ALTERNATIVE ANALYSIS REPORT FOR OPERABLE UNIT 1
EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
CONSENT ORDER NUMBER 0-20180516-519
SITE ID NO. 231110

CONSOLIDATED EDISON CO. OF NEW YORK, INC.
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July 2020

Consolidated Edison Company of New York, Inc.

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February 2013
Revised June 2020

Alternative Analysis Report for Operable Unit 1

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B0043013.0011/30056091

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Certification Statement

I, Jason D. Brien, P.E. certify that I am currently a NYS registered professional engineer and that this *Alternatives Analysis Report* was prepared in accordance with all applicable statutes and regulations and substantial conformance with DER *Technical Guidance for Site Investigation and Remediation* (DER-10).

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1 INTRODUCTION

1.1 General

This *Alternative Analysis Report* (AAR) identifies and evaluates proposed remedies for Operable Unit 1 (OU-1) of the East 11th Street Works Site (Site No. 231110) located on the lower east side of Manhattan, New York (Site Location Map; Figure 1-1). The East 11th Street Works Site is the location of a former manufactured gas plant (MGP). Consolidated Edison Company of New York, Inc. (Con Edison) conducted site investigation and prior remedial planning activities under Voluntary Cleanup Agreement (VCA) Index No. D2-0003-02-08 with the New York State Department of Environmental Conservation (NYSDEC) dated August 15, 2002. The Site is now governed by NYSDEC Order on Consent and Administrative Settlement Index No.: CO 0-20180516-519, effective July 23, 2018 In 2004, Con Edison conducted a Site Characterization Study (SCS) at the East 11th Street Works Site. Based on the results of the NYSDEC-approved *Site Characterization Study Report for the Former East 11th Street Works* (TRC 2005) (SCS Report), the study area was enlarged to include the sidewalk area along East 13th Street between Avenue D and Szold Place, a portion of East River Park (between East 11th and 13th Street) and the East River. To expedite Con Edison's ability to evaluate potential remedial alternatives for the Jacob Riis, Haven Plaza and St. Emeric's properties while further investigating the East River Park property and the East River, the site was initially divided into two operable units. The properties listed in Table 1-1 are included in Appendix A of the VCA and were initially included in OU-1. East River Park and the East River were included in Operable Unit 2 (OU-2). Potential remedial alternatives for OU-2 are being investigated and evaluated independent of OU-1.

Table 1-1. Initial OU-1 Properties

Street Address	Tax Map Block/Lot Numbers
Jacob Riis Houses 152 Avenue D, New York, NY	Block 367 Lot 1
Manhattan Pump Station 184 Avenue D, New York NY	Block 367 Lot 25
Haven Plaza 3 188 Avenue C, New York NY	Block 382 Lot 1
St. Emeric R.C. Church and School 181 Avenue D, New York NY	Block 382 Lot 22

In addition to expediting the evaluation of potential remedial alternatives for OU-1, dividing the site into two study areas (i.e., operable units) was prudent based on the nature and uses of the two areas. The parcels included in OU-1 consist primarily of densely populated multi-story residences and small community facilities, businesses and services, along with a church and school. Many of the physical structures that occupy OU-1 are continuously occupied (e.g., apartment buildings) and represent vital components of the community. The level of awareness and sensitivities to disturbances caused by site activities, and the numbers of individuals potentially affected by increased noise, construction equipment, access restrictions, and temporary loss of common recreation areas, are much higher than for OU-2, which consists of a park and waterway occupied by more transient visitors. These disturbances and quality of life factors will be presented and included in the evaluation of potential remedial alternatives for OU-1. Based on these potential disruptions to the community, it is anticipated that OU-1 will have significantly more community involvement during the selection of a remedy than for OU-2.

Due primarily to logistical considerations associated with differences in property ownership, OU-1 has been modified to include only the Jacob Riis Houses and Manhattan Pump Station. The remaining properties that were initially included in OU-1 (Haven Plaza and Saint Emeric's) will be addressed as separate operable units.

The two properties that currently comprise OU-1 are identified on Figure 1-2. On the block bounded by east side of Avenue D and the west side of the FDR, OU-1 includes the area bounded to the south by the north side of the extension of East 11th Street and on the north by the north side of the extension of East 13th Street. Further description of the physical setting and current uses of the properties included in OU-1 is presented in Section 1.3.1.

While this AAR differentiates between OU-1 and OU-2 to facilitate the evaluation of remedial alternatives, Con Edison understands that the practical/logistical implementation of any remedy will require consideration of the site-wide impacts, receptors, and remedial objectives. While the parcels comprising OU-1 and OU-2 have different uses, common impacts and remedial objectives exist, and therefore, the remedies for both operable units may have common elements. One common medium between OU-1 and OU-2 is the groundwater beneath the site. The Remedial Investigation Report (ARCADIS BBL, 2007) confirmed that MGP-related impacts exist within the subsurface at both OU-1 and OU-2. While this AAR for OU-1 presents potential remedial alternatives for reducing the effects of these impacts to groundwater, reducing impacts to groundwater within OU-2 and reducing groundwater impacts to the East River will be addressed in the AAR for OU-2.

Consistent with the definitions used during the remedial investigation phase of the project, the terms defined below are used throughout this AAR:

- **Site**. Specific properties listed in Appendix A of the VCA, in addition to the East River Park and the East River (i.e., OU-1, OU-2, St. Emeric's Roman Catholic Church and School [OU-3], and Haven Plaza [OU-4]).
- **Works**. The area that encompasses the footprint of the former East 11th Street Works (the Works). During its most developed stage, the Works encompassed approximately 7 acres of land, generally bounded to the north by East 13th Street, to the east by the East River, to the west by Avenue D (south of E. 12th Street) and extending approximately 450 feet west of Avenue D north of E. 12th Street, and to the south by E. 11th Street (no longer exists). Locations of the former MGP structures and the overall footprint of the Works are provided on Figure 1-3.
- **OU-1**. The Jacob Riis and Manhattan Pump Station properties described in Section 1.3.1, which are the focus of this AAR.
- **OU-2**. Portions of the East River Park, the FDR, and East River, which are not the focus of this AAR and will be addressed in separate documents. For completeness and to better understand the physical site setting, historical uses, and the extent of environmental impacts, descriptions of East River Park

and the East River are also included in Section 1.3 (Background Information) and Section 1.4 (Site Characterization).

Additionally, while not part of the Site, at the direction of the NYSDEC, Con Edison has conducted soil vapor sampling and two indoor air sampling events at New York City Public School 34 to demonstrate that indoor air quality within the school is not being impacted by residual MGP-related impacts at the Site. The results of the sampling events were presented in the following documents:

- *Indoor Air and Soil Vapor Monitoring and Sump Sampling Report (ARCADIS, 2010a)*
- *Indoor Air Monitoring Report (ARCADIS, 2011a)*

Both reports concluded that no evidence of MGP impacts existed in the indoor air.

1.2 Purpose and Report Organization

The purpose of this AAR is to identify and evaluate remedial alternatives that are appropriate for site-specific conditions, protective of human health and the environment, and consistent with relevant sections of NYSDEC guidance, which incorporates (by reference) the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations. The overall objective of this AAR is to recommend a reliable, cost-effective remedy that satisfies the remedial action objectives (RAOs) established for OU-1 while considering the community's sensitivities to disturbances of daily activities. This AAR conforms to the NYSDEC requirements in Part 375-6 of Title 6 of the Official Compilation of New York Codes, Rules and Regulations (6 NYCRR Part 375-6).

The organization of this AAR is presented in Table 1-2.

Table 1-2. Report Organization

Section	Purpose
Section 1 - Introduction	Presents the purpose and objective of the AAR. In addition, describes the properties that comprise OU-1 and the site and their physical characteristics, and summarizes the site history and the nature and extent of impacts based on results of previous environmental investigations.
Section 2 – Identification of Potential Standards, Criteria and Guidelines	Identifies the standards, criteria and guidelines (SCGs) that govern the development and selection of remedial alternatives for OU-1.
Section 3 – Development of Remedial Action Objectives	Summarizes the conclusions from the qualitative human health exposure assessment conducted for the site and presents RAOs for OU-1 that are protective of human health and the environment.
Section 4 – Technology Screening and Development of Remedial Alternatives	Identifies and screens the General Response Actions (GRAs) and remedial technology types and process options by medium. Potential remedial alternatives by medium that meet the OU-1 RAOs are listed based on results of the screening.
Section 5 – Detailed Evaluation of Remedial Alternatives	Describes the criteria used to evaluate the remedial alternatives, and describes and evaluates each potential remedial alternative.
Section 6 – Comparative Analysis of Remedial Alternatives	Presents a comparative analysis of each of the remedial alternatives.
Section 7 – Preferred Remedial Alternative	Identifies the recommended remedial alternative for OU-1.
Section 8 – References	Lists the references cited in this AAR.

1.3 Background Information

This section summarizes site background information relevant to the development and evaluation of remedial alternatives, including site location and physical setting, site history, a summary of previous investigations, and the overall site characteristics including the nature and extent of MGP-related impacts.

1.3.1 Site Location and Physical Setting

The site (i.e., operable units OU-1, OU-2, OU-3, and OU-4) is located on the lower east side section of the Borough of Manhattan in New York City, New York. As described in Section 1.1, OU-1, the focus of this AAR, is bounded by the north side of the extension of East 13th Street to the north, the north side of East 11th Street to the south, the west side of the FDR to the east, and the east side of Avenue D to the west.

The two properties within OU-1 are zoned as a residential district (R7-2) by the New York City Planning Commission and include land uses designated as multilevel elevator residential buildings, transportation and utility use, and public facilities and institutions. Each property included within OU-1 is described below:

- **Block 367 Lot 1 – Jacob Riis Houses**. The Jacob Riis Houses complex was completed in 1949, is owned by the New York City Housing Authority (NYCHA) and consists of 19 multistory residential buildings. The portion of the Jacob Riis complex that is located within OU-1 includes five multistory brick apartment buildings known as Building No. 2 (170 Avenue D), Building No.3 (178 Avenue D), Building No.4 (1223 and 1225 FDR Drive), Building No.5 (1141 FDR Drive) and Building No.6 (1115 FDR Drive) (Figure 1-2). While the New York City Housing Authority indicates that Building No. 4 is currently assigned two street addresses, for the purpose of this AAR, and to maintain consistency with historical reporting and ease of reference, Building No. 4 is referred to as located at 1223 FDR Drive. Landscaped areas and a recreational area consisting of a basketball court, playground equipment and several park benches exist in the center of the complex. None of the buildings within OU-1 have below grade basement levels. Buildings 3 and 5 have utility rooms on the first floor with concrete floors, as well as crawl spaces with earthen floors. Buildings 2, 4, and 6 have utility rooms with concrete floors and storage rooms with earthen floors.
- **Block 367 Lot 25 – Manhattan Pump Station**. The Manhattan Pump Station (also known as the East 13th Street Pump Station) is owned and operated by the New York City Department of Environmental Protection (NYCDEP). The pump station was constructed during the 1960s, was recently upgraded and consists of a one-story brick building with a parking area on the north side of the building and a vertical surge tank on the east side of the building.

For completeness, properties that are adjacent to OU-1 are described below:

- **Block 382 Lot 22 – Church of St. Emeric (OU-3)**. The St. Emeric's Property includes The Church of St. Emeric (St. Emeric's), a multistory school building with a basement, a playground area along Avenue D, a corrugated metal Quonset hut-like structure, a small shed, a paved parking lot area and a landscaped garden area. The multistory school is currently occupied by the Escuela Hispana Montessori School and is used for parish offices, daycare and a Head Start Facility.

  The school building was built in 1953 as the St. Emeric's School (a parochial elementary school). Portions of the foundation of the gas holder that was formerly located on the property are visible in the school building's basement. An asphalt parking lot is located to the north and west of the school. A recently constructed play area is located along Avenue D between the school building and East 13th Street. The property is surrounded by a chain link fence.
- **Block 382 Lot 1 – Haven Plaza (OU-4)**. Block 382 Lot 1 consists of six buildings, portions of three of which are located within OU-4:
  - Three Haven Plaza, a 15-story residential apartment building

- o The eastern end of a one-story brick parking garage attached to Three Haven Plaza
- o The eastern end of a two-story brick building with approximately 22 studio apartments located north of the parking garage

In addition, properties that are adjacent to OU-1 and included within OU-2 are described below:

- **East River Park and FDR Drive**. The portion of East River Park that was part of the Works extends from approximately 200 feet north of East 10th Street (the former location of East 11th Street) to the northern boundary of present day Block 316 Lot 114. Historical maps indicate that no MGP-related structures except for a coal shed (circa 1868) were present on this portion of the grounds of the Works. However, the portion of East River Park that is currently included in OU-2 is defined to the south by the extent of MGP-related impacts identified during investigation activities. Therefore, the southern extent of OU-2 extends to the approximate extension of East 5th Street (approximately 1,200 feet south of East 10th Street). The portion of FDR Drive adjacent to the west side of East River Park is also included in OU-2.
- **East River**. The East River is a tidal strait and has no direct input of freshwater (i.e., via tributaries). The historical shoreline of the East River was located along the south side of East 13th Street and west of the FDR, between the FDR and Avenue D. Areas north of East 13th Street and east of Avenue D were under water prior to being filled (Baskerville 1994). The approximate location of the original shoreline is shown on Figure 1-3. Historical maps indicate that at least two piers were located on the East River adjacent to OU-1.

Each of the above listed properties is also described in the Remedial Investigation Report, East 11th Street Works Site (RI Report; BBL, an ARCADIS company[1] 2007).

1.3.2 Historical MGP Operations

Based on historical information, the Works began operations sometime between 1859 and 1868, and was shut down in approximately 1933. During this operational period, the Works consisted of 17 gas holders ranging in capacity from approximately 50,000 cubic feet (cf) to 5,000,000 cf. Several of the gas holders were converted from gas storage to liquid storage of naphtha, tar or gas oil. The original gas holders built during the late 1800s were most likely constructed with below grade bottoms. Many of these were replaced by large gas holders built on grade, with storage capacities greater than 1,000,000 cf of gas. Other production and storage facilities that were present during the operational life of the Works included:

- Retorts
- Fuel/gas oil tanks
- Tar separators
- Purifying houses

[1] As Blasland, Bouck & Lee, Inc. (BBL) was integrated into ARCADIS, the BBL name changed from "BBL" (through 2006) to "BBL, an ARCADIS company" (2007) to "ARCADIS BBL" (2008), and eventually to "ARCADIS" in 2009. Work on this project was performed under all of these names during the transition to ARCADIS.

- Condensers
- Scrubbers

The initial gas manufacturing process and construction details of the early gas holders could not be determined with certainty from available historical information; however, based on the processes available at the time of construction, the coal carbonization process is assumed to have been originally used. Based on information from the New York Public Service Commission (PSC) Report for 1907, gas manufacturing using the Lowe Carbureted Water Gas process began at the Works in December 1903 and was used exclusively until at least December 31, 1905, and possibly as late as 1915. The historical information reviewed does not indicate the gas manufacturing process used after this time until the Works were retired in 1933.

1.3.3 Summary of Previous Investigations

Multiple investigations have been conducted at the site (i.e., OU-1, OU-2, OU-3, and OU-4). This section identifies those investigations that included investigations on the OU-1 properties, and presents a summary of the results specific to the OU-1 study area. Previous investigations meeting those criteria include the following:

- Indoor air quality and soil gas study completed in 2003
- SCS completed in 2004
- Remedial investigation (RI) completed in 2006 and 2007
- Groundwater gauging and sampling event conducted in February 2008
- Annual Interim Site Monitoring Plan (ISMP) indoor air monitoring conducted in 2010, 2011, 2013, and 2019

Summaries of the work completed during each of the above-listed investigations are presented below. A key finding of the studies is the extensive presence of below grade obstructions throughout the eastern portion of the site, including foundation walls and old piles. In addition, obstructions that appear to be historical piers, bulkhead structures or cribbing are also present on the eastern portion of the site. Accordingly, the presence of below grade obstructions must be considered when evaluating potential remedial alternatives.

1.3.3.1 Indoor Air Quality and Soil Gas Study

Prior to the SCS, the RETEC Group (RETEC) conducted an indoor air quality and soil gas sampling event in October 2003 for Con Edison at the Jacob Riis Property. Results of this study were presented in a separate report (RETEC, 2004) prepared for Con Edison and previously submitted to the NYSDEC.

The NYSDEC and NYSDOH requested that until a remedy for OU-1 is implemented, or it is determined that no additional monitoring is necessary, that periodic monitoring of indoor air be conducted. As a result of that request, an Interim Site Management Plan for Indoor Air Monitoring (ARCADIS, 2009) (ISMP for Indoor Air) was developed as a component of a comprehensive management plan that is being developed to ensure that the public and the environment are protected until a final remedy for OU-1 is implemented. The indoor air monitoring associated with the ISMP is presented in Section 1.3.3.5 below.

1.3.3.2 Site Characterization Study

The objectives of the SCS, as stated in the Work Plan for Site Characterization Study (Langan, 2002), were to:

- Confirm the presence or absence of remnant historical MGP structures
- Determine the presence or absence of residual MGP waste materials/impacts
- Identify the presence of contaminant impacts resulting from non-MGP sources

The SCS included installing soil borings and test trenches, and collecting surface soil and groundwater samples at the Jacob Riis Property; and installing soil borings and test trenches, and collecting groundwater samples at the St. Emeric's Property. Results from the SCS were presented in the Site Characterization Study Report for the Former East 11th Street Works (TRC 2005). Access to the Haven Plaza property was not obtained before the site characterization was completed; therefore, this property was not investigated as part of the SCS.

1.3.3.3 Remedial Investigation

BBL conducted an RI at the site between June 2006 and March 2007. The objectives of the RI were to:

- Delineate the horizontal and vertical extent of residual MGP waste materials/ impacts in soil and groundwater identified during the SCS
- Determine the extent and continuity of oil-like material (OLM) and tar-like material (TLM) identified during the SCS in the eastern portion of the Jacob Riis Property
- Determine the presence and locations of contaminant levels that pose potential risks to human health and/or the environment
- Collect sufficient data to develop a proposed site remediation strategy, if necessary

BBL completed the following specific activities as part of the RI to meet these objectives:

- Subsurface soil investigation
- Groundwater investigation
- Field survey
- Indoor air sampling
- Soil vapor sampling
- Chemical analysis of collected soil, groundwater and vapor samples

The results from the RI were presented in the RI Report (BBL, an ARCADIS Company 2007).

1.3.3.4 Groundwater Gauging and Sampling Event

ARCADIS BBL conducted a groundwater sampling event at the site from February 13, 2008 through February 15, 2008. The groundwater sampling event included the following activities:

- Groundwater-level measurements and non-aqueous phase liquid (NAPL) gauging from 27 wells installed during the SCS and RI
- Sampling of groundwater from 12 of 14 wells located on the Jacob Riis Property

Results from the groundwater gauging and sampling event were presented to Con Edison in the *Groundwater Sampling Event at Jacob Riis* letter report (ARCADIS, 2008).

1.3.3.5 ISMP Indoor Air Monitoring

Through June 2020, four indoor air monitoring events have been conducted at the Jacob Riis property on behalf of Con Edison. Each of the monitoring events were conducted in accordance with the ISMP for Indoor Air (ARCADIS, 2009). As stated above, the ISMP for Indoor Air is a component of a comprehensive management plan that is being developed to ensure that the public and the environment are protected until a final remedy for OU-1 is implemented.

The first monitoring event was conducted from March – April 2010 and included five buildings located in the Jacob Riis Housing development. Each of the following three monitoring events also included the same five buildings located in the Jacob Riis Housing development, and were conducted in February 2011, March 2013, and October/November 2019. Pre-monitoring walk-through visual inspections and chemical inventories were conducted concurrent with indoor air monitoring during both events. Results from the monitoring events were presented in the following reports:

- *Interim Site Management Plan – Annual Indoor Air Monitoring Report (ARCADIS, 2010)*
- *Interim Site Management Plan – Annual Indoor Air Monitoring Report (ARCADIS, 2011)*
- *Interim Site Management Plan – Annual Indoor Air Monitoring Report (ARCADIS, 2013)*
- *Interim Site Management Plan – Annual Indoor Air Monitoring Report (ARCADIS, 2019)*

1.4 Site Characterization

This section presents summary descriptions of the overall characterization of OU-1 based on the investigations conducted to date (as listed in Section 1.3.3). The characterization consists of a summary of the geology, hydrogeology and nature and extent of impacts within OU-1, along with descriptions of the regional geology and hydrogeology.

1.4.1 Geology

1.4.1.1 Regional Geological Setting

Bedrock beneath the site is gneiss of the Ravenswood Unit (Baskerville 1994), located at least 90 feet below ground surface (bgs). None of the soil borings completed during the SCS or RI were installed to a depth that encountered bedrock.

Overburden materials in the area of the site include — from the surface downward — fill, alluvium, and glacial deposits. The fill material reportedly consists of typical urban debris including reworked gravel, sand

and clay, as well as various types of anthropogenic material such as concrete, brick, ash, cinder and glass. The alluvium and glacial deposits consist of interbedded well-sorted gravel, sand, silt and clay.

Most of the fill materials in the site vicinity were placed during the 19th and early 20th centuries, when the river was filled to extend the usable land surface eastward. The river was filled in by constructing timber cribbing and filling with cinders, ash and spoils from construction sites. As stated above, the historical Manhattan shoreline was located south of East 13th Street and west of the FDR (east of Avenue D). Areas north of East 13th Street and east of Avenue D were under water prior to being filled (Baskerville 1994). This was confirmed by historical Perris & Browne maps and Sanborn Fire Insurance maps reviewed by BBL during the RI. The bulkhead in the 1850s ran along the west side of Avenue D, inland from the original shoreline. By 1879, the shoreline had been extended east of the current location of FDR Drive. In 1920, the bulkhead extended even farther into the East River in some locations, while in the northern portion of the site the 1920 bulkhead was inland when compared to the 1879 shoreline. The historical location of the East River shoreline is shown on Figure 1-3.

Groundwater is typically first encountered in the fill or alluvial deposits.

1.4.1.2 OU-1 Geology

Three stratigraphic units were encountered during the site investigations: Fill Unit, Sand-Silt Unit and Silty-Clay Unit. The Fill Unit is the uppermost unit encountered and the top of the unit represents the present-day surface of the site. The Fill Unit is underlain by the Sand-Silt Unit, which is underlain by the Silty-Clay Unit. Figure 1-4 (Site Geology) depicts these units on two 3-dimensional cross-sections that run east-west and north-south, respectively. In addition to Figure 1-4, additional generalized cross sections for the site are presented in the RI Report (BBL, an ARCADIS company 2007).

Each of the stratigraphic units encountered at the site are described in further detail below:

- **Fill Unit**. This unit comprises materials typically found in urban environments such as Manhattan (urban fill). The Fill Unit consists of historical fill including cribbing (brick, cinders, ash and wood) intermingled with undifferentiated brown to black sand, cobbles, gravel and silt. The thickness of the Fill Unit ranges from 7 to 30 feet. The thickness of this unit generally increases from west to east, consistent with the progressive extension of the East River shoreline during the 19th and early 20th centuries. A maximum thickness of 30 feet was observed in the northeastern portion of the site. A key finding of the subsurface investigations is the extensive presence of obstructions below grade throughout the site, including old piles. In addition, obstructions that appeared to be an historical pier, bulkhead structures, and/or cribbing were also present on the eastern half of the site (Figure 1-3). Accordingly, the presence of below grade obstructions must be considered when evaluating potential remedial alternatives.

- **Sand-Silt Unit**. This unit underlies the Fill Unit and consists of fine to medium sand with silt and clay lenses, and trace gravel lenses. Organic material and shell fragments were also observed in the Sand-Silt Unit, pointing to the inferred alluvial origin of this unit. The Sand-Silt Unit is laterally continuous beneath the site and varies in thickness from 10 to 35 feet. In general, the Sand-Silt Unit thickens from east to west.

- **Silty-Clay Unit**. This unit underlies the Sand-Silt Unit and consists of variably colored silt and clay with trace fine sand. The Silty-Clay Unit was encountered in most soil borings completed during the RI that were located on the Jacob Riis property, with the exception of borings MW-107B, SB-108 and SB-109, located on the northern edge of the Jacob Riis Property. The thickness of the Silty-Clay Unit beneath OU-1 is unknown. Elevation contours were generated using all soil borings that were advanced to the Silty-Clay Unit during the SCS and RI. The Silty-Clay Unit is shallowest in the area beneath Jacob Riis buildings No. 2 and 3. In this area, the depth to the Silty-Clay Unit is approximately 25 feet bgs. The depth to the Silt-Clay Unit increases to the north and toward the East River.

1.4.2 Hydrogeology

Based on lithologic properties, the Fill and Sand-Silt Units appear to be permeable units whereas the Silty-Clay Unit appears to be semi-confining to groundwater. In most soil borings completed during the SCS and RI across OU-1, saturated soil conditions were first encountered in the Fill Unit and as such, the Fill Unit along with the Sand-Silt Unit represents a shallow unconfined aquifer (or water table aquifer).

Shallow groundwater appears to flow in a radial pattern from a groundwater mound centered in the western vicinity of the Jacob Riis Property. Groundwater contours from gauging events conducted in 2004, 2006 and 2007 each exhibited this radial pattern (roughly centered around MW-2, MW-115A and MW-121A). The groundwater flow pattern in the water table aquifer mimics the top of the Silty-Clay Unit elevations. Horizontal hydraulic gradients in the water table range from 0.01 to 0.004 foot/foot north of MW-115A. The RI Report (BBL, an ARCADIS company 2007) indicated that both downward and upward vertical hydraulic gradients exist at the site. The greatest downward vertical gradient was measured between MW-121A and MW-121B (located on the Jacob Riis Property), which indicates an area of recharge.

Surface-water elevations in the East River in the area of the site are influenced by tides. According to the National Oceanic and Atmospheric Administration (NOAA), the mean tidal range at the Williamsburg Bridge (NOAA station no. 8518687), located approximately 0.6 miles south of the site, is 4.2 feet. Water elevations based on North American Vertical Datum (NAVD) typically range from 2 feet to -2 feet above mean sea level (amsl).

1.4.3 Nature and Extent of Impacts

This section describes the nature and extent of impacts identified within OU-1. Both petroleum- and MGP-related impacts were observed during the SCS and the RI. Subsurface impacts included odors, staining, sheens, OLM and TLM. For this AAR, OLM is used to denote visible impact that may be of petroleum or MGP origin and that has an apparent viscosity similar to oil, while TLM is used to denote black, highly viscous material (including material that appears to be solid) that is likely of MGP origin.

1.4.3.1 NAPL Extent

Sheens, OLM and TLM were only observed within the Fill and Sand-Silt units, with the majority of impacts occurring in the Fill Unit. The approximate distribution of NAPL (including OLM and TLM) beneath OU-1 is depicted on Figure 1-5. This 3-dimensional model of NAPL distribution was developed using the descriptions of visual impacts recorded on soil boring logs to construct a database of the locations of observed NAPL collected during the site investigations. The figure shows that the majority of observed NAPL impacts are concentrated in the eastern half of the Jacob Riis Property. The greatest measured NAPL thickness in a monitoring well was observed in well MW-5 (1.6 feet), located in the southeastern portion of the Jacob Riis Property. OLM or TLM was not observed in the Silty-Clay Unit. Sheens, OLM and

TLM were not observed in the Silty-Clay Unit, suggesting that the Silty-Clay Unit acts as a confining layer to the downward migration of NAPL.

Field observations of sheen, OLM and TLM documented during soil boring installation associated with the SCS and RI are summarized in Table 1-3.

Hydraulic influences, such as tidal fluctuations and hydraulic gradients, may be affecting the distribution of MGP-related NAPL because its density is similar to the density of water. MGP-related NAPLs are typically only slightly denser than water; therefore, NAPL movement can be greatly influenced by hydraulic gradients. The density difference is further reduced when the water quality is brackish or saline, as may be expected in portions of the site closest to the East River.

1.4.3.2 Surface Soil

During the site characterization study conducted in 2004, 58 surface soil samples were collected for laboratory analysis at the Jacob Riis Property. Four of the surface soil samples were collected from the Jacob Riis property earthen storage rooms in #1223 FDR Drive (Building No. 4). In addition, four background surface soil samples were collected from the Jacob Riis property at locations three blocks south of the former gas works. All surface soil samples were collected from the 0 to 0.2 foot bgs interval. Data were compared to 6 NYCRR Part 375 unrestricted use soil cleanup objectives (SCOs; NYSDEC 2006). These SCOs represent the most conservative (i.e., most protective) values of the human health, groundwater and ecological SCOs.

This AAR also compares surface soil data to the Manhattan background data presented in the Characterization of Soil Background PAH and Metal Concentrations, Manhattan, New York report (Manhattan Background Report; RETEC 2007). This study of background concentrations of polycyclic aromatic hydrocarbons (PAHs) and metals in Manhattan soils was conducted because more than 400 years of human activity in New York City has resulted in the widespread presence of PAHs and metals in surface soil. PAHs are ubiquitous in the environment and are formed during the incomplete combustion of wood, garbage, coal, oil, gas, gasoline and diesel fuels, and other organic substances such as tobacco and charbroiled foods. Many trace metals, including those commonly associated with human activities such as zinc, copper, chromium, selenium and lead, are also naturally present in the minerals that make up soil and fill materials. The results of several studies indicated that urban background PAH and metals concentrations in soil may exceed the NYSDEC unrestricted use SCOs. Therefore, a dataset of background PAH and metal concentrations specific to Manhattan was established to accurately evaluate the potential impact of historical gas manufacturing operations on surface and subsurface soil at Con Edison’s MGP sites. This study was developed to compliment the state-wide Survey to Describe Concentration Ranges for Selected Analytes in Rural New York State Surface Soils conducted jointly by the NYSDEC and the New York State Department of Health (NYSDOH).

The nature and extent of impacts within surface soil at OU-1 is summarized below:

1.4.3.2.1 VOCs

Fifteen surface soil samples were analyzed for volatile organic compounds (VOCs). VOCs were not detected in 13 of the 15 samples. Where detected, the VOCs were present at concentrations below the unrestricted use SCOs.

1.4.3.2.2 SVOCs

Thirty-three surface soil samples were analyzed for semi-volatile organic compounds (SVOCs). SVOCs, including PAH compounds, were detected at concentrations above the unrestricted use SCO on the Jacob Riis property. PAHs represent the highest concentrations of SVOCs detected. Eight PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, benzo(k)fluoranthene, fluoranthene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene were detected at concentrations above unrestricted use SCOs. The highest concentrations of PAHs appear to be located at discrete locations on the eastern portion of OU-1 (eastern portion of the Jacob Riis property) and appear to be located in the vicinity of former MGP structures (specifically the former gas holder #7, tar separator, fuel oil and tar storage tanks, and engine room). Data presented in the Manhattan Background Report (RETEC 2007) indicates that six of these eight PAHs were typically found in Manhattan background surface soil at concentrations above the unrestricted use SCOs (all except fluoranthene and dibenz(a,h)anthracene).

Similarly, four background surface soil samples exhibited exceedances of unrestricted use SCOs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, benzo(k)fluoranthene, and dibenz(a,h)anthracene. A comparison performed using statistical analysis (Kruskal-Wallace ANOVA on Ranks) indicated that the differences between the site and background surface soil SVOCs were not statistically significant, and SVOCs in site surface soils are attributable to background (TRC, 2005).

1.4.3.2.3 Inorganics

Arsenic, barium, chromium, lead and mercury were detected in each surface soil sample analyzed. The maximum arsenic concentration of 54.4 parts per million (ppm) was observed in sample SS-13. Maximum concentrations of chromium and lead were found in samples SS-2 (50.3 ppm) and SS-3 (2,640 ppm), respectively, which are located in the northeast section of the Jacob Riis Property. Sample SS-17, which is located in the southeast section of the Jacob Riis Property, had the highest mercury concentration (1.2 ppm). The surface soil concentration of chromium, lead and mercury exceeded the unrestricted use SCO in each surface soil sample analyzed; however, the detected concentrations were all below the reported average Manhattan background concentrations with the exception of lead at SS-3 and SS-5 (located in the northeast section of the Jacob Riis Property).

In addition, select soil samples (SS-5, SS-10 and SS-17) contained silver at concentrations above their respective unrestricted use SCO and Manhattan background concentrations; however, concentrations were similar to the concentrations of silver detected in the project-specific background samples.

The concentrations of inorganics detected in the surface soil are consistent with the concentrations of inorganics detected in subsurface soil. Therefore, the presence of inorganics in the surface soil at concentrations above unrestricted use SCOs is likely associated with historical fill and is consistent with urban background concentrations. These inorganics are not attributed to former MGP operations at the site.

1.4.3.2.4 PCBs

Fifteen surface soil samples were analyzed for polychlorinated biphenyls (PCBs). PCBs were not detected at concentrations above the associated laboratory detection limit in 14 of the 15 samples. Only one PCB analyte (Aroclor-1260) was detected in one sample; however, it was detected at a concentration below the unrestricted use SCO.

1.4.3.3 Subsurface Soil

The evaluation of environmental conditions in subsurface soil is based on 22 test trench soil samples and 148 subsurface soil samples collected during the SCS and the RI. The nature and extent of impacts within subsurface soil at the site is summarized below. As stated above, during the soil investigation activities, extensive historical subsurface obstructions were noted throughout the site.

1.4.3.3.1 VOCs

Analytical results for VOCs indicate that benzene and xylene were detected at the highest frequencies (detected in approximately 50 and 57 percent of the samples analyzed, respectively). Ethylbenzene, isopropylbenzene, and toluene were each detected in approximately 32 to 40 percent of the samples analyzed. While benzene and xylenes were detected most frequently, xylenes and ethylbenzene, and 1,3,5-trimethylbenzene were detected in the highest relative concentrations.

Figure 1-6 provides 3-dimensional views of the distribution of total benzene, toluene, ethylbenzene and xylene (BTEX) concentrations within OU-1. Total BTEX concentrations greater than 10 ppm (reference concentration for discussion purposes only) were generally detected below the groundwater throughout the northeast portion of the Jacob Riis Property, at depths ranging from 5 to 32 feet bgs. Total BTEX concentrations greater than 1,000 ppm were limited to the northeastern portion of the Jacob Riis Property within the Fill and Sand-Silt units at depths ranging from 17 to 47 feet bgs. Total BTEX concentrations greater than 10 ppm were generally found in the northern half of the Jacob Riis property. In general, when comparing Figure 1-5 to Figure 1-6, BTEX concentrations greater than 10 ppm correlate with the presence of OLM and TLM on the site.

1.4.3.3.2 SVOCs

Analytical results for SVOCs in subsurface soil indicated that each of the PAH analytes, with the exception of dibenz(a,h)anthracene, were detected in at approximately 65 percent of the subsurface soil samples. The concentration of individual PAH compounds ranged seven orders of magnitude from less than 0.1 ppm to more than 10,000 ppm. Each of the PAH compounds were detected at concentrations above their respective unrestricted use SCO, ranging from benzo(g,h,i)perylene (detected in approximately 1 percent of the samples at concentrations exceeding unrestricted use SCO) to Benzo(a)anthracene and chrysene (detected in approximately 38 percent of samples at concentrations exceeding their unrestricted use SCOs).

Two 3-dimensional views of the distribution of total PAH concentrations greater than 500 ppm (reference concentration for discussion purposes only) are presented on Figure 1-7. Total PAH concentrations greater than 500 ppm were present below the groundwater (i.e., within the saturated zone) throughout the northeast portion of the Jacob Riis property. The distribution of individual PAHs at concentrations greater than their respective unrestricted use SCO appear to be limited to the upper 37 feet of the subsurface soil (i.e., above the Silty-Clay Unit).

Similar to the distribution of VOCs in subsurface soil, total PAHs greater than 500 ppm typically occurred on the Jacob Riis property in the 15- to 35-foot subsurface soil horizon. Subsurface soil samples collected below 35 feet bgs typically contained individual PAH concentrations less than their respective unrestricted use SCO, and total PAH concentrations less than 10 ppm.

Consistent with the distribution of VOCs, total PAHs greater than 500 ppm generally correlate with the presence of OLM and TLM. Figure 1-8 also presents the distribution of PAHs greater than 500 ppm along with the locations of visible NAPL.

1.4.3.3.3 Inorganics

In general, inorganic metals present throughout the Jacob Riis property are above their respective SCO throughout the subsurface. Based on the Manhattan Background Report (RETEC, 2007), approximately 50 percent of the metals present in general Manhattan subsurface soil are present above unrestricted use SCOs. Consistent with the surface soil sample results, the inorganics detected in subsurface soil samples are generally attributed to historical fill materials and do not appear to be related to historical MGP operations.

1.4.3.3.4 PCBs

PCBs were not detected in subsurface soil samples at concentrations above the unrestricted use SCO.

1.4.3.4 Groundwater

The RI Report (BBL, an ARCADIS Company 2007) characterized the nature and extent of groundwater impacts at the site by comparing analytical results obtained during three groundwater sampling events (October 2004, August 2006 and March 2007) to NYSDEC's Class GA Groundwater Standards (Technical and Operational Guidance Series [TOGS] 1.1.1 Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations [NYSDEC, 1998]). The discussion of groundwater presented below includes results from one additional groundwater sampling event conducted in February 2008. For ease of understanding, and because groundwater generally flows from OU-1 to OU-2, the nature and extent of impacts in groundwater beneath the entire site (including the Haven Plaza and St. Emeric's properties) is summarized below.

1.4.3.4.1 VOCs

Analytical results indicate the BTEX compounds and other select VOCs were detected in at least one groundwater sample from the site; the majority of groundwater samples analyzed (29 of the 35 groundwater samples) contained at least one VOC analyte. Benzene was the most prevalent VOC, detected in 20 out of 35 groundwater samples above the Glass GA Groundwater Standard. Other VOCs detected in at least 50 percent of the groundwater samples included toluene, ethylbenzene, xylenes, 1,2-4-trimethylbenzene and isopropylbenzene.

The following VOCs were detected in groundwater at concentrations above their Class GA Groundwater Standard (maximum concentrations are noted): 1,2,4-trimethylbenzene (150 parts per billion [ppb]), 1,3,5-trimethylbenzene (12 ppb), benzene (7,900 ppb), chloroform (8.7 ppb), ethylbenzene (2,900 ppb), isopropylbenzene (70 ppb), toluene (9,300 ppb) and xylenes (3,900 ppb).

In general, VOC concentrations in the deeper screened "B"-designated monitoring wells were greater than the VOC concentrations in the shallow "A"-designated monitoring wells. This is consistent with the distribution of soil impacts in which the greatest impacts were identified in the zones where the "B" wells are screened. In addition, the distribution of VOCs in groundwater appears to be more related to the presence of isolated residual impacts (TLM/OLM) than to a well-defined groundwater plume that has developed as a result of groundwater transport.

The southern extent of the dissolved VOC plume appears to be delineated by monitoring wells MW-122A, MW-122B, MW-121A, MW-121B, MW-125A and MW-125. During the February 2008 sampling event, VOCs were not detected above groundwater standards in any of these wells. The western extent of the dissolved VOC plume does not appear to be delineated. During the February 2008 sampling event, groundwater collected from monitoring well MW-115A contained concentrations of BTEX above groundwater standards. Concentrations of total BTEX at this location increased from 107.9 micrograms per liter (µg/L) to 367 µg/L from the August 2006 to the February 2008 sampling event. The northern extent of VOCs in shallow groundwater appears to be delineated by MW-107A (screened from 6 to 16 feet bgs); no VOC analytes were detected at this location during the February 2008 sampling event. However, the extent of VOCs in deep groundwater does not appear to be delineated to the north; BTEX was detected above groundwater standards at a concentration of 1,307 µg/L at MW-107B (screened from approximately 29 to 32 feet bgs). The concentration of benzene increased within this well from 360 µg/L to 1,200 µg/L from August 2006 to the February 2008 sampling event.

Sufficient information regarding the extent of the dissolved VOC plume exists to evaluate potential remedial alternatives for this AAR; additional delineation of the western extent of the VOC plume will be conducted during implementation of the groundwater remedial alternative.

1.4.3.4.2 SVOCs

SVOC analytical results for groundwater samples indicated that most of the PAH analytes (including acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene) were detected in at least one groundwater sample. Acenaphthene, naphthalene and fluorene were detected in more than 50 percent of the groundwater samples. Similar to the distribution of VOCs presented above, the distribution of SVOCs appears to be more related to the presence of isolated residual impacts (TLM/OLM) than to a well-defined groundwater plume that has developed as a result of groundwater transport.

Similar to the dissolved VOC plume, the southern extent of the dissolved PAH plume appears to be delineated by monitoring wells MW-122A, MW-122B, MW-121A, MW-121B, MW-125A and MW-125. During the February 2008 sampling event, PAHs were not detected above groundwater standards in any of these wells. The western extent of the dissolved SVOC plume also appears to be delineated. Groundwater collected from monitoring well MW-115A during the February 2008 sampling event contained only phenol at a concentration above groundwater standards. The northern extent of SVOCs in shallow groundwater appears to be delineated by MW-107A; no SVOC analytes were detected during the February 2008 sampling event. However, the extent of SVOCs in deep groundwater does not appear to be delineated to the north; several SVOC analytes (2,4-dimethylphenol, acenaphthene, naphthalene and phenol) were detected above groundwater standards at MW-107B. The concentration of SVOCs decreased within this well from 692 µg/L in August 2006 to 426 µg/L in the February 2008 sampling event.

Sufficient information regarding the extent of the dissolved SVOC plume exists to evaluate potential remedial alternatives for this AAR.

1.4.3.4.3 Inorganics

Based on the February 2008 sampling event, analytical results indicate that nickel, arsenic, cyanide, copper, cadmium, zinc, chromium, lead and selenium were detected in at least one of the groundwater samples collected. Copper, lead and selenium were the only inorganic analytes detected above their respective Class GA standard; copper and lead were each detected in one well above groundwater standards, and selenium was detected in two wells above its groundwater standard. The presence of inorganics in groundwater is not attributed to former MGP operations, but rather to the prevalence of historical fill in the site vicinity.

1.4.3.5 Indoor Air and Soil Vapor Sampling

Indoor air and soil vapor samples were collected as part of the SCS and RI to determine if a complete transport pathway of MGP-related VOCs exists from soil gas and/or sub-slab vapor to indoor air. In addition, four indoor air monitoring events were conducted within OU-1 in accordance with the ISMP for Indoor Air (ARCADIS, 2009).

RETEC conducted an indoor air sampling event at the Jacob Riis Property in 2003. Results of that sampling event indicated that the quality of indoor air within the apartment buildings located on the former MGP section of the Jacob Riis Property did not appear to be impacted by MGP-related vapors (RETEC 2003).

Indoor air and sub-slab vapor samples were also collected in 2007 during the RI from accessible portions of the basements at the Jacob Riis property. Indoor air sample results were compared to ambient air, soil gas and sub-slab vapor results, as well as the 75th percentile, 90th percentile and Upper Fence (Upper F) criteria of the NYSDOH Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes (NYSDOH 2005). The indoor air samples were collected in buildings that are not heated by fuel oil; however, the 2005 NYSDOH guidance states “the Upper Fence values from the NYSDOH Fuel Oil Study data may be used as initial benchmarks when evaluating residential indoor air.”

The RI indicated that MGP-related compounds (including BTEX and naphthalene) were detected in indoor air, as well as soil vapor and sub-slab samples at the Jacob Riis property. Indoor air sample concentrations were compared to the NYSDOH background data for indoor air. All BTEX concentrations were below the NYSDOH Upper F background criteria. In addition, all but one ethylbenzene concentration and one m,p-xylene concentration was below the respective 75th percentile background concentration. Based on these results, the RI report concluded that indoor air did not appear to be impacted by MGP-related vapors.

The Interim Site Management Plan for Indoor Air Monitoring (ARCADIS 2009) was prepared as part of a comprehensive management plan that is being developed for OU-1 to protect the public and the environment until a final remedy is implemented. While previous indoor air monitoring has determined that there did not appear to be MGP-related impacts to indoor air from the MGP residuals, the NYSDEC and NYSDOH requested that until a site remedy is implemented, or it is determined that no additional monitoring is necessary, that Con Edison conduct periodic monitoring of indoor air within OU-1. The ISMP presents the scope of work required to collect indoor air samples on an annual basis, and the evaluation and reporting requirements. As presented above, the four monitoring events conducted in five buildings of the Jacob Riis housing development were completed in March/April 2010, February 2011, March 2013, and October/November 2019. Pre-monitoring walk-through visual inspections and chemical inventories were conducted concurrent with indoor air monitoring during both events. Each of the associated reports concluded that no evidence of MGP-related indoor air impacts existed within the areas monitored.

2 IDENTIFICATION OF POTENTIAL STANDARDS, CRITERIA, AND GUIDELINES

This AAR was prepared in general conformance with the applicable guidelines, criteria and considerations set forth in the following NYSDEC guidance, criteria and regulations:

- DER-10 – Technical Guidance for Site Investigation and Remediation, dated May 2010
- 6 NYCRR Part 375 Environmental Remediation Programs

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

2.1 Definition of Standards, Criteria, and Guidelines

"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.

"Guidelines" are 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]).

Standards, criteria and guidelines 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 Guidelines

The NYSDEC has established guidance on the application of SCGs during the feasibility study process. SCGs will be progressively identified on a site-specific basis as the AAR proceeds. The potential SCGs considered in this AAR were categorized into the following NYSDEC-recommended classifications:

- **Chemical-Specific SCGs**. These SCGs are usually health- or risk-based numerical values or methodologies, which, when applied to site-specific conditions, result in the establishment of numerical values for each concentration of constituents of potential concern (COPCs). These values establish the acceptable amount or COC that may be found in, or discharged to, the ambient environment.
- **Action-Specific SCGs**. These SCGs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous waste management and site cleanup.
- **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.

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. While all SCGs are considered during the evaluation of potential remedial alternatives, emphasis is generally placed on chemical-specific

SCGs. As such, for the purposes of this AAR, action-specific and location-specific SCGs will not be discussed in as much detail for each potential remedial alternative unless they make the alternative less (or more) attractive.

2.3 Standards, Criteria, and Guidelines

The SCGs identified for the evaluation of remedial alternatives are presented in Tables 2-1, 2-2, and 2-3. The SCGs included in these tables 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 work plan (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/will not be obtained.

2.3.1 Chemical-Specific Standards, Criteria, and Guidelines

The potential chemical-specific SCGs for OU-1 are summarized in Table 2-1. As mentioned above, 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, soil vapor, and groundwater within 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. 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 40 CFR 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 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 (e.g., soil that is excavated and determined to be a hazardous waste) are the 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 for those hazardous wastes on the basis of their waste code characteristics. The UTSs/LDRs also provide a set of numerical criteria at which a hazardous waste is restricted from land disposal.

Groundwater beneath the site is classified as Class GA and, as such, the New York State Groundwater Quality Standards (6 NYCRR Parts 700-705) and ambient water quality standards presented in the NYSDEC's Division of Water, Technical and Operational Guidance Series (TOGS 1.1.1) Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (NYSDEC, reissued June 1998 and addended April 2000 and June 2004) are potentially applicable. These standards identify acceptable levels of constituents in groundwater based on potable use.

The Guidance for Evaluating Soil Vapor Intrusion in the State of New York (NYSDOH, 2006) provides guidance on identifying and addressing current and potential human exposures to contaminated subsurface vapors associated with known or suspected volatile chemical contamination. As previously discussed, the vapor intrusion investigations conducted at the site have indicated that indoor air quality within the buildings located on site did not appear to be impacted by subsurface intrusion of MGP-related vapors.

2.3.2 Action-Specific Standards, Criteria, and Guidelines

Potential action-specific SCGs for this site are summarized in Table 2-2. 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 for site activities (including permitting requirements for on-site treatment systems). Action-specific criteria will be identified for the selected 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), incorporates applicable federal and New York State regulations and requirements pertaining to air emissions, which may be applicable for alternatives that disturb impacted soil or groundwater resulting in air emissions. Community air monitoring may be required in accordance with the NYSDOH Generic Community Air Monitoring Plan. New York Air Quality Standards provides requirements for air emissions (6 NYCRR Parts 257).

6 NYCRR Parts 370-374 and 376 and NYSDEC’s TAGM HWR-4061 (DER-4), Management of Coal Tar Waste and Coal Tar Contaminated Soils and Sediment from Former Manufactured Gas Plants (NYSDEC, 2002a) may be applicable to alternatives that include the disposal of impacted soil. LDRs that regulate the disposal of hazardous wastes may be applicable to alternatives involving the disposal of hazardous waste (if any). MGP-impacted material is only considered a hazardous waste in New York if it is removed (generated) and it exhibits a characteristic of a hazardous waste. However, if the MGP-impacted material only exhibits the hazardous characteristic of toxicity for benzene (D018), it is conditionally exempt from the hazardous waste management requirements. If MGP-related hazardous wastes are destined for land disposal in New York, the state hazardous waste regulations apply, including LDRs and alternative LDR treatment standards for hazardous waste soil.

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 may also apply. These rules include procedures for packaging, labeling, manifesting and transporting hazardous materials and are potentially applicable to the transport of hazardous materials under any remedial alternative. 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). If the selected remedial alternative for OU-1 results in discharges to a publicly owned treatment works (POTW) due to dewatering or other activities, discharge limits must be established with the NYCDEP Bureau of Wastewater Treatment for individual constituents in accordance with New York City sewer discharge influent parameters. Remedial alternatives conducted within OU-1 must comply with applicable requirements outlined under the Occupational Safety and Health Administration (OSHA) general industry standards (29 CFR 1910). These standards 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 site remediation are specified under 29 CFR 1926, and record keeping and reporting-related regulations 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 storing hazardous wastes.

2.3.3 Location-Specific Standards, Criteria, and Guidelines

Potential location-specific SCGs for the site are summarized in Table 2-3. Examples of potential location-specific SCGs include regulations and federal acts concerning activities conducted in floodplains, wetlands, historical areas and activities affecting navigable waters and endangered/threatened or rare species.

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), and local pollution requirements (air and noise).

According to Federal Emergency Management Agency (FEMA) map No. 3604970201F, a majority of the Jacob Riis Housing complex is located within the 100-year flood plain for the East River. Therefore, federal floodplain management laws and regulations are potential SCGs for remedial alternatives that involve excavation or fill within the floodplain. Federal requirements for activities conducted within floodplains are provided in 40 CFR Part 6, Appendix A.

3 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

3.1 General

This section presents the RAOs for impacted media identified within OU-1. These RAOs represent medium-specific goals that are protective of human health and the environment (NYSDEC, 2010). These site-specific RAOs were developed by considering the results of the SCS and RI (specifically the human health exposure assessment [HHEA]) and with reference to potential SCGs identified for the project area, as well as current and foreseeable future anticipated uses of OU-1. These site-specific RAOs address site-specific conditions within OU-1. These RAOs assist in developing goals for cleanup of COPCs in each medium that may require remediation.

This section summarizes results from the HHEA and identifies the RAOs for impacted media within OU-1.

3.2 Exposure Evaluation Summary

A qualitative HHEA was completed as part of the RI. The HHEA was conducted in accordance with NYSDEC/NYSDOH Guidance as presented in Draft DER-10 Technical Guidance for Site Investigation and Remediation (NYSDEC, 2002b) and evaluated the potential for human exposure to MGP residuals at the site (OU-1 and OU-2). Results of the HHEA as it relates to OU-1 are summarized in Section 3.2.1. Results from the HHEA were used to support the development of RAOs, and to develop and evaluate potential remedial alternatives.

3.2.1 Human Health Exposure Assessment

Information regarding current and foreseeable land use and available data for OU-1 was evaluated to identify media-specific COPCs and to assess potentially complete exposure pathways to human receptors. The HHEA defined COPCs as any chemical constituent detected at a concentration greater than a cleanup objective or screening value. Applicable screening criteria for soil included unrestricted use SCOs as presented in 6 NYCRR Part 375. At the time the RI was completed, Manhattan background PAH and metals concentrations were not considered, and therefore were not used as a screening tool when developing COPCs. Generic screening levels for target shallow soil vapor concentrations presented in the Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (USEPA 2002) and United States Department of Labor OSHA permissible exposure limits (PELs) were used for comparison of soil vapor data, and NYSDEC Class GA Groundwater Standards were used as criteria for groundwater data. In general, similar COPCs were identified for each media at the Jacob Riis property, and included:

- Surface soil: PAHs, arsenic, chromium, lead, mercury and silver
- Subsurface soil: BTEX, PAHs and metals
- Groundwater: BTEX, VOCs, PAHs, SVOCs, copper, lead and mercury

Note that when compared to Manhattan background levels of metals in surface soil, chromium, lead, mercury and silver are all within (or below) typical background concentrations and therefore, should not be considered as site COPCs. Similarly, concentrations of metals in subsurface soil were generally within typical Manhattan background concentrations.

Based on current and potential future land uses within OU-1, potential receptor populations at the Jacob Riis property include residents living in the apartment buildings, visitors, recreational users of the playground, on-site personnel including maintenance/commercial workers and construction workers that may work on the property, and workers at the sewage pumping station.

The magnitude of potential exposure to COPCs depends on the type of worker or resident activity, specific areas of the site used in daily activities and frequency and length of time spent at the properties.

The HHEA concluded that:

- **Surface Soil**. For the Jacob Riis property, surface soil represents a potentially complete exposure pathway for the general population (e.g., residents, recreational users, students, workers). However, the presence of vegetation (e.g., grass) likely mitigates the potential for exposure of these receptors to COPCs. COPCs are primarily nonvolatile constituents (i.e., PAHs). Further, because there are no ongoing activities at exposed areas on the properties, there is likely little potential for dust generation. Children playing in exposed areas represent the highest potential for exposure. Construction or maintenance workers may be exposed to surface soil during intrusive activities (e.g., landscaping or other intrusive activities), but potential exposures can be mitigated by using personal protective equipment (PPE).
- **Subsurface Soil**. The potential for exposure to COPCs in subsurface soil is most likely limited to construction workers engaged in intrusive activities, although potential exposures can be mitigated by using PPE. Potential exposures of other human receptors to COPCs in subsurface soil are unlikely because these receptors are not likely to be involved in intrusive activities.
- **Groundwater**. Groundwater beneath OU-1 is not used as a potable source and therefore exposure via ingestion of groundwater is unlikely. Likewise, there is relatively little potential for direct contact to groundwater for residents, recreational users and workers given the depth to groundwater and because these receptors are not likely to be involved in intrusive activities. Construction workers may be exposed to groundwater during future intrusive activities, although these exposures can be mitigated by using PPE.

The potential risk exposure for each of these populations can be mitigated through a combination of administrative and engineering controls, which will be identified and evaluated as part of the remedy selection process.

3.3 Remedial Action Objectives

This section presents the RAOs for environmental media at OU-1. According to NYSDEC DER-10 guidance (NYSDEC, 2010), RAOs are medium-specific or operable-unit-specific objectives that result in the protection of human health and the environment. RAOs for protecting human receptors can express qualitative and quantitative remediation goals for COPCs in association with an exposure route (e.g., surface and subsurface soil, groundwater) because protectiveness may be achieved qualitatively by eliminating exposure (such as capping an area, limiting access or providing an alternate water supply), as well as by reducing the quantifiable levels of COPCs. The hierarchy of preferable control measures to be used for an identifiable source of contamination is presented in DER-10 (Chapter 4.2[d][2]) and 6 NYCRR Part 375-1.8(c). The hierarchy includes, from most preferable to least preferable: removal and/or treatment, containment, elimination of exposure, and treatment at the point of exposure.

Consistent with the requirements of DER-10, RAOs were developed for the site using the following information:

- Identifying contaminants that exceed applicable SCGs and the environmental media impacted by the contaminants. In particular, the results of the SCS completed by TRC in 2005 and the RI completed by BBL in 2006 and 2007 were considered.
- Identifying SCGs (as presented in Section 2 of this AAR).
- The potential public health and environmental exposures resulting from contaminants in environmental media, as presented in Section 3.2.

The RAOs for OU-1, considering the COPCs, exposure pathways and receptors, are presented in Table 3-1.

Table 3-1. Remedial Action Objectives

Environmental Media	RAOs
Soil Vapor	1. Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at a site.
Surface Soil	1. Reduce, to the extent practicable, potential human exposure to surface soil containing COPCs.
Subsurface Soil	1. Reduce, to the extent practicable, potential human exposure to subsurface soil containing COPCs (including ingestion/direct exposure and inhalation of vapors from impacted soil), and be protective of human health. 2. Remediate, to the extent practicable, soil containing MGP-related COPCs (hierarchy of preference includes removal and/or treatment, containment, elimination of exposure, and treatment at the point of exposure) 3. Reduce, to the extent practicable, potential human exposure to MGP-related NAPL. 4. Reduce, to the extent practicable, further off-site migration of MGP-related NAPL
Groundwater	1. Restore, to the extent practicable, COPC-impacted groundwater to current New York State groundwater quality standards. 2. Reduce, to the extent practicable, future COPC impacts to groundwater. 3. Reduce, to the extent practicable, potential human exposure to groundwater containing COPCs. 4. Prevent, to the extent practicable, off-site migration of COPC-impacted groundwater. (Note however, as pertaining to the groundwater RAOs, as stated in DER-10 (Chapter 4.1[d][4][i](3)), a participant in the Voluntary Cleanup program is only required to evaluate the feasibility of containing a groundwater plume on site) 5. Remove, to the extent practicable, the source of groundwater contamination.

The RAOs are used to evaluate potential remedial options relative to their capacity to protect human health and the environment, by considering exposure pathways and applicable SCGs. Rationale supporting the development of each RAO is presented in Sections 3.3.1, 3.3.2 and 3.3.3.

Consistent with DER-10 at a minimum, the objective of the remedy will be to be protective of public health and the environment given the intended use of the site.

3.3.1 Rationale for Soil Vapor RAO

Existing indoor air data suggests that MGP-related impacts do not exist in the building areas monitored within the; however, as a conservative approach, the NYSDEC's generic soil vapor RAO to mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the site will be used.

The RAO for soil vapor is currently being addressed by the ISMP air monitoring being conducted to mitigate the potential for soil vapor intrusion into buildings at the site.

3.3.2 Rationale for Surface Soil RAOs

The RAO for surface soil was developed to be protective of human health and the environment, to the extent practicable, and to assist with identifying potential remedial technologies. The HHEA identified PAHs and several metals (arsenic, chromium, lead and mercury) as COPCs for surface soil; however, when compared to Manhattan background data, these metals were within typical background ranges; therefore, metals are not being included as COPCs and will not be further discussed in this AAR. While the HHEA concluded that the presence of vegetation (i.e., grass) likely mitigates the potential for exposure to the COPCs, the RAO is targeted at reducing the potential for exposure (dermal, ingestion or inhalation) of current and future residents, occupants, and/or visitors to surface soil potentially impacted by MGP-related COPCs, and protecting the environment (e.g., migration of impacts). The unrestricted use SCOs presented in 6NYCRR Part 375-6 will be used as remediation goals for evaluation of surface soil remedial alternatives.

3.3.3 Rationale for Subsurface Soil RAOs

The HHEA identified BTEX, PAHs and metals as COPCs for subsurface soil. However, when concentrations of metals in on-site soil were compared to Manhattan background data, the metals were within typical background ranges. The RAOs for subsurface soil were also developed to be protective of human health and the environment, to the extent practicable, and to assist with identifying potential remedial technologies. These RAOs are targeted at reducing the potential for human exposure to subsurface soil impacted by MGP-related COPCs and protecting the environment. The potential for direct contact or exposure to COPCs in subsurface soil is most likely limited to construction workers engaged in intrusive activities; potential exposure of other human receptors to COPCs is unlikely. The following remediation goals for subsurface soil have been developed for OU-1:

- Minimize the potential for exposure of current and future residents, visitors, recreational users and construction workers to subsurface soil containing total BTEX compounds at concentrations greater than 10 ppm, to the extent practicable. Total BTEX is determined by the sum of the detected concentrations of benzene, toluene, ethylbenzene and xylenes (total) in a soil sample. The 10 ppm total BTEX remediation goal is consistent with the application of soil cleanup levels described in NYSDEC Policy CP-51/Soil Cleanup Objectives for sites under the Voluntary Cleanup Program (VCP), specifically as a supplemental soil cleanup objective (SSCO). SSCOs include soil cleanup levels for a contaminants that had been included in former TAGM 4046 and was not included in 6NYCRR 375-6 (a cleanup objective of 10 ppm total VOCs had been included in former TAGM 4046). BTEX detected in OU-1 subsurface soil represents greater than approximately 97 percent of the total VOCs present and, as indicated above, the VOCs of interest at MGP sites are BTEX because they occur in abundance. Therefore, total BTEX will be used as a SSCO. In addition, precedence has been set by the NYSDEC for the use of 10 ppm BTEX as a cleanup objective at similar MGP sites. Therefore, the soil evaluation uses BTEX less than or equal to 10 ppm as the SCO.

The estimated areal extent of soil containing BTEX at concentrations greater than 10 ppm is presented on Figure 1-6. Areas containing NAPL are assumed to also contain BTEX at concentrations greater than 10 ppm.

- Minimize, to the extent practicable, the potential for exposure of current and future residents, visitors, recreational users, and construction workers to subsurface soil containing total PAHs at concentrations greater than 500 ppm. Total PAHs are determined by the sum of the detected concentrations for the following 17 compounds: 2-methylnaphthalene; acenaphthene; acenaphthylene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(g,h,i)perylene, benzo(k)fluoranthene; chrysene; dibenz(a,h)anthracene; fluoranthene; fluorene; indeno(1,2,3-c,d)pyrene; naphthalene; phenanthrene; and pyrene. As indicated above, the SVOCs of interest at MGP sites are PAHs because they occur in abundance and represent greater than approximately 98 percent of the SVOCs detected within OU-1. Therefore, the soil evaluation uses PAHs less than or equal to 500 ppm as the SCO. A remediation goal of 500 ppm total PAHs for subsurface soil, to the extent practicable, is consistent with NYSDEC-approved goals at similar MGP sites.

  The estimated aerial extent of soil containing PAHs at concentrations greater than 500 ppm and NAPL-impacted soil is presented on Figure 1-7. Areas containing NAPL are also assumed to contain PAHs at concentrations greater than 500 ppm. The areas containing PAHs at concentrations greater than 500 ppm generally exist within areas with NAPL-impacted soil and soil containing BTEX at concentrations greater than 10 ppm.

3.3.4 Rationale for Groundwater RAOs

Groundwater beneath the site (OU-1 and East River Park) is classified as Class GA and, as such, NYS Groundwater Quality Standards (6 NYCRR Parts 700-705) are applicable. However, groundwater at the site is not used as a potable source for drinking water. Public water is supplied by the City of New York from an upstate source. BTEX and six VOC compounds, several PAH and SVOC compounds, and three metals have been identified as COPCs for groundwater. The groundwater table ranges from approximately 5 to 9 feet below grade; therefore, potential direct exposure to residents, visitors and/or recreational users does not exist. The greatest potential for exposure to impacted groundwater is via direct contact, which may occur during construction/excavation work. The potential exposure to impacted groundwater can be minimized by using properly trained personnel and PPE.

The RAOs for groundwater were developed to be protective of both human health and the environment, to the extent practicable. Human health and the environment will be protected by reducing impacts and restoring the groundwater quality, to the extent practicable, to current New York State groundwater quality standards. Human health will be protected by preventing, to the extent practicable, exposure to site-related COPCs. Protection of the environment will be accomplished, to the extent practicable, by mitigating further off-site migration of dissolved-phase COPCs.

4 TECHNOLOGY SCREENING AND DEVELOPMENT OF REMEDIAL ALTERNATIVES

4.1 General

The objective of the technology screening conducted as a part of this Alternative Analysis Report is to present general response actions (GRAs) and associated remedial technology types and technology process options that have documented success at achieving similar RAOs at MGP sites, and to 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 more detailed evaluation. This approach is also consistent with the screening and selection process provided in DER-10.

This section identifies potential remedial alternatives to address impacted media within OU-1. As an initial step, GRAs potentially capable of addressing impacted media were identified. GRAs are medium-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 process options were identified and screened to determine the technologies that were the most appropriate for OU-1. Technologies/process options that were retained through the screening were used to develop potential remedial alternatives. Detailed evaluations of these assembled remedial alternatives are presented in Section 5.

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, capping. The term “technology process options” refers to specific processes within each remedial technology type. For each GRA identified, a series of remedial technology types and associated technology process options has been assembled. Remedial technology types and technology process options can be identified by drawing on a variety of sources, including regulatory references and standard engineering texts not specifically directed toward impacted sites. In accordance with the DER-10 guidance document, each remedial technology type and associated technology process options are briefly described and screened, 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.

4.2 General Response Actions

Based on the RAOs identified in Section 3.3, the following GRAs have been established for soil and groundwater within OU-1:

- No Action
- Institutional Controls/Engineering Controls
- In-Situ Containment/Controls

- In-Situ Treatment
- Removal
- Ex-Situ On-Site Treatment and/or Disposal
- Off-Site Treatment and/or Disposal

These GRAs would be applied to the media that contain COPCs at concentrations greater than remediation goals identified in Section 3.

4.3 Identification of Remedial Technologies

Remedial technology types that are potentially applicable for addressing the impacted media at OU-1 were identified through a variety of sources including review of scientific journals, vendor information, engineering experience, and review of the following documents:

- *Technical Guidance for Site Investigation and Remediation* (DER-10) (NYSDEC, 2010)
- *Presumptive/Proven Remedial Technologies for New York States Remedial Programs* (DER-15) (NYSDEC, 2007)
- "Management of Manufactured Gas Plant Sites" (Gas Research Institute [GRI], 1996);
- *Selection of Remedial Actions at Inactive Hazardous Waste Sites* (TAGM 4030) (NYSDEC, 1990)
- *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988a)

Section 4.3 of DER-10 indicates that GRAs should be established such that they give preference to presumptive remedies. Although each former MGP site offers its own unique site characteristics, 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. Therefore, this collective knowledge and experience, and regulatory acceptance of previous alternatives analysis studies performed on MGP-related sites with similar impacts, were used to reduce the universe of potentially applicable process options for OU-1 to those with documented success in achieving similar RAOs.

The objective of this Alternative Analysis Report was to briefly present GRAs and associated technology types; however, quickly focus on the process options/remedial technologies that have documented success at achieving similar RAOs at former MGP sites. The identified remedial technologies for addressing impacted media are presented in the following sections.

4.4 Remedial Technology Screening

Potentially applicable remedial technology types and technology process options were identified for each of the GRAs, and were subjected to preliminary and secondary screening to retain the technologies that would most effectively achieve the RAOs identified for OU-1. As stated above, for the purposes of the screening evaluations, remedial technology type refers to a general category of technologies, such as capping or immobilization, while the technology process option is a specific process within each remedial technology type (e.g., asphalt cap, multi-media cap, jet-grouting, shallow soil mixing).

As required by Section 4 of DER-10, the “No Action” technology has been included and retained through the screening evaluation. The “No Action” GRA will serve as a baseline for comparing the potential overall effectiveness of the other technologies. As detailed in the screening evaluation presented below, remediation to pre-disposal conditions is not implementable or practicable and would not be accepted by the public.

A summary of the preliminary and secondary screening of remedial technologies to address MPG-impacted soil and groundwater is presented in the following subsections and in Tables 4-1 and 4-2, respectively. Technology process options that were not retained have been shaded on the table.

4.4.1 Preliminary Screening

Preliminary screening was performed to reduce the number of potentially applicable technologies on the basis of technical implementability and ability to meet the RAOs. Technical implementability was determined using existing site characterization information to screen out remedial technology types and technology process options that could not reasonably or practically be implemented. The results of the preliminary screening for soil (surface and subsurface soil) are presented in Table 4-1; preliminary screening results for groundwater are presented in Table 4-2.

4.4.1.1 Surface and Subsurface Soil

The following remedial technology types were identified under the GRAs to address impacted surface and subsurface soil within OU-1:

No Action

No action would be completed 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/Engineering Controls (ICs/ECs)

The remedial technology types identified under this GRA consist of non-intrusive controls focused on minimizing potential contact with impacted media. The remedial technology types screened under this GRA consist of institutional controls and engineering controls; these are typically elements included in a Site Management Plan (SMP). If institutional and engineering controls are implemented in conjunction with other remedial technologies, a SMP will be prepared following completion of the installation of the remedy to identify activities required to document that that the controls are effective and are being monitored. Technology process options screened under these remedial technology types include:

- Deed restrictions, environmental land use restrictions, enforcement and permit controls, and informational devices (institutional controls)
- Building design standards, low-permeability liners, vapor mitigation systems, and fencing (engineering controls)

Institutional controls would be utilized to limit permissible future uses of OU-1, as well as subsurface activities that could result in contact with impacted soil, and restrict groundwater use.

Engineering controls consists of performance standards, building design standards, low-permeability liners (e.g., vapor barrier), vapor mitigation systems (e.g., sub-slab depressurization systems), and fencing that would be used to reduce the intrusion of soil vapors into buildings within OU-1 or reduce access to surface soil.

Although establishing institutional controls and engineering controls would require acceptance of these controls by the current property owner(s), both technologies are considered readily implementable and therefore, were retained for further evaluation under the secondary screening.

In-Situ Containment/Control

Remedial technology types associated with this GRA consist of measures to address the impacted media by reducing mobility and/or exposure without removal or treatment. Remedial technology types evaluated under this GRA consisted of surface controls/capping (i.e., infiltration control/capping), and containment. Technology process options screened under these remedial technology types include:

- Asphalt/concrete capping, clay/soil capping, and multi-media capping (surface controls/capping)
- Slurry walls, secant pile walls, and sheet piles (containment)

Each of the capping processes evaluated under surface controls/capping remedial technology are readily implementable within OU-1 and were retained for the further evaluation under the secondary screening.

None of the containment technology processes were retained for further evaluation. Slurry walls and sheet piles were not retained due to nature of subsurface materials within OU-1 (e.g., fill, cribbing, and piling) which would limit the ability to construct (or prevent construction of) these types of containment walls. While secant pile walls can generally be installed in a wide variety of subsurface conditions, an extensive amount of pre-excavation would be required to implement any of these technology processes. The pre-excavation and containment barrier wall installation activities would be extremely disruptive to the surrounding community. The invasive nature of these remedial activates and associated noise, visual presence, increased truck and equipment traffic, and restrictions on accessing the grounds would significantly reduce the quality of life for residents of the Jacob Riis Housing complex. Direct, daily nuisances to the local residents during construction would include noise and dust generation from driving sheeting, installing secant piles, and excavation associated with installation of slurry walls. Due to their close proximity to the buildings, implementation of these remedial technologies would also create potential health and safety concerns based on the probable location of containment barrier walls with relation to the complex's residents.

In-Situ Treatment

Remedial technology types associated with this GRA consist of treating or stabilizing MGP-impacted soil in-situ (i.e., without removal). These technologies would treat the soil to remove or otherwise alter the COPCs to achieve the RAOs established for OU-1. The remedial technology types evaluated under this GRA consisted of immobilization, steam injection/extraction, chemical treatment, and biological treatment. Technology process options screened under these remedial technology types include:

- Solidification/stabilization of soil (immobilization)
- Dynamic underground stripping and hydrous pyrolysis/oxidation (DUS/HPO) (steam injection/extraction)
- Chemical oxidation (chemical treatment)

- Biodegradation, enhanced biodegradation, and biosparging (biological treatment)

Based on the results of preliminary screening, DUS/HPO, chemical oxidation, biodegradation, enhanced biodegradation, and biosparging were retained for secondary screening as each of these technology processes are implementable. Solidification/stabilization of soil would not be implementable within OU-1 based on the nature of subsurface materials (e.g., fill, cribbing, and piling) that would prohibit the complete mixing of soil within OU-1. Based on the invasive nature of solidification/stabilization activities, implementation of this technology process option would present significant safety concerns and nuisances for the residents of the Jacob Riis Housing complex and surrounding community. The presence of large remedial construction equipment would create visual and noise related nuisances, building access/egress concerns, thereby significantly reducing the quality of life for local residents. Additionally, limited space is available within OU-1 for slurry/grout mixing and materials handling activities.

Removal

Remedial technology types associated with this GRA consist of measures to remove surface and/or subsurface soil containing MGP-impacts above the RAOs. Excavation was the only technology type and technology process option screened under this GRA. Based on the results of preliminary screening, excavation was retained for secondary evaluation.

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 consisted of immobilization, extraction, thermal destruction, chemical treatment, and disposal. Technology process options screened under these remedial technology types include:

- Solidification/stabilization of soil (immobilization)
- Low-temperature thermal desorption (LTTD) (extraction)
- Incineration (thermal destruction)
- Chemical oxidation (chemical treatment)
- Solid waste landfill and RCRA landfill (disposal)

Due to the current and anticipated future uses of OU-1 and the surrounding areas (i.e., residential housing, school, playground, public open space), none of the ex-situ on-site treatment and/or disposal technologies and associated technology process are considered practicable, technically implementable, or administratively feasible given the density of the buildings and population, lack of available space, public acceptance, and potential for short- and long-term exposures during on-site treatment/disposal. Ex-situ on-site treatment technologies could potentially present significant health and safety concerns for the residents of the Jacob Riis Housing complex and surrounding community based on the presence of treatment systems and or equipment. Additionally, on-site treatment/disposal facilities would create visual and noise nuisances and reduce available recreational space for local residents.

Off-Site Treatment and/or Disposal

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

- Asphalt batching, brick/concrete manufacturer, and fuel blending/co-burn in utility boiler (recycle/reuse)
- Incineration (thermal destruction)
- LTTD (extraction)
- Solid waste landfill and RCRA landfill (disposal)

The asphalt concrete batch plant and brick/concrete manufacturer technology processes are not considered implementable. The number of facilities capable of implementing these process and demand for raw materials are limited. Excavated material would require significant screening and processing based on the nature of subsurface material. Fuel blending/co-burn in utility boiler, incineration, LTTD, and solid waste and RCRA landfills were all retained for further evaluation during secondary screening.

4.4.1.2 Groundwater

The following remedial technology types were identified under the GRAs to address impacted groundwater within OU-1:

<u>No Action</u>

No active remedial activities would be implemented to address groundwater that contains MGP-related COPCs above New York State groundwater standards or guidance values, or to mitigate future impacts to groundwater. The “No Action” alternative is readily implementable and was retained to serve as a baseline against which other alternatives will be compared.

<u>Institutional Controls</u>

Remedial technology types associated with this GRA generally consist of non-intrusive administrative controls used to minimize the potential for contact with, or use of, the groundwater. The remedial technology types screened under this GRA consisted of institutional controls. Technology process options for institutional controls include deed restrictions, groundwater use restrictions, enforcement and permit controls, and informational devices. Although establishing institutional controls would require obtaining approval from the current property owner(s), the technology is considered readily implementable and therefore, was retained for further evaluation under the secondary screening. The institutional controls that would be established for OU-1 would be documented in a site-specific SMP. If institutional controls and engineering were implemented in conjunction with other remedial technologies, a SMP would be prepared following completion of the installation to identify activities required to document that the controls are effective and are being monitored.

<u>In-Situ Containment/Controls</u>

Remedial technology types associated with this GRA involve addressing MGP-impacted groundwater without removal or treatment. Remedial technology types evaluated under this GRA consisted of containment and hydraulic control. Technology process options screened under these remedial technology types included:

- Slurry walls, secant pile walls, and sheet pile walls (containment)

- Vertical extraction wells (hydraulic control)

Similar to the preliminary screening completed for soil containment options, none of the containment technology processes for groundwater were retained for further evaluation. As indicated in the previous section, slurry walls and sheet pile walls were not retained due to nature of subsurface materials within OU-1 (e.g., fill, cribbing, and piling), which would limit the ability to construct (or prevent construction of) these types of containment walls and due to nuisance impacts to the community. While secant pile walls can generally be installed in a wide variety of subsurface conditions, an extensive amount of pre-excavation would be required to implement any of these technology process options. Lack of available space, along with noise and visual impacts, obstructions due to equipment and staging areas, and potential odor and safety concerns are associated with this technology. Additionally, installation of any low-permeability containment wall would likely cause significant changes in local groundwater flow patterns, potentially including raising the groundwater table.

The technology process option of hydraulic control was also not retained for further evaluation. In-situ hydraulic control would require installation of groundwater extraction wells that would be pumped to maintain a desired hydraulic gradient to reduce the off-site migration of MGP-related impacts. Pumping to maintain hydraulic control would require construction and operation of a water treatment system at the Jacob Riis property to treat the water removed from the wells. Noise and visual impacts, along with obstruction nuisances to the community would be present during construction coupled with the lack of space available to construct a treatment system, and the presence of a permanent water treatment system on the property would cause a visual and noise nuisance to the residents. Additionally, high pumping rates would likely be required to overcome the hydraulic influence of the East River. Based on these factors, hydraulic control was not retained for further evaluation.

<u>In-Situ Treatment</u>

Remedial technology types associated with this GRA involve addressing MGP-impacted groundwater without removal or ex-situ treatment. Remedial technology types evaluated under this GRA consisted of biological treatment, chemical treatment, and extraction (i.e., in-situ stripping). Technology process options screened under these remedial technology types included:

- Groundwater monitoring, enhanced biodegradation, and biosparging (biological treatment)
- Chemical oxidation and permeable reactive barrier (PRB) (chemical treatment)
- Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation (DUS/HPO) (extraction/in-situ stripping)

PRBs were not retained due to constructability concerns similar to those for containment barrier walls; the nature of subsurface materials within OU-1 (e.g., fill, cribbing, and piling) would limit the ability to construct (or prevent construction of) a PRB. All other remedial technology process options evaluated for in-situ treatment technology are considered implementable and therefore, were retained for further evaluation under the secondary screening.

<u>Removal</u>

Remedial technology types associated with this GRA consider removal of NAPL and/or MGP-impacted groundwater for treatment and/or disposal. The remedial technology types evaluated under this GRA consisted of hydraulic removal and NAPL removal. Technology process options screened under these remedial technology types included:

- Vertical extraction wells and horizontal extraction wells (hydraulic removal)
- Active removal, passive removal, and collection trenches/passive barrier wall (NAPL removal)

Horizontal extraction wells were not retained for further evaluation as this process requires specialized drilling equipment requiring 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, passive barrier walls were not retained due to the lack of space available for large-scale passive NAPL barrier walls to be installed within OU-1 and the increased potential for exposure to public during construction of the wall. Vertical extraction wells, active and passive NAPL removal, and collection trenches are considered implementable and therefore, were retained for evaluation under the secondary screening.

Ex-Situ On-Site Treatment

Remedial technology types associated with this GRA consider the treatment of extracted MGP-impacted groundwater. The remedial technology types evaluated under this GRA consisted of chemical treatment and physical treatment. Technology process options screened under these remedial technology types included:

- Ultraviolet (UV) oxidation and chemical oxidation (chemical treatment)
- Carbon adsorption, filtration, air stripping, precipitation/coagulation/flocculation, and oil/water separation (physical treatment)

Similar to the ex-situ on-site soil treatment technologies, due to the current and anticipated future uses of OU-1 and the surrounding areas (i.e., residential housing, school, playground), none of the ex-situ on-site groundwater treatment technology process options are considered practicable, technically implementable, or administratively feasible given the density of the building spacing and population, lack of available space, public acceptance, and potential for long-term exposures as a result of the construction and operation of an on-site water treatment system. An on-site treatment/ disposal facility would create visual and noise nuisances, along with potential olfactory nuisances, safety concerns, and increased site traffic and activities associated with operation and maintenance requirements.

Off-Site Treatment and/or Disposal

Remedial technology types associated with this GRA consider the off-site treatment/disposal of extracted groundwater. The remedial technology type evaluated under this GRA consisted of disposal. Technology process options screened under this technology type included: discharge to a POTW, discharge to a privately-owned and commercially operated treatment facility, and discharge to surface water via a storm sewer. Each of these technology processes are considered implementable and therefore, were retained for further evaluation under the secondary screening.

4.4.2 Secondary Screening

As indicated above, a number of potentially applicable remedial technology types and technology process options were retained through the preliminary screening. The technology process options retained through preliminary screening were subjected to a secondary screening to further evaluate their applicability to OU-

1. The purpose of the secondary screening was to choose, when possible, one representative remedial technology process option for each retained remedial technology type to simplify the subsequent development and evaluation of the remedial alternatives. The results of the secondary screening of technology processes are also presented in Tables 4-1 and 4-2. In general, technology process options are presented and discussed in relative terms as they relate to other technology process options of the same remedial technology type. A description of the secondary screening criteria is listed below:

- **Effectiveness** – This criterion is used to evaluate each technology process option relative to other process options within the same remedial technology type. This evaluation focused on the process option's:
  - effectiveness at meeting the RAOs by reducing the toxicity, mobility and/or volume of chemical constituents in the impacted medium
  - impacts to human health and the environment during the construction and implementation phase
  - reliability with respect to the nature and extent of impacts and conditions at the site
- **Implementability** – Implementability encompasses both the technical and administrative feasibility of implementing a process option. Because technical implementability was used during the preliminary screening, this subsequent, more detailed evaluation places more emphasis on the institutional aspects of implementability (e.g., the ability to obtain necessary permits for off-site actions, the availability of treatment, storage, and disposal services, etc.). This criterion also evaluates the ability to construct and reliably operate the technology process option, and availability of specific equipment and technical specialists to design, install, and operate and maintain the equipment.
- **Relative Cost** – This criterion evaluates the overall cost required to implement the remedial technology. As a screening tool, relative capital and operation and maintenance (O&M) costs are used rather than detailed cost estimates. For each technology process option, relative costs are presented as low, moderate or high, and made on the basis of engineering judgment and industry experience.

Based on the results of the secondary screening, the remedial technology types and technology process options that were retained for further evaluation are presented below.

4.4.2.1 Surface and Subsurface Soil

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

<u>No Action</u>

The "No Action" alternative would not be an effective alternative for achieving the RAOs for surface and subsurface soil. However, consistent with DER-10 guidance for remedy selection, the No Action alternative must be developed and evaluated as a baseline to which other remedial alternatives are compared. Through time, natural attenuation processes would reduce the toxicity, mobility and volume of impacts to the environment. However, monitoring of site conditions would not be conducted to document the natural attenuation processes. It is not anticipated that this technology would receive regulatory approval.

Institutional Controls/Engineering Controls

Institutional controls and engineering controls were both retained through the preliminary screening. Institutional controls and engineering controls will not achieve soil RAOs as stand-alone processes as these measures would not treat, contain or remove MGP-impacted soil. However, these processes were retained through the secondary screening because institutional controls and engineering controls can be implemented in conjunction with other remedial technologies to enhance their effectiveness and reduce the potential for exposure to MGP-impacted soil. As indicated above, the institutional and engineering controls would be identified in a SMP for OU-1 that would be developed once the remedy has been implemented

As indicated under the preliminary screening for surface and subsurface soil, Con Edison would be required to receive the approval of the current property owner(s) to implement institutional controls (i.e., deed restrictions, environmental land use restrictions, enforcement and permit controls, and informational devices) and engineering controls (i.e., building design standards, low-permeability liners, vapor mitigation systems, and fencing). However, as indicated in Section 1, indoor air is not impacted with MGP-related COPCs. Therefore, engineering controls such as liners and vapor mitigation systems within the basements and lower levels of buildings within OU-1 are not warranted at this time. If future indoor air monitoring indicates the presence of MGP-related COPCs, these engineering controls would be implemented and could effectively reduce the potential for exposures to impacted vapors.

In-Situ Containment/Controls

The surface controls/capping (asphalt concrete, clay/soil, and multi-media caps) technology was retained through the preliminary screening. Surface controls/capping are proven remedial technology types and the equipment, materials, and contractors to implement these technology process options are readily available. The existing cover materials in outdoor areas (sidewalks, paved areas, vegetated areas, etc.) within OU-1 would be maintained to provide continued protection against exposure to subsurface soil containing COPCs. Jacob Riis Building No. 4 (1223 FDR Drive) ground level flooring consists of a combination of concrete and earthen floors in utility and storage rooms, respectively. The existing utility room concrete floors would be maintained and a new surface control (e.g., concrete) would be installed in storage rooms to provide protection against potential dermal exposure to soils containing COPCs. Based on the surface soil exposure pathway evaluation presented in the SCS Report (i.e., the only exposure pathway that is potentially complete is direct ingestion and/or dermal contact), along with the results of indoor air monitoring for Jacob Riis Building No. 4 (1223 FDR Drive) that indicated indoor air MGP-related impacts were not present (discussed in Section 1.4), and consistent with existing concrete floor surfaces within the utility rooms, the surface control would not include vapor/water-proof barrier. Surface control materials and construction details for inside Building No. 4 will be evaluated during the remedial design.

Each of the surface control/capping processes could be easily implemented, and their relative costs are comparable (low to moderate). While surface controls/capping would not reduce toxicity or volume of impacts or prevent further migration of MGP-related COPCs, a surface control/cap would limit direct contact between site personnel and impacted soil. Asphalt/concrete, clay/soil caps and vegetative cover would be consistent with the existing surface covers (i.e., concrete floors, roadways, sidewalks, vegetated areas) and therefore were retained for further evaluation. A multi-media cap was not retained for further evaluation as the geosynthetic liners used to construct the cap would prohibit vegetation of trees and shrubs within the exterior cap areas, and is not necessary to prevent exposure and meet the RAO. As indicated under the preliminary screening for surface and subsurface soil, none of the containment technology processes were retained due subsurface obstructions (which would make installation of barrier wall components very difficult), space limitations, and hydrogeologic impacts.

In-Situ Treatment

As indicated in Section 4.4.1.1, the steam injection/extraction (DUS/HPO), chemical treatment (chemical oxidation), and biological treatment (biodegradation, enhanced biodegradation, and biosparging) technologies and associated process options were retained through preliminary screening. However, none of the in-situ treatment technologies and process options were retained through the secondary screening due to general ineffectiveness at addressing heavily MGP-impacted soil or NAPL and implementation challenges.

DUS/HPO was not retained as this option could potentially result in the controlled migration of NAPL and the presence of underground structures and obstructions could limit the effectiveness of the technology option.

Pilot studies conducted at other former MGP sites have shown that in-situ chemical oxidation including surfactant enhanced in-situ chemical oxidation) is only partially effective in the treatment of MGP-derived NAPL, in that the technology treats the dissolved-phase portion of the residual MGP-derived NAPL, but does not significantly reduce the volume of NAPL. Multiple treatments with large quantities of highly reactive oxidants would be required due to the nature of the subsurface geology and site impacts. The presence of underground utilities and associated preferential pathways and the limited space available on site for process chemical storage reduces implementability. The presence of basements in several buildings located on the Jacob Riis property presents potential soil vapor intrusion concerns associated with DUS/HPO and chemical oxidation. The relative costs to implement DUS/HPO and chemical oxidation are high.

Biodegradation, enhanced biodegradation, and biosparging are relatively ineffective processes for addressing MGP-impacted soil or NAPL, and it is anticipated that the treatment systems would need to operate for an indefinite period of time to have a measurable effect. Additionally, tidal fluctuations and brackish water may limit the effectiveness of these processes. Biosparging would require closely spaced injection points requiring long-term operation and maintenance, and was therefore not retained for treatment of soil. Enhanced biodegradation would require addition of air/ amendments to create and sustain an aerobic environment, and would also require long-term operation and maintenance, and was also not retained for soil.

Removal

In general, removal is a proven technology to address impacted material and would achieve several RAOs. When combined with proper handling of the excavated material, this technology process would be effective at minimizing potential risks to current and future on-site workers and residents. Excavation could be implemented (i.e., equipment and contractors needed to complete soil removal are readily available). However, the presence of extensive subsurface obstructions and underground utilities throughout OU-1, the potential volume of water (i.e., dewatering fluids) to be managed/treated based on the close proximity of the East River and the depths of the highest impacts, the presence of the active high-use roadways (e.g., FDR), and the density of buildings/structures that exist above the impacted soil would make side-wide soil removal very difficult. Excavation activities would create visual, noise, and olfactory nuisances, and large scale excavation would present significant access restraints, increased traffic and parking concerns, and potential safety issues for residents of the Jacob Riis Housing complex. Excavation below the FDR or buildings located within OU-1 to access impacted soil is considered impracticable. Additionally, as indicated previously, installation of water-tight sheet pile is not feasible due to the nature of subsurface fill and cribbing and because a prohibitive amount of water would be generated if excavation activities were completed at significant depths below the water table. As indicated under the technology screening for groundwater technologies, there is limited space available on-site to conduct water treatment activities (to treat water removed from excavation areas if excavation below the groundwater is conducted). Therefore, a large scale excavation is not implementable within OU-1. However, shallow or targeted excavations (e.g., to the top of the water table) are retained for further evaluation. The anticipated relative capital cost of removal is high.

Ex-Situ On-Site Treatment and/or Disposal

None the remedial technologies and associated technologies were retained through the preliminary screening.

Off-Site Treatment and/or Disposal

Remedial technology types and process options retained through preliminary screening consisted of recycle/reuse (fuel blending/co-burn in a utility boiler), thermal destruction (incineration), extraction (LTTD), and off-site disposal (solid waste landfill or RCRA landfill). Incineration and RCRA landfill technology processes were not retained through the secondary 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 MGP-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 NYS LDRs and USTs prior to disposal.

Fuel blending/co-burn in utility boiler, LTTD, and off-site disposal at a solid waste landfill were all retained for further evaluation. The relative cost for these process options is moderate and each is considered an effective means for treating/disposing MGP-impacted soil. While each of these process options were retained, the final off-site treatment or disposal of materials that may be removed will be evaluated as part of the remedial design for the selected site remedy. This will allow for an evaluation of costs of potential off-site treatment/disposal processes, which can fluctuate significantly based on season, market conditions, and facility capacity. In addition, multiple off-site treatment technologies could be utilized to treat or dispose of media with different concentrations of impacts. However, for the purpose of preparing this AAR, LTTD and solid waste landfill will be assumed as the off-site treatment/disposal technology process options for hazardous and non-hazardous materials (respectively).

4.4.2.2 Groundwater

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

No Action

The “No Action” alternative would not be an effective alternative for achieving the RAOs for groundwater. However, consistent with the requirements of DER-10 guidance for remedy selection, the No Action alternative must be developed and evaluated as a baseline to which other remedial alternatives are compared.

Through time, natural attenuation processes would reduce the toxicity, mobility and volume of impacts in groundwater. However, monitoring of groundwater conditions would not be conducted to document the natural attenuation processes. This technology would not likely receive regulatory approval or public support.

Institutional Controls

Institutional controls for groundwater use restrictions (deed restrictions, groundwater use restrictions, enforcement and permit controls, and informational devices [e.g., signs, postings, etc.]) were retained for further evaluation. Because institutional controls would not treat, contain or remove any COPCs in site groundwater, institutional controls alone would not achieve the RAOs established for OU-1. However, institutional controls may partly achieve the RAO of reducing, to the extent practicable, potential human exposure to groundwater containing COPCs. Institutional controls could enhance the effectiveness or implementability of other technologies/technology process options. As previously stated, the institutional and engineering controls would be identified the SMP that would be prepared for OU-1 after the remedy was selected and implemented.

In-Situ Containment/Controls

As indicated under the preliminary screening for groundwater, none of the containment technology processes were retained due the difficulties associated with installing the walls based on subsurface conditions, space limitations, and hydrogeologic impacts. Additionally, containment technologies typically have a high relative cost. Even if a containment wall could be constructed west of the FDR, a significant quantity of NAPL and impacted soil is located beneath and east of the FDR and serves as sources for dissolved-phase impacts in groundwater. Containment may be considered as a potential option for OU-2 to mitigate migration of NAPL into the East River. Construction of costly containment barrier wall that does contain/limit the migration of impacted groundwater (or the materials that serve as a source to groundwater impacts) is not considered an effective means for addressing impacts and would not achieve groundwater RAOs.

In-Situ Treatment

Remedial technology types and processes retained through preliminary screening consisted of biological treatment (groundwater monitoring, enhanced biodegradation, and biosparging), chemical treatment (chemical oxidation) and extraction (DUS/HPO). Although groundwater monitoring alone without source removal will likely not achieve groundwater RAOs, the technology process was retained as a measure to monitor and document groundwater conditions over time based on the ease of implementation and low relative costs.

None of the other remedial technology processes were retained through secondary screening. Enhanced biodegradation, biosparging, and chemical oxidation were not retained as these processes would not be an effective means for treating NAPL (i.e., the source for dissolved-phase impacts). Additionally, without a means to address the source for dissolved-phase impacts, ongoing treatment of dissolved-phase COPCs in groundwater (i.e., enhanced biodegradation, biosparging, chemical oxidation) would not be a cost-effective means for addressing site impacts. DUS/HPO was not retained as (indicated previously) this option could potentially result in the controlled migration of NAPL and the presence of underground structures and obstructions could limit the effectiveness of the technology option. Additionally the presence of basements in several buildings located on the Jacob Riis property presents potential soil vapor intrusion concerns associated with biosparging, DUS/HPO, and chemical oxidation.

Chemical oxidation was not retained for further evaluation because significant constraints exist that may limit the application of this process option, including the presence of underground utilities and associated preferential pathways, the presence of underground obstructions (e.g. cribbing and piles), the limited space available on site for process chemical storage/generation of ozone, the high organic content of the soil (creating the need for significant oxidant quantities), and the presence of basements in several buildings located on the Jacob Riis property (creating potential exposure pathways to unreacted oxidant). A bench-scale treatability study would be required to estimate oxidant demand, however, it is anticipated that multiple treatments with highly reactive oxidants would likely be required. Also, this relative cost associated with ISCO is considered high.

<u>Removal</u>

Technologies retained through the preliminary screening consisted of hydraulic removal (vertical extraction wells) and NAPL removal (active removal, passive removal, and collection trenches). Each of the NAPL removal technology processes were retained as each process may be effective in removing NAPL. NAPL removal processes have relative costs that range from low to high and the most effective means to remove NAPL would be evaluated as part of a remedial design and/or pilot study. NAPL recovery via passive methods is a feasible technology process that could potentially provide effective means of removing NAPL and achieve several RAOs. This technology process may be effective at mitigating future impacts to groundwater and limiting the potential for migration of NAPL off OU-1.

In general, inefficiencies associated with pump and treat technologies exist, including the overall ineffectiveness of treating source material (especially PAHs/NAPL that have high Koc values and; therefore, do not dissolve rapidly), large volumes of water that would require removal and treatment (especially given the presence of the East River), lack of long-term access to areas that may require wells (i.e., implementability concerns), and the limited space to construct and operate for pumping and treatment equipment. The presence of a water treatment system on the Jacob Riis Property would create a visual and noise nuisance to the residents, along with increased worker and vehicular traffic associated with operation and maintenance activities. High pumping rates may be required to overcome the hydraulic influence of the East River.

Additionally, ex-situ on-site treatment technologies and associated processes were not retained through preliminary screening based on implementability concerns. Therefore, vertical extraction wells were not retained for further evaluation as a stand-alone process option; however, pumping and treating of water may be used to support the implementation of other technologies (e.g., dewatering during excavation).

<u>Ex-Situ On-Site Treatment</u>

Although ex-situ on-site treatment technology processes may be used in support of constructing other remedial technology processes, none the remedial technologies and associated technologies were retained as a stand-alone technology process option through the preliminary screening.

<u>Off-Site Treatment and/or Disposal</u>

Technology process options retained through the preliminary screening consisted of discharge to a POTW, discharge to a commercially operated treatment facility, and discharge to surface water via storm sewer.

These technology process options were not retained through the secondary screening. As indicated above, groundwater pump and treat processes are not considered effective or readily implementable. Therefore, potential remedial alternatives will not require an ongoing to discharge/ disposal of treated/untreated groundwater removed from the subsurface. However, off-site treatment/disposal technology process options may be used during in support of construction other remedial technology processes.

4.5 Summary of Retained Remedial Technologies

Tables 4-3 and 4-4 summarize the remedial technology types and process options that were retained for soil and groundwater through secondary screening:

Table 4-3. Retained Soil Technologies

GRA	Technology Type	Technology Process Option
No Action	No Action	No Action
Institutional Controls/ Engineering Controls	Institutional Controls	Deed Restrictions, Environmental Land Use Restrictions, Enforcement and Permit Controls, Informational Devices
	Engineering Controls	Building Design Standards, Low-Permeability Liners, Vapor Mitigation Systems, Fencing
In-Situ Containment/Controls	Surface Controls/Capping	Asphalt/Concrete Cap, Clay/Soil Cap
Removal	Excavation	Excavation
Off-Site Treatment and/or Disposal	Recycle/Reuse	Fuel Blending/Co-Burn in Utility Boiler
	Extraction	Low-Temperature Thermal Desorption
	Disposal	Solid Waste Landfill

As stated in Section 4.4.2.1, off-site treatment/disposal of soil would be determined by Con Edison during the remedial design.

Table 4-4. Retained Groundwater Technologies

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

4.6 Development of Remedial Alternatives

This section uses the screened technologies presented in Tables 4-3 and 4-4 to develop remedial alternatives capable of addressing the RAOs for OU-1. Consistent with DER-10 and the USEPA's "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988a), evaluation of the following alternatives are required:

- The "No-Action" alternative
- An alternative that would restore OU-1 to pre-disposal conditions

This AAR; however, does not include a detailed evaluation of a remedial alternative that would remediate OU-1 to unrestricted use, pre-disposal conditions. As discussed with the NYSDEC during a December 23, 2008 project meeting, this alternative would not be feasible based on a number of site characteristics and constraints, including:

- Remediation to 6NYCRR Part 375-6 unrestricted use SCOs would require demolition of Jacob Riis high-rise apartment buildings and the NYC Department of Environmental Protection building. Based on existing data, MGP impacts may potentially exist beneath these buildings. In-situ technologies do not exist that could effectively and safely remove NAPL and/or NAPL-impacted soil beneath the buildings given the nature of the subsurface (fill materials, cribbing, potential preferred migration pathways, etc.). To excavate beneath the buildings, apartment residents would need to be re-located, prior to excavation.
- The limits of OU-1 are immediately adjacent to the FDR. The depth of the excavation at the southern end of OU-1 to achieve pre-disposal conditions would extend to approximately 35 to 40 feet bgs. Stability of the FDR during excavation, combined with the presence and unknown integrity of subsurface structures/cribbing, would likely require that portions of the FDR highway be closed, or traffic limited during a portion of the excavation activities.
- Excavation activities below that water table within in OU-1 would encounter significant implementation challenges. Subsurface conditions within OU-1 (i.e., foundations walls, old piles, cribbing, and fill material) would make installation of soil excavation support systems (e.g., sheeting, soldier pile and lagging, secant pile walls) difficult. Historical data describing the New York waterfront indicates that

cribworks were commonly constructed of giant timber frame boxlike receptacles (commonly 40 feet long by 40 feet wide and 35 feet deep) filled with stone, debris and concrete for stability.

- A large-scale excavation alternative that includes excavation below the groundwater would require a significant groundwater extraction and on-site treatment system, as the East River has a strong hydraulic connection with OU-1 groundwater. Upwelling of water within the excavation area would be a concern.
- The density of buildings/structures, and available space and constructability concerns associated with ancillary excavation processes (i.e., excavation support systems, dewatering and water treatment systems). Additionally, existing subsurface infrastructure/utilities within OU-1 would have to bypassed or relocated.
- As presented above, groundwater generally flows towards the East River. Existing data indicates that a significant amount of subsurface impacts exists between OU-1 and the East River (i.e., beneath the FDR and within OU-2). Even if remediation to pre-disposal conditions was feasible, groundwater would be re-impacted upon leaving the site. Impacted groundwater entering the East River will be addressed as part of the OU-2 AAR.
- It is anticipated that there would be a lack of public acceptance associated with this remedy, especially, as indicated in Section 1, there are no current exposures to MGP-impacted subsurface soil and groundwater. Relocating the residents of the apartment buildings and the NYC Department of Environmental Protection Manhattan Pump Station (i.e., critical infrastructure for NYC) would not be administratively feasible.

The cost of implementing a remedial alternative that would include large-scale excavation and the associated relocation of the community that would provide minimal added benefit to human health and the environment, and is not anticipated to receive public support, is considered highly impractical from both an administrative and cost standpoint.

Additional alternatives were developed in accordance with the remedy selection considerations presented in DER-10, Section 4.2, and include those based on:

- Current, intended and reasonably anticipated future use of the site
- Removal of source areas of contamination
- Containment of contamination

These additional alternatives require varying levels of remediation but provide protection of human health and the environment by preventing or minimizing exposure to the COPCs through the use of containment options and/or institutional controls; remove COPCs to the extent possible thereby minimizing the need for long-term management; and treat the COPCs but vary in the degree of treatment employed and long-term management needed.

Remedial alternatives that have been assembled and developed for addressing the impacted media at OU-1 are presented below. Detailed technical descriptions of the remedial alternatives are presented in Section 5 as part of the detailed remedial alternative evaluations.

4.6.1 Alternative 1 – No Action

No remedial activities would be completed under this alternative.

4.6.2 Alternative 2 – Groundwater Monitoring, Indoor Air Monitoring and ICs/ECs

This remedial alternative would include establishing institutional controls and implementing engineering controls. Institutional controls would consist of placing deed restrictions on the properties that contain MGP-related impacts to restrict the future development and use of OU-1 and control permissible invasive (i.e., subsurface) activities at the properties. Engineering controls would include indoor air monitoring for buildings with basements and installing vapor mitigation/barrier systems, if warranted based on the results from indoor air monitoring, and periodic inspection and maintenance of existing fencing, vegetation, and hard surfaces (i.e., asphalt and concrete) that limit access to and cover surface soil within OU-1. A groundwater monitoring well would be installed near (south of) Public School 34 to monitor/ document the western limits of dissolved-phase groundwater impacts. An SMP would be prepared to establish monitoring and inspection requirements (e.g. groundwater, indoor air, condition of fencing, etc.) and would also present health and safety protocols/controls associated with conducting intrusive activities.

4.6.3 Alternative 3 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery and ICs/ECs

Alternative 3 would include the same institutional controls, engineering controls, groundwater monitoring, and indoor air monitoring components as Alternative 2. Alternative 3 would also include installation of NAPL recovery wells (or trenches) to facilitate collection of mobile NAPL within the subsurface. The recovery wells would be located in the eastern portion of the Jacob Riis property in areas where measurable quantities of NAPL have been documented during the remedial investigation. The recovery wells would be periodically monitored for the presence of NAPL, and if encountered, NAPL would be passively removed and managed, transported, and disposed in accordance with applicable rules and regulations. NAPL monitoring and recovery protocols would be established in the SMP. Additionally, Alternative 3 would include installation of a surface control (e.g., concrete floor) to cover exposed earthen floors in the ground level of Jacob Riis Building No. 4 (1223 FDR Drive) to mitigate potential dermal exposures.

4.6.4 Alternative 4 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal, and ICs/ECs

Alternative 4 would include the same institutional controls, engineering controls, groundwater monitoring, indoor air monitoring, passive NAPL recovery, and indoor surface control components as Alternative 3. Alternative 4 would also include removal of the top two feet of all exposed soil surfaces within the Jacob Riis property (vegetated and non-vegetated) that contain constituents of potential concern (COPCs) at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs. Excavated material would be transported off-site for disposal. A highly visible demarcation layer would be placed within the bottom of the removal areas and the disturbed areas would be restored to the previously existing grade with clean imported fill material and vegetated as appropriate.

4.6.5 Alternative 5 – Groundwater and Indoor Air Monitoring, Shallow Soil Removal, Targeted Subsurface Soil Removal, Limited Surface Control within 1223 FDR Drive, NAPL Recovery, and ICs/ECs

As indicated in Section 4.6, the presence of roadways and buildings, as well as the nature of subsurface material within OU-1 would prohibit large-scale excavation activities (or presents significant implementation and public acceptance challenges). Based on the 3-dimensional model developed for the Site, OU-1 contains approximately 73,600 cubic-yards of MGP-impacted soil (i.e., soil that contains NAPL, total PAHs at concentrations greater than 500 ppm, and/or total BTEX at concentrations greater than 10 ppm). Assuming that excavation activities cannot be completed beneath roadways and buildings, the following table summarizes the estimated quantity of MGP-impacted material that would be removed by completing soil excavation activities to varying depths.

Table 4-5. Soil Removal Volumes

Excavation Depth (ft)	Total Volume of Soil that Would Require Removal (CY)	Total Volume of MGP-Impacted Soil Removal (CY)	% of MGP-Impact Soil Removed from OU-1 (CY)*
8	8,500	1,300	1.7%
15	32,500	10,500	14%
20	54,000	19,400	26%

* % of MGP-impacted soil removed based on a total of 73,600 cubic-yards of MGP-impacted soil in OU-1.

As indicated in Table 4-5, a remedial alternative that includes excavation activities to a depth 8 feet bgs (i.e., approximately one foot below the water table) would remove less than 2% of MGP-impacted soil within OU-1. Remedial alternatives that included excavations to depths of 15 and 20 feet bgs would remove approximately 14% and 26% of MGP-impacted soil with OU-1, respectively. Although detailed cost estimates for remedial alternatives that include excavation to depths of 15 and 20 feet have not been prepared as part of this AAR, the disruption to the surrounding community and potential for short-term community exposures to NAPL-impacted soils and groundwater, associated with implementing these alternatives does not justify the limited quantity of MGP-impacted soil that would be addressed by these excavation alternatives. Additionally, MGP-impacted soil would still remain beneath buildings and roadways, as well as within OU-2.

Therefore, Alternative 5 includes targeted excavation activities to address accessible subsurface soil to a depth of 8 feet bgs to reduce the mass of MGP-related impacts. Targeted MGP-impacted soil is defined as containing visual MGP-related impacts (i.e., NAPL) and/or soil containing total BTEX or total PAHs at concentrations greater than 10 ppm and 500 ppm, respectively. Excavated soil would be transported for off-site disposal. Soil beneath existing buildings and roadways would not be included in the excavation areas. Similar to Alternatives 3 and 4, a highly visible demarcation layer would be placed within the bottom of the removal areas and disturbed areas would be restored to the previously existing grade with clean imported fill material and existing surfaces would be restored, in kind. Alternative 5 would include the same institutional controls, engineering controls, groundwater and indoor air monitoring, passive NAPL recovery, shallow soil removal, and indoor surface control components as Alternatives 3 and 4.

5 DETAILED EVALUATION OF REMEDIAL ALTERNATIVES

5.1 General

This section presents detailed descriptions of the remedial alternatives developed to achieve the site-specific RAOs. Each of the retained remedial alternatives are described and evaluated with respect to the criteria presented in 6 NYCRR Part 375 and DER-10 (NYSDEC, 2010). The results of the detailed evaluation of remedial alternatives are used to aid in the recommendation of appropriate alternatives to be implemented at the site.

5.2 Description of Evaluation Criteria

The detailed evaluation of remedial alternatives presented in this section consists of an evaluation of each assembled alternative (presented in Section 4.6) against the following threshold and primary balancing criteria as required by DER-10 (NYSDEC, 2010):

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

These evaluation criteria encompass statutory requirements and include other gauges such as overall feasibility. Descriptions of the evaluation criteria are presented in the following sections. Additional criteria, including public and state acceptance, will be addressed following submittal of this AAR.

5.2.1 Short-Term Impacts and Effectiveness

The short-term impacts and effectiveness of the remedial alternative are evaluated relative to its potential effect on human health and the environment during implementation of the alternative. The evaluation of each alternative with respect to its short-term 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.
- The sustainability and use of green remediation practices utilized during implementation of the remedy.

- Amount of time required until protection of public health and the environment is achieved.

5.2.2 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 exposure pathways or risks to human health, the environment, and ecological receptors 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 waste.

5.2.3 Land Use

This criterion evaluates the current and reasonably anticipated future land use of OU-1 relative to the cleanup objectives of the remedial alternative when unrestricted use cleanup levels would not be achieved. This evaluation considers local zoning laws and community master plans,, proximity to residential properties, accessibility to infrastructure, proximity to natural resources including groundwater drinking supplies, and the extent to which the proposed remedy may reasonably be expected to cause or increase a burden on the community.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion is an evaluation of the ability of an alternative or remedy to permanently reduce the toxicity, mobility, or volume of the constituents present in the site media. The evaluation focuses on the following factors:

- The treatment process and the amount of materials to be treated.
- The anticipated ability of the treatment process to reduce the toxicity, mobility, or volume of OU-1 impacts.
- The nature and quantity of treatment residuals that will remain after treatment.
- The degree to which the treatment is irreversible.

Preference is given to remedies that permanently or significantly reduce the toxicity, mobility, or volume of the constituents at OU-1

5.2.5 Implementability

This criterion addresses the technical and administrative (i.e., non-technical) feasibility of implementing the remedial alternative, including the availability of the various services and materials required for implementation. The following factors are considered during the implementability evaluation:

- **Technical Feasibility** – This factor refers to the relative ease of implementing or completing the remedial alternative based on site-specific constraints. In addition, the alternative's operational reliability is considered, as well as the ability to monitor the effectiveness of the remedial alternative.

- **Administrative (non-technical) Feasibility** – This factor refers to the availability of necessary personnel and material along with potential difficulties in obtaining operating approvals, access for construction, and required approvals and permits.

5.2.6 Compliance with SCGs

This threshold criterion evaluates the remedial alternative's ability to comply with officially promulgated SCGs that were identified in Section 2 and directly applicable or that are relevant and appropriate. Conformance with standards and criteria is required, unless a good cause exists why conformity should be dispensed. Consideration is also given to guidance, which through the application of scientific and engineering judgment is determined to be applicable to the alternative evaluation. Compliance with the following criteria is considered during evaluation of the remedial alternative:

- Chemical-specific SCGs
- Action-specific SCGs
- Location-specific SCGs

This evaluation criterion also addresses whether the remedial alternative would be in compliance with other appropriate federal and state criteria, advisories, and guidance. Applicable chemical-, action-, and location-specific SCGs are presented in Tables 2-1 through 2-3, respectively.

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. While all SCGs are considered during the evaluation of potential remedial alternatives, emphasis is generally placed on chemical-specific SCGs. As such, for the purposes of this AAR, action-specific and location-specific SCGs will not be discussed in as much detail for each potential remedial alternative unless they make the alternative less (or more) attractive.

5.2.7 Overall Protection of Public Health and the Environment

This threshold criterion is an evaluation of the ability of each alternative or the remedy to protect public health and the environment. This evaluation assesses how exposure pathways are eliminated, reduced, or controlled through removal, treatment, engineering controls, or institutional controls. This evaluation also considers the ability of the remedial alternative to meet the RAOs.

5.2.8 Cost Effectiveness

This criterion is an evaluation of the overall cost effectiveness relative to the effectiveness of the alternative or remedy. The estimated total cost to implement the remedial alternative is based on a present worth analysis of the sum of the direct capital costs (materials, equipment, and labor), indirect capital costs (engineering, licenses/permits, and contingency allowances), and O&M costs. O&M costs may include operating labor, energy, chemicals, and sampling and analysis. These costs will be estimated with an anticipated accuracy between -30% to +50% in accordance with NYSDEC guidance. A 25% 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 rate (before taxes and after inflation) is used to determine the present-worth factor.

5.3 Detailed Evaluation of Site-Wide Alternatives

This section presents the detailed analysis of each of the site-wide alternatives previously identified in Section 4.

- Alternative 1 – No Action
- Alternative 2 – Groundwater Monitoring, Indoor Air Monitoring and ICs/ECs
- Alternative 3 – Groundwater and Indoor Air Monitoring, Passive NAPL Recovery and ICs/ECs
- Alternative 4 – Groundwater and Indoor Air Monitoring, Passive NAPL Recovery, Shallow Soil Removal, and ICs/ECs
- Alternative 5 – Groundwater and Indoor Air Monitoring, Shallow Soil Removal, Targeted Subsurface Soil Removal, NAPL Recovery, and ICs/ECs

Each alternative is evaluated against the seven evaluation criteria described above (as indicated, public acceptance will be evaluated following submittal of this Alternatives Analysis Report).

5.3.1 Alternative 1 – No Action

The "No Action" alternative was retained for evaluation for each of the environmental media to be addressed at the site 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 the COPCs in the environmental media within OU-1. 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.

Short-Term Impacts and Effectiveness – Alternative 1

No remedial actions would be implemented for the impacted environmental media within OU-1. Therefore, there would be no short-term environmental impacts or risks associated with remedial activities posed to the community.

Long-Term Effectiveness and Permanence – Alternative 1

Under the "No Action" alternative, the COPCs in OU-1 media would not be addressed or the potential for on-going releases and/or migration of impacts. As a result, this alternative would not meet the RAOs identified for OU-1, and; therefore is not considered effective on a long-term basis.

Land Use – Alternative 1 (No Action)

The current and foreseeable future use of OU-1 is a densely populated urban setting consisting of primarily of multi-story residences and small community businesses and services, along with a church and school. The majority of the site is covered with asphalt, concrete, buildings, or vegetated soil. Additionally, drinking water is currently and will continue to be provided via a public supply.

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

Reduction of Toxicity, Mobility, or Volume 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 the COPCs in the impacted environmental media within OU-1 would not be reduced.

Implementability – Alternative 1

The "No Action" alternative does not require implementation of any remedial activities or ICs/ECs, and; therefore, is technically and administratively implementable.

Compliance with SCGs – Alternative 1

- **Chemical-Specific SCGs**: Because removal or treatment is not included as part of this alternative, the chemical-specific SCGs identified for OU-1 would not be met by this alternative.
- **Action-Specific SCGs**: This alternative does not involve implementation of any remedial activities; therefore, the action-specific SCGs are not applicable.
- **Location-Specific SCGs**: Because no remedial activities would be conducted under this alternative, the location-specific SCGs are not applicable.

Overall Protection of Public Health and the Environment – Alternative 1

The "No Action" alternative does not address the toxicity, mobility, or volume of impacted environmental media within OU-1and is not effective on a long-term basis for eliminating potential migration or potential exposure to impacts. Therefore, the "No Action" alternative would be ineffective and would not meet the RAOs established for environmental media within OU-1.

Cost Effectiveness – Alternative 1

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

5.3.2 Alternative 2 – Groundwater Monitoring, Indoor Air Monitoring, and ICs/ECs

The major components of Alternative 2 include the following:

- Preparing an SMP that establishes institutional controls and/or engineering controls and identifies activities to insure their enforcement after implementation.
- Installing a groundwater monitoring well to evaluate the western extent of the dissolved phase BTEX in groundwater.
- Conducting long-term groundwater monitoring.
- Conducting indoor air monitoring.

This alternative would indirectly address the potential for exposure to MGP-impacted surface soil in outdoor common areas of the Jacob Riis property, along with earthen floors in the ground level of Jacob Riis Building No. 4 (1223 FDR Drive) through the implementation of institutional and engineering controls. This alternative also includes long-term groundwater monitoring and indoor air monitoring at the Jacob Riis property to facilitate identification of significant changes in the quality of these media.

Under Alternative 2, institutional controls in the form of deed restrictions and environmental easements would be established for the Jacob Riis property. Specifically, the institutional and engineering controls would limit the use of vegetated and non-vegetated (i.e., bare soil) areas within the outdoor areas of the property and the earthen floor storage rooms of Jacob Riis Building No. 4 that potentially contain PAHs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs (as identified by the RI). The institutional and engineering controls would be documented in the SMP that would be prepared for OU-1. Access to vegetated surface soil surrounding the Jacob Riis buildings is currently restricted by fencing. Existing fencing would be inspected annually to document that fencing is limiting access to surface soil. Public access to earthen floor storage rooms in Jacob Riis Building No. 4 would be prohibited (e.g., via secured doors). Additionally, the institutional controls would establish controls on intrusive (i.e., subsurface) activities that are conducted within the Jacob Riis property and restrict the use of OU-1 groundwater. Annual verification would be required and reports submitted to NYSDEC to document that institutional and engineering controls are maintained and effective. Implementation of institutional controls and/or engineering controls is highly dependent upon the current property owner’s willingness to enter into an agreement with Con Edison to accept and maintain the controls. Implementation of institutional and engineering controls would require coordination with State agencies (i.e., NYSDEC and NYSDOH), as well as the owners of the Jacob Riis property.

As indicated in Section 1, groundwater within OU-1 contains BTEX, PAHs, and inorganics at concentrations greater than NYSDEC Class GA groundwater standards and guidance values. Although there are no current users of groundwater or exposure to impacted groundwater within OU-1, this alternative would also include conducting annual groundwater monitoring to document potential changes in COPC concentrations in groundwater within OU-1. Based on the concentrations of COPCs detected in monitoring wells MW-4 and MW-115A (located near Jacob Riis Building No. 2) and the groundwater flow direction, a groundwater monitoring well would be installed within the East 11th Street pedestrian walkway between Public School 34 and NYC Parks and Recreation Dry Dock Playground and Pool. The new monitoring well would be used to delineate the western extent of dissolved phase BTEX, confirm groundwater flow direction in this area, verify that dissolved phase COPCs are not present in properties west of Avenue D, and be used as an “early detection” or “sentinel” well to document conditions west of OU-1. Annual groundwater monitoring activities would include collecting groundwater samples from up to 20 monitoring wells within OU-1. The specific wells would be determined during the remedial design for this alternative. Groundwater samples would be submitted for laboratory analysis for BTEX, PAHs, and select inorganics. Analytical results would be used to document the extent of dissolved impacts and trends in COPC concentrations. The results of the annual groundwater monitoring would be presented to NYSDEC in an annual report. Based on the results of the monitoring activities, Con Edison may request to modify the quantity or frequency of wells sampled. However, for the purpose of developing a cost estimate for this alternative, it has been assumed that annual groundwater monitoring activities would be conducted for 30 years. Note that annual groundwater monitoring could only be completed if the current property owners are willing to grant access to complete the sampling activities.

Alternative 2 would also include conducting annual indoor monitoring within the basement and/or ground level of buildings within the Jacob Riis property. As indicated in Section 1, based on the results of previous sampling activities, indoor air is not impacted with MGP-related COPCs. Therefore, engineering controls are not warranted at this time. If, based on the results of the annual indoor air monitoring, MGP-related COPCs are detected at concentrations greater than applicable standards and guidance values, engineering controls such as soil vapor barriers and/or soil vapor mitigation systems (i.e., sub-slab depressurization systems) would be evaluated. For the purpose of developing a cost estimate for this alternative, it has been assumed that annual indoor air monitoring and reporting would be conducted for 30 years, however, no costs have been assumed for installing engineering controls to address the potential for future soil vapor intrusion for buildings within OU-1. Note that annual indoor monitoring could only be completed if current property owners are willing to grant access to complete the sampling activities.

This alternative would include preparation of an SMP to document the following:

- The requirements for documenting that institutional and engineering controls that have been established are being maintained for OU-1.
- Known locations of soil within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs.
- Requirements for fencing inspection and maintenance.
- Protocols and requirements for annual groundwater and indoor air monitoring.
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities.
- Protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor air based on the results obtained from the annual monitoring activities.

<u>Short-Term Impacts and Effectiveness – Alternative 2</u>

Implementation of this alternative could result in minimal short-term exposure to surrounding community and field personnel. Potential short-term exposures to impacted soil, groundwater, and/or NAPL could occur during installation of the groundwater monitoring well east of Avenue D (although NAPL impacted soil and groundwater containing dissolved phase COPCs is not expected to be encountered at the anticipated well location). Potential exposure mechanisms would include ingestion of or dermal contact with impacted soil, groundwater, and NAPL and/or inhalation of volatile organic vapors. Potential exposures to field personnel would be minimized through training and PPE, as specified in a site-specific Health and Safety Plan (HASP) that would be developed as part of the remedial design. Air monitoring would be performed during well installation activities to confirm that volatile organic vapors are within acceptable levels, to be specified in the site-specific HASP. Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. Potential risks to the community could occur during periodic groundwater monitoring activities via exposure to purged groundwater and/or groundwater samples. Potential exposures to the community would be minimized by following appropriate procedures and protocols described in the SMP.

The relative carbon footprint of this alternative (compared to the other alternatives) is considered minimal. The greatest contribution to greenhouse gases would occur as a result of equipment used during well installation activities.

This remedial alternative could be implemented in less than one month and monitoring would be conducted over an assumed 30-year period.

Long-Term Effectiveness and Permanence – Alternative 2

Alternative 2 could reduce potential long-term exposures to COPCs in MGP-impacted media. Alternative 2 includes establishing institutional controls and engineering controls to prohibit contact with surface soil and use of groundwater, and establish controls/protocols for conducting subsurface activities within OU-1. The institutional controls would set restrictions and limit the use of vegetated and non-vegetated (i.e., bare soil) areas. In addition, access to the portions of Jacob Riis Building No. 4 that contain earthen floor storage rooms would be limited (e.g. restricted access). Existing fencing would be utilized as an engineering control to restrict access to OU-1 surface soils. Annual verification of the institutional and engineering controls would be completed to document that the controls are maintained and remain effective.

Alternative 2 could reduce potential human exposures to surface soil and subsurface soil containing COPCs (surface soil RAO #1 and subsurface soil RAO #1), reduce potential human exposures to MGP-related NAPLs (subsurface RAO #3), and reduce potential human exposure to groundwater containing COPCs (groundwater RAO #3) through implementation of institutional controls and engineering controls such as maintaining fencing around OU-1 surface soil.

Land Use – Alternative 2

The current and foreseeable future use of OU-1 is a densely populated urban setting consisting of primarily of multi-story residences. The majority of the site is covered with asphalt, concrete, buildings, or vegetated soil. Additionally, drinking water is currently and will continue to be provided via a public supply.

Alternative 2 would be consistent with the current land use at OU-1 and should not interfere with redevelopment of this area under the current zoning. Although OU-1 is not expected to be significantly re-developed in the foreseeable future, based on the proposed long-term groundwater monitoring, any re-development of the properties that would contain groundwater monitoring wells may require coordination with the developer to maintain the wells or to make provisions to access/repair/re-install the wells as needed.

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

As indicated above, no remedial activities would be conducted under this alternative to address media within OU-1 containing MGP-related impacts. Although dissolved phase COPCs in OU-1 groundwater could be reduced via natural processes (e.g., biodegradation, dispersion, dilution, volatilization, etc.) and documented by the periodic groundwater monitoring activities, without removal of the source of dissolved phase groundwater impacts (i.e., NAPL and impacted soil), the reduction would occur over a prolonged, indeterminate amount of time. Therefore, implementation of Alternative 2 would not significantly reduce the toxicity, mobility, or volume of MGP-impacted media present in OU-1.

Implementability – Alternative 2

This remedial alternative would be both technically and administratively implementable. From a technical standpoint, equipment and personnel qualified to install the new groundwater monitoring well and conduct periodic groundwater and indoor air monitoring activities are readily available. Prior to installing the groundwater monitoring well, subsurface utilities would be identified to ensure that utilities are not damaged during well installation. The groundwater monitoring well would be secured in lockable subsurface vault to prevent potential access by unauthorized personnel.

Access agreements would need to be secured by Con Edison to install the monitoring well and conduct the periodic groundwater and indoor air monitoring activities. Monitoring activities could only be completed if the property owner is willing to grant access to sampling areas. Implementation of institutional and engineering controls is highly dependent upon current property owner's willingness to enter into an agreement with Con Edison to establish the controls and would require coordination with State agencies (i.e., NYSDEC and NYSDOH), as well as the owners of the Jacob Riis property.

<u>Compliance with SCGs – Alternative 2</u>

- **Chemical-Specific SCGs** – Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6NYCRR Part 375-6 soil cleanup objectives and 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values. Potentially applicable chemical-specific SCGs for soil vapor include NYSDOH guidance values established in *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (NYSDOH, 2006).

  Alternative 2 would not address soil containing COPCs at concentrations greater than 6NYCRR Part 375-6 restricted use SCOs. Process residuals generated during the implementation of this alternative (e.g., drilling waste and development/purge water from well installation) would be managed in accordance with 40 CFR 261 and 6NYCRR Part 371 regulations. Process residuals would be characterized to determine off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.

  As indicated in Section 1, groundwater within OU-1 contains VOCs, SVOCs, and inorganics at concentrations greater than NYSDEC Class GA standards and guidance values. As this alternative does not include active remedial measures to address MGP-impacted soil, this alternative would likely not achieve groundwater SCGs within a determinate period of time.

  As part of this alternative, indoor air quality would be periodically monitored. If, based on the results of the monitoring, MGP-related COPCs are detected at concentrations greater than applicable guidance values, potential concerns would be addressed by the protocols to be set forth in the SMP to be prepared as part of this alternative.

- **Action-Specific SCGs** – Action-specific SCGs are presented in Table 2-2. 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 during remedial activities and O&M activities would be accomplished by following a site-specific HASP.

  Residual soil generated during well installation 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 a NYSDEC-approved Remedial Design/Remedial Action (RD/RA) Work Plan and using licensed waste transporters and permitted disposal facilities. If any of the materials are characterized as a hazardous waste, NYS LDRs could be applicable.

- **Location-Specific SCGs** – Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities within flood plains. A majority of the Jacob Riis Housing complex is located within the 100-year flood plain for the East River. Compliance with these SCGs would be achieved by obtaining a joint United States Army Corp of Engineering (USACE) and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances.

Overall Protection of Public Health and the Environment – Alternative 2

Alternative 2 would mitigate potential long-term exposures to MGP-impacted media by establishing institutional and engineering controls. Alternative 2 could reduce potential human exposures to surface soil and subsurface soil containing COPCs (surface soil RAO #1 and subsurface soil RAO #1), reduce potential human exposures to MGP-related NAPLs (subsurface RAO #3), and reduce potential human exposure to groundwater containing COPCs (groundwater RAO #3). These RAOs would be achieved through implementation of, and verification of adherence to, institutional controls and engineering controls such as maintaining fencing (or installing new fencing) around OU-1 surface soil and restricting access to earthen floor storage rooms in Jacob Riis Building No. 4.

As indicated above, Alternative 2 would not remediate soil containing MGP-related COPCs (subsurface soil RAO #2), reduce further off-site migration of MGP-related NAPL (subsurface soil RAO #4), restore COPC-impacted groundwater (groundwater RAO #1), reduce future COPC impacts to groundwater (groundwater RAO #2), prevent off-site migration of COPC-impacted groundwater (groundwater RAO #4), or remove the source of groundwater contamination (groundwater RAO #5) as this alternative does not include means to actively address MPG-impacted media.

Cost Effectiveness – Alternative 2

The estimated costs associated with Alternative 2 are presented in Table 5-1. The total estimated 30-year present worth cost for this alternative is approximately $3,400,000. The estimated capital cost, including costs for establishing institutional controls, is approximately $500,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting annual groundwater and indoor air monitoring, is approximately $2,900,000.

5.3.3 Alternative 3 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery and ICs/ECs

The major components of Alternative 3 include the following:

- Preparing an SMP that establishes institutional controls and/or engineering controls and identifies activities to insure their enforcement after implementation.
- Installing a groundwater monitoring well to evaluate the western extent of the dissolved phase BTEX in groundwater.
- Conducting long-term groundwater monitoring.
- Conducting indoor air monitoring.
- Installing NAPL recovery wells.

- Conducting NAPL gauging and passive recovery.
- Installing a surface control in portions of Jacob Riis Building No. 4 (1223 FDR Drive) that contain earthen storage areas.

Similar to Alternative 2, this alternative would indirectly address the potential for exposure to MGP-impacted surface soil in outdoor common areas of the Jacob Riis property through the implementation of institutional controls. Alternative 3 also includes long-term groundwater and indoor air monitoring to facilitate identification of significant changes in the quality of these media. This alternative also provides provisions to recover mobile NAPL within OU-1. The primary objective of the NAPL recovery component of this alternative is to remove the mobile fraction of NAPL within OU-1. Immobile NAPL would remain in subsurface soil within OU-1 and not be directly addressed by this remedial alternative.

Additionally, Alternative 3 would include installation of a surface control to cover the existing earthen floors in the storage room areas of Jacob Riis Building No. 4 (1223 FDR Drive) to mitigate potential exposure (e.g., ingestion, dermal contact) to soil containing COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs. For the purpose of developing this AAR, the surface control is assumed to consist of 6 inches of concrete installed to meet the elevations of existing hard floor surfaces within the ground level of the building (i.e., removal of existing material may be required to achieve required grades). The specific areas in need of surface control, and materials and construction details of the surface control, would be developed during the pre-design investigation and remedial design phases of the project. As stated above, based on the surface soil exposure pathway evaluation presented in the SCS Report (i.e., the only exposure pathway that is potentially complete is direct ingestion and/or dermal contact), along with the results of indoor air monitoring for Jacob Riis Building No. 4 (1223 FDR Drive) that indicated MGP-related impacts were not present (discussed in Section 1.4), and consistent with existing concrete floor surfaces within the utility rooms, the surface control would not include vapor/water-proof barrier.

Alternative 3 would include the same institutional controls as Alternative 2. Deed restrictions and environmental easements would be established to prohibit use of outdoor vegetated and non-vegetated (i.e., bare soil) areas and use of groundwater (although there are no current users of groundwater), as well as limit the invasive activities that could be conducted within OU-1. Existing fencing used to limit access to surface soil would be inspected annually to document that fencing is limiting access to surface soil. The institutional and engineering controls would be documented in the SMP that would be prepared for OU-1. Implementation of institutional controls is highly dependent upon current property owner's willingness to enter into an agreement with Con Edison to establish these controls. Implementation of institutional controls would require coordination with State agencies (i.e., NYSDEC and NYSDOH), as well as the owner of the Jacob Riis property.

As with Alternative 2, a new groundwater monitoring well would be installed within the East 11th Street pedestrian walkway and annual groundwater monitoring would be conducted to document dissolved phase COPC concentrations and groundwater flow direction within OU-1. Annual indoor air monitoring would also be conducted for Alternative 3. If, based on the results of the annual monitoring, MGP-related COPCs are detected at concentrations greater than applicable standards and guidance values, engineering controls would be installed within the basements and/or the ground level of affected buildings within OU-1. Note that annual groundwater and indoor monitoring could only be completed if the current property owners are willing to grant access to complete the sampling activities.

Alternative 3 would also include the installation of NAPL recovery wells or collection trenches to facilitate the collection and removal of mobile NAPL in OU-1. For the purpose of developing a cost estimate for this alternative, it has been assumed that up to 12 NAPL recovery wells would be installed along the eastern portion of the Jacob Riis property where measurable quantities of NAPL have been historically observed in monitoring wells and during the completion of soil borings (Figure 5-1). The final number, location, and construction of the NAPL recovery wells (or collection trenches) would be evaluated during the remedial design. As part of the remedial design, a pre-design investigation (PDI) would be conducted to assess the physical characteristics of the NAPL observed within OU-1 and evaluate potential means and methods for removing the NAPL that collects within the recovery wells/collection trenches. NAPL samples would be collected and submitted for laboratory analysis for specific gravity, viscosity, and interfacial tension at ambient groundwater temperatures.

Following installation of the recovery wells/collection trenches, NAPL removal may be conducted passively by periodic manual bailing or pumping NAPL from the recovery wells. If warranted based on the rate of NAPL recovery by the wells/collection trenches, NAPL could be removed actively via an automated pumping system. NAPL would be pumped from the wells and stored within a structure that would have to be constructed within OU-1 (either above or below grade). An active NAPL recovery system would also likely collect groundwater that would have to be stored, treated, and disposed of, as appropriate.

NAPL would initially be monitored and passively recovered on a semi-annual basis. If no recoverable quantities of NAPL are observed during multiple consecutive NAPL monitoring events (e.g., four consecutive semi-annual monitoring events), Con Edison may request to conduct NAPL monitoring less frequently or cease NAPL monitoring altogether. However, for the purpose of developing a cost estimate for this alternative, it has been assumed that semi-annual passive NAPL recovery activities would be conducted for 30 years.

This alternative would include preparation of an SMP to document the following:

- The requirements for documenting that institutional and engineering controls have been established and are being maintained for OU-1.
- Known locations of soil within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs.
- Requirements for fencing inspection and maintenance.
- Protocols and requirements for semi-annual NAPL monitoring and annual groundwater and indoor air monitoring.
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities.
- Protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor based on the results obtained from the annual groundwater monitoring activities.

<u>Short-Term Impacts and Effectiveness – Alternative 3</u>

Implementation of this alternative could result in short-term exposure to the surrounding community and field personnel. Potential short-term exposures to impacted soil, groundwater, and/or NAPL could occur during installation of the groundwater monitoring well west of Avenue D (although NAPL impacted soil and groundwater containing dissolved phase COPCs is not expected to be encountered at the anticipated well location) and the NAPL recovery wells installed along the eastern portion of the Jacob Riis property. Additionally, potential short-term exposures to impacted soil could occur during installation of the surface control in the storage room areas of Jacob Riis Building No. 4. Potential exposure mechanisms would include ingestion of or dermal contact with impacted soil, groundwater and NAPL and/or inhalation of volatile organic vapors. Potential exposures to field and construction personnel would be minimized through the use of training and PPE, as specified in a site-specific HASP that would be developed as part of the remedial design for this alternative. Air monitoring would be performed during well installation activities to confirm that volatile organic vapors are within acceptable levels, as specified in the site-specific HASP. Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community.

The relative carbon footprint of this alternative (compared to the other alternatives) is considered minimal. The greatest contribution to greenhouse gases would occur as a result of equipment used during well installation activities.

This remedial alternative could be implemented in approximately two months and monitoring would be conducted over an assumed 30-year period.

<u>Long-Term Effectiveness and Permanence – Alternative 3</u>

Alternative 3 could reduce potential long-term exposures to COPCs in MGP-impacted media. This alternative includes installation of a surface control in Jacob Riis Building No. 4, establishing institutional controls to prohibit contact with surface soil in outdoor common areas and for use of groundwater, and control subsurface activities that could be conducted within OU-1, which all work toward reducing the potential for exposure to impacted media. The institutional controls would set restrictions and limit the use of outdoor vegetated and non-vegetated (i.e., bare soil) areas. Existing fencing would be utilized as an engineering control to restrict access to OU-1 surface soils in outdoor areas. Annual verification of the institutional and engineering controls would be completed to document that the controls are maintained and remain effective.

This alternative also includes NAPL recovery to collect and remove mobile NAPL from OU-1. Field personnel and the community could potentially be exposed to recovered/ stored NAPL during periodic monitoring activities. Potential exposures to the community would be minimized by following appropriate procedures and protocols as defined in the SMP.

<u>Land Use – Alternative 3</u>

The current and foreseeable future use of OU-1 is a densely populated urban setting consisting primarily of multi-story residences. The majority of the site is covered with asphalt, concrete, buildings, or vegetated soil. Additionally, drinking water is currently and will continue to be provided via a public supply.

Alternative 3 would be consistent with the current land use at OU-1 and should not interfere with re-development of this area under the current zoning. Although OU-1 is not expected to be significantly re-developed in the foreseeable future, based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery activities, any re-development of the properties that contain groundwater monitoring and/or NAPL recovery wells may require coordination with the developer to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

<u>Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative 3</u>

This alternative does not include direct treatment or containment of media in OU-1 that contains MGP-related impacts. However, Alternative 3 does include installation of NAPL recovery wells to monitor for and passively recover mobile NAPL. Through NAPL monitoring and recovery, the volume of mobile NAPL within OU-1 would be reduced, thereby reducing the potential for further migration of mobile NAPL from OU-1. Additionally, by reducing the volume of source material that contributes to dissolved phase COPCs in OU-1 groundwater, passive NAPL recovery would reduce the mass flux of COPCs to the groundwater, thereby reducing the concentration and extent of dissolved phase COPCs.

<u>Implementability – Alternative 3</u>

This remedial alternative would be both technically and administratively implementable. From a technical implementability aspect, equipment and personnel qualified to install groundwater monitoring and NAPL recovery wells and conduct groundwater, NAPL, and indoor air monitoring activities are readily available. Equipment and personnel qualified to install surface controls (e.g., concrete floors) are also readily available. As indicated above, a pre-design investigation would be conducted during the remedial design to evaluate the location and construction details of NAPL recovery wells and/or collection trenches. Prior to installing the NAPL recovery and groundwater monitoring wells, subsurface utilities would be identified to ensure that utilities are not damaged during well installation. The groundwater monitoring well and NAPL recovery wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL removal methods would also be assessed during the design of this alternative. Active NAPL recovery (i.e., automated pumping) would be more difficult to implement, when compared to passive NAPL recovery, as active recovery would require an on-site NAPL storage structure/facility. Construction of a storage structure in a public area is not considered readily implementable or practicable. Active NAPL recovery would also generate groundwater that would have to be managed.

Administratively, institutional and engineering controls would be established for properties not owned by Con Edison, which would require Con Edison to secure agreements with the current property owner. Additionally, access agreements would need to be secured by Con Edison to conduct the periodic NAPL, groundwater, and indoor air monitoring activities. Annual monitoring activities could only be completed if the current property owner is willing to grant access to sampling areas. Implementation of institutional controls is highly dependent upon current property owner's willingness to accept the controls and would require coordination with state agencies (i.e., NYSDEC and NYSDOH), as well as the owners of the Jacob Riis, property. Coordination with, and cooperation of the property owner would be required to temporarily isolate the storage areas to allow for the surface control to be installed, and inspected if required by the SMP.

<u>Compliance with SCGs – Alternative 3</u>

- **Chemical-Specific SCGs** – Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6NYCRR Part 375-6 soil cleanup objectives and 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values. Potentially applicable chemical-specific SCGs for soil vapor include NYSDOH guidance values established in *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (NYSDOH, 2006).

Alternative 3 would not address soil containing COPCs at concentrations greater than 6NYCRR Part 375-6 restricted use SCOs. Process residuals generated during the implementation of this alternative (e.g., drilling waste and development/purge water from well installation) would be managed in accordance with 40 CFR 261 and 6NYCRR Part 371 regulations. Process residuals would be characterized to determine off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.

As indicated in Section 1, groundwater within OU-1 contains VOCs, SVOCs, and inorganics at concentrations greater than NYSDEC Class GA standards and guidance values. As this alternative does not include active remedial measures to address MGP-impacted soil, this alternative would likely not achieve groundwater SCGs within a determinate period of time.

As part of this alternative, indoor air quality would be periodically monitored. If, based on the results of the monitoring, MGP-related COPCs are detected at concentrations greater than applicable guidance values, potential concerns would be addressed by the protocols set forth in the SMP to be prepared as part of this alternative.

- **Action-Specific SCGs** – Action-specific SCGs are presented in Table 2-2. 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.

  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 a NYSDEC-approved RD/RA Work Plan and using licensed waste transporters and permitted disposal facilities. If any of the materials are characterized as a hazardous waste, NYS LDRs could be applicable.

- **Location-Specific SCGs** – Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting construction activities on flood plains. A majority of the Jacob Riis Housing complex is located within the 100-year flood plain for the East River. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances.

Overall Protection of Public Health and the Environment – Alternative 3

Alternative 3 would mitigate potential long-term exposures to MGP-impacted media by conducting passive recovery of mobile NAPL, establishing institutional and engineering controls, installing surface controls in storage room areas of Jacob Riis Building No. 4, and conducting groundwater and indoor air monitoring. Alternative 3 could potentially reduce potential human exposures to surface soil and subsurface soil containing COPCs (surface soil RAO #1 and subsurface soil RAO #1), reduce potential human exposures to MGP-related NAPLs (subsurface RAO #3), and reduce potential human exposure to groundwater containing COPCs (groundwater RAO #3) through implementation of institutional controls and maintaining current site fencing (or installation new fencing) around OU-1 surface soil in outdoor common areas.

Alternative 3 would reduce further off-site migration of NAPL (subsurface soil RAO #4) through passive NAPL recovery of mobile NAPL from OU-1. Passive NAPL recovery would also work toward restoring COPC-impacted groundwater (groundwater RAO #1) and reducing future COPC impacts to groundwater (groundwater RAO #2) by removing a source of dissolved phase groundwater impacts. However, Alternative 3 would not remediate soil containing MGP-related COPCs (subsurface soil RAO #2) and therefore, sources for dissolved phase groundwater impacts would remain and off-site migration of COPC-impacted groundwater would not be prevented (groundwater RAO #4) and the source of groundwater contamination would not be removed (groundwater RAO #5).

Cost Effectiveness – Alternative 3

The estimated costs associated with Alternative 3 are presented in Table 5-2. The total estimated 30-year present worth cost for this alternative is approximately $4,300,000. The estimated capital cost, including costs for installing surface controls in the storage room areas of Jacob Riis Building No. 4, installing NAPL recovery wells and establishing institutional controls, is approximately $800,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL and annual groundwater and indoor air monitoring, is approximately $3,500,000.

5.3.4 Alternative 4 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal, and ICs/ECs

The major components of Alternative 4 include the following:

- Preparing an SMP that establishes institutional controls and/or engineering controls and identifies activities to insure their enforcement after implementation.
- Installing a groundwater monitoring well to evaluate the western extent of dissolved phase BTEX.
- Conducting long-term groundwater monitoring.
- Conducting indoor air monitoring.
- Installing NAPL recovery wells.
- Conducting NAPL gauging and passive recovery.
- Installing a surface control portions of Jacob Riis Building No. 4 (1223 FDR Drive) that contain earthen storage areas.
- Removing shallow soil containing elevated concentrations of PAHs.

This alternative would directly address potential exposures to MGP-impacted surface soil located in outdoor common areas of the Jacob Riis property. Similar to Alternative 3, this alternative includes installing a surface control to cover the existing earthen floors in the storage room areas of Jacob Riis Building No. 4 (1223 FDR Drive); monitoring for, and passive recovery of mobile NAPL from within OU-1; and long-term groundwater and indoor air monitoring to facilitate identification of significant changes in the quality of these media. The need for surface control, and materials and construction details of the surface control, would be developed during the pre-design investigation and remedial design phases of the project. This alternative also provides provisions to recover mobile NAPL within OU-1.

Similar to Alternatives 2 and 3, Alternative 4 would establish deed restrictions and environmental easements to prohibit use of groundwater (although there are no current users of groundwater), as well as establish protocols/procedures for invasive activities that are conducted within OU-1. The institutional and engineering controls would be documented in the SMP that would be prepared for OU-1. Implementation of institutional controls is highly dependent upon current property owner's willingness to enter into an agreement with Con Edison to establish the controls. Implementation of institutional controls would require coordination with State agencies (i.e., NYSDEC and NYSDOH), as well as the owner of the Jacob Riis, property.

As with Alternatives 2 and 3, a groundwater monitoring well would be installed west of Avenue D and annual groundwater monitoring would be conducted to document dissolved phase COPC concentrations and groundwater flow direction within OU-1. Annual indoor air monitoring would also be conducted as part of Alternative 4. If, based on the results of the annual monitoring, MGP-related COPCs are detected at concentrations greater than applicable standards and guidance values, engineering controls within the basements and/ or the ground level of affected buildings will be evaluated. Alternative 4 would also include installation of NAPL monitoring wells/collection trenches and the same NAPL monitoring/recovery activities as described for Alternative 3. Note that annual groundwater and indoor monitoring could only be completed if the current property owners are willing to grant access to complete the sampling activities.

In addition to the installation of a surface control in the storage room areas of Jacob Riis Building No. 4 as described above, Alternative 4 would also include removal of shallow soil containing PAHs at concentrations greater than the Manhattan background levels reported in the *Characterization of Soil Background PAH and Metal Concentrations* (RETEC, 2007). Analytical results for samples collected as part of the site investigation indicated that surface soil surrounding Jacob Riis Buildings Nos. 2, 3, 4, 5, and 6 contain elevated concentrations of PAHs (i.e., concentrations greater than the reported Manhattan background levels). Approximately 5,000 CY of shallow soil (i.e., top 2 feet) would be removed from these areas (shown on Figure 5-2) using conventional construction equipment (e.g., backhoes, skid steer) or by hand digging. Shallow soil beneath sidewalks and roadways would not be removed as part of this alternative. A stormwater pollution prevention plan (SWPPP) would be prepared as part of the remedial design and erosion controls (e.g., silt fencing, hay bales) would be placed around removal areas to reduce soil erosion.

Pre-excavation waste characterization sampling would be conducted to determine off-site disposal requirements due to the limited space available for material staging. Removed material would be direct-loaded into lined roll-offs or three-axle dump trucks and transported for off-site disposal. For the purpose of developing a cost estimate, it has been assumed that removed material would be disposed of as a non-hazardous waste at a solid waste landfill. As indicated in Section 4, the final off-site disposal means would be evaluated and selected as part of the remedial design for this alternative.

Prior to restoring the soil removal areas, a highly visible demarcation layer (e.g., geotextile fabric, snow fence) would be placed along excavation area bottoms and side walls to denote soil removal limits. Removal areas would then be restored with clean imported fill material to match the previously existing lines and grades and vegetated to match previously existing surface covers, in kind. Restored shallow soil would be inspected annually to monitor for areas of erosion and areas of erosion would be repaired, as needed.

This alternative would include preparation of an SMP to document the following:

- The requirements for documenting that institutional and engineering controls that have been established are being maintained for OU-1.
- Known locations of soil remaining within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs.
- Requirements for shallow soil inspection and maintenance.
- Protocols and requirements for semi-annual NAPL monitoring and annual groundwater and indoor air monitoring.
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities.
- Protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor based on the results obtained from the annual monitoring activities.

<u>Short-Term Impacts and Effectiveness – Alternative 4</u>

Implementation of this alternative may result in short-term exposures to the surrounding community and field personnel. Potential short-term exposures could occur as a result of surface control installation, shallow soil excavation, material handling, and off-site transportation activities. Additionally, potential exposures could occur during installation of the groundwater monitoring well and the NAPL recovery wells. Potential routes of exposure include ingestion and dermal contact with impacted soil, NAPL, and/or groundwater, and inhalation of volatile organic vapors or dust containing COPCs during remedial construction. Potential exposure of remedial workers would be minimized through training and the appropriate level of PPE, as specified in a site-specific HASP. A Community Air Monitoring Plan (CAMP) would be prepared and community 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 the removal areas would be restricted by temporary security fencing.

Additional worker safety concerns include working with and around 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. Off-site transportation of excavated material and importation of clean fill materials would result in approximately 830 dual-axle dump truck round trips (assuming 12 CY per truck). The increase in local truck traffic could create a nuisance to the surrounding community, as well as an increase in the potential for motor vehicle accidents on local roads and highways. Transportation activities would be managed to minimize en-route risks to the community. The relative carbon footprint (as compared to the other alternatives) is considered moderate. The greatest contribution to greenhouse gases would occur as a result of equipment operation during excavation, backfilling, and transportation activities.

Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. Field personnel and the community could be potentially exposed to recovered/stored NAPL during periodic monitoring activities.

Potential exposures to the community would be minimized by following appropriate procedures and protocols set forth in the SMP.

This remedial alternative could be implemented in approximately 5 months and monitoring would be conducted over an assumed 30-year period.

Long-Term Effectiveness and Permanence – Alternative 4

Alternative 4 would reduce potential long-term exposures to COPCs in MGP-impacted media. This alternative includes removing shallow soil in outdoor areas and installing a surface control over earthen surfaces in Jacob Riis Building No. 4 storage areas that contains elevated concentrations of PAHs, as well as passive NAPL recovery to collect and remove mobile NAPL from OU-1. Shallow soil beneath sidewalks and roadways would not be removed as part of this alternative. Additionally, Alternative 4 includes establishing institutional controls to prohibit use of groundwater and establishing protocols/requirements for subsurface activities that are conducted within OU-1. By replacing shallow soil with clean imported fill, potential exposures to shallow soil containing COPCs at concentrations greater than Manhattan background levels are eliminated and a physical barrier of clean material (e.g., imported soil outdoors and a concrete floor in portions of Jacob Riis Building No. 4) is placed over remaining subsurface soil that contains MGP-related impacts. The institutional controls would establish protocols/procedures for invasive activities that are conducted within OU-1 that may result in worker exposure to remaining subsurface soil that contains MGP-related impacts. Annual verification of the institutional and engineering controls would be completed to document that the controls are maintained and remain effective.

Field personnel and the community could be potentially exposed to recovered/stored NAPL during periodic monitoring activities. Potential exposures to the community would be minimized by following appropriate procedures and protocols described in the SMP.

Land Use – Alternative 4

The current and foreseeable future use of OU-1 is a densely populated urban setting consisting primarily of multi-story residences. The majority of the site is covered with asphalt, concrete, buildings, or vegetated soil. Additionally, drinking water is currently and will continue to be provided via a public supply.

Alternative 4 would be consistent with the current land use at OU-1 and should not interfere with re-development of this area under the current zoning. Although OU-1 is not expected to be significantly re-developed in the foreseeable future, based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery activities, any re-development of the properties that contain groundwater monitoring and/or NAPL recovery wells may require coordination with the developer to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

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

This alternative would include the removal and off-site disposal of approximately 5,000 CY of shallow soil that contains PAHs at concentrations greater than Manhattan background levels. Shallow soil potentially containing MGP-related impacts would remain in OU-1 beneath imported clean fill materials and existing asphalt and concrete surfaces (i.e., roadways and sidewalks) that would not be disturbed as part of this alternative.

Alternative 4 also includes installation of NAPL recovery wells to monitor and passively recover mobile NAPL. Through NAPL monitoring and recovery, the volume of mobile NAPL within OU-1 would be reduced, thereby reducing the potential for further migration of mobile NAPL from OU-1. Additionally, by reducing the volume of source material that contributes to dissolved phase COPCs in OU-1 groundwater, passive NAPL recovery would reduce the mass flux of COPCs to the groundwater, thereby reducing the concentration and extent of dissolved phase COPCs.

Implementability – Alternative 4

Implementation of this alternative would present numerous logistical and administrative challenges. Equipment and personnel qualified to install groundwater monitoring and NAPL recovery wells and conduct periodic groundwater, NAPL, and indoor air monitoring activities are readily available. Equipment and personnel qualified to install surface controls (e.g., concrete floors) are also readily available. As indicated previously, a pre-design investigation would be conducted as part of the remedial design to evaluate the location and construction of NAPL recovery wells and/or collection trenches. Prior to installing the NAPL recovery and groundwater monitoring wells, subsurface utilities would be identified to ensure that utilities are not damaged during well installation. The groundwater monitoring well and NAPL recovery wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL removal methods would also be evaluated during the design of this alternative. Active NAPL recovery would be more difficult to implement, when compared to passive NAPL recovery, as active recovery would require an on-site NAPL storage structure/facility. Construction of a storage structure in a public area is not considered readily implementable or practicable. Active NAPL recovery would also generate groundwater that would have to be managed.

Removal and off-site disposal of shallow soil is technically feasible, although conducting soil removal activities in the densely populated urban public setting presents numerous logistical challenges. There is very limited available space within OU-1 for material handling and staging and small construction equipment would be required to conduct the removal activities. Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required from 6-axle vehicles. Additionally, soil removal activities would need to be conducted in a manner as to not jeopardize the health and safety of, and minimize nuisance to, the residents of the Jacob Riis buildings. Removal of surface soils would cause a significant disruption to the residents and surrounding community. Public access to the excavation areas would be restricted. Sidewalks, playgrounds, and basketball courts at the Jacob Riis property would potentially be closed for safety and to provide room for remedial construction equipment to operate. The presence of remedial construction equipment would create visual and noise related nuisances, thereby significantly reducing the quality of life for local residents. While this alternative would not remove subsurface soil containing MGP-related impacts above SCGs, there is no exposure route associated with subsurface soil that would impact human health.

Administratively, institutional controls would be required on a property not owned by Con Edison, which would require cooperation from the current property owner. Access agreements would be required to implement the alternative and conduct the periodic NAPL, groundwater, and indoor air monitoring activities. Remedial construction and annual monitoring activities could only be completed if the current property owner is willing to grant access to excavation and sampling areas. Implementation of institutional controls is highly dependent upon current property owner’s willingness to accept the controls and would require coordination with State agencies (i.e., NYSDEC and NYSDOH). Coordination with, and cooperation of the property owner would be required to temporarily isolate the storage areas to allow for the surface control to be installed, and inspected if required by the SMP.

<u>Compliance with SCGs – Alternative 4</u>

- *Chemical-Specific SCGs* – Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6NYCRR Part 375-6 soil cleanup objectives and 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values. Potentially applicable chemical-specific SCGs for soil vapor include NYSDOH guidance values established in *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (NYSDOH, 2006).

  Through the removal of surface soil containing COPCs at concentrations greater than Manhattan background levels, Alternative 4 would address shallow soil (i.e., top 2 feet) containing PAHs at concentrations greater than 6NYCRR Part 375-6 restricted use SCOs. All excavated material and process residuals would be characterized in accordance with 40 CFR Part 261 and 6NYCRR Part 371 to determine appropriate off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.

  As indicated in Section 1, groundwater within OU-1 contains VOCs, SVOCs, and inorganics at concentrations greater than NYSDEC Class GA standards and guidance values. As this alternative does not include active remedial measures to address all MGP-impacted soil, this alternative would likely not achieve groundwater SCGs within a determinate period of time.

  As part of this alternative, indoor air quality would be periodically monitored. If, based on the results of the monitoring, MGP-related COPCs are detected at concentrations greater than applicable guidance values, potential concerns would be addressed by the protocols set forth in the SMP to be prepared as part of this alternative.

- *Action-Specific SCGs* – Action-specific SCGs are presented in Table 2-2. 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 a NYSDEC-approved RD/RA Work Plan and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC, 2002a), excavated material from a former MGP site that is characteristically toxic for benzene only is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (i.e., LTTD). All excavated material would be disposed of in accordance with applicable NYS LDRs.

- *Location-Specific SCGs* – Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting excavation, backfilling, and construction activities on flood plains. A majority of the Jacob Riis Housing complex is located within the 100-year flood plain for the East River. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances.

Overall Protection of Public Health and the Environment – Alternative 4

Alternative 4 would mitigate potential long-term exposures to MGP-impacted media by removing and replacing shallow soil in outdoor areas and covering soil in Jacob Riis Building No. 4 storage areas that potentially contain elevated concentrations of PAHs. This alternative would also reduce potential human exposures to subsurface soil containing COPCs (subsurface soil RAO #1), reduce potential human exposures to MGP-related NAPLs (subsurface RAO #3), and reduce potential human exposure to groundwater containing COPCs (groundwater RAO #3) through implementation of institutional and engineering controls.

Alternative 4 would reduce further off-site migration of impacts (subsurface soil RAO #4) through passive recovery of recoverable NAPL from OU-1. Passive NAPL recovery would also work toward restoring COPC-impacted groundwater (groundwater RAO #1) and reducing future COPC impacts to groundwater (groundwater RAO #2) by removing a source of dissolved phase groundwater impacts. However, Alternative 4 would not remediate subsurface soil containing MGP-related COPCs (subsurface soil RAO #2) and therefore, sources for dissolved phase groundwater impacts would remain and off-site migration of COPC-impacted groundwater would not be prevented (groundwater RAO #4) and the source of groundwater contamination would not be removed (groundwater RAO #5). Alternatives 4 would be more protective of public health and the environment due to the removal of a potential exposure pathway by the removal/off-site disposal of soil containing PAHs greater than Manhattan background levels. As a result, the potential long-term success of Alternative 4 relies less on administrative controls than Alternatives 2 and 3.

Cost Effectiveness – Alternative 4

The estimated costs associated with Alternative 4 are presented in Table 5-3. The total estimated 30-year present worth cost for this alternative is approximately $8,700,000. The estimated capital cost, including costs for installing surface controls in the storage room areas of Jacob Riis Building No. 4, installing NAPL recovery wells, removing shallow soil, restoring removal areas, and establishing institutional controls, is approximately $5,400,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater and indoor air monitoring, is approximately $3,300,000.

5.3.5 Alternative 5 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Shallow Soil Removal, Targeted Subsurface Soil Removal, NAPL Recovery, and ICs/ECs

The major components of Alternative 5 include the following:

- Preparing an SMP that establishes institutional controls and/or engineering controls and identifies activities to insure their enforcement after implementation.
- Installing a monitoring well to monitor the western extent of dissolved phase BTEX in groundwater.
- Conducting long-term groundwater monitoring.
- Conducting indoor air monitoring.
- Installing NAPL recovery wells.

- Conducting NAPL gauging and passive recovery.
- Installing a surface control portions of Jacob Riis Building No. 4 (1223 FDR Drive) that contain earthen storage areas.
- Removing shallow soil containing elevated concentrations of PAHs.
- Removing accessible MGP-impacted subsurface soil.

This alternative would directly address potential exposures to MGP-impacted surface soil located in outdoor common areas of the Jacob Riis property and within exposed soil storage areas within Jacob Riis Building No. 4. Alternative 5 also includes removal of accessible MGP-impacted subsurface soil within OU-1. Similar to Alternatives 3 and 4, this alternative includes: installing a surface control to cover the existing earthen floors in the storage room areas of Jacob Riis Building No. 4 (1223 FDR Drive); monitoring and passive recovery of mobile NAPL from within OU-1; long-term groundwater and indoor air monitoring to document conditions. The specific areas in need of surface control, and materials and construction details of the surface control, would be developed during the pre-design investigation and remedial design phases of the project. This alternative also provides provisions to recover mobile NAPL within OU-1.

Similar to Alternatives 2, 3, and 4, Alternative 5 would establish deed restrictions and environmental easements to prohibit use of groundwater (although there are no current users of groundwater), as well as establish protocols/procedures for invasive activities that are conducted within OU-1. The institutional and engineering controls, along with requirements to verify they are being enforced, would be included in the SMP that would be prepared for OU-1. Implementation of institutional controls is highly dependent upon current property owner’s willingness to agree to the controls. Implementation of institutional controls would require coordination with State agencies (i.e., NYSDEC and NYSDOH), as well as the owner of the Jacob Riis property.

As with the other alternatives, a groundwater monitoring well would be installed west of Avenue D and annual groundwater monitoring would be conducted to document dissolved phase COPC concentrations and groundwater flow direction within OU-1. Annual indoor air monitoring would also be conducted as part of Alternative 5. If, based on the results of the annual monitoring, MGP-related COPCs are detected at concentrations greater than applicable standards and guidance values, engineering controls within the basements and/or the ground level of buildings within OU-1 will be evaluated. Alternative 5 would also include installation of NAPL monitoring wells/collection trenches and the same NAPL monitoring/recovery activities as described for Alternatives 3 and 4. Note that annual groundwater and indoor monitoring could only be completed if property owners are willing to grant access to complete the sampling activities.

Under this alternative, approximately 13,300 CY of soil would be excavated to address accessible MGP-impacted soil within OU-1. MGP-impacted soil is defined as containing visual MGP-related impacts (i.e., NAPL) and/or soil containing total BTEX or total PAHs at concentrations greater than 10 ppm and 500 ppm, respectively. Removal limits are shown on Figure 5-3 and excavations would be completed to a maximum depth of 8 below grade (i.e., approximately one foot below the water table). Excavation activities would be conducted using conventional construction equipment such as backhoes, excavators, front-end loaders, dump trucks, etc. Based on the proposed extent of excavation activities for Alternative 5, excavation support (e.g., sheet pile, soldier piling, etc.) is not anticipated to be required and the excavation area sidewalls would be sloped at an appropriate pitch based on site soil conditions. The dead and live loads associated with Jacob Riis buildings and FDR would be evaluated to determine how these loads would affect the stability of an open, unsupported excavation. The final excavation plan would be developed as part of a remedial design. Similar to Alternative 4, Alternative 5 would include removal of shallow soil containing PAHs at concentrations greater than Manhattan background levels reported in the *Characterization of Soil Background PAH and Metal Concentrations* (RETEC, 2007). Shallow soil (i.e., top 2 feet) would be removed from these areas using conventional construction equipment (e.g., backhoes, skid steer) or by hand digging. A SWPPP would be developed as part of the remedial design and erosion controls (e.g., silt fencing, hay bales) would be placed around excavation and material staging areas to reduce soil erosion in these areas. Additionally, Alternative 5 would include installation of a surface control in the storage room areas of Jacob Riis Building No. 4 (for the purposes of the AAR assumed to consist of 6 inches of concrete installed to meet the elevations of existing hard floor surfaces).

Pre-excavation waste characterization sampling would be conducted to determine off-site disposal requirements due to the limited space available for material staging. Removed material would be direct-loaded into roll-offs or three-axle dump trucks and transported for off-site disposal. For the purpose of developing a cost estimate, it has been assumed that 25% of removed subsurface soil would be transported off-site for treatment/disposal via LTTD and all other excavated material would be disposed of as a non-hazardous waste at a solid waste landfill. As indicated in Section 4, the final off-site disposal means would be evaluated and selected as part of the remedial design for this alternative.

Prior to restoring the soil removal areas, a highly visible demarcation layer (e.g., geotextile fabric, snow fence) would be placed along excavation area bottoms and side walls to denote soil removal limits. Removal areas would then be restored with clean imported fill material to match the previously existing lines and grades and vegetated to match previously existing surface covers, in kind.

This alternative would include preparation of a SMP to document the following:

- The requirements for documenting that institutional and engineering controls that have been established are being maintained for OU-1.
- Known locations of soil remaining within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs.
- Protocols and requirements for semi-annual NAPL monitoring and annual groundwater and indoor air monitoring.
- Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities.
- Protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor based on the results obtained from the annual monitoring activities.

Short-Term Impacts Effectiveness – Alternative 5

Implementation of this alternative may result in short-term exposures to the surrounding community and field personnel. Potential short-term exposures could occur as a result of surface control installation, soil excavation, material handling, and off-site transportation activities. Additionally, potential exposures could occur during installation of the groundwater monitoring well and the NAPL monitoring wells. Potential routes of exposure would include ingestion and dermal contact with impacted soil, NAPL, and/or groundwater, and inhalation of volatile organic vapors or dust containing COPCs during remedial construction. Potential exposure of remedial workers would be minimized through training and the appropriate level of PPE, as specified in a site-specific HASP. A CAMP would be prepared and community 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 the excavation areas would be restricted by temporary security fencing.

Additional worker safety concerns include working with and around 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. Off-site transportation of excavated material and importation of clean fill materials would result in approximately 2,550 dual-axle dump truck round trips (assuming 12 CY per truck). The increase in local truck traffic would create a nuisance to the surrounding community, as well as an increase in the potential for motor vehicle accidents on local roads and highways. Transportation activities would be managed to minimize en-route risks to the community. The relative carbon footprint (as compared to the other alternatives) is considered significant. The greatest contribution to greenhouse gases would occur as a result of heavy equipment operation during excavation, backfilling, and transportation activities.

Potentially impacted soil and groundwater generated during well installation activities would be properly managed to minimize potential exposures to the surrounding community. Field personnel and the community could potentially be exposed to recovered/stored NAPL during periodic monitoring activities. Potential exposures to the community would be minimized by following appropriate procedures and protocols set forth in the SMP.

This remedial alternative could be implemented in approximately 14 months and monitoring would be conducted over an assumed 30-year period.

Long-Term Effectiveness and Permanence – Alternative 5

Alternative 5 would reduce potential long-term exposures to COPCs in MGP-impacted media. This alternative includes excavating accessible MGP-impacted subsurface soil, removing shallow surface soil (0 to 2 feet bgs) that contains elevated concentrations of PAHs, installation a surface control over earthen surfaces in Jacob Riis Building No. 4 storage areas, and passive NAPL recovery to collect and remove mobile NAPL from OU-1. Additionally, Alternative 5 includes establishing institutional controls to prohibit use of groundwater and establish protocols/requirements for subsurface activities that are conducted within OU-1. By installing a surface control or replacing shallow soil with clean imported fill, potential exposures to shallow soil containing COPCs at concentrations greater than Manhattan background levels are eliminated. Although Alternative 5 includes the removal of accessible subsurface soil containing MGP-related impacts, the institutional controls would establish protocols/procedures for invasive activities that are conducted within OU-1 that may result in worker exposure to remaining subsurface soil that contains MGP-related impacts. Annual verification of the institutional and engineering controls would be completed to document that the controls are maintained and remain effective.

Field personnel and the community could potentially be exposed to recovered/stored NAPL during periodic monitoring activities. Potential exposures to the community would be minimized by following appropriate procedures and protocols described in the SMP.

Land Use – Alternative 5

The current and foreseeable future use of OU-1 is a densely populated urban setting consisting primarily of multi-story residences. The majority of the site is covered with asphalt, concrete, buildings, or vegetated soil. Additionally, drinking water is currently and will continue to be provided via a public supply.

Alternative 5 would be consistent with the current land use at OU-1 and should not interfere with re-development of this area under the current zoning. Although OU-1 is not expected to be significantly re-developed in the foreseeable future, based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery activities, any re-development of the properties that contain groundwater monitoring and/or NAPL recovery wells may require coordination with the developer to maintain the wells or to make provisions to access/repair/reinstall the wells as needed.

Reduction of Toxicity, Mobility, or Volume through Treatment – Alternative 5

This alternative would include the removal and off-site disposal of approximately 5,000 CY of shallow soil that contains PAHs at concentrations greater than Manhattan background levels and the removal and off-site transportation of 8,500 CY of subsurface soil to address MGP-impacted subsurface soil at depths up to 8 feet below grade. As indicated in Section 4.6.5. This removal volume corresponds to approximately 2% of MGP-impacted soil within OU-1. However, this alternative addresses the material most likely to be encountered based on accessibility. Soil containing MGP-related impacts would remain in OU-1 beneath imported clean fill materials.

Alternative 5 also includes installation of NAPL recovery wells to monitor for and passively recover mobile NAPL that cannot be excavated based on constructability limitations. Through soil excavation and NAPL monitoring and recovery, the volume of mobile NAPL within OU-1 would be reduced, thereby reducing the potential for further migration of mobile NAPL from OU-1. Additionally, by reducing the volume of source material that contributes to dissolve phase COPCs in OU-1 groundwater, soil excavation and passive NAPL recovery would reduce the mass flux of COPCs to the groundwater, thereby reducing the concentration and extent of dissolved phase COPCs.

Implementability – Alternative 5

Implementation of this alternative would present numerous logistical and administrative challenges from the technical implementability standpoint, equipment and personnel qualified to install groundwater monitoring and NAPL recovery wells and conducting periodic groundwater, NAPL, and indoor air monitoring activities are readily available. Equipment and personnel qualified to install surface controls (e.g., concrete floors) are also readily available. As indicated previously, a pre-design investigation would be conducted during the remedial design to evaluate the location and construction of NAPL recovery wells and/or collection trenches. Prior to installing the NAPL recovery and groundwater monitoring wells, all subsurface utilities would be identified to ensure that utilities are not damaged during well installation. The groundwater monitoring well and NAPL recovery wells would be secured in lockable subsurface vaults to prevent access by unauthorized personnel. NAPL removal methods would also be evaluated during the design of this alternative. Active NAPL recovery would be more difficult to implement, when compared to passive NAPL recovery, as active recovery would require an on-site NAPL storage structure/facility. Construction of a storage structure in a public area is not considered readily implementable or practicable. Active NAPL recovery would also generate groundwater that would have to be managed.

Removal and off-site disposal of subsurface soil is technically feasible, although conducting soil removal activities in a densely populated public setting presents numerous logistical challenges. Soil removal activities would need to be conducted in a manner as to minimize noise, odors, and visual nuisances and ensure safety for the residents of the Jacob Riis buildings. Removal of surface and subsurface soils would cause a significant disruption to the residents and surrounding community. Public access to the excavation areas would need to be restricted. Sidewalks, playgrounds, and basketball court at the Jacob Riis property would need to be closed for safety and to provide room for remedial construction equipment to operate. The presence of remedial construction equipment would create visual and noise related nuisances, thereby significantly affecting the quality of life for local residents.

Additionally, there is no available space within OU-1 for material handling and staging and removal activities would have to be conducted with small construction equipment. Transportation planning would be conducted prior to the remedial activities. Tractor trailers would likely not be used based on the larger turning radius required from 6-axle vehicles. Soil loading conditions from OU-1 buildings would need to be evaluated and subsurface utilities would need to be protected or otherwise bypassed.

Administratively, institutional controls would be placed on property not owned by Con Edison, which would require agreements with the current property owner(s). Additionally, access agreements would be required to conduct the periodic NAPL, groundwater, and indoor air monitoring activities. Remedial construction and annual monitoring activities could only be completed if property owner is willing to grant access to excavation and sampling areas. Implementation of institutional controls would require coordination with state agencies (i.e., NYSDEC and NYSDOH) and is highly dependent upon current property owner's willingness to establish the controls. Coordination with, and cooperation of the property owner would be required to temporarily isolate the storage areas to allow for the surface control to be installed, and inspected if required by the SMP.

<u>Compliance with SCGs – Alternative 5</u>

- *Chemical-Specific SCGs* – Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for soil include 6NYCRR Part 375-6 soil cleanup objectives and 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials. Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values. Potentially applicable chemical-specific SCGs for soil vapor include NYSDOH guidance values established in *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (NYSDOH, 2006).

  Through the removal of surface soil containing COPCs at concentrations greater than Manhattan background levels, Alternative 5 would address shallow soil containing PAHs at concentrations greater than 6NYCRR Part 375-6 restricted use SCOs. Alternative 5 would also address accessible MGP-impacted subsurface soil. All excavated material and process residuals would be characterized in accordance with 40 CFR Part 261 and 6NYCRR Part 371 to determine appropriate off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.

  As indicated in Section 1, groundwater within OU-1 contains VOCs, SVOCs, and inorganics at concentrations greater than NYSDEC Class GA standards and guidance values. As this alternative does not include active remedial measures to address all MGP-impacted soil, this alternative would likely not achieve groundwater SCGs within a determinate period of time.

As part of this alternative, indoor air quality would be periodically monitored. If, based on the results of the monitoring, MGP-related COPCs are detected at concentrations greater than applicable guidance values, potential concerns would be addressed by the protocols set forth in the SMP to be prepared as part of this alternative.

- *Action-Specific SCGs* – Action-specific SCGs are presented in Table 2-2. 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 a NYSDEC-approved RD/RA Work Plan and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC, 2002a), excavated material from a former MGP site that is characteristically toxic for benzene only is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (i.e., LTTD). All excavated material would be disposed of in accordance with applicable NYS LDRs.

- *Location-Specific SCGs* – Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting excavation, backfilling, and construction activities on flood plains. A majority of the Jacob Riis Housing complex is located within the 100-year flood plain for the East River. Compliance with these SCGs would be achieved by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances.

<u>Overall Protection of Public Health and the Environment – Alternative 5</u>

Alternative 5 would mitigate potential long-term exposures to MGP-impacted media by removing and replacing accessible subsurface soil containing MGP-related COPCs and shallow soil in outdoor areas; covering exposed surface areas in Jacob Riis Building No. 4 storage areas that potentially contain elevated concentrations of PAHs; conducting passive recovery of mobile NAPL; and establishing institutional and engineering controls. Groundwater containing MGP-related COPCs would not be addressed through active containment, treatment, or removal. Potential short-term exposures to COCs during implementation of this alternative would be mitigated by appropriate health and safety planning and practices.

Through excavation of accessible MGP-impacted subsurface soil and removal or covering of shallow soil potentially containing elevated concentrations of PAHs greater than Manhattan background concentrations, Alternative 5 would reduce potential human exposure to subsurface soil containing COPCs (subsurface soil RAO #1), remediate, to extent practicable, soil containing MGP-related COPCs (subsurface soil RAO #2), and reduce potential human exposure to surface soil containing COPCs (surface RAO #1).This alternative would also reduce potential human exposures to MGP-related NAPLs (subsurface RAO #3) and reduce potential human exposure to groundwater containing COPCs (groundwater RAO #3) through implementation of institutional controls.

Alternative 5 would reduce further off-site migration of impacts (subsurface soil RAO #4) through passive recovery of mobile NAPL. Passive NAPL recovery would also work toward restoring COPC-impacted groundwater (groundwater RAO #1) and reducing future COPC impacts to groundwater (groundwater RAO #2) by removing a source of dissolved phase groundwater impacts. However, Alternative 5 would not address all subsurface soil containing MGP-related COPCs and therefore, sources for dissolved phase groundwater impacts would remain and off-site migration of COPC-impacted groundwater would not be prevented (groundwater RAO #4) and the source of groundwater contamination would not be removed (groundwater RAO #5).

Cost Effectiveness – Alternative 5

The estimated costs associated with Alternative 5 are presented in Table 5-4. The total estimated 30-year present worth cost for this alternative is approximately $18,600,000. The estimated capital cost, including costs for installing surface controls in the storage room areas of Jacob Riis Building No. 4, installing a NAPL recovery wells, removing shallow soil and completing targeted excavations, restoring removal areas, and establishing institutional controls, is approximately $15,300,000. The estimated 30-year present worth cost of O&M activities associated with this alternative, including conducting semi-annual NAPL monitoring and annual groundwater and indoor air monitoring, is approximately $3,300,000.

6 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

6.1 General

This section presents the comparative analysis of each remedial alternative using the seven evaluation criteria identified in Section 5.2. The comparative analysis identifies the advantages and disadvantages of each alternative relative to each other and with respect to the seven evaluation criteria.

6.2 Comparative Analysis of Alternatives

The alternatives evaluated in Section 5 consist of the following:

- Alternative 1 – No Action
- Alternative 2 – Groundwater Monitoring, Indoor Air Monitoring and ICs/ECs
- Alternative 3 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery and ICs/ECs
- Alternative 4 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal, and ICs/ECs
- Alternative 5 – Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Shallow Soil Removal, Targeted Subsurface Soil Removal, Passive NAPL Recovery, and ICs/ECs

Discussion of the comparative analysis of these site-wide alternatives is presented below. A summary of the relative results from these comparisons is presented in Table 6-1.

6.2.1 Short-Term Impacts and Effectiveness

The short-term effectiveness criterion consists of an evaluation of potential impacts and nuisances to the public and environment, and potential impacts to site workers during implementation of the alternative, the effectiveness of measures used to mitigate the short-term impacts, the sustainability of the remedy, and the relative time frame for implementation.

Alternative 1 would not include any active remediation and subsequently would not present potential short-term impacts to remedial workers, the surrounding community, or the environment.

Alternatives 2 and 3 include installation of a groundwater monitoring well west of Avenue D. Alternative 3 also includes installation of NAPL recovery wells in the eastern portion of OU-1 and installation of a surface control in portions of 1223 FDR Drive (Jacob Riis Building No. 4) that contain earthen floor storage areas. Soil cuttings generated during NAPL recovery well installation activities would be transported for off-site treatment/disposal, which represents a slightly greater potential for short-term exposures and nuisances to the community and residences when compared to Alternative 2. Overall, Alternatives 2 and 3 would pose minimal potential short-term risks and potential disturbances to remedial workers and the surrounding community.

In addition to the installation of a groundwater monitoring well, NAPL recovery wells, and a surface control in Jacob Riis Building No.4, Alternative 4 also includes removal and replacement of shallow soil in outdoor areas of the Jacob Riis property. Alternative 5 also includes excavation of accessible MGP-impacted subsurface soil. Alternatives 4 and 5 would pose significantly greater potential short-term noise, visual, access, and increased traffic nuisances and safety risks to remedial workers and the surrounding community from associated construction equipment and potential exposure to impacted soil during soil excavation, off-site transportation of excavated material, and backfilling. The excavation activities conducted under Alternatives 4 and 5 would pose short-term risks from the operation of construction equipment, work area safety concerns for area residents, and generation of noise and dust. Alternatives 4 and 5 would require approximately 830 and 2,550 dual-axle dump truck round trips, respectively.

Estimated field times to implement each of the alternatives are presented below.

- Alternative 1 – no time required
- Alternative 2 – Less than one month
- Alternative 3 – 2 months
- Alternative 4 – 5 months
- Alternative 5 – 14 months

Potential exposures would be mitigated, to the extent practicable, by the use of proper PPE, air and work space monitoring, implementation of dust control and noise mitigation measures (as appropriate and if necessary based on monitoring results), proper planning and training of remedial workers, and use of temporary security fencing. Mitigation measures for each alternative would be identified in the remedial design. However, Alternatives 4 and 5 would pose significantly greater potential short-term risks and impacts to remedial workers and the surrounding community based on the nature and duration of the soil removal activities. Alternative 5 would be the most disruptive to the surrounding community and would require the longest time to implement. Subsequently, Alternative 5 has the lowest level of short-term effectiveness (i.e., the greatest potential for exposure during implementation).

A summary of the relative results from the comparative analysis for the short-term impacts and effectiveness criterion is presented in Table 6-1.

6.2.2 Long-Term Effectiveness and Permanence

The long-term effectiveness comparison includes an evaluation of the risks remaining within OU-1 after implementation of the remedy, as well as the effectiveness of the controls implemented to manage the remaining risks (if any).

Alternative 1 does not include the implementation of any remedial activities and therefore, would not address potential long-term exposures to MGP-related impacts within OU-1. Alternatives 2 and 3 would both rely on institutional and engineering controls that would be established under an SMP to limit potential exposures to MGP-impacted surface soil in outside common areas, subsurface soil, and groundwater. Alternative 3 would also include installation of a surface cover in portions of Jacob Riis Building No. 4 that contain earthen floor storage areas. Although groundwater is not used for potable purposes within or in areas surrounding OU-1, these alternatives would only be effective over the long-term if the controls are maintained. Additionally, potential exposure to surface soil for site workers during periodic maintenance activities (e.g., lawn moving, exterior building maintenance) would remain under Alternatives 2 and 3. While Alternative 3 includes passive NAPL recovery, it is anticipated that recoverable NAPL represents a small portion of the impacts that exist within OU-1, and the NAPL exists at a depth that does not present a human health exposure concern; therefore, Alternative 3 does not significantly reduce potential risks to human health.

Alternatives 4 and 5 could both significantly reduce the potential for long-term exposures to impacted surface soil in OU-1 by removal (outdoors) and eliminating potential exposure pathways (in Jacob Riis Building No. 4) of surface soil potentially containing PAHs at concentrations greater than Manhattan background levels. Under Alternative 4, clean imported fill that would be used to replace the removed shallow soil would provide a physical barrier to MGP-impacted subsurface soil (i.e., at depths greater than two feet). Alternative 4 would also rely on institutional controls to limit potential exposures to impacted environmental media that would remain in the subsurface. Alternative 5 would include the targeted removal of MGP-impacted subsurface soil to a depth of up to 8 feet below grade in accessible areas (i.e., accessible areas not under existing buildings) and importation of clean fill material, thereby further reducing the potential for exposure to impacted media that would remain at depths greater than 8 feet below grade. However, as shown on Figure 5-3, most of these areas are currently under paved areas; therefore, Alternative 5 would not significantly reduce potential risks to human health that remain after the remedy is implemented. MPG-impacted subsurface soil, groundwater, and NAPL would remain beneath buildings and at depths greater than 8 feet below grade under Alternative 5. Although Alternative 5 would remove accessible soil at depths up 8 feet below, a majority of MGP-impacted media would remain in OU-1. Therefore, Alternative 4 is considered to be equally effective at protecting both human health and the environment from potential long-term risks associated with MGP-impacted media when compared to Alternative 5.A summary of the relative results from the alternatives comparative analysis for the long-term effectiveness and permanence criterion is presented in Table 6-1.

6.2.3 Land Use

This criterion evaluates the current and intended future land use of the site relative to the degree to which the remedial alternative addresses site impacts when unrestricted use cleanup levels would not be achieved.

The current and foreseeable future use of OU-1 is a densely populated urban setting consisting primarily of multi-story residences. A majority of the site is covered with asphalt, concrete, buildings, or vegetated soil. Additionally, drinking water is currently and will continue to be provided via a public supply.

Each of the alternatives would be consistent with the current land use at OU-1 and should not interfere with re-development of this area under the current zoning. Although OU-1 is not expected to be significantly re-developed in the foreseeable future, based on the proposed long-term groundwater monitoring and NAPL monitoring/recovery activities, any re-development of the properties that contain groundwater monitoring and/or NAPL recovery wells may require coordination with the developer to maintain the wells or to make provisions to access/repair/reinstall the wells as needed. Following completion of the excavation and backfilling activities conducted as part of Alternatives 4 and 5, disturbed surfaces would be restored to match or be similar to existing site conditions and land use should not change relative to the current zoning. As a result, the current and intended future land use of the site relative to the degree to which the remedial alternative addresses site impacts when unrestricted use cleanup levels would not be achieved is similar for each alternative. A summary of the relative results from the alternatives comparative analysis for the land use criterion is presented in Table 6-1.

6.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The comparative analysis for the reduction of toxicity, mobility, or volume consists of an evaluation of the ability of the remedial process to address the impacted material, the mass of material destroyed or treated, the irreversibility of the processes employed, and the nature of the residuals that would remain following implementation of the remedy.

Alternatives 1 and 2 would not actively treat, remove, recycle or destroy impacted environmental media within OU-1 and; therefore, are considered the least effective for this criterion. The groundwater monitoring activities that would be conducted as part of Alternative 2 would document the potential reduction (via natural processes) in dissolved phase COPCs in OU-1 groundwater. Alternative 3 would include semi-annual passive NAPL recovery which would reduce the volume of mobile NAPL within OU-1, thereby reducing the further migration of mobile NAPL from OU-1 (i.e., mobility). However, it is anticipated that only a small portion of recoverable NAPL exists within OU-1. By reducing the volume of mobile NAPL that contributes to dissolved phase COPCs in groundwater, Alternatives 3, 4, and 5 would reduce the mass flux of COPCs to groundwater, thereby reducing the toxicity of dissolved phase COPCs.

In addition to the groundwater monitoring and passive NAPL recovery activities, Alternatives 4 and 5 both include the removal and off-site disposal of MGP-impacted soil. Alternative 4 would include the removal of approximately 5,000 CY of shallow soil containing PAHs at concentrations greater than Manhattan background levels. MGP-impacted subsurface soil and groundwater would remain beneath two feet of clean imported fill material. Alternative 5 would include excavation of accessible MGP-impacted subsurface soil (approximately 15,300 CY, including the 5,000 CY of shallow soil removed under Alternative 4). Although Alternative 5 would include the greatest volume removal of MGP-impacted material within OU-1, it only represents an additional approximately 2% decrease in the quantity of MGP-impacted soil (by volume) when compared to Alternative 4, and is therefore not considered a significant difference in reduction in toxicity, mobility, or volume.

A summary of the relative results from the alternatives comparative analysis for the reduction of toxicity, mobility, and volume through treatment, criterion is presented in Table 6-1.

6.2.5 Implementability

The implementability comparison includes an evaluation of the technical and administrative feasibility of implementing the remedial alternative.

Alternative 1 would not include implementation of any remedial activities and therefore, is considered the most implementable. Alternatives 2 through 5 would each require the establishment of institutional and engineering controls, installation of a groundwater monitoring well, and annual groundwater and indoor air monitoring. Access agreements would be required to conduct the periodic groundwater and indoor air monitoring activities. Implementation of institutional and engineering controls would require coordination with State agencies (i.e., NYSDEC and NYSDOH) and the property owner(s) and implementation of institutional controls is highly dependent upon current property owner’s willingness to establish the controls.

Alternatives 3, 4, and 5 include installation of surface control in portions of Jacob Riis Building No. 4 that contain earthen floor storage areas. Equipment and personnel qualified to install surface controls (e.g., concrete floors) are also readily available. Material and construction details of the surface control would be evaluated and developed as part of a remedial design. Coordination with, and cooperation of the property owner would be required to temporarily isolate the storage areas to allow for the surface control to be installed, and inspected if required by the SMP.

Alternative 4 also includes the removal of shallow soil (i.e., top 2 feet) containing PAHs at concentrations greater than Manhattan background concentrations. Alternative 5 also includes excavation of accessible (i.e., top 8 feet) subsurface soil containing MGP-related impacts. Removal and off-site disposal of surface and subsurface soil is technically feasible, although conducting soil removal activities in a densely populated urban setting presents numerous logistical challenges. There is no available space within OU-1 for material handling and staging and removal activities would have to be conducted using small construction equipment. Transportation planning would be conducted prior to the remedial activities to minimize impacts of construction trucks on local traffic. Tractor trailers would likely not be used based on the larger turning radius required for 6-axle vehicles. Noise, visual, and access nuisances associated with soil removal would increase for the area residents with Alternatives 4 and 5 due to the increasing volumes of soil being removed over longer periods of time. Soil removal activities would need to be conducted in a manner to minimize these nuisances and reduce potential health and safety hazards.

Potential safety and impacts/nuisances to nearby residents is significantly greater for Alternative 5 based on the excavation limits/depths and removal volumes. For the deeper excavations that would be conducted for Alternative 5, soil loading conditions from OU-1 buildings would have to be evaluated and subsurface utilities would have to be protected or otherwise bypassed. Soil removal activities would have to be conducted in a manner as to not jeopardize the health and safety of or cause a nuisance for the residents of the Jacob Riis buildings. Removal of surface and subsurface soils would cause a significant disruption to the residents and surrounding community. Public access to the excavation areas would have to be restricted. Sidewalks, playgrounds, and basketball courts at the Jacob Riis property would have to be closed to allow for excavation underneath those structures. The presence of remedial construction equipment would create visual and noise related nuisances, thereby significantly impacting the quality of life for local residents. Based on this rationale, Alternative 5 is considered the least implementable.

A summary of the relative results from the alternatives comparative analysis for the implementability criterion is presented in Table 6-1.

6.2.6 Compliance with SCGs

The compliance with SCGs comparison includes an evaluation of the alternative's ability to comply with applicable federal, state, and local criteria, advisories, and guidance.

- ***Chemical-Specific SCGs*** – Chemical-specific SCGs are presented in Table 2-1. Potentially applicable chemical-specific SCGs for subsurface soil include 6NYCRR Part 375-6 soil cleanup objectives and 40 CFR Part 261 and 6NYCRR Part 371 regulations for the identification of hazardous materials. Guidance for chemical-specific PAHs in Manhattan surface soils is presented in *Characterization of Soil Background PAH and Metal Concentrations* (RETEC, 2007). Potentially applicable chemical-specific SCGs for groundwater include NYSDEC Class GA standards and guidance values. Potentially applicable chemical-specific SCGs for soil vapor include NYSDOH guidance values established in *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* (NYSDOH, 2006).

Alternative 1 would not address chemical-specific SCGs. Additionally, Alternatives 2 and 3 would not address SCGs other than periodic monitoring of indoor air. Alternatives 4 and 5 would address shallow soil containing PAHs through the removal of surface soil containing COPCs at concentrations greater than Manhattan background levels, Only Alternative 5 would address (through excavation) accessible MGP-impacted subsurface soil. MPG-impacted soil (and subsequently soil containing COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs) would remain within OU-1 under each of the remedial alternatives. However, only a small volume of subsurface soil exceeding 6NYCRR Part 375-6 unrestricted use SCOs would be removed due to accessibility issues.

Excavated material and process residuals generated during implementation of the alternatives would be characterized in accordance with 40 CFR Part 261 and 6NYCRR Part 371 to determine appropriate off-site treatment/disposal requirements. NYS LDRs would apply to any materials that are characterized as a hazardous waste.

As indicated in Section 1, groundwater within OU-1 contains VOCs, SVOCs, and inorganics at concentrations greater than NYSDEC Class GA standards and guidance values. None of the alternatives include active remedial measures to address all MGP-impacted soil; therefore, none of the alternatives would achieve groundwater SCGs within a determinate period of time.

As part of each alternative (other than No Action), indoor air quality would be periodically monitored as defined in a SMP. If, based on the results of the monitoring, MGP-related COPCs are detected at concentrations greater than applicable guidance values, potential concerns would be addressed by the protocols set forth in the SMP.

Therefore, comparatively, Alternatives 4 and 5 are considered equivalent and most effective for achieving chemical-specific SCGs, while Alternatives 2 and 3 are considered less effective (rely primarily on monitoring), and Alternative 1 does not achieve any SCGs.

- ***Action-Specific SCGs*** – Action-specific SCGs are presented in Table 2-2. 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 generated for each alternative 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 a NYSDEC-approved RD/RA Work Plan and using licensed waste transporters and permitted disposal facilities. Per DER-4 (NYSDEC, 2002a), excavated material from a former MGP site that is characteristically toxic for benzene only is conditionally exempt from hazardous waste management requirements when destined for thermal treatment (i.e., LTTD). All excavated material and process residuals would be disposed of in accordance with applicable NYS LDRs.

- ***Location-Specific SCGs*** – Location-specific SCGs are presented in Table 2-3. Potentially applicable location-specific SCGs generally include regulations on conducting excavation, backfilling, and construction activities on flood plains. A majority of the Jacob Riis Housing complex is located within the 100-year flood plain for the East River. Compliance with these SCGs would be achieved for each active alternative by obtaining a joint USACE and NYSDEC permit prior to conducting site activities. Additionally, remedial activities would be conducted in accordance with local building/construction codes and ordinances.

A summary of the relative results from the alternatives comparative analysis for the compliance with SCGs criterion is presented in Table 6-1.

6.2.7 Overall Protection of Public Health and the Environment

This criterion evaluates the ability of each alternative to protect human health and the environment, and the ability of each alternative to achieve each of the RAOs.

Based on the nature and extent of impacts within OU-1 and site-specific constraints (i.e., proximity of apartment buildings, the FDR, nature of subsurface fill materials) none of the alternatives would remediate all subsurface soil within OU-1 containing MGP-related COPCs (subsurface RAO #2). Therefore, each of the alternatives would rely on establishing and enforcing institutional and engineering controls to prevent future exposures to remaining MGP-impacted subsurface soil, NAPL, and groundwater (subsurface soil RAOs #1 and #3 and groundwater RAO #3). For each alternative, its ability to protect human health and the environment is in part related to how heavily the alternative depends on the institutional and engineering controls as a primary remedy, and how effectively these controls can be maintained and monitored.

Alternative 1 does not include implementation of any remedial activities or institutional and/or engineering controls; therefore, it would not be effective at reducing long-term risk to human health or the environment. Additionally, Alternative 1 would not achieve the site-specific RAOs.

Alternatives 2 and 3 would rely on institutional and engineering controls to reduce potential exposure to outdoor surface soil containing COPCs (surface soil RAO #1) by restricting access to surface soil. Alternative 3 would also include installation of a surface control in portions of Jacob Riis Building No. 4 containing earthen floor storage areas. Access to surface soil surrounding the Jacob Riis apartment buildings is currently limited by fencing. Although the fencing would limit access to surface soil, the exposure pathway would still exist under Alternatives 2 and 3, as site maintenance workers would be required to periodically maintain the vegetated surfaces.

Alternatives 3, 4, and 5 each include installation of NAPL recovery wells and semi-annual monitoring and passive recovery of mobile NAPL that may collect in the wells. Each of these alternatives would reduce the potential for further off-site migration of MGP-related NAPL (subsurface soil RAO #4). Passive NAPL recovery would also work toward restoring groundwater (groundwater RAO #1) and reducing future COPC impacts (groundwater RAO #2) by reducing the mass of material serving as a source of dissolved phase groundwater impacts. However, groundwater would likely not be restored as a significant quantify of MGP-impacted soil would remain in the saturated zone following implementation of each of the alternatives.

Alternatives 4 and 5 both include the removal of outdoor shallow soil (and covering earthen floors in Jacob Riis Building No. 4 storage areas) that potentially contain PAHs at concentrations greater than Manhattan background levels, followed by backfilling and re-vegetation of the removal areas. The clean fill used to backfill the excavation areas would serve as a physical barrier to remaining MGP-impacted subsurface soil. Therefore, Alternatives 4 and 5 would be more protective of public health and the environment due to the removal of a potential exposure pathway and the removal/off-site disposal of soil containing PAHs greater than Manhattan background levels. As a result, the potential long-term success of Alternatives 4 and 5 relies less on administrative controls than Alternatives 2 and 3.

Alternative 5 would also include the excavation and removal of shallow (i.e., up to 8 feet bgs) accessible MGP-impacted subsurface soil and backfilling the removal areas with clean imported fill. However, this material only represents a small fraction (approximately 2%) of the MGP-impacted soil within OU-1. Also, as shown on Figure 5-3, areas of OU-1 containing shallow (i.e., up to 8 feet bgs) MGP-impacted subsurface soil will remain (in non-accessible areas). Therefore, the potential long-term success of Alternative 5 still relies on the implementation and enforcement of administrative controls. For this reason, Alternatives 4 and 5 are assumed to rely equally on institutional and engineering controls for success.

As indicated above, none of the alternatives would remediate all MGP-impacted soil (subsurface soil RAO #1) and subsequently COPC-impacted groundwater would likely not be restored by any alternative (groundwater RAO #1) in a determinant amount of time. Alternatives 3, 4, and 5 have the potential to reduce COPC impacts to groundwater (groundwater RAO #2) via NAPL recovery and targeted soil removal (Alternative 5 only). None of the alternatives would effectively address the off-site migration of COPC-impacted groundwater (groundwater RAO #4) or remove the source of groundwater contamination (groundwater RAO #5).

Therefore, Alternatives 4 and 5 are considered more effective in the long-term when compared to Alternatives 1, 2, and 3. Alternatives 4 and 5 are considered equally effective when compared to one another as each alternative removes shallow soil containing elevated concentrations of PAHs, which represents the greatest potential for exposures to residents and site workers in the foreseeable future.

A summary of the relative results from the alternatives comparative analysis for the overall protection of public health and the environment criterion is also presented in Table 6-1.

6.2.8 Cost Effectiveness

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

Table 6-2. Alternative Cost Estimates

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost*	Total Estimated Cost
Alternative 1 – No Action	$0	$0	$0
Alternative 2 – Groundwater Monitoring, Indoor Air Monitoring, and ICs/ECs	$500,000	$2,900,000	$3,400,000
Alternative 3 – Groundwater and Indoor Air Monitoring, Limited Surface Controls within 1223 FDR Drive, Passive NAPL Recovery, and ICs/ECs	$800,000	$3,500,000	$4,300,000
Alternative 4 – Groundwater and Indoor Air Monitoring, Limited Surface Controls within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal, and ICs/ECs	$5,400,000	$3,300,000	$8,700,000
Alternative 5 – Groundwater and Indoor Air Monitoring, Limited Surface Controls within 1223 FDR Drive, Shallow Soil Removal, Targeted Subsurface Soil Removal, NAPL Recovery, and ICs/ECs	$15,300,000	$3,300,000	$18,600,000

* = Estimated present worth of O&M cost is over an assumed 30-year period.

Both Alternatives 4 and 5 would include the removal (and limited surface controls in Jacob Riis Building No. 4) of surface soil that exceeds Manhattan background levels to eliminate potential future exposures to the surface soil. Although Alternative 5 would include the removal of the greatest slightly larger volume of MGP-impacted material than Alternative 4, a majority of soil containing MGP-related impacts would remain in the subsurface in inaccessible areas (i.e., at depths below the water table and beneath existing buildings). Therefore, Alternative 5 is considered less cost effective than Alternative 4 because it does not significantly reduce additional MGP-related impacts (as compared with Alternative 4). Alternatives 2 and 3 rely heavily on institutional controls that would mitigate potential future exposures to surface soil containing COPCs at concentrations greater than Manhattan background levels; therefore, are not considered as cost effective as Alternative 4, which reduces a potential exposure pathway and therefore is less dependent upon institutional and engineering controls.

A summary of the relative results from the alternatives comparative analysis for the cost effectiveness criterion is also presented in Table 6-1.

7 PREFERRED REMEDIAL ALTERNATIVE

7.1 General

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 remedial alternative for the site. The components of the preferred remedy are presented below.

7.2 Summary of Preferred Remedial Alternative

Based on the comparative analysis of the remedial alternatives presented in Section 6, Alternative 4 is the preferred remedial alternative for the site. This alternative cost-effectively achieves the best balance of the NYSDEC evaluation criteria while minimizing disturbance nuisances to the community. The highest potential for human exposure to site impacts is direct contact with shallow soil that exists below the vegetated cover and contains PAHs above Manhattan background levels. The preferred remedial alternative would remove this potential exposure scenario.

As described in Section 5 and Table 5-3, the primary components of the preferred remedial alternative consist of the following:

- Removing approximately 5,000 CY of shallow soil (i.e., top 2 feet) from the areas surrounding Jacob Riis buildings Nos. 2, 3, 4, 5, and 6 that contains PAHs at concentrations greater than the reported Manhattan background levels.
- Installing a highly visible demarcation layer (e.g., geotextile fabric, snow fence) along excavation area bottoms and side walls to denote soil removal limits.
- Replacing shallow excavated soil with clean imported fill material to match the previously existing lines and grades and vegetating soil to match previously existing surface covers, in kind.
- Installing a surface control to cover existing earthen floors in the storage room areas of 1223 FDR Drive (Jacob Riis Building No. 4) to mitigate potential exposure to soil containing COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs.
- Conducting a pre-design investigation to evaluate the physical characteristics of the NAPL observed within OU-1 and evaluating potential means and methods for removing the NAPL that collects within the recovery wells/collection trenches.
- Installing up to 12 NAPL recovery wells (or a series of collection trenches, based on the results of a pre-design investigation) along the eastern portion of the Jacob Riis property where measurable quantities of NAPL have been historically observed in monitoring wells and during the installation of soil borings.
- Conducting passive NAPL removal by periodic manual bailing or pumping NAPL from the recovery wells (or collection trenches).

- Installing a new groundwater monitoring well within the East 11th Street pedestrian walkway to delineate the western extent of dissolved phase BTEX, confirm groundwater flow direction in this area, verify that dissolved phase COPCs are not present in properties west of Avenue D, and be used as an "early detection" or "sentinel" well to document conditions west of OU-1.
- Conducting annual groundwater monitoring to document dissolved phase COPC concentrations and groundwater flow direction within OU-1.
- Establishing deed restrictions and environmental easements to prohibit use of groundwater (although there are no current users of groundwater), as well as establishing protocols/procedures for invasive activities that are conducted within OU-1.
- Preparing a Site Management Plan that includes:
  - The requirements for documenting the institutional and engineering controls that have been established are being maintained for OU-1.
  - Known locations of subsurface soil remaining within OU-1 after the remedy is implemented that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use SCOs.
  - Requirements for shallow soil inspection and maintenance.
  - Protocols and requirements for semi-annual NAPL monitoring, annual groundwater monitoring, and indoor air monitoring within the basement and/or ground level of buildings within the Jacob Riis property.
  - Protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities.
  - Protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor based on the results obtained from the annual monitoring activities.

Implementation challenges associated with Alternative 4 would primarily be related to conducting remedial activities in an urban public setting on property not owned by Con Edison. Excavation of impacted soil is proven remedial technology. Removal and off-site disposal of shallow soil is technically feasible, although conducting soil removal activities in the densely populated urban public setting presents numerous logistical challenges. There is very limited available space within OU-1 for material handling and staging and small construction equipment would be required to conduct the removal activities. Transportation planning would be conducted prior to the remedial activities.

Potential short-term exposures could occur as a result of surface control installation, shallow soil excavation, material handling, and off-site transportation activities. Additionally, potential exposures could occur during installation of the groundwater monitoring well and the NAPL recovery wells (or recovery trenches). Potential exposure of remedial workers would be minimized through training and the appropriate level of PPE, as specified in a site-specific HASP. A CAMP would be prepared during the remedial design and implemented during the remedial action. Community air monitoring would be performed during the remedial action and would be used 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 the removal areas would be restricted by temporary security fencing. Additionally, site safety concerns include working with and around 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.

A pre-design investigation would be conducted as part of the remedial design to evaluate the location and construction of NAPL recovery wells and/or collection trenches. Active NAPL recovery would be more difficult to implement due primarily to space constraints, when compared to passive NAPL recovery, as active recovery would require an on-site NAPL storage structure/facility. Construction of a storage structure in a public area is not considered readily implementable or practicable. Active NAPL recovery would also generate groundwater that would need to be managed.

Institutional controls would be required; however, Con Edison does not own these properties and cooperation from the current property owner would be required. Access agreements would be required to implement the remedial construction and conduct the periodic NAPL, groundwater, and indoor air monitoring activities. Implementation of institutional controls is highly dependent upon current property owner's willingness to accept the controls and would require coordination with State agencies (i.e., NYSDEC and NYSDOH).

Alternative 4 would protective of public health and the environment by mitigating potential long-term exposures to MGP-impacted media by eliminating a potential exposure pathway to shallow soils within portions of Jacob Riis Building No. 4 or removing and replacing shallow soil in outdoor areas containing concentrations of PAHs above Manhattan background levels, recovery/removal of recoverable NAPL, and by establishing and maintaining institutional and engineering controls. Alternative 4 would reduce potential human exposure to surface soil containing COPCs (surface soil RAO #1) through shallow soil removal and placement of imported clean fill. This alternative would also reduce potential human exposures to subsurface soil containing COPCs (subsurface soil RAO #1), reduce potential human exposures to MGP-related NAPLs (subsurface RAO #3), and reduce potential human exposure to groundwater containing COPCs (groundwater RAO #3) through implementation of institutional and engineering controls.

Alternative 4 would reduce further off-site migration of impacts, to the extent practicable, (subsurface soil RAO #4) through passive recovery/removal of recoverable NAPL from OU-1. Passive NAPL recovery would also work toward restoring COPC-impacted groundwater (groundwater RAO #1) and reduce future COPC impacts to groundwater (groundwater RAO #2) by reducing a source of dissolved phase groundwater impacts (Alternative 4 would not remediate subsurface soil containing MGP-related COPCs; therefore, sources for dissolved phase groundwater impacts would remain).

As presented in Section 5, due to site characteristics, constraints, and logistics, none of the alternatives would remediate all MGP-impacted soil. While Alternative 5 includes the excavation and removal of accessible unsaturated (i.e., up to 8 feet bgs) MGP-impacted subsurface soil, this material only represents a small fraction (approximately 2%) of the MGP-impacted soil within OU-1, would result in only a small reduction in potential for human exposure, and would not significantly reduce impacts to groundwater. Both Alternatives 4 and 5 both include the removal of shallow soil that contains PAHs at concentrations greater than Manhattan background levels followed by backfilling and re-vegetation of the removal areas. The clean fill used to backfill the shallow excavation areas would serve as a physical barrier to remaining MGP-impacted subsurface soil. Alternatives 4 and 5 are considered comparatively equally effective as each alternative removes the greatest potential for exposures to residents and site workers. Therefore, Alternative 5 is considered less cost effective and substantially more disruptive to the community than Alternative 4 because it does not significantly reduce additional MGP-related impacts.

7.3 Estimated Cost of Preferred Alternative

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

Table 7-1. Alternative 4 Cost Estimate

Alternative	Estimated Capital Cost	Estimated Present Worth of O&M Cost*	Total Estimated Cost
Alternative 4 – Groundwater and Indoor Air Monitoring, Passive NAPL Recovery, Shallow Soil Removal, and ICs/ECs	$5,400,000	$3,300,000	$8,700,000

* = Estimated present worth of O&M cost is over an assumed 30-year period.

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TABLES

Table 1-3
Summary of Field Observations

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Sample ID	Investigation	Sample Location	Depth (feet bgs)	Observation
B-4	SC	JR	7-9	Solvent odor
B-5/MW-2	SC	JR	**3-5**	**Visible OLM**
			3-9.3	MGP odor
			7-9	**Visible OLM**
			11-13	Slight solvent odor
			17-19	Petroleum odor
B-6	SC	JR	0.5-4	Petroleum odor
			7-23	**Visible OLM, MGP odor**
			19-23	**Visible TLM**
B-7	SC	JR	15-17	Slight sulfur odor
B-8	SC	JR	**10-14**	**Visible OLM/TLM, MGP odor**
B-10	SC	JR	5-15	MGP odor
			7-13	**Visible OLM**
B-11/MW-3	SC	JR	1-2	Slight naphthalene odor
			6-18	**Visible TLM**
			6-24	**Visible OLM**
B-12	SC	JR	6-24	MGP odor
			7-9	**Visible OLM**
			15-23	**Visible OLM/TLM**
B-13	SC	JR	--	Refusal due to wood timbers at 10' bgs
B-14	SC	JR	6-14	Petroleum odor
B-15	SC	JR	8-12	MGP odor
B-16	SC	JR	3-11	Petroleum odor
			13-19	MGP odor
			17-18.2	**Visible OLM**
B-17	SC	JR	7-18.9	MGP odor
			8-20	**Visible OLM**
B-18	SC	JR	7-7.5	Slight solvent odor
B-19	SC	JR	8-12	Slight solvent odor
			12-18.5	MGP odor
			14-18	**Visible OLM/TLM**
B-20	SC	JR	--	Refusal due to concrete at 6.5' bgs
B-21	SC	JR	**13-15**	**Visible product**
			13-23	Petroleum odor
B-22	SC	JR	**8-18**	**Visible OLM, MGP odor**
B-23/MW-5	SC	JR	0.5-4	Petroleum odor
			9-15	**Visible OLM**
			9-21	MGP odor
			19-21	**Visible TLM**
B-27	SC	JR	2-3	MGP odor
			10-13	MGP odor
B-32	SC	JR	5-27	MGP odor
			7-19	**Visible OLM**
			11-21	**Visible TLM**
			21-25	**Visible OLM**
			25-27	**Visible TLM**
B-33	SC	JR	5-29.5	MGP odor
			7-29.5	**Visible OLM**
			19-27	**Visible TLM**
B-34	SC	JR	7-23	MGP odor
			15-23	**Visible OLM/TLM**
B-35	SC	JR	--	Refusal due to concrete at 7.5' bgs

Table 1-3
Summary of Field Observations

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Sample ID	Investigation	Sample Location	Depth (feet bgs)	Observation
B-37	SC	JR	5-11	Strong solvent odor
			7-29	MGP odor
			17-19	**Visible OLM**
			19-23	**Visible TLM**
B-38	SC	JR	10-14	Slight solvent odor
			10-18	Slight sheen
B-39/MW-4	SC	JR	--	No visual impacts
B-41	SC	JR	--	Refusal due to concrete at 5.5' bgs
B-45	SC	JR	9-33	MGP odor
			11-33	**Visible OLM**
			17-33	**Visible TLM**
B-46	SC	JR	--	Refusal due to wood timbers
TT-3	SC	JR	2-3	Slight MGP-related odor
TT-4	SC	JR	--	No visual impacts
TT-5	SC	JR	--	No visual impacts
TT-8	SC	JR	2-3.5	Slight MGP-related odor
TT-10	SC	JR	4-8	Strong solvent odor
TT-13	SC	JR	3-5	Slight MGP-related odor
TT-14	SC	JR	2-4	MGP-related odor
TT-15	SC	JR	--	No visual impacts
TT-16	SC	JR	0.6-2	Slight MGP-related odor
			2-4	**Strong MGP-related odor, Black TLM seam at northern end of trench**
			4-5.5	Strong MGP-related odor
TT-17	SC	JR	--	No visual impacts
TT-18	SC	JR	--	No visual impacts
TT-19	SC	JR	7-8	MGP-related odor, sheen
TT-21	SC	JR	1.8-6	Slight MGP-related odor
TT-22	SC	JR	2-4	Slight MGP-related and creosote odor
MW-107A/B	RI	JR	16.5-28.5	Slight odor
			28.5-29	Heavy sheen, odor
			28.5-34	**Trace tar-like material, strong MGP odor**
			34-37	**Tar-like material, odor**
			37-39	**Oil-like material, MGP odor**
			39-48.5	Slight MGP odor
SB-108	RI	JR	19-21	Slight MGP odor
			31-33	Slight MGP odor
			34-34.5	**Tar-like material, strong MGP odor**
			34.5-45	Slight MGP odor
SB-109	RI	JR	19-31	Trace sheen, non-MGP odor
			31-35	**Red brown Tar-like material , MGP odor**
			35-38	Slight odor, trace sheen
			38-43	Slight odor
SB-110	RI	JR	9-12	Slight MGP odor
			17-22	Slight MGP odor
			23-25	Slight MGP odor
MW-111B	RI	JR	6-19	Sheen, MGP odor
			19-40	**Red-brown Tar-like material , strong MGP odor**
			40-44	Sheen, MGP odor
SB-112	RI	JR	**7-12**	**Oil-like material, sheen, MGP odor**
			12-17.5	Slight MGP odor
			17.5-18	Strong MGP odor, sheen
			18-18.25	**Tar-like material**
			25-25.5	MGP odor
			25.5-26	Sheen, MGP odor
			26-26.5	Odor
			26.5-30	Slight MGP odor

Table 1-3
Summary of Field Observations

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Sample ID	Investigation	Sample Location	Depth (feet bgs)	Observation
SB-113	RI	JR	0-35	No visual impacts
MW-115A	RI	JR	0-35	No visual impacts
SB-116	RI	JR	5-9	Sheen
			9-14	MGP odor, slight sheen
			14-20	**Trace tar-like material, MGP odor**
SB-117	RI	JR	**6.9-18.5**	**Tar-like material , MGP odor**
			18.5-20	MGP odor
			26-28	Slight odor
SB-118	RI	JR	9-15	MGP odor, slight sheen
			15-21.5	**Red brown tar-like material , MGP odor**
			21.5-27	MGP odor
			27-31	Sheen, MGP odor
			31-38.5	Slight MGP odor
SB-119	RI	JR	7-7.5	Sheen, odor
			7.5-11	**Tar-like material, strong odor**
			11-17	Sheen, strong odor
			17-19.5	Slight odor
			21-24.5	Sheen, slight odor
			25-34	Slight odor
SB-120	RI	JR	11-13	Slight MGP odor
MW-121A/B	RI	JR	10-12	Slight odor
MW-122A/B	RI	JR	11-12.5	Slight odor
SB-123	RI	JR	13.8-15	Slight odor
SB-124	RI	JR	0-39	No visual impacts
MW-125A/B	RI	JR	0-45	No visual impacts

Notes:
Bold = indicates presence of OLM or TLM.
OLM = oil-like material.
TLM = tar-like material.
MGP = manufactured gas plant.
bgs = below ground surface.
JR = Jacob Riis.
SC = Site Characterization Study, TRC, March 2005.
RI = Remedial Investigation.

Table 2-1
Potential Chemical-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Federal			
CWA Section 404	33 USC 1344	Regulates discharges to surface water or ocean, indirect discharges to POTWs, and discharge of dredged or fill material into waters of the U.S. (including wetlands).	Potentially applicable for remedial activities that discharge water to the East River during remedial action.
RCRA-Regulated Levels for Toxic Characteristics Leaching Procedure (TCLP) Constituents	40 CFR Part 261	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristic of toxicity.	Excavated soil 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	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	Provides an outline for the development and execution of the soil remedial programs. Includes soil cleanup objective tables.	These guidance values are applicable in evaluating soil quality.
NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 (6/98)	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 applicable in evaluating groundwater and surface water quality.
Groundwater Quality Standards and Guidance Values	6 NYCRR Parts 700-705	Establishes quality standards for groundwater.	These standards are applicable in evaluating groundwater quality standards

Table 2-1
Potential Chemical-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/Remedial Action
Identification and Listing of Hazardous Wastes	6 NYCRR Part 371	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 soil generated during implementation of remedial activities are hazardous wastes. These regulations do not set cleanup standards, but are considered when developing remedial alternatives.
Air Quality Standards	6 NYCRR Part 257	Establishes quality standards for air.	These criteria are applicable in evaluating air quality and will be considered in the preparation of the site-specific HASP and Community Air Monitoring Plans.
Guidance for Evaluating Soil Vapor Intrusion in the State of New York		Establishes the methodology for performing vapor intrusion evaluation including exposures, data, and appropriate actions.	This guidance is applicable in evaluating indoor air quality for buildings located onsite.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
Federal			
Occupational Safety and Health Act (OSHA) - General Industry Standards	29 CFR Part 1910	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	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	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	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	Provides requirements for outlining emergency procedures to be used following explosions, fires, etc. when storing hazardous wastes.	Plans will be developed and implemented during remedial design. Copies of the plan will be kept on-site.
CWA - Discharge to Waters of the U.S., and Section 404	40 CFR Parts 122, 125, 403, 230, and 402 CWA Section 401, Section 404 (b)(1); 33 USC 1344	Establishes site-specific pollutant limitations and performance standards which are designed to protect surface water quality. Types of discharges regulated under CWA include: indirect discharge to a POTW and discharge of dredged or fill material into U.S. waters.	May be relevant and appropriate for remediation alternatives which discharge to the POTW, or the East River, or that include dredging/filling of the East River/East River floodplain.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
CWA Section 401	33 U.S.C. 1341	Requires that 401 Water Quality Certification permit be provided to federal permitting agency (USACE) for any activity including, but not limited to, the construction or operation of facilities which may result in any discharge into jurisdictional waters of the U.S. and/or state.	May be relevant and appropriate for remediation alternatives adjacent to the East River.
90 Day Accumulation Rule for Hazardous Waste	40 CFR Part 262.34	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.	May be relevant and appropriate 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)	Establishes provisions for a deed notation for closed hazardous waste disposal units, to prevent land disturbance by future owners.	The regulations may be relevant and appropriate because closed areas may be similar to closed RCRA units.
RCRA - General Standards	40 CFR Part 264.111	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.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
Standards Applicable to Transporters of Applicable Hazardous Waste - RCRA Section 3003	49 CFR Parts 170-179 40 CFR Parts 262, and 263	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	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 50	Establishes ambient air quality standards for protection of public health.	Remedial operations will be designed to meet these emissions limits.
USEPA-Administered Permit Program: The Hazardous Waste Permit Program	RCRA Section 3005; 40 CFR Part 270.124	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.
RCRA – regulated Levels for Characteristic Leaching Procedure (TCLP) Constituents	40 CFR 261	These regulations specify the TCLP constituent levels for identification of hazardous wastes that exhibit the characteristics of toxicity.	Excavated soil may be sampled and analyzed for TCLP constituents prior to disposal to determine if the materials are hazardous based on the characteristic of toxicity.
Land Disposal Restrictions	40 CFR Part 268	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 soils 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.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
RCRA Subtitle C	42 U.S.C. Section 6901 et seq.; 40 CFR Part 268	Restricts land disposal of hazardous wastes that exceed specific criteria. Establishes UTSs to which hazardous wastes must be treated prior to land disposal.	May be relevant and appropriate to remedial activities that include the disposal of soil from the site.
New York State			
Discharges to Public Waters	New York State Environmental Conservation Law, Section 71-3503	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	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	Establishes procedures for identifying solid waste that are subject to regulations as a hazardous waste.	Materials excavated/removed from the site will be handled in accordance with RCRA and New York State hazardous waste regulations, if appropriate.
Hazardous Waste Manifest System and Related Standards for Generators, Transporters, and Facilities	6 NYCRR Part 372	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	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.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
Waste Transporter Permits	6 NYCRR Part 364	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	TAGMs are NYSDEC guidance documents 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	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.
Management of Soil and Sediment Contaminated With Coal Tar From Former Manufactured Gas Plants	NYSDEC Program Policy	Purpose of the guidance is to facilitate the permanent treatment of soil contaminated with coal tar from the sites of former MGPs.	Policy will be considered for D018 hazardous and non-hazardous soil removed during removal activities.
Land Disposal of a Hazardous Waste	6 NYCRR Part 376	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	TAGM 4061 (DER-4) (2002)	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.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
New York Hazardous Waste Management Facilities	6 NYCRR Part 373-2.15	Provides requirements for the operation of a thermal treatment unit, including information about monitoring, inspections, closure, and hazardous waste constituents.	Operational requirements must be followed during thermal treatment.
New York Hazardous Waste Management Facilities	NYCRR Part 373-2.16	Outlines requirements for the operation of a thermal treatment unit, including information about waste analysis, general operating requirements, closure, and standards for particular hazardous wastes.	Operation requirements must be followed during thermal treatment.
New York Requirements Specific to Thermal Treatment	6 NYCRR Part 373-3.16	Outlines requirements for the operation of a thermal treatment unit, including information about waste analysis, general operating requirements, closure, and standards for particular hazardous wastes.	Operational requirements must be followed during thermal treatment.
Contained-In" Criteria for Environmental Media: Soil Action Levels	TAGM 3028	May eliminate need for management of waste as hazardous waste based on established generic health-based "contained-in" levels for listed hazardous wastes.	May be appropriate and relevant for certain remedial alternatives.
Lime Kiln Dust/quick lime Guidance from NYSDEC	N/A (05.20.2008 letter to NYS Utilities)	Prohibit use of lime kiln dust /quick lime to amend soil at MGP sites.	Lime kiln dust/quick lime will not be used to amend soil during remedial activities.
Guidelines for the Control of Toxic Ambient Air Contaminants	DAR-1 (Air Guide 1)	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 appropriate and relevant for remedial alternatives that result in certain air emissions.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
New York State Air Quality Classification System	6 NYCRR Part 256	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	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. The Site is included in air quality Class IV.
New York Permits and Certificates	6 NYCRR Part 201	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 this alternative.
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)	Establishes permitting requirements for point source discharges; regulates discharge of water into navigable waters including the quantity and quality of discharge.	May be relevant and appropriate for activities adjacent to the East River.
New Discharges to Publicly Owned Treatment Works (POTW)	TOGS 1.3.8	Focuses on the effects of a new, increased or changed discharge to a POTW and the potential effects on the POTW's SPDES permit and pre-treatment program.	Applicable for the discharge of treated groundwater or other waste waters generated during the remedial activities that are discharged to a POTW.
Local			
New York City Air Pollution Control Code	Administrative Code of the City of New York Section 24-6	Establishes emissions standards for New York City.	Remedial actions will meet the emissions standards.

Table 2-2
Potential Action-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
NYCDEP Sewer Discharge Parameters		Establishes influent parameters that are required to discharge to New York City sewer system.	Water generated during construction dewatering activities would be required to meet these criteria.

Table 2-3
Potential Location-Specific SCGs

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site – Manhattan, New York

Regulation	Citation	Summary of Requirements	Applicability to the Remedial Design/ Remedial Action
Federal			
National Environmental Policy Act Executive Orders 11988 and 11990, Floodplains Management and Wetlands Protection	40 CFR 6.302; 40 CFR Part 6, Appendix A	Requires federal agencies, where possible, to avoid or minimize adverse impact of federal actions upon wetlands/floodplains and enhance natural values of such. Establishes the "no-net-loss" of waters/wetland area and/or function policy.	May be relevant and appropriate if remedial activities are conducted within floodplain or wetland areas.
CWA Section 404	Section 404	Types of discharges regulated under CWA include: discharge to surface water or ocean, indirect discharge to a POTW, and discharge of dredged or fill material into waters of the U.S. (including wetlands).	May be relevant and appropriate for remediation alternatives which discharge to the POTW, or the East River, or that include dredging/filling of the East River/East River floodplain.
Hazardous Waste Facility Located on a Floodplain	40 CFR Part 264.18(b)	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.
New York State			
New York State Floodplain Management Development Permits	6 NYCRR Part 500	Provides conditions necessitating NYSDEC permits and provides definitions and procedures for activities conducted within floodplains.	May be relevant and appropriate if remedial activities are conducted within the floodplain.
Floodplain Management Criteria for State Projects	6 NYCRR Part 502	Establishes floodplain management practices for projects involving state-owned and state-financed facilities.	May be relevant and appropriate if remedial activities are conducted within the floodplain.
Local			
Rules for City Wide Construction Noise Mitigation	Section 1043 of the Charter of the city of New York and Section 24-219 of the Administrative code of the City of New York	Establishes standards and procedures to reduce noise levels from construction	Construction activities must be conducted in accordance with required Construction Noise Mitigation Plan.
Local Building Permits	N/A	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.

Table 4-1
Technology Screening Evaluation for Surface and Subsurface Soil

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
No Action	No Action	No Action	Alternative would not include any active 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 draft DER-10 and NCP	Implementable	Would not achieve RAOs for soil.	None	Yes
Institutional Controls/Engineering 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 soil and/or the potential to jeopardize the integrity of a remedy. Examples of potential institutional controls include establishing land use restrictions and health and safety requirements for subsurface activities.	Implementable. Would require ConEdison to negotiate with current property owners to implement controls.	Institutional controls and engineering controls may be effective to limit and control contact with impacted soils. Can be effective when implemented in combination with other technologies. However, this technology alone would not meet the RAOs for remediating soil containing MGP-related COPCs or reducing further off-site migration of MGP-related NAPL.	Low Capital and O&M Costs	Yes
	Engineering Controls	Building Design Standards, Low-Permeability Liners, Vapor Mitigation Systems, Fencing	Engineering controls would include building design standards and materials to mitigate potential exposures. Examples of engineering controls include requirements for materials of construction, vapor barriers, sub-slab depressurization systems, site fencing, etc.			Low Capital and O&M Costs	Yes
In-Situ Containment/ Controls	Surface Controls/ Capping	Asphalt/Concrete Cap	Application of a layer of asphalt or concrete over impacted soil.	Implementable. Equipment and materials necessary to construct the cap are readily available. Asphalt cap is consistent with current and future uses of roadways and sidewalks in and around Jacob Riis property. If used for large-scale applications, green space would be reduced within OU-1	May reduce the mobility of chemical constituents by reducing infiltration; would not reduce toxicity or volume of impacts or further off-site migration of MGP-related COPCs. Long-term effectiveness requires ongoing maintenance.	Moderate Capital and O&M Costs	Yes
		Clay/Soil Cap	Placing and compacting clay material or soil material over impacted soil.	Implementable. Equipment and materials necessary to construct the cap are readily available. Clay/soil cap is consistent with current and future uses of grassed/ vegetated areas of Jacob Riis property.	May reduce the mobility of chemical constituents by reducing infiltration; would not reduce toxicity or volume of impacts or further off-site migration of MGP-related COPCs. Long-term effectiveness requires ongoing maintenance.	Low Capital and O&M Costs	Yes
		Multi-Media Cap	Application of a combination of clay/soils and synthetic membrane(s) over impacted soil.	Implementable. Equipment and materials necessary to construct the cap are readily available. Membrane layer would prohibit vegetation of trees, shrubs, etc.	May reduce the mobility of chemical constituents by reducing infiltration; would not reduce toxicity or volume of impact, or further off-site migration of MGP-related COPCs. Long-term effectiveness requires ongoing maintenance.	Moderate Capital and O&M Costs	No

Table 4-1
Technology Screening Evaluation for Surface and Subsurface Soil

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
In-Situ Containment/ Controls (cont'd)	Containment	Slurry Walls	Involves excavating a trench and adding a slurry (e.g., soil/cement-bentonite mixture) to contain impacted soil and control potential off-site migration of impacted groundwater and NAPLs. Slurry walls are typically keyed into a confining layer (e.g., an underlying silt/clay layer).	Potentially implementable. Equipment and materials required to install slurry walls are available. Presence of underground obstructions may hinder technology use. Would require trenching through fill material and obstructions (e.g., cribbing, pilings, etc.) to facilitate installation. May require relocation of utilities that cross path of barrier.	Effective for reducing the migration of NAPL. However, limited space is available west of the FDR and a significant quantity of NAPL is located beneath and east of the FDR. Additionally, low-permeability containment options would like cause the groundwater table to raise and changes in groundwater flow patterns that would result in flooding of building basements. May help achieve RAOs when combined with other technologies (i.e., as excavation support).	High Capital and Low O&M Costs	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.	Implementable. May require relocation of utilities that cross path of barrier.		High Capital and Low O&M Costs	No
		Sheet pile	Steel sheet piles are driven into the subsurface to contain impacted soils and NAPLs. The sheet pile wall is typically keyed into a confining unit and impermeable to groundwater flow.	Potentially implementable. Presence of underground obstructions may hinder technology use. Would require trenching through fill material and obstructions (e.g., cribbing, pilings, etc.) to facilitate installation. May require relocation of utilities that cross path of barrier.		High Capital and Low O&M Costs	No
In-Situ Treatment	Immobilization	Stabilization/ Solidification	Addition of material to the impacted soil that limits the solubility or mobility of the COPCs present. Involves treating soil (e.g., with cement) to produce a stable, non-leachable material, that physically or chemically locks the COPCs within the solidified matrix.	Not implementable. Nature of fill material and obstructions (i.e., urban fill and cribbing) inhibits mixing of site soils. Limited space available for grout/slurry mixing and material handling.	Overall effectiveness of this process would need to be evaluated during a bench scale treatability study. Could be used to focus on areas where COPCs and/or NAPL is concentrated to minimize the potential for migration.	Moderate Capital and Low O&M Costs	No
	Extraction	Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation (DUS/HPO)	Steam is injected into the subsurface to mobilize COPCs and NAPLs. The mobilized impacts are captured and constituents are re-condensed, collected, and treated. In addition, HPO can degrade impacts in subsurface heated zones. In most cases, this technology requires long-term operation and maintenance of on-site injection, collection and/or treatment systems.	Potentially implementable. Process may result in uncontrolled NAPL migration. Limited space for vapor recovery and treatment systems. Presence of underground MGP structures may hinder technology use.	This option would require a pilot scale study to determine effectiveness. Underground structures and obstructions would need to be removed prior to implementation. Further mobilization of dissolved plume a concern; tidal fluctuations may preclude use.	High Capital and O&M Costs	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.	Potentially implementable. Limited space available for large quantities of oxidizing agents and equipment. Soil vapor collection a concern due to close proximity of housing and schools.	Not proven to be effective for treatment of MGP NAPLs, but shown to be effective in treating dissolved phase hydrocarbons. Tidal fluctuation/ brackish water may affect overall effectiveness of oxidizing agents. Large amounts of oxidizing agents would be needed to oxidize NAPL and highly impacted soil; unreacted ozone would need to be captured in the vadose zone to eliminate potential for exposures.	High Capital and O&M Costs	No

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East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
In-Situ Treatment (cont'd)	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 COPCs. 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.	Low Capital and O&M Costs	No
		Enhanced Biodegradation	Addition of amendments (e.g., oxygen, nutrients) to the subsurface to enhance indigenous microbial populations to improve the rate of natural degradation.	Implementable	May not achieve RAOs for soil. Not effective for NAPLs.	Moderate Capital and O&M Costs	No
		Biosparging	Air/oxygen injection wells are installed within the impacted regions to enhance biodegradation of COPCs by increasing oxygen availability. Low-flow injection technology may be incorporated. This technology requires long-term monitoring.	Technically Implementable. Limited space available for equipment. Access to areas that would require injection wells for this option to be effective is limited.	Would require closely spaced application points for injection of air. Would require long-term maintenance of injection system. Less effective for heavier, more condensed PAHs on soil and NAPL.	Moderate Capital and High O&M Costs	No
Removal	Excavation	Excavation	Physical removal of impacted soil. Typical excavation equipment includes backhoes, excavators, loaders, and/or bulldozers. Excavation may be difficult below the groundwater table and near buildings/structures. Would be very difficult to remove all impacted material based on depth and proximity to buildings and subsurface obstructions.	Technically implementable. Equipment capable of excavating the soil is readily available. Site conditions (i.e., presence of buildings, subsurface obstructions, utilities and shallow groundwater) inhibits large-scale excavation. Installation of support systems (i.e., sheet pile) to facilitate excavation would be very difficult in areas of subsurface obstructions (i.e., cribbing and fill).	Proven process for effectively removing impacted soil.	High Capital and Low O&M Costs	Yes
Ex-Situ On-Site Treatment and/or Disposal	Immobilization	Solidification/ Stabilization	Addition of material to excavated soil that limits the solubility or mobility of the COPCs present. Involves treating soil to produce a stable, non-leachable material that physically or chemically locks the constituents within the solidified matrix.	Not Implementable. Not sufficient space available to perform treatment technology. Not considered practical for residential area.	Proven process for effectively reducing mobility and toxicity of organic COPCs. Overall effectiveness of this process would need to be evaluated during a bench-scale study.	High Capital and Low O&M Costs	No
	Extraction	Low-Temperature Thermal Desorption (LTTD)	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 to treat materials that are determined to be characteristically hazardous for benzene (D018) based on TCLP analysis.		Proven process for effectively addressing organic COPCs. The efficiency of the system and rate of removal of organic COPCs would require evaluation during bench-scale and/or pilot-scale testing. Dewatering would be required prior to treatment to maximize effectiveness of technology.	Moderate Capital and Low O&M Costs	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.		Proven process for effectively addressing organic COPCs. 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. Dewatering may need to occur prior to treatment to maximize effectiveness of technology.	High Capital and Low O&M Costs	No

Table 4-1
Technology Screening Evaluation for Surface and Subsurface Soil

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
Ex-Situ On-Site Treatment and/or Disposal (cont'd)	Chemical Treatment	Chemical Oxidation	Addition of oxidizing agents to degrade organic constituents to less-toxic by-products.	Not implementable. Large amounts of oxidizing agents may be required. Limited space for soil management and application of the chemical oxidation.	Not known to be effective for NAPL.	High capital and O&M costs.	No
	Disposal	Solid Waste Landfill	Construction of a landfill that would meet NYSDEC solid waste requirements.	Site setting and space limitations make on-site landfilling infeasible.	This technology process would be effective at meeting the RAOs for soil. Excavated material would be contained in an appropriately constructed solid waste landfill. Long-term effectiveness requires ongoing maintenance and monitoring.	High capital and moderate O&M costs.	No
		RCRA Landfill	Construction of a landfill that would meet RCRA requirements.	Site setting and space limitations make on-site landfilling infeasible.	This technology process would be effective at meeting the RAOs for soil. Excavated material would be contained in an appropriately constructed RCRA landfill. Long-term effectiveness requires ongoing maintenance and monitoring.	High capital and moderate O&M costs.	No
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.	Based on the nature of the fill materials, 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. No long-term data available.	Moderate Capital and Low Costs	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.	Based on the nature of the fill materials, 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 vitrification. A bench-scale/pilot study may be necessary to determine effectiveness.	Moderate Capital and Low Costs	No
		Fuel Blending/Co-Burn in Utility Boiler	Soil is blended with feed coal to fire a utility boiler used to generate steam. Organics are destroyed.	Implementable. Permitted facilities available for burning MGP soils would need to be identified during the remedial design phase.	Effective for treating organics COPCs. Soil would be blended with coal prior to burning. Overall effectiveness of this process would need to be evaluated during a trial burn	Moderate Capital and Low O&M Costs	Yes
	Thermal Destruction	Incineration	Soils are transported off-site for high temperature thermal destruction of the organic compounds present in the media. Soils are excavated and conditioned prior to incineration.	Not 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.	High capital and O&M costs.	No

Table 4-1
Technology Screening Evaluation for Surface and Subsurface Soil

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
Off-Site Treatment and/or Disposal (cont'd)	Extraction	Low-Temperature Thermal Desorption (LTTD)	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 to treat materials that are determined to be characteristically hazardous for benzene (D018) based on TCLP analysis.	Implementable. Treatment facilities are available.	Proven process for effectively addressing organic constituents.	Moderate Capital and Low O&M Costs	Yes
	Disposal	Solid Waste Landfill	Disposal of impacted soil in an existing permitted non-hazardous landfill.	Implementable. Excavated soil can be disposed at a solid waste landfill assuming the waste material meets the requirements of the disposal facility.	Proven process that, in conjunction with excavation, can effectively achieve the RAOs.	Moderate Capital and Low O&M Costs	Yes
		RCRA Landfill	Disposal of impacted soil in an existing RCRA permitted landfill facility.	Not implementable. 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.	High Capital and Low O&M Costs	No

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

Table 4-2
Technology Screening Evaluation for Groundwater

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
No Action	No Action	No Action	Alternative would not include any active 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 draft DER-10 and NCP.	Implementable	Would not achieve the RAOs for groundwater in an acceptable timeframe.	None	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 health and safety requirements when conducting subsurface activities and restrictions on groundwater use and/or extraction.	Implementable. Would require ConEdison to negotiate with current property owners to implement controls.	May be effective for reducing the potential for human exposure. This option would not meet the RAO for restoring, to the extent practicable, groundwater to current NYS Groundwater Quality Standards. This option may be effective when combined with other process options.	Low Capital and O&M Costs	Yes
In-Situ Containment/ Controls	Containment	Slurry Walls	Involves excavating a trench and adding a slurry (e.g., soil/cement-bentonite mixture) to contain impacted soil and control potential off-site migration of impacted groundwater and NAPLs. Slurry walls are typically keyed into a confining layer (e.g., an underlying silt/clay layer).	Potentially implementable. Equipment and materials required to install slurry walls are available. Presence of underground obstructions may hinder technology use. Would require trenching through fill material and obstructions (e.g., cribbing, pilings, etc.) to facilitate installation. May require relocation of utilities that cross path of barrier.	Effective for reducing the migration of NAPL. However, limited space is available west of the FDR and a significant quantity of NAPL is located beneath and east of the FDR. Additionally, low-permeability containment options would like cause the groundwater table to raise and changes in groundwater flow patterns that would results in flooding of building basements.	High Capital and Low O&M Costs	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.	Implementable. May require relocation of utilities that cross path of barrier.		High Capital and Low O&M Costs	No
		Sheet pile	Steel sheet piles are driven into the subsurface to contain impacted soils and NAPLs. The sheet pile wall is typically keyed into a confining unit and impermeable to groundwater flow.	Potentially implementable. Equipment and materials required to install slurry walls are available. Presence of underground obstructions may hinder technology use. Would require trenching through fill material and obstructions (e.g., cribbing, pilings, etc.) to facilitate installation. May require relocation of utilities that cross path of barrier.		High Capital and Low O&M Costs	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. This process relies on long-term monitoring to demonstrate the reduction of impacts.	Implementable. Would require long-term monitoring to demonstrate reduction of impacts.	May be effective if NAPL/source material is removed or is prevented from contributing to the dissolved phase impacts.	Low Capital and O&M Costs	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.	Implementable. Would require monitoring to demonstrate reduction of COPCs.	May not achieve RAOs for groundwater. Not effective for NAPLs.	Low Capital and O&M Costs	No

Table 4-2
Technology Screening Evaluation for Groundwater

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
In-Situ Treatment (cont'd)	Biological Treatment (cont'd)	Biosparging	Air/oxygen injection wells are installed within the dissolved plume to enhance biodegradation of constituents by increasing oxygen availability. Low-flow injection technology may be incorporated. This technology requires long-term monitoring and maintenance of air/oxygen delivery system.	Technically Implementable. Limited space available for equipment. Access to areas that would require injection wells for this option to be effective is limited. Vapor intrusion concerns with injecting air/oxygen in close proximity to residential buildings.	Would require closely spaced application points for injection of air. Would require long-term maintenance of injection system. Less effective for heavier, more condensed PAHs in groundwater and NAPL. Presence of brackish water may affect overall effectiveness of oxidizing agents.	Moderate Capital and High O&M Costs	No
	Chemical Treatment	Chemical Oxidation	Oxidizing agents are added to oxidize and reduce the mass of organic COPCs. In-situ chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate, or potassium permanganate.	Technically Implementable. Limited space available for large quantities of oxidizing agents and equipment. Soil vapor collection a concern due to close proximity of housing and schools.	Would require long-term treatment to reduce constituents unless combined with source removal technology. Not proven to be effective for treatment of MGP-related DNAPLs. A bench scale treatability study would be required to evaluate/estimate the amount of oxidizing agent. Large amounts of oxidizing agents are needed to oxidize NAPL.	High Capital and O&M Costs	No
		Permeable Reactive Barrier (PRB)	Involves creating a reactive treatment area oriented to intercept and passively remove COPCs from groundwater flow via physical, biological, or chemical processes.	Potentially Implementable. Presence of underground obstructions may hinder technology use. Would require trenching through fill material and obstructions (e.g., cribbing, pilings, etc.) to facilitate installation. May require relocation of utilities that cross path of barrier. 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.	Moderate Capital and High O&M Costs	No
	Extraction	Dynamic Underground Stripping and Hydrous Pyrolysis/Oxidation (DUS/HPO)	Steam is injected into the subsurface to mobilize COPCs and NAPLs. The mobilized COPCs are captured and recondensed, collected and treated. In addition, HPO can degrade COPCs in subsurface heated zones. In most cases, this technology requires long-term operation and maintenance of on-site injection, collection, and/or treatment systems.	Potentially implementable. Access to locations for installation of recovery wells is limited. Limited space for recovery system and treatment. Presence of underground obstructions may hinder technology use. Vapor intrusion concerns with steam/vapors in close proximity to residential buildings.	This option would require a pilot scale study to determine effectiveness. Process may result in NAPL and/or dissolved plume migration. Effectiveness in tidal and brackish waters is unknown.	High Capital and O&M Costs	No
Removal	Hydraulic Removal	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.	Limited space for water treatment on-site. Proximity to East River makes option impracticable.	Inefficient for recovery/ treatment of dissolved plume and NAPL. Would require pumping and treating large quantities of water over long periods of time. Implementation of this process could achieve the RAOs over a long period of time.	Moderate Capital and High O&M Costs	No
		Horizontal Extraction Wells	Horizontal wells are utilized to replace conventional well clusters in soil and containment/migration control.	Not implementable. Limited space for water treatment on-site. Proximity to East River makes option impracticable. Requires specialized horizontal drilling equipment.	Effective for recovering groundwater; however, not effective for NAPL recovery at this site. Subsurface obstructions may inhibit use of this technology. Presence of brackish water and tidal influences may affect technology effectiveness.	High Capital and O&M Costs	No

Table 4-2
Technology Screening Evaluation for Groundwater

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
Removal (cont'd)	NAPL Removal	Active Removal	Process by which automated pumps are utilized to remove DNAPL from recovery wells.	Implementable. Likely to also remove groundwater that will require treatment. Limited space for water treatment on-site.	May be effective in recovering NAPL. Would need pilot testing to determine technical feasibility of recovering NAPL that collects within sump/well.	Moderate Capital and O&M Costs.	Yes
		Passive Removal	NAPL is passively collected in vertical wells and periodically removed (i.e., via bottom-loading bailers, manually operated pumps, etc.).	Implementable	May be effective in recovering NAPL. Would need pilot testing to determine technical feasibility of recovering NAPL that collects within sump/well.	Low Capital and O&M Costs.	Yes
		Collection Trenches/Passive 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.	Implementable. May require relocation of utilities that cross path of barrier. Hydraulic effects and placement of barrier wall would have to be evaluated as part of the remedial design. Limited space is availible for large-scale passive NAPL barrier wall, target collection trenches may be more applicable given site conditions.		High Capital and Moderate O&M Costs.	Yes
Ex-Situ On-Site Treatment	Chemical Treatment	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.	Not implementable due to limited space.	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. May require special provisions for the storage of process chemicals.	High Capital and O&M Costs	No
		Chemical Oxidation	Extraction of groundwater and treatment using oxidizing agents. Oxidizing agents are injected into the groundwater treatment train to oxidize and reduce the mass of dissolved organic constituents. Chemical oxidation involves the introduction of chemicals such as ozone, hydrogen peroxide, magnesium peroxide, sodium persulfate or potassium permanganate.	Not implementable due to limited space. Space to perform water treatment is limited. May require special provisions for storage of process chemicals.	A bench-scale treatability study may be required to evaluate the efficiency of this process and to make project-specific adjustments to the process.	High Capital and O&M Costs	No
	Physical Treatment	Carbon Adsorption	Process by which organic constituents are adsorbed to the carbon as groundwater is passed through carbon units.	Potentially implementable. Typically used in MGP-impacted groundwater treatment train. Limited space on-site for treatment system.	Effective at removing organic constituents. Use of this treatment process may effectively achieve the RAOs when combined with groundwater extraction.	High capital and O&M costs.	No
		Filtration	Extraction of groundwater and treatment using filtration. Process in which the groundwater is passed through a granular media in order to remove suspended solids by interception, straining, flocculation, and sedimentation activity within the filter.	Not implementable. Limited space available for on-site for treatment system. Typically used in MGP-impacted groundwater treatment train.	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.	Low capital and O&M costs.	No

Table 4-2
Technology Screening Evaluation for Groundwater

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site, New York City, New York

General Response Action	Remedial Technology Type	Technology Process Option	Description	Implementability	Effectiveness	Relative Cost	Retained?
Ex-Situ On-Site Treatment (cont'd)	Physical Treatment (cont'd)	Air Stripping	A process in which VOCs are removed through volatilization by increasing the contact between the groundwater and air.	Not implementable. Limited space available for on-site for treatment system.	This technology process would be effective at removing VOCs from water. Process would potentially be used as part of a treatment train to treat groundwater removed from excavation areas. Has potential to be used as part of a treatment system to meet the RAOs.	High capital and O&M costs.	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.	Not implementable. Limited space available for on-site for treatment system.	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.	Moderate capital and O&M costs.	No
		Oil/Water Separation	Process by which insoluble oils are separated from water via physical separation technologies, including gravity separation, baffled vessels, etc.	Not implementable. Limited space available for on-site for treatment system. Typically used in MGP-impacted groundwater treatment train.	Effective at separating insoluble oil from groundwater. This process could be used as part of a groundwater treatment train to address separate-phase liquids. Has potential to be used as part of a treatment system to meet the RAOs.	Low capital and O&M costs.	No
Off-Site Treatment and/or Disposal	Groundwater Disposal	Discharge to a local Publicly Owned Treatment Works (POTW)	Treated or untreated groundwater is discharged to a sanitary sewer and treated at a local POTW facility. Impacted groundwater may require treatment to achieve water quality criteria established by the POTW.	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 must meet POTW requirements, including a discharge permit. No space available for on-site for treatment system, therefore, no discharge option required.	Proven process for effectively disposing of groundwater. Impacted groundwater would require treatment to achieve water quality criteria established by the POTW. Treated groundwater may be subject to additional treatment at the POTW.	Moderate Capital and O&M	No
		Discharge to a Privately Owned/Commercially Operated Treatment Facility.	Treated or untreated water is collected and transported to a privately owned treatment facility. This process option can be used to support long-term technologies (e.g., pump and treat) or short-term activities (e.g., dewatering of excavation area).	Implementable. Equipment and materials to pretreat the water at the site are readily available. No space available for on-site for treatment system, therefore, no discharge option required.	Proven process for effectively disposing of groundwater. Impacted groundwater may require pre-treatment to achieve water quality criteria required by the treatment facility.	High Capital and O&M Costs	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. No space available for on-site for treatment system, therefore, no discharge option required.	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.	Low capital and O&M costs.	No

Table 5-1
Cost Estimate for Alternative 2
Groundwater Monitoring, Indoor Air Monitoring and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permitting/Access Agreements	1	LS	$20,000	$20,000
2	Mobilization/Demobilization	1	LS	$5,000	$5,000
3	Construct and Remove Decontamination Pad	1	LS	$10,000	$10,000
4	Utility Markout and Clearance	1	day	$2,500	$2,500
5	Install Groundwater Monitoring Well	30	VLF	$75	$2,250
6	Waste Characterization	2	each	$1,000	$2,000
7	Waste Disposal	4	drums	$500	$2,000
8	Site Management Plan	1	LS	$50,000	$50,000
9	Establish Institutional Controls	1	LS	$250,000	$250,000
				Subtotal Capital Cost	$343,750
10				Administration & Engineering (15%)	$51,563
				Construction Management (25%)	$5,938
				Contingency (25%)	$85,938
				Total Capital Cost	$487,188
Operation and Maintenance Costs					
11	Annual Permitting/Access Agreements	1	LS	$10,000	$10,000
12	Annual Groundwater Sampling	1	LS	$35,000	$35,000
13	Laboratory Analysis of Groundwater Samples	24	each	$500	$12,000
14	Annual Groundwater Report	1	LS	$15,000	$15,000
15	Annual Indoor Air Sampling	1	LS	$20,000	$20,000
16	Laboratory Analysis of Indoor Air Samples	30	each	$250	$7,500
17	Annual Indoor Air Report	1	LS	$10,000	$10,000
18	Waste Disposal	8	drums	$500	$4,000
19	Annual Inspection and Maintenance of Site Fencing	1	LS	$10,000	$10,000
20	Verifications of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$133,500
				Contingency (25%)	$33,375
				Total Annual O&M Cost	$166,875
21				30-Year Total Present Worth Cost of O&M	$2,885,608
				Total Estimated Cost:	**$3,372,796**
				Rounded To:	**$3,400,000**

General Notes:

1. Cost estimate is based on Arcadis of New York's (Arcadis') past experience and vendor estimates using 2020 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. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

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

Table 5-1
Cost Estimate for Alternative 2
Groundwater Monitoring, Indoor Air Monitoring and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to install a new groundwater monitoring well near Public School #34.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to install the new groundwater monitoring well.

3. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.

4. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at the location of the new groundwater monitoring well. Cost assumes that utility location and markout would be conducted by a private utility locating company.

5. Install groundwater monitoring well cost estimate includes all labor, equipment, and materials necessary to install a new groundwater monitoring well near Public School #34. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes PVC well construction.

6. Waste characterization cost estimate includes costs for the laboratory analysis of waste characterization samples for PCBs, TCLP VOCs, TCLP SVOCs, TCLP metals, ignitability, corrosivity, and reactivity. Cost assumes that waste characterization samples will be collected from the monitoring well construction soil cuttings and monitoring well development/purge water.

7. Waste disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of monitoring well construction soil cuttings and well development/purge water. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

8. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: known locations of soil within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives; requirements for fencing inspection and maintenance; protocols and requirements for annual groundwater and indoor air monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities; protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor air, based on the results obtained from the annual monitoring activities.

9. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions to control the use of vegetated and non-vegetated (i.e., bare soil) areas within the properties that contain PAHs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives, control the intrusive (i.e., subsurface) activities that could be conducted within the Jacob Riis property, and control the use of OU-1 groundwater.

10. Administration/engineering and construction management costs are based on an assumed 15% of the total capital costs and 25% of the construction costs, respectively.

11. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater and indoor air monitoring activities within OU-1.

12. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater monitoring activities. Cost estimate assumes groundwater samples will be collected from up to 20 groundwater monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 10 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

13. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and metals. Estimate assumes laboratory analysis of groundwater samples from up to 20 groundwater monitoring wells and up to four QA/QC samples.

14. Annual groundwater report cost estimate includes all labor necessary to prepare an annual report summarizing the annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

15. Annual indoor air sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual indoor air monitoring activities. Cost estimate assumes indoor samples will be collected from up to 18 locations within the Jacob Riis property (plus QA/QC samples) and one ambient air sample collected each day of sampling. Cost estimate assumes two workers will require 6 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

16. Laboratory analysis of indoor air samples cost estimate includes the analysis of indoor air and ambient air samples for VOCs (i.e., USEPA TO-15 compound list). Estimate assumes laboratory analysis of up to 30 indoor air, ambient air, and QA/QC samples.

17. Annual indoor air report cost estimate includes all labor necessary to prepare an annual report summarizing the annual indoor air monitoring activities and results. Annual report to be submitted to NYSDEC.

18. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during annual groundwater and indoor air monitoring activities. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

19. Annual inspection and maintenance of site fencing cost estimate includes all labor, equipment, and materials necessary to conduct annual inspection of new and existing fencing in OU-1 that limits access surface soils and repair/replace up to 50 linear-feet of fencing per year.

20. Verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

21. Present worth is estimated based on a 4% beginning-of-year discount rate. It is assumed that "year zero" is 2012.

Table 5-2
Cost Estimate for Alternative 3
Groundwater Monitoring, Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permitting/Access Agreements	1	LS	$50,000	$50,000
2	Mobilization/Demobilization	1	LS	$5,000	$5,000
3	Construct and Remove Decontamination Pad	1	LS	$10,000	$10,000
4	Utility Markout and Clearance	5	day	$2,500	$12,500
5	Install Groundwater Monitoring Well	30	VLF	$75	$2,250
6	Install NAPL Recovery Wells	360	VLF	$75	$27,000
7	Install Surface Control at Jacob Riis Building No. 4	5,800	SF	$20	$116,000
8	Waste Characterization	4	each	$1,000	$4,000
9	Waste Disposal	20	drums	$500	$10,000
10	Site Management Plan	1	LS	$50,000	$50,000
11	Establish Institutional Controls	1	LS	$250,000	$250,000
				Subtotal Capital Cost	$536,750
12				Administration & Engineering (15%)	$80,513
				Construction Management (15%)	$28,013
				Contingency (25%)	$134,188
				Total Capital Cost	$779,463
Operation and Maintenance Costs					
13	Annual Permitting/Access Agreements	1	LS	$10,000	$10,000
14	Annual Groundwater Sampling	1	LS	$35,000	$35,000
15	Laboratory Analysis of Groundwater Samples	24	each	$500	$12,000
16	Annual Groundwater Report	1	LS	$15,000	$15,000
17	Annual Indoor Air Sampling	1	LS	$20,000	$20,000
18	Laboratory Analysis of Indoor Air Samples	30	each	$250	$7,500
19	Annual Indoor Air Report	1	LS	$10,000	$10,000
20	Semi-Annual Passive NAPL Gauging	2	event	$8,000	$16,000
21	NAPL Recovery Gauging	2	event	$5,000	$10,000
22	Waste Disposal	16	drums	$500	$8,000
23	Annual Inspection and Maintenance of Site Fencing	1	LS	$10,000	$10,000
24	Verifications of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$163,500
				Contingency (25%)	$40,875
				Total Annual O&M Cost	$204,375
25				30-Year Total Present Worth Cost of O&M	$3,534,059
				Total Estimated Cost:	**$4,313,522**
				Rounded To:	**$4,300,000**

General Notes:

1. Cost estimate is based on Arcadis of New York's (Arcadis') past experience and vendor estimates using 2020 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. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

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

Table 5-2
Cost Estimate for Alternative 3
Groundwater Monitoring, Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to install a new groundwater monitoring well near Public School #34 and to install new NAPL recovery wells along the eastern limits of OU-1.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to install a new groundwater monitoring well and NAPL recovery wells.

3. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.

4. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at the locations of the new groundwater monitoring well and NAPL recovery wells. Cost assumes that utility location and markout would be conducted by a private utility locating company.

5. Install groundwater monitoring well cost estimate includes all labor, equipment, and materials necessary to install a new groundwater monitoring well near Public School #34. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes PVC well construction.

6. Install NAPL recovery wells cost estimate includes all labor, equipment, and materials necessary to install up to 12 NAPL recovery wells to a depth of 30 feet along eastern limits of OU-1. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes PVC well construction.

7. Install surface control cost estimate includes all labor, equipment, and materials necessary to install a surface control in earthen floor storage room areas in Jacob Riis Building No. 4 (1223 FDR Drive). Cost estimate assumes surface controls consists of 6 inches of concrete and prepared sub-base. Area calculated using an assumed 75% of the total building footprint square-footage based on visual estimates only during historical building inspections. Surface control installed to meet the elevations of existing building features (i.e., concrete floors, curbs, doorways): soil removal only as necessary to meet required grades. Final surface control details (i.e., materials of construction, construction means/methods, areas requiring surface control, etc) to be evaluated as part of the remedial design.

8. Waste characterization cost estimate includes costs for the laboratory analysis of waste characterization samples for PCBs, TCLP VOCs, TCLP SVOCs, TCLP metals, ignitability, corrosivity, and reactivity. Cost assumes that waste characterization samples will be collected from the monitoring and recovery well construction soil cuttings and monitoring well development/purge water.

9. Waste disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of monitoring and recovery well construction soil cuttings, well development/purge water, and NAPL recovery. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

10. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: known locations of soil within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives; requirements for fencing inspection and maintenance; protocols and requirements for annual groundwater and indoor air monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities; protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor air, based on the results obtained from the annual monitoring activities.

11. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions to control the use of vegetated and non-vegetated (i.e., bare soil) areas within the properties that contain PAHs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives, control the intrusive (i.e., subsurface) activities that could be conducted within the Jacob Riis property, and control the use of OU-1 groundwater.

12. Administration/engineering and construction management costs are based on an assumed 15% of the total capital costs and 15% of the construction costs, respectively.

13. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater and indoor air monitoring activities within OU-1.

14. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater monitoring activities. Cost estimate assumes groundwater samples will be collected from up to 20 groundwater monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 10 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

15. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and metals. Estimate assumes laboratory analysis of groundwater samples from up to 20 groundwater monitoring wells and up to four QA/QC samples.

16. Annual groundwater report cost estimate includes all labor necessary to prepare an annual report summarizing the annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

17. Annual indoor air sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual indoor air monitoring activities. Cost estimate assumes indoor samples will be collected from up to 18 locations within the Jacob Riis property (plus QA/QC samples) and one ambient air sample collected each day of sampling. Cost estimate assumes two workers will require 6 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

18. Laboratory analysis of indoor air samples cost estimate includes the analysis of indoor air and ambient air samples for VOCs (i.e., USEPA TO-15 compound list). Estimate assumes laboratory analysis of up to 30 indoor air, ambient air, and QA/QC samples.

19. Annual indoor air report cost estimate includes all labor necessary to prepare an annual report summarizing the annual indoor air monitoring activities and results. Annual report to be submitted to NYSDEC.

20. Semi-annual passive NAPL gauging cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL recovery activities. Cost estimate assumes that up to 12 NAPL recovery wells will be gauged, and if present, NAPL will be recovered via manual bailing or using a peristaltic pump. Cost estimate assumes two workers will require 2 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

21. NAPL gauging report cost estimate includes all labor necessary to prepare a semi-annual report summarizing the NAPL recovery activities. Semiannual report to be submitted to NYSDEC.

22. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during groundwater monitoring and indoor air monitoring activities and NAPL gauging. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

Table 5-2
Cost Estimate for Alternative 3
Groundwater Monitoring, Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

23. Annual inspection and maintenance of site fencing cost estimate includes all labor, equipment, and materials necessary to conduct annual inspection of new and existing fencing in OU-1 that limits access surface soils and repair/replace up to 50 linear-feet of fencing per year.

24. Verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

25. Present worth is estimated based on a 4% beginning-of-year discount rate. It is assumed that "year zero" is 2012.

Table 5-3
Cost Estimate for Alternative 4
Groundwater Monitoring, Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permitting/Access Agreements	1	LS	$100,000	$100,000
2	Mobilization/Demobilization	1	LS	$280,000	$280,000
3	Utility Markout and Clearance	20	day	$2,500	$50,000
4	Install Temporary Fencing	4,100	LF	$100	$410,000
5	Construct and Remove Decontamination Pad	1	LS	$25,000	$25,000
6	Pre-Excavation Waste Characterization Sampling	10	each	$4,000	$40,000
7	Shallow Soil Excavation and Handling	5,000	CY	$100	$500,000
8	Demarcation Layer	8,300	SY	$5	$41,500
9	Solid Waste Transportation and Disposal - Non-Hazardous Waste	7,500	tons	$165	$1,237,500
10	Fill Importation, Placement, Grading, and Compaction	3,800	CY	$60	$228,000
11	Vegetated Surface Restoration	67,500	SF	$2	$135,000
12	Install Groundwater Monitoring Well	30	VLF	$75	$2,250
13	Install NAPL Recovery Wells	360	VLF	$75	$27,000
14	Install Surface Control at Jacob Riis Building No. 4	5,800	SF	$20	$116,000
15	Waste Disposal	20	drums	$500	$10,000
16	Site Management Plan	1	LS	$50,000	$50,000
17	Establish Institutional Controls	1	LS	$250,000	$250,000
				Subtotal Capital Cost	$3,502,250
18				Administration & Engineering (15%)	$525,338
				Construction Management (15%)	$465,338
				Contingency (25%)	$875,563
				Total Capital Cost	$5,368,488
Operation and Maintenance Costs					
19	Annual Permitting/Access Agreements	1	LS	$10,000	$10,000
20	Annual Groundwater Sampling	1	LS	$35,000	$35,000
21	Laboratory Analysis of Groundwater Samples	24	each	$500	$12,000
22	Annual Groundwater Report	1	LS	$15,000	$15,000
23	Annual Indoor Air Sampling	1	LS	$20,000	$20,000
24	Laboratory Analysis of Indoor Air Samples	30	each	$250	$7,500
25	Annual Indoor Air Report	1	LS	$10,000	$10,000
26	Semi-Annual Passive NAPL Gauging	2	event	$8,000	$16,000
27	NAPL Gauging Report	2	event	$5,000	$10,000
28	Waste Disposal	16	drums	$500	$8,000
29	Verifications of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$153,500
				Contingency (25%)	$38,375
				Total Annual O&M Cost	$191,875
30				30-Year Total Present Worth Cost of O&M	$3,317,909
				Total Estimated Cost:	**$8,686,396**
				Rounded To:	**$8,700,000**

Table 5-3
Cost Estimate for Alternative 4
Groundwater Monitoring, Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

General Notes:

1. Cost estimate is based on Arcadis of New York's (Arcadis') past experience and vendor estimates using 2020 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. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

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

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to install a new groundwater monitoring well near Public School #34, new NAPL recovery wells along the eastern limits of OU-1, and excavate shallow soils in the vicinity of the Jacob Riis buildings 2 through 6.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to install a new groundwater monitoring well, install new NAPL recovery wells, and excavate shallow soils in the vicinity of the Jacob Riis buildings 2 through 6. Estimated cost based on assumed 10% of the total construction costs.

3. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at the locations of the new groundwater monitoring well, NAPL recovery wells, and shallow soils around Jacob Riis buildings 2 through 6. Cost assumes that utility location and markout would be conducted by a private utility locating company.

4. Install temporary fencing cost estimate includes labor, equipment, and materials necessary to install and remove temporary fencing to limit public access to excavation and work areas.

5. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.

6. Pre-excavation waste characterization cost estimate includes labor, equipment, materials necessary to collect and submit soil samples for waste characterization analysis prior to conducting excavation activities. Cost estimate includes oversight by a geologist, and drill rig and crew. Costs includes the analysis of soil samples for PCBs, TCLP VOCs, TCLP SVOCs, TCLP metals, ignitability, corrosivity, and reactivity. Cost assumes that waste characterization samples would be collected at a frequency of one sample per 500 cubic-yards of material destined for off-site disposal. Waste characterization samples will be taken prior to excavation to facilitate direct loading of excavated material.

7. Shallow soil excavation and handling cost estimate includes labor, equipment, and materials necessary to excavate and transfer excavated shallow soil (i.e. up to two feet below grade) in the vicinity of the Jacob Riis buildings 2 through 6. Cost estimate is based on in-place soil volumes. Cost assumes shallow soil removal completed with small equiment (e.g., dozer, bobcat, etc.) and excavated material would be direct-loaded into lined roll-offs. Cost estimate includes air monitoring during intrusive activities. Cost does not include structural/geotechnical monitoring.

8. Demarcation layer cost estimate includes labor, equipment, and materials necessary to place a woven, light-weight, non-biodegradable, high-visibility demarcation layer within the footprint of the soil removal areas.

9. Solid waste transportation and disposal - non-hazardous waste cost estimate includes labor, equipment, and materials necessary to transport and dispose of excavated soils as non-hazardous waste. Cost assumes all the shallow soil will be non-hazardous and that excavated soil will be loaded directly into lined roll-offs and transported to GROWS Landfill in Morrisville, PA. Cost estimate assumes a soil weight of 1.5 tons per cubic-yard. Cost estimate includes disposal fee, a 4% disposal fuel surcharge and a 22% transportation fuel surcharge and environmental, transportation, and spotting fees. Cost estimate is subject to change based on fuel prices. Cost estimate based on information provided to ARCADIS by Waste Management in October 2009.

10. Fill importation, placement, grading, and compaction cost estimate includes labor, equipment, and materials necessary to import, place, grade and compact general fill to replace excavated material. Cost estimate is based on in-place soil volume. Cost estimate assumes fill placed in 12-inch lifts and compacted to 95% compaction based on standard proctor testing. Cost estimate includes survey verification and compaction testing.

11. Vegetated surface restoration cost estimate includes labor, equipment, and materials necessary to import, place, and grade 6 inches of seeded top soil and fertilizer following soil removal and backfilling activities in the vicinity of Jacob Riis buildings 2 through 6.

12. Install groundwater monitoring well cost estimate includes all labor, equipment, and materials necessary to install a new groundwater monitoring well near Public School #34. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes PVC well construction.

13. Install NAPL recovery wells cost estimate includes all labor, equipment, and materials necessary to install up to 12 NAPL recovery wells to a depth of 30 feet along the eastern limits of OU-1. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes PVC well construction.

14. Install surface control cost estimate includes all labor, equipment, and materials necessary to install a surface control in earthen floor storage room areas in Jacob Riis Building No. 4 (1223 FDR Drive). Cost estimate assumes surface controls consists of 6 inches of concrete and prepared sub-base. Area calculated using an assumed 75% of the total building footprint square-footage based on visual estimates only during historical building inspections. Surface control installed to meet the elevations of existing building features (i.e., concrete floors, curbs, doorways): soil removal only as necessary to meet required grades. Final surface control details (i.e., materials of construction, construction means/methods, areas requiring surface control, etc) to be evaluated as part of the remedial design.

15. Waste disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of monitoring and recovery well construction soil cuttings, well development/purge water, and NAPL recovery. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

16. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: known locations of soil within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives; requirements for fencing inspection and maintenance; protocols and requirements for annual groundwater and indoor air monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities; protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor air, based on the results obtained from the annual monitoring activities.

17. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions to control the use of vegetated and non-vegetated (i.e., bare soil) areas within the properties that contain PAHs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives, control the intrusive (i.e., subsurface) activities that could be conducted within the Jacob Riis property, and control the use of OU-1 groundwater.

18. Administration/engineering and construction management costs are based on an assumed 15% of the total capital costs and 15% of the construction costs, respectively.

19. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater and indoor air monitoring activities within OU-1.

20. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater monitoring activities. Cost estimate assumes groundwater samples will be collected from up to 20 groundwater monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 10 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

21. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and metals. Estimate assumes laboratory analysis of groundwater samples from up to 20 groundwater monitoring wells and up to four QA/QC samples.

22. Annual groundwater report cost estimate includes all labor necessary to prepare an annual report summarizing the annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

23. Annual indoor air sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual indoor air monitoring activities. Cost estimate assumes indoor samples will be collected from up to 18 locations within the Jacob Riis property (plus QA/QC samples) and one ambient air sample collected each day of sampling. Cost estimate assumes two workers will require 6 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

24. Laboratory analysis of indoor air samples cost estimate includes the analysis of indoor air and ambient air samples for VOCs (i.e., USEPA TO-15 compound list). Estimate assumes laboratory analysis of up to 30 indoor air, ambient air, and QA/QC samples.

25. Annual indoor air report cost estimate includes all labor necessary to prepare an annual report summarizing the annual indoor air monitoring activities and results. Annual report to be submitted to NYSDEC.

26. Semi-annual passive NAPL gauging cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL recovery activities. Cost estimate assumes that up to 12 NAPL recovery wells will be gauged, and if present, NAPL will be recovered via manual bailing or using a peristaltic pump. Cost estimate assumes two workers will require 2 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

27. NAPL gauging report cost estimate includes all labor necessary to prepare a semi-annual report summarizing the NAPL recovery activities. Semiannual report to be submitted to NYSDEC.

28. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during groundwater monitoring and indoor air monitoring activities and NAPL gauging. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

29. Verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

30. Present worth is estimated based on a 4% beginning-of-year discount rate. It is assumed that "year zero" is 2012.

Table 5-4
Cost Estimate for Alternative 5
Groundwater Monitoring, Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal, Targeted Subsurface Soil Removal and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

Item #	Description	Estimated Quantity	Unit	Unit Price	Estimated Cost
Capital Costs					
1	Permitting/Access Agreements	1	LS	$150,000	$150,000
2	Mobilization/Demobilization	1	LS	$850,000	$850,000
3	Utility Markout and Clearance	20	day	$2,500	$50,000
4	Utility Relocation	1	LS	$500,000	$500,000
5	Install Temporary Fencing	2,500	LF	$100	$250,000
6	Construct and Remove Decontamination Pad	1	LS	$25,000	$25,000
7	Pre-Excavation Waste Characterization Sampling	40	each	$4,000	$160,000
8	Shallow Soil Excavation and Handling	7,600	CY	$100	$760,000
9	Subsurface Soil Excavation and Handling	7,700	CY	$150	$1,155,000
10	Vapor/Odor Control	18	week	$5,000	$90,000
11	Demarcation Layer	12,100	SY	$5	$60,500
12	Solid Waste Transportation and Disposal - Non-Hazardous Waste	20,100	tons	$165	$3,316,500
13	Solid Waste Transportation and Disposal - LTTD	2,900	tons	$195	$565,500
14	Fill Importation, Placement, Grading, and Compaction	13,600	CY	$60	$816,000
15	Vegetated Surface Restoration	67,500	SF	$2	$135,000
16	Concrete Surface Restoration	28,600	SF	$20	$572,000
17	Install Groundwater Monitoring Well	30	VLF	$75	$2,250
18	Install NAPL Recovery Wells	360	VLF	$75	$27,000
19	Install Surface Control at Jacob Riis Building No. 4	5,800	SF	$20	$116,000
20	Waste Disposal	20	drums	$500	$10,000
21	Site Management Plan	1	LS	$50,000	$50,000
22	Establish Institutional Controls	1	LS	$250,000	$250,000
				Subtotal Capital Cost	$9,910,750
23				Administration & Engineering (15%)	$1,486,613
				Construction Management (15%)	$1,419,113
				Contingency (25%)	$2,477,688
				Total Capital Cost	$15,294,163
Operation and Maintenance Costs					
24	Annual Permitting/Access Agreements	1	LS	$10,000	$10,000
25	Annual Groundwater Sampling	1	LS	$35,000	$35,000
26	Laboratory Analysis of Groundwater Samples	24	each	$500	$12,000
27	Annual Groundwater Report	1	LS	$15,000	$15,000
28	Annual Indoor Air Sampling	1	LS	$20,000	$20,000
29	Laboratory Analysis of Indoor Air Samples	30	each	$250	$7,500
30	Annual Indoor Air Report	1	LS	$10,000	$10,000
31	Semiannual Passive NAPL Recovery	2	event	$8,000	$16,000
32	NAPL Recovery Report	2	event	$5,000	$10,000
33	Waste Disposal	16	drums	$500	$8,000
34	Verifications of Institutional Controls	1	LS	$10,000	$10,000
				Subtotal O&M Cost	$153,500
				Contingency (25%)	$38,375
				Total Annual O&M Cost	$191,875
35				30-Year Total Present Worth Cost of O&M	$3,317,909
				Total Estimated Cost:	**$18,612,071**
				Rounded To:	**$18,600,000**

Table 5-4
Cost Estimate for Alternative 5
Groundwater Monitoring, Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal, Targeted Subsurface Soil Removal and Institutional Controls/Engineering Controls

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

General Notes:

1. Cost estimate is based on Arcadis of New York's (Arcadis') past experience and vendor estimates using 2020 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. Changes in cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual projected cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such; this cost estimate information is not intended to be utilized for complying with financial reporting requirements associated with liability services.

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

Assumptions:

1. Permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to install a new groundwater monitoring well near Public School #34, new NAPL recovery wells along the eastern limits of OU-1, and excavate shallow and subsurface soils in the vicinity of the Jacob Riis buildings 2 through 6.

2. Mobilization/demobilization cost estimate includes mobilization and demobilization of all labor, equipment, and materials necessary to install a new groundwater monitoring well, install new NAPL recovery wells, and excavate shallow and subsurface soils in the vicinity of the Jacob Riis buildings 2 through 6. Estimated cost based on assumed 10% of the total construction costs.

3. Utility markout and clearance cost estimate includes all labor, equipment, and materials necessary to identify, markout, and clear (via hand-digging) any underground utilities at the locations of the new groundwater monitoring well, NAPL recovery wells, and shallow and subsurface soils around Jacob Riis buildings 2 through 6. Cost assumes that utility location and markout would be conducted by a private utility locating company.

4. Utility relocation cost estimate includes all labor, equipment, and materials necessary to deactivate, remove, or bypass existing utilities within soil removal areas and install new utilities to maintain service to the Jacob Riis buildings.

5. Install temporary fencing cost estimate includes labor, equipment, and materials necessary to install and remove temporary fencing to limit public access to excavation and work areas.

6. Construct and remove decontamination pad cost estimate includes all labor, equipment, and materials necessary to construct, maintain, and remove a decontamination pad and appurtenances.

7. Pre-excavation waste characterization cost estimate includes labor, equipment, materials necessary to collect and submit soil samples for waste characterization analysis prior to conducting excavation activities. Cost estimate includes oversight by a geologist, and drill rig and crew. Costs includes the analysis of soil samples for PCBs, TCLP VOCs, TCLP SVOCs, TCLP metals, ignitability, corrosivity, and reactivity. Cost assumes that waste characterization samples would be collected at a frequency of one sample per 500 cubic-yards of material destined for off-site disposal. Waste characterization samples will be taken prior to excavation to facilitate direct loading of excavated material.

8. Shallow soil excavation and handling cost estimate includes labor, equipment, and materials necessary to excavate and transfer excavated shallow soil (i.e. up to two feet below grade) in the vicinity of the Jacob Riis buildings 2 through 6. Cost estimate is based on in-place soil volumes. Cost assumes shallow soil removal completed with small equiment (e.g., dozer, bobcat, etc.) and excavated material would be direct-loaded into lined roll-offs. Cost estimate includes air monitoring during intrusive activities. Cost does not include structural/geotechnical monitoring.

9. Subsurface soil excavation and handling cost estimate includes labor, equipment, and materials necessary to excavate and transfer excavated subsurface soil (i.e. from 2 up to 8 feet below grade) in the vicinity of the Jacob Riis buildings 2 through 6. Cost estimate is based on in-place soil volumes. Cost assumes deep soil removal conducted using convention excavation equipment (e.g., excavator, loader, dump trucks) and excavated material would be direct-loaded into lined roll-offs. Cost estimate includes air monitoring during intrusive activities. Cost estimate includes increased cost for geotechnical (i.e., excavation stability) and structural monitoring (i.e., vibration), as well as pre- and post-construction structural surveys. Cost assumes larger footprint for project support/laydown, compared to Alternative 4.

10. Vapor/odor control cost estimate includes all labor, equipment, and materials necessary to monitor vapor/odor emission during intrusive site activities. Cost estimate includes application of vapor/odor suppressing foam to open excavations and material loaded into lined roll-offs.

11. Demarcation layer cost estimate includes labor, equipment, and materials necessary to place a woven, light-weight, non-biodegradable, high-visibility demarcation layer within the footprint of the soil removal areas.

12. Solid waste transportation and disposal - non-hazardous waste cost estimate includes labor, equipment, and materials necessary to transport and dispose of excavated soils as non-hazardous waste. Costs assume that all shallow soil (i.e., the top two feet) and 75% of subsurface soil will be non-hazardous and that excavated soil will be loaded directly into lined roll-offs and transported to GROWS Landfill in Morrisville, PA. Cost estimate assumes a soil weight of 1.5 tons per cubic-yard. Cost estimate includes disposal fee, a 4% disposal fuel surcharge and a 22% transportation fuel surcharge and environmental, transportation, and spotting fees. Cost estimate is subject to change based on fuel prices. Cost estimate based on information provided to ARCADIS by Waste Management in October 2009.

13. Solid waste transportation and disposal - LTTD cost estimate includes labor, equipment, and materials necessary to transport and thermally treat excavated soil exhibiting toxicity characteristic for benzene at a thermal treatment facility located in Morrisville, PA. Cost estimate assumes that all 25% of excavated subsurface soil will exhibit toxicity characteristic for benzene. Cost estimate assumes a soil weight of 1.5 tons per cubic yard. Cost estimate includes LTTD treatment fee, a 22% transportation fuel surcharge and transportation and spotting fees. Cost estimate is subject to change based on fuel and natural gas prices and assumes thermally treated soil can be used by CleanEarth and does not require subsequent treatment or disposal. Cost estimate based on information provided to ARCADIS by CleanEarth and Waste Management in October 2009.

14. Fill importation, placement, grading, and compaction cost estimate includes labor, equipment, and materials necessary to import, place, grade and compact general fill to replace excavated material. Cost estimate is based on in-place soil volume. Cost estimate assumes fill placed in 12-inch lifts and compacted to 95% compaction based on standard proctor testing. Cost estimate includes survey verification and compaction testing.

15. Vegetated surface restoration cost estimate includes labor, equipment, and materials necessary to import, place, and grade 6 inches of seeded top soil and fertilizer following soil removal and backfilling activities in the vicinity of Jacob Riis buildings 2 through 6.

16. Surface restoration - concrete cost estimate includes labor, equipment, and materials necessary to install concrete surfaces surrounding the Jacob Riis buildings that are disturbed as part of the soil excavation activities. Cost estimate assumes a concrete surface thickness of 6 inches.

17. Install groundwater monitoring well cost estimate includes all labor, equipment, and materials necessary to install a new groundwater monitoring well near Public School #34. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes PVC well construction.

18. Install NAPL recovery wells cost estimate includes all labor, equipment, and materials necessary to install up to 12 NAPL recovery wells to a depth of 30 feet along the eastern limits of OU-1. Cost estimate includes oversight by a geologist, and drill rig and crew. Cost estimate assumes PVC well construction.

19. Install surface control cost estimate includes all labor, equipment, and materials necessary to install a surface control in earthen floor storage room areas in Jacob Riis Building No. 4 (1223 FDR Drive). Cost estimate assumes surface controls consists of 6 inches of concrete and prepared sub-base. Area calculated using an assumed 75% of the total building footprint square-footage based on visual estimates only during historical building inspections. Surface control installed to meet the elevations of existing building features (i.e., concrete floors, curbs, doorways): soil removal only as necessary to meet required grades. Final surface control details (i.e., materials of construction, construction means/methods, areas requiring surface control, etc) to be evaluated as part of the remedial design.

20. Waste disposal cost estimate includes labor, equipment, materials, and services required for the transportation and disposal of monitoring and recovery well construction soil cuttings, well development/purge water, and NAPL recovery. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

21. Site management plan cost estimate includes all labor necessary to prepare a site management plan to document: known locations of soil within OU-1 that contain COPCs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives; requirements for fencing inspection and maintenance; protocols and requirements for annual groundwater and indoor air monitoring; protocols (including health and safety requirements) for conducting invasive (i.e., subsurface) activities within OU-1 and managing potentially impacted material encountered during these activities; protocols for addressing significant changes in COPC concentrations in groundwater and/or indoor air, based on the results obtained from the annual monitoring activities.

22. Establish institutional controls cost estimate includes all legal expenses to institute environmental easements and deed restrictions to control the use of vegetated and non-vegetated (i.e., bare soil) areas within the properties that contain PAHs at concentrations greater than 6NYCRR Part 375-6 unrestricted use soil cleanup objectives, control the intrusive (i.e., subsurface) activities that could be conducted within the Jacob Riis property, and control the use of OU-1 groundwater.

23. Administration/engineering and construction management costs are based on an assumed 15% of the total capital costs and 15% of the construction costs, respectively.

24. Annual permitting/access agreements cost estimate includes all costs necessary to obtain appropriate permits and access agreements to conduct annual groundwater and indoor air monitoring activities within OU-1.

25. Annual groundwater sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual groundwater monitoring activities. Cost estimate assumes groundwater samples will be collected from up to 20 groundwater monitoring wells using low-flow sampling procedures. Cost estimate assumes two workers will require 10 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

26. Laboratory analysis of groundwater samples cost estimate includes the analysis of groundwater samples for BTEX, PAHs, and metals. Estimate assumes laboratory analysis of groundwater samples from up to 20 groundwater monitoring wells and up to four QA/QC samples.

27. Annual groundwater report cost estimate includes all labor necessary to prepare an annual report summarizing the annual groundwater monitoring activities and results. Annual report to be submitted to NYSDEC.

28. Annual indoor air sampling cost estimate includes all labor, equipment, and materials necessary to conduct annual indoor air monitoring activities. Cost estimate assumes indoor samples will be collected from up to 18 locations within the Jacob Riis property (plus QA/QC samples) and one ambient air sample collected each day of sampling. Cost estimate assumes two workers will require 6 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

29. Laboratory analysis of indoor air samples cost estimate includes the analysis of indoor air and ambient air samples for VOCs (i.e., USEPA TO-15 compound list). Estimate assumes laboratory analysis of up to 30 indoor air, ambient air, and QA/QC samples.

30. Annual indoor air report cost estimate includes all labor necessary to prepare an annual report summarizing the annual indoor air monitoring activities and results. Annual report to be submitted to NYSDEC.

31. Semi-annual passive NAPL gauging cost estimate includes all labor, equipment, and materials necessary to conduct semi-annual NAPL recovery activities. Cost estimate assumes that up to 12 NAPL recovery wells will be gauged, and if present, NAPL will be recovered via manual bailing or using a peristaltic pump. Cost estimate assumes two workers will require 2 days to complete the monitoring activities. Estimate includes labor, field vehicle, lodging, subsidence, and equipment rental.

32. NAPL gauging report cost estimate includes all labor necessary to prepare a semi-annual report summarizing the NAPL recovery activities. Semiannual report to be submitted to NYSDEC.

33. Waste disposal cost estimate includes off-site disposal of drummed PPE, disposable sampling equipment, purge water, and NAPL generated/collected during groundwater monitoring and indoor air monitoring activities and NAPL gauging. Cost estimate assumes a disposal cost of $250 and a transportation cost of $500 including taxes, fees, and surcharges per 55 gallon drum.

34. Verification of institutional controls cost estimate includes administrative costs for confirming institutional controls to minimize the potential for human exposure to site soil and groundwater are present. Annual costs associated with institutional controls include verifying the status of institutional controls and preparing/submitting notification to the NYSDEC to demonstrate that the institutional controls are being maintained and remain effective.

35. Present worth is estimated based on a 4% beginning-of-year discount rate. It is assumed that "year zero" is 2012.

Table 6-1
Summary of Comparative Analysis

Alternative Analysis Report for Operable Unit 1
Consolidated Edison Company of New York, Inc.
East 11th Street Works Site - Manhattan, New York

	Short-Term Impacts and Effectiveness	Long-Term Effectiveness and Permanence	Land Use	Reduction of Toxicity, Mobility, and Volume through Treatment	Implementability	Compliance with SCGs	Overall Protection of Public Health and the Environment	Cost Effectiveness
Alternative 1 - No Action	1	5	1	5	1	1	4	1
Alternative 2 - Groundwater Monitoring, Indoor Air Monitoring and ICs/ECs	2	3	1	4	2	1	3	3
Alternative 3 - Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery and ICs/ECs	3	2	1	3	3	1	2	4
Alternative 4 - Groundwater and Indoor Air Monitoring, Limited Surface Control within 1223 FDR Drive, Passive NAPL Recovery, Shallow Soil Removal, and ICs/ECs	4	1	1	2	4	1	1	2
Alternative 5 - Groundwater and Indoor Air Monitoring, Shallow Soil Removal, Targeted Subsurface Soil Removal, Limited Surface Control within 1223 FDR Drive, NAPL Recovery, and ICs/ECs	5	1	1	1	5	1	1	5

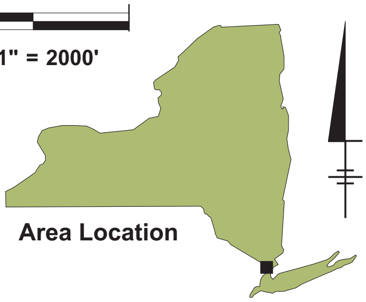
Notes:
1. Rank of 1 indicates alternative is most effective for the given criterion. Rank of 5 indicates alternative is least effective for the given criterion.
2. Tie ranking indicates that alternatives are equally effective at meeting the given criterion.

FIGURES

REFERENCE: BASE MAP USGS 7.5 MIN. QUAD., BROOKLYN, NEW YORK, 1967, PHOTOREVISED 1979.

2000' 0 2000'

Approximate Scale: 1" = 2000'



Area Location

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSES REPORT FOR OU-1

SITE LOCATION MAP

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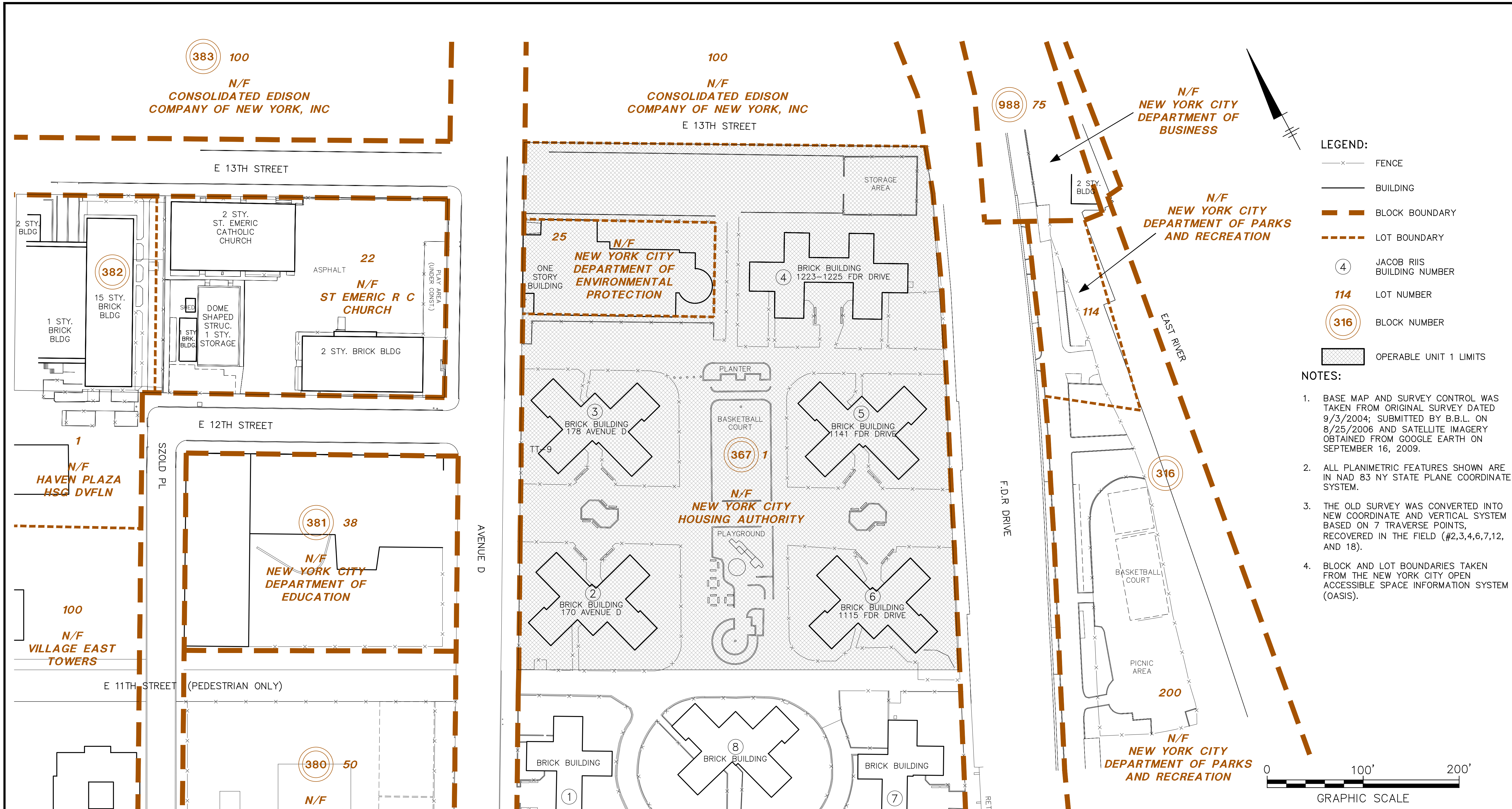
FIGURE
1-1

10/26/2012 SYRACUSE, NY-ENV/CAD-DJHOWES
B0043013/0002/00031/CDR/43013N01.CDR

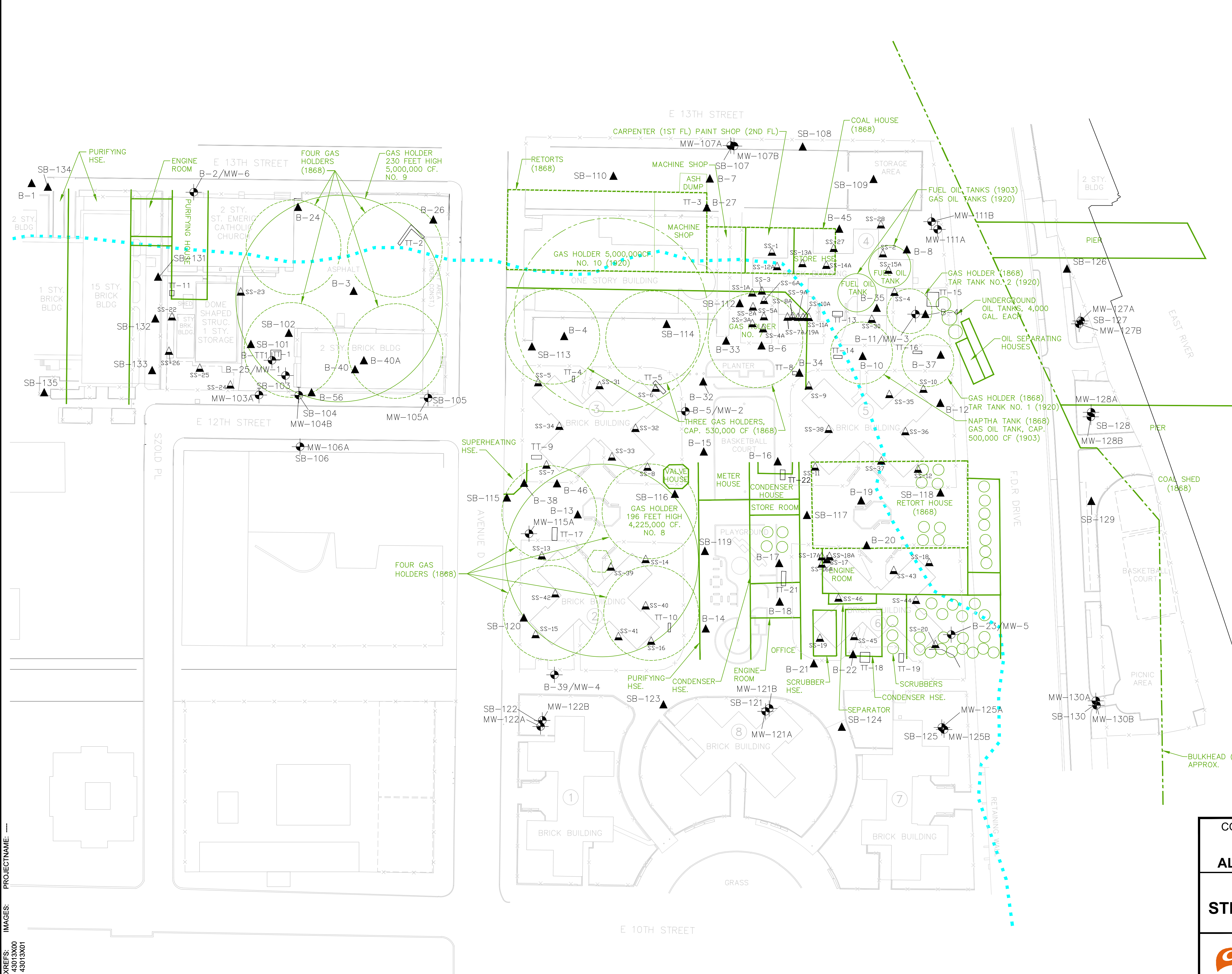


CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSIS REPORT FOR OU-1

EAST 11th STREET WORKS SITE
OPERABLE UNIT 1

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-2



LEGEND:

- SS-4 △ SURFACE SOIL SAMPLE
- B-35 ▲ SOIL BORING
- TT-16 ▭ TEST TRENCH
- B-25/MW-1 ⊕ MONITORING WELL
- APPROXIMATE HISTORICAL SHORELINE
- FORMER SITE FEATURES (FIRST OCCURENCE–1868)
- FORMER SITE FEATURES (FIRST OCCURENCE–1903)
- FORMER SITE FEATURES (FIRST OCCURENCE–1920)
- ④ JACOB RIIS BUILDING NUMBER

NOTES:

1. BASE MAP AND SURVEY CONTROL WAS TAKEN FROM ORIGINAL SURVEY DATED 9/3/2004; SUBMITTED BY B.B.L. ON 8/25/2006 AND SATELLITE IMAGERY OBTAINED FROM GOOGLE EARTH ON SEPTEMBER 16, 2009.
2. ALL PLANIMETRIC FEATURES SHOWN ARE IN NAD 83 NY STATE PLANE COORDINATE SYSTEM.
3. THE ORIGINAL SURVEY WAS CONVERTED INTO NEW COORDINATE AND VERTICAL SYSTEM BASED ON 7 TRAVERSE POINTS, RECOVERED IN THE FIELD (#2,3,4,6,7,12, AND 18).

0 100' 200'

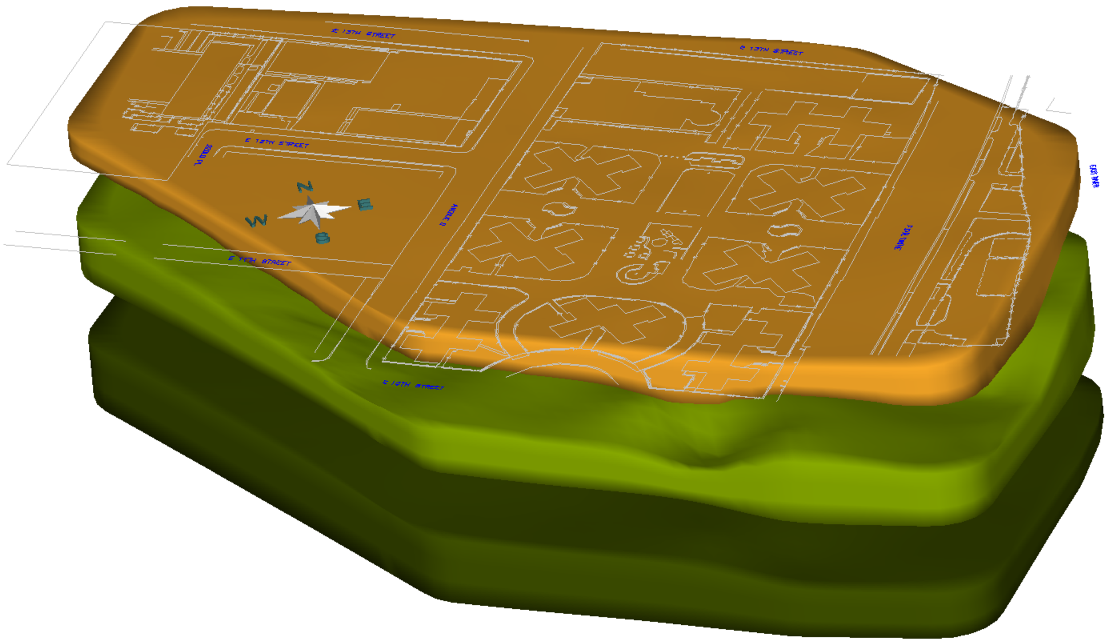
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSIS REPORT FOR OU-1

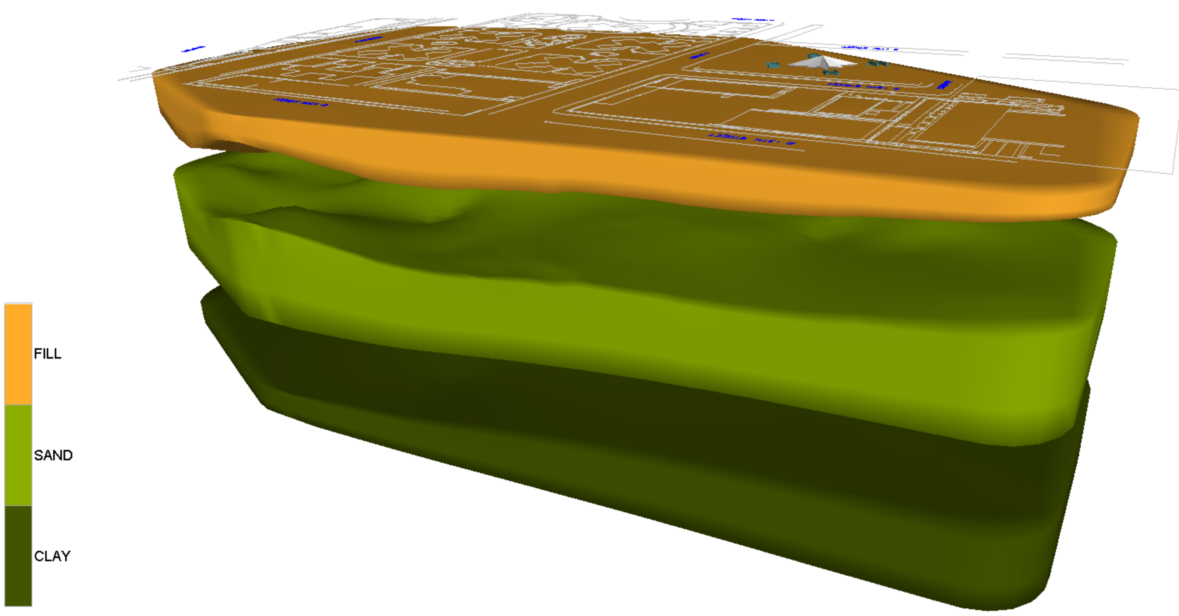
SITE PLAN WITH FORMER MGP STRUCTURES AND SAMPLE LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1-3



Looking North



Looking South

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSES REPORT FOR OU-1

SITE GEOLOGY

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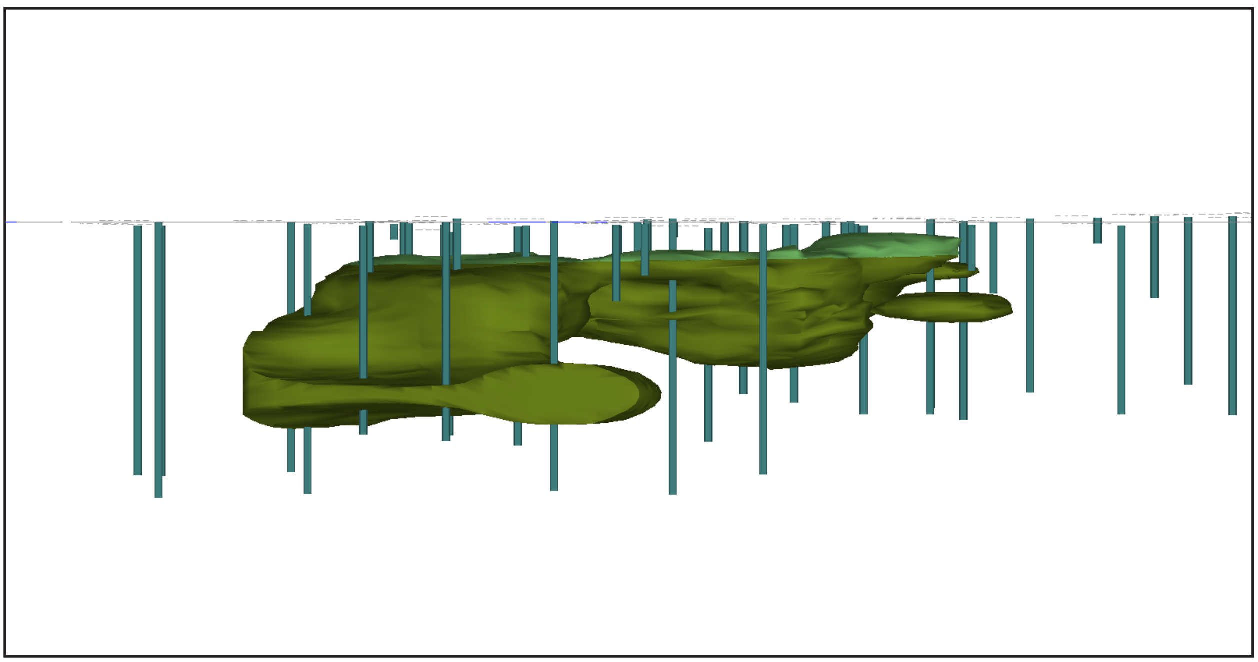
FIGURE **1-4**

10/26/2012 SYRACUSE, NY-ENV/CAD-DJHOWES
B0043013/0002/00031/CDR/43013G01.CDR

Plan View



Profile View - Facing South

Legend:

= NAPL above the water table

= NAPL below the water table

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSES REPORT FOR OU-1

EXTENT OF NAPL

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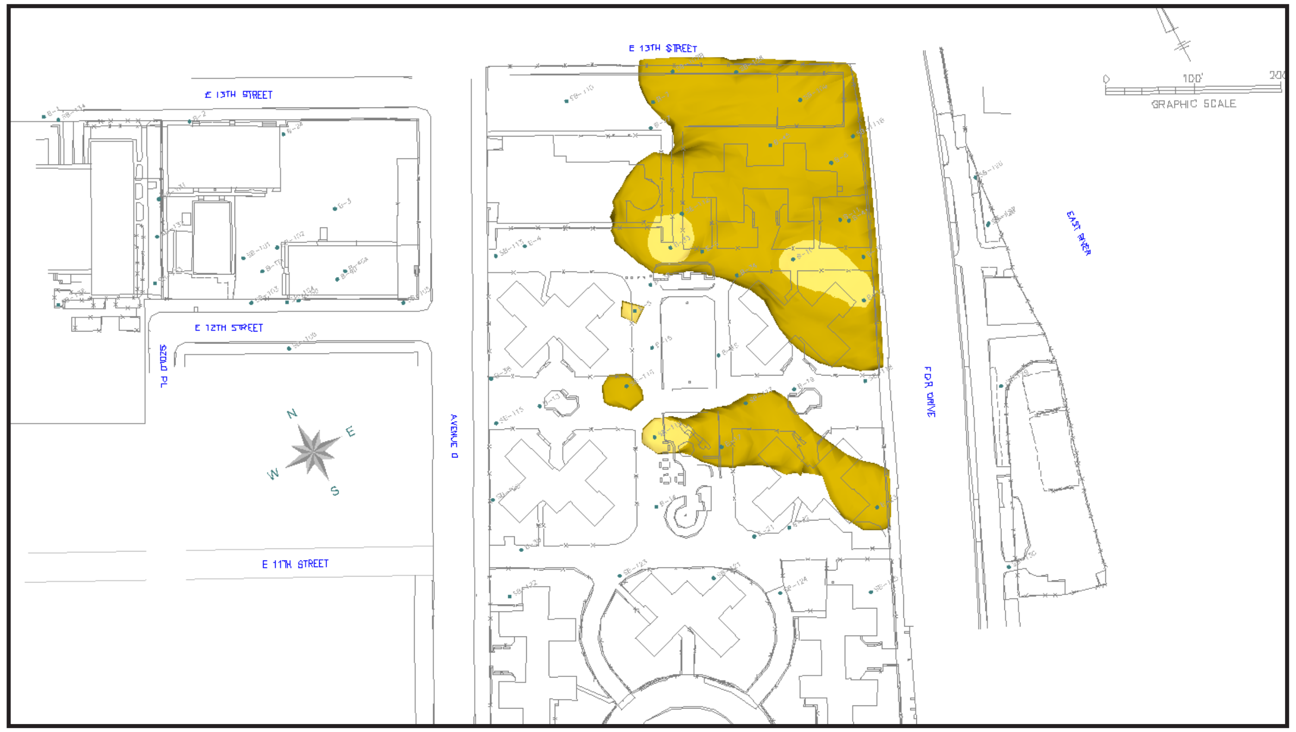
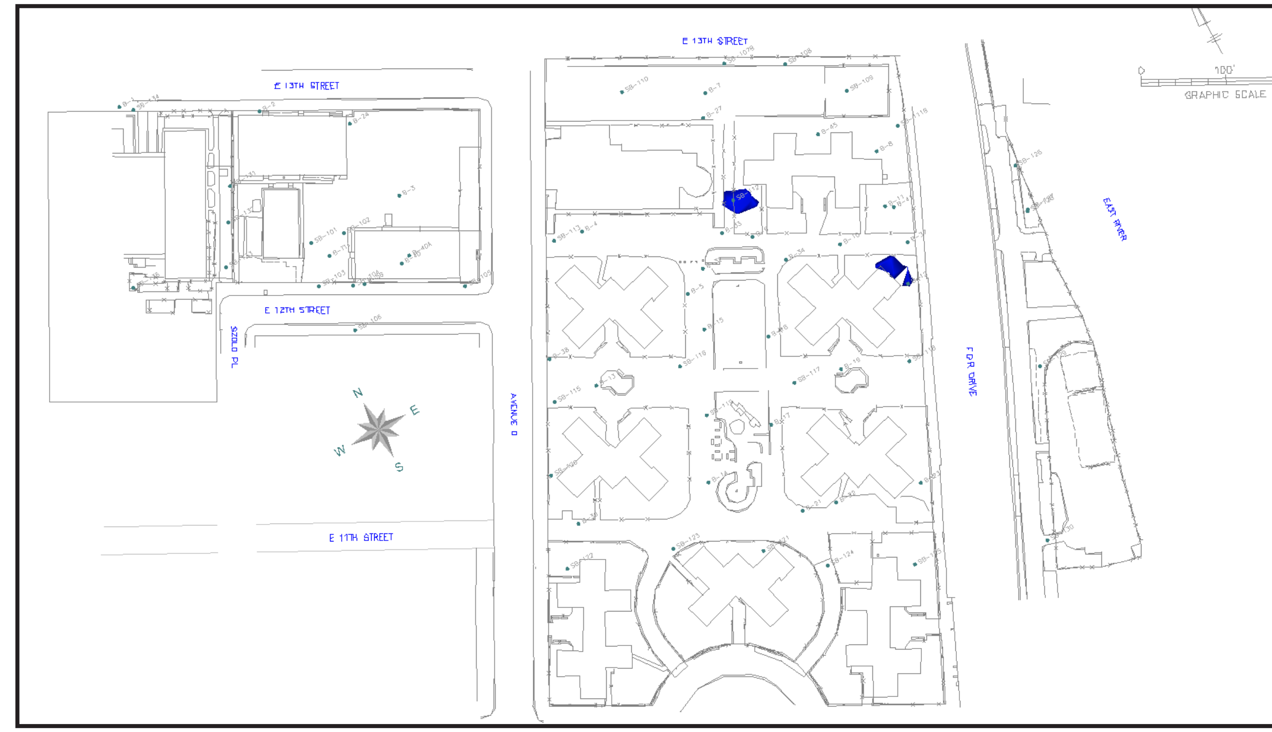
FIGURE **1-5**

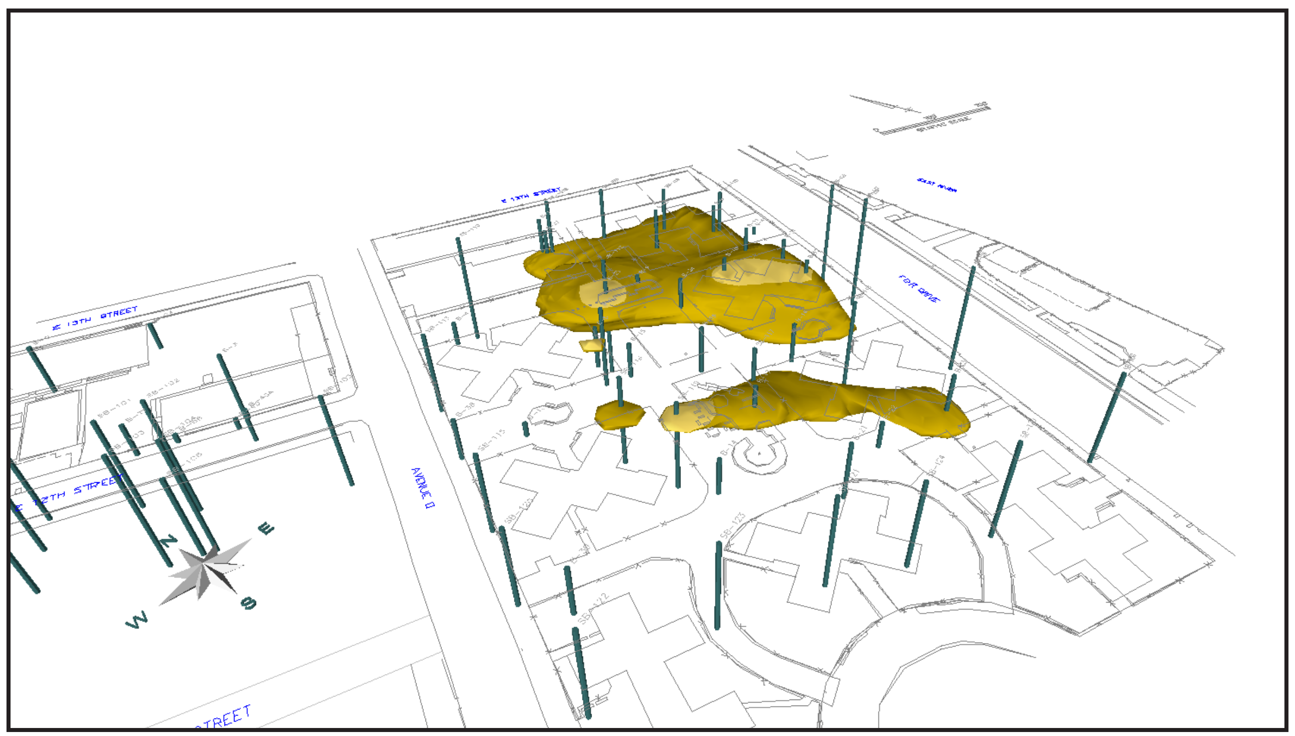
10/26/2012 SYRACUSE, NY-ENV/CAD-DJHOWES
B0043013/0002/00031/CDR/43013G04.CDR



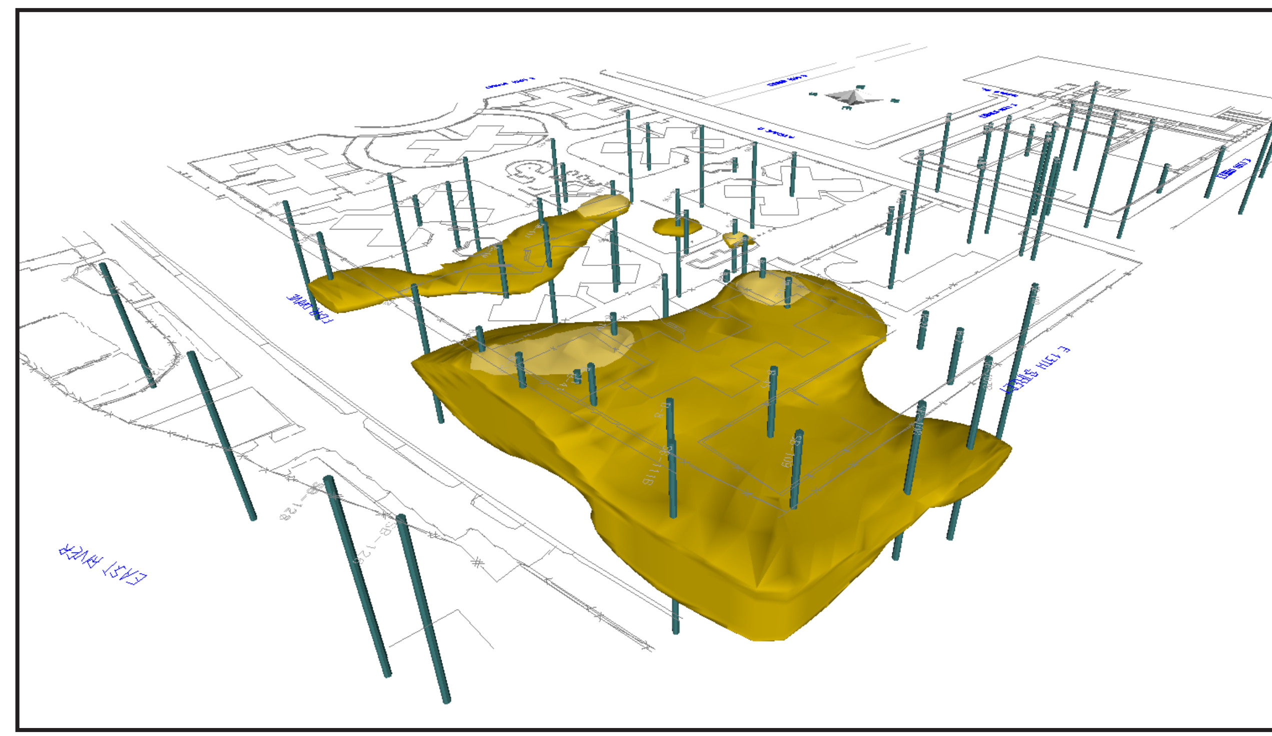
BTEX ≥10 ppm - Plan View



BTEX ≥1,000 ppm - Plan View



BTEX ≥10 ppm - Looking Northeast



BTEX ≥10 ppm - Looking Southwest

Legend:

- = BTEX ≥10ppm above the water table
- = BTEX ≥10ppm below the water table
- = BTEX ≥1,000ppm below the water table

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FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSES REPORT FOR OU-1

BTEX IN SUBSURFACE SOIL

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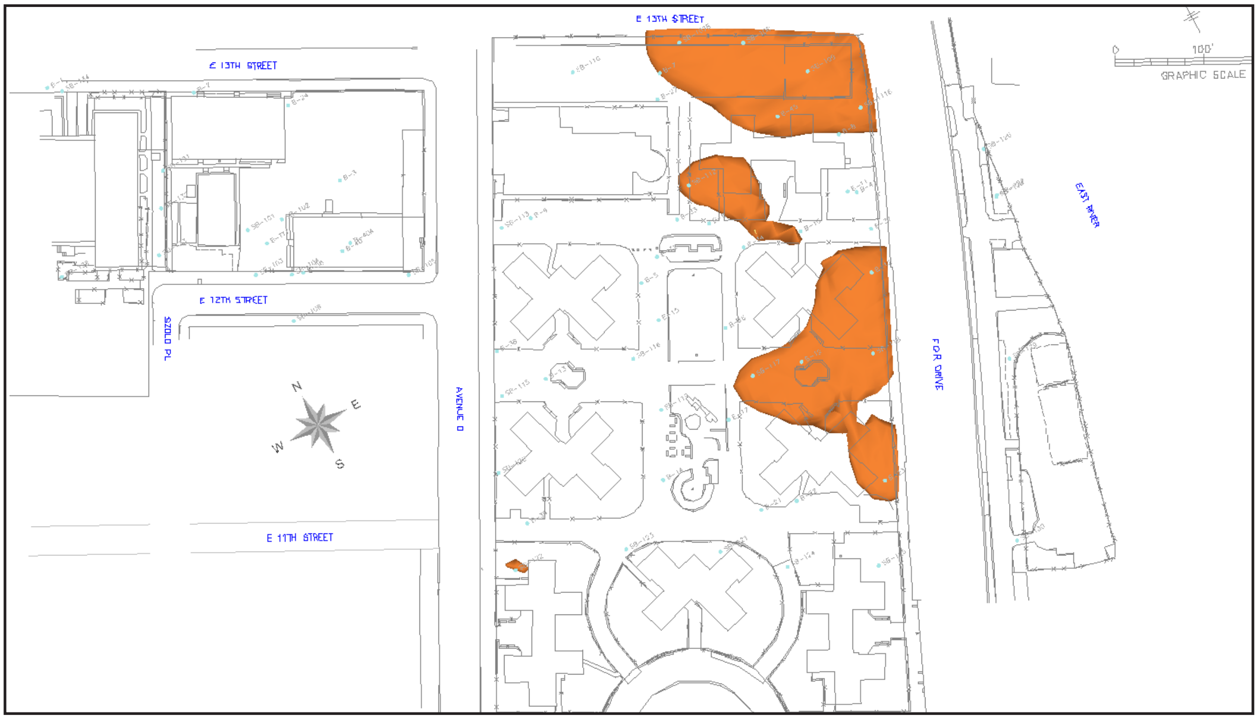
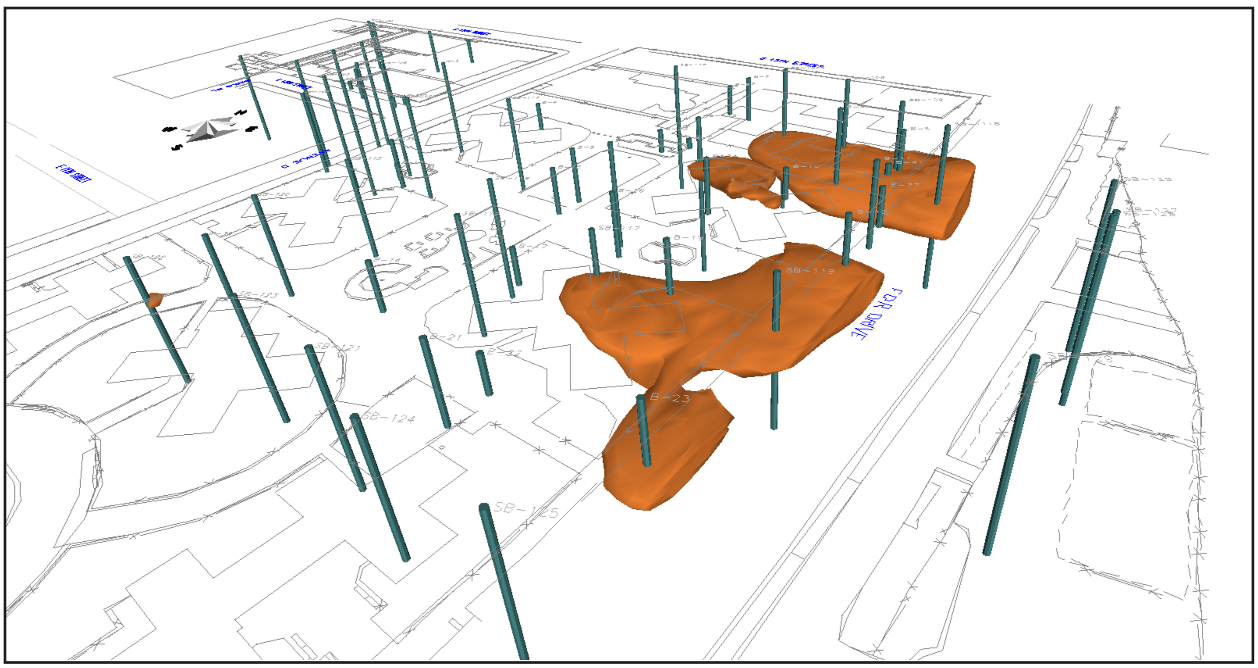
FIGURE
1-6

10/26/2012 SYRACUSE, NY-ENV/CAD-DJHOWES
B0043013/0002/00031/CDR/43013G02.CDR



Plan View



Looking Northwest

Legend:

= PAHs ≥500 ppm above the water table

= PAHs ≥500 ppm below the water table

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSES REPORT FOR OU-1

PAHs IN SUBSURFACE SOIL

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FIGURE
1-7

10/26/2012 SYRACUSE, NY-ENV/CAD-DJHOWES
B0043013/0002/00031/CDR/43013G03.CDR

10/26/2012 SYRACUSE, NY-ENV/CAD-DJHOWES
B0043013/0002/00031/CDR/43013G05.CDR

Plan View

Legend:

- = NAPL (and assumed PAHs) above water table
- = NAPL (and assumed PAHs) below water table
- = PAHs ≥500 ppm above water table
- = PAHs ≥500 ppm below water table

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSES REPORT FOR OU-1

NAPL AND PAHs IN SUBSURFACE SOIL

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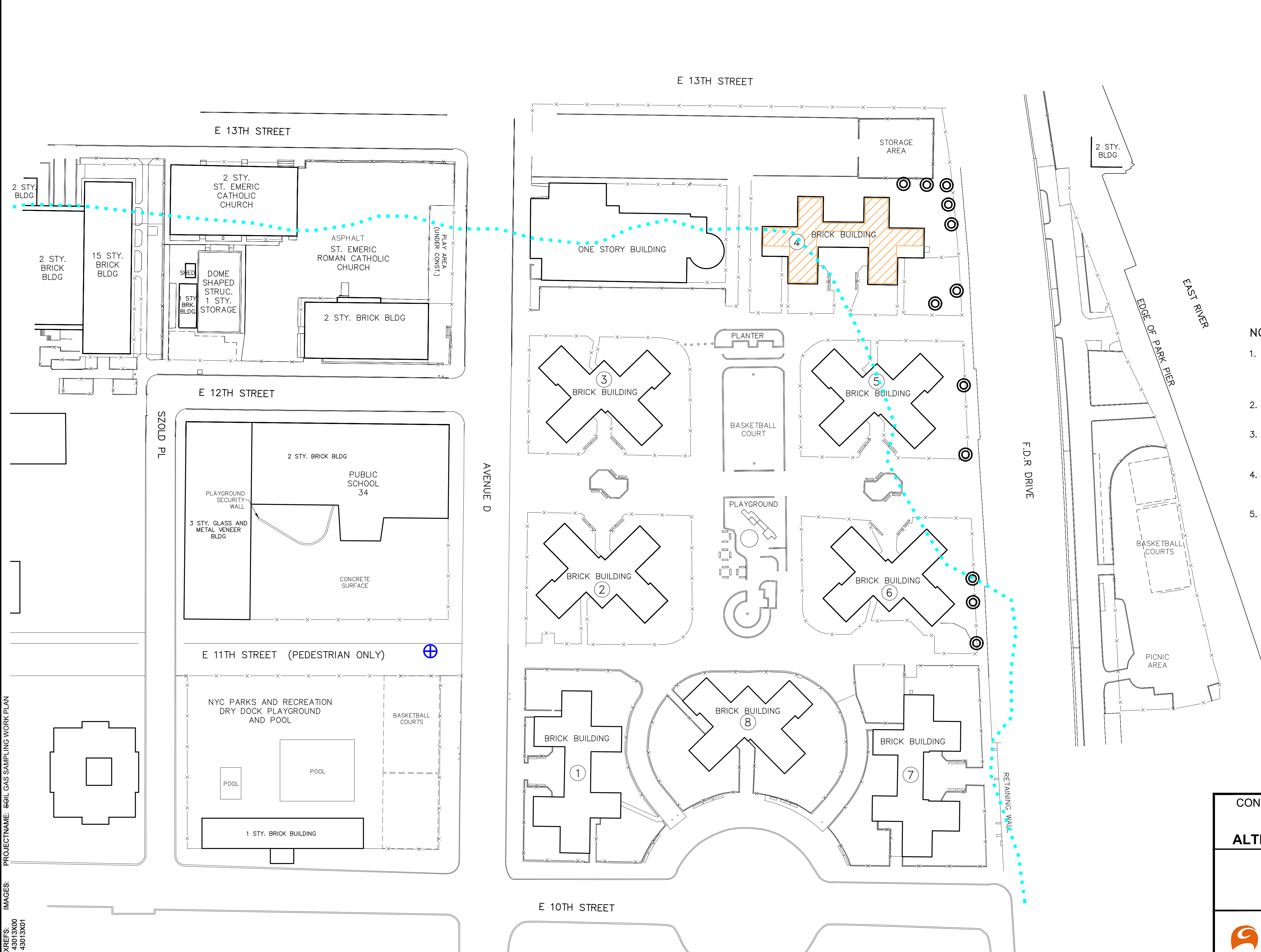
FIGURE **1-8**



LEGEND:

- PROPOSED NAPL RECOVERY WELL
- PROPOSED NEW GROUNDWATER MONITORING WELL
- APPROXIMATE HISTORICAL SHORELINE
- FENCE
- BUILDING
- (4) JACOB RIIS BUILDING NUMBER
- PROPOSED SURFACE CONTROL (SEE NOTE 5)

NOTES:

1. BASE MAP AND SURVEY CONTROL WAS TAKEN FROM ORIGINAL SURVEY DATED 9/3/2004; SUBMITTED BY B.B.L. ON 8/25/2006 AND SATELLITE IMAGERY OBTAINED FROM GOOGLE EARTH ON SEPTEMBER 16, 2009.
2. ALL PLANIMETRIC FEATURES SHOWN ARE IN NAD 83 NY STATE PLANE COORDINATE SYSTEM.
3. THE OLD SURVEY WAS CONVERTED INTO NEW COORDINATE AND VERTICAL SYSTEM BASED ON 7 TRAVERSE POINTS, RECOVERED IN THE FIELD (#2,3,4,6,7,12, AND 18).
4. PROPOSED NAPL RECOVERY WELL LOCATIONS ARE CONCEPTUAL. ACTUAL LOCATION AND CONFIGURATION WOULD BE DETERMINED DURING DESIGN.
5. ESTIMATED EXTENT OF SURFACE CONTROL TO BE INSTALLED OVER EARTHEN FLOOR STORAGE AREAS IN JACOB RIIS BUILDING No. 4 BASED ON FIELD OBSERVATIONS (ASSUMED 75% OF BUILDING FOOTPRINT). ACTUAL AREA TO BE CONFIRMED.

0 100' 200'

GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK

ALTERNATIVES ANALYSIS REPORT FOR OU-1

ALTERNATIVE 3

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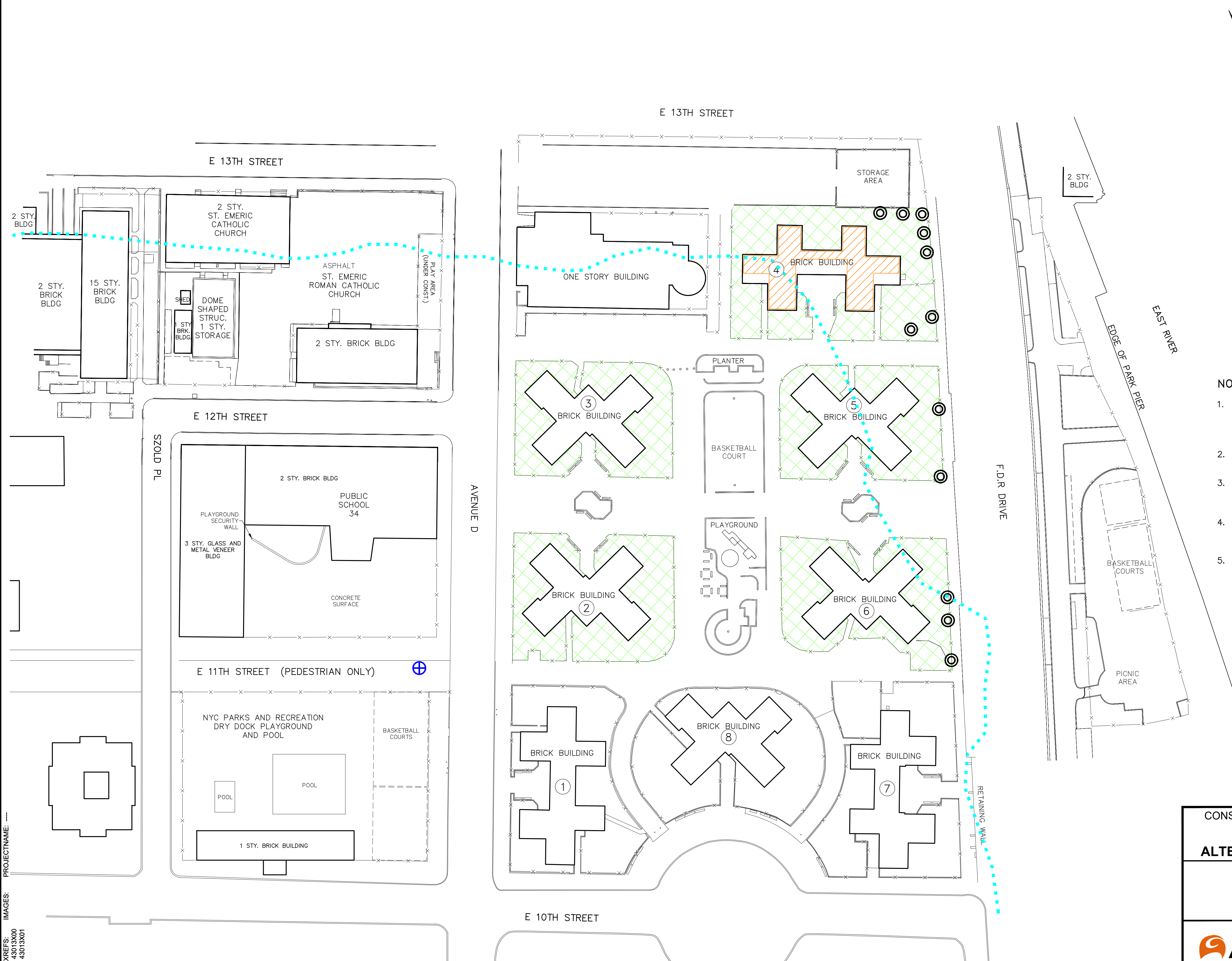
FIGURE

5-1



LEGEND:

- PROPOSED NAPL RECOVERY WELL
- PROPOSED NEW GROUNDWATER MONITORING WELL
- APPROXIMATE HISTORICAL SHORELINE
- FENCE
- BUILDING
- JACOB RIIS BUILDING NUMBER
- AREA OF SHALLOW SOIL REMOVAL TO A DEPTH OF 2 FEET
- PROPOSED SURFACE CONTROL (SEE NOTE 5)

NOTES:

1. BASE MAP AND SURVEY CONTROL WAS TAKEN FROM ORIGINAL SURVEY DATED 9/3/2004; SUBMITTED BY B.B.L. ON 8/25/2006 AND SATELLITE IMAGERY OBTAINED FROM GOOGLE EARTH ON SEPTEMBER 16, 2009.
2. ALL PLANIMETRIC FEATURES SHOWN ARE IN NAD 83 NY STATE PLANE COORDINATE SYSTEM.
3. THE OLD SURVEY WAS CONVERTED INTO NEW COORDINATE AND VERTICAL SYSTEM BASED ON 7 TRAVERSE POINTS, RECOVERED IN THE FIELD (#2,3,4,6,7,12, AND 18).
4. PROPOSED NAPL RECOVERY WELL LOCATIONS ARE CONCEPTUAL. ACTUAL LOCATION AND CONFIGURATION WOULD BE DETERMINED DURING DESIGN.
5. ESTIMATED EXTENT OF SURFACE CONTROL TO BE INSTALLED OVER EARTHEN FLOOR STORAGE AREAS IN JACOB RIIS BUILDING No. 4 BASED ON FIELD OBSERVATIONS (ASSUMED 75% OF BUILDING FOOTPRINT). ACTUAL AREA TO BE CONFIRMED.

0 100' 200'
GRAPHIC SCALE

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK
ALTERNATIVES ANALYSIS REPORT FOR OU-1

ALTERNATIVE 4

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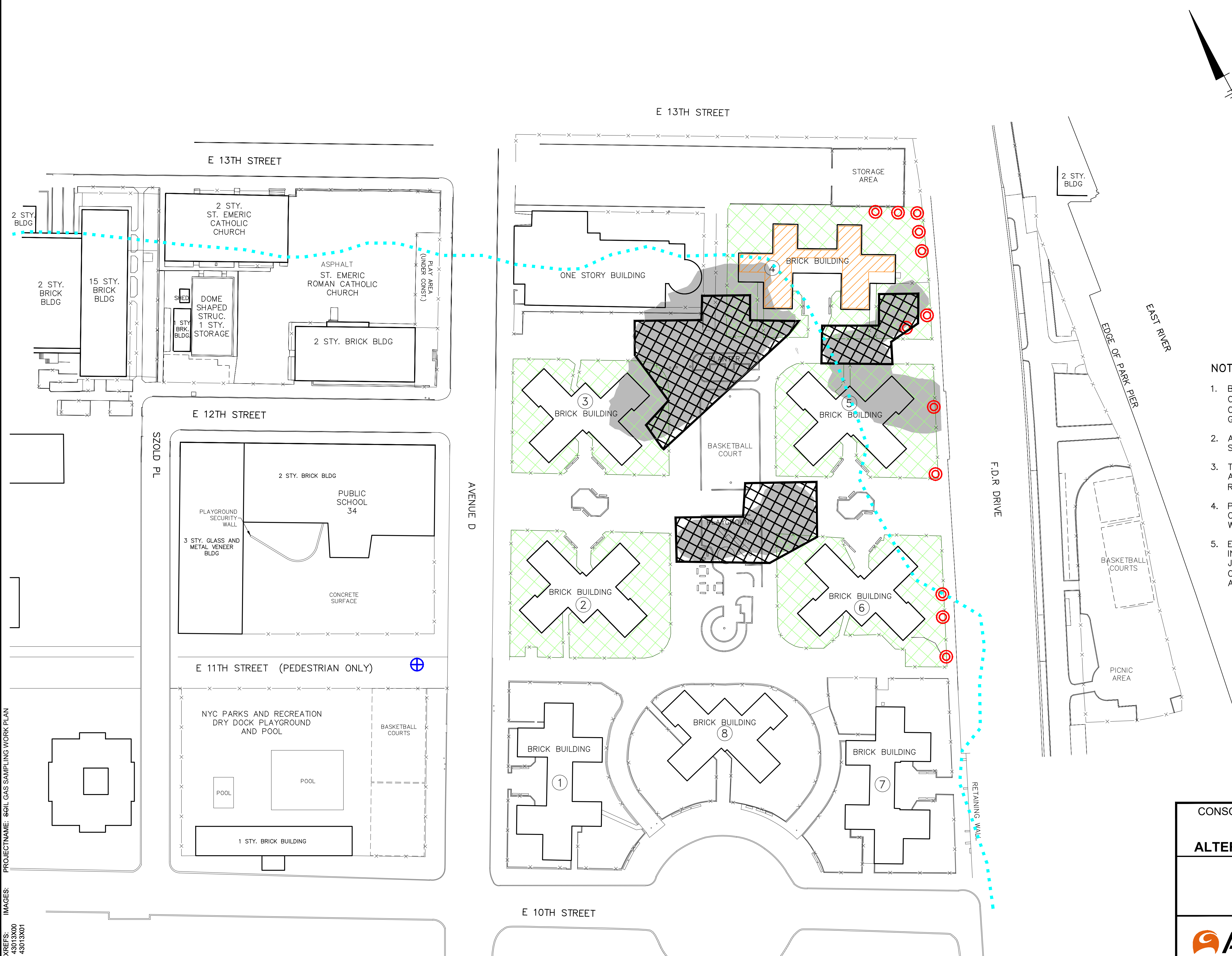
FIGURE
5-2



LEGEND:

- PROPOSED NAPL RECOVERY WELL
- PROPOSED NEW GROUNDWATER MONITORING WELL
- APPROXIMATE HISTORICAL SHORELINE
- FENCE
- BUILDING
- JACOB RIIS BUILDING NUMBER
- AREA OF SHALLOW SOIL REMOVAL TO A DEPTH OF 2 FEET
- APPROXIMATE LIMITS OF MGP–IMPACTED SOIL TO DEPTH OF 8 FEET BELOW GRADE
- APPROXIMATE REMOVAL LIMITS FOR ACCESSIBLE MGP–IMPACTED SOIL TO A DEPTH OF 8 FEET BELOW GRADE
- PROPOSED SURFACE CONTROL (SEE NOTE 5)

NOTES:

1. BASE MAP AND SURVEY CONTROL WAS TAKEN FROM ORIGINAL SURVEY DATED 9/3/2004; SUBMITTED BY B.B.L. ON 8/25/2006 AND SATELLITE IMAGERY OBTAINED FROM GOOGLE EARTH ON SEPTEMBER 16, 2009.
2. ALL PLANIMETRIC FEATURES SHOWN ARE IN NAD 83 NY STATE PLANE COORDINATE SYSTEM.
3. THE OLD SURVEY WAS CONVERTED INTO NEW COORDINATE AND VERTICAL SYSTEM BASED ON 7 TRAVERSE POINTS, RECOVERED IN THE FIELD (#2,3,4,6,7,12, AND 18).
4. PROPOSED NAPL RECOVERY WELL LOCATIONS ARE CONCEPTUAL. ACTUAL LOCATION AND CONFIGURATION WOULD BE DETERMINED DURING DESIGN.
5. ESTIMATED EXTENT OF SURFACE CONTROL TO BE INSTALLED OVER EARTHEN FLOOR STORAGE AREAS IN JACOB RIIS BUILDING No. 4 BASED ON FIELD OBSERVATIONS (ASSUMED 75% OF BUILDING FOOTPRINT). ACTUAL AREA TO BE CONFIRMED.

CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.
FORMER EAST 11TH STREET WORKS SITE
MANHATTAN, NEW YORK

ALTERNATIVES ANALYSIS REPORT FOR OU-1

ALTERNATIVE 5

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5-3

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Syracuse, New York 13202

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