OU-1 ALTERNATIVES ANALYSIS REPORT
FORMER OSSINING WORKS SITE
OSSINING, NEW YORK
SITE NO. 360172

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OU-1 Alternatives Analysis Report

Former Ossining Works Site
Site No. 360172
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Certification Statement

I, Jason D. Brien, certify that I am currently a New York State registered professional engineer and that this *OU-1 Alternatives Analysis Report* 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) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

____ Date _______________

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Acronyms and Abbreviations

AAR	Alternatives Analysis Report
BFS	blast furnace slag
bss	below sediment surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CFR	Code of Federal Regulations
COC	constituents of concern
CWA	Clean Water Act
CY	cubic yard
COPECs	constituents of potential environmental concern
DAR	Division of Air Resources
DER	Division of Environmental Remediation
DUS	dynamic underground stripping
ECL	Environmental Conservation Law
FEMA	Federal Emergency Management Agency
FWRIA	Fish and Wildlife Resource Impact Analysis
GRAs	general response actions
HASP	health and safety plan
HPO	hydrous pyrolysis/oxidation
ISCO	in-situ chemical oxidation
ISS	in-situ solidification
LDRs	Land Disposal Restrictions
LTTD	low-temperature thermal desorption
MGP	manufactured gas plant
MNR	monitored natural recovery
MTA	Metropolitan Transit Authority
NAPL	non-aqueous phase liquid
NPDES	National Pollutant Discharge Elimination System
NYCRR	New York Code of Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation

NYSDOH	New York State Department of Health
O&M	operation and maintenance
ODPW	Ossining Department of Public Works
OSHA	Occupational Safety and Health Administration
OU	operational unit
PAHs	polycyclic aromatic hydrocarbons
POTW	publicly-owned treatment works
PPE	personal protective equipment
PRB	permeable reactive barrier
QA	quality assurance
QC	quality control
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
SCGs	standards, criteria, and guidance
SCOs	soil cleanup objectives
SMP	Site Management Plan
SPDES	State Pollutant Discharge Elimination System
SVOC	semi-volatile organic compounds
TCLP	Toxicity Characteristic Leaching Procedure
TOGS	Technical and Operational Guidance Series
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
UTS	Universal Treatment Standards
UV	ultraviolet
VCA	Voluntary Cleanup Agreement
VOC	volatile organic compounds

Executive Summary

Introduction

This Alternatives Analysis Report (AAR) presents an evaluation of remedial alternatives to address MGP-related environmental impacts identified for Operable Unit No. 1 (OU-1) of the Consolidated Edison Company of New York, Inc. (Con Edison) Ossining Works former manufactured gas plant (MGP) site (site) located in Ossining, New York. The site is identified as New York State Department of Environmental Conservation (NYSDEC) Site No. 360172. This AAR has been prepared in accordance with an existing multi-site Consent Order (Consent order No, 0.20180516-519) between Con Edison and the NYSDEC.

The purpose of this AAR is to identify and evaluate remedial alternatives that are:

- Appropriate for site-specific conditions;
- Protective of public health and the environment; and
- Consistent with relevant sections of NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10) and Title 6 of the New York Code of Rules and Regulations (NYCRR) Part 375-6 (6 NYCRR Part 375-6).

The overall objective of this AAR is to recommend a reliable and cost-effective remedy that achieves the site-specific remedial action objectives (RAOs) and the best balance of the NYSDEC evaluation criteria.

Background

OU-1 of the former Ossining Works site is located in the Village of Ossining located in Westchester County, New York (Figure 1). As shown on Figure 2, OU-1 consists of two parcels (divided by Central Avenue) as follows:

- The largest parcel (south of Central Avenue) is where most of the currently occupied by the Ossining Department of Public Works (ODPW) and consists of an approximately 3.45-acre area bordered by Central Avenue to the north, Main Street to the south, and North Water Street to the west. Additionally, this parcel is divided by Kill Brook which flows from east to west across OU-1.

  Most of the historical MGP features associated with the former Ossining Works were located in the area south of Kill Brook, including gas generators, purifies, coal storage, and gas holders. The area south of Kill Brook. is mostly covered with asphalt and concrete pads and is currently utilized for storage of yard waste and recycled materials collected by ODPW. No structures are currently located in the area south of Kill Brook. The area north of Kill Brook is occupied by an ODPW vehicle garage and storage building located within an asphalt-paved and fenced area. The only historical MGP features in the area north of Kill Brook included a small gas holder and possible oil storage tanks. The eastern portion of the parcel consists of a wooded area that is bordered by steep-nearly vertical bedrock walls.

  A retaining wall is located along Kill Brook. The retaining wall starts at the eastern portion of OU-1, along the limits of the wooden area, and extends to the western portion of OU-1 forming a bulkhead in both sides of Kill Brook. The retaining wall generally starts at ground surface and increases in height to approximately 10 feet at the western portion of OU-1 (i.e., the ground surface in OU-1 is 10 feet higher in elevation that Kill Brook).

- The second parcel consists of a 0.5-acre area located north of Central Avenue, near the intersection with North Water Street. The parcel north of Central Avenue was the location of a former gas holder associated with the Ossining Works site and is currently occupied by a Con Edison electrical substation.

OU-1 generally comprises the former MGP operations area of the former Ossining Works site.

Nature and Extent of Impacts

As identified in the RI Report, MGP-related impacts in the form of coal tar, non-aqueous phase liquid (NAPL), and elevated concentrations of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, polycyclic aromatic hydrocarbons (PAHs), and (to a lesser extent) cyanide have been identified as the constituents of concern (COCs) for the site. The MGP-related impacts are generally distributed as follows:

Distribution of Visual Impacts and NAPL

NAPL is the most frequently encountered environmental impact resulting from the former MGP operations at OU-1. Evidence of visible NAPL (i.e., NAPL in quantities greater than sheens) has been generally observed in the south-central portion of OU-1 within the sand and gravel unit at depths varying from 1.6 feet below grade to 26.8 feet below grade. Visible NAPL was encountered at 12 of the 19 soil borings/monitoring wells. NAPL was observed in the saturated zone in a majority of the locations, with the exception of TP-01, SB-07, SB-18, SB-20, and SB-52, where NAPL was observed only in the unsaturated zone (NAPL was observed in both the saturated zone and the unsaturated zones at SB-05 and SB-19). No evidence of NAPL was observed at the property currently occupied by the Con Edison-owned electrical substation north of Central Avenue. Forensic fingerprint analyses of one soil sample (from SB-19) indicates carbureted water gas as a potential hydrocarbon source. NAPL observations are shown on the geologic cross-sections presented as Figure 5. In addition, Figure 7 shows locations where NAPL was identified in subsurface soil.

Soil Characterization

BTEX compounds, PAHs, and inorganic constituents were detected in several of the soil samples collected as part of the remedial investigations. Subsurface soil analytical results were compared to restricted-residential and commercial use soil cleanup objectives (SCOs) and SCOs for protection of groundwater presented in 6 NYCRR Part 375-6. The restricted-residential SCOs are applicable to OU-1 based on the current and anticipated future site use. The SCOs for the protection of groundwater are also potentially applicable because Kill Brook is located within OU-1. The highest concentrations of BTEX and PAHs were generally detected in soil samples collected at locations that contained NAPL. Soil impacts are distributed as follows:

- BTEX concentrations identified in soil samples collected at OU-1 are shown on Figure 9. Individual BTEX compounds were detected at concentrations exceeding the SCOs for the protection of groundwater in 12 of 57 subsurface soil samples collected from 26 locations. A total of 4 subsurface soil samples contained individual BTEX compounds at concentrations exceeding restricted-residential SCOs and no subsurface soil samples contained individual BTEX compounds at concentrations exceeding commercial SCOs.
- PAHs concentrations identified in soil samples collected at OU-1 are shown on Figure 10. Individual PAHs were detected at concentrations exceeding SCOs for the protection of groundwater and at concentrations exceeding the restricted-residential use SCOs in 31 of 57 subsurface soil samples collected from 26 locations. A total of 29 soil samples contained individual PAH compounds at concentrations exceeding the commercial use SCOs.
- Cyanide was identified at concentrations exceeding the restricted-residential and commercial use SCOs in one (1) subsurface soil sample collected from the 9- to 10-foot depth interval at boring SB-52. This boring location was in the area of the former purifiers. Cyanide is frequently associated with purifier waste impacted material. Cyanide was not detected at concentrations exceeding the SCOs in the remaining soil samples.

Five (5) additional inorganic constituents were detected at concentrations greater than applicable SCOs, including arsenic, barium, copper, lead, and mercury. However, elevated concentrations of inorganics were attributed to historic and recent fill materials and/or background concentrations.

Groundwater Characterization

Analytical results for groundwater samples collected during the remedial investigation were compared to the Class GA groundwater quality standards/guidance values presented in the NYSDEC's Division of Water, Technical and Operational Guidance Series 1.1.1: Ambient Water Quality Standards and Groundwater Effluent Limitations (TOGS 1.1.1) (NYSDEC, 2008). Analytical results indicated the following:

- BTEX concentrations identified in groundwater samples collected at OU-1 are shown on Figure 11. Individual BTEX compounds were detected at concentrations exceeding the NYSDEC standards/ guidance values in groundwater samples collected at monitoring wells MW-04 and MW-06.
- PAHs concentrations identified in groundwater samples collected at OU-1 are shown on Figure 12. Individual PAH compounds were detected at concentrations exceeding the NYSDEC standards/guidance values in groundwater samples collected at monitoring wells MW-03, MW-04, and MW-06.
- Total cyanide was not detected at concentrations exceeding the groundwater quality standards at any of the monitoring well locations.

Iron and sodium were detected at concentrations exceeding the groundwater quality standards in each of the groundwater samples collected from MW-03, MW-04, and MW-06. Manganese was also detected at concentrations exceeding the groundwater quality standards in a groundwater sample collected from MW-6. However, groundwater exceedances for iron, sodium, and manganese detections were attributed to naturally occurring background conditions.

Sediment Quality

Analytical results for individual BTEX compounds and total PAHs were compared to sediment guidance values (SGVs) presented in the NYSDEC Division of Fish, Wildlife, and Marine Resources guidance document entitled Screening and Assessment of Contaminated Sediment (CP-60) (NYSDEC, June 2014). The sediment results are compared to the NYSDEC SGVs for Class A through Class C water. The portion of Kill Brook that flows through OU-1 is classified by the NYSDEC as a Class C freshwater system. Per the instructions in the NYSDEC guidance, the sediment results were also compared to the USEPA PAH SGVs. Sediment impacts are distributed as follows:

- Individual BTEX compounds were not detected at concentrations exceeding the NYSDEC CP-60 criteria in any sediment sample collected in Kill Brook.
- PAH concentrations identified in sediment samples collected from the reach of Kill Brook that flows through OU-1 are shown on Figure _13. Total PAHs in surface sediment samples were below the NYSDEC Class A SGV. Total PAHs in subsurface sediment samples collected at SS-06 and SS-07 exceeded the NYSDEC Class A SGV and were well below the Class C SGV. Individual PAH concentrations were also below the USEPA PAH SGVs, with the exception of phenanthrene and pyrene at 6- to 12-inch depth interval at sampling location SS-07.

Fish and Wildlife Resources Impact Assessment

The FWRIA was conducted to identify fish and wildlife resources that exist at and in the vicinity of the site and evaluate the potential for exposure of these resources to MGP-related impacts in site soil and sediment.

Soil sample analytical results for individual BTEX compounds, PAHs, and cyanide were compared to the SCOs for the Protection of Ecological Resources presented in 6 NYCRR Part 375. Based on the comparison of soil data to ecological SCOs, PAHs are the primary constituents of potential environmental concern (COPECs) for the site. However, exposure of ecological receptors to MGP-related COPECs is not expected to be significant given the general absence of wildlife habitat on the site. Although metals were detected in site soils, these constituents are generally found in urban fill and are not MGP-related.

Based on the comparison of sediment data to ecological screening values, PAHs are the primary COPEC. However, exposure of ecological receptors to sediment within Kill Brook is likely limited due to surrounding land use, the small size of Kill Brook, and anthropogenic disturbances. The RI sediment results support a conclusion that the former Ossining Works site is not a significant source of MGP-related impacts to sediment in Kill Brook. Based on the findings of the sediment investigation, no further action in connection with the Kill Brook adjacent to the former Ossining Works site was recommended.

Remedial Action Objectives

RAOs are developed to address the specific COCs at the site, and to assist in developing goals for cleanup of COCs in each media that may require remediation. The RAOs in the table below have been developed based on the generic RAOs listed on NYSDEC's website (http://www.dec.ny.gov/regulations/67560.html).

Table ES.1 – Remedial Action Objectives

RAOs for Soil
RAOs for Public Health Protection
1. Prevent, to the extent practicable, ingestion/direct contact with MGP-related COCs/ NAPL.
2. Prevent, to the extent practicable, inhalation of or exposure to MGP-related COCs from impacted soil.
RAOs for Environmental Protection
3. Address, to the extent practicable, MGP-related COCs/NAPL in soil that could result in impacts to groundwater, surface water, or sediment.
4. Prevent, to the extent practicable, impacts to biota from ingestion/direct contact with soil containing MGP-related COCs.
RAOs for Groundwater
RAOs for Public Health Protection
1. Prevent, to the extent practicable, ingestion of groundwater containing MGP-related dissolved phase COCs at concentrations exceeding NYSDEC groundwater quality standards or guidance values.
2. Prevent, to the extent practicable, contact with or inhalation of volatile organic compounds (VOCs) from groundwater containing MGP-related COCs at concentrations exceeding NYSDEC groundwater quality standards or guidance values.
RAOs for Environmental Protection
3. Restore groundwater to pre-disposal/pre-release conditions, to the extent practicable.
4. Prevent the discharge of MGP-related COCs from groundwater to surface water and sediment, to the extent practicable.
5. Address the source of MGP-related groundwater impacts to the extent practicable.
RAOs for Soil Vapor
RAOs for Public Health Protection
1. Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the site.

Remedial Technology Screening and Development of Remedial Alternatives

The objective of the technology screening is to:

- Present general response actions (GRAs) and the associated remedial technology types and technology process options that have documented success at achieving similar RAOs at MGP sites.
- Identify options that are implementable and potentially effective at addressing site-specific concerns.

Based on this screening, remedial technology types and technology process options were eliminated or retained and subsequently combined into potential remedial alternatives for further, more detailed evaluation. This approach is consistent with the screening and selection process provided in NYSDEC DER-10.

Based on the results of the technology screening, the following potential remedial alternatives were developed:

- Alternative 1 – No Action;
- Alternative 2 – Targeted Soil Removal and NAPL Recovery;
- Alternative 3 – Targeted Soil Removal, Targeted ISS Treatment of Visually Impacted Material, and NAPL Recovery; and
- Alternative 4 – Soil Removal to Unrestricted Use SCOs.

Based on the remedial investigation results, no remedial activities are proposed to address the former gas holder at the Con Edison electrical substation located across Central Avenue from the main portion of OU-1.

Detailed Evaluation of Alternatives

Following the development of the remedial alternatives, a detailed description of each alternative was prepared and each alternative was evaluated with respect to the following criteria presented in DER-10:

- Short-Term Impacts and Effectiveness;
- Long-Term Effectiveness and Permanence;
- Land Use;
- Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment;
- Implementability;
- Compliance with standards, criteria, and guidelines (SCGs);
- Overall Protectiveness of Public Health and the Environment; and
- Cost Effectiveness.

Comparative Analysis of Alternatives

Following the detailed evaluation of each alternative, a comparative analysis of the alternatives was completed using the evaluation criteria. The comparative analysis identified the advantages and disadvantages of each alternative relative to each other and with respect to the evaluation criteria. The results of the comparative analysis were used as a basis for recommending the preferred remedy for achieving the RAOs.

Preferred Remedial Alternative

The results of the comparative analysis were used as the basis for recommending a preferred remedial alternative for the site: Alternative 3. The primary components of the preferred remedial alternative consist of the following:

- Excavating 2,830 cy of material to depths up to 5 feet below grade to facilitate ISS treatment activities and/or to address 610 cy of soil containing COCs at concentrations greater than 6NYCRR Part 375-6 restricted residential SCOs and/or significant quantities of NAPL.
- Conducting ISS treatment of approximately 5,890 cy of subsurface soil to address an estimated 2,880 cy of soil containing significant quantities of NAPL to depths up to 34 feet below grade.
- Installing NAPL recovery wells in the downgradient portion of OU-1 and establishing a long-term monitoring and recovery program to remove NAPL from the wells and limit the potential for future migration of NAPL downgradient of OU-1.
- Installing additional groundwater monitoring wells to establish a new groundwater monitoring network.
- Conducting annual groundwater monitoring to document the extent and concentrations of dissolved phase COCs and potential trends in COC concentrations.
- Establishing institutional controls in the form of deed restrictions and/or environmental easements to limit the future development and use of OU-1 to restricted-residential or commercial use (i.e., the site will be redeveloped to house retail and multifamily buildings); limit the potential future use of site groundwater as a source of potable or process water, without necessary water quality treatment; and to limit the permissible invasive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts.
- Preparing an SMP to document the institutional/engineering controls as well as protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities.

As part of the remedial design phase for this alternative, pre-design investigation (PDI) activities will be conducted to facilitate the development of several components of the preferred alternative, including an appropriate ISS mix design, the extent of shallow excavation and ISS areas, excavation support system(s); backfill materials and surface restoration details; and the final number, location, and construction of the NAPL recovery wells/groundwater monitoring wells. PDI activities will generally consist of advancing additional direct push borings and collecting surface soil sampling across OU-1.

1 Introduction

This Alternatives Analysis Report (AAR) presents an evaluation of remedial alternatives to address environmental impacts identified for Operable Unit No. 1 (OU-1) of the Consolidated Edison Company of New York, Inc. (Con Edison) former Ossining Works former manufactured gas plant (MGP) site (site) located in Ossining, New York. Prior to 2018, activities associated with the former Ossining Works site were addressed under an existing Voluntary Cleanup Agreement (VCA) between Con Edison and the New York State Department of Environmental Conservation (NYSDEC). The site identification number under the VCA was V00568. In 2018 the VCA was replaced by a multi-site Consent Order (Consent Order No. 0-20180516-519), with the former Ossining Works site identified as Site No. 360172. This AAR has been prepared in accordance with the multi-site consent order between Con Edison and the NYSDEC.

As indicated in the September 2020 Remedial Investigation Report (RI Report), the site is divided into three operable units as follows:

- OU-1 includes the former MGP operations area consisting of two parcels. The largest parcel is bordered by Central Avenue to the north, Main Street to the south, and North Water Street to the west. The second parcel is an active Con Edison electrical substation located north of Central Avenue near the intersection with North Water Street.
- OU-2 includes a property located west of OU-1, across Water Street, consisting of an asphalt-paved commuter parking lot for the Metropolitan Transit Authority (MTA) and several commercial and residential properties.
- OU-3 includes a property located west of OU-2 consisting of the Harbor Square Property.

Each of the above operable units represent a portion of the site remedy that for technical or administrative reasons can be addressed separately to eliminate or mitigate a release, threat of release, or exposure pathway resulting from site impacts. This AAR focuses on OU-1 of the Ossining Works former manufactured gas plant site and does not develop or evaluate potential remedial alternatives for OU-2 or OU-3 at the site.

1.1 Regulatory Framework

This AAR has been prepared to evaluate remedial alternatives to address identified environmental impacts at OU-1 in a manner consistent with the VCA and with NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC, 2010a).

This AAR has also been prepared in consideration of applicable provisions of the New York State Environmental Conservation Law (ECL) and associated regulations, including Title 6 of the New York Code of Rules and Regulations (NYCRR) Part 375-6 (6 NYCRR Part 375-6).

1.2 Purpose

The purpose of this AAR is to identify and evaluate remedial alternatives that are:

- Appropriate for site-specific conditions;
- Protective of public health and the environment; and
- Consistent with relevant sections of NYSDEC DER-10 and 6NYCRR Part 375.

The overall objective of this AAR is to recommend a reliable and cost-effective remedy that achieves the site-specific remedial action objectives (RAOs) and the best balance of the NYSDEC evaluation criteria.

1.3 Report Organization

This AAR is organized as presented in the following table.

Table 1.1 – Report Organization

Section	Purpose
Section 1 – Introduction	Provides background information relevant to the development of remedial alternatives evaluated in this AAR.
Section 2 – Identification of Standards, Criteria, and Guidance	Identifies standards, criteria, and guidance (SCGs) that govern the development and selection of remedial alternatives.
Section 3 – Development of Remedial Action Objectives	Presents the site-specific RAOs that have been developed to be protective of public health and the environment.
Section 4 – Technology Screening and Development of Remedial Alternatives	Presents the results of a screening process completed to identify potentially applicable remedial technologies and develops remedial alternatives that have the potential to meet the RAOs.
Section 5 – Detailed Evaluation of Remedial Alternatives	Presents a detailed description and analysis of each potential remedial alternative using the evaluation criteria presented in the referenced guidance documents.
Section 6 – Comparative Analysis of Alternatives	Presents a comparative analysis of the remedial alternatives using the evaluation criteria.
Section 7 – Preferred Remedial Alternative	Identifies the preferred remedial alternative for addressing the environmental concerns at the site.
Section 8 – References	Provides a list of references utilized to prepare this AAR.

1.4 Background Information

This section summarizes site background information relevant to the development and evaluation of remedial alternatives for OU-1, including location and physical setting, MGP site history and operation, and a summary of previous investigations completed at the site.

1.4.1 Site Location and Physical Setting

OU-1 of the Ossining Works Former MGP site is located in the Village of Ossining located in Westchester County, New York (Figure 1). As shown on Figure 2, OU-1 consists of two parcels (divided by Central Avenue) as follows:

- The largest parcel (south of Central Avenue) is currently occupied by the Ossining Department of Public Works (ODPW) and consists of an approximately 3.45-acre area bordered by Central Avenue to the north, Main Street to the south, and North Water Street to the west. Additionally, this parcel is divided by Kill Brook which flows from east to west across OU-1.

  Most of the historical MGP features associated with the former Ossining Works were located in the area south of Kill Brook, including gas generators, purifies, coal storage, and gas holders. The area south of Kill Brook. is mostly covered with asphalt and concrete pads and is currently utilized for storage of yard waste and recycled materials collected by ODPW. No structures are currently located in the area south of Kill Brook. The area north of Kill Brook is occupied by an ODPW vehicle garage and storage building located within an asphalt-paved and fenced area. The only historical MGP features in the area north of Kill Brook included a small gas holder and possible oil storage tanks. The eastern portion of the parcel consists of a wooded area that is bordered by steep-nearly vertical bedrock walls.

A retaining wall is located along Kill Brook. The retaining wall starts at the eastern portion of OU-1, along the limits of the wooden area, and extends to the western portion of OU-1 forming a bulkhead in both sides of Kill Brook. The retaining wall generally starts at ground surface and increases in height to approximately 10 feet at the western portion of OU-1 (i.e., the ground surface in OU-1 is 10 feet higher in elevation that Kill Brook).

- The second parcel consists of a 0.5-acre area located north of Central Avenue, near the intersection with North Water Street. The parcel north of Central Avenue was the location of a former gas holder associated with the Ossining Works site and is currently occupied by a Con Edison electrical substation.

OU-1 generally comprises the former MGP operations area of the former Ossining Works site. Historical MGP-related structures in OU-1 are shown on Figure 3.

1.4.2 Site History and Operation

The former MGP operated at OU-1 from circa 1855 to 1930 and initially included the production of coal gas. By 1904 the MGP operation transitioned to the production of carbureted water gas using the Lowe carbureted gas method. Based on a review of available records, the MGP property ownership history is as follows:

- 1855 to 1901 – Sing Gas Manufacturing Company;
- 1901 to 1905 – Ossining Light, Heat, and Power Company; and
- In 1905 the Northern Westchester Lighting Company assumed ownership of the MGP. Ownership was later incorporated under control on Consolidated Gas Company of New York (predecessor of Con Edison).

The former MGP operation initially consisted of a single gas holder, as well as a production building. By 1897, the MGP utilized a second gas holder, a gas production building, and coal houses. In 1911, the retorts were replaced by gas generators and a third gas holder was added, bringing the above ground storage capacity to 100,000 cubic feet. The original gas holder of the generator house was converted to an oil tank with a capacity of 144,000 gallons. An additional 500,000 cubic foot gas holder was constructed on the parcel north of Central Avenue in 1921. By 1924, an additional oil tank, purifying tank, and meter house had been added south of Kill Brook. Historical site structures are shown on Figure 3.

MGP operations at the site produced approximately 9 million cubic feet to 140 million cubic feet per year, operating continuously until 1929. After 1926, production decreased until the plant was placed on stand-by status in 1930. Records indicate that the former MGP was retired from service in 1943.

1.4.3 Summary of Previous Investigations and Site Activities

OU-1 has been subject to the following environmental investigations:

- 2007 Remedial Investigation (RI) conducted by CMX, Inc. (CMX) and HDR/LMR, Inc. The 2007 RI was conducted to evaluate on-site soil conditions and groundwater quality and potential off-site impacts. The 2007 RI activities consisted of completing 50 soil borings, installing 17 groundwater monitoring wells, performing fluid level gauging, and collecting soil and groundwater samples for laboratory analysis. Detailed results of the 2007 RI are presented in the March 2008 Remedial Investigation Report (RIR) (CDX and HDR|LMR, 2008).

- 2012 RI conducted by Arcadis. The 2012 RI was conducted to supplement the results of previous RI activities to further assess the nature and extent of the MGP-related environmental impacts. The 2012 RI activities consisted of the following:
  - Completing test pitting activities to determine the horizontal extent of subsurface former MGP structures and subsurface soil conditions.
  - Implementing soil and groundwater investigation activities, including completion of soil borings, installation of monitoring wells, and associated sampling to characterize and delineate subsurface soil and groundwater impacts.
  - Conducting a bank inspection/visual reconnaissance and collecting sediment samples in portions of Kill Brook within the site.
  - Completing a Fish and Wildlife Resource Impact Analysis (FWRIA) to identify fish and wildlife resources that exist at and in the vicinity of the site and evaluate the potential for exposure of these resources to MGP-related impacts in environmental media.

Detailed results of the 2007 and 2012 RI activities implemented for OU-1 are presented in the NYSDEC-approved September 2020 Remedial Investigation Report (RI Report) (Arcadis, 2020).

The results of these investigations were collectively used to develop the current site characterization as presented in Section 1.5.

1.5 Site Characterization

This section presents an overall site characterization and a summary of the nature and extent of impacted media at OU-1 based on the results for the RIs implemented for the site. The site characterization consists of an overview of the site geology and hydrogeology, and a summary of the nature and extent of identified impacts for OU-1.

1.5.1 Geology

A geologic cross-section location map and associated geologic cross-sections are provided as Figures 4 through 6. As shown on these figures, OU-1 is underlain by three principal stratigraphic units: fill, sand & gravel, and bedrock (in descending order from the ground surface). The character of these stratigraphic units is briefly described below:

- Fill – The fill unit was likely deposited and reworked as a result of the historical MGP operations at OU-1. The fill unit consists of fine to coarse sand, with varying amounts of unsorted angular gravel and lesser amounts of silt, concrete, brick, wood, slag, coal, metal and/or glass. The thickness of this unit varies from approximately 3 to 15 feet. The water table is generally found within this unit.
- Sand & Gravel – The sand and gravel appears to be continuous across OU-1, with the exception easternmost portion of OU-1. The sand and gravel unit generally consists of a relatively loose dark gray unsorted sand and unsorted gravel with lesser amounts of silt, cobbles and mica. The thickness of this unit increases east to west from non-present to over 30 feet.
- Bedrock – The bedrock unit is comprised of metamorphic Schist. Bedrock is encounter at depths ranging from 15 feet below grade to greater than 40 feet below grade dipping steeply toward the Hudson River.

1.5.2 Hydrogeology

Both shallow and deep overburden groundwater in OU-1 flow towards the Hudson River. The water table across OU-1 is typically found within the fill materials at depths ranging from approximately 6 feet below grade to 16 feet below grade. The hydraulic conductivity of the fill unit and the underlying sand and gravel are similar (ranging from 0.8 to 8 feet/day) and therefore, these units can be considered the same unit with regard to hydraulic characteristics (i.e., same hydrostratigraphic unit). A shallow groundwater contour map (prepared using water-level data collected on April 3, 2012) is presented as Figure 7. A deep overburden groundwater flow map was not prepared for OU-1 due to the limited number of deep overburden wells located in OU-1.

1.5.3 Nature and Extent of Impacts

Manufactured gas-production byproducts encountered at former MGP sites typically consist of coal tar and gas purifier waste. Coal tar is frequently encountered as non-aqueous phase liquid (NAPL). Principal components of coal tar that are routinely analyzed for at MGP sites are benzene, toluene, ethylbenzene, and xylene (BTEX) compounds, which are volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs), which are semi-volatile organic compounds (SVOCs). Gas purifier waste often contains cyanide and as such, total and free cyanide analyses are typically analyzed during investigations of MGP sites. As detailed below, coal tar, BTEX, PAHs, and (to a lesser extent) cyanide have been identified as the constituents of concern (COCs) for OU-1. The following subsections present a summary of the nature and extent of MGP-related environmental impacts identified for OU-1 based on these COCs and the presence of coal tar NAPL.

1.5.3.1 Distribution of Visual Impacts and NAPL

NAPL is the most frequently encountered environmental impact resulting from the former MGP operations at OU-1. Evidence of visible NAPL (i.e., NAPL in quantities greater than sheens) has been generally observed in the south-central portion of OU-1 within the sand and gravel unit at depths varying from 1.6 feet below grade to 26.8 feet below grade. Visible NAPL was encountered at 12 of the 19 soil borings/monitoring wells (i.e., MW-04, MW-05, SB-04, SB-05, SB-07, SB-18, SB-18A, SB-19, SB-20, SB-24, SB-52 and SB 53). NAPL was observed in the saturated zone in a majority of the locations, with the exception of TP-01, SB-07, SB-18, SB-20, and SB-52, where NAPL was observed only in the unsaturated zone (NAPL was observed in both the saturated zone and the unsaturated zones at SB-05 and SB-19). No evidence of NAPL was observed at the property currently occupied by the Con Edison-owned electrical substation north of Central Avenue. Forensic fingerprint analyses of one soil sample (from SB-19) indicates carbureted water gas as a potential hydrocarbon source. NAPL observations are shown on the geologic cross-sections presented as Figures 5 and 6. In addition, Figure 8 shows locations where NAPL was identified in subsurface soil.

1.5.3.2 Soil Characterization

BTEX compounds, PAHs, and inorganic constituents were detected in several of the soil samples collected as part of the RIs. Subsurface soil analytical results were compared to restricted-residential and commercial use soil cleanup objectives (SCOs) and SCOs for protection of groundwater presented in 6 NYCRR Part 375-6. The restricted-residential SCOs are applicable to OU-1 based on the current and anticipated future site use. The SCOs for the protection of groundwater are also potentially applicable because Kill Brook is located within OU-1. The greatest concentrations of BTEX and PAHs were generally detected in soil samples collected from locations where visual impacts were observed. Soil impacts are distributed as follows:

- BTEX concentrations identified in soil samples collected at OU-1 are shown on Figure 9. Individual BTEX compounds were detected at concentrations exceeding the SCOs for the protection of groundwater in 12 of 57 subsurface soil samples collected from 26 locations. A total of 4 subsurface soil samples contained individual BTEX compounds at concentrations exceeding restricted-residential SCOs and no subsurface soil samples contained individual BTEX compounds at concentrations exceeding commercial SCOs.
- PAH concentrations identified in soil samples collected at OU-1 are shown on Figure 10. Individual PAHs were detected at concentrations exceeding SCOs for the protection of groundwater and at concentrations exceeding the restricted-residential use SCOs in 31 of 57 subsurface soil samples collected from 26 locations. A total of 29 soil samples contained individual PAH compounds at concentrations exceeding the commercial use SCOs.
- Cyanide was identified at concentrations exceeding the restricted-residential and commercial use SCOs in one (1) subsurface soil sample collected from the 9- to 10-foot depth interval at boring SB-52. This boring location was in the area of the former purifiers. Cyanide is frequently associated with purifier waste impacted material. Cyanide was not detected at concentrations exceeding the SCOs in the remaining soil samples.

Five (5) additional inorganic constituents were detected at concentrations greater than applicable SCOs, including arsenic, barium, copper, lead, and mercury. However, elevated concentrations of inorganics were attributed to historic and recent fill materials and/or background concentrations.

1.5.3.3 Groundwater Characterization

Analytical results for groundwater samples collected during the remedial investigation were compared to the Class GA groundwater quality standards/guidance values presented in the NYSDEC's Division of Water, Technical and Operational Guidance Series 1.1.1: Ambient Water Quality Standards and Groundwater Effluent Limitations (TOGS 1.1.1) (NYSDEC, 2008). Analytical results indicated the following:

- BTEX concentrations identified in groundwater samples collected from monitoring wells located at OU-1 are shown on Figure 11. Individual BTEX compounds were detected at concentrations exceeding the NYSDEC standards/ guidance values in groundwater samples collected at monitoring wells MW-04 and MW-06.
- PAH compounds identified in groundwater samples collected from monitoring wells located at OU-1 are shown on Figure 12. Individual PAH compounds were detected at concentrations exceeding the NYSDEC standards/ guidance values in groundwater samples collected at monitoring wells MW-03, MW-04, and MW-06.
- Total cyanide was not detected at concentrations exceeding the groundwater quality standards at any of the monitoring well locations.

Iron and sodium were detected at concentrations exceeding the groundwater quality standards in each of the groundwater samples collected from MW-03, MW-04, and MW-06. Manganese was also detected at concentrations exceeding the groundwater quality standards in a groundwater sample collected from MW-6. However, groundwater exceedances for iron, sodium, and manganese detections were attributed to naturally occurring background conditions.

1.5.3.4 Sediment Quality

Analytical results for individual BTEX compounds and total PAHs were compared to sediment guidance values (SGVs) presented in the NYSDEC Division of Fish, Wildlife, and Marine Resources guidance document entitled

Screening and Assessment of Contaminated Sediment (CP-60) (NYSDEC, June 2014). The sediment results are compared to the NYSDEC SGVs for Class A through Class C water. According to the NYSDEC Environmental Resource Mapper, the portion of Kill Brook (also known as Sing Sing Kill) that flows through OU-1 is a Class C freshwater system. Per the instructions in the NYSDEC guidance, the sediment results were also compared to the USEPA PAH SGVs. Sediment impacts are distributed as follows:

- Individual BTEX compounds were not detected at concentrations exceeding the NYSDEC CP-60 criteria in any sediment sample collected at Kill Brook.
- PAH concentrations identified in sediment samples collected from the reach of Kill Brook that flows through OU-1 are shown on Figure 13. Total PAHs in surface sediment samples were below the NYSDEC Class A SGV. Total PAHs in subsurface sediment samples collected at SS-06 and SS-07 exceeded the NYSDEC Class A SGV and were well below the Class C SGV. Individual PAH concentrations were also below the USEPA PAH SGVs, with the exception of phenanthrene and pyrene in the 6- to 12-inch depth interval at SS-07.

1.5.4 Fish and Wildlife Resources Impact Assessment

The FWRIA was conducted to identify fish and wildlife resources that exist at and in the vicinity of the site and evaluate the potential for exposure of these resources to MGP-related impacts in site soil and sediment.

Soil sample analytical results for individual BTEX compounds, PAHs, and cyanide were compared to the SCOs for the Protection of Ecological Resources presented in 6 NYCRR Part 375. Based on the comparison of soil data to ecological SCOs, PAHs are the primary constituents of potential environmental concern (COPECs) for the site. However, exposure of ecological receptors to MGP-related COPECs is not expected to be significant given the general absence of wildlife habitat on the site. Although metals were detected in site soils, these constituents are generally found in urban fill and are not MGP-related.

Based on the comparison of sediment data to ecological screening values, PAHs are the primary COPEC. However, exposure of ecological receptors to sediment within Kill Brook is likely limited due to surrounding land use, the small size of Kill Brook, and anthropogenic disturbances. The RI sediment results support a conclusion that the former Ossining Works site is not a significant source of MGP-related impacts to sediment in Kill Brook. Based on the findings of the sediment investigation, no further action in connection with the Kill Brook adjacent to the former Ossining Works site was recommended.

2 Identification of Standards, Criteria, and Guidance

This section presents SCGs that have been identified for OU-1.

2.1 Definitions of Standards, Criteria, and Guidance

As defined in 6 NYCRR Part 375-1.8(f)(2), standards, criteria, and guidance values are defined as:

- "Standards and criteria" are cleanup standards, standards of control and other substantive environmental protection requirements, criteria or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance.
- "Guidance" is non-promulgated criteria, advisories and/or guidance that are not legal requirements and do not have the same status as "standards and criteria;" however, remedial programs should be designed with consideration given to guidance documents that, based on professional judgment, are determined to be applicable to the project (6 NYCRR 375-1.8[f][2][ii]).

Per the regulations, standards, criteria and guidance will be applied so that the selected remedy will conform to standards and criteria that are generally applicable, consistently applied and officially promulgated; and that are either directly applicable, or that are not directly applicable but relevant and appropriate, unless good cause (as defined in 6 NYCRR 375-1.8 [f][2][i]) exists why conformity should be dispensed with.

2.2 Types of Standards, Criteria, and Guidance

Potential SCGs considered in this AAR are categorized as follows:

- Chemical-Specific SCGs – These SCGs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical values for each COC. These values establish the acceptable amount or concentration of chemical constituents that may be found in, or discharged to, the ambient environment.
- Action-Specific SCGs – These SCGs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and remediation of the site.
- Location-Specific SCGs – These SCGs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in specific locations.

2.3 Standards, Criteria, and Guidance

The SCGs identified for the evaluation of remedial alternatives are presented in the following subsections. These SCGs have been identified as potentially applicable; their actual applicability will be determined during the evaluation of a particular remedy, and further described during development of the remedial design (i.e., after the final site remedy has been selected). Each potential remedy will comply with the identified SCGs, or indicate why compliance with an SCG cannot or will not be obtained.

2.3.1 Chemical-Specific SCGs

The potential chemical-specific SCGs are summarized in Table 1. Chemical-specific SCGs are the criteria that typically drive the remedial efforts at former MGP sites because they are most directly associated with addressing potential human exposure. The primary chemical-specific SCGs that exist for impacted soil and groundwater at OU-1 are briefly summarized below.

The SCOs presented in 6 NYCRR Part 375-6 are chemical-specific SCGs that are relevant and appropriate to OU-1. Specifically, the SCOs for the protection of human health assuming a future residential use (restricted-residential SCOs) are applicable.

Chemical-specific SCGs that potentially apply to the waste materials generated during remedial activities are the Resource Conservation and Recovery Act (RCRA) and New York State regulations regarding identifying and listing hazardous wastes outlined in Title 40 of the Code of Federal Regulations (40 CFR) Part 261 and 6 NYCRR Part 371, respectively. Included in these regulations are the regulated levels for the Toxicity Characteristic Leaching Procedure (TCLP) constituents. The TCLP constituent levels are a set of numerical criteria at which solid waste is considered to be a hazardous waste by the characteristic of toxicity. In addition, the hazardous characteristics of ignitability, reactivity, and corrosivity may also apply, depending upon the results of waste characterization activities.

Another set of chemical-specific SCGs that may apply to waste materials generated at OU-1 (e.g., soil that is excavated and determined to be a hazardous waste) are the United States Environmental Protection Agency (USEPA) Universal Treatment Standards/Land Disposal Restrictions (UTSs/LDRs), as listed in 40 CFR Part 268. These standards and restrictions identify hazardous wastes for which land disposal is restricted and define acceptable treatment technologies or concentration limits which may apply prior to land disposal.

Groundwater beneath OU-1 is classified as Class GA in accordance with the New York State Groundwater Classification System presented in 6 NYCRR Part 701. Therefore, the New York State Groundwater Quality Standards (6 NYCRR Parts 700-705) and NYSDEC’s TOGS 1.1.1 Class GA groundwater quality standards and guidance values are potentially applicable. These standards identify acceptable levels of constituents in surface water and groundwater based on potable use.

The section of the Kill Brook within OU-1 is classified as Class C fresh surface water per 6 NYCRR 876.4 and, as such, the New York State Surface Water and Groundwater Quality Standards (6 NYCRR Parts 700-705) are potentially applicable. Specifically, 6 NYCRR Part 703.2 identifies the surface water quality standards that need to be met during in-water activities, such as standards for turbidity and generation of sheens.

2.3.2 Action-Specific SCGs

Potential action-specific SCGs are summarized in Table 2. Action-specific SCGs include general health and safety requirements, and general requirements regarding handling and disposal of waste materials (including transportation and disposal, permitting, manifesting, disposal, and treatment facilities), discharge of water generated during implementation of remedial alternatives, and air monitoring requirements (including permitting requirements for on-site treatment systems). Action-specific criteria will be identified for the selected site remedy in the remedial design work plan; compliance with these criteria will be required. Several action-specific SCGs that may be applicable to OU-1 are briefly summarized below.

The NYSDEC Division of Air Resources (DAR) policy document DAR-1: Guidelines for the Control of Toxic Ambient Air Contaminants (formerly issued as Air Guide 1) (NYSDEC, 1997), incorporates applicable federal and

New York State regulations and requirements pertaining to air emissions, which may be applicable for soil or groundwater alternatives that result in certain air emissions. Community air monitoring would be required in accordance with the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan. New York Air Quality Standards provide requirements for air emissions (6 NYCRR Parts 257). Emissions from remedial activities will meet the air quality standards based on the New York State Air Quality Classification System (6 NYCRR Part 256) and the permit requirements in New York Permits and Certificates (6 NYCRR Part 201).

The New York State hazardous waste management regulations presented in 6 NYCRR Parts 370-374 and 376 and the NYSDEC Management of Coal Tar Waste and Coal Tar Contaminated Soils from Former Manufactured Gas Plants (DER-4) (NYSDEC, 2002) may be applicable to alternatives that include the disposal of impacted soil. LDRs that regulate the disposal of hazardous wastes may also be applicable to alternatives involving the disposal of hazardous waste (if any). In accordance with DER-4, thermal treatment of MGP-impacted material that only exhibits the hazardous characteristic of toxicity for benzene (D018) is conditionally exempt from the hazardous waste management requirements. If MGP-related hazardous wastes are destined for land disposal, the federal and New York State hazardous waste regulations apply, including LDRs and alternative LDR treatment standards for hazardous soil.

The NYSDEC no longer allows 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. Guidance issued in the form of a letter from the NYSDEC to the New York State utility companies, dated May 20, 2008, indicated that lime kiln dust/quick lime will not be permitted for use during future remedial activities.

The United States Department of Transportation (USDOT) and New York State rules for the transport of hazardous materials are provided in 49 CFR Parts 107 and 171.1 through 172.558 and 6 NYCRR 372.3, respectively. These rules include procedures for packaging, labeling, manifesting, and transporting hazardous materials. New York State requirements for waste transporter permits are included in 6 NYCRR Part 364, along with standards for collection, transport, and delivery of regulated wastes within New York State.

Section 404 of the Clean Water Act (CWA) establishes site-specific pollutant limitations and performance standards that are designed to protect surface water quality, and Section 401 of the CWA requires a 401 Water Quality Certification permit be obtained for those activities that may result in a discharge to a waters of the United States. The National Pollutant Discharge Elimination System (NPDES) program is also administered in New York by the NYSDEC as a State Pollutant Discharge Elimination System (SPDES). A temporary discharge approval, or SPDES Permit Equivalent, would be required for point source discharges of treated wastewater generated during the remedial activities. If the selected remedial alternative for OU-1 results in discharges to a publicly-owned treatment works (POTW), discharge limits must be established with the local POTW.

Remedial alternatives conducted within OU-1 must comply with applicable requirements outlined under the Occupational Safety and Health Administration (OSHA). General industry standards are outlined under OSHA (29 CFR 1910) that specify time-weighted average concentrations for worker exposure to various compounds and training requirements for workers involved with hazardous waste operations. The types of safety equipment and procedures to be followed during remediation are specified under 29 CFR 1926, and record keeping and reporting requirements are outlined under 29 CFR 1904.

In addition to OSHA requirements, the RCRA (40 CFR 264) preparedness and prevention procedures, contingency plan and emergency procedures are potentially relevant and appropriate to those remedial alternatives that include generation, treatment, or storage of hazardous wastes.

2.3.3 Location-Specific SCGs

Potential location-specific SCGs are summarized in Table 3. Examples of potential location-specific SCGs include regulations and federal acts concerning activities conducted in floodplains, historical areas, and activities affecting navigable waters and endangered/threatened or rare species.

Based on the Federal Emergency Management Agency (FEMA) National Flood Insurance Program Map Number 36119C0136F dated September 26, 2007, the southern portion around Kill Brook in OU-1 is located within the limits of a 100-year floodplain. Because portions of OU-1 are located within a 100-year floodplain, federal floodplain management laws and regulations are potential SCGs for remedial alternatives that involve excavation or backfilling within the floodplain. Federal requirements for activities conducted within floodplains are provided in 40 CFR Part 6.

Location-specific SCGs also include local requirements, such as local building permit conditions for permanent or semi-permanent facilities constructed during the remedial activities (if any), influent/pre-treatment requirements for discharging water to the POTW, and local pollution requirements (e.g., air and noise).

3 Development of Remedial Action Objectives

This section presents the RAOs for impacted media (soil and groundwater) identified at OU-1. These RAOs represent media-specific goals that are protective of public health and the environment that have been developed through consideration of the results of the site investigation activities and with reference to potential SCGs, as well as current and foreseeable future anticipated site uses.

RAOs are developed to address the specific COCs at OU-1, and to assist in developing goals for cleanup of COCs in each media that may require remediation. The RAOs presented in the following table have been developed based on the generic RAOs listed on NYSDEC's website (http://www.dec.ny.gov/regulations/67560.html).

Table 3.1 – Remedial Action Objectives

RAOs for Soil
RAOs for Public Health Protection
1. Prevent, to the extent practicable, ingestion/direct contact with MGP-related COCs/ NAPL.
2. Prevent, to the extent practicable, inhalation of or exposure to MGP-related COCs from impacted soil.
RAOs for Environmental Protection
3. Address, to the extent practicable, MGP-related COCs/NAPL in soil that could result in impacts to groundwater, surface water, or sediment.
4. Prevent, to the extent practicable, impacts to biota from ingestion/direct contact with soil containing MGP-related COCs.
RAOs for Groundwater
RAOs for Public Health Protection
1. Prevent, to the extent practicable, ingestion of groundwater containing MGP-related dissolved phase COCs at concentrations exceeding NYSDEC groundwater quality standards or guidance values.
2. Prevent, to the extent practicable, contact with or inhalation of VOCs from groundwater containing MGP-related COCs at concentrations exceeding NYSDEC groundwater quality standards or guidance values.
RAOs for Environmental Protection
3. Restore groundwater to pre-disposal/pre-release conditions, to the extent practicable.
4. Prevent the discharge of MGP-related COCs from groundwater to surface water and sediment, to the extent practicable.
5. Address the source of MGP-related groundwater impacts to the extent practicable.
RAOs for Soil Vapor
RAOs for Public Health Protection
1. Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the site.

Potential remedial alternatives are evaluated (in Section 5) based on their ability to meet the RAOs and be protective of public health and the environment.

4 Technology Screening and Assembly of Remedial Alternatives

The objective of the technology screening is to:

- Present general response actions (GRAs) and the associated remedial technology types and technology process options that have documented success at achieving similar RAOs at MGP sites.
- Identify options that are implementable and potentially effective at addressing site-specific concerns.

This section identifies remedial alternatives to address impacted media at OU-1. GRAs potentially capable of addressing impacted media were identified as an initial step. GRAs are media-specific and describe actions that will satisfy the RAOs. GRAs may include various non-technology specific actions such as treatment, containment, institutional controls, and excavation, or any combination of such actions. Based on the GRAs, potential remedial technology types and technology process options were identified and screened to determine the technologies that were the most appropriate for addressing OU-1 impacts.

According to DER-10, the term “technology type” refers to general categories of technologies appropriate to the site-specific conditions and impacts, such as chemical treatment, immobilization, biodegradation, and capping. The term “technology process options” refers to specific processes within each remedial technology type. A series of remedial technology types and associated technology process options have been assembled for each GRA identified. Each remedial technology type and associated technology process options are briefly described and screened in accordance with DER-10 (on a medium-specific basis) to identify those that are technically implementable and capable of meeting the RAOs. This approach was used to determine if the application of a particular remedial technology type and technology process option is applicable, given site-specific conditions for remediation of the impacted media. Technologies/process options that were retained through the screening were used to assemble remedial alternatives. Detailed evaluation of these assembled remedial alternatives is presented in Section 5.

4.1 General Response Actions

Based on the RAOs identified in Section 3, the following GRAs have been established for soil and groundwater:

- No Action;
- Institutional Controls/Engineering Controls;
- In-Situ Containment/Control;
- In-Situ Treatment;
- Removal;
- Ex-Situ On-Site Treatment and/or Disposal; and
- Off-Site Treatment and/or Disposal.

4.2 Identification of Remedial Technologies

Remedial technology types that are potentially applicable for addressing the impacted media were identified through a variety of sources, including vendor information, engineering experience, and review of various available literature, including DER-10.

Section 4.3 of DER-10 indicates that GRAs should be established such that they give preference to presumptive remedies. The evaluation of remedial technology types and process options that are applicable to MGP-related impacts (or have been implemented at other MGP sites) is well documented, although each former MGP site offers its own unique site characteristics. Therefore, this collective knowledge and experience, and regulatory acceptance of previous feasibility studies performed on MGP-related sites with similar impacts, were used to reduce the universe of potentially applicable process options to those with documented success in achieving similar RAOs.

4.3 Remedial Technology Screening Criteria

Potentially applicable remedial technology types and technology process options were identified for each of the GRAs, and were screened on a media-specific basis (i.e., separately for soil and groundwater) to retain the technology types and process options that could be implemented and would potentially be effective at achieving the site-specific RAOs.

Technology process options were evaluated in relative terms to other technology process options of the same remedial technology type using the following criteria:

- Implementability – This criterion evaluates the ability to construct and reliably operate the technology process option as well as the availability of specific equipment and technical specialists to design, install, and operate and maintain the remedy.
- Effectiveness – This criterion is focused on the process option’s ability to meet the site-specific RAOs, either as a single technology or when used in combination with other technologies.

4.4 Remedial Technology Screening

This AAR presents a brief overview of GRAs while focusing on the remedial technology types and associated process options that have documented success at achieving similar RAOs at former MGP sites. Summaries of the remedial technology screening to address impacted soil and groundwater are presented in Tables 4 and 5, respectively.

4.4.1 Soil

This section describes the basis for retaining representative soil remedial technology types and technology process options through the technology screening.

No Action

As required by DER-10, the “No Action” GRA has been included and retained through the screening evaluation. “No action” indicates that no remedial action would be implemented to address impacted soil. The “No Action” alternative is readily implementable and was retained to serve as a baseline against which other alternatives will be compared.

Institutional Controls

Remedial technology types associated with this GRA consist of non-intrusive controls focused on minimizing potential exposure to impacted media. The remedial technology type screened under this GRA consists of institutional controls. Technology process options screened under this remedial technology type include deed restrictions, environmental land use restrictions, enforcement and permit controls, and informational devices. Institutional controls would be utilized to limit permissible future site use, as well as establish health and safety requirements to be followed during subsurface activities that could result in construction worker exposure to impacted soil.

Institutional controls will not achieve the soil RAOs as a stand-alone process, as these measures would not treat, contain, or remove impacted soil. However, this process option was retained because institutional controls can be implemented in conjunction with other remedial technologies to reduce the potential for exposure to impacted soil.

In-Situ Containment/Control

Remedial technology types associated with this GRA consist of measures to address the impacted media by reducing mobility and/or the potential for exposure without removal or treatment. The remedial technology type evaluated under this GRA consists of capping. Technology process options screened under this remedial technology type include: soil cap, asphalt/concrete cap, and multi-media cap.

None of the capping technology process options were retained for further evaluation. While each of these technology process options is readily implementable, surface soils do not contain MGP-related impacts. Therefore, construction of a cap would not provide any significant reduction to potential future exposures to impacts and would not achieve a majority of the site-specific RAOs.

In-Situ Treatment

Remedial technology types associated with this GRA consist of those that treat impacted soil in-situ (i.e., without removal). These technologies would actively address MGP-related COCs in soil to achieve the RAOs. The remedial technology types evaluated under this GRA consist of immobilization, extraction/in-situ stripping, chemical treatment, biological treatment, and thermal treatment. Technology process options screened under these remedial technology types include:

- solidification (immobilization via in-situ soil solidification);
- dynamic underground stripping and hydrous pyrolysis/oxidation (DUS/HPO) (extraction/in-situ stripping);
- chemical oxidation and surfactant/co-solvent flushing (chemical treatment);
- biodegradation, enhanced biodegradation, and biosparging (biological treatment); and
- in-situ thermal desorption and electrical resistance heating (thermal treatment).

In-situ soil solidification (ISS) was retained for further evaluation as this technology process option is an effective means to reduce the mobility of MGP-related COCs, eliminate free liquids, and reduce the hydraulic conductivity of NAPL-impacted soil. The presence of subsurface obstructions (i.e., former MGP structures and utilities) could potentially limit the implementability of ISS.

Based on the results of the screening, DUS/HPO, chemical oxidation, biodegradation, enhanced biodegradation, and biosparging were not retained for further evaluation due to known general ineffectiveness at addressing

NAPL-impacted soil at MGP sites. Additionally, each of these processes would require long-term operation and monitoring due to the nature of impacts.

Specific concerns related to DUS/HPO include the potential for the uncontrolled migration of NAPL that could limit the effectiveness of the technology process option. DUS/HPO is typically more effective for addressing chlorinated solvents.

Pilot studies conducted at other former MGP sites have shown that in-situ chemical oxidation (ISCO) (including surfactant/co-solvent flushing) is only partially effective in the treatment of NAPL-impacted soil. ISCO has been shown to be effective at treating the dissolved phase impacts associated with the NAPL, but does not effectively treat soil containing NAPL. Multiple applications with large quantities of highly reactive oxidants would be required due to the nature and location of impacts. Based on the ineffectiveness in addressing impacted soil, oxidants would need to be administrated over a long period of time.

In-situ thermal treatment technologies were not retained as these technologies would present numerous implementability concerns associated with controlling groundwater flow into the treatment area that could limit the effectiveness of treatment, and utilities present within the treatment and surrounding areas, as well as space limitations for treatment equipment.

Removal

Remedial technology types associated with this GRA consist of measures to remove impacted soil from the ground. The remedial technology type and technology process option evaluated under this GRA consists of excavation.

Excavation is a proven technology that could be implemented to address impacted material and would achieve several of the RAOs. When combined with proper handling of the excavated material, this technology process would be effective at minimizing potential future exposures. Equipment and contractors needed to complete soil excavation activities are readily available).

Ex-Situ On-Site Treatment and/or Disposal

Remedial technology types associated with this GRA consist of measures to treat impacted soil on-site after soil has been excavated or otherwise removed from the ground. The remedial technology types evaluated under this GRA consist of on-site ex-situ immobilization, extraction, thermal destruction, chemical treatment, and on-site disposal. Technology process options screened under these remedial technology types include:

- solidification (immobilization);
- low-temperature thermal desorption (LTTD) (extraction);
- incineration (thermal destruction);
- chemical oxidation (chemical treatment); and
- solid waste landfill and RCRA landfill (disposal).

Due to the current and anticipated future use of OU-1 (i.e., restricted-residential) and surrounding areas, as well as space limitations, none of the ex-situ on-site treatment and/or disposal technology types and associated technology process options are considered practicable, technically implementable, or administratively feasible given lack of available space, public acceptance, and potential for exposures during on-site treatment/disposal. None of these process options were retained for further evaluation.

Off-Site Treatment and/or Disposal

Remedial technology types associated with this GRA consist of measures to treat/dispose of impacted soil at off-site locations after soil has been removed from the ground. The remedial technology types evaluated for this GRA consist of recycle/reuse, extraction, thermal destruction, and off-site disposal. Technology process options screened under these remedial technology types include:

- asphalt concrete batching, brick/concrete manufacturer, and fuel blending/co-burn in utility boiler (recycle/reuse);
- LTTD (extraction);
- incineration (thermal destruction); and
- solid waste landfill and RCRA landfill (off-site disposal).

LTTD and off-site disposal at a solid waste landfill were retained for further evaluation. Disposal at an off-site solid waste landfill would be reserved for material that is not suitable for on-site reuse as subsurface fill, that does not contain visual impacts, and that is not appropriate for treatment via LTTD (e.g., concrete, debris). While each of these process options were retained, the final off-site treatment or disposal of waste materials will be evaluated as part of the remedial design for the selected remedy. This will allow for an evaluation of the costs associated with these potential off-site treatment/disposal processes, which can fluctuate significantly based on season, market conditions, and treatment/disposal facility capacity. In addition, multiple off-site treatment technologies could be utilized to treat or dispose of media with different concentrations of COCs. However, for the purpose of preparing this AAR, LTTD and solid waste landfill are assumed as the off-site treatment/disposal technology process options for solid waste that may be excavated during remedial construction.

The asphalt concrete batch plant, brick/concrete manufacturer, and fuel blending/co-burn in utility boiler technology processes are not considered implementable. The number of facilities capable of implementing these processes and demand for raw materials are limited. Incineration and RCRA landfill technology processes were not retained through the technology screening. The relative cost for incineration is high and although incineration would be an effective means for treating soil containing MGP-related impacts, LTTD is equally effective for treating impacted soil at a lower cost. Disposal at a RCRA landfill was not retained, as material that is characteristically hazardous would still require pre-treatment to meet New York State UTSs/LDRs prior to disposal.

4.4.2 Groundwater

This section describes the basis for retaining representative groundwater remedial technology types and technology process options through the technology screening.

No Action

As required by DER-10, the “No Action” technology has been included and retained through the screening evaluation. “No action” indicates that no remedial efforts would be implemented to address impacted groundwater. The “No Action” alternative is readily implementable and was retained to serve as a baseline against which other alternatives will be compared.

Institutional Controls

Remedial technology types associated with this GRA generally consist of non-intrusive administrative controls used to reduce the potential for contact with, or use of site groundwater. The remedial technology type screened under this GRA consists of institutional controls. Technology process options for institutional controls include deed restrictions, groundwater use restrictions, enforcement and permit controls, and informational devices. This technology process is considered implementable and therefore, was retained for further evaluation. Because institutional controls would not treat, contain, or remove any COCs in groundwater, institutional controls alone would not achieve the RAOs established for OU-1. However, institutional controls would work toward meeting the RAO of preventing potential human exposures to groundwater containing COCs. Institutional controls could enhance the effectiveness of other technology types/technology process options when included as part of a remedial alternative.

In-Situ Containment/Control

Remedial technology types associated with this GRA involve addressing impacted groundwater and NAPL without removal or treatment. The remedial technology type evaluated under this GRA consists of containment. Technology process options screened under this remedial technology type consist of sheet pile walls, secant pile walls, and slurry/jet grout walls. Based on the presence of subsurface utilities and Kill Brook, the implementability of a continuous barrier would be limited and containment options would not be effective at preventing groundwater flow to and from areas containing MGP-related impacts. Additionally, containment process options would not address potential exposures to future utility/construction workers. Therefore, none of the containment process options were retained.

In-Situ Treatment

Remedial technology types associated with this GRA involve treating impacted groundwater and NAPL without removal. Remedial technology types evaluated under this GRA consist of biological treatment, chemical treatment, and extraction. Technology process options screened under these remedial technology types include:

- Groundwater monitoring, enhanced biodegradation, and biosparging (biological treatment);
- Chemical oxidation and permeable reactive barrier (PRB) (chemical treatment); and
- DUS/HPO (Extraction).

Although groundwater monitoring will likely not achieve groundwater RAOs without source removal, this technology was retained as a measure to monitor and document groundwater conditions over time. However, enhanced biodegradation and biosparging were not retained because these technologies would not be a cost-effective means for addressing impacted groundwater over the long-term (i.e., significant amounts of oxygen would be required to enhance degradation over a long period of time).

PRB was not retained because this technology process would not be an effective means for treating NAPL (i.e., the source for dissolved phase impacts) and furthermore, the presence of NAPL would inhibit the effectiveness of and could foul the barrier. Therefore, this technology would not be an effective means for addressing impacted groundwater over the long-term.

Chemical oxidation and DUS/HPO were not retained as these processes would not be a cost-effective means for achieving the RAOs and could result in NAPL and/or dissolved plume migration.

Removal

Remedial technology types associated with this GRA consist of removing groundwater containing MGP-related impacts for treatment and/or disposal. The remedial technology type evaluated under this GRA consists of hydraulic control. Technology process options screened under this remedial technology type include:

- vertical extraction wells and horizontal extraction wells (hydraulic removal); and
- active removal, passive removal, and collection trenches/permeable NAPL barrier wall (NAPL removal).

In general, hydraulic control, by means of vertical or horizontal extraction wells would generate water that would require treatment over a long period of time. Equipment and tools necessary to install and operate vertical extraction wells are readily available. However, the project area has limited space to construct and operate pump and treat equipment. Installation of horizontal extraction wells includes use of specialized drilling equipment that requires a large amount of space, and subsurface site conditions (e.g., multiple obstructions, subsurface utilities, etc.) are not suitable for the installation of horizontal wells. Additionally, long-term pump-and-treat alternatives would not be an effective means to address dissolved phase impacts without the removal of potential source material (i.e., NAPL). Therefore, vertical and horizontal extraction wells were not retained for further evaluation.

Active and passive NAPL removal technology process options were retained based on the potential effectiveness and implementability for recovering NAPL. Collection trenches/passive barrier walls were not retained as large scale trenches and passive barrier walls are not considered implementable due to the limited availability of space and foreseeable use of OU-1 (i.e., restricted-residential). Additionally, NAPL recovery rates are not expected to be significant, and therefore, these technology process options would not be cost-effective compared to active and passive NAPL removal options at individual monitoring/ recovery wells.

Ex-Situ On-Site Treatment

The remedial technology types associated with this GRA consists of on-site treatment of impacted groundwater. The remedial technology types evaluated under this GRA consist of chemical treatment and physical treatment. Technology process options screened under these remedial technology types include:

- ultraviolet (UV) oxidation and chemical oxidation (chemical treatment); and
- carbon adsorption, filtration, precipitation/coagulation/flocculation, and oil/water separation (physical treatment).

As indicated above, groundwater extraction technology process options were not retained through the technology screening. Therefore, ex-situ on-site treatment technology process options will not be required. Additionally, similar to the ex-situ on-site soil treatment technologies, due to the current and anticipated future uses of OU-1 (i.e., restricted-residential), none of the ex-situ on-site groundwater treatment technology process options are considered practicable given the potential for long-term exposures as a result of the construction and operation of an on-site water treatment system. Although not retained, ex-situ on-site groundwater treatment technology process options could be used in support of other remedial technology processes during remedial construction (i.e., treatment of groundwater removed during excavation activities).

Off-Site Treatment and/or Disposal

Remedial technology types associated with this GRA consist of off-site treatment/disposal of extracted groundwater. The remedial technology type evaluated under this GRA consisted of groundwater disposal. Technology process options screened under this technology type consisted of: discharge to a local POTW, discharge to surface water, and discharge to a privately-owned and commercially operated treatment facility.

As indicated above, groundwater extraction processes are not considered effective or readily implementable and therefore, were not retained. Potential remedial alternatives will not require an ongoing discharge/disposal of treated/untreated groundwater removed from the subsurface. Although not retained, off-site treatment/disposal technology process options may be used in support of other remedial technology processes during remedial constructions (i.e., treatment/disposal of groundwater removed during excavation activities).

4.5 Summary of Retained Technologies

Results of the remedial technology screening process for soil and groundwater are presented in Tables 4 and 5, respectively. Retained remedial technologies are summarized in the following tables.

Table 4.1 – Retained Soil Technologies

GRA	Technology Type	Technology Process Option
No Action	No Action	No Action
Institutional Controls	Institutional Controls	Deed Restrictions, Environmental Land Use Restrictions, Enforcement and Permit Controls, Informational Devices
In-situ treatment	Immobilization	In-situ Soil Stabilization
Removal	Excavation	Excavation
Off-Site Treatment and/or Disposal	Extraction Disposal	Low-Temperature Thermal Desorption Solid Waste Landfill

Table 4.2 – Retained Groundwater Technologies

GRA	Technology Type	Technology Process Option
No Further Action	No Further Action	No Further Action
Institutional Controls	Institutional Controls	Deed Restrictions, Enforcement and Permit Controls, Informational Devices
In-Situ Treatment	Biological Treatment	Groundwater Monitoring
Removal	NAPL Removal	Active Removal, Passive Removal

4.6 Assembly of Remedial Alternatives

Retained remedial technology types and technology process options were combined into remedial alternatives that have the potential to achieve or work toward achieving site-specific RAOs. DER-10 requires an evaluation of the following alternatives:

- The “No Action” alternative; and
- An alternative that would restore the site to pre-disposal conditions.

Additional alternatives were developed based on the current, intended and reasonably anticipated future use of OU-1, as well as removal of source area(s) of MGP-related impacts.

These remedial considerations require varying levels of remediation, but provide protection of public health and the environment by:

- Preventing or minimizing exposure to the COCs through the use of institutional controls;
- Removing COCs to the extent possible thereby minimizing the need for long-term management; and
- Treating COCs, to a degree that potentially requires long-term management in the form of treatment system operation and maintenance (O&M), institutional controls, engineering controls, etc.

Remedial alternatives that have been assembled and developed for addressing the impacted media are presented below. Detailed technical descriptions of the remedial alternatives are presented in Section 5.

Note that based on the remedial investigation results (as described in Section 1.5), no remedial activities are proposed to address the former gas holder at the Con Edison electrical substation located across Central Avenue from the main portion of OU-1.

4.6.1 Alternative 1 – No Further Action

The "No Action" alternative was retained for evaluation as required by DER-10. Under this alternative, no remedial activities would be completed to address MGP-related impacts to soil and/or groundwater. The "No Action" alternative serves as the baseline for comparison of the overall effectiveness of the other remedial alternatives.

4.6.2 Alternative 2 – Targeted Soil Removal and NAPL Recovery

Alternative 2 includes the targeted removal of shallow subsurface soil (to depths of up to 5 feet below grade) containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL (i.e., greater than sheens and blebs). Excavated material would be transported off-site for treatment and/or disposal (as appropriate) and excavated areas would be backfilled with clean imported fill.

Under this alternative, NAPL recovery wells would be installed on the downgradient portion of OU-1, to facilitate monitoring and recovery of potentially mobile NAPL that accumulates into the newly installed recovery wells. NAPL monitoring activities would be conducted passively via gauging and manually bailing/pumping monitoring wells that contain NAPL (if any).

Alternative 2 also includes annual groundwater monitoring to document the extent of dissolved phase impacts and the potential trends in COC concentrations. This alternative also includes the installation of additional groundwater monitoring wells to establish a new groundwater monitoring network and facilitate annual groundwater monitoring activities. Additionally, institutional controls (i.e., deed restrictions and/or environmental easements, signs) would be established for the properties that contain MGP-related impacts to limit the future development and use of OU-1 and site groundwater, as well as limit permissible invasive (i.e., subsurface) activities. For properties not owned by Con Edison, implementation of institutional controls would require coordination between NYSDEC and the property owners. A Site Management Plan (SMP) would be prepared to document the extent of remaining impacts in OU-1, long-term site monitoring requirements, and protocols for potential future site activities that may be conducted in OU-1.

4.6.3 Alternative 3 – Targeted Soil Removal, Targeted ISS Treatment of Visually Impacted Material, and NAPL Recovery

Alternative 3 includes the same soil removal components and similar groundwater monitoring well/NAPL recovery well installation efforts as Alternative 2. In addition, Alternative 3 includes ISS treatment activities to address subsurface soil containing significant quantities of NAPL at depths greater than 5 feet below grade. Under this alternative, ISS treatment areas would be excavated to a depth up to 5 feet below grade to clear subsurface obstructions (i.e., former building foundations and utilities). ISS would then be conducted to address soil that contains significant quantities of NAPL, which were observed to depths up to 34 feet below grade. The ISS process involves mixing Portland cement (and other pozzolanic materials) with impacted soil to reduce the leachability and mobility of COCs and NAPL present in soil. Alternative 3 also includes the same SMP, long-term groundwater/NAPL monitoring, and institutional control components as Alternative 2.

4.6.4 Alternative 4 – Soil removal to Unrestricted Use SCOs

Alternative 4 includes removal activities to address soil containing MGP-related COCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs to depths up to 35 feet below grade. Excavated material would be transported off-site for treatment and/or disposal (as appropriate) and excavated areas would be backfilled with clean imported fill. Alternative 4 does not include institutional controls and SMP components. Post-remediation groundwater monitoring/NAPL recovery activities would also not be conducted.

5 Detailed Evaluation of Remedial Alternatives

This section presents a detailed evaluation of the remedial alternatives developed to address identified site impacts. Each of the remedial alternatives is evaluated with respect to the criteria presented in DER-10. The results of the detailed evaluation of remedial alternatives are used to support the recommendation of a preferred remedial alternative for addressing impacted site media.

5.1 Description of Evaluation Criteria

Consistent with DER-10, each of the assembled remedial alternatives (presented in Section 4.6) are evaluated against the following criteria:

- Short-Term Impacts and Effectiveness;
- Long-Term Effectiveness and Permanence;
- Land Use;
- Reduction of Toxicity, Mobility, or Volume of Contamination through Treatment;
- Implementability;
- Compliance with SCGs;
- Overall Protection of Public Health and the Environment; and
- Cost Effectiveness.

The evaluation criteria are described in the following sections. Additional criteria, including public and state acceptance, will be addressed following submittal of this AAR.

Per DER-10, sustainability and green remediation will also be considered in the remedial evaluation with the goal of minimizing ancillary environmental impacts, such as greenhouse gas emissions during the implementation of remedial programs. The evaluation will consider the alternative’s ability to; reduce energy use; reduce greenhouse gas and other emissions; maximize reuse of land and material recycling; and preserve, enhance, or create natural habitats. Sustainability and green remediation will be discussed under the short-term impacts and effectiveness criterion.

5.1.1 Short-Term Impacts and Effectiveness

The short-term impacts and effectiveness criterion is used to evaluate the remedial alternative relative to its potential effect on public health and the environment during construction and/or implementation of the alternative. The evaluation of each alternative with respect to its short-term impacts and effectiveness will consider the following:

- Potential short-term adverse impacts and nuisances to which the public and environment may be exposed during implementation of the alternative;
- Potential impacts to workers during implementation of the remedial actions and the effectiveness and reliability of protective measures;
- Amount of time required to implement the remedy and the time until the remedial objectives are achieved; and
- The sustainability and use of green remediation practices during implementation of the remedy.

5.1.2 Long-Term Effectiveness and Permanence

The evaluation of each remedial alternative relative to its long-term effectiveness and permanence is made by considering the risks that may remain following completion of the remedial alternative. The following factors will be assessed in the evaluation of the alternative's long-term effectiveness and permanence:

- Potential impacts to human receptors, ecological receptors, and the environment from untreated waste or treatment residuals remaining at the completion of the remedial alternative.
- The adequacy and reliability of institutional and/or engineering controls (if any) that will be used to manage treatment residuals or remaining untreated impacted media.

5.1.3 Land Use

The current and intended future use of OU-1 is a restricted-residential development. This criterion evaluates the current and anticipated future land use of the site relative to the cleanup objectives of the remedial alternative when commercial use cleanup levels would not be achieved. This evaluation considers local zoning laws, proximity to residential property, accessibility to infrastructure, and proximity to natural resources including groundwater drinking supplies.

5.1.4 Reduction of Toxicity, Mobility, and Volume of Contamination through Treatment

This evaluation criterion addresses the degree to which the remedial alternative will permanently and significantly reduce the toxicity, mobility, or volume of the constituents present in the site media through treatment technologies.

5.1.5 Implementability

This criterion addresses the technical and administrative feasibility of implementing the remedial alternative, including the availability of the various services and materials required for implementation. The following factors will be considered during the implementability evaluation:

- Technical Feasibility – This factor considers the remedial alternative's constructability, as well as the ability to monitor the effectiveness of the remedial alternative.
- Administrative Feasibility – This factor refers to the availability of necessary personnel and material along with potential difficulties in obtaining approvals for long-term operation of treatment systems, access agreements for construction, and acquiring necessary approvals and permits for remedial construction.

5.1.6 Compliance with SCGs

This criterion evaluates the remedial alternative’s ability to comply with SCGs that were identified in Section 2. Compliance with the following items is considered during evaluation of the remedial alternative:

- Chemical-specific SCGs;
- Action-specific SCGs; and
- Location-specific SCGs.

Potentially applicable chemical-, action-, and location-specific SCGs are presented in Tables 1, 2 and 3, respectively.

5.1.7 Overall Protection of Public Health and the Environment

This criterion evaluates whether the remedial alternative provides adequate protection of public health and the environment based on the following:

- How the alternative would eliminate, reduce, or control (through removal, treatment, containment, other engineering controls, or institutional controls) potentially complete exposure routes and other identified environmental impacts;
- The ability of the remedial alternative to meet the site-specific RAOs; and
- A combination of the above-listed criteria including: long-term effectiveness and permanence; short-term impacts and effectiveness; and compliance with SCGs.

5.1.8 Cost Effectiveness

This criterion evaluates the overall cost of the assembled alternative relative to its effectiveness at meeting the RAOs.

The estimated total cost to implement the remedial alternative is based on a present worth analysis of the sum of the direct capital costs (i.e., materials, equipment, and labor), indirect capital costs (i.e., engineering, licenses/permits, and contingency allowances), and O&M costs. O&M costs may include future site management, operating labor, energy, chemicals, and sampling and analysis. These costs are estimated with an anticipated accuracy between -30% to +50%. A 20% contingency factor is included to cover unforeseen costs incurred during implementation of the remedial alternative. Present-worth costs are calculated for alternatives expected to last more than 2 years. A 4% discount (i.e., interest) rate is used to determine the present-worth factor. No soil borings have been completed south of Kill Brook within the footprint of structures that were demolished following the RI or in areas that were being utilized for storage by the ODPW. The lack of data coverage in these areas introduces some level of uncertainty to the estimated costs presented for Alternatives 2 through 4. This uncertainty will be addressed through focused Pre-Design Investigation (PDI) activities that will be implemented to support the future design of the selected remedy.

5.2 Detailed Evaluation of Alternatives

This section presents the detailed analysis of each of the assembled remedial alternatives presented in Section 4.

- Alternative 1 – No Action;
- Alternative 2 – Targeted Soil Removal and NAPL Recovery;
- Alternative 3 – Targeted Soil Removal, Targeted ISS Treatment of Visually Impacted Material, and NAPL Recovery; and
- Alternative 4 – Soil Removal to Unrestricted Use SCOs.

Each alternative is evaluated against the evaluation criteria described above (as indicated, public and state acceptance will be evaluated following submittal of this AAR).

5.2.1 Alternative 1 – No Action

The “No Action” alternative was retained for evaluation as required by DER-10. The “No Action” alternative serves as the baseline for comparison of the overall effectiveness of the other remedial alternatives. The “No Action” alternative would not involve implementation of any remedial activities to address MGP-related impacts. OU-1 would be allowed to remain in its current condition and no effort would be made to change or monitor the current site conditions.

5.2.1.1 Short-Term Impacts and Effectiveness – Alternative 1

No remedial actions would be implemented to address impacted environmental media. Therefore, no short-term environmental impacts or risks associated with remedial activities would be posed to the community.

5.2.1.2 Long-Term Effectiveness and Permanence – Alternative 1

Under the “No Action” alternative, the presence of COCs in impacted media and the potential for on-going migration of impacts would not be addressed. As a result, this alternative is not considered effective on a long-term basis.

5.2.1.3 Land Use – Alternative 1

The current zoning for OU-1 is listed as a planned waterfront development, in accordance with the Village of Ossining Zoning Map dated September 2013. Areas immediately surrounding OU-1 are zoned for planned waterfront development, commercial, and residential. The current and foreseeable future use of the area surrounding OU-1 is commercial/residential. The area of OU-1 north of Central Avenue will continue to house the electrical substation that is owned and operated by Con Edison. Additionally, the area of OU-1 south of Central Avenue will be redeveloped for restricted-residential use.

No remedial actions would be completed under this alternative and OU-1 would remain in its current condition. The “No Action” alternative would not alter the anticipated future intended use of OU-1.

5.2.1.4 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment – Alternative 1

Under the “No Action” alternative, environmental media would not be treated (other than by natural processes), recycled, or destroyed. Therefore, the toxicity, mobility, and volume of environmental media containing MGP-related impacts would not be reduced.

5.2.1.5 Implementability – Alternative 1

The “No Further Action” alternative does not require construction of any additional remedial activities and therefore, is considered technically and administratively implementable.

5.2.1.6 Compliance with SCGs – Alternative 1

- Chemical-Specific SCGs – Because removal or treatment is not included as part of this alternative, chemical-specific SCGs would not be met.
- Action-Specific SCGs – This alternative does not involve implementation of any remedial activities. Therefore, the action-specific SCGs are not applicable.
- Location-Specific SCGs – Location-specific SCGs are not applicable as no remedial activities would be conducted under this alternative.

5.2.1.7 Overall Protectiveness of the Public Health and the Environment – Alternative 1

The "No Action" alternative does not address the toxicity, mobility, or volume of impacted environmental media and is not effective on a long-term basis for eliminating potential migration or potential exposure to impacts. Therefore, the "No Action" alternative would not be protective of public health and the environment and would not meet the RAOs.

5.2.1.8 Cost Effectiveness – Alternative 1

The "No Action" alternative does not involve implementation of any active remedial activities or monitoring conditions; therefore, there are no costs associated with this alternative.

5.2.2 Alternative 2 – Targeted Soil Removal and NAPL Recovery

The major components of Alternative 2 consist of the following:

- Excavating shallow subsurface soil containing COCs at concentrations greater than NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL;
- Installing NAPL recovery wells;
- Implementing a NAPL recovery program;
- Installing groundwater monitoring wells as needed for long-term groundwater monitoring;
- Conducting long-term groundwater/NAPL monitoring;
- Establishing institutional controls; and
- Developing a SMP.

As part of the remedial design phase for this alternative, pre-design investigation (PDI) activities will be conducted to facilitate the development of several components of the remedy, including the extent of shallow excavation areas, excavation support system(s); backfill materials and surface restoration details; and the final number, location, and construction of the NAPL recovery wells/groundwater monitoring wells. PDI activities will generally consist of advancing additional direct push borings and collecting surface soil sampling across OU-1.

<u>Soil Excavation</u>

Alternative 2 includes the targeted removal of approximately 1,760 cubic yards (cy) of material to address 610 cy of shallow subsurface soil (to a depth of up to 5 feet below grade) containing COCs at concentrations greater than

6 NYCRR Part 375-6 restricted-residential SCOs. The anticipated limits for areas to be targeted for excavation are shown on Figure 14.

It has been assumed that excavation sidewalls would be stabilized by sloping and benching and no additional excavation support would be needed to facilitate excavation activities, based on the anticipated excavation depths. Final excavation support system(s) would be further evaluated and developed as part of the remedial design phase of this alternative. Excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, dump trucks, etc. An assumed 75% of the excavated soil would be transported off-site for disposal as a non-hazardous waste and 25% would be transported off-site for treatment/disposal via LTTD. Excavation areas would be restored with imported clean fill material to match previously existing lines and grades. Backfill materials and surface restoration details would be developed as part of the remedial design phase of this alternative.

<u>NAPL Recovery Wells/NAPL Recovery Program</u>

Alternative 2 includes the installation of NAPL recovery wells in the downgradient portion of OU-1. It has been assumed that up to nine NAPL recovery wells would be installed for the purpose of developing a cost estimate for this alternative. The NAPL recovery wells are assumed to consist of 6-inch diameter stainless steel wells, equipped with 5-foot long sumps, installed to the top of bedrock (to an average depth of approximately 40 feet below grade). The final number, location, and construction of the NAPL recovery wells would be evaluated as part of the remedial design phase for this alternative.

A long-term monitoring and recovery program would be established following installation of the NAPL recovery wells to remove NAPL from the wells and limit the potential for future migration of NAPL downgradient of OU-1. NAPL recovery may be conducted passively by periodic manual bailing or by periodically pumping (with a portable pump) NAPL from the wells. NAPL could also be removed via an automated pumping system (if warranted) based on the rate of NAPL recovery. For the purpose of developing a cost estimate for this alternative, NAPL recovery activities are assumed to consist of passive NAPL collection with manual recovery conducted on a quarterly basis during the first year following remedial construction, and on an annual basis following the first year for a total period of 30 years. The results of the NAPL monitoring activities would be presented to NYSDEC in an annual report. Con Edison may request to conduct NAPL monitoring/recovery activities less frequently or cease the program altogether if recoverable quantities of NAPL are not observed during multiple consecutive NAPL monitoring/recovery events (e.g., four consecutive annual monitoring events).

<u>Groundwater Monitoring</u>

Groundwater within OU-1 contains BTEX and PAHs at concentrations greater than NYSDEC Class GA standards, as indicated in Section 1. Therefore, this alternative includes the installation of additional groundwater monitoring wells to establish a new groundwater monitoring well network and conducting annual groundwater monitoring on an annual basis for a period of 30 years to document potential changes in groundwater conditions. It has been assumed that up to six groundwater monitoring wells would be installed for the purpose of developing a cost estimate for this alternative. The groundwater monitoring wells are assumed to consist of 2-inch diameter PVC wells, equipped with 5-foot long screens, installed to an average depth of approximately 20 feet below grade. The final number, location, and construction of the groundwater monitoring wells would be evaluated as part of the remedial design phase for this alternative. Annual groundwater monitoring activities would consist of collecting groundwater samples from the existing groundwater monitoring well network. Groundwater samples would be submitted for laboratory analysis for BTEX, PAHs, and cyanide. Analytical results would be used to document the extent of dissolved phase impacts and potential trends in COC concentrations.

The results of the groundwater monitoring activities would be presented to NYSDEC in an annual report. Based on the results of the monitoring activities, Con Edison may request to modify the wells that are sampled or the frequency of sampling events. However, it has been assumed that annual groundwater/NAPL monitoring activities would be conducted on an annual basis over a period of 30 years for the purpose of developing a cost estimate for this alternative.

Institutional Controls and SMP

Alternative 2 also includes establishing institutional controls in the form of a deed restriction and/or environmental easement to limit the future development and use of OU-1 to restricted-residential or commercial use (i.e., the site will be redeveloped to house retail and multifamily buildings); limit the potential future use of site groundwater as a source of potable or process water, without necessary water quality treatment; and limit the permissible invasive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts. Additionally, the institutional controls would require compliance with the SMP (described below) that would be prepared as part of this alternative. An annual report would be submitted to NYSDEC to document that institutional controls are maintained and remain effective, as well as to summarize annual groundwater monitoring/NAPL recovery activities.

As indicated above, this alternative includes the preparation of an SMP that would document the following:

- The institutional controls that would be established and maintained for OU-1;
- Known locations of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted-residential SCOs;
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities;
- Protocols and requirements for conducting annual groundwater monitoring/NAPL recovery;
- Requirements for performing periodic site inspections, providing NYSDEC-required certifications, and submitting periodic reports to NYSDEC; and
- Requirements for soil vapor intrusion contingencies to reduce the potential for off-site migration of and exposures to vapors (assuming a new building would be constructed as part of the redevelopment of OU-1).

5.2.2.1 Short-Term Impacts and Effectiveness – Alternative 2

Implementation of this alternative could result in short-term exposure of the surrounding community and workers to MGP-related COCs during soil excavation, installation of NAPL recovery wells/groundwater monitoring wells, and material handling and off-site transportation activities. Potential exposure mechanisms include ingestion and dermal contact with NAPL; impacted soil and/or groundwater; and inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized through the use of appropriately trained field personnel, engineering controls, and personal protective equipment (PPE), as specified in a site-specific health and safety plan (HASP) that would be developed as part of the remedial design phase of this alternative. Air monitoring would be performed during excavation and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust, modify the rate of construction, etc.). Community access to OU-1 would be restricted by temporary security fencing during remedial construction to reduce the potential for exposure to MGP-related COCs.

Additional worker safety concerns include working with and around large construction equipment, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from OU-1 and delivery of fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices.

Potential short-term risks to the community could occur during periodic groundwater/NAPL monitoring activities via exposure to purged groundwater, groundwater samples, and recovered NAPL (if any). Potential exposures to the community would be reduced by following appropriate procedures and protocols that would be described in the SMP.

Off-site transportation of excavated material and importation of clean fill materials would result in approximately 160 truck round trips (assuming 35 tons per dump truck). Alternative 2 would have a moderate disruption to the nearby community due to the increased local truck traffic. Transportation activities would be managed appropriately to reduce risks to the community. Alternative 2 does not employ green remediation practices and the relative carbon footprint (as compared to the other alternatives) is considered moderate. The greatest contribution to greenhouse gas emissions would likely result from the off-site LTTD treatment of impacted soil.

Soil excavation and installation of NAPL recovery wells/groundwater monitoring wells could be completed in approximately 3 months. Groundwater/NAPL monitoring activities would be conducted over an assumed 30-year period.

5.2.2.2 Long-Term Effectiveness and Permanence – Alternative 2

Approximately 1,760 cy of material would be excavated to address 610 cy of shallow subsurface soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL. The NAPL recovery wells would prevent further off-site migration of potentially mobile NAPL that would remain at OU-1.

The removal of shallow subsurface soil (to an approximate depth of 5 feet below grade) would create a clean fill/buffer zone reducing potential long-term exposure to remaining subsurface material containing MGP-related COCs at concentrations greater than restricted-residential SCOs and/or significant quantities of NAPL. Removal and disposal of the shallow subsurface materials is a permanent process. Alternative2 also includes establishing institutional controls and developing an SMP to reduce the potential for future exposures to remaining impacted material.

Activities that could potentially result in exposure to environmental media (i.e., soil and groundwater) containing MGP-related COCs would not be routinely conducted based on the current and foreseeable future use of OU-1 (i.e., restricted-residential). Additionally, if non-routine invasive work (e.g., utility installation) were to be conducted at OU-1, activities would likely be conducted within imported clean fill placed above remaining impacted material. The potential for exposures to remaining impacts during non-routine invasive work (including handling of potentially impacted material) would be further reduced by adhering to the protocols and requirements that would be presented in the SMP.

Annual verification of the institutional controls would be completed to document that the controls are maintained and remain effective. Alternative 2 also includes periodic groundwater/NAPL monitoring activities to document site conditions.

5.2.2.3 Land Use – Alternative 2

The current zoning for OU-1 is listed as a planned waterfront development, in accordance with the Village of Ossining Zoning Map dated September 2013. Areas immediately surrounding OU-1 are zoned for planned waterfront development, commercial, and residential. The current and foreseeable future use of the area surrounding OU-1 is commercial/residential. The area of OU-1 north of Central Avenue will continue to house the electrical substation that is owned and operated by Con Edison. Additionally, the area of OU-1 south of Central Avenue will be redeveloped for restricted-residential use.

Implementation of Alternative 2 is not anticipated to alter current or anticipated future site use. In the event that the property is sold, future owners/operators would be required to comply with the SMP and institutional controls established based on the continued presence of soil and groundwater containing MGP-related COCs.

5.2.2.4 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment – Alternative 2

Alternative 2 includes the removal and off-site treatment and/or disposal of approximately 1,760 cy of material to address 610 cy of shallow subsurface soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL. This alternative also includes the installation of NAPL recovery wells, periodic NAPL monitoring and removal of NAPL that may collect in the wells. Through the NAPL monitoring/recovery activities, the volume of mobile NAPL would be permanently reduced, thereby reducing the potential for further downgradient migration of mobile NAPL. NAPL removal would also permanently reduce the volume of material that is serving as a source to dissolved phase groundwater impacts. This removal would reduce the flux of COCs from source material to groundwater, which would reduce the toxicity and volume of dissolved phase groundwater impacts. Alternative 2 also includes annual groundwater monitoring to document the extent and potential long-term reduction (i.e., toxicity and volume) of dissolved phase groundwater impacts.

5.2.2.5 Implementability – Alternative 2

Alternative 2 is both technically and administratively feasible. Removal and off-site disposal of shallow subsurface soil, NAPL recovery well/groundwater monitoring well installation, and groundwater/NAPL monitoring are technically feasible and remedial contractors capable of performing these activities are readily available. Potential implementation challenges associated with this alternative include: conducting excavation activities where utilities may be present (e.g., electric and gas lines) and in close proximity to the retaining wall located along Kill Brook. Con Edison would assess potential options to protect/or temporarily relocate utility lines (if any) located within the proposed excavation areas during the remedial design.

This alternative assumes that excavation sidewalls would be stabilized by sloping and benching and no additional excavation support would be needed to facilitate excavation activities. However, the retaining wall located along Kill Brook poses an implementability challenge. The retaining wall forms a bulkhead in both sides of Kill Brook with a height ranging from approximately 4 to 10 feet in portions of the wall adjacent to proposed excavation areas. Excavation areas near the retaining wall would require additional planning and design to support the retaining wall to prevent wall failure.

Logistically, limited space is available for equipment and material handling and staging. Soil removal activities would have to be conducted in a manner that would not jeopardize health and safety or cause a nuisance to the surrounding community. Transportation planning would be conducted prior to the remedial activities.

Administratively, implementation of Alternative 2 would require access agreements for work activities on properties not owned by Con Edison. Access agreements would also be required to conduct long-term groundwater/NAPL monitoring on non-owned properties.

5.2.2.6 Compliance with SCGs – Alternative 2

- Chemical-Specific SCGs – Chemical-specific SCGs are presented in Table 1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs (i.e., restricted-residential) and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA Standards and Guidance Values.

  Alternative 2 would address shallow subsurface soil containing COCs at concentrations greater than restricted-residential SCOs and/or significant quantities of NAPL. However, a significant quantity of soil remaining at OU-1 would contain COCs at concentrations greater than the 6 NYCRR Part 375.6 restricted-residential SCOs and/or significant quantities of NAPL. All excavated material and process residuals would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. LDRs would apply to any materials that are characterized as a hazardous waste.

  Although this alternative includes installation of NAPL recovery wells and implementation of a NAPL recovery program, impacted soil would remain below the water table and therefore, Alternative 2 would likely not achieve groundwater SCGs within a determinate period of time.

- Action-Specific SCGs – Action-specific SCGs are presented in Table 2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

  Excavated soil would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following an NYSDEC-approved remedial design and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC, 2002), excavated MGP-related material that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable LDRs (where applicable).

- Location-Specific SCGs – Location-specific SCGs are presented in Table 3. Potentially applicable location-specific SCGs generally include regulations related to conducting construction activities on flood plains. Other applicable location-specific SCGs generally include local building codes and construction permits. Remedial activities would be conducted in accordance with flood plain regulations, as well as the Village of Ossining construction codes and ordinances. Local permits would be obtained prior to initiating the remedial activities.

5.2.2.7 Overall Protectiveness of the Public Health and the Environment – Alternative 2

Alternative 2 would address shallow subsurface soil containing COCs at concentrations greater than restricted-residential SCOs and/or significant quantities of NAPL. Exposures to remaining impacts would be addressed through the protocols and requirements that would be presented in the SMP.

Alternative 2 would work toward preventing exposures (i.e., direct contact, ingestion, and/or inhalation) to MGP-related impacts in soil through the targeted excavation of impacted soil (soil RAOs #1, #2, #4). If future intrusive activities were conducted within OU-1, potential exposures to remaining soil and groundwater impacts would be minimized by adhering to the institutional controls and the procedures set forth in the SMP that would be developed as part this alternative (soil RAOs #1 and #2 and groundwater RAOs #1 and #2).

Although Alternative 2 would not address soil containing MGP-related impacts below the water table, this alternative would work toward addressing potential sources of groundwater impacts (soil RAO #3 and groundwater RAO #5) by removing NAPL via NAPL recovery wells that would be installed along the western border of OU-1. However, this alternative would not prevent the discharge of contaminants from groundwater to surface water and sediment (groundwater RAO #4). Additionally, if groundwater is restored to pre-disposal/pre-release conditions (groundwater RAO #3), it would occur over a prolonged period of time (i.e., through continued weathering of NAPL and dissociation of related COCs and natural attenuation of dissolved phase impacts), as the source of soil and groundwater impacts would remain upgradient of the NAPL recovery wells.

Alternative 2 would also work toward reducing impacts to public health resulting from exposures to constituents associated with the former MGP via soil vapor intrusion through the removal of shallow subsurface soil and by following the protocols and requirements set forth in the SMP that would be developed as part this alternative (soil vapor RAO #1).

5.2.2.8 Cost Effectiveness – Alternative 2

The estimated costs associated with Alternative 2 are presented in Table 7. The total estimated 30-year present worth cost for this alternative is approximately $2,170,000. The estimated capital cost; including costs for conducting soil removal, NAPL recovery well installation, preparing an SMP, and establishing institutional controls; is $1,230,000. The estimated 30-year present worth cost of O&M activities, including groundwater/NAPL monitoring, is approximately $940,000.

5.2.3 Alternative 3 – Targeted Soil Removal, Targeted ISS Treatment of Visually Impacted Material, and NAPL Recovery

The major components of Alternative 3 include the following:

- Excavating shallow subsurface material (to depths of up to 5 feet below grade) to address soil containing COCs at concentrations greater than NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL or to remove shallow obstructions and allow for material bulking during ISS treatment;
- Implementing ISS treatment to address subsurface soil containing significant quantities of NAPL;
- Installing NAPL recovery wells;
- Implementing a NAPL recovery program;
- Installing groundwater monitoring wells;
- Conducting long-term groundwater/NAPL monitoring;
- Establishing institutional controls; and
- Developing a SMP.

As part of the remedial design phase for this alternative, PDI activities will be conducted to facilitate the development of several components of the remedy, including an appropriate ISS mix design, the extent of shallow excavation and ISS areas, excavation support system(s); backfill materials and surface restoration details; and the final number, location, and construction of the NAPL recovery wells/groundwater monitoring wells. PDI activities will generally consist of advancing additional direct push borings and collecting surface soil sampling across OU-1.

Soil Excavation and ISS Treatment

Alternative 3 includes the same shallow subsurface soil removal component as Alternative 2 (i.e., targeted removal of shallow subsurface soil to address soil containing COCs at concentrations greater than 6NYCRR Part 375-6 restricted residential SCOs and/or significant quantities of NAPL). Alternative 3 also includes ISS treatment of approximately 5,890 cy of subsurface soil (to depths up to 34 feet below grade) to address an estimated 2,880 cy of soil containing significant quantities of NAPL. The anticipated limits for areas to be targeted for excavation/ISS treatment are shown on Figure 15.

In general, the ISS process involves mixing Portland cement (and other pozzolanic materials) with impacted soil to reduce the leachability and mobility of COCs and NAPL present in soil. The resulting mixture is generally a homogeneous mixture of soil, groundwater, and grout that hardens to become a weakly-cemented material. The ISS process would solidify media (i.e., soil and groundwater) containing MGP-related impacts (micro-encapsulation), as well as soil surrounding MGP-related materials (macro-encapsulation), thereby preventing migration of COCs and NAPL beyond the solidified mass.

Bench-scale testing would be required prior to implementing this alternative. ISS bench-scale testing would consist of an evaluation of various soil solidification mixtures to determine the effectiveness of each mixture at meeting performance goals for permeability and strength that will be established as part of the remedial design. ISS mixtures could potentially consist of site soil and groundwater, blast furnace slag (BFS), Portland cement, bentonite, and water. The mixtures would be tested for density, permeability, strength, and/or leachability of COCs to identify an optimal mix design based on site-specific soil conditions (i.e., physical characteristics and quantity of impacts).

Prior to ISS treatment, pre-ISS excavation activities would be conducted (in areas that have not been previously targeted for shallow subsurface soil excavation) to remove shallow obstructions and allow for material bulking during soil solidification. Approximately 1,070 cy of material would be removed during pre-ISS excavation activities. Excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, dump trucks, etc. An assumed 75% of the excavated soil would be transported off-site for disposal as a non-hazardous waste and 25% would be transported off-site for treatment/disposal via LTTD.

Following pre-ISS excavation activities, ISS treatment would be conducted via conventional mixing methods/tools such as bucket mixing, small diameter augers, and jet-grouting. Bucket mixing would be used to treat subsurface materials to a depth up to approximately 26 feet due to equipment limitations, while small diameter augers would be used to treat deeper materials. Subsurface obstructions (i.e., materials measuring greater than 6 inches in any direction) that are present and not removed as part of the pre-ISS excavation activities could limit or prohibit complete mixing and solidification of impacted soils (when using auger mixing methods). In the event that subsurface obstructions are encountered, jet-grouting methods would be used to solidify impacted soil below the obstruction.

Quality assurance/quality control (QA/QC) sampling would be conducted during ISS treatment activities to verify that performance criteria (e.g., strength and permeability) are met. If performance criteria are not achieved at certain locations, soil would be re-mixed until performance criteria are achieved. Additionally, QA/QC sampling would be conducted following ISS treatment in accordance with NYSDEC requirements to ensure treatment effectiveness.

NAPL Recovery Wells/NAPL Recovery Program

Alternative 3 also includes the same long-term NAPL monitoring and recovery program as Alternative 2. Similar to Alternative 2, Alternative 3 includes the installation of NAPL recovery wells along the western border of OU-1. However, as the majority of the NAPL present at the site is expected to be addressed via ISS treatment, for the purpose of developing a cost estimate for this alternative, it has been assumed that only six NAPL recovery wells would be installed for this alternative. The NAPL recovery wells would be constructed as described in Alternative 2.

Groundwater Monitoring

Alternative 3 includes the same groundwater monitoring well installation and groundwater monitoring components as Alternative 2.

Institutional Controls, and SMP

Alternative 3 also includes the same long-term groundwater/NAPL monitoring, institutional control, and SMP components as Alternative 2.

5.2.3.1 Short-Term Impacts and Effectiveness – Alternative 3

Implementation of this alternative could result in short-term exposure of the surrounding community and workers to MGP-related COCs during soil excavation, soil mixing, installation of NAPL recovery wells/groundwater monitoring wells, and material handling and off-site transportation activities. Potential exposure mechanisms include ingestion and dermal contact with NAPL; impacted soil and/or groundwater; and inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized through the use of appropriately trained field personnel, engineering controls, and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design phase for this alternative. Air monitoring would be performed during excavation, soil mixing, and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust, modify the rate of construction, etc.). Community access to OU-1 would be restricted by temporary security fencing during remedial construction to reduce the potential for exposure to MGP-related COCs.

Additional worker safety concerns include working with and around large construction equipment, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from OU-1 and delivery of ISS aggregate and fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices.

Potential short-term risks to the community could occur during periodic groundwater/NAPL monitoring activities via exposure to purged groundwater, groundwater samples, and recovered NAPL (if any). Potential exposures to the community would be reduced by following appropriate procedures and protocols that would be described in the SMP.

Off-site transportation of excavated material and importation of ISS aggregate and clean fill materials would result in approximately 350 truck round trips (assuming 35 tons per dump truck). Alternative 3 would have a moderate disruption to the nearby community due to the increased local truck traffic. Transportation activities would be managed appropriately to reduce risks to the community. Although ISS is not considered a green remediation practice, impacted soil and groundwater would be solidified in place, thereby significantly reducing the volume of soil that may otherwise require transportation for off-site treatment and/or disposal. The need to import clean fill is also significantly reduced when stabilizing materials in place. The reduction in volume of imported fill needed would subsequently result in a decrease of truck traffic and non-renewable resources (i.e., fuel) required to export excavated material and to import clean fill. The relative carbon footprint (as compared to the other alternatives) is considered moderate. The greatest contribution to greenhouse gas emissions would likely result from the off-site LTTD treatment of impacted soil.

Soil excavation, ISS treatment, and installation of NAPL recovery wells could be completed in approximately 5 months. Groundwater/NAPL monitoring activities would be conducted over an assumed 30-year period.

5.2.3.2 Long-Term Effectiveness and Permanence – Alternative 3

The potential for future long-term impacts to MGP-related COCs would be significantly reduced through the implementation of this alternative. Approximately 1,760 cy of material would be excavated to address 610 cy of shallow subsurface soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL. Additionally, remaining soil containing significant quantities of NAPL (beneath excavated areas) would be treated in place via ISS. As part of the ISS treatment, impacted groundwater within the treatment area would also be incorporated into the solidified mass. QA/QC sampling would be completed during ISS treatment to confirm that performance criteria are met. If performance criteria are not met in specific areas, soil would be remixed until performance criteria are met. QA/QC sampling would also be conducted following ISS treatment in accordance with NYSDEC requirements to ensure treatment effectiveness. The NAPL recovery wells would also prevent further off-site migration of potentially mobile NAPL that would remain at OU-1.

The removal of shallow subsurface soil (to an approximate depth of 5 feet below grade) would create a clean fill/buffer zone addressing potential long-term exposure to underlying solidified material containing MGP-related impacts. Removal and disposal of these shallow subsurface materials is a permanent process. Although impacted soil and groundwater would remain (i.e., solidified in-place), the impacted materials would be encapsulated by the solidified mass. Alternative 3 also includes establishing institutional controls and developing an SMP to reduce the potential for future exposures to remaining impacted material/ solidified mass.

Activities that could potentially result in exposure to environmental media (i.e., soil and groundwater) and solidified material containing MGP-related COCs would not be routinely conducted based on the current and foreseeable future use of OU-1 (i.e., restricted-residential). Additionally, if non-routine invasive work (e.g., utility installation) were to be conducted at OU-1, activities would likely be conducted within the 5-foot zone of imported clean fill placed above remaining impacted/solidified material. The potential for exposures to remaining impacts during non-routine invasive work would be further reduced by adhering to the protocols and requirements (for conducting invasive activities and managing the excavated solidified material) that would be presented in the SMP.

Annual verification of the institutional controls would be completed to document that the controls are maintained and remain effective. Alternative 3 also includes periodic groundwater/NAPL monitoring activities to document site conditions.

5.2.3.3 Land Use – Alternative 3

The current zoning for OU-1 is listed as a planned waterfront development, in accordance with the Village of Ossining Zoning Map dated September 2013. Areas immediately surrounding OU-1 are zoned for planned waterfront development, commercial, and residential. The current and foreseeable future use of the area surrounding OU-1 is commercial/residential. The area of OU-1 north of Central Avenue will continue to house the electrical substation that is owned and operated by Con Edison. Additionally, the area of OU-1 south of Central Avenue will be redeveloped for restricted-residential use.

Implementation of Alternative 3 is not anticipated to alter current or anticipated future site use. However, the presence of ISS treated material at depths of 5 feet below grade may limit the potential future development of OU-1. Potential future construction of a building with a subgrade basement level and foundation would be more difficult based on the nature of the solidified material. In the event that the property is sold, future owners/operators would be required to comply with the SMP and institutional controls established based on the continued presence of soil and groundwater, and solidified material containing MGP-related COCs.

5.2.3.4 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment – Alternative 3

Alternative 3 includes the removal and off-site treatment and/or disposal of approximately 1,760 cy of material to address 610 cy of shallow subsurface soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL. Additionally, Alternative 3 includes ISS treatment of approximately 5,890 cy of subsurface soil to address an estimated 2,880 cy of soil containing significant quantities of NAPL. This alternative also includes the installation of NAPL recovery wells, periodic NAPL monitoring, and removal of NAPL that may collect in the wells.

Excavated material would be permanently transported off-site for treatment via LTTD and/or disposal as a non-hazardous waste at a solid waste landfill. Soil containing significant quantities of NAPL would be solidified in-place via ISS treatment reducing the mobility of NAPL and leachability of COCs from source material to groundwater. Impacted groundwater within the ISS treatment areas would also be solidified in-place with the soil. This is anticipated to reduce the toxicity and volume of residual dissolved phase groundwater impacts. As this alternative would address a majority of the material that serves as the source of groundwater impacts, dissolved phase concentrations of BTEX and PAHs in groundwater downgradient of the ISS areas would be anticipated to naturally attenuate via natural processes (e.g., biodegradation, sorption, dispersion, dilution, and volatilization).

The potential for further downgradient migration of mobile NAPL that may remain (if any) following excavation and ISS treatment would be reduced through the NAPL monitoring/recovery activities.

5.2.3.5 Implementability – Alternative 3

Alternative 3 is both technically and administratively feasible. Removal and off-site disposal of shallow subsurface soil, ISS treatment, NAPL recovery well/groundwater monitoring well installation, and groundwater/NAPL monitoring are technically feasible and remedial contractors capable of performing these activities are readily available. Potential implementation challenges associated with this alternative include: conducting excavation activities where utilities may be present (e.g., electric and gas lines), conducting excavation/soil mixing activities in close proximity to the retaining wall located along Kill Brook, and encountering obstructions during soil mixing.

Con Edison would assess potential options to protect/or temporarily relocate utility lines (if any) located within the proposed excavation areas during the remedial design.

Although technically feasible, bench-scale testing would be required prior to ISS treatment to identify an optimal mix design that would achieve strength and permeability performance criteria based on site-specific conditions. If auger mixing methods were used for ISS treatment, obstructions greater than six inches in diameter could prevent homogenous mixing and potentially damage ISS equipment. The ISS activities could potentially be limited by subsurface obstructions such as cobbles, debris, historical fill materials, and subsurface former building foundations and slabs. Pre-ISS excavation would be conducted to identify obstructions from the top 5 feet of the ISS areas during pre-ISS excavation activities. Bucket mixing methods could be used to clear deeper obstructions and treat impacted soil to depths up to approximately 26 feet below grade. Jet-grouting methods (if necessary) could be used to solidify material near/beneath obstructions that are unable or not practicable to remove or that are located at depths greater than 26 feet below grade.

Excavation/In-situ solidification activities near the retaining wall located along Kill Brook pose an additional implementability challenge. The retaining wall forms a bulkhead in both sides of Kill Brook with a height ranging from approximately 4 to 10 feet in portions of the wall adjacent to proposed excavation/ISS treatment areas. Excavation/ISS treatment areas near the retaining wall would require additional planning and design to support the retaining wall to prevent wall failure.

Although technically feasible, conducting ISS treatment activities in an urban setting presents numerous logistical challenges. Limited space would be available in OU-1 for equipment, and material handling and staging. A working area would have to be available to set up and operate the ISS mix plant. Additionally, soil removal and ISS treatment activities would have to be conducted in a manner that would not jeopardize the health and safety or cause a nuisance to the surrounding community. Transportation planning would also be conducted prior to the remedial activities. Administratively, implementation of Alternative 2 would require access agreements for work activities on properties not owned by Con Edison. Access agreements would also be required to conduct long-term groundwater/NAPL monitoring on non-owned properties.

5.2.3.6 Compliance with SCGs – Alternative 3

- Chemical-Specific SCGs – Chemical-specific SCGs are presented in Table 1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs (i.e., restricted-residential) and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA Standards and Guidance Values.

  Alternative 3 would address shallow subsurface soil containing COCs at concentrations greater than restricted-residential SCOs and/or significant quantities of NAPL. Additionally, Alternative 3 would address significant quantities of NAPL at depths up to 34 feet below grade via ISS treatment. This alternative would also address NAPL that may remain following excavation and ISS treatment by removing NAPL via NAPL recovery wells that would be installed downgradient of OU-1. Although this alternative would not address all subsurface soil that contains COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted-residential SCOs, the most heavily impacted soil (and subsequently most heavily impacted groundwater) would be solidified in place. All excavated material and process residuals would be managed and characterized in accordance with 40 CFR Part 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. LDRs would apply to any materials that are characterized as a hazardous waste.

As indicated in Section 1, individual BTEX compounds and PAHs have been detected in groundwater at concentrations exceeding groundwater quality standards. As Alternative 3 would address the majority of source MGP-related impacts, this alternative would likely achieve groundwater SCGs via direct treatment (i.e., ISS) or natural degradation following treatment/removal of source material.

- Action-Specific SCGs – Action-specific SCGs are presented in Table 2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.
- Excavated soil and process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following an NYSDEC-approved remedial design and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC, 2002), excavated MGP-related material that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable LDRs (where applicable).
- Location-Specific SCGs – Location-specific SCGs are presented in Table 3. Potentially applicable location-specific SCGs generally include regulations related to conducting construction activities on flood plains. Other applicable location-specific SCGs generally include local building codes and construction permits. Remedial activities would be conducted in accordance with flood plain regulations, as well as the Village of Ossining construction codes and ordinances. Local permits would be obtained prior to initiating the remedial activities.

5.2.3.7 Overall Protectiveness of the Public Health and the Environment – Alternative 3

Alternative 3 would address subsurface soil containing COCs at concentrations greater than restricted-residential SCOs and/or significant quantities of NAPL through a combination of removal and ISS treatment. The potential for exposures to remaining impacts/solidified material would be addressed through the protocols and requirements that would be presented in the SMP.

Alternative 3 would prevent exposures (i.e., direct contact, ingestion, and/or inhalation) to MGP-related impacts in soil (soil RAOs #1, #2, #4) and would address the source of soil and groundwater impacts (soil RAO #3 and groundwater RAOs #4 and #5) through soil excavation and ISS treatment. Potential exposures to remaining soil and groundwater impacts and/or the solidified mass would be prevented by adhering to the institutional controls and the procedures set forth in the SMP that would be developed as part this alternative (soil RAOs #1 and #2 and groundwater RAOs #1 and #2).

Alternative 3 would address a majority of impacted material located below the water table (i.e., the source for dissolved phase impacts) through ISS treatment, resulting in a reduction in the extent and concentrations of dissolved phase COCs following remedial construction activities. Additionally, NAPL that may remain (if any) following excavation and ISS treatment would be addressed by removing NAPL via NAPL recovery wells that would be installed along the western border of OU-1. Therefore, groundwater will eventually be restored to pre-disposal/pre-release conditions downgradient of the ISS treatment areas (groundwater RAO #3). Additionally, this alternative would reduce exposures to impacted groundwater (groundwater RAOs #1 and #2) and prevent discharge of COCs from groundwater to surface water and sediment (groundwater RAO #4), as residual dissolved phase impacts would naturally attenuate following ISS treatment.

Impacts to public health resulting from exposures to constituents associated with the former MGP via soil vapor intrusion would be reduced via excavation of shallow subsurface soil/ISS treatment of a majority of impacted material and by following the protocols and requirements set forth in the SMP that would be developed as part this alternative (soil vapor RAO #1).

5.2.3.8 Cost Effectiveness – Alternative 3

The estimated costs associated with Alternative 3 are presented in Table 8. The total estimated 30-year present worth cost for this alternative is approximately $3,690,000. The estimated capital cost; including costs for conducting soil removal, ISS treatment, preparing an SMP, and establishing institutional controls; is $2,750,000. The estimated 30-year present worth cost of O&M activities, including groundwater/NAPL monitoring, is approximately $940,000.

5.2.4 Alternative 4 – Soil Removal to Unrestricted Use SCOs

The major component of Alternative 4 consists of Excavating soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted-use SCOs. As part of the remedial design phase for this alternative, pre-design investigation (PDI) activities would be implemented to evaluate the extent of excavation areas, excavation support system(s); backfill materials and surface restoration details. PDI activities will generally consist of advancing additional direct push borings and collecting surface soil sampling across OU-1.

<u>Soil Excavation</u>

Alternative 5 includes removal of approximately 15,520 cy of material to address 6,130 cy of soil containing MGP-related COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs. Anticipated soil removal limits are shown on Figure 16.

This alternative includes excavation at depths ranging from 5 feet below grade up to 35 feet below grade and therefore, excavation support systems would be required to complete soil removal activities based on these anticipated excavation depths. For the purpose of developing this alternative, it has been assumed that sheet piles would be used as excavation support to facilitate these excavation activities. Multiple cells and internal bracing and tie backs would be required to facilitate soil removal. The final excavation support system(s) would be further evaluated and developed as part of the remedial design phase of this alternative.

Excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, dump trucks, etc. An assumed 60% of the excavated soil would be transported off-site for disposal as a non-hazardous waste and 40% would be transported off-site for treatment/disposal via LTTD. The excavation area would be backfilled with imported clean fill material to match the previously existing lines and grades. Backfill materials and surface restoration details would be developed as part of the remedial design phase of this alternative.

Excavations completed to depths below the water table (located from approximately 7 feet to 17 feet below grade) would be dewatered to facilitate impacted soil removal to target depths. Water generated during remedial construction activities would be treated via a temporary on-site water treatment system, and treated water would be discharged to Kill Brook under a NYSDEC SPDES equivalent discharge permit. Temporary water treatment system capacity and details would be evaluated as part of the remedial design phase of this alternative.

Former Gas Holders Removal

Alternative 4 includes the removal of the former gas holders located in the southwestern portion of the site. Approximately 1,300 cy of material will be excavated to facilitate the removal of the former gas holders. Anticipated soil removal limits are shown on Figure 16.

For the purpose of developing this alternative, it has been assumed that the gas holders will be excavated to a depth of approximately 7 feet below grade and that the holders' structures will be used as excavation support. The final excavation support system(s) would be further evaluated and developed as part of the remedial design phase of this alternative.

Excavation activities would be conducted using conventional construction equipment and excavated soil would be transported off-site for disposal as a non-hazardous waste. The excavation area would be backfilled with imported clean fill material to match the previously existing lines and grades. Backfill materials and surface restoration details would be developed as part of the remedial design phase of this alternative.

Groundwater/NAPL Monitoring, Institutional Controls, and SMP

Alternative 4 does not include provisions or costs for any long-term groundwater/NAPL monitoring, institutional control, and SMP components as the impacted media (soil and groundwater) would be removed.

5.2.4.1 Short-Term Impacts and Effectiveness – Alternative 4

Alternative 4 presents significant short-term impacts to site workers and the surrounding community. Implementation of this alternative could result in short-term exposure of the surrounding community and workers to MGP-related COCs as a result of soil excavation, excavated material handling, and off-site transportation activities. Potential exposure mechanisms would include ingestion and dermal contact with NAPL; impacted soil, and/or groundwater; and inhalation of volatile organic vapors or dust containing COCs during remedial construction.

Potential exposure of remedial workers would be minimized through the use of appropriately trained field personnel, engineering controls, and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design phase of this alternative. Air monitoring would be performed during excavation and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust, modify the rate of construction, etc.). Community access to OU-1 would be restricted by a temporary security fencing during remedial construction to reduce the potential for exposure to MGP-related COCs.

Additional worker safety concerns include working within excavation shoring systems, working with and around large construction equipment, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from OU-1 and delivery of fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices. Transportation activities would need to be managed to minimize en-route risks to the community.

Off-site transportation of excavated material and importation of clean fill materials would result in approximately 1,470 dump truck round trips (assuming 35 tons per dump truck). Alternative 4 would have a significant disruption to the nearby community due to the increased local truck traffic. Alternative 4 does not employ green remediation practices and the relative carbon footprint resulting from the treatment of excavated materials via LTTD, as well as from transportation of excavated material and importation of clean fill materials, is considered to be significant (as compared to the other alternatives).

Soil excavation and backfilling activities could be completed in approximately 17 months, assuming all remedial activities are completed as one mobilization.

5.2.4.2 Long-Term Effectiveness and Permanence – Alternative 4

The potential for future long-term impacts from exposures to MGP-related COCs would be significantly reduced under this alternative. Soil containing COCs at concentrations greater than unrestricted use SCOs would be excavated and permanently transported off-site for treatment/disposal. Excavation and disposal is a permanent process for removing impacts from OU-1.

The vast majority (if not all) of impacted soil (i.e., the source of dissolved phase impacts) would be removed from OU-1 under this alternative. Therefore, no groundwater monitoring, SMP, or institutional controls would be required to reduce the potential for exposures.

5.2.4.3 Land Use – Alternative 4

The current zoning for OU-1 is listed as a planned waterfront development, in accordance with the Village of Ossining Zoning Map dated September 2013. Areas immediately surrounding OU-1 are zoned for planned waterfront development, commercial, and residential. The current and foreseeable future use of the area surrounding OU-1 is commercial/residential. The area of OU-1 north of Central Avenue will continue to house the electrical substation that is owned and operated by Con Edison. Additionally, the area of OU-1 south of Central Avenue will be redeveloped for restricted-residential use.

Implementation of Alternative 4 is not anticipated to alter current or anticipated future use of OU-1. Soil containing MGP-related COCs at concentrations greater than unrestricted use SCOs would be removed. Excavation areas would be backfilled with imported fill. There would be no limitations to the potential future use of OU-1. Dissolved phase concentrations of COCs in groundwater beyond the excavation limits would be expected to naturally attenuate over a relatively short time period.

5.2.4.4 Reduction of Toxicity, Mobility or Volume of Contamination through Treatment – Alternative 4

Alternative 4 includes the excavation of approximately 15,520 cy of material to address 6,130 cy of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs. Additionally, this alternative would include the removal of 1,300 cy of material to facilitate the removal of the former gas holders. Excavated material would be permanently transported off-site for treatment via LTTD and/or disposal as a non-hazardous waste at a solid waste landfill. Alternative 4 would address a vast majority of soil containing MGP-related impacts, thereby reducing the flux of COCs from source material to groundwater and the toxicity and volume of residual dissolved phase groundwater impacts. Dissolved phase concentrations of BTEX and PAHs in groundwater downgradient of the excavation areas would be expected to naturally attenuate.

5.2.4.5 Implementability – Alternative 4

Alternative 4 would be both technically and administratively implementable. Excavation of soil to depths up to 35 feet below grade is technically feasible. Remedial contractors capable of performing the excavation activities are readily available. Potential implementation challenges associated with conducting activities at OU-1 include: conducting excavation activities where subsurface utilities may be present (i.e., gas and water lines) and in close proximity to the retaining wall located along Kill Brook. Con Edison would assess potential options to protect/or temporarily relocate utility lines (if any) located within the proposed excavation area during the remedial design.

This alternative assumes that excavation support, consisting of sheet piles, would be required to facilitate excavation activities. Excavation support systems may require multiple levels of internal bracing and/or external tie-backs to maintain excavation stability based on the anticipated excavation depths. Additionally, excavation areas would be subdivided into smaller excavation cells to facilitate excavation activities based on the extent and varying excavation depths. Excavation support system options would be evaluated as part of the remedial design phase of this alternative.

Excavation activities near the retaining wall located along Kill Brook poses an additional implementability challenge. The retaining wall forms a bulkhead in both sides of Kill Brook with a height ranging from approximately 4 to 10 feet in portions of the wall adjacent to proposed excavation areas. Excavation areas near the retaining wall would require additional planning and design to support the retaining wall to prevent wall failure.

Logistically, limited space is available for equipment, material handling and staging. Soil removal activities would have to be conducted in a manner that would not jeopardize the health and safety or cause a nuisance to the surrounding community. Transportation planning would be conducted prior to the remedial activities. Administratively, implementation of Alternative 4 would require access agreements to work activities on properties not owned by Con Edison.

5.2.4.6 Compliance with SCGs – Alternative 4

- Chemical-Specific SCGs – Chemical-specific SCGs are presented in Table 1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs (i.e., restricted-residential) and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA Standards and Guidance Values.

  Alternative 4 includes the removal and off-site treatment/disposal of soil containing COCs at concentrations greater than unrestricted use SCOs. All excavated material and process residuals would be managed and characterized in accordance with 40 CFR 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. LDRs would apply to any materials that are characterized as a hazardous waste.

  As indicated in Section 1, BTEX and PAHs have been detected in groundwater at concentrations exceeding groundwater quality standards. As Alternative 4 would address the majority of source MGP-related impacts, this alternative would likely achieve groundwater SCGs.

- Action-Specific SCGs – Action-specific SCGs are presented in Table 2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

  Excavated soil would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting hazardous or regulated materials. Compliance with these requirements would be achieved by following an NYSDEC-approved remedial design and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC, 2002), excavated MGP-related material that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable LDRs (where applicable).

- Location-Specific SCGs – Location-specific SCGs are presented in Table 3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on flood plains. Other applicable location-specific SCGs generally include local building codes and construction permits. Remedial activities would be conducted in accordance with flood plain regulations, as well as the Village of Ossining construction codes and ordinances. Local permits would be obtained prior to initiating the remedial activities.

5.2.4.7 Overall Protectiveness of the Public Health and the Environment – Alternative 4

Alternative 4 would address soil containing COCs at concentrations greater than unrestricted use SCOs. Excavated material would be permanently removed from OU-1. Therefore, Alternative 4 would eliminate potential exposures (i.e., direct contact, ingestion, and/or inhalation) to MGP-related impacts in soil (soil RAOs #1, #2 and #4). Impacts to public health resulting from exposures to constituents associated with the former MGP via soil vapor intrusion would also be mitigated (soil vapor RAO #1).

Alternative 4 would address the migration of MGP-related COCs (soil RAO #3) and source of groundwater impacts (groundwater RAO #5) through the removal of soil containing COCs at concentrations greater than unrestricted use SCOs. Reduction in the extent and concentrations of dissolved phase COCs is anticipated following remedial construction activities, as a majority (if not all) impacted material located below the water table (i.e., the source for dissolved phase impacts) would be removed. Therefore, groundwater would eventually be restored to pre-disposal/pre-release conditions (groundwater RAO #3). Additionally, as residual dissolved phase impacts would naturally attenuate following soil removal, this alternative would eliminate exposures to impacted groundwater (groundwater RAOs #1 and #2) and prevent discharge of COCs from groundwater to surface water and sediment (groundwater RAO #4).

5.2.4.8 Cost Effectiveness – Alternative 4

The estimated costs associated with Alternative 4 are presented in Table 9. The total estimated cost for this alternative, including costs for conducting soil removal and backfilling activities, is $9,350,000.

6 Comparative Analysis of Alternatives

This section presents the comparative analysis of each remedial alternative using the evaluation criteria identified in Section 5. The comparative analysis identifies the advantages and disadvantages of each alternative relative to each other and with respect to the eight evaluation criteria.

6.1 Comparative Analysis

The alternatives evaluated in Section 5 consist of the following:

- Alternative 1 – No Action;
- Alternative 2 – Targeted Soil Removal and NAPL Recovery;
- Alternative 3 – Targeted Soil Removal, Targeted ISS Treatment of Visually Impacted Material, and NAPL Recovery; and
- Alternative 4 – Soil removal to Unrestricted Use SCOs.

The comparative analysis of these alternatives is presented in the following subsections.

6.1.1 Short-Term Impacts and Effectiveness

Alternative 1 does not include additional active remediation and subsequently would not present potential short-term impacts to the community. Alternatives 2 through 4 each include intrusive activities (i.e., soil excavation and/or ISS treatment) to address MGP-related impacts. Each of these alternatives would pose potential short-term risks to remedial workers and the public from potential exposure to impacted soil and groundwater, and NAPL during soil excavation removal, ISS treatment, and off-site transportation of excavated material. Additionally, the remedial construction activities conducted under these alternatives would pose short-term risks to site workers from the operation of construction equipment, and generation of noise and dust.

Nuisances to the surrounding community would include noise from installing excavation support systems (e.g., sheet pile) and/or operating construction equipment, as well as an increase in local truck traffic associated with importing backfill/ISS aggregate materials and transportation of excavated materials for off-site treatment/disposal. Estimated durations to implement each of the alternatives and number of truck trips required for each alternative are presented below.

- Alternative 1 – no time required and no truck trips;
- Alternative 2 – 3 months and 160 truck trips;
- Alternative 3 – 5 months and 350 truck trips; and
- Alternative 4 – 17 months and 1,470 truck trips.

Potential exposures during remedial construction of these alternatives would be mitigated, to the extent practicable, by using appropriate PPE, implementing air and work space monitoring during remedial construction, implementing dust control and noise mitigation measures (as appropriate and/or necessary based on monitoring results), and proper planning and training of remedial workers.

As Alternatives 2 and 3 include annual groundwater monitoring and/or NAPL recovery activities, potential short-term risks to field personnel and the community could occur during these activities via exposure to purged groundwater, groundwater samples, and recovered NAPL (if any). The potential exposures to field personnel would be reduced through the use of proper training and PPE as specified in a site-specific HASP. Potential exposures to the community would be reduced by following appropriate procedures and protocols that would be described in the SMP.

Alternative 1 would have no carbon footprint. While Alternatives 2 and 3 are considered to have moderate carbon footprints, Alternative 3 would have a greater carbon footprint, when compared to Alternative 2 based on the number of truck trips. Under Alternative 3, ISS treatment would offer some sustainable practices as the volume of material transported off-site for treatment/disposal, as well as volume of imported fill needed, is significantly reduced by solidifying impacted material in-place. Alternative 4 has the greatest carbon footprint compared to the other alternatives based on the significantly greater volume of soil excavated and backfilled under this alternative. The greatest contribution to greenhouse gases would occur as a result of treatment of excavated materials via LTTD, as well as from equipment operation during excavation, backfilling, and transportation activities.

Although each successive alternative includes the removal or ISS treatment of a greater quantity of soil, and the potential for short-term impacts to the public and remedial workers inherently increases, Alternatives 2 and 3 would have a relatively equivalent short-term impact on the surrounding community and are anticipated to require similar timeframes to implement. Compared to the other remedial alternatives, Alternative 4 would be the most disruptive to the surrounding community, has the greatest potential for exposures to remedial workers and the public, would require the longest time to implement, and has the greatest carbon footprint.

6.1.2 Long-Term Effectiveness and Permanence

Alternative 1 would not include the implementation of any remedial activities and therefore, would not present potential long-term exposures to MGP-related impacts. Alternatives 2, 3, and 4 each rely on varying degrees of removal and/or treatment to reduce the potential for long term exposures to MGP-related impacts. Alternative 2 relies on the removal of shallow subsurface soil (to an approximate depth of 5 feet below grade) to mitigate the potential long-term exposures to remaining subsurface material containing MGP-related impacts. Additionally, Alternative 2 relies on the installation of NAPL recovery wells downgradient of OU-1 to address potentially mobile NAPL. Under Alternative 3, long-term exposures would be reduced through removal/ISS treatment of impacted material. Alternative would also include the same NAPL recovery well installation component as Alternative 2 to address potentially mobile NAPL that would remain (if any) following excavation/ISS treatment. Alternative 4 would eliminate long-term impacts by excavating soil containing COCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs. Alternative 4 would have the greatest degree of long-term effectiveness and permanence based on the removal of the vast majority of impacted material.

Although Alternative 4 would have the highest degree of long-term effectiveness and permanence based on the removal of the vast majority of impacted material, Alternative 3 is considered similarly effective as Alternative 4 as this alternative addresses the majority of MGP-related impacts (which are generally encountered below the water table) through ISS treatment of soil containing significant quantities of NAPL and NAPL recovery. Although limited impacts would remain following ISS treatment, the potential for future exposures to soil and groundwater containing MGP-related impacts following implementation of Alternative 3 is low.

Alternatives 2 and 3 include annual groundwater/NAPL monitoring to document potential changes in site groundwater conditions (i.e., the extent of dissolved phase impacts and the potential trends in COC concentrations). Alternatives 2 and 3 also include the establishment of institutional controls and development of an SMP to limit the potential for future exposures to MGP-related impacts. Compared to Alternatives 3 and 4, Alternative 2 would address the least amount of MGP-related impacts. Therefore, Alternative 2 would rely more on the institutional controls and the SMP to mitigate future exposures, as compared to Alternative 3.

6.1.3 Land Use

The current zoning for OU-1 is listed as a planned waterfront development, in accordance with the Village of Ossining Zoning Map dated September 2013. Areas immediately surrounding OU-1 are zoned for planned waterfront development, commercial, and residential. The current and foreseeable future use of the area surrounding OU-1 is commercial/residential. The area of OU-1 north of Central Avenue will continue to house the electrical substation that is owned and operated by Con Edison. The area of OU-1 south of Central Avenue will be redeveloped for restricted-residential/commercial use.

Implementation of Alternatives 1 through 4 is not anticipated to alter current or anticipated future use of the site. Alternative 1 does not include any remedial actions and therefore OU-1 would remain in its current condition. Alternatives 2 and 3 include establishing institutional controls on the site properties and conducting groundwater/NAPL monitoring activities for an assumed 30 years. Additionally, Alternatives 2 and 3 include a combination of soil removal, ISS treatment, and/or NAPL recovery to address site related-impacts. In the event that the property is sold following implementation of Alternatives 1, 2, or 3, future owners/ operators would be required to comply with the SMP and established institutional controls based on the continued presence of soil and/or groundwater containing MGP-related COCs. Under these alternatives, OU-1 would be limited to restricted residential use.

Alternative 4 would address a majority of MGP-related impacts by extensive excavation and therefore, there would likely be no limitations to the potential future use of the site. Dissolved phase concentrations of COCs in groundwater beyond the excavation limits would be expected to naturally attenuate over a relatively short time period.

6.1.4 Reduction of Toxicity, Mobility and Volume of Contamination through Treatment

Alternative 1 would not actively treat, remove, recycle, or destroy impacted media and therefore, is considered the least effective for this criterion. Alternative 2 would only address impacted material at depths up to 5 feet below grade through excavation and off-site transportation and treatment/disposal of excavated material. Alternative 3 would address impacted material to approximately 34 feet below grade through excavation and targeted ISS treatment that would solidify the impacted material in-place. Alternative 4 would address impacted material through the removal of soil to approximately 35 feet below grade. Alternatives 2 and 3 include groundwater/NAPL monitoring to document the trends in concentrations of dissolved phase impacts, as well as to recover potentially mobile NAPL that accumulates in site wells.

Alternative 2 includes installing NAPL recovery wells to prevent further migration of potentially mobile NAPL downgradient of OU-1. Periodic NAPL monitoring/recovery would be conducted to remove NAPL from NAPL recovery wells, reducing the volume of material that is serving as a source for dissolved phase groundwater impacts. Under Alternative 3, potentially mobile NAPL would be treated in-place via ISS reducing the mobility of NAPL and leachability of COCs from source material to groundwater. Alternative 3 would also include a similar NAPL recovery well installation component as Alternative 2 (with fewer recovery wells due to the in-place solidification of NAPL-containing soils) to address potentially mobile NAPL that would remain (if any) outside the

ISS treatment areas. Under Alternative 4, MGP-related impacts below the water table would be removed via excavation.

For Alternatives 2 through 4, each successive alternative includes the excavation (and associated off-site treatment and/or disposal) and/or ISS treatment of a greater quantity of soil. Alternatives 2 and 3 include the removal of approximately 1,760 cy and 2,830 cy of material, respectively. Alternative 3 also includes the targeted ISS treatment of 5,890 cy of soil. As described above, impacted soil and NAPL would remain on-site in a solidified state and limited impacts would remain beneath the solidified mass. However, the ISS treatment would effectively reduce the mobility and toxicity of the material by encapsulating impacts in the solidified mass. Alternative 4 would remove the greatest volume of soil containing MGP-related impacts (approximately 15,520 cy of material).

Although Alternative 4 would remove a greater volume of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 unrestricted use SCOs, Alternative 3 would also be effective at reducing toxicity, mobility, and volume of MGP-related impacts via soil removal and ISS treatment. Alternative 3 would address the majority of MGP-related impacts, including the material serving as a source of dissolved phase impacts, and therefore, the toxicity and volume of residual dissolved phase groundwater impacts would be expected to be reduced over time.

6.1.5 Implementability

No additional remedial activities would be conducted as part of Alternative 1 and therefore, Alternative 1 is considered the most implementable. PDI activities would be conducted for Alternatives 2, 3, and 4 to define specific components of each alternative, including the extent of excavation and ISS area, ISS mix designs, excavation support requirements, backfill materials, and surface restoration details, Alternatives 2 and 3 include long-term groundwater/NAPL monitoring, preparation of an SMP, and implementation of institutional controls. From a technical implementability aspect, these activities do not require highly specialized equipment or personnel and could be easily implemented. Administratively, establishing institutional controls on properties not owned by Con Edison would require coordination with state agencies (i.e., NYSDEC and NYSDOH) and the property owners. Additionally, access agreements would be required to conduct long-term groundwater/NAPL monitoring and MNR.

Alternatives 2, 3, and 4 each include soil removal and/or ISS treatment and therefore, have similar implementation challenges. However, Alternative 4 is considered the least implementable given the associated extent and depth of excavation activities.

Remedial contractors capable of performing excavation and ISS activities are readily available. Potential implementation challenges are associated with these alternatives include conducting excavation activities where utilities may be currently present (e.g., electric and gas lines) and conducting excavation/soil mixing activities in close proximity to the retaining wall located along Kill Brook. Potential options to protect/or temporarily relocate utility lines located within the proposed excavation areas would be evaluated during the remedial design.

Alternatives 2 and 3 include the targeted removal of subsurface soil to depths up to 5 feet below grade. Excavation sidewalls would be stabilized by sloping and benching and no additional excavation support would be needed to facilitate excavation activities.

Under Alternative 3, bench-scale testing would be required prior to ISS treatment to identify an optimal mix design that would achieve strength and permeability performance criteria based on site-specific conditions. If auger mixing methods were used for ISS treatment, obstructions greater than six inches in diameter could prevent homogenous mixing and potentially damage ISS equipment. The ISS activities could potentially be limited by subsurface obstructions such as cobbles, debris, historical fill materials, and subsurface former building foundations and slabs. Pre-ISS excavation would be conducted to identify obstructions and clear the top of fill material during pre-trenching activities. Bucket mixing methods could be used to clear deeper obstructions and treat impacted soil to depths up to 26 feet below grade. Jet-grouting methods could be used to solidify material near/beneath obstructions that are unable or not practicable to remove or are located at depths greater than 26 feet below grade.

Alternative 4 has the most significant implementation challenges based on the removal depths associated with the alternative (i.e., up to 35 feet below grade). This alternative would require excavation support, consisting of sheet piles with multiple levels of internal bracing and/or external tie-backs, to maintain excavation stability during excavation activities. Additionally, excavation areas would be subdivided into smaller excavation cells to facilitate excavation activities based on the extent and varying excavation depths. Excavation support system options would be evaluated as part of the remedial design phase of this alternative.

Excavation/soil mixing activities near the retaining wall located along Kill Brook pose additional implementability challenges. The retaining wall forms a bulkhead in both sides of Kill Brook with a height ranging from approximately 4 to 10 feet in portions of the wall adjacent to proposed excavation/ISS treatment areas. Excavation/ISS treatment areas near the retaining wall would require additional planning and design to support the retaining wall to prevent wall failure.

Logistically, limited space would be available in OU-1 for equipment, and material handling and staging. Additionally, soil removal and ISS treatment activities would have to be conducted in a manner that would not jeopardize the health and safety or cause a nuisance to the surrounding community. Transportation planning would also be conducted prior to the remedial activities. Administratively, implementation of Alternatives 2, 3, and 4 would require access agreements for work activities on properties not owned by Con Edison.

6.1.6 Compliance with SCGs

- Chemical-Specific SCGs – Chemical-specific SCGs are presented in Table 1. Potentially applicable chemical-specific SCGs for soil include 6 NYCRR Part 375-6 SCOs (i.e., restricted-residential) and 40 CFR Part 261 and 6 NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA Standards and Guidance Values.

  Alternative 1 does not include intrusive remedial construction activities and therefore, would not achieve chemical-specific SCGs for soil or groundwater. Alternative 2 would address shallow subsurface soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted-residential SCOs and/or significant quantities of NAPL to a depth of approximately 5 feet below grade. Additionally, Alternative 2 would address potentially mobile NAPL via NAPL recovery wells that would be installed along the downgradient portion of OU-1. However, remaining soil at the site would contain COCs at concentrations greater than the 6 NYCRR Part 375.6 restricted-residential SCOs. In addition to the impacted material to be addressed under Alternative 2, Alternative 3 would address subsurface soil containing significant quantities of NAPL to depths up to 34 feet below grade via ISS treatment. Alternative 4 includes the removal and off-site treatment/disposal of soil containing COCs at concentrations greater than unrestricted use SCOs. Under each alternative, excavated material and process residuals would be managed and characterized in accordance with 40 CFR 261 and 6 NYCRR Part 371 regulations to determine off-site treatment/disposal requirements. LDRs would apply to any materials that are characterized as a hazardous waste.

As indicated in Section 1, BTEX and PAHs have been detected in groundwater at concentrations exceeding groundwater quality standards. Alternative 2 does not address soil containing MGP-related impacts below the water table and therefore, if this alternative could achieve groundwater SCGs, the SCGs would only be achieved over a prolonged period of time (i.e., through natural attenuation of dissolved phase impacts). Alternatives 3 and 4 would address the majority of source MGP-related impacts and these alternatives would likely achieve groundwater SCGs (although Alternative 4 would likely achieve ground SCGs in a shorter period of time than Alternative 3).

- Action-Specific SCGs – Action-specific SCGs are presented in Table 2. Potentially applicable action-specific SCGs include health and safety requirements and regulations associated with handling impacted media. Work activities would be conducted in accordance with OSHA requirements that specify general industry standards, safety equipment and procedures, and record keeping and reporting regulations. Compliance with these action-specific SCGs would be accomplished by following a site-specific HASP.

  Under Alternatives 2, 3, and 4, excavated soil and process residuals would be subject to USDOT requirements for packaging, labeling, manifesting, and transporting of hazardous or regulated materials. Compliance with these requirements would be achieved by following an NYSDEC-approved remedial design and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC, 2002), excavated MGP-related material that is characteristically hazardous for benzene only (D018) is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (e.g., LTTD). All excavated material would be disposed of in accordance with applicable LDRs (where applicable).
- Location-Specific SCGs – Location-specific SCGs are presented in Table 3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on flood plains. Other applicable location-specific SCGs generally include local building codes and construction permits. Remedial activities would be conducted in accordance with flood plain regulations, as well as the Village of Ossining construction codes and ordinances. Local permits would be obtained prior to initiating the remedial activities.

6.1.7 Overall Protection of Public Health and the Environment

As Alternative 1 does not include any active remedial measures or administrative controls, Alternative 1 is not considered protective of human health and the environment.

Alternatives 2, 3, and 4 would rely on a combination of varying amounts of excavation, NAPL recovery (via NAPL recovery wells), institutional controls, and/or an SMP to prevent human and biota exposures (i.e., direct contact, ingestion, and inhalation) to MGP-related impacts in soil and groundwater (soil RAOs #1, #2 and #4, groundwater RAOs #1 and #2). Compared to Alternative 4, Alternative 2 and 3 would rely more on the implementation of institutional controls and adherence to the procedures to be presented in the SMP to prevent exposures (i.e., direct contact, ingestion) to MGP-related impacts in soil and groundwater.

Alternatives 2 would work toward addressing potential sources of groundwater impacts (soil RAO #3 and groundwater RAOs #5) through the installation of NAPL recovery wells and associated NAPL monitoring/recovery activities. However, if groundwater is restored to pre-disposal/pre-release conditions under this alternative (groundwater RAO #3), it would occur over a prolonged period of time (i.e., through continued natural weathering of NAPL and dissociation of related COCs and attenuation of dissolved phase impacts), as the source of soil and groundwater impacts would remain upgradient of the NAPL recovery wells. Alternatives 3 and 4 would address the migration of MGP-related COCs (soil RAO #3) and source of groundwater impacts (groundwater RAO #5) through ISS treatment of soils containing significant quantities of NAPL/NAPL recovery via NAPL recovery wells that would be installed downgradient of OU-1 and removal of soil containing COCs at concentrations greater than unrestricted use SCOs, respectively. Groundwater would likely be restored to pre-disposal/pre-release conditions (groundwater RAO #3) as a majority (if not all) impacted material located below the water table (i.e., the source for dissolved phase impacts) would be treated in-place/removed. Additionally, as residual dissolved phase impacts would naturally attenuate following ISS treatment/soil removal, Alternatives 3 and 4 would also eliminate exposures to impacted groundwater (groundwater RAOs #1 and #2) and prevent discharge of COCs from groundwater to surface water and sediment (groundwater RAO #4).

Although Alternatives 2 and 3 would reduce exposures to constituents associated with the former MGP via soil vapor intrusion through excavation of shallow subsurface soil and/or ISS treatment and by following the protocols and requirements set forth in the SMP that would be developed as part these alternatives (soil vapor RAO #1), only Alternative 4 would address those exposures through the removal of the majority (if not all) material containing MGP-related impacts.

6.1.8 Cost Effectiveness

The following table summarizes the estimated costs associated with implementing each of the remedial alternatives.

Table 6.1 – Estimated Costs

Alternative	Estimated Capital Cost	Estimated Present Worth Cost of O&M[1]	Total Estimated Cost
Alternative 1 – No Action	$0	$0	$0
Alternative 2 – Targeted Soil Removal and NAPL Recovery	$1,230,000	$940,000	$2,170,000
Alternative 3 – Targeted Soil Removal, Targeted ISS Treatment of Visually Impacted Material, and NAPL recovery	$2,690,000	$940,000	$3,690,000
Alternative 4 – Soil removal to Unrestricted Use SCOs	$9,350,000	$0	$9,350,000

Note:
1. Estimated present worth of O&M cost is over an assumed 30-year period.

The capital cost to implement Alternative 4 is significantly greater relative to the capital cost to implement the other alternatives (i.e., approximately two to three times the cost of Alternatives 2 and 3). The higher cost for Alternatives 4 corresponds to the large volume of excavation and backfilling associated with this alternative, as Alternative 4 would address the greatest volume of soil. However, Alternative 4 corresponds to the greatest technical implementation difficulties, short-term effectiveness concerns, disruption to the surrounding community, and potential for exposures based on the extent of excavation and anticipated timeframe required to implement this remedial alternative. Therefore, Alternative 4 is considered to be the least cost-effective alternative.

Although the cost for implementing Alternative 3 is greater than Alternative 2, Alternative 3 addresses significantly more impacted site materials compared to Alternative 2. Alternative 3 would address approximately 460% more impacted material (i.e., an additional 2,880 cy), for approximately 40% increase in cost (i.e., $1,800,000), compared to Alternative 2. Therefore, Alternative 3 is considered to be the most cost-effective alternative.

6.2 Comparative Analysis Summary

The following table provides a summary of the remedial alternatives' abilities to meet the RAOs, as well as the volume of material addressed, relative short-term impacts, and estimated cost for each alternative.

Table 6.2 – Comparative Analysis Summary

Criteria	Alternative No.			
	1	2	3	4
Overall Protection (RAOs)				
Soil RAO 1	No	Yes	Yes	Yes
Soil RAO 2	No	Yes	Yes	Yes
Soil RAO 3	No	Limited	Yes	Yes
Soil RAO 4	No	Moderate	Yes	Yes
Groundwater RAO 1	No	Yes	Yes	Yes
Groundwater RAO 2	No	Yes	Yes	Yes
Groundwater RAO 3	No	Limited	Moderate	Yes
Groundwater RAO 4	No	No	Yes	Yes
Groundwater RAO 5	No	Limited	Yes	Yes
Soil Vapor RAO 1	No	Moderate	Moderate	Yes
Reduction of Toxicity, Mobility, and Volume				
Soil/ISS Treatment Volume	0 cy	760 cy	3,640 cy	6,130 cy
Short Term Impacts				
Length of Disruption	None	3 months	5 months	17 months
Cost				
Total Cost	$0	$2.170,000	$3,690,000	$9,350,000

7 Preferred Remedial Alternative

This section presents a description of the preferred remedial alternative. The results of the comparative analysis conducted in Section 6 were used as a basis for recommending a preferred remedial alternative.

7.1 Summary of Preferred Remedial Alternative

Based on the comparative analysis of the remedial alternatives presented in Section 6, Alternative 3 is the preferred remedial alternative for OU-1. Alternative 3 would achieve the best balance of the NYSDEC evaluation criteria, while reducing the potential for future exposure to MGP-related impacts.

As described in Section 5 and presented in Table 8, the primary components of Alternative 3 consist of the following:

- Excavating 2,830 cy of material to depths up to 5 feet below grade to facilitate ISS treatment activities and/or to address shallow subsurface soil containing COCs at concentrations greater than 6NYCRR Part 375-6 restricted residential SCOs and/or significant quantities of NAPL.
- Conducting ISS treatment of approximately 5,890 cy of subsurface soil to address an estimated 2,880 cy of soil containing significant quantities of NAPL to depths up to 34 feet below grade.
- Transporting an estimated 120 tons of excavated material off-site for disposal as C&D debris.
- Transporting an estimated 5,270 tons of excavated material (75% of the excavated soil) off-site for disposal as a non-hazardous solid waste.
- Transporting an estimated 1,760 tons of excavated material (25% if the excavated soil) off-site for treatment/ disposal via LTTD.
- Installing NAPL recovery wells in the downgradient portion of OU-1 and establishing a long-term monitoring and recovery program to remove NAPL from the wells and limit the potential for future migration of NAPL downgradient of OU-1.
- Installing additional groundwater monitoring wells to establish a new groundwater monitoring network.
- Conducting annual groundwater monitoring to document the extent and concentrations of dissolved phase COCs and potential trends in COC concentrations.
- Preparing an annual report to summarize annual groundwater monitoring activities.
- Establishing institutional controls in the form of deed restrictions and/or environmental easements to limit the future development and use of OU-1 to restricted-residential or commercial use (i.e., the site will be redeveloped to house retail and multifamily buildings); limit the potential future use of site groundwater as a source of potable or process water, without necessary water quality treatment; and to limit the permissible invasive (i.e., subsurface) activities that could result in potential exposures to subsurface soil and groundwater containing MGP-related impacts. Additionally, the institutional controls would require compliance with the SMP (described below) that would be prepared as part of this alternative.
- Preparing an SMP to document the following:
  - The institutional controls that have been established and will be maintained for the site;
  - Known locations of soil containing COCs at concentrations greater than 6 NYCRR Part 375-6 restricted residential use SCOs;

  - Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities and managing potentially impacted material encountered during these activities;
  - Protocols and requirements for conducting annual groundwater monitoring;
  - Protocols for addressing significant changes in COC concentrations in groundwater based on the results of the annual monitoring activities; and
  - Requirements for performing periodic site inspections, providing NYSDEC-required certifications, and submitting periodic reports to NYSDEC.

As part of the remedial design phase of this alternative, PDI activities will be conducted to facilitate the development of several components of the preferred alternative. Anticipated PDI activities include:

- Collecting additional surface soil samples to further define the potential extent of shallow soils that exceed restricted-residential SCOs in the area north and south of Kill Brook.
- Completing additional subsurface soil borings:
  - Obtain information to evaluate the spacing and placement of NAPL recovery wells.
  - Characterize subsurface in soil in areas that were not accessible during the RI (including within the footprint of structures that were subsequently demolished and in areas that were being used for storage by ODPW).
  - Completing soil borings to obtain soil samples for ISS treatability testing and testing of soil geotechnical parameters to evaluate excavation support system requirements.
- Collecting a sample of available public water for use in ISS treatability test mix designs.
- Completing an updated baseline site survey.

A detailed PDI Work Plan would be included in the Remedial Design Work Plan (RDWP) that will be prepared to support remedial design efforts for the approved remedy.

7.2 Preferred Remedy Selection Rationale

The primary components of the preferred alternative include soil excavation removal, ISS treatment, NAPL recovery well installation, and groundwater/NAPL monitoring. These are proven technologies for addressing soil that contains MGP-related impacts. Additionally, these technologies have been successfully implemented at other MGP sites and are considered technically and administratively implementable. Remedial contractors capable of conducting soil excavation removal, ISS treatment, and NAPL recovery well installation activities are readily available. Potential implementation challenges associated with this alternative include: conducting excavation activities where utilities may be currently present (e.g., electric and gas lines), conducting excavation/soil mixing activities in close proximity to the retaining wall located along Kill Brook, and encountering obstructions during soil mixing. Con Edison would assess potential options to protect/or temporarily relocate utility lines (if any) located within the proposed excavation areas during the remedial design.

Excavation/in-situ solidification activities near the retaining wall located along Kill Brook poses an additional implementability challenge. The retaining wall forms a bulkhead in both sides of Kill Brook with a height ranging from approximately 4 to 10 feet in portions of the wall adjacent to proposed excavation/ISS treatment areas. Excavation/ISS treatment areas near the retaining wall would require additional planning and design to support the retaining wall to prevent wall failure.

If auger mixing methods were used for ISS treatment, obstructions greater than six inches in diameter could prevent homogenous mixing and potentially damage ISS equipment. The ISS activities could potentially be limited by subsurface obstructions such as cobbles, debris, historical fill materials, and subsurface former building foundations and slabs. Pre-ISS excavation would be conducted to identify obstructions and clear the top of fill material during pre-trenching activities. Bucket mixing methods could be used to clear deeper obstructions and treat impacted soil to depths up to 26 feet below grade. Jet-grouting methods could be used to solidify material near/beneath obstructions that are not feasible or practicable to remove or are located at depths greater than 26 feet below grade.

Potential short-term impacts to the surrounding community and workers would include potential exposures to soil and/or groundwater containing MGP-related COCs during soil excavation, soil mixing, installation of NAPL recovery wells, and material handling and off-site transportation activities. The potential for exposure would be minimized through the use of appropriately trained field personnel and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design phase of this alternative. Air monitoring would be performed during excavation, soil mixing, and backfilling activities to evaluate the need for additional engineering controls (e.g., use of water sprays to suppress dust, modify the rate of construction, etc.). Community access to OU-1 would be restricted by temporary security fencing during remedial construction.

Additional worker safety concerns include working with and around large construction equipment, noise generated from operating construction equipment, and increased vehicle traffic associated with transportation of excavated material from OU-1 and delivery of ISS aggregate and fill materials. These concerns would be minimized by using engineering controls and appropriate health and safety practices.

Potential short-term risks to the community could occur during periodic groundwater/NAPL monitoring activities via exposure to purged groundwater, groundwater samples, and recovered NAPL (if any). Potential exposures to the community would be reduced by following appropriate procedures and protocols that would be described in the SMP.

Alternative 3 would prevent exposures (i.e., direct contact, ingestion, and/or inhalation) to MGP-related impacts in soil (soil RAOs #1, #2, #4) and would address the source of soil and groundwater impacts (soil RAO #3 and groundwater RAOs #4 and #5) through targeted soil excavation and ISS treatment. Potential exposures to remaining soil and groundwater impacts and/or the solidified mass would be prevented by adhering to the institutional controls and the procedures set forth in the SMP that would be developed as part this alternative (soil RAOs #1 and #2 and groundwater RAOs #1 and #2).

Alternative 3 would address a majority of impacted material located below the water table (i.e., the source for dissolved phase impacts) through ISS treatment, resulting in a reduction in the extent and concentrations of dissolved phase COCs following remedial construction activities. Additionally, NAPL that may remain following excavation and ISS treatment would be addressed would also address NAPL that may remain following excavation and ISS treatment by removing NAPL via NAPL recovery wells that would be installed downgradient of OU-1. Therefore, groundwater will eventually be restored to pre-disposal/pre-release conditions downgradient of the ISS treatment areas (groundwater RAO #3). Additionally, this alternative would reduce exposures to impacted groundwater (groundwater RAOs #1 and #2) and prevent discharge of COCs from groundwater to surface water and sediment (groundwater RAO #4), as residual dissolved phase impacts would naturally attenuate following ISS treatment.

Impacts to public health resulting from exposures to MGP-related constituents via soil vapor intrusion would be reduced by addressing the majority of impacted material at the site through soil excavation/ISS treatment, and by following the protocols and requirements set forth in the SMP that would be developed as part this alternative (soil vapor RAO #1).

Generally, Alternative 3 is preferred over the other remedial alternatives based on the following:

- Alternative 3 would address the majority of MGP-related impacts that serve as the source of dissolved phase constituents in groundwater.
- Alternative 3 has a lower carbon footprint than Alternative 4 and similar carbon footprint to Alternative 2, based on volume of material transported off-site for LTTD treatment and on the number of truck trips associated with the alternatives.
- Alternative 3 would have a similar timeframe as Alternative 2.
- Alternative 3 would address approximately 460% more impacted material (i.e., 3,640 cy versus 760 cy), for an approximately 25% increase in cost (i.e., increase of $600,000) as compared to Alternative 2.
- Remedial construction activities associated with Alternative 3 would require approximately 5 months to implement, compared to Alternative 4 which would require approximately 16 months to complete, and is thereby significantly less disruptive to the surrounding community.
- Alternative 4 is not a cost-effective alternative, given the duration of remedial construction activities, potential for exposure during remediation, and associated duration of disruption to the surrounding community.
- From a sustainability perspective, through the solidification of impacted soil, Alternative 3 significantly reduces the volume of excavated soil that may otherwise require transportation for off-site treatment/disposal and reduces the volume of imported material that would be required to backfill excavation areas.

7.3 Estimated Cost of Preferred Remedial Alternative

The total estimated cost associated with implementation of the preferred remedial alternative is summarized in the following table.

Table 7.1 – Cost Estimate for Alternative 3

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost[1]	Total Estimated Cost
Alternative 3 – Targeted Soil Removal and Targeted ISS Treatment of Visually Impacted Material	$2,750,000	$940,000	$3,690,000

Note:
1. Estimated present worth of O&M cost is over an assumed 30-year period.

8 References

Arcadis, 2020. Remedial Investigation Report. Former Ossining Works Manufactured Gas Plant Site, Ossining, New York, dated September 2020.

CMX and HDR|LMR, 2008. Remedial Investigation Report. Ossining Former Works, Ossining, New York, dated March 2008.

NYSDEC, 1997. Guidelines for the Control of Toxic Ambient Contaminants (DAR-1), dated November 12, 1997.

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

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, 2010a. DER-10 Technical Guidance for Site Investigation and Remediation. May 3, 2010.

NYSDEC, 2014. Screening and Assessment of Contaminated Sediment, dated June 24, 2014.

Tables

Table 1
Summary of Chemical-Specific SCGs

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works MGP Site - Ossining, New York

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
National Primary Drinking Water Standards	40 CFR Part 141	S	Establishes maximum contaminant levels (MCLs) which are health-based standards for public water supply systems.	These standards are potentially applicable if an action involves future use of ground water as a public supply source.
RCRA-Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	40 CFR Part 261	S	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.	Excavated materials may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
Universal Treatment Standards/Land Disposal Restrictions (UTS/LDRs)	40 CFR Part 268	S	Identifies hazardous wastes for which land disposal is restricted and provides a set of numerical constituent concentration criteria at which hazardous waste is restricted from land disposal (without treatment).	Applicable if waste is determined to be hazardous and for remedial alternatives involving off-site land disposal.
New York State				
NYSDEC Guidance on Remedial Program Soil Cleanup Objectives	6 NYCRR Part 375	G	Provides an outline for the development and execution of the soil remedial programs. Includes soil cleanup objective tables.	These guidance values are to be considered, as appropriate, in evaluating soil quality.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	S	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.	Applicable for determining if materials generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
Soil Cleanup Guidance	CP-51	G	Provides the framework and policies for the selection of soil cleanup levels.	Guidance would be used to develop site-specific soil cleanup objectives (SCOs).
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1	G	Provides a compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in the NYSDEC programs.	These standards are to be considered in evaluating groundwater and surface water quality.
New York State Surface Water and Groundwater Quality Standards	6 NYCRR Parts 700-705	S	Establishes quality standards for surface water and groundwater.	Potentially applicable for assessing water quality at the site during remedial activities.
Guidance for Evaluating Soil Vapor Intrusion in the State of New York	NYSDOH	G	Establishes the methodology for performing vapor intrusion evaluation including exposures, data, and appropriate actions.	This guidance is applicable in evaluating indoor air quality for the new building that would be potentially constructed after remedial construction activities.

Table 2
Summary of Action-Specific SCGs

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works MGP Site - Ossining, New York

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
Occupational Safety and Health Act (OSHA) - General Industry Standards	29 CFR Part 1910	S	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below required concentrations. Appropriate training requirements will be met for remedial workers.
OSHA - Safety and Health Standards	29 CFR Part 1926	S	These regulations specify the type of safety equipment and procedures to be followed during site remediation.	Appropriate safety equipment will be on-site and appropriate procedures will be followed during remedial activities.
OSHA - Record-keeping, Reporting and Related Regulations	29 CFR Part 1904	S	These regulations outline record-keeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate and maintain remedial actions at hazardous waste sites.
RCRA - Preparedness and Prevention	40 CFR Part 264.30 - 264.31	S	These regulations outline requirements for safety equipment and spill control when treating, handling and/or storing hazardous wastes.	Safety and communication equipment will be installed at the site as necessary. Local authorities will be familiarized with the site.
RCRA - Contingency Plan and Emergency Procedures	40 CFR Part 264.50 - 264.56	S	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc. when storing hazardous wastes.	Emergency and contingency plans will be developed and implemented during remedial design. Copies of the plan will be kept on-site.
90 Day Accumulation Rule for Hazardous Waste	40 CFR Part 262.34	S	Allows generators of hazardous waste to store and treat hazardous waste at the generation site for up to 90 days in tanks, containers and containment buildings without having to obtain a RCRA hazardous waste permit.	Potentially applicable to remedial alternatives that involve the storing or treating of hazardous materials on-site.
Land Disposal Facility Notice in Deed	40 CFR Parts 264 and 265 Sections 116-119(b)(1)	S	Establishes provisions for a deed notation for closed hazardous waste disposal units, to prevent land disturbance by future owners.	The regulations are potentially applicable because closed areas may be similar to closed RCRA units.
RCRA - General Standards	40 CFR Part 264.111	S	General performance standards requiring minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires decontamination or disposal of contaminated equipment, structures and soils.	Decontamination actions and facilities will be constructed for remedial activities and disassembled after completion.
Standards Applicable to Transporters of Applicable Hazardous Waste - RCRA Section 3003	40 CFR Parts 170-179, 262, and 263	S	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation and management of the waste. Requires manifesting, recordkeeping and immediate action in the event of a discharge.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
United States Department of Transportation (USDOT) Rules for Transportation of Hazardous Materials	49 CFR Parts 107 and 171.1 - 172.558	S	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous materials.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
Clean Air Act-National Ambient Air Quality Standards	40 CFR Part 60	S	Establishes ambient air quality standards for protection of public health.	Remedial operations will be performed in a manner that minimizes the production of benzene and particulate matter.
USEPA-Administered Permit Program: The Hazardous Waste Permit Program	RCRA Section 3005; 40 CFR Part 270.124	S	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted. Implementation of the site remedy will include consideration of these requirements.
Land Disposal Restrictions	40 CFR Part 368	S	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes Universal Treatment Standards (UTSs) to which hazardous waste must be treated prior to land disposal.	Excavated materials that display the characteristic of hazardous waste or that are decharacterized after generation must be treated to 90% constituent concentration reduction capped at 10 times the UTS.
RCRA Subtitle C	40 U.S.C. Section 6901 et seq.; 40 CFR Part 268	S	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous wastes must be treated prior to land disposal.	Potentially applicable to remedial activities that include disposal waste material from the site.

Table 2
Summary of Action-Specific SCGs

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works MGP Site - Ossining, New York

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
New York State				
NYSDEC's Monitoring Well Decommissioning Guidelines	NPL Site Monitoring Well Decommissioning dated May 1995	G	This guidance presents procedure for abandonment of monitoring wells at remediation sites.	This guidance is applicable for soil or groundwater alternatives that require the decommissioning of monitoring wells onsite.
Guidelines for the Control of Toxic Ambient Air Contaminants	DAR-1 (Air Guide 1)	G	Provides guidance for the control of toxic ambient air contaminants in New York State and outlines the procedures for evaluating sources of air pollution.	This guidance may be applicable for soil or groundwater alternatives that results in certain air emissions.
New York Permits and Certificates	6 NYCRR Part 201	G	Provides instructions and regulations for obtaining a permit to operate air emission source.	Permits are not required for remedial actions taken at hazardous waste sites; however, documentation for relevant and appropriate permit conditions would be provided to NYSDEC prior to and during implementation of the selected alternative.
New York State Air Quality Classification System	6 NYCRR Part 256	G	Outlines the air quality classifications for different land uses and population densities.	Air quality classification system will be referenced during the treatment process design.
New York Air Quality Standards	6 NYCRR Part 257	G	Provides air quality standards for different chemicals (including those found at the site), particles, and processes.	Emissions from the treatment process will meet the air quality standards.
Discharges to Public Waters	New York State Environmental Conservation Law, Section 71-3503	S	Provides that a person who deposits gas tar, or the refuse of a gas house or gas factory, or offal, refuse, or any other noxious, offensive, or poisonous substances into any public waters, or into any sewer or stream running or entering into such public waters, is guilty of a misdemeanor.	During the remedial activities, MGP-impacted materials will not be deposited into public waters or sewers.
New York Hazardous Waste Management System - General	6 NYCRR Part 370	S	Provides definitions of terms and general instructions for the Part 370 series of hazardous waste management.	Hazardous waste is to be managed according to this regulation.
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	S	Outlines criteria for determining if a solid waste is a hazardous waste and is subject to regulation under 6 NYCRR Parts 371-376.	Applicable for determining if solid waste generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	S	Provides guidelines relating to the use of the manifest system and its recordkeeping requirements. It applies to generators, transporters and facilities in New York State.	This regulation will be applicable to any company(s) contracted to do treatment work at the site or to transport or manage hazardous material generated at the site.
New York Regulations for Transportation of Hazardous Waste	6 NYCRR Part 372.3 a-d	S	Outlines procedures for the packaging, labeling, manifesting and transporting of hazardous waste.	These requirements will be applicable to any company(s) contracted to transport hazardous material from the site.
Waste Transporter Permits	6 NYCRR Part 364	S	Governs the collection, transport and delivery of regulated waste within New York State.	Properly permitted haulers will be used if any waste materials are transported off-site.
NYSDEC Technical and Administrative Guidance Memorandums (TAGMs)	NYSDEC TAGMs	G	TAGMs are NYSDEC guidance that are to be considered during the remedial process.	Appropriate TAGMs will be considered during the remedial process.
New York Regulations for Hazardous Waste Management Facilities	6 NYCRR Part 373.1.1 - 373.1.8	S	Provides requirements and procedures for obtaining a permit to operate a hazardous waste treatment, storage and disposal facility. Also lists contents and conditions of permits.	Any off-site facility accepting waste from the site must be properly permitted.
Land Disposal of a Hazardous Waste	6 NYCRR Part 376	S	Restricts land disposal of hazardous wastes that exceed specific criteria.	New York defers to USEPA for UTS/LDR regulations.
NYSDEC Guidance on the Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants	DER-4	G	Outlines the criteria for conditionally excluding coal tar waste and impacted soils from former MGPs which exhibit the hazardous characteristic of toxicity for benzene (D018) from the hazardous waste requirements of 6 NYCRR Parts 370 - 374 and 376 when destined for thermal treatment.	This guidance will be used as appropriate in the management of MGP-impacted soil and coal tar waste generated during the remedial activities.
National Pollutant Discharge Elimination System (NPDES) Program Requirements, Administered Under New York State Pollution Discharge Elimination System (SPDES)	40 CFR Parts 122 Subpart B, 125, 301, 303, and 307 (Administered under 6 NYCRR 750-758)	S	Establishes permitting requirements for point source discharges; regulates discharge of water into navigable waters including the quantity and quality of discharge.	Removal activities may involve treatment/disposal of water. If so, water generated at the site will be managed in accordance with NYSDEC SPDES permit requirements.

Table 3
Summary of Location-Specific SCGs

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works MGP Site - Ossining, New York

Regulation	Citation	Potential Standard (S) or Guidance (G)	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal				
Historical and Archaeological Data Preservation Act	16 USC 469a-1	S	Provides for the preservation of historical and archaeological data that might otherwise be lost as the result of alteration of the terrain.	The National Register of Historic Places register would be consulted to determine the presence of historical sites in the immediate vicinity of the MGP site.
National Historic and Historical Preservation Act	16 USC 470; 36 CFR Part 65; 36 CFR Part 800	S	Requirements for the preservation of historic properties.	The National Register of Historic Places register would be consulted to determine the presence of historical sites in the immediate vicinity of the MGP site.
Hazardous Waste Facility Located on a Floodplain	40 CFR Part 264.18(b)	S	Requirements for a treatment, storage and disposal (TSD) facility built within a 100-year floodplain.	Hazardous waste TSD activities (if any) will be designed to comply with applicable requirements cited in this regulation.
Endangered Species Act	16 USC 1531 et seq.; 50 CFR Part 200; 50 CFR Part 402	S	Requires federal agencies to confirm that the continued existence of any endangered or threatened species and their habitat will not be jeopardized by a site action.	Federal agencies would be consulted to determine if any wildlife species are identified on the USFWS list of Threatened, Endangered, Sensitive Species, or if any biota species are identify by the NHP as sensitive species in the vicinity of the site.
Floodplains Management and Wetlands Protection	40 CFR 6 Appendix A	S	Activities taking place within floodplains and/or wetlands must be conducted to avoid adverse impacts and preserve beneficial value. Procedures for floodplain management and wetlands protection provided.	Remedial activities will be conducted within the 100-year floodplain.
New York State				
New York State Floodplain Management Development Permits	6 NYCRR Part 500	S	Provides conditions necessitating NYSDEC permits and provides definitions and procedures for activities conducted within floodplains.	Potentially applicable to remedial activities conducted within the 100-year flood plain (i.e., the site).
New York State Parks, Recreation, and Historic Preservation Law	New York Executive Law Article 14	S	Requirements for the preservation of historic properties.	The National Register of Historic Places register would be consulted to determine the presence of historical sites in the immediate vicinity of the MGP site.
Endangered & Threatened Species of Fish and Wildlife	6 NYCRR Part 182	S	Identifies endangered and threatened species of fish and wildlife in New York.	State agencies would be consulted to determine if any species in the vicinity of the site are identified on the list of Endangered, Threatened and Special Concern Fish & Wildlife Species of New York State.
Floodplain Management Criteria for State Projects	6 NYCRR Part 502	S	Establishes floodplain management practices for projects involving state-owned and state-financed facilities.	The area to be remediated is located within the 100-year floodplain. Therefore activities conducted at the site would be performed in accordance with this regulation.
Local				
Local Building Permits	N/A	S	Local authorities may require a building permit for any permanent or semi-permanent structure, such as an on-site water treatment system building or a retaining wall.	Substantive provisions are potentially applicable to remedial activities that require construction of permanent or semi-permanent structures.
Local Street Work Permits	N/A	S	Local authorities will require a permits for conducting work within and closing local roadways.	Street work permits will be required to conduct remedial activities within public roadways.

Table 4
Remedial Technology Screening Evaluation for Soil

Alternatives Analysis Report
Consolidated Edison of New York Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Retained?
No Action	No Action	No Action	Alternative would not include any remedial action. A 'No Action' alternative serves as a baseline for comparison of the overall effectiveness of other remedial alternatives. Consideration of a 'No Action' alternative is required by the NYSDEC DER-10.	Implementable.	Would not achieve the RAOs for soil in an acceptable time frame.	Yes
Institutional Controls	Institutional Controls	Deed Restrictions, Environmental Land Use Restrictions, Enforcement and Permit Controls, Informational Devices	Institutional controls would include legal and/or administrative controls that mitigate the potential for exposure to impacted soils and/or jeopardize the integrity of a remedy. Examples of potential institutional controls include establishing land use restrictions, health and safety requirements for subsurface activities.	Implementable. Would require coordination between NYSDEC and property owners to establish institutional controls on properties not owned by Con Edison.	When properly implemented and followed, this technology could reduce potential human exposures, and may be effective when combined with other technology processes. Would help to reduce human exposure to impacted soil. May not achieve RAOs for environmental protection.	Yes
In-Situ Containment/ Control	Capping	Soil Cap	Placing and compacting soil/gravel material over impacted soil to provide a physical barrier to human and biota exposure to impacted soil at the site.	Implementable. Equipment and materials necessary to construct the cap are readily available.	Although construction of a cap is readily implementable, surface soils do not contain MGP-related impacts and therefore, capping would not reduce the potential for exposure to MPG-related impacts relative to current site conditions. Additionally, construction of a cap would not achieve a majority of the site-specific RAOs.	No
		Asphalt/Concrete Cap	Application of a layer of asphalt or concrete over impacted soils.			No
		Multi-Media Cap	Application of a combination of synthetic membrane(s) over impacted soil.			No
In-Situ Treatment	Immobilization	Solidification	Addition of material to the impacted soil that limits the solubility and mobility of the NAPL and COCs in soil and groundwater. Involves treating soil to produce a stable material with low leachability of NAPL and associated COCs.	Implementable. Solidification materials are readily available. The presence of subsurface structures would limit the implementation of this technology process.	Overall effectiveness of this process would need to be evaluated during a bench-scale treatability study. Assuming an effective solidification mix could be developed, this technology would effectively address each of the RAOs for soil.	Yes
	Extraction/In-Situ Stripping	Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation (DUS/HPO)	Steam is injected into the subsurface to mobilize contaminants and NAPLs. The mobilized contaminants are captured and constituents are recondensed, collected, and treated. In addition, HPO can degrade contaminants in subsurface heated zones. In most cases, this technology requires long-term operation and maintenance of on-site injection, collection and/or treatment systems.	Technically implementable. This option would require a pilot scale study to determine effectiveness. Process may result in uncontrolled NAPL migration. Not a preferred technology process due to risks and potential technical implementability issues.	Could potentially promote NAPL mobilization. Focused on saturated zone, not effective for soil/NAPL above the water table. Alone, this technology would not effectively address the RAO of preventing direct exposure to impacted soil. This option would require a pilot scale study to determine effectiveness.	No
	Chemical Treatment	Chemical Oxidation	Oxidizing agents are added to oxidize and reduce the mass of organic constituents in-situ chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate or potassium permanganate. A pilot study would be required to evaluate/determine oxidant application requirements. May not effectively oxidize NAPL.	Implementable. Equipment and materials necessary to inject/apply surfactants are readily available. May require special provisions for storage of process chemicals.	Would require multiple treatments of chemicals to reduce COCs. Would not be effective at treating NAPL and NAPL-containing soil. Not effective for treating impacts in unsaturated zone.	No
		Surfactant/Cosolvent Flushing	A surfactant or cosolvent solution is delivered and extracted by a network of injection and extraction wells to flush the NAPL source area. Reduction of the NAPL mass occurs by increasing the dissolution of the NAPL or selected constituents or by increasing the NAPL mobility with reduction of the interfacial tension between the NAPL and groundwater and/or reduction of the NAPL viscosity. A bench-scale and treatability study would be required to determine surfactant/cosolvent solution.	Implementable. Equipment and materials necessary to inject/apply oxidizing agents are readily available. May require special provisions for storage of process chemicals.	Overall effectiveness of this process would need to be evaluated during a bench- and field-scale pilot test to determine the site-specific design. Would not be effective at treating all NAPL and NAPL-containing soil.	No
	Biological Treatment	Biodegradation	Natural biological and physical processes that, under favorable conditions, act without human intervention to reduce the mass, volume, concentration, toxicity, and/or mobility of COCs. This process relies on long-term monitoring to demonstrate the reduction of impacts.	Implementable.	Less effective for PAHs; not effective for NAPLs; would not achieve RAOs in an acceptable time frame.	No
		Enhanced Biodegradation	Addition of amendments (e.g., oxygen, nutrients) and controls to the subsurface to enhance indigenous microbial populations to improve the rate of natural degradation.			No

Table 4
Remedial Technology Screening Evaluation for Soil

Alternatives Analysis Report
Consolidated Edison of New York Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Retained?
In-Situ Treatment (Cont.)		Biosparging	Air/oxygen injection wells are installed within the impacted regions to enhance biodegradation of constituents by increasing oxygen availability. Low-flow injection technology may be incorporated. This technology requires long-term monitoring.			No
	Thermal Treatment	In-Situ Thermal Desorption	Heat is injected into the subsurface via vacuum wells and heat transfer is completed via thermal conduction. COCs are destroyed via oxidation, pyrolysis, boiling, and volatilization. Vapor/water is recovered and treated.	Potentially implementable. Numerous concerns related to conducting thermal treatment in close proximity utilities. Additionally, Limitations of space and public proximity concerns limits the implementability of this technology.	May not achieve RAOs for soil.	No
		Electrical Resistance Heating	Electrical current is applied to the subsurface via network of probes installed through standard drilling techniques. Electrical resistance is used to transfer heat via thermal conduction. COCs are destroyed via oxidation, boiling, and volatilization Vapor/water is recovered and treated.			No
Removal	Excavation	Excavation	Physical removal of impacted soil. Typical excavation equipment would include excavators, backhoes, loaders, and/or dozers. Extraction wells and pumps or other methods may be used to obtain hydraulic control to facilitate use of typical excavation equipment to physically remove soil.	Implementable. Equipment capable of excavating the soil is readily available.	Would achieve RAOs. Proven process for effectively removing impacted soil.	Yes
Ex-Situ On-Site Treatment and/or Disposal	Immobilization	Solidification	Addition of material to excavated soil that limits the solubility or mobility of the constituents present. Involves treating soil to produce a solidified material with low leachability, that physically and chemically locks the constituents within the solidified matrix.	Not implementable. Heavily impacted material that is solidified may still require treatment and/or disposal as a hazardous waste. Pilot study would be needed to verify implementability.	May achieve RAOs. Proven process for effectively reducing mobility and toxicity of NAPL and organic and inorganic constituents. Overall effectiveness of this process would need to be evaluated during a bench-scale study.	No
	Extraction	Low-Temperature Thermal Desorption	Process by which soils containing organics with boiling point temperatures less than 800° Fahrenheit are excavated, conditioned, and heated; the organic compounds are desorbed from the soils into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction. Treated soils are returned to the subsurface. Treatment is conducted in a thermal treatment unit that is mobilized or constructed on-site.	Not implementable. Potential emissions concerns based on site's location near residential areas. Additionally, there is not sufficient space.	Proven process for effectively removing organic constituents from excavated soil. The efficiency of the system and rate of removal of organic constituents would require evaluation during bench-scale and/or pilot-scale testing.	No
	Thermal Destruction	Incineration	Use of a mobile incineration unit installed on-site for high temperature thermal destruction of the organic compounds present in the media. Soils are excavated and conditioned prior to incineration. Treated soils are returned to the subsurface.	Not implementable. Potential emissions concerns based on site's location near residential areas. Additionally, there is not sufficient space.	Proven process for effectively addressing organic constituents. The efficiency of the system and rate of removal of organic constituents would need to be verified during bench-scale and/or pilot-scale testing.	No
	Chemical Treatment	Chemical Oxidation	Addition of oxidizing agents to degrade organic constituents to less-toxic by-products.	Implementable. Equipment and materials necessary to apply oxidizing agents are available. Large amounts of oxidizing agents may be required. May require special provisions for storage of process chemicals.	May not achieve RAOs for soil. Not known to be effective for NAPL.	No
	On-Site Disposal	RCRA Landfill	Construction of a landfill that would meet RCRA requirements.	Not implementable. Space limitations and intended future use as restricted-residential make on-site landfilling infeasible. The site setting is not appropriate for a landfill.	This technology process would be effective at meeting the RAOs for soil. Excavated material would be contained in an appropriately constructed soil management cell. Long-term effectiveness requires ongoing maintenance and monitoring.	No
		Solid Waste Landfill	Construction of a landfill that would meet NYSDEC solid waste requirements.			No

Table 4
Remedial Technology Screening Evaluation for Soil

Alternatives Analysis Report
Consolidated Edison of New York Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Retained?
Off-Site Treatment and/or Disposal	Recycle/ Reuse	Asphalt Concrete Batch Plant	Soil is used as a raw material in asphalt concrete paving mixtures. The impacted soil is transported to an off-site asphalt concrete facility and can replace part of the aggregate and asphalt concrete fraction. The hot-mix process melts asphalt concrete prior to mixing with aggregate. During the cold-mix process, aggregate is mixed at ambient temperature with an asphalt concrete/water emulsion. Organics and inorganics are bound in the asphalt concrete. Some organics may volatilize in the hot-mix.	Not implementable. Based on the nature of the fill materials at the site, the soil would need excessive processing to make it usable/acceptable for this application. Permitted facilities and demand are limited.	Effective for treating organics and inorganics through volatilization and/or encapsulation. Thermal pretreatment may be required to prevent leaching. Limited number of projects to support comparison of effectiveness.	No
		Brick/Concrete Manufacture	Soil is used as a raw material in manufacture of bricks or concrete. Heating in ovens during manufacture volatilizes organics and some inorganics. Other inorganics are bound in the product.		Effective for treating organics and inorganics through volatilization and/or vitrification. A bench-scale/pilot study may be necessary to determine effectiveness.	No
		Co-Burn in Utility Boiler	Soil is blended with feed coal to fire a utility boiler used to generate steam. Organics are destroyed.	Permitted facilities available for burning MGP soils are limited. Additional handling/ management and blending of material may be required.	Effective for treating organic constituents. Soil would be blended with coal prior to burning. Overall effectiveness of this process would need to be evaluated during a trial burn.	No
	Extraction	Low-Temperature Thermal Desorption	Process by which soils containing organics with boiling point temperatures less than 800° Fahrenheit are heated and the organic compounds are desorbed from the soils into an induced airflow. The resulting gas is treated either by condensation and filtration or by thermal destruction. Would be used on materials that are determined to be characteristically hazardous based on TCLP analysis.	Implementable. Treatment facilities are available.	Effective means for treatment of materials that are characteristically hazardous due to the presence of organic compounds (i.e., benzene).	Yes
	Thermal Destruction	Incineration	Soils are incinerated off-site for high temperature thermal destruction of the organic compounds present in the media. Soils are excavated and conditioned prior to incineration.	Implementable. Not a cost effective means for treating impacted soil. Limited number of treatment facilities. LTTD is a more appropriate technology process for thermally treating MGP-impacted media.	Proven process for effectively addressing organic constituents. The efficiency and effectiveness of the system and rate of removal of organic constituents would need to be verified during bench-scale and/or pilot-scale testing.	No
	Off-Site Disposal	Solid Waste Landfill	Disposal of non-hazardous soil and C&D debris in an existing permitted non-hazardous landfill.	Implementable.	Proven process that, in conjunction with excavation, can effectively achieve the RAOs.	Yes
		RCRA Landfill	Disposal of impacted soil in an existing RCRA permitted landfill facility.	Hazardous materials would not meet New York State LDRs and USTs without pre-treatment. Effective pre-treatment would be cost prohibitive when considering DER-4 exemption for permanent thermal treatment of D018 characteristically hazardous material.	Proven process that, in conjunction with excavation, can effectively achieve the RAOs.	No

Note:

1. Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 5
Remedial Technology Screening Evaluation for Groundwater

Alternatives Analysis Report
Consolidated Edison of New York Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Retained?
No Action	No Action	No Action	Alternative would not include any remedial action. A 'No Action' alternative serves as a baseline for comparison of the overall effectiveness of other remedial alternatives. Consideration of a 'No Action' alternative is required by the NYSDEC DER-10.	Implementable.	Would not achieve the RAOs for groundwater in an acceptable time frame.	Yes
Institutional Controls	Institutional Controls	Deed Restrictions, Groundwater Use Restrictions, Enforcement and Permit Controls, Informational Devices	Institutional controls would include legal and/or administrative controls that mitigate the potential for exposure to impacted materials and/or jeopardize the integrity of a remedy. Examples of potential institutional controls include establishing land use restrictions, health and safety requirements for subsurface activities, and restrictions on groundwater use and/or extraction.	Implementable. Would require coordination between NYSDEC and property owners to establish institutional controls on properties not owned by Con Edison.	May be effective for reducing the potential for human exposure. This option would not meet the RAO for restoring groundwater, to the extent practicable, the quality of groundwater. This option may be effective when combined with other process options.	Yes
In-Situ Containment/ Control	Containment	Sheet Pile	Steel sheet piles are driven into the subsurface to contain groundwater and NAPLs. The sheet pile wall is typically keyed into a confining unit and could be permeable or impermeable to groundwater flow.	Presence of subsurface utilities and the Kill Brook would prevent installation of a continuous barrier, limiting the implementability of this alternative. Hydraulic effects on-site groundwater would have to be evaluated. Equipment and materials required are readily available.	Effective for reducing the groundwater flow to and from impacted areas. Would effectively limit the potential for future migration of NAPL. Could be used in conjunction with a low-permeability cap to effectively address soil RAOs.	No
		Secant Pile Wall	Wall is formed by a series of interlocking reinforced concrete piles. Technology used primarily with high water tables or unsuitable ground conditions. Minimal disturbance due to lack of noise and vibration.			No
		Slurry Walls/Jet Grout Wall	Involves excavating a trench and adding a slurry (e.g., soil/cement-bentonite mixture) to control migration of groundwater and NAPL from an area. Slurry walls are typically keyed into a low permeability unit (e.g., an underlying silt/clay layer).			No
In-Situ Treatment	Biological Treatment	Groundwater Monitoring	Natural biological, chemical, and physical processes that under favorable conditions, act without human intervention to reduce the mass, volume, concentration, toxicity, and mobility of chemical constituents. Long-term monitoring is required to demonstrate the reduction of COCs.	Easily implemented. Would require monitoring to demonstrate reduction of COCs.	May be effective if NAPL and impacted soil is addressed.	Yes
		Enhanced Biodegradation	Addition of amendments (e.g., nutrients, oxygen) to the subsurface to enhance indigenous microbial populations to improve the rate of natural biodegradation of constituents.	Would be difficult to sufficiently oxygenate the soil using amendments due to the thickness of the saturated zone and depth of impacts.	May not be effective if the subsurface conditions cannot be made and maintained aerobic. Would not be effective at restoring groundwater to pre-release/pre-disposal conditions unless MGP source materials are addressed (i.e., through excavation).	No
		Biosparging	Air/oxygen injection wells are installed within the impacted regions to enhance biodegradation of constituents by increasing oxygen availability. Low-flow injection technology may be incorporated. This technology requires long-term monitoring.	Implementable. Equipment for installing wells and injecting air/oxygen is readily available.	Could be effective at addressing dissolved-phase impacts in combination with source material mass reduction. Would not be effective at addressing coal tar NAPL..	No

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Retained?
In-Situ Treatment (Cont.)	Chemical Treatment	Chemical Oxidation	Oxidizing agents are added to oxidize and reduce the mass of organic constituents. In-situ chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate, or potassium permanganate. Large amounts of oxidizing agents are needed to oxidize NAPL.	Implementable for areas containing dissolved-phase groundwater impacts and not source material. Equipment and materials necessary to inject/apply oxidizing agents are readily available. May require special provisions for storage of process chemicals. Access to areas that would require injection wells for this process option to be effective is limited.	Assuming removal of source materials, this technology could meet the RAOs for groundwater. However, may not be a cost effective means to achieve the RAOs. Not effective for NAPL. Dissolved-phase COCs concentrations would likely rebound following treatment if NAPL/source material for the dissolved-phase COCs is not removed.	No
		Permeable Reactive Barrier (PRB)	PRBs are installed in or downgradient from the flow path of a contaminant plume. The contaminants in the plume react with the media inside the barrier to either break the compound down into harmless products or immobilize contaminants by precipitation or sorption.	Implementable. Pilot study would be required to evaluate appropriate design given site-specific hydraulic conditions.	NAPL in subsurface would inhibit effectiveness of PRB. Groundwater conditions may potentially encourage biological growth and fouling of PRB. Could meet the RAOs when combined with source removal.	No
	Extraction	Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation (DUS/HPO)	Steam is injected into the subsurface to mobilize contaminants and NAPLs. The mobilized contaminants are captured and constituents are recondensed, collected and treated. In addition, HPO can degrade contaminants in subsurface heated zones. In most cases, this technology requires long-term operation and maintenance of on-site injection, collection, and/or treatment systems.	This option would require a pilot scale study to determine effectiveness. Process may result in uncontrolled NAPL migration. Not a preferred technology process due to risks and potential technical implementability issues.	This option would require a pilot scale study to determine effectiveness. Process may result in NAPL and/or dissolved plume migration. Not certain in the ability of this alternative to meet the RAOs.	No
Removal	Hydraulic Control	Vertical Extraction Wells	Vertical wells are installed and utilized to recover groundwater for treatment/disposal and containment/migration control. Typically requires extensive design/testing to determine required hydraulic gradients and feasibility of achieving those gradients.	Equipment and tools necessary to install and operate vertical extraction wells are readily available. Would require operation for an extended period of time.	Would not meet RAOs as a stand alone technology. Would likely be used in conjunction with an ex-situ treatment system (i.e., pump and treat). Pumping would be required over a prolonged period of time.	No
		Horizontal Extraction Wells	Horizontal wells are utilized to replace conventional well clusters in soil and containment/migration control.	Requires specialized horizontal drilling equipment. Not implementable.	Proven process for effectively extracting groundwater. Not likely to meet RAOs in an acceptable amount of time.	No
	NAPL Removal	Active Removal	Process by which automated pumps are utilized to remove DNAPL from recovery wells.	Technically implementable.	May be effective for removing potentially mobile NAPL.	Yes
		Passive Removal	NAPL is passively collected in vertical wells and periodically removed (i.e., via bottom-loading bailers, manually operated pumps, etc.).	Technically implementable.		Yes
		Collection Trenches/Permeable NAPL Barrier Wall	A zone of higher permeability material is installed within a trench hydraulically downgradient from the NAPL-impacted area. A perforated collection trench/pipe is placed laterally along the base of trench or permeable wall to direct NAPL to a collection sump for recovery and disposal.	Technically implementable. Would be used in conjunction with active or passive NAPL removal.	May be effective for removing potentially mobile NAPL.	No

Table 5
Remedial Technology Screening Evaluation for Groundwater

Alternatives Analysis Report
Consolidated Edison of New York Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Retained?
Ex-Situ/On-Site Treatment	Chemical Treatment	Ultra-violet (UV) Oxidation	Oxidation by subjecting groundwater to UV light and ozone. If complete mineralization is achieved, the final products of oxidation are carbon dioxide, water, and salts.	Potentially implementable. Limited space for a full-scale treatment system. Not typically used in MGP-impacted groundwater treatment train. Not effective on NAPL.	Proven process for effectively treating organic compounds. Use of this process may effectively achieve the RAOs. A bench-scale treatability study may be required to evaluate the efficiency of this process and to make project-specific adjustments to the process.	No
		Chemical Oxidation	Addition of oxidizing agents to degrade organic constituents to less-toxic byproducts.	Potentially implementable. Not typically used in MGP-impacted groundwater treatment train. Not effective on NAPL.	A bench-scale treatability study may be required to evaluate the efficiency of this process and to make project-specific adjustments to the process. Large amounts of oxidizing agents are needed to oxidize NAPL.	No
	Physical Treatment	Carbon Adsorption	Process by which organic constituents are adsorbed to the carbon as groundwater is passed through carbon units.	Limited space for a full-scale treatment system. Potentially implementable. May be used as part of a temporary water treatment system in support of excavation dewatering activities. However, permanent on-site treatment technologies are not required because groundwater removal technologies have not been retained.	Effective at removing organic constituents. Use of this treatment process may effectively achieve the RAOs when combined with groundwater extraction.	No
		Filtration	Extraction of groundwater and treatment using filtration. Process in which the groundwater is passed through a granular media in order to removed suspended solids by interception, straining, flocculation, and sedimentation activity within the filter.		Effective pre-treatment process to reduce suspended solids. Use of this process along with other processes (i.e., that address organic constituents) could effectively achieve the RAOs.	No
		Air Stripping	A process in which VOCs are removed through volatilization by increasing the contact between the groundwater and air.		This technology process would be effective at removing VOCs from water. Process would potentially be used as part of a temporary treatment train to treat groundwater removed from excavation areas. Has potential to be used as part of a treatment system to meet the RAOs.	No
		Precipitation/ Coagulation/ Flocculation	Process which precipitates dissolved constituents into insoluble solids and improves settling characteristics through the addition of amendments to water to facilitate subsequent removal from the liquid phase by sedimentation/filtration.		Process which transforms dissolved constituents into insoluble solids by adding coagulating agents to facilitate subsequent removal from the liquid phase by sedimentation/filtration. Has potential to be used as part of a treatment system to meet the RAOs.	No
		Oil/Water Separation	Process by which insoluble oils are separated from water via physical separation technologies, including gravity separation, baffled vessels, etc.		Effective at separating insoluble oil from groundwater. This process could be used as part of the groundwater treatment train if needed to address separate-phase liquids. Has potential to be used as part of a treatment system to meet the RAOs.	No

Table 5
Remedial Technology Screening Evaluation for Groundwater

Alternatives Analysis Report
Consolidated Edison of New York Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Retained?
Off-Site Treatment and/or Disposal	Groundwater/NAPL Management	Discharge to a local Publicly-Owned Treatment Works (POTW)	Treated or untreated water is discharged to a sanitary sewer and treated at a local POTW facility.	Implementable. Equipment and materials necessary to extract, pretreat (if necessary), and discharge the water to the sewer system are readily available. Discharges to the sewer will require a POTW-issued discharge permit.	Proven process for effectively disposing of groundwater. Typically requires the least amount of pretreatment because the discharged water will be subjected to additional treatment at the POTW. May be used in support of excavation dewatering activities. However, permanent off-site treatment/disposal technologies are not required because groundwater removal technologies have not been retained.	No
		Discharge to Surface Water via Storm Sewer	Treated or untreated water is discharged to surface water, provided that the water quality and quantity meet the allowable discharge requirements for surface waters (NYSDEC SPDES compliance).	Discharges to surface water must meet substantive requirements of a SPDES permit. Cleanup objectives and sampling requirements may be restrictive.	This technology process would effectively dispose of groundwater. Impacted groundwater would require treatment to achieve water quality discharge limits. Helps in the management of treated water, but does not directly lend to achieving the RAOs for groundwater. May be used in support of excavation dewatering activities. However, permanent off-site treatment/disposal technologies are not required because groundwater removal technologies have not been retained.	No
		Discharge to a privately-owned treatment/ disposal facility.	Treated or untreated water is collected and transported to a privately-owned treatment facility.	Equipment and materials to pretreat the water at the site are readily available on a commercial basis. Facilities capable of transporting and disposing of the groundwater are available. Treatment may be required prior to discharge.	Proven process for effectively disposing of groundwater. Typically requires the least amount of pretreatment because the discharged water will be subjected to additional treatment at the disposal facility. May be used in support of excavation dewatering activities. However, permanent off-site treatment/disposal technologies are not required because groundwater removal technologies have not been retained.	No

Note:
1. Shading indicates that technology process has not been retained for development of a remedial alternative.

Table 6
Cost Estimate for Alternative 2 - Targeted Soil Removal and NAPL Recovery

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	General Site Conditions	1	LS	$240,000	$240,000
2	Soil Excavation and Handling	1,760	CY	$57	$100,320
3	Community Air Monitoring and Vapor/Odor Control	6	WEEK	$5,700	$34,200
4	Backfill and Site Restoration	1,760	CY	$40	$70,400
5	Install NAPL Recovery/Groundwater Monitoring Wells	1	LS	$180,000	$180,000
6	Solid Waste Characterization	6	EACH	$575	$3,450
7	Solid Waste Transportation and Disposal - Non-Hazardous Waste	2,030	TON	$86	$174,580
8	Solid Waste Transportation and Disposal - LTTD	660	TON	$110	$72,600
9	Site Management Plan/FER/Institutional Controls	1	LS	$150,000	$150,000
				Subtotal Capital Cost	$1,025,550
				Contingency (20%)	$205,110
				Total Capital Cost	$1,230,660
Operation and Maintenance (O&M) Costs (Year 1)					
10	Annual Verification of Institutional Controls	1	EVENT	$11,500	$11,500
11	Annual Groundwater Sampling/NAPL Recovery	1	EVENT	$14,300	$15,200
12	Quarterly NAPL Recovery	3	EVENT	$8,600	$25,800
13	Annual Summary Report	1	LS	$17,200	$17,200
				Subtotal O&M Cost	$69,700
				Contingency (20%)	$13,940
				Total Annual O&M Cost	$83,640
				30-Year Total Present Worth Cost	$80,423
Operation and Maintenance Costs (Years 2 Through 30)					
14	Annual Verification of Institutional Controls	1	EVENT	$11,500	$11,500
15	Annual Groundwater Sampling/NAPL Monitoring	1	EVENT	$14,300	$15,200
16	Annual Summary Report	1	LS	$17,200	$17,200
				Subtotal O&M Cost	$43,900
				Contingency (20%)	$8,780
				Total Annual O&M Cost	$52,680
				30-Year Total Present Worth Cost	$860,290
				Total Estimated Cost:	**$2,171,373.55**
				Rounded To:	**$2,170,000**

General Notes:

1. Cost estimate is based on Arcadis of New York's (Arcadis') past experience and vendor estimates using 2023 dollars.
2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost.
3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. General Site conditions includes conducting a Pre-Design Investigation; permitting/access agreements; utility location; mobilization/demobilization of labor, equipment, and materials; and construction of decontamination/material staging pads.
2. Soil excavation and handling includes labor, equipment, and materials necessary to excavate soil containing constituents of concern (COCs) at concentrations greater than NYCRR Part 375-6 restricted-residential soil cleanup objectives (SCOs) to depths up to 5 feet below grade using conventional construction equipment. Cost estimate is based on in-place soil volume.
3. Community air monitoring and vapor/odor control cost estimate includes labor, equipment, and materials necessary to monitor vapor/odor emissions during intrusive site activities and to apply vapor/odor suppressing foam to open excavations.
4. Backfill - excavation areas cost estimate includes labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas to match previously existing surrounding grades. Cost estimate is based on in-place soil volume.
5. Install NAPL recovery/groundwater monitoring wells assumes that nine 6-inch diameter recovery wells and six 2-inch diameter groundwater monitoring wells will be installed following site restoration to support future monitoring for the site.
6. Solid waste characterization cost estimate assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

7. Solid waste transportation and disposal - non-hazardous waste cost estimate includes transport and dispose of excavated soil not requiring low-temperature thermal desorption (LTTD) treatment and disposal of surface C&D debris generated by site preparation efforts. Cost estimate assumes that 75% of excavated soil will be disposed as non-hazardous waste. Cost estimate includes transportation and disposal of excavated soil and sediment at an assumed density of 1.5 tons per cubic-yard.

8. Solid waste transportation and disposal - LTTD cost estimate includes costs to transport and thermally treat excavated soil and ISS/jet grout spoils exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost estimate assumes that 25% of excavated material will be treated/disposed of via LTTD. Cost assumes excavated soil and sediment will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard.

9. Site Management Plan (SMP), FER, and institution controls includes costs to prepare Site Management Plan, Final Engineering Report, and to coordinate with Con Edison and property owner to implement institutional controls for the site.

10. Annual verification of institutional controls cost estimate includes administrative costs to confirm the status of institutional controls and prepare/submit a notification to NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

11. Annual groundwater sampling/NAPL recovery cost estimate includes annual groundwater sampling/NAPL recovery activities.

12. Quarterly NAPL recovery cost estimate includes quarterly NAPL recovery activities for 3 quarters following completion of remediation activities. 4th quarter NAPL recovery event will be conducted concurrently with groundwater sampling.

13. Annual summary report cost estimate includes labor necessary to prepare and submit an annual report summarizing annual groundwater sampling/NAPL recovery and results.

14. See note 10.

15. See note 11.

16. See note 12.

17. Present worth is estimated based on a 4% beginning-of-year discount rate. It is assumed that "year zero" is 2020.

Table 7
Cost Estimate for Alternative 3 - Targeted Soil Removal, Targeted ISS Treatment of Visually Impacted Material, and NAPL Recovery

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	General Site Conditions	1	LS	$425,000	$425,000
2	Soil Excavation and Handling	2,830	CY	$57	$161,310
3	ISS Treatment	5,890	CY	$93	$547,770
4	Community Air Monitoring and Vapor/Odor Control	12	WEEK	$5,700	$68,400
5	Backfill and Site Restoration	2,830	CY	$40	$113,200
6	Install NAPL Recovery/Groundwater Monitoring Wells	1	LS	$180,000	$180,000
7	Solid Waste Characterization	20	EACH	$575	$11,500
8	Solid Waste Transportation and Disposal - Non-Hazardous Waste	5,220	TON	$86	$448,920
9	Solid Waste Transportation and Disposal - LTTD	1,700	TON	$110	$187,000
10	Site Management Plan/FER/Institutional Controls	1	LS	$150,000	$150,000
				Subtotal Capital Cost	$2,293,100
				Contingency (20%)	$458,620
				Total Capital Cost	$2,751,720
Operation and Maintenance (O&M) Costs (Year 1)					
11	Annual Verification of Institutional Controls	1	EVENT	$11,500	$11,500
12	Annual Groundwater Sampling/NAPL Recovery	1	EVENT	$14,300	$15,200
13	Quarterly NAPL Recovery	3	EVENT	$8,600	$25,800
14	Annual Summary Report	1	LS	$17,200	$17,200
				Subtotal O&M Cost	$69,700
				Contingency (20%)	$13,940
				Total Annual O&M Cost	$83,640
				30-Year Total Present Worth Cost	$80,423
Operation and Maintenance Costs (Years 2 Through 30)					
15	Annual Verification of Institutional Controls	1	EVENT	$11,500	$11,500
16	Annual Groundwater Sampling/NAPL Monitoring	1	EVENT	$14,300	$15,200
17	Annual Summary Report	1	LS	$17,200	$17,200
				Subtotal O&M Cost	$43,900
				Contingency (20%)	$8,780
				Total Annual O&M Cost	$52,680
				30-Year Total Present Worth Cost	$860,290
				Total Estimated Cost:	**$3,692,434**
				Rounded To:	**$3,690,000**

General Notes:

1. Cost estimate is based on Arcadis of New York's (Arcadis') past experience and vendor estimates using 2023 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost.

3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. General Site conditions includes conducting a Pre-Design Investigation; permitting/access agreements; utility location; mobilization/demobilization of labor, equipment, and materials; and construction of decontamination/material staging pads.

2. Soil excavation and handling includes labor, equipment, and materials necessary to excavate soil containing constituents of concern (COCs) at concentrations greater than NYCRR Part 375-6 restricted-residential soil cleanup objectives (SCOs) to depths up to 5 feet below grade using conventional construction equipment. Cost estimate is based on in-place soil volume.

3. ISS treatment cost estimate includes labor, equipment, and materials necessary to conduct in-situ soil solidification (ISS) to depths up to 34 feet below grade. Cost assume approximate 5,600 CY of soil will be treated using conventional construction equipment (i.e., bucket mixing or small diameter auger) with an additional approximately 290 CY of soil treated by jet grouting where obstructions are encountered.

4. Community air monitoring and vapor/odor control cost estimate includes labor, equipment, and materials necessary to monitor vapor/odor emissions during intrusive site activities and to apply vapor/odor suppressing foam to open excavations.

5. Backfill - excavation areas cost estimate includes labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas to match previously existing surrounding grades. Cost estimate is based on in-place soil volume.

6. Install NAPL recovery/groundwater monitoring wells assumes that six 6-inch diameter recovery wells and six 2-inch diameter groundwater monitoring wells will be installed following site restoration to support future monitoring for the site.

7. Solid waste characterization cost estimate assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

8. Solid waste transportation and disposal - non-hazardous waste cost estimate includes transport and dispose of excavated soil and ISS/jet grout spoils not requiring low-temperature thermal desorption (LTTD) treatment and disposal of surface C&D debris generated by site preparation efforts. Cost estimate assumes that 75% of excavated soil will be disposed as non-hazardous waste. Cost estimate includes transportation and disposal of excavated soil and sediment at an assumed density of 1.5 tons per cubic-yard.

9. Solid waste transportation and disposal - LTTD cost estimate includes costs to transport and thermally treat excavated soil and ISS/jet grout spoils exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost estimate assumes that 25% of excavated material will be treated/disposed of via LTTD. Cost assumes excavated soil and sediment will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard.

10. Site Management Plan (SMP), FER, and institution controls includes costs to prepare Site Management Plan, Final Engineering Report, and to coordinate with Con Edison and property owner to implement institutional controls for the site.

11. Annual verification of institutional controls cost estimate includes administrative costs to confirm the status of institutional controls and prepare/submit a notification to NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

12. Annual groundwater sampling/NAPL recovery cost estimate includes annual groundwater sampling/NAPL recovery activities.

13. Quarterly NAPL recovery cost estimate includes quarterly NAPL recovery activities for 3 quarters following completion of remediation activities. 4th quarter NAPL recovery event will be conducted concurrently with groundwater sampling.

14. Annual summary report cost estimate includes labor necessary to prepare and submit an annual report summarizing annual groundwater sampling/NAPL recovery and results.

15. See note 11.

16. See note 12.

17. See note 14.

18. Present worth is estimated based on a 4% beginning-of-year discount rate. It is assumed that "year zero" is 2020.

Table 8
Cost Estimate for Alternative 4 - Soil Removal to Unrestricted Use SCOs

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	General Site Conditions	1	LS	$730,000	$730,000
2	Install and Remove Temporary Sheet Pile Wall (w/ bracing)	21,600	VSF	$86	$1,857,600
3	Soil Excavation and Handling	15,520	CY	$57	$890,227
4	Former Gas Holders Excavation and Handling	1,300	CY	$52	$66,950
5	Temporary Water Treatment System	8	MONTH	$89,000	$712,000
6	Community Air Monitoring and Vapor/Odor Control	36	WEEK	$5,735	$206,460
7	Stabilization Admixture	1,400	TON	$132	$184,800
8	Backfill - Excavation Areas	16,820	CY	$40	$672,800
9	Solid waste Characterization	35	EACH	$575	$20,125
10	Solid Waste Transportation and Disposal - Non-Haz	16,500	TON	$86	$1,419,000
11	Solid Waste Transportation and Disposal - LTTD	9,400	TON	$110	$1,034,000
				Subtotal Capital Cost	$7,793,962
				Contingency (20%)	$1,558,792
				Total Capital Cost	$9,352,755
				Total Estimated Cost:	**$9,352,755**
				Rounded To:	**$9,350,000**

General Notes:

1. Cost estimate is based on Arcadis of New York's (Arcadis') past experience and vendor estimates using 2023 dollars.

2. This estimate has been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the site investigation and the anticipated scope of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost.

3. All costs assume construction field work to be conducted by non-unionized labor.

Assumptions:

1. General Site conditions includes conducting a Pre-Design Investigation; permitting/access agreements; utility location; mobilization/demobilization of labor, equipment, and materials; and construction of decontamination/material staging pads.

2. Install and remove temporary sheet pile cost estimate includes labor, equipment, and materials necessary to install, remove, and decontaminate temporary steel sheet pile. Cost estimate assumes sheet pile will be installed to the top of bedrock (i.e., approximately 40 feet below grade).

3. Soil excavation and handling includes labor, equipment, and materials necessary to excavate soil to address soil containing constituents of concern (COCs) at concentrations greater than 6 NYCRR Part 375-6 unrestricted use soil cleanup objectives (SCOs). Cost estimate assumes excavation activities would be completed using conventional construction equipment. Cost estimate is based on in-place soil volume.

4. Former gas holders excavation and handling includes labor, equipment, and materials necessary to remove tw0 former gas holders located at the southwestern portion of the site. Cost estimate assumes excavation activities would be completed to depths up to 7 feet below ground surface using conventional construction equipment. Cost estimate is based on in-place sediment volume.

5. Temporary water treatment system cost estimate includes installation of sumps and associated pumps to dewater excavation areas and rental and operation of a portable water treatment system capable of operating at 50 gpm. Cost estimate assumes that treated water would be discharged to Kill Brook under a NYSDEC State Pollutant Discharge Elimination System (SPDES) Permit Equivalent.

6. Community air monitoring and vapor/odor control cost estimate includes labor, equipment, and materials necessary to monitor vapor/odor emissions during intrusive site activities and to apply vapor/odor suppressing foam to open excavations.

7. Stabilization admixture cost estimate includes purchasing and importing stabilizing agents to amend sediment and material excavated from below the water table. Cost estimate assumes stabilization admixture (e.g., Portland cement) will be added at ratio of 10% of the weight of material to be stabilized.

8. Backfill - excavation areas cost estimate includes labor, equipment, and materials necessary to import, place, grade and compact general fill in excavation areas to match previously existing surrounding grades. Cost estimate is based on in-place soil volume.

9. Solid waste characterization cost estimate includes laboratory analysis of soil and sediment samples (including, but not limited to, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and Resource Conservation and Recovery Act-(RCRA-) regulated metals). Cost assumes that waste characterization samples would be collected at a frequency of one sample per every 500 tons of material destined for off-site treatment/disposal.

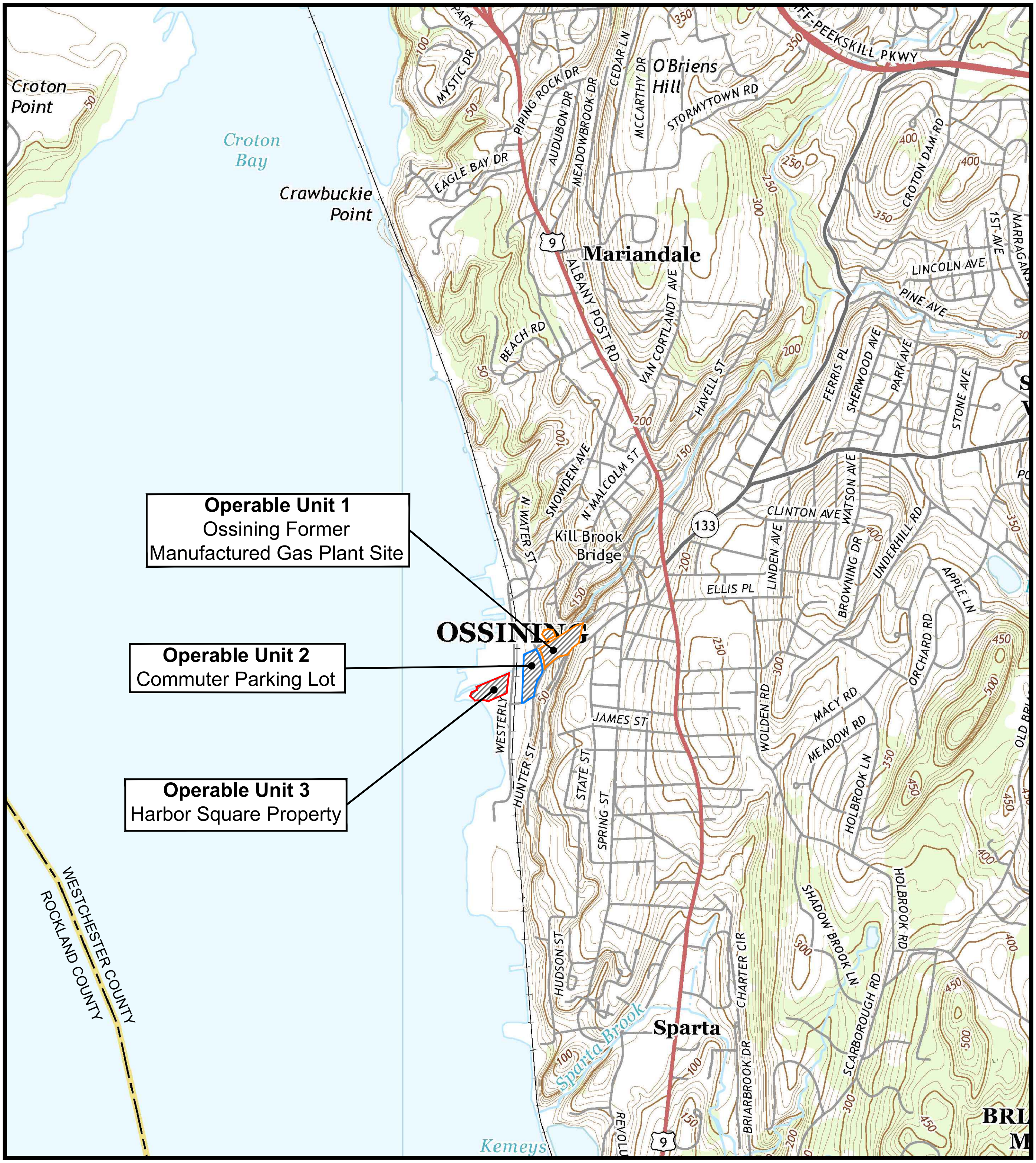
Table 8
Cost Estimate for Alternative 4 - Soil Removal to Unrestricted Use SCOs

Alternatives Analysis Report
Consolidated Edison Company of New York, Inc. - Former Ossining Works Manufactured Gas Plant Site - Ossining, New York

10. Solid waste transportation and disposal - non-hazardous waste cost estimate includes transport and dispose of excavated soil and ISS/jet grout spoils not requiring low-temperature thermal desorption (LTTD) treatment and disposal of surface C&D debris generated by site preparation efforts. Cost estimate assumes that 75% of excavated soil will be disposed as non-hazardous waste. Cost estimate includes transportation and disposal of excavated soil and sediment at an assumed density of 1.5 tons per cubic-yard.

11. Solid waste transportation and disposal - LTTD cost estimate includes costs to transport and thermally treat excavated soil and ISS/jet grout spoils exhibiting toxicity characteristic for benzene at a thermal treatment facility. Cost estimate assumes that 25% of excavated material will be treated/disposed of via LTTD. Cost assumes excavated soil and sediment will be treated/disposed of via LTTD at an estimated density of 1.5 tons per cubic-yard.

Figures



REFERENCE: BASE MAP USGS 7.5 MIN. QUAD., OSSINING AND HAVERSTRAW, NEW YORK, 2016

2000' 0 2000'

Approximate Scale: 1" = 2000'

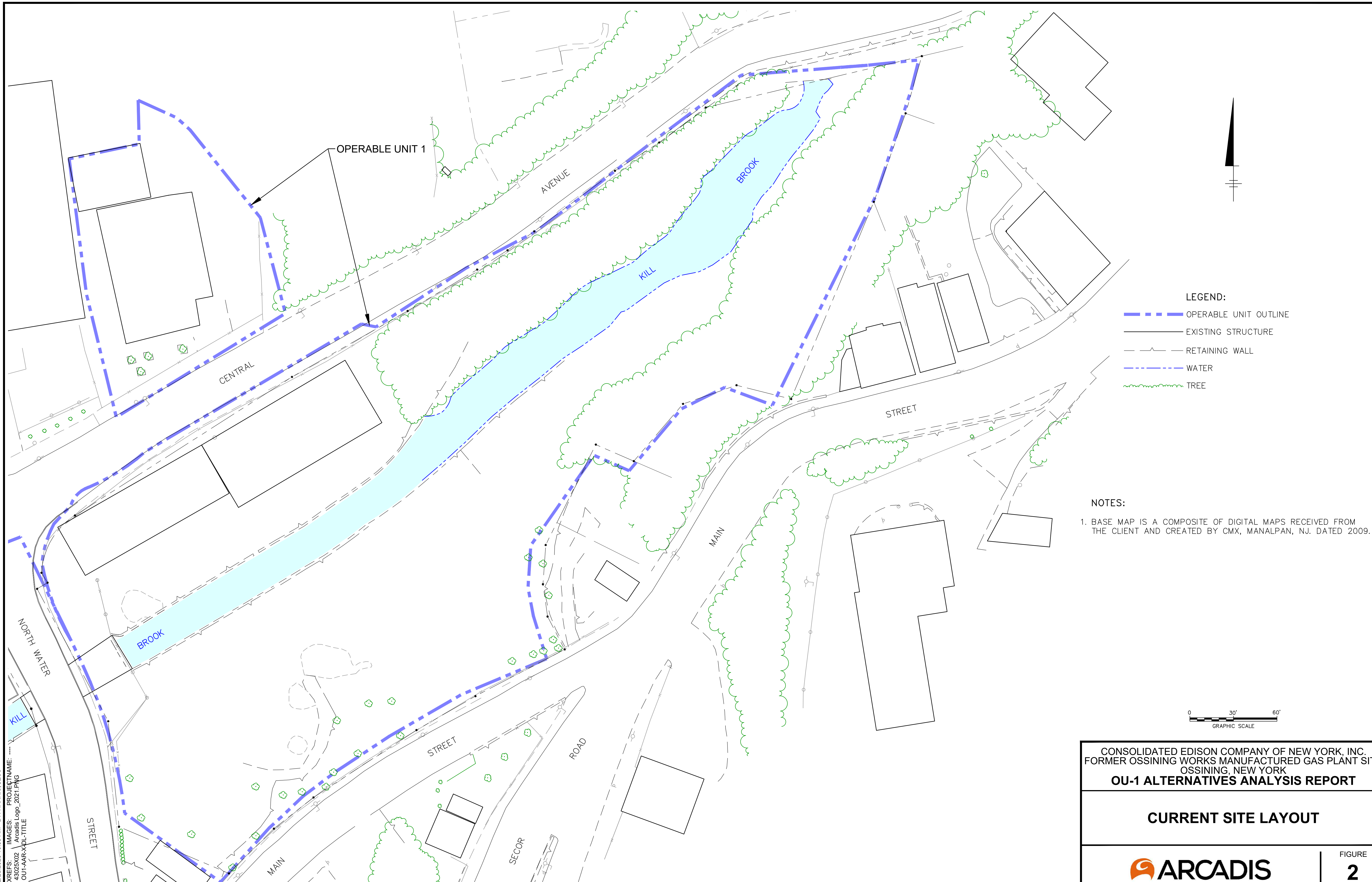
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

OU-1 ALTERNATIVES ANALYSIS REPORT

SITE LOCATION MAP

ARCADIS

FIGURE
1



NOTES:

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CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

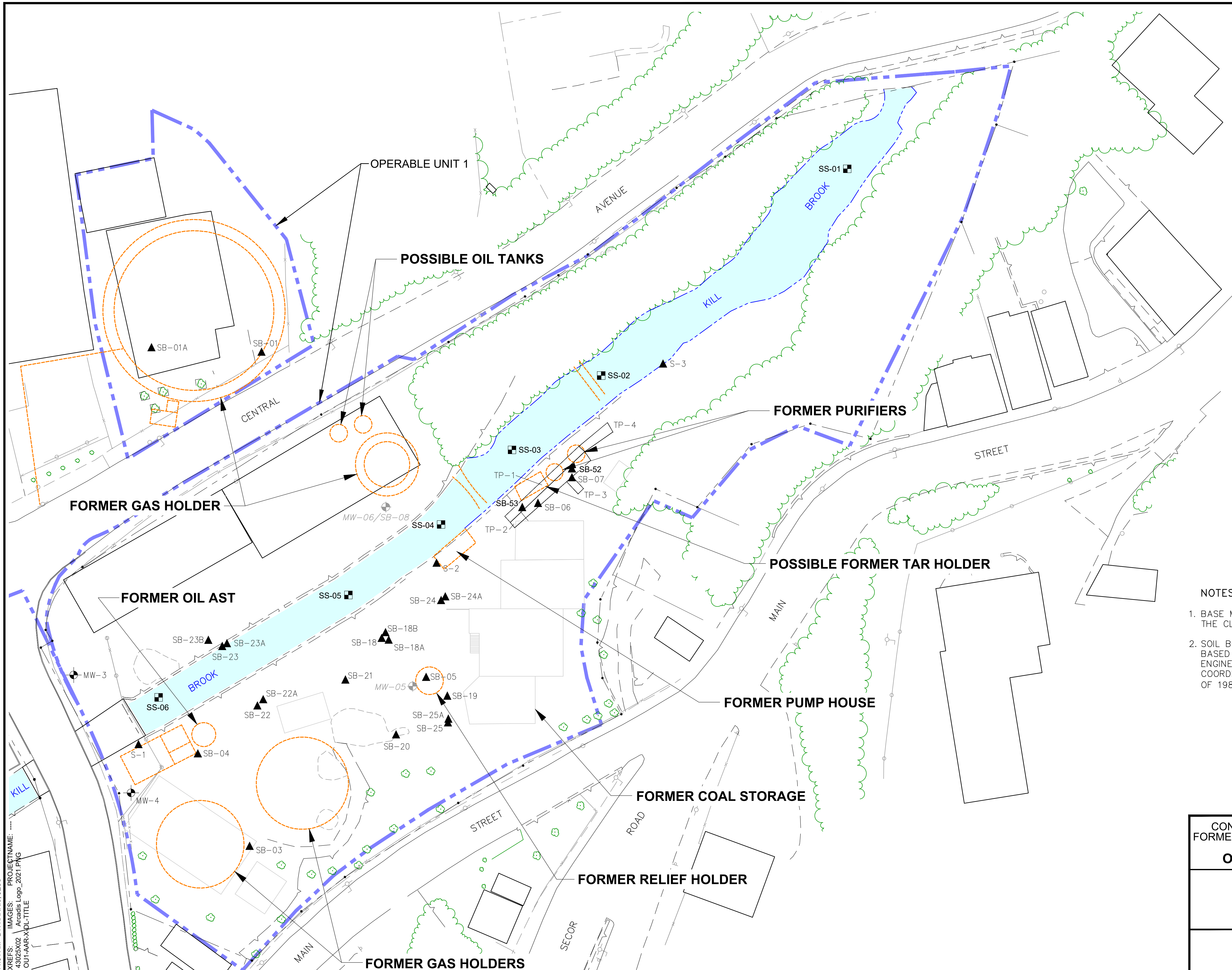
OU-1 ALTERNATIVES ANALYSIS REPORT

CURRENT SITE LAYOUT

ARCADIS

FIGURE
2

C:\Users\jlharris\ACCDocs\Arcadis\AUS-CON ED-FORMER MGP-OSSINING New York\Project Files\2023\01-In Progress\01-DWG\OU1-AAR-F02-SITE MAP CURRENT.dwg LAYOUT: 2 SAVED: 2/20/2023 10:16 AM ACADVER: 24.2S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 2/20/2023 10:59 AM BY: HARRIS, JESS
XREFS: 43025X02 OU1-AAR-XDL-TITLE IMAGES: Arcadis_Logo_2021.PNG PROJECTNAME: ----



LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- FORMER STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE

NOTES:

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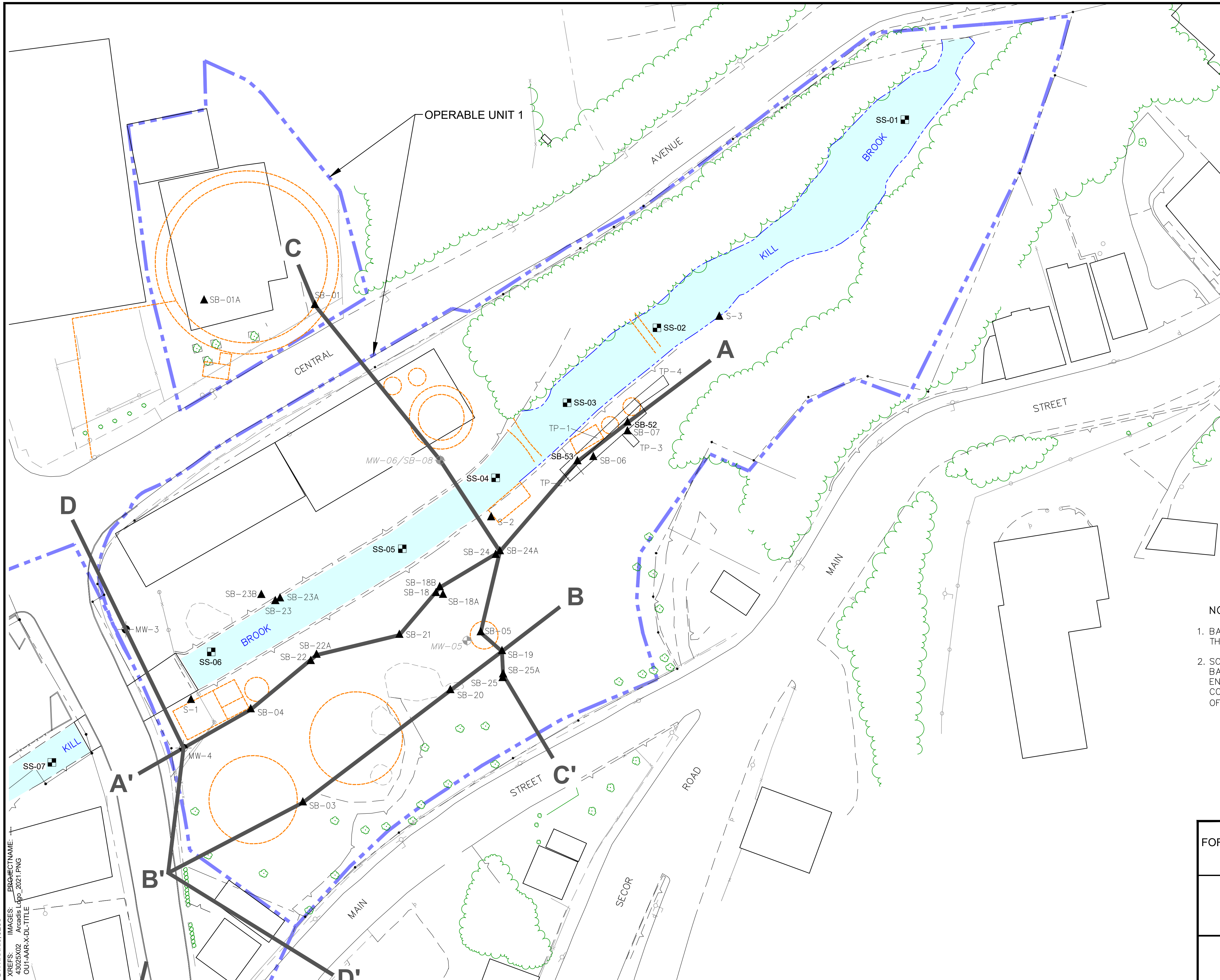
0 30' 60'
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK
OU-1 ALTERNATIVES ANALYSIS REPORT

SITE MAP WITH FORMER MGP STRUCTURES AND SAMPLING LOCATIONS

ARCADIS

FIGURE
3



LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE
- A—A' LINE OF CROSS SECTION

NOTES:

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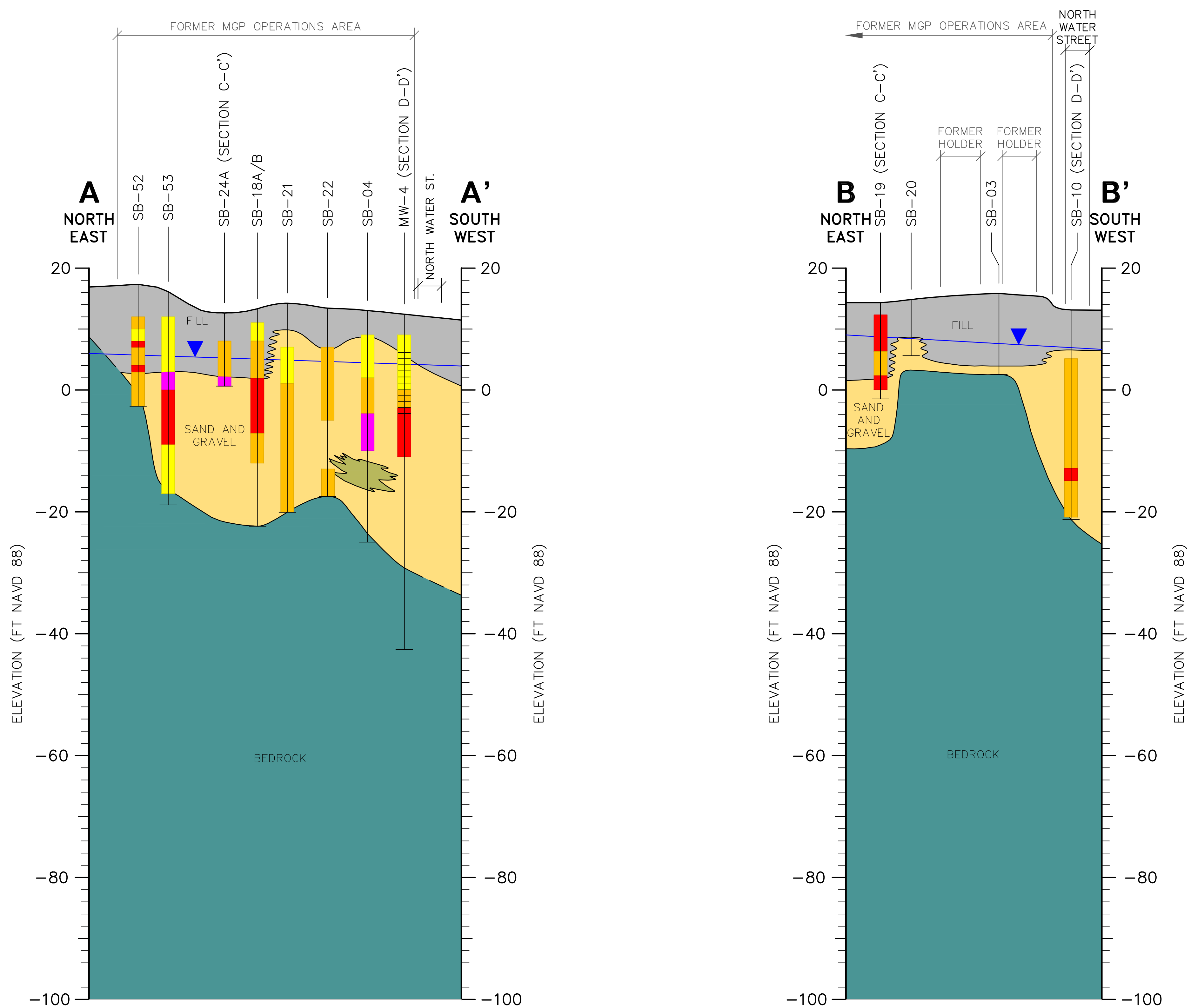
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

OU-1 ALTERNATIVES ANALYSIS REPORT

GEOLOGIC CROSS SECTION MAP

ARCADIS

FIGURE
4



SB-52

LEGEND:

WELL OR BORING ID

GROUND SURFACE

WATER TABLE

LITHOLOGIC CONTACT (DASHED WHERE INFERRED)

SCREEN

BOTTOM OF BORING

FILL

SILT AND CLAY

SAND AND GRAVEL

BEDROCK (SCHIST)

NYSDEC IMPACT COLOR CHART:

TAR SATURATED

COATED MATERIAL

BLEBS, SHEEN

STAINING, ODOR

VERTICAL EXAGGERATION = 8X

0 20' 40'

VERTICAL SCALE

0 160' 320'

HORIZONTAL SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

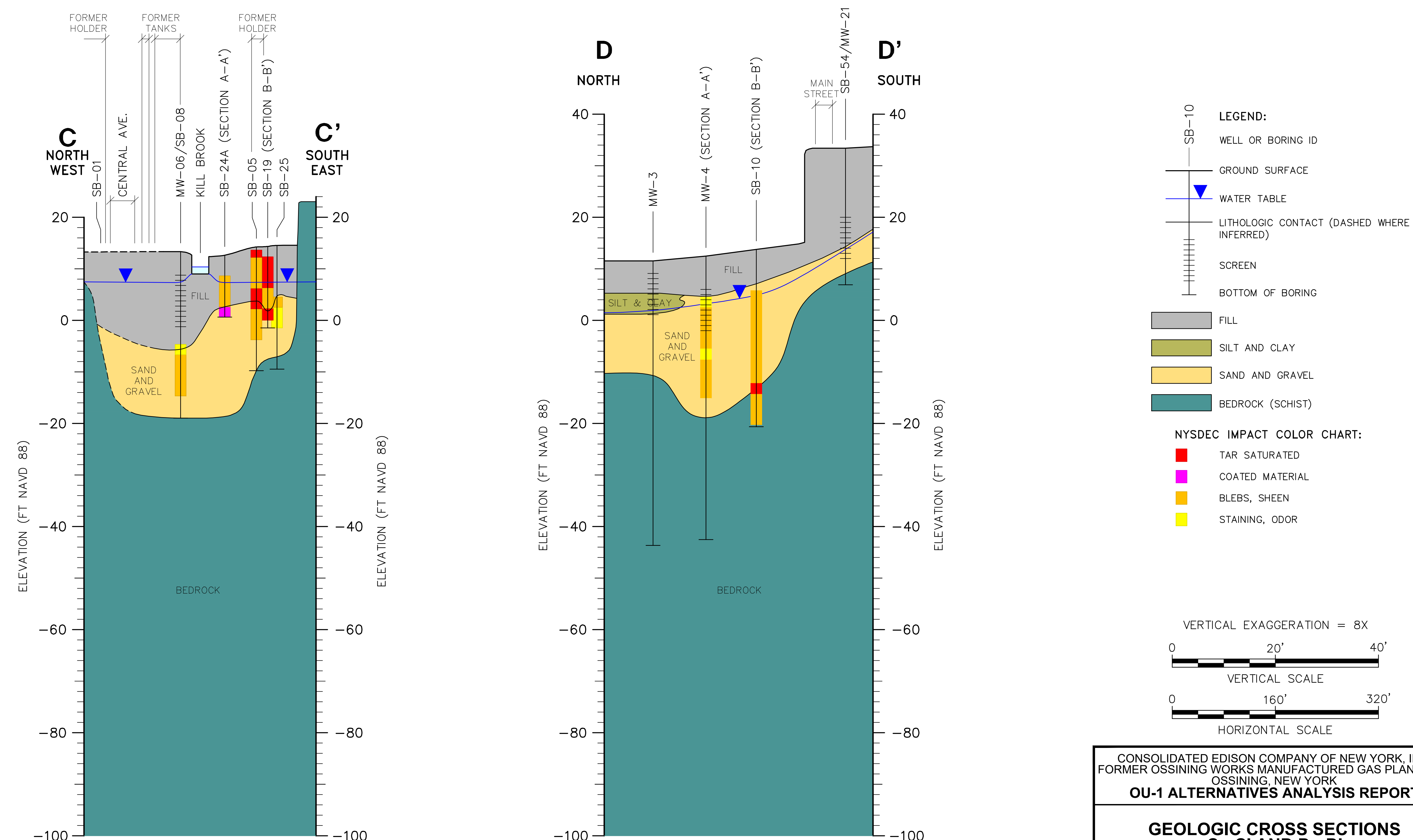
OU-1 ALTERNATIVES ANALYSIS REPORT

GEOLOGIC CROSS SECTIONS A - A' AND B - B'

ARCADIS

FIGURE

5



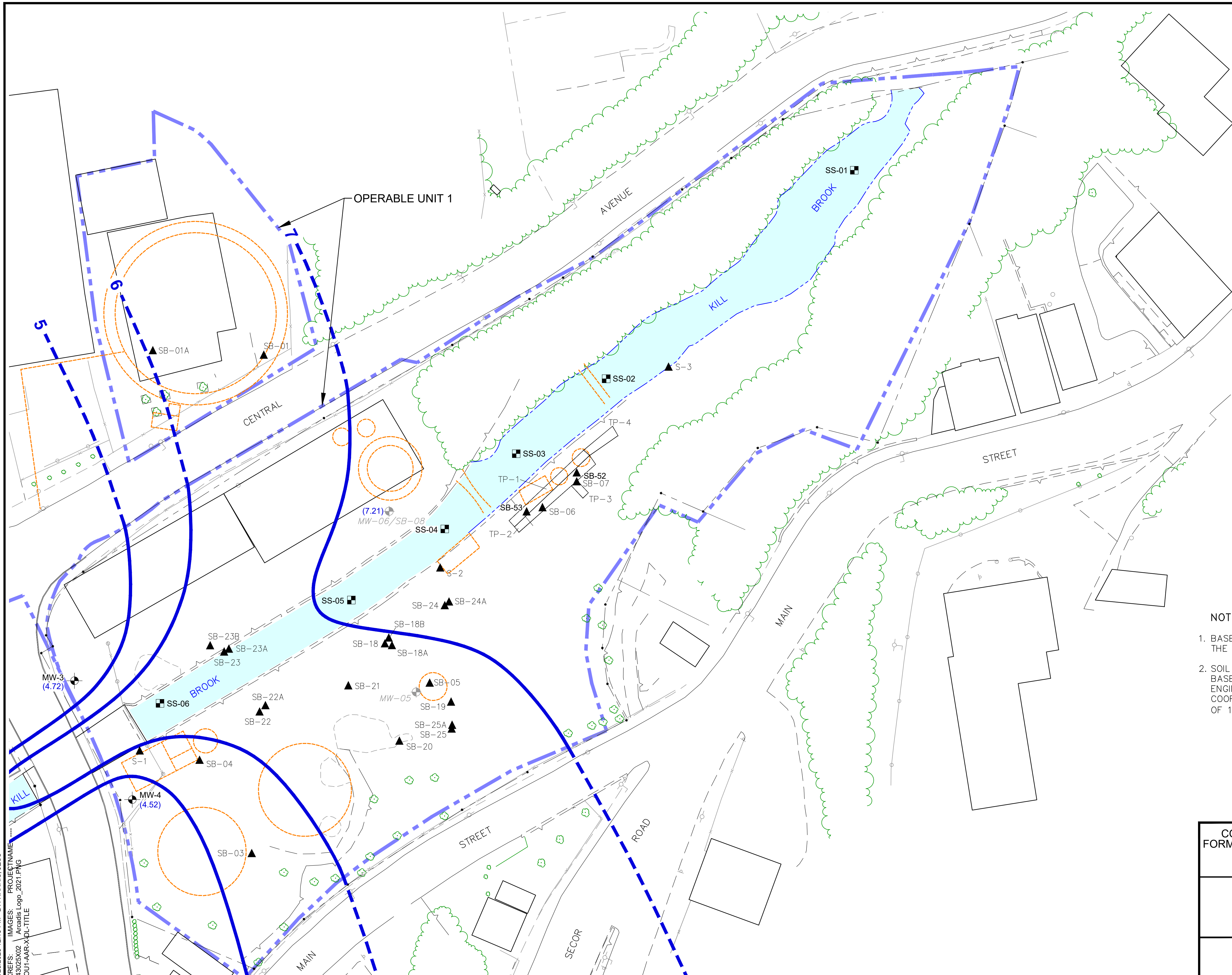
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

OU-1 ALTERNATIVES ANALYSIS REPORT

GEOLOGIC CROSS SECTIONS C - C' AND D - D'

ARCADIS

FIGURE 6



LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE
- (7.21) GROUNDWATER ELEVATION
- 6 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)

NOTES:

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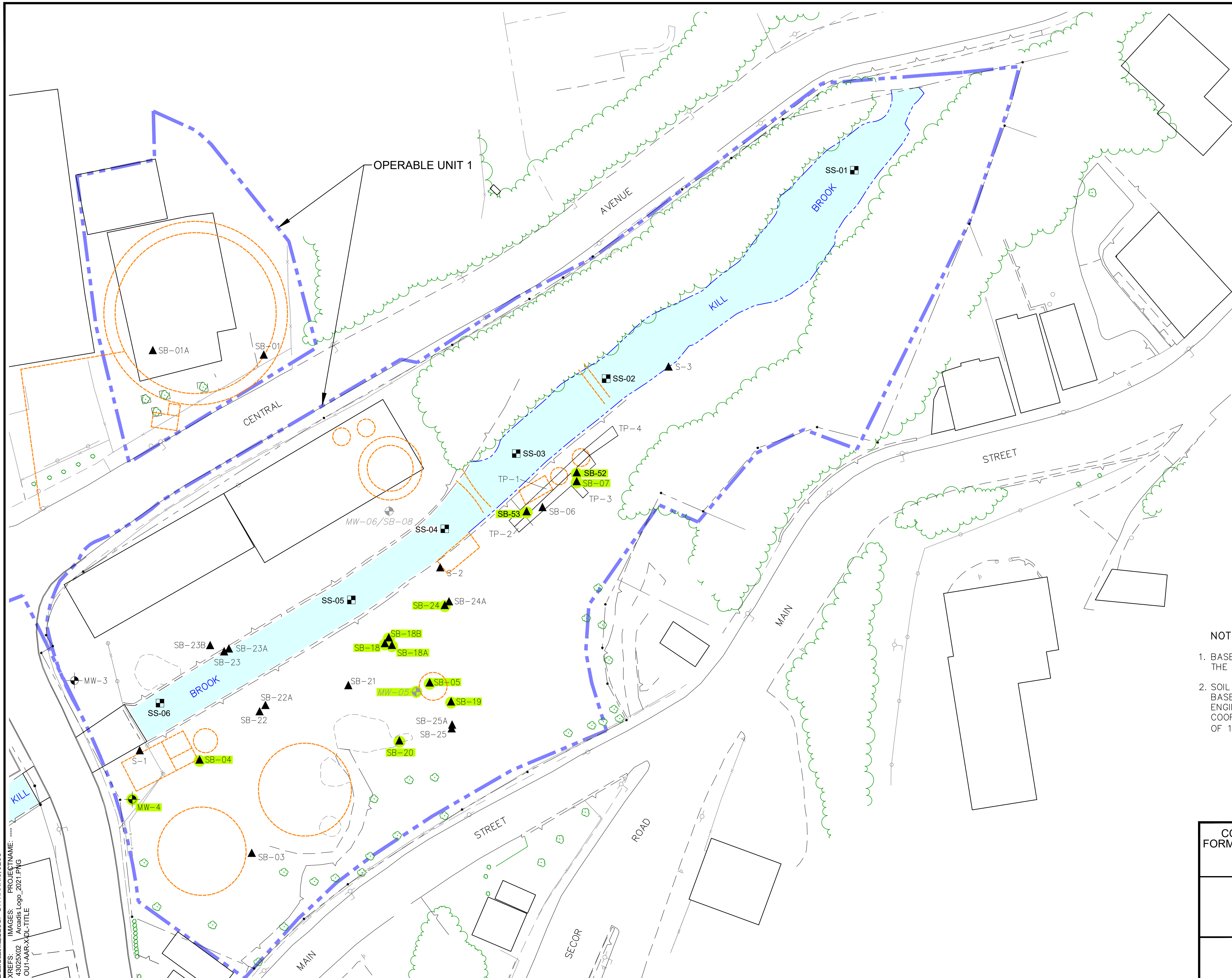
0 30' 60'
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK
OU-1 ALTERNATIVES ANALYSIS REPORT

SHALLOW OVERBURDEN GROUNDWATER ELEVATION CONTOUR MAP-APRIL 13, 2012

ARCADIS

FIGURE
7



LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE
- BORING WHERE NAPL WAS ENCOUNTERED DURING HISTORICAL RI ACTIVITES

NOTES:

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0 30' 60'
GRAPHIC SCALE

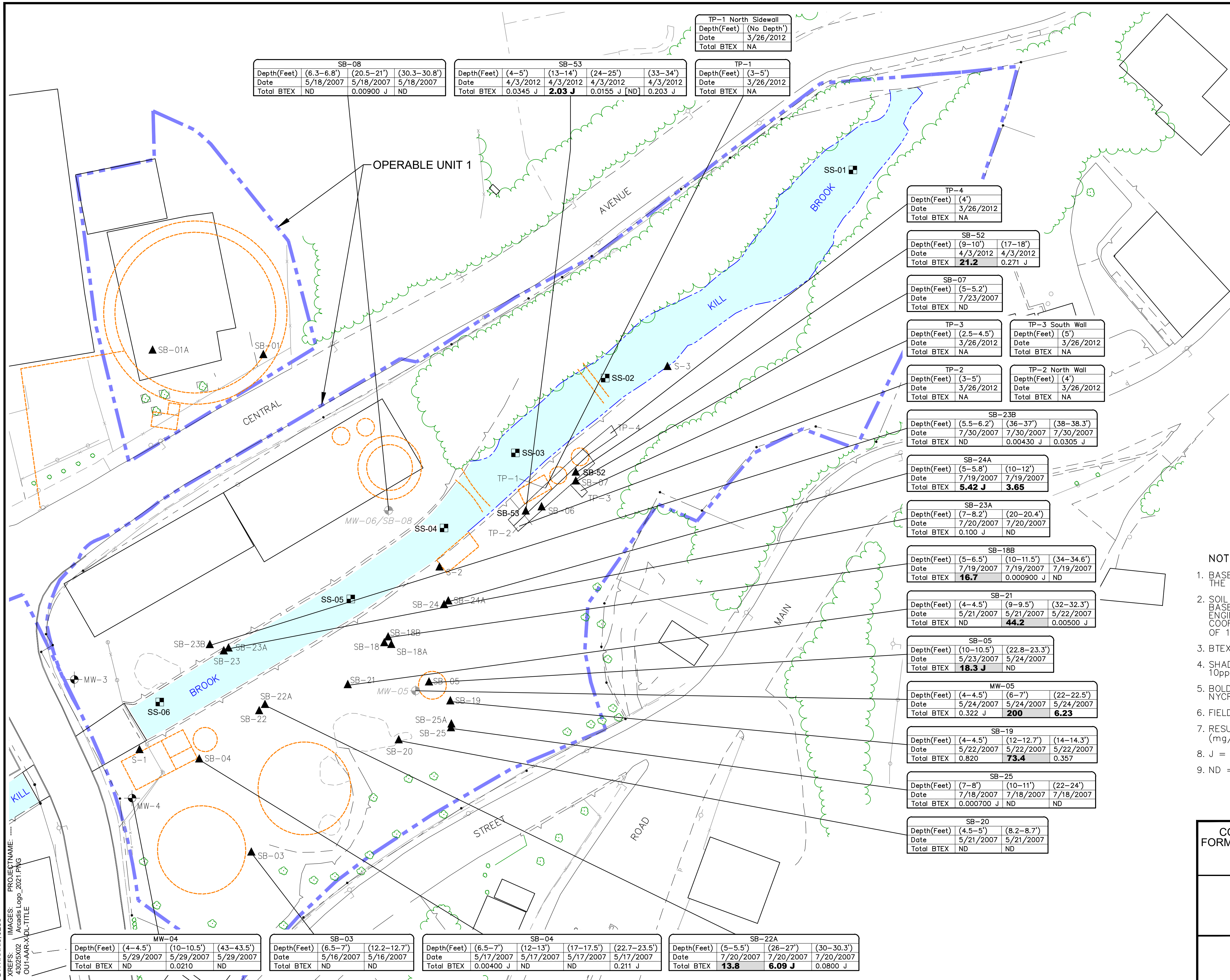
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

OU-1 ALTERNATIVES ANALYSIS REPORT

NAPL IN SUBSURFACE SOIL

ARCADIS

FIGURE
8



SB-08			
Depth(Feet)	(6.3–6.8')	(20.5–21')	(30.3–30.8')
Date	5/18/2007	5/18/2007	5/18/2007
Total BTEX	ND	0.00900 J	ND

SB-53				
Depth(Feet)	(4–5')	(13–14')	(24–25')	(33–34')
Date	4/3/2012	4/3/2012	4/3/2012	4/3/2012
Total BTEX	0.0345 J	**2.03 J**	0.0155 J [ND]	0.203 J

TP-1 North Sidewall	
Depth(Feet)	(No Depth')
Date	3/26/2012
Total BTEX	NA

TP-1	
Depth(Feet)	(3–5')
Date	3/26/2012
Total BTEX	NA

TP-4	
Depth(Feet)	(4')
Date	3/26/2012
Total BTEX	NA

SB-52		
Depth(Feet)	(9–10')	(17–18')
Date	4/3/2012	4/3/2012
Total BTEX	**21.2**	0.271 J

SB-07	
Depth(Feet)	(5–5.2')
Date	7/23/2007
Total BTEX	ND

TP-3	
Depth(Feet)	(2.5–4.5')
Date	3/26/2012
Total BTEX	NA

TP-3 South Wall	
Depth(Feet)	(5')
Date	3/26/2012
Total BTEX	NA

TP-2	
Depth(Feet)	(3–5')
Date	3/26/2012
Total BTEX	NA

TP-2 North Wall	
Depth(Feet)	(4')
Date	3/26/2012
Total BTEX	NA

SB-23B			
Depth(Feet)	(5.5–6.2')	(36–37')	(38–38.3')
Date	7/30/2007	7/30/2007	7/30/2007
Total BTEX	ND	0.00430 J	0.0305 J

SB-24A		
Depth(Feet)	(5–5.8')	(10–12')
Date	7/19/2007	7/19/2007
Total BTEX	**5.42 J**	**3.65**

SB-23A		
Depth(Feet)	(7–8.2')	(20–20.4')
Date	7/20/2007	7/20/2007
Total BTEX	0.100 J	ND

SB-18B			
Depth(Feet)	(5–6.5')	(10–11.5')	(34–34.6')
Date	7/19/2007	7/19/2007	7/19/2007
Total BTEX	**16.7**	0.000900 J	ND

SB-21			
Depth(Feet)	(4–4.5')	(9–9.5')	(32–32.3')
Date	5/21/2007	5/21/2007	5/22/2007
Total BTEX	ND	**44.2**	0.00500 J

SB-05		
Depth(Feet)	(10–10.5')	(22.8–23.3')
Date	5/23/2007	5/24/2007
Total BTEX	**18.3 J**	ND

MW-05			
Depth(Feet)	(4–4.5')	(6–7')	(22–22.5')
Date	5/24/2007	5/24/2007	5/24/2007
Total BTEX	0.322 J	**200**	**6.23**

SB-19			
Depth(Feet)	(4–4.5')	(12–12.7')	(14–14.3')
Date	5/22/2007	5/22/2007	5/22/2007
Total BTEX	0.820	**73.4**	0.357

SB-25			
Depth(Feet)	(7–8')	(10–11')	(22–24')
Date	7/18/2007	7/18/2007	7/18/2007
Total BTEX	0.000700 J	ND	ND

SB-20		
Depth(Feet)	(4.5–5')	(8.2–8.7')
Date	5/21/2007	5/21/2007
Total BTEX	ND	ND

MW-04			
Depth(Feet)	(4–4.5')	(10–10.5')	(43–43.5')
Date	5/29/2007	5/29/2007	5/29/2007
Total BTEX	ND	0.0210	ND

SB-03		
Depth(Feet)	(6.5–7')	(12.2–12.7')
Date	5/16/2007	5/16/2007
Total BTEX	ND	ND

SB-04				
Depth(Feet)	(6.5–7')	(12–13')	(17–17.5')	(22.7–23.5')
Date	5/17/2007	5/17/2007	5/17/2007	5/17/2007
Total BTEX	0.00400 J	ND	ND	0.211 J

SB-22A			
Depth(Feet)	(5–5.5')	(26–27')	(30–30.3')
Date	7/20/2007	7/20/2007	7/20/2007
Total BTEX	**13.8**	**6.09 J**	0.0800 J

LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE

NOTES:

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3. BTEX = BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE.
4. SHADED VALUES INDICATE TOTAL BTEX CONCENTRATIONS OF 10ppm OR GREATER.
5. BOLD VALUES INDICATE ONE OR MORE BTEX COMPOUNDS EXCEED NYCRR PART 375-6 SOIL CLEANUP OBJECTIVES.
6. FIELD DUPLICATE SAMPLE RESULTS ARE PRESENTED IN BRACKETS.
7. RESULTS ARE PRESENTED IN UNITS OF MILLIGRAMS PER KILOGRAM (mg/kg).
8. J = INDICATES AN ESTIMATED VALUE.
9. ND = NONE DETECTED.

0 30' 60'
GRAPHIC SCALE

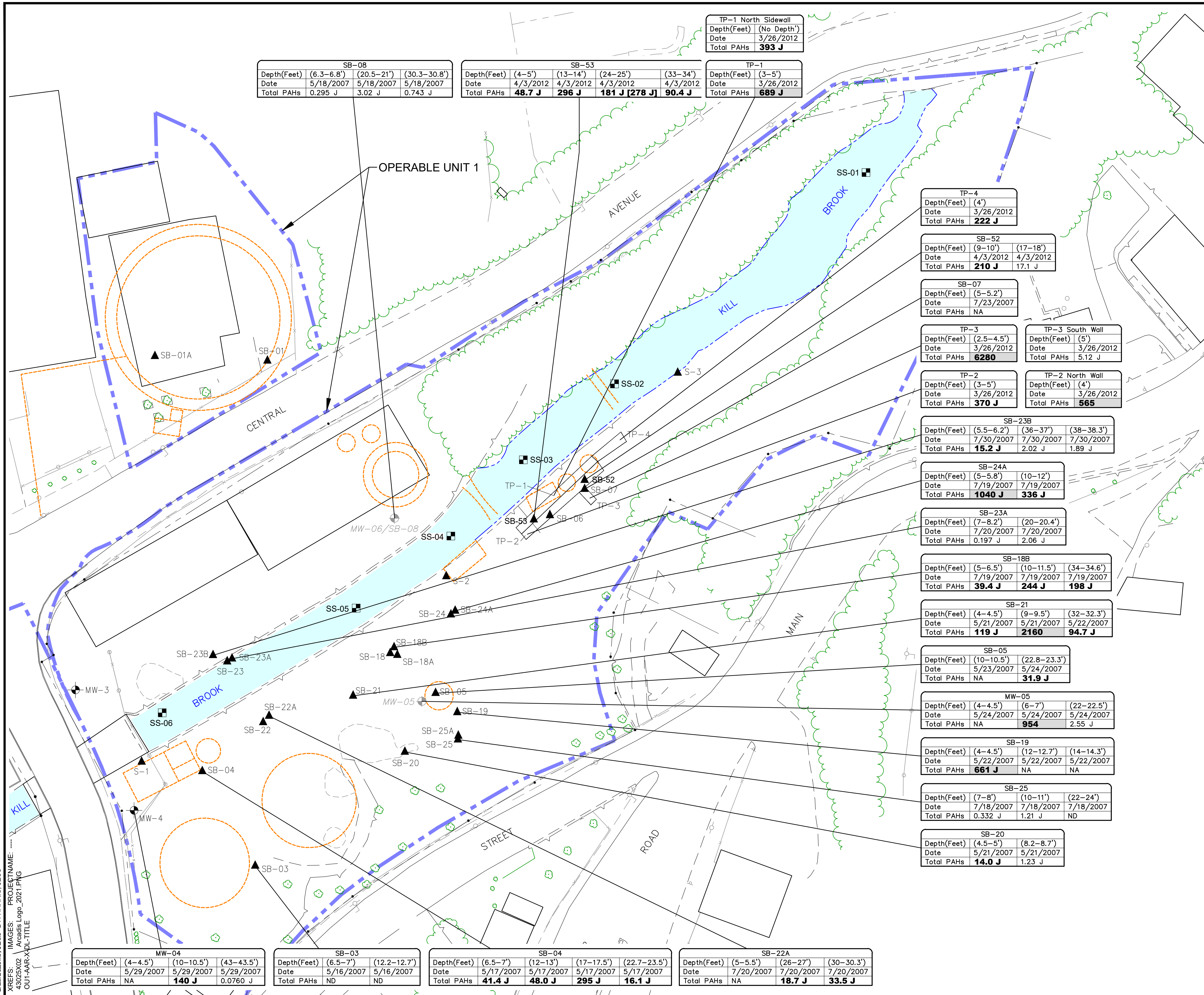
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

OU-1 ALTERNATIVES ANALYSIS REPORT

SOIL BTEX

ARCADIS

FIGURE
9



LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE

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3. PAHs = POLYAROMATIC HYDROCARBONS.
4. SHADED VALUES INDICATE TOTAL PAH CONCENTRATIONS OF 500ppm OR GREATER.
5. BOLD VALUES INDICATE ONE OR MORE PAH COMPOUNDS EXCEED NYCRR PART 375-6 SOIL CLEANUP OBJECTIVES.
6. FIELD DUPLICATE SAMPLE RESULTS ARE PRESENTED IN BRACKETS.
7. RESULTS ARE PRESENTED IN UNITS OF MILLIGRAMS PER KILOGRAM (mg/kg).
8. J = INDICATES AN ESTIMATED VALUE.
9. ND = NONE DETECTED.

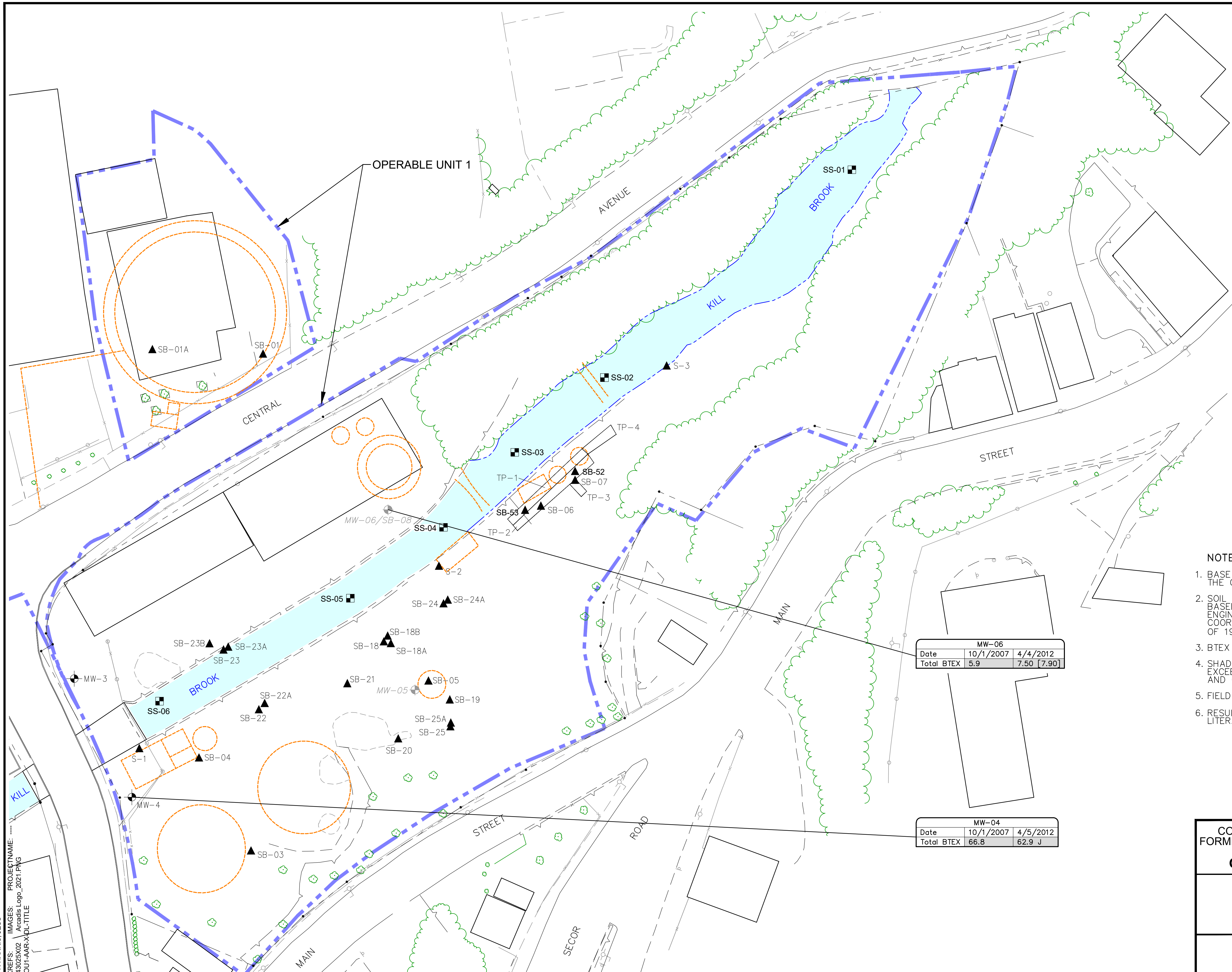
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
OSSINING, NEW YORK

OU-1 ALTERNATIVES ANALYSIS REPORT

SOIL PAHs

ARCADIS

FIGURE
10



MW-06		
Date	10/1/2007	4/4/2012
Total BTEX	5.9	7.50 [7.90]

MW-04		
Date	10/1/2007	4/5/2012
Total BTEX	66.8	62.9 J

LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE

NOTES:

1. BASE MAP IS A COMPOSITE OF DIGITAL MAPS RECEIVED FROM THE CLIENT AND CREATED BY CMX, MANALPAN, NJ. DATED 2009.
2. SOIL BORING, TEST PIT, AND MONITORING WELL LOCATIONS ARE BASED ON SURVEYS PERFORMED BY CMX INC, MUNOZ ENGINEERING P.C., AND C.T. MALE ASSOCIATES. HORIZONTAL COORDINATES ARE REFERENCED TO THE NORTH AMERICAN DATUM OF 1983 (NAD 83) – NEW YORK STATE PLANE EAST.
3. BTEX = BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE.
4. SHADED VALUES INDICATE ONE OR MORE BTEX COMPOUNDS EXCEED NYSDEC TOGS 1.1.1. AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES.
5. FIELD DUPLICATE SAMPLE RESULTS ARE PRESENTED IN BRACKETS.
6. RESULTS ARE PRESENTED IN UNITS OF (μg/L) MICROGRAMS PER LITER.

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FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
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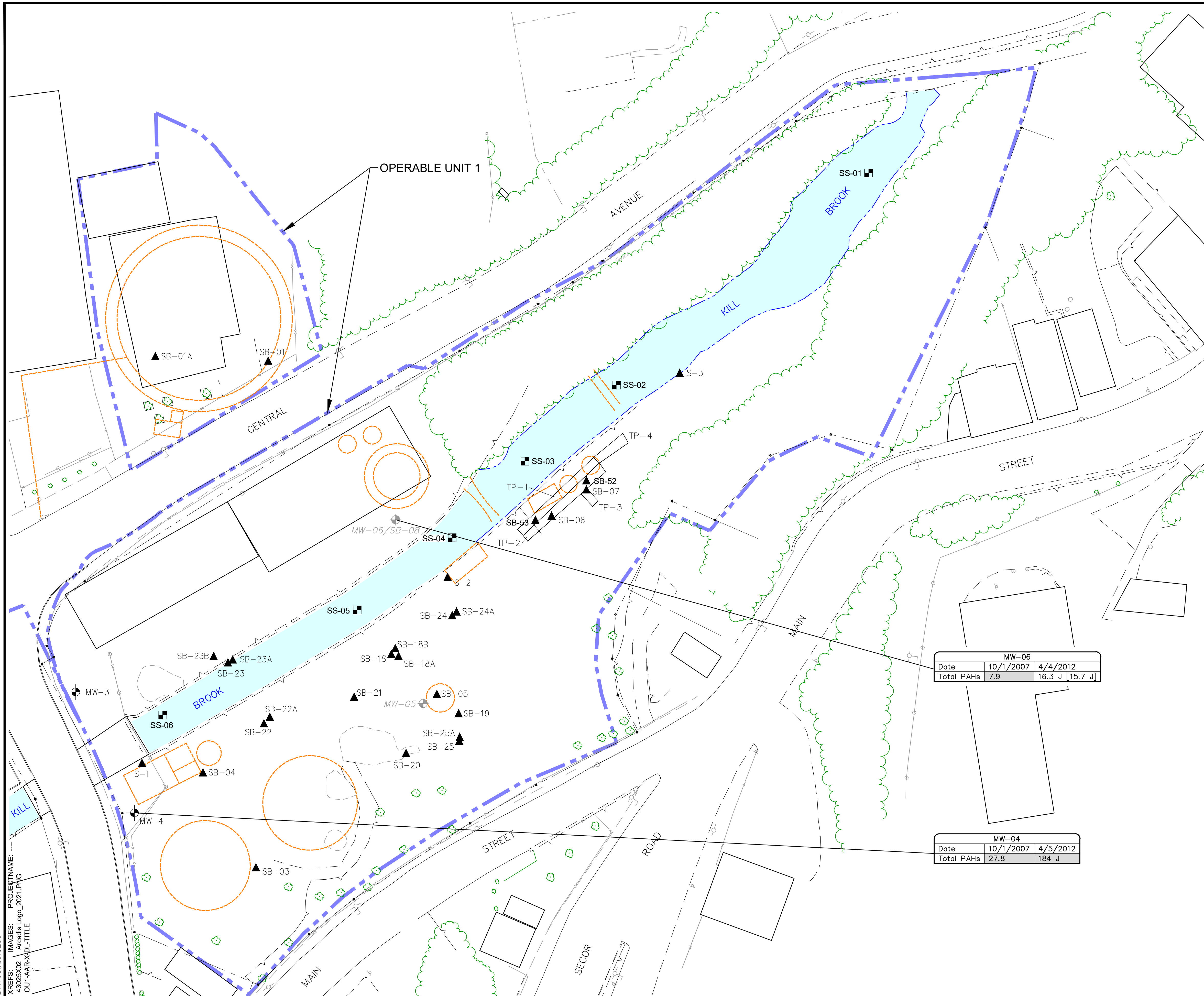
OU-1 ALTERNATIVES ANALYSIS REPORT

GROUNDWATER BTEX

ARCADIS

FIGURE

11



MW-06		
Date	10/1/2007	4/4/2012
Total PAHs	7.9	16.3 J [15.7 J]

MW-04		
Date	10/1/2007	4/5/2012
Total PAHs	27.8	184 J

LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE

NOTES:

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3. PAHs = POLYAROMATIC HYDROCARBONS.
4. SHADED VALUES INDICATE ONE OR MORE PAH COMPOUNDS EXCEED NYSDEC TOGS 1.1.1. AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES..
5. FIELD DUPLICATE SAMPLE RESULTS ARE PRESENTED IN BRACKETS.
6. RESULTS ARE PRESENTED IN UNITS OF MICROGRAMS PER LITER ($\mu g/l$).
7. J = INDICATES AN ESTIMATED VALUE.

0 30' 60'
GRAPHIC SCALE

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FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
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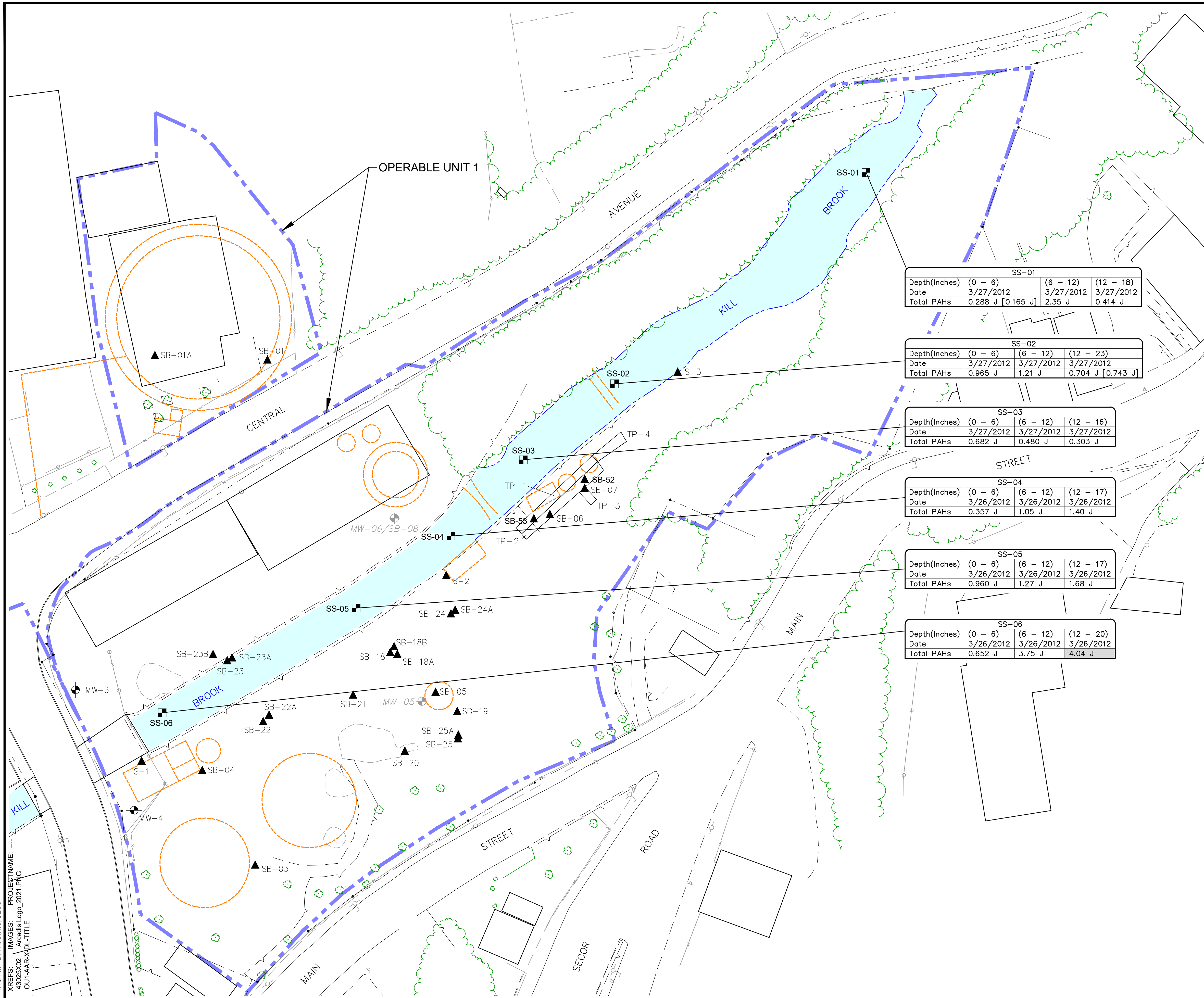
OU-1 ALTERNATIVES ANALYSIS REPORT

GROUNDWATER PAHs

ARCADIS

FIGURE
12



SS-01			
Depth(Inches)	(0 – 6)	(6 – 12)	(12 – 18)
Date	3/27/2012	3/27/2012	3/27/2012
Total PAHs	0.288 J [0.165 J]	2.35 J	0.414 J

SS-02			
Depth(Inches)	(0 – 6)	(6 – 12)	(12 – 23)
Date	3/27/2012	3/27/2012	3/27/2012
Total PAHs	0.965 J	1.21 J	0.704 J [0.743 J]

SS-03			
Depth(Inches)	(0 – 6)	(6 – 12)	(12 – 16)
Date	3/27/2012	3/27/2012	3/27/2012
Total PAHs	0.682 J	0.480 J	0.303 J

SS-04			
Depth(Inches)	(0 – 6)	(6 – 12)	(12 – 17)
Date	3/26/2012	3/26/2012	3/26/2012
Total PAHs	0.357 J	1.05 J	1.40 J

SS-05			
Depth(Inches)	(0 – 6)	(6 – 12)	(12 – 17)
Date	3/26/2012	3/26/2012	3/26/2012
Total PAHs	0.960 J	1.27 J	1.68 J

SS-06			
Depth(Inches)	(0 – 6)	(6 – 12)	(12 – 20)
Date	3/26/2012	3/26/2012	3/26/2012
Total PAHs	0.652 J	3.75 J	4.04 J

LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE

NOTES:

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3. PAHs = POLYAROMATIC HYDROCARBONS.
4. SHADED VALUES INDICATE TOTAL PAH CONCENTRATION EXCEEDS NYSDEC CLASS A SEDIMENT GUIDANCE VALUE OF 4 mg/kg.
5. FIELD DUPLICATE SAMPLE RESULTS ARE PRESENTED IN BRACKETS.
6. RESULTS ARE PRESENTED IN UNITS OF MILLIGRAMS PER KILOGRAM (mg/kg).
7. J = INDICATES AN ESTIMATED VALUE.

0 30' 60'
GRAPHIC SCALE

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FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
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OU-1 ALTERNATIVES ANALYSIS REPORT

STREAMBANK CONDITIONS AND SEDIMENT PAHs

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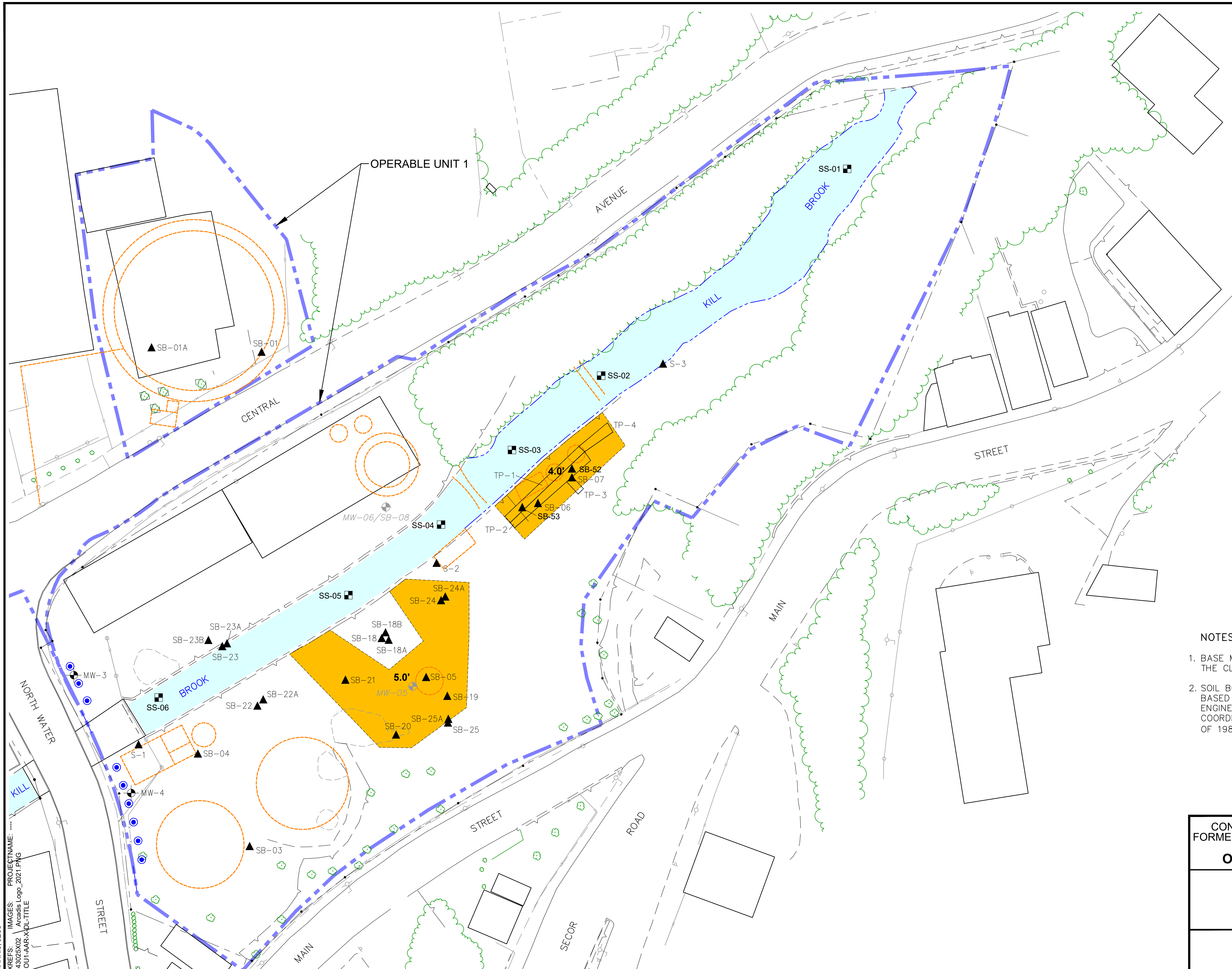
FIGURE
13



LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- RETAINING WALL
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE
- 5.0' LIMITS AND DEPTH OF SOIL EXCAVATION
- LNAPL RECOVERY WELL

NOTES:

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0 30' 60'
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
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OU-1 ALTERNATIVES ANALYSIS REPORT

ALTERNATIVE 2

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FIGURE
14

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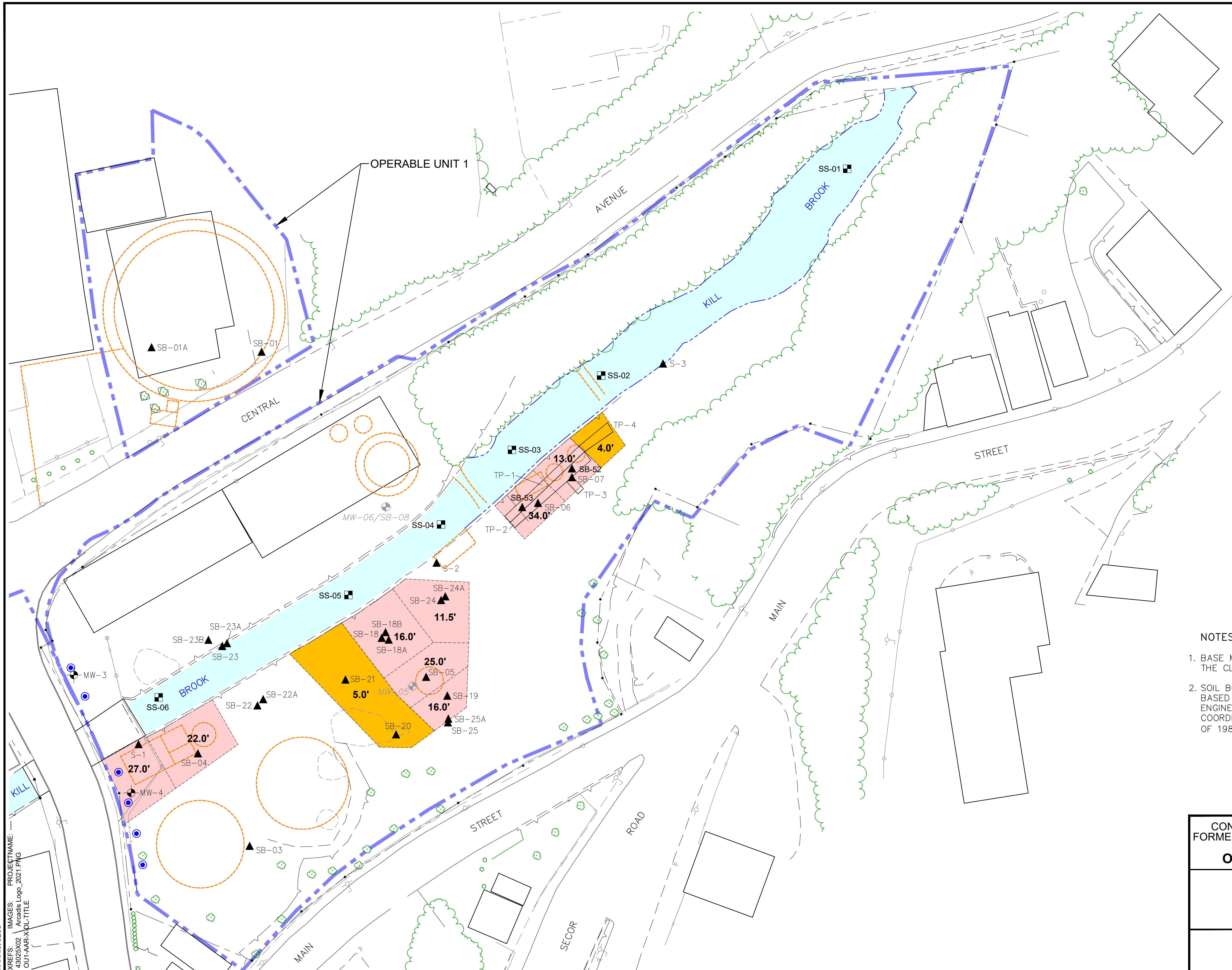

LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- RETAINING WALL
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE
- 5.0' LIMITS AND DEPTH OF SOIL EXCAVATION
- 16' LIMITS AND DEPTH OF ISS TREATMENT
- LNAPL RECOVERY WELL

NOTES:

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0 30' 60'
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER OSSINING WORKS MANUFACTURED GAS PLANT SITE
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ALTERNATIVE 3

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FIGURE
15

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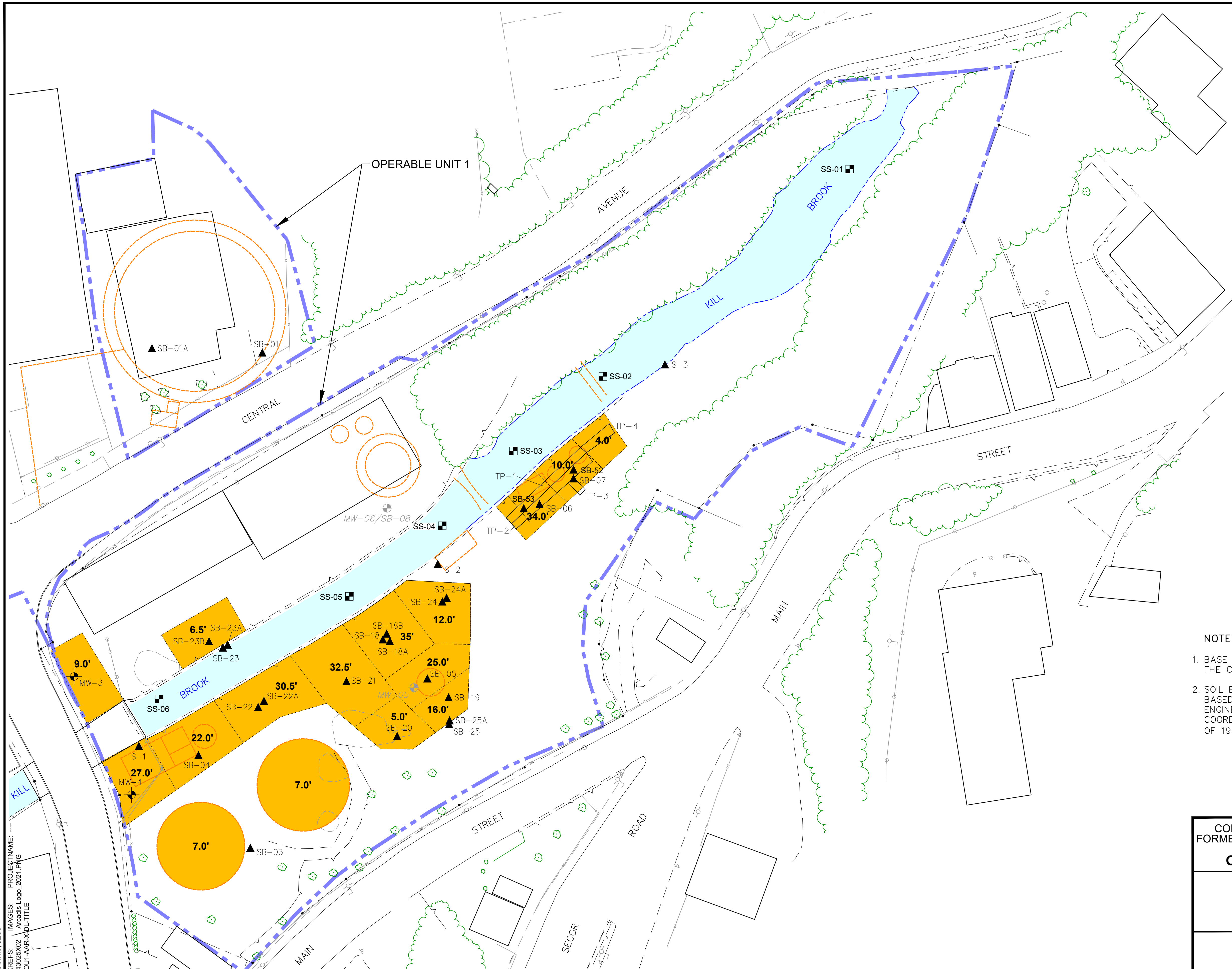

LEGEND:

- OPERABLE UNIT OUTLINE
- EXISTING STRUCTURE
- RETAINING WALL
- WATER
- TREE
- MONITORING WELL
- SOIL BORING
- SEDIMENT SAMPLE
- TP-3 TEST PIT
- ABANDONED MONITORING WELL
- HISTORICAL MGP STRUCTURE
- 6.5' LIMITS AND DEPTH OF SOIL EXCAVATION

NOTES:

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0 30' 60'
GRAPHIC SCALE

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ALTERNATIVE 4

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FIGURE **16**

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