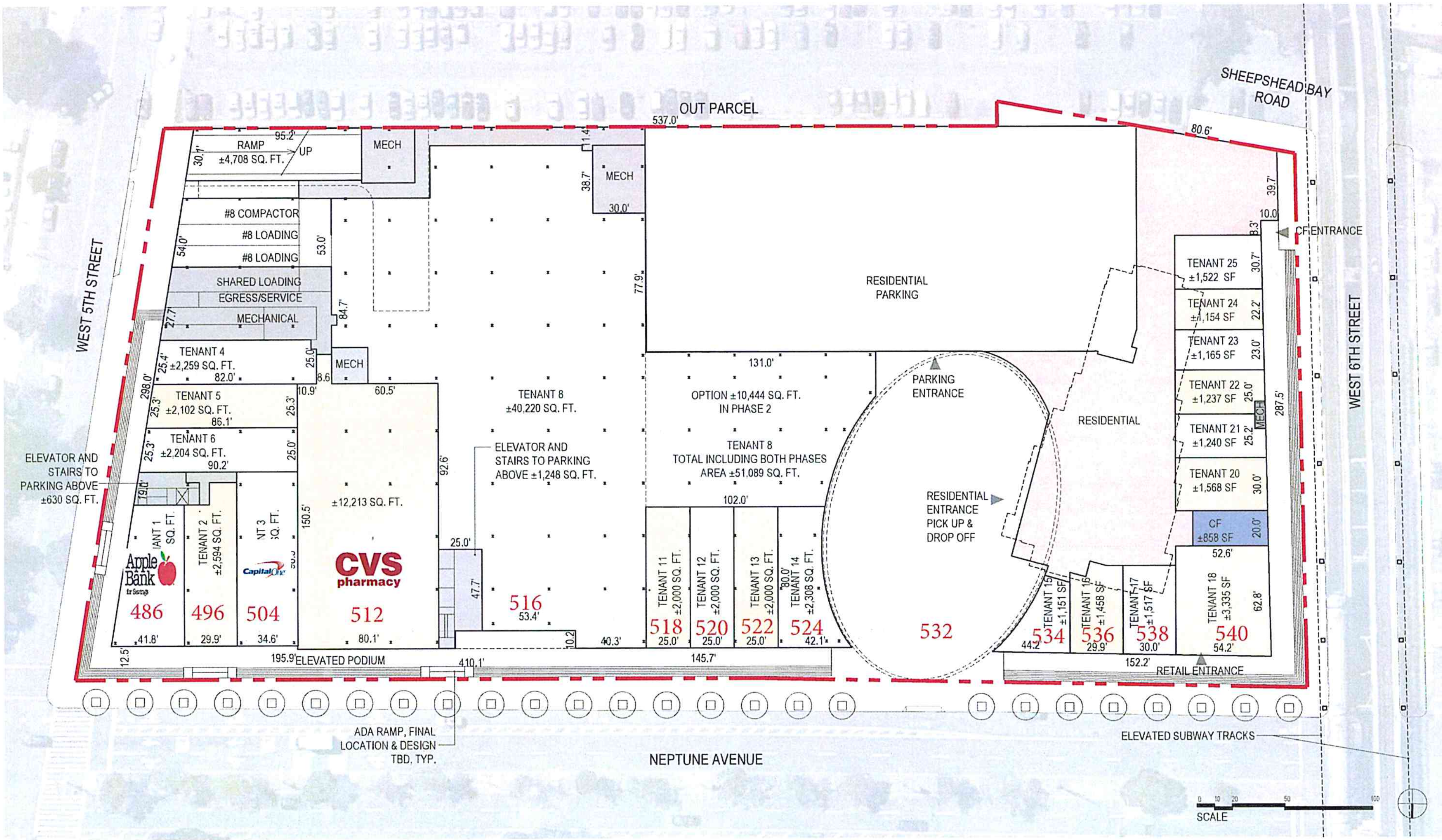
SITE SPECIFIC INFORMATION SUCH AS SURVEY, EXISTING CONDITIONS, ZONING, AND CODE REQUIREMENTS MUST BE VERIFIED.

532 NEPTUNE AVENUE
BROOKLYN, NEW YORK

CAMMEBY'S MANAGEMENT CO. LLC

Proposed Neptune Avenue Addresses



PRELIMINARY

THIS CONCEPTUAL STUDY IS FOR PLANNING PURPOSE ONLY.
SITE SPECIFIC INFORMATION SUCH AS SURVEY, EXISTING CONDITIONS, ZONING, AND CODE REQUIREMENTS MUST BE VERIFIED.

GROUND FLOOR

532 NEPTUNE AVENUE
BROOKLYN, NEW YORK

S9 an affiliate of Perkins Eastman Architects, PC

CAMMEBY'S MANAGEMENT CO. LLC

Arcadis U.S., Inc.

Two Huntington Quadrangle

Suite 1S10

Melville, New York 11747

Tel 631 249 7600

Fax 631 249 7610

www.arcadis.com