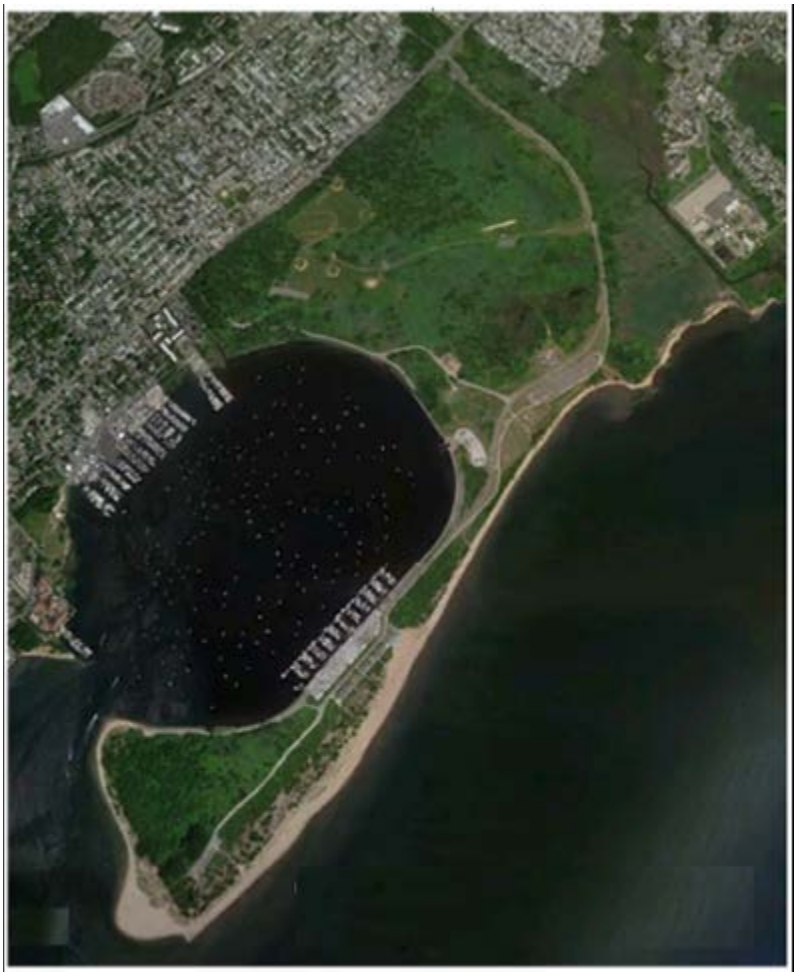

Final Environmental Investigation Report for Great Kills Park Operable Unit 1

Gateway National Recreation Area, New York

Great Kills Park Site
EDL #5NER1580

November 13, 2017

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NPS Federal Government Lead

KATHLEEN CUZZOLINO Digitally signed by KATHLEEN CUZZOLINO
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Signature, Date

By signing above, the signatory verifies that they understand and concur with the information and procedures, and recommendations presented herein.

Final Environmental Investigation Report for Operable Unit 1

Great Kills Park Site, Operable Unit 1
Gateway National Recreation Area, New York
National Park Service

Document Date: **November 13, 2017**

Prepared by: **AECOM Tidewater Joint Venture (AECOM-Tidewater JV)**
3101 Wilson Blvd, Suite 900
Arlington, Virginia, 22201

Prepared for: **U.S. Army Corps of Engineers, North Atlantic Division, Baltimore District (NAB); and North Atlantic Division, New York District (NAN)**

Approved by: **National Park Service**

November 13, 2017
Date

Bruce Reynolds, CHMM
Deputy Program Manager
AECOM-Tidewater Joint Venture

November 13, 2017
Date

Ryan Wensink, PE
Project Manager
AECOM-Tidewater Joint Venture

November 13, 2017
Date

John S. Wyckoff, PG
Project Geologist
AECOM-Tidewater Joint Venture

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LIST OF ABBREVIATIONS AND ACRONYMS

ATSDR	U.S. Agency for Toxic Substances and Disease Registry
bgs	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
City	City of New York
cpm	Counts Per Minute
COPCs	Contaminants of Potential Concern
CSM	Conceptual Site Model
CWG	Consultative Working Group
DOHMH	City of New York Department of Health and Mental Hygiene
EE/CA	Engineering Evaluation and Cost Analysis
EIR	Environmental Investigation Report
EIS	Environmental Impact Statement
EM	Electromagnetic Survey
ESV	Ecological Screening Value
FEMA	Federal Emergency Management Agency
FID	Flame Ionization Detector
FOV	Field of View
FS	Feasibility Study
GAO	U.S. Government Accountability Office
GKP	Great Kills Park
GMP	General Management Plan
GWS	Gamma Walkover Survey
HSA/RS	Historical Site Assessment/Records Search Summary Report
IDW	Investigation-Derived Waste
IRA	Interim Response Action
JV	AECOM-Tidewater Joint Venture
LUW	Land Under Water
MAG	Magnetic Survey
MCL	Maximum Contaminant Level
MGD	Million Gallons per Day
mg/kg	milligrams per kilogram
mR/hr	milliroentgens per hour
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NYCDEP	New York City Department of Environment Protection

NYPD	New York City Police Department
NYSDEC	New State Department of Environmental Conservation
OU	Operable Unit
PA	Preliminary Assessment
PCBs	Polychlorinated Biphenyls
PID	Photo Ionization Detector
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
RAP	USDOE Radiological Assistance Program
RI	Remedial Investigation
ROPCs	Radionuclides of Potential Concern
ROW	Right of Way
RSL	Regional Screening Level
SAP	Sampling Analysis Plan
SSSI CSRM	South Shore of Staten Island Coastal Storm Risk Management Project
SVOCs	Semi-Volatile Organic Compounds
TCRA	Time Critical Removal Action
TEF	Toxic Equivalency Factor
TEQ	Toxic Equivalency
µg/l	Micrograms per liter
µRem/hr	Microrem per hour
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
VOCs	Volatile Organic Compounds
WPCP	Water Pollution Control Plant

EXECUTIVE SUMMARY

This Environmental Investigation Report (EIR) presents the results of environmental investigation activities conducted within Operable Unit 1 (OU1) at the Great Kills Park (GKP) Site (Site), which includes approximately 43 acres of the 523-acre park. GKP is located on Staten Island, NY and is managed by the National Park Service (NPS) as a part of the Staten Island Unit of the Gateway National Recreation Area (Gateway). NPS performed the investigation activities within OU1 pursuant to its lead agency authority under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601 *et seq.*, and associated regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. With the exception of a quantitative risk assessment, this EIR follows the format of a Remedial Investigation (RI) Report. The NPS contaminated sites team (CST) established OU1 so that the investigation results could inform construction planning for the South Shore of Staten Island Coastal Storm Risk Management Project (SSSI CSRM) which may be sited within or adjacent to OU1.

Within OU1, historical operations, including waste disposal and sludge management, have resulted in contaminant sources and impacts to environmental media. Previous investigations and Site historical research identified the primary contaminant sources within OU1 are: (1) waste fill derived from historical waste disposal operations at GKP (e.g., refuse, incinerator residue, and coal ash), (2) radiological artifacts incidentally contained in waste fill, and (3) sewage sludge that was dried in the sludge impoundment area and then used as a soil amendment (artificial topsoil) after the completion of waste disposal operations in OU1. OU1 fieldwork was completed to satisfy two objectives: finding both the nature and extent of contaminant sources and associated releases to environmental media. The investigation was completed in accordance with the Final OU1 Sampling and Analysis Plan (NPS, 2016a) and involved two phases of fieldwork, with the first being conducted from April to June 2016 and the second from September to October 2016. A multi-step field investigation approach was used so that sampling activities performed during the second phase could be refined based on the results from the first phase. During the second phase of fieldwork, an investigation also was completed within areas outside of OU1 to generate a site-specific background dataset. Based on the completion of the field activities described in this report and the resulting datasets, the OU1 sampling objectives were successfully achieved.

Investigation activities determined that historical operations (i.e., spreading waste fill and covering it with a soil amendment containing sewage sludge) resulted in a well-mixed, but still heterogeneous source that is widespread throughout OU1, corresponding to an impacted area covering approximately 32 acres and comprising approximately 284,000 cubic yards of impacted media. The primary Site contaminants include metals, PAHs, PCBs, dioxins/furans, and radionuclides at levels that exceeded project screening benchmarks and may pose a risk to human health and the environment. Radiological artifacts are also associated with waste fill and may potentially be present throughout OU1; however, due to shielding from overlying soil, the prevalence of radiological artifacts is difficult to quantify. Sampling activities indicate that compromised radiological artifacts may leak and release localized contamination to soil in close proximity to the item. Investigations of a concentrated ash layer (i.e., coal ash, incinerator residue, or a combination of the two) determined that radionuclides were slightly elevated in the ash layer, roughly two times higher than results from background samples. Sampling results did not show clear spatial trends in the distribution of contamination, which aligns with the release mechanism of spreading waste fill and sewage sludge as a well-mixed, but heterogeneous source.

This EIR provides a thorough summary of the OU1 field activities and investigation findings, including detailed estimates defining the extent of contaminated media and summaries of analytical data characterizing the nature of contaminant sources within OU1. The information presented in this report effectively characterizes Site conditions for the purpose of informing construction planning for the SSSI CSRM. At this date, the NPS CST's approach under CERCLA is to combine the results of activities completed within OU1 with future investigation results for the remainder of the Site to complete a single, Site-wide RI Report. Any future response action under CERCLA at OU1 will consider the design of the SSSI CRSM. Until then, all existing engineering (i.e., fencing and signage) and institutional controls (i.e., administrative requirements for access to the Site, including OU1) will be maintained so that exposure to contaminants is appropriately managed.

Any construction performed within OU1, such as the SSSI CSRM, must be conducted in a manner that considers hazards to the public, hazards to site workers, and management and offsite disposal of waste generated during construction (e.g., potential radiological waste, potential RCRA hazardous waste, and other contaminated materials that are not suitable for re-use at the Site). Potential impacts on construction activities could be minimized by selecting work areas that coincide with the portions of OU1 in which the waste fill layer is thinnest, which is along the northeastern extent of OU1.

1. INTRODUCTION

This Environmental Investigation Report (EIR) presents the results of environmental investigation activities conducted within Operable Unit 1 (OU1) at the Great Kills Park (GKP) Site (Site), which includes approximately 43 acres of the 523-acre park. GKP is located on Staten Island, NY and is managed by the National Park Service (NPS) as a part of the Staten Island Unit of the Gateway National Recreation Area (Gateway) (**Figure 1-1**). This report was prepared on behalf of NPS by the AECOM-Tidewater Inc. Joint Venture (AECOM-Tidewater JV), under contract with the United States (U.S.) Army Corps of Engineers (USACE), per Contract No. W912DR-13-D-0016, Delivery Order 0003. Investigation activities within OU1 at GKP were undertaken pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601 *et seq.*, and its associated regulations, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300. The National Park Service (NPS) has been delegated CERCLA response authority to respond to releases or threatened releases of hazardous substances on any facility under the jurisdiction, custody or control of NPS. NPS is the lead CERCLA agency for this and other response actions taken or to be taken at the Site.

As was described in the Final OU1 Remedial Investigation (RI) Sampling and Analysis Plan (SAP) (NPS, 2016a), sampling activities within OU1 were undertaken by NPS as the lead agency under CERCLA. The NPS contaminated sites team (CST) accelerated the investigation of OU1 so that the results presented in this EIR could inform construction planning for the South Shore of Staten Island Coastal Storm Risk Management Project (SSSI CSRM) which may be sited within or adjacent to OU1. Based on the results of environmental sampling within OU1, the NPS CST plans to complete RI field activities for the remainder of the Site and prepare an RI and Feasibility Study (FS) Report for the entire Site. This revised approach will facilitate a more complete and comprehensive analysis of remedial alternatives for the entire Site in a single RI/FS document.

This EIR provides a thorough summary of the OU1 field activities and investigation findings associated with field work completed in 2016, including detailed summaries of all analytical data generated within OU1. The information contained in this EIR is considered usable for the purposes of characterizing Site conditions and to support future remedial decision-making for the Site. The results of environmental investigation activities completed within OU1 in 2016 will be combined with future sampling results for remaining investigation areas to provide a comprehensive dataset that will be used to evaluate risk to human health and the environment as part of the RI Report for the entire Site.

1.1 PURPOSE AND OBJECTIVES

The purpose of this EIR is to document and present the results from the field activities completed within OU1 and to inform construction planning for the SSSI CSRM. Fieldwork within OU1 was conducted in two phases so that Phase 2 sampling could be refined based on the Phase 1 results (NPS, 2016a). The objectives of sampling were to: (1) delineate and verify the vertical and horizontal extent of the waste filled area in OU1; (2) identify the presence of radionuclides and chemicals within OU1 through the collection and analysis of environmental data from surface soil, subsurface soil, sediment, groundwater, and surface water; (3) identify the extent of surface and subsurface contamination; and (4) evaluate the extent of radionuclides and chemicals in shallow and deep groundwater. OU1 fieldwork was completed in two phases, with the first being conducted from April to June 2016 and the second being conducted from September to October 2016. During the second phase of fieldwork, an investigation also was completed

within areas outside of OU1 to generate a Site-specific background dataset. Sampling activities were completed as planned in 2016 and the data collected achieved the objectives outlined in the Final OU1 RI SAP (NPS, 2016a).

1.2 SITE DESCRIPTION

GKP is located at the intersection of Buffalo Street and Hylan Boulevard, Staten Island, NY 10306 and is included within the Staten Island Unit of the Gateway National Recreation Area, New York. Site center coordinates are approximately 40°33'01.66" north latitude and 74°07'37.67" west longitude. The coordinates for the entrance to GKP at Buffalo Street and Hylan Boulevard are 40°33'23.97" north latitude and 74°08'36.37" west longitude. GKP is approximately 523 acres in size and is directly adjacent to the Great Kills Harbor (**Figure 1-1**). GKP is part of the Staten Island Unit, which is one of three National Park Units—the Jamaica Bay Unit in Brooklyn and Queens Counties, the Staten Island Unit, and the Sandy Hook Unit (northern shore of New Jersey) that comprise the 26,607-acres of the Gateway National Recreation Area in the New York and New Jersey metropolitan area.

During previous investigations, radionuclides of potential concern (ROPCs) were identified within a 265-acre waste filled area of GKP, known as the Site, as a result of the historical placement of waste fill. The waste fill includes incinerator residue, coal ash, wood, glass, metal, food refuse, street sweepings, and excavation and construction materials. Parts of the Site also contain hydraulic fill (sediment dredged from Great Kills Harbor anchorage area and channel), and sewage sludge from the adjacent Oakwood Beach Water Pollution Control Plant (WPCP) (**Figure 1-2**). Based on the Time Critical Removal Action (TCRA) Report issued in 2015, several ROPCs including radium-226, thorium-232, and uranium-238, including their progeny were identified in discrete locations at the 265-acre Site (Tidewater, 2015).

The 265-acre Site was divided into two OUs for the purposes of CERCLA activities (**Figure 1-3**). OU1 is a 43-acre parcel situated within and along the northeastern perimeter of the 265-acre Site, and contains waste fill, hydraulic fill, sewage sludge and former sludge impoundments (sludge drying beds). OU1 is bounded by: the GKP and Buffalo Street to the south; Hylan Boulevard to the west; residential properties to the north and northeast, and the Oakwood Beach WPCP and Raritan Bay to the east. OU1 location and Site features are illustrated on **Figure 1-3**.

OU1 has low relief, with elevations generally less than 15 feet above sea level (NYCDEP, 2013) and is located within the lower portion of Oakwood Beach Watershed, which covers approximately 1,329 acres (New York City Department of Environmental Protection [NYCDEP], 2013). Throughout OU1, the ground surface is characterized by dense vegetation with mature trees and shrubs predominant in the northwestern portion of OU1 (near Hylan Boulevard). In lower lying areas to the southeast, the ground surface remains heavily vegetated, but is dominated by phragmites.

The Oakwood Beach Watershed includes the NYCDEP Bluebelt property, which comprises the Oakwood Beach wetland area located to the north of OU1 and west of the Oakwood Beach WPCP. The Staten Island Bluebelt Program was developed to address the consequences of development (e.g., flooding) and included the acquisition of local properties (Bluebelt Property) for the preservation of wetlands and introduction of new natural storage areas for stormwater conveyance (NYCDEP, 2013).

1.3 SITE HISTORY

This section presents the history of the Site from the late 1800s when the property primarily consisted of a near shore marine wetland; through the late 1920s to the mid-1950s when the land plan for the Marine Park was implemented by the City of New York (City) (i.e., resulting in the placement of the waste fill,

sewage sludge and hydraulic fill), which raised the elevation and allowed the property to be developed as a City Park; to the mid-1970s when the City Park was transferred to NPS.

In 1865, John Jeremy Crooke purchased what is today largely the GKP property and surrounding area and as a result "Crooke's Point" takes its name from Mr. Crooke (Staten Island Museum Bulletin, August, 1939). The property use during this time included farming, growing salt hay, fishing and boat building. The property was largely vacant, with few structures and consisted of near shore marine wetlands and creeks (Bass Creek, Mill Pond Creek, Flat Creek, Lockmans Creek, and Duck Creek) that drained from the upland (west of Hylan Boulevard) to Great Kills Harbor to the southeast (**Figure 1-4**).

Between 1894 and 1902, Crooke's Point and adjacent wetlands underwent significant erosion and loss of land (Staten Island Museum Bulletin, 1939, and G.W. Bromley and Co., 1917). Crooke's Point was initially comprised of 180 acres, but as a result of the erosion was reduced to a 30-acre island (Balch, 1923; G.W. Bromley and Co., 1917) (**Figure 1-5**). The sand from the erosion of the spit was re-deposited into Great Kills Harbor. The land plan for the Marine Park (a.k.a. Great Kills Park) was initiated in 1925. In 1926, the City constructed the Bay Terrace Burner House and Incinerator (Sanborn, 1937) (**Figure 1-6**). Between 1929 and 1930, the City acquired 18 parcels involving over 290 acres of upland. The State of New York granted to the City 445 acres in 1932 and 83 acres in 1934, for a total of approximately 529 acres of land under water (LUW). In 1936, the City acquired 94 acres of property (upland) by condemnation (New York City Department of Parks, Public Notice Purchase Private Property, October 25, 1935 and New York City Board of Estimate and Apportionment, July 15, 1936, Record Map of Great Kills Park, R-16, 1982). In 1940, the State of New York granted an additional 411 acres of LUW to the City. The 411 acre grant required the land be improved for the proposed public park within 5 years (New York State Report of Attorney General, November 26, 1940 re: Application of the City New York). The complete Marine Park area at that time was bounded by Fairlawn Avenue (on the southwest to west), Hylan Boulevard (on the northwest to north), and Emmet Avenue (on the north to the northeast) (**Figure 1-7**).

In addition to the hydraulic fill, the 1935 and 1936 New York City Department of Parks topographic maps for the Marine Park indicate waste fill and incinerator residue were disposed of in the vicinity of the Bay Terrace Incinerator. The New York City Department of Sanitation Oakwood Truck Fill commenced operations in 1934 (New York City Department of Parks Press Release, 1949). The exact location of the Oakwood Truck Fill is unknown; however, it is believed to be co-located with the Bay Terrace Garage and Incinerator (**Figure 1-8**). The Bay Terrace Incinerator was reportedly abandoned on or before 1941 (New York City Department of Parks, Press Release, 1941). The Oakwood Truck Fill ceased operations in 1948 (New York City Department of Parks Press Release, 1949).

Starting in 1944 to 1949, the City operated the Marine Unloading Plant(s) and Landfill. During 1944 through 1948, over 265 acres of low lying wetland area (within the acquired property) and LUW were covered with over 15.1 million cubic yards of waste fill. In 1945, in anticipation of filling the area east of Hylan Boulevard, the City developed plans to reconstruct the existing manholes for the sanitary sewer located beneath both Mansion and Gratten Avenues and Bach Street described above. The reconstruction effort raised the elevations of the manholes by installing manhole extensions (in some cases over ten feet) to prevent the manholes from being buried by the waste fill (New York City Department of Parks, 1945). By 1949, the City park was opened (limited opening) to the public and was completely filled and graded (**Figure 1-9**).

The Oakwood Beach Water Pollution Control Plant (WPCP) was constructed by the City in 1954 and 1955, and it commenced treatment in 1956. The plant replaced a screening plant. The WPCP was designed to serve a population of 60,000 with a treatment capacity of 15 million gallons per day (MGD).

Between early 1955 and late 1959, 213,000 cubic yards of clay and 285,000 cubic yards of sewage sludge (presumably from the Oakwood Beach WPCP) were mixed together to create artificial topsoil (Wrenn, 1975) used to facilitate vegetative growth over the waste fill area. By 1966, sludge drying beds were established to the west of the Oakwood Beach WPCP.

On October 27, 1972, United States Congress approved Public Law 92-592 (a.k.a. Enabling Legislation) that established the Gateway National Recreation Area which included the Staten Island Unit and the Great Kills Park. The Enabling Legislation in part authorized the Secretary of Interior to acquire the land to create the Gateway National Recreation Area "to preserve and protect for the use and enjoyment of present and future generations an area possessing outstanding natural and recreational features." In 1974, the City conveyed via deed to the United States of America for the use and development by NPS, the City owned properties (16,665 acres) within the Gateway Recreation Area including GKP (1,198.9 acres). The deed excluded 47.7 acres located along the northeast section of the GKP. This parcel was retained by the City and remains today owned by City.

In the mid-1970s, the Oakwood Beach WPCP initiated an upgrade of its facilities to increase its treatment capacity from 15 MGD to 40 MGD. As part of the upgrade, the sewage sludge drying beds were removed from service, the treatment plant was enlarged, a new Lower New York Bay outfall was installed, and a 8-foot diameter "West Branch" sewer interceptor to service western Staten Island was constructed beneath the GKP from Fairlawn Avenue to the Oakwood Beach WPCP.

1.4 PREVIOUS ENVIRONMENTAL INVESTIGATIONS

This section presents information regarding previous environmental investigations conducted at the Site. NPS initiated response actions under CERCLA after receiving notification in 2005 regarding elevated radiation levels detected during a flyover survey performed as part of a baseline radiological mapping effort conducted by the Counter Terrorism Bureau of the New York City Police Department (NYPD) and United States Department of Energy (USDOE) (U.S. Government Accountability Office [GAO]), 2006; Tidewater, 2015). Prior to 2005, Sidney M. Johnson and Associates (Johnson, 1985), on behalf of NPS conducted a structural engineering analysis of the bathhouse, sewer, and impacts due to erosion and issued its report in 1985. As part of this analysis, Johnson also conducted a field investigation to determine: 1) the limits of the waste fill; 2) the nature of the fill; and 3) the nature of leachate. The results of the 1985 field investigation are presented below followed by a summary of the environmental investigations that commenced in 2005 and thereafter. These investigations did not solely focus on OU1 and addressed Site areas as described below.

1.4.1 Sidney M. Johnson and Associates 1985 Field Investigation

As part of the field investigation, Johnson conducted a magnetometer survey and excavated a total of 41 test pits in Crooke's Point, the Public Beach, and the former landfill area. The magnetometer survey found an area with ferrous metal west of NPS Education Field Station. Johnson identified the waste fill only in the northwest quadrant of GKP, ranging in thickness from 8 feet to more than 15 feet thick. Johnson noted gray or red brown sand overlying the "black garbage fill", and in some areas red brown inorganic clay at 6-inches to 12-inches thick overlying "brown garbage fill." Johnson attributed the clay layer to the soil amendment efforts performed by the City of New York (City). The "brown garbage fill"

overlies the "black garbage fill" at all areas of the landfill except at the perimeter where sand is present. The presence of sand at the perimeter of the waste fill is consistent with the City's efforts to "armor" and surround the waste fill with hydraulic fill (sand). Johnson stated, "Overall the bulk of the fill has the appearance of highly decomposed or incinerated material." Johnson found no drums, barrels, or evidence of toxic materials. Johnson noted a black semi-cemented soil underlies the waste fill and is composed of pre-existing material mixed with the waste fill and incinerator residue.

Johnson also collected four groundwater samples for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), and metals analyses; and only detected low concentrations of toluene (maximum concentration 20.3 micrograms per liter [µg/l]) and tetrachloroethylene (9.1 µg/l). The tap water Regional Screening Level (RSL) for toluene is 1,100 µg/l and the Maximum Contaminant Level (MCL) is also 1,100 µg/l). The tap water RSL for tetrachloroethylene is 11 µg/l and the MCL is 5.0 µg/l. All other analytes were either not detected or below their respective residential USEPA RSLs. Both toluene and tetrachloroethylene were detected in the equipment blank suggesting the sampling equipment may not have been properly decontaminated between sampling locations. With respect to the fill, Johnson collected three waste fill samples from depths of 6 feet to 8 feet and analyzed them for VOCs, SVOCs, pesticides, PCBs, and metals. The analytical results indicated VOCs, SVOCs, pesticides, and PCBs were not detected. Of the detected metals and inorganic elements, only antimony (35.2 milligrams per kilogram [mg/kg] to 82 mg/kg), arsenic (6.34 mg/kg to 7.83 mg/kg), and cyanide (4.28 mg/kg to 24.8 mg/kg) were detected above their respective residential RSLs of 31 mg/kg, 0.68 mg/kg, and 23.0 mg/kg.

1.4.2 Environmental Investigations and CERCLA Response Actions Conducted From 2005-2015

Between 2005 and 2015, NPS and its contractors implemented a series of response actions under CERCLA to investigate the nature of the radiological contamination at the Site and to mitigate risk to human health and the environment. A chronological listing of previous investigations and activities is summarized below:

- On August 2, 2005, NYPD notified USEPA Region 2 that elevated gamma radiation levels were identified at the Site during a flyover survey of the area. NYPD reported that the highest radiation reading was 1.5 milliroentgens per hour (mR/hr) located near a parking lot for the model airplane field. (Michael Baker, 2007, Appendix D: USEPA Region 2 Bullet-Great Kills Park Radiation Response Investigation).
- On August 3, 2005, USEPA conducted a ground radiological survey/assessment confirming that the "fire break" area had above-background, but relatively low-level, radiation readings. This survey also identified the source of the readings as radium-226. NPS further restricted access to the area by erecting a fence and allowing the area to re-vegetate (Michael Baker, 2007; Tidewater, 2015).
- In November 2006, NPS initiated a CERCLA response action and contracted Michael Baker Jr., to prepare a Preliminary Assessment (PA) for potential radiological contamination at the Site (Tidewater, 2015).
- On March 6, 2007, while the PA was in progress, a brush fire occurred at the Site (Michael Baker, 2007). Following the fire, NPS surveyed the burned area on March 15, 2007 and detected elevated radiation readings (Michael Baker, 2007: Tidewater, 2015). NYPD was notified and responded with USDOE Radiological Assistance Program (RAP) team. The highest gamma

reading obtained by the RAP team was 0.2 mR/hr (Michael Baker, 2007). On March 21, 2007, the City of New York Department of Health and Mental Hygiene (DOHMH) conducted a survey and identified "a hot spot just off the road leading to the model airplane field. Readings at contact at the grass were 10 mR/hr and 0.5 mR/hr at 1 meter over the spot. Natural background readings for the area are 0.01 mR/hr." (March 22, 2007, Letter from Gene Miskin, Director, Office of Radiological Health DOHMH to Dave Avrin, NPS. Included as Appendix E in Michael Baker, 2007).

- On March 30 and April 3, 2007, DOHMH conducted a limited radiological gamma survey of the public access areas including ball fields 1 through 5 and associated parking lot, as well as the model airplane field and parking lot, fishing area (Harbor Beach) and access road, hiking trail, Sewerline Road, Fire Road and the main park access road (Buffalo Street). The survey confirmed the location of the three previously identified areas and identified two additional areas: south of Ball Field 1 and east of the model airplane field parking lot. DOHMH concluded that while the detected radiation levels were many times above background, the levels were reduced to background three feet from the source. DOHMH recommended that a radiological contaminant assessment be conducted at the Site (Michael Baker, 2007). As a result of DOHMH findings, NPS installed additional fencing to isolate the identified areas (Tidewater, 2015).
- On May 25, 2007, the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) completed a Health Consultation and its evaluation of potential hazards to public health posed by the radiological contamination at GKP. USEPA requested ATSDR develop a public health statement based on existing data. ATSDR concluded that the areas posed an "Indeterminate Public Health Hazard." ATSDR referred to its conclusions regarding past radiation exposures (for the areas of concern) as indeterminate because the conclusions were based on limited data and analyses. ATSDR also reported that past exposures were not expected to be a health hazard because the radioactivity readings "dropped" significantly three feet away from the peak readings, it was unlikely that anyone would remain on any of the identified hot spots for an extended period of time (i.e., three hours or more), and the elevated readings were limited to five distinct areas (ATSDR, 2007 and Tidewater, 2015).
- In August 2007, Michael Baker, Jr. Inc., on behalf of NPS, completed and issued its PA report. The PA concluded the radiological contamination at the Site appeared to be concentrated in five locations and is comprised of radium-226 and its decay products. It further concluded that the radiological contaminants identified were not likely to pose an immediate health risk to park users because NPS closed public access to the five suspect areas with fencing. The PA recommended the identified contaminated radiological material be removed and disposed of, with follow-up confirmatory screening, and any future detections of radiological contamination be handled in a similar fashion (Michael Baker, 2007; Tidewater, 2015).
- In January 2009, Cabrera Services on behalf of NPS conducted an Interim Response Action (IRA) consisting of additional radiological surveys and removal of radiological materials. The IRA identified a total of fourteen hot spots. Seven of these hot spots were in the five areas previously identified and discussed above. The other seven areas were locations that had not been previously identified. Of the 14 areas, seven hot spots were prioritized for removal based on public accessibility and detected readings (e.g., highly accessible areas with the highest readings were prioritized over less accessible areas and/or those with lower readings). During excavation,

two radium sources were recovered. As part of the IRA, a total of four drums of material were removed from the Site and disposed of at permitted and licensed facilities. One drum containing the two radium sources was disposed of at the U.S. Ecology facility (State of Washington Radioactive Materials License WN-I01902) in Richland, Washington. The three drums containing investigation-derived waste (IDW) were disposed at the Energy Solutions facility (State of Utah Radioactive Material License UT 2300249) in Clive, Utah. Cabrera Services completed the IRA and issued its report in November 2010 (Cabrera Services, 2010; and Tidewater, 2015). As a result of the discovery of the additional hot spots and the subsequent removal of two radium sources, around 2010 NPS put up barricades and signs to close off access to Wetland Road, the ball fields and Model Airplane field and stopped issuing permits for these activities.

- On October 14, 2010, NPS issued an Approval Memorandum to conduct an Engineering Evaluation and Cost Analysis (EE/CA) at the Site to evaluate non-time critical removal action alternatives (Tidewater, 2015).
- On February 2, 2012, NPS conducted fire protection activities, including cutting back vegetation in the area south of Wetland Road and east of Buffalo Street. The area was subsequently checked for radiation and three distinct hot spots were identified. Testing of the area by USACE confirmed the elevated readings and located a fourth elevated reading within the same area. The source of the radioactivity was identified as radium-226 (Tidewater, 2015).
- During June through August 2012, USACE at the request of NPS conducted a gamma walk-over survey (GWS) and dose rate survey of four additional areas including: 1) the multi-use path along Buffalo Street; 2) the trails around the Education Field Station; 3) Bulkhead Road; and 4) the Bulkhead Road fishing area. The results of GWS and a dose rate survey were consistent with typical natural background gamma radiation levels and confirmed the absence of radiation hazards in the near surface soil. (USACE, 2012).
- On July 31, 2012, NPS Northeast Regional Director signed an Action Memorandum approving the decision to conduct a TCRA at the Site. The EE/CA, initiated per NPS on October 14, 2010 Approval Memorandum, was put on hold to expedite the TCRA and the identification and removal of radioactive contamination which posed an immediate risk to human health and the environment (Tidewater, 2015).
- In June 2015, Tidewater, Inc. on behalf of NPS issued the Final Great Kills Park TCRA Completion Report. Activities conducted as part of the TCRA involved clearing of brush, trees, and phragmites; installing security fencing along the perimeter of the waste fill area to prevent access; conducting drive-over and walk-over gamma surveys; installing 51 borings to delineate waste fill area; conducting a radiation dose assessment for firefighters, park rangers/law enforcement officers, maintenance workers, nearby residents, and trespassers; and the excavation and removal of 37 source areas including five areas that exceeded the dose measurement of 2 mR/hr. As a result of the TCRA, 25 drums of waste were generated, transported, and disposed of at permitted and licensed facilities. 24 of the 25 drums were disposed of at the U.S. Ecology facility in Grand View, Idaho and one drum was disposed of at the Energy Solutions facility in Clive, Utah (Tidewater, 2015)

1.5 REPORT ORGANIZATION

OU1 was established to support expedited investigations in areas of the Site coinciding with potential construction areas for the SSSI CSRM. The NPS CST's approach under CERCLA is to combine the results of investigation activities completed within OU1 with future sampling results from the remainder of the Site to provide a comprehensive dataset that will be used to complete a single baseline risk assessment to be presented in a Site-wide RI Report. As a result, this EIR follows the general outline of an RI in accordance with U.S. EPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (U.S. EPA, 1988), but does not include human health or ecological risk assessments. The EIR includes the following sections: 1. Introduction; 2. Study Area Investigation; 3. Physical Characteristics of the Study Area; 4. Nature and Extent of Contamination; 5. Contaminant Fate and Transport; 6. Baseline Risk Assessment (note: this section documents the NPS CST's decision to evaluate risk for the entire Site in a future Site-wide RI Report); 7. Summary and Conclusions; and 8. References. The Appendices to the EIR include:

- Appendix A: Technical Memoranda Documenting Field Activities;
- Appendix B: Boring Logs;
- Appendix C: Gamma Scanning of Open Boreholes and Soil Cores;
- Appendix D: Groundwater Well Development Logs;
- Appendix E: Groundwater Purge and Sampling Logs;
- Appendix F: Sediment and Surface Water Sampling Logs;
- Appendix G: Chains of Custody;
- Appendix H: Slug Testing Results;
- Appendix I: Tidal Study Results;
- Appendix J: USACE Field Laboratory Data Summary and Analytical Reports;
- Appendix K: Test America Analytical Reports;
- Appendix L: ARS Analytical Reports;
- Appendix M: Data Validation Reports;
- Appendix N: Analytical Summary Tables for Field Quality Assurance/Quality Control Samples;
- Appendix O: Analytical Summary Tables for Background Samples; and
- Appendix P: Analytical Summary Tables for OU1 Samples.

2. STUDY AREA INVESTIGATION

The following section presents a summary of the study area investigation completed in 2016 during investigation activities for OU1.

2.1 FIELD INVESTIGATION ACTIVITIES ASSOCIATED WITH SITE CHARACTERIZATION

Investigation activities within OU1 were conducted in two mobilizations, the first being completed from April to June of 2016, followed by a second phase, completed in September and October of 2016. A multi-step field investigation approach was used so that sampling activities performed during the second phase could be refined based on the results from the first phase. In addition to performing investigations of OU1, environmental media also was sampled at designated Site-specific background locations as part of the second phase of fieldwork. The following section provides a summary of the field investigations completed as part of site characterization activities for OU1.

2.1.1 Contaminant Source Investigations

Historical operations at GKP, including waste disposal and sewage sludge management, may have resulted in sources and contaminant releases within OU1. Previous investigations and Site historical research identified the following primary contaminant sources within OU1: (1) waste fill derived from New York City Department of Sanitation's historical waste disposal operations at the Site (e.g., refuse, incinerator residue, and coal ash), (2) radiological artifacts incidentally contained in waste fill, and (3) sewage sludge that was dried in the sludge impoundment area and then used as a soil amendment (artificial topsoil) after the completion of waste disposal operations in OU1. The following section summarizes activities conducted to support the investigation of contaminant sources within OU1.

2.1.1.1 Waste Fill

The Historical Site Assessment/Records Search Summary Report (HSA/RS) (NPS, 2017) establishes waste fill as a source of contamination at the Site. The waste fill is known to consist primarily of refuse, incinerator residue, and coal ash. The primary, and most successful, method implemented during the field effort to identify the extent of waste fill involved visual observation of soil sampled from OU1. Geophysical surveys were also performed over portions of OU1 to augment information gained from visual observation of soil samples.

Surface and subsurface soil samples were collected at 50 locations using a direct push technology (DPT) drill rig to support the delineation of waste fill within OU1; these activities also supported collection and analysis of discrete samples for soil/vadose zone investigations discussed in Section 2.1.4. At each location, continuous cores of soil were collected from the ground surface to a sufficient depth to identify the top and bottom of the waste layer (generally between 10 and 15 ft below ground surface [bgs]). The soil cores were inspected by a project geologist and lithological features of the cores were documented on soil boring logs. During inspections of the soil cores, waste fill was identified by observing pieces of debris that were less susceptible to decomposition, such as glass, masonry, ceramics, rubber, and metal, in the core. **Figure 2-1** presents a map of OU1 detailing the locations of all 50 DPT soil borings. The results of geologic logging of the soil cores are included in the boring logs presented in Appendix B.

Information gained from visual observation of the soil cores from the 50 DPT borings was compiled and combined with information from previous investigations, including the TCRA, to prioritize areas of OU1

for additional investigation to refine the delineation of waste fill. A combination of test pits and additional soil boings were focused along the suspected outer perimeter of the waste fill area to further delineate the extent and to observe the composition of the waste. In total, eight additional soil borings and 31 test pits were completed. **Figures 2-2 and 2-3** present maps of OU1 that show the locations of all DPT borings and test pits conducted to delineate the extent of waste fill within OU1.

In addition to the visual observation efforts, geophysical surveys were performed around the anticipated perimeter of the waste fill area using electromagnetic (EM) and magnetic (MAG) survey instruments to detect surface and subsurface metallic and magnetic objects that may be present within the OU1 waste fill. **Figures 2-4 through 2-7** present the areas of OU1 over which geophysical investigations were performed.

2.1.1.2 Radiological Artifacts

Based on historical investigation activities, including the 2015 TCRA, radiological artifacts are present in OU1 due to their association with waste fill. Radiological artifacts are incidental items in waste fill that contain radium, such as medical devices (brachytherapy), radioluminescent markers and dials, commercial products, and industrial applications (radiography). The investigation of radiological artifacts within OU1 involved radiological scans of each open borehole, surface surveys within accessible areas of OU1; identification of radiological anomalies observed in the survey data; and collection of dose rate measurements at 99 anomalies selected for further evaluation.

Each of the 50 DPT soil boring locations were surveyed for gamma radiation by collecting gamma count rates at 1 foot intervals in each open borehole to determine whether radiological artifacts were present in subsurface soil near or immediately adjacent to the borehole. The location of each DPT soil boring surveyed for gamma radiation is presented in **Figure 2-1**. Radiological survey data from the open boreholes were recorded on the soil boring logs provided in Appendix B.

A majority of the waste filled areas at the Site were previously surveyed in support of the 2015 TCRA, but additional radiological surveys were required to investigate potential surface and near surface radiological anomalies in areas of OU1 that were outside the TCRA footprint or to fill gaps within the TCRA footprint. The radiological surveys were performed using a gamma walkover survey (GWS) methodology to investigate all reasonably accessible areas not previously surveyed. The results were combined with existing survey data from the 2015 TCRA (see **Figure 2-8**) to identify artifacts through the investigation of anomalous readings within OU1.

The combined radiological survey dataset was evaluated and 99 locations exhibiting anomalous readings were identified for further evaluation through the collection of dose rate measurements to determine gamma exposure rates and confirm the potential presence of radiological artifacts. Dose rate measurements were collected at each location by placing the detector at the ground surface at the location of the source of the radiological anomaly (i.e., referred to as the dose rate on contact). General area dose rates were also collected at waist height, approximately 1 meter above the contact location. **Figure 2-9** provides a map of OU1 detailing the location of the 99 radiological anomalies that were selected for further investigation. During the collection of dose rate measurements, some radiological anomalies were observed in close proximity to each other and in some cases, large areas were observed to exhibit continuous, elevated radiation levels. These four areas were further investigated by performing refined gamma walkover surveys (i.e., multi-directional survey transects conducted at a slower pace) to bound the area exhibiting elevated radiation levels. After each area was surveyed, the results were evaluated to inform biased radiological investigations of these four areas (see **Figure 2-9**) to understand the suspected

source and concentration of radionuclides. The results of the four biased radiological investigations are discussed in Section 2.1.4.

2.1.1.3 Sewage Sludge

The HSA/RS establishes that sewage sludge (i.e., a potential source of chemical and radiological contamination) was mixed with clay and the resulting mixture was used as a soil amendment at the ground surface throughout areas of OU1 containing waste fill to support revegetation. Sewage sludge also is present in the former sludge drying beds located in the southeast portion of OU1 adjacent to Oakwood Beach WPCP. The extent of the soil amendment containing sewage sludge was investigated by logging lithological features of the 50 DPT soil borings depicted on **Figure 2-1** to define the vertical extent of cover material overlying the waste fill. Historical records indicate that the soil amendment containing sewage sludge was placed over waste fill to serve as artificial topsoil and support revegetation. Therefore, for the purposes of estimating the extent of the soil amendment containing sewage, all material overlying waste fill is assumed to contain sewage sludge. The results of geologic logging of the soil cores are included in the boring logs presented in Appendix B.

2.1.2 Surface Water and Sediment Investigations

Four co-located surface water and sediment samples were collected from the Oakwood Beach Creek running along the northeast edge of OU1 (see **Figure 2-1**) to assess the potential presence of Site-related contamination. Two co-located surface water and sediment samples were collected from the Oakwood Beach Creek upstream of OU1 to provide Site-specific background data (see **Figure 2-10**). All OU1 and background surface water and sediment samples were analyzed for VOCs, SVOCs, PCBs, metals (including mercury), herbicides, pesticides, dioxins/furans, and radionuclides as specified in **Tables 2-1 and 2-2**, respectively. Surface water and sediment sampling logs are provided in Appendix F.

2.1.3 Geologic Investigations

The geologic investigation within OU1 involved the collection and logging of soil cores from 50 DPT soil boring locations and 13 monitoring wells throughout OU1 to better understand the geologic characteristics beneath the surface of OU1. Each core was logged using the Unified Soil Classification System (USCS) to define lithologic characteristics observed within the core. In addition, each of the cores from the 50 DPT soil boring locations and the seven monitoring well locations (i.e., 13 monitoring wells were installed at seven locations) was evaluated for the presence of waste fill by observing pieces of debris that were less susceptible to decomposition, such as glass, masonry, ceramics, rubber, and metal. Each core was also field screened for VOCs and methane. **Figure 2-1** presents the locations of the 50 DPT soil borings and 13 monitoring wells. Also, the results of geologic logging and field screening are included in the boring logs presented in Appendix B.

2.1.4 Soil and Vadose Zone Investigations

The investigation of soil and the vadose zone within OU1 involved collection of both surface and subsurface soil samples at each of the 50 DPT sampling locations depicted on **Figure 2-1** to characterize the nature of contamination in surface and subsurface soil. The surface soil sample was collected from 0 to 6 inches and subsurface soil samples were collected from the depth interval just above the saturated zone or from native soil encountered below waste fill if still within the vadose zone. Subsurface soil samples for radiological analysis were collected from the depth interval corresponding to the highest gamma measurement observed along the soil core, which was determined by performing gamma scans at 1 ft intervals along each soil core. A total of 50 surface and 54 subsurface soil samples were collected

from the sampling locations depicted on **Figure 2-1**. In addition to the OU1 sampling activities described above, surface and subsurface soil samples also were collected from 15 background locations within the Willowbrook ROW, which is adjacent to OU1 across Hylan Boulevard (see **Figure 2-10**). Soil samples collected from OU1 and the background area were analyzed for VOCs, SVOCs, PCBs, metals (including mercury), herbicides, pesticides, dioxins/furans, and radionuclides as specified in **Table 2-1 and 2-2**, respectively. **Tables 2-3 and 2-4** provide location information for all soil and vadose sampling locations conducted within OU1 and the background area, respectively, during fieldwork.

The soil investigation results from the first phase of fieldwork (i.e., the 50 DPT sampling locations shown on **Figure 2-1**) indicated the presence of a PCB hotspot at DPT-016, where Aroclor 1254 was detected in surface soil at 220 mg/kg. In response, confirmation and step-out sampling of surface soil was conducted during the second phase of field work at DPT-016 to further investigate the presence of PCBs in this area of the Site (see **Figure 2-1**). Confirmation and step-out samples were sent off-Site for expedited, seven-day turnaround so that additional biased sampling could be directed, if warranted. The results for step-out sampling confirmed that PCBs were present in this area, but at concentrations that were 2 to 3 orders of magnitude below the initial Aroclor-1254 result of 220 mg/kg in surface soil at DPT-016. To further support this finding, an additional confirmation sample was collected in surface soil at DPT-016, which further corroborated that PCBs were present, but at much lower concentrations than initially detected. These results are more fully described in Section 4.2.

Biased radiological investigations also were performed to understand the suspected source and concentration of radionuclides within four areas identified during the collection of dose rate measurements discussed in Section 2.1.1.2. At each biased radiological investigation area, surface and subsurface soil samples were collected using grab sampling techniques and analysis was performed by an on-Site gamma spectroscopy laboratory (operated by USACE) for semi-quantitative screening purposes. All samples were analyzed on-Site for radium-226, thorium-232, and uranium-238 via their progeny. Based on the screening results from the on-Site laboratory, twenty-four samples were selected and sent to an accredited laboratory for gamma spectroscopy analysis to provide definitive results for characterizing the concentrations of radionuclides within each biased radiological investigation area. **Figure 2-9** provides a map of OU1 detailing the grids in which the four biased radiological investigation areas were located. Appendix J provides a summary of the analytical results and reports from the on-Site field laboratory.

2.1.5 Groundwater Investigations

The investigation of groundwater within OU1 was performed by collecting groundwater samples from temporary and permanent monitoring wells to assess the nature and extent contaminants in groundwater and by conducting a tidal study and slug tests to characterize the hydrogeologic characteristics of the Site.

Temporary wells were installed at 25 of the 50 DPT soil boring locations identified in **Figure 2-1** to characterize the nature of potential groundwater contamination within OU1. Each temporary well was constructed with a 5 ft slotted screen installed with the top of the screen one foot above the groundwater surface so that floating free product could be detected if it were present. **Table 2-5** provides location details for temporary wells installed during fieldwork. Groundwater samples were collected from each temporary well and analyzed for VOCs, SVOCs, PCBs, metals (including mercury), herbicides, pesticides, dioxins/furans, and radionuclides, as specified in **Table 2-1**. Groundwater sampling logs for each temporary well are provided in Appendix E.

Thirteen permanent monitoring wells were installed at multiple depths at the seven locations depicted in **Figure 2-1** to characterize the shallow aquifer beneath OU1, above the Raritan clay formation. During drilling activities, the Raritan clay was encountered at approximately 50 ft bgs, which rendered the deepest monitoring well interval specified in the Final OU1 RI SAP (i.e., 60 to 70 ft bgs) to be unnecessary. Altogether, five water table monitoring wells (screened 5 to 15 ft bgs), six shallow monitoring wells (screened 20 to 30 ft bgs) and two intermediate monitoring wells (screened 40 to 50 ft bgs) were installed within OU1 (see **Figure 2-1**). In addition, four background groundwater monitoring wells, all screened from 20-30 ft bgs, were installed upgradient and outside of OU1, immediately adjacent to Hylan Boulevard (see **Figure 2-10**). Table 2-4 provides location information and construction details for OU1 and background monitoring wells. Groundwater samples were collected from OU1 and background monitoring wells and were analyzed for VOCs, SVOCs, PCBs, metals (including mercury), herbicides, pesticides, dioxins/furans, and radionuclides, as specified in **Tables 2-1 and 2-2**, respectively. Well development and purge logs are provided in Appendix D and E, respectively.

Slug tests were conducted on five OU1 groundwater monitoring wells, including three wells screened from 20 to 30 ft bgs and two wells screened from 40 to 50 ft bgs. All five wells that were subject to slug testing were screened in the Upper Pleistocene outwash deposit. Dedicated data loggers were used to conduct slug tests at each well. The slug tests consisted of three falling and three rising head slug tests at each well location. Appendix H provides a summary of slug test results. A tidal study of OU1 was also conducted by logging time-series water level data from five groundwater monitoring wells (i.e., the same five wells at which slug tests were performed) within the OU1 for a one month period. During the tidal study, dedicated data loggers recorded pressure/water level changes for a one month period. The tidal study results are provided in Appendix I.

2.2 TECHNICAL MEMORANDA DOCUMENTING FIELD ACTIVITIES

During fieldwork within OU1, technical memoranda were developed to document and refine field approaches for conducting: (1) test pitting, (2) dose rate measurements, and (3) anomaly area investigations. These technical memoranda are provided in Appendix A.

3. PHYSICAL CHARACTERISTICS OF THE STUDY AREA

3.1 SURFACE FEATURES

The current ground surface topography within OU1 reflects historical filling and grading activities and ranges from sea-level to less than 15 feet above mean sea-level at the intersection between Buffalo Street and Hylan Boulevard. **Figure 3-1** presents a topographic map of the Site, including OU1. As shown in **Figure 3-1**, OU1 slopes to the southeast and grades consistent with the Buffalo Street Drainage Channel and the Oakwood Beach Creek. Seven former sludge drying beds are located to the south of the Oakwood Beach WPCP. The sludge drying beds occupy approximately 13 acres, with each basin being approximately 2 acres in size. Wetland Road traverses OU1 and is underlain by the West Branch Interceptor which connects to the Oakwood Beach WPCP. There are no permanent structures within OU1, but debris piles were observed, which may be related to unauthorized dumping within accessible areas. Throughout OU1, the ground surface is characterized by dense vegetation with mature trees and shrubs predominant in the northwestern portion of OU1 (near Hylan Boulevard). In lower lying areas to the southeast, the ground surface remains heavily vegetated, but is dominated by phragmites.

3.2 METEOROLOGY

Information regarding the climate in the vicinity of GKP was obtained from the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service. The nearest weather station is located at the Newark Liberty International Airport. **Table 3-1** summarizes the mean monthly meteorological data including average temperatures, precipitation, and snowfall. These data were obtained for the years 1996 through 2015. The total average annual rainfall exceeds 40 inches per year.

3.3 SURFACE WATER HYDROLOGY

The streams, ponds, and groundwater of Staten Island primarily derive their flow from precipitation and in dry periods flowing streams are maintained by groundwater discharge (Soren, 1988). Two surface water bodies are present within OU1, the Buffalo Street (Northwest to Southeast) Drainage Channel and the Oakwood Beach Creek. The Buffalo Street Drainage Channel originates along the Willowbook Parkway right-of-way (ROW) and flows south (beneath Hylan Boulevard via buried culvert) into GKP and OU1. The Oakwood Beach Creek drains from a channel that originates at Hylan Boulevard (northeast of the Site) and enters OU1 from the northeast, where it turns south to connect with the Buffalo Street Drainage Channel and then discharge to the Lower New York Bay. The two drainages and OU1 are within the Oakwood Beach watershed which encompasses approximately 1,329 acres (NYCEP, 2013). Both channels are tidally influenced and classified for recreational uses that include fishing. State and Federal designated wetlands are present in OU1 (**Figures 3-2 and 3-3**) and portions of the Site are considered a high flood risk area, as designated by Federal Emergency Management Agency (FEMA) (**Figure 3-4**).

3.4 GEOLOGY

GKP is located within the Atlantic Coastal Plain Physiographic Province. Regionally, the Atlantic Coastal Plain Physiographic Province is bordered to the north and west by the Piedmont Physiographic Province and on the south and east by the Atlantic Ocean. The northern Atlantic Coastal Plain is underlain by a wedge of unconsolidated sediments that generally thicken and dip to the east. The sedimentary rocks lie unconformably (erosional contact) on top of metamorphic, igneous, and consolidated sedimentary rocks. The metamorphic, igneous, and consolidated sedimentary rocks outcrop to the west (up-dip) and underlie

the Piedmont Physiographic Province. The Coastal Plain sedimentary formations range in age from Jurassic (135 to 195 million years ago) to Holocene (10,000 years ago to the present). The surficial geology of OU1 consists of artificial fill, primarily comprised of hydraulic fill and waste fill, with the waste fill being covered by a soil amendment containing sewage sludge. The artificial fill was placed over the Holocene deposit comprised of dark gray silty clay to clayey silt with sand lenses, overlying glacial outwash deposit. The surficial geologic units are underlain by the Raritan Formation and bedrock. **Table 3-2** summarizes the geologic units present within OU1 along with boring data from the fieldwork described in Section 2.0. **Figures 2-2 and 2-3** provide a Site map of OU1 detailing the locations of four geologic cross-sections developed based on the geologic investigations completed during fieldwork; **Figures 3-5 through 3-8** present geologic cross sections A-A' through D-D', respectively.

The hydraulic fill consists of sediment (red to dark gray graded sand) dredged from Great Kills Harbor (anchorage area) and navigation channels (New York City Department of Parks, 1943 a, b, c). In OU1, the hydraulic fill was installed in a "curvilinear" narrow band beneath what is today the GKP utility corridor and Buffalo Street toward Hylan Boulevard (New York City Department of Parks, 1947 a, b, c) to provide firm foundations for roadways and other improvement (New York City Department of Parks, 1947d). The hydraulic fill is present beneath and adjacent to Buffalo Street and extends to the north east to the Buffalo Street Drainage Channel (**Figure 3-9**) and ranges in thickness from 3 to 8.5 feet with an average thickness of 5.6 feet.

A soil amendment containing sewage sludge (i.e., a clay and sewage sludge mixture) was placed at the ground surface over waste fill to facilitate vegetative growth. Within OU1, the soil amendment consists of red-brown clayey to silty sand and ranges in thickness from 0.5 feet to 7 feet thick, with an average thickness of 1.7 feet. **Figure 2-2** provides a map of OU1 that details the estimated depth to the top of the waste fill throughout the investigation area. The waste fill consists of brown to black waste fill (highly decomposed) comprised of incinerator residue (cinder-like material), coal ash, and refuse containing organic material with scattered glass, metal, rubber, and wood debris (Johnson, 1985). Radiological artifacts and elevated levels of radioactivity (primarily radium-226) have been identified and associated with the waste fill. As shown in **Figures 2-2 and 2-3**, waste fill was placed within OU1, north-northeast of Buffalo Street, extending approximately to the City property boundary (or what was known at the time as Emmet Avenue) (see **Figure 1-9**). The southern extent of the waste fill generally corresponds to the eastern boundary of the sludge drying beds and the undisturbed wetland area. The waste fill in OU1 ranges in thickness from 0.5 feet thick to 11 feet thick with an average thickness of 4.5 feet thick and generally occurs at depths ranging from 0 to 7 feet bgs with an average depth of 1.4 bgs. The waste fill is thickest adjacent to the Buffalo Street Drainage Channel and thins to the north and east toward the Legislative Boundary and Oakwood Beach Creek. Geologic cross sections A-A' through D-D' (see **Figures 3-5 through 3-8**) provide details regarding the vertical distribution of waste fill throughout OU1.

Hydraulic fill and waste fill were placed directly on top of the Holocene marsh and creek deposits, which consist of dark gray silty clay to clayey silt with organic zones (peat) and sand lenses. The Holocene deposit underlying OU1 ranges in thickness from 0 to 10 feet thick with an average thickness of 4 feet. The depth to the Holocene deposit ranges from 0 feet to 10.5 feet bgs and averages 5.4 feet bgs. Underlying the Holocene deposit is the Pleistocene glacial outwash deposit, which consists of dark red to brown stratified fine to coarse sand and gravel deposited by glacial melt water. The glacial outwash deposit underlies most of OU1 at depths ranging from 3 to 14 feet bgs with an average depth of 8.7 feet bgs. The upper Raritan Formation underlies the Pleistocene glacial outwash deposit within OU1 and consists of a varicolored interbedded brown to tan to light gray to white medium to fine sand (with a trace

of silt) and clayey silt (with mica). The depth of the glacial outwash and Raritan Formation contact was encountered at 52 feet bgs in OU1-3-MW-7-I. Beneath the Raritan Formation is the Staten Island Serpentine which occurs at an approximate depth of 250 to 270 feet bgs, followed by the Manhattan Schist which occurs at a depth of 260 to 370 feet bgs (Perlmutter, 1953, Soren, 1988, and Rosenberg, 2013).

3.5 HYDROGEOLOGY

Based on surface topography of the Site and the associated drainage channels located in OU1, groundwater flows from the northern corner of the Site to the southeast towards the coastline (USGS, 2013). During waste disposal operations at GKP, several areas were routinely saturated due to springs (New York City Department of Parks, 1949), which suggests the presence of an upward gradient. Based on soil borings conducted in OU1, the first occurrence of saturated soil ranged from 3 to 10 feet bgs with an average depth of 6.5 feet bgs. The Holocene deposit beneath OU1 is laterally continuous and has, with its clay-silt lithology, a lower hydraulic conductivity then the overlying waste fill and underlying glacial outwash. The average depth of the glacial outwash deposit occurred at 8 feet bgs.

Slug testing determined that the average hydraulic conductivity in Site monitoring wells was 753 ft/day, which is high, but consistent with literature estimates for the Upper Pleistocene formation. During field activities within OU1, several wells exhibited nearly instantaneous equilibration to the static water level during slug testing. The OU1 tidal study results indicate that the three monitoring wells closest to the coast (i.e., MW003S, MW005I, and MW007I) exhibit discernable trends that mimic the tidal fluctuations observed at the Bergen Point West Reach, New York tide station. The tidal study results indicated that groundwater fluctuations were most pronounced in MW007I, in which water levels were observed to fluctuate approximately 1 ft over a 24-hour period. Groundwater fluctuations were comparable in MW001S, MW002S, and MW005I, in which the average water level fluctuations over a 24-hour period were 0.56, 0.6, and 0.5 ft, respectively. Water level fluctuations were observed to be 0.27 ft over a 24-hour period in MW-3S. Comparisons of groundwater fluctuations to tidal data from the Bergen Point tide station indicated that fluctuation trends in MW003S, MW005I, and MW007I closely aligned with the tides, whereas the results from MW001S and MW002S were less comparable to the tidal changes observed at the Bergen Point tide station. Overall, the results of the tidal study indicate that a majority of OU1 is tidally-influenced, but that hydraulic connectivity to tidal fluctuation diminishes further inland and may dissipate altogether within the portions of OU1 closest to Hylan Boulevard.

3.6 DEMOGRAPHY AND LAND USE

OU1 is included in the portion of GKP that was closed to the public through the installation of security measures that include fencing and signage. As a result, the primary receptors based on current land use within OU1 include NPS and/or New York City workers requiring intermittent access to the Site, as well unauthorized trespassers. OU1 is bordered to the northeast by 24 residential properties on Chesterton Avenue and two residential properties on Grayson Street. OU1 also is situated directly adjacent to the Oakwood Beach wetland and the Oakwood Beach WPCP. While OU1 remains closed, it is bordered to the southwest by portions of GKP that are open and used on a daily basis by parks guests for recreational purposes that include walking, running, and biking.

Exposure to Site contaminants is controlled by the closure of OU1, which is intended to prevent members of the public from occupying areas that may pose a risk. Exposure to OU1 groundwater through consumption is not anticipated because groundwater on Staten Island is not used as a potable water supply. All potable water is sourced from the municipal system supplied by reservoirs located in

Westchester County, Putnam County, and Ulster County New York. Staten Island groundwater is used for other activities including irrigation, swimming pools, and automobile cleaning (e.g., carwash). The New York State Department of Environmental Conservation (NYSDEC) water withdrawal data indicate that there are four water withdrawal systems with capacities greater than or equal to 100,000 gallons per day located on Staten Island, including 1) Silver Lake Golf Course located 4.8 miles north of GKP, 2) Richmond County Country Club located 2.4 miles north of GKP, 3) Arthur Kill Generating Station located 4.2 miles northwest of GKP, and 4) South Shore Country Club located 4 miles west of GKP. These systems are all located several miles from GKP and in separate groundwater basins. Based on DOHMH water withdrawal data, 13 water withdrawal systems were identified within the ZIP codes surrounding OU1, which are presented on **Figure 3-10**. Twelve of the 13 water withdrawal systems are for residential use (e.g., lawn irrigation and pools), with the nearest being located over 2,000 feet to the northeast of OU1. OU1 is located immediately adjacent to the Lower New York Bay and Site groundwater flows in a southeasterly direction towards the coastline and is not expected to impact water withdrawal systems in the vicinity of OU1.

3.7 ECOLOGY

Much of the vegetation within OU1 has been altered by human activities (filling activities). Over 465 plant species have been identified within Gateway, and of these NPS estimates that 33 to 50 percent are non-native species. **Table 3-3** presents the vegetation associations and communities present at GKP along with the underlying soil and vegetative assemblages. Much of Crooke's Point is covered with invasive vines, the removal of which is a target of an NPS partnership project with volunteers and the New York City Department of Parks and Recreation. Mudflats and vegetation associated with the North Atlantic Coast estuarine intertidal mudflat occupies a portion of the coast at GKP. Within OU1, phragmites dominate the majority of the area.

The bird community in the Staten Island Unit of Gateway is most varied at GKP, including Crooke's Point. Wintering horned larks, snow buntings (*Plectrophenax nivalis*), and Lapland longspurs (*Calcarius lapponicus*) occupy shoreline habitat; and purple sandpipers (*Calidris maritima*), ruddy turnstones (*Arenaria interpres*), and gulls visit jetties at Crooke's Point and north of the tidal flats at GKP (NPS, 2014). Fall bird migrants are numerous and include red-shouldered hawk (*Buteo lineatus*), rough-legged hawk, and northern harrier; as well as numerous warblers, vireos, orioles, and flycatchers. Shorebirds, wading birds, and waterfowl including herons, ibis, and egrets occupy seasonal ponds. Bank swallow (*Riparia riparia*) nests are present southeast of the parking lot.

Species present at GKP include waterfowl, wading birds, raptors and passerine species of birds. Open areas of beach grass provide habitat for amphibians and reptiles. Historically, diamond-backed terrapins (turtles) were found at the harbor on Crooke's Point and green frogs and Fowler's toads were found in shaded areas south of Hylan Boulevard. Small mammals likely present at OU1 include bats, mice, chipmunks, shrews, squirrels, and voles. OU1 generally provides less suitable habitat than other areas of GKP, such Crooke's Point, which contains diverse wildlife habitat and remains an important habitat for migrating birds and insects, particularly the Monarch butterfly (NPS, 2014). **Table 3-4** presents the New York State-listed endangered and threatened species found within GKP, principally Crooke's Point.

4. NATURE AND EXTENT OF CONTAMINATION

The following section provides a detailed discussion of the nature and extent of contamination within OU1 based on the results of investigation activities described in Section 2.0 as well as the analytical results from sampling activities performed for surface soil, subsurface soil, groundwater, sediment, and surface water. A summary level discussion of the nature and extent of contamination for OU1 is presented in Section 7.1.1.

4.1 SOURCES

Contaminant sources within OU1 include, (1) waste fill derived from New York City Department of Sanitation's historical waste disposal operations at GKP (e.g., refuse, incinerator residue, and coal ash), (2) radiological artifacts incidentally contained in waste fill, and (3) sewage sludge that was used throughout OU1 as part of a soil amendment to facilitate revegetation and also present in the former sludge drying beds. The results of investigations conducted to characterize the nature and extent of contaminant sources are summarized in the following section.

4.1.1 Waste Fill

The results of DPT soil borings and test pitting activities have been analyzed to delineate the vertical and horizontal extent of waste fill within OU1. **Figures 2-2 and 2-3** present contours showing the lateral extent, the depth to the top, and depth to the bottom of the waste fill layer, respectively. In addition, the geologic cross-sections presented in **Figures 3-5 through 3-8** show the distribution of waste fill underlying OU1 along each transect. The investigation determined that a majority of OU1 is underlain by waste fill and that the waste fill is thickest adjacent to the Buffalo Street Drainage Channel. Waste fill gradually tapers to the northeast and terminates altogether approaching the Park's Legislative Boundary at the northeast extent of GKP. Waste fill is also present beneath the former sludge drying beds (impoundments), which suggests that these impoundments were graded and constructed over waste fill. Within OU1, waste fill terminates to the southeast near the transition from the former sludge drying beds to the natural wetland that extends to the shoreline; the four DPT borings conducted in the natural wetland did not identify waste fill. Test pitting completed within the OU1 allowed the field team to observe the transition between areas containing waste fill to areas without waste fill. These transitions are best characterized as a gradual tapering of the waste layer. Radiological and PID measurements collected during the completion of the 31 test pits were not elevated above ambient background levels.

The geophysical surveys were less useful in delineating the extent of waste fill. The results of the geophysical surveys are presented in **Figures 2-4 and 2-7**. The georeferenced EM (quadrature phase and inphase) and MAG (total field and gradient analytic signal grid) geophysical data were contoured using the same color scale with yellow to red contours corresponding to geophysical data indicative of potential waste fill. Overall, the geophysical results indicate that a majority of the survey area is underlain by waste fill, with the exception of the northwestern portion of the Site and the narrow area of property between the waste fill and the adjacent residential property.

Based on the OU1 delineation activities, approximately 32 acres of OU1 are underlain by an estimated 220,000 cubic yards of waste fill. The nature of contamination associated with waste fill is discussed in Section 4.2.

4.1.2 Radiological Artifacts

Investigation activities within OU1 confirmed that radiological artifacts are present in OU1 due to their association with waste fill at the time in which waste disposal operations occurred at GKP. Radiological survey data from down hole gamma logging was evaluated to determine whether radiological sources were present in soil adjacent to each borehole conducted in OU1. Most downhole gamma logging measurements were within two standard deviations of the mean count rate and all measurements were within three standard deviations, suggesting that radioactive sources were likely not present in soil near or immediately adjacent to the boring. The results indicate that while radiological artifacts are known to be present and potentially scattered throughout the waste fill within OU1, the probability of encountering an artifact immediately adjacent to a non-biased borehole is low, such that elevated readings were not observed in any of the 50 DPT soil borings evaluated. The downhole gamma logging results are presented in Appendix C.

Based on the combined gamma survey dataset generated for OU1 (i.e., 2015 TCRA and OU 1 RI data), the locations of 99 anomalous radiological readings were identified for further evaluation. Contact and general area dose rate measurements for each of the 99 anomalies are shown in **Figure 2-9**. Contact and general area dose rate results are reported in µrem/hr and static gamma measurements are reported in counts per minute (cpm). **Figures 4-1 through 4-4** are maps of OU1 that provide graphical summaries of the results of the anomaly investigation.

The results indicate that a majority of locations exhibit dose rates on contact that were consistent with ambient levels, with measurements at 67 of the 99 locations ranging between 5 and 10 µrem/hr. However, several anomaly locations exhibit dose rates on contact that are considerably higher than ambient levels and are likely indicative of radiological artifacts. For example, within OU1, 13 anomalies exhibited dose rates greater than 50 µrem/hr and two anomalies exhibited dose rates greater than 100 µrem/hr, including Location 66 in Grid G-23 and Location 41 in Grid L-24. The anomaly locations with elevated dose rate measurements are located within areas of OU1 containing waste fill, which is the suspected source of radiological artifacts. Of the 99 anomalies, 16 were located outside of the area interpreted to contain waste fill. In general, these locations exhibited dose rates on contact that were consistent with ambient levels, with 15 locations yielding results between 5 and 7 µrem/hr. Only one of the radiological anomalies located outside of waste fill exhibited an elevated dose rate (i.e., Location 67 in Grid E-23). This anomaly was investigated further because it was located approximately 100 ft northeast of the waste fill boundary, as determined through DPT borings and test pitting. The source of the anomaly was identified as granitic rock with elevated levels of naturally occurring radioactive material (NORM). Investigations of Location 67 confirmed that waste fill was not present and the source of the anomaly (i.e., a discrete granitic rock) was removed as part of sampling. Dose rate results collected within the general area of each anomaly primarily ranged between 3 to 10 µrem/hr (total 84 of the 99 locations). The maximum observed general area dose rate measurement was identified at Location 66 within Grid G-23 (located in central portion of OU 1) with a result of 90 µrem/hr. This is the same location with the highest contact dose rate.

Based on the observations made during the collection of dose rate measurements, four areas were identified for biased radiological investigations. The results of the biased radiological investigations are presented in Section 4.2.

4.1.3 Sewage Sludge

As discussed in Section 2.1.1.3, a soil amendment containing sewage sludge was placed over waste fill to serve as artificial topsoil and support revegetation. As shown in the geologic cross sections presented in

Figures 3-5 through 3-8, the ground surface through a majority of OU1 was characterized as a silty sand fill, which was interpreted to correspond to the soil amendment containing sewage sludge. Where present, this surface cover ranges in thickness from 0.5 feet to 7 feet thick, with an average thickness of 1.7 feet. Based on the available records, this sewage sludge mixture was placed over waste fill and it is assumed that the areal extent of waste fill approximately coincides with the footprint in which the soil amendment containing sewage sludge was placed. **Figure 2-2** provides a map of OU1 that details the estimated depth to the top of the waste fill throughout the investigation area. The contacts between the soil amendment cover and waste fill were estimated based on evaluations of soil cores collected within OU1. Significant mixing is expected between the waste fill and the overlying soil amendment due to the manner in which the soil cover was placed and from ongoing fate and transport processes, such as tree falls, frost heave, and roots from on-Site vegetation, most notably phragmites.

Based on the areal extent and depth to waste fill shown on **Figure 2-2**, approximately 64,000 cubic yards of the soil amendment containing sewage sludge is estimated to be present within OU1. The nature of contamination associated with sewage sludge is characterized by surface soil sampling results discussed in Section 4.2.

4.2 SOIL AND VADOSE ZONE

The soil and vadose zone evaluation determined that several contaminants, including metals, organic chemicals, and radionuclides are present at concentrations that are elevated above background. The soil screening benchmarks for chemicals in surface and subsurface soil are based on USEPA regional screening levels (USEPA, 2016) corresponding to a target cancer risk of $1x10^{-6}$ and a target hazard quotient of 1.0, specifically for residential and industrial receptors. The receptors that will be considered in the human health risk assessment for GKP differ somewhat from these screening benchmarks, but the RSLs provide a useful context for evaluating the OU1 dataset. Some chemicals, including carcinogenic polycyclic aromatic hydrocarbons (PAHs) and dioxins/furans, exhibit similar toxicological properties that differ in the degree of toxicity. Therefore, to provide an appropriate evaluation of these chemicals, toxicity equivalence factors (TEF) were applied in accordance with USEPA's 2016 RSL User's Guide (USEPA, 2016) to adjust the measured concentrations to a toxicity equivalent concentration, which resulted in calculated Toxic Equivalent (TEQ)s for benzo(a)pyrene and dioxins/furans. The soil screening benchmarks for radionuclides are based on soil screening levels for evaluating surface soil, as specified in US Nuclear Regulatory Commission Regulation (NUREG) 1757, Volume 1 (U.S. NRC, 2006).

Tables 4-1 and 4-2 provide a statistical summary for all chemicals and radionuclides evaluated as part of analyses of surface and subsurface soil samples collected from the 50 DPT sampling locations depicted on **Figure 2-1**, respectively. These statistical summary tables also provide an evaluation of the number of results that exceed screening benchmarks. Site maps were prepared to graphically depict the analytical results for all chemicals that exceeded their most conservative screening benchmark. **Figures 4-5 through 4-15** provide class postings of the analytical results for surface and subsurface soil analytes for all chemicals that exceeded screening benchmarks in more than three samples. In addition, 95% UCLs (95UCLs) and box and whisker plots were developed using ProUCL software version 5.1 and are included in each figure to support comparisons of surface and subsurface results for OU1 and the Site-specific background area. The remaining exceedances are presented together on **Figure 4-16**, which provides spider plot tables for each instance in which a detected concentration exceeded screening benchmarks. The 95UCL is a useful summary statistic that represents a conservative estimate of the mean for a given dataset and is used to estimate exposure point concentrations in human health risk

assessments. As a result, the 95UCL has been used as the primary summary statistic to compare OU1 and background datasets.

In addition to the summary tables and figures described above, **Appendix P** includes a cross-tabbed summary of all analytical results for surface and subsurface soils in relation to screening benchmarks. All non-detects are reported as being less than the method detection limit. Variations in the method detection limit are attributable to sample dilutions that were required to overcome matrix interference associated with the organic-rich nature of the soil at the Site.

Metals. Based on the sampling conducted within OU1, arsenic, cobalt, iron, and lead were the four metals that most frequently exceeded residential RSLs in surface and subsurface soil within OU1. **Figures 4-5 through 4-8** summarize the analytical results for surface and subsurface soil for arsenic, cobalt, iron, and lead, respectively. The results indicate that concentrations of cobalt detected within OU1 are generally equal to or less than those observed in soil collected from the background sampling locations (see **Figure 4-6**). Conversely, the results indicate that concentrations of arsenic, iron, and lead are elevated in surface and subsurface soil collected from OU1 in relation to the background results (see **Figures 4-5, 4-7, and 4-8**, respectively). The OU1 data do not show clear spatial trends in the distribution of arsenic, iron, and lead throughout OU1, which aligns with the release mechanism of spreading waste-fill as a generally well mixed source. However, the data does show discernable trends that indicate higher concentrations of arsenic, iron, and lead in subsurface soil than in surface soil as demonstrated by 95UCLs that are higher in the subsurface data set for each of these three metals within OU1. The presence of metals in surface and subsurface soil above background concentrations is likely attributable to the presence of sewage sludge and waste fill within OU1. The finding that metals were higher in subsurface soil than in surface soil within OU1, suggests that the ash-like material that was encountered in buried waste fill (i.e., coal ash and/or incinerator residue) contains higher concentrations of metals than the soil amendment (i.e., containing sewage sludge) present at the ground surface.

Organics. Based on the sampling conducted within OU1, Aroclor 1254, Aroclor 1260, benzo(a)pyrene TEQ, and dioxin TEQ were the four organic chemicals (or group of chemicals, as represented by the TEQs) that most frequently exceeded residential RSLs in surface and subsurface soil within OU1. **Figures 4-9 through 4-12** summarize the analytical results for surface and subsurface soil for Aroclor 1254, Aroclor 1260, benzo(a)pyrene TEQ, and dioxin TEQ, respectively. The results indicate that concentrations of all four organic chemicals are elevated in both surface and subsurface soil collected from OU1 in relation to the background results. Similar to the metals results, the OU1 data does not show clear spatial trends in the distribution of Aroclor 1254, Aroclor 1260, benzo(a)pyrene TEQ, and dioxin TEQ throughout OU1, which aligns with the release mechanisms of spreading waste-fill as a generally well mixed source. However, the data shows differences in the concentrations of organic chemicals in surface and subsurface soil. Specifically, higher concentrations of Aroclor 1254, Aroclor 1260, and dioxin TEQ were observed in surface soil as demonstrated by 95UCLs that are higher in the surface data set for each of these three organic compounds within OU1. Conversely, higher concentrations of benzo(a)pyrene TEQ were observed in subsurface soil as demonstrated by 95UCLs that are higher in the subsurface data set within OU1. Based on historical operations at the Site, a soil amendment containing sewage sludge was used to facilitate revegetation over the waste fill area. The presence of elevated concentrations of recalcitrant organic compounds, such as PCBs and dioxins, at higher concentrations in surface soil may be related to their association with sewage sludge, while the PAHs may be associated with the ash-like material that was encountered in buried waste fill.

PCB step-out and confirmatory sampling was conducted during Phase 2 sampling activities to investigate a suspected PCB hotspot in surface soil at DPT 016 (i.e., Aroclor 1254 in surface soil at 220 mg/kg). As shown in **Figure 4-9,** the results of step-out sampling confirmed that PCBs were present in this area, but at concentrations that were 2 to 3 orders of magnitude below the initial Aroclor-1254 result of 220 mg/kg in surface soil at DPT-016. Step-out sampling indicated that Aroclor-1254 results were generally greater than the residential RSL (0.24 mg/kg), but below the industrial RSL (0.97 mg/kg). The highest concentration of Aroclor-1254 detected within the DPT-016 step-out samples was located at DPT-016S with an estimated result of 1.2 mg/kg, which exceeds the industrial RSL, but aligns with the range of concentrations observed in other samples collected within OU1. Based on the results of confirmatory and step-out sampling at DPT-016, the initial Aroclor-1254 detection of 220 mg/kg is considered an anomalous result that could not be replicated. Therefore, the results of confirmatory and step-out sampling within the DPT-016 area will be used to replace the anomalous data point.

Radionuclides. All three radionuclides investigated in soil at OU1 (i.e., radium-226, thorium-232, and uranium-238) exceeded project screening benchmarks in non-biased surface and subsurface samples. **Figures 4-13 through 4-15** summarize the analytical results for surface and subsurface soil for radium-226, thorium-232, and uranium-238, respectively. The results indicate the datasets for radium-226 and thorium-232 in non-biased samples have 95UCLs that are comparable to background for both sampling intervals (see **Figures 4-13 and 4-14**). However, the box and whisker plots presented in **Figure 4-13 and 4-14**, show background soil is characterized by a more uniform dataset than is observed within OU1, where the upper quartiles for radium-226 and thorium-232 are clearly elevated in relation to the background datasets for both surface and subsurface sampling intervals. This is likely due to sewage sludge (surface soil) and waste fill (subsurface soil) serving as sources of elevated radionuclide concentrations in OU1. Uranium-238 is also higher in both surface and subsurface soil as compared to background results (see **Figure 4-15**) and exhibits 95UCLs that are clearly higher in OU1. Similar to the findings previously described for metals and organic chemicals, the OU1 data does not show clear spatial trends in the distribution of uranium-238 throughout OU1, which aligns with the release mechanism of spreading waste-fill as a generally well mixed source.

Biased Radiological Investigations. As discussed in Section 4.1.2, during investigations of radiological artifacts, several anomalies were observed in close proximity to each other and in some cases, large areas were observed with continuous elevated radiation levels. As a result, biased radiological investigations were conducted in four areas to better understand the potential for radiological artifacts to impact soil and to determine the nature of soil impacts in areas that were determined to contain radiological sources. The specific objectives for the biased radiological investigations were to (1) determine whether radiological artifacts leak, (2) determine the concentration of radionuclides in soil adjacent to suspected artifacts, and (3) evaluate whether gamma walkover surveys can effectively define the extent of near surface radiological impacts in soil. At each biased radiological investigation area, soil sampling and analysis was first performed using on-Site gamma spectroscopy laboratory (i.e., operated by USACE) for semi-quantitative screening purposes. Based on the screening results from the on-Site laboratory, a select subset of the samples was sent to an accredited laboratory for gamma spectroscopy analysis for confirmatory analysis. **Figures 4-17 through 4-19** provide the results of each biased radiological investigation and present spider plots that report concentrations of radium-226, thorium-232 and uranium-238, based on the analytical results from the off-Site accredited laboratory.

Investigation Area 1 is located in the lower left portion of Grid C-22 (see **Figure 4-17**). This area was identified for further evaluation because scanning surveys of the grid identified multiple elevated

locations throughout the area (i.e., indicating the potential for clusters of discrete anomalies). The refined gamma scanning results ranged from a minimum of 12,301 cpm to a maximum of 431,260 cpm. Eleven locations were selected for screening analysis with the on-Site laboratory (see Appendix J), with five biased radiological samples being identified for off-Site analysis. **Figure 4-17** provides the sample locations and analytical results from the off-Site laboratory for Investigation Area 1. During the investigation of Investigation Area 1, several radiological artifacts (i.e., deck markers) were identified near C22-A-005 and C22-A-009 (see **Figure 4-17**). The analytical results indicated elevated radium-226 results in soil adjacent to the suspect anomalies, with maximum concentrations of 44.0 pCi/g and 39.8 pCi/g detected from 1 to 2 ft bgs at C22-A-005 and 2 to 3 ft bgs at C22-A-009, respectively. The elevated radium-226 concentrations suggest localized impacts related to the presence of the deck markers. However, as shown in **Figure 4-17**, soil samples from C22-A-005 collected at the ground surface and from 2 to 3 ft bgs, suggest that the impacts from the deck marker are isolated. The findings in Investigation Area 1 confirm the presence of discrete artifacts within OU1 and suggest that compromised radiological artifacts may leak and release localized contamination into soil immediately adjacent to the artifact. Within Investigation Area 1, thorium-232 was detected at concentrations between 0.69 pCi/g and 1.31 pCi/g, which is within the range of concentrations observed in the 50 DPT soil sampling locations from OU1 (i.e., the non-biased sampling) and in background soil; uranium-238 was not detected in any sample from Investigation Area 1.

Investigation Area 2 is located in the upper right portion of Grid C-22 (see **Figure 4-17**). This area was identified for further evaluation because scanning surveys of the grid identified anomalous readings distributed over an area instead of an individual point (see **Figure 4-17**). The refined gamma scanning results ranged from a minimum of 12,333 cpm to a maximum result of 51,843 cpm. Five locations were selected for screening analysis with the on-Site laboratory (see **Appendix J**), with three biased radiological samples being identified for off-Site analysis. **Figure 4-17** provides the sample locations and analytical results from the off-Site laboratory for Investigation Area 2. Investigation Area 2 was investigated to approximately 3 ft bgs. The soil sampling results for Investigation Area 2 indicated that radium-226 and thorium-232 were detected at concentrations ranging from 0.82 pCi/g to 0.94 pCi/g and 0.69 pCi/g to 0.84 pCi/g, respectively. Based on these findings, radium-226 and thorium-232 are both present within Investigation Area 2 within the range of concentrations observed in the 50 DPT soil sampling locations from OU1 (i.e., the non-biased sampling) and in background soil; uranium-238 was not detected in any sample from Investigation Area 2. The field team observed that contact dose rate measurements were elevated throughout the investigation area and did not decrease significantly one meter from the anomaly location. In addition, the concentrations of radium-226 and thorium-232 in surface and subsurface soil were low throughout Investigation Area 2. Based on these observations, it is suspected that discrete radiological artifacts were present, but below the maximum investigation depth of 3 ft bgs.

Investigation Area 3 was located in the left portion of Grid D-23 (see **Figure 4-18**). This was identified for further evaluation because the GWS results indicated anomalous readings over a larger area instead of an individual point (**Figure 4-18**). The refined gamma scanning results ranged from a minimum of 12,686 cpm to a maximum of 49,470 cpm. Five locations were selected for screening analysis with the on-Site laboratory (see **Appendix J**), with three biased radiological samples being identified for off-Site analysis. During the investigation of Investigation Area 3, a radiological artifact (i.e., a suspected deck marker) was identified at approximately 1 ft bgs at D23-A-001. **Figure 4-18** provides the sample locations and analytical results from the off-Site laboratory for Investigation Area 3. As shown, the soil sampling

results for Investigation Area 3 indicated that radium-226 and thorium-232 were detected at concentrations ranging from 0.40 pCi/g to 0.70 pCi/g and 0.55 pCi/g to 0.79 pCi/g, respectively. Based on these findings, radium-226 and thorium-232 are both present within Investigation Area 3 within the range of concentrations observed in the 50 DPT soil sampling locations from OU1 (i.e., the non-biased sampling) and in background soil; uranium-238 was not detected in any sample from Investigation Area 3. The sampling results from D23-A-001 (i.e., adjacent to a deck marker), indicates that discrete artifacts are present within OU1 and suggests that some of the radiological artifacts may be intact, such that they have not released contamination into soil immediately adjacent to the source.

Investigation Area 4 coincides with a large portion of Grid G-23 and was selected based on GWS results showing anomalous readings over a large area instead of an individual point (**Figure 4-19**). The initial footprint of Investigation Area 4 was two separate, localized areas, but upon completion of the GWS, the two areas were combined into a single large area. GWS results ranged from a minimum of 13,066 cpm to a maximum result of 273,759 cpm. Twenty locations were selected for screening analysis with the on-Site laboratory (see **Appendix J**), with 10 biased radiological samples being identified for off-Site analysis. **Figure 4-19** provides the sample locations and analytical results from the off-Site laboratory for Investigation Area 4. During investigations within Investigation Area 4, a uniform layer of ash-like material containing fragments of waste, including coal and coal ash, was encountered at the ground surface to the maximum investigation depth of 3 ft bgs. Within this layer, the field team also observed a small fragment of uranium-glazed pottery which was detected by the on-Site laboratory during screening (see Appendix J). Concentrations of both radium-226 and thorium-232 were elevated in relation to the range of concentrations observed in the 50 DPT soil sampling locations from OU1 (i.e., the non-biased sampling) and in background soil, see below:

	Radium-226 (pCi/g):	Thorium-232 (pCi/g):
• Investigation Area 4 (Maximum)	3.48	2.95
• Investigation Area 4 (Average)	2.04	1.97
• OU1 – non-biased (Maximum)	2.983	2.406
• OU1 Surface – non-biased (95UCL)	0.896	0.998
• OU1 Subsurface – non-biased (95UCL)	1.139	1.25
• Background (Maximum)	1.281	1.482
• Background Surface (95UCL)	0.945	1.128
• Background Subsurface (95UCL)	1.031	1.154

As shown above, the average detected concentrations of radium-226 and thorium-232 within Investigation Area 4 is nearly double the 95UCLs for OU1 non-biased surface and subsurface soil datasets and in background datasets. Another noteworthy observation within Investigation Area 4 is the relative consistency in elevated concentrations of both radium-226 and thorium-232. Unlike the results for Investigation Area 1, where radium-226 was significantly elevated and thorium-232 was not, Investigation Area 4 shows consistency in the observed concentrations of both radionuclides. Overall, the results for Investigation Area 4 confirm that elevated radium-226 and thorium-232 are associated with the ash-like material (i.e., possibly coal ash, incinerator residue, or a combination of the two) observed from the ground surface to the maximum investigation depth of 3 ft bgs.

4.3 GROUNDWATER

The groundwater evaluation determined that several contaminants, including metals, organic chemicals, and radionuclides are present at concentrations that are elevated above background. The evaluation of

groundwater is based on both federal Maximum Contaminant Levels (MCLs) for drinking water and USEPA RSLs for tap water (May 2016) (USEPA, 2016). Consumption of groundwater underlying the Site is not a complete exposure pathway, but comparisons to these conservative screening benchmarks still provide useful context for evaluating the OU1 dataset. **Table 4-3** provides a statistical summary for all chemicals and radionuclides evaluated as part of OU1 sampling for groundwater. These statistical summary tables also provide an evaluation of the number of results that exceed the both the federal MCLs for drinking water and USEPA RSLs for tap water. Site maps were prepared to graphically depict the analytical results for all chemicals that exceeded the lower of the federal MCL for drinking water or USEPA RSL for tap water in at least one sample. **Figures 4-20 through 4-22** provide spider plot tables for each instance in which a detected metal, organic chemical, and radionuclide exceeded drinking water criteria and also highlights when an exceedance also was greater than the range of concentrations observed in background monitoring wells, respectively.

In addition to the summary tables and figures described above, **Appendix P** includes a cross-tabbed summary of all analytical results for groundwater, screened against federal MCLs for drinking water and USEPA RSLs for tap water (May 2016). All non-detects are reported as being less than the method detection limit. Variations in the method detection limit are attributable to sample dilutions that were required to overcome matrix interference associated with the brackish, saline nature of the shallow aquifer at OU1. In some cases, extract dilutions were required to ensure that laboratory QC standards for data usability were achieved.

Metals. As shown in **Table 4-3**, a variety of metals were detected in OU1 groundwater at concentrations that exceed tapwater RSLs and federal MCLs. Arsenic, barium, cadmium, lead, and thallium each exceeded the federal MCL in at least one groundwater sample within OU1. Arsenic, barium, cadmium, cobalt, iron, lead, manganese, nickel, thallium, and zinc each exceeded the tapwater RSL in at least one sample. Metals were also analyzed in four designated background wells. In general, the range of metal concentrations detected in background wells was less than those observed in temporary wells and monitoring wells sampled within OU1. **Figure 4-20** provides a map of OU1 with spider plot tables for each instance in which a detected metal exceeded federal MCLs and/or tapwater RSLs. The range of metals detected in background wells were added to **Figure 4-20** to provide context to the OU1 groundwater data. Based on a comparison of OU1 metals concentrations to the background results, there are a few instances where manganese was detected above groundwater comparison criteria within OU1, but within the range of concentrations observed in background wells. However, as shown in **Figure 4-20**, nearly all of the metals that exceeded federal MCLs and/or tapwater RSLs within OU1, also exceeded the range of metals concentrations detected in background wells. Similar to the soil results, the OU1 data do not show clear spatial trends in the distribution of metals detected in groundwater within OU1.

Organics. As shown in **Table 4-3**, no organic chemicals exceeded federal MCLs in OU1 groundwater, however, Aroclor 1260, dioxin TEQ, 4-4'-DDD, 4-chloroaniline, benzo(a)pyrene TEQ, and chloroform were detected in OU1 groundwater at concentrations that exceed tapwater RSLs in at least one sample. Organics chemicals also were analyzed in groundwater sampled from four designated background wells. **Figure 4-21** provides a map of OU1 with spider plot tables for each instance in which an organic chemical exceeded federal MCLs and/or tapwater RSLs. The range of organic chemicals detected in background wells were added to **Figure 4-21** to provide context to the OU1 groundwater data. As shown in **Figure 4-21**, Aroclor 1260, 4-4'-DDD, 4-chloroaniline, and benzo(a)pyrene TEQ were not detected in groundwater collected from the four designated background monitoring wells. Also, there are three instances in which dioxin TEQ and one instance in which chloroform was detected within OU1

groundwater at concentrations that exceed the tapwater RSL and the range of concentrations detected in background wells. Similar to previous observations, the OU1 data do not show clear spatial trends in the distribution of organic chemicals detected in groundwater within OU1.

Radionuclides. As shown in **Table 4-3**, gross alpha, gross beta, and radium-226/228 were each detected in groundwater at concentrations that exceed federal MCLs. **Figure 4-22** provides a map of OU1 with spider plot tables for each instance in which a detected radionuclide exceeded federal MCLs. As shown in **Figure 4-22**, gross beta exhibited the highest number of detections above the federal MCLs, with 12 total exceedances. Elevated gross beta is associated with the presence of potassium-40 in seawater, which is supported by follow on laboratory gamma spectroscopy results for potassium-40 (i.e., for groundwater samples exhibiting elevated gross beta results) and the spatial trends observed in the exceedances of gross beta. Specifically, the instances of gross beta exceeding the federal MCLs all occur in the southeast portion of OU1, in the areas closest to the coast. In addition, the tidal nature of the drainage channels within OU1 also provides a mechanism for elevated gross beta concentrations associated with seawater to mix with groundwater, where high tide likely causes the drainage channels to transmit seawater into the shallow aquifer.

Gross alpha and radium-226/228 also were detected in groundwater above federal MCLs (see **Figure 4-22**), but at a low frequency, with gross alpha exceeding the federal MCL at one location (MW003WT) and radium-226/228 exceeding the federal MCL at two locations (MW003WT and MW004WT). Both MW003WT and MW004WT are situated in low-lying areas of OU1, where shallow groundwater is in direct contact with the waste layer. Furthermore, the groundwater samples from monitoring wells were not filtered, suggesting that elevated gross alpha and radium-226/228 may be related to particulates in the sample.

4.4 SEDIMENT AND SURFACE WATER

The evaluation of detected concentrations in surface water and sediment is based on relevant ecological screening values (ESVs) specified in NPS guidance (NPS, 2016c and 2016d) for investigating and conducting screening level ecological risk assessments at NPS sites. **Tables 4-4 and 4-5** provide statistical summary tables for all chemicals and radionuclides evaluated in OU1 sediment and surface water, respectively. These statistical summary tables also provide an evaluation of the number of results that exceed relevant ESVs established by NPS. **Figures 4-23 and 4-24** provide spider plot tables for each instance in which a detected concentration exceeded relevant ESVs for sediment and surface water, respectively. Based on the OU1 results, there was no instance where a radionuclide was detected in surface or sediment at levels that exceeded relevant ESVs. There were however, a variety of metals and organic chemicals that were detected in sediment and surface water from the Oakwood Beach Creek at concentrations that exceed relevant ESVs and observations from background sampling locations. These include the following:

- **Sediment:** mercury, 4-4'-DDD, 4-4'-DDE, chlordane, anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, fluoranthene, and pyrene.
- **Surface Water:** aluminum, barium, cadmium, cobalt, manganese, nickel, anthracene, benzo(a)anthracene, benzo(a)pyrene, chloroform, fluoranthene, and pyrene.

Appendix P includes a cross-tabbed summary of all analytical results for sediment and surface water, screened against relevant ESVs established by NPS (NPS, 2016c and 2016d). All non-detects are reports as being less than the method detection limit.

5. CONTAMINANT FATE AND TRANSPORT AND CONCEPTUAL SITE MODEL

Sources of contamination within OU1 have resulted in concentrations above background within the environmental media from metals, PAHs, PCBs, and radionuclides, as summarized in the conceptual site model (CSM) presented in Section 5.1. The following sections provide a discussion of the conceptual site model as well as the persistence and potential migration pathways for contaminants identified within OU1.

5.1 CONCEPTUAL SITE MODEL

Unlike many other environmentally contaminated sites, there is a considerable amount known at the Site regarding the sources of contamination and how they were deposited/placed. A Site CSM is presented in the following subsection and summarized graphically in **Figure 5-1**.

5.1.1 Sources

Contaminant sources within OU1 include, (1) waste fill derived from historical waste disposal operations at GKP (e.g., refuse, incinerator residue, and coal ash), (2) radiological artifacts incidentally contained in waste fill, and (3) sewage sludge that was used throughout OU1 as part of a soil amendment to facilitate revegetation and also present in the former sludge drying beds.

5.1.2 Extent of Contamination

Extent of waste fill is estimated at 32 acres and the estimated volume of waste fill is approximately 220,000 cubic yards. The soil amendment containing sewage sludge overlies the waste fill, from the ground surface to the top of the waste layer, which represents an estimated volume of approximately 64,000 cubic yards. Radiological artifacts are also present throughout the waste fill, however due to shielding from overlying soil, the prevalence buried artifacts is difficult to quantify.

5.1.3 Nature of Contamination

Contaminants associated with waste fill and sewage sludge generally include metals, PAHs, PCBs, dioxins/furans and radionuclides. Radiological sampling of a concentrated ash layer in Grid G-23 determined that radionuclides were approximately two times higher in samples collected in the ash layer than in other areas of OU1 and in the background area. Radiological artifacts are also present within the waste fill. Biased radiological investigations determined that compromised radiological artifacts may release localized contamination into soil immediately adjacent to the source and that artifacts that are not compromised are not expected to impact adjacent soil. Based on the evaluation of groundwater, organic chemicals were not detected above federal MCLs, however, several metals were, including arsenic, barium, cadmium, lead, and thallium. Many of the same contaminants detected in soil were also detected in Site groundwater, but spatial trends were not observed and there were no signs of widespread contaminant plumes resulting from the presence of waste fill.

5.2 POTENTIAL ROUTES OF MIGRATION

OU1 Site contaminants (attached to particles or dissolved in water) within surface and subsurface soil may be transported to other areas on-Site and off-Site (e.g. adjacent wetlands and surface waterbodies) by surface water run-on and runoff. Similarly, OU 1 Site contaminants may leach from the surface and subsurface soil into surrounding soil and groundwater. Site contaminants present in groundwater may migrate and attenuate with groundwater flow and groundwater may discharge to the Buffalo Street

Drainage Channel, Oakwood Beach Creek, and wetlands. These surface water bodies and wetlands are tidal and receive surface water from on-Site and off-Site sources including from the Willowbrook ROW, the Oakwood Beach watershed, and the Lower New York Bay (due to tides). While contaminants were detected in soil, erosion of surface and subsurface soil (not adjacent to the drainage channel) within OU1 is likely minimal because of the thick vegetation present over the ground surface. Certain contaminant classes also may volatilize, but this is unlikely in OU1 because volatile organic compounds were not detected in environmental media. Radon gas could be generated from radium sources, but exposure to radon gas is negligible in OU1 because there are no indoor structures present on-Site. Lastly, the damaged radiological artifacts within waste fill may leak and release radioactivity to soil in the immediate vicinity of the item.

Contaminant transport mechanisms including advection (dissolved solute transport), dispersion (contaminant dilution), sorption (contaminant partitioning between solution [liquid] and sorbent [solid phase]); and decay (contaminant abiotic (e.g., radioactive decay) and biodegradation reactions) will also change the fate of the contaminant and its persistence in the environment.

5.3 CONTAMINANT PERSISTENCE

The principle contaminant classes detected in environmental media within OU1 include: metals, PAHs (represented by benzo(a)pyrene TEQ), PCBs, dioxins/furans (represented by dioxin TEQ), and radionuclides; Table 5-1 summarizes key chemical and physical properties relevant to contaminant fate and transport. In addition, the following section provides a brief discussion of the fate and transport for the more toxic contaminants (or contaminant classes) frequently detected above screening benchmarks within environmental media in OU1 (as summarized in Section 4.0).

Arsenic. Anthropogenic sources of arsenic include metal smelting, and burning of coal, oil and wood and waste incineration (ATSDR, 2007). Arsenic was also detected in sewage sludge from 23 cities at concentrations 0.3 mg/kg to 53 mg/kg (ATSDR, 2007). In the environment, arsenic generally exists in two oxidation states, including arsenite (arsenic [III]) and arsenate (arsenic [V]). Arsenic compounds tend to partition to the soil or sediment under oxidizing conditions (ATSDR, 2007). Conversely under reducing conditions, the arsenic compound may leach and dissolve into groundwater and surface water (ATSDR, 2007). Arsenic beneath the Site in shallow soil and within the unconfined aquifer may dissolve or precipitate depending on the fluctuating redox environment. Other parameters include pH, organic matter content, and cation exchange capacity will also influence the fate and transport of arsenic (ATSDR, 2007). Arsenic that is adsorbed on to iron and manganese oxides may be released (leach and dissolve into water) under reducing conditions (ATSDR, 2007). In the pH range of natural groundwater and surface water, the predominant aqueous inorganic arsenic species is arsenic(V) particularly in oxidizing environments. Arsenic (III) dominates under reducing condition (ATSDR, 2007). Arsenic may bioaccumulate in plants and animals but it generally does not biomagnify between trophic levels (ATSDR, 2007).

Lead. Anthropogenic sources of lead include mining and smelting of lead ore, combustion of coal and oil, and waste incineration (Chillrud et al. 1999). Other anthropogenic sources include the former use of leaded gasoline, lead-based paint, lead solder in food cans, lead-arsenate pesticides, and ammunition (birdshot and bullet) and sinkers (fishing). Lead use in these products was phased out due to its toxicity, persistence, and bioaccumlative nature. Lead exists in three oxidation states, lead(0), lead(II) and lead(IV) or lead oxide. In the environment, lead primarily exists as lead(II). Lead is dispersed throughout the environment primarily as the result of anthropogenic activities. The solubility and speciation of lead

compounds in water is a function of pH (under acidic conditions lead compounds are more likely to leach), hardness, salinity and presence of humic (organic) material (ATSDR, 2007). Lead is strongly adsorbed to soil and is retained in the upper layers of soil and does not leach appreciably into the subsoil and groundwater. Lead is generally adsorbed to solids and sediments in aquatic systems and it occurs in relatively immobile forms in soil. Similar to arsenic, lead may bioaccumulate but is not biomagnified in aquatic or terrestrial food chains (ATSDR, 2007).

PAHs (represented by benzo(a)pyrene). Benzo(a)pyrene was frequently detected in soil within OU1. Sources of PAHs in the environment include vehicle exhausts, asphalt roads, coal, coal tar, wildfires, agricultural burning, residential wood burning, municipal and industrial waste incineration to name just few. In urban settings, PAH concentrations are 3 to 5 times higher than nonurban settings (ATSDR, 1995). PAHs have low solubility and high partitioning coefficients, suggesting a strong affinity to associate with particulates and not be present in the dissolved phase (i.e., groundwater or surface water). They are present in air as vapors but are more often bound to the surfaces of small solid particles. Some PAHs may evaporate into the atmosphere from surface waters, but most are particulate bound to solid particles and organic matter and settle with sediment at the bottom of the surface waterbody. In soil, PAHs are most likely to bind tightly to soil particles. PAHs in the atmosphere can break down to longer-lasting daughter-products by reacting with sunlight and other chemicals in the air, generally over a period of days to weeks. Breakdown of PAHs in soil and water generally takes weeks to months and is caused primarily by the actions of microorganisms (ATSDR, 1995). PAHs may accumulate in terrestrial and aquatic animals, however many are able to metabolize and eliminate these compounds (ATSDR, 1995). Food chain uptake does not appear to be a major source of exposure to PAHs for aquatic animals (ATSDR, 1995).

PCBs. Unlike the other contaminant classes described above, PCBs including Aroclor-1254 and Aroclor-1260 are a group of synthetic (manmade) organic compounds that do not occur naturally in the environment. PCBs are mixtures and are generally known by their trade name, “Aroclor” and further defined by the chlorine weight percent, (e.g., Aroclor-1254 is 54% chlorine by weight, and Aroclor-1260 is 60% chlorine by weight) (ATSDR, 2000). Because of their indestructible and inflammable nature, PCBs were used in oil and coolants (heat transfer fluids) -- particularly in electrical equipment (transformers, capacitors, ballast, cables etc.) -- and in lubricants. Wastewater discharges containing PCBs may have resulted in sewage sludge containing PCBs (ATSDR, 2000). PCB manufacturing was ceased in 1977. PCBs are very resistant to breakdown (physical and chemical) and tend to remain in the environment. The more chlorine atoms within the PCB mixture, the more slowly the PCB molecules will break down. In addition, higher chlorinated (heavier) mixtures are more likely to sorb (to particulates) and lower chlorinated (lighter) mixtures are more likely to volatilize (from soil and water to air) (ATSDR, 2000). PCBs present in the atmosphere may attach (sorb) to particulates and settle as particulates. PCBs present in precipitation will also be deposited on land and in water. PCBs in water tend to sorb to suspended solids and sediments. Once PCBs have sorbed to soil or sediment, they are expected to remain bound and are unlikely to migrate unless the soil or sediment is disturbed, eroded, or re-suspended. PCBs will bioaccumulate in animals (terrestrial and aquatic) and biomagnify and are not readily metabolized or excreted.

Dioxins/Furans (represented by dioxin TEQ). In the environment, dioxins/furans tend to be associated with ash and soil (ATSDR, 1998) and can occur naturally through incomplete combustion (e.g., forest fire) of organic matter as well through anthropogenic sources (the predominant environmental source) including industrial, municipal, medical, and domestic incineration and combustion (coal and oil)

facilities (stationary and mobile). Burning materials that contain chlorine, such as plastics or chemicals (PCBs) also produce dioxins/furans. Generally, they are found in the environment with other related chlorinated compounds, such as PCBs. Dioxins/furans can be released in air as emissions from stationary and mobile sources and once emitted, they will most often associate with particulates. Dioxins/furans are persistent and do not tend to break down in the atmosphere (i.e., due to sunlight and reactions with other chemicals) and most will be deposited on land or water. They will also be present in residues that remain from incomplete incineration and combustion and be present in ash from wildland fires, coal ash and incinerator residue. Dioxins/furans are relatively insoluble (do not dissolve easily) in water and will sorb strongly to particles of soil and organic matter, suggesting they are more likely to be found in soil and sediments. Dioxins/furans also bioaccumulate and biomagnify in the food chain. (ATSDR, 1998).

Radium-226. Radium is present naturally at low concentrations in soil, water, rock, and coal. The radium isotope detected within OU1 is radium-226, which has several sources, including waste fill (i.e., coal ash and incinerator residue), radiological artifacts, and possibly sewage sludge. Radium-226 has a half-life of 1,622 years. Radium decays to radon gas, which migrates through the soil and soil vapor and eventually released to the atmosphere. Radon gas can build up in indoor air through vapor intrusion, but this route of exposure is not a concern for OU1 because there are no indoor structures within OU1. Radium may be transported in the atmosphere in association with particulate matter. Radium does not degrade in water other than through radioactive decay, is readily adsorbed by solids (within the soil and aquifer matrix), and is generally not mobile in the environment (ATSDR, 1990). Because of its association with particulate matter, Radium was found in soil and sediment and not generally in surface water or groundwater, unless sorbed onto suspended solids. Radium will bioaccumulate in terrestrial and aquatic animals and plants and will biomagnify from lower trophic to higher trophic levels (ATSDR, 1990).

Thorium-232. Thorium is ubiquitous in the environment having both natural and anthropogenic sources. Thorium is present naturally in soil, water, rock, and coal. Anthropogenic sources include phosphate rock processing and fertilizer production, coal fired utilities (emissions and coal ash) and industrial boilers (emissions and coal ash) (ATSDR, 1990). The coal fired utilities and boilers are the primary sources for thorium in the atmosphere. Thorium-232 has a half-life of 1.4E+10 years. Particulate bound thorium via wet and dry deposition is the main removal mechanism for thorium from the atmosphere. Once in soil and or sediment it will typically remain particulate bound and the mobility of thorium will be slow unless the sediments are re-suspended or the soil is disturbed. Thorium will bioaccumulate but does not biomagnify from lower to higher trophic levels (ATSDR, 1990).

Uranium-238. Uranium is present naturally in soil, water, rock, and coal. Uranium-234, uranium-235, and uranium-238 are present within the earth's crust in the following relative mass abundances; 0.005%, 0.72%, and 99.275% (ATSDR, 2013). The predominant isotope of uranium found in nature is uranium-238. Examples of uranium redistribution by natural processes include activities and processes that move soil and rock, such as resuspension of soils containing uranium through wind and water erosion and burning coal which naturally contains uranium. Uranium sorbed to particles may be removed from the atmosphere via precipitation and deposition. It can be resuspended into the atmosphere or incorporated with surface water runon and runoff into surface water and subsequently into groundwater. Uranium in soil will form complexes with anions or humic acid. In general uranium tends to sorb to sediment, soil and organic matter. While uranium may bioaccumulate it does not appear to biomagnify in the environment. Levels of uranium in aquatic animals have been found to decline with each successive trophic level due to the low assimilation efficiencies in the higher trophic animals (ATSDR, 2013).

5.4 CONTAMINANT MIGRATION

In general, the primary Site contaminants identified within OU1 (metals, PAHs, PCBs, dioxins/furans, and radionuclides) are persistent in the environment and generally adsorb to solids (e.g., have a higher affinity to be sorbed to particulates) and have a low potential for migration (as a dissolved solute) in surface water, groundwater, and air. The OU1 analytical results for environmental media support this conclusion in that the contaminants were largely detected in soil (surface and subsurface) and fewer contaminants at lower concentrations were detected in sediment, surface water, and groundwater. Due to the tendency of all Site contaminants to sorb strongly to soil and sediment, erosion, resuspension, and redisposition are the primary mechanisms through which contaminants would be expected to migrate in the environment. The heavily vegetated nature of the ground surface in OU1 is expected to minimize contaminant migration through these physical pathways. With the exception of radium decay producing radon, there is a very low likelihood of exposure to OU1 Site contaminants in air, especially given the dispersed nature of the radiological artifacts and the lack of indoor structures within OU1. Elevated concentrations of radionuclides, primarily radium-226, associated with releases from artifacts were found to be isolated, generally within a foot or less of the artifact. While many of the same contaminants detected in soil were also detected in OU1 Site groundwater above background and at concentrations that exceeded screening benchmarks, spatial trends were not observed. Overall, based on the fate and transport characteristics of the contaminants identified within OU1 and the heavily vegetated nature of the Site, there is a low potential for contaminants within OU1 to migrate off-Site.

6. BASELINE RISK ASSESSMENT

The NPS CST's approach under CERCLA is to combine the results of investigation activities completed within OU1 with future sampling results from the remainder of the Site to provide a comprehensive dataset that will be used to complete a single baseline risk assessment to be presented in a Site-wide RI Report. OU1 was established to support expedited investigations in areas of the Site coinciding with potential construction areas for the SSSI CSRM. These investigations were completed and the NPS CST determined that the presence of hazardous substances did not warrant immediate action under CERCLA, but would require that any construction activities in OU1 be conducted in manner that appropriately consider hazards to the public, hazards to site workers, management of potential radiological waste, and management of potential RCRA hazardous waste.

7. SUMMARY AND CONCLUSIONS

The objectives of environmental sampling (NPS, 2016a) at the Site were to: (1) delineate and verify the vertical and horizontal extent of the waste filled area in OU1; (2) identify the presence of radionuclides and chemicals within OU1 through the collection and analysis of environmental data from surface soil, subsurface soil, sediment, groundwater, and surface water; (3) identify the extent of surface and subsurface contamination; and (4) evaluate the extent of radionuclides and chemicals in shallow and deep groundwater. Based on the completion of the field activities described in this EIR and the resulting datasets, OU1 objectives were successfully achieved. The following section provides a summary of technical findings and conclusions for OU1.

7.1 SUMMARY

The following section provides a summary of the findings within OU1 regarding the nature and extent of contamination and the fate and transport of impacted media.

7.1.1 Nature and Extent of Contamination

The primary contaminant sources within OU1 include waste fill derived from historical waste disposal operations at GKP (e.g., refuse, incinerator residue, and coal ash), radiological artifacts incidentally contained in waste fill, and sewage sludge that was dried in the sludge impoundment area and also used as a soil amendment (artificial topsoil) after the completion of waste disposal operations in OU1.

Based on the delineation activities performed during fieldwork (see **Figures 2-2 and 2-3**), the areal extent and volume of waste fill within OU1 is estimated to be approximately 32 acres and 220,000 cubic yards respectively. The investigation determined that a majority of OU1 contains waste fill, with the thickest portion of the waste fill located along the northeast bank of the Buffalo Street Drainage Channel. Waste fill gradually tapers to the northeast and terminates altogether approaching NPS's Legislative Boundary at the northeast extent of GKP. Waste fill also is present in the vicinity of the former sludge drying beds (impoundments), consistent with the finding that the impoundments were graded and constructed into the waste fill after the fill was placed in OU1. Within OU1, waste fill terminates to the southeast near the transition from the former sludge drying beds to the natural wetland that extends to the shoreline.

Waste fill was covered with a soil amendment containing sewage sludge. The soil amendment layer is present from the ground surface to the top of the waste layer, as shown in **Figure 2-2**. Based on the areal extent and depth to waste fill, approximately 64,000 cubic yards of the soil amendment containing sewage sludge is estimated to be present over the 32 acres containing waste fill within OU1. The contact between the soil amendment and waste fill were estimated based evaluations of soil cores collected within OU1. The distinction between the soil amendment and the underlying waste fill is often difficult to determine because waste disposal and soil amendment operations occurred over 60 years ago and the OU1 surface has been extensively overgrown with heavy vegetation (including phragmites that have deep root penetration), obscuring the soil amendment and underlying waste fill contact.

Radiological artifacts are present within OU1 due to their association with the waste fill. Gamma surveys identified 99 radiological anomalies for further evaluation within OU1. Dose rate measurements were collected at each location on contact with the anomaly (i.e., at the ground surface) and in the general area of the anomaly (i.e., at waist level), which are summarized in **Figures 4-1 through 4-4**. The results indicate that a majority of locations exhibit dose rates on contact that were consistent with ambient levels,

with measurements at 67 of the 99 locations ranging between 5 and 10 µrem/hr. However, several anomaly locations exhibit dose rates on contact that are considerably higher than ambient levels and are likely indicative of radiological artifacts. For example, within OU1, 13 anomalies exhibited dose rates greater than 50 µrem/hr and two anomalies exhibited dose rates greater than 100 µrem/hr, including Location 66 in Grid G-23 and Location 41 in Grid L-24. The anomaly locations with elevated dose rate measurements are located within areas of OU1 containing waste fill, which is the suspected source of radiological artifacts. Of the 99 anomalies, 16 were located outside of the area interpreted to contain waste fill. In general, these locations exhibited dose rates on contact that were consistent with ambient levels, with 15 locations yielding results between 5 and 7 µrem/hr. Only one of the radiological anomalies located outside of waste fill exhibited an elevated dose rate (i.e., Location 67 in Grid E-23). This anomaly was investigated further because it was located approximately 100 ft northeast of the waste fill boundary. The source of the anomaly was identified as granitic rock with elevated levels of naturally occurring radioactive material. Investigations of Location 67 confirmed that waste fill was not present and the source of the anomaly (i.e., a discrete granitic rock) was removed.

Grid-based soil sampling was conducted at 50 locations with approximate spacing of 200 ft to investigate surface and subsurface soil for VOCs, SVOCs, PCBs, metals (including mercury), herbicides, pesticides, dioxins/furans, and radionuclides. Based on the OU1 sampling results, several metals (arsenic, iron, lead) and organic chemicals (Aroclor 1254, Aroclor 1260, benzo(a)pyrene TEQ, and dioxin TEQ) exceeded background and frequently exceeded residential RSLs in surface and subsurface soil within OU1. Concentrations of metals and benzo(a)pyrene TEQ were higher in subsurface soil, which may be related to their association with the ash-like material that was encountered in buried waste fill (i.e., coal ash and/or incinerator residue). Aroclor 1254, Aroclor 1260, and dioxin TEQ were observed at higher concentrations in surface soil, which may be related to their association with sewage sludge. All three radionuclides investigated in soil at OU1 (i.e., radium-226, thorium-232, and uranium-238) exceeded project screening benchmarks in grid-based surface and subsurface samples. The datasets for radium-226 and thorium-232 have 95UCLs that are comparable to background for both surface and subsurface soil datasets. However, the upper quartiles for radium-226 and thorium-232 in the OU1 datasets are clearly elevated in relation to background for both surface and subsurface sampling intervals. Uranium-238 is also higher in both surface and subsurface soil as compared to background results, as demonstrated by 95UCLs that are higher in OU1. Surface and subsurface soil data do not show clear spatial trends in the distribution of contamination within OU1, which aligns with the release mechanism of spreading waste fill as a generally well mixed source.

Biased radiological investigations were conducted in four areas to better understand the potential for radiological artifacts to impact soil and to determine the nature of soil impacts in areas that were determined to contain radiological sources. The four areas were selected because radiological anomalies were observed in close proximity to each other and in some cases, large areas were observed to exhibit continuous elevated radiation levels. Biased radiological investigations involved collecting and analyzing soil samples for radium-226, thorium-232, and uranium-238 to develop a refined understanding of environmental impacts near suspected radiological artifacts. The specific objectives for the biased radiological investigations were to (1) determine whether radiological artifacts leak, (2) determine the concentration of radionuclides in soil adjacent to suspected artifacts, and (3) evaluate whether gamma walkover surveys can effectively define the extent of near surface radiological impacts in soil. The results of biased radiological investigations indicate that compromised radiological artifacts may leak and release localized contamination. Radium-226 was detected at a maximum concentration of 44.0 pCi/g, but

impacts were isolated to a one foot area around the deck marker. Biased radiological sampling also demonstrated that some artifacts may not be compromised and may not release radionuclides to adjacent soil. Radiological samples collected from ash-like material (i.e., coal ash, incinerator residue, or a combination of the two) exhibited elevated concentrations of radionuclides that are approximately two times higher than in the background area. Overall, gamma walkover surveys were generally effective at defining the extent of near surface radiological impacts, however, there are limitations that are inherent to the technology and its ability to detect radiological impacts due to variations in source materials and shielding effects.

Groundwater was evaluated by sampling 25 temporary wells and 13 permanent monitoring wells for VOCs, SVOCs, PCBs, metals (including mercury), herbicides, pesticides, dioxins/furans, and radionuclides. Evaluations of groundwater within OU1 determined that organic chemicals were not detected above federal MCLs, however, several metals were, including arsenic, barium, cadmium, lead, and thallium. Similar to the soil results, the groundwater data do not show clear spatial trends in the distribution of metals detected in groundwater within OU1. Gross alpha, gross beta, and radium-226/228 were each detected in groundwater at concentrations that exceeded federal MCLs. Elevated gross beta is associated with the presence of potassium-40 in seawater in areas of OU1 closest to the coast and around the tidally influenced sections of the drainage channels within the southeastern portion of the Site. Gross alpha and radium-226/228 were detected above federal MCLs at a low frequency, with gross alpha exceeding the federal MCL at one location (MW003WT) and radium-226/228 exceeding the federal MCL at two locations (MW003WT and MW004WT). Both MW003WT and MW004WT are situated in low-lying areas of OU1, where shallow groundwater is suspected to be in direct contact with the waste fill layer. Furthermore, the groundwater samples from monitoring wells were not filtered, suggesting that elevated gross alpha and radium-226/228 may be related to particulates in the sample.

Surface water and sediment sampling within OU1 identified metals and organic chemicals in sediment and surface water from the Oakwood Beach Creek at concentrations that exceed relevant screening levels and observations from background sampling locations. Mercury, 4-4’-DDD, 4-4’-DDE, chlordane, anthracene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, fluoranthene, and pyrene each exceeded their ESVs and the range of concentrations detected in background sediment. Aluminum, barium, cadmium, cobalt, manganese, nickel, anthracene, benzo(a)anthracene, benzo(a)pyrene, chloroform, fluoranthene, and pyrene each exceeded their ESVs and the range of concentrations detected in background surface water.

7.1.2 Fate and Transport

In general, the primary Site contaminants identified within OU1 (metals, PAHs, PCBs, dioxins/furans, and radionuclides) are persistent in the environment and generally adsorb to solids (e.g., have a higher affinity to be sorbed to particulates) and have a low potential for migration (as a dissolved solute) in surface water, groundwater, and air. The OU1 analytical results for environmental media support this conclusion in that the contaminants were largely detected in soil (surface and subsurface) and fewer contaminants at lower concentrations were detected in sediment, surface water, and groundwater. Due to the tendency of all Site contaminants to sorb strongly to soil and sediment, erosion, resuspension, and redisposition are the primary mechanisms through which contaminants would be expected to migrate in the environment. The heavily vegetated nature of the ground surface in OU1 is expected to minimize contaminant migration through these physical pathways. Radium decay can produce radon in soil vapor. However, there is a very low likelihood of exposure to Site contaminants in air, especially given the

dispersed nature of the radiological artifacts and the lack of indoor structures within OU1. Elevated concentrations of radionuclides, primarily radium-226, associated with releases from artifacts were found to be isolated, generally within a foot or less of the artifact. While many of the same contaminants detected in soil were also detected in Site groundwater above background and at concentrations that exceeded screening groundwater consumption benchmarks, spatial trends were not observed and there were no signs of widespread contaminant plumes resulting from the waste fill. Overall, based on the fate and transport characteristics of the contaminants identified within OU1 and the heavily vegetated nature of the Site, there is a low potential for contaminants within OU1 to migrate off-Site.

7.2 CONCLUSIONS

All areas of OU1 that are underlain by waste fill have the potential to exhibit chemical and radiological contamination associated with sewage sludge, waste fill, and radiological artifacts within the waste fill. The release mechanism of spreading waste fill during historical waste disposal operations and covering it with a soil amendment containing sewage sludge resulted in a well-mixed, but still heterogeneous source that is widespread throughout OU1. Within OU1, this corresponds to an impacted area covering 32 acres with 284,000 cubic yards of impacted media (soil amendment and waste fill). The primary Site contaminants identified within OU1 include metals, PAHs, PCBs, dioxins/furans, and radionuclides at levels that may pose a risk to human health and the environment. Radiological artifacts also are present within the waste fill, however due to shielding from overlying soil, the prevalence of these items in waste fill and their associated radioactivity is difficult to quantify. The contaminants identified in OU1 are persistent in the environment and generally adsorb strongly to soil and have a low potential for migration.

This EIR provides a thorough summary of the OU1 field activities and investigation findings, including detailed estimates defining the extent of contaminated media and summaries of analytical data characterizing the nature of contaminant sources within OU1. The information presented in this report effectively characterizes Site conditions for the purpose of informing construction planning for the SSSI CSRM. At this date, the NPS CST's approach under CERCLA is to combine the results of activities completed within OU1 with future investigation results for the remainder of the Site to complete a single, Site-wide RI Report. Any future response action under CERCLA will consider the design of the SSSI CRSM. Until then, all existing engineering (i.e., fencing and signage) and institutional controls (i.e., administrative requirements for access to the Site, including OU1) will be maintained so that exposure to contaminants is appropriately managed.

Any construction performed within OU1, such as the SSSI CSRM, must be conducted in a manner that considers hazards to the public, hazards to site workers, and management and offsite disposal of waste generated during construction (e.g., potential radiological waste, potential RCRA hazardous waste, and other contaminated materials that are not suitable for re-use at the Site). Specifically, the presence of radiological sources within the waste fill requires that radiological controls be implemented during work conducted in impacted areas of OU1. Project plans should be developed prior to initiating work/construction activities to establish Site-specific procedures and controls to protect the public and workers from exposure to radiological hazards associated with the waste fill. Prior to mobilization, appropriate criteria and instrumentation should be selected to identify discrete radiological artifacts and areas exhibiting distributed radioactivity associated with ash. Also, approaches should be established to handle potential radioactive material encountered during construction and excavation activities. In addition to potential radiological hazards, the OU1 analytical results indicate that areas impacted with waste fill also contain hazardous chemicals, such as lead, at concentrations that could exceed TCLP

standards for RCRA hazardous waste. Therefore, proper characterization and management (including transportation and off-Site disposal) of waste generated on-Site also would be required during all construction activities performed within OU1. Potential impacts on construction activities could be minimized by selecting work areas that coincide with the portions of OU1 in which the waste fill layer is thinnest, which is along the northeastern extent of OU1.

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FIGURES

Map source: National Park Service (www.nps.gov)
Accessed 9/1/2016.

National Park Service
Gateway National Recreation Area

Gateway National Recreation Area and Geographic Unit Locations

Great Kills Park, Staten Island, NY | February 2017

Figure 1-1. Gateway National Recreation Area and Geographic Unit Locations

Legend

Approximate Waste Fill Area

TCRA Boundary

Note: Dashed Lines Indicate Approximate Location

North

0 1,400

Scale in Feet

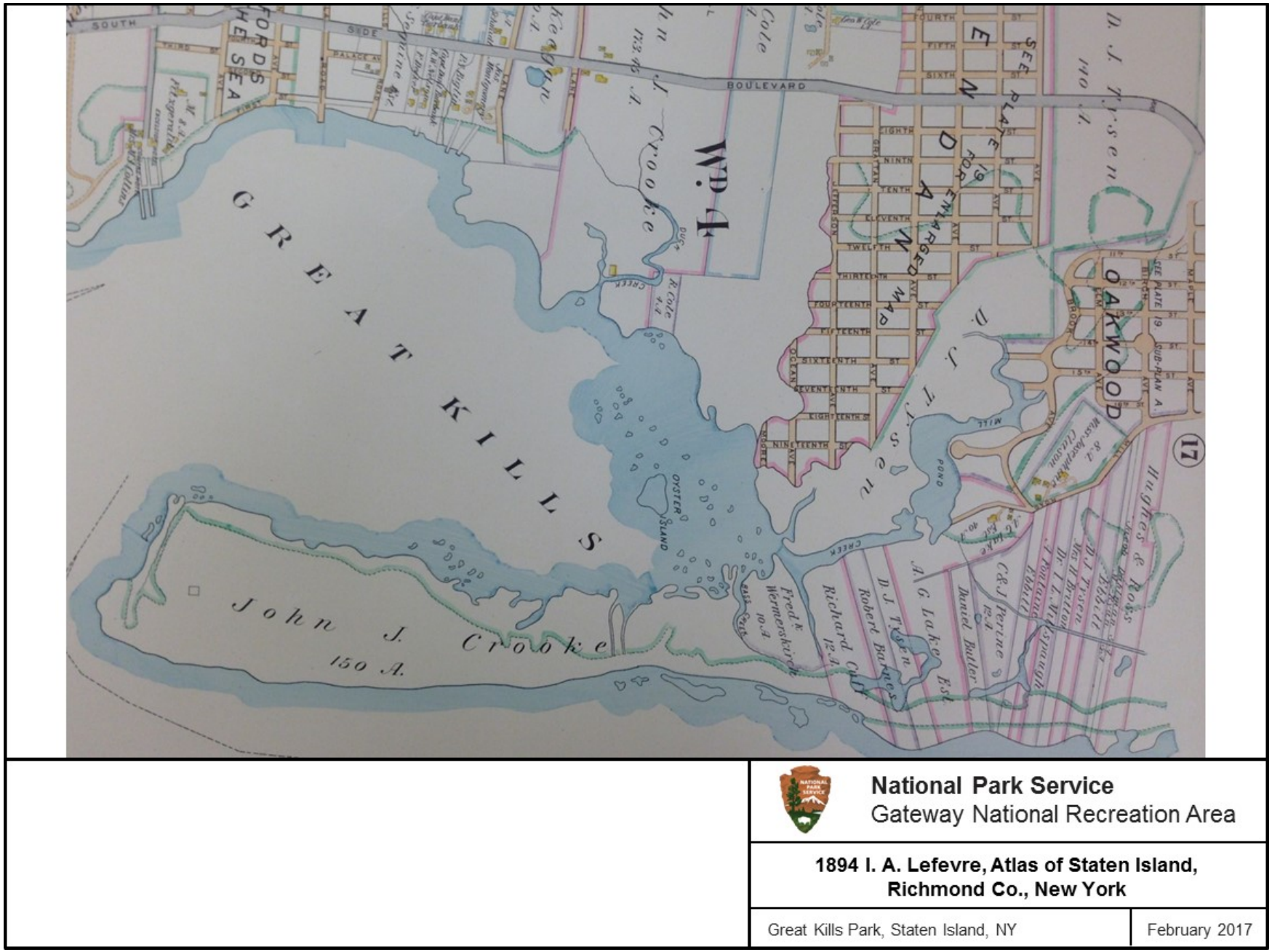
National Park Service
Gateway National Recreation Area

Great Kills Park Site Features

Great Kills Park, Staten Island, NY | May 2017

Figure 1-2 Great Kills Park Site Features

Figure 1-3. Map of the Great Kills Park Site Showing Operable Units 1 and 2

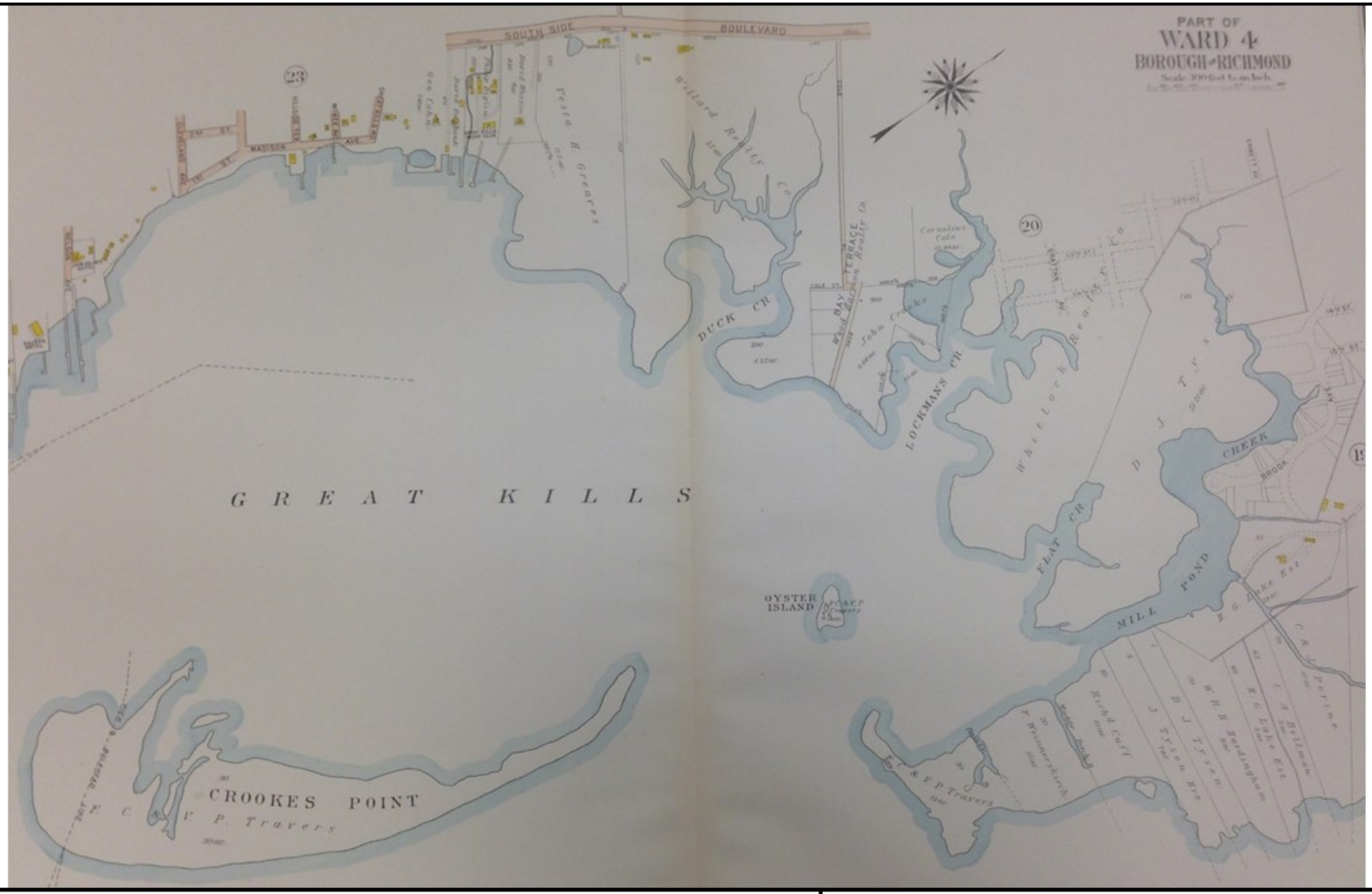


National Park Service
Gateway National Recreation Area

1894 I. A. Lefevre, Atlas of Staten Island, Richmond Co., New York

Great Kills Park, Staten Island, NY	February 2017

Figure 1-4. 1894 I.A. Lefevre, Atlas of Staten Island, Richmond County, New York



National Park Service
Gateway National Recreation Area

1917 G.W. Bromley and Co. Atlas of the City of New York, Borough of Richmond, Staten Island, Portion of Ward 4

Great Kills Park, Staten Island, NY	February 2017

Figure 1-5. 1917 G.W. Bromley and Co. Atlas of City of New York, Borough of Richmond, Staten Island

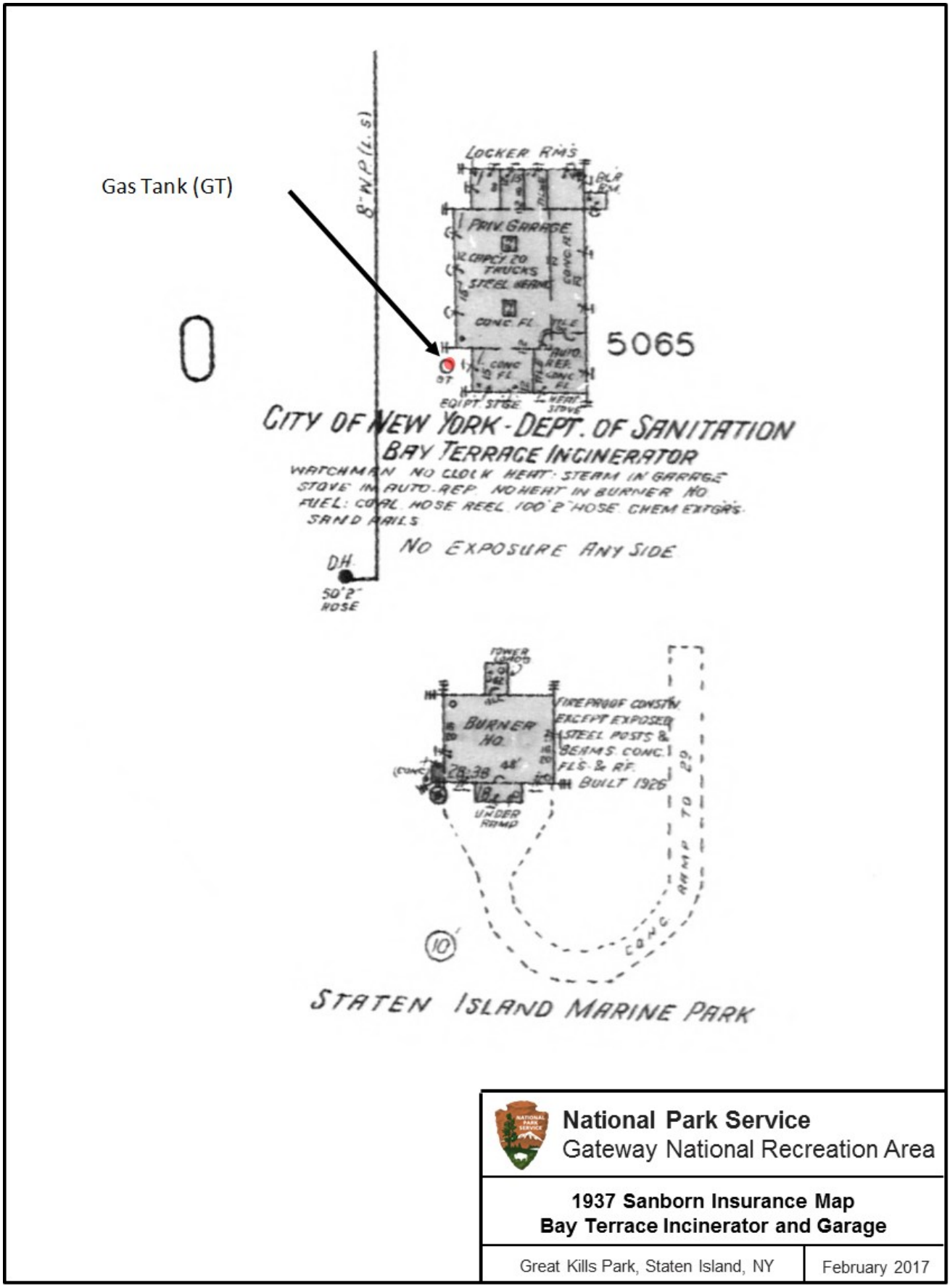


Figure 1-6. 1937 Sanborn Insurance Map, Bay Terrace Incinerator and Garage

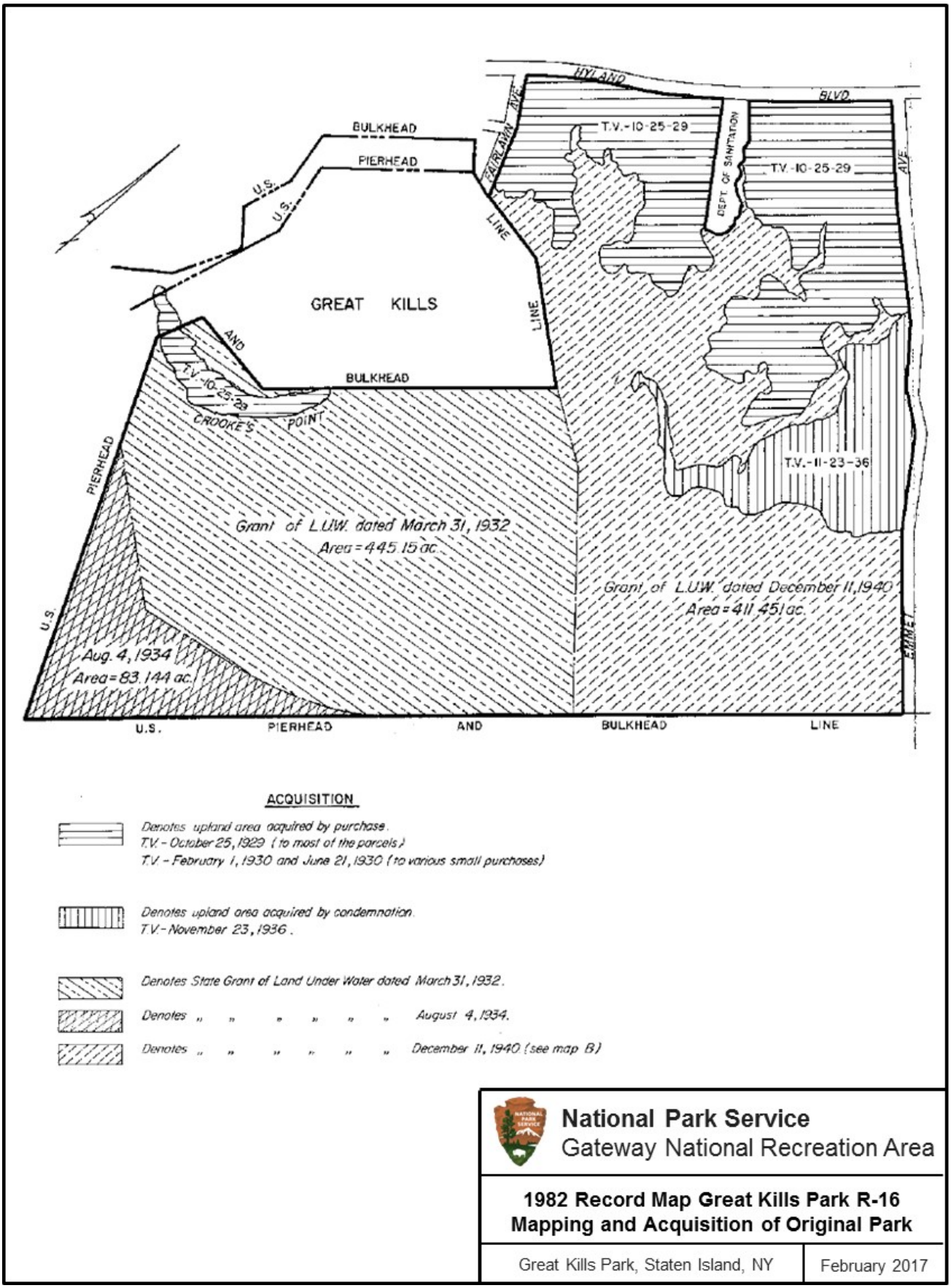
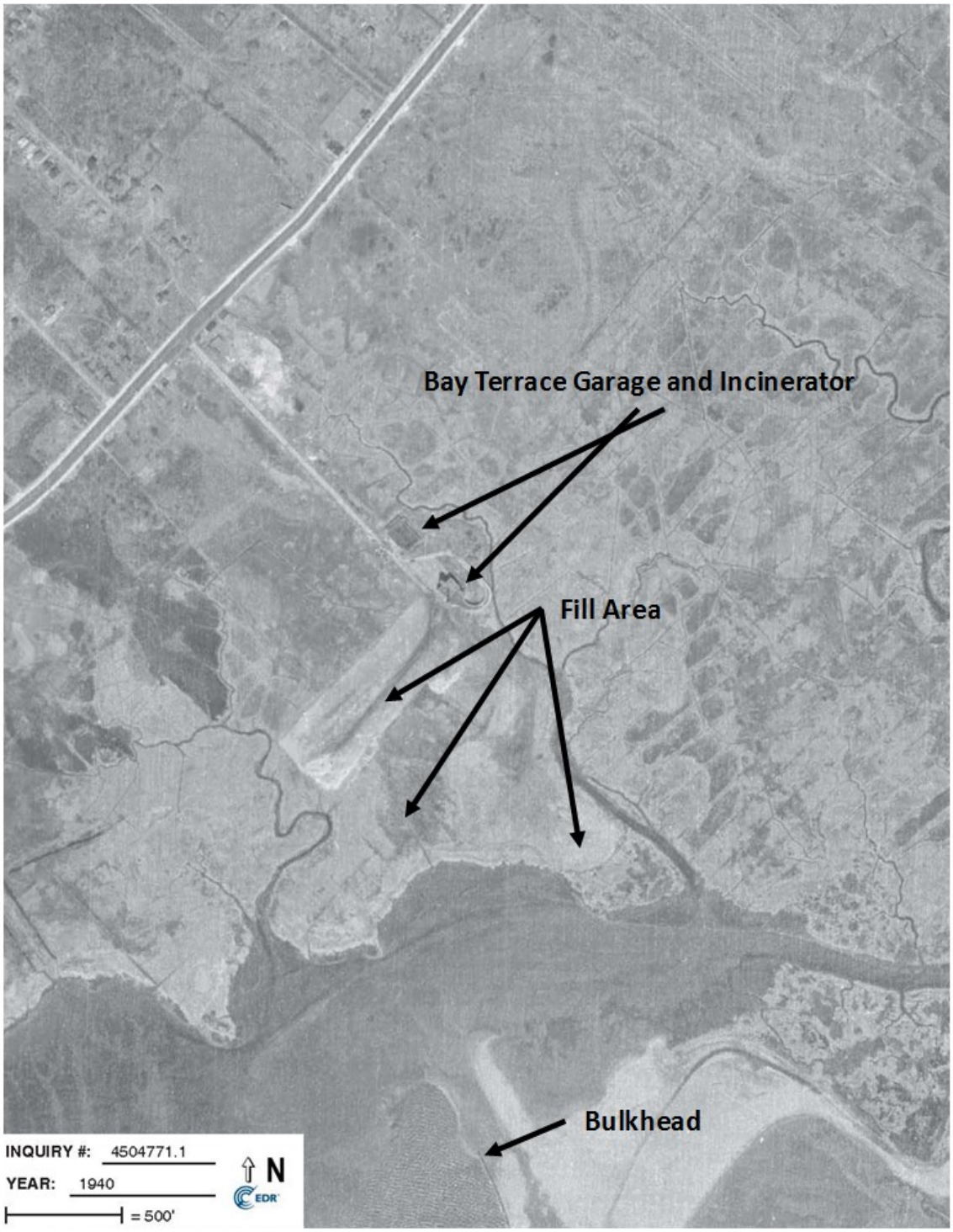


Figure 1-7. 1982 Record Map, Great Kills Park R-16 Mapping and Acquisition of Original Park



National Park Service
Gateway National Recreation Area

1940 Aerial Photograph Showing GKP Site (Source: EDR Aerial Viewpoint)

Great Kills Park, Staten Island, NY | February 2017

Figure 1-8. 1940 Aerial Photograph Showing GKP Site

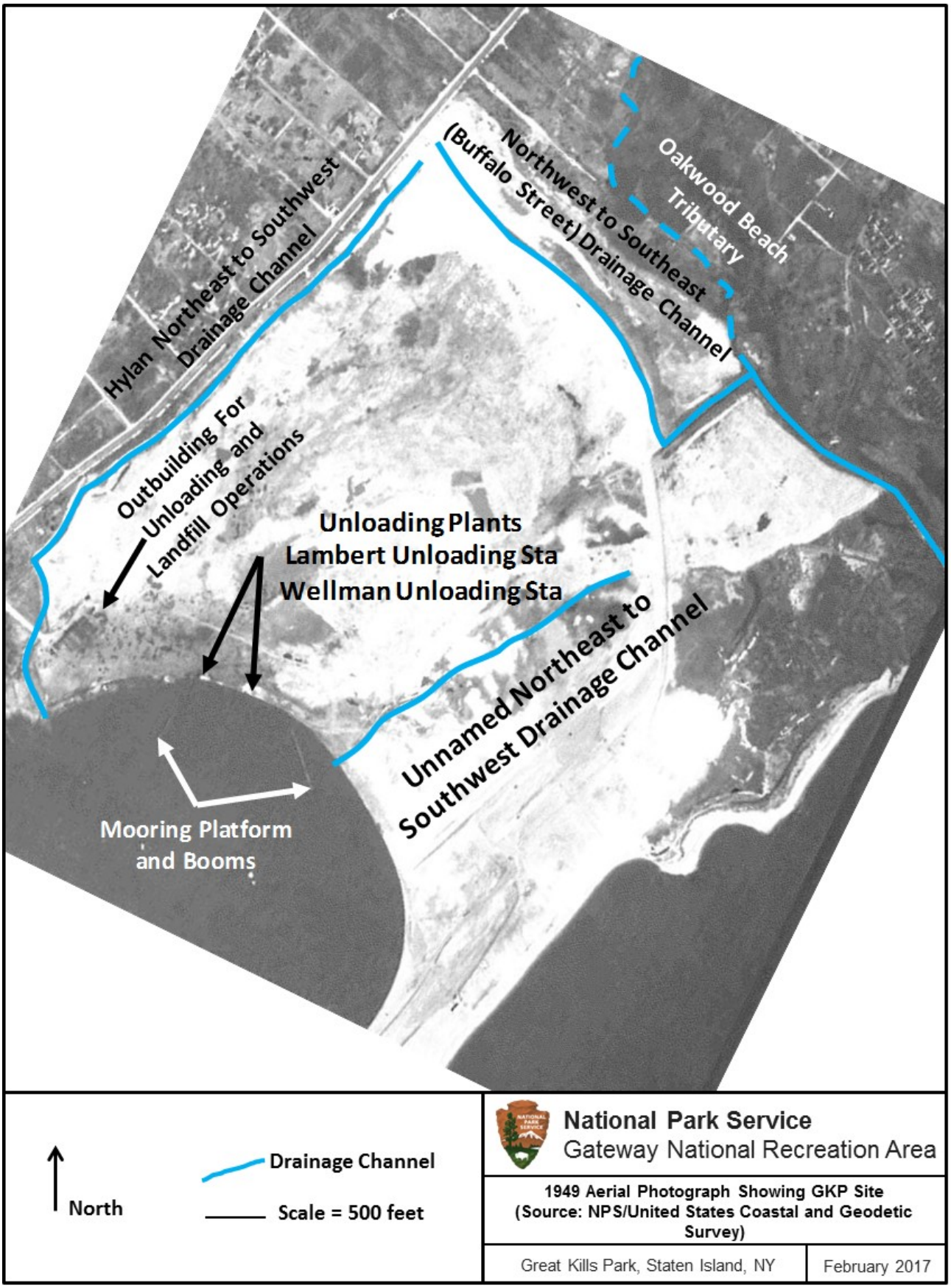


Figure 1-9. 1949 Aerial Photograph Showing GKP Site

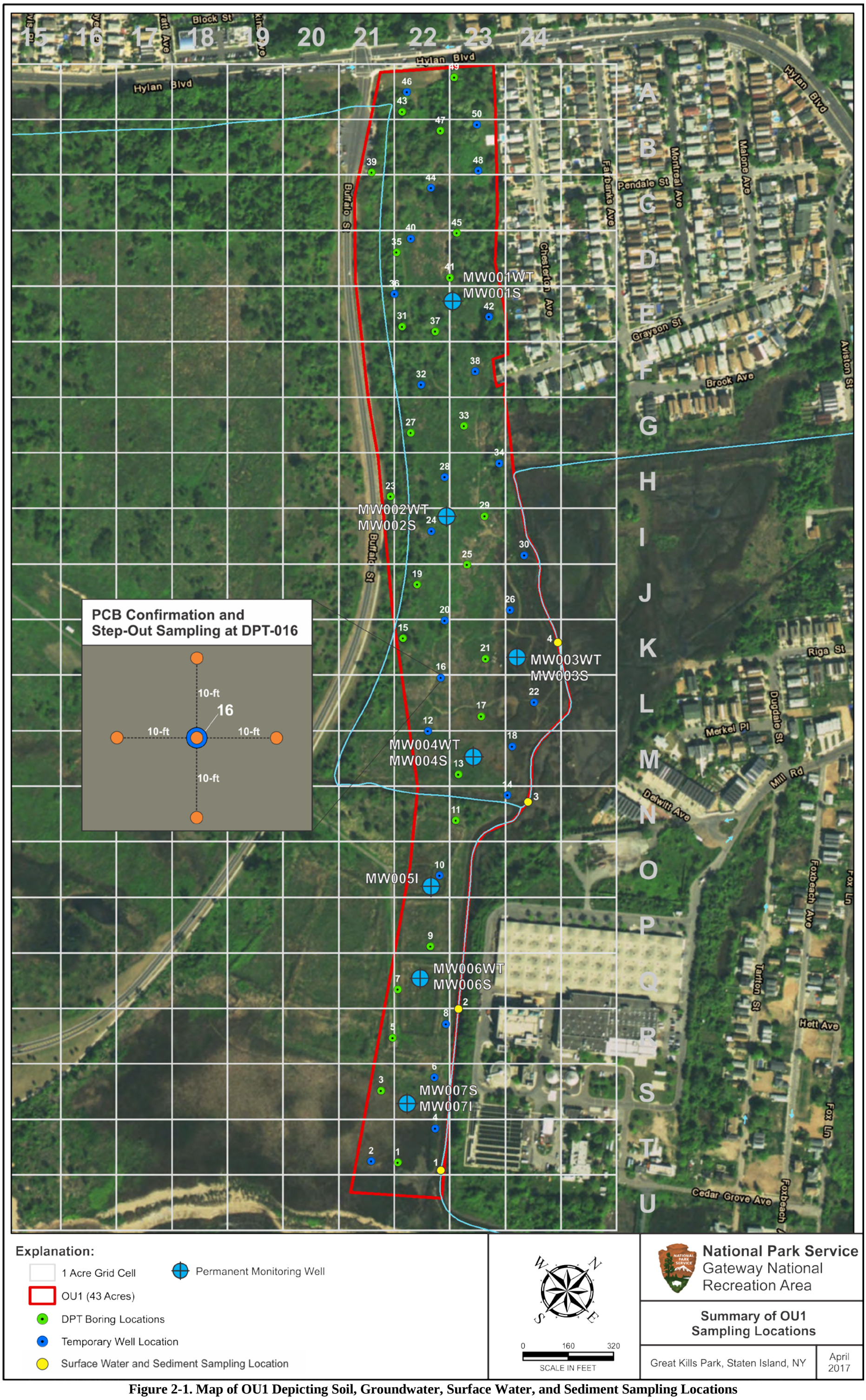


Figure 2-1. Map of OU1 Depicting Soil, Groundwater, Surface Water, and Sediment Sampling Locations

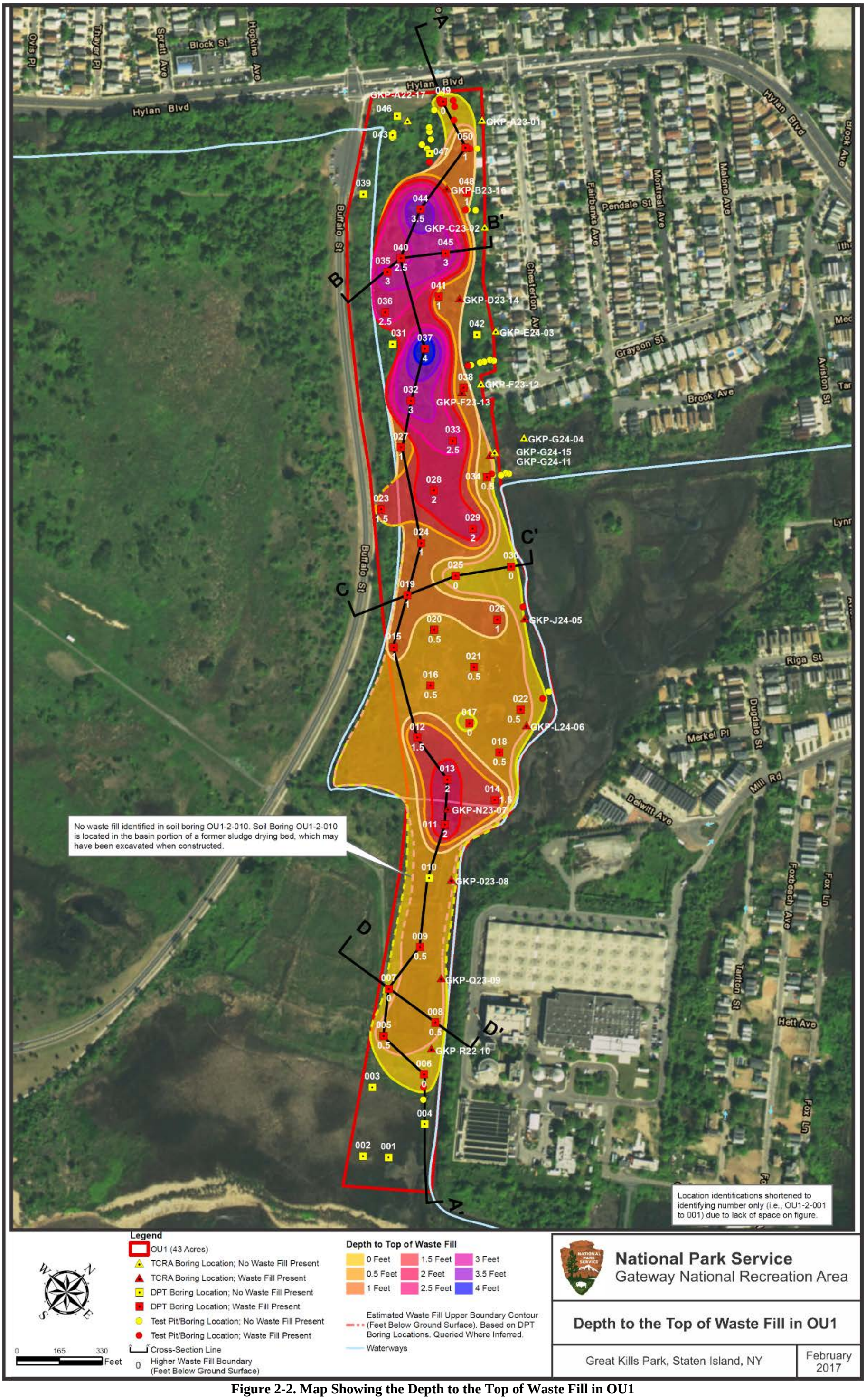


Figure 2-2. Map Showing the Depth to the Top of Waste Fill in OU1

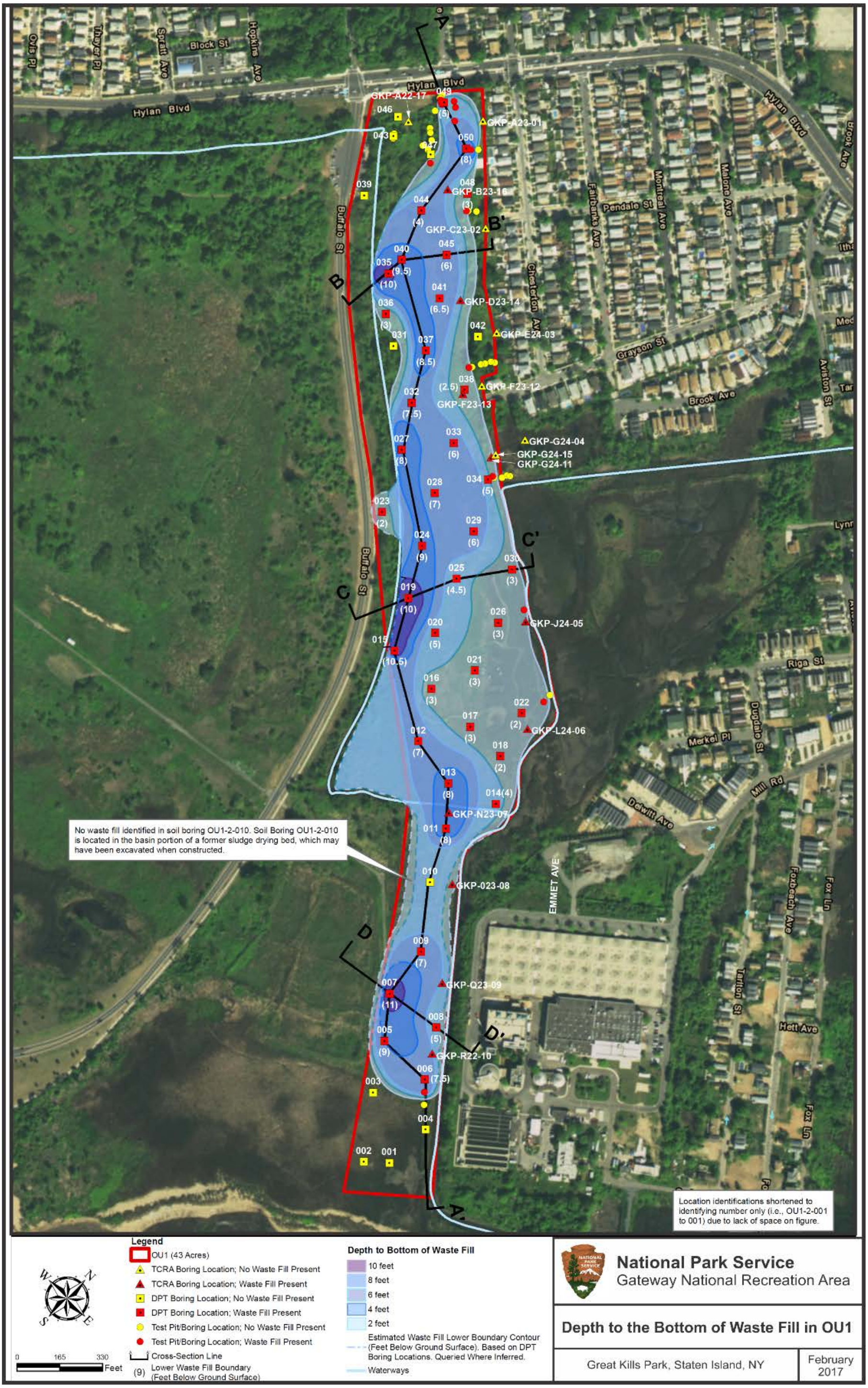


Figure 2-3. Map Showing the Depth to the Bottom of Waste Fill in OU1

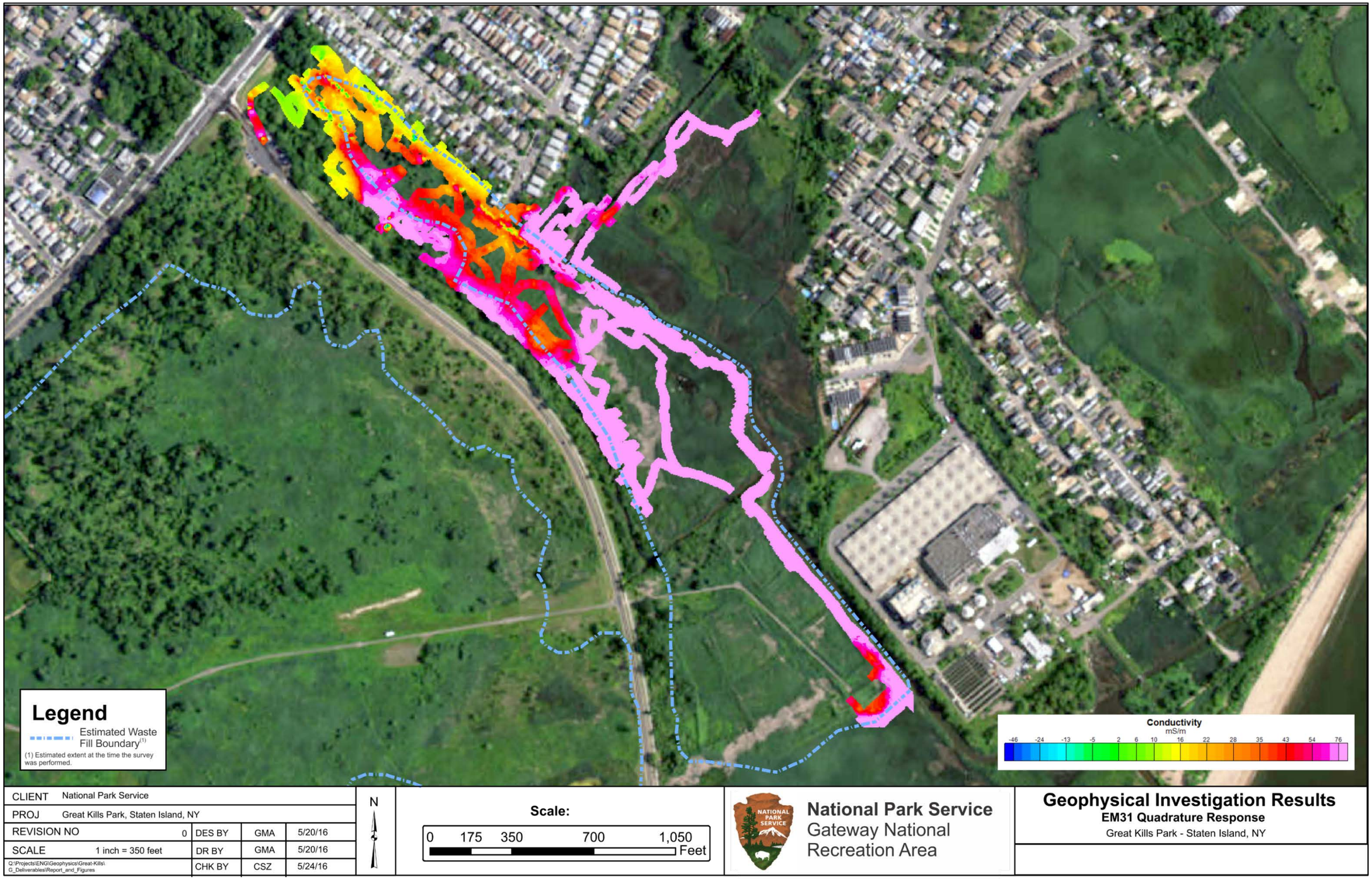


Figure 2-4. Map of Geophysical Survey Results: EM31 Quadrature Response (Conductivity)

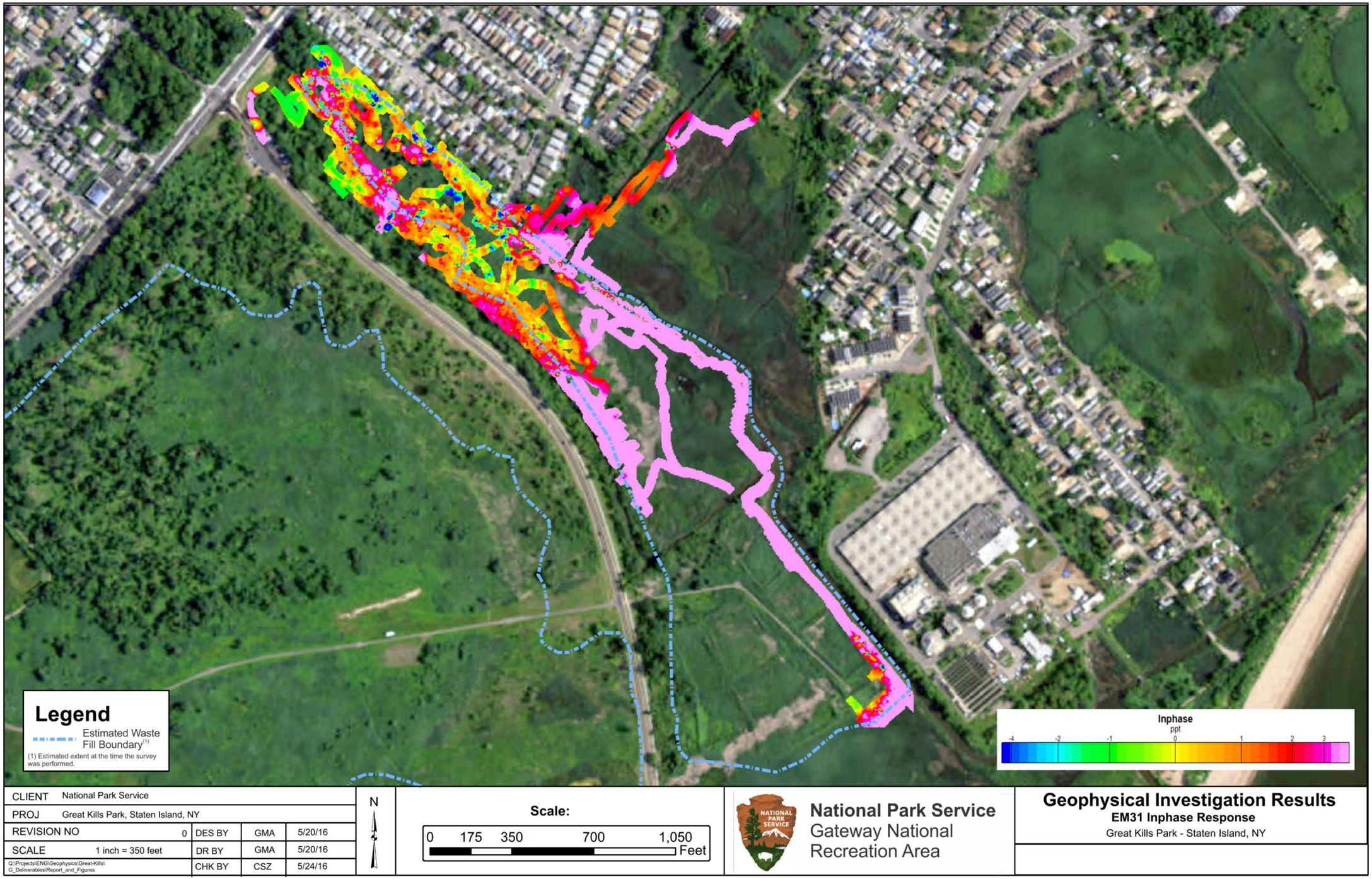


Figure 2-5. Map of Geophysical Survey Results: EM31 In-Phase Response

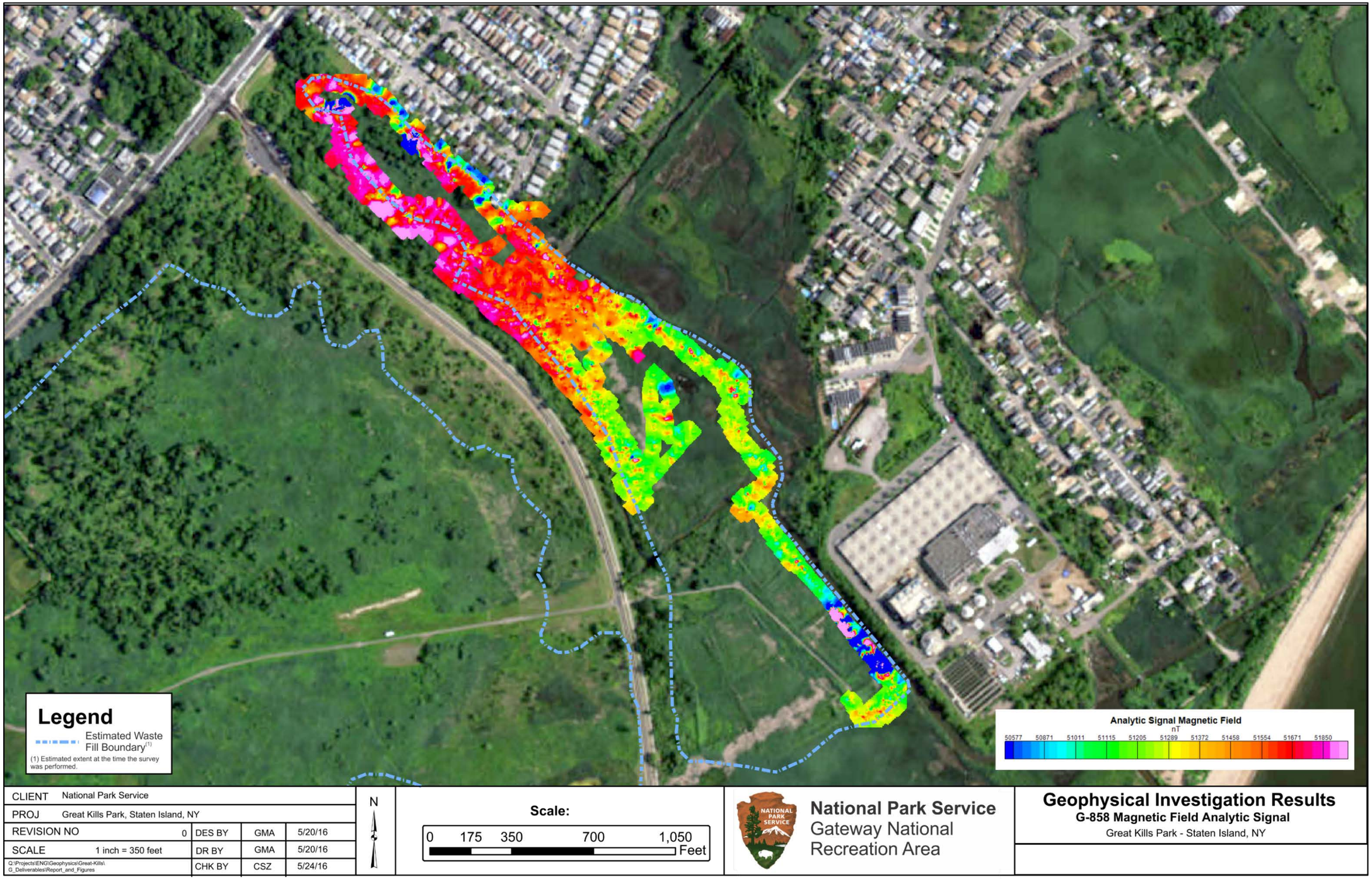


Figure 2-6. Map of Geophysical Survey Results: G858 Magnetic Field Analytical Signal

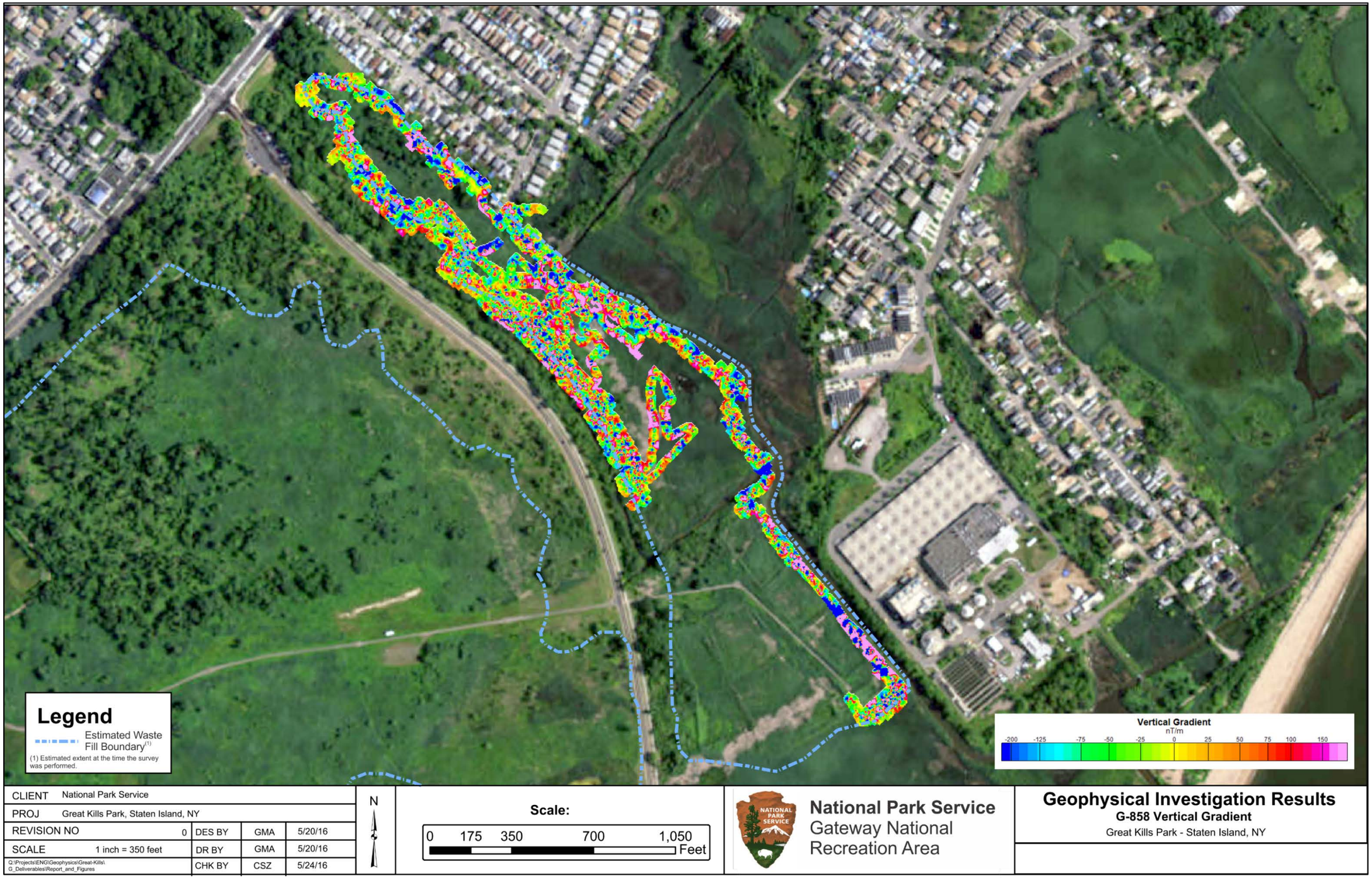


Figure 2-7. Map of Geophysical Survey Results: G858 Vertical Gradient

Figure 2-8. Summary of Gamma Surveys Conducted within OU1

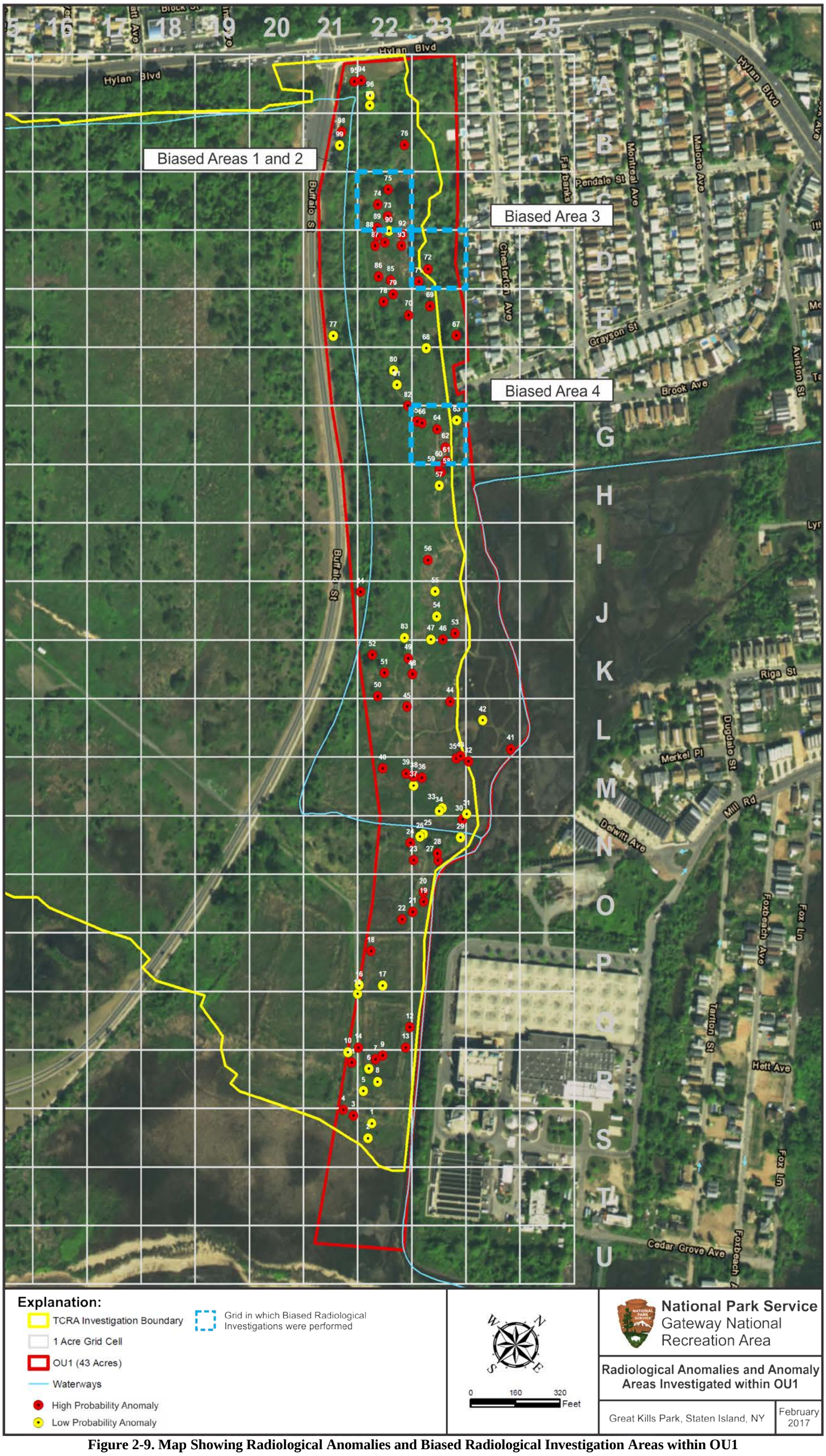


Figure 2-9. Map Showing Radiological Anomalies and Biased Radiological Investigation Areas within OU1

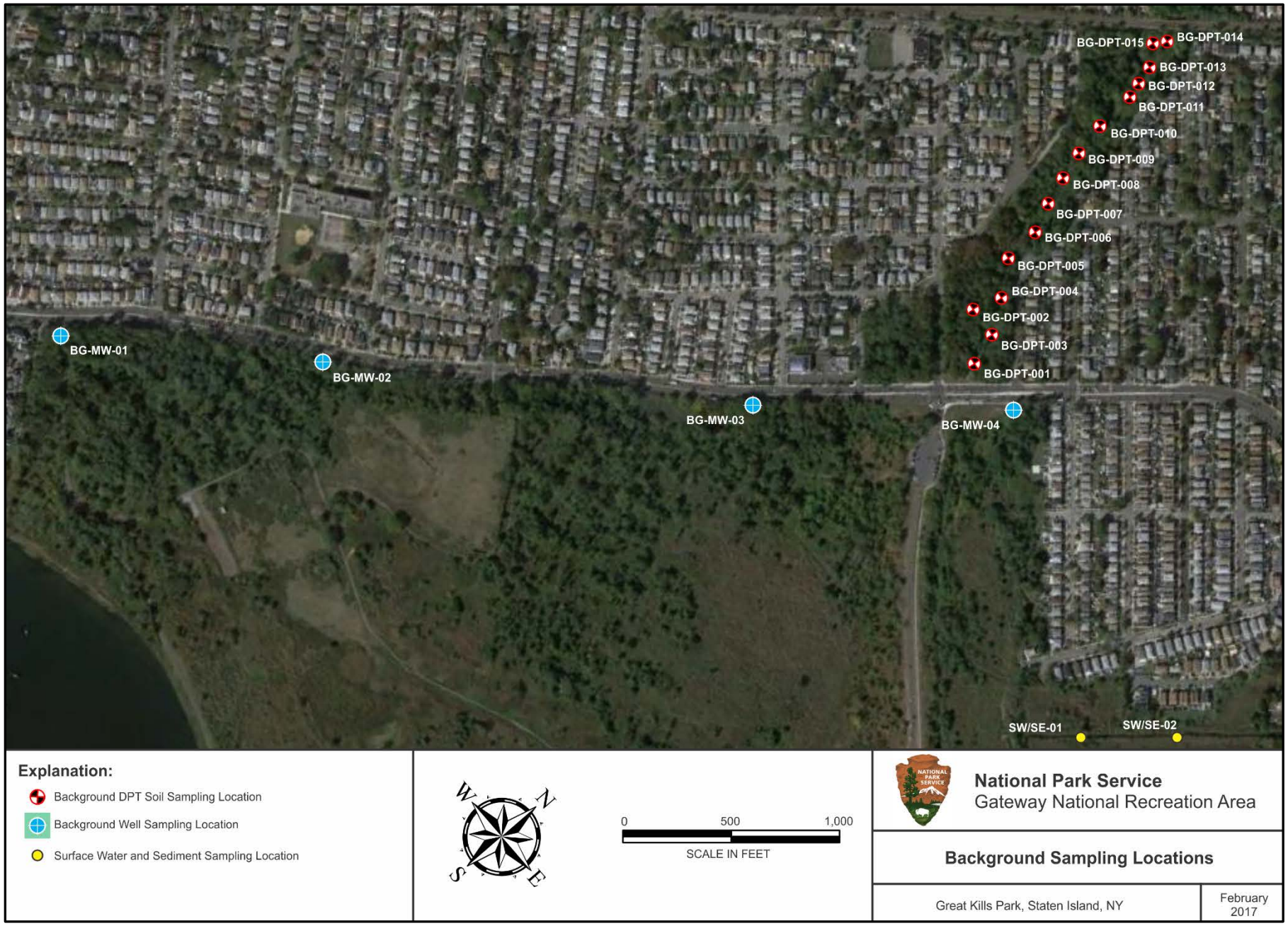


Figure 2-10. Map Showing Background Soil, Groundwater, Surface Water, and Sediment Sampling Locations

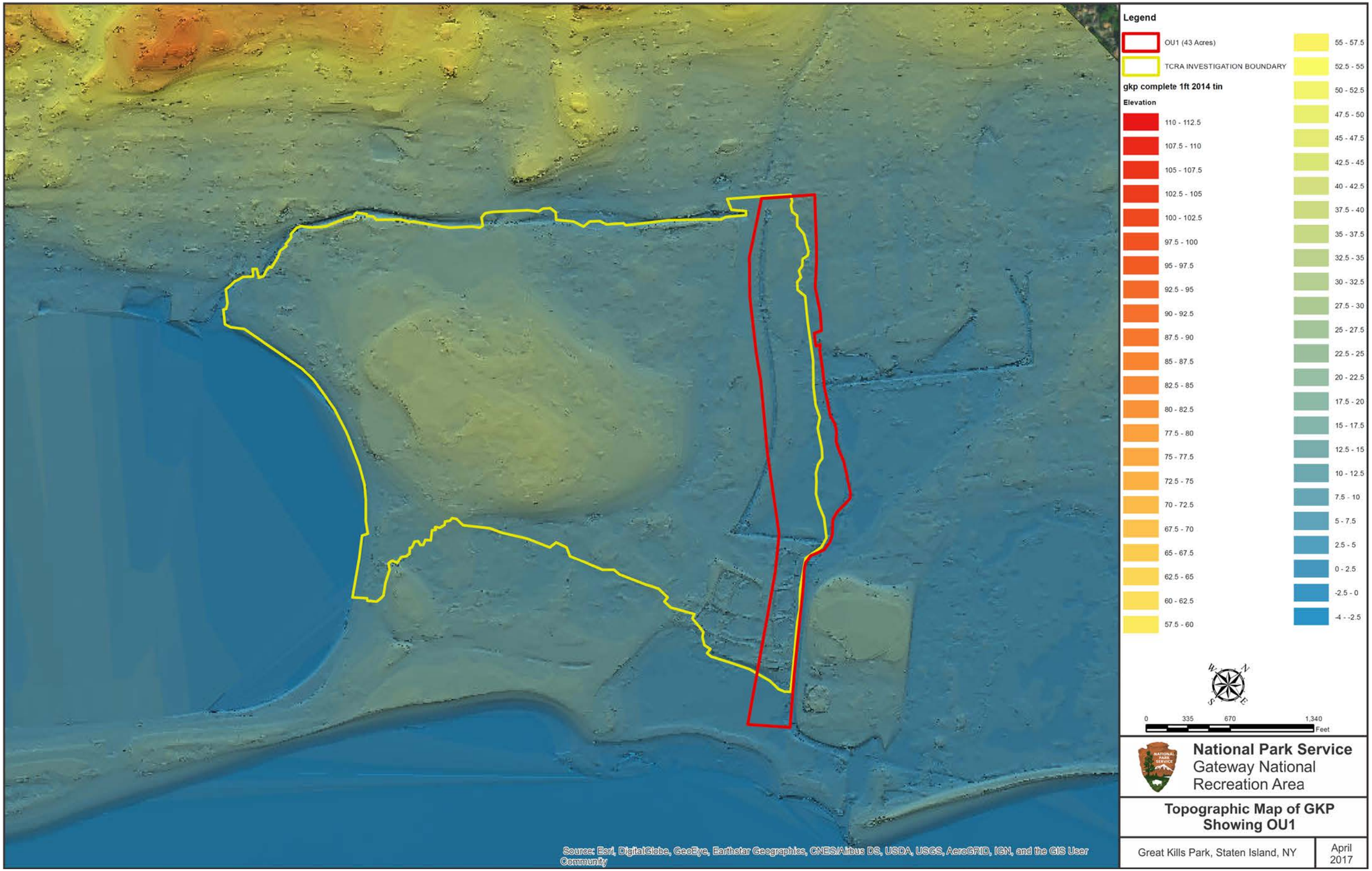


Figure 3-1. Topographic Map of the GKP Showing OU1

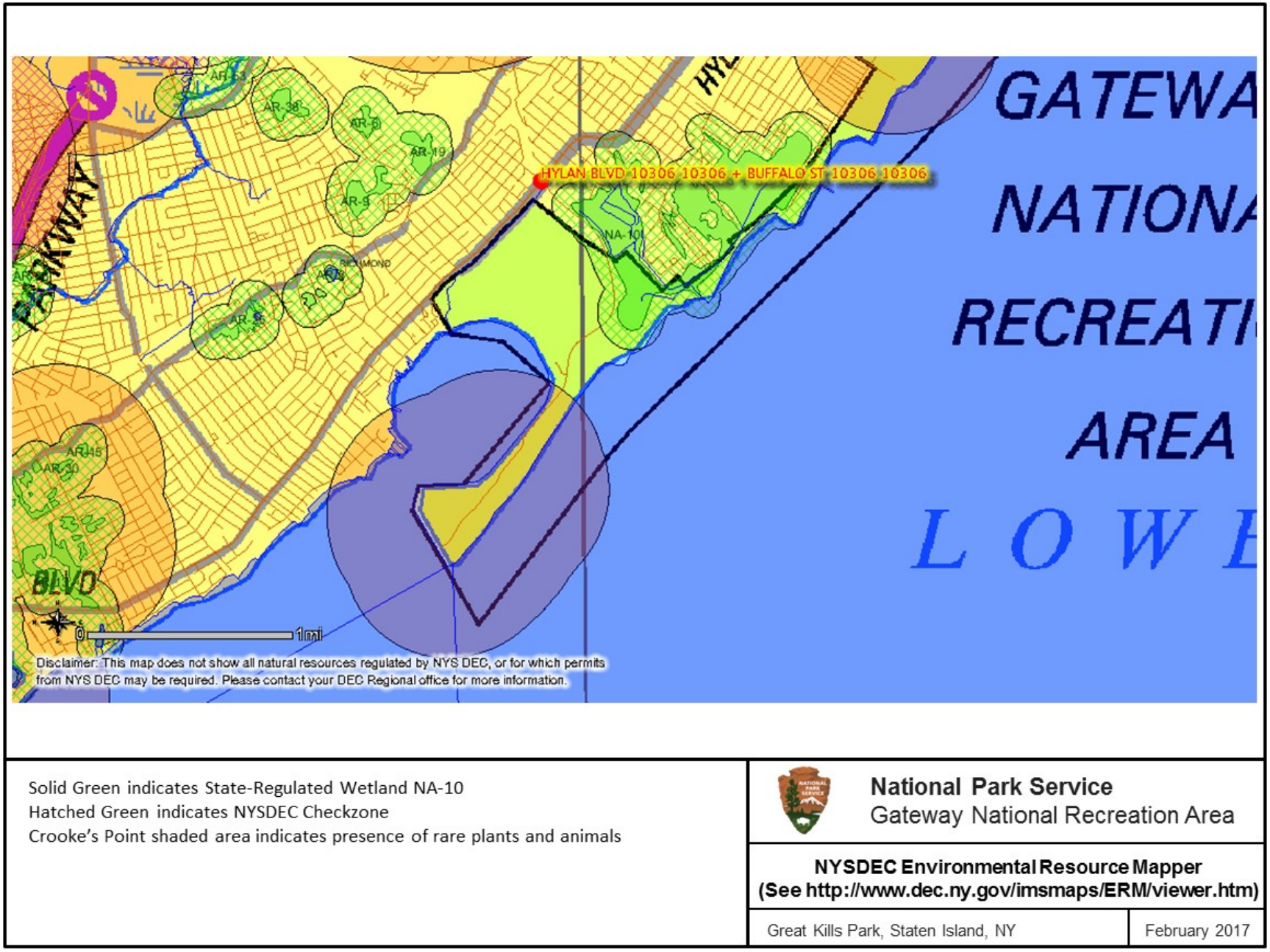


Figure3-2. NYSDEC Environmental Resource Mapper

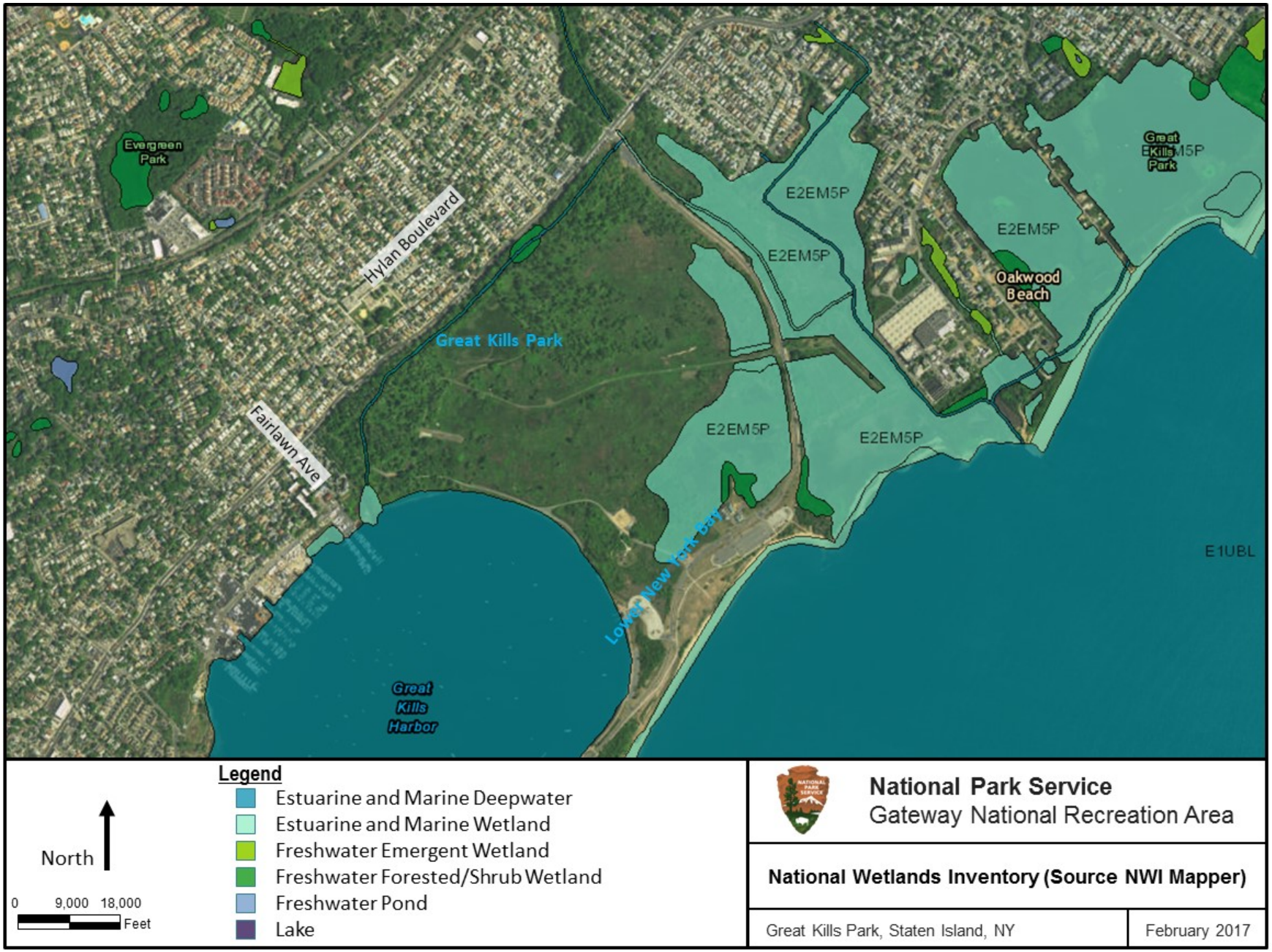


Figure 3-3. National Wetlands Inventory

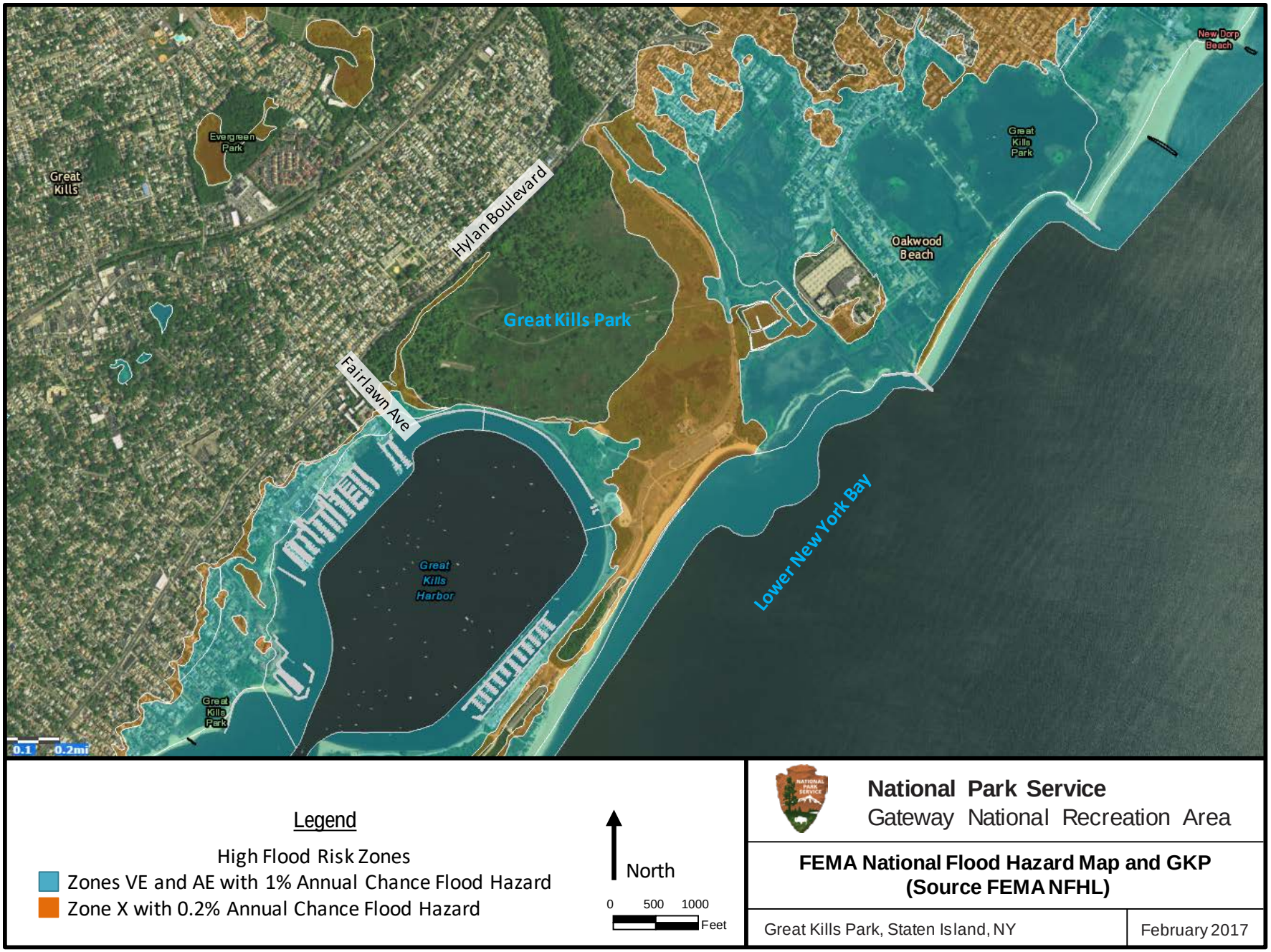


Figure 3-4. FEMA National Flood Hazard Map and GKP Site

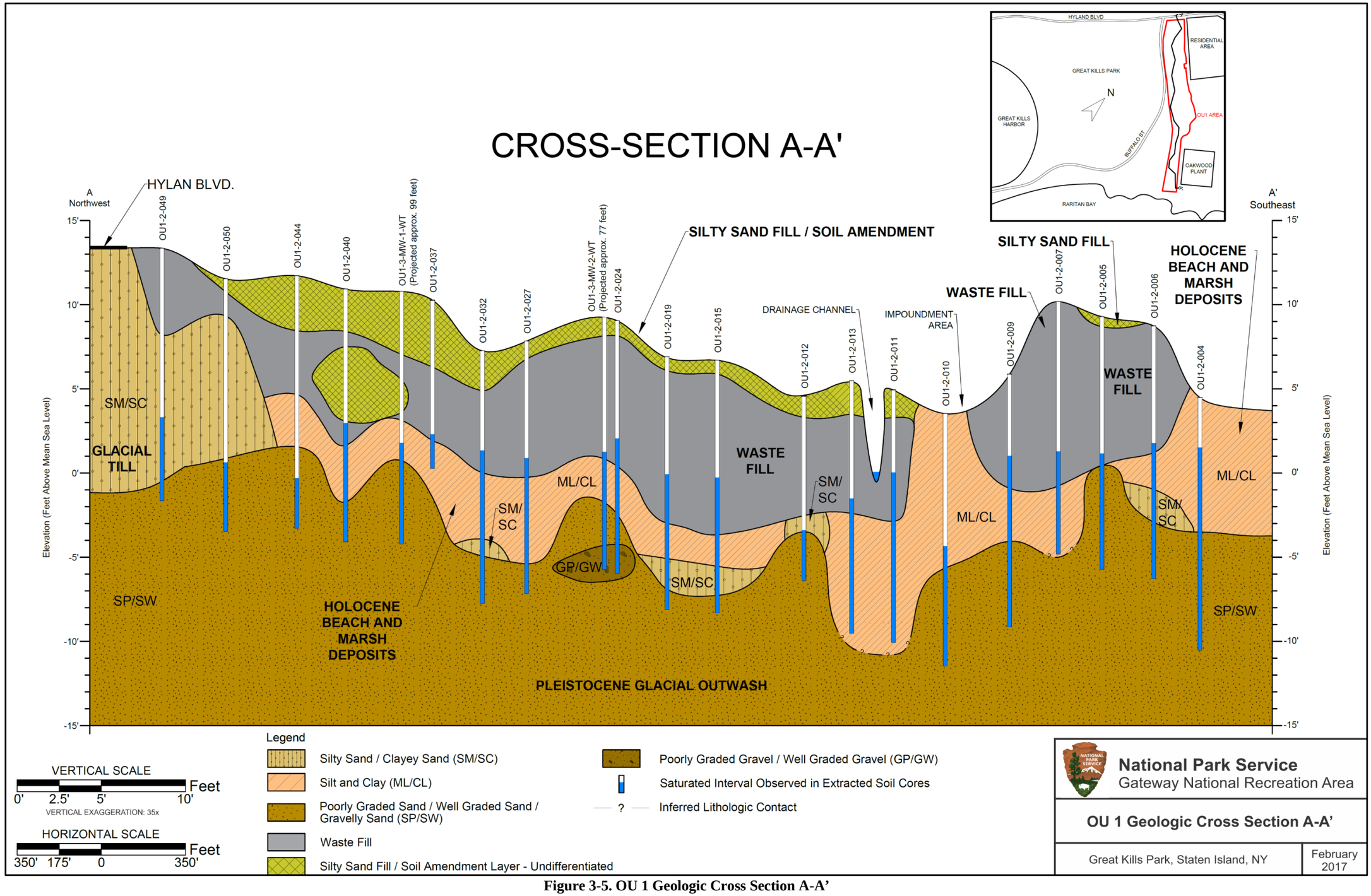


Figure 3-5. OU 1 Geologic Cross Section A-A'

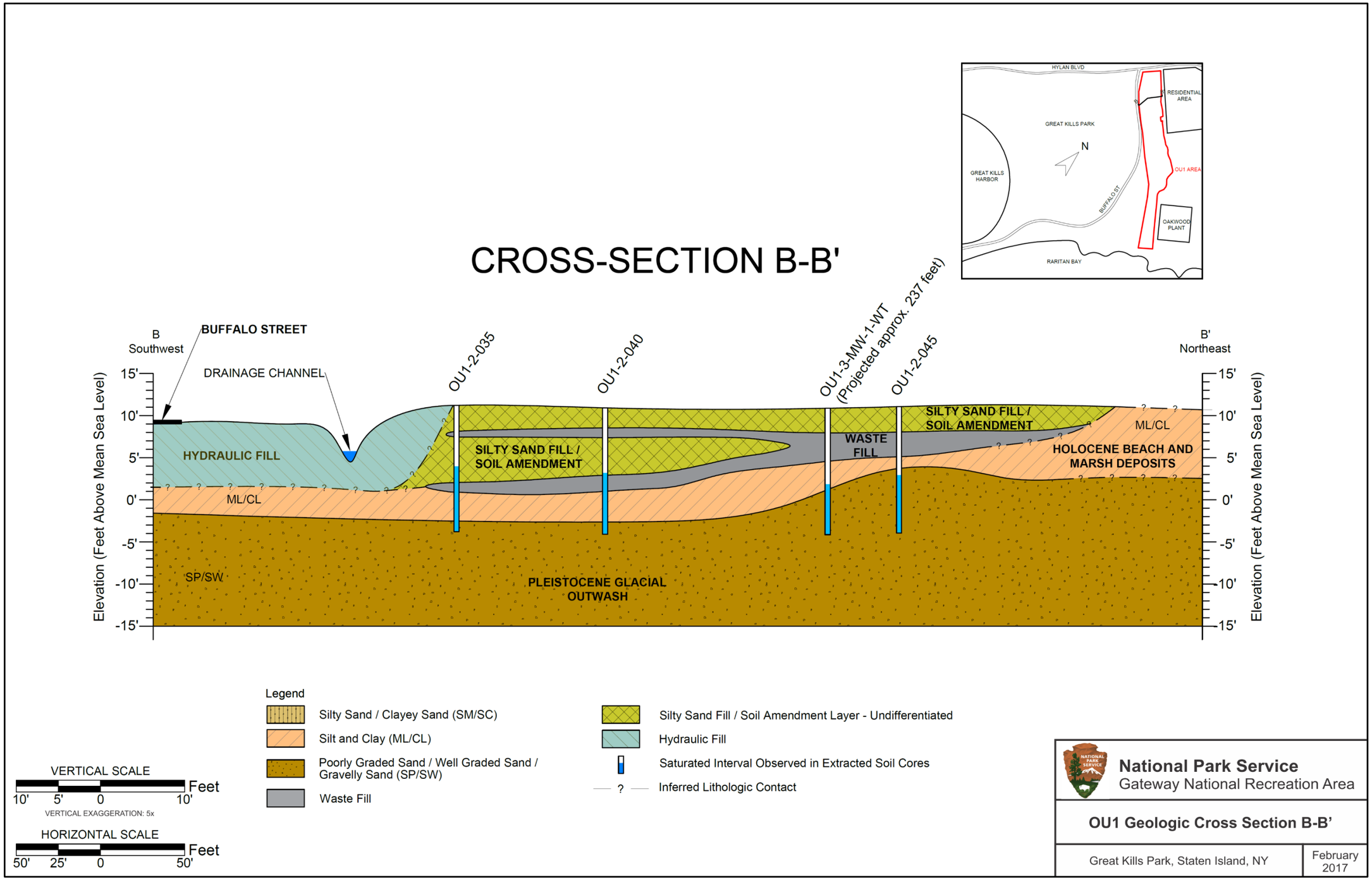


Figure 3-6. OU 1 Geologic Cross Section B-B'

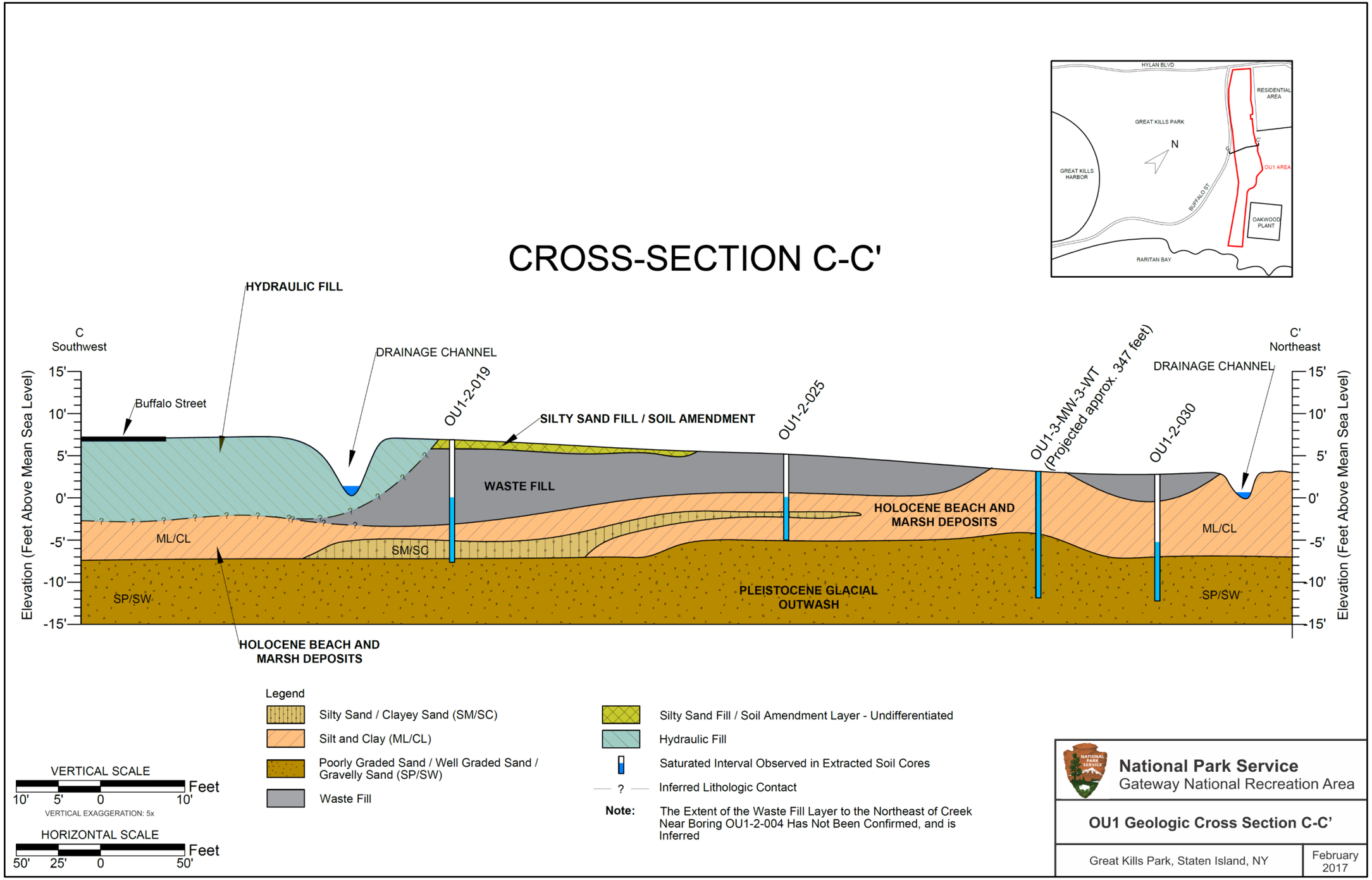


Figure 3-7. Geologic Cross Section C-C'

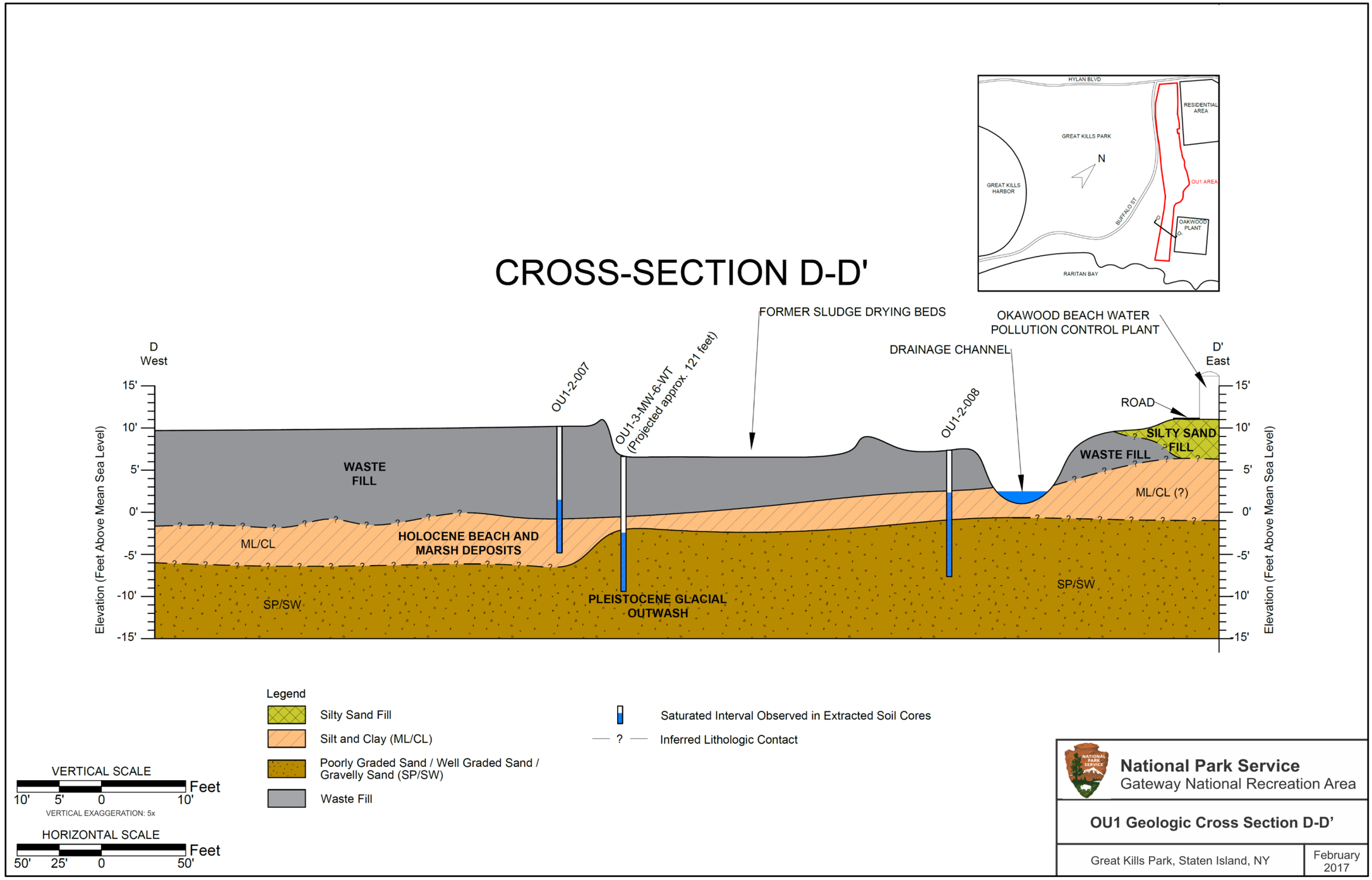


Figure 3-8. Geologic Cross Section D-D'

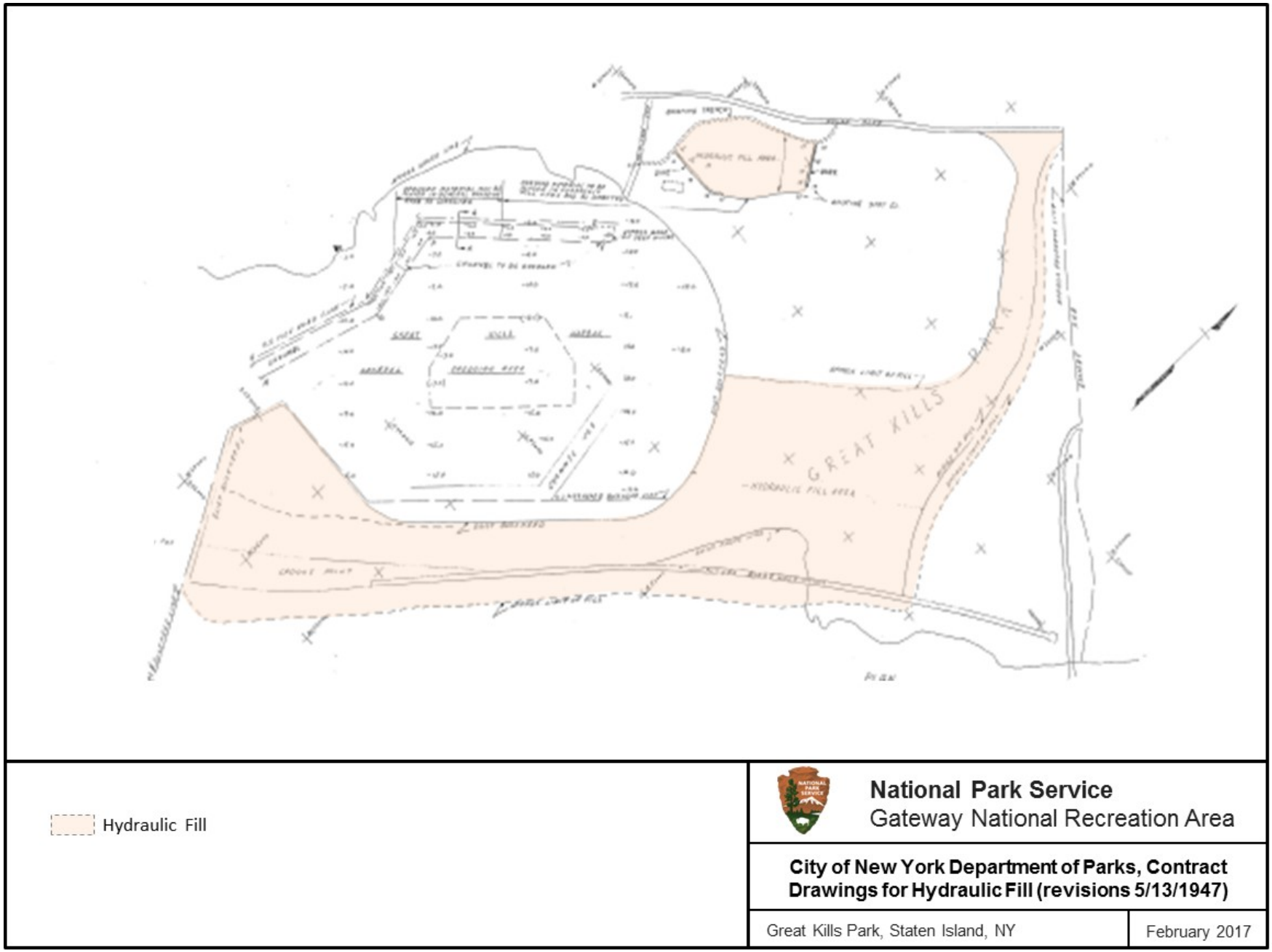


Figure 3-9. City of New York, Department of Parks, Contract Drawings for Hydraulic Fill

Figure 3-10. Map Showing Locations of Permitted Non-Potable Water Wells in Zip Code 10306

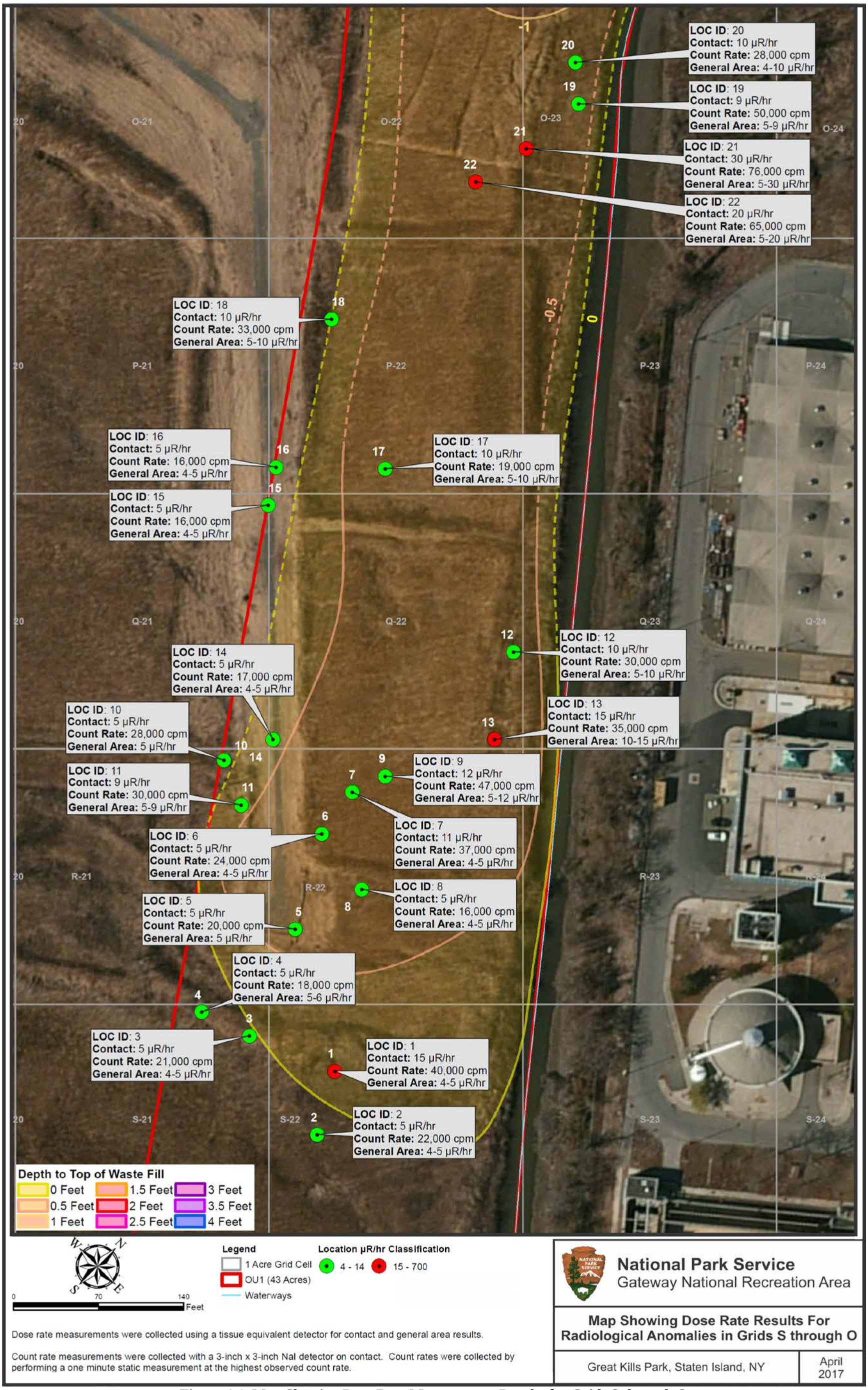


Figure 4-1. Map Showing Dose Rate Measurement Results for Grids S through O

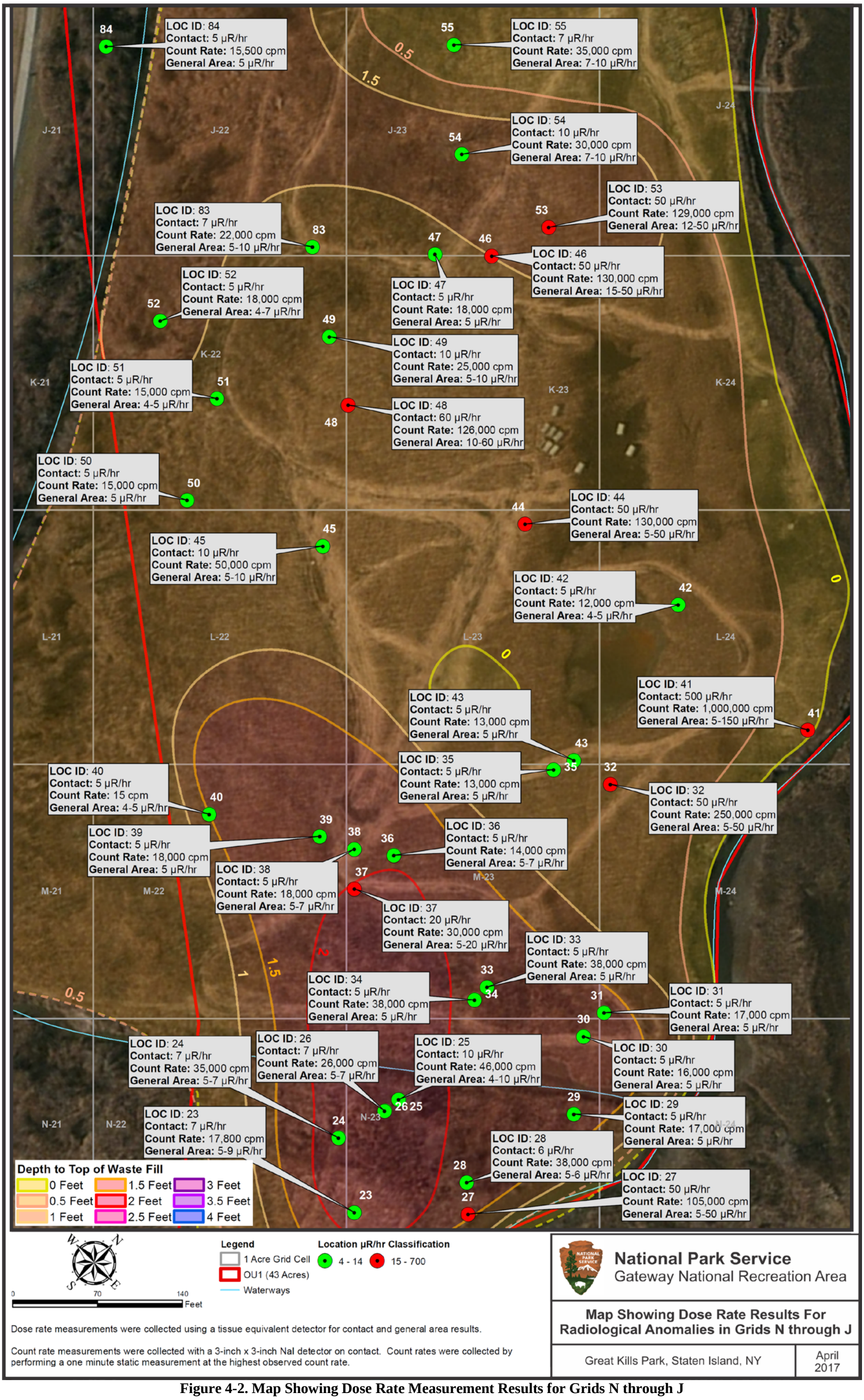


Figure 4-2. Map Showing Dose Rate Measurement Results for Grids N through J

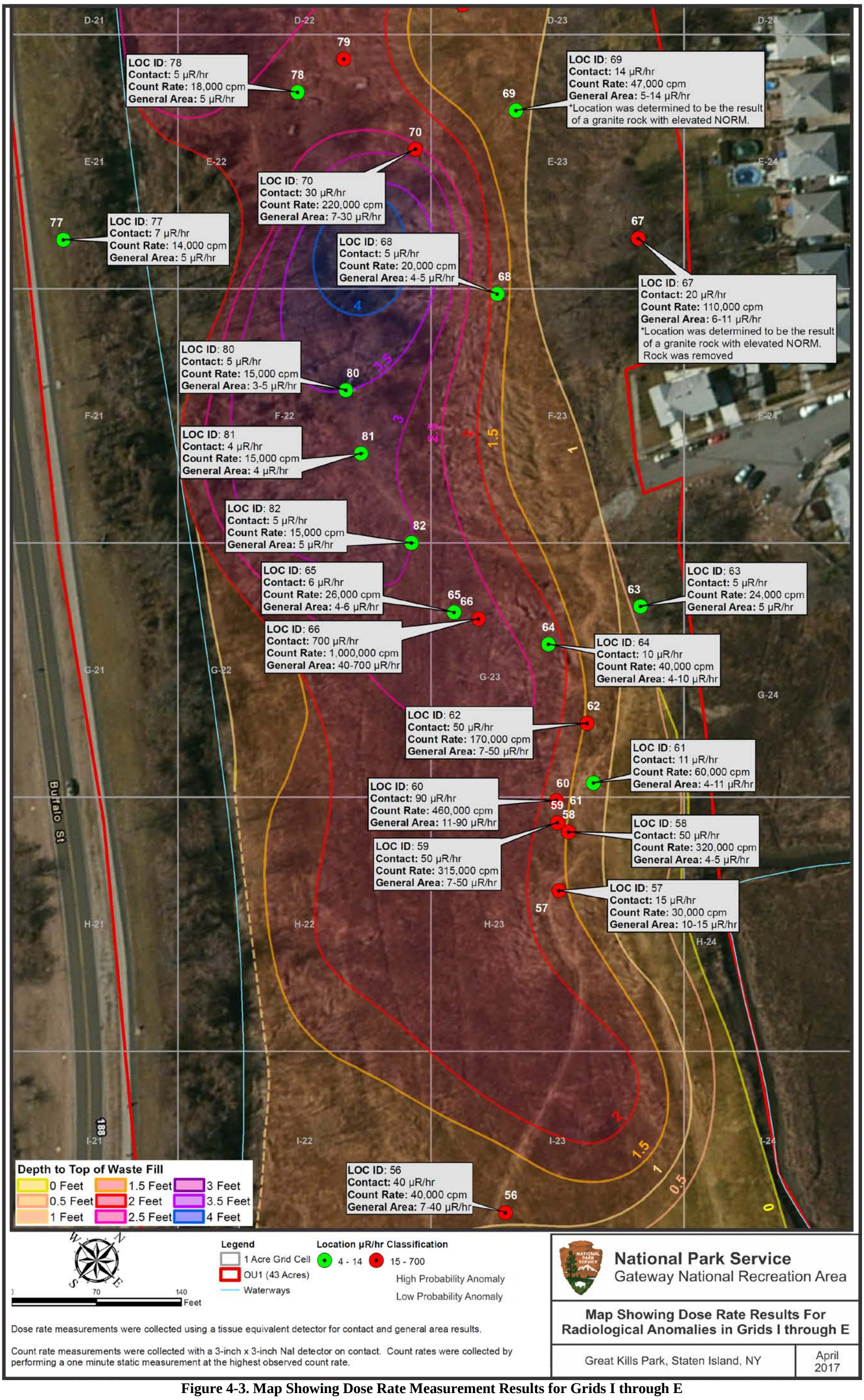


Figure 4-3. Map Showing Dose Rate Measurement Results for Grids I through E

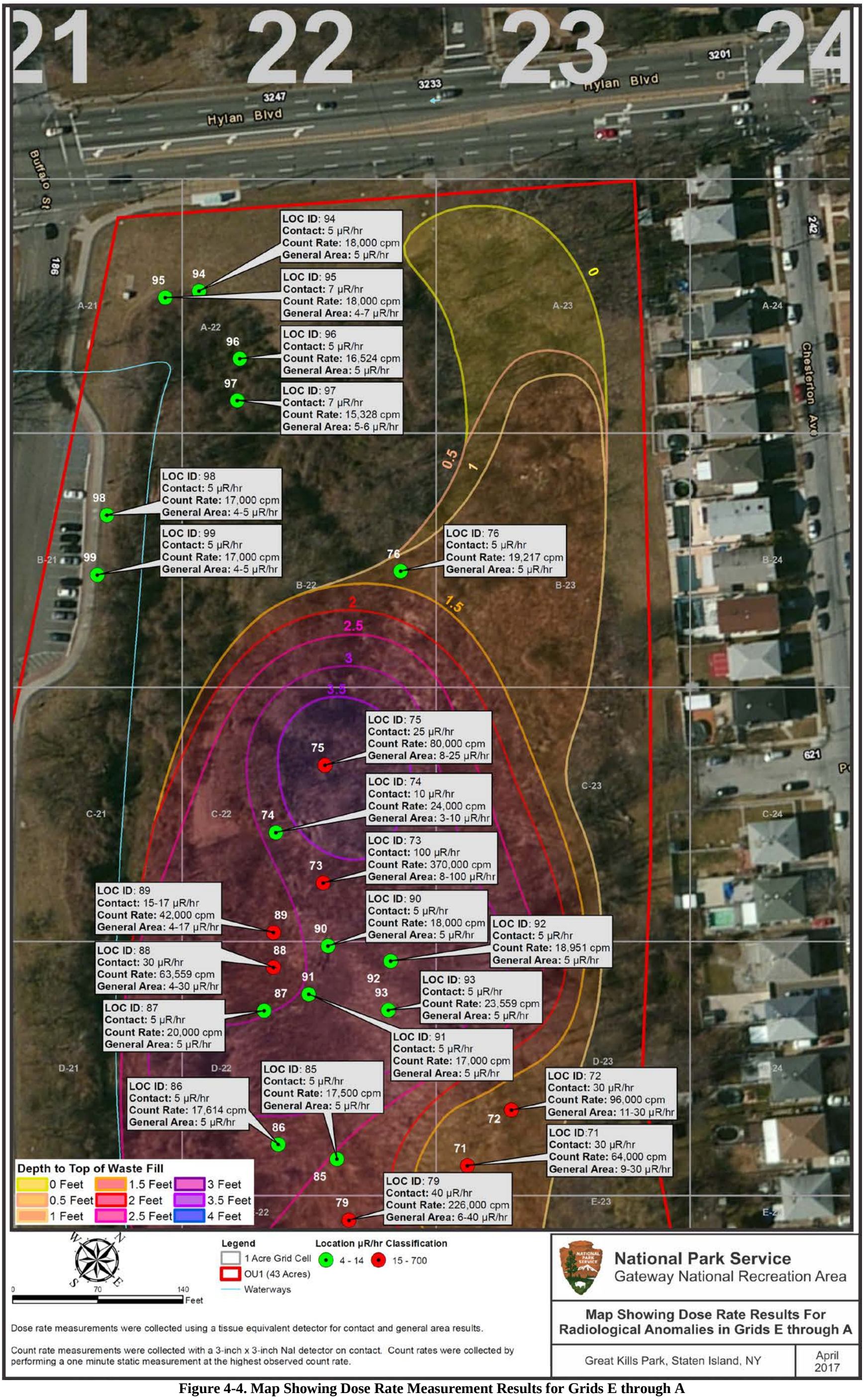


Figure 4-4. Map Showing Dose Rate Measurement Results for Grids E through A

Figure 4-5. Summary of OU1 Arsenic Results in Soil

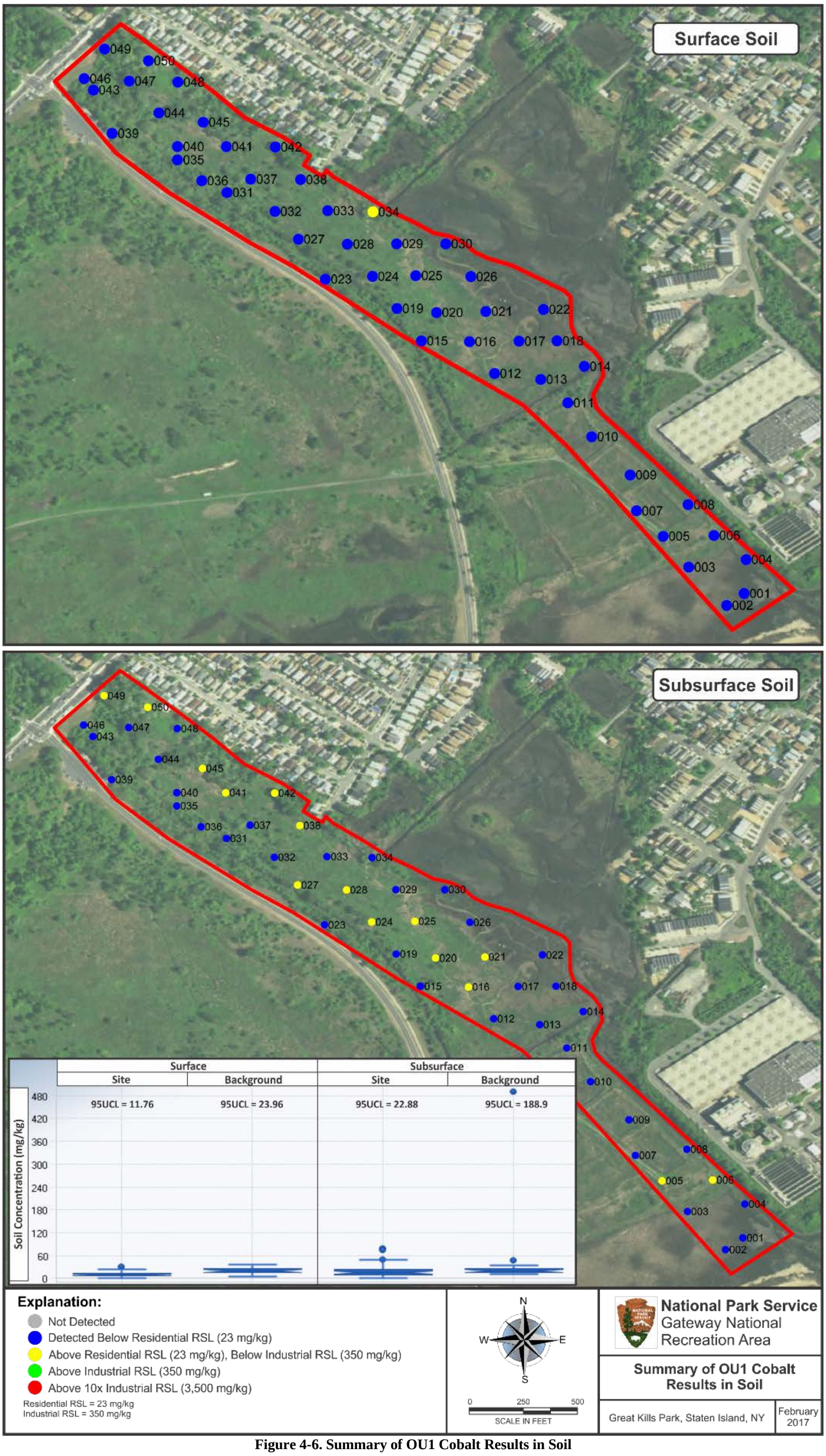


Figure 4-6. Summary of OU1 Cobalt Results in Soil

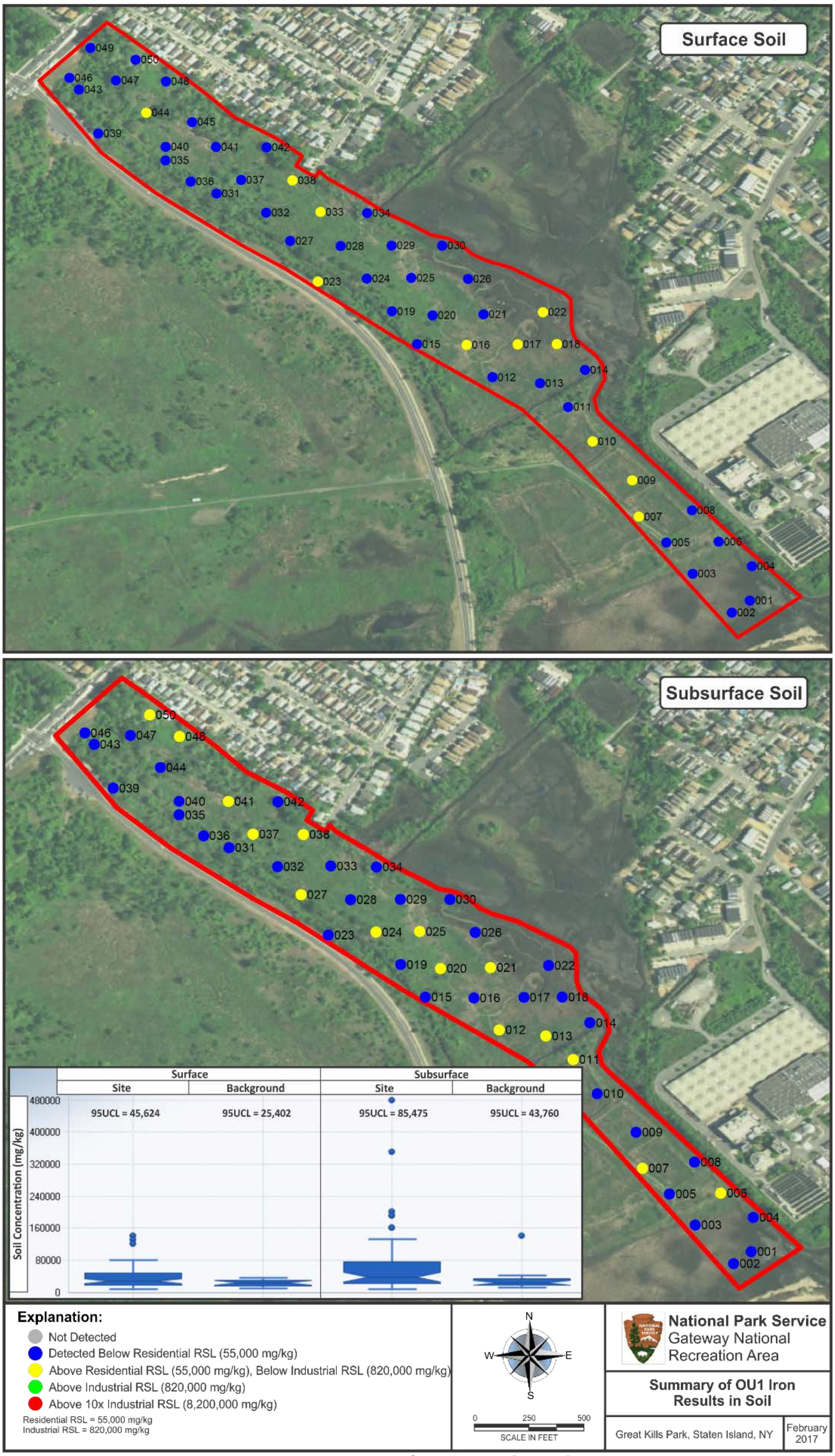


Figure 4-7. Summary of OU1 Iron Results in Soil

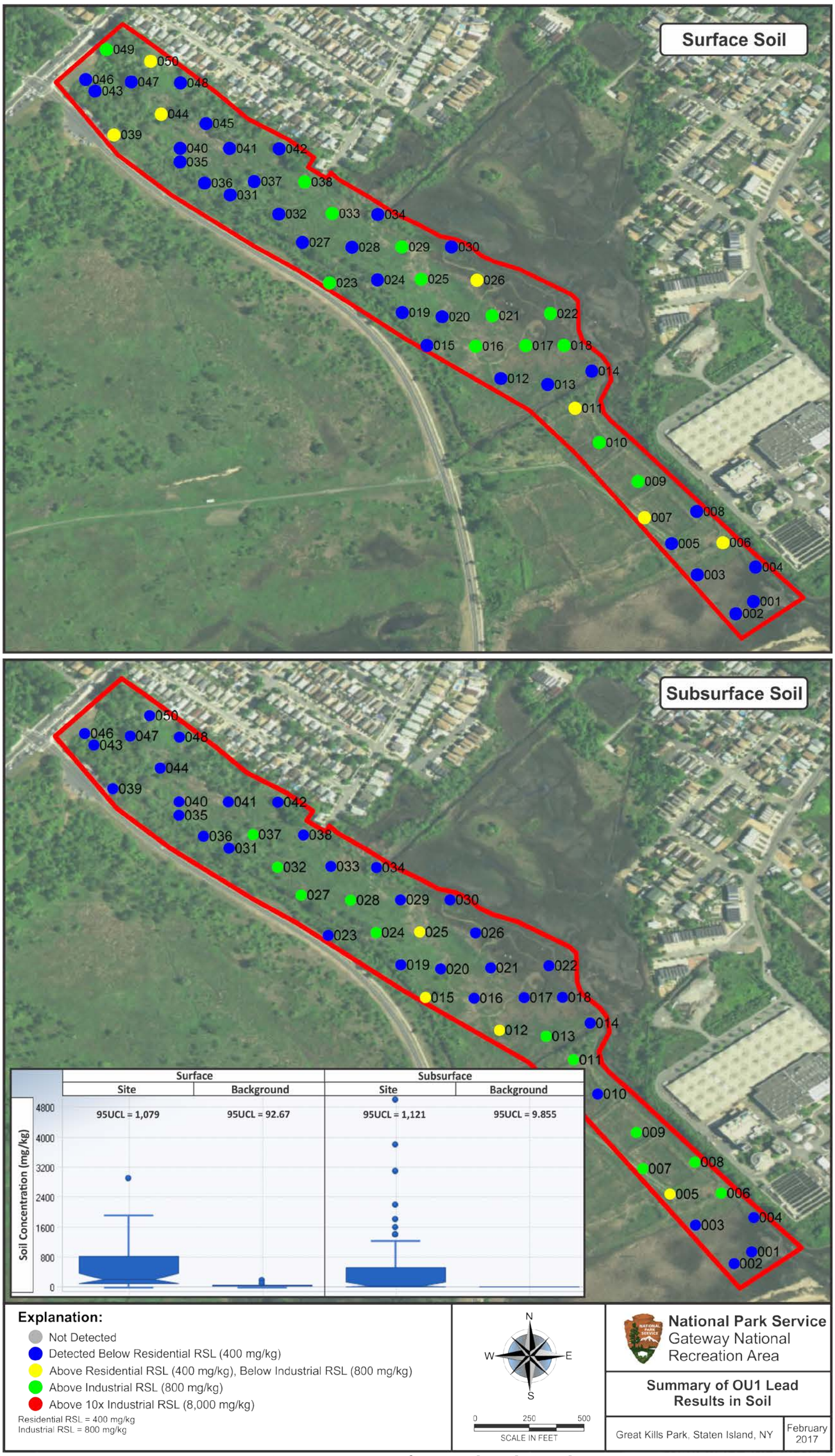


Figure 4-8. Summary of OU1 Lead Results in Soil

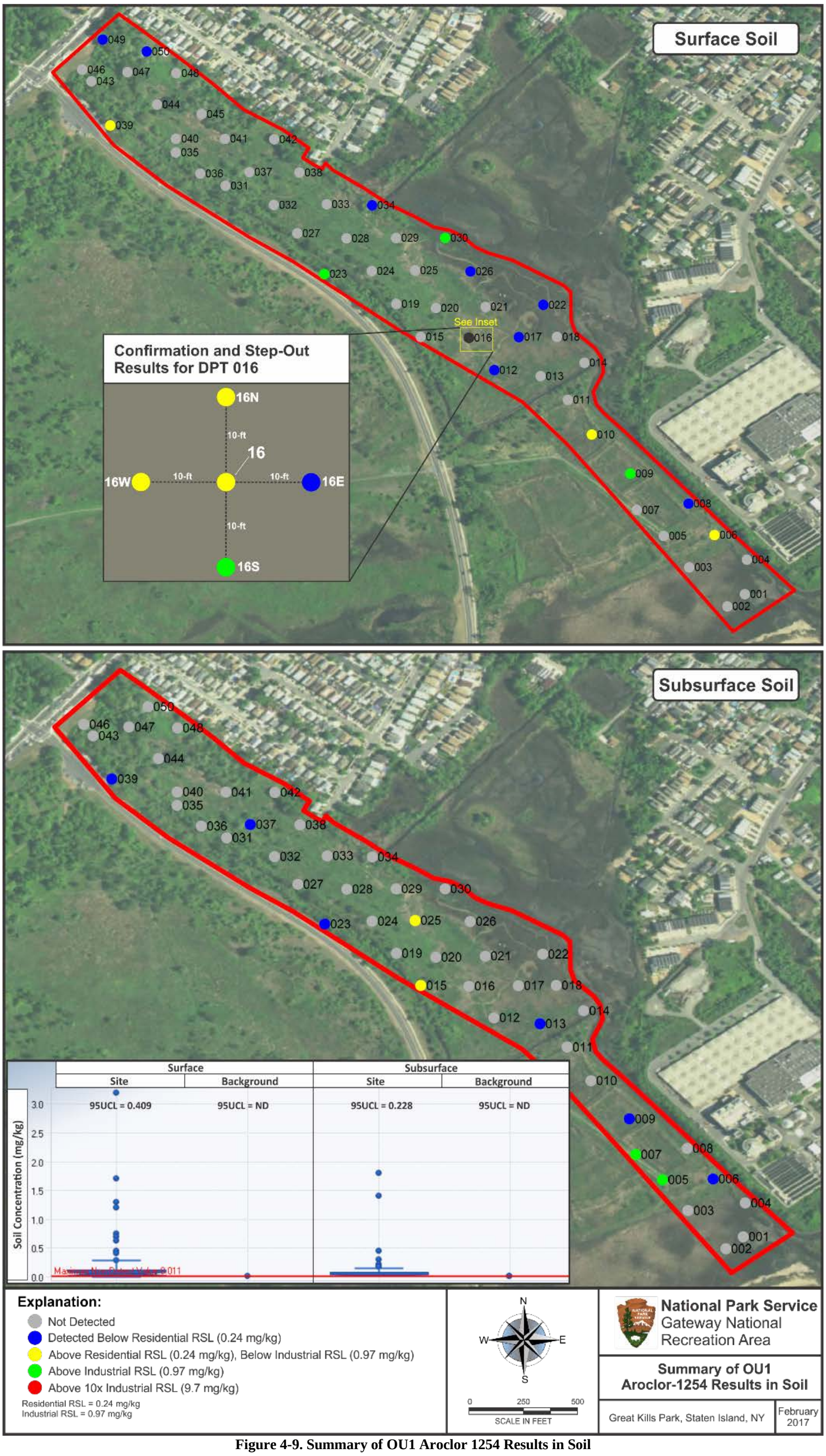


Figure 4-9. Summary of OU1 Aroclor 1254 Results in Soil

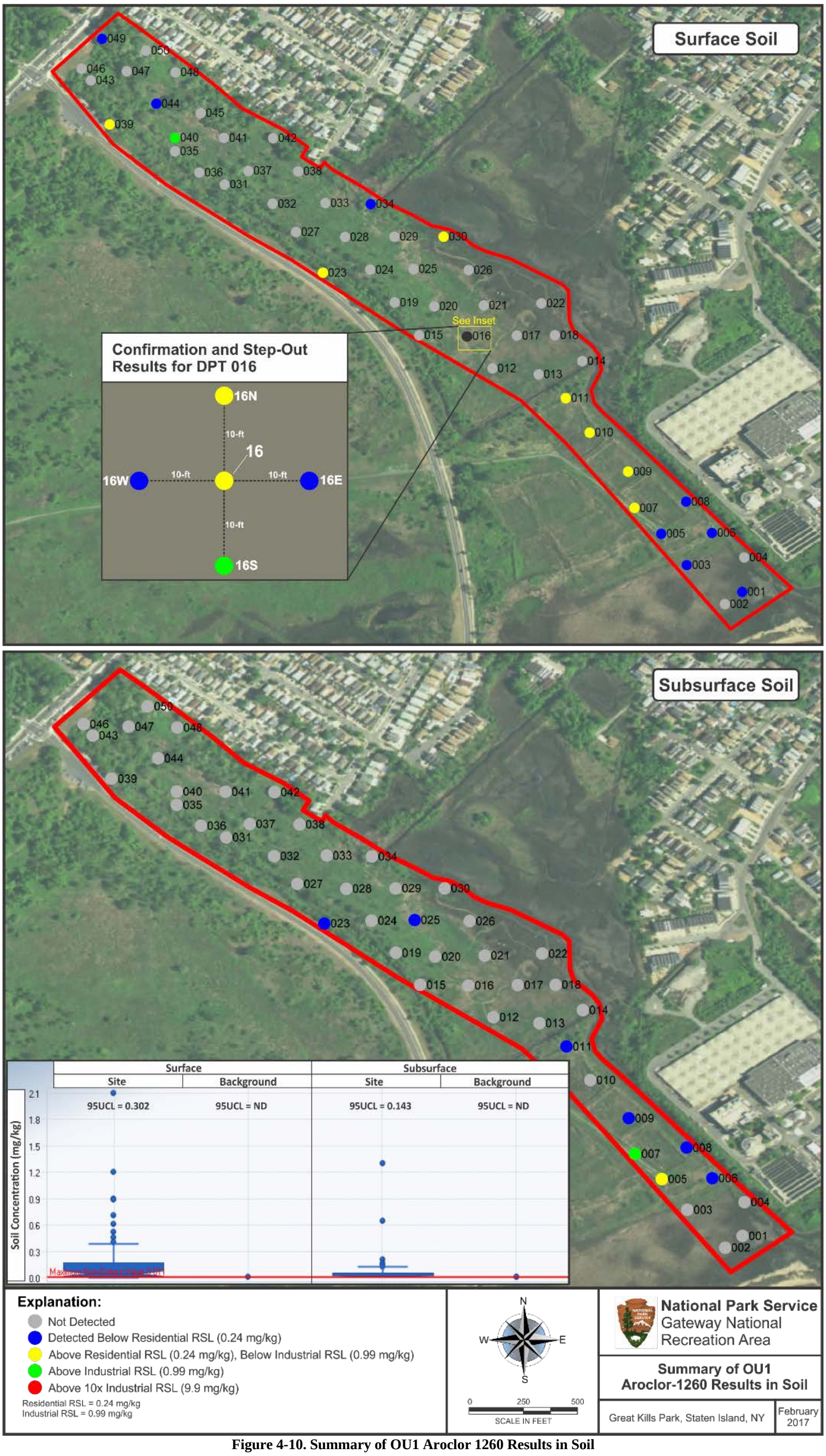


Figure 4-10. Summary of OU1 Aroclor 1260 Results in Soil

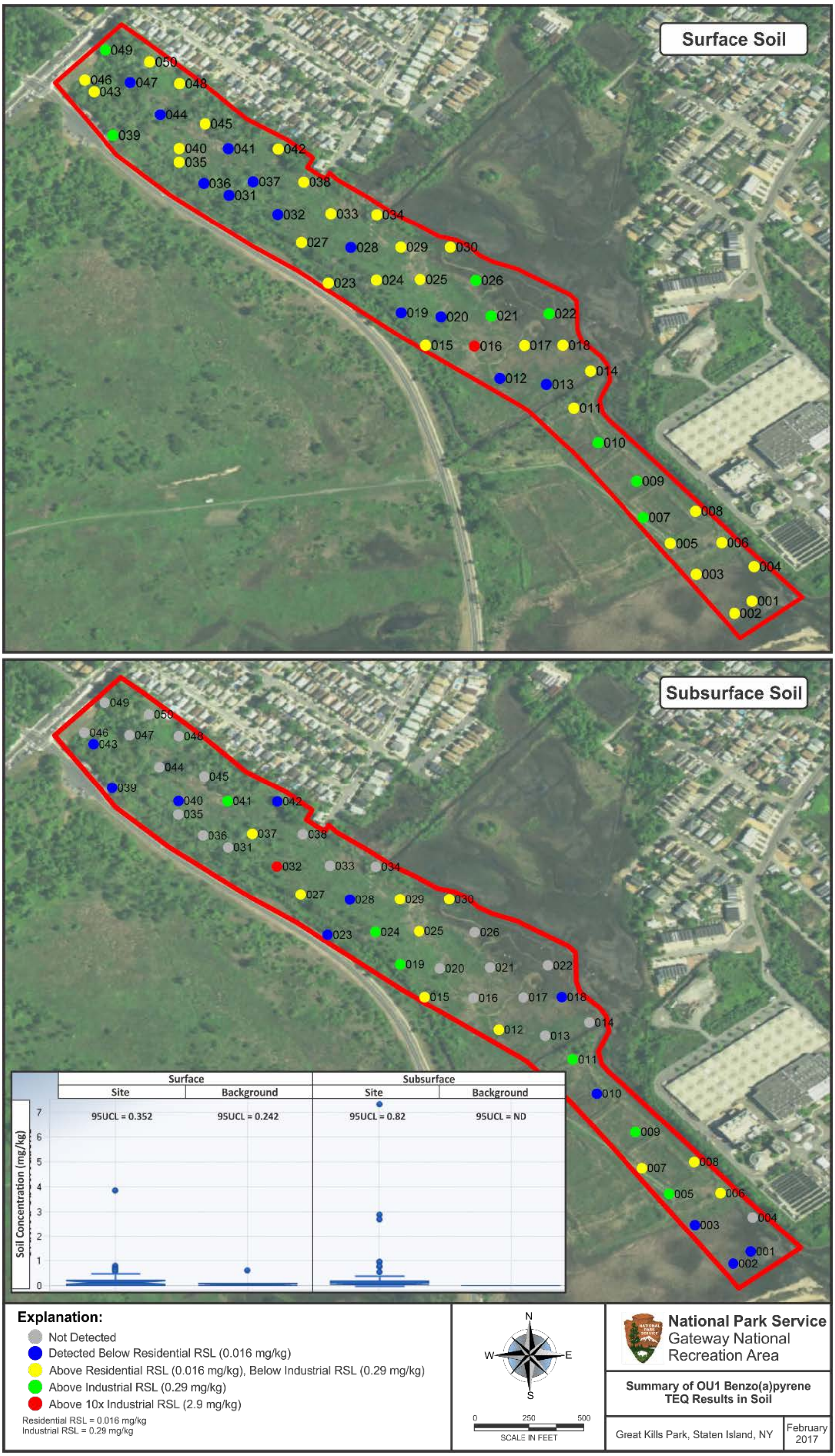


Figure 4-11. Summary of OU1 Benzo(a)Pyrene TEQ Results in Soil

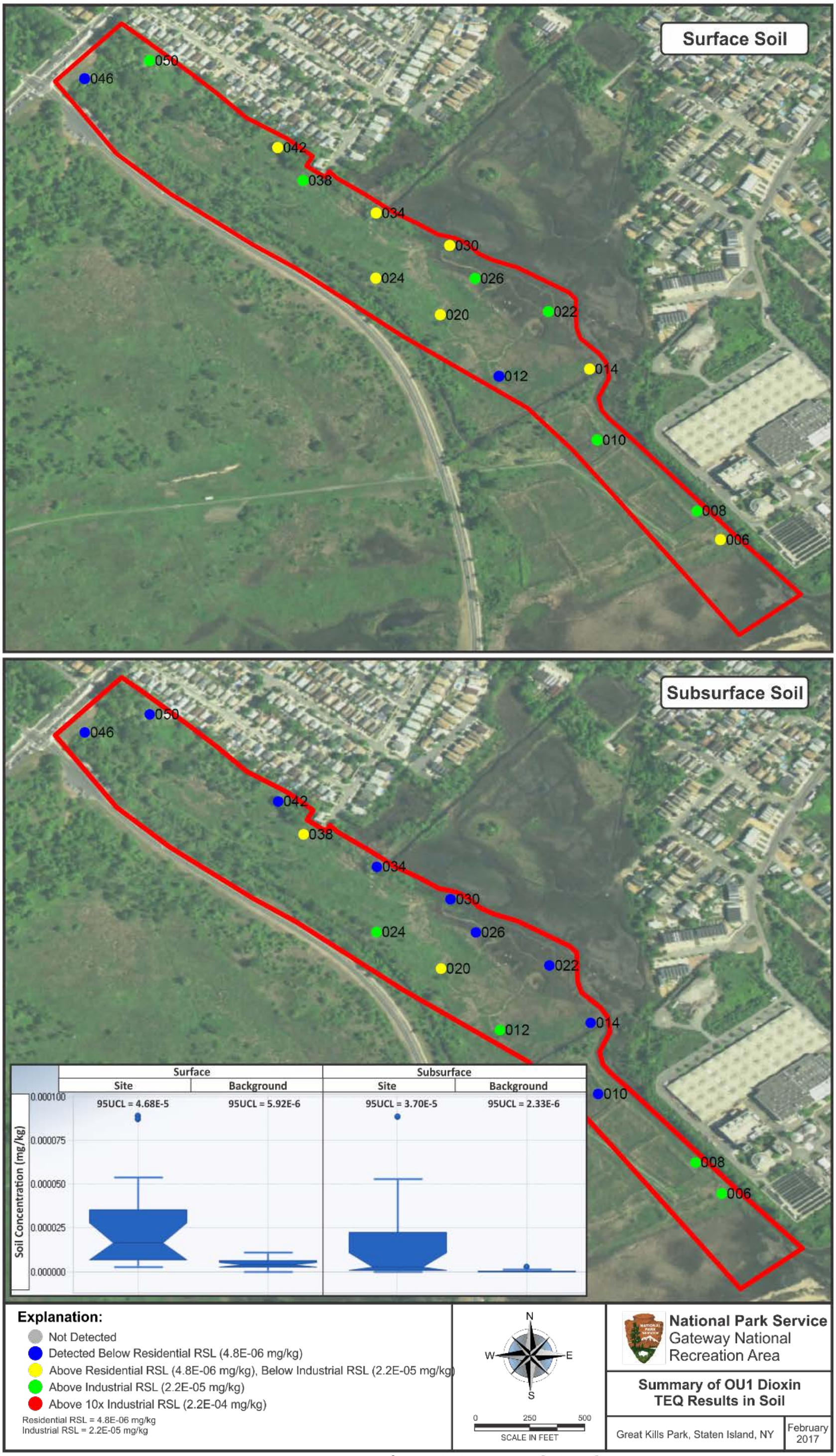


Figure 4-12. Summary of OU1 Dioxin TEQ Results in Soil

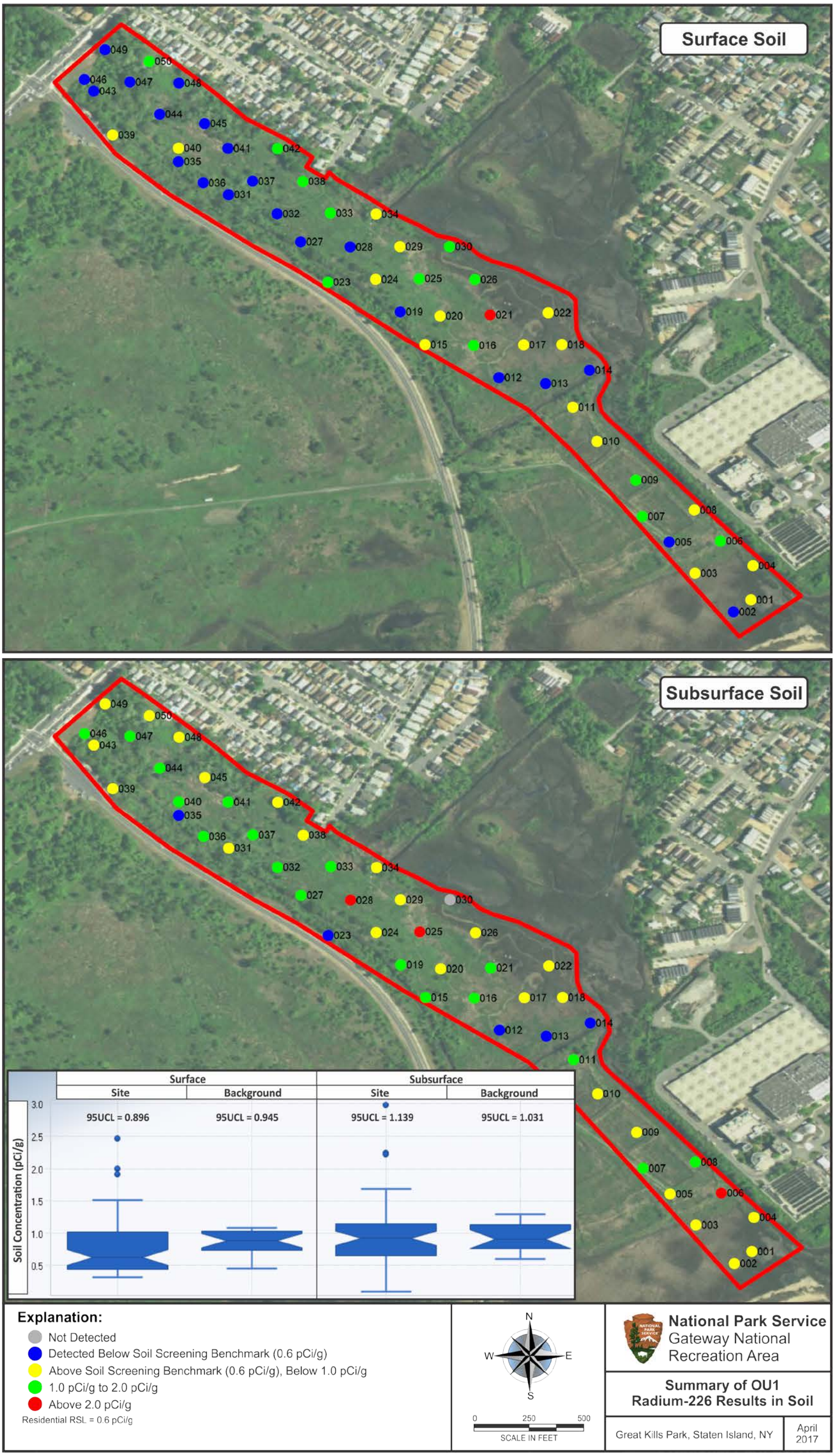


Figure 4-13. Summary of OU1 Radium-226 Results in Soil

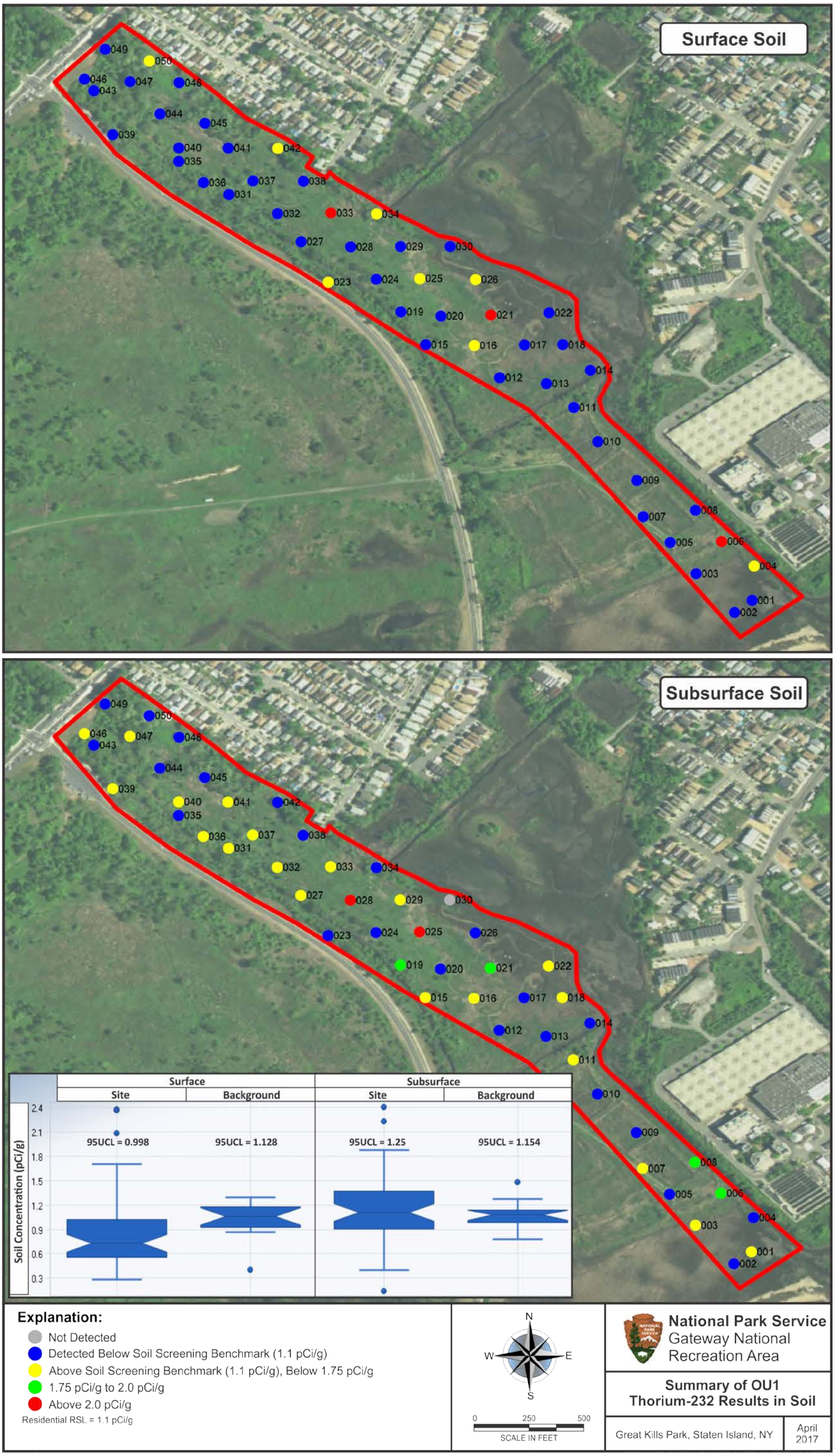


Figure 4-14. Summary of OU1 Thorium-232 Results in Soil

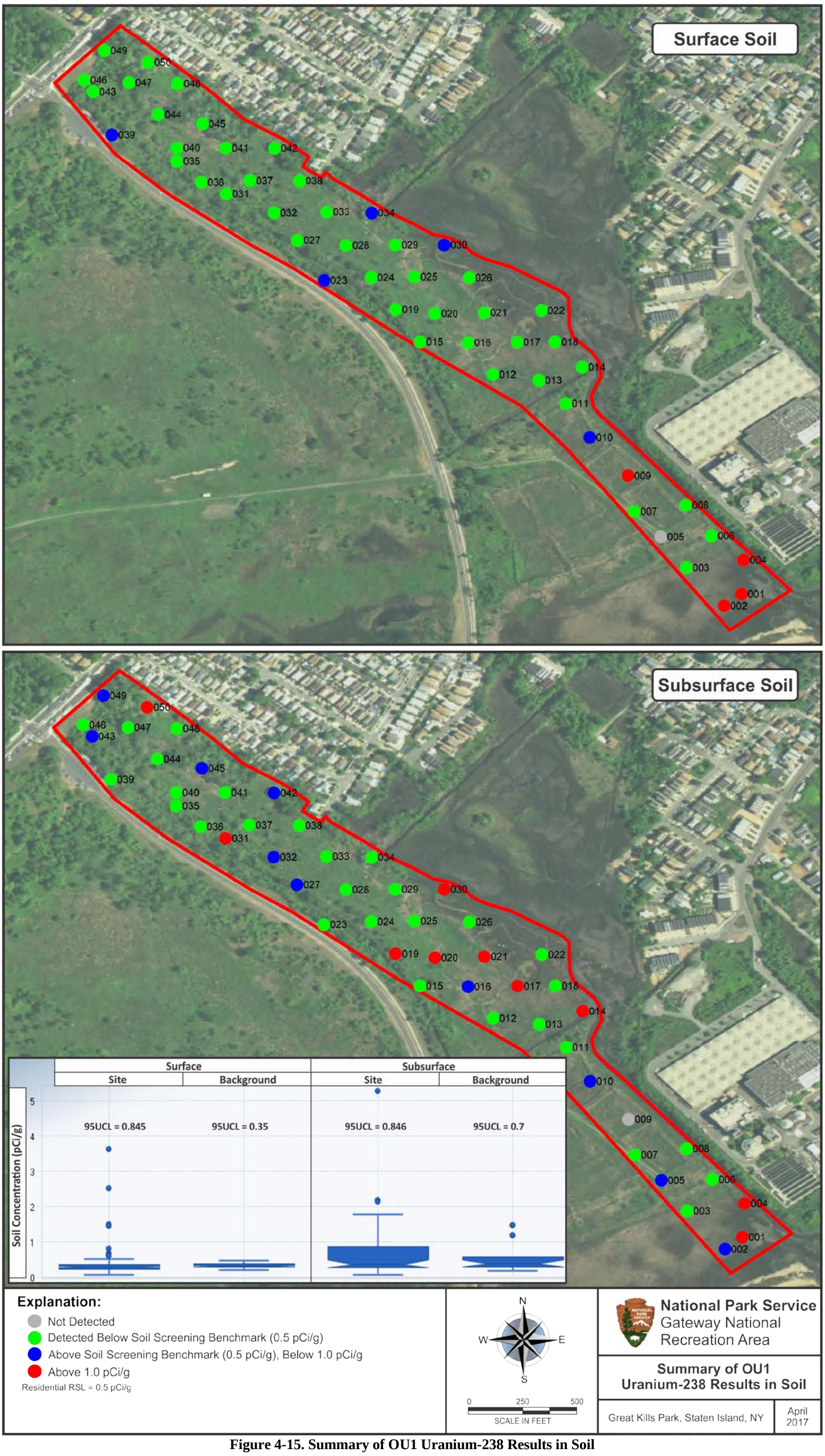


Figure 4-15. Summary of OU1 Uranium-238 Results in Soil

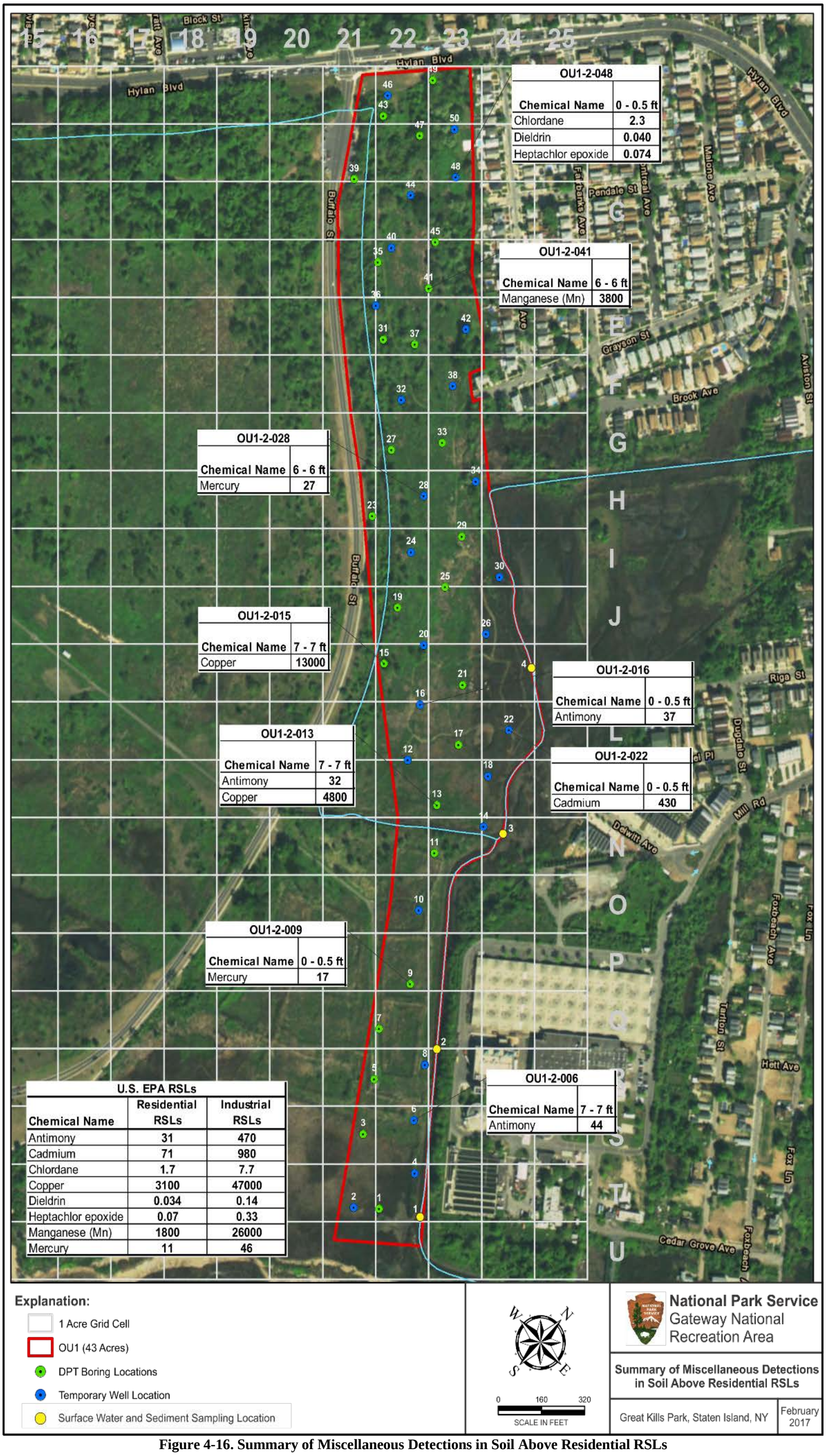
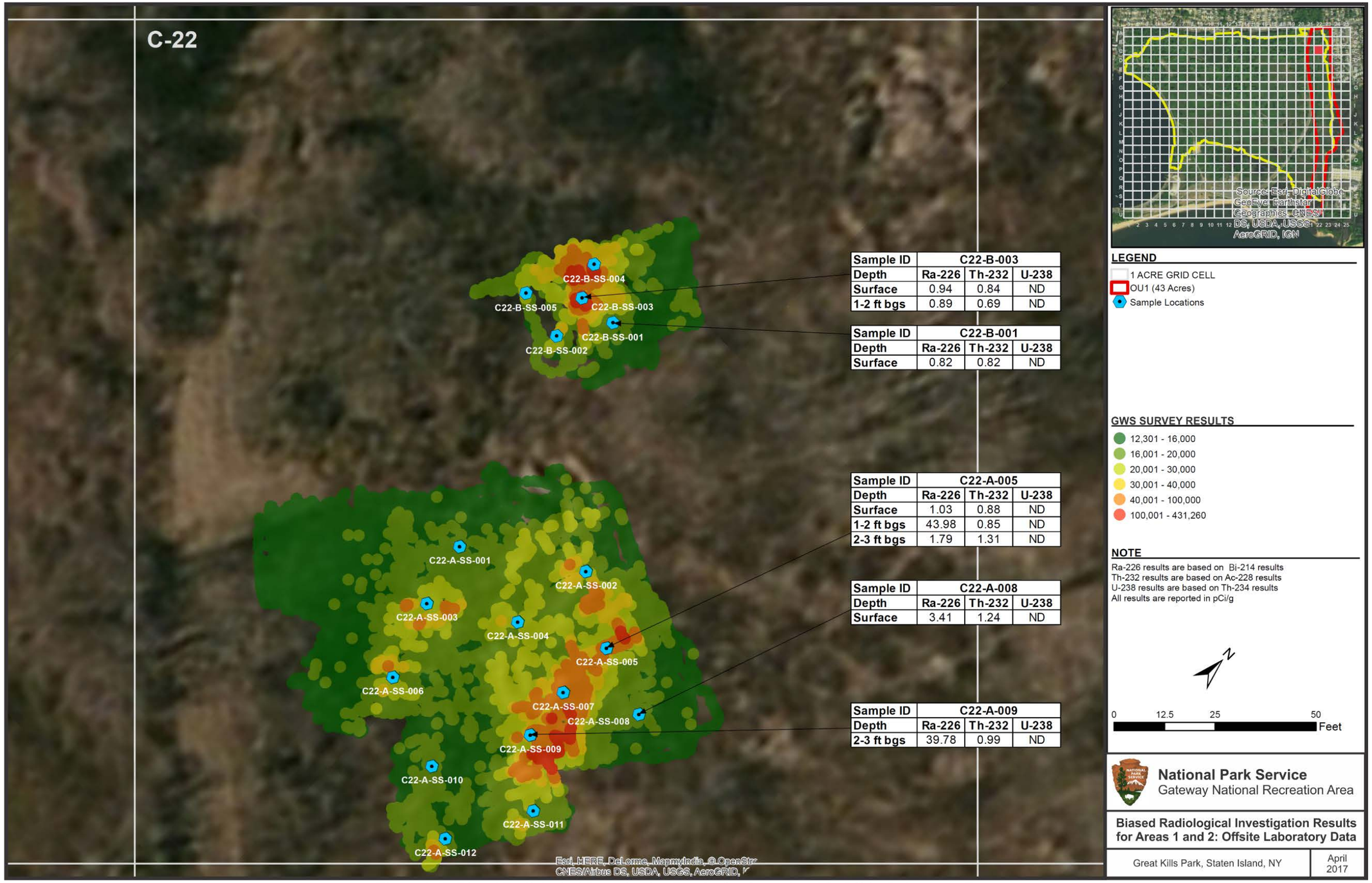


Figure 4-16. Summary of Miscellaneous Detections in Soil Above Residential RSLs



Sample ID	C22-B-003		
Depth	Ra-226	Th-232	U-238
Surface	0.94	0.84	ND
1-2 ft bgs	0.89	0.69	ND

Sample ID	C22-B-001		
Depth	Ra-226	Th-232	U-238
Surface	0.82	0.82	ND

Sample ID	C22-A-005		
Depth	Ra-226	Th-232	U-238
Surface	1.03	0.88	ND
1-2 ft bgs	43.98	0.85	ND
2-3 ft bgs	1.79	1.31	ND

Sample ID	C22-A-008		
Depth	Ra-226	Th-232	U-238
Surface	3.41	1.24	ND

Sample ID	C22-A-009		
Depth	Ra-226	Th-232	U-238
2-3 ft bgs	39.78	0.99	ND

Figure 4-17. Biased Radiological Investigation Results for Areas 1 and 2: Offsite Laboratory Data

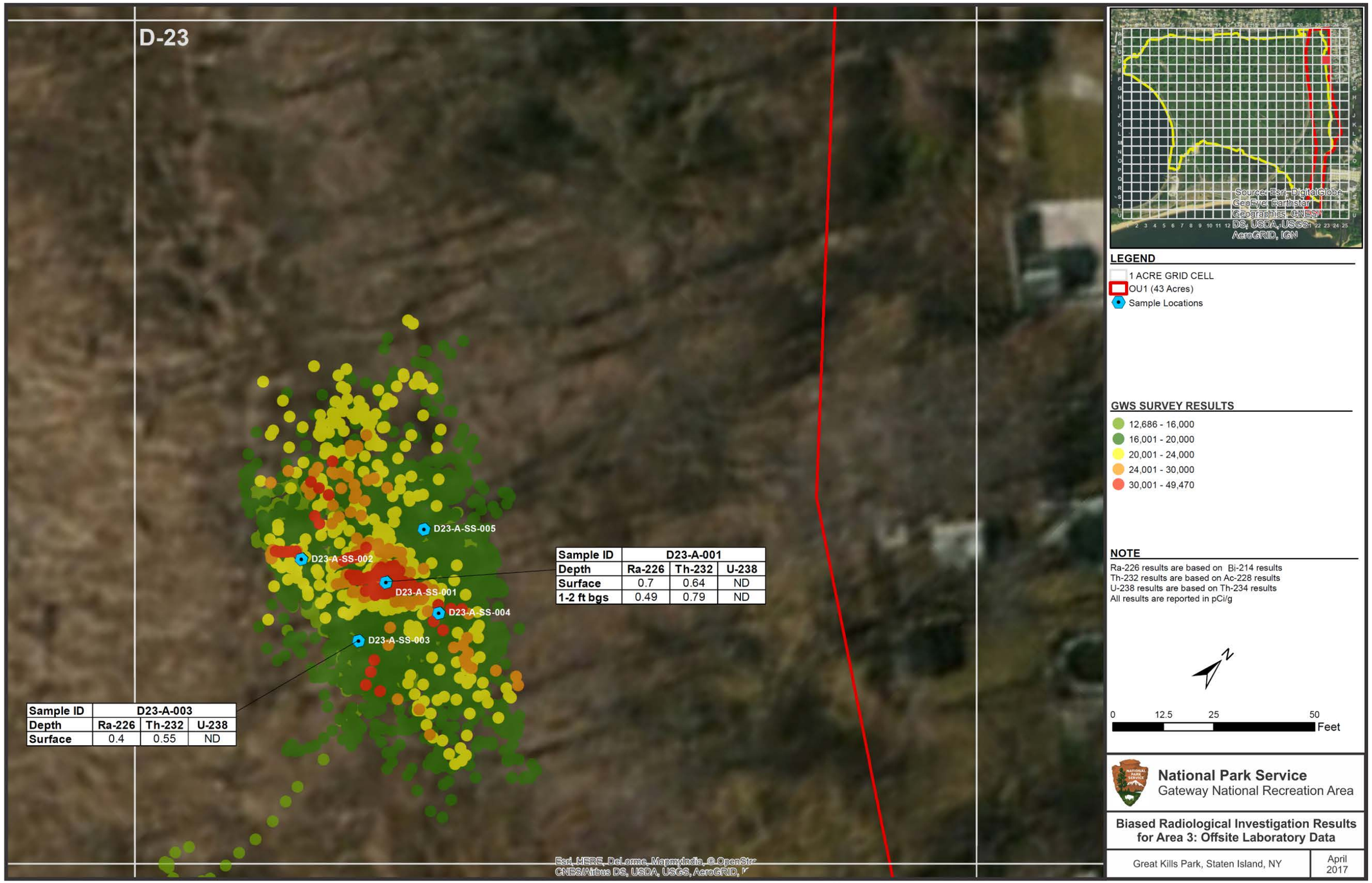
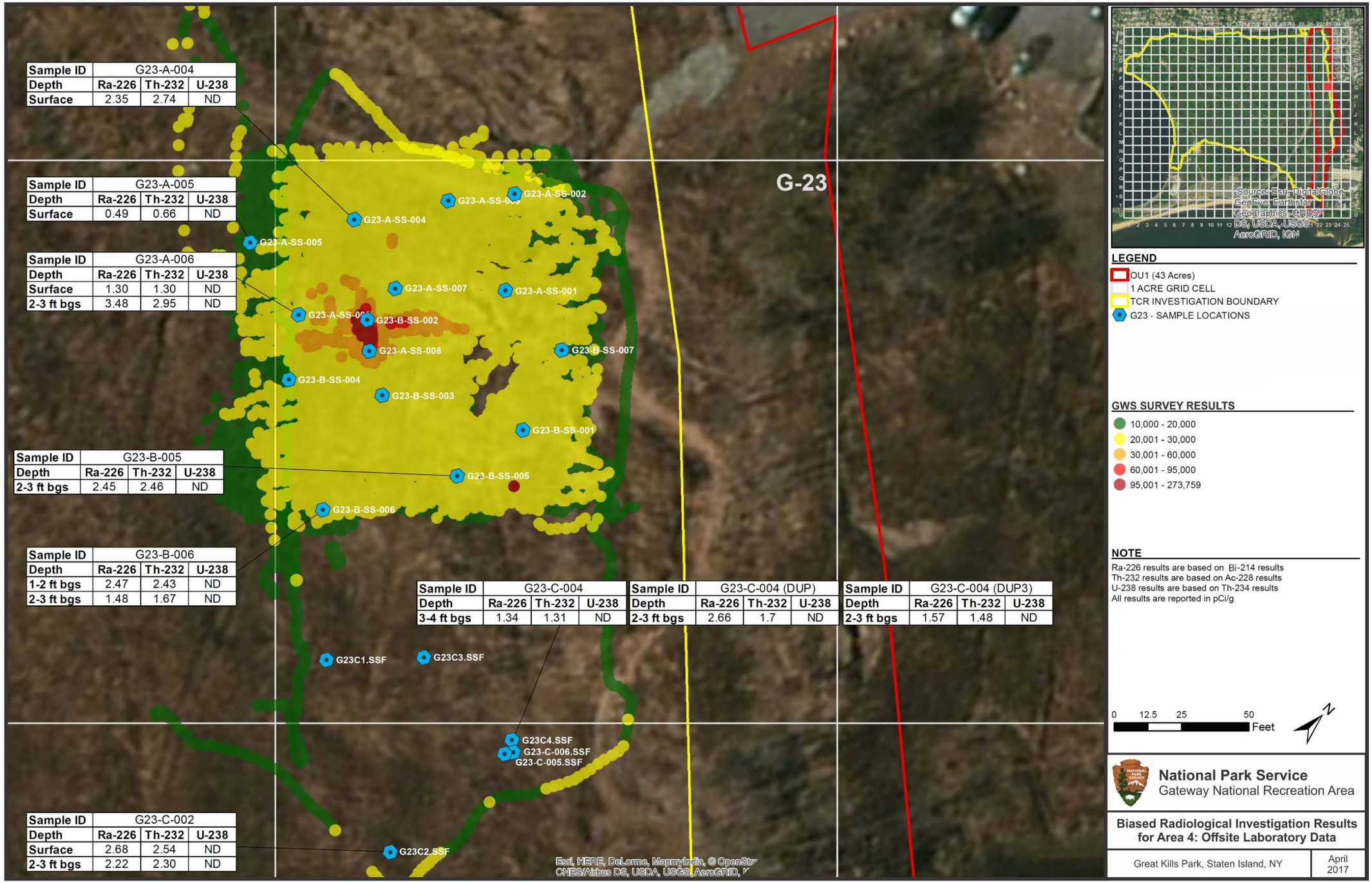


Figure 4-18. Biased Radiological Investigation Results for Area 3: Offsite Laboratory Data



Sample ID	G23-A-004		
Depth	Ra-226	Th-232	U-238
Surface	2.35	2.74	ND

Sample ID	G23-A-005		
Depth	Ra-226	Th-232	U-238
Surface	0.49	0.66	ND

Sample ID	G23-A-006		
Depth	Ra-226	Th-232	U-238
Surface	1.30	1.30	ND
2-3 ft bgs	3.48	2.95	ND

Sample ID	G23-B-005		
Depth	Ra-226	Th-232	U-238
2-3 ft bgs	2.45	2.46	ND

Sample ID	G23-B-006		
Depth	Ra-226	Th-232	U-238
1-2 ft bgs	2.47	2.43	ND
2-3 ft bgs	1.48	1.67	ND

Sample ID	G23-C-004		
Depth	Ra-226	Th-232	U-238
3-4 ft bgs	1.34	1.31	ND

Sample ID	G23-C-004 (DUP)		
Depth	Ra-226	Th-232	U-238
2-3 ft bgs	2.66	1.7	ND

Sample ID	G23-C-004 (DUP3)		
Depth	Ra-226	Th-232	U-238
2-3 ft bgs	1.57	1.48	ND

Sample ID	G23-C-002		
Depth	Ra-226	Th-232	U-238
Surface	2.68	2.54	ND
2-3 ft bgs	2.22	2.30	ND

Figure 4-19. Biased Radiological Investigation Results for Area 4: Offsite Laboratory Data

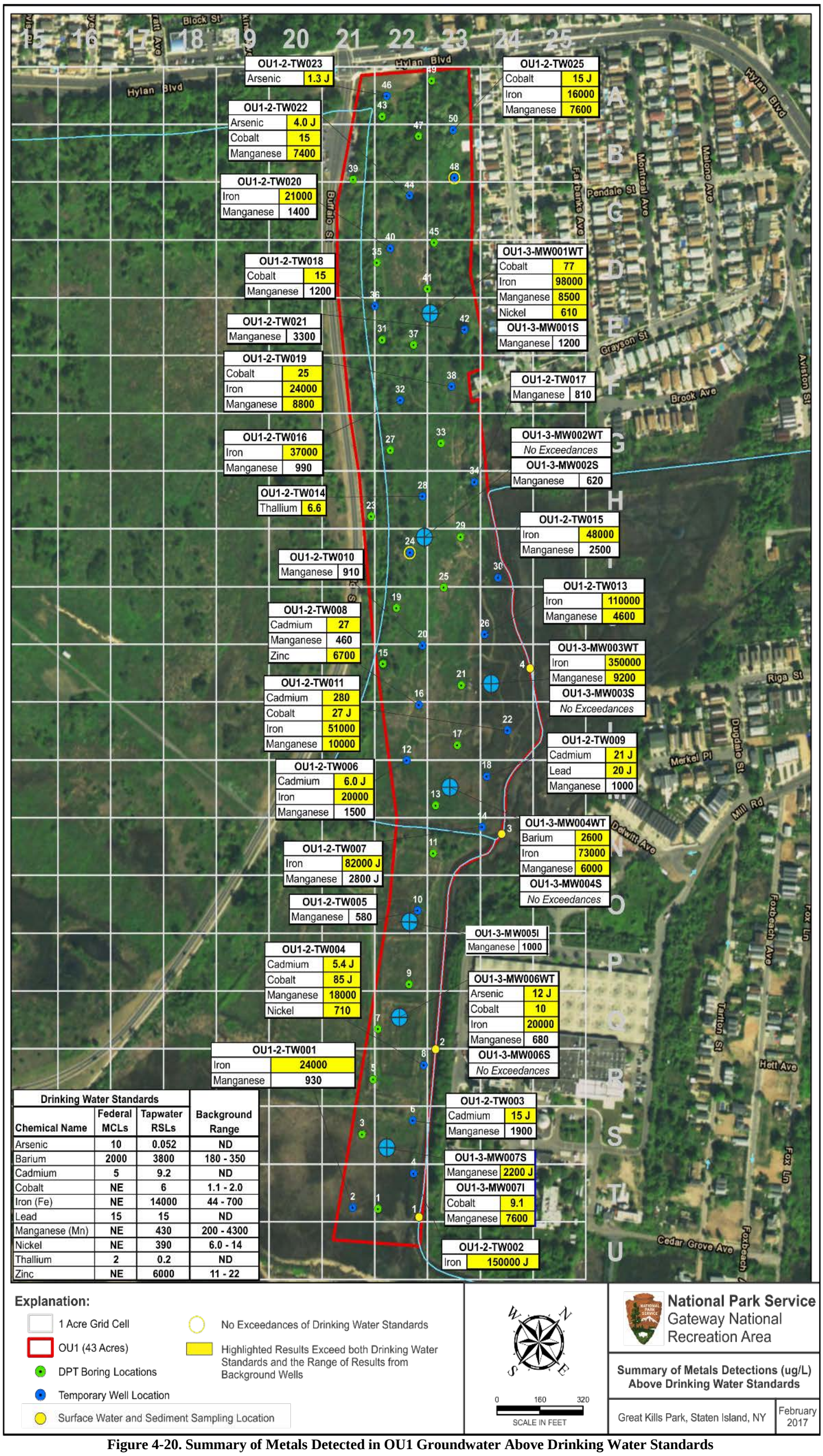
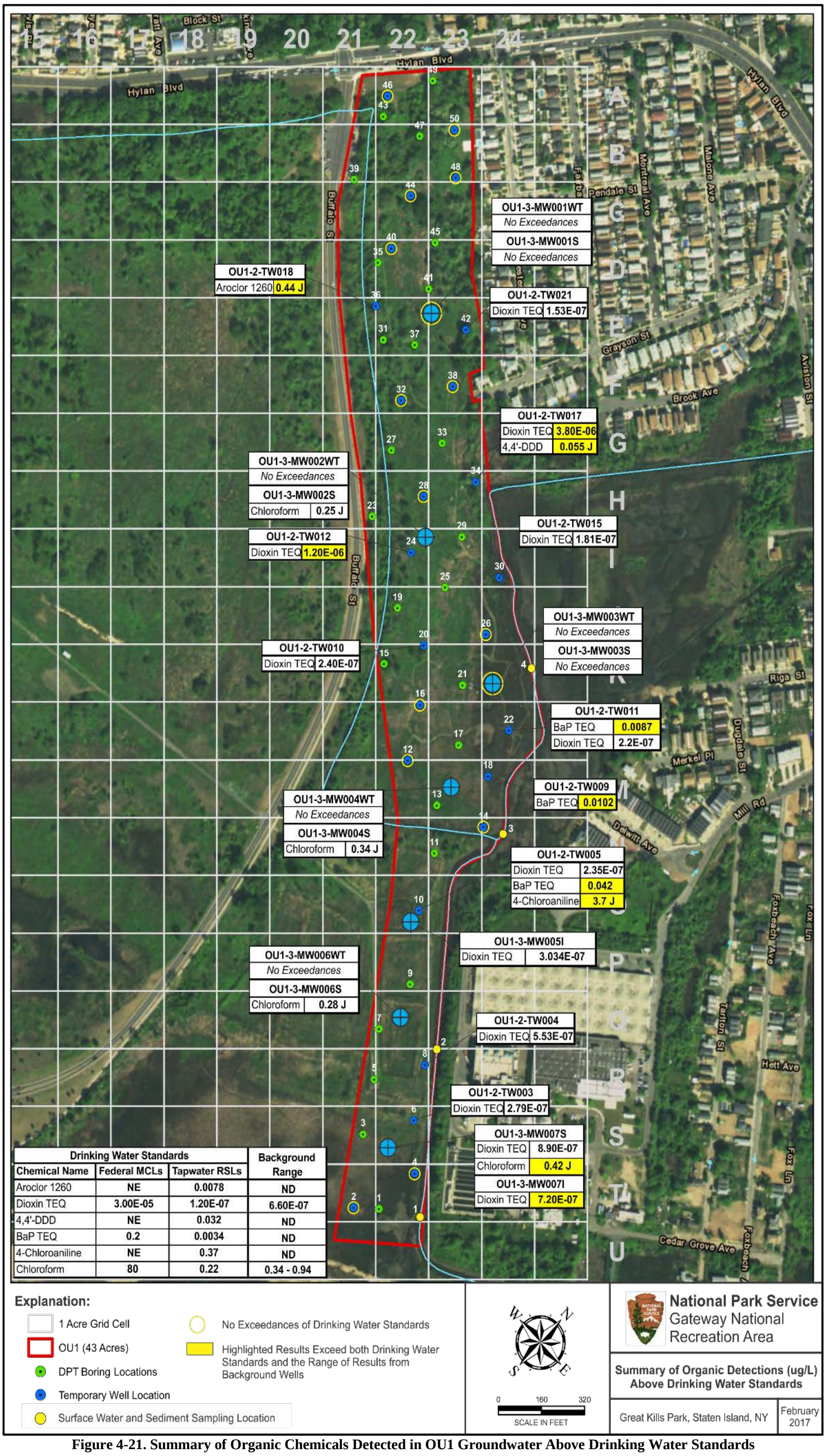
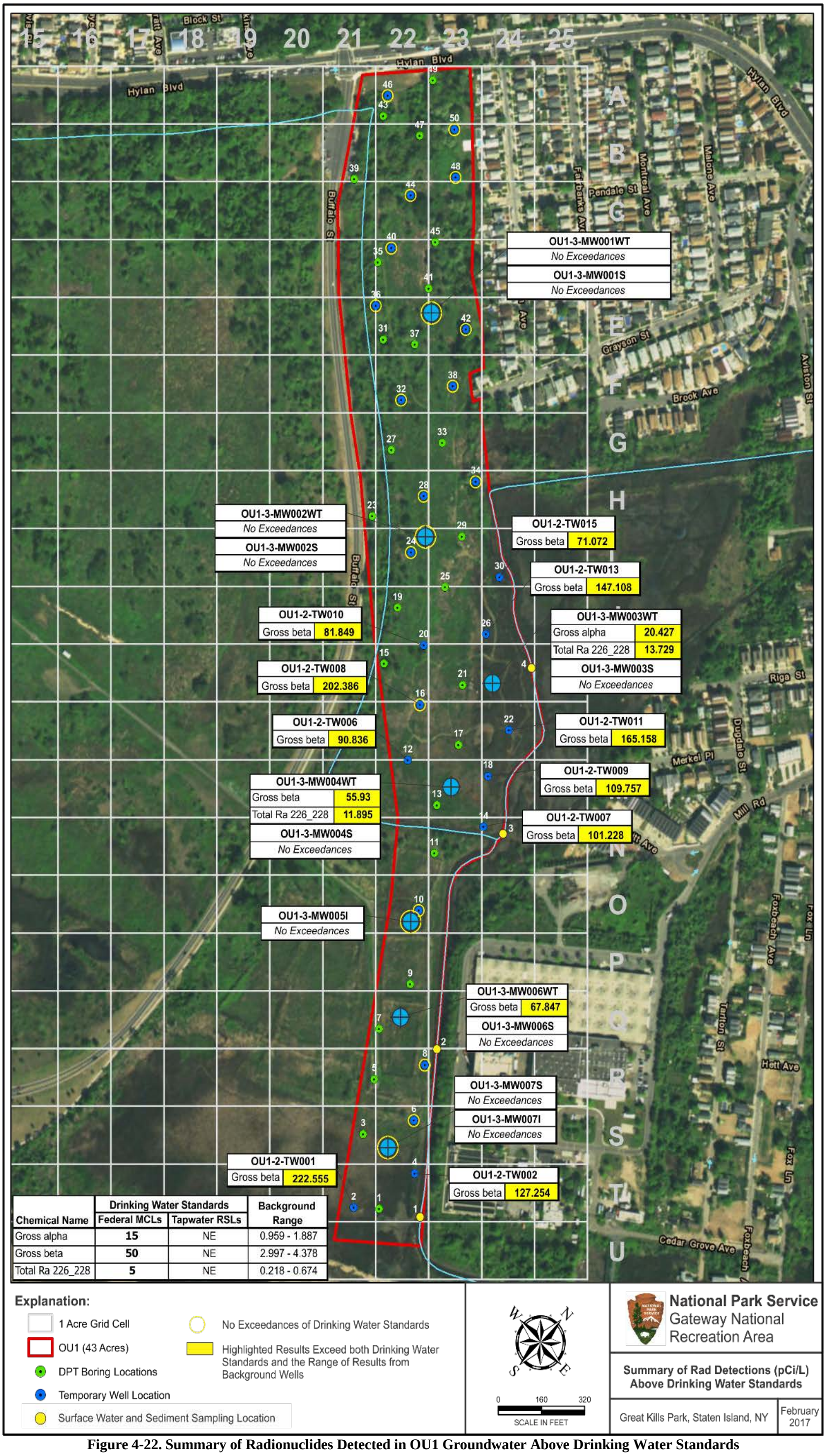


Figure 4-20. Summary of Metals Detected in OU1 Groundwater Above Drinking Water Standards



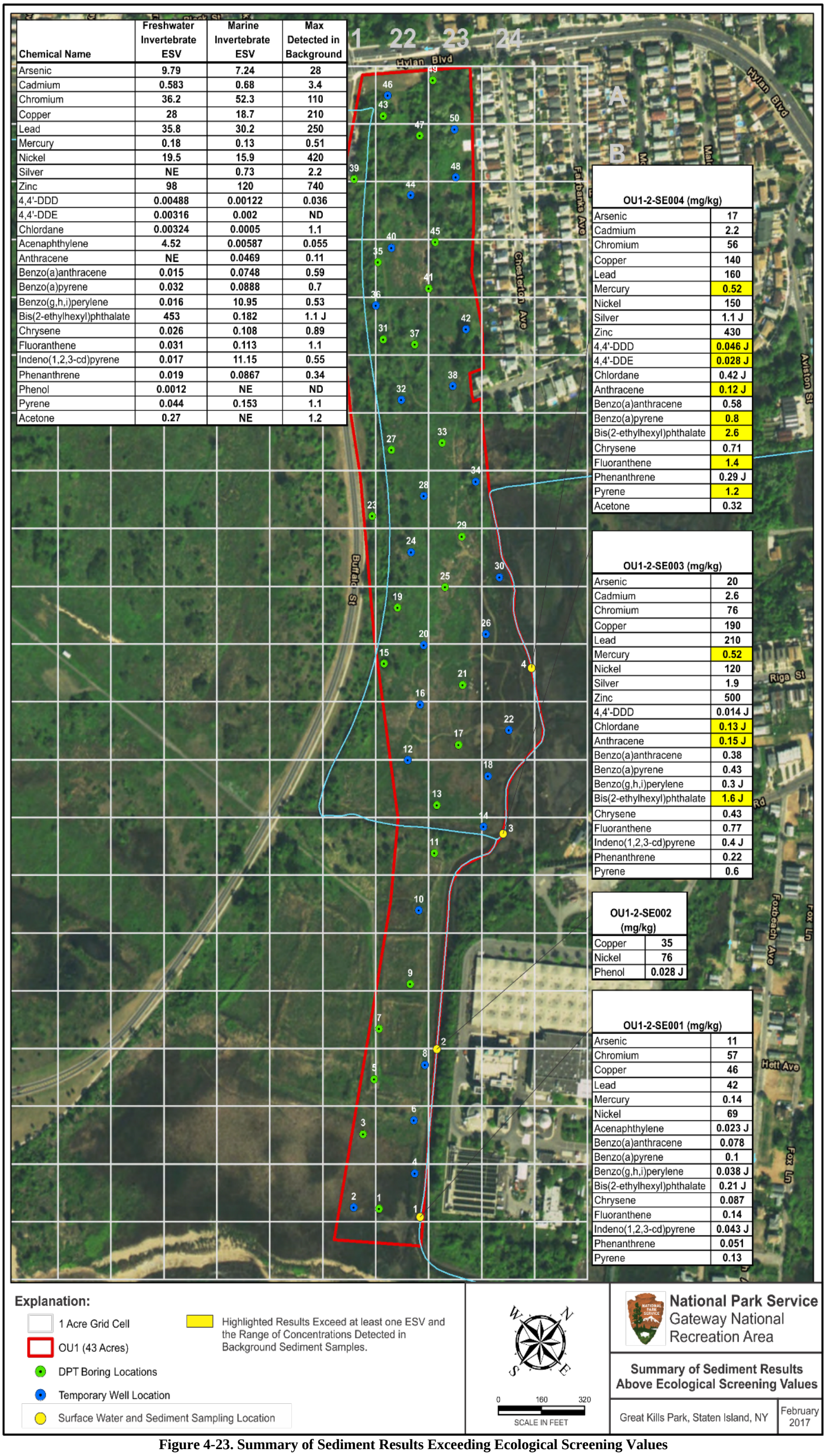
Drinking Water Standards			Background Range
Chemical Name	Federal MCLs	Tapwater RSLs	
Aroclor 1260	NE	0.0078	ND
Dioxin TEQ	3.00E-05	1.20E-07	6.60E-07
4,4'-DDD	NE	0.032	ND
BaP TEQ	0.2	0.0034	ND
4-Chloroaniline	NE	0.37	ND
Chloroform	80	0.22	0.34 - 0.94

Figure 4-21. Summary of Organic Chemicals Detected in OU1 Groundwater Above Drinking Water Standards



Chemical Name	Drinking Water Standards		Background Range
	Federal MCLs	Tapwater RSLs	
Gross alpha	15	NE	0.959 - 1.887
Gross beta	50	NE	2.997 - 4.378
Total Ra 226_228	5	NE	0.218 - 0.674

Figure 4-22. Summary of Radionuclides Detected in OU1 Groundwater Above Drinking Water Standards



Chemical Name	Freshwater Invertebrate ESV	Marine Invertebrate ESV	Max Detected in Background
Arsenic	9.79	7.24	28
Cadmium	0.583	0.68	3.4
Chromium	36.2	52.3	110
Copper	28	18.7	210
Lead	35.8	30.2	250
Mercury	0.18	0.13	0.51
Nickel	19.5	15.9	420
Silver	NE	0.73	2.2
Zinc	98	120	740
4,4'-DDD	0.00488	0.00122	0.036
4,4'-DDE	0.00316	0.002	ND
Chlordane	0.00324	0.0005	1.1
Acenaphthylene	4.52	0.00587	0.055
Anthracene	NE	0.0469	0.11
Benzo(a)anthracene	0.015	0.0748	0.59
Benzo(a)pyrene	0.032	0.0888	0.7
Benzo(g,h,i)perylene	0.016	10.95	0.53
Bis(2-ethylhexyl)phthalate	453	0.182	1.1 J
Chrysene	0.026	0.108	0.89
Fluoranthene	0.031	0.113	1.1
Indeno(1,2,3-cd)pyrene	0.017	11.15	0.55
Phenanthrene	0.019	0.0867	0.34
Phenol	0.0012	NE	ND
Pyrene	0.044	0.153	1.1
Acetone	0.27	NE	1.2

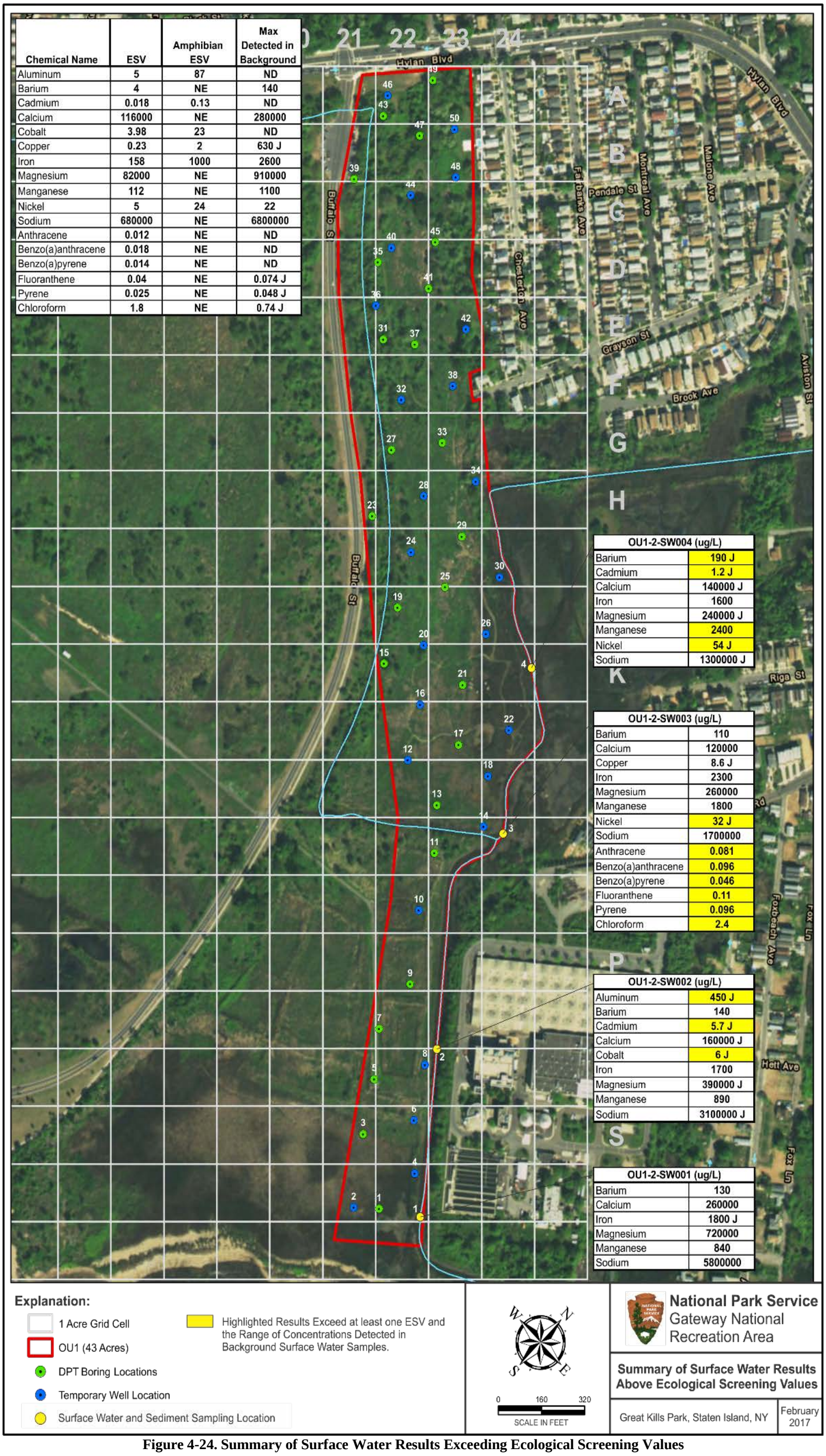
OU1-2-SE004 (mg/kg)	
Arsenic	17
Cadmium	2.2
Chromium	56
Copper	140
Lead	160
Mercury	0.52
Nickel	150
Silver	1.1 J
Zinc	430
4,4'-DDD	0.046 J
4,4'-DDE	0.028 J
Chlordane	0.42 J
Anthracene	0.12 J
Benzo(a)anthracene	0.58
Benzo(a)pyrene	0.8
Bis(2-ethylhexyl)phthalate	2.6
Chrysene	0.71
Fluoranthene	1.4
Phenanthrene	0.29 J
Pyrene	1.2
Acetone	0.32

OU1-2-SE003 (mg/kg)	
Arsenic	20
Cadmium	2.6
Chromium	76
Copper	190
Lead	210
Mercury	0.52
Nickel	120
Silver	1.9
Zinc	500
4,4'-DDD	0.014 J
Chlordane	0.13 J
Anthracene	0.15 J
Benzo(a)anthracene	0.38
Benzo(a)pyrene	0.43
Benzo(g,h,i)perylene	0.3 J
Bis(2-ethylhexyl)phthalate	1.6 J
Chrysene	0.43
Fluoranthene	0.77
Indeno(1,2,3-cd)pyrene	0.4 J
Phenanthrene	0.22
Pyrene	0.6

OU1-2-SE002 (mg/kg)	
Copper	35
Nickel	76
Phenol	0.028 J

OU1-2-SE001 (mg/kg)	
Arsenic	11
Chromium	57
Copper	46
Lead	42
Mercury	0.14
Nickel	69
Acenaphthylene	0.023 J
Benzo(a)anthracene	0.078
Benzo(a)pyrene	0.1
Benzo(g,h,i)perylene	0.038 J
Bis(2-ethylhexyl)phthalate	0.21 J
Chrysene	0.087
Fluoranthene	0.14
Indeno(1,2,3-cd)pyrene	0.043 J
Phenanthrene	0.051
Pyrene	0.13

Figure 4-23. Summary of Sediment Results Exceeding Ecological Screening Values



Chemical Name	ESV	Amphibian ESV	Max Detected in Background
Aluminum	5	87	ND
Barium	4	NE	140
Cadmium	0.018	0.13	ND
Calcium	116000	NE	280000
Cobalt	3.98	23	ND
Copper	0.23	2	630 J
Iron	158	1000	2600
Magnesium	82000	NE	910000
Manganese	112	NE	1100
Nickel	5	24	22
Sodium	680000	NE	6800000
Anthracene	0.012	NE	ND
Benzo(a)anthracene	0.018	NE	ND
Benzo(a)pyrene	0.014	NE	ND
Fluoranthene	0.04	NE	0.074 J
Pyrene	0.025	NE	0.048 J
Chloroform	1.8	NE	0.74 J

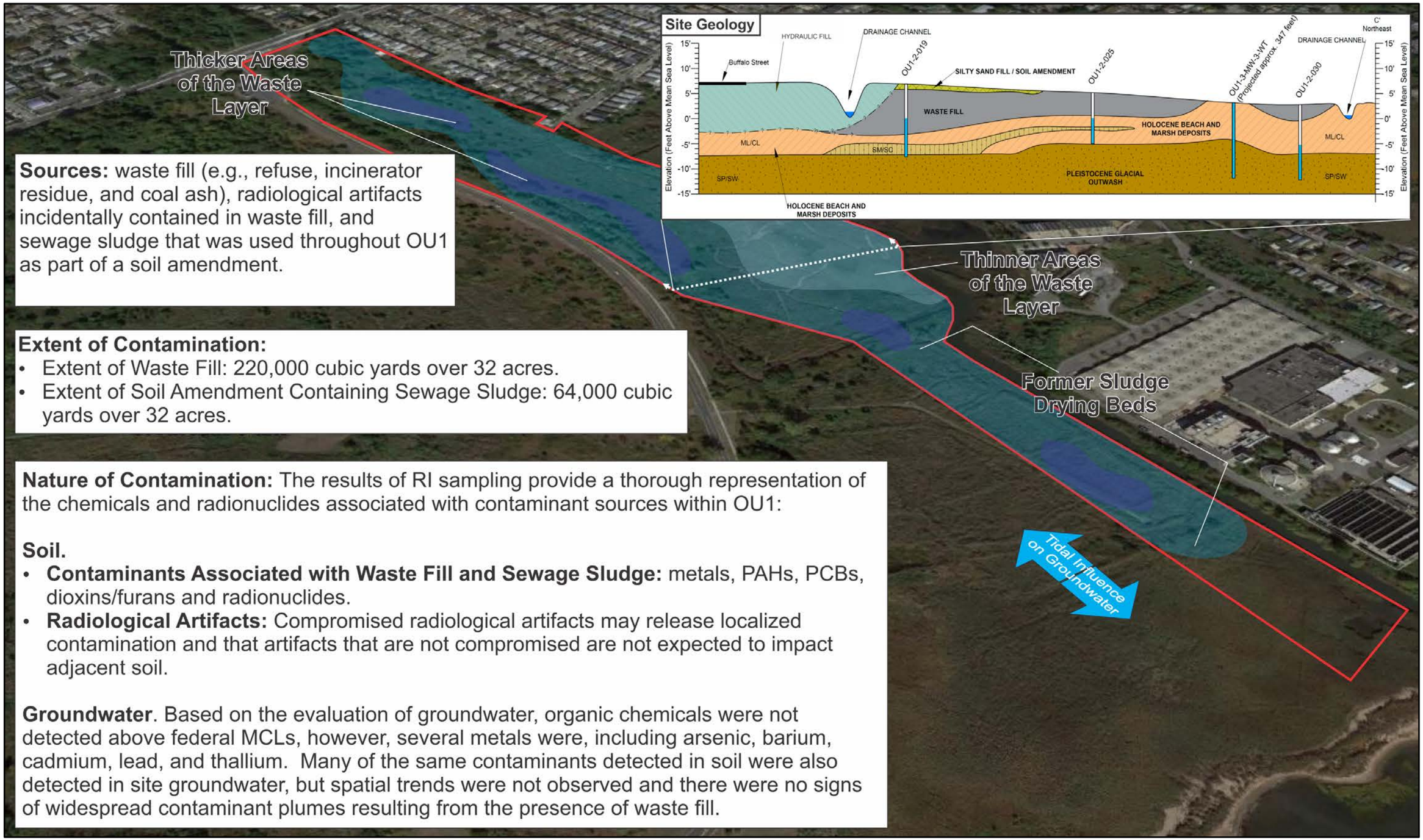
OU1-2-SW004 (ug/L)	
Barium	190 J
Cadmium	1.2 J
Calcium	140000 J
Iron	1600
Magnesium	240000 J
Manganese	2400
Nickel	54 J
Sodium	1300000 J

OU1-2-SW003 (ug/L)	
Barium	110
Calcium	120000
Copper	8.6 J
Iron	2300
Magnesium	260000
Manganese	1800
Nickel	32 J
Sodium	1700000
Anthracene	0.081
Benzo(a)anthracene	0.096
Benzo(a)pyrene	0.046
Fluoranthene	0.11
Pyrene	0.096
Chloroform	2.4

OU1-2-SW002 (ug/L)	
Aluminum	450 J
Barium	140
Cadmium	5.7 J
Calcium	160000 J
Cobalt	6 J
Iron	1700
Magnesium	390000 J
Manganese	890
Sodium	3100000 J

OU1-2-SW001 (ug/L)	
Barium	130
Calcium	260000
Iron	1800 J
Magnesium	720000
Manganese	840
Sodium	5800000

Figure 4-24. Summary of Surface Water Results Exceeding Ecological Screening Values



Sources: waste fill (e.g., refuse, incinerator residue, and coal ash), radiological artifacts incidentally contained in waste fill, and sewage sludge that was used throughout OU1 as part of a soil amendment.

Extent of Contamination:

- Extent of Waste Fill: 220,000 cubic yards over 32 acres.
- Extent of Soil Amendment Containing Sewage Sludge: 64,000 cubic yards over 32 acres.

Nature of Contamination: The results of RI sampling provide a thorough representation of the chemicals and radionuclides associated with contaminant sources within OU1:

Soil.

- **Contaminants Associated with Waste Fill and Sewage Sludge:** metals, PAHs, PCBs, dioxins/furans and radionuclides.
- **Radiological Artifacts:** Compromised radiological artifacts may release localized contamination and that artifacts that are not compromised are not expected to impact adjacent soil.

Groundwater. Based on the evaluation of groundwater, organic chemicals were not detected above federal MCLs, however, several metals were, including arsenic, barium, cadmium, lead, and thallium. Many of the same contaminants detected in soil were also detected in site groundwater, but spatial trends were not observed and there were no signs of widespread contaminant plumes resulting from the presence of waste fill.

Figure 5-1. Updated Conceptual Site Model for OU1

TABLES

Table 2-1. Summary of Sampling Conducted within OU1

Location ID	RAD [1]	VOCs (8260C)	SVOCs (8270D)	PAH-SIM (8270D-SIM)	Pesticides (8081B)	PCBs (8082A)	Herbicides (8151A)	Metals/ Mercury (6020D/7141A)	Dioxins/Furans (8290A)
OU1 Surface Soil									
SS001	X	X	X		X	X	X	X	
SS002	X	X	X		X	X	X	X	
SS003	X	X	X		X	X	X	X	
SS004	X	X	X		X	X	X	X	
SS005	X	X	X		X	X	X	X	
SS006	X	X	X		X	X	X	X	X
SS007	X	X	X		X	X	X	X	
SS008	X	X	X		X	X	X	X	
SS009	X	X	X		X	X	X	X	X
SS010	X	X	X	X	X	X	X	X	X
SS011	X	X	X		X	X	X	X	
SS012	X	X	X		X	X	X	X	X
SS013	X	X	X		X	X	X	X	
SS014	X	X	X		X	X	X	X	X
SS015	X	X	X		X	X	X	X	
SS016	X	X	X		X	X	X	X	
SS017	X	X	X		X	X	X	X	
SS018	X	X	X	X	X	X	X	X	
SS019	X	X	X		X	X	X	X	
SS020	X	X	X		X	X	X	X	X
SS021	X	X	X		X	X	X	X	
SS022	X	X	X		X	X	X	X	X
SS023	X	X	X		X	X	X	X	
SS024	X	X	X		X	X	X	X	X
SS025	X	X	X		X	X	X	X	
SS026	X	X	X		X	X	X	X	X
SS027	X	X	X		X	X	X	X	
SS028	X	X	X		X	X	X	X	
SS029	X	X	X		X	X	X	X	
SS030	X	X	X		X	X	X	X	X
SS031	X	X	X		X	X	X	X	
SS032	X	X	X		X	X	X	X	
SS033	X	X	X		X	X	X	X	
SS034	X	X	X		X	X	X	X	X
SS035	X	X	X		X	X	X	X	
SS036	X	X	X		X	X	X	X	
SS037	X	X	X	X	X	X	X	X	
SS038	X	X	X		X	X	X	X	X
SS039	X	X	X	X	X	X	X	X	

Table 2-1. Summary of RI Sampling Conducted within OU1 (Continued)

Location ID	RAD [1]	VOCs (8260C)	SVOCs (8270D)	PAH-SIM (8270D-SIM)	Pesticides (8081B)	PCBs (8082A)	Herbicides (8151A)	Metals/ Mercury (6020D/7141A)	Dioxins/Furans (8290A)
SS040	X	X	X		X	X	X	X	
SS041	X	X	X		X	X	X	X	
SS042	X	X	X		X	X	X	X	X
SS043	X	X	X		X	X	X	X	
SS044	X	X	X		X	X	X	X	
SS045	X	X	X		X	X	X	X	
SS046	X	X	X		X	X	X	X	X
SS047	X	X	X		X	X	X	X	
SS048	X	X	X		X	X	X	X	
SS049	X	X	X	X	X	X	X	X	
SS050	X	X	X		X	X	X	X	X
OU1 Subsurface Soil									
SU001-3	X	X	X		X	X	X	X	
SU002-4	X	X	X		X	X	X	X	
SU003-3	X	X	X	X	X	X	X	X	
SU004-3	X	X	X		X	X	X	X	
SU005-8	X	X	X		X	X	X	X	
SU006-7	X	X	X	X	X	X	X	X	X
SU007-9	X	X	X		X	X	X	X	
SU008-5	X	X	X		X	X	X	X	X
SU009-5	X	X	X		X	X	X	X	
SU010-8	X	X	X	X	X	X	X	X	X
SU011-5	X	X	X		X	X	X	X	
SU012-5	X	X	X		X	X	X	X	X
SU013-7	X	X	X		X	X	X	X	
SU014-5	X	X	X		X	X	X	X	X
SU014-9 (biased)	X	X	X		X	X	X	X	X
SU015-7	X	X	X		X	X	X	X	
SU016-6	X	X	X		X	X	X	X	
SU017-6	X	X	X		X	X	X	X	
SU018-6	X	X	X	X	X	X	X	X	
SU019-10 (biased)	X	X	X		X	X	X	X	
SU019-7	X	X	X		X	X	X	X	
SU020-7	X	X	X		X	X	X	X	X
SU021-6	X	X	X		X	X	X	X	
SU022-5	X	X	X		X	X	X	X	X
SU023-7	X	X	X		X	X	X	X	
SU024-7	X	X	X		X	X	X	X	X
SU025-5	X	X	X		X	X	X	X	
SU026-6	X	X	X		X	X	X	X	X
SU027-7	X	X	X		X	X	X	X	
SU028-6	X	X	X		X	X	X	X	
SU029-4	X	X	X		X	X	X	X	
SU030-7	X	X	X		X	X	X	X	X
SU031-6	X	X	X		X	X	X	X	
SU032-6	X	X	X		X	X	X	X	

Table 2-1. Summary of RI Sampling Conducted within OU1 (Continued)

Location ID	RAD [1]	VOCs (8260C)	SVOCs (8270D)	PAH-SIM (8270D-SIM)	Pesticides (8081B)	PCBs (8082A)	Herbicides (8151A)	Metals/ Mercury (6020D/7141A)	Dioxins/Furans (8290A)
SU033-7	X	X	X		X	X	X	X	
SU034-8	X	X	X		X	X	X	X	X
SU035-7	X	X	X		X	X	X	X	
SU036-7	X	X	X		X	X	X	X	
SU036-9 (biased)	X	X	X		X	X	X	X	
SU037-8	X	X	X	X	X	X	X	X	
SU038-6	X	X	X		X	X	X	X	X
SU039-5	X	X	X	X	X	X	X	X	
SU040-10 (biased)	X	X	X		X	X	X	X	
SU040-8	X	X	X		X	X	X	X	
SU041-6	X	X	X		X	X	X	X	
SU042-6	X	X	X		X	X	X	X	X
SU043-8	X	X	X		X	X	X	X	
SU044-9	X	X	X		X	X	X	X	
SU045-8	X	X	X		X	X	X	X	
SU046-7	X	X	X		X	X	X	X	X
SU047-10	X	X	X		X	X	X	X	
SU048-9	X	X	X		X	X	X	X	
SU049-8	X	X	X	X	X	X	X	X	
SU050-6	X	X	X		X	X	X	X	X
OU1 PCB Confirmation Sampling at DPT-016									
OU1-3-016						X			
OU1-3-016E						X			
OU1-3-016N						X			
OU1-3-016R1						X			
OU1-3-016S						X			
OU1-3-016W						X			
OU1 Biased Radiological Samples									
C22-A-1-005	X								
C22-A-2-005	X								
C22-A-2-009	X								
C22-B-1-003	X								
D23-A-1-001	X								
G23-A-2-006	X								
G23-B-1-006	X								
G23-B-2-005	X								
G23-B-2-006	X								
G23-C-2-002	X								
G23-C-2-004	X								
G23-C-2-004D3	X								
G23-C-3-004	X								
67-001	X								
67-001	X								
C22-A-005	X								
C22-A-008	X								

Table 2-1. Summary of RI Sampling Conducted within OU1 (Continued)

Location ID	RAD [1]	VOCs (8260C)	SVOCs (8270D)	PAH-SIM (8270D-SIM)	Pesticides (8081B)	PCBs (8082A)	Herbicides (8151A)	Metals/ Mercury (6020D/7141A)	Dioxins/Furans (8290A)
C22-B-001	X								
C22-B-003	X								
D23-A-001	X								
D23-A-003	X								
G23-A-004	X								
G23-A-005	X								
G23-A-006	X								
G23-C-002	X								
OU1 Groundwater – Temporary Wells									
TW001	X	X	X		X	X	X	X	
TW002	X	X	X		X	X	X	X	
TW003	X	X	X		X	X	X	X	X
TW004	X	X	X		X	X	X	X	X
TW005	X	X	X	X	X	X	X	X	X
TW006	X	X	X		X	X	X	X	X
TW007	X	X	X		X	X	X	X	X
TW008	X	X	X		X	X	X	X	
TW009	X	X	X	X	X	X	X	X	
TW010	X	X	X		X	X	X	X	X
TW011	X	X	X	X	X	X	X	X	X
TW012	X	X	X		X	X	X	X	X
TW013	X	X	X		X	X	X	X	X
TW014	X	X	X		X	X	X	X	
TW015	X	X	X		X	X	X	X	X
TW016	X	X	X		X	X	X	X	
TW017	X	X	X		X	X	X	X	X
TW018	X	X	X		X	X	X	X	
TW019	X	X	X		X	X	X	X	X
TW020	X	X	X		X	X	X	X	
TW021	X	X	X		X	X	X	X	X
TW022	X	X	X		X	X	X	X	
TW023	X	X	X		X	X	X	X	X
TW024	X	X	X		X	X	X	X	
TW025	X	X	X		X	X	X	X	X
OU1 Monitoring Wells									
MW001S	X	X	X		X	X	X	X	X
MW001WT	X	X	X		X	X	X	X	X
MW002S	X	X	X	X	X	X	X	X	
MW002WT	X	X	X	X	X	X	X	X	
MW003S	X	X	X		X	X	X	X	X
MW003WT	X	X	X		X	X	X	X	X
MW004S	X	X	X		X	X	X	X	
MW004WT	X	X	X		X	X	X	X	
MW005I	X	X	X		X	X	X	X	X
MW006S	X	X	X		X	X	X	X	
MW006WT	X	X	X		X	X	X	X	

Table 2-1. Summary of RI Sampling Conducted within OU1 (Continued)

Location ID	RAD (1)	VOCs (8260C)	SVOCs (8270D)	PAH-SIM (8270D-SIM)	Pesticides (8081B)	PCBs (8082A)	Herbicides (8151A)	Metals/ Mercury (6020D/7141A)	Dioxins/Furans (8290A)
MW007I	X	X	X	X	X	X	X	X	X
MW007S	X	X	X	X	X	X	X	X	X
OU1 Surface Water and Sediment									
SW001	X	X	X	X	X	X	X	X	X
SW002	X	X	X		X	X	X	X	
SW003	X	X	X	X	X	X	X	X	X
SW004	X	X	X		X	X	X	X	
SE001	X	X	X		X	X	X	X	X
SE002	X	X	X		X	X	X	X	X
SE003	X	X	X		X	X	X	X	X
SE004	X	X	X		X	X	X	X	X

(1) Soil and sediment samples were analyzed for radium-226, thorium-232, and uranium-238 via their progeny using EPA Method E901.1M; groundwater and surface water were analyzed for gross alpha (EPA Method SM7110C), gross beta (EPA Method 900.0), radium-226 (EPA Method 904.0), Radium 228 (EPA Method 903.0), and Total Uranium (EPA Method 200.8).

Table 2-2. Summary of Sampling Conducted at Background Locations

Location ID	RAD [1]	VOCs (8260C)	SVOCs (8270D)	PAH-SIM (8270D-SIM)	Pesticides (8081B)	PCBs (8082A)	Herbicides (8151A)	Metals/Mercury (6020D/7141A)	Dioxins/Furans (8290A)
Background Surface Soil									
BG-001	X	X	X		X	X	X	X	X
BG-002	X	X	X	X	X	X	X	X	
BG-003	X	X	X		X	X	X	X	X
BG-004	X	X	X		X	X	X	X	X
BG-005	X	X	X	X	X	X	X	X	
BG-006	X	X	X		X	X	X	X	X
BG-007	X	X	X		X	X	X	X	X
BG-008	X	X	X		X	X	X	X	X
BG-009	X	X	X	X	X	X	X	X	X
BG-010	X	X	X		X	X	X	X	X
BG-011	X	X	X		X	X	X	X	X
BG-012	X	X	X	X	X	X	X	X	X
BG-013	X	X	X		X	X	X	X	X
BG-014	X	X	X		X	X	X	X	X
BG-015	X	X	X	X	X	X	X	X	X
Background Subsurface Soil									
BG-001	X	X	X		X	X	X	X	X
BG-002	X	X	X	X	X	X	X	X	
BG-003	X	X	X		X	X	X	X	X
BG-004	X	X	X		X	X	X	X	X
BG-005	X	X	X	X	X	X	X	X	
BG-006	X	X	X		X	X	X	X	X
BG-007	X	X	X		X	X	X	X	X
BG-008	X	X	X		X	X	X	X	X
BG-009	X	X	X	X	X	X	X	X	X
BG-010	X	X	X		X	X	X	X	X
BG-011	X	X	X		X	X	X	X	X
BG-012	X	X	X	X	X	X	X	X	X
BG-013	X	X	X		X	X	X	X	X
BG-014	X	X	X		X	X	X	X	X
BG-015	X	X	X	X	X	X	X	X	X
Background Groundwater – Monitoring Wells									
BG-MW001	X	X	X	X	X	X	X	X	X
BG-MW002	X	X	X	X	X	X	X	X	X
BG-MW003	X	X	X	X	X	X	X	X	X
BG-MW004	X	X	X	X	X	X	X	X	X
Background Sediment									
BG-001	X	X	X	X	X	X	X	X	X
BG-002	X	X	X	X	X	X	X	X	X
Background Surface Water									
BG-001	X	X	X	X	X	X	X	X	X
BG-002	X	X	X	X	X	X	X	X	X

(1) Soil and sediment samples were analyzed for radium-226, thorium-232, and uranium-238 via their progeny using EPA Method E901.1M; groundwater and surface water were analyzed for gross alpha (EPA Method SM7110C), gross beta (EPA Method 900.0), radium-226 (EPA Method 904.0), Radium 228 (EPA Method 903.0), and Total Uranium (EPA Method 200.8).

Table 2-3. Location Details for DPT Soil Borings and Temporary Wells Completed During Phase 1 Field Activities

DPT Boring ID	Temporary Well ID	Longitude	Latitude	Ground Surface Elevation (ft MSL)	Top of Screen (ft MSL)	Bottom of Screen (ft MSL)
1	NA	-74.117284	40.548734	2.32189	NA	NA
2	TW001	-74.11755	40.548551	2.23393	1.92	-8.08
3	NA	-74.118132	40.549139	3.43494	NA	NA
4	TW002	-74.117253	40.549255	4.48169	3.45	-6.55
5	NA	-74.118522	40.549612	9.27673	NA	NA
6	TW003	-74.117746	40.549625	8.73283	6.29	-3.71
7	NA	-74.118931	40.550003	10.17835	NA	NA
8	TW004	-74.118142	40.550098	7.34535	4.90	-5.10
9	NA	-74.119029	40.550552	5.87002	NA	NA
10	TW005	-74.119617	40.551139	3.5311	3.53	-6.47
11	NA	-74.119982	40.55166	4.92639	NA	NA
12	TW006	-74.121103	40.55211	4.5714	3.57	-6.43
13	NA	-74.120397	40.552019	5.48408	NA	NA
14	TW007	-74.11973	40.55222	3.29134	3.05	-6.95
15	NA	-74.122224	40.55261	6.69822	NA	NA
16	TW008	-74.121487	40.552598	4.01601	3.51	-6.49
17	NA	-74.120729	40.552607	2.8034	NA	NA
18	TW009	-74.120148	40.552611	3.53424	3.29	-6.71
19	NA	-74.122597	40.553107	6.90277	NA	NA
20	TW010	-74.121993	40.553045	5.4675	4.90	-5.10
21	NA	-74.121236	40.553061	3.92475	NA	NA
22	TW011	-74.120355	40.553093	3.11865	2.88	-7.12
23	NA	-74.123695	40.553556	7.82221	NA	NA
24	TW012	-74.122971	40.553601	9.04839	2.88	-2.12
25	NA	-74.12231	40.553611	5.20515	NA	NA
26	TW013	-74.121467	40.553596	3.33977	3.30	-6.70
27	NA	-74.124107	40.55417	7.83543	NA	NA
28	TW014	-74.123357	40.554094	6.79603	2.82	-2.18
29	NA	-74.122602	40.554099	5.35425	NA	NA
30	TW015	-74.121851	40.554099	2.69642	2.68	-7.32
31	NA	-74.125199	40.554887	9.74049	NA	NA
32	TW016	-74.124464	40.554597	7.2508	3.25	-1.75
33	NA	-74.123657	40.554608	5.12293	NA	NA
34	TW017	-74.122965	40.554592	5.09978	6.80	-3.20
35	NA	-74.125958	40.555388	11.29712	NA	NA
36	TW018	-74.125585	40.555068	9.944861	4.33	-0.67
37	NA	-74.124836	40.555092	10.26743	NA	NA
38	TW019	-74.124073	40.555086	4.51468	3.13	-1.87
39	NA	-74.126957	40.555794	11.406807	NA	NA
40	TW020	-74.125957	40.555593	10.91598	4.27	-0.73
41	NA	-74.125209	40.555591	9.568455	NA	NA
42	TW021	-74.124458	40.555586	6.843594	3.59	-1.41
43	NA	-74.127244	40.556459	11.63198	NA	NA
44	TW022	-74.126243	40.556108	11.71534	3.57	-1.43
45	NA	-74.125564	40.555966	11.057776	NA	NA
46	TW023	-74.127385	40.556635	12.16443	5.57	0.57
47	NA	-74.126695	40.556597	11.718861	NA	NA
48	TW024	-74.125951	40.556581	9.891508	4.62	-0.38
49	NA	-74.127073	40.557088	13.342512	NA	NA
50	TW025	-74.126402	40.556909	11.533626	11.86	1.86

Table 2-4. Location Details for Background DPT Soil Borings

DPT Boring ID	Longitude	Latitude	Easting	Northing	Ground Surface (MSL)
BG-1	-74.12811672	40.55715432	595452.198	628087.561	13.45
BG-2	-74.12879756	40.55756933	595262.392	628237.947	16.89
BG-3	-74.12828297	40.55753523	595405.421	628226.126	14.56
BG-4	-74.12864121	40.55793597	595305.269	628371.692	16.44
BG-5	-74.12904497	40.55831057	595192.515	628507.68	19.35
BG-6	-74.12910103	40.55878202	595176.217	628679.36	25.24
BG-7	-74.12931673	40.5591298	595115.754	628805.798	28.76
BG-8	-74.12949432	40.559457	595065.909	628924.786	30.78
BG-9	-74.12964718	40.55981826	595022.886	629056.209	32.43
BG-10	-74.12976098	40.5602399	594990.624	629209.673	32.33
BG-11	-74.12979206	40.56074341	594981.217	629393.061	31.71
BG-12	-74.129863	40.56094009	594961.209	629464.624	32.98
BG-13	-74.12996161	40.56116962	594933.46	629548.125	34.33
BG-14	-74.13011761	40.56153335	594889.562	629680.447	35.48
BG-15	-74.13024309	40.56139069	594854.917	629628.331	34.42

Table 2-5. Construction Details for Monitoring Wells Installed During Phase 2 Field Activities

Well ID	Longitude	Latitude	Top of Casing (ft MSL)	Ground Surface (ft MSL)	Top of Screen (ft bgs)	Top of Screen (ft MSL)	Bottom of Screen (ft bgs)	Bottom of Screen (ft MSL)
OU1 Monitoring Wells								
MW001WT	-74.124975	40.555475	12.10	8.80	5	3.80	15	-6.20
MW001S	-74.124980	40.555477	12.41	9.02	20	-10.98	30	-20.98
MW002WT	-74.123005	40.553878	9.54	6.45	5	1.45	15	-8.55
MW002S	-74.123013	40.553883	9.75	6.52	20	-13.48	30	-23.48
MW003WT	-74.120992	40.553390	6.40	3.06	5	-1.94	15	-11.94
MW003S	-74.120996	40.553385	6.33	3.01	20	-16.99	30	-26.99
MW004WT	-74.120449	40.552346	6.14	3.58	5	-1.42	15	-11.42
MW004S	-74.120450	40.552351	6.14	3.45	20	-16.55	30	-26.55
MW005I	-74.119620	40.551108	5.91	3.38	40	-36.62	50	-46.62
MW006WT	-74.118860	40.550361	8.84	6.51	5	1.51	15	-8.49
MW006S	-74.118856	40.550363	8.84	6.47	20	-13.53	30	-23.53
MW007S	-74.117778	40.549352	7.64	5.21	20	-14.79	30	-24.79
MW007I	-74.117781	40.549354	7.83	5.25	40	-34.75	50	-44.75
Background Monitoring Wells								
BG-MW001	-74.127188	40.556984	15.874	13.344	20	-6.656	30	-16.656
BG-MW002	-74.129967	40.554606	14.632	12.093	20	-7.907	30	-17.907
BG-MW003	-74.135070	40.550770	23.613	21.166	20	1.166	30	-8.834
BG-MW004	-74.138181	40.548609	25.761	23.515	20	3.515	30	-6.485

Table 3-1. Summary of Mean Monthly Meteorological Data Near GKP

Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Average Temp. (F)	32.2	34.6	42.7	54.0	63.7	73.0	78.5	76.7	69.1	57.3	47.3	37.9	
Average Precipitation (in)	3.5	2.9	3.9	4.1	3.9	4.7	4.3	4.2	4.1	4.0	3.2	4.1	47
Average Snowfall (in)	9.7	12.2	5.5	0.6	0.0	0.0	0.0	0.0	0.0	0.3	1.0	8.0	37

Table 3-2. Summary of OU1 Site-Specific Geologic Rock Units

Unit and Age	Description	OU1 Boring Data
Cover Layer - Sewage Sludge/Clay-Silt Sand Undifferentiated	Red to brown clay-silty sand.	Where present ranges in thickness from 0.5 inches to 7 feet thick, with an average thickness of 1.7 feet.
Waste Fill	Waste fill, consists of brown to black heterogeneous mixture of highly decomposed waste fill consisting of incinerator residue (cinder-like material), coal ash, and organic material with scattered glass, metal, rubber, and wood debris.	Ranges in thickness from 0.5 feet thick to 11 feet thick with an average thickness of 4.5 feet thick. The waste fill occurs at a depth ranging from 0 to 7 feet bgs with an average depth of 1.4 bgs.
Hydraulic Fill	Hydraulic fill graded gray to brown sand.	Present beneath and adjacent to Buffalo Street and ranges in thickness from 3 to 8.5 feet thick with an average thickness of 5.6 feet.
Holocene 10,000 years to present	Marsh/estuarine deposits (plastic dark gray silty clay to clayey silt with organics).	The Holocene ranges in thickness from 0 to 10 feet thick with an average thickness of 4 feet. The depth to the Holocene ranges from 0 feet to 10.5 feet and averages 5.4 feet bgs.
Pleistocene 3 Ma to 10,000 years	Outwash deposit consists melt water deposited stratified red to brown fine to coarse sand and gravel. Highly permeable.	Underlies OU 1 at a depth ranging from 3 to 14 feet bgs with an average depth of 8.7 feet bgs.
	Till deposit consist of compact dark red-brown gravel to sand in a clay silt matrix.	Underlies only the upland area adjacent to Hylan and Buffalo Street.
Upper Cretaceous 85 Ma to 65 Ma	Raritan Formation Undivided – The mostly clayey formation consists of a varicolored interbedded brown to tan to light gray to white medium to fine sand (with trace of silt) with a clayey silt (with mica).	Encountered in borehole hole OU1-3-MW-7-1 at 52 feet bgs.
Upper Proterozoic (Precambrian to Cambrian) >590 Ma	Staten Island Serpentine – greenish brown metamorphic ultramafic crystalline rock. Present in northeast corner of GKP near intersection of Buffalo Street and Hylan Road.	Present at a depth of approximately 270 feet below MSL.
	Manhattan Schist consisting of dark-gray micaceous metamorphic rock.	Present at a depth of over 300 feet below MSL.

Table 3-3. Summary of Vegetation Associations and Communities Identified at GKP

	Community	Underlying Soil	Vegetation Community Occurrence and Description
Backdune Association	The North Atlantic Coast Backdune Grassland Community	Fine sand, coarse sand, gravelly fine sand, or (less commonly) loamy sand derived from various natural and non-natural sediments, including landfills capped with sand, sandy dredge fill, eolian and marine sediments, and sandy fill mixed with demolished construction debris.	Vegetation is variable and depends on landscape setting and land-use history. It is dominated by gray clubawn grass (*Corynephorus canescens*) in more disturbed settings and by little bluestem (*Schizachyrium scoparium*).
	Northern Tall Maritime Shrubland Community	Coarse to fine sand originating from marine sediments, eolian deposition, or dredge fill.	Characterized with very dense vegetation and often occurs inland of northern bayberry dune shrubland in sheltered settings.
Maritime Forest Associations	Successional Maritime Forest Community	Poorly drained to excessively drained, coarse to fine sands originating from marine- or eolian-derived sand or sandy dredge fill.	Occurs on stabilized backdunes, generally leeward of secondary maritime dunes or in protected hollows and is found farther inland in association with Tall Maritime Shrubland Community. This community is characterized as having a somewhat open tree canopy (to 50 feet [15 meters] tall) of successional maritime forest strongly dominated by black cherry with common hackberry. Associated canopy species include red maple, American holly, white poplar, black locust, and lesser amounts of eastern red cedar, Japanese black pine, and eastern cottonwood (*Populus deltoides*).
Human-Modified Vegetation Associations	Early Successional Woodland/Forest Community	Coarse sand formed from sandy dredge fill.	Consists of successional shrubland or open woodland or forest with northern hardwoods occurring in various settings following disturbance such as clearing, fragmentation, and deposition of fill material. Often occurs in a mosaic with other disturbed or successional communities, such as successional maritime forest and reed/grass tidal marsh, or even with paved areas. In the forests or woodlands, the open canopy is composed of a mix of early-successional species, including white popular, quaking aspen (*Populus tremuloides*), gray birch *(Betula populifolia*), and black cherry. The shrubland expression of this community is characterized by a dense layer of tall shrubs that are strongly dominated by white poplar, with northern bayberry and black cherry.
	Little Bluestem Old Field Community	Coarse sand to sandy loam and well-drained to somewhat poorly drained soils formed in sandy dredge fill and loamy fill over sandy sediments.	Occurs in disturbed areas and is generally maintained by mowing. Adjacent communities include northern tall maritime shrubland, northern bayberry dune shrubland, northeastern old field, and North Atlantic Coast backdune grassland, as well as parking lots and airstrips. This successional vegetation is dominated and characterized by little bluestem. Associated species include weeping lovegrass (*Eragrostis curvula*), purple lovegrass (*E. spectabilis*), gray clubawn grass, or a host of other grass or forb species.
	Northeastern Old Field Community	Coarse sand and sandy loam to mucky peat.	Extremely variable assortment of sites, from mowed fields to disturbed maritime dunes often dominated by common wormwood (*Artemisia vulgaris*) with a variety of grasses and forbs.
	Reed/Grass Tidal Marsh Community	Coarse to fine sand or (less often) mucky peat or mucky, fine, sandy loam. Soils can be derived from eolian sands or dredge fill.	Occurs adjacent to and commonly intermingled with mid-Atlantic maritime salt shrub and a range of tidal wetland habitats. Characterized by dense stands of Phragmites, which tends to grow in colonies of tall, stout, leafy plants, often to the exclusion of all other vascular plant species.

Table 3-4. Summary of Rare Animals and Plants Listed by New York State as Endangered and Threatened, Source: NYSDEC Environmental Resources Mapper

Common Name	Scientific Name	Subgroup	Distribution Status	Year Last Documented	State Protection Status
Mocha Emerald	*Somatochlora linearis*	Dragonflies	Historically Confirmed	1926	
Rambur's Forktail	*Ischnura ramburii*	Damselflies	Recently Confirmed	2007	
Dune Sandspur	*Cenchrus tribuloides*	Grasses	Recently Confirmed	1998	Threatened
Fairy Wand	*Chamaelirium luteum*	Other Flowering Plants	Historically Confirmed	1905	Endangered
Fringed Boneset	*Eupatorium torreyanum*	Asters Goldenrods and Daisies	Recently Confirmed	2008	Threatened
Great Plains Flatsedge	*Cyperus lupulinus ssp. lupulinus*	Sedges	Recently Confirmed	1997	Threatened
Hyssop-skullcap	*Scutellaria integrifolia*	Other Flowering Plants	Historically Confirmed	1909	Endangered
Oakes' Evening-primrose	*Oenothera oakesiana*	Other Flowering Plants	Recently Confirmed	1992	Threatened
Persimmon	*Diospyros virginiana*	Other Flowering Plants	Recently Confirmed	2006	Threatened
Primrose-leaf Violet	*Viola primulifolia*	Other Flowering Plants	Recently Confirmed	1997	Threatened
Rose-pink	*Sabatia angularis*	Other Flowering Plants	Recently Confirmed	2003	Endangered
Southern Wood Violet	Viola hirsutula	Other Flowering Plants	Possible but not Confirmed	1908	Endangered
Trinerved White Boneset	Eupatorium album var. subvenosum	Asters Goldenrods and Daisies	Recently Confirmed	1992	Threatened

Table 4-1. Summary Statistics for OU1 Surface Soil Sampling Locations

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Herbicides (mg/kg)											
2,4,5-T	50	0	0.00	NA	NA	NA	NA	630	0	8200	0
2,4,5-TP (Silvex)	50	0	0.00	NA	NA	NA	NA	510	0	6600	0
2,4-D	50	1	0.0200	0.038	0.038	0.0380	NA	700	0	9600	0
2,4-DB	50	4	0.0800	0.063	0.19	0.113	0.0565	510	0	6600	0
Dalapon	50	0	0.00	NA	NA	NA	NA	1900	0	25000	0
Dicamba	50	0	0.00	NA	NA	NA	NA	1900	0	25000	0
Dichlorprop	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dinoseb	50	0	0.00	NA	NA	NA	NA	63	0	820	0
MCPA (2-Methyl-4-chlorophenoxy acetic acid)	50	0	0.00	NA	NA	NA	NA	32	0	410	0
MCPP (2-(2-Methyl-4-chlorophenoxy) propanoic acid)	50	0	0.00	NA	NA	NA	NA	63	0	820	0
Metals (mg/kg)											
Aluminum	50	50	1.00	2400	17000	7170	3610	77000	0	1100000	0
Antimony	50	34	0.680	0.73	37	5.71	7.15	31	1	470	0
Arsenic	50	50	1.00	1.4	36	11.3	8.30	0.68	50	3	46
Barium	50	49	0.980	8.2	4600	387	727	15000	0	220000	0
Beryllium	50	49	0.980	0.13	1.2	0.508	0.241	160	0	2300	0
Cadmium	50	50	1.00	0.093	430	10.5	60.6	71	1	980	0
Calcium (Ca)	50	50	1.00	360	19000	3020	3580	NA	0	NA	0
Chromium	50	50	1.00	12	170	56.4	37.4	120000	0	1800000	0
Cobalt	50	50	1.00	3.7	31	10.5	5.00	23	1	350	0
Copper	50	50	1.00	18	2200	380	554	3100	0	47000	0
Iron (Fe)	50	50	1.00	8900	140000	38700	29800	55000	10	820000	0
Lead	50	50	1.00	12	2900	517	606	400	19	800	13
Magnesium (Mg)	50	50	1.00	1200	12000	3870	2530	NA	0	NA	0
Manganese (Mn)	50	50	1.00	72	850	360	199	1800	0	26000	0
Mercury	50	49	0.980	0.033	17	1.26	2.73	11	1	46	0
Nickel	50	50	1.00	14	380	73.5	62.4	1500	0	22000	0
Potassium (K)	50	50	1.00	390	3900	1070	738	NA	0	NA	0
Selenium	50	45	0.900	0.86	6.6	2.44	1.47	390	0	5800	0
Silver	50	48	0.960	0.14	45	4.71	8.99	390	0	5800	0

Table 4-1. Summary Statistics for OU1 Surface Soil Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Sodium (Na)	50	49	0.980	36	25000	2010	4740	NA	0	NA	0
Thallium	50	0	0.00	NA	NA	NA	NA	0.78	0	12	0
Thorium	50	49	0.980	0.56	7.8	2.22	1.52	NA	0	NA	0
Uranium 238	50	50	1.00	0.27	11	1.42	1.85	230	0	3500	0
Vanadium	50	50	1.00	10	380	48.1	52.7	390	0	5800	0
Zinc	50	50	1.00	32	4300	445	687	23000	0	350000	0
PCBs (mg/kg)											
Aroclor 1016	55	0	0.00	NA	NA	NA	NA	4.1	0	27	0
Aroclor 1221	55	0	0.00	NA	NA	NA	NA	0.2	0	0.83	0
Aroclor 1232	55	0	0.00	NA	NA	NA	NA	0.17	0	0.72	0
Aroclor 1242	55	0	0.00	NA	NA	NA	NA	0.23	0	0.95	0
Aroclor 1248	55	0	0.00	NA	NA	NA	NA	0.23	0	0.95	0
Aroclor 1254	55	21	0.382	0.022	3.2	0.535	0.781	0.24	10	0.97	4
Aroclor 1260	55	22	0.400	0.01	2.1	0.420	0.506	0.24	11	0.99	2
Aroclor 1262	55	10	0.182	0.018	0.16	0.0679	0.0486	NA	0	NA	0
Aroclor 1268	55	4	0.0727	0.018	1.4	0.387	0.677	NA	0	NA	0
Total PCBs Calculated	55	33	0.600	0.01	4.7	0.688	1.13	NA	0	NA	0
Dioxins (mg/kg)											
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	15	15	1.00	0.000013	0.0011	0.000381	0.000400	NA	0	NA	0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	15	15	1.00	0.000033	0.0018	0.000501	0.000551	NA	0	NA	0
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	15	15	1.00	0.0000011	0.000079	0.0000136	0.0000204	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	15	15	1.00	0.0000035	0.00015	0.0000245	0.0000386	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	15	15	1.00	0.00000079	0.000017	0.00000443	0.00000480	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	15	15	1.00	0.0000013	0.000053	0.0000114	0.0000143	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	15	15	1.00	0.0000017	0.000079	0.0000195	0.0000222	NA	0	NA	0
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	15	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	15	15	1.00	0.0000021	0.000031	0.00000905	0.00000906	NA	0	NA	0
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	15	15	1.00	0.0000011	0.000074	0.00000919	0.0000183	NA	0	NA	0

Table 4-1. Summary Statistics for OU1 Surface Soil Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	15	14	0.933	0.00000036	0.0000099	0.00000276	0.00000291	NA	0	NA	0
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	15	15	1.00	0.000002	0.000035	0.00000887	0.00000929	NA	0	NA	0
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	15	15	1.00	0.000001	0.000039	0.00000875	0.0000104	NA	0	NA	0
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	15	15	1.00	0.0000015	0.000053	0.0000119	0.0000138	NA	0	NA	0
Octachlorodibenzofuran (OCDF)	15	15	1.00	0.00002	0.0018	0.000449	0.000567	NA	0	NA	0
Octachlorodibenzo-p-dioxin (OCDD)	15	14	0.933	0.00044	0.024	0.00724	0.00777	NA	0	NA	0
TCDD, 2,3,7,8-	15	15	1.00	0.00000018	0.0000042	0.00000124	0.00000121	4.8E-06	0	2.2E-05	0
Total TEQ Calculated	15	15	1.00	0.000002985	0.00008865	0.0000268	0.0000283	4.8E-06	13	2.2E-05	6
Pesticides (mg/kg)											
4,4'-DDD	50	31	0.620	0.00065	0.074	0.0198	0.0186	2.3	0	9.6	0
4,4'-DDE	50	49	0.980	0.0014	1.4	0.133	0.211	2	0	9.3	0
4,4'-DDT	50	47	0.940	0.002	0.91	0.150	0.189	1.9	0	8.5	0
Aldrin	50	0	0.00	NA	NA	NA	NA	0.039	0	0.18	0
alpha Chlordane	50	16	0.320	0.0019	0.53	0.111	0.143	NA	0	NA	0
alpha-BHC	50	0	0.00	NA	NA	NA	NA	0.086	0	0.36	0
beta-BHC	50	0	0.00	NA	NA	NA	NA	0.3	0	1.3	0
Chlordane	50	16	0.320	0.017	2.3	0.616	0.664	1.7	1	7.7	0
delta-BHC	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dieldrin	50	3	0.0600	0.0015	0.04	0.0178	0.0199	0.034	1	0.14	0
Endosulfan I	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Endosulfan II	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Endosulfan sulfate	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Endrin	50	0	0.00	NA	NA	NA	NA	19	0	250	0
Endrin aldehyde	50	9	0.180	0.00089	1.1	0.132	0.363	NA	0	NA	0
Endrin ketone	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
gamma-BHC (Lindane)	50	0	0.00	NA	NA	NA	NA	0.57	0	2.5	0
gamma-Chlordane	50	17	0.340	0.00091	0.23	0.0551	0.0642	NA	0	NA	0
Heptachlor	50	2	0.0400	0.00062	0.0029	0.00176	0.00161	0.13	0	0.63	0
Heptachlor epoxide	50	2	0.0400	0.0037	0.074	0.0389	0.0497	0.07	1	0.33	0
Methoxychlor	50	1	0.0200	0.02	0.02	0.0200	NA	320	0	4100	0
Total Chlordane Calculated	50	17	0.340	0.0011	0.76	0.159	0.203	NA	0	NA	0

Table 4-1. Summary Statistics for OU1 Surface Soil Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Total DDD, DDE, DDT Calculated	50	49	0.980	0.0041	1.4	0.287	0.318	NA	0	NA	0
Toxaphene	50	0	0.00	NA	NA	NA	NA	0.49	0	2.1	0
SVOCs (mg/kg)											
1,2,4-Trichlorobenzene	50	2	0.0200	0.022	0.024	0.0230	0.00141	24	0	110	0
1,2-Dichlorobenzene	50	2	0.0200	0.0089	0.022	0.0155	0.00926	1800	0	9300	0
1,3-Dichlorobenzene	50	1	0.0100	0.019	0.019	0.0190	NA	NA	0	NA	0
1,4-Dichlorobenzene	50	2	0.0200	0.022	0.025	0.0235	0.00212	2.6	0	11	0
2,4,5-Trichlorophenol	50	0	0.00	NA	NA	NA	NA	6300	0	82000	0
2,4,6-Trichlorophenol	50	0	0.00	NA	NA	NA	NA	49	0	210	0
2,4-Dichlorophenol	50	0	0.00	NA	NA	NA	NA	190	0	2500	0
2,4-Dimethylphenol	50	0	0.00	NA	NA	NA	NA	1300	0	16000	0
2,4-Dinitrophenol	50	0	0.00	NA	NA	NA	NA	130	0	1600	0
2,4-Dinitrotoluene	50	0	0.00	NA	NA	NA	NA	1.7	0	7.4	0
2,6-Dinitrotoluene	50	0	0.00	NA	NA	NA	NA	0.36	0	1.5	0
2-Chloronaphthalene	50	2	0.0400	0.021	0.031	0.0260	0.00707	4800	0	60000	0
2-Chlorophenol	50	2	0.0400	0.012	0.022	0.0170	0.00707	390	0	5800	0
2-Methylnaphthalene	50	16	0.320	0.0068	0.035	0.0166	0.00761	240	0	3000	0
2-Methylphenol	50	2	0.0400	0.019	0.021	0.0200	0.00141	3200	0	41000	0
2-Nitroaniline	50	0	0.00	NA	NA	NA	NA	630	0	8000	0
2-Nitrophenol	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
3,3-Dichlorobenzidine	50	0	0.00	NA	NA	NA	NA	1.2	0	5.1	0
3,4-Methylphenol	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
3-Nitroaniline	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4,6-Dinitro-2-methylphenol	50	0	0.00	NA	NA	NA	NA	5.1	0	66	0
4-Bromophenyl-phenylether	50	1	0.0200	0.022	0.022	0.0220	NA	NA	0	NA	0
4-Chloro-3-methylphenol	50	1	0.0200	0.028	0.028	0.0280	NA	6300	0	82000	0
4-Chloroaniline	50	6	0.120	0.048	0.48	0.162	0.161	2.7	0	11	0
4-Chlorophenyl-phenylether	50	1	0.0200	0.024	0.024	0.0240	NA	NA	0	NA	0
4-Nitroaniline	50	0	0.00	NA	NA	NA	NA	27	0	110	0
4-Nitrophenol	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Acenaphthene	50	12	0.240	0.0053	0.03	0.0164	0.00817	3600	0	45000	0
Acenaphthylene	50	22	0.440	0.0083	0.34	0.0376	0.0687	NA	0	NA	0
Aniline	50	1	0.0200	0.12	0.12	0.120	NA	95	0	400	0
Anthracene	50	31	0.620	0.0071	0.16	0.0373	0.0355	18000	0	230000	0
Benzo(a)anthracene	50	47	0.940	0.0079	1.7	0.160	0.268	0.16	11	2.9	0

Table 4-1. Summary Statistics for OU1 Surface Soil Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Benzo(a)pyrene	50	37	0.740	0.008	2.5	0.233	0.408	0.016	35	0.29	7
Benzo(b)fluoranthene	50	48	0.960	0.016	4.3	0.297	0.631	0.16	23	2.9	1
Benzo(g,h,i)perylene	50	35	0.700	0.0083	1.5	0.154	0.250	NA	0	NA	0
Benzo(k)fluoranthene	50	38	0.760	0.0061	1.3	0.138	0.210	1.6	0	29	0
Benzyl Alcohol	50	0	0.00	NA	NA	NA	NA	6300	0	82000	0
Bis(2-chloro-1-methylethyl) ether	50	0	0.00	NA	NA	NA	NA	3100	0	47000	0
Bis(2-chloroethoxy)methane	50	2	0.0400	0.011	0.02	0.0155	0.00636	190	0	2500	0
Bis(2-chloroethyl)ether	50	1	0.0200	0.19	0.19	0.190	NA	0.23	0	1	0
Bis(2-ethylhexyl)phthalate	50	34	0.680	0.096	12	1.18	2.40	39	0	160	0
CARBAZOLE	50	17	0.340	0.0069	0.066	0.0241	0.0168	NA	0	NA	0
Chrysene	50	49	0.980	0.011	1.9	0.173	0.292	16	0	290	0
Dibenz(a,h)anthracene	50	8	0.160	0.017	0.5	0.104	0.161	0.016	8	0.29	1
Dibenzofuran	50	9	0.180	0.006	0.027	0.0144	0.00749	73	0	1000	0
Diethyl phthalate	50	0	0.00	NA	NA	NA	NA	51000	0	660000	0
Dimethyl phthalate	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Di-n-butyl phthalate	50	15	0.300	0.11	1	0.307	0.242	6300	0	82000	0
Di-n-octyl phthalate	50	4	0.0800	0.077	0.33	0.154	0.118	630	0	8200	0
Fluoranthene	50	47	0.940	0.02	2.2	0.294	0.404	2400	0	30000	0
Fluorene	50	11	0.220	0.0066	0.033	0.0208	0.00952	2400	0	30000	0
Hexachlorobenzene	50	3	0.0600	0.012	0.031	0.0233	0.0100	0.21	0	0.96	0
Hexachlorobutadiene	50	0	0.00	NA	NA	NA	NA	1.2	0	5.3	0
hexachlorocyclopentadiene	50	0	0.00	NA	NA	NA	NA	1.8	0	7.5	0
Hexachloroethane	50	1	0.0200	0.024	0.024	0.0240	NA	1.8	0	8	0
Indeno(1,2,3-cd)pyrene	50	31	0.620	0.0092	2.3	0.203	0.403	0.16	9	2.9	0
Isophorone	50	0	0.00	NA	NA	NA	NA	570	0	2400	0
Naphthalene	50	13	0.260	0.009	0.051	0.0211	0.0133	3.8	0	17	0
Nitrobenzene	50	0	0.00	NA	NA	NA	NA	5.1	0	22	0
n-Nitroso-di-n-propylamine	50	0	0.00	NA	NA	NA	NA	0.078	0	0.33	0
n-Nitrosodiphenylamine	50	0	0.00	NA	NA	NA	NA	110	0	470	0
Pentachlorophenol	50	2	0.0400	0.2	0.23	0.215	0.0212	1	0	4	0
Phenanthrene	50	49	0.980	0.0078	0.56	0.0957	0.120	NA	0	NA	0
Phenol	50	8	0.160	0.015	0.086	0.0383	0.0232	19000	0	250000	0
Pyrene	50	49	0.980	0.017	2.8	0.262	0.444	1800	0	23000	0
Pyridine	50	0	0.00	NA	NA	NA	NA	78	0	1200	0
Total BaP PAHs Calculated	50	50	1.00	0.00201	3.84	0.246	0.554	NA	0	NA	0
VOC (mg/kg)											

Table 4-1. Summary Statistics for OU1 Surface Soil Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
1,1,1-Trichloroethane	50	0	0.00	NA	NA	NA	NA	8100	0	36000	0
1,1,2,2-Tetrachloroethane	50	0	0.00	NA	NA	NA	NA	0.6	0	2.7	0
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	50	0	0.00	NA	NA	NA	NA	40000	0	170000	0
1,1,2-Trichloroethane	50	0	0.00	NA	NA	NA	NA	1.1	0	5	0
1,1-Dichloroethane	50	0	0.00	NA	NA	NA	NA	3.6	0	16	0
1,1-Dichloroethene	50	0	0.00	NA	NA	NA	NA	230	0	1000	0
1,2,4-Trichlorobenzene	50	2	0.0200	0.022	0.024	0.0230	0.00141	24	0	110	0
1,2-Dibromo-3-chloropropane	50	0	0.00	NA	NA	NA	NA	0.0053	0	0.064	0
1,2-Dibromoethane	50	0	0.00	NA	NA	NA	NA	0.036	0	0.16	0
1,2-Dichlorobenzene	50	2	0.0200	0.0089	0.022	0.0155	0.00926	1800	0	9300	0
1,2-Dichloroethane	50	0	0.00	NA	NA	NA	NA	0.46	0	2	0
1,2-Dichloropropane	50	0	0.00	NA	NA	NA	NA	1	0	4.4	0
1,3-Dichlorobenzene	100	1	0.0100	0.019	0.019	0.0190	NA	NA	0	NA	0
1,4-Dichlorobenzene	100	2	0.0200	0.022	0.025	0.0235	0.00212	2.6	0	11	0
2-Butanone	50	3	0.0600	0.045	0.65	0.298	0.314	27000	0	190000	0
2-Hexanone	50	0	0.00	NA	NA	NA	NA	200	0	1300	0
4-Methyl-2-pentanone	50	0	0.00	NA	NA	NA	NA	33000	0	140000	0
Acetone	50	15	0.300	0.0065	0.2	0.0431	0.0546	61000	0	670000	0
Benzene	50	1	0.0200	0.0025	0.0025	0.00250	NA	1.2	0	5.1	0
Bromodichloromethane	50	0	0.00	NA	NA	NA	NA	0.29	0	1.3	0
Bromoform	50	0	0.00	NA	NA	NA	NA	19	0	86	0
Bromomethane	50	0	0.00	NA	NA	NA	NA	6.8	0	30	0
Carbon disulfide	50	2	0.0400	0.0048	0.0072	0.00600	0.00170	770	0	3500	0
Carbon tetrachloride	50	0	0.00	NA	NA	NA	NA	0.65	0	2.9	0
Chlorobenzene	50	0	0.00	NA	NA	NA	NA	280	0	1300	0
Chloroethane	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Chloroform	50	0	0.00	NA	NA	NA	NA	0.32	0	1.4	0
Chloromethane	50	0	0.00	NA	NA	NA	NA	110	0	460	0
cis-1,2-Dichloroethene	50	0	0.00	NA	NA	NA	NA	160	0	2300	0
cis-1,3-Dichloropropene	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
cyclohexane	50	0	0.00	NA	NA	NA	NA	6500	0	27000	0
Cyclohexanone	50	0	0.00	NA	NA	NA	NA	28000	0	130000	0
Dibromochloromethane	50	0	0.00	NA	NA	NA	NA	8.3	0	39	0
Dichlorodifluoromethane	50	0	0.00	NA	NA	NA	NA	87	0	370	0
Ethylbenzene	50	0	0.00	NA	NA	NA	NA	5.8	0	25	0

Table 4-1. Summary Statistics for OU1 Surface Soil Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Isopropylbenzene	50	0	0.00	NA	NA	NA	NA	1900	0	9900	0
Methyl tert-butyl ether	50	0	0.00	NA	NA	NA	NA	47	0	210	0
Methylacetate	50	0	0.00	NA	NA	NA	NA	78000	0	1200000	0
methylcyclohexane	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Methylene chloride	50	0	0.00	NA	NA	NA	NA	57	0	1000	0
Styrene	50	0	0.00	NA	NA	NA	NA	6000	0	35000	0
Tetrachloroethene	50	1	0.0200	0.002	0.002	0.00200	NA	24	0	100	0
Toluene	50	0	0.00	NA	NA	NA	NA	4900	0	47000	0
trans-1,2-Dichloroethene	50	0	0.00	NA	NA	NA	NA	1600	0	23000	0
trans-1,3-Dichloropropene	50	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Trichloroethene	50	0	0.00	NA	NA	NA	NA	0.94	0	6	0
Trichlorofluoromethane	50	0	0.00	NA	NA	NA	NA	23000	0	350000	0
Vinyl chloride	50	0	0.00	NA	NA	NA	NA	0.059	0	1.7	0
Xylenes (total)	50	0	0.00	NA	NA	NA	NA	580	0	2500	0
RAD (pci/g)											
Actinium-228 as Thorium-232	50	50	1.00	0.295	2.375	0.883	0.484	1.1	11	NA	0
Bi-214 as Radium-226	50	50	1.00	0.338	2.458	0.790	0.460	0.6	29	NA	0
Uranium-238	50	50	1.00	0.09	3.63	0.469	0.610	0.5	20	NA	0

Table 4-2. Summary Statistics for OU1 Subsurface Soil DPT Boring Locations

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Herbicides (mg/kg)											
2,4,5-T	54	0	0.00	NA	NA	NA	NA	630	0	8200	0
2,4,5-TP (Silvex)	54	0	0.00	NA	NA	NA	NA	510	0	6600	0
2,4-D	54	0	0.00	NA	NA	NA	NA	700	0	9600	0
2,4-DB	54	0	0.00	NA	NA	NA	NA	510	0	6600	0
Dalapon	54	0	0.00	NA	NA	NA	NA	1900	0	25000	0
Dicamba	54	0	0.00	NA	NA	NA	NA	1900	0	25000	0
Dichlorprop	54	0	0.00	NA	NA	NA	NA	NA	0		0
Dinoseb	54	0	0.00	NA	NA	NA	NA	63	0	820	0
MCPA (2-Methyl-4-chlorophenoxy acetic acid)	54	0	0.00	NA	NA	NA	NA	32	0	410	0
MCPP (2-(2-Methyl-4-chlorophenoxy) propanoic acid)	54	0	0.00	NA	NA	NA	NA	63	0	820	0
Metals (mg/kg)											
Aluminum	54	54	1.00	2200	41000	11600	7340	77000	0	1100000	0
Antimony	54	26	0.481	0.22	44	9.45	10.7	31	2	470	0
Arsenic	54	53	0.981	1.9	100	18.7	20.5	0.68	53	3	45
Barium	54	54	1.00	12	13000	674	1950	15000	0	220000	0
Beryllium	54	47	0.870	0.24	4.1	0.890	0.802	160	0	2300	0
Cadmium	54	35	0.648	0.028	31	3.90	6.34	71	0	980	0
Calcium (Ca)	54	54	1.00	320	54000	6730	9870	NA	0		0
Chromium	54	54	1.00	9.6	800	103	138	120000	0	1800000	0
Cobalt	54	54	1.00	2.6	78	19.3	15.7	23	14	350	0
Copper	54	54	1.00	5.7	13000	622	1910	3100	2	47000	0
Iron (Fe)	54	54	1.00	8800	480000	67300	85800	55000	16	820000	0
Lead	54	54	1.00	3.4	5000	519	1020	400	17	800	11
Magnesium (Mg)	54	54	1.00	600	20000	4460	3270	NA	0		0
Manganese (Mn)	54	54	1.00	43	3800	507	590	1800	1	26000	0
Mercury	54	32	0.593	0.017	27	2.06	4.82	11	1	46	0
Nickel	54	54	1.00	16	1400	165	220	1500	0	22000	0
Potassium (K)	54	54	1.00	290	3500	1210	873	NA	0		0
Selenium	54	48	0.889	0.65	11	3.17	2.16	390	0	5800	0
Silver	54	33	0.611	0.12	360	13.7	62.3	390	0	5800	0

Table 4-2. Summary Statistics for OU1 Subsurface Soil DPT Boring Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Sodium (Na)	54	54	1.00	62	20000	2900	3850	NA	0		0
Thallium	54	0	0.00	NA	NA	NA	NA	0.78	0	12	0
Thorium	54	51	0.944	1.1	14	4.71	2.87	NA	0		0
Uranium 238	54	51	0.944	0.26	16	2.09	2.51	230	0	3500	0
Vanadium	54	53	0.981	10	110	42.4	23.6	390	0	5800	0
Zinc	54	53	0.981	21	4900	882	1390	23000	0	350000	0
PCBs (mg/kg)											
Aroclor 1016	54	0	0.00	NA	NA	NA	NA	4.1	0	27	0
Aroclor 1221	54	0	0.00	NA	NA	NA	NA	0.2	0	0.83	0
Aroclor 1232	54	0	0.00	NA	NA	NA	NA	0.17	0	0.72	0
Aroclor 1242	54	0	0.00	NA	NA	NA	NA	0.23	0	0.95	0
Aroclor 1248	54	0	0.00	NA	NA	NA	NA	0.23	0	0.95	0
Aroclor 1254	54	12	0.222	0.012	1.8	0.385	0.587	0.24	4	0.97	2
Aroclor 1260	54	8	0.148	0.029	1.3	0.301	0.453	0.24	2	0.99	1
Aroclor 1262	54	6	0.111	0.037	0.19	0.0813	0.0577	NA	0		0
Aroclor 1268	54	2	0.0370	0.02	0.031	0.0255	0.00778	NA	0		0
Total PCBs Calculated	54	17	0.315	0.012	3.1	0.448	0.839	NA	0		0
Dioxins (mg/kg)											
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	16	10	0.625	0.00000048	0.0027	0.000514	0.000948	NA	0	NA	0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	16	16	1.00	0.0000022	0.0027	0.000367	0.000676	NA	0	NA	0
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	16	7	0.438	0.00000013	0.000021	0.00000822	0.00000874	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	16	9	0.563	0.000000052	0.000034	0.0000117	0.0000154	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	16	8	0.500	0.00000017	0.0000091	0.00000241	0.00000301	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	16	9	0.563	0.000000035	0.000029	0.00000679	0.00000993	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	16	13	0.813	0.00000022	0.000075	0.0000143	0.0000211	NA	0	NA	0

Table 4-2. Summary Statistics for OU1 Subsurface Soil DPT Boring Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	16	3	0.188	0.000000038	0.00000092	0.000000338	0.000000504	NA	0	NA	0
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	16	16	1.00	0.00000016	0.000077	0.0000107	0.0000190	NA	0	NA	0
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	16	6	0.375	0.00000008	0.0000062	0.00000312	0.00000258	NA	0	NA	0
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	16	5	0.313	0.00000046	0.0000043	0.00000245	0.00000145	NA	0	NA	0
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	16	7	0.438	0.000000055	0.000014	0.00000556	0.00000571	NA	0	NA	0
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	16	4	0.250	0.0000042	0.000013	0.00000910	0.00000381	NA	0	NA	0
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	16	4	0.250	0.0000043	0.000015	0.00000890	0.00000463	NA	0	NA	0
Octachlorodibenzofuran (OCDF)	16	10	0.625	0.000001	0.0016	0.000302	0.000550	NA	0	NA	0
Octachlorodibenzo-p-dioxin (OCDD)	16	16	1.00	0.000078	0.05	0.00687	0.0123	NA	0	NA	0
TCDD, 2,3,7,8-	16	4	0.250	0.0000011	0.0000021	0.00000153	0.000000419	4.8E-06	0	2.2E-05	0
Total TEQ Calculated	16	16	1.00	8.33E-08	0.000088417	0.0000148	0.0000245	4.8E-06	6	2.2E-05	4
Pesticides (mg/kg)											
4,4'-DDD	54	15	0.278	0.0011	0.31	0.0665	0.0927	2.3	0	9.6	0
4,4'-DDE	54	13	0.241	0.00064	0.1	0.0206	0.0297	2	0	9.3	0
4,4'-DDT	54	6	0.111	0.00095	0.62	0.132	0.247	1.9	0	8.5	0
Aldrin	54	0	0.00	NA	NA	NA	NA	0.039	0	0.18	0
alpha Chlordane	54	4	0.0741	0.0047	0.035	0.0195	0.0163	NA	0	NA	0
alpha-BHC	54	0	0.00	NA	NA	NA	NA	0.086	0	0.36	0
beta-BHC	54	0	0.00	NA	NA	NA	NA	0.3	0	1.3	0
Chlordane	54	3	0.0556	0.036	0.066	0.0540	0.0159	1.7	0	7.7	0
delta-BHC	54	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dieldrin	54	0	0.00	NA	NA	NA	NA	0.034	0	0.14	0
Endosulfan I	54	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Endosulfan II	54	0	0.00	NA	NA	NA	NA	NA	0	NA	0

Table 4-2. Summary Statistics for OU1 Subsurface Soil DPT Boring Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Endosulfan sulfate	54	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Endrin	54	0	0.00	NA	NA	NA	NA	19	0	250	0
Endrin aldehyde	54	4	0.0741	0.00046	0.059	0.0176	0.0278	NA	0	NA	0
Endrin ketone	54	1	0.0185	0.00054	0.00054	0.000540	NA	NA	0	NA	0
gamma-BHC (Lindane)	54	0	0.00	NA	NA	NA	NA	0.57	0	2.5	0
gamma-Chlordane	54	4	0.0741	0.0021	0.017	0.00843	0.00634	NA	0	NA	0
Heptachlor	54	0	0.00	NA	NA	NA	NA	0.13	0	0.63	0
Heptachlor epoxide	54	1	0.0185	0.00081	0.00081	0.000810	NA	0.07	0	0.33	0
Methoxychlor	54	0	0.00	NA	NA	NA	NA	320	0	4100	0
Total Chlordane Calculated	54	6	0.111	0.0068	0.035	0.0186	0.0121	NA	0	NA	0
Total DDD, DDE, DDT Calculated	54	20	0.370	0.00064	1	0.101	0.225	NA	0	NA	0
Toxaphene	54	0	0.00	NA	NA	NA	NA	0.49	0	2.1	0
SVOCs (mg/kg)											
1,2,4-Trichlorobenzene	54	2	0.0370	0.015	0.083	0.0490	0.0481	24	0	110	0
1,2-Dichlorobenzene	54	4	0.0741	0.016	0.37	0.114	0.171	1800	0	9300	0
1,3-Dichlorobenzene	54	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,4-Dichlorobenzene	54	5	0.0926	0.013	0.29	0.0978	0.112	2.6	0	11	0
2,4,5-Trichlorophenol	54	0	0.00	NA	NA	NA	NA	6300	0	82000	0
2,4,6-Trichlorophenol	54	0	0.00	NA	NA	NA	NA	49	0	210	0
2,4-Dichlorophenol	54	0	0.00	NA	NA	NA	NA	190	0	2500	0
2,4-Dimethylphenol	54	0	0.00	NA	NA	NA	NA	1300	0	16000	0
2,4-Dinitrophenol	54	0	0.00	NA	NA	NA	NA	130	0	1600	0
2,4-Dinitrotoluene	54	0	0.00	NA	NA	NA	NA	1.7	0	7.4	0
2,6-Dinitrotoluene	54	0	0.00	NA	NA	NA	NA	0.36	0	1.5	0
2-Chloronaphthalene	54	1	0.0185	0.068	0.068	0.0680	NA	4800	0	60000	0
2-Chlorophenol	54	1	0.0185	0.072	0.072	0.0720	NA	390	0	5800	0
2-Methylnaphthalene	54	19	0.352	0.0049	0.19	0.0578	0.0576	240	0	3000	0
2-Methylphenol	54	0	0.00	NA	NA	NA	NA	3200	0	41000	0
2-Nitroaniline	54	0	0.00	NA	NA	NA	NA	630	0	8000	0
2-Nitrophenol	54	0	0.00	NA	NA	NA	NA	NA	0		0
3,3-Dichlorobenzidine	54	0	0.00	NA	NA	NA	NA	1.2	0	5.1	0
3,4-Methylphenol	54	5	0.0926	0.027	0.069	0.0450	0.0156	NA	0		0
3-Nitroaniline	54	0	0.00	NA	NA	NA	NA	NA	0		0
4,6-Dinitro-2-methylphenol	54	0	0.00	NA	NA	NA	NA	5.1	0	66	0
4-Bromophenyl-phenylether	54	1	0.0185	0.095	0.095	0.0950	NA	NA	0		0

Table 4-2. Summary Statistics for OU1 Subsurface Soil DPT Boring Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
4-Chloro-3-methylphenol	54	0	0.00	NA	NA	NA	NA	6300	0	82000	0
4-Chloroaniline	54	3	0.0556	0.031	2.1	0.817	1.12	2.7	0	11	0
4-Chlorophenyl-phenylether	54	0	0.00	NA	NA	NA	NA	NA	0		0
4-Nitroaniline	54	0	0.00	NA	NA	NA	NA	27	0	110	0
4-Nitrophenol	54	0	0.00	NA	NA	NA	NA	NA	0		0
Acenaphthene	54	9	0.167	0.00021	0.9	0.175	0.293	3600	0	45000	0
Acenaphthylene	54	13	0.241	0.0024	0.074	0.0343	0.0264	NA	0		0
Aniline	54	0	0.00	NA	NA	NA	NA	95	0	400	0
Anthracene	54	19	0.352	0.0015	3.8	0.294	0.869	18000	0	230000	0
Benzo(a)anthracene	54	26	0.481	0.0029	6.7	0.574	1.38	0.16	9	2.9	1
Benzo(a)pyrene	54	19	0.352	0.0021	5.4	0.704	1.29	0.016	16	0.29	8
Benzo(b)fluoranthene	54	22	0.407	0.0038	7.3	0.825	1.65	0.16	11	2.9	2
Benzo(g,h,i)perylene	54	18	0.333	0.0043	1.2	0.284	0.312	NA	0		0
Benzo(k)fluoranthene	54	15	0.278	0.0018	3	0.479	0.788	1.6	1	29	0
Benzyl Alcohol	54	2	0.0370	0.057	0.075	0.0660	0.0127	6300	0	82000	0
Bis(2-chloro-1-methylethyl) ether	54	0	0.00	NA	NA	NA	NA	3100	0	47000	0
Bis(2-chloroethoxy)methane	54	2	0.0370	0.041	0.065	0.0530	0.0170	190	0	2500	0
Bis(2-chloroethyl)ether	54	0	0.00	NA	NA	NA	NA	0.23	0	1	0
Bis(2-ethylhexyl)phthalate	54	24	0.444	0.086	12	1.44	2.59	39	0	160	0
CARBAZOLE	54	9	0.167	0.015	0.72	0.183	0.260	NA	0		0
Chrysene	54	25	0.463	0.0035	6	0.600	1.25	16	0	290	0
Dibenz(a,h)anthracene	54	10	0.185	0.0014	0.32	0.0982	0.109	0.016	7	0.29	1
Dibenzofuran	54	11	0.204	0.011	0.69	0.112	0.199	73	0	1000	0
Diethyl phthalate	54	0	0.00	NA	NA	NA	NA	51000	0	660000	0
Dimethyl phthalate	54	2	0.0370	0.15	0.26	0.205	0.0778	NA	0		0
Di-n-butyl phthalate	54	11	0.204	0.15	1.9	0.572	0.597	6300	0	82000	0
Di-n-octyl phthalate	54	3	0.0556	0.078	0.53	0.309	0.226	630	0	8200	0
Fluoranthene	54	29	0.537	0.0057	16	1.17	3.17	2400	0	30000	0
Fluorene	54	10	0.185	0.0022	1.1	0.201	0.334	2400	0	30000	0
Hexachlorobenzene	54	1	0.0185	0.088	0.088	0.0880	NA	0.21	0	0.96	0
Hexachlorobutadiene	54	0	0.00	NA	NA	NA	NA	1.2	0	5.3	0
hexachlorocyclopentadiene	54	0	0.00	NA	NA	NA	NA	1.8	0	7.5	0
Hexachloroethane	54	0	0.00	NA	NA	NA	NA	1.8	0	8	0
Indeno(1,2,3-cd)pyrene	54	17	0.315	0.0047	1.7	0.347	0.452	0.16	7	2.9	0
Isophorone	54	0	0.00	NA	NA	NA	NA	570	0	2400	0
Naphthalene	54	20	0.370	0.0019	0.74	0.146	0.195	3.8	0	17	0

Table 4-2. Summary Statistics for OU1 Subsurface Soil DPT Boring Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Nitrobenzene	54	0	0.00	NA	NA	NA	NA	5.1	0	22	0
n-Nitroso-di-n-propylamine	54	0	0.00	NA	NA	NA	NA	0.078	0	0.33	0
n-Nitrosodiphenylamine	54	2	0.0370	0.071	0.35	0.211	0.197	110	0	470	0
Pentachlorophenol	54	3	0.0556	0.2	0.45	0.297	0.134	1	0	4	0
Phenanthrene	54	23	0.426	0.0056	17	1.08	3.57	NA	0	NA	0
Phenol	54	7	0.130	0.013	0.2	0.0603	0.0653	19000	0	250000	0
Pyrene	54	29	0.537	0.0074	16	1.10	3.07	1800	0	23000	0
Pyridine	54	0	0.00	NA	NA	NA	NA	78	0	1200	0
Total BaP PAHs Calculated	54	29	0.537	0.000106	7.33	0.633	1.48	NA	0	NA	0
VOC (mg/kg)											
1,1,1-Trichloroethane	54	0	0.00	NA	NA	NA	NA	8100	0	36000	0
1,1,2,2-Tetrachloroethane	54	0	0.00	NA	NA	NA	NA	0.6	0	2.7	0
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	54	0	0.00	NA	NA	NA	NA	40000	0	170000	0
1,1,2-Trichloroethane	54	0	0.00	NA	NA	NA	NA	1.1	0	5	0
1,1-Dichloroethane	54	0	0.00	NA	NA	NA	NA	3.6	0	16	0
1,1-Dichloroethene	54	0	0.00	NA	NA	NA	NA	230	0	1000	0
1,2,4-Trichlorobenzene	54	0	0.00	NA	NA	NA	NA	24	0	110	0
1,2-Dibromo-3-chloropropane	54	0	0.00	NA	NA	NA	NA	0.0053	0	0.064	0
1,2-Dibromoethane	54	0	0.00	NA	NA	NA	NA	0.036	0	0.16	0
1,2-Dichlorobenzene	54	7	0.127	0.00035	0.0095	0.00320	0.00345	1800	0	9300	0
1,2-Dichloroethane	54	0	0.00	NA	NA	NA	NA	0.46	0	2	0
1,2-Dichloropropane	54	0	0.00	NA	NA	NA	NA	1	0	4.4	0
1,3-Dichlorobenzene	54	2	0.0364	0.00051	0.017	0.00876	0.0117	NE	NE	NE	NE
1,4-Dichlorobenzene	54	10	0.182	0.0016	0.021	0.00634	0.00656	2.6	0	11	0
2-Butanone	54	18	0.333	0.0034	0.2	0.0568	0.0519	27000	0	190000	0
2-Hexanone	54	0	0.00	NA	NA	NA	NA	200	0	1300	0
4-Methyl-2-pentanone	54	0	0.00	NA	NA	NA	NA	33000	0	140000	0
Acetone	54	32	0.593	0.0096	0.5	0.113	0.110	61000	0	670000	0
Benzene	54	2	0.0370	0.0022	0.006	0.00410	0.00269	1.2	0	5.1	0
Bromodichloromethane	54	0	0.00	NA	NA	NA	NA	0.29	0	1.3	0
Bromoform	54	0	0.00	NA	NA	NA	NA	19	0	86	0
Bromomethane	54	0	0.00	NA	NA	NA	NA	6.8	0	30	0
Carbon disulfide	54	17	0.315	0.0012	0.081	0.0109	0.0195	770	0	3500	0
Carbon tetrachloride	54	0	0.00	NA	NA	NA	NA	0.65	0	2.9	0
Chlorobenzene	54	6	0.111	0.0012	0.0094	0.00397	0.00322	280	0	1300	0

Table 4-2. Summary Statistics for OU1 Subsurface Soil DPT Boring Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Residential		Commercial/Industrial	
								RSL	# Exceedances	RSL	# Exceedances
Chloroethane	54	0	0.00	NA	NA	NA	NA	NA	0		0
Chloroform	54	1	0.0185	0.011	0.011	0.0110	NA	0.32	0	1.4	0
Chloromethane	54	0	0.00	NA	NA	NA	NA	110	0	460	0
cis-1,2-Dichloroethene	54	0	0.00	NA	NA	NA	NA	160	0	2300	0
cis-1,3-Dichloropropene	54	0	0.00	NA	NA	NA	NA	NA	0		0
cyclohexane	54	1	0.0185	0.00083	0.00083	0.000830	NA	6500	0	27000	0
Cyclohexanone	54	1	0.0185	0.35	0.35	0.350	NA	28000	0	130000	0
Dibromochloromethane	54	0	0.00	NA	NA	NA	NA	8.3	0	39	0
Dichlorodifluoromethane	54	0	0.00	NA	NA	NA	NA	87	0	370	0
Ethylbenzene	54	2	0.0370	0.00092	0.0018	0.00136	0.000622	5.8	0	25	0
Isopropylbenzene	54	3	0.0556	0.0013	0.026	0.0101	0.0138	1900	0	9900	0
Methyl tert-butyl ether	54	0	0.00	NA	NA	NA	NA	47	0	210	0
Methylacetate	54	0	0.00	NA	NA	NA	NA	78000	0	1200000	0
methylcyclohexane	54	2	0.0370	0.00088	0.0011	0.000990	0.000156	NA	0		0
Methylene chloride	54	0	0.00	NA	NA	NA	NA	57	0	1000	0
Styrene	54	0	0.00	NA	NA	NA	NA	6000	0	35000	0
Tetrachloroethene	54	6	0.111	0.0012	0.044	0.00943	0.0170	24	0	100	0
Toluene	54	3	0.0556	0.0017	0.0069	0.00367	0.00282	4900	0	47000	0
trans-1,2-Dichloroethene	54	0	0.00	NA	NA	NA	NA	1600	0	23000	0
trans-1,3-Dichloropropene	54	0	0.00	NA	NA	NA	NA	NA	0		0
Trichloroethene	54	0	0.00	NA	NA	NA	NA	0.94	0	6	0
Trichlorofluoromethane	54	0	0.00	NA	NA	NA	NA	23000	0	350000	0
Vinyl chloride	54	0	0.00	NA	NA	NA	NA	0.059	0	1.7	0
Xylenes (total)	54	3	0.0556	0.0011	0.011	0.00587	0.00496	580	0	2500	0
RAD (pci/g)											
Actinium-228 as Thorium-232	50	49	0.980	0.411	2.406	1.17	0.414	1.1	26		0
Bi-214 as Radium-226	50	49	0.980	0.266	2.983	1.02	0.505	0.6	44		0
Uranium-238	54	51	0.944	0.0858	5.28	0.751	0.996	0.5	20		0

Table 4-3. Summary Statistics for OU1 Groundwater Sampling Locations

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	MCLs		Tapwater RSLs	
								MCLs	# Exceedances	RSL	# Exceedances
Herbicides (ug/l)											
2,4,5-T	38	0	0.00	NA	NA	NA	NA		0	160	0
2,4,5-TP (Silvex)	38	0	0.00	NA	NA	NA	NA	50	0	110	0
2,4-D	38	0	0.00	NA	NA	NA	NA	70	0	170	0
2,4-DB	38	0	0.00	NA	NA	NA	NA		0	120	0
Dalapon	38	0	0.00	NA	NA	NA	NA	200	0	600	0
Dicamba	38	0	0.00	NA	NA	NA	NA		0	570	0
Dichlorprop	38	0	0.00	NA	NA	NA	NA		0		0
Dinoseb	38	0	0.00	NA	NA	NA	NA	7	0	15	0
MCPA (2-Methyl-4-chlorophenoxy acetic acid)	38	0	0.00	NA	NA	NA	NA		0	7.5	0
MCPP (2-(2-Methyl-4-chlorophenoxy) propanoic acid)	38	0	0.00	NA	NA	NA	NA		0	16	0
Metals (ug/l)											
Aluminum	38	14	0.368	17	5000	795	1390		0	20000	0
Antimony	38	0	0.00	NA	NA	NA	NA	6	0	7.8	0
Arsenic	38	3	0.0789	1.3	12	5.77	5.56	10	1	0.052	3
Barium	38	38	1.00	47	2600	357	503	2000	1	3800	0
Beryllium	38	2	0.0526	0.26	0.32	0.290	0.0424	4	0	25	0
Cadmium	38	8	0.211	0.24	280	44.4	95.7	5	6	9.2	4
Calcium (Ca)	38	38	1.00	1900	780000	221000	184000		0		0
Chromium	38	2	0.0526	6.5	43	24.8	25.8	100	0	22000	0
Cobalt	38	24	0.632	0.72	85	13.6	22.0		0	6	9
Copper	40	16	0.400	0.49	590	74.4	172	1300	0	800	0
Iron (Fe)	38	32	0.842	70	350000	36900	68300		0	14000	15
Lead	40	11	0.275	0.44	20	5.90	6.58	15	1	15	1
Magnesium (Mg)	38	38	1.00	7800	1100000	298000	332000		0		0
Manganese (Mn)	38	38	1.00	63	18000	3060	3950		0	430	29
Mercury	38	14	0.368	0.06	0.22	0.0939	0.0516	2	0	0.63	0
Nickel	38	30	0.789	5.5	710	90.4	162		0	390	2
Potassium (K)	38	38	1.00	2200	350000	86600	101000		0		0
Selenium	38	1	0.0263	15	15	15.0	NA	50	0	100	0
Silver	38	0	0.00	NA	NA	NA	NA		0	94	0

Table 4-3. Summary Statistics for OU1 Groundwater Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	MCLs		Tapwater RSLs	
								MCLs	# Exceedances	MCLs	# Exceedances
Sodium (Na)	38	38	1.00	17000	9500000	2420000	2840000		0		0
Thallium	38	1	0.0263	6.6	6.6	6.60	NA	2	1	0.2	1
Thorium	38	2	0.0526	0.63	6.6	3.62	4.22		0		0
Uranium 238	38	20	0.526	0.51	31	4.93	6.85	30	1	60	0
Vanadium	38	3	0.0789	4.7	15	8.17	5.92		0	86	0
Zinc	38	18	0.474	8.6	6700	714	1640		0	6000	1
PCBs (ug/l)											
Aroclor 1016	38	0	0.00	NA	NA	NA	NA		0	0.22	0
Aroclor 1221	38	0	0.00	NA	NA	NA	NA		0	0.0047	0
Aroclor 1232	38	0	0.00	NA	NA	NA	NA		0	0.0047	0
Aroclor 1242	38	0	0.00	NA	NA	NA	NA		0	0.0078	0
Aroclor 1248	38	0	0.00	NA	NA	NA	NA		0	0.0078	0
Aroclor 1254	38	0	0.00	NA	NA	NA	NA		0	0.0078	0
Aroclor 1260	38	1	0.0263	0.44	0.44	0.440	NA		0	0.0078	1
Aroclor 1262	38	0	0.00	NA	NA	NA	NA		0		0
Aroclor 1268	38	0	0.00	NA	NA	NA	NA		0		0
Total PCBs Calculated	38	1	0.0263	0.44	0.44	0.440	NA		0		0
Dioxins (ug/l)											
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	22	9	0.409	0.00000049	0.000072	0.0000119	0.0000228		0		0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	22	7	0.318	0.0000037	0.00012	0.0000248	0.0000423		0		0
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	22	1	0.0455	0.0000016	0.0000016	0.00000160	NA		0		0
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	22	2	0.0909	0.00000091	0.0000023	0.00000161	0.000000983		0		0
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	22	2	0.0909	0.00000049	0.00000055	0.000000520	0.0000000424		0		0
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	22	2	0.0909	0.00000054	0.000001	0.000000770	0.000000325		0		0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	22	7	0.318	0.0000003	0.0000042	0.00000137	0.00000131		0		0
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	22	0	0.00						0		0
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	22	5	0.227	0.00000036	0.0000025	0.000000956	0.000000877		0		0
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	22	1	0.0455	0.000002	0.000002	0.00000200	NA		0		0

Table 4-3. Summary Statistics for OU1 Groundwater Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	MCLs		Tapwater RSLs	
								MCLs	# Exceedances	MCLs	# Exceedances
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	22	2	0.0909	0.00000068	0.00000072	0.000000700	0.0000000283		0		0
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	22	1	0.0455	0.00000095	0.00000095	0.000000950	NA		0		0
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	22	3	0.136	0.00000072	0.0000025	0.00000154	0.000000898		0		0
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	22	1	0.0455	0.0000014	0.0000014	0.00000140	NA		0		0
Octachlorodibenzofuran (OCDF)	22	4	0.182	0.0000025	0.000013	0.00000533	0.00000512		0		0
Octachlorodibenzo-p-dioxin (OCDD)	22	10	0.455	0.000025	0.0026	0.000522	0.000819		0		0
TCDD, 2,3,7,8-	22	0	0.00	NA	NA	NA	NA	3E-05	0	1.2E-07	0
Total TEQ Calculated	22	17	0.773	1.74E-08	0.000003795	0.000000534	0.000000903	3E-05	0	1.2E-07	12
Pesticides (ug/l)											
4,4'-DDD	38	1	0.0263	0.055	0.055	0.0550	NA		0	0.032	1
4,4'-DDE	38	2	0.0526	0.012	0.037	0.0245	0.0177		0	0.046	0
4,4'-DDT	38	2	0.0526	0.011	0.019	0.0150	0.00566		0	0.23	0
Aldrin	38	0	0.00	NA	NA	NA	NA		0	0.00092	0
alpha Chlordane	38	0	0.00	NA	NA	NA	NA		0		0
alpha-BHC	38	0	0.00	NA	NA	NA	NA		0	0.0072	0
beta-BHC	38	0	0.00	NA	NA	NA	NA		0	0.025	0
Chlordane	38	0	0.00	NA	NA	NA	NA	2	0	0.02	0
delta-BHC	38	0	0.00	NA	NA	NA	NA		0		0
Dieldrin	38	0	0.00	NA	NA	NA	NA		0	0.0018	0
Endosulfan I	38	0	0.00	NA	NA	NA	NA		0		0
Endosulfan II	38	0	0.00	NA	NA	NA	NA		0		0
Endosulfan sulfate	38	0	0.00	NA	NA	NA	NA		0		0
Endrin	38	0	0.00	NA	NA	NA	NA	2	0	2.3	0
Endrin aldehyde	38	0	0.00	NA	NA	NA	NA		0		0
Endrin ketone	38	1	0.0263	0.036	0.036	0.0360	NA		0		0
gamma-BHC (Lindane)	38	0	0.00	NA	NA	NA	NA	0.2	0	0.042	0
gamma-Chlordane	38	0	0.00	NA	NA	NA	NA		0		0
Heptachlor	38	0	0.00	NA	NA	NA	NA	0.4	0	0.0014	0
Heptachlor epoxide	38	0	0.00	NA	NA	NA	NA	0.2	0	0.0014	0
Methoxychlor	38	0	0.00	NA	NA	NA	NA	40	0	37	0
Total Chlordane Calculated	38	0	0.00	NA	NA	NA	NA		0		0
Total DDD, DDE, DDT Calculated	38	1	0.0263	0.11	0.11	0.110	NA		0		0

Table 4-3. Summary Statistics for OU1 Groundwater Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	MCLs		Tapwater RSLs	
								MCLs	# Exceedances	MCLs	# Exceedances
Toxaphene	38	0	0.00	NA	NA	NA	NA	3	0	0.071	0
SVOCs (ug/l)											
1,2,4-Trichlorobenzene	38	0	0.00	NA	NA	NA	NA	70	0	1.2	0
1,2-Dichlorobenzene	38	0	0.00	NA	NA	NA	NA	600	0	300	0
1,3-Dichlorobenzene	38	0	0.00	NA	NA	NA	NA		0		0
1,4-Dichlorobenzene	38	0	0.00	NA	NA	NA	NA	75	0	0.48	0
2,4,5-Trichlorophenol	38	0	0.00	NA	NA	NA	NA		0	1200	0
2,4,6-Trichlorophenol	38	0	0.00	NA	NA	NA	NA		0	4.1	0
2,4-Dichlorophenol	38	0	0.00	NA	NA	NA	NA		0	46	0
2,4-Dimethylphenol	38	0	0.00	NA	NA	NA	NA		0	360	0
2,4-Dinitrophenol	38	0	0.00	NA	NA	NA	NA		0	39	0
2,4-Dinitrotoluene	38	0	0.00	NA	NA	NA	NA		0	0.24	0
2,6-Dinitrotoluene	38	0	0.00	NA	NA	NA	NA		0	0.049	0
2-Chloronaphthalene	38	0	0.00	NA	NA	NA	NA		0	750	0
2-Chlorophenol	38	0	0.00	NA	NA	NA	NA		0	91	0
2-Methylnaphthalene	38	0	0.00	NA	NA	NA	NA		0	36	0
2-Methylphenol	38	0	0.00	NA	NA	NA	NA		0	930	0
2-Nitroaniline	38	0	0.00	NA	NA	NA	NA		0	190	0
2-Nitrophenol	38	0	0.00	NA	NA	NA	NA		0		0
3,3-Dichlorobenzidine	38	0	0.00	NA	NA	NA	NA		0	0.13	0
3,4-Methylphenol	38	2	0.0526	0.18	0.78	0.480	0.424		0		0
3-Nitroaniline	38	0	0.00	NA	NA	NA	NA		0		0
4,6-Dinitro-2-methylphenol	38	0	0.00	NA	NA	NA	NA		0	1.5	0
4-Bromophenyl-phenylether	38	0	0.00	NA	NA	NA	NA		0		0
4-Chloro-3-methylphenol	38	0	0.00	NA	NA	NA	NA		0	1400	0
4-Chloroaniline	38	1	0.0263	3.7	3.7	3.70	NA		0	0.37	1
4-Chlorophenyl-phenylether	38	0	0.00	NA	NA	NA	NA		0		0
4-Nitroaniline	38	0	0.00	NA	NA	NA	NA		0	3.8	0
4-Nitrophenol	38	0	0.00	NA	NA	NA	NA		0		0
Acenaphthene	38	4	0.105	0.0067	0.47	0.144	0.221		0	530	0
Acenaphthylene	38	1	0.0263	0.013	0.013	0.0130	NA		0		0
Aniline	38	0	0.00	NA	NA	NA	NA		0	13	0
Anthracene	38	2	0.0526	0.012	0.05	0.0310	0.0269		0	1800	0
Benzo(a)anthracene	38	1	0.0263	0.033	0.033	0.0330	NA		0	0.012	1
Benzo(a)pyrene	38	3	0.0789	0.0049	0.0098	0.00677	0.00265	0.2	0	0.0034	3

Table 4-3. Summary Statistics for OU1 Groundwater Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	MCLs		Tapwater RSLs	
								MCLs	# Exceedances	MCLs	# Exceedances
Benzo(b)fluoranthene	38	1	0.0263	0.043	0.043	0.0430	NA		0	0.034	1
Benzo(g,h,i)perylene	38	1	0.0263	0.021	0.021	0.0210	NA		0		0
Benzo(k)fluoranthene	38	3	0.0789	0.0066	0.041	0.0191	0.0190		0	0.34	0
Benzyl Alcohol	38	1	0.0263	0.83	0.83	0.830	NA		0	2000	0
Bis(2-chloro-1-methylethyl) ether	38	0	0.00	NA	NA	NA	NA		0	710	0
Bis(2-chloroethoxy)methane	38	0	0.00	NA	NA	NA	NA		0	59	0
Bis(2-chloroethyl)ether	38	0	0.00	NA	NA	NA	NA		0	0.014	0
Bis(2-ethylhexyl)phthalate	38	2	0.0526	1.5	2.5	2.00	0.707	6	0	5.6	0
CARBAZOLE	38	0	0.00	NA	NA	NA	NA		0		0
Chrysene	38	3	0.0789	0.011	0.046	0.0230	0.0199		0	3.4	0
Dibenz(a,h)anthracene	38	3	0.0789	0.0038	0.022	0.0101	0.0103		0	0.0034	3
Dibenzofuran	38	0	0.00	NA	NA	NA	NA		0	7.9	0
Diethyl phthalate	38	2	0.0526	1.8	120	60.9	83.6		0	15000	0
Dimethyl phthalate	38	1	0.0263	2.9	2.9	2.90	NA		0		0
Di-n-butyl phthalate	38	1	0.0263	230	230	230	NA		0	900	0
Di-n-octyl phthalate	38	0	0.00	NA	NA	NA	NA		0	200	0
Fluoranthene	38	2	0.0526	0.019	0.29	0.155	0.192		0	800	0
Fluorene	38	2	0.0526	0.037	0.26	0.149	0.158		0	290	0
Hexachlorobenzene	38	0	0.00	NA	NA	NA	NA	1	0	0.0098	0
Hexachlorobutadiene	38	0	0.00	NA	NA	NA	NA		0	0.14	0
hexachlorocyclopentadiene	38	0	0.00	NA	NA	NA	NA	50	0	0.41	0
Hexachloroethane	38	0	0.00	NA	NA	NA	NA		0	0.33	0
Indeno(1,2,3-cd)pyrene	38	1	0.0263	0.025	0.025	0.0250	NA		0	0.034	0
Isophorone	38	0	0.00	NA	NA	NA	NA		0	78	0
Naphthalene	38	4	0.105	0.018	0.6	0.187	0.279		0	0.17	1
Nitrobenzene	38	0	0.00	NA	NA	NA	NA		0	0.14	0
n-Nitroso-di-n-propylamine	38	0	0.00	NA	NA	NA	NA		0	0.011	0
Pentachlorophenol	38	0	0.00	NA	NA	NA	NA	1	0	0.041	0
Phenanthrene	38	4	0.105	0.062	0.92	0.279	0.428		0		0
Phenol	38	4	0.105	0.12	3.2	0.950	1.50		0	5800	0
Pyrene	38	2	0.0526	0.021	0.14	0.0805	0.0841		0	120	0
Pyridine	38	0	0.00	NA	NA	NA	NA		0	20	0
Total BaP PAHs Calculated	38	3	0.0789	0.008777	0.042356	0.0204	0.0190	0.2	0	0.0034	3
VOC (ug/l)											
1,1,1-Trichloroethane	38	0	0.00	NA	NA	NA	NA	200	0	8000	0

Table 4-3. Summary Statistics for OU1 Groundwater Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	MCLs		Tapwater RSLs	
								MCLs	# Exceedances	MCLs	# Exceedances
1,1,2,2-Tetrachloroethane	38	0	0.00	NA	NA	NA	NA		0	0.076	0
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	38	0	0.00	NA	NA	NA	NA		0	55000	0
1,1,2-Trichloroethane	38	0	0.00	NA	NA	NA	NA	5	0	0.28	0
1,1-Dichloroethane	38	0	0.00	NA	NA	NA	NA		0	2.8	0
1,1-Dichloroethene	38	0	0.00	NA	NA	NA	NA	7	0	280	0
1,2,4-Trichlorobenzene	38	0	0.00	NA	NA	NA	NA	70	0	1.2	0
1,2-Dibromo-3-chloropropane	38	0	0.00	NA	NA	NA	NA	0.2	0	0.00033	0
1,2-Dibromoethane	38	0	0.00	NA	NA	NA	NA	0.05	0	0.0075	0
1,2-Dichlorobenzene	38	1	0.0263	0.89	0.89	0.890	NA	600	0	300	0
1,2-Dichloroethane	38	0	0.00	NA	NA	NA	NA	5	0	0.17	0
1,2-Dichloropropane	38	0	0.00	NA	NA	NA	NA	5	0	0.44	0
1,3-Dichlorobenzene	38	0	0.00	NA	NA	NA	NA		0		0
1,4-Dichlorobenzene	38	5	0.132	0.11	0.34	0.200	0.100	75	0	0.48	0
2-Butanone	38	7	0.184	0.48	65	17.6	23.0		0	5600	0
2-Hexanone	38	0	0.00	NA	NA	NA	NA		0	38	0
4-Methyl-2-pentanone	38	0	0.00	NA	NA	NA	NA		0	6300	0
Acetone	38	5	0.132	2	3.8	2.92	0.823		0	14000	0
Benzene	38	1	0.0263	0.26	0.26	0.260	NA	5	0	0.46	0
Bromodichloromethane	38	0	0.00	NA	NA	NA	NA	80	0	0.13	0
Bromoform	38	0	0.00	NA	NA	NA	NA	80	0	3.3	0
Bromomethane	38	0	0.00	NA	NA	NA	NA		0	7.5	0
Carbon disulfide	38	0	0.00	NA	NA	NA	NA		0	810	0
Carbon tetrachloride	38	0	0.00	NA	NA	NA	NA	5	0	0.46	0
Chlorobenzene	38	6	0.158	0.18	0.83	0.415	0.242	100	0	78	0
Chloroethane	38	0	0.00						0		0
Chloroform	38	9	0.237	0.11	0.42	0.241	0.0982	80	0	0.22	4
Chloromethane	38	2	0.0526	0.67	1.2	0.935	0.375		0	190	0
cis-1,2-Dichloroethene	38	0	0.00	NA	NA	NA	NA	70	0	36	0
cis-1,3-Dichloropropene	38	0	0.00	NA	NA	NA	NA		0		0
cyclohexane	38	0	0.00	NA	NA	NA	NA		0	13000	0
Cyclohexanone	38	0	0.00	NA	NA	NA	NA		0	1400	0
Dibromochloromethane	38	0	0.00	NA	NA	NA	NA	80	0	0.87	0
Dichlorodifluoromethane	38	0	0.00	NA	NA	NA	NA		0	200	0
Ethylbenzene	38	0	0.00	NA	NA	NA	NA	700	0	1.5	0
Isopropylbenzene	38	1	0.0263	0.87	0.87	0.870	NA		0	450	0

Table 4-3. Summary Statistics for OU1 Groundwater Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	MCLs		Tapwater RSLs	
								MCLs	# Exceedances	MCLs	# Exceedances
Methyl tert-butyl ether	38	0	0.00	NA	NA	NA	NA		0	14	0
Methylacetate	38	0	0.00	NA	NA	NA	NA		0	20000	0
methylcyclohexane	38	0	0.00	NA	NA	NA	NA		0		0
Methylene chloride	38	0	0.00	NA	NA	NA	NA	5	0	11	0
Styrene	38	0	0.00	NA	NA	NA	NA	100	0	1200	0
Tetrachloroethene	38	0	0.00	NA	NA	NA	NA	5	0	11	0
Toluene	38	1	0.0263	0.13	0.13	0.130	NA	1000	0	1100	0
trans-1,2-Dichloroethene	38	0	0.00	NA	NA	NA	NA	100	0	360	0
trans-1,3-Dichloropropene	38	0	0.00	NA	NA	NA	NA		0		0
Trichloroethene	38	0	0.00	NA	NA	NA	NA	5	0	0.49	0
Trichlorofluoromethane	38	0	0.00	NA	NA	NA	NA		0	5200	0
Vinyl chloride	38	0	0.00	NA	NA	NA	NA	2	0	0.019	0
Xylenes (total)	38	0	0.00	NA	NA	NA	NA	10000	0	190	0
RAD (pci/l)											
Gross alpha	38	25	0.658	0.877	20.427	3.36	4.22	15	1		0
Gross beta	38	36	0.947	2.476	222.555	49.4	59.7	50	12		0
Radium 226	38	34	0.895	0.075	6.588	0.594	1.23	5	1		0
Radium 228	38	11	0.289	0.696	8.192	2.41	2.64	5	2		0
Total Ra 226_228 Calculated	38	33	0.868	0.075	13.729	1.41	3.04	5	2		0

Table 4-4. Summary Statistics for OU1 Sediment Sampling Locations

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Marine		Freshwater	
								ESV	# Exceedances	ESV	# Exceedances
Herbicides (mg/kg)											
2,4,5-T	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4,5-TP (Silvex)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-D	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-DB	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dalapon	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dicamba	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dichlorprop	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dinoseb	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
MCPA (2-Methyl-4-chlorophenoxy acetic acid)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
MCPP (2-(2-Methyl-4-chlorophenoxy) propanoic acid)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Metals (mg/kg)											
Aluminum	4	4	1.00	8900	14000	11300	2580	NA	0	NA	0
Antimony	4	0	0.00	NA	NA	NA	NA	2	0	NA	0
Arsenic	4	4	1.00	4.1	20	13.0	7.03	7.24	3	9.79	3
Barium	4	4	1.00	26	110	70.3	37.9	NA	0	NA	0
Beryllium	4	4	1.00	0.45	0.93	0.685	0.227	NA	0	NA	0
Cadmium	4	4	1.00	0.33	2.6	1.37	1.20	0.68	2	0.583	2
Calcium (Ca)	4	4	1.00	1000	7000	3850	3090	NA	0	NA	0
Chromium	4	4	1.00	34	76	55.8	17.2	52.3	3	36.2	3
Cobalt	4	4	1.00	9	16	13.3	3.40	NA	0	NA	0
Copper	4	4	1.00	35	190	103	74.9	18.7	4	28	4
Iron (Fe)	4	4	1.00	19000	56000	38500	15600	NA	0	188400	0
Lead	4	4	1.00	22	210	109	91.0	30.2	3	35.8	3
Magnesium (Mg)	4	4	1.00	3700	10000	7330	3180	NA	0	NA	0
Manganese (Mn)	4	4	1.00	130	570	313	215	NA	0	631	0
Mercury	4	4	1.00	0.066	0.52	0.312	0.243	0.13	3	0.18	2
Nickel	4	4	1.00	69	150	104	38.2	15.9	4	19.5	4
Potassium (K)	4	4	1.00	1200	3000	2150	755	NA	0	NA	0
Selenium	4	4	1.00	1.4	3.6	3.00	1.07	NA	0	NA	0
Silver	4	4	1.00	0.33	1.9	0.960	0.708	0.73	2	NA	0

Table 4-4. Summary Statistics for OU1 Sediment Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Marine		Freshwater	
								ESV	# Exceedances	ESV	# Exceedances
Sodium (Na)	4	4	1.00	5100	26000	13300	9460	NA	0	NA	0
Thallium	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Thorium	4	4	1.00	3.5	7.9	5.05	2.08	NA	0	NA	0
Uranium 238	4	4	1.00	0.79	2	1.42	0.497	NA	0	NA	0
Vanadium	4	4	1.00	22	69	48.3	19.9	NA	0	NA	0
Zinc	4	4	1.00	94	500	280	216	120	2	98	2
PCBs (mg/kg)											
Aroclor 1016	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1221	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1232	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1242	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1248	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1254	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1260	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1262	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1268	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Total PCBs Calculated	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
PCDD/F (mg/kg)											
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	4	4	1.00	0.00001	0.00033	0.000164	0.000165	NA	0	NA	0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	4	4	1.00	0.000041	0.0011	0.000539	0.000555	NA	0	NA	0
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	4	3	0.750	0.0000021	0.000019	0.0000114	0.00000857	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	4	4	1.00	0.00000087	0.000016	0.00000852	0.00000620	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	4	4	1.00	0.00000038	0.000017	0.00000767	0.00000816	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	4	4	1.00	0.00000061	0.000019	0.00000885	0.00000829	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	4	4	1.00	0.0000013	0.000046	0.0000207	0.0000220	NA	0	NA	0
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	4	4	1.00	0.0000013	0.00004	0.0000180	0.0000183	NA	0	NA	0
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	4	4	1.00	0.00000025	0.0000077	0.00000424	0.00000321	NA	0	NA	0

Table 4-4. Summary Statistics for OU1 Sediment Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Marine		Freshwater	
								ESV	# Exceedances	ESV	# Exceedances
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	4	4	1.00	0.00000038	0.0000085	0.00000381	0.00000393	NA	0	NA	0
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	4	4	1.00	0.00000036	0.000013	0.00000619	0.00000571	NA	0	NA	0
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	4	4	1.00	0.00000048	0.0000077	0.00000440	0.00000308	NA	0	NA	0
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	4	4	1.00	0.00000087	0.000012	0.00000659	0.00000487	NA	0	NA	0
Octachlorodibenzofuran (OCDF)	4	4	1.00	0.000021	0.00056	0.000285	0.000300	NA	0	NA	0
Octachlorodibenzo-p-dioxin (OCDD)	4	4	1.00	0.0021	0.012	0.00673	0.00492	NA	0	NA	0
TCDD, 2,3,7,8-	4	4	1.00	0.00000018	0.0000035	0.00000170	0.00000165	NA	0	NA	0
Total TEQ Calculated	4	4	1.00	2.6968E-06	0.000048299	0.0000238	0.0000224	NA	0	NA	0
Pesticides (mg/kg)											
4,4'-DDD	4	2	0.500	0.014	0.046	0.0300	0.0226	0.00122	2	0.00488	2
4,4'-DDE	4	1	0.250	0.028	0.028	0.0280	NA	0.002	1	0.00316	1
4,4'-DDT	4	0	0.00	NA	NA	NA	NA	0.001	0	0.00416	0
Aldrin	4	0	0.00	NA	NA	NA	NA	3.19	0	7.4	0
alpha Chlordane	4	1	0.250	0.04	0.04	0.0400	NA	NA	0	NA	0
alpha-BHC	4	0	0.00	NA	NA	NA	NA	NA	0	0.03	0
beta-BHC	4	0	0.00	NA	NA	NA	NA	NA	0	0.03	0
Chlordane	4	2	0.500	0.13	0.42	0.275	0.205	0.0005	2	0.00324	2
delta-BHC	4	0	0.00	NA	NA	NA	NA	NA	0	0.14	0
Dieldrin	4	0	0.00	NA	NA	NA	NA	2E-05	0	0.0019	0
Endosulfan I	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Endosulfan II	4	0	0.00	NA	NA	NA	NA	4E-06	0	6.4E-06	0
Endosulfan sulfate	4	0	0.00	NA	NA	NA	NA	4E-06	0	6.4E-06	0
Endrin	4	0	0.00	NA	NA	NA	NA	NA	0	0.0022	0
Endrin aldehyde	4	0	0.00	NA	NA	NA	NA	0.00028	0	0.0044	0
Endrin ketone	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
gamma-BHC (Lindane)	4	0	0.00	NA	NA	NA	NA	0.00032	0	0.00237	0
gamma-Chlordane	4	2	0.500	0.0092	0.032	0.0206	0.0161	NA	0	NA	0
Heptachlor	4	0	0.00	NA	NA	NA	NA	0.0508	0	0.05	0
Heptachlor epoxide	4	0	0.00	NA	NA	NA	NA	NA	0	0.00247	0
Methoxychlor	4	0	0.00	NA	NA	NA	NA	0.0293	0	0.02	0
Total Chlordane Calculated	4	2	0.500	0.0092	0.072	0.0406	0.0444	NA	0	NA	0
Total DDD, DDE, DDT Calculated	4	2	0.500	0.014	0.074	0.0440	0.0424	NA	0	NA	0

Table 4-4. Summary Statistics for OU1 Sediment Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Marine ESV	Marine # Exceedances	Freshwater ESV	Freshwater # Exceedances
Toxaphene	4	0	0.00	NA	NA	NA	NA	0.0005	0	0.00051	0
SVOCs (mg/kg)											
1,2,4-Trichlorobenzene	4	1	0.250	0.081	0.081	0.0810	NA	0.0961	0	0.0961	0
1,2-Dichlorobenzene	4	1	0.250	0.087	0.087	0.0870	NA	0.259	0	NA	0
1,3-Dichlorobenzene	4	1	0.250	0.081	0.081	0.0810	NA	NA	0	0.44	0
1,4-Dichlorobenzene	4	1	0.250	0.086	0.086	0.0860	NA	NA	0	0.09	0
1,4-Dioxane	1	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4,5-Trichlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	0.29	0
2,4,6-Trichlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-Dichlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-Dimethylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-Dinitrophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-Dinitrotoluene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,6-Dinitrotoluene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2-Chloronaphthalene	4	1	0.250	0.075	0.075	0.0750	NA	NA	0	NA	0
2-Chlorophenol	4	1	0.250	0.088	0.088	0.0880	NA	NA	0	0.027	1
2-Methylnaphthalene	4	2	0.500	0.011	0.097	0.0540	0.0608	0.0202	1	4.47	0
2-Methylphenol	4	1	0.250	0.074	0.074	0.0740	NA	NA	0	0.012	1
2-Nitroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2-Nitrophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
3,3-Dichlorobenzidine	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
3,4-Methylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
3-Nitroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4,6-Dinitro-2-methylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Bromophenyl-phenylether	4	1	0.250	0.087	0.087	0.0870	NA	NA	0	0.26	0
4-Chloro-3-methylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Chloroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Chlorophenyl-phenylether	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Nitroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Nitrophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Acenaphthene	4	1	0.250	0.1	0.1	0.100	NA	0.00671	1	4.91	0
Acenaphthylene	4	2	0.500	0.023	0.12	0.0715	0.0686	0.00587	2	4.52	0
Aniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Anthracene	4	3	0.750	0.021	0.15	0.0970	0.0675	0.0469	2	NA	0
Benzo(a)anthracene	4	4	1.00	0.0092	0.58	0.262	0.266	0.0748	3	0.015	3
Benzo(a)pyrene	4	3	0.750	0.1	0.8	0.443	0.350	0.0888	3	0.032	3

Table 4-4. Summary Statistics for OU1 Sediment Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Marine		Freshwater	
								ESV	# Exceedances	ESV	# Exceedances
Benzo(b)fluoranthene	4	3	0.750	0.13	1.4	0.753	0.635	9.79	0	9.79	0
Benzo(g,h,i)perylene	4	2	0.500	0.038	0.3	0.169	0.185	10.95	0	0.016	2
Benzo(k)fluoranthene	4	3	0.750	0.058	0.53	0.296	0.236	9.81	0	9.81	0
Benzyl Alcohol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-chloro-1-methylethyl) ether	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-chloroethoxy)methane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-chloroethyl)ether	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-ethylhexyl)phthalate	4	3	0.750	0.21	2.6	1.47	1.20	0.182	3	453	0
CARBAZOLE	4	2	0.500	0.0078	0.13	0.0689	0.0864	NA	0	NA	0
Chrysene	4	4	1.00	0.01	0.71	0.309	0.324	0.108	2	0.026	3
Dibenz(a,h)anthracene	4	1	0.250	0.17	0.17	0.170	NA	0.00622	1	0.033	1
Dibenzofuran	4	1	0.250	0.08	0.08	0.0800	NA	NA	0	0.3	0
Diethyl phthalate	4	0	0.00	NA	NA	NA	NA	NA	0	0.6	0
Dimethyl phthalate	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Di-n-butyl phthalate	4	0	0.00	NA	NA	NA	NA	NA	0	1.2	0
Di-n-octyl phthalate	4	1	0.250	0.39	0.39	0.390	NA	NA	0	17	0
Fluoranthene	4	4	1.00	0.018	1.4	0.582	0.637	0.113	3	0.031	3
Fluorene	4	2	0.500	0.0094	0.099	0.0542	0.0634	0.0212	1	0.01	1
Hexachlorobenzene	4	1	0.250	0.088	0.088	0.0880	NA	NA	0	NA	0
Hexachlorobutadiene	4	0	0.00	NA	NA	NA	NA	NA	0	0.7	0
hexachlorocyclopentadiene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Hexachloroethane	4	1	0.250	0.066	0.066	0.0660	NA	NA	0	0.21	0
Indeno(1,2,3-cd)pyrene	4	2	0.500	0.043	0.4	0.222	0.252	11.15	0	0.017	2
Isophorone	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Naphthalene	4	2	0.500	0.013	0.086	0.0495	0.0516	0.0346	1	NA	0
Nitrobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
n-Nitroso-di-n-propylamine	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
n-Nitrosodiphenylamine	4	0	0.00	NA	NA	NA	NA	NA	0	0.52	0
Pentachlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Phenanthrene	4	3	0.750	0.051	0.29	0.187	0.123	0.0867	2	0.019	3
Phenol	4	1	0.250	0.028	0.028	0.0280	NA	NA	0	0.0012	1
Pyrene	4	4	1.00	0.018	1.2	0.487	0.538	0.153	2	0.044	3
Pyridine	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
VOCs (mg/kg)											
1,1,1-Trichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	0.01	0
1,1,2,2-Tetrachloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	0.57	0

Table 4-4. Summary Statistics for OU1 Sediment Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Marine		Freshwater	
								ESV	# Exceedances	ESV	# Exceedances
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,1,2-Trichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	0.6	0
1,1-Dichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	0.01	0
1,1-Dichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	0.01	0
1,2,4-Trichlorobenzene	4	0	0.00	NA	NA	NA	NA	0.0961	0	0.0961	0
1,2-Dibromo-3-chloropropane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2-Dibromoethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	0.259	0	NA	0
1,2-Dichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	0.02	0
1,2-Dichloropropane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,3-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	0.44	0
1,4-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	0.09	0
2-Butanone	4	3	0.750	0.023	0.059	0.0430	0.0183	NA	0	NA	0
2-Hexanone	4	0	0.00	NA	NA	NA	NA	NA	0	0.01	0
4-Methyl-2-pentanone	4	0	0.00	NA	NA	NA	NA	NA	0	0.03	0
Acetone	4	4	1.00	0.031	0.32	0.163	0.126	NA	0	0.27	1
Benzene	4	0	0.00	NA	NA	NA	NA	0.0648	0	0.08	0
Bromodichloromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bromoform	4	0	0.00	NA	NA	NA	NA	NA	0	0.28	0
Bromomethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Carbon disulfide	4	2	0.500	0.0028	0.018	0.0104	0.0107	NA	0	NA	0
Carbon tetrachloride	4	0	0.00	NA	NA	NA	NA	NA	0	0.02	0
Chlorobenzene	4	0	0.00	NA	NA	NA	NA	0.0548	0	0.0028	0
Chloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Chloroform	4	0	0.00	NA	NA	NA	NA	NA	0	0.00072	0
Chloromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
cis-1,2-Dichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
cis-1,3-Dichloropropene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
cyclohexane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Cyclohexanone	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dibromochloromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dichlorodifluoromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Ethylbenzene	4	0	0.00	NA	NA	NA	NA	0.0908	0	0.026	0
Isopropylbenzene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Methyl tert-butyl ether	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0

Table 4-4. Summary Statistics for OU1 Sediment Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Marine		Freshwater	
								ESV	# Exceedances	ESV	# Exceedances
Methylacetate	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
methylcyclohexane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Methylene chloride	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Styrene	4	0	0.00	NA	NA	NA	NA	NA	0	0.56	0
Tetrachloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	0.078	0
Toluene	4	0	0.00	NA	NA	NA	NA	0.391	0	NA	0
trans-1,2-Dichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	0.31	0
trans-1,3-Dichloropropene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Trichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	0.035	0
Trichlorofluoromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Vinyl chloride	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Xylenes (total)	4	0	0.00	NA	NA	NA	NA	NA	0	226	0
RAD (pCi/g)											
Actinium-228 as Thorium-232	4	4	1.00	0.24	1.104	0.750	0.381	NA	0	NA	0
Bi-214 as Radium-226	4	4	1.00	0.252	0.871	0.664	0.284	NA	0	1400	0
Uranium-238	4	4	1.00	0.265	0.672	0.478	0.167	NA	0	NA	0

Table 4-5. Summary Statistics for OU1 Surface Water Sampling Locations

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Amphibian		Ecological Screening	
								ESV	# Exceedances	ESV	# Exceedances
Herbicides (ug/l)											
2,4,5-T	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4,5-TP (Silvex)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-D	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-DB	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dalapon	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dicamba	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dichlorprop	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dinoseb	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
MCPA (2-Methyl-4-chlorophenoxy acetic acid)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
MCPP (2-(2-Methyl-4-chlorophenoxy) propanoic acid)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Metals (ug/l)											
Aluminum	4	1	0.250	450	450	450	NA	87	1	5	1
Antimony	4	0	0.00	NA	NA	NA	NA	NA	0	30	0
Arsenic	4	0	0.00	NA	NA	NA	NA	150	0	3.1	1
Barium	4	4	1.00	110	190	143	34.0	NA	0	4	4
Beryllium	4	0	0.00	NA	NA	NA	NA	0.66	0	0.66	0
Cadmium	4	2	0.500	1.2	5.7	3.45	3.18	0.13	2	0.018	2
Calcium (Ca)	4	4	1.00	120000	260000	170000	62200	NA	0	116000	4
Chromium	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Cobalt	4	1	0.250	6	6	6.00	NA	23	0	3.98	1
Copper	4	1	0.250	8.6	8.6	8.60	NA	2	1	0.23	1
Iron (Fe)	4	4	1.00	1600	2300	1850	311	1000	4	158	4
Lead	4	0	0.00	NA	NA	NA	NA	0.92	0	0.92	0
Magnesium (Mg)	4	4	1.00	240000	720000	403000	222000	NA	0	82000	4
Manganese (Mn)	4	4	1.00	840	2400	1480	754	NA	0	112	4
Mercury	4	0	0.00	NA	NA	NA	NA	0.77	0	0.026	0
Nickel	4	2	0.500	32	54	43.0	15.6	24	2	5	2
Potassium (K)	4	4	1.00	37000	210000	106000	77600	NA	0	NA	0
Selenium	4	0	0.00	NA	NA	NA	NA	5	0	1	0
Silver	4	0	0.00	NA	NA	NA	NA	0.067	0	0.067	0

Table 4-5. Summary Statistics for OU1 Surface Water Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Amphibian		Ecological Screening	
								ESV	# Exceedances	ESV	# Exceedances
Sodium (Na)	4	4	1.00	1300000	5800000	2980000	2040000	NA	0	680000	4
Thallium	4	0	0.00	NA	NA	NA	NA	NA	0	0.8	0
Thorium	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Total hardness	4	4	1.00	1400000	3600000	2100000	1040000	NA	0	NA	0
Total Uranium	4	4	1.00	0.759	1.47	1.09	0.333	NA	0	NA	0
Uranium 238	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Vanadium	4	0	0.00	NA	NA	NA	NA	NA	0	20	0
Zinc	4	0	0.00	NA	NA	NA	NA	54	0	30	0
PCBs (ug/l)											
Aroclor 1016	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Aroclor 1221	4	0	0.00	NA	NA	NA	NA	NA	0	0.28	0
Aroclor 1232	4	0	0.00	NA	NA	NA	NA	NA	0	0.58	0
Aroclor 1242	4	0	0.00	NA	NA	NA	NA	NA	0	0.053	0
Aroclor 1248	4	0	0.00	NA	NA	NA	NA	NA	0	0.081	0
Aroclor 1254	4	0	0.00	NA	NA	NA	NA	NA	0	0.33	0
Aroclor 1260	4	0	0.00	NA	NA	NA	NA	NA	0	2.3	0
Aroclor 1262	4	0	0.00	NA	NA	NA	NA	NA	0	0.014	0
Aroclor 1268	4	0	0.00	NA	NA	NA	NA	NA	0	0.014	0
Total PCBs Calculated	4	0	0.00	NA	NA	NA	NA	0.014	0	0.014	0
PCDD/F (ug/l)											
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	2	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	2	1	0.500	0.000014	0.000014	0.0000140	NA	NA	0	NA	0
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	2	1	0.500	0.0000014	0.0000014	0.00000140	NA	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	2	1	0.500	0.00000083	0.00000083	0.000000830	NA	NA	0	NA	0
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	2	2	1.00	0.00000091	0.00000095	0.000000930	0.0000000283	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	2	1	0.500	0.00000094	0.00000094	0.000000940	NA	NA	0	NA	0
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	2	2	1.00	0.000001	0.0000015	0.00000125	0.000000354	NA	0	NA	0
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	2	1	0.500	0.000001	0.000001	0.00000100	NA	NA	0	NA	0

Table 4-5. Summary Statistics for OU1 Surface Water Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Amphibian		Ecological Screening	
								ESV	# Exceedances	ESV	# Exceedances
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	2	1	0.500	0.0000021	0.0000021	0.00000210	NA	NA	0	NA	0
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	2	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	2	1	0.500	0.00000065	0.00000065	0.000000650	NA	NA	0	NA	0
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	2	1	0.500	0.0000011	0.0000011	0.00000110	NA	NA	0	NA	0
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	2	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	2	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Octachlorodibenzofuran (OCDF)	2	1	0.500	0.000011	0.000011	0.0000110	NA	NA	0	NA	0
Octachlorodibenzo-p-dioxin (OCDD)	2	2	1.00	0.000076	0.00015	0.000113	0.0000523	NA	0	NA	0
TCDD, 2,3,7,8-	2	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Total TEQ Calculated	2	2	1.00	8.678E-07	1.0403E-06	0.000000954	0.000000122	NA	0	NA	0
Pesticides (ug/l)											
4,4'-DDD	4	0	0.00	NA	NA	NA	NA	0.011	0	0.11	0
4,4'-DDE	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4,4'-DDT	4	0	0.00	NA	NA	NA	NA	0.001	0	0.001	0
Aldrin	4	0	0.00	NA	NA	NA	NA	0.3	0	0.3	0
alpha Chlordane	4	0	0.00	NA	NA	NA	NA	0.0043	0	0.0043	0
alpha-BHC	4	0	0.00	NA	NA	NA	NA	NA	0	2.2	0
beta-BHC	4	0	0.00	NA	NA	NA	NA	NA	0	2.2	0
Chlordane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
delta-BHC	4	0	0.00	NA	NA	NA	NA	NA	0	2.2	0
Dieldrin	4	0	0.00	NA	NA	NA	NA	0.056	0	0.056	0
Endosulfan I	4	0	0.00	NA	NA	NA	NA	0.056	0	0.003	0
Endosulfan II	4	0	0.00	NA	NA	NA	NA	0.056	0	0.003	0
Endosulfan sulfate	4	0	0.00	NA	NA	NA	NA	0.056	0	0.003	0
Endrin	4	0	0.00	NA	NA	NA	NA	0.036	0	0.036	0
Endrin aldehyde	4	0	0.00	NA	NA	NA	NA	0.036	0	0.036	0
Endrin ketone	4	0	0.00	NA	NA	NA	NA	0.036	0	0.036	0
gamma-BHC (Lindane)	4	0	0.00	NA	NA	NA	NA	0.095	0	0.01	0
gamma-Chlordane	4	0	0.00	NA	NA	NA	NA	0.0043	0	0.0043	0
Heptachlor	4	0	0.00	NA	NA	NA	NA	0.0038	0	0.0038	0

Table 4-5. Summary Statistics for OU1 Surface Water Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Amphibian		Ecological Screening	
								ESV	# Exceedances	ESV	# Exceedances
Heptachlor epoxide	4	0	0.00	NA	NA	NA	NA	0.0038	0	0.0038	0
Methoxychlor	4	0	0.00	NA	NA	NA	NA	0.03	0	0.019	0
Total Chlordane Calculated	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Total DDD, DDE, DDT Calculated	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Toxaphene	4	0	0.00	NA	NA	NA	NA	0.0002	0	0.0002	0
SVOCs (ug/l)											
1,2,4-Trichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	24	0
1,2-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	0.7	0
1,3-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	71	0
1,4-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	15	0
2,4,5-Trichlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4,6-Trichlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-Dichlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	0.2	0
2,4-Dimethylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-Dinitrophenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,4-Dinitrotoluene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2,6-Dinitrotoluene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2-Chloronaphthalene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2-Chlorophenol	4	0	0.00	NA	NA	NA	NA	NA	0	7	0
2-Methylnaphthalene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2-Methylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2-Nitroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
2-Nitrophenol	4	0	0.00	NA	NA	NA	NA	NA	0	60	0
3,3-Dichlorobenzidine	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
3,4-Methylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
3-Nitroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4,6-Dinitro-2-methylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Bromophenyl-phenylether	4	0	0.00	NA	NA	NA	NA	NA	0	1.5	0
4-Chloro-3-methylphenol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Chloroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Chlorophenyl-phenylether	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Nitroaniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
4-Nitrophenol	4	0	0.00	NA	NA	NA	NA	NA	0	60	0
Acenaphthene	4	2	0.500	0.015	0.035	0.0250	0.0141	NA	0	5.8	0
Acenaphthylene	4	1	0.250	0.012	0.012	0.0120	NA	NA	0	NA	0
Aniline	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0

Table 4-5. Summary Statistics for OU1 Surface Water Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Amphibian		Ecological Screening	
								ESV	# Exceedances	ESV	# Exceedances
Anthracene	4	1	0.250	0.081	0.081	0.0810	NA	NA	0	0.012	1
Benzo(a)anthracene	4	1	0.250	0.096	0.096	0.0960	NA	NA	0	0.018	1
Benzo(a)pyrene	4	1	0.250	0.046	0.046	0.0460	NA	NA	0	0.014	1
Benzo(b)fluoranthene	4	1	0.250	0.052	0.052	0.0520	NA	NA	0	NA	0
Benzo(g,h,i)perylene	4	1	0.250	0.028	0.028	0.0280	NA	NA	0	NA	0
Benzo(k)fluoranthene	4	1	0.250	0.064	0.064	0.0640	NA	NA	0	NA	0
Benzyl Alcohol	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-chloro-1-methylethyl) ether	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-chloroethoxy)methane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-chloroethyl)ether	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Bis(2-ethylhexyl)phthalate	4	0	0.00	NA	NA	NA	NA	3	0	3	0
CARBAZOLE	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Chrysene	4	1	0.250	0.089	0.089	0.0890	NA	NA	0	NA	0
Dibenz(a,h)anthracene	4	1	0.250	0.042	0.042	0.0420	NA	NA	0	NA	0
Dibenzofuran	4	0	0.00	NA	NA	NA	NA	NA	0	3.7	0
Diethyl phthalate	4	0	0.00	NA	NA	NA	NA	NA	0	210	0
Dimethyl phthalate	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Di-n-butyl phthalate	4	0	0.00	NA	NA	NA	NA	NA	0	19	0
Di-n-octyl phthalate	4	0	0.00	NA	NA	NA	NA	NA	0	708	0
Fluoranthene	4	2	0.500	0.016	0.11	0.0630	0.0665	NA	0	0.04	1
Fluorene	4	2	0.500	0.015	0.046	0.0305	0.0219	NA	0	3	0
Hexachlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Hexachlorobutadiene	4	0	0.00	NA	NA	NA	NA	NA	0	1.3	0
hexachlorocyclopentadiene	4	0	0.00	NA	NA	NA	NA	NA	0	12	0
Hexachloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Indeno(1,2,3-cd)pyrene	4	1	0.250	0.038	0.038	0.0380	NA	NA	0	NA	0
Isophorone	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Naphthalene	4	2	0.500	0.013	0.021	0.0170	0.00566	NA	0	1.1	0
Nitrobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
n-Nitroso-di-n-propylamine	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
n-Nitrosodiphenylamine	4	0	0.00	NA	NA	NA	NA	NA	0	40	0
Pentachlorophenol	4	0	0.00	NA	NA	NA	NA	15	0	0.5	0
Phenanthrene	4	2	0.500	0.049	0.13	0.0895	0.0573	NA	0	0.4	0
Phenol	4	0	0.00	NA	NA	NA	NA	NA	0	4	0
Pyrene	4	2	0.500	0.014	0.096	0.0550	0.0580	NA	0	0.025	1
Pyridine	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0

Table 4-5. Summary Statistics for OU1 Surface Water Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Amphibian ESV	Amphibian # Exceedances	Ecological Screening ESV	Ecological Screening # Exceedances
Total BaP PAHs Calculated	4	1	0.250	0.107329	0.107329	0.107	NA	NA	0	NA	0
VOCs (ug/l)											
1,1,1-Trichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	11	0
1,1,2,2-Tetrachloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	610	0
1,1,2-trichloro-1,2,2-trifluoroethane (Freon 113)	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,1,2-Trichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	1200	0
1,1-Dichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	47	0
1,1-Dichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	25	0
1,2,4-Trichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	24	0
1,2-Dibromo-3-chloropropane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2-Dibromoethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,2-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	0.7	0
1,2-Dichloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	100	0
1,2-Dichloropropane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
1,3-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	71	0
1,4-Dichlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	15	0
2-Butanone	4	0	0.00	NA	NA	NA	NA	NA	0	140000	0
2-Hexanone	4	0	0.00	NA	NA	NA	NA	NA	0	99	0
4-Methyl-2-pentanone	4	0	0.00	NA	NA	NA	NA	NA	0	170	0
Acetone	4	4	1.00	3.2	3.9	3.53	0.330	NA	0	1500	0
Benzene	4	0	0.00	NA	NA	NA	NA	NA	0	130	0
Bromodichloromethane	4	1	0.250	0.26	0.26	0.260	NA	NA	0	NA	0
Bromoform	4	0	0.00	NA	NA	NA	NA	NA	0	320	0
Bromomethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Carbon disulfide	4	0	0.00	NA	NA	NA	NA	NA	0	0.92	0
Carbon tetrachloride	4	0	0.00	NA	NA	NA	NA	NA	0	9.8	0
Chlorobenzene	4	0	0.00	NA	NA	NA	NA	NA	0	1.3	0
Chloroethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Chloroform	4	3	0.750	0.97	2.4	1.46	0.817	NA	0	1.8	1
Chloromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
cis-1,2-Dichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	590	0
cis-1,3-Dichloropropene	4	0	0.00	NA	NA	NA	NA	NA	0	0.055	0
cyclohexane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Cyclohexanone	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Dibromochloromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0

Table 4-5. Summary Statistics for OU1 Surface Water Sampling Locations (Continued)

Analyte	# Samples	# Detects	Frequency of Detection	Min	Max	Average	Standard Deviation	Amphibian		Ecological Screening	
								ESV	# Exceedances	ESV	# Exceedances
Dichlorodifluoromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Ethylbenzene	4	0	0.00	NA	NA	NA	NA	NA	0	7.3	0
Isopropylbenzene	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Methyl tert-butyl ether	4	2	0.500	0.3	0.76	0.530	0.325	NA	0	10000	0
Methylacetate	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
methylcyclohexane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Methylene chloride	4	0	0.00	NA	NA	NA	NA	NA	0	98.1	0
Styrene	4	0	0.00	NA	NA	NA	NA	NA	0	72	0
Tetrachloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	50	0
Toluene	4	0	0.00	NA	NA	NA	NA	NA	0	2	0
trans-1,2-Dichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	590	0
trans-1,3-Dichloropropene	4	0	0.00	NA	NA	NA	NA	NA	0	0.055	0
Trichloroethene	4	0	0.00	NA	NA	NA	NA	NA	0	21	0
Trichlorofluoromethane	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Vinyl chloride	4	0	0.00	NA	NA	NA	NA	NA	0	NA	0
Xylenes (total)	4	0	0.00	NA	NA	NA	NA	NA	0	62308	0
RAD (pci/l)											
Gross alpha	4	4	1.00	0.999	1.97	1.34	0.438	NA	0	NA	0
Gross beta	4	4	1.00	24.158	108.956	63.6	41.9	NA	0	NA	0
Radium 226	4	3	0.750	0.142	0.557	0.282	0.238	NA	0	8110	0
Radium 228	4	1	0.250	0.968	0.968	0.968	NA	NA	0	6780	0
Total Ra 226_228 Calculated	4	3	0.750	0.142	1.53	0.606	0.800	NA	0	NA	0

Table 5-1. Summary of Select Physical and Chemical Properties of Principle Contaminant Classes Detected in OU1

Contaminant	Reference	Molecular Weight	Solubility (mg/liter in water)	Kow (Log)	Koc (Log)	Vapor Pressure (mm Hg)	Henry Law Constant (atm-m3/mol)
Arsenic	ATSDR, 2007	74.9	Insoluble	NA	NA	NA	NA
Lead	ATSDR, 2007	207.2	Insoluble	NA	NA	NA	NA
Benzo(a)Pyrene	ATSDR, 1995	252	2.3E-03	6.06	6.74	5.6E-09	4.9E-07
Aroclor-1254	ATSDR, 2000	328	0.012	6.5	No Data	7.7E-05	2.0E-03
Aroclor-1260	ATSDR, 2000	358	0.0027	6.8	No Data	4.1E-05	4.6E-03
Dioxins/Furans (as TCDD 2,3,7,8)	ATSDR, 1998	322	7.9E-06 to 3.2E-04	6.8	No Data	1.5E-09 to 3.4E-05	16.1E-06 to 101.7E-06
Radium-226	ATSDR, 1990	226	Insoluble half-life is 1,600 years	NA	NA	NA	NA
Thorium -232	ATSDR, 1990	232	Insoluble half-life is 1.4E+10 years	NA	NA	NA	NA
Uranium (Natural) U238	ATSDR, 2013	238	Insoluble half-life is 4.5E+09 years	NA	NA	NA	NA

NA = Not applicable.